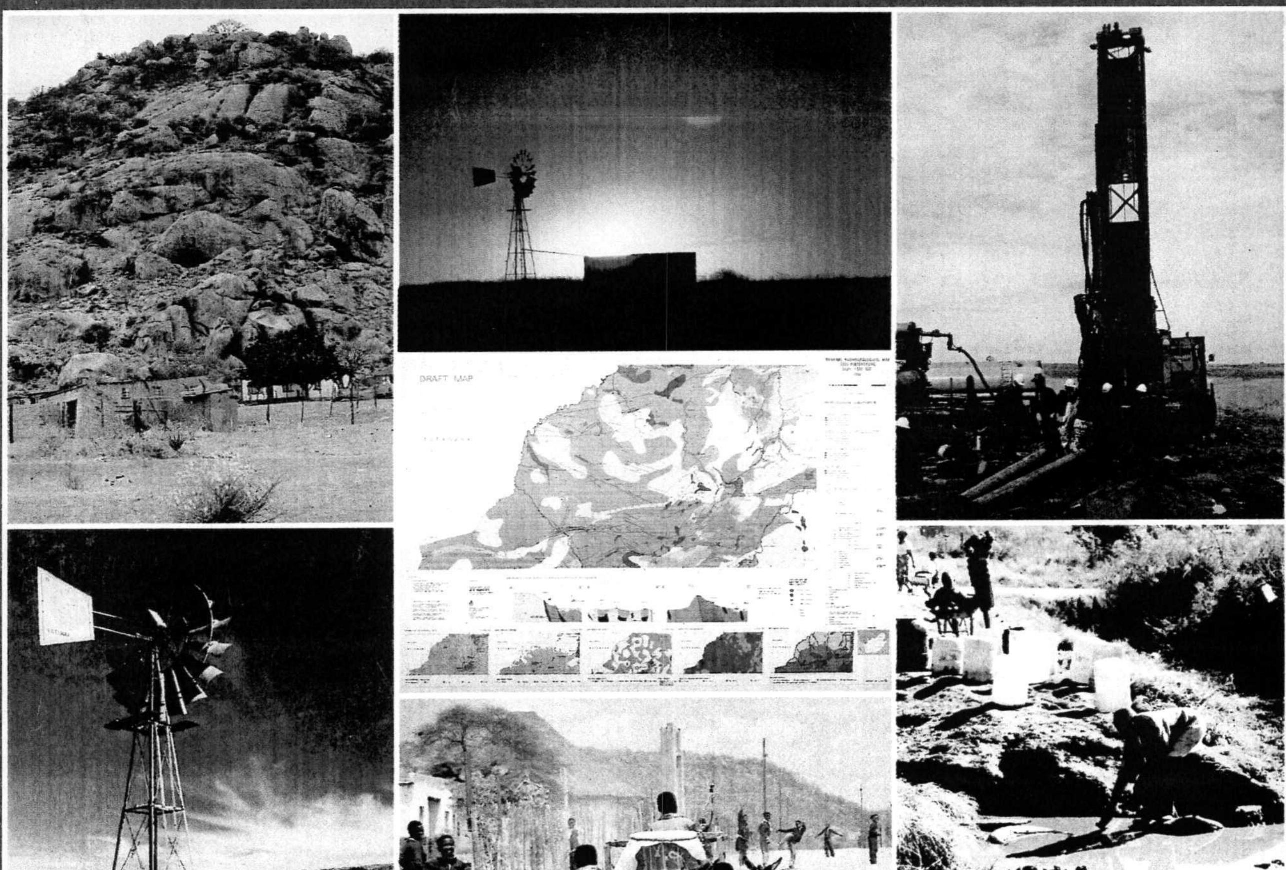
Explanation of the 1:500 000 Hydrogeological Map 2326 Pietersburg



Water Systems Management

Department of Water Affairs and Forestry

EXPLANATION OF THE

1 : 500 000 HYDROGEOLOGICAL MAP 2326 PIETERSBURG

Prepared for the Water Research Commission by

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DEPARTMENT OF WATER AFFAIRS
AND FORESTRY

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FOREWORD

Hydrogeological mapping has been recognised worldwide as a powerful tool in the planning, development and management of groundwater resources, and in the protection of the environment. The cartographic representation of hydrogeological information reflects the state of the art in hydrogeological knowledge and corresponds with the specific requirements of the map-users.

The need for hydrogeological maps of South Africa has been recognised for some time. During 1990 a committee was formed representing the Department of Water Affairs and Forestry, Directorate: Geohydrology, the Water Research Commission, the Groundwater Division of the Geological Society of South Africa and the groundwater consulting fraternity, to initiate a process of compiling hydrogeological maps of South Africa as a matter of high priority.

Various workshops and meetings were held and it was finally agreed that a two-pronged approach to the hydrogeological mapping programme should be adopted, namely :

- That immediate priority be given to the production of a national overview map at a scale of 1 : 2 500 000 following the division of South Africa into various hydrogeological regions and sub-regions.

- That this be followed by a series of regional, or reconnaissance, maps at a scale of 1 : 500 000 compiled concurrently with the regional aquifer characterisation programme to be undertaken by the Directorate : Geohydrology of the Department of Water Affairs and Forestry. The entire country is covered by 23 of these map sheets and it is envisaged that the programme could be completed by 1999.

The Pietersburg map sheet is thus one of the first maps in this series of regional, or reconnaissance maps at a scale of 1 : 500 000.

AIMS OF THE PROJECT

The main aims of this project were :

- to produce a 1 : 500 000 general hydrogeological map of the Pietersburg 2326 sheet, with an explanation document, according to the protocol and legend developed for the regional hydrogeological map series, during a prior consulting phase, for the Department of Water Affairs and Forestry, Directorate: Geohydrology;
- that this hydrogeological map sheet and explanation document serve as a prototype for the production of the 23 map sheets of the 1 : 500 000 hydrogeological map series; and
- to gain experience on regional hydrogeological map production.

ACKNOWLEDGEMENTS

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The project team would like to thank the Water Research Commission and the Steering Committee for guidance and comments throughout the project.

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The effort and dedication shown by the members of the project team are greatly appreciated, viz.:

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EXPLANATION OF THE 1 : 500 000 HYDROGEOLOGICAL MAP 2326 PIETERSBURG

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1 : 500 000 HYDROGEOLOGICAL MAP 2326 PIETERSBURG

1 INTRODUCTION

The hydrogeological map of sheet 2326 Pietersburg, scale 1 : 500 000, is a reconnaissance map and is the first general synthesis of groundwater resources of this area.

The main aim of this map and explanation document is to serve as a general reference for the planning, development and management of groundwater resources as well as for general educational purposes.

This map portrays general hydrogeological conditions at a relatively small scale and thus cannot be used to determine specific local conditions, for example, siting of individual boreholes.

Site-specific detailed investigations will be required to determine local conditions. This map and explanation document will, however, provide guidelines as to which detailed investigations are required and which hydrogeological conditions are expected to occur.

2 PHYSICAL CHARACTERISTICS

The map sheet covers the area situated between latitudes 23°S and 25°S and longitude 30° east and the Botswana border to the west. The town of Louis Trichardt is situated in the north-eastern corner and the towns of Northam, Warmbaths, Marble Hall and Nebo are found along the southern boundary.

Approximately 2.2 million people are resident in the area with only approximately 15% living in urban areas, the remaining 85% of the population residing in rural areas (see Table 1 and Figure 1).

FIGURE 1: PROVINCES AND DISTRICTS (DWAF, 1994)

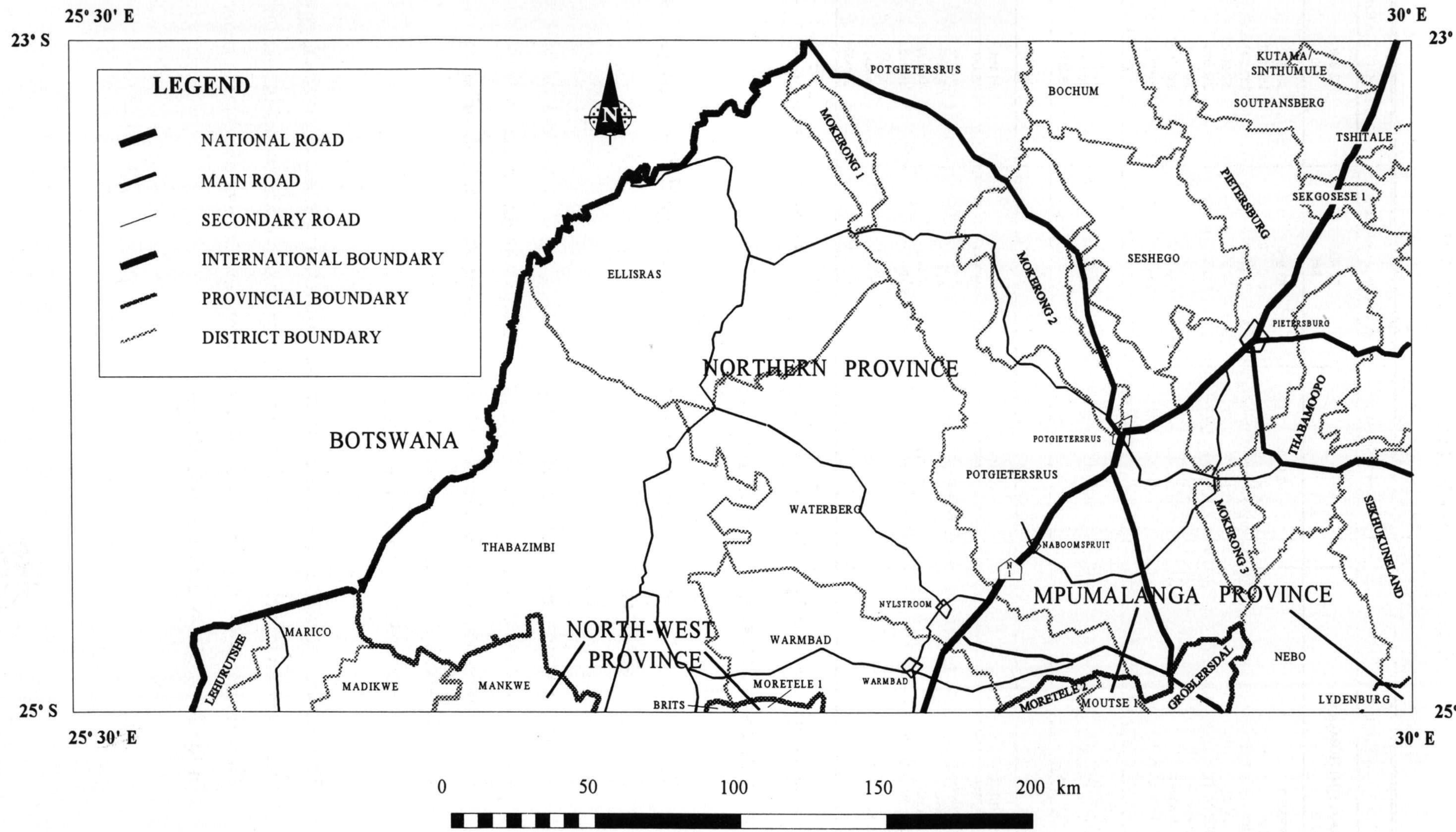

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TABLE 1 : 1991 POPULATION (CCS, 1991)

DISTRICTS	URBAN POPULATION	RURAL POPULATION	TOTAL POPULATION
KUTAMA/ SINTHUMULE	-	52 000	52 000
TSHITALE	-	800	800
SEKGOSESE 1	2 000	83 000	85 000
BOCHUM	-	150 000	150 000
SESHEGO	60 000	243 000	303 000
MOKERONG 1	-	52 500	52 500
MOKERONG 2	50 000	182 000	232 000
MOKERONG 3	-	162 000	162 000
THABAMOOPO	30 000	323 500	353 500
SEKHUKHUNELAND	20 000	80 000	100 000
NEBO	20 000	290 000	310 000
LEHURUTSHE	-	11 000	11 000
MADIKWE & MANKWE	-	30 000	30 000
MORETELE 1 & 2	-	5 000	5 000
MOUTSE 1	-	30 000	30 000
SOUTPANSBERG	12 000	22 000	34 000
PIETERSBURG	50 000	15 000	65 000
POTGIETERSRUS	15 000	55 000	70 000
WATERBERG	8 000	41 000	49 000
WARMBATHS	28 000	6 000	34 000
THABAZIMBI & BRITS	12 000	33 000	45 000
MARICO	-	8 000	8 000
GROBLERSDAL	3 500	3 000	3 500
ELLISRAS	10 000	15 000	25 000
TOTAL	320 500	1 892 800	2 213 300

2.1 TERRAIN MORPHOLOGY AND CLIMATE

The area can be divided into six main terrain morphological units (Kruger, 1983) see Figure 2, viz.:

- Plains with low relief
- Plains with moderate relief
- Lowlands, hills and mountains with moderate and high relief
- Open hills, lowlands and mountains with moderate and high relief
- Closed hills and mountains with moderate and high relief
- Table lands with moderate to high relief.

The climate is generally hot and dry in the plains areas especially along the Limpopo valley, becoming more moist and cooler in the more mountainous and plateau areas. The area receives 90% of its annual rainfall between October and March generally in the form of convective thunderstorms.

FIGURE 2 : TERRAIN MORPHOLOGY (KRUGER, 1983)

BROAD DIVISION	MAP SYMBOL	DESCRIPTION	DRAINAGE DENSITY (km/km²)	% AREA WITH SLOPES <5 %
Plains with low relief	1 3	Plains Slightly undulating plains	low - medium 0 - 2	> 80 %
Plains with moderate relief	9 11	Moderately undulating plains Strongly undulating plains	low - medium 0 - 2	
Lowlands, hills and mountains with moderate to high relief	12 13 16	Lowlands with hills Lowlands with parallel hills Lowlands with mountains	low - medium 0 - 2	50 - 80 %
Open hills, lowlands and mountains with moderate and high relief	18 19	Hills and lowlands Parallel hills and lowlands	medium 0.5 - 2	20 - 50 %
Closed hills and mountains with moderate and high relief	23 27 29	Hills Low mountains High mountains	medium 0.5 - 2	< 20 %
Table lands with moderate to high relief	30	Table lands (mountain and hill plateaux)	medium 0.5 - 2	< 80 %

Mean annual rainfall varies from approximately 380 mm in the Limpopo valley and the plains area south of the Soutpansberg to about 1 500 mm along the Drakensberg escarpment in the east. Rainfall occurrence over the largest part of this area is very erratic and unreliable and long periods of droughts occur. High evaporation rates occur over most of the area. Refer to inset map, *Mean annual rainfall,* on the main map sheet.

2.2 SURFACE WATER

The area can be divided into two main drainage regions, namely the Limpopo River system (A) which covers most of the area, and the Olifants River system (B). Rivers of the Limpopo system mainly flow northwards. See Figure 3 for the location of the surface water drainage basins. Only the Limpopo, Olifants and Crocodile rivers can be considered as perennial, although in exceptionally dry years they may have no flow.

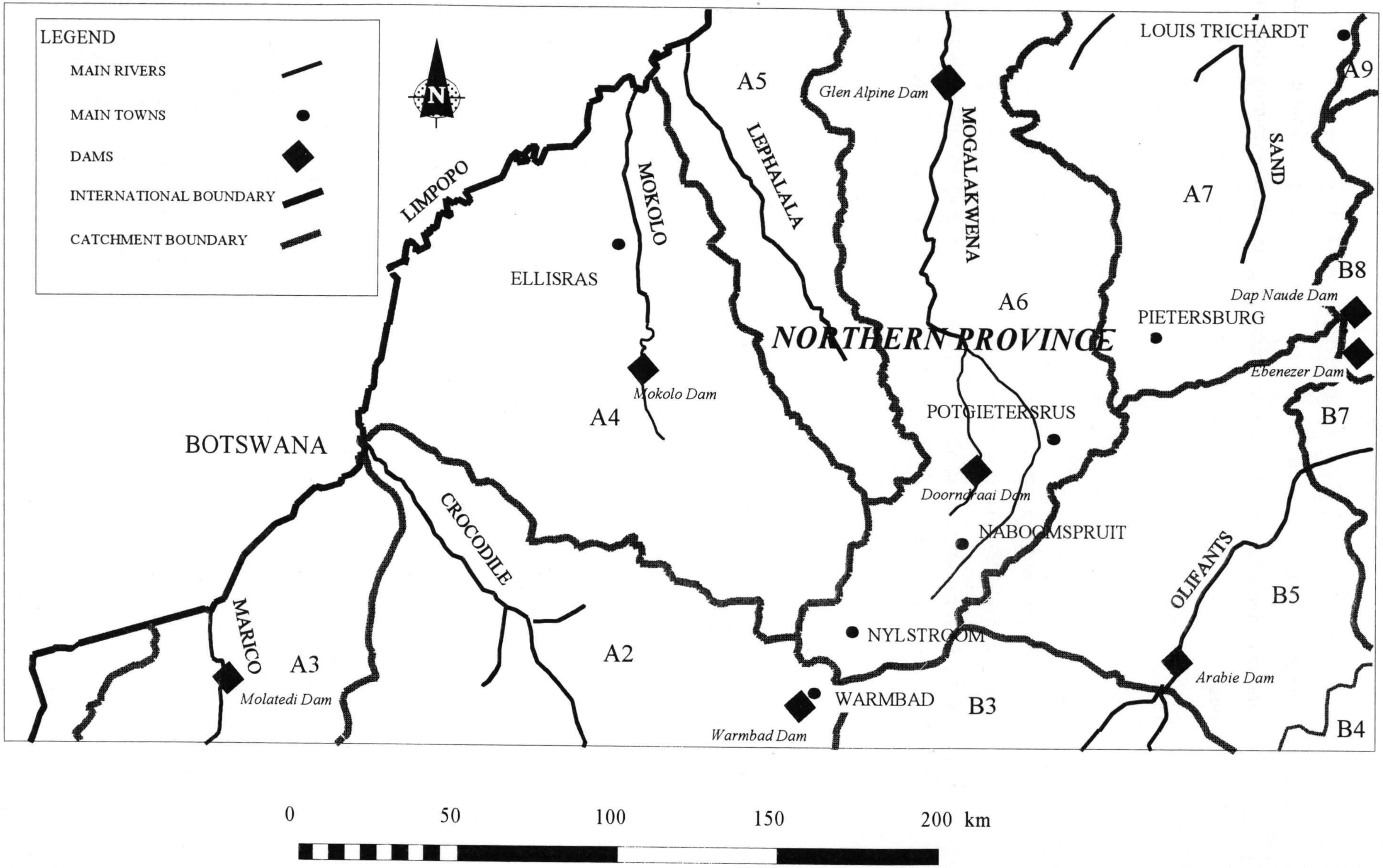
The other rivers have water throughout the wet season but are otherwise dry. These rivers often have underground flow through the alluvial deposits during the dry season.

Major dams are listed in Table 2.

TABLE 2 : MAJOR DAMS (HRU, 1981)

DAM NAME	DRAINAGE BASIN	RIVER	STORAGE CAPACITY (10^6 m^3)
GLEN ALPINE	A6	MOGALAKWENA	24
MOKOLO	A4	MOKOLO	157
DOORNDRAAI	A6	STERK	40
MOLATEDI	A3	MARICO	30
WARMBAD	A2	BUFFELSPRUIT	1
DAP NAUDE	B8	LETABA	2
EBENEZER	B8	LETABA	67
ARABIE	B5	OLIFANTS	100

FIGURE 3: SURFACE WATER RESOURCES (HRU, 1981)



2.3 GEOLOGY

The geology on this map sheet spans the length of South African geological history and contains most of the major stratigraphic groups in the country (see Figure 4), viz.:

- Basement Complex
- Granite Intrusives
- Ventersdorp Sequence
- Transvaal Sequence
- Bushveld Complex
- Soutpansberg Sequence
- Waterberg Sequence
- Karoo Sequence
- Quaternary.

The Basement Complex which occurs in the northern and eastern portions of the map, consists essentially of granite gneiss with infolded xenoliths of mafic to ultra-mafic material (Zgo), greenstones (Zp), undifferentiated metamorphics (Z), granite gneiss (Za) and migmatite gneiss (Rho). The Basement Complex has been intruded by younger granites (R-V, Rga) of Randian age.

The Greenstone belt (Zp) occurs within the gneisses as a south-west striking belt of steeply folded material ranging from ultra-mafic to mafic lavas, acidic lavas, arenaceous sediments and chemical sediments such as banded iron formation and chert. The sequence was subjected to low grade greenschist facies metamorphism. The central zone of the Limpopo Mobile Belt strikes east-north-east across the north of the map sheet and forms part of the Basement Complex. It is bounded in the south by major faults, i.e. Abbotspoort, Melinda and Vivo faults which have exposed deeper levels of the Earth's crust, hence the high grade of metamorphism of the rocks that prevails within this belt.

The Ventersdorp Sequence represents a massive outpouring of andesitic lava (Val) prior to deposition of the Transvaal Sequence and is found at the base of the

Transvaal Sequence rocks in the south-western quadrant of the map sheet.

The Transvaal Sequence occurs as steeply dipping strata striking approximately east-west across the map sheet and folded about the Bushveld Complex. The sequence consists of a basal quartzite, shale and basalt layer followed by a period of chemical sediment deposition consisting of a lower banded iron formation and chert layer (Vbr) followed by a thick sequence of dolomite and interlayered chert (Vm). Chemical deposition was followed by cyclic episodes of sandstone and shale deposition (Vle, Vta and Vt). A capping of acidic lava (Vsh) marks the end of Transvaal deposition and the beginning of the intrusion of the Bushveld Complex.

The Bushveld Complex is the largest known igneous intrusive of which the northern, western and eastern lobes are present in the south and central part of the map sheet. It consists of a lower layered ultra-mafic unit, a middle massive gabbro unit, an upper layered mafic unit (Vv) and capped with a red granite and granophyre unit(Mle). The Phalala granites (Mpa) located intermittently along the Abbotspoort and Melinda faults are related to the Bushveld granites.

The Bushveld Complex intrusion was followed by the deposition of the Soutpansberg (Mt, Mw) and Waterberg (Mko, Ma, Ms) Sequences. The Soutpansberg is considered slightly older than the Waterberg and was deposited in the fault bounded troughs of the Limpopo Mobile Belt to form the Soutpansberg and Blouberg mountain ranges. The Waterberg was deposited in the basin formed by sagging of the cooling Bushveld Complex intrusion.

The Soutpansberg differs from the Waterberg in that it has a larger basaltic lava component in an otherwise essentially sedimentary sequence of sandstone and conglomerate.

The Karoo Sequence marks the final major episode of deposition before the break-up of Gondwanaland. The lower formations of the sequence are not represented on the map sheet. The Karoo strata present on this map sheet were deposited in the fault bounded troughs of the Limpopo Mobile belt in the north and the Springbok Flats in the south of the map sheet.

The sequence consists of lower shale, mudstone and sandstone (Pe, P-TR) horizons grading into an upper sandstone layer (TR) and capped by a thick sequence of basalt (Jl).

Diabase dykes and sills (MD) are pervasive throughout the whole region. Most dykes are generally related to two main igneous events. The older dykes are thought to be of Bushveld Complex age and the younger dykes are generally of Karoo age. Karoo age dykes were the feeder conduits to the Karoo basalt suggesting that the basalt outpouring probably covered the whole map sheet area prior to Gondwana break-up and removal by erosion.

The youngest strata are thin sequences of Quaternary to Tertiary aeolian Kalahari sand (not shown on map) and alluvial sand deposits along the major drainages in the area.

For more detailed information on the geology refer to the 1 : 250 000 published geological map series and explanation notes :

- 2326 Ellisras
- 2328 Pietersburg
- 2426 Thabazimbi
- 2428 Nylstroom.

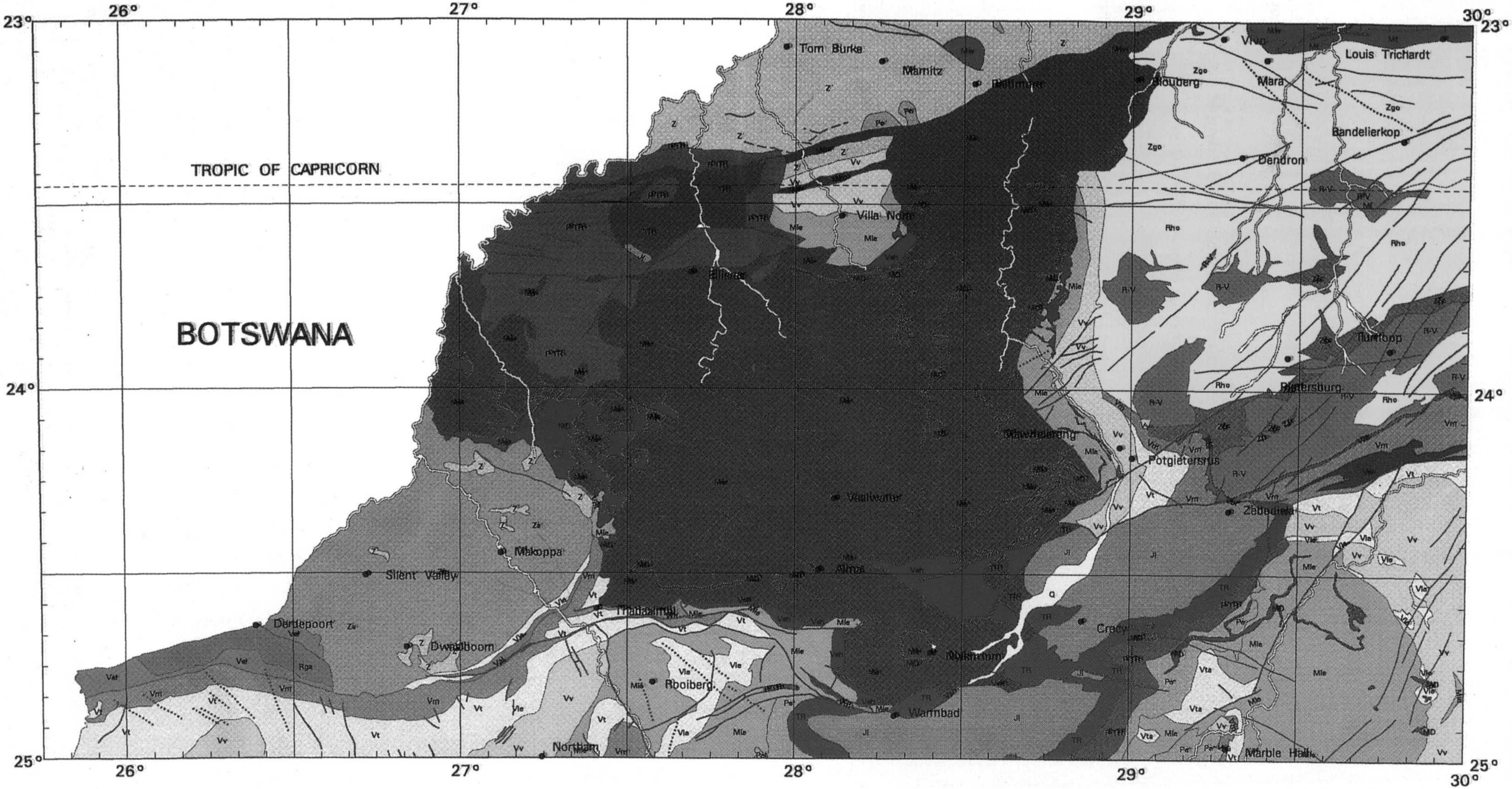


FIGURE 4 : GEOLOGY OF THE AREA COVERED BY MAP SHEET 2326 PIETERSBURG

Ma	System / Sisteem	Sedimentary & Volcanic Rock Hydro-geological Unit	Intrusive Rock Hydro-geological Unit	Lithology	Stratigraphy	
	Cenozoic / Senosoïkum	Q		Alluvium		
65						
	Mesozoic / Mesosoïkum	Jl		Basalt	Letaba Formation	KAROO SUPERGROUP
		TR		Sandstone	Clarens Formation	KAROO SUPERGROUP
230						
	Palaeozoic / Paleosoïkum	P-TR		Shale, sandstone, mudstonw	Unclassified Permo-Triassic Formations and Irrigasie Formation	KAROO SUPERGROUP
		Pe		Shale	Ecca Group	KAROO SUPERGROUP
570						
	Mokolian / Mokolium		MD	Diabase		
		Mw		Sandstone, conglomerate	Wyllies Poort Formation	SOUTPANSBERG GROUP
		Mt		Basalt, tuff, sandstone, conglomerate	Tshifhefhe & Sibasa Formations	SOUTPANSBERG GROUP
		Ms		Sandstone, conglomerate	Kransberg Subgroup	WATERBERG GROUP
		Ma		Sandstone, conglomerate, mudstone	Nylstroom & Matlabas Subgroups	WATERBERG GROUP
		Mko		Quartzite, conglomerate	Koedoesrand Formation	WATERBERG GROUP
			Mpa	Granite	Palala Granite	
2070						
			Mle	Granite	Lebowa Granite Suite	BUSHVELD COMPLEX
			Vv	Gabbro, norite, anorthosite	Rustenburg Layered Suite	BUSHVELD COMPLEX
	Vaalian / Vaalium	Vsh		Acidic lava	Rooiberg Group	TRANSVAAL SUPERGROUP
		Vt		Shale, mudstone	Pretoria Group	TRANSVAAL SUPERGROUP
		Vta		Shale, quartzite	Pretoria Group	TRANSVAAL SUPERGROUP
		Vle		Quartzite, shale	Pretoria Group	TRANSVAAL SUPERGROUP
		Vp		Banded ironstone	Penge Formation	TRANSVAAL SUPERGROUP
		Vm		Dolomite, chert	Duitschland Formation & Malmani Subgroup	TRANSVAAL SUPERGROUP
		Vbr		Quartzite, shale, basalt	Black Reef Formation	TRANSVAAL SUPERGROUP
		Val		Andesite	Allanridge Formation	VENTERSDORP SUPERGROUP
2620						
	Randian / Randium		R-V	Various granite intrusives	Matlala, Moletsi, Turfloop, Matok, Mashashani Suite	
			Rga	Granite	Gaborone Granite	
			Rho	Migmatite gneiss	Hout River Gneiss	BASEMENT COMPLEX
3090						
	Swazian / Swazium		Za	Granite gneiss	Unnamed Granite Gneiss	BASEMENT COMPLEX
			Z	Undifferentiated metamorphic rocks	Beit Bridge Complex	BASEMENT COMPLEX
			Zp	Greenstone	Pietersburg Group	BASEMENT COMPLEX
			Zgo	Gneiss with xenoliths	Goudplaats Gneiss	BASEMENT COMPLEX

FIGURE 5 : GEOLOGICAL LEGEND

3 HYDROGEOLOGICAL CLASSIFICATION

Due to the unique features of South African hydrogeology the international UNESCO classification (UNESCO 1983) has been adapted in order to obtain a more meaningful picture. The UNESCO classification distinguishes the occurrence of groundwater only according to the primary or secondary nature of openings in the rock. For the Pietersburg map the secondary nature of openings has been further subdivided into Karst, Weathered and Fractured, and Fractured.

The occurrence of groundwater is the map's dominant theme and is subdivided into classes, groups and units. The classes are represented by colours, the expected borehole yield by the tone of the respective colour and the units by lithological ornaments and stratigraphic symbols.

The division into four classes, viz. Intergranular, Weathered and Fractured, Fractured and Karst is based on the dominant porosity type.

The **Intergranular Class** (coloured blue) represents aquifers in which water flows through intergranular pores.

The **Weathered and Fractured Class** (coloured orange and yellow) represents aquifers in which water flows through intergranular pores resulting from decomposition, and fractures or fissures, and is a so-called double porosity medium. The groundwater rest level is within the weathered zone (decomposed area provides storage).

The **Fractured Class** (coloured green) represents aquifers in which water flows through fractures or fissures only.

The **Karst Class** (coloured mauve) represents aquifers in carbonate rocks in which water flows predominantly through solution cavities and/or fractures.

The subdivision of each of the four classes into four groups is principally based on the yield prospects of boreholes for various uses, namely :

- **High**, borehole yields generally > 10 ℓ/s, can be used for urban supply or large- scale irrigation.
- **Moderate**, borehole yields generally 3 - 10 ℓ/s, can be used for domestic supply to small towns or small-scale irrigation.
- **Low**, borehole yields generally 0.3 - 3 ℓ/s, can be used for domestic supply to rural settlements, or irrigation of community gardens.
- **Very low**, borehole yields generally < 0.3 ℓ/s, can be used for domestic supply to single homesteads or small rural villages (<500 persons), or stock watering. Boreholes in this group are mostly equipped with handpumps or windpumps.

The subdivision into units is based on lithostratigraphic criteria.

4 AVAILABLE INFORMATION AND DATA USED

The hydrogeological map of Pietersburg is the result of the analysis and synthesis of all available relevant information. Appendix A gives a list of maps and reports used. Most of these reports contain information on local borehole siting activities or can be classified as simple groundwater inventories. Only a few studies concern regional characterisation, viz. Doornlaagte catchment study around Dendron, evaluation of the Beauty/Swartwater area and the evaluation of the Northern Springbok Flats.

More than 16 000 borehole records were extracted from the National Groundwater Data Base. 15 004 records were used to evaluate borehole yield, 6 710 records of groundwater levels, 7 225 records of electrical conductivity, 4 893 of nitrates and fluorides and 3 367 complete chemical analyses were obtained. An inset map gives the distribution of borehole data over the map sheet.

5 MAPPING METHODOLOGY

Because lithology (rock type) was considered the single most important property affecting the occurrence of groundwater, it was used as the basic building block for the map. The map sheet was thus subdivided into hydrogeologically relevant lithological units capable of being distinguished at the scale of the map.

These lithological units were then grouped together according to their capacity to store and transmit groundwater expected to occur in the various rock types, i.e. intergranular, weathered and fractured, fractured, or karst.

Each of the classes of groundwater occurrence was then subdivided into different groups of expected borehole yield using existing borehole records. This was done by superimposing a 1 minute by 1 minute grid over the map sheet and colour coding each grid block according to the maximum borehole yield. Four colour codes were used corresponding to the group subdivision i.e. > 10 ℓ/s, 3 - 10 ℓ/s, 0.3 - 3 ℓ/s and < 0.3 ℓ/s. From the colour coded grid, regional trends were manually identified and delineated. Where no information was available, interpolations were made from other hydrogeologically similar areas.

Once the classes and groups of groundwater occurrence were delineated, hydrogeological units could then be distinguished by means of the lithological ornaments and stratigraphic symbols.

To avoid cluttering the map, various smaller-scale inset maps were included, viz.:

- Diagrammatic cross-sections showing the third dimension and hydrogeological relationships
- Distribution of borehole data used
- Mean annual rainfall
- Water quality in terms of electrical conductivity in mS/m and problem chemical species (nitrates and fluorides)
- Depth to groundwater, showing the regional trend of the groundwater table
- Recharge potential which gives a qualitative assessment of that portion of the natural precipitation which replenishes the groundwater resources.

6 HYDROGEOCHEMISTRY

The chemical composition of groundwater is the result of interaction between rain water, soils and various rock types. Most of this interaction takes place in the unsaturated zone and later in the saturated zone along the groundwater flow path, where physical and geochemical properties of the rock types influence the type and character of the groundwater quality.

In order to characterise and compare the chemical composition of groundwater in the various rock formations, complete chemical analyses of 3 367 groundwater samples, taken during the period from 1970 to 1994, were utilised.

Due to the large number of groundwater samples, a basic method of general characterisation of water composition known as the Kurlov method (Kurlov, 1928) was used and is based on the relative concentration (meq/ℓ) of major cations and anions.

The results of the analysis show the following and are summarised in Table 3 :

- **Bicarbonate water (Recently recharged groundwater)**

  Recently recharged water is usually characterised by a high content of HCO_3^- and Ca^{2+}/Mg^{2+} content with Mg^{2+} being dominant in groundwater associated with dolomitic aquifers. Groundwater encountered in gneiss (Zgo), undifferentiated metamorphic rocks (Z), migmatite gneiss (Rho), dolomite/chert (Vm), Waterberg sandstone (Ms); Karoo basalt (Jl) and deposits adjacent to the middle part of the Crocodile River (Q) can be classified as bicarbonate water.

- **Sodium bicarbonate water (Dynamic water)**

  This type of water is related to the movement of groundwater from recharge areas and normally indicates a cation exchange process. It is dominated by a high content of Na^+ and HCO_3^-. Sodium bicarbonate water has a limited occurrence in the study area being only encountered in the alluvial deposit of the Nyl, Crocodile and Limpopo Rivers (Q) and some fault zones of the Letaba basalt and Karoo sedimentary rocks.

- **Sulphate water**

This type of water is dominated by SO_4^{2-} and Ca^{2+} or Mg^{2+} and occasionally Na^+. The sulphate water is usually associated with groundwater encountered in lavas and gypsum deposits as for example found in the Letaba basalt (Jl) of the Springbok Flats. A limited number of samples of this water type, were found in the sandstone/conglomerate formation (Ma) of the Waterberg Sequence.

- **Chloride water (Discharge and stagnant waters)**

This type of water is dominated by the anion chloride. The cation content is variable. Where Ca^{2+} and Mg^{2+} are dominant, water is related to reverse ion exchange (replacement of Na^+ with Ca^{2+} and Mg^{2+}). These types of water are found in the Letaba basalt (Jl) north-west of Roedtan, along the Crocodile River (Q) in Karoo sedimentary rocks (TR, PTR, Pe), Waterberg sandstone (Ma, Mw, Ms) and Metamorphic rocks (Z). A predominance of Na^+ and Cl^- indicates an end point of discharge or stagnation of water. This type of water is encountered in Karoo sedimentary rocks (TR, P-TR, Pe), river bed deposits along the Mokolo, Limpopo and Matlabas Rivers (Q), Transvaal shale (Vta) and some granite intrusions (R-V).

TABLE 3 : SUMMARY OF THE CHARACTERISATION OF GROUNDWATER QUALITY

HYDROGEOLOGICAL UNIT	BICARBONATE WATER (RECHARGE WATER)	SODIUM BICARBONATE WATER (DYNAMIC WATER)	SULPHATE WATER	CHLORIDE WATER (DISCHARGE AND STAGNATION WATER)	
				CA^{2+}, MG^{2+}	NA^{+}
INTERGRANULAR					
Q	X	X		X	X
WEATHERED AND FRACTURED					
Jl	X		X		
TR		X		X	X
Mt					
Vv					
Rho	X				
Zgo	X				
FRACTURED					
Jl		X	X	X	
TR		X		X	X
P-TR		X		X	X
Pe		X		X	X
MD					
Mw				X	
Ms	X			X	
Ma			X	X	
Mko					
Mpa					
Mle					
Vsh					
Vt					
Vta					X
Vle					
Vp					
Vbr					
Val					
R-V					X
Rga					
Za					
Z	X			X	
Zp					
KARST					
Vm	X				

Table 4 gives some water quality guidelines for electrical conductivity in domestic, stock and irrigation water. This table should be read together with the inset map GROUNDWATER QUALITY to determine the suitability of water for the various user groups.

TABLE 4 : GUIDELINES FOR GROUNDWATER QUALITY SUITABILITY (DWAF, 1993)

ELECTRICAL CONDUCTIVITY RANGE (mS/m)	SUITABILITY		
	DOMESTIC	STOCK	IRRIGATION
<70	Suitable	Suitable	Suitable
70 - 150	Suitable - slightly salty taste	Suitable	Suitable - salt sensitive crops may show a 10% decrease in yield. Wetting of foilage should be prevented.
150 - 300	Tolerable - a marked salty taste	Suitable	Suitable for moderately salt tolerant crops although a 10% decrease in yield can be expected. Wetting of foilage should be prevented.
300 - 450	Unacceptable - tolerable for short- term consumption only	Suitable, but some loss in productivity can be expected	Tolerable for moderately salt tolerant crops although a 20% decrease in yield can be expected. Wetting of foilage should be prevented.
>450	Totally unacceptable	Tolerable, but may be refused by animals not accustomed to the water	Generally unacceptable.

Other problem chemical species which occur in the area covered by the map sheet includes nitrates and fluorides (see inset map GROUNDWATER QUALITY). Nitrates in concentration of greater than 10 mg/ℓ (N) can cause methaemoglobinaemia (blue baby syndrome) in children younger than 2 years. Fluorides in concentrations greater than 1.5 mg/ℓ (F) can cause brown staining of teeth and crumbling of teeth and bone structure.

7 HYDROGEOLOGICAL ASSESSMENT

The hydrogeological assessment is given below in terms of a series of tables (Tables 5, 6). The first table (Table 5) summarises the characteristics of the four main classes of groundwater occurrences and the following tables (Tables 6a - 6h) describe the characteristics of each of the units.

TABLE 5 : SUMMARY OF HYDROGEOLOGICAL CHARACTERISTICS

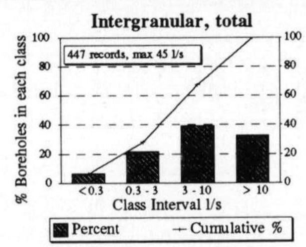
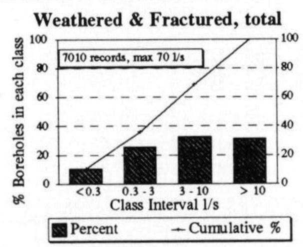
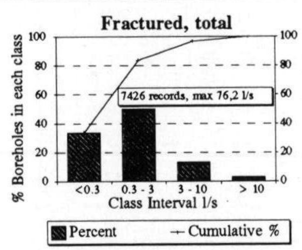
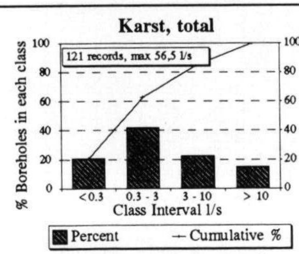
OCCURRENCE OF GROUND WATER	HYDROGEOLOGICAL UNIT	TARGETS FOR BOREHOLE SITING	RECOMMENDED BOREHOLE SITING TECHNIQUES	BOREHOLE YIELD DISTRIBUTION OF EXISTING BOREHOLES	GROUND WATER QUALITY	COMMENTS
INTERGRANULAR Ground water occurs mainly in alluvial deposits along the main river channels	Q	Thick, coarse, well graded deposits	Air photo interpretation mechanical probing resistivity soundings seismics electromagnetic soundings depth sampling & grain size analysis		Generally good (EC 10 - 300 mS/m) but decreaes in dry season. Water quality type varies from a bicarbonate to a chloride type	Usually good storage (5 % to 20 % of aquifer volume). Recharge mainly from river flow. Alluvial aquifers are highly susceptible to pollution.
WEATHERED & FRACTURED Ground water occurs within the weathered and fractured zones. Rest water level within the weathered zone	Jl, TR, Mt, Vv, Rho, Zgo	Deeply weathered zones	Air photo interpretation resistivity profiling soundings electromagnetic profiling soundings magnetometry		Generally good (EC 70 - 250 mS/m) with high nitrates and fluorides in certain areas. Water quality type generally bicarbonate to a sodium bicarbonate type	Usually good storage (1 % to 10 % of aquifer volume). Water table is generally shallow (< 20 m) except in areas where overabstraction has occurred eg Dendron area. Where shallow water tables occur aquifers are highly susceptible to pollution.
FRACTURED Ground water occurs in fractured zones within the bedrock	Jl, TR, P-TR, Pe, MD, Mw, Ms, Ma, Mko, Mpa, Mle, Vsh, Vt, Vta, Vle, Vp, Vbr, Val, R-V, Rga, Za, Z, Zp	Faults, dyke contact zones, formation contact zones, bedding planes, fracture zones	Air photo interpretation resistivity and electromagnetic profiling, magnetometry		Water quality generally moderate to poor (EC 70 - 450 mS/m). Water quality type is a sodium bicarbonate to chloride type. High nitrates and fluorides occur in certain areas	Storage generally poor (< 1 % of aquifer volume). Boreholes often have high initial yields and if pumped continuously yields drop off dramatically and holes often dry up. Susceptible to pollution at point sources.
KARST Ground water occurs in solution cavities in karstic carbonate rocks	Vm	Karstic features in carbonate rocks	Air photo interpretation gravity surveys, resistivity, electromagnetics, magnetometry		Water quality good (EC 70 - 180 mS/m). Water is mostly a magnesium bicarbonate type	Storage can be very good in highly karstic areas (> 10 % of aquifer volume). Karstic aquifers are mostly found in the more mountainous higher rainfall areas and contribute significantly to base flow of rivers. Highly susceptable to pollution.

TABLE 6a : HYDROGEOLOGICAL CHARACTERISTICS

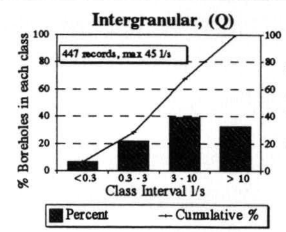
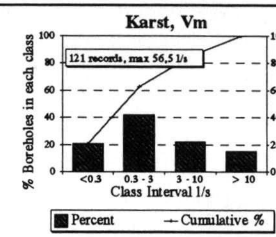
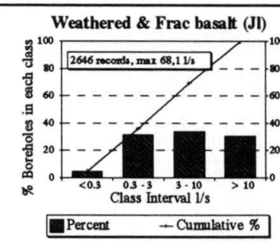
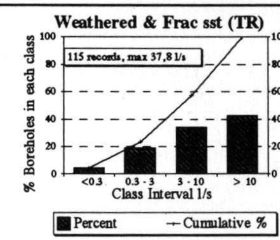
OCCURRENCE OF GROUND WATER	HYDROGEOLOGICAL UNIT	TARGETS FOR BOREHOLE SITING	RECOMMENDED BOREHOLE SITING TECHNIQUES	ESTIMATED SUCCESS RATE	BOREHOLE YIELD DISTRIBUTION OF EXISTING BOREHOLES	GROUND WATER QUALITY	COMMENTS
INTERGRANULAR	Q	Thick, coarse, well graded deposits along the main river channels	Air photo interpretation mechanical probing resistivity soundings seismics electromagnetic soundings depth sampling & grain size analysis radar	80% for achieving yields > 0,3 l/s		Generally good (EC 10 - 300 mS/m) but decreaes in dry season. Water quality type varies from a bicarbonate to a chloride type	Usually good storage (5 % to 20 % of aquifer volume). Recharge from river flow. Alluvial aquifers are highly susceptable to pollution.
KARST	Vm	Karstic features in carbonate rocks	Air photo interpretation gravity surveys, resistivity, electromagnetics, magnetometry	75% for achieving yields > 0,3 l/s		Water quality good (EC 70 - 180 mS/m). Water is mostly a magnesium bicarbonate type	Storage can be very good in highly kartic areas (> 10 % of aquifer volume). Karstic aquifers are mostly found in the more mountaineous higher rainfall areas and contribute significantly to base flow of rivers. Highly susceptable to pollution.
WEATHERED & FRACTURED	Jl	Deeply weathered zones Contact zone with underlying sandstone	Air photo interpretation Resistivity, electromagnetics magnetometry	70% for achieving yields > 0,3 l/s		Good to moderate EC 70 mS/m - 300 mS/m High nitrates occur in certain areas	Thick clay deposits overly aquifer in certain areas Large scale irrigation occurs along the basalts of the Springbok flats Fertilizer could be the source of the high nitrates
WEATHERED & FRACTURED	TR	Deeply weathered zones	Air photo interpretation Resistivity, electromagnetics magnetometry	70% for achieving yields > 0,3 l/s		Generally good EC < 200 mS/m High flourides occur in certain areas	Weathered sandstone has similar characteristics to intergranular aquifers

TABLE 6b : HYDROGEOLOGICAL CHARACTERISTICS

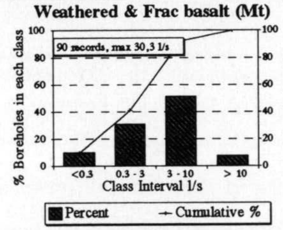
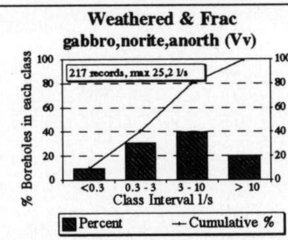
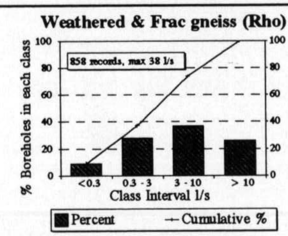
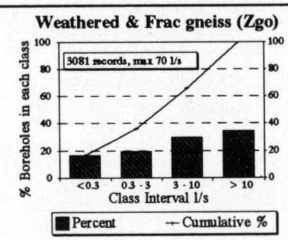
OCCURRENCE OF GROUND WATER	HYDROGEOLOGICAL UNIT	TARGETS FOR BOREHOLE SITING	RECOMMENDED BOREHOLE SITING TECHNIQUES	ESTIMATED SUCCESS RATE	BOREHOLE YIELD DISTRIBUTION OF EXISTING BOREHOLES	GROUND WATER QUALITY	COMMENTS
WEATHERED & FRACTURED	Mt	Deeply weathered zones Contact zone with gneiss	Air photo interpretation Resistivity & electromagnetic profiling & soundings Magnetometry	60 % to achieve yields of >0,3 l/s		Expected to be good EC < 200 mS/m	Generally mountaineous & inaccessable Higher yields expected at the base of the mountain
WEATHERED & FRACTURED	Vv	Deeply weathered zones associated with faults & fracturing & pyroxenite	Air photo interpretation Resistivity & electromagnetic profiling & soundings Magnetometry	60 % to achieve yields of >0,3 l/s		Good to moderate EC 100 mS/m - 300 mS/m	Water table generally shallow <15m Good aquifers occur north of Potgietersrus
WEATHERED & FRACTURED	Rho	Deeply weathered zones associated with faults & fracturing Pegmatite zones	Air photo interpretation Resistivity & electromagnetic profiling & soundings Magnetometry	50 % to achieve yields of >0,3 l/s		Generally good EC < 200 mS/m	Resource over developed in certain areas Good storage capacity but only moderate recharge
WEATHERED & FRACTURED	Zgo	Deeply weathered zones associated with faults & fracturing Contact zones with amphibolite Pegmatite zones	Air photo interpretation Resistivity & electromagnetic profiling & soundings Magnetometry	50 % to achieve yields of > 3 l/s		Generally good EC < 200 mS/m	Resource over developed in certain areas Good storage capacity but only moderate recharge High yielding boreholes associated with pegmatite zones

TABLE 6c : HYDROGEOLOGICAL CHARACTERISTICS

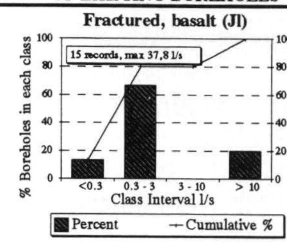
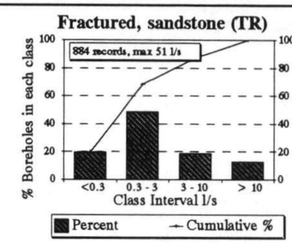
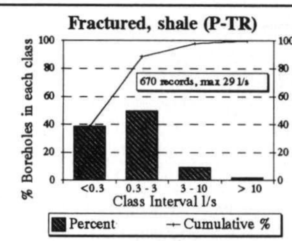
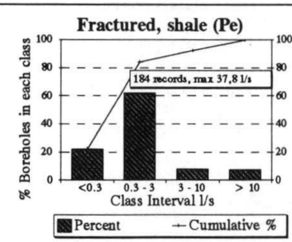
OCCURRENCE OF GROUND WATER	HYDROGEOLOGICAL UNIT	TARGETS FOR BOREHOLE SITING	RECOMMENDED BOREHOLE SITING TECHNIQUES	ESTIMATED SUCCESS RATE	BOREHOLE YIELD DISTRIBUTION OF EXISTING BOREHOLES	GROUND WATER QUALITY	COMMENTS
FRACTURED	Jl	Faults Lava flow contacts	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	50 % to achieve yields of 0,3 l/s - 3 l/s		Expected to be moderate to poor EC 100 mS/m - 450 mS/m	Resources limited Higher yields (5 l/s) can be obtained along faults which bound the area
FRACTURED	TR	Faults Bedding planes Dyke & sill contacts	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	60 % to achieve yields of 0,3 l/s - 3 l/s		Expected to be moderate EC 100 mS/m - 350 mS/m High flourides can occur	Resources limited Higher yields (5 l/s) can be obtained along faults which bound the area Not many dykes & sills occur
FRACTURED	P-TR	Faults Dyke & sill contacts Bedding planes	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	30 % to achieve yields of 0,3 l/s - 3 l/s		Good to moderate to poor EC 150 mS/m - 400 mS/m High flourides can occur Quality can vary over short distances	Resources limited due to poor storage capacity Not many dykes & sills occur
FRACTURED	Pe	Faults Dykes & sill contacts Bedding planes	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	30 % to achieve yields of 0,3 l/s - 3 l/s		Expected to be moderate to poor EC 150 mS/m - 450 mS/m High flourides can occur Quality can vary over short distances	Resources limited due to poor storage capacity Not many dykes & sills occur

TABLE 6d : HYDROGEOLOGICAL CHARACTERISTICS

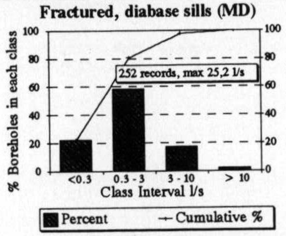
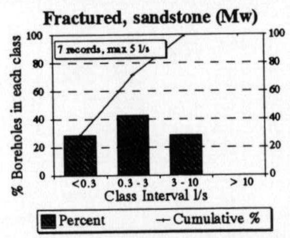
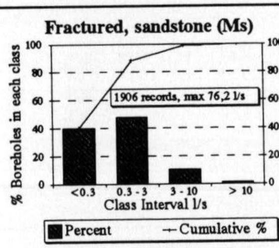
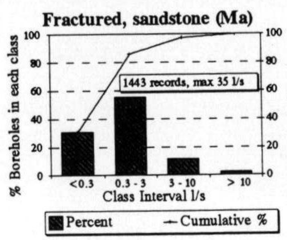
OCCURRENCE OF GROUND WATER	HYDROGEOLOGICAL UNIT	TARGETS FOR BOREHOLE SITING	RECOMMENDED BOREHOLE SITING TECHNIQUES	ESTIMATED SUCCESS RATE	BOREHOLE YIELD DISTRIBUTION OF EXISTING BOREHOLES	GROUND WATER QUALITY	COMMENTS
FRACTURED	MD	Contact zones Faults & fractures	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	55 % to achieve yields of 0,3 l/s - 3 l/s		Generally moderate EC 100 mS/m - 350 mS/m	Top or bottom sill contacts are often water bearing, the sill itself seldom has water
FRACTURED	Mw	Faults & shear zones Dyke & sill contacts Contact with gneiss Bedding planes	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	55 % to achieve yields of 0,3 l/s - 3 l/s		Generally moderate to poor EC 100 mS/m - 450 mS/m	Large areas mountaineous & inaccessable Resources limited Ground water strongly associated with diabase dykes & sills Deep drilling recommended (100m - 150m)
FRACTURED	Ms	Faults & shear zones Dyke & sill contacts Bedding planes	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	45 % to achieve yields of 0,3 l/s - 3 l/s		Generally moderate to poor EC 100 mS/m - 450 mS/m	Some areas mountaineous & inaccessable Resources limited Ground water strongly associated with diabase dykes & sills Deep drilling recommended (100m - 150m)
FRACTURED	Ma	Faults & shear zones Dyke & sill contacts Bedding planes	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	40 % to achieve yields of 0,3 l/s - 3 l/s		Generally moderate to poor EC 100 mS/m - 450 mS/m High iron content	Resources limited Ground water strongly associated with diabase dykes & sills Deep drilling recommended (100m - 150m)

TABLE 6e : HYDROGEOLOGICAL CHARACTERISTICS

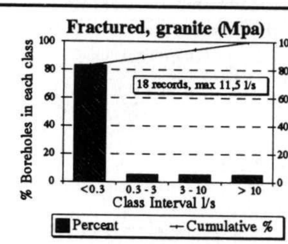
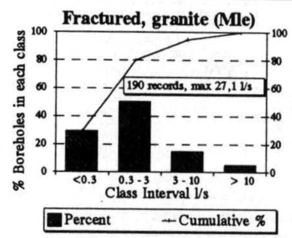
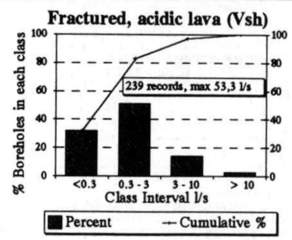
OCCURRENCE OF GROUND WATER	HYDROGEOLOGICAL UNIT	TARGETS FOR BOREHOLE SITING	RECOMMENDED BOREHOLE SITING TECHNIQUES	ESTIMATED SUCCESS RATE	BOREHOLE YIELD DISTRIBUTION OF EXISTING BOREHOLES	GROUND WATER QUALITY	COMMENTS
FRACTURED	Mko	Faults Bedding planes Contact zones with Bushveld rocks Shear zones	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	50 % to achieve yields up to 0,3 l/s	Insufficient data	Expected to be moderate EC 100 mS/m - 350 mS/m	Resources very limited Higher yields (5 l/s) can be obtained along faults which bound the area
FRACTURED	Mpa	Faults Shear zones	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	45 % to achieve yields up to 0,3 l/s	 	Expected to be moderate EC 100 mS/m - 350 mS/m	Resources very limited Higher yields (5 l/s) can be obtained along faults which bound the area
FRACTURED	Mle	Faults Dyke & sill contacts	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	20 % to achieve yields of 0,3 l/s - 3 l/s	 	Good to moderate EC 50 mS/m - 300 mS/m High flourides can occur	Resources limited due to poor storage capacity & low permeability
FRACTURED	Vsh	Faults Dykes & sill contacts Lava flow contacts	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	20 % to achieve yields of 0,3 l/s - 3 l/s	 	Expected to be moderate EC 100 mS/m - 350 mS/m	Resources limited due to poor storage capacity & low pearmeability

TABLE 6f : HYDROGEOLOGICAL CHARACTERISTICS

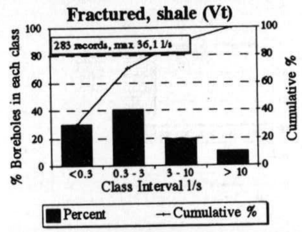
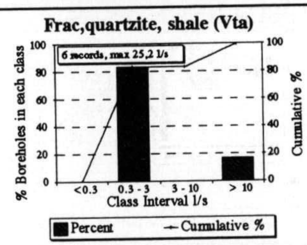
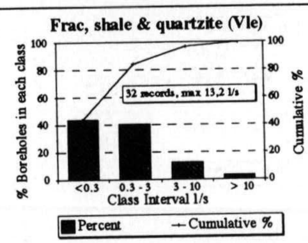
OCCURRENCE OF GROUND WATER	HYDROGEOLOGICAL UNIT	TARGETS FOR BOREHOLE SITING	RECOMMENDED BOREHOLE SITING TECHNIQUES	ESTIMATED SUCCESS RATE	BOREHOLE YIELD DISTRIBUTION OF EXISTING BOREHOLES	GROUND WATER QUALITY	COMMENTS
FRACTURED	Vt	Dyke & sill contacts Faults Bedding planes Quartzitic zones Contact zone with Bushveld rocks	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	40 % to achieve yields of 0,3 l/s - 3 l/s		Expected to be moderate EC 100 mS/m - 400 mS/m Sodium bicarbonate to chloride type water	'Poor storage capacity (mostly less than 0,1 % of aquifer volume)
FRACTURED	Vta	Dyke & sill contacts Faults Bedding planes Quartzitic zones Contact zone with Bushveld rocks	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	45 % to achieve yields of 0,3 l/s - 3 l/s		Expected to be moderate EC 100 mS/m - 350 mS/m Sodium bicarbonate to chloride type water	Poor storage capacity (mostly less than 0,1 % of aquifer volume)
FRACTURED	Vle	Dyke & sill contacts Faults Bedding planes Quartzitic zones Contact zone with Bushveld rocks	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	35 % to achieve yields of 0,3 l/s - 3 l/s		Expected to be moderate EC 100 mS/m - 400 mS/m Sodium bicarbonate to chloride type water	Poor storage capacity (mostly less than 0,1 % of aquifer volume)
FRACTURED	Vp	Dyke contacts Faults Formation contact zones	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	40 % to achieve yields of 0,3 l/s - 3 l/s	Insufficient data	Expected to be good EC < 200 mS/m, high iron concentration Bicarbonate to sodium bicarbonate type water	Area is very mountaineous and generally inaccessable

TABLE 6g : HYDROGEOLOGICAL CHARACTERISTICS

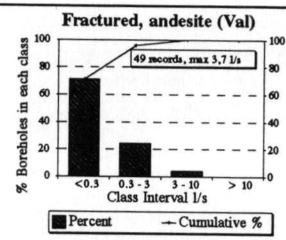
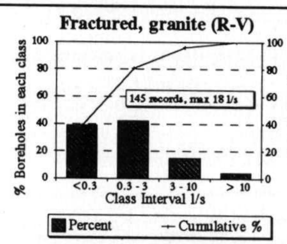
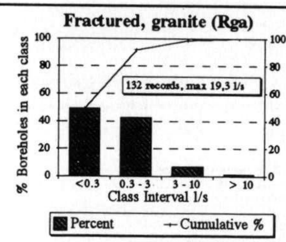
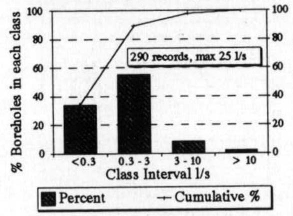
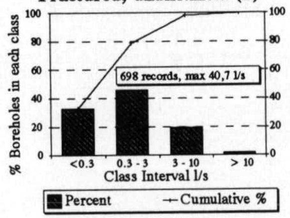
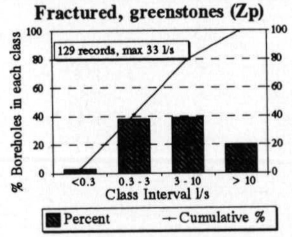
OCCURRENCE OF GROUND WATER	HYDROGEOLOGICAL UNIT	TARGETS FOR BOREHOLE SITING	RECOMMENDED BOREHOLE SITING TECHNIQUES	ESTIMATED SUCCESS RATE	BOREHOLE YIELD DISTRIBUTION OF EXISTING BOREHOLES	GROUND WATER QUALITY	COMMENTS
FRACTURED	Vbr	Faults Dyke contacts Fracture zones	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	50 % to achieve yields of up to 0,3 l/s	Insufficient data	Expected to be good EC < 150 mS/m	Area occurs on the rim of the escarpment and is generally inaccessable
FRACTURED	Val	Faults Lava flow contacts Contact zone with gneiss & sediments	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	70 % to achieve yields of up to 0,3 l/s		Expected to be good to moderate EC 50 mS/m - 300 mS/m	Poor storage capacity (mostly less than 0,1 % of aquifer volume) Successful boreholes will mostly have very low yields
FRACTURED	R-V	Faults Fracture zones Isolated dyke contacts Contact zone with gneiss & greenstones	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	50 % to achieve yields of up to 0,3 l/s		Expected to be good to moderate EC 50 mS/m - 300 mS/m Bicarbonate to sodium chloride type water	Granites in these areas are generally unweathered and outcrop as scattered koppies Poor storage capacity (mostly less than 0,1 % of aquifer volume) Higher yields are expected on the contact zones with the gneisses and greenstones (up to 3 l/s)
FRACTURED	Rga	Faults Fracture zones Isolated dyke contacts Contact zone with gneiss	Air photo interpretation Magnetometry Resistivity & electromagnetic profiling	50 % to achieve yields of up to 0,3 l/s		Expected to be good to moderate EC 50 mS/m - 300 mS/m Bicarbonate to sodium chloride type water	Granites in these areas are generally unweathered and outcrop as scattered koppies Poor storage capacity (mostly less than 0,1 % of aquifer volume) Higher yields are expected on the contact zones with the gneisses (up to 3 l/s)

TABLE 6h : HYDROGEOLOGICAL CHARACTERISTICS

OCCURRENCE OF GROUND WATER	HYDROGEOLOGICAL UNIT	TARGETS FOR BOREHOLE SITING	RECOMMENDED BOREHOLE SITING TECHNIQUES	ESTIMATED SUCCESS RATE	BOREHOLE YIELD DISTRIBUTION OF EXISTING BOREHOLES	GROUND WATER QUALITY	COMMENTS
FRACTURED	Za	Fault zones pegmatites quartz veins some dyke contact zones	Air photo interpretation Magnetometry Resistivity and electromagnetic profiling	35 % to achieve yields of 0.3 l/s - 3 l/s	**Fractured, granite/gneiss (Za)** 	Generally moderate to poor (EC 150 - 450 mS/m). Some areas have high nitrates and fluorides.	Poor storage capacity (mostly less than 0.1 % of aquifer volume). Rest water level generally deep (30 - 60 m).
FRACTURED	Z	Fault zones pegmatites contact zones between mafic and acidic rocks some dyke contact zones Calc-silicates	Air photo interpretation Magnetometry Resistivity and electromagnetic profiling	30 % to achieve yields of 0.3 l/s - 3 l/s	**Fractured, undiff.meta (Z)** 	Generally moderate to poor (EC 150 - 450 mS/m). Sodium bicarbonate to chloride type water. Some areas have high nitrates and fluorides.	Poor storage capacity (mostly less than 0.1 % of aquifer volume). Rest water level generally deep (30 - 60 m).
FRACTURED	Zp	Fault zones pegmatites quartz schists schist gneiss contacts dyke contacts	Air photo interpretation Magnetometry Resistivity and electromagnetic profiling	40 % to achieve yields of 0.3 l/s - 3 l/s	**Fractured, greenstones (Zp)** 	Generally good to moderate (EC 70 - 300 mS/m).	Poor storage capacity (mostly less than 0.1 % of aquifer volume). Rest water level generally less than 30 m.

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GH reports available at the Department of Water Affairs and Forestry, Directorate: Geohydrology are listed in Appendix A.

APPENDIX A

LIST OF REPORTS AVAILABLE AT DEPARTMENT OF WATER AFFAIRS AND FORESTRY, DIRECTORATE: GEOHYDROLOGY

GH0007, Taljaard, J.J., Boorplekke vir Lyons Hall en Tarn Northam Rustenburg, 01/09/1946

GH0021, Taljaard, J.J., Boorplekke vir Potgietersrus Hoërskool, 01/02/1946

GH0028, Taljaard, J.J., Geofisiese ondersoek vir boorplekke op Nourse- en Conterberg plaasgroepe Potgietersrus, 01/12/1945

GH0030, Taljaart, J.J., Verslag van geofisiese ondersoek vir boorplekke vir voorgestelde sentrale skool Sydney en Gruispan Potgietersrus distrik, 14/10/1992

GH0036, Simpson, D.J., Water boring sites : Turkaspost, Bandolierskop and Alldays

GH0042, Simpson, D.J., Boring sites in Louis Trichardt and Pietersburg districts, 01/07/1944

GH0042, Simpson, D.J., Location of boring sites for underground water supplies in the Louis Trichardt and Pietersburg districts, 15/10/1992

GH0115, Schumann, F.W., Geophysical investigation at Pietersburg railway station, 01/03/1943

GH0118, Enslin, J.F., Survey for selection of boreholes sites Military Aerodrome Pietersburg, 01/06/1941

GH0121, Paver, G.L., Borehole on Karoobult : owner J.H. van Rooyen Northam, 01/05/1940

GH0127, Strauss, C.A., Borehole site Grace Dieu, Mission station, Pietersburg, 01/06/1940

GH0128, Strauss, C.A., Boring site : Chiefs village, Matlalas location, Pietersburg, 01/05/1940

GH0133, Snyman, B.F., Sites selction on native trust farms in Potgietersrus district, 01/09/1939

GH0144, De Wet, N.P., Location reclamation scheme : Molietzies Location, Pietersburg, 01/02/1938

GH0155, Maree, B.D., Boring sites selection on Slagtboom 1190, Waterberg, 01/08/1939

GH0157, Le Roux, H.D., Borehole sites on native trust farms in the Potgietersrus area, 01/08/1939

GH0168, Spies, J.J., Investigation for underground water on Matlalas Location, Pietersburg, 01/09/1938

GH0169, Spies, J.J., Investigation for underground water on Slagtboom, Waterberg district, 01/09/1938

GH0219, Frommurze, H.F., Notes on boring for Mccord Bros Warmbaths, 01/06/1934

GH0236, Strauss, C.A., Borehole sites, Baviaanskrantz and Baineskloof, Potgietersrus, 01/05/1940

GH0267, Taljaard, J.J., Verslag van geologiese ondersoek vir boorplek, Louis Trichardt Munisipaliteit, 01/04/1945

GH0278, Taljaard, J.J., Investigation for underground water for Pietersburg Municipality, 01/02/1946

GH0287, Burger, P., Selection of additional borehole sites for Louis Trichardt Municipality, 01/04/1948

GH0288, Burger. P., Selection of borehole sites for the Municipality of Potgietersrus, 01/06/1948

GH0318, Serfontein, J.C., Boorplek aanwysings Smitskraal en Magataspruit vir Mnr Ivy, 01/07/1945

GH0319, Vegter, J.R., Boorplek aanwysing Goedehoop en Kalkfontein in Bandolierkop, 01/06/1945

GH0323, Enslin, J.F., Selection of sites New Belgium, Waterberg and Potgietersrus, 01/08/1942

GH0394, Van Eeden, O.R., Boorplekke Bandolierkop gebied

GH0423, Burger, P., Selection of borehole sites for Nature Affairs Department Potgietersrus district, 01/11/1947

GH0424, Burger P., Selection of borehole sites geophysically for Louis Trichardt Municipality

GH0425, Burger, P., Selection of borehole sites for National Administration Department Pietersburg district, 01/05/1948

GH0447, Taljaard, J.J., Boorplekke vir Naboomspruit Dorpsraad, 01/12/1946

GH0482, Truter, F.C., Waterondersoek te Doornhoek 814 Potgietersrus, 01/03/1940

GH0519, Strauss, C.A., Geology of Far Eastern portion New Belgium block, Potgietersrus, 01/05/1942

GH0532, Taljaard, J.J., Verslag boorplekke gekies SAS by Roedtan, Makeepsvlei Settlers, 01/12/1939

GH0541, Strauss, A., Borehole site, Bontfontein 1373 Pietersburg, 01/01/1940

GH0549, Paver, P.L., Borehole sites of farms in the Northam area, 01/06/1940

GH0552, Von Backstroom, J.W., Investigation of the thermal spring in the Potgietersrus district

GH0585, Van Eeden, O.R., Boorplekke in omgewing van Beauty, Distrik Waterburg, 01/05/1949

GH0610, Hayghton, J.F., Enslin J.F., Boring for water Jane Furse Hospital, 01/01/1937

GH0612, Frommurze, H.F., Boring for water "Keulen" 961 Madras 960 Potgietersrus, 01/07/1938

GH0618, Frommurze, H.F., Proposed borehole Leesdale 966 Matlala area Pietersburg, 01/06/1940

GH0620, Frommurze, H.F., Boring for water Pietersburg district, 01/05/1940

GH0648, Simpson, D.J., Water boring sites in the Bandolierkop area, 01/04/1945

GH0660, Schumann, Report on well on farm Wonderkop 503 district Pietersburg, 01/09/1943

GH0683, Frommurze H.F., Hollaagte and Groenboom, 01/01/1931

GH0691, Kent, L, Water supply investigation village of Naboomspruit, 01/03/1950

GH0715, Burger, P., Survey and well sites SAR and H (E Transvaal) Nile River Potgietersrus, 01/06/1950

GH0761, Van Backstrom, J.W., Thermal springs : Driefontein 1044 north of Naboomspruit

GH0787, Vegter, J.R., Ondergrondse water vir die SAS Rustenburg-Thabazimbi, 01/01/1952

GH0794, Van Rooyen, D.P., Keuse van boorplekke op Rooibosback, 01/04/1952

GH0799, Burger, P., Survey Bandelierkop Station and vicinity, SAR&H Eastern Transvaal system, 01/07/1952

GH0830, Borehole selection : Nature Affairs Department : Potgietersrus, 01/09/1939

GH0843, Enslin, J.F., Geophysical report on water survey on the Pietersburg lands, 01/05/1941

GH0965, Van Rager, D.P., Water in die gebied vanaf Waaddrift tot aan Beken van Zyl distrik Potgietersrus Transvaal, 01/01/1953

GH1163, Vegter, J.R., Enkele notas en opmerkings oor elektrise diepte metings op alluvium van die Krokodil Rivier distrik Rustenburg, 01/03/1962

GH1193, Graats, Water supply and reticulation for the Potgietersrus Municipality, 01/02/1957

GH1233, Vegter, J.R., Delfplekke : Amcor op Zoetfeld 294Kr and Grassvalley 293KR voorgestelde bron vir die Munisipaliteit Potgietersrus, 01/05/1964

GH1271, Taljaard, J.J., Boorplekke vir water Naboomspruit Dorpsraad, 01/12/46

GH1274, Wilson, P.T., Report on borehole siting for Nylstroom Town Council, 01/04/1965

GH1358, Temperley, B.N., Rainfall data Kalkfontein farm Somerset est, Potgietersrus, 01/09/1966

GH1369, De Villiers, S.B., Beskikbaarheid en standhoudendheid van ondergrondse water plaas Kalkbank 552LS en Kaalspruit 575LS Pietersburg, 01/08/1967

GH1423, De Vries, Posisies en inligting oor boorgate distrik Waterberg

GH1441, Dziembowski, Z.M., Grondwater ontwikkeling vir die Munisipaliteit Pietersburg, 01/08/1969

GH1443, Abtmier, Borehole survey in the Dendron-Vivo area, 01/04/1969

GH1445, Kent, L, Sand-en Brakrivier opbangsgebiede, Noord Transvaal

GH1446, Borcherds, Sandrivier opvangsgebied boorgatopname distrik Pietersburg

GH1489, Tinter, F.C., Selection of borehole sites, native areas, Potgietersrus, 01/11/1939

GH1509, Abtmaier, Dziembowski, Z.M., Die geohidrologie van die Pietersburg dorpsgebied, 01/04/1969

GH1521, De Villiers, S.B., Grondwater opname : Omgewing Blinkwater 244KR distrik Potgietersrus, 01/07/1970

GH1530, Rech, W., Ground water survey along Palala, Mogol, Matlabas, Crocodile rivers, 01/05/1970

GH1713, De Villiers, S.B., Pomptoets van boorgat Palmietfontein 648, Pietersburg, 01/08/1971

GH1719, Temperley, B.W., Welgevonden fault aquifer - hydrology, 01/05/1970

GH1723, Venter, B.L., Elektrise dieptemetings Nylriviervallei distrik Potgietersrus, 01/09/1971

GH1751, Venter, B.L., Nylrivier projek - aanvullende verslag, 01/02/1972

GH1776, Meyer, P.S., Grobler G.J.J., Thabamoopo gebied saamgestelde verslag van boorplekaanwysings, 01/11/1972

GH1818, Dziembowski, Z.M., Mew, A.C.W., Altona (696LR) Potgietersrus distrik grondwatervoorraad, 01/04/1973

GH1843, Gombar, L., Volspruit district Potgietersrus evaluation of a pumping test, 01/08/1973

GH1846, Meyer, P.S., Louis Trichardt watervoorsiening, 01/09/1973

GH1851, Mew, A.C.W., Rhenosterpan 361LQ - Waterberg distrik, Verslag oor boorgatresultate, 01/04/1973

GH1861, Vegter, J.R., Dziembowski, Z.M., Grondwater geberg : Mafiese waterdraer : Bosveld stollings kompleks distrik Potgietersrus, 01/10/1973

GH1862, Burvenich, T.M., Elektriecal resistivity survey : Nile valley, district Potgieters/ 01/11/1973

GH1871, Potgietersrus watervoorsiening (Voorlopige), 01/11/1973

GH1881, Meyer, P.S., Sandrivier water ondersoek distrik Pietersburg, 01/10/1973

GH1890, De Villiers, S.B., Combro (163LS) distrik Pietersburg bepalings : lewering aanvulling, 06/02/1974

GH2808, Kok, T.S., Grootvalley 529KR distrik Naboomspruit - beskikbare gronewater, 01/11/1974

GH2832, Dziembowski, Z.M., Meyer, P.S., Grond water ontwikkeling Munisipale gebruik uit boorgate : Sandriviervallei en op die suidelike deel van Sterkloop (688LS) Pietersburg, 01/06/1975

GH2837, Meyer, P.S., Zebediela omgewing boorgat opname, 01/01/1974

GH2844, Meyer, P.S., Sand-en Brakrivier boorgatopname, 01/01/1974

GH2849, De Villiers, S.B., Dolomiet gebied ten ooste van Chuniespoort, 01/01/1967

GH2860, Kok, T.S., Dreineringsgebied in geheel Warmbad warmbron, 01/12/1975

GH2867, Steyn M.J., Dolomiet streek Thabazimbi ondersoek na fonteine en boorgate, 01/05/1969

GH2964, Porszasz, K., Bredenkamp, D.B., Groundwater resources : Aquifer of Crocodile River Thabazimbi, 01/07/1967

GH2867, Steyn, M.J., Dolomiet streek Thabazimbi ondersoek na fonteine en boorgate, 01/05/1969

GH2871, Kok, T.S., Steyn, M.J., Warmbad Warmbron, 01/01/1976

GH2878, Dziembowski, Z.M., Die geohidrologie van die Dendrongebied distrik Pietersburg, 01/01/1976

GH2880, Dziembowski, Z.M., Brocherd, Evaluasie : Grondwater potensiaal, Dendrongebied, Pietersburg distrik, 01/01/1976

GH2882, Dziembowski. Z.M., Voortsetting van grondwater projekte Dendron distrik Pietersburg, 01/01/1976

GH2884, Kok, T.S., Die grondwater potensiaal van die gebied rondom Marble Hall, 01/05/1976

GH2898, Dziembowski, Z.M., Aanvulling van grondwater op Altona 696LR distrik Potgietersrus, deur Matlalarivier tydens vloed

GH2917, Venter, B.L., Grondwater studie : Sisteem Waterberg Vaalwater - Visgatgebied, 01/11/1973

GH2930, Kok, T.S., Geohidrologie van Naboomspruit omgewing, 01/06/1977

GH2931, Porszasz, K., Nyl river valley : Subterranean water supply provisional report, 01/01/1971

GH2932, Porszasz, K., Bredenkamp, D.B., Nyl River valley : Investigation of the groundwater potential, 01/04/1973

GH2949, Mulder, M.P., Fotogeologie opname van die Buffelshoek-Zebediela gebied, 01/01/1974

GH2950, Porszasz, K., Groundwater conditions and geology reconaissance : Dorps-Mogoto Dolorite area, 01/01/1968

GH2951, Porszasz K., Agricultural ground water pollution in Northern Transvaal, 01/04/1970

GH2954, Meyer, P.S., Humon, Geofisiese opname : Planknek 43KS en Oorlogsfontein 45KS Potgietersrus, 01/08/1977

GH2965, Porszasz, Bredenkamp, Verslag oor die ondergrondse water in Warmbad omgewing, 01/08/1973

GH2973, Porzsasz, K., Dorps-Mogoto dolomite area, 01/01/1977

GH2975, Rekky, B.H., Assesment : Potential undergroundwater supply for Potgietersrus, 01/11/71

GH2984, Porszasz, K., Report : Nyl River valley subterranean water supply project, 01/01/1971

GH2990, Groats, O., Augmentation of water supply : Municipality of Potgietersrus : Water from Nylriver, 01/01/1960

GH2992, Porszasz, K., Outline of present stage of Nyl river groundwater recharge, 01/01/1978

GH3002, Porszasz, K., Proposed areas for restriction : N. Springbok flats and Dorps Molopo

GH3007, Dziembowski, Z.M., Grondwater toestande van Valhbank 182LS distrik Pietersburg, 01/03/1978

GH3012, Venter, B.L, Kok, T.S., Eksplorasie ontwikkeling produksie gat : Blinkwater 244KR Potgietersrus, 01/04/1978

GH3029, Porszasz, K., Periodical report of Northern Springbok flats

GH3031, Porszasz, K., Preliminary report of Settlers - Tuinplaas investigated areas

GH3049, Porszasz, K., Water analysis from the Nyl River groundwater controlled area, 01/09/1978

GH3050, Porszasz, K., Records of boreholes in Nyl River basin, 01/09/1978

GH3053, Porszasz, K., Geology of upper Nyl River basin at Nylstroom, 01/10/1978

GH3055, Steyn, M.J., Groundwater investigation : N. Springbokflats Potgietersrust-Roedtan

GH3056, Grondwater aangeleenthede : Springbokvlakte, Hidrologiese, 01/03/1965

GH3059, Meyer, P.S., History of the Potgietersrus water supply, 01/12/1978

GH3063, Porszasz, K., Augmentation : Water supply Potgietersrus Municipality Magalakwin (Nyl)

GH3066, Porszasz, K., General mining exploration borehole Warmbad and Zebediela proposals, 01/01/1978

GH3087, Porszasz, K., "Nylvallei - kunsmatige aanvulling", 01/04/1979

GH3089, Calitz, J.M.N., Nylriviervallei, Potgietersrus distrik besonderhede : Grondwater kunsmatige aanvulling, 01/04/1979

GH3097, Greer, S.E., Geology : Potgietersrus area (Composition South portion of sheet 2429AA), 01/06/1979

GH3098, Greer, S.E., The Warmbaths hot springs project - an interim report, 01/06/1979

GH3099, Dziembowski, Z.M., Grondwater potentsiaal : Buiksloet en Ringfontein, Pietersburg, 01/07/1979

GH3103, Taylor, C.J., The geology of area North West of Zebediela

GH3108, Dziembowski, Z.M., Grondwater potensiaal tussen Preston 69LS en 10LS Pietersburg, 01/08/1979

GH3130, Lyness, L.S., Groundwater supply potential : Selected areas near Potgietersrus, 01/01/1980

GH3140, Hewitt, R.F., Investigation groundwater Settlers particular nitrate and fluoride levels, 01/07/1980

GH3145, Taylor, C.J., Regional groundwater investigation Warmbaths

GH3154, Vipond, S.H., Hydrology of area south west of Crecy Northern Transvaal, 01/09/1980

GH3174, Taylor, C.J., Geohydrology upper Magalakwin valley North West of Potgietersrus, 01/06/1981

GH3176, Venter, B.L., Naboomspruit - Bogrondse bekhoogtes en watervlakke, 01/04/1977

GH3191, Orpen, W.R.G., Groundwater resources vicinity Potgietersrus Northern Transvaal, 01/10/1981

GH3198, Hobbs, P.J., Geohydrology Crocodile River valley Groundwater survey Thabazimbi district, 01/06/1983

GH3199, Jackson, M.L., Investigation of alluvial deposits Nile River valley - Nylstroom

GH3202, Meyer, P.S., Tussentydse verslag : Besonderheidskool Roedtan, 01/02/1982

GH3240, Du Toit, W.H., Opname op SAOT plase Dendron en Vivo evaluasie beskikbare grondwater, 01/11/1982

GH3247, Du Toit, W.H., Verslag pomptoets en boor van boorgate Munisipaliteit Louis Trichardt, 01/11/1982

GH3278, Hobbs, P.J., Esterhuyse, Preliminary investigation groundwater resources of upper Limpoporiver, 01/09/1983

GH3286, Timmerman, K.M.G., Geohydrological investigation Military Air Base near Louis Trichardt, 01/08/1983

GH3305, Meyer, P.S., Grondwaterondersoek - Roedtan, 01/02/1982

GH3306, Foster, M., Geohydrological investigation over Nylstroom townlands, 01/12/1983

GH3310, Timmerman, K.M.G., Geohydrological investigations part of Nile River valley centred on farms Olifantsklip and Brak, 01/03/1984

GH3329, Van Niekerk, et al, Water voorsiening aan Potgietersrus en omgewing : Beplannings Afdeling, 01/06/1982

GH3331, Orpen, W.R.G., Groundwater potential of Dorpsriver catchment - Potgietersrus, 01/06/1984

GH3345, Foster, M.B.J., Geology Chuniespoort Hydrogeology Karst areas, 01/10/1984

GH3356, Orpen, W.R.G., Fayazi, M., Water borehole Sandriver - Military Air Base Louis Trichardt, 01/01/1985

GH3409, Opren, W.R.G., Possible groundwater at Louis Trichardt Northern Transvaal, 01/10/1985

GH3366, Orpen, W.R.G., Installation and evaluation of water borehole in Rooisloot area for provision of water supply for black township of Mahwelereng North West of Potgietersrus, 01/03/1987

GH3414, Orpen, W.R.G., Development groundwater supplies for Louis Trichardt, 01/04/1986

GH3432, Fayazi, M., Geohydrological data from the Diepriver catchment Potgietersrus, 01/12/1985

GH3432, Fayazi, M., Collection of some existing geohydrological data available from the Dorpsriver catchment Potgietersrus, 01/01/1988

GH3439, Hobbs, P. J., Venables, A.J., Discussion of the Thabazimbi urban water supply, 01/02/1986

GH3439, Hobbs, P.J., Venables, A.J., Discussion of the Thabazimbi urban water supply, 31/07/1991

GH3443, Hobbs, P.J., Chipps, R.J., Groundwater resource evaluation of the lower Crocodile River valley North-western Transvaal, 20/04/1990

GH3448, Du Toit, W.H., Die aanwys en kontrolering van boorwerk en pomptoetse van boorgate in die Pietersburgse dorpsgebied vir die gebruik deur die munisipaliteit, 23/04/1990

GH3459, Hobbs, P.J., Cursory evaluation of Iscor urban water supply boreholes to Thabazimbi

GH3465, Orpen, W.R.G., A preliminary evaluation of the possible groundwater resources within a radius of 30 km of Pietersburg for the use of the municipality, 23/04/1990

GH3470, Vipond, S.H., The water resource potential of the sand bed of the lower Mogol river, 23/04/1990

GH3490, Hobbs, P.J., Parsons, R.P., Report on the exploitation of the primary (alluvial) aquifer of the Mogol river below the Hans Strydom Dam, 08/06/1990

GH3495, Jolly, J.L., Borehole irrigation survey and groundwater evaluation of the Doringlaagte drainage basin Dendron Northern Transvaal, 12/07/1990

GH3500, Dziembowski, Z.M., Preliminary survey of groundwater occurrence in the Delportshoop area

GH3519, Vipond, S.H., Groundwater potential of the lower Mogol channel : Review of existing data, 04/06/1990

GH3570, Vipond, S.H., The water resource potential of the sand bed of the lower Mogol river, 12/02/1990

GH3577, Bush, R.A., A geohydrological assessment of the Swartwater and Beauty areas, North-west Transvaal, 13/02/1990

GH3589, Simonis, J.J., Grondwater kwaliteit van die Matlabasrivier omgewing Noord Transvaal, 13/02/1990

GH3600, Hobbs, P.J., Beukes, P.J., Krokodilrivier (Wes Transvaal) ondergrondse water beheer gebied besproeiingsopname van noordelike dele, 13/02/1990

GH3605, Simonis, J., Grondwaterkwaliteit van die Matlabasrivier omgewing, 14/02/1990

GH3624, Orpen, W.R.G., Borehole and irrigation census of the Hout River basin, 14/02/1990

GH3625, Orpen W.R.G., Borehole and irrigation census along the upper Sand River Northern Transvaal Hollandsrif 15KS to Breypaal 760KS, 14/02/1990

GH3638, Walton, D., Possible impact of the proposed Olifantsspruitdam on the groundwater resources of the Nyl River flood plain in part at Nylsvley Nature Reserve, 15/02/1990

GH3678, Fayazi, M., Coal exploration boreholes in the Northern Springbok flats, 15/02/1990

GH3713, Fayazi M., Orpen W.R.G., Development potential of groundwater resources as a prei-urban water supply for Roedtan/Vlakte, 17/10/1990

GH3723, Orpen, W.R.G., Grondwater bronne Nylstroom verslag uitstaande, 23/01/1991

GH3731, Enslin, J.F., Die potensiaal van die waterbronne van Warmbad waaruit Overvaal sy benodigdhede verkry en die optimale benutting daarvan, 04/06/1991

GH3777, Fayazi, M., Deterioration of groundwater quality on the farm Doornfontein 669KS district Potgietersrus, 17/07/1992

GH3787, Nel, G.P., Regionale grondwater ondersoek van Springbokvlakte met spresiale verwysing na grondwater onttrekking en aanvulling, 29/06/1990

GH3793, Van Rensburg, H.J., Botha, L., Estimation of groundwater potential of the Dorpsriver aquifer by means of different methods and compilation of a dynamical model of aquifer system, 18/02/1993

GH3810, Nel, G.P., Evaluasie van die metode vir die bepaling van onttrekkingsyfers in Springbokvlakte Suid, 19/08/1993

GH3811, Vegter, J.R., Effect of cleaning on sweet bushveld vegetation on groundwater North and Northwestern Transvaal, 14/01/1994

GH3816, Fayazi, M., Potgieter, G., Groundwater development potential of the Wolkberg area as a possible source of a water supply for Pietersburg and environs, 11/02/1994

APPENDIX B

LIST OF GROUNDWATER LEVEL RECORDS

STATION NR	SITE ID	FARM NAME	DISTRICT	LAT	LONG	START DATE	RAINFALL STATION
A2N003	2427CB00001	BUFFELSHOEK	THABAZIMBI	24 39	27 22	19670729	0587/697
A2N005	2427DC00007	WACHTEENBEETJIE	THABAZIMBI	24 58	27 30	19670630	0588/230
A2N010	2426DA00094	MERINO WALK	THABAZIMBI	24 33	26 34	19600519	0586/006
A2N011	2426DC00102	PARYS	THABAZIMBI	24 50	26 41	19600517	0586/523
A2N067	2427CB00004	WACHTEENBIETJESDRA	THABAZIMBI	24 24	27 24	19760802	0587/697
A2N068	2427CB00008	OLIFANTSKOP	THABAZIMBI	24 46	27 29	19760723	0588/230
A2N089	2427CB00003	WACHTEENBIETJESDRA	THABAZIMBI	24 39	27 22	19760823	0587/697
A2N114	2428CD00001	MUNICIPALITY	WARMBATHS	24 53	28 17	19840313	0589/503A
A2N115	2428CD00002	MUNICIPALITY	WARMBATHS	24 53	28 17	19840314	0589/503A
A2N116	2428CD00003	MUNICIPALITY	WARMBATHS	24 53	28 17	19840314	0589/503A
A2N118	2428CD00010	MUNICIPALITY	WARMBATHS	24 53	28 17	19851104	0589/503A
A5N001	2327BD00255	OUDENBOSCH	WATERBERG	23 20	27 55	19890118	0718/772
A5N002	2327BD00256	OUDENBOSCH	WATERBERG	23 21	27 55	19890118	0718/772
A5N004	2327BD00257	OUDENBOSCH	WATERBERG	23 21	27 54	19890118	0718/772
A5N005	2327BD00254	GROOTPAN	WATERBERG	23 17	27 53	19890118	0718/772
A5N006	2327BD00253	GROOTPAN	WATERBERG	23 16	27 53	19890118	0718/772
A5N007	2327BD00260	GROOTPAN	WATERBERG	23 16	27 54	19890118	0718/772
A5N008	2327BD00259	GROOTPAN	WATERBERG	23 16	27 53	19890118	0718/772
A6N017	2428BD00002	DU TOITSKRAAL	POTGIETERSRUS	24 34	28 45	19670112	0590/361
A6N019	2429AA00025	MAKAPANSGAT	POTGIETERSRUS	24 10	29 10	19690318	0634/011
A6N022	2428BD00002	OLIFANTSKLIP	POTGIETERSRUS	24 29	28 52	19710109	0590/361
A6N023	2428DB00001	DU TOITSKRAAL	POTGIETERSRUS	24 33	28 45	19701104	0590/361
A6N044	2429AA00001	COMMONAGE	POTGIETERSRUS	24 10	29 01	19810129	0634/011
A6N048	2428DA00003	ZANDFONTEIN	POTGIETERSRUS	24 42	28 34	19730810	0590/307
A6N053	2428BD00006	ZOETFONTEIN	POTGIETERSRUS	24 24	28 57	19710728	0634/050
A6N069	2429AA00010	DE HOOP	POTGIETERSRUS	24 10	29 10	19770308	0634/011
A6N070	2429AA00009	DE HOOP	POTGIETERSRUS	24 11	29 09	19761119	0634/011
A6N078	2429AA00007	MAKAPANSGAT	POTGIETERSRUS	24 09	29 09	19800109	0634/011
A6N079	2428BB00001	LISBON	POTGIETERSRUS	24 12	28 59	19800110	0633/881A
A6N082	2428DB00004	KLIPPUT	POTGIETERSRUS	24 41	28 47	19841022	0590/370
A6N083	2428BB00002	BLINKWATER	POTGIETERSRUS	24 07	28 55	19850117	0633/881A
A6N503	2328DB00001	ROODEPOORT	POTGIETERSRUS	23 37	28 47	19720802	0676/363
A6N505	2328DB00002	GILEAD	POTGIETERSRUS	23 38	28 47	19720714	0676/523
A6N508	2329DD00001	LIMBURG	POTGIETERSRUS	23 53	28 53	19720713	0676/523
A6N514	2428DB00452	GROOTVALLEI	POTGIETERSRUS	24 33	28 45	19741210	0590/361
A6N515	2428DB00856	GROOTVALLEI	POTGIETERSRUS	24 33	28 45	19741210	0590/361
A6N534	2428BB00004	BLINKWATER	POTGIETERSRUS	24 07	28 55	19770302	0633/881A
A6N535	2429AA00006	PLANKNEK	POTGIETERSRUS	24 11	29 05	19871109	0634/011
A6N538	2429AA00005	PLANKNEK	POTGIETERSRUS	24 11	29 05	19871109	0634/011
A6N540	2428DA00011	NYLSVLEI	POTGIETERSRUS	24 37	28 41	19881206	0590/307
A6N552	2428DA00010	NYLSVLEI	POTGIETERSRUS	24 37	28 41	19881206	0590/307
A7N013	2329CD00009	STERKLOOP	PIETERSBURG	23 54	29 25	19790801	0677/834
A7N014	2329CD00016	STERKLOOP	PIETERSBURG	23 55	29 26	19790808	0677/834
A7N015	2329CD00015	STERKLOOP	PIETERSBURG	23 55	29 27	19790910	0677/834
A7N019	2329BA00001	LORGENSRY	SOUTPANSBERG	23 06	29 35	19840629	0722/277
A7N020	2329BA00002	LORGENSRY	SOUTPANSBERG	23 07	29 35	19840705	0722/099
A7N021	2329BA00003	LORGENSRY	SOUTPANSBERG	23 06	29 35	19840705	0722/099
A7N024	2329BA00006	LORGENSRY	SOUTPANSBERG	23 07	29 35	19840629	0722/099
A7N025	2329CD00011	STERKLOOP	PIETERSBURG	23 55	29 28	19850903	0677/834
A7N027	2329CD00022	STERKLOOP	PIETERSBURG	23 56	29 27	19850829	0677/834
A7N028	2329BB00001	MUNICIPALITY	LOUIS TRICHARDT	23 03	29 54	19850902	0722/721
A7N029	2329CD00003	DOORNKRAAL	PIETERSBURG	23 51	29 26	19850415	0677/834
A7N031	2329CD00001	EERSTE GELUK	PIETERSBURG	23 49	29 23	19870209	0677/834
A7N032	2329CD00002	VAALWATER	PIETERSBURG	23 50	29 22	19861203	0677/834
A7N504	2329CD00005	DOORNKRAAL	PIETERSBURG	23 51	29 25	19680424	0677/834
A7N506	2329CD00013	STERKLOOP	PIETERSBURG	23 53	29 26	19680824	0677/834
A7N509	2329CD00025	STERKLOOP	PIETERSBURG	23 55	29 26	19720313	0677/834
A7N511	2329CD00023	STERKLOOP	PIETERSBURG	23 55	29 27	19720313	0677/834
A7N513	2329CD00020	WELTEVREDEN	PIETERSBURG	23 55	29 28	19720313	0677/834
A7N514	2329CD00024	WELTEVREDEN	PIETERSBURG	23 56	29 26	19720310	0677/834
A7N526	2329DC00001	TWEEFONTEIN	PIETERSBURG	23 49	29 32	19750507	0678/023
A7N529	2329AC00001	COMBRO	PIETERSBURG	23 25	29 13	19671229	0721/257
A7N538	2329CD00006	STERKLOOP	PIETERSBURG	23 10	29 25	19731112	0721/665
A7N539	2329CD00014	STERKLOOP	PIETERSBURG	23 10	29 25	19731113	0721/665
A7N549	2329CD00010	STERKLOOP	PIETERSBURG	23 54	29 24	19711105	0677/834
A7N556	2329DA00002	ZANDRIVIERSPOORT	PIETERSBURG	23 39	29 35	19690915	0678/023
A7N561	2329CD00008	STERKLOOP	PIETERSBURG	23 54	29 25	19731112	0677/834
A7N575	2329DA00003	PAPKUIL	PIETERSBURG	23 43	29 33	19760930	0678/023
A7N580	2329DC00002	MATJIESKRAAL	PIETERSBURG	23 58	29 35	19770106	0678/144
A7N581	2329BB00002	MUNICIPALITY	LOUIS TRICHARDT	23 05	29 53	19841101	0722/700
A7N582	2329BB00003	MUNICIPALITY	LOUIS TRICHARDT	23 03	29 53	19850902	0722/721
A7N583	2329BB00004	MUNICIPALITY	LOUIS TRICHARDT	23 03	29 54	19850902	0722/731
A7N584	2329CD00018	STERKLOOP	PIETERSBURG	23 55	29 27	19851030	0677/834
A7N585	2329CD00004	STERKLOOP	PIETERSBURG	23 52	29 27	19851029	0677/834
A7N586	2329CD00037	DOORNKRAAL	PIETERSBURG	23 49	29 26	19890322	0677/834
A7N587	2329CD00038	DOORNKRAAL	PIETERSBURG	23 50	29 26	19890605	0677/834
B3N012	2428DC00002	TUINPLAAS	WATERBERG	24 54	28 44	19760728	0590/444
B3N014	2428DC00003	GEMOED	WATERBERG	24 56	28 41	19870728	0590/444

B3N016	2528BA00001	DE KUIL	WARMBATHS	25 04	28 31	19870901	0590/028
B5N011	2429AA00011	PORTUGAL	POTGIETERSRUS	24 11	29 11	19680429	0634/580
B5N013	2429AC00002	MODDERFONTEIN	POTGIETERSRUS	24 18	29 12	19681022	0634/580
B5N018	2429AC00004	WILDEBEESPAN	POTGIETERSRUS	24 27	29 07	19620821	0634/050
B5N031	2429AC00003	DOELEN	POTGIETERSRUS	24 23	29 00	19720215	0634/050
B5N044	2429CA00678	BYZONDERHEID	POTGIETERSRUS	24 36	29 05	19830217	0591/125
B5N046	2429CA00185	HOORNPLAAT	POTGIETERSRUS	24 30	29 04	19840327	0591/125
A10	2429AA00020	PLANKNEK	POTGIETERSRUS	24 10	29 04	19900607	0634/011
DT51	2329CD00036	DOORNBULT	PIETERSBURG	23 49	29 27	19850510	0677/259
PP3	2329CD00026	PELGRIMSHOOP	PIETERSBURG	23 49	29 24	19901109	0677/259
PP5	2329CD00039	PELGRIMSHOOP	PIETERSBURG	23 49	29 24	19910722	0677/259
PP12	2329CD00065	PELGRIMSHOOP	PIETERSBURG	23 49	29 25	19910613	0677/259
RW18	2329DA00007	ROODEWAL	PIETERSBURG	23 38	29 38	19890920	0677/259
S8	2429AA00019	PLANKNEK	POTGIETERSRUS	24 12	29 04	19900607	0634/011
WN16	2429AA00036	WEENEN	POTGIETERSRUS	24 10	29 07	19910129	0634/011