TECHNICAL REPORT NO. GH 3288

THE GROUNDWATER POTENTIAL OF THE WILLISTON AREA

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ABSTRACT

The main objective of this investigation was to ascertain whether or not groundwater offered a permanent solution to Williston's water supply problems.

The safe yield of the groundwater units containing the existing municipal boreholes was estimated to be about 200 m^3/day, while municipal water requirements are expected to rise to about 600 m^3/day in the near future.

Two new groundwater units were identified. Both of these units straddle the municipal boundary. The safe yield of unit A, situated to the east of Williston, was estimated to be 1170 m^3/day, the water quality averaging 450 mg/ℓ. Unit B, situated to the south-east of Williston has an estimated safe yield of 19,6 m^3/day and water with a total dissolved solids content in the 350-400 mg/ℓ range.

Although these safe yield estimates should be considered only as very rough guidelines, subject to revision, they do suggest that groundwater could solve Williston's water supply problems. Furthermore, geological and borehole evidence suggest that additional exploitable supplies are present in significant quantities outside the municipal area.

Exploitable groundwater supplies are usually only found in fractures associated with dolerite intrusions. It is suspected that aerial photographs and Landsat images might be of value in delineating areas where groundwater prospects are better than average.

SAMEVATTING

Die hoofdoel van die grondwaterondersoek in die Williston omgewing was om vas te stel of grondwater 'n permanente oplossing vir Williston se terugkerende watervoorsieningsprobleme kan bied.

Die geraamde veilige lewering van die grondwatereenhede waarin die bestaande munisipale boorgate geleë is, is sowat 200 m^3/dag. Daar word verwag dat die munisipale waterbenodighede in die toekoms in die orde van 600 m^3/dag sal wees.

Twee nuwe grondwatereenhede is omlyn. Beide hierdie eenhede is grotendeels binne die munisipale gebied geleë. Eenheid A, oos van Williston, het 'n veilige lewering van sowat 1170 m^3/dag en die grondwater het 'n gemiddelde k.o.s. van 450 mg/ℓ. Eenheid B, suidoos van die dorp, het 'n geraamde veilige lewering van 19,3 m^3/dag terwyl die gehalte van die water in die 350-400 mg/ℓ k.o.s.-klas val.

Hoewel hierdie leweringsyfers net as 'n rowwe skatting beskou moet word, blyk dit tog dat grondwaterbronne Williston se watervoorsieningsprobleme na die verlede sal verwys. Geologiese inligting en gegewens van bestaande boorgate dui daarop dat bykomende water in ontginbare hoeveelhede selfs nog buite die munisipale gebied bekom kan word.

Ontginbare grondwater word telkemale aangetref in nate wat met dolerietintrusies geassosieer is. Dit word vermoed dat lugfoto's en Landsat beelde van waarde mag wees by die seleksie van areas met 'n bogemiddelde grondwater potensiaal.

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1. INTRODUCTION

Water shortages have been a recurring problem throughout Williston's existence. Although numerous borehole siting exercises were carried out by the Geological Survey in an attempt to alleviate the problem, no permanent solution was ever found. The most recent geohydrological work was done by M F Borcherds in 1972/73, and yet by 1975 the municipality found it necessary to ask for government assistance in obtaining a more reliable water supply.

The fundamental objective of this investigation was therefore to ascertain, once and for all, whether or not groundwater offered a permanent solution to Williston's water supply problems. This involved identifying any groundwater units present and estimating the safe yield of these units. A secondary objective of the project was to investigate methods of selecting borehole sites in the case of fractures associated with dolerite intrusions.

Field procedures used to realise these objectives were geological mapping, a borehole survey, magnetic work, exploration drilling and pumping tests. Geohydrology staff members W E Bertram (preliminary mapping from aerial photographs), D Anderson (borehole survey) and P L Havenga (pumping tests on municipal boreholes) assisted in the project.

The regional location of Williston in the western interior of the Cape Province is shown on the figure below.

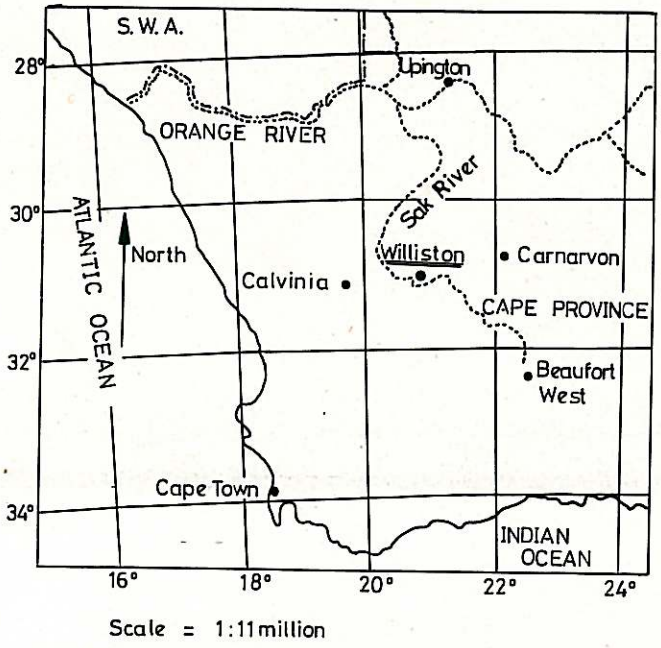


FIG. 1 LOCATION OF WILLISTON

The mean radius of the investigation area was 15 km (fig. 2). The investigation area is covered by the 3120 BD (Williston) and 3121 AC (Walkraal) 1:50 000 topographic maps. Field data have been stored in Gh envelope number 537.

This report deals with work carried out between October 1981 and July 1983. Further fieldwork in the study area was initiated during August 1983 with the objective of analysing a spectrum of geohydrological topics in more detail than is normally thought necessary for a standard source investigation.

FIG 2 EXTENT OF WILLISTON INVESTIGATION AREA

2. BACKGROUND INFORMATION

2.1 PREVIOUS INVESTIGATIONS

Report No. 252 - Advice on Water Supply : Town Council Williston, C P. (F C Truter, 1937)

Following a days reconnaissance visit two areas were delineated where Williston might find sufficient water supplies, and specific borehole sites were selected. Since no map is included it is not absolutely clear where these borehole sites were.

Report No. C105 (F W Schumann, 1949)

Schumann and Truter carried out a borehole siting exercise for the municipality between 6-11th December 1948. Five sites were selected: G3691, G3667, G3692, G3695 and G3686. These sites, together with the existing boreholes were plotted on a sketch plan (G143/Ghp 458). Schumann concludes that these boreholes will only bring temporary relief to the water supply problems and that the Sak River must be used to effect a permanent solution. Mention is made of a plan by Ninham Shand, Consulting Engineers, to pump water out of the Sak River to the earth dam immediately to the north-east of Williston, thus improving the recharge to the boreholes below the dam. Schumann makes the interesting assertion that groundwater will not be intercepted in the parts of the municipal area covered by dolerite sheets even though all sites selected by him were situated on such sheets.

Report No. 694 - Waterskema Williston (O R van Eeden, 1950)

This report details the planned scheme to pump water from the Sak River, stored temporarily in "saaidamme", to the earth dam immediately north-east of Williston, so that this water can recharge the boreholes below the dam. O R van Eeden makes the point that it is not known how much of the water infiltrating and then stored underneath the earth dam will eventually become reclaimable. F W Schumann asserts in this report that the rate of infiltration for the dam concerned is relatively fast, observing that it takes between one and two weeks for the completely full dam to empty. The final part of report 694 gives the detailed plan by Ninham Shand to pump water from the Sak River, and also gives a breakdown of costs. Ninham Shand make the pertinent point that flow records for 1930-50 might not be representative of the worst possible flow conditions for the Sak River, and that water restrictions might still be necessary in the future, even with the planned pumping scheme.

Report G357 (F W Schumann, 1958)

This report relates primarily to a borehole siting exercise. Sites G11656, G11657 and G11658 were selected. These sites, together with several existing boreholes are plotted on a geological profile (Go 143). This profile also gives the divisional numbers for boreholes drilled by the Drilling Services Subdivision.

The 1957 water requirements for Williston were estimated to be 200 m^3/day.

Schumann maintains that the Sak River should be considered as the principal supply of water for Williston with boreholes merely providing supplementary water. At this time the scheme to pump water from the Sak River was in use

although Schumann reports that the Sak River had not been in flood since November 1956. Various suggestions were made as to how this scheme could be improved.

At this time the municipality were offering a prize of £1000 to any private person drilling a borehole with a yield of 2000 gph or more, of fresh water, after a 12 hour test.

Report no. GH 1783 - Boorgat-opname en aanwysing van Boorplekke vir Munisipaliteit Williston - Distrik Williston (M F Borcherds, 1972)

This report gives a very thorough inventory of all the boreholes situated within the municipal area. Borehole sites G26890, 26891, 26892, 26893, 26894 and 26895 were selected. Borehole positions are shown on an unnumbered enclosure. A geological map is also included, but should not be taken seriously because it gives a totally wrong impression of the geology of the area. The sites where magnetic and resistivity work were carried out are shown but the results of this work are not included.

Report no. GH 1802 - Williston Munisipaliteit, Geohidrologiese, Geofisiese Opname en Boorplekaanwysing (M F Borcherds, 1973a)

The results of electromagnetic and magnetic work were used to modify the sites given in GH 1783 and to select new borehole sites. Geophysical field curves are included. A summary of the results of the drilling work is given in the report, but for full details the field data have to be searched. A summary of a pumping test on borehole G26893 (renumbered WN6 in the present report) is given. This was the only succesful borehole arising out of the 1972/73 work.

2.3 PRECIPITATION DATA

Annual precipitation data, for the years 1958 to 1982, have been plotted in histogram form (fig. 4). For this period the mean annual precipitation was 178mm. The below average precipitation for the years 1978, 79, 80 and 82 can clearly be seen.

WILLISTON : ANNUAL PRECIPITATION

Station Number = 136/740
Latitude = 31° 20'
Longitude = 20° 55'

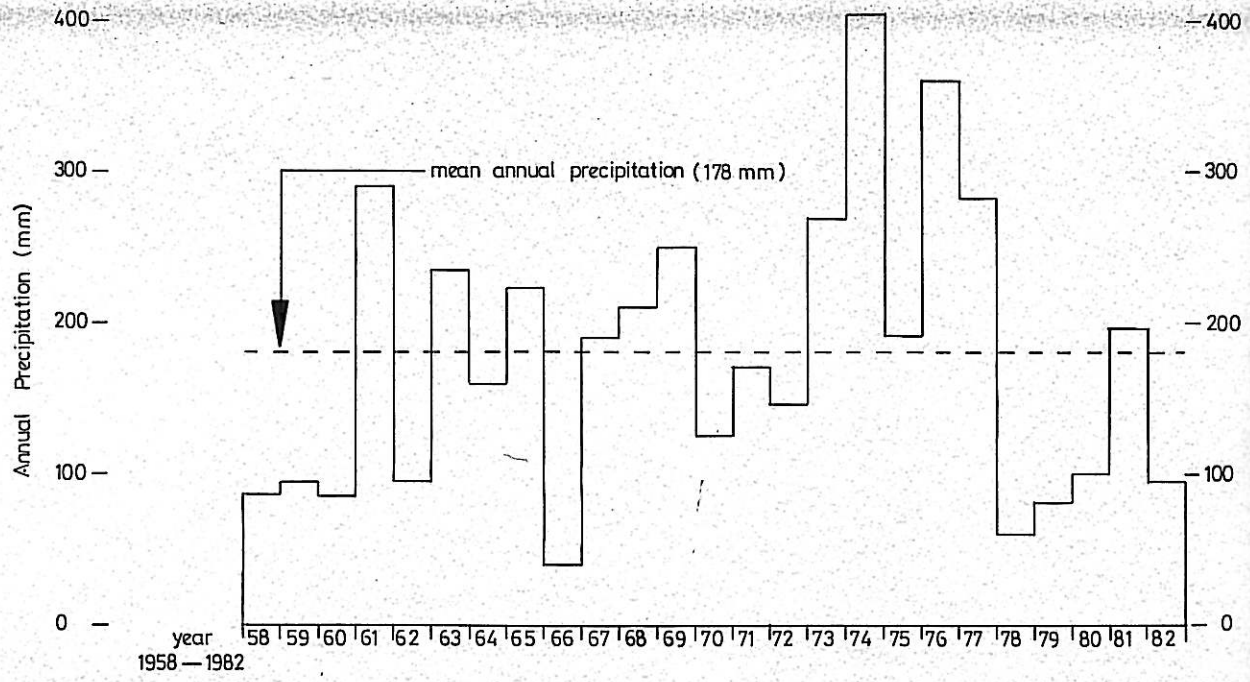


FIG. 4 Williston : Annual Precipitation

3. WILLISTON'S WATER PROVISIONS AND REQUIREMENTS

3.1 EXISTING MUNICIPAL WATER SUPPLIES

The quantities of water abstracted from the municipal boreholes for the years 1980 to 1982 are given in fig. 5. The average daily abstracted quantities are:

1980 - 342 m^3/day

1981 - 320 m^3/day

1982 - 444 m^3/day

The municipality arrived at these figures by multiplying the pump capacity with the number of hours pumped for all the boreholes in use. Thus, dropping yields caused by drought and/or overpumping are ignored, so that actual abstraction figures will be less than the municipal estimates when dropping yields do occur.

Water is supplied by boreholes WN1 to 8. Borehole WN6 was drilled following the work of Borcherds in 1972 (Borcherds, 1972) while the other boreholes pre-date the 1972 investigation.

Water restrictions were enforced from 3-2-1981 to 2-3-1981 and from 22-12-82. This water restriction was still being applied at the time of writing this report (August 1983). According to the town clerk no other water restrictions have been applied from 1975/6 onwards. These restrictions normally place a limit on the outside use of water. For example the 1982/3 restrictions allow gardens to be watered for 2 hours a week only.

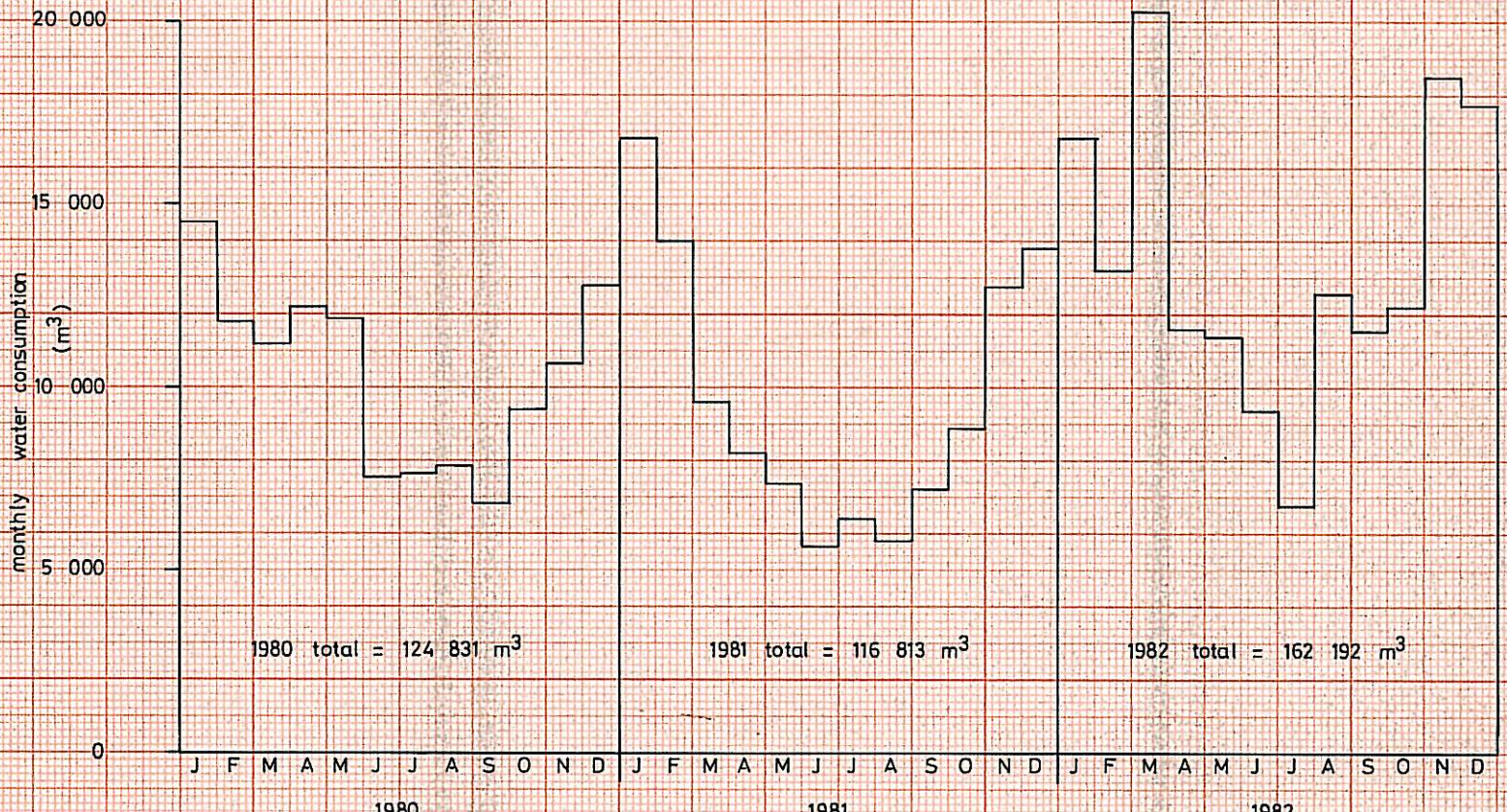


FIG. 5 Histogram of volume of water abstracted from existing municipal boreholes (1980—1982)

3.2 FUTURE WATER REQUIREMENTS

An estimate of future water requirements can be made by extrapolating past consumption figures. The following average daily consumption figures were calculated from the available data (report Gh 1783, and the Williston file):

1970 : 242 m^3/day

1971 : 179 m^3/day

1975 : 341 m^3/day

1976 : 303 m^3/day

1980 : 342 m^3/day

1981 : 320 m^3/day

1982 : 444 m^3/day

By assuming an overall linear variation in water consumption with respect to time the water demand for the year 2000 can be estimated to be 655 m^3/day.

On the other hand, if it is assumed that population levels will remain static to the year 2000, and if it is further assumed that the daily consumption at that time will be 200 ℓ/day for whites and 150 ℓ/day for non-whites, then an estimated water demand of 580 m^3/day is arrived at.

From these calculations it seems reasonable to assume that Williston's medium term water demand will be in the order of 600 m^3/day. As mentioned in Section 3.1, it is by no means certain what the exact water consumption is under adverse conditions because dropping yields of boreholes are not taken into account. If the water consumption in 1981 is taken to represent the total yield of the municipal boreholes under worst possible conditions,

and this figure is reduced by 60% to allow for dropping yields, then it can be argued that the existing municipal boreholes can only supply about 200 m^3/day on a continual basis. Thus, an extra 400 m^3/day would be required in order to meet the deficit between supply and future demand as estimated above.

4. GEOLOGY

Williston has an elevation of approximately 1080m above mean sea level and is situated some 1,5 km to the north-east of the Sak River which follows a roughly east-west course. The geology of the Williston area is shown on Enclosure 1, GHp 6070.

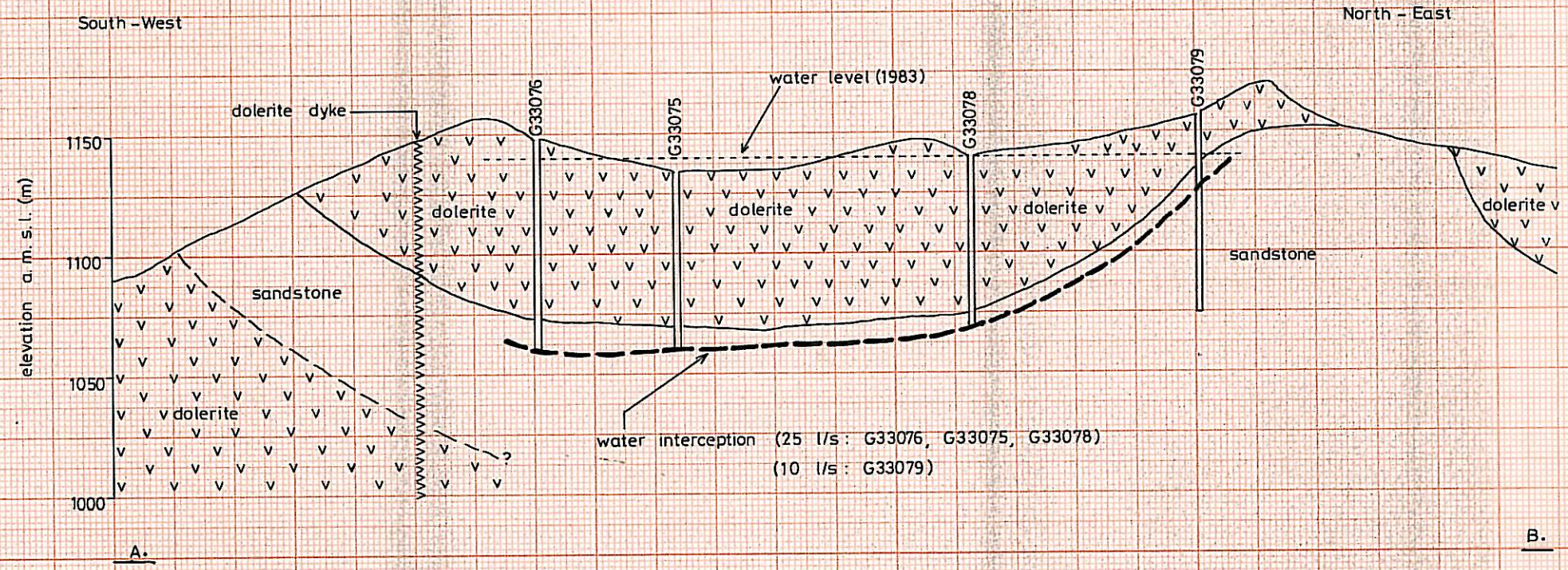
Alluvium in the Williston area varies from red and sandy to light grey and clayey. The typical width of alluvial deposits associated with the Sak River is 1 km.

Sedimentary rocks in the investigation area belong to the Ecca Group. Tierberg Shale consists principally of shale and outcrops only on the cadastral farm Lekkerleg 179 to the west of Williston. Resting on the Tierberg Shale is the Waterford Formation which comprises mainly sandstone. The Waterford Formation outcrops throughout the investigation area. The dip of the sedimentary rocks, is, for all practical purposes, horizontal.

Dolerite sheets form a large proportion of the surface geology. For the purposes of this investigation two main sheets are recognised: The "Upper" dolerite sheet outcrops in the Municipal Allotment Area and on the cadastral farms Bokvlakte and De Kruis. Usually an underlying band of sandstone separates the "Upper" dolerite sheet from the "Lower" dolerite sheet which occurs throughout the investigation area. However, in certain cases, the two sheets merge. Local lateral branching of the major sheets into two or more smaller sheets also occurs.

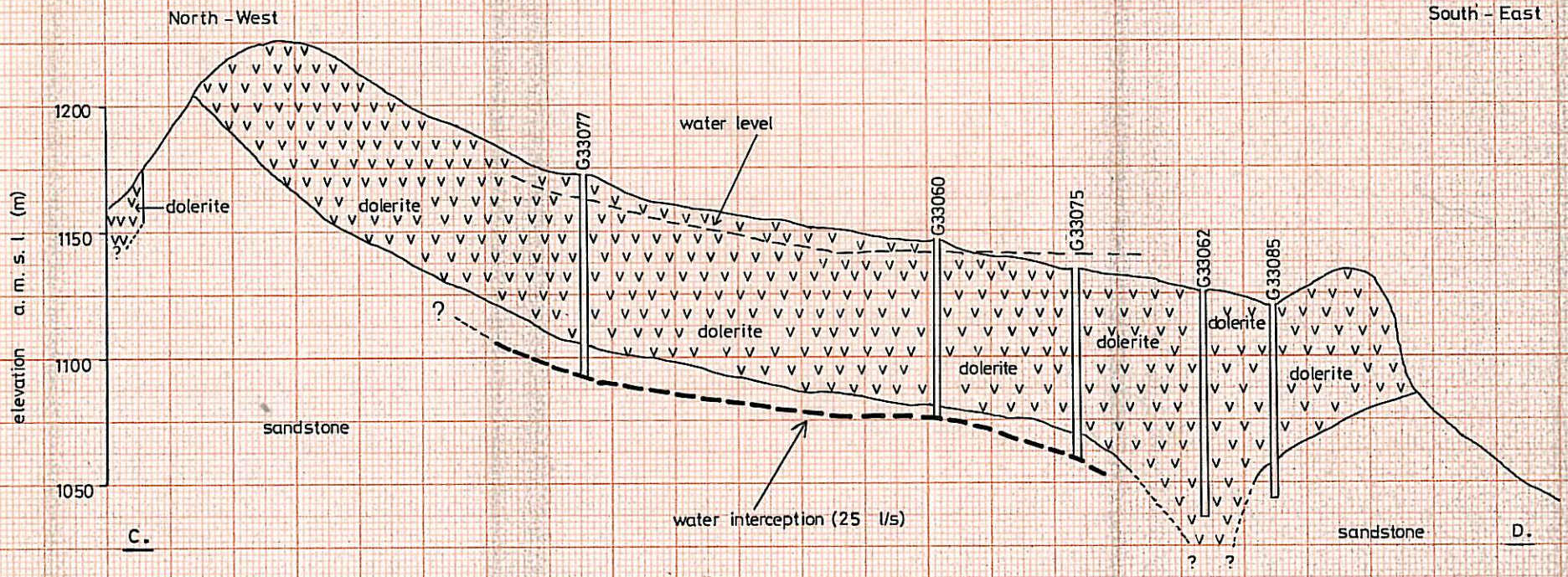
Subsequent exploration drilling revealed that the Upper dolerite sheet occurs as a saucer-like structure in the investigation area with a tilt towards the south-east (figs. 6 and 7). Thus the north-western rim of this saucer has a higher elevation than the south-eastern rim, while the south-western and north-eastern rims have approximately equal elevations. Dips within this saucer structure, as calculated from borehole information, seldom exceed 1,5°.

Dolerite dykes occur throughout the investigation area and are usually less than 13m in width.



(refer to FIG. 10)

FIG. 6 South-West to North-East geological section across groundwater unit A.



(refer to FIG 10)

Horizontal scale: 2cm = 1km

FIG. 7 North-West to South-East geological section across groundwater unit A

5. GEOPHYSICS : MAGNETICS

Reconnaissance type traverses were taken across dolerite sheets and short traverses across magnetic dykes (Appendix I). The purpose of the work on sheets was to investigate the possibility of identifying localised high-yielding fracture zones from magnetic anomalies. However, subsequent drilling revealed that high-yielding fractures associated with dolerite sheets in the Williston investigation area were either present virtually everywhere in a given groundwater unit or else were totally absent. These fractures were, therefore, decidedly non-localised although local magnetic anomalies were detected in both high-yielding and dry groundwater units. This indicates that magnetic anomalies bear no relation to groundwater occurrences in this particular case.

Magnetic anomalies were also used to position borehole sites on dykes where exposures were poor. It was found that boreholes could be positioned reasonably accurately with respect to the dyke using this method (boreholes G33071 and G33072).

6. BOREHOLE SURVEY

Borehole sites have been plotted on Enclosure 1 (GHP 6070), while details of the borehole survey are given in Appendix II.

Water quality was measured using a conductivity meter. This reading was then multiplied by a constant to obtain the total dissolved solids (T.D.S.) measured in mg/ℓ. Of the 123 measurements taken only 8 exceeded the 1971 SABS limit of 2000 mg/ℓ. Boreholes yielding this salty water were almost always situated in the floodplain of the Sak River. However, the converse is not true since not all the boreholes situated in the floodplain of the Sak River deliver salty water. For example, borehole DS6 on the cadastral farm De Kruis delivers water with a TDS of 1586 mg/ℓ. The reason for this anomolous, relatively fresh, alluvial water is not known. However, the water quality data do imply that fresh water (TDS less than 2000 mg/ℓ) can be intercepted at any location away from the Sak River.

Excluding the municipal boreholes, all the boreholes equipped with engines are situated in the south-western quadrant of the investigation area (fig. 8). This feature is probably just a peculiarity arising from the shape and extent of the investigation area, and no particular significance should be attached to it because high-yielding boreholes are reported beyond the investigation area in other directions. A list of all the boreholes equipped with engines, together with their average daily abstraction figures, as calculated from yield measurements made by the Division of Geohydrology and pumping times supplied by the owner, is given below:

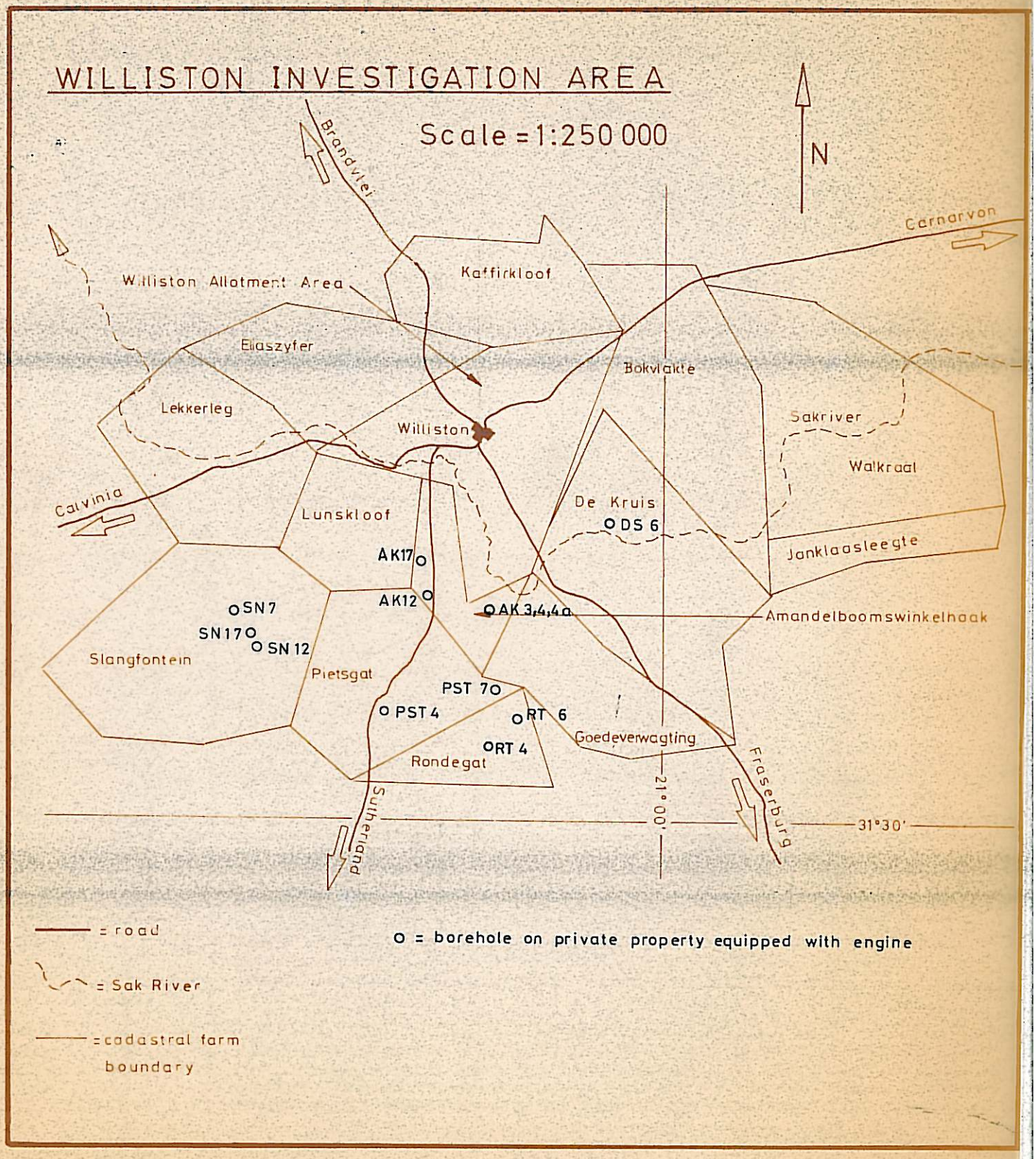


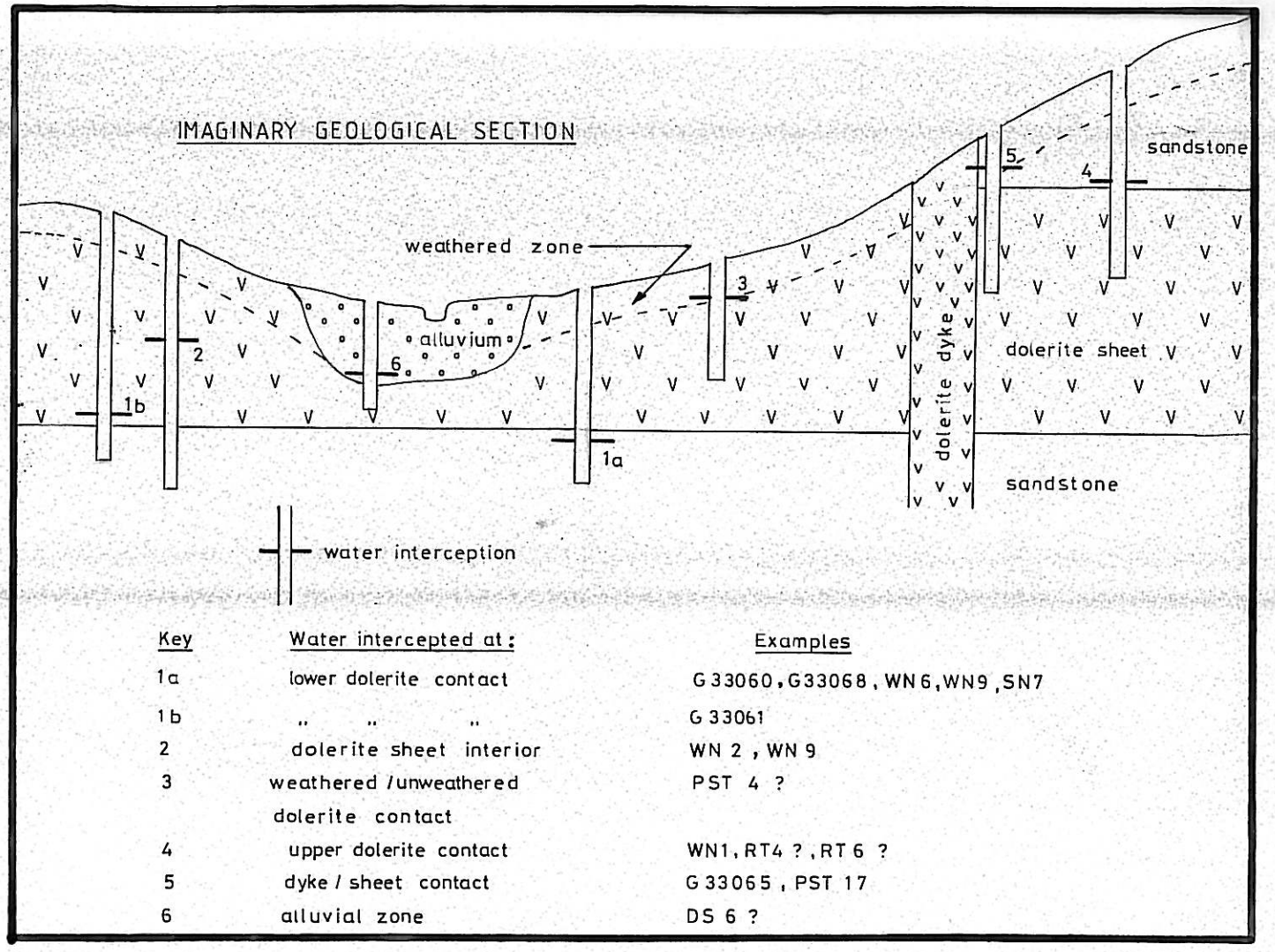
FIG 8 PLAN OF BOREHOLES EQUIPPED WITH ENGINES IN THE WILLISTON INVESTIGATION AREA - EXCLUDING MUNICIPAL BOREHOLES

Borehole number	Average daily yield (m^3/day)	T.D.S. (mg/ℓ)
AK 3	29	1099
AK 4a	42	1741
AK12	2	1723
AK17	46	1207
DS 6	60	1586
PST 4	approximately 100?	1229
PST17	29	873
RT 4	88	917
RT 6	78	936
SN 7	98	730
SN12	58	464
SN17	111	508

Total = 741 m^3/day

The total quantity abstracted suggests that a groundwater solution to Williston's water supply problem ought to be feasible, especially when it is recalled that in Section 3.2 it was estimated that Williston requires additional water supplies in the order of 400 m^3/day.

Since the majority of the boreholes listed above intercepted water in fractures associated with dolerite dykes and/or dolerite sheets (fig. 9), and since dolerite intrusions are widespread throughout the investigation area, the chances of intercepting similar yields in similar geological environments in other parts of the investigation area should be favourable. This means that the exploitation potential of the entire investigation area could be far in excess of 741 m^3/day.



Key	Water intercepted at :	Examples
1a	lower dolerite contact	G 33060, G 33068, WN 6, WN 9, SN 7
1b	" " "	G 33061
2	dolerite sheet interior	WN 2, WN 9
3	weathered / unweathered dolerite contact	PST 4 ?
4	upper dolerite contact	WN 1, RT 4 ?, RT 6 ?
5	dyke / sheet contact	G 33065, PST 17
6	alluvial zone	DS 6 ?

FIG 9 Geological situations associated with high-yielding boreholes

7. DRILLING PROGRAMME

The main purpose of the drilling programme was to identify and delineate groundwater units containing exploitable groundwater supplies. Secondary objectives were to clarify the structure of certain dolerite intrusions, investigate the relationship between high yields and geology and test methods for siting high-yielding boreholes. Six observation boreholes were drilled for pumping test purposes.

A total of twenty-six boreholes were drilled between 24-1-83 and 12-7-83 to a total depth of 1933m. Borehole details are given in Appendix III, while borehole positions are given in fig. 10 and Enclosure 1 (GHP 6070).

Two new groundwater units were located. Unit A is located to the east of Williston and contains boreholes G33060, 61, 68, 69, 70, 75, 76, 77, 78 and 79. This groundwater unit is situated within the "Upper" dolerite sheet described in chapter 4. Yields of approximately 25 ℓ/s were intercepted throughout this unit, at the lower contact of the dolerite sheet, usually in baked sandstone a few metres below the actual contact. At the time of this investigation borehole G33075 was artesian, overflowing at a rate of 10 ℓ/s (22-6-83). The average groundwater quality for this unit, as determined from field conductivity measurements, was 457 mg/ℓ.

Unit B is situated to the south-east of Williston. The highest yielding borehole within this unit (G33065) had a blow-out yield of 4 ℓ/s. Water was intercepted at a depth of 11m at the intersection of a dyke contact and an upper dolerite sheet contact (fig. 11). Other boreholes drilled in this unit were G33064, G33083 and G33084. The average water quality within

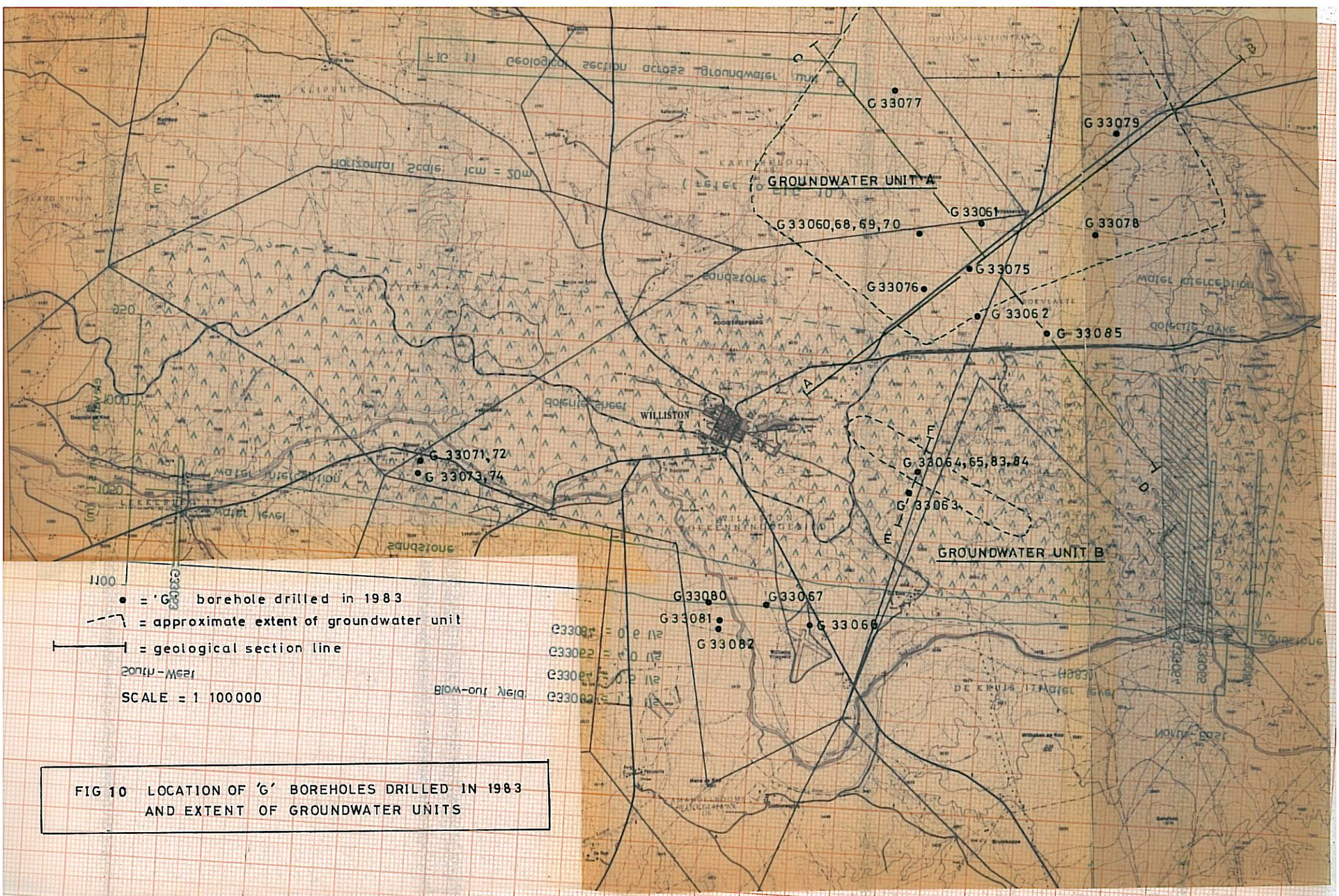


FIG 10 LOCATION OF 'G' BOREHOLES DRILLED IN 1983 AND EXTENT OF GROUNDWATER UNITS

this unit was 387 mg/ℓ.

The remaining boreholes, drilled mostly on dykes, and through a dolerite sheet in the Sak River valley, were effectively dry. This poses the question why dolerite structures deliver high yields in certain areas and not in others. At this stage it is only possible to list the differences that have been noted between areas giving high yields and dry areas. For example, unit A contains a tilted basin dolerite structure and a high density of linear features visible on both satellite images and aerial photographs, while the dolerite sheet along the Sak River is flat and contains a dearth of linear features. It is beyond the scope of a normal investigation to attempt to discern whether these differences listed are meaningful or not, although the variations in linear features seem to be worthy of further investigation.

8. PUMPING TESTS

8.1 EXISTING MUNICIPAL BOREHOLES

From 4-2-82 to 24-2-82 municipal boreholes WN 1, 2, 3, 6, 7 and 8 were tested by the Division of Geohydrology in an attempt to obtain a better understanding of the safe yields of the groundwater units in which they lie. The main details of these tests are tabulated below:

Borehole no.	WN 1	WN 2	WN 3	WN 6	WN 7	WN 8
Date commenced	8-2-82	16-2-82	10-2-82	22-2-82	8-2-82	4-2-82
Length of test (min)	360	4320	4500	2895	4260	1020
Initial yield (ℓ/s)	0,65	1,95	1,57	1,82	0,69	2,08
Final yield (ℓ/s)	0,65	0,26	1,51	1,57	0,58	1,67
Initial water level (m) below collar	28,53	18,87	52,05	35,85	19,28	36,31
Final water level (m) below collar	32,91	27,00	55,20	47,46	20,63	42,50
Depth of intake (m) below collar	33,53	46,33	58,52	58,52	30,48	42,67
Borehole depth (m)	37,19	56,08	64,01	89,00	37,80	61,57
Average quality TDS (mg/ℓ)	426	423	444	465	465	397
Recovery time (min)	360	3500	3000	1400	4260	2500
Water level after recovery (m) below collar	30,06	18,82	50,79	34,09	19,16	36,55

This table shows that low yields, dropping yields, deep water levels and water levels close to the pump intake level were prevalent characteristics of the municipal boreholes during February 1982. These facts suggest that the final yields of these boreholes cannot be maintained on a continual basis. Thus the safe yield of the groundwater unit or units in which these boreholes lie must be less than their combined final yield of 539 m^3/day. This assertion is supported by the fact that a number of these boreholes have dried up since the time of testing.

8.2 TESTS ON G33065

Pumping tests on borehole G33065 described below were carried out with a 75mm mono pump with the intake at a depth of 25m. The location of the borehole is given on Enclosure 1 and fig. 10. A plan of the test site (fig. 12) and a geological section (fig. 11) have been drawn up.

8.2.1 Step-drawdown test

Borehole G33065 was pumped for 55 minutes at 2,91 ℓ/s, then 50 minutes at 3,56 ℓ/s, 60 minutes at 4,33 ℓ/s, 60 minutes at 4,83 ℓ/s and finally for 60 minutes at 5,60 ℓ/s. The resultant step-drawdown curves have been plotted on semi-log paper (fig. 13).

Using a step-drawdown calculator program (Seward, 1982) values of B = 1,33 x 10^{-3} day/m^2 and C = 3,66 x 10^{-6} day^2/m^5 for the formation and well loss coefficients respectively were obtained. These values can be used to calculate

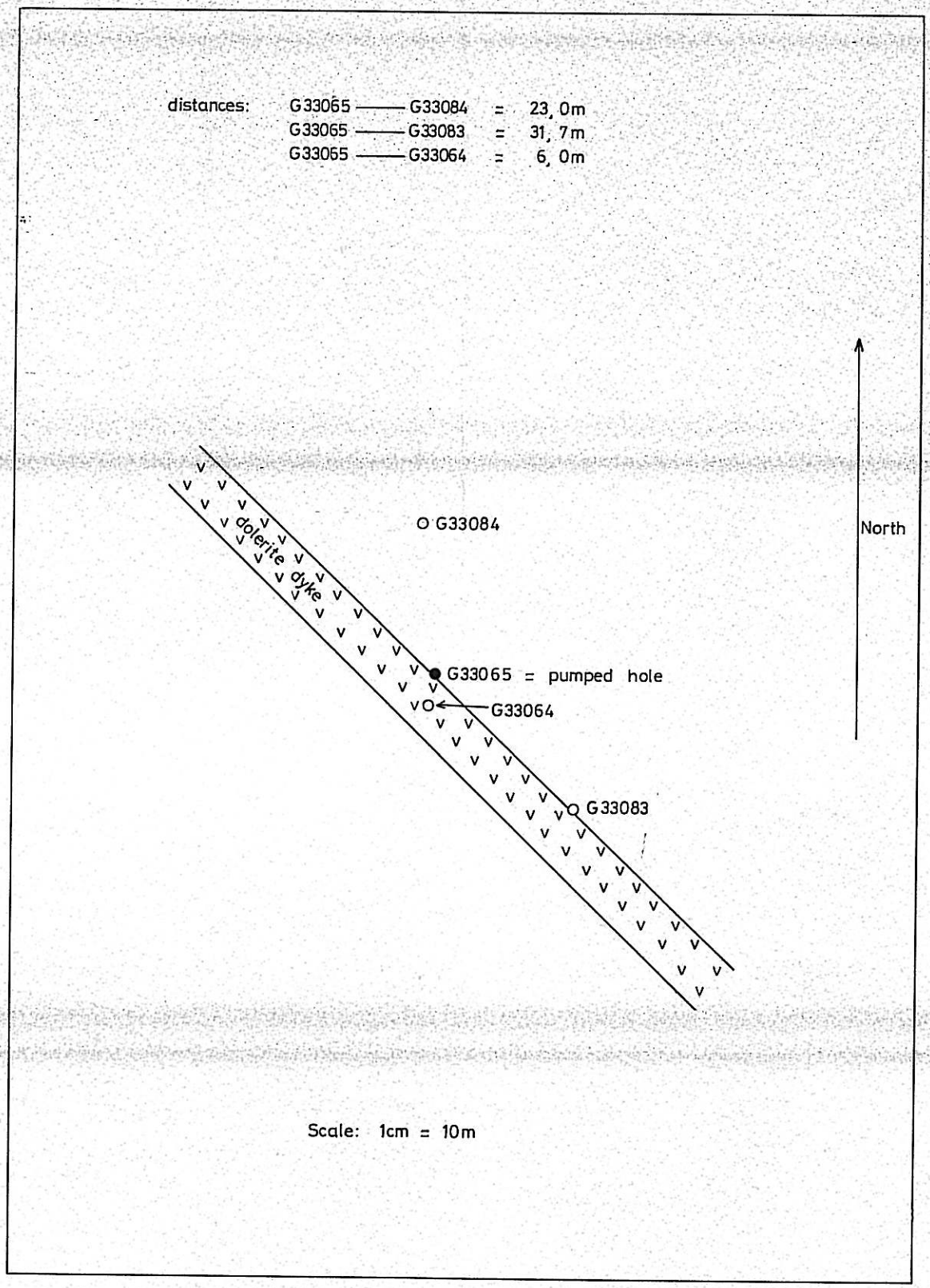


FIG. 12 G33065 pumping test site plan.

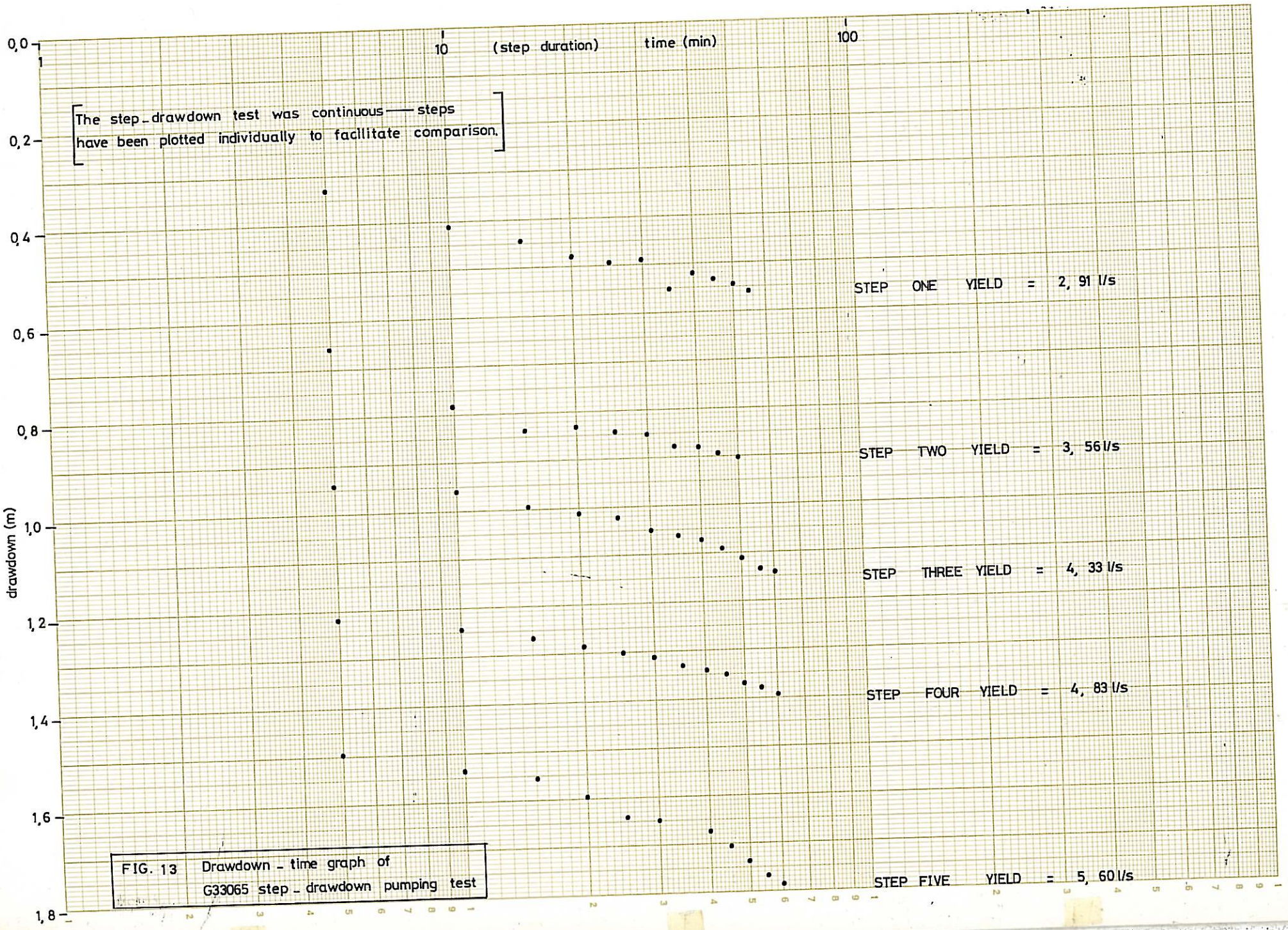


FIG. 13 Drawdown - time graph of G33065 step - drawdown pumping test

a percentage well loss of 42% for the constant rate test yield of 3,1 ℓ/s. However, it is by no means certain that the Jacob step-drawdown equation holds true for the fractured aquifer in question.

8.2.2 Constant rate test

Borehole G33065 was pumped for 3 days at 3,1 ℓ/s during which time the water level dropped from 7,185m to 9,928m, while the water quality averaged 380 mg/ℓ. Water levels were also measured in observation boreholes G33064, 83 and 84.

A graph of drawdown against the root of time has been plotted on linear paper (fig. 14). The straight line plots obtained are a characteristic feature of linear fracture flow. It can be seen that all the observation boreholes had virtually identical drawdowns. The difference between observation and pump hole drawdowns can be ascribed to effects that fall loosely under the heading of "well losses".

Using linear regression the following relationships were calculated:

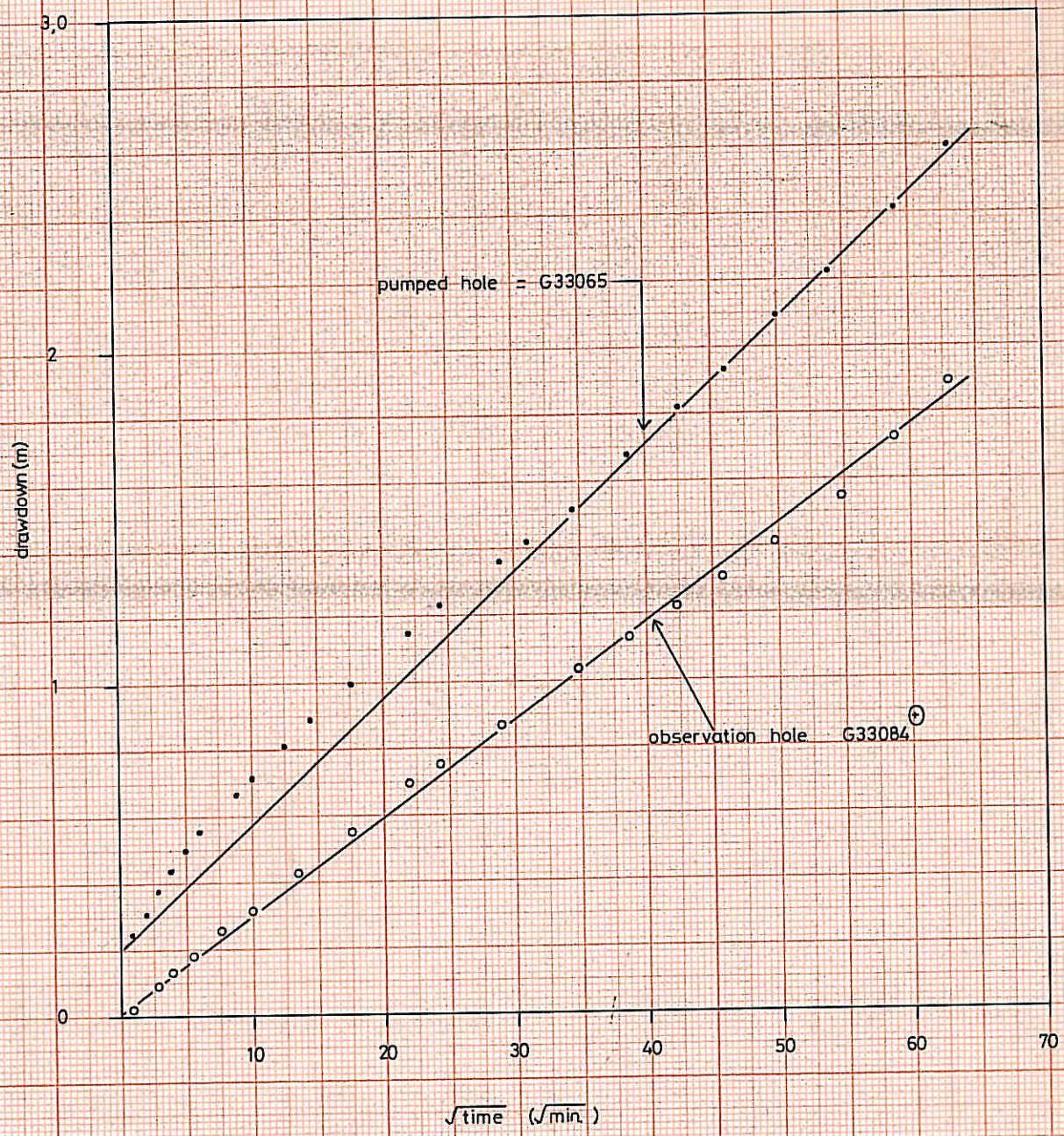
G33065 : $s = Q * \sqrt{t} * 0,00535 + 0,19$

Observation holes : $s = Q * \sqrt{t} * 0,00416$

where s = drawdown (m)

Q = yield (m^3/day)

t = time (day)



⊕ drawdowns measured in observation boreholes G33083 and G33064 were effectively equal to G33084 drawdown.

Yield during test = 3,11 l/s

FIG. 14 Graph of drawdown against square root of time ——— G33065 constant rate pumping test.

Since all the boreholes are situated within the main fracture system it is not possible to calculate hydraulic characteristics such as transmissivity and storage from the pumping test data. Additional observation boreholes drilled further from the pump hole might be of little value for pumping test purposes because it is highly likely that the main fracture system is bounded by a completely, or virtually, impermeable system.

Three days after stopping the pump the water level in G33065 was 7,605m, which was 0,42m short of its original rest level. Complete recovery was effected approximately ten days after the pump had been stopped.

8.3 TESTS ON G33069

Borehole G33069 was tested using a turbine pump with a 120mm intake and 100mm pipes. The location of the test site is given on Enclosure 1 and fig. 10. A pumping test site plan (fig. 15) and a geological section (fig. 16) are included.

8.3.1 Step-drawdown test

Borehole G33069 was pumped for 47 minutes at 16,4 ℓ/s, then 50 minutes at 19,2 ℓ/s, 50 minutes at 21,6 ℓ/s, 50 minutes at 22,6 ℓ/s, 60 minutes at 25,2 ℓ/s and finally for 60 minutes at 26,8 ℓ/s. The resultant drawdown-time curves have been plotted on semi-log paper (fig. 17). Values of $B = 3,09 \times 10^{-4}$ day/m^2 for formation loss and $C = 2,26 \times 10^{-7}$ day^2/m^5 for well loss were obtained using the calculator program. These values of B

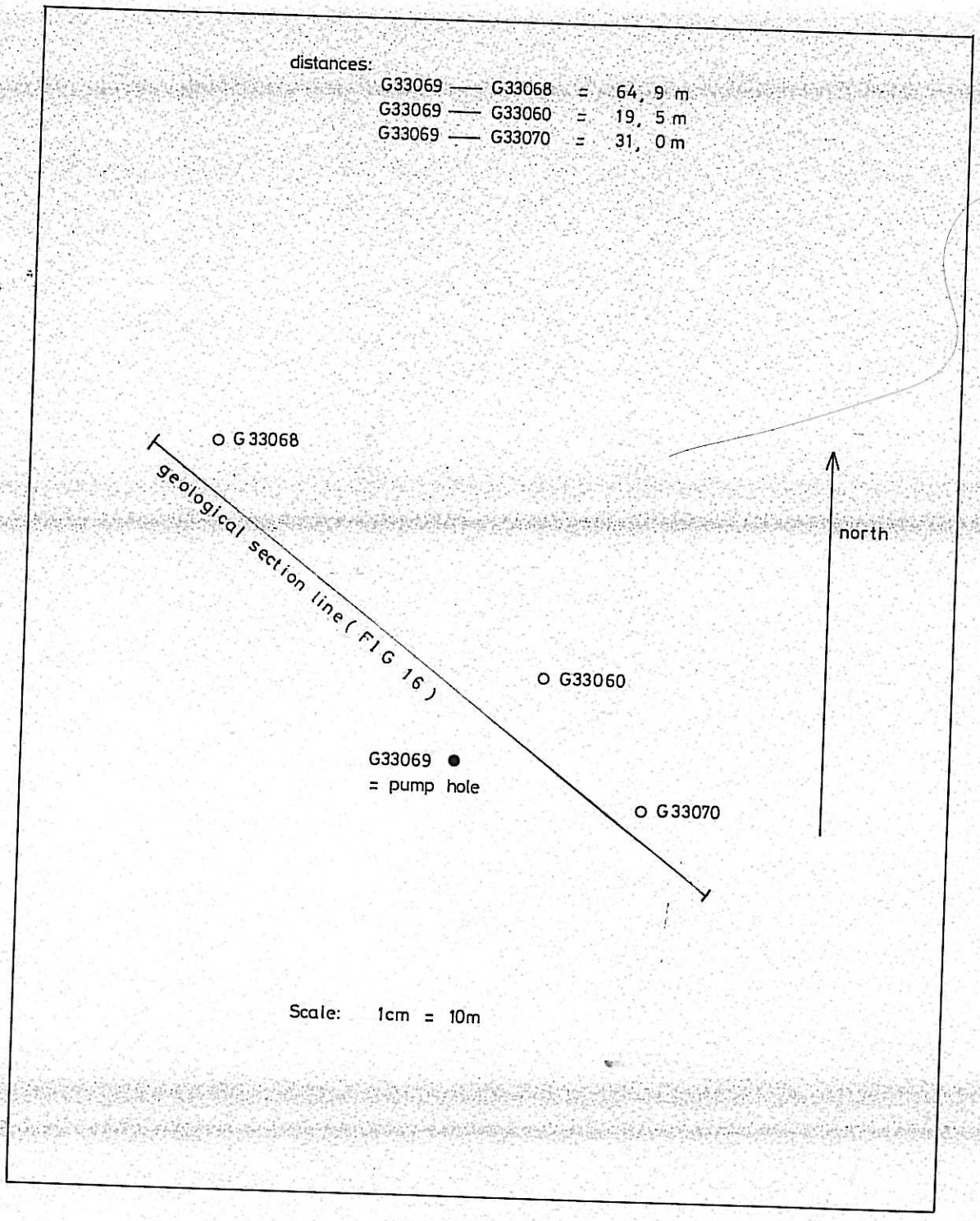
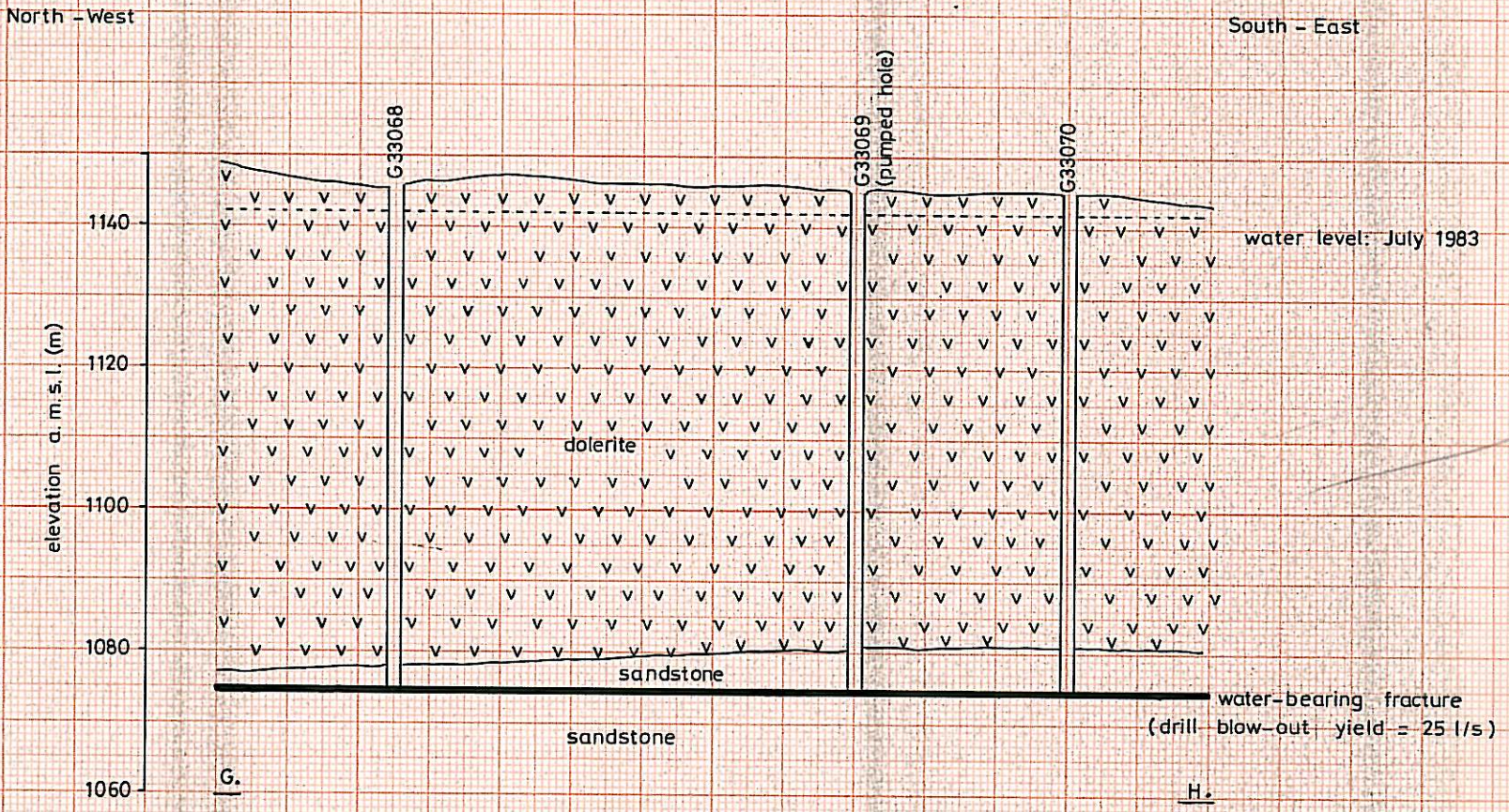


FIG 15 G33069 pumping test site plan.



Horizontal Scale: 1cm = 10m

(refer to FIG 15)

FIG. 16 Section across G33069 pumping test site.

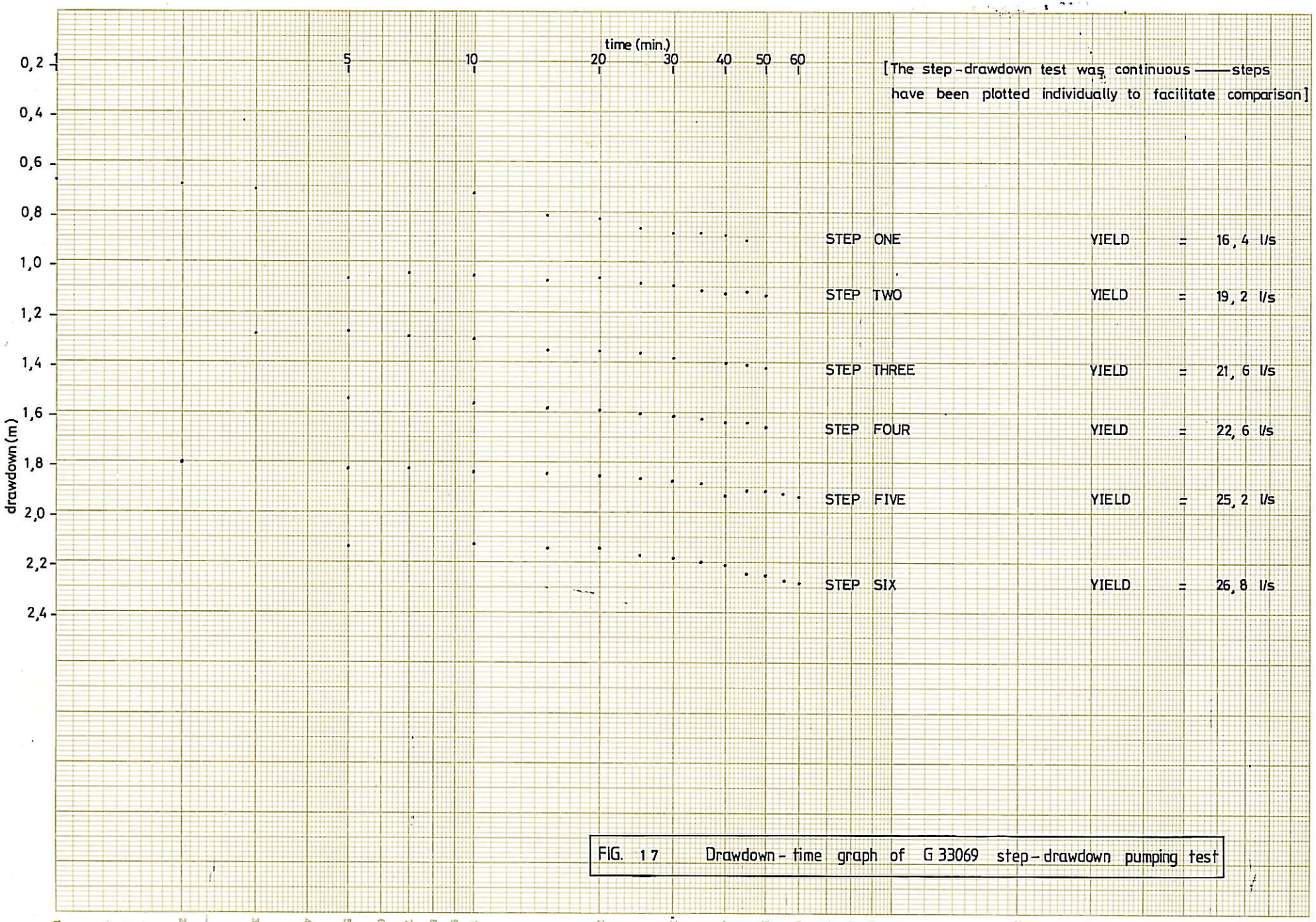


FIG. 17 Drawdown-time graph of G 33069 step-drawdown pumping test

and C give a well loss of 53% for the constant rate test yield of 17,9 ℓ/s. However, linear fracture flow rather than radial flow is involved and it is by no means certain that the Jacob step-drawdown equation, with associated B, C and well loss values is applicable. It is possible that in cases such as these the whole concept and terminology of step-drawdown tests need to be revised.

8.3.2 Constant rate test

Borehole G33069 was pumped for three days with a constant yield of 17,9 ℓ/s. The rest level prior to pumping was 3,585m and the final drawdown was 8,190m. Water quality averaged 419 mg/ℓ. Three days after the pump was stopped the water level was 5,332m - short of the original rest level by 1,747m.

The interpretation of this pumping test was greatly facilitated by the fact that the groundwater unit concerned had been well defined by exploration drilling (figs. 6 and 7). It was known that the horizontal fracture intercepted in borehole G33069 extended for several kilometres and occurred virtually throughout the entire groundwater unit. It was also known that the main fracture had to be limited by an impermeable boundary in the direction of groundwater flow in order to account for the observed artesian and sub-artesian conditions. The drawdown-time curves obtained (fig. 18) were therefore interpreted using a fracture flow method. The following relationships were obtained from a linear plot of drawdown against the square root of time:

G33069 = pump hole : $s = Q * \sqrt{t} * 1,27 * 10^{-4} - 0,52$

observation boreholes: $s = Q * \sqrt{t} * 1,28 * 10^{-4} - 0,84$

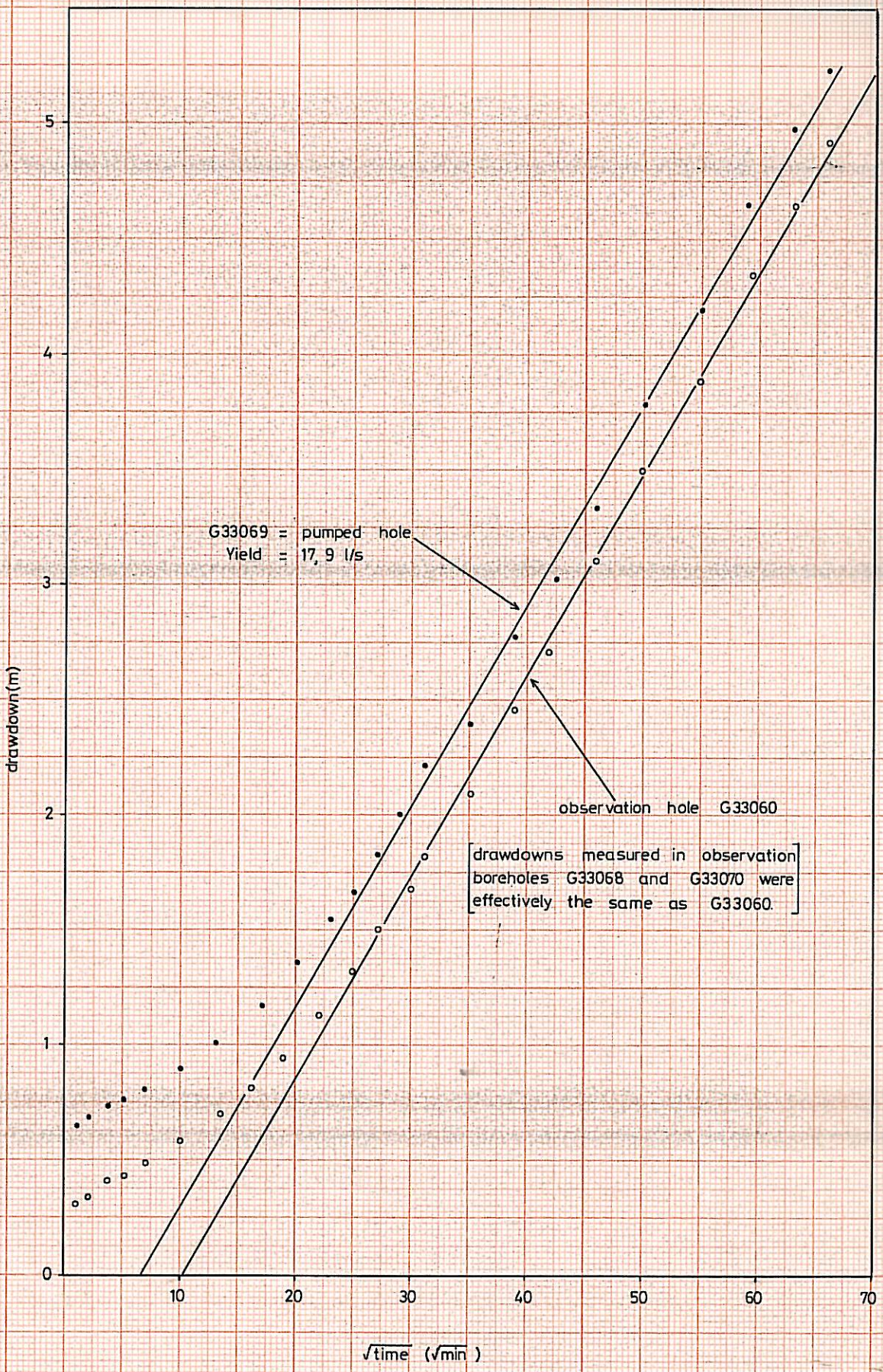


FIG. 18 Graph of drawdown against square root of time ——— G33069 constant rate pumping test.

The drawdowns for the observation boreholes have been grouped together because they are virtually identical. A correalation coefficient of 0,999 was obtained for the straight line fitted to both the pump hole and ovservation holes data, which supports the choice of interpretation procedure.

Normal fracture flow pumping test interpretation methods, correctly applied, cannot be used to calculate transmissivity and storage values for this particular aquifer because it consists principally of one major fracture without any surrounding secondary fractures where flow might tend to become radial rather than linear.

9. GROUNDWATER CHEMISTRY

Chemical analyses of water samples taken from municipal and private boreholes as well as from the 'G' boreholes drilled in 1983 have been represented on a Piper diagram (figs. 19 and 20).

According to the literature (Johnson, 1975, for example) a Piper diagram can be used to divide groundwater into 4 types as shown below:

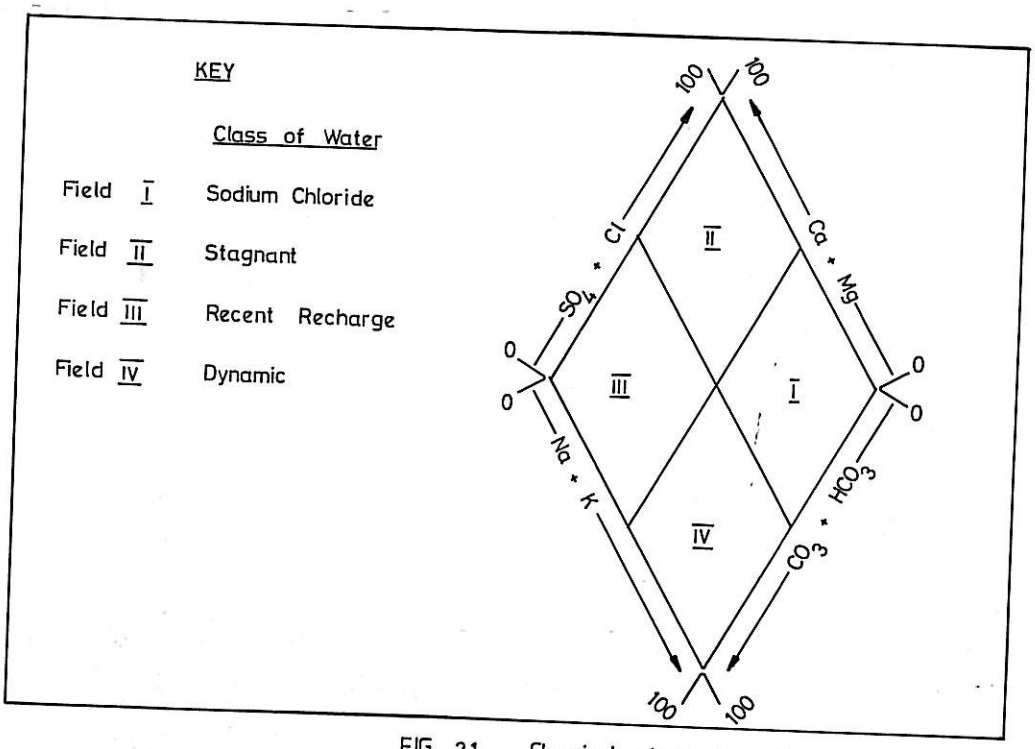


FIG. 21 Chemical character of groundwater as shown by a Piper diagram.

Thus it can be seen that the majority of the Williston samples fall under the recent recharge, stagnant or sodium chloride water types. The lack of groundwater belonging to the dynamic type could possibly be due to the fact that the underground movement of water is relatively limited. In other

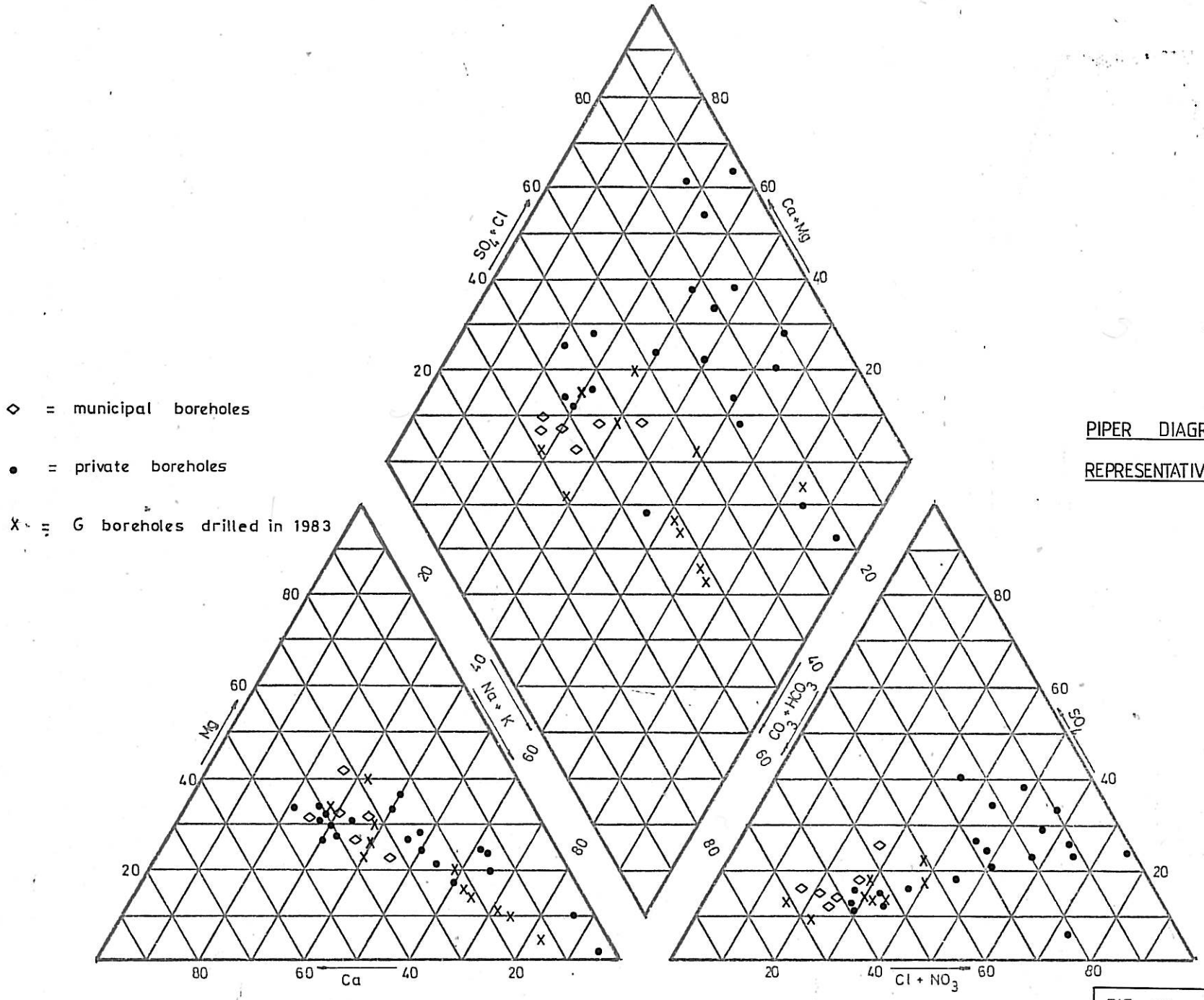


FIG. 19 Piper diagram plot of representative water samples

(G33069 start and finish refers to constant rate pumping test)

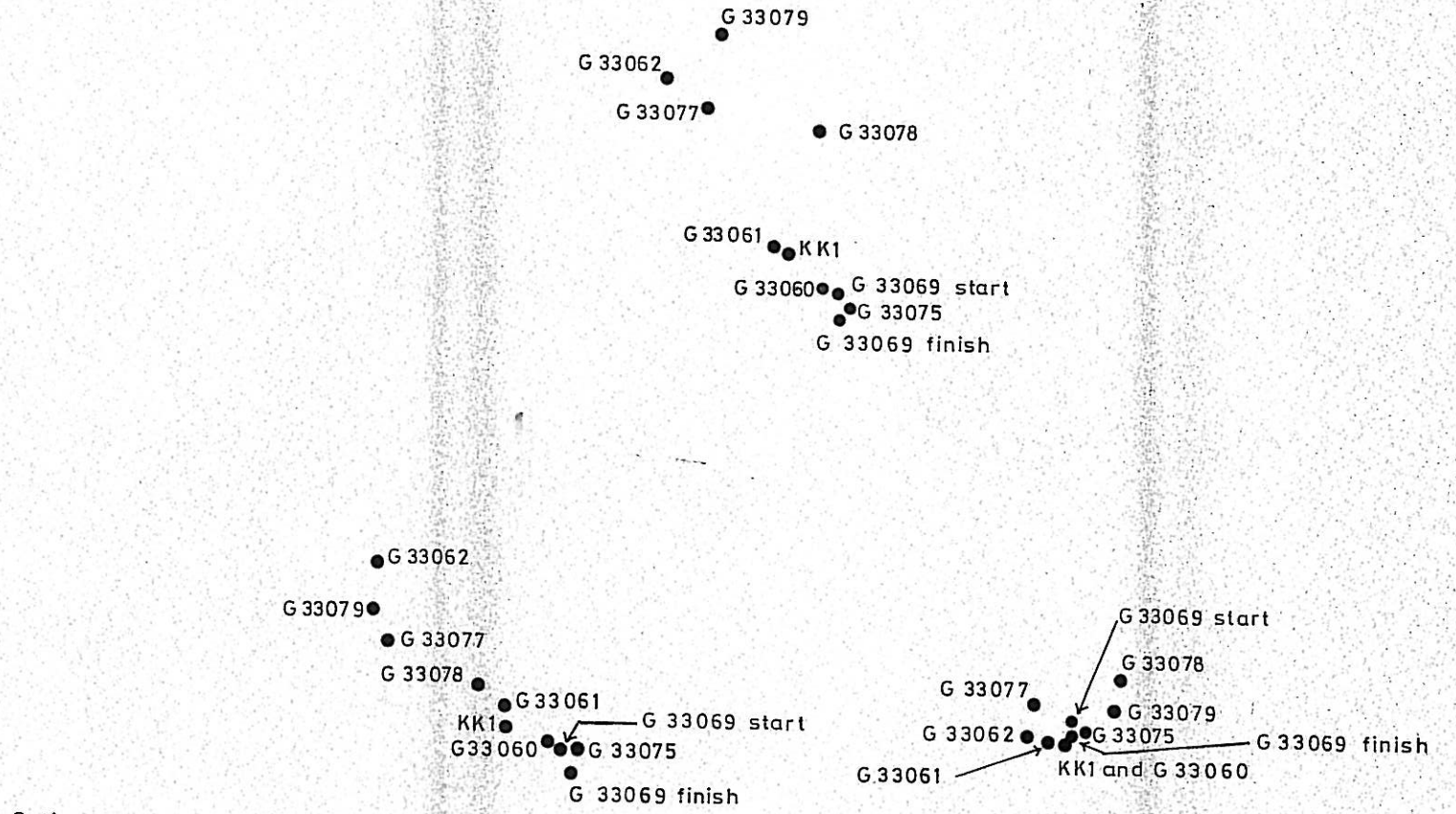
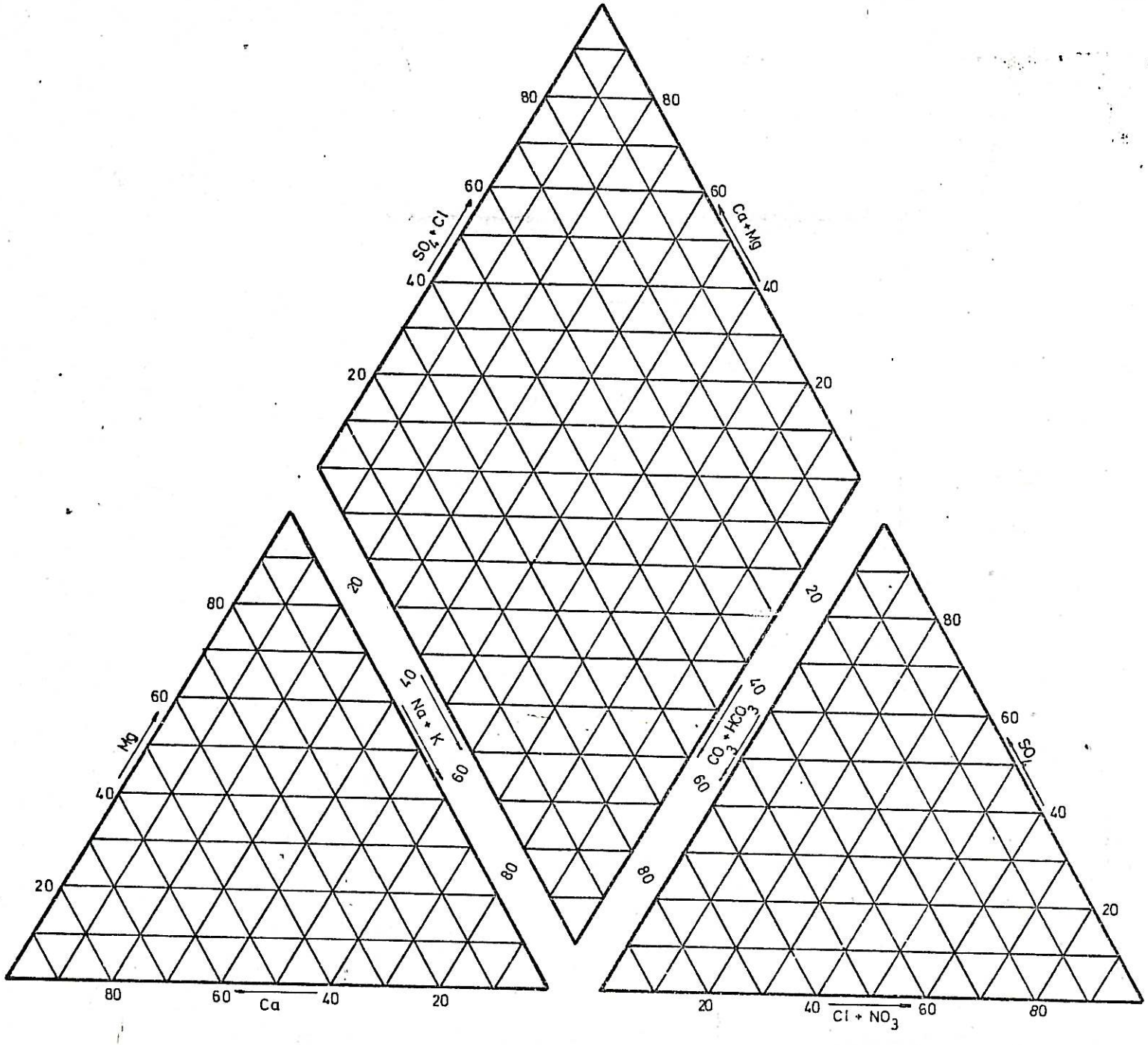


FIG 20 PIPER DIAGRAM OF SAMPLES FROM GROUNDWATER UNIT A


80
60
40
20
$SO_4 + Cl$
$Ca + Mg$
Mg
$Na + K$
$CO_3 + HCO_3$
SO_4
Ca
$Cl + NO_3$

words, water composition progresses directly from a recent recharge type to a static type without any significant underground movement.

It is interesting to note that samples from the municipal boreholes fall mainly under the recent recharge type, as do samples from groundwater unit B, while samples from unit A fall just within the dynamic type.

Finally it should be noted that high total dissolved solids are not necessarily associated with stagnant and sodium chloride water types in the Williston case. For example water from borehole G33063 plots clearly as a sodium chloride type yet has a total dissolved solids of only 273 mg/ℓ. Water from borehole G33063, along with other samples showing similar characteristics, was intercepted in sandstone, while water with a similar total dissolved solids but of a recent recharge or dynamic type was commonly associated with water intercepted in or near dolerite. Thus it is possible that geological factors are as important, or even more important than the relative position of water in the groundwater cycle in determining the water type of a given sample in the Williston area.

10. SAFE YIELD ESTIMATES

10.1 GROUNDWATER UNITS CONTAINING EXISTING MUNICIPAL BOREHOLES

In section 3.2 it was argued that the measured rate of groundwater abstraction under the least favourable recharge/storage conditions is a good indicator of safe yield, and a figure of 200 m^3/day was obtained for the groundwater units containing the municipal boreholes. A better estimate cannot be obtained using, for example, pumping test or geological data because there are too many unknown factors. However, it should be possible to obtain a better safe yield estimate if abstraction figures are obtained more accurately using meters rather than estimates based on the number of hours pumped and if these measurements are maintained over a number of years.

10.2 GROUNDWATER UNIT A

This groundwater unit contains boreholes KK 1, G33060, G33061, G33068, G33069, G33070, G33075, G33076, G33077, G33078 and G33079. Safe yield estimates were made using three methods:

Water stored in fracture:

From drilling evidence it is estimated that the average width of the fracture aperture is 200mm, and it is assumed that the fracture extends throughout the groundwater unit, the surface area of which is 48 km^2. If it is further assumed that water stored in the fracture will have to be capable of meeting a 4 year demand without recharge - 4 years being the maximum duration of periods with below average rainfall - then the safe yield can be estimated by:

(surface area) x (aperture width)/(4 x 365) m^3/day

= ·7671 m^3/day

Pumping test extrapolation:

A safe yield estimate can also be calculated from the maximum yield that can be pumped over a 4 year no-recharge period without the water level dropping below the water interception. From the drawdown-time equation derived in Section 8.3.2 the safe yield is then given by:

$(s + 0{,}52)/(\sqrt{t} * 1{,}27 * 10^{-4})$ m^3/day

= 12 884 m^3/day

Percentage recharge:

It is commonly assumed that 5% of the mean annual precipitation is effectively recharged when dealing with the Karoo environment, although there is very little evidence available to substantiate this figure. However, if this figure is accepted, and if it is assumed that all the water recharged into unit A becomes available for abstraction, then the safe yield can be estimated by:

(mean annual precipitation) x (surface area) x 5% ÷ 365 (m^3/day)

= 1170 m^3/day

The first two estimates utilise groundwater storage principles while the final method is based on recharge. Obviously, there is likely to be a large degree of uncertainty in all three methods. However the percentage recharge value is selected because it is the lowest. The safe yield of groundwater unit A is thus estimated as 1170 m^3/day.

10.3 GROUNDWATER UNIT B

This unit contains boreholes G33064, 65, 83 and 84. The same procedures as in section 10.2 were followed to estimate the safe yield of this unit.

Water stored in fracture:

By assuming that the fracture aperture is 50mm and that the surface area of the groundwater unit is 2,5 km^2 the safe yield is estimated to be 85 m^3/day.

Pumping test extrapolation:

From the drawdown-time equation derived in section 8.2.2 the safe yield is calculated to be 19,6 m^3/day.

Percentage recharge:

This method gives a safe yield of 61 m^3/day.

The lowest of these three values is selected, giving an estimated safe yield for groundwater unit B of 19,6 m^3/day.

10.4 CONCLUSIONS

The final safe yield estimates are:

groundwater units containing existing municipal boreholes	=	200 m^3/day
groundwater unit A	=	1 170 m^3/day
groundwater unit B	=	19,6 m^3/day
Total	=	1 390 m^3/day

It hardly needs to be pointed out that these estimates are likely to contain considerable margins of error. To allow these estimates to be revised reliable abstraction records should be maintained, and records of rainfall data and waterlevel fluctuations should be kept.

It should also be remembered that groundwater occurrences in the investigation area are not limited to the units described above. These units were considered to be examples, or type cases, of similar units in the area and were therefore investigated in detail. The fact that private boreholes equipped with engines, scattered throughout the investigation area, were yielding a total of 741 m^3/day suggests that the safe yield of the entire investigation area could easily be as much as 2-3000 m^3/day, or more.

11. DISCUSSION

11.1 OPTIMUM UTILISATION OF GROUNDWATER UNIT A

Since the municipality are planning to use borehole G33076, situated within unit A, it seems worthwhile to comment on the optimum utilisation of this unit.

Firstly, it should be understood that if any one of boreholes G33060, 61, 68, 69, 70, 75 or 76 is pumped then an appreciable drawdown will occur in all the rest of these boreholes. This fact was determined from temporary water level recordings while drilling was underway. Furthermore, the constant rate test on borehole G33069 produced a nearly identical drawdown in borehole G33061, situated 1,5 km to the east of borehole G33069. Therefore, from a groundwater management point of view, it would be ill-advised and totally uneconomical to pump more than one of the above-mentioned boreholes.

It can also be argued that no other boreholes within this unit, for example G33078 and 79 at Bokvlakte, should be used unless it is proved that there is no hydraulic connection between these boreholes and borehole G33076. This can be determined if water levels are monitored throughout this unit. It should be remembered that if impermeable boundaries are found then unit A should be referred to as a set of units rather than a single unit.

11.2 COMMENTS ON GROUNDWATER MANAGEMENT

Even though the estimated safe yield of groundwater unit A (1170 m^3/day) exceeds the estimated future municipal requirements of 600 m^3/day, it would be very unwise, from a groundwater conservation point of view, to rely solely on this unit for the town's water supply for two reasons:

- the figure of 1170 m^3/day was obtained by assuming that 5% of the mean annual precipitation effectively infiltrates this groundwater unit and is thus, at best, only a rough estimate. Subsequent abstraction, rainfall and water level measurements might, for example, reveal a percentage recharge as low as 1%, and this would indicate a safe yield of 234 m^3/day rather than 1170 m^3/day.

- Infiltration of rainwater into unit A is likely to be slower than for the other units, where water was generally intercepted at shallower depths. Furthermore, subsurface outflow from unit A is prevented by the presence of impermeable boundaries, while subsurface outflow from the other units is a distinct possibility. To take advantage of this situation it seems sensible to utilise unit A during dry spells, and the other units during periods of active recharge.

Thus, a sensible groundwater policy would be to use different groundwater units on a rotational basis, taking due note of periodic fluctuations in rainfall. This procedure should be applied to groundwater units as a whole rather than individual boreholes.

12. CONCLUSIONS

1. The safe yield of the groundwater units containing the existing municipal boreholes was estimated to be in the order of 200 m^3/day, while municipal water requirements in the near future were estimated to be about 600 m^3/day.

2. Two new groundwater units were identified. Both these units straddle the municipal boundary yet can be tapped by boreholes situated within the municipal area. The safe yield of unit A, situated to the east of Williston, was estimated to be 1170 m^3/day, while that of unit B, situated to the south-east of Williston, was estimated to be 19,6 m^3/day.

3. The safe yield estimates for units A and B are, at best, only very rough guidelines. They should be revised after water level, abstraction and rainfall data have been collected for a number of years.

4. Water from unit A has a total dissolved solids value averaging 450 mg/ℓ, while water from unit B has a typical total dissolved solids content of 350-400 mg/ℓ. The TDS of groundwater away from the Sak River is almost always less than 2000 mg/ℓ, while groundwater in the floodplain of the Sak River often has a TDS greater than 2000 mg/ℓ.

5. Exploitable groundwater occurrences within the investigation area are not limited to units A and B and the municipal boreholes. Indeed, it was argued that the safe yield of the entire investigation area could well be in the order of 2000-3000 m^3/day.

6. Magnetic methods were found to be of no value in locating high yielding fractures associated with dolerite intrusions. Preliminary studies suggest that aerial photographs and Landsat images might be of help in delineating areas where groundwater prospects are better than average. It is suspected that the chances of intercepting high yields might be greater in areas with a high density of linear features, and less in areas with a low density.

7. At the time of writing this report the municipality were making preparations to use borehole G33076, situated in groundwater unit A. It is strongly recommended that no other borehole in this unit should be used unless water level measurements indicate that it is desirable to do so.

P SEWARD

DIVISION GEOHYDROLOGY
CAPE TOWN

SEPTEMBER 1983

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APPENDIX I

MAGNETIC TRAVERSES

A map of the traverses is given on page 1, while the remainder of the Appendix contains the actual traverses.

= magnetic traverse

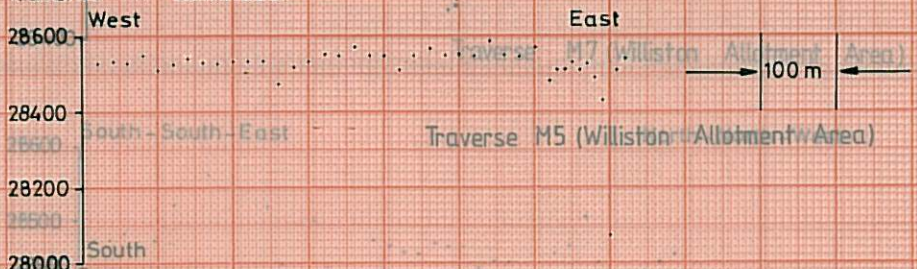
SCALE = 1:100 000

N

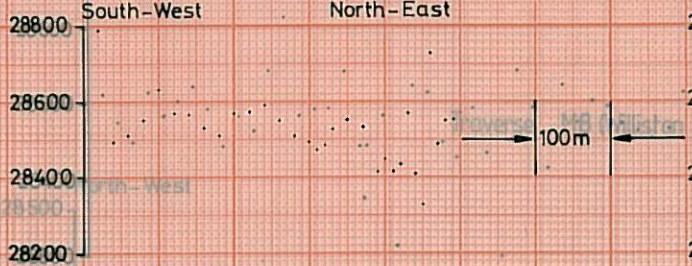
Location of Magnetic Traverses

Traverse M1 (Williston Allotment Area)

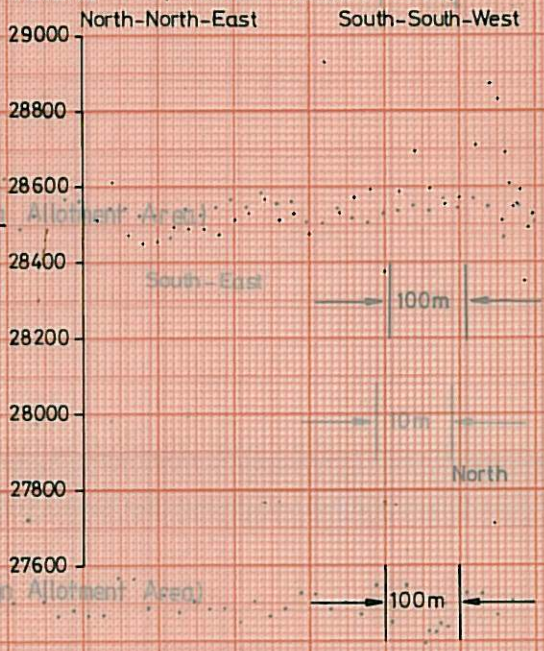
Traverse M1 continued:



Traverse M2 (Williston Allotment Area)

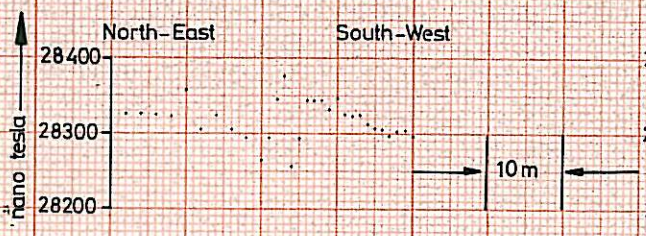


Traverse M3 (Williston Allotment Area)



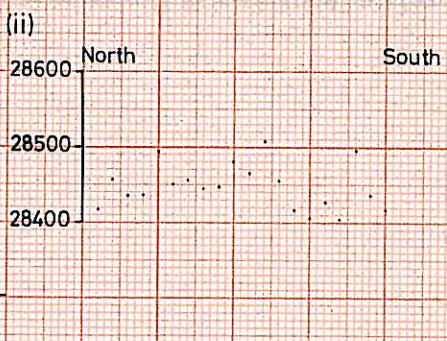
Traverse M5 continued:

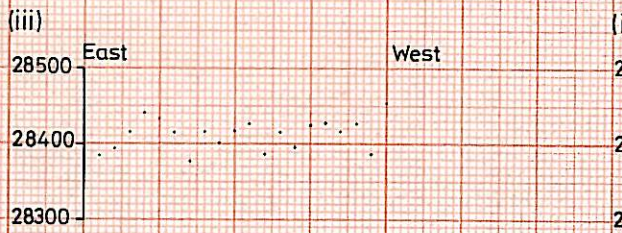
Traverse M 10 (Williston Allotment Area)

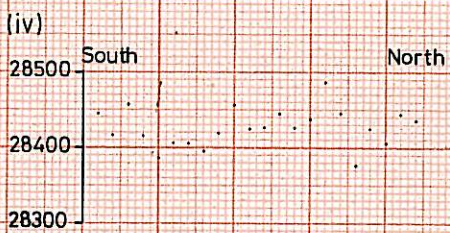


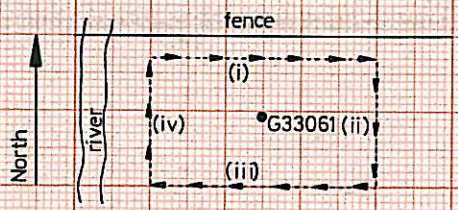
Traverse M 11 (Williston Allotment Area)

Traverse M 12 (Williston Allotment Area)









PLAN OF TRAVERSE M12
(not to scale)

APPENDIX II

BOREHOLE SURVEY

References

All borehole sites are given on Enclosure 1, GHP 6070

Abbreviations used

w.p. - windpump

dom. - domestic

irrig. - irrigation

Comments

Unless otherwise indicated the following holds true:

- water levels and water qualities were measured by the Division of Geohydrology
- all other information was supplied by the owner
- the boreholes were drilled and tested privately
- open spaces in the table indicate no data available.

APPENDIX III

DRILLING PROGRAMME (24-1-1983 TO 27-7-1983)

Notes

- water qualities (TDS - mg/ℓ) have been obtained from field conductivity measurements
- yields blown out during drilling were measured with a 20ℓ drum and stopwatch
- borehole sites are plotted on Enclosure 1, GHP 6070 and on fig. 10.

APPENDIX IV

CHEMICAL ANALYSES

- Samples taken during borehole survey, drilling programme and pumping tests (1981-1983)
- Sampling points are given on Enclosure 1, GHP 6070.

WILLISTON BOREHOLE SURVEY 1981-1983

APPENDIX IV

Sampling point (= borehole no.)	Date of sample	H number	pH	Conductivity (mS/m)	Na	K	Ca	Mg	SO_4	Cl	TAL	NH_4	NO_3	F	Si	P
					in mg/ℓ											
AK 4	81-11-18	81416616	8,0	243,2	349,431	3,872	78,330	79,325	314,899	402,148	369,276	0,054	0,938	1,349	18,139	0,003
BE 7	81-11-25	81416551	7,8	106,0	69,584	2,506	86,027	43,747	64,945	127,460	229,212	0,026	13,515	0,540	27,687	0,005
DS 2	81-11-20	81416569	7,8	422,4	655,261	5,485	126,693	105,241	572,807	831,197	286,538	0,022	14,417	1,117	23,953	0,005
DS10	81-11-20	81416577	7,9	116,5	103,943	1,271	64,457	43,680	95,425	181,020	189,696	0,056	3,898	0,677	21,145	0,003
DS17	81-11-23	81416585	7,8	582,4	873,590	7,352	179,430	190,351	1014,451	1300,845	312,245	0,025	2,103	0,771	17,127	0,003
GG 6	81-11-18	81416624	7,7	90,0	113,429	2,253	44,214	23,644	65,756	78,223	239,797	0,024	6,078	0,964	10,326	0,002
KK 1	83-01-27	83400996	8,1	66,6	94,251	0,510	27,171	11,276	37,478	75,494	155,855	0,025	0,117	0,820	7,936	0,021
KK 2	83-01-27	83401007	7,8	67,0	41,159	1,423	56,316	28,945	31,339	41,336	219,439	0,039	3,287	0,566	25,293	0,016
P 1	82-02-08	82403030	7,6	67,0	40,716	1,264	59,198	27,469	42,226	55,712	206,100	0,019	3,558	0,585	22,299	0,010
P 1	82-02-09	82403048	7,7	66,5	43,516	1,271	55,202	26,623	40,842	58,013	202,278	0,009	3,524	0,700	20,688	0,013
P 2	82-02-16	82403056	7,7	68,0	44,229	4,121	55,202	28,602	49,360	49,323	217,774	0,391	1,883	0,655	22,659	0,009
P 2	82-02-19	82403064	7,7	68,0	42,168	2,638	56,798	29,170	44,809	49,361	215,805	0,019	3,874	0,655	23,587	0,004
P 3	82-02-10	82403014	7,8	74,5	78,740	3,732	50,435	21,038	86,261	73,366	175,224	0,070	0,142	0,560	19,645	0,016
P 3	82-02-16	82403022	7,7	75,5	75,666	3,488	51,624	20,485	89,872	76,672	173,306	0,395	0,140	0,560	19,754	0,005
P 6	82-02-22	82402995	7,6	75,0	67,237	2,363	48,458	26,886	63,663	73,279	202,273	0,000	1,772	0,536	16,288	0,005
P 6	82-02-24	82403006	7,6	75,0	63,524	1,996	48,458	28,033	63,646	73,323	202,278	0,004	1,620	0,510	16,876	0,003
P 7	82-02-08	82402953	7,5	72,0	63,424	3,712	54,007	23,260	45,677	59,854	213,846	0,000	4,689	0,700	12,481	0,164
P 7	82-02-11	82402961	7,8	72,5	64,932	3,716	54,803	23,539	43,685	61,406	215,805	0,000	5,046	0,848	20,076	0,018
P 8	82-02-04	82402979	7,7	64,6	32,484	1,121	53,212	27,469	40,311	51,836	179,069	0,000	5,113	0,700	27,474	0,007
P 8	82-02-05	82402987	7,7	65,2	33,839	2,371	53,609	27,752	39,610	53,321	175,224	0,000	5,811	0,678	28,366	0,007

Sampling point (= borehole no.)	Date of sample	H number	pH	Conductivity (mS/m)	Na	K	Ca	Mg	SO_4	Cl	TAL	NH_4	NO_3	F	Si	P
					in mg/ℓ											
PST 2	81-11-17	81416593	7,7	160,5	182,695	1,560	85,449	48,088	148,379	284,218	230,905	0,024	2,606	0,715	23,315	0,003
PST14	81-11-18	81416608	7,6	196,0	175,455	3,416	138,933	64,018	196,479	395,652	182,829	0,024	4,676	0,489	21,364	0,002
RT 1	81-11-19	81416658	7,9	284,8	418,761	3,557	129,241	68,004	346,898	510,695	413,089	0,037	10,720	1,348	11,530	0,005
WL 2	81-11-24	81416632	8,0	311,9	354,648	2,270	145,384	112,006	588,580	547,784	205,452	0,042	4,200	1,006	16,351	0,006
WL 6	81-11-24	81416640	7,4	820,0	713,333	6,549	652,651	347,589	999,616	2355,880	54,292	0,056	13,425	0,284	10,981	0,007
G33060	83-01-27	83401015	7,9	65,9	101,933	0,713	22,782	8,474	37,037	76,185	157,431	0,011	0,000	0,462	7,454	0,010
G33061	83-02-01	83401023	8,0	61,8	85,003	0,815	25,972	12,208	32,935	70,049	151,900	0,022	0,000	0,366	9,692	0,012
G33062	83-02-08	83401031	7,8	63,4	40,434	9,830	38,022	30,501	35,551	59,892	163,177	0,035	3,708	0,581	14,297	0,032
G33063	83-02-14	83425920	8,5	41,6	69,000	6,300	9,000	2,000	14,000	88,000	39,000	0,060	0,090	2,500	10,900	0,050
G33064	83-02-21	83425938	7,6	64,0	46,000	20,100	44,000	18,000	31,000	39,000	212,000	0,040	3,130	0,900	17,500	0,036
G33065	83-02-23	83425946	7,8	60,2	37,000	3,100	45,000	23,000	28,000	41,000	188,000	0,030	4,240	0,600	24,300	0,012
G33065	83-04-25	83403554	7,6	59,4	36,000	3,200	50,000	22,000	26,000	35,000	186,000	0,030	4,030	0,700	24,500	0,003
G33065	83-04-28	83403562	7,6	59,4	36,000	2,200	49,000	22,000	26,000	33,000	189,000	0,010	4,270	0,600	24,300	0,001
G33069	83-04-11	83403512	7,6	66,6	105,000	1,800	21,000	8,000	45,000	77,000	153,000	0,030	0,410	0,500	7,800	0,003
G33069	83-04-14	83403520	7,8	66,8	105,000	1,500	21,000	5,000	39,000	76,000	155,000	0,010	0,080	0,500	7,900	0,007
G33075	83-06-10	83405742	7,8	67,0	118,228	1,843	20,000	8,525	44,909	86,549	165,054	0,047	0,291	0,586	7,718	0,014
G33077	83-06-28	83405768	7,6	61,8	59,112	2,171	41,544	22,493	49,856	57,814	154,793	0,052	3,276	0,572	15,474	0,012
G33078	83-07-06	83405776	7,6	80,0	94,064	24,826	35,330	19,846	75,387	101,580	148,360	0,125	0,962	0,522	5,132	0,230
G33079	83-07-12	83405784	7,6	80,0	62,208	7,221	51,776	30,870	60,000	94,280	144,610	0,082	10,182	0,636	21,565	0,037

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level (m) below collar	Date of measurement	Collar elevation (m)	Geology (m)
Walkraal	P v.Schalkwyk Walkraal	WL 1	windpump			1995	37					
		WL 2	windpump			1935	24		12,290	24-11-81		
		WL 3	windpump				18					
		WL 4	powerhead 2" pipes		7,5		46	9,2				
		WL 5	windpump				36		9,920	24-11-81		
		WL 6	windpump			4565	30					
	According to the owner the yield of WL4 is 7,5ℓ/s.											
	OGv.Schalkwyk Vleiwerf	WL 7	windpump				18		5,900	24-11-81		
		WL 8	windpump				67					
		WL 9	windpump				101		14,665	24-11-81		
		WL10	windpump				37		4,430	24-11-81		
		WL11	windpump				43					
		WL12	windpump				37					
		WL13	windpump				37		8,450	24-11-81		
		WL14	windpump			1010	49		14,605	24-11-81		
		WL15	windpump			638	37		11,560	24-11-81		

WILLISTON DRILLING PROGRAMME 1983

BOREHOLE NUMBER : G 33079

DATE DRILLED : 6-7-83 to 12-7-83

CADASTRAL FARM : Bokvlakte 146

MAP REFERENCE : 3121 AC

CO-ORDINATES : LONGITUDE : 21° 00' 34" LATITUDE : 31° 16' 57"

LEVELLED COLLAR ELEVATION (m): 1158,117

WATER LEVEL (m), WITH DATE : 19,995 (14-7-83)

TOTAL DEPTH (m) : 85

CASING (m) : 5

TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 10

T.D.S. OF FINAL SAMPLE (mg/ℓ) : 548

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
26	1,25	664
30	8,75	548

GEOLOGY(m) : 0- 5: weathered medium grained dolerite
-19: medium grained dolerite
-25: baked sandstone
-26: blocky sandstone (largest block had 12cm diameter)
-29: sandstone
-30: block sandstone (largest block had 12 cm diameter)
-85: sandstone (large fracture at 75m but no water)

BOREHOLE NUMBER : G 33085

DATE DRILLED : 13-7-83 to 27-7-83

CADASTRAL FARM : Bokvlakte 146

MAP REFERENCE : 3120 BD

CO-ORDINATES : LONGITUDE : 20° 59' 28" LATITUDE: 31° 19' 23"

LEVELLED COLLAR ELEVATION (m): 1119,474

WATER LEVEL (m), WITH DATE : -

TOTAL DEPTH (m) : 90

CASING (m) : 6

TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : seepage

T.D.S. OF FINAL SAMPLE (mg/ℓ) : -

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
9	seepage	-

GEOLOGY(m) : 0-12: weathered dolerite
-75: dolerite
-90: sandstone

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level (m) below collar	Date of measurement	Collar elevation (m)	Geology (m)
Elias Zyfer	AK Coetzee Skipperskloof	ER 4	windpump	stock	11		111,9					
		ER 5	open	stock			180		10,950	14-10-81	1106	
		ER 6	windpump	stock	2,5	510	90		8,560	14-10-81	1078	
		ER 7	open	stock		510	1,2					
		ER 8	windpump	stock	3,75	397	45		29,855	14-10-81	1080	
		ER 9	windpump	stock	1,0	449	48		9,350	14-10-81	1080	
	The following yields were measured by the Division of Geohydrology: ER1=0,17ℓ/s; ER3=0,17ℓ/s; ER6=0,38ℓ/s; ER8=0,051ℓ/s; ER9=0,35ℓ/s.											
	A Steenkamp Kleintan	ER10	windpump	stock		1690			6,780	15-10-81	1036	
		ER11	windpump	stock		763			6,415	15-10-81		
		ER12	windpump	stock		2044			3,565	15-10-81		
		ER13	windpump	stock/ broken					7,080	15-10-81		
		ER14	windpump	stock		669			7,505	15-10-81		
		ER15	windpump	stock/ broken								
		ER16	windpump	stock		1891			17,745	15-10-81		
		ER17	windpump	stock/ broken					17,110	15-10-81	1045	
	The following yields were measured by the Division of Geohydrology: ER10=0,3ℓ/s; ER11=0,37ℓ/s; ER14=0,38ℓ/s.											

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level below collar (m)	Date of measurement	Collar elevation (m)	Geology (m)
Goedverwachting	J Kuhn Goedverwachting	GG 1	windpump		1,25	1542	61		12,930	18-11-81		
		GG 2	w.p./not working		7,5		12	3				
		GG 3	windpump		12,5	651	24	24				
		GG 4	windpump		3,75	526	36	24				
		GG 5	windpump		2,5		21	15				
		GG 6	windpump		7,5	581	15	8				Stopped on dolerite
Jan-Klaas-Leegte	OG v.Schalkwyk Vleiwerf	JE 1	windpump				67		28,645	24-11-81		
		JE 2	windpump				9,8					
Kaffirkloof	PL v.d Colff Kafferskloof	KK 1	windpump*	stock	2,7ᵘ (1959)	423	94ᵘ	84ᵘ	19,940	27-01-83	1164	0- 2: calcrete ᵘ -89: dolerite -94: indurated shale
		KK 2	windpump	stock		433						
	*Was equipped with engine: previous owner irrigated 4,5 morgen lucerne. ᵘIt is inferred that borehole KK1 corresponds to borehole 72824 drilled by the boring division in 1959 - information is thus from MD.306 borehole records. Owner says according to previous owner KK1 is 300ft deep, drilled by government drill (1962??).											
	M Steenkamp(mrs) Sandkop	KK 3	open		6,1?				17,675	27-01-83	1128	sandstone + shale ?
		KK 4	windpump	stock		619						
		KK 5	windpump	stock		1076						
		KK 6	powerhead -2" pipes	Not used for last 5 years								

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level (m) below collar	Date of measurement	Collar elevation (m)	Geology (m)
Lekkerleg	A Steenkamp Waterkloof	LG 1	handpump			472			3,130	15-10-81		
		LG 2	w.p./not working									
		LG 3	windpump			500			12,540	15-10-81	1037	
		LG 4	windpump			1224						
		LG 5	windpump	stock		1043						
		LG 6	windpump	stock		1173						
		LG 7	w.p./not working	stock					7,080	15-10-81	1026	
		LG 8	windpump	stock					14,500	15-10-81	1061	
		LG 9	windpump	stock		2140			7,720	16-10-81	1052	
		LG10	windpump	stock		1315			6,415	16-10-81	1022	
		LG11	windpump	stock		2068			16,990	16-10-81	1029	
	The following yields were measured by the Division of Geohydrology: LG1=0,16ℓ/s; LG3=0,35ℓ/s; LG4=0,14ℓ/s; LG5=0,54ℓ/s; LG6=0,95ℓ/s; LG9=0,26ℓ/s; LG10=0,18ℓ/s; LG11=0;07ℓ/s.											
	JP Avenant Heeltevrede	LG12	windpump	stock		886			16,125	16-10-81		
		LG13	w.p./not working	stock					12,655	16-10-81	1031	
		LG14	w.p./not working	stock					9,100	16-10-81		

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level below collar (m)	Date of measurement	Collar elevation (m)	Geology (m)
Walkraal	P v.Schalkwyk Walkraal	WL16	windpump			501	21		6,005	24-11-81		
		WL17	windpump				15					
		WL18	windpump				37					
Williston Allotment Area	Williston Municipality	WN 1	submersible, 76mm pipes to 34m	Municipal supply	0,64 (1982)	435	37,2	33?	28,530	08-02-82	1109,820	0-33: sandstone? -37: dolerite?
		WN1A	waterlevel recorder						27,715	08-02-82	1108,418	
		WN 2	turbine, 63,5mm pipes to 46m	Municipal supply	0,26 (1982)	442	56,0	22	18,865	16-02-82	1092,831	0-28: weathered dolerite -56: dolerite
		WN 3	turbine, 76mm pipes to 59m	Municipal supply	1,51 (1982)	488	64,01		52,050	10-02-82	1089,073	
		WN 4	turbine, 76mm pipes to 29m	Municipal supply			31?	18 26			1081,971	0-18: weathered dolerite -31: dolerite
		WN 5	mono 63,5 mm to 56m	Municipal supply			85	41 55 72			1074,081	

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level below collar (m)	Date of measurement	Collar elevation (m)	Geology (m)
Williston Allotment Area	Williston Municipality	WN 6	turbine, 63,5mm to 58m	Municipal supply	1,57 (1982)	488	90	12 48 54	35,845	22-02-82	1075	0-47: dolerite -90: sandstone
		WN 7	turbine, 51mm pipes to 30m	Municipal supply	0,58 (1982)	468	38,1		19,285	08-02-82	1075,9	
		WN7A	open						19,408	08-02-82		
		WN 8	electric submersible 50,8mm pipes to 43m	Municipal supply	1,7 (1982)	424	61,6	35 38	36,313	04-02-82	1130,692	
		WN8A	waterlevel recorder	Municipal supply			38		36,010	04-02-82		
		WN 9		Municipal supply	3,75 (1982)	1613	50,6	29 45	27,3	11-02-80	1068,119	0-47: dolerite -50: baked sediments
		WN10	open		0,86 (1958)		106,7				1105,496	
		WN11	open		1,9 (1973)	710	38	15 19	11,755	19-01-73		0-38: dolerite
		WN11A	open		0,31 (1973)	850	91	14	11,170	24-01-73		0-81: dolerite -90: shale -91: dolerite

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level below collar (m)	Date of measurement	Collar elevation (m)	Geology (m)
Williston Allotment Area	Williston Municipality	WN12	open		0,06 (1973)	840	85,3	15 42 72	9,390	1973		0-85,3: sandstone and shale
		WN12A	open		0,06 (1973)	860	24	12	10,025	14-02-73		0-25: dolerite
		WN13	open		1,11 (1973)	770	90	36 40 72	16,420	02-02-83	1133	0- 6: calcrete -36: dolerite -71: sandstone -90: dolerite
		WN14	windpump	stock		851			10,880	02-02-83	1124	
		WN15	windpump	stock		1788					1061	samples from "haalboor" show both dolerite and baked sedimentary rock
		WN16	windpump	stock		3342			6,495	01-02-83	1044	
	Borehole WN6 had a blow-out yield of 2ℓ/s (1972/73). Boreholes WN11, WN11A, WN12 and WN12A have collapsed (1983).											
	Provincial Administration	WN17	windpump	irrigation		1856					1042	
	Williston Municipality	WN18	windpump	stock		648						
		WN19	windpump	irrigation		2151	51,51				1045	
		WN20	windpump	irrigation		3172			10,982	01-12-82	1041	

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level (m) below collar	Date of measurement	Collar elevation (m)	Geology (m)
Williston Allotment Area	Williston Municipality	WN21	windpump	dry	1,01 (1957)		45,7	32			1059	
		WN22	windpump	irrigation		879						
		WN23	windpump	dry			30±				1079	
	S A R	WN24	electric submersible	S A R gardens*		2305	50,6	42	30,010	1972	1066	
	Borehole WN24 was completed on 16-9-1954. * Municipal water is used for railway houses domestic use because WN24 delivers water that is too salty. According to railways staff the borehole is pumped at 0,625ℓ/s for 10 hours/day = 22,5 m^3/day. Borehole WN24 = G5491 = B29 in Borcherd's 1972 report (Gh 1783).											

WILLISTON DRILLING PROGRAMME 1983

BOREHOLE NUMBER : G 33083

DATE DRILLED : 14-4-83 to 15-4-83

CADASTRAL FARM : Williston Allotment Area

MAP REFERENCE : 3120 BD

CO-ORDINATES : LONGITUDE : 20° 57' 44" LATITUDE : 31° 21' 02"

INTERPOLATED COLLAR ELEVATION (m): 1096

WATER LEVEL (m), WITH DATE : 8,896 (18-4-83)

TOTAL DEPTH (m) : 40

CASING (m) : 6,1

TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 1,5

T.D.S. OF FINAL SAMPLE (mg/ℓ) : 387

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
9,5	1,5	387

GEOLOGY(m) : 0- 3: weathered fine grained dolerite
- 9: intermixed baked sandstone and fine grained dolerite, weathered
-14: weathered fine grained dolerite
-40: medium grained dolerite

BOREHOLE NUMBER : G 33084

DATE DRILLED : 15-4-83 to 19-4-83

CADASTRAL FARM : Williston Allotment Area

MAP REFERENCE : 3120 BD

CO-ORDINATES : LONGITUDE : 20° 57' 43" LATITUDE: 31° 21' 00"

INTERPOLATED COLLAR ELEVATION (m): 1094

WATER LEVEL (m), WITH DATE : 7,600 (20-4-83)

TOTAL DEPTH (m) : 108

CASING (m) : 6,1

TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 0,6

T.D.S. OF FINAL SAMPLE (mg/ℓ) : 394

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
11	0,6	394

GEOLOGY(m) : 0-10: weathered sandstone
-16: weathered medium grained dolerite
-108: medium grained dolerite

WILLISTON DRILLING PROGRAMME 1983

BOREHOLE NUMBER : G 33081
DATE DRILLED : 30-3-83 to 12-4-83
CADASTRAL FARM : Williston Allotment Area
MAP REFERENCE : 3120 BD
CO-ORDINATES : LONGITUDE : 20° 54' 57" LATITUDE : 31° 22' 45"
INTERPOLATED COLLAR ELEVATION (m): 1049
WATER LEVEL (m), WITH DATE : 10,470 (18-4-83)
TOTAL DEPTH (m) : 60
CASING (m) : 6,1
TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : seepage
T.D.S. OF FINAL SAMPLE (mg/ℓ) : -

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
14	seepage	-

GEOLOGY(m) : 0-6 : weathered medium grained dolerite
-14: medium grained dolerite
-16: brown, decomposed, medium grained dolerite
-39: medium grained dolerite
-43: baked sandstone
-60: sandstone

BOREHOLE NUMBER : G 33071
DATE DRILLED : 6-4-83 to 12-4-83
CADASTRAL FARM : Williston Allotment Area
MAP REFERENCE : 3120 BD
CO-ORDINATES : LONGITUDE : 20° 50' 45" LATITUDE: 31° 20' 45"
INTERPOLATED COLLAR ELEVATION (m): 1040
WATER LEVEL (m), WITH DATE : 18,440 (7-5-83)
TOTAL DEPTH (m) : 70
CASING (m) : 6
TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : -
T.D.S. OF FINAL SAMPLE (mg/ℓ) : -

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
-	-	-

GEOLOGY(m) : 0- 5: very highly weathered fine grained dolerite
-24: very fine grained dolerite
-40: baked sandstone
-70: very fine grained dolerite

WILLISTON DRILLING PROGRAMME 1983

BOREHOLE NUMBER : G 33082
DATE DRILLED : 12-4-83 to 13-4-83
CADASTRAL FARM : Williston Allotment Area
MAP REFERENCE : 3120 BD
CO-ORDINATES : LONGITUDE : 20° 54' 54" LATITUDE : 31° 22' 51"
INTERPOLATED COLLAR ELEVATION (m): 1051
WATER LEVEL (m), WITH DATE : 9,744 (18-4-83)
TOTAL DEPTH (m) : 60
CASING (m) : 6,1
TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 0,25
T.D.S. OF FINAL SAMPLE (mg/ℓ) : 729

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
42	0,25	729

GEOLOGY(m) : 0-15: weathered medium grained dolerite
-36: medium grained dolerite
-41: baked sandstone
-60: sandstone

BOREHOLE NUMBER : G 33072
DATE DRILLED : 12-4-83 to 18-4-83
CADASTRAL FARM : Williston Allotment Area
MAP REFERENCE : 3120 BD
CO-ORDINATES : LONGITUDE : 20° 50' 45" LATITUDE: 31° 20' 45"
INTERPOLATED COLLAR ELEVATION (m): 1040
WATER LEVEL (m), WITH DATE : -
TOTAL DEPTH (m) : 80
CASING (m) : 2
TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : -
T.D.S. OF FINAL SAMPLE (mg/ℓ) : -

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
-	-	-

GEOLOGY(m) : 0-16: weathered, very fine grained dolerite
-80: very fine grained dolerite

WILLISTON DRILLING PROGRAMME 1983

BOREHOLE NUMBER : G 33060

DATE DRILLED : 24-1-83 to 27-1-83

CADASTRAL FARM : Williston Allotment Area

MAP REFERENCE : 3120 BD

CO-ORDINATES : LONGITUDE : 20° 57' 45" LATITUDE : 31° 18' 07"

LEVELLED COLLAR ELEVATION (m): 1144,536

WATER LEVEL (m), WITH DATE : 1,702 (30-1-1983)

TOTAL DEPTH (m) : 68

CASING (m) : 2,0

TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 25 *

T.D.S. OF FINAL SAMPLE (mg/ℓ) : 430

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
39	seepage	-
68	25 *	430

* blow-out yield actually greater than 25 ℓ/s - water flowing over top of V-notch (20cm.V)

GEOLOGY(m) : 0-19 : weathered dolerite
-64 : dolerite, medium grained
-67 : highly baked sandstone
-68 : blocky, highly baked sandstone: blocks up to 70mm in diameter, calcite also present

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BOREHOLE NUMBER : G 33061

DATE DRILLED : 27-1-83 to 1-2-83

CADASTRAL FARM : Williston Allotment Area

MAP REFERENCE : 3120 BD

CO-ORDINATES : LONGITUDE : 20° 58' 36" LATITUDE: 31° 18' 02"

LEVELLED COLLAR ELEVATION (m): 1139,906

WATER LEVEL (m), WITH DATE : 1,1 ℓ/s artesian flow (1-2-83)

TOTAL DEPTH (m) : 62

CASING (m) : 16 plus 1,37 above ground

TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 25 *

T.D.S. OF FINAL SAMPLE (mg/ℓ) : 472

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
39	1,37	463
62	23,6 *	472

*total blow-out yield greater than 25 ℓ/s - water flowing over top of 20cm 'V' V-notch

GEOLOGY(m) : 0- 6: decomposed dolerite
-18: weathered dolerite
-38: medium grained dolerite
-39: blocky dolerite (2cm diameter blocks)with calcite, slightly decomposed, medium grained
-61: medium grained dolerite
-62: blocky (up to 40mm) medium grained dolerite with calcite and pyrites

WILLISTON DRILLING PROGRAMME 1983

BOREHOLE NUMBER : G 33070

DATE DRILLED : 25-3-83 to 6-4-83

CADASTRAL FARM : Williston Allotment Area

MAP REFERENCE : 3120 BD

CO-ORDINATES : LONGITUDE : 20° 57' 45" LATITUDE : 31° 18' 08"

LEVELLED COLLAR ELEVATION (m): 1144,650

WATER LEVEL (m), WITH DATE : 2,194 (7-4-83)

TOTAL DEPTH (m) : 70

CASING (m) : 2

TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 25

T.D.S. OF FINAL SAMPLE (mg/ℓ) : 380

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
26	seepage *	
70	25	380

* waterlevel recorder NOT affected by this interception, but affected by 70m interception

GEOLOGY(m) : 0-15: weathered medium grained dolerite
-25: medium grained dolerite
-26: brown, decomposed, medium grained dolerite
-66: medium grained dolerite
-69: baked sandstone
-70: blocky baked sandstone

BOREHOLE NUMBER : G 33080

DATE DRILLED : 28-3-83 to 30-3-83

CADASTRAL FARM : Williston Allotment Area

MAP REFERENCE : 3120 BD

CO-ORDINATES : LONGITUDE : 20° 54' 48" LATITUDE: 31° 22' 35"

INTERPOLATED COLLAR ELEVATION (m): 1051

WATER LEVEL (m), WITH DATE : 9,738 (18-4-83)

TOTAL DEPTH (m) : 60

CASING (m) : 6,1

TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : -

T.D.S. OF FINAL SAMPLE (mg/ℓ) : -

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
-	-	-

GEOLOGY(m) : 0- 6: weathered dolerite
-45: medium grained dolerite
-48: baked sandstone
-60: sandstone

WILLISTON DRILLING PROGRAMME 1983

BOREHOLE NUMBER : G 33068

DATE DRILLED : 9-3-83 to 22-3-83

CADASTRAL FARM : Williston Allotment Area

MAP REFERENCE : 3120 BD

CO-ORDINATES : LONGITUDE : 20° 57' 44" LATITUDE : 31° 18' 06"

LEVELLED COLLAR ELEVATION (m): 1143,608

WATER LEVEL (m), WITH DATE : 2,950 (23-3-83)

TOTAL DEPTH (m) : 71

CASING (m) : 12

TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 25

T.D.S. OF FINAL SAMPLE (mg/ℓ) : 412

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
71	25	412

GEOLOGY(m) : 0-18: medium grained weathered dolerite
-68: medium grained dolerite
-70: highly baked sandstone.
-71: baked sandstone with up to 4cm blocks

BOREHOLE NUMBER : G 33069

DATE DRILLED : 22-3-83 to 25-3-83

CADASTRAL FARM : Williston Allotment Area

MAP REFERENCE : 3120 BD

CO-ORDINATES : LONGITUDE : 20° 57' 44" LATITUDE: 31° 18' 07"

INTERPOLATED COLLAR ELEVATION (m): 1145

WATER LEVEL (m), WITH DATE : 2,350 (26-3-83)

TOTAL DEPTH (m) : 70

CASING (m) : 2

TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 25

T.D.S. OF FINAL SAMPLE (mg/ℓ) : 380

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
21	seepage	-
70	25	380

GEOLOGY(m) : 0- 8: weathered medium grained dolerite
-66: medium grained dolerite
-69 baked sandstone
-70: baked sandstone with up to 4cm diameter blocks

WILLISTON DRILLING PROGRAMME 1983

BOREHOLE NUMBER : G 33066
DATE DRILLED : 2-3-83 to 7-3-83
CADASTRAL FARM : Williston Allotment Area
MAP REFERENCE : 3120 BD
CO-ORDINATES : LONGITUDE : 20° 56' 10" LATITUDE : 31° 22' 50"
INTERPOLATED COLLAR ELEVATION (m): 1065
WATER LEVEL (m), WITH DATE : 26,275 (26-3-83)
TOTAL DEPTH (m) : 72
CASING (m) : 6
TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : -
T.D.S. OF FINAL SAMPLE (mg/ℓ) : -

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
-	-	-

GEOLOGY(m) : 0-13: medium grained weathered dolerite
-62: medium grained dolerite
-72: grey sandstone

BOREHOLE NUMBER : G 33067
DATE DRILLED : 7-3-83 to 9-3-83
CADASTRAL FARM : Williston Allotment Area
MAP REFERENCE : 3120 BD
CO-ORDINATES : LONGITUDE : 20° 55' 32" LATITUDE: 31° 22' 36"
INTERPOLATED COLLAR ELEVATION (m): 1047
WATER LEVEL (m), WITH DATE : 9,860 (23-3-83)
TOTAL DEPTH (m) : 60
CASING (m) : 3
TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : -
T.D.S. OF FINAL SAMPLE (mg/ℓ) : -

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
-	-	-

GEOLOGY(m) : 0- 4: weathered medium grained dolerite
-50: medium grained dolerite
-60: grey sandstone

WILLISTON DRILLING PROGRAMME 1983

BOREHOLE NUMBER : G 33077
DATE DRILLED : 20-6-83 to 28-6-83
CADASTRAL FARM : Kaffirkloof 145
MAP REFERENCE : 3120 BD
CO-ORDINATES : LONGITUDE : 20° 57' 31" LATITUDE : 31° 16' 36"
LEVELLED COLLAR ELEVATION (m): 1170,685
WATER LEVEL (m), WITH DATE : 9,070 (1-7-83)
TOTAL DEPTH (m) : 75
CASING (m) : 12
TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 25
T.D.S. OF FINAL SAMPLE (mg/ℓ) : 431

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
75	25	431

GEOLOGY(m) : 0-17: weathered, medium grained dolerite
-66: medium grained dolerite
-75: baked sandstone

BOREHOLE NUMBER : G 33078
DATE DRILLED : 28-6-83 to 6-7-83
CADASTRAL FARM : Bokvlakte 146
MAP REFERENCE : 3121 AC
CO-ORDINATES : LONGITUDE : 21° 00' 14" LATITUDE: 31° 18' 12"
LEVELLED COLLAR ELEVATION (m): 1138,757
WATER LEVEL (m), WITH DATE : 0,610 (11-7-83)
TOTAL DEPTH (m) : 70
CASING (m) : 6
TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 25
T.D.S. OF FINAL SAMPLE (mg/ℓ) : 512

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
66	0,25	510
70	24,75	512

GEOLOGY(m) : 0-10: weathered, medium grained dolerite
-65: medium grained dolerite
-70: grey metasediments

WILLISTON DRILLING PROGRAMME 1983

BOREHOLE NUMBER : G 33075

DATE DRILLED : 6-6-83 to 10-6-83

CADASTRAL FARM : Williston Allotment Area

MAP REFERENCE : 3120 BD

CO-ORDINATES : LONGITUDE : 20° 58' 24" LATITUDE : 31° 18' 32"

LEVELLED COLLAR ELEVATION (m): 1132,205

WATER LEVEL (m), WITH DATE : (artesian) artesian flow=10 ℓ/s (22-6-83)
51b pressure: 20-6-83

TOTAL DEPTH (m) : 76

CASING (m) : 5

TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 27

T.D.S. OF FINAL SAMPLE (mg/ℓ) : 455

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
73	2	455
76	25	455

GEOLOGY(m) : 0-14: weathered medium grained dolerite
-65: medium grained dolerite
-74: light grey metasediments
-76: blocky (up to 2cm diameter) light grey metasediments

BOREHOLE NUMBER : G 33076

DATE DRILLED : 10-6-83 to 20-6-83

CADASTRAL FARM : Williston Allotment Area

MAP REFERENCE : 3120 BD

CO-ORDINATES : LONGITUDE : 20° 57' 50" LATITUDE: 31° 18' 51"

LEVELLED COLLAR ELEVATION (m): 1143,718

WATER LEVEL (m), WITH DATE : 7,055 (22-6-83)

TOTAL DEPTH (m) : 90

CASING (m) : 2

TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 25

T.D.S. OF FINAL SAMPLE (mg/ℓ) : 553

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
90	25	553

GEOLOGY(m) : 0- 7: weathered medium grained dolerite
-76: medium grained dolerite
-85: light grey metasediments
-89: baked grey sandstone
-90: blocky (up to 3cm diameter) baked grey sandstone with calcite and pyrite crystals

WILLISTON DRILLING PROGRAMME 1983

BOREHOLE NUMBER : G 33064
DATE DRILLED : 14-2-83 to 21-2-83
CADASTRAL FARM : Williston Allotment Area
MAP REFERENCE : 3120 BD
CO-ORDINATES : LONGITUDE : 20° 57' 43" LATITUDE : 31° 21' 01"
INTERPOLATED COLLAR ELEVATION (m): 1093
WATER LEVEL (m), WITH DATE : 6,955 (3-3-83)
TOTAL DEPTH (m) : 80
CASING (m) : 6
TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 0,48
T.D.S. OF FINAL SAMPLE (mg/ℓ) : 378

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
15	0,48	378

GEOLOGY(m) : 0-14: weathered, very fine grained dolerite
-19: very fine grained dolerite with occasional calcite crystals
-60: fine grained dolerite
-62: very fine grained dolerite with calcite crystals
-80: fine grained dolerite

BOREHOLE NUMBER : G 33065
DATE DRILLED : 21-2-83 to 2-3-83
CADASTRAL FARM : Williston Allotment Area
MAP REFERENCE : 3120 BD
CO-ORDINATES : LONGITUDE : 20° 57' 43" LATITUDE: 31° 21' 01"
INTERPOLATED COLLAR ELEVATION (m): 1094
WATER LEVEL (m), WITH DATE : 7,295 (3-3-83)
TOTAL DEPTH (m) : 100
CASING (m) : 4
TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 4,0
T.D.S. OF FINAL SAMPLE (mg/ℓ) : 389

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
11	4,0	389

GEOLOGY(m) : 0- 5: very fine grained, weathered dolerite
- 11: very fine grained dolerite
- 15: blocky, very fine grained dolerite (up to 3cm diameter blocks)
-100: medium grained dolerite (grey to 55m, thereafter much whiter in colour, but still medium grained: chips actually consist of distinctive white and black minerals)

WILLISTON DRILLING PROGRAMME 1983

BOREHOLE NUMBER : G 33073
DATE DRILLED : 18-4-83 to 26-4-83
CADASTRAL FARM : Williston Allotment Area
MAP REFERENCE : 3120 BD
CO-ORDINATES : LONGITUDE : 20° 50' 43" LATITUDE : 31° 20' 57"
INTERPOLATED COLLAR ELEVATION (m): 1061
WATER LEVEL (m), WITH DATE : -
TOTAL DEPTH (m) : 80
CASING (m) : 2
TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : -
T.D.S. OF FINAL SAMPLE (mg/ℓ) : -

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
-	-	-

GEOLOGY(m) : 0-15: weathered, very fine grained dolerite
-39: very fine grained dolerite
-46: baked sandstone
-80: very fine grained dolerite

BOREHOLE NUMBER : G 33074
DATE DRILLED : 26-4-83 to 3-5-83
CADASTRAL FARM : Williston Allotment Area
MAP REFERENCE : 3120 BD
CO-ORDINATES : LONGITUDE : 20° 50' 43" LATITUDE: 31° 20' 57"
INTERPOLATED COLLAR ELEVATION (m): 1061
WATER LEVEL (m), WITH DATE : -
TOTAL DEPTH (m) : 90
CASING (m) : 3
TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : seepage
T.D.S. OF FINAL SAMPLE (mg/ℓ) : -

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
-	-	-

GEOLOGY(m) : 0- 8: weathered fine grained dolerite
-11: weathered, baked sandstone
-14: weathered grey shale
-70: baked light grey sandstone
-90: very fine grained dolerite

WILLISTON DRILLING PROGRAMME 1983

BOREHOLE NUMBER : G 33062
DATE DRILLED : 1-2-83 to 8-2-83 (and 4-5-83 to 6-6-83)*
CADASTRAL FARM : Williston Allotment Area
MAP REFERENCE : 3120 BD
CO-ORDINATES : LONGITUDE : 20° 58' 34" LATITUDE : 31° 19' 08"
LEVELLED COLLAR ELEVATION (m): 1124,878
WATER LEVEL (m), WITH DATE : 9,610 (8-2-83)
TOTAL DEPTH (m) : 86
CASING (m) : 2
TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 0,28
T.D.S. OF FINAL SAMPLE (mg/ℓ) : 370

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
11	0,28	370

GEOLOGY(m) : 0-10: weathered, coarse dolerite
-11: weathered blocky, coarse dolerite
-12: weathered, coarse dolerite
-86: coarse dolerite

()* During this time an unsuccesful attempt was made to deepen the borehole

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BOREHOLE NUMBER : G33063
DATE DRILLED : 10-2-83 to 14-2-83
CADASTRAL FARM : Williston Allotment Area
MAP REFERENCE : 3120 BD
CO-ORDINATES : LONGITUDE : 20° 57' 37" LATITUDE: 31° 21' 12"
INTERPOLATED COLLAR ELEVATION (m): 1087
WATER LEVEL (m), WITH DATE : 28,610 (15-2-83) 21,786 (3-3-83)
TOTAL DEPTH (m) : 60
CASING (m) : 3
TOTAL YIELD BLOWN OUT BY DRILL (ℓ/s) : 1,33
T.D.S. OF FINAL SAMPLE (mg/ℓ) : 276

DEPTH OF INTERCEPTION (m)	BLOW-OUT YIELD (ℓ/s)	T.D.S. (mg/ℓ)
33	1,33	276

GEOLOGY(m) : 0- 5: weathered light grey sandstone
-49: mixed light grey medium grained and grey fine grained sandstone
-50: blocky, light grey, baked sandstone (5cm rectangular blocks)
-52: grey baked sandstone
-60: medium grained dolerite

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level (m) below collar	Date of measurement	Collar elevation (m)	Geology (m)
Lekkerleg	JP Avenant Heeltevrede	LG15	w.p./not working	stock					8,860	16-10-81		
		LG16	w.p./not working						9,453	16-10-81		
		LG17	w.p./not working						4,505	16-10-81		
		LG18	w.p./not working						3,410	16-10-81	1046	
		LG19	windpump						3,645	16-10-81	1066	
		LG20	windpump			1890			8,750	19-10-81	1021	
	Yields measured by the Division of Geohydrology: LG12=0,41ℓ/s; LG19=0,310ℓ/s; LG20=0,19ℓ/s.											
Lunskloof	AK Coetzee Skipperskloof	LF 1	windpump	stock	0,75	1063	45					
		LF 2	windpump	stock	1,25	625	48		8,120	13-10-81	1051	
		LF 3	windpump	stock	1,0	494	51		5,705	13-10-81	1083	
		LF 4	windpump	stock	0,5	531	18		8,050	13-10-81	1083	
	Yields measured by the Division of Geohydrology: LF1=0,24ℓ/s; LF2=0,59ℓ/s; LF3=0,19ℓ/s; LF4=0,13ℓ/s.											

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level (m) below collar	Date of measurement	Collar elevation (m)	Geology (m)
Pietsgat	J Kuhn Goedverwachting	PST16	windpump	stock	3,75		30		9,650	19-11-81	1064	
		PST17	engine, 4"pipes turbine	stock	10	873	37					
	21-1-83: The yield of PST17 was measured by the Division of Geohydrology at 7,1ℓ/s. It is estimated that it is pumped 8 hours/week.											
Rondegat	GJ Louw Wilgerhof	RT 1	windpump		0,5	1877	15		2,000	19-11-81		
		RT 2	windpump		2,5	1565	24					
		RT 3	windpump		10	702	18		4,810	19-11-81		
		RT 4	3" pipes powerhead		10	917	26					
		RT 5	windpump		18,75	830	18		4,780	19-11-81		
		RT 6	mono, 2,5"pipes		18,75	936	32					
		RT 7	windpump		3,0	1149	36		4,503	19-11-81	1080	
	The Division of Geohydrology measured the yield of RT3 to be 0,43ℓ/s (19-11-81). On 21-1-83 RT4 was measured by Geohydrology at 4,3ℓ/s and RT6 at 3,8ℓ/s. Both boreholes are pumped about 40 hours/week.											

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level (m) below collar	Date of measurement	Collar elevation (m)	Geology (m)
Amandelbooms-winkelhaak	J Kuhn Goedverwagting	AK 1	windpump	stock	1,25	589	24,4		8,610	18-11-81		Geology not known, boreholes drilled in time of owner's father who is now dead.
		AK 2	windpump	stock	8,75		36,6		17,145	18-11-81		
		AK 3	2,5" sub-mersible	domestic + stock	8,75	1099	39,6					
		AK 4	windpump	stock	17,5	1469	33		7,910	18-11-81		
		AK4a	4"turbine	domestic	17,5	1741	33					
	21-1-83: Geohydrology yield measurements: AK3 = 2,7ℓ/s; AK4a = 10,3ℓ/s. AK3 is pumped 3 hours everyday. AK4a is pumped about 8 hours/week. Water from AK3 has a sulphur smell.											
	M Steenkamp(mrs) Petrusville	AK 5	windpump			1205	30,5		9,215	19-11-81		
		AK 6	windpump			1064	18,3		8,240	19-11-81	1064	
		AK 7	engine 2" pipes (powerhead)				45,7					
		AK 8	windpump			1164	30,5		9,310	19-11-81		
		AK 9	windpump			1175	33,5					
		AK10	windpump			762	36,6		13,110	19-11-81	1060	
	According to owner, boreholes AK5,6,7,8,9,10 currently yield 1,9ℓ/s; 2,5ℓ/s; 3,75ℓ/s; 1,2ℓ/s; 1,2ℓ/s and 1,0ℓ/s respectively. 19-1-83: AK7 broken for over a year - previously pumped 8 hours/day, 5 days/week.											

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level (m) below collar	Date of measurement	Collar elevation (m)	Geology (m)
Amandelbooms-winkelhaak	P Theron Cest Si Bon	AK11	windpump		17,5		91,4					
		AK12	2" mono	domestic+ irrigation	17,5	1723	61,0					
		AK13	windpump	domestic + irrigation	3,73		45,7					
		AK14	engine, 2"pipes	broken	12,5		45,7					
		AK15	engine, 2"pipes	broken	12,5		45,7					
		AK16	engine, 2"pipes		10,0	830	85,3					
		AK17	engine, 3"pipes (mono)		25,0	1207	62,5					
		AK18	windpump		2,5	1344	36,6					
		AK19	open		0,375				10,095	20-11-81	1064	
		AK20	open		0,375				10,605	20-11-81		

18-1-83: of the boreholes equipped with engines, only 2 are in use (the engines on the remaining boreholes are broken). Borehole AK12 was measured at 1,6ℓ/s and is pumped for approximately 2 hours/week. Borehole AK17 is pumped for 3 hours/day, 6 days/week and was measured at 5,0ℓ/s.

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level (m) below collar	Date of measurement	Collar elevation (m)	Geology (m)
Amandelbooms-winkelhaak	SWP Esterhuyse Na Ure	AK21	windpump			551	36,6		14,800	25-11-81		
		AK22	windpump			720	35,0		18,320	25-11-81		
		AK23	engine, 2"pipes				36,6		17,360	25-11-81	1064	
		AK24	windpump			688	45,7					
		AK25	windpump				48,8					
		AK26	windpump				39,6					
	According to the owner, boreholes AK21,22,23,24,25,26 yield 1ℓ/s;1ℓ/s;1,25ℓ/s;1,1ℓ/s;1,0ℓ/s and 0,625ℓ/s respectively. The yield of borehole AK24 was measured by the Division of Geohydrology at 0,47ℓ/s. 19-1-83: engine on AK23 has now been replaced by a windpump.											
	J Esterhuysen Montana	AK27	windpump				30,4					
		AK28	windpump				30,4		29,040	25-11-81		
		AK29	open				30,4		27,600	25-11-81		
	According to the owner all 3 boreholes currently yield 2,5 ℓ/s.											
Bokvlakte	P van Schalkwyk Bokwater	BE 1	windpump				9,14					
		BE 2	windpump				12,19		2,350	23-11-81	1110	
		BE 3	windpump				24,38		4,090	23-11-81	1116	
		BE 4	windpump				24,38					

Cadastral Farm	Name of owner + Local farm name or address	Borehole no. Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level (m) below collar	Date of measurement	Collar elevation (m)	Geology (m)
Bokvlakte	OGvan Schalkwyk Vleiwerf	BE 5 windpump				36,58		14,020	24-11-81		
	P van Schakwyk Bokwater	BE 6 windpump				30,48		5,705	25-11-81		
		BE 7 windpump			467	37		24,245	25-11-81	1157	
		BE 8 windpump			638	37					
	According to the owners current yields are: BE1=1,25ℓ/s; BE2=1,25ℓ/s; BE3=0,6ℓ/s; BE4=0,6ℓ/s; BE5=0,6ℓ/s; BE6=0,6ℓ/s; BE7=0,6ℓ/s and BE8=1ℓ/s. The Division of Geohydrology measured the yield of BE6 to be 0,18ℓ/s.										
De Kruis	M vd Spuy De Kruis	DS 1 windpump				25,91		8,140	20-11-81		
		DS 2 windpump			2234	24		5,900	20-11-81		
		DS 3 windpump				20		11,620	20-11-81	1064	
		DS 4 windpump				20		9,820	20-11-81		
		DS 5 windpump			1213	13		5,945	20-11-81		
		DS 6 5" pipes (mono)			1586	10					
		DS 7 windpump			520	27		16,335	20-11-81	1080	
		DS 8 windpump			490	24		6,425	20-11-81	1080	
		DS 9 windpump			1040	37		25,230	20-11-81	1118	
		DS10 windpump			751	29					

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level below collar (m)	Date of measurement	Collar elevation (m)	Geology (m)
De Kruis	M vd Spuy De Kruis	DS11	windpump				48		20,475	20-11-81	1098	
		DS12	windpump				17		9,850	20-11-81	1087	
		DS13	windpump			575	22		8,87	23-11-81	1129	
		DS14	windpump			457	24		13,110	23-11-81	1066	
		DS15	windpump			751	24		14,245	23-11-81	1078	
		DS16	windpump			1915	24		7,175	23-11-81	1060	
		DS17	windpump			3408	22		7,925	23-11-81	1055	
	Borehole DS6 is pumped very irregularly for irrigation purposes. When used the pump is driven by a tractor. An "average" pumping pattern is estimated as 14 hours/day, 1 day in 10. 21-1-83: The yield of DS6 was measured at 16,7 ℓ/s by the Division of Geohydrology. According to the owner borehole DS6 is currently yielding 10ℓ/s.											
	P van Schalkwyk Bokwater	DS18	windpump				37					
		DS19	windpump			990	15		2,890	23-11-81	1080	
		DS20	windpump			583	9		3,680	23-11-81		
		DS21	windpump				11		3,865	23-11-81	1098	
Elias Zyfer	AK Coetzee Skipperskloof	ER 1	windpump	stock	0,75	545	9		1,060	14-10-81		
		ER 2	windpump	stock			45					
		ER 3	windpump	stock	10,0	250	181,2		11,315	14-10-81	1113	

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level (m) below collar	Date of measurement	Collar elevation (m)	Geology (m)
Pietsgat	LD Theron Pietsgat	PST 1	windpump	stock		711	11					stopped on dolerite
		PST 2	windpump	stock		1021	11					stopped on dolerite
		PST 3	engine	stock			11		4,027	17-11-81	1100	stopped on dolerite
		PST 4	3"engine (mono)	stock		1229	11					alluvium/weathered rock/stopped on dolerite
		PST 5	windpump	stock			24		13,200	17-11-81		
		PST 6	windpump	stock			46		23,300	17-11-81	1101	
		PST 7	windpump	stock			15		6,565	17-11-81	1124	
	According to the owner borehole PST3 currently yields 3,12ℓ/s and PST4 yields 8,75ℓ/s. 19-1-83: PST3 is now completely dry. PST4 measured by Geohydrology at 4,9ℓ/s. According to the owner PST4 is pumped 12 hours/day (during the night) 6 days/week. The yield at the end of the pumping period is said to be noticeably less than at the beginning - this does not happen in years of normal rainfall.											
	M Theron(mrs) De Rust	PST 8	windpump				21		6,955	18-11-81		
		PST 9	windpump			949	30		6,200	18-11-81		
		PST10	windpump			1068	18		6,230	18-11-81		
		PST11	windpump			972	18		5,413	18-11-81		
		PST12	windpump				18		5,265	18-11-81		
		PST13	windpump				27		5,655	18-11-81	1074	
		PST14	windpump			1126	18		5,433	18-11-81	1092	
		PST15	windpump			775	24		6,445	18-11-81	1069	

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level (m) below collar	Date of measurement	Collar elevation (m)	Geology (m)
Slangfontein	SJ Spamer Rusoord	SN12	mono, 3" pipes	irrigation	16,25	464	43,5					
		SN13	windpump		1	652	18,6		3,770	21-10-81	1116	
		SN14	windpump		1,5		18		4,050	21-10-81		
		SN15	windpump		1,5		21		3,735	21-10-81		
		SN16	windpump		1,5	542	21		5,355	21-10-81		
		SN17	mono, 2,5" pipes	irrigation	7,5	508	45					
	Yield measurements made by the Division of Geohydrology: SN11=0,165ℓ/s; SN12=7,5ℓ/s (13-1-83); SN16=0,42ℓ/s; SN17=3,6ℓ/s. According to owner (13-1-83) SN17 is pumped 60 hours/week and SN12 15 hours/week.											
	GMN Augustyn Slangfontein	SN18	windpump	stock	1,5	408	21,6	7	6,540	22-10-81	1080	
		SN19	windpump	stock	0,125		37,5		11,090	22-10-81	1086	
		SN20	open		0,125	586	45		10,715	22-10-81		

Cadastral Farm	Name of owner + Local farm name or address	Borehole no.	Equipment installed	Water use	Tested Yield (ℓ/s)	T.D.S. (mg/ℓ)	Depth of borehole (m)	Depth of water interceptions (m)	Water level (m) below collar	Date of measurement	Collar elevation (m)	Geology (m)
Slangfontein	M van Wyk Rouxheuwel	SN 1	windpump	stock	0,25	535	15		13,490	20-10-81	1089	
		SN 2	windpump	stock	2,5	523	13,5		12,170	20-10-81		
		SN 3	windpump	stock	2,5	867	15		10,745	20-10-81		
		SN 4	windpump	stock	0,625	446	18		8,045	20-10-81	1121	
	The yield of SN3 was measured by the Division of Geohydrology at 0,29ℓ/s.											
	GMN Augustyn Slangfontein	SN 5	windpump	stock	1,0	1018	37,2		8,615	20-10-81		
		SN 6	windpump	stock	0,75		17,1		4,610	20-10-81	1098	0- 9 :unconsolidated deposits -17,1:dolerite
		SN 7	mono, 5"pipes	stock/ irrigation	22,5 (1965 /66)	730	83,4	83,4	5 approx. according to owner 4-1-83			0- 9 :unconsolidated rock -83,4:dolerite, stopped at contact with sediments
		SN 8	windpump	stock	1,5	625	21,6		8,150	20-10-81	1118	
	The yield of SN5 was measured by the Division of Geohydrology at 0,17ℓ/s; and SN8 at 0,29ℓ/s on 20-10-81. On 4-1-83 Geohydrology measured SN7 at 10,0ℓ/s. According to owner SN7 is pumped 17-21 hours/week currently (4-1-83).											
	SJ Spamer Rusoord	SN 9	w.p./not working		0,125		30	12,2	7,150	20-10-81	1139	0-12:shale -30:dolerite
		SN10	open		0,125	717	45	18,3	10,170	20-10-81		0-18,3:shale -45 :dolerite
		SN11	windpump		0,75	425	60		17,960	20-10-81		