

ANNUAL REPORT  
OF THE  
GEOLOGICAL SURVEY AND MINES  
DEPARTMENT  
FOR THE YEAR  
1973

## 1.1 Introduction

The Geological Survey and Mines Department continued to fall within the Ministry of Commerce, Industry and Water Affairs until April, 1973. After that date the Department was divided into the Geological Survey Department and the Mines Department, forming two Departments within the newly-established Ministry of Natural Resources and Water Affairs.

During the year, no staff was recruited for the Mines Department, other than by transfer of the officers of the existing Mines Inspectorate. Thus the Director of Geological Survey continued to act in the capacity of Mining Commissioner being concerned with administration of mining and prospecting rights in the country. In September, 1973, however, physical separation of the two Departments was achieved by the Mines Department moving to the capital, Gaborone, and the Geological Survey Department remaining in Lobatse 75km to the south.

The fundamental aim of the Geological Survey is the assessment of both the mineral and the water potential of Botswana and to establish an inventory of the rock, mineral and underground water resources of the country. In order to attain these objectives, it is necessary to study the rocks and geological structures of the whole country. Regional geological mapping, and the publication of maps and reports describing the geology of Botswana, are, therefore, a prime function of the Geological Survey. Some mineral survey and prospecting is also conducted by means of geological and geophysical techniques and by laboratory work. The Geological Survey is also responsible for the supervision of private sector prospecting activities in the search for economic minerals. Assistance is given to prospecting organisations and, wherever possible, interest in Botswana's mineral resources is stimulated.

Development of underground water supplies and hydrogeological research is another major responsibility of the Geological Survey. Siting of water boreholes, chiefly by geophysical investigations is followed by drilling on selected sites to the stage where productive boreholes can be passed to the Department of Water Affairs for equipping and maintenance. Borehole drilling is carried out by the Drilling Branch section of the Geological Survey, which has its headquarters at Gaborone. This is under the control of a Drilling Superintendent who is directly responsible to the Director of Geological Survey. Hydrogeological research continues to contribute to present knowledge of the nature and occurrence of underground water resources in Botswana.

Besides these main activities, the Geological Survey undertakes investigations where geological advice is needed, and assists other Government Departments.

The Director of Geological Survey, as Mining Commissioner, is responsible for processing applications for Prospecting Licences, for making recommendations to the Minister, and for ensuring that the conditions of the Mines and Minerals Act (1967) are observed, and that company prospecting is carried out energetically and efficiently in terms of the Act.

With the separation of the Department into two, the Mines Inspectorate passed to the Mines Department. The Geological Survey's interest in the country's mines is now with regard to the geological occurrences and ore genesis, and the light these may throw on undiscovered reserves.

The main costs of running the Geological Survey Department during 1973 were again borne by the recurrent budget. Mineral Exploration, Underground Water Development and Underground Water Research were financed as Development Projects by United Kingdom Development Loans. The Driller Training Scheme was funded under a Swedish Development Grant.

## 1.2 Summary of the Year's Work

During the year, the Department continued to enjoy an almost full establishment, thanks to the influx of contract, seconded and local officers in late 1971 and early 1972. The Department was able to move, therefore, towards a full tempo of productivity, the achievement of which was deferred by the delay in the decision as to whether or not to relocate the Geological Survey in Gaborone. This led to the Building Programme being frozen throughout most of the year, with a consequential effect upon other Development Projects and Departmental activities, the most serious deficiency being the lack of an adequate store.

Six continuing Development Projects are funded by U.K. and one Development Project is funded by SIDA.

- GS 01 Mineral Exploration
- GS 02 Underground Water Development
- GS 03 Underground Water Research
- GS 04 Research in Okavango Delta
- GS 05 National Gravity and Magnetic Survey
- GS 07 Driller Training Scheme
- GS 08 Building Programme was frozen
- GS 09 Contract borehole drilling project was formulated.

A proposal for a wide ranging airborne magnetic survey of the Kgalagadi region was formulated in December, 1972. After an initial delay in acceptance of the project a consultant from CIDA visited Botswana in August to assist in finalizing details. His report was still awaited at the end of the year.

Training continued within the Department in those cadres where suitable men were available. The Driller Training Scheme continued with theoretical and practical training of thirteen men. By the end of the year, one of these had been recommended for promotion to Senior Drilling Assistant.

A successful Foreman Training Scheme operated during the year.

One officer returned from U.K. after attending a one-year's course in hydrogeology, and was awarded a Diploma and the degree of M.Sc.

Another young man went to Leeds University in September to begin a four-year degree course in geology.

One laboratory technician continued studies in U.K. with a view to obtaining qualifications for the post of Chemist.

Considerable progress was made on the economic geology side of the Survey, first in the development of mineral policy, and second in the consideration of major new prospecting concessions.

Suggestions originating in the Geological Survey, and a paper by a Consultant (Dr. Goundrey), were considered at Ministry level, and by the newly formed Mineral Policy Committee, and an outline of mineral and mining policy was elaborated and submitted to Cabinet for consideration. A statement of Government's thinking of Mineral and Mining Policy eventually appeared in Chapter 10 of the new National Development Plan, 1975-1978. Most policy issues affecting mineral concessions, mining leases and matters relating to the development of the country's mineral resources are considered by the Mineral Policy Committee (established in April, 1973) of which the Director of Geological Survey and the Principal Economic Geologist are members.

As the importance of coal as an alternative energy resource began to be appreciated, increasing interest was shown in Botswana's reserves by energy companies and applications for coal prospecting concessions were received from several major international companies during the year. Agreement was reached as to the form and conditions of the concessions. New thought was given to

the importance of radioactive minerals and as to whether they should be treated separately or in combined prospecting concessions.

There was less interest in new base metal prospecting concessions, but new applications were received for precious stones, radioactive minerals, gypsum and gold, for silica for the Selebi-Pikwe smelter. Prospecting continued under existing concessions for diamonds, copper and nickel ores, fluorspar and asbestos, in addition to a range of minerals of lesser interest.

Ten Special Prospecting Licences were awarded or renewed. Twenty-five Special Prospecting Licences were in force at the end of the year.

Assistance was given to the SWECO consultancy on building materials, and a special investigation was begun into the recently recognised limestone deposits at Maratsane, north of Mmadinare.

New pumping trials of brine from ditches at Sua Pan by Makgadikgadi Soda Ltd. were observed and accepted as demonstrating that the brine could be extracted by this method.

Proposals for completing the evaluation of the DK1 kimberlite pipe southeast of Orapa, and the proposed mining plan, were examined in detail prior to the commencement of discussions regarding the opening of a new diamond mine.

Negotiations continued with regard to the development of the gypsum deposits at Foley. A Mining Lease was granted to Marlime Asbestos for the existing workings at Gopane.

Semi-precious stones continued to be exported by one dealer, while another application was also received for a dealer's permit.

The dwindling water supply for Orapa diamond mine (Mopipi dam) caused much concern during the year, and the Department collaborated with the Company's consultants in the search for an underground water alternative. The dam was expected to dry up in mid-December, but the exceptional damp and cloudy weather at the year's end fortunately delayed this happening.

A thorough review of the organisation of underground water supply was made and the outstanding backlog of borehole applications was reviewed. This was handicapped by the continued inability to fill the post of head of hydrogeology which had been under recruitment since September, 1972.

Selection of boreholes continued and drilling by the Government Drilling Branch produced 43 boreholes, of which 23 were successful.

In order to increase the capacity to drill boreholes, a Contract Drilling Scheme was formulated (GS 09) and one contractor started work in April. This produced 6 boreholes, of which 5 were successful, by the year's end. Much planning and organisation of an expanded borehole drilling programme under contract was carried out towards the end of the year.

Regional geological exploration and mapping was devoted mainly to a mapping traverse across the Kalahari between latitudes  $21^{\circ}\text{S}$  and  $21^{\circ}30'\text{S}$ . Three geologists, supported by geophysicists, were engaged on this traverse, which attempted to use all available methods - photo-interpretation, ERTS imagery, geophysics, geochemistry, air reconnaissance, and diamond drilling - to investigate this previously unmapped terrain. The logistic problems encountered in maintaining 60 men and some 20 vehicles in the remote and waterless region were profound, but the opening up of the Kalahari to systematic geological mapping has already changed the outlook on the prospecting potential of this vast area.

Meanwhile, conventional mapping continued in the east, two geologists completing a continuous geotraverse from the Rhodesian craton into the Limpopo mobile belt, between latitudes  $20^{\circ}\text{S}$  and  $22^{\circ}\text{S}$ .

Both the trans-Kalahari traverse and the work in the east are being treated as geotraverses forming contributions to the International Geodynamics programme.

Supervisory visits were made to both of the field projects by the Director, Deputy Director and the Principal Economic Geologist, on several occasions during the six months field season from April to October.

In addition to the geophysical contribution to the trans-Kalahari traverse, two specialized geophysical investigations were undertaken. The seismic survey of the eastern part of the Okavango delta, designed to determine the depth of the sedimentary in-fill, begun in November, 1972, was completed in February. The Institute of Geological Sciences, London, provided two geophysicists and seismic equipment and the Botswana Geological Survey Department gave counterpart aid and logistic support.

The National Gravity and Magnetic Survey was carried out during the year under a U.K. funded Development Project. After flying-in the primary network by fixed wing aircraft in late 1972, the survey continued with the establishment of 1 854 stations by means of Land-Rover and lorry, together with three weeks' work and some 6 500 km flown by helicopter, the project terminating in November. This project establishes for the first time a gravity network for the whole country,

linked to the international global network, which will form one of the basic documents for the interpretation of the concealed geology of Botswana.

Satellite-derived imagery (ERTS-1) continued to be received from NASA, Botswana being a participating country in the American ERTS-1 programme. Colour composites in particular have provided valuable information on resource inventorisation as a whole, while in geological terms, the data is extremely useful in evaluating the distribution of the Kalahari Beds and bedrock, as well as revealing the extent of rather recent faulting.

A one-day seminar on the usages and potential of ERTS-1 imagery was held during the visit of three experts from NASA in December which was attended by 26 representatives from other participating departments and interested persons.

Two notable publications took place, one being the first National Geological Map of Botswana, produced by the newly adopted three-colour system, and now distributed throughout the world, the second being the first Mineral Resources Inventory Bulletin on Industrial Minerals and Rocks. Three other maps were published and reached new heights of technical excellence in reproduction.

The Library and Records system continued to be augmented and improved, particularly by a gift of £600 from the British Books Presentation Programme.

### 1.3 Staff

#### 1.3.1 Death of Mr. C. Boocock

It is with regret that the tragic death in a motor accident of the Geological Survey's former Director, Mr. C. Boocock, MBE, OBE, is reported.

Mr. Boocock joined the Geological Survey in April, 1950, and was promoted Director in 1957 on the retirement of Dr. R. B. McConnell. His many activities included economic mineral surveys, geological mapping, geophysical investigations and groundwater studies but he will be remembered mainly for his work in establishing a virile and forceful Geological Survey.

For a long period following the founding of the Geological Survey in 1948 outside interest in the economic mineral potential of the territory was at a low ebb and the survey was frequently faced with a struggle to justify its existence. The greatest tribute can now be paid to Mr. Boocock for his continued faith and confidence in the mining future of the country and his persuasion by which the Geological Survey survived. It was through his

inspiration that a wider interest in the mineral potential of the territory was engendered and maintained.

The successes in mineral development ultimately achieved in Botswana are historical and they resulted in added responsibilities during the early development stage of the mining industry. Mr. Boocock was here again instrumental in drafting legislation and laying the foundations for a Mines Inspectorate.

Mr. Boocock retired in 1971 under the terms of the Botswana Independence Agreement and joined the private sector. In the year of his death in 1973 he was President Elect of the Geological Society of South Africa and his passing is a sad loss to the geological profession in Southern Africa.

### 1.3.2 Staff Movements

Mr. M. T. Jones, Deputy Director, resigned in May after thirteen years of service with the Department. Dr. C. R. Jones was appointed Deputy Director with effect from 1st April.

Mr. N. S. Robins, Hydrogeologist, resigned on completion of his contract appointment in July.

Mr. B. Motsete returned to the department in September and was promoted from Scientific Assistant to Hydrogeologist having successfully completed the M.Sc. course in hydrogeology at London University.

Dr. B. S. I. Marengwa was re-recruited to the department as Geologist in September on his return from the University of Leeds where he was awarded a doctorate in July. Dr. Marengwa has been assigned to the Economic Geology division.

Mr. T. P. Mchaeli, a UBLS General Science graduate, came to the department in May as an in-service trainee. Between May and July, he assisted Kalatraverse field investigations, while from July until September he was employed in the Chemistry Laboratory. He has now begun a 4-year degree course in Earth Sciences at the University of Leeds.

Mr. R. J. Malejane, Senior Laboratory Technician, continued his studies at Bristol Polytechnic for the City and Guilds Advanced Chemical Technician's Certificate. During the year, it was decided that he should study further for the qualification of Licenciate in the Royal Institute of Chemistry which would enable him to take up a post as Chemist on his return.

Mr. L. G. Hutton, Senior Chemist, Dr. M. Litherland, Geologist, and Mr. P. Robinson, Drill Training Instructor, were all on leave from August to November. Mr. E. R. James was Acting Senior Chemist in Mr. Hutton's absence.

Mr. K. Jennings, Senior Cartographer, proceeded on leave in mid-December; Mr. M. G. H. Sales was promoted to Acting Senior Cartographer in Mr. Jennings' absence.

Mr. D. G. Hutchins also went on leave in December.

Mr. J. N. M. Coates and Mr. J. Davies joined the department early in the year as Scientific Assistants on contract terms.

Mr. A. Dunsmuir, Mechanic, was transferred to the Government Drilling Branch in August.

Miss J. M. McKie, Personal Secretary to the Director, resigned on completion of her contract at the end of July and was replaced by Mrs. O. J. Kenna, also on contract terms, at the end of August.

Miss E. K. Chibana began in-service training as a Library Assistant from the very beginning of the year, while Miss J. Mulenga was appointed as a Clerk in May.

Mr. T. S. Kgalaeng, Executive Officer, was transferred to the Ministry of Mineral Resources and Water Affairs early in the year and Mr. T. M. Mogatle was appointed in his place on his successful completion of a course at the Botswana Training Centre.

Mr. E. Moabi and Mr. C. P. Matshaba, Tracers, concluded a course in cartography at the Department of Surveys and Lands, in May and then returned to the Geological Survey.

Mr. L. Maruatona, formerly Field Assistant, also completed this course but stayed at the Department of Surveys and Lands for a further six months in-service training as a draughtsman.

Mr. C. P. Matshaba was re-graded as Publications Officer in November following rationalisation of departmental publications' holdings and sales procedure.

Mr. L. G. Hutton, Senior Chemist, and Miss S. M. Akehurst, Technical Records Officer, married in October.

In the Drilling Branch, Mr. E. Mudenda joined the establishment in January while Mr. R. J. Hutchens was appointed on contract terms in August. There were still 5 outstanding vacancies for drill foremen at the end of the year.

#### 1.4 Financial Summary

During the year 1973 the costs of Recurrent Expenditure

<u>Project</u>	<u>Capital Expenditure</u>	<u>Estimated</u>
	R	R
7. Driller Training Scheme GS 07	-	25 494
8. Building Programme GS 08	-	74 100
9. Contract Drilling GS 09	-	100 000

Revenue collected by the Department during the financial year 1972-73 amounted to R1 077 423 as compared with R481 812 the previous year. The large increase was due to production starting at Orapa Diamond Mine and the royalties which accrued from these activities. Starting with the financial year 1973-74, the new Mines Department will assume responsibility for collecting revenue from (a) Issue of Magazine and Blasting Licences, (b) Diamond Royalties, (c) Royalties on Minerals other than Diamonds and (d) Mining Leases.

Financial statements of expenditure for both the recurrent and development budgets and for revenue for the financial year 1st April, 1972 to 31st March, 1973 and corresponding estimates for the financial year 1st April, 1973 to 31st March, 1974 are given in Appendix 2.

## 1.5 Development

Under the Government's Five Year Development Plan, 1973-78, nine development projects aggregating a total estimated expenditure of R302 969 were in operation throughout most of the year. In addition, plans were formulated for a further four projects and brief statements outlining these were prepared for incorporation in the Development Plan.

The Mineral Exploration Project GS 01 is a continuing project funded under a UK Development Loan whereby expanded activities in the routine exploratory and scientific research work of the Geological Survey are financed. During the year a second diamond drill, microscopes, laboratory and camping equipment were supplied through this source.

The Underground Water Development Project GS 02 is another continuing project financed under a UK Development Loan and provides for the acquisition of additional water borehole drilling equipment. Two Ruston Bucyrus 60RL Percussion Drills and accessory equipment were obtained from this source during the year.

Basic underground water research to assess the source, yield and replenishment of aquifers is conducted through

the Underground Water Research project GS 03 which is funded from a UK Development Loan. A specific ion meter, water samplers and winches and cables were supplied from this source during the year.

Geophysical Research in the Okavango GS 04 is a short-term UK-funded project to investigate the structure and seismicity of the Okavango basin, a region of pronounced earthquake activity. The first phase of this programme which investigated the structure of the basin was completed early in the year but monitoring of the seismic activity and the building of a permanent seismological observatory were postponed pending completion of the National Gravity and Magnetic Survey GS 05. Fieldwork on the latter project, which is also UK-funded, was completed during November and documentation of the results should be completed by mid-1974.

Administration of the Air Pollution Control Project GS 06 was transferred to the newly created Mines Department on 1st April but Geological Survey remained responsible for the analytical side of the programme. With funds available under the project a Techtron AA6 Atomic Absorption Spectrophotometer was acquired and additional laboratory space equipped to house the instrument which had become operational by the end of the year.

The Driller Training Scheme GS 07 is a project funded by the Swedish International Development Authority with the object of training Batswana as Drill Foremen. Thirteen trainees were under instruction during the year and a Driller Training School with office and workshop facilities was completed in Gaborone.

The Geological Survey Building Programme GS 08 was in abeyance for most of the year awaiting a decision from Cabinet on whether Geological Survey should be re-located in Gaborone. The decision not to move the Department allowed a revival of plans for expanding the office and laboratory facilities at Lobatse and in December the first allocation of funds was made from internal sources for improvements to the Stores Block.

The Contract Borehole Drilling Project GS 09 was initiated using internal funds in September with the object of contracting out drilling of water boreholes to local contractors in an effort to reduce the backlog of holes under request by Geological Survey's Drilling Branch. A total of seven successful boreholes had been completed by the end of the year.

4.1 Geological Survey Activities

With the departure of Mr. M. T. Jones in May, Dr. D. Gould assumed responsibility as acting head of the Hydrology Division pending the arrival of the Principal Hydrologist on UN appointment in 1974.

Geophysical surveys for groundwater supply were undertaken in the Kgalagadi, Ghanzi, Central, Southern and South-East Districts at the following locations.

4.1.1 Phuduhudu (Kgalagadi District) - Mr. D. J. Hunt conducted surveys in and to the south of the quarantine camp, as part of a drilling programme for the Department of Veterinary Services and the Western State Lands Livestock Project. The geometry of a large dolerite sill underlying the camp was defined.

4.1.2 Okwa - Kalkfontein (Ghanzi District) - Mr. D. J. Hunt commenced a resistivity survey of an area proposed for development by the Western State Land Livestock Project. This followed a preliminary hydrogeological reconnaissance by Mr. J. F. T. Houston in which one of the two areas under consideration was assessed as having water potential at depths of approximately 200 m while it was thought probable that the second area would not yield good groundwater supplies. It was this latter area which was designated for geophysical follow-up.

A series of depth probes was run along the Okwa Valley, running west from the Lobatse - Ghanzi road. Another series of probes was run west - northwest from survey beacon BPP74 between the Okwa and Hanahai valleys.

A complete interpretation of the survey awaits drilling operations in the area since reference probes could not be run because of the existing lack of boreholes.

4.1.3 Machaneng (Central District) - Mr. J. Davies conducted resistivity surveys to locate a water supply for Government offices and housing.

4.1.4 Sebina (Central District) - Mr. J. Davies carried out resistivity surveys to locate two suitable sites requested by Botswana Livestock Development Corporation. The results of the

surveys were disappointing and although drilling went ahead early in 1974, all three holes were unsuccessful.

- 4.1.5 Musi and Dikgatlong (Southern District) - Mr. B. Jessie conducted successful resistivity surveys over Basement rocks on these two research farms for the Animal Production Division, Ministry of Agriculture.
- 4.1.6 Matasalalo, Maratadibe and north of Dikgatlong (Southern District) - Mr. B. Jessie carried out resistivity surveys in these areas on behalf of private applicants. Basins of decomposition in the predominantly granitic rocks were defined as potential aquifers but considerable thicknesses of clay encountered at Maratadibe and just north of Dikgatlong rendered drilling unsuccessful.
- 4.1.7 Mabutsane-Kokong-Morwamosu (Southern District) - A series of depth probes was run in this area by Mr. D. J. Hunt. A tentative map of the sub-Kalahari Beds was produced from the results of this survey. When information on the grazing potential of the land is available from the Ministry of Agriculture, it will be possible to delineate suitable areas for grazing development under the western Ngwaketse Development Project. However, more detailed work will be required before drilling commences.
- 4.1.8 Woodhall Farm (Southeast District) - A resistivity survey was conducted by Mr. J. Davies for a private applicant and also as a training exercise for field assistants.

Sites were also selected geologically for 76 boreholes in all districts of Botswana; 39 of these sites had been drilled by the end of the year. Of the 54 boreholes, (all sited by the Geological Survey Department), which were drilled by or under contract to Government, 28 were successful, a rate of 53%. The criterion for success is taken as a yield of 15 litres per minute or greater of potable water. On this criterion the corresponding figures for 1972 were 27 out of 65 (42%). The success rate for 1973 has been boosted by the 8 high-yielding boreholes drilled in a short period for Maun township.

A table giving the drilling details of all holes drilled or otherwise worked on by Drilling Branch and contractors is given in Appendix 4.

## 4.2 Drilling Branch Activities

During 1973, a total of 3 851 metres,

(11 737 feet), was drilled by the Government Drilling Branch, while 869 metres, (2 649 feet), were drilled under contract to Government for underground water development. The depth drilled by Geological Survey was only 58% of that drilled in 1972. During the year, the number of rigs in operation varied from 5 to 10. Five drill foremen remained in post throughout the year, two new foremen were recruited, one veteran drill-hand was promoted to foreman, and the Driller Training School had up to 2 rigs in the field.

The Drilling Branch worked on 71 boreholes during the year; 8 boreholes which had been started in 1972 were completed, 40 new boreholes were completed, 7 new boreholes were still in progress at the end of the year, while 16 existing boreholes were cleaned out and retested. Five boreholes had to be abandoned for technical reasons. Of the 4 720 metres, (14 387 feet), drilled by Government and contractors in new boreholes for water supply, 2 163 metres, (6 592 feet) were drilled in successful boreholes.

Most of the boreholes drilled during the year were requested by Government or District Councils, but a few repayment holes for private applicants were drilled (see Appendix 4 for details).

Three boreholes were drilled for the Botswana-Zambia highway project on sites determined during intensive geophysical surveys in 1971 and 1972. This completed the Department's test drilling programme, and production holes are now being drilled under subcontract from the main construction contractors.

Eight boreholes were drilled on sites selected geologically at Maun for the Department of Water Affairs. All were successful, except for one which was deepened on instruction from the Deputy Director of Water Affairs, whereupon saline water entered the hole.

Four boreholes were drilled in the Phuduhudu area on sites selected geophysically for the Ministry of Agriculture (Department of Veterinary Services and Western State Lands Livestock Project). Drilling here proved quite difficult due to dolerite in the Quarantine Camp and running sand to the south. Of the 4 holes, one was successful, one was blank, one was abandoned for technical reasons, and one was still in progress at the end of the year. Other holes drilled for the Ministry of Agriculture were for the Department of Veterinary Services 5 (all at Makoba, all successful), Animal Production Division 2 (both blank), and Botswana Agricultural College 1 (in progress at the end of the year).

Other Government Departments for whom boreholes were drilled were Roads (5, of which 3 were successful, 1 blank, 1 in progress), Police (5, of which 2 were successful, 3 were blank), Customs (1, which was successful), Government Offices, Machaneng 1 (in progress), and Geological Survey (6, of which 2 were successful, 2 were abandoned for technical reasons, 2 were saline). The two saline holes were drilled at Deception Pan in the Central Kalahari Game Reserve in an unsuccessful attempt to provide a potable water supply for the Department's Kalatraverse base camp, and the two successful boreholes were drilled at Selokolela as part of the Kanye project, and at Gugae as part of the Serowe-Letlhakane traverse. Fourteen new village boreholes for District Councils were worked on during the year. Of these only one was successful. Another had an adequate yield, but the water was contaminated by 10 parts per million of fluoride (compared to the W.H.O. recommended maximum for drinking water of 1,5 p.p.m.). Three boreholes had yields of 10 to 15 litres per minute, sufficient for fitting a hand pump or windmill but not a diesel pump, four had yields below 10 litres per minute and 5 were in progress at the end of the year. In addition, two existing boreholes were cleaned out for District Councils and work on a third clean-out was in progress at the end of the year.

Ten repayment boreholes were drilled for private applicants for stock watering purposes. Of these, only 5 were successful, including 2 for the Botswana Livestock Development Corporation (a subsidiary of the Botswana Meat Commission). Two repayment holes were unsuccessful and three were in progress at the end of the year. In addition, two boreholes were cleaned out for private applicants. Total revenue accruing to Government from sale of these boreholes is R8 125-40.

4.3

#### Contract Drilling Project GS 09

By the beginning of 1973, 300 borehole applications had accumulated on the files of the Geological Survey, which lacked the capacity to reduce this backlog for some time to come. A major project for drilling 405 boreholes under contract between 1st October, 1973 and 31st March, 1976 was accepted by the Ministries of Mineral Resources and Water Affairs and Finance and Development Planning. As a result, contracts for 50 boreholes were awarded to 3 Botswana-based contractors in September - October, planned for completion by 31st March, 1974. In November, the Cabinet decided to introduce an Accelerated Rural Development Programme, as part of which the Contract Borehole Drilling Programme was to be expanded by 50%, which would allow for 644 contract boreholes to be drilled by 31st March, 1976.

INSTITUTE OF GEOLOGICAL SCIENCES

A success rate of 66%, rather higher than has been achieved by Government recently, was assumed and the planned total of successful boreholes was 429. However, there has been little progress in implementing even the original programme and by the end of the year only 6 boreholes had been completed under contract, and a further 4 were in progress.

#### 4.4

#### General Hydrogeological Research Work

During 1973, three major on-going projects were terminated and none were started. This was due to staff reductions during the year combined with the need to divert available manpower to planning the contract borehole drilling project.

#### 4.4.1

Serowe - Orapa area: Mr. N. S. Robins, with assistance from Mr. D. G. Hutchins and Mr. B. Jessie, completed his study of the hydrogeology of the area between Serowe and Letlhakane. Resistivity depth probes were run at 1,6km intervals along the Serowe-Makoba-Letlhakane road, a magnetometer traverse was run along the same line, and the results were correlated with the records of existing boreholes in the area. A preliminary interpretation and report were completed before Robins' departure in July, but a final report should be available by October, 1974. To complement this work, a successful test hole, no. 2526, was drilled in an area of recharge at Gugae (an extensive shear zone) after the first hole there, no. 2524, had to be abandoned for technical reasons. This second hole is to be used as an observation borehole, and rest levels are to be measured at 2-month intervals.

#### 4.4.2

#### Botswana - Zambia Highway Project:

Mr. D. J. V. Pretorius and Mr. D. J. Hunt completed a series of resistivity depth probes along the line of the new highway during 1972, and produced an interpretation of the structure of the underlying Karroo rocks. Several fault zones cutting gently dipping strata were located, in which the last 3 test boreholes were drilled in the southern part of the route. Only one of these boreholes struck fresh water, the other two being saline. However, this was acceptable for road construction, and the Department's work was terminated. The construction contractors are now employing subcontractors to drill production boreholes in the favourable areas located by Geological Survey.

#### 4.4.3

Kanye Water Supply: Most of the work for this project had been completed by the end of 1972 although a further borehole, successful only at the second attempt, was drilled at Selokolela early in 1973 with the intention of carrying out an extended pump test. However, the Department of Water Affairs revised its plans for the future of Kanye's water requirements and this, together with pressing

administrative commitments at headquarters, caused the investigator, Mr. J. F. T. Houston, to defer the project.

4.4.4

Groundwater Age Dating Programme: Routine measurements on the tritium, carbon-14 and stable isotope contents of Botswana groundwaters continued for selected areas, although most of the year's effort was expended on analysis and interpretation of data gathered over the previous three years. The programme has been carried out by the Nuclear Physics Research Unit of the University of the Witwatersrand in collaboration with members of the Geological Survey with the financial support of a research contract funded by the International Atomic Energy Agency, Vienna. 1973 was the final year of the contract. Preliminary results of the study indicated recharge by rainfall in the Northern Kalahari (See 1972 Annual Report) and a report was submitted to De Beers Industrial Division on this subject in respect of water supply to Orapa Diamond Mine. A research proposal was submitted to Anglo-American Corporation for continued work in the Orapa area; Anglo-American are also interested in extending the studies to Selebi-Pikwe and Morupule.

4.4.5

Rest Level Monitoring: Rest level monitoring continued on a routine basis throughout the year. Rest levels were measured manually on boreholes in the western Kweneng (Letlhakeng to Morwamosu) and in the Serowe-Orapa area at two-monthly intervals, while in the Lobatse and Kanye areas, several rest-level recorders were in continual operation and other boreholes were measured manually at intervals of from 1 to 4 weeks. Measurements of water level were recorded at Nuane Dam and Lobatse Hospital Weir and 2 rain gauges were maintained, at Sokwe Hill and at Geological Survey. Relatively little analysis of this data has taken place because of lack of staff but the following results have been derived:

- i) Lobatse Township Basin-Sokwe Hill recharge - No recharge took place in the 1970/71 and 1972/73 summer seasons while the percentage run-off in the 1970/71 season was 88% and in 1972/73 was 1,0%. The maximum flood run-off was  $3,6\text{m}^3/\text{s}/\text{km}^2$  on 9th March, 1973. Above average rains are necessary for run-off to occur. The minimum rainfall intensity needed to induce surface run-off is between 24,3 and 34,0 mm in 48 hours if the catchment is dry.
- ii) Pikwe-Letlhakane boreholes - Data from the automatic recorders on boreholes 2213 and 2397 established that not less than 2 million cubic metres was available in storage.

4.4.6

Gerhaert-Owen Well Logger: This equipment was serviced in April with the help of Mr. M. Young,

Senior Logging Engineer, BPB Industries, Pretoria, and was then loaned to Australia Groundwater Consultants (Pty) Ltd. in July for their programme to locate and develop a groundwater supply to Orapa Mine. Four boreholes were logged by gamma-ray, resistivity, self-potential and caliper by Mr. D. J. V. Pretorius in conjunction with Australian Groundwater Consultants' personnel. Little further use was made of the instrument which returned to headquarters in September.

4.5

Miscellaneous

Borehole records were metricated during the year, and a new set of metric reference cards was written out.

Technical Assistants received instruction in elementary Hydrology and practical aspects of the subject.

The seismic results reveal that the thickness of recent sediments toward the base of the delta is generally about 300m and that the delta is bounded along the Thamalakane and Kunyere Rivers by considerable faults in the Karroo and Pre-Karroo bedrock, as suspected from the Ngamiland Gravity Survey and photogeological evidence. At the sites investigated, the throws of the faults appear variable in the range 100 to 300m, though always downthrown on the swamp side. However, the seismic evidence also suggests that the thickness of recent sediments does not increase markedly as one moves further out into the delta. Thicknesses of only 150 to 200m were determined at a few locations 50km or more northwest from the fault lines.

The contents of the report will be incorporated in a wider-ranging discussion of the geological structure of the Okavango Delta area including a broader interpretation of the Gravity Survey of Ngamiland in due course.

### 6.3

#### Kalatraverse Geophysics

A large programme of geophysical work was mounted by Mr. D. G. Hutchins and Mr. J. N. M. Coates in support of the Kalatraverse project between May and October. Some 800 gravity stations were established at 2km intervals along cut lines and access tracks. These lines were also covered by total-field magnetometer readings. In addition, a total of 160 Schlumberger electrical soundings were made over the Kalatraverse strip in an attempt to delimit the thickness and nature of the superficial deposits, and variations in the electrical properties of the bedrock. At the end of the year, the results of this work were being prepared for incorporation into the Kalatraverse report. The work should be completed in the first half of 1974.

### 6.4

#### Geophysical Surveys for Groundwater

Progress was made during the year towards a closer integration of the large geophysical efforts routinely made in the search for groundwater into the professional and technical supervision of the geophysics section. This is intended to further improve the standards of geophysical work planned and executed for the groundwater section, thereby securing a greater return on effort by confining sophisticated geophysical work to those projects where geophysics can be expected to make a very real contribution to the success-rate of borehole drilling. With the projected two-fold expansion of the drilling programme, these projects can only be a

small fraction of the total siting programme.

During the year, geophysical surveys for groundwater were carried out, using electrical resistivity techniques, in the following localities: Phuduhudu, Barolong Farms, Sebina, Machaneng, Western State Lands and Lobatse.

In addition, some assistance was afforded to Australian Groundwater Consultants with well-logging equipment and personnel for their groundwater studies at Orapa in July and August.

A report on the "Water Potential of the North-Western Bopwaketse" was prepared from recent field work by Mr. D. J. Hunt and Mr. D. J. V. Pretorius.

6.5

#### General

Several new design improvements were effected to the sophisticated Departmental resistivity equipment specially developed by Mr. D. J. V. Pretorius over the last few years for work under local conditions. The equipment is now proving reliable in operations under very severe conditions and results of a high standard are being obtained from the five sets regularly in use through the country.

The small geophysical laboratory, where electronic and other technical work is carried out, was completely refurbished during the year to provide much improved working conditions.

It is hoped that a custom-built Geophysics Building will be built within the next few years.

- Houston, J. F. T.      Outline of Hydrology -  
training pamphlet. JFTH/8/71.
- Aquifer test at Kgwakgwe and  
implications regarding the  
Water Supply Scheme. JFTH/9/71.
- Provisional reconnaissance  
hydrogeology of the South  
Ghanzi District JFTH/10/73.
- Hutchins, D. G.        Kalatraverse Gravity survey -  
brief notes on the preliminary  
Bouguer Anomaly map.  
DGH/5/73.
- Kalatraverse Gravity survey  
1973, field procedure and  
data reduction. DGH/6/73.
- Hutton, L. G.         Foreman Training Scheme, 1971  
LGH/5/73
- Foreman Training - progress  
report July 1973. LGH/6/73
- Jones, C. R.          The third Gondwana Symposium,  
Canberra, August 1973.  
CRJ/2/73
- Key, R. M.            An interim report on the  
Geology of Sheet 2127D, the  
Pikwe area. RMK/5/73.
- A preliminary photogeological  
study of sheet 2127D, Pikwe  
district. RMK/6/73.
- Some hematitic shales from an  
outlier of Middle Ecca beds  
northeast of Mmadinare in  
sheet 2127D. RMK/8/73
- Metamorphism of Tati Schist  
Belt. RMK/9/73.
- Possible emplacement of  
Selkirk metagabbro.  
RMK/10/73.
- Madamarb cement prospect,  
phase 1, geological  
reconnaissance. RMK/12/71
- The economic potential of the  
border zone of the Rhodesia  
Craton Tectonic domain and  
the Limpopo Mobile Belt  
tectonic domain in northeast  
Botswana. RMK/13/73.
- Gravels (Pikwe area).  
RMK/14/73
- Section across southern end of  
Eastern Geotraverse.  
RMK/11/73
- and Hepworth, J. V.

- Hepworth, J. V. and Litherland, M.  
Litherland, M. Field trip to Swaziland. RMK/7/73.
- Litherland, M. Notes on the Timbale Granite. ML/12/73.
- Sampling of Timbale Granite for age determinations. ML/13/73.
- Botswana Geodynamics Project: A progress report. ML/14/73.
- Key, R. M. and Walker, I. R. Botswana-Malawi-Zambia joint age dating programme - Contribution of the Botswana Geological Survey. ML/11/73.
- Massey, N. W. D. Mookane Calcrete Investigation NWDM/10/73
- Pretorius, D. J. V. and Hunt, D. J. Water potential investigation of the northwestern Bangwaketse DJVP/10/73.
- Reeves, C. V. The Gravity Survey of Ngamiland, 1970-1971 Part (i). CVR/13/73.
- Botswana National Gravity Survey gravity reference network. CVR/14/73.
- ERTS imagery as a navigation aid for helicopter - borne gravity traverse in the Kalahari. CVR/15/73.
- Some notes concerning the proposed CIDA aeromagnetic coverages of Botswana. CVR/16/73.
- Robins, N. S. The Lobatse Hospital gauging weir - 1973. NSR/17/73
- Further observations on the Letlhakane boreholes at Pikwe. NSR/18/73.
- A provisional analysis of the Serowe to Letlhakane resistivity traverse. NRS/19/73.
- ERTS-A applied to the analysis of the Serowe - Letlhakane resistivity traverse.
- Stansfield, G. Some notes and observations on the Kalahari sand in the Sekgoma area. GS/12/73.

## Statistics of Drilling Operations carried out by the Drilling Branch and Under Contract during 1973

District	Boreholes completed	No. of successful boreholes for Government	No. of successful boreholes for District Councils	No. of successful boreholes for Private Customers	Total	Unsuccessful Boreholes (dry, saline, etc).	Abandoned Boreholes (technical reasons)	Uncompleted Boreholes at 31:12:73	Total depth drilled (new holes) (metres)	Depth drilled in successful holes (metres)	Depth drilled in unsuccessful holes (metres)	Depth drilled in abandoned holes (metres)	Depth drilled in uncompleted holes (metres)	Depth drilled in deepened holes (metres)	No. of boreholes cleaned out, re-drilled, etc.	Water supply developed (litres per min.)
Central	15	7	-	2	9	5	1	1	1 594	1 021	411	17	145	-	7	849
Ghanzi	2	-	-	-	-	2	-	1	178	-	147	-	33	-	-	-
Kgalagadi	4	2	-	-	2	1	1	1	774	339	223	67	145	-	-	89
Kgatleng	2	-	-	-	-	2	-	1	262	-	201	-	61	-	2	-
Kweneng	6	2	-	1	3	2	1	1	530	319	145	14	52	-	-	172
North-East	1	1	-	-	1	1	1	1	22	4	-	-	18	-	-	39
North-West	12	9	-	1	10	1	1	-	290	438	15	37	-	2	983	
South-East	1	-	-	-	-	1	-	2	137	-	67	-	70	4	3	-
Southern	11	1	1	1	3	7	1	3	933	242	481	30	178	57	2	254
TOTAL	54	22	1	5	28	21	5	11	4 720	2 163	1 690	165	702	61	16	2 386
Drilled by Government	48	17	1	5	23	20	5	7	3 851	1 525	1 614	165	547	61	16	1 768
Drilled by Contractors	6	5	-	-	5	1	-	4	869	638	76	-	155	-	-	418

## APPENDIX 5

(a) Details of Boreholes sunk by the Drilling Branch during 1973

Official No.	Locality	District	Customer	Total depth (m)	Depth water struck (m)	Static water level (m)	Pumping rate (l/min)	Water quality	Geology
2481	Morupule	Central	Colliery	372	-	-	Blank	-	Sand, partly calcretised (Kalahari Beds) (18m); Micaceous siltstone (Waterberg - Lotsani Shale fm) (to 283m); quartzite (Waterberg Palapye sst. fm).
2494	Molapo wa Bojang	Southern	Council	91	11	6	11	Fresh	Clay (2m); Gaborone Granite.
2513	Tlhareselele	Southern	Council	66	27-30 57-60	12	11	Fresh	Sand and gravel (14m); felsite.
2514	Bot-Zam Highway	Central	Government	92	90	72	152	Fresh	Sand with silcrete (Kalahari Beds).
2515	Francistown PMU	North-East	Police	31	18-21	11	39	Fresh	Quartzite (?) (decomposed to 21m), (Basement Complex).
2516	Tare	Central	Private	152	70	61	2	Fresh	Gneiss (?) (Basement Complex) (70m); Schist (Basement Complex).
2517	Bot-Zam Highway	Central	Government	95	94	76	114	Saline	Clay with silcrete (56m), sand with silcrete (Kalahari Beds).
2518	Moshupa	Southern	Police	63	43	-	0.4	-	Gaborone Granite, decomposed to 40m.
2519	Moshupa	Southern	Police	42	12	3	2	Fresh	Gaborone Granite, decomposed to 12m.
2520	Bot-Zam Highway	Central	Government	88	86	80	53	Saline	Sand and silcrete (Kalahari Beds).
2521	Phuduhudu	Kgalagadi	Veterinary	218	157	124	45	Fresh	Sand and clay (Kalahari Beds) (112m); clay and black shale (U. Ecca) (to 134m); sandstone (M. Ecca), with thin dolerite sills.
2522	Bokaa	Kgatleng	Roads	125	78	91	1	Fresh	Gaborone Granite.
2523	Seletswe Pan	Kweneng	Private	37	-	-	Blank	-	Sand (9m); red decomposed shale (? Pretoria Series).
2524	Gugae	Central	Geol. Svy.	17	Abandoned for technical reasons				Sand and silcrete (Kalahari Beds).
2525	Kgomokasitwa	Southern	Council	108	-	-	Blank	-	Decomposed Gaborone Granite (22m); fresh Gaborone Granite (to 40m); dolerite.
2526	Gugae	Central	Geol. Svy.	95	40	38	136	Fresh	Sand and silcrete (Kalahari Beds) (30m); Stormberg Basalt (to 82m); Cave Sandstone.
2527	Maun (peg 1)	North-West	Township	24	14-24	?	152	Fresh	Sand and clay (Kalahari Beds).
2528	Maun (peg 8)	North-West	Township	27	9-24	5	152	Fresh	Sand and clay (Kalahari Beds).
2529	Maun (peg 2)	North-West	Township	12	5-11	5	121	Fresh	Sand and clay (Kalahari Beds).
2530	Kgomokasitwa	Southern	Council	70	21-55	8	15	Fresh	Clay and gravel (6m); weathered granite (to 21m); felsite (to 54m); Black Reef quartzite.
2531	Maun (peg 3)	North-West	Township	15	5-14	5	91	Fresh	Sand and clay (Kalahari Beds).
2532	Maun (Hospital)	North-West	Township	21	12-18	7	106	Fresh	Sand and clay (Kalahari Beds).
2533	Maun (peg 4)	North-West	Township	18	5-15	6	91	Fresh	Sand and clay (Kalahari Beds).

Official No.	Locality	District	Customer	Total depth (m)	Depth water (m) struck	Static water (m) level	Pumping rate (l/min)	Water quality	Geology
2534	Maun (peg 5)	North-West	Township	12	5-11	5	91	Fresh	Sand and clay (Kalahari Beds).
2535	Serwe Pan	Central	B.L.D.C.	157	142	90	45	Fresh	Sand and silcrete (Kalahari Beds) (34m); Stormberg Basalt (up to 142m); Cave Sandstone.
2536	Selokolela	Southern	Geol. Svy.	30	Abandoned for technical reasons				Sand (6m); boulders (to 15m); Waterberg sandstone.
2537	Matasalalo	Southern	Private	67	In progress				Basement granite.
2538	Maun (peg 9)	North-West	Township	37	Abandoned for technical reasons				Sand and clay (Kalahari Beds).
2539	Number not used								
2540	Number not used								
2541	Seletswe Pan	Kweneng	Private	166	76,113	61	35	Fresh	Sand (10m); red and blue shales (? Pretoria Series).
2542	Mokgale	North-West	Private	79	76	67	61	Fresh	Kalahari Beds.
2543	Kgope	Kweneng	Council	14	Abandoned for technical reasons				Sand and gravel (3m); dolerite.
2544	Kgope	Kweneng	Council	108	-	-	Blank	-	Sand and gravel (6m); dolerite.
2545	Dikgatlong	Southern	An. Prod.	91	-	-	Blank	-	Chert rubble (8m); red clay (to 35m); decomposed granite (to 67m); fresh Basement Complex.
2546	Deception Pan	Ghanzi	Geol. Svy.	82	73,77	?	Above capacity	Very saline	Calcrete (6m), soft uncemented sandstone (Kalahari Beds).
2547	Deception Pan	Ghanzi	Geol. Svy.	65	59	?	estd. 11	Very saline	Soft uncemented sandstone (Kalahari Beds).
2548	Phuduhudu	Kgalalgadi	Veterinary	67	Abandoned for technical reasons				Sand (Kalahari Beds).
2549	Selokolela	Southern	Geol. Svy.	81	44,58, 79	41	182	Fresh	Sand (2m); boulders (to 15m); Waterberg sandstone (to 79m); loose sand.
2550	Metsemotlhaba	Kweneng	Roads	32	26	20	100	Fresh	Gaborone Granite (decomposed to 26m).
2551	Makalamabedi	North-West	Roads	15	11	5	61	Fresh	Sand, silcrete and mud (Kalahari Beds).
2552	Kavimba	North-West	Police	15	-	-	Blank	-	Decomposed quartzite (Kalahari Beds).
2553	Kavimba	North-West	Police	15	12	11	57	Fresh	Decomposed quartzite (Kalahari Beds).
2554	Badukanye	South-East	Council	67	?	20	20	High fluoride (10ppm)	Shales (decomposed to 9m) (Ventersdorp supergroup, Mogobane assemblage).
2555	Maratadibe	Southern	Private	121	100	89	5	Fresh	Basement granite (decomposed to 89m, including clay from 20 to 54m).
2556	Mosinki	Kweneng	Roads	121	?	72	37	Fresh	Sand (6m); dolerite (post-Waterberg) (to 49m); Waterberg sandstone (to 82m), dolerite (to 88m), sandstone (to 94m), Waterberg shales.
2557	Moshaneng	Southern	Water Affairs	102	-	11	182	Fresh	Clean out-old private borehole.
2558	Moshaneng	Southern	Water Affairs	74	-	11	182	Fresh	Clean out-old private borehole.

Official No.	Locality	District	Customer	Total depth (m)	Depth water struck (m)	Static water level (m)	Pumping rate (l/min)	Water quality	Geology
2559	Serwe Pan	Central	B.L.D.C.	118	109	94	98	Fresh	Silcrete, clay and sand (Kalahari Beds) (60m); Stormberg Basalt (to 108m, and partly decomposed to 105m); Cave Sandstone.
2560	Matasalalo	Southern	Private	91	55-85	43	57	Fresh	Soil and silcrete (7m); decomposed granite (to 61m); fresh granite (Basement).
2561	Bray	Kgalagadi	Customs	121	100	91	44	Fresh	Sand and clay (Kalahari Beds) (110m), (? Waterberg).
2562	Marapong	Central	Council	76	7	4	9	Fresh	Granite boulders (7m); Basement granite.
2563	Phuduhudu	Kgalagadi	Veterinary	223	201	183	14	Fresh	Sand and conglomerate (Kalahari Beds) (113m); dolerite (to 167m); black shale (U. Ecca) (to 191m); dolerite (to 193m), white sandstone (M. Ecca) (to 223m), dolerite.
2564	South of Phuduhudu	Kgalagadi	Livestock Proj.	145	In progress				
2565 to 2570	Contract holes (see below)								
2571	Ntlhantlhe	Southern	Council	74	In progress				
2572	Machaneng	Central	Government Camp	84	In progress				
2573	Contract hole	(see below)							
2574	Matlagatse	Kweneng	Roads	52	In progress				
2575	Contract hole	(see below)							
2576	Dikgatlong	Southern	Private	37	In progress				
2577	Boswelatlou	South-East	Animal Prodn.	61	In progress				
2578 to 2580	contract holes (see below)								
2581	Content	South-East	Bots. Agric. Coll.	9	In progress				
2582	Tati Siding	North-East	Council	18	In progress				
176	Tlokweg	South-East	Private	62	-	10	45	Good	Clean out-old borehole.
242	Natetse (Nxai Pan)	Central	Veterinary	48	-	26	76	Very fresh	Clean out-old borehole.
243	Natetse (Nxai Pan)	Central	Veterinary	48	-	?	136	Very good	Clean out-old borehole.
1073	Mookane	Central	Private	76	-	19	114	Good	Clean out-old borehole.
1223	Mamagofu	South-East	Council	80	-	51	10	Good	Clean out and deepen (from 76 to 80m)-old borehole.
1237	Dira	Southern	Veterinary	129	-	29	34	Fresh	Clean out and deepen (from 76 to 129m)-old borehole.
1346	North of Bottle Pan	North-West	Veterinary	45	-	?	70	Very good	Clean out-old borehole.

Official No.	Locality	District	Customer	Total depth (m)	Depth water struck (m)	Static water level (m)	Pumping rate (l/min)	Water quality	Geology	
1507	Oodi	Kgatleng	Council	46	-	23	90	Good	Clean out-old borehole.	
1527	Bottle Pan	North-West	Veterinary	71	-	?	91	Good	Clean out-old borehole.	
1583	Tswagare	Southern	Private	65	-	29	23	Good	Clean out and deepen (from 61 to 65m)-old borehole.	
1624	Mochudi	Kgatleng	Mission	59	-	21	20	Fresh	Clean out-old borehole.	
1748	Bushman Pits	North-West	Veterinary	28	-	?	151	Good	Clean out-old borehole.	
1774	Bushman Pits	North-West	Veterinary	31	-	25	61	Very saline	Clean out-old borehole.	
2401	Lethakane Valley (Selebi-Pikwe)	Central	Township	99	-	?	not tested	Fresh	Clean out-old borehole. Original pump refitted.	
P. 810A	Kule	Ghanzi	Council		Clean out in progress					
None	Near Bushman Mine	Central	Private	29	-	?	72	Fresh	Clean out-old privately-drilled borehole.	
None	Moeding	South-East	College	28	-	?	?	?	Clean out-old privately drilled borehole.	

(b) Details of Boreholes sunk under contract to Government

Official No.	Locality	District	Customer	Total depth (m)	Depth water (m)	Static water level (m)	Pumping rate (l/min)	Water quality	Geology	
2565	Makoba A.I. Camp	Central	Animal Prodn.	115	33,66,107	21	55	Brackish	Sand and silcrete (Kalahari Beds) (30m); Stormberg Basalt.	
2566	Makoba A.I. Camp	Central	Animal Prodn.	158	33,130,140	27	45	Brackish	Sand and silcrete (Kalahari Beds) (21m); Stormberg Basalt (to 140m); Cave sandstone.	
2567	Makoba Quarantine	Central	Veterinary	122	33,83,111	27	114	Brackish	Sand and silcrete (Kalahari Beds) (17m); Stormberg Basalt (to 111m); Cave sandstone.	
2568	Makoba Quarantine	Central	Veterinary	121	34,71,97, 116	30	159	Brackish	Sand and silcrete (Kalahari Beds) (12m); Cave Sandstone with intercalated basalt flows at 65-67, 71-97, and 118-121m.	
2569	Makoba Quarantine	Central	Veterinary	122	49,115	46	45	Brackish	Sand and silcrete (Kalahari Beds) (11m); sandstone (to 48m); Stormberg Basalt (to 115m); sandstone (to 117m), Basalt.	
2570	Mosetse	Central	Council	1	In progress					Basement granite.
2571	South of Mosetse	Central	Private	21	In progress					Basement granite.
2572	South of Mosetse	Central	Private	21	In progress					Basement granite.

