CAUSES OF FLUCTUATIONS IN THE RATE OF DISCHARGE OF LOOP-SPRUIT SPRINGS SOUTHERN WEST RAND (PRELIMINARY REPORT - OUTLINE OF FOLLOWING INVESTIGATION).

The purpose of the investigation was to assess the availability of groundwater and its extent for development of the domestic and agricultural requirements of the farming area. This report is a part of the general overall investigation of the Southern West-Rand Mining Area. An evaluation of the water resources of this area is made necessary by the rapid growth of the industrial mining complex along the southern West-Rand Pretoria Series ridges. Several plants were in operation or under construction during the last five year period of this water resources study.

Because a big portion of the present water supplies have been obtained from the groundwater reservoir, the potential effect of increased withdrawals on the slowly declining water-level has caused increasing concern. The attention of local planners has therefore been directed towards development of surface reservoirs to provide a water supply to meet the anticipated increase in water use. Surface water impoundments will require adequate run-off, reliable damsites, and quality control.

The Loopspruit springs in particular (see the attached map) are one of the sources of water for the maintenance of irrigation for 3 morgen of vegetables. Seasonal declines or increases in the rate of discharge are not fully recorded yet.

Fluctuations in the flow of the springs can be caused by the natural variations in the quantity of water pumped from an increasing number of boreholes or wells (shafts) in the southern area of the valley.

The/.....

The springs are the principal discharge point for an aquifer in a comples highly decomposed Pretoria Series strata (grits, quartzites, shales) intrusion rocks (diabase). Water enters the rocks as direct recharge from precipitation as interformational leakage from a contiguous aquifer complex, as a perched watertable above the dolomite occurrence and as infiltration of infrequent flood run-off.

The geology most closely related to the groundwater conditions in the area is outlined in this report and is shown on figure (1).

The Timeball hill formation of Pretoria Series is the oldest known sedimentary rock unit of the area.

The lateral extend is not known but aggregate thickness, according to gold prospecting boreholes, exceeds 500 feet. The formation is a shale in different varities, black carbonaceous, generally finely laminated. This rock is fairly impermeable, and generally forms a floor beneath the principal quartzite aquifer. Above this sediment formation occur fine grained grits, weathered in parts.

The volcanic rocks are dark blueish grey diabase which are sandwiched as sills among the sediment rocks. The diabase is relatively impermeable compared to the sediment origin contiguous formations. The weathered, decomposed diabase however yields moderate potable water. The thickness in the valley is unknown but in the Kloofshaft measured 90 feet. This eruptive rock in the valley floor is deeply eroded and its base is covered by superficial sediments. No boreholes are known to top the diabase, even in the mine shaft the water level is far below the diabase sill (60').

Groundwater/.....

Groundwater in the area is derived from several sources and moves through a fairly complex aquifer system.

The water used from the Loopspruit springs was originally only for stock and domestic supply, lately the farmers have been using it also for limited irrigation, i.e. 3 morgen of vegetables. The spring water after rainfall issues from numerous small orifices, but later reduces to one or two outlets at the bottom of the valley.

The first spring discharge from shale and the quartzite contact of the decomposed diabase sill. In the dry period the water seeps deeper into the diabase and eventually dries out. The second spring occurs on the decomposed diabase. According to the geophysical survey a dyke cuts through the valley and keeps the watertable at a high level (see the attached graphs). At present there is no record of the discharge rate of these springs. On inspection of the eyes, the lower spring was running at ± 2,000 g.p.h. with a P.H. value of 7.5. This information is insufficient to calculate the annual discharge rate. According to the geological and morphological condition of the valley, the fluctuation of the discharge rate is presumably high. It was necessary therefore to build a small measuring weir with a "V" notch to determine the combined annual discharge of the eyes.

Below the springs several boreholes, drilled in the last decade, yield from 350 to 1900 g.p.h. (see the attached table).

The waterlevel has been declining steadily from 1966 ..... (first data collection) in the adjacent area of the valley, but the yield of the boreholes remained steady.

Sinking/.....

Sinking operations started in the Ventilation Shaft in September 1965, and the No. 1 Main Shaft commenced in December 1965.

Total quantities of water discharged into the valley from the commencement of mining operations to date amount to ± 204 million gallons from the dolomite and quarzite-shale strata.

During the sinking of the Ventilation Shaft a small quantity of water, approximately 1,000 g.p.h. was intersected at 330 feet below the surface. This was in the Pretoria Series watertable - Timeball Hill Shales and was injected with 370 packets of cement. In the No. 1 Main Shaft, the Pretoria Series watertable was intersected at 256 and 276 feet and was injected with a total 6,122 packets cement. Water seeps at present into No. 1 Main Shaft at the Pretoria Series water-table 2,000 g.p.h.

The groundwater that moves through the aquifer to the Springs is derived principally from two sources:

(1) Direct infiltration of the precipitation that falls on the rock outcrops and the adjacent areas which are thinly veneered with soil.

(2) Percolation from infrequent flood run-off. A hydrograph of the flow of the springs will probably indicate that precipitation on the rock outcrop recharges the aquifer. At present this has not been established as there is no gauging of the flow. This conclusion may be strengthened by fluctuations in the chemical quality of the springwater. The effect due to precipitation, however, is partly masked by the pumping of groundwater for domestic, stocking, irrigation and industrial supply in adjacent area. Withdrawal of groundwater from boreholes in the closed area and the drought

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(see:) causes seasonal reductions in the flow of springs by reducing the hydrolical gradient between the boreholes (shafts) and the springs.

Statistical analysis of three parameters, (1) October-April precipitation (2) annual pumpage, and (3) annual lowest rate of spring discharge - should show that a reduction in precipitation on the valley is accompanied by a change of yield of the springs. Similarly a change in the average during a specified period will be reflected in the yield of the springs. The equation derived from statistical analysis should show that of the average annual discharge was derived from precipitation on the rock, the water quantity, from underflow from the valley.

At present only three factors are available for this equation, namely the pumping figures, the annual recharge and discharge figures of Spring. Although only four months of regular records are available to date from this measuring station a fairly general pattern of flow has emersed.

Dariation of eye flow closely follows the variation in rainfall with a time log of approximately one month. If in deed this has always been pattern of flow even before the Klooftime adjacent activities 900 feet away then two questions arise -

1. Why was irrigation even attempted by the local farmers
2. Why was such a small dam of only 1 morgen feet built

The total annual requirement of water are as follows:-

Irrigation 3 morgen x 3' = 9 morgen feet.
Evaporation = 2 morgen feet.

TOTAL = ± 11 morgen feet.

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The total amount of eye flow available per annum is predicted as ±10 morgen feet at its present rate of flow. This is insufficient bearing in mind that for 2-3 months of the year the eye is dry.

It would appear therefore that there is some substance in the local farmer complaint that the mines activities have reduced the eye flow.

The present leackage of water into the main shaft of the mine of ± 2,000 g.p.h. i.e.: 0.09 cusecs at a lower level than the eye does in fact appear to be the base flow of the eye.

The attached rainfall flow pattern should therefore be superimposed upon the base flow of ±0.09 cusecs thus giving an adequate supply of water compatible with the rise of dam and farmers water requirements.

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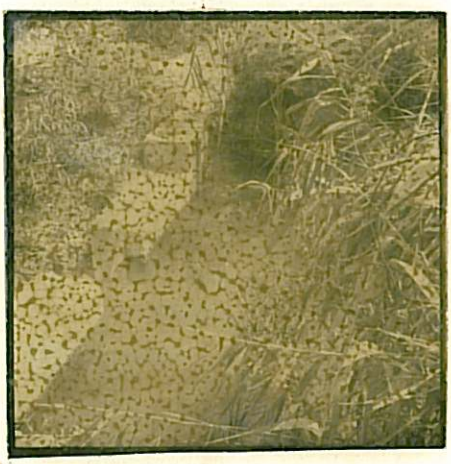

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