

# AERIAL SURVEY IN THE VICINITY OF POTCHEFSTROOM, TRANSVAAL

by

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## 1. INTRODUCTORY

In the course of years various authors have divided Southern Africa into a number of physico-geographical units. One of the most recent divisions is the one drafted by Wellington (1955).

In his excellent handbook on Southern Africa this investigator distinguishes 12 regions which are again subdivided. This division is undoubtedly of great scientific value. However for purposes of soil conservation, soil science, botanical survey and advisory work on spatial arrangement this division is less valuable. It appears that for these purposes the regions of Wellington's division provide almost no or very few data or in other words: the given division is insufficiently detailed. Therefore it appeared useful to investigate to what extent geographical interpretation of aerial photos can contribute to the framing of a more detailed division.

In the first place we will contemplate the geological and morphological characteristics of the landscapes distinguished by aerial survey. In the second place the vegetation of the landscapes will be dealt with and finally the soil scientific value of a detailed survey will be reviewed.

## 2. AERIAL SURVEY

The survey was carried out based on stereoscopic interpretation of aerial photos of the vicinity of Potchefstroom.

Potchefstroom is situated ca. 120 km southwest of Johannesburg at an altitude of about 1350 m on the vast South-African plateau called the Highveld.

Wellington (1955) divides the Highveld into four areas (fig. 1). In this article only the Highveld with pre-Karoo surface will be dealt with.

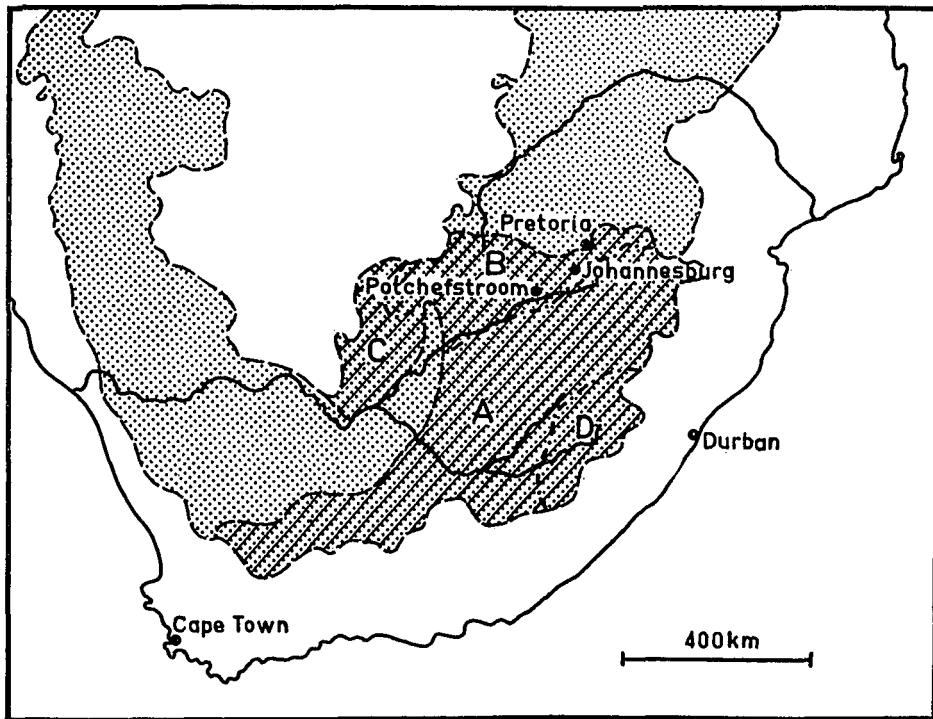
Apart from the high situation the landscape is characterized by the outcrop of rocks of pre-Karoo age. The presence of ridges consisting of hard rock is related to differences in resistance against weathering of the various deposits: the ridges are the remaining harder rocks.

The firm rocks of importance in this article are of pre-Cambrian age and belong for the greater part to the Transvaal System. This System is subdivided into three series: the Black Reef Series, the Dolomite Series and the Pretoria Series. The Black Reef Series is the oldest and is seldom found in the investigated area. The *Dolomite Series* is very important and consists of dolomitic limestones or Olifantsklip alternating with cherty bands and occasionally thin shales. Sparse vegetation and little differences in relief are typical for areas where dolomite crops out. Here the rises of the ground have

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1. Peripheral Highlands
2. South African Highveld region
  - A: Highveld (Karoo formation)
  - B: Highveld (pre-Karoo surface)
  - C: KaaP Plateau
  - D: Basuto Highlands.

Fig. 1. Peripheral Highlands and Highveld in South-Africa according to Wellington (1955)

as a rule softly inclining slopes consisting of chert. Numerous quartz veins easily recognizable on the aerial photos occur in the dolomite. These quartz veins have a special hydrological significance as they can prevent water circulation (Nel, Truter and Willemse, 1939). Besides many sinkholes (depressions of varying size) occur. Furthermore dolomitic rock is known for the occurrence of subterranean water flow. In other places water comes to the surface as "eyes". These springs give rise to permanently water carrying rivers as the Mooirivier near Potchefstroom. It is obvious that the area in which dolomite crops out, has to be considered a special landscape. The dolomite landscape is easily recognizable on aerial photos especially by its typical relief, by the frequent outcrops of hard rock and by a tree-less vegetation.

The youngest Series of the Transvaal System is the Pretoria Series called after its typical development in the vicinity of the city of Pretoria. Here quartzites typical for this Series crop out: the Timeball Hill, the Daspoort and the Magaliesberg quartzites with intercalated shales and lavas. In the neighbourhood of Potchefstroom these rocks are also found. Caused by complicated tectonic movements recurrence of the same sequence of rocks is found in various places. Hills and ridges consisting of quartzite are easily

recognizable on aerial photos. Here the hard rock crops out nearly always and the ridges sometimes run parallel. We have named the area in which these ridges and hills occur the *ridge-and-valley landscape*. In this landscape also more level parts occur consisting of fairly deeply weathered shales as field investigations have shown. The ridge-and-valley landscape is easily recognizable on the aerial photo also by its special vegetation which will be discussed later on. The ridge-and-valley landscape is bordered by the *pediment landscape* which slopes to the river valleys. The pediments have been developed in diabase and amygdaloidal andesite. Field research has shown that fine material lies at the surface in most cases with occasionally coarse and angular material at some depth which material, according to its composition, originates from higher grounds. In this case the reason for distinguishing a special landscape was its typical relief. The vegetation of this landscape will be discussed elsewhere in this article.

In the area near Potchefstroom two locally important rivers occur: the Mooirivier and the Loopspruit. Throughout the year the Mooirivier carries water supplied by the springs in the dolomite landscape. The Loopspruit carries varying amounts of water dependent on the precipitation. The Loopspruit has a wide alluvial plain especially at the place where this river falls into the Mooirivier. On aerial photos the moist soils along the rivers are easily recognizable by their darker hues but also by a different vegetation. As the alluvial soils along the Mooirivier and Loopspruit occupy a much greater area than along the brooks (spruiten), a special river landscape has been distinguished. Field investigations have shown that these soils are heavy with black to grey coloured topsoils, however the occurrence of gravel and stones is not uncommon. Concretions of lime are generally found at slight depths. The heavy fluviatile deposit overlies a layer of very coarse, more or less rounded material especially near the river or brook. This layer can be traced going upwards along the slopes the material becoming more angularly shaped, until further upwards at a fairly steep slope the coarse angular material crops out. Also the heavy grey to black layer can be continued like the layer of the coarse material. In this direction the colour changes and the layer becomes lighter textured.

### 3. VEGETATION

The vegetation of the various landscapes has already been mentioned before. Of the vegetation in the vicinity of Potchefstroom Louw (1951) has made a thorough study of which a thankful use is made here. This investigator distinguishes: the vegetation of vleis and pools, those of hills and ridges, the grassveld and the thornveld. In this article we will only trace how far the distinguished landscapes are characterized by a certain vegetation.

In the first place we will dwell on the heavy soils along the rivers and brooks i.e. on the association with the largest distribution in the river landscape. As the soils here are heavy and not aerated this is the cause that only shallow rooting trees occur. Only two exotic species are found viz: *Salix babylonica* and *Populus canescens*.

The *pediment landscape* with its faint slopes is characterized by grasses and the Thorn Veld. This grassland is called Themeda Veld<sup>1)</sup> or Sweet Veld and is well reputed with the farmers. It is included among the best grasslands of

<sup>1)</sup> Consequently of the dominating of *Themeda triandra*.

Southern Africa. The accompanying Thorn Veld is characterized by the dominance of *Acacia karroo*.

To-day the Thorn Veld is expanding which is ascribed to deterioration of the grassland, mainly due to overgrazing.

On the higher parts of the *ridge-and-valley* landscape trees, shrubs and herbs rooted in quartzite crevices are found. The lower slopes are generally occupied by mountain grass and *Acacia caffra*, while on the lowest parts often *Acacia karroo* grows. For the *dolomite landscape* "sour" grasses are typical. Very characteristic are *Triraphis andropogonoides*, *Pogonarthria squarrosa* and *Eragrostis gummiflora*. In the Veld this type of grassland is known to be bad, being at its best in spring and early summer.

*From the above mentioned appears that by dividing into natural landscapes based on aerial photos, regions can be defined characterized by a specific morphology, geological (petrological) conditions and a specific vegetation.* Therefore it is not surprising that the number of farms strongly fluctuates with the type of landscape.

#### 4. SOIL SURVEY

Remains the question of the soil scientific value of the aerial photo map. To be informed on this subject a small part was surveyed in detail and a great number of borings to ca. 1.40 m below surface were made. The surveyed area is indicated on appendix 1. When comparing the soil map (appendix 2) with the aerial photo map (appendix 1) the close similarity is striking. The valley soils in the centre of the map are also indicated on the soil map. According to the soil map parent rock crops out in the ridges occurring in the eastern part of the area. The soil map reveals that the ridge in the centre of the aerial photo map consists of a number of narrow quartzite ridges also with outcroppings of hard rock. Between the ridges rock debris is found. The fairly level soils lying between the ridges (see aerial photo map) consists of grey loam of varying thickness overlying a cemented layer called "ferricrete" (the grey ferruginous lateritic soil of Van der Merwe, 1941). In places the loam layer is thin mostly caused by soil erosion.

The eastern part of the surveyed area consists of chert and belongs to the Dolomite Series. On the aerial photo map this part is indicated as belonging to the higher part of the dolomite landscape. In many places chert crops out while downward on the slopes chert debris comes to the surface. Further downward red loam of varying thickness is found (the brown to reddish-brown ferruginous lateritic soil of Van der Merwe, 1941). The chert debris partly overlies shales, thus a downward movement of the debris must have taken place.

*Taking all together it may be inferred that the aerial photo map provides very valuable data for the soil surveyor.* At least aerial photo interpretation facilitates to a great extent the work of the soil surveyor.

(Submitted December 1958.)

#### SAMENVATTING

Aan de hand van stereoscopisch uitgewerkte luchtfoto's werd een bodemkundige opname verricht van een deel van het Highveld in de omgeving van Potchefstroom (Unie van Zuid-Afrika). Ter toetsing van de bodemkundige waarde van de, door luchtfoto-interpretatie verkregen, geomorfologische kaart

(bijlage 1) werd deze vergeleken met een detailbodempopname (bijlage 2) van een deel van hetzelfde gebied. Hierbij bleek, dat eerstgenoemde kaart zeer waardevolle gegevens voor de bodempopname leverde.

De streek rond Potchefstroom werd verdeeld in vier gebieden nl.: het reliëfrijke landschap, het pedimentlandschap, het dolomietlandschap en het rivierlandschap (bijlage 1). Het reliëfrijke landschap is vrij sterk heuvelachtig met tussen de heuvels vlakke delen bestaande uit diep-verweerde schalies. Dit landschap is op de luchtfoto gemakkelijk aan zijn vegetatie te herkennen, nl. op de hoogste delen alleen begroeiing van bomen en struiken in spleten van het kwartsietgesteente, gebergtegras en *Acacia caffra* op de lagere hellingen en vaak *Acacia karroo* op de laagste delen van de hellingen. Het pedimentlandschap ligt tussen het reliëfrijke- en het rivierlandschap. De pedimenten zijn ontwikkeld in diabaas en amygdaloidale andesiet. De vegetatie bestaat in hoofdzaak uit grassen en het zg. Thorn Veld. Het grasland, genaamd Themeda Veld of Sweet Veld, behoort tot het beste van Zuid Afrika. In het Thorn Veld domineert *Acacia karroo*. Het dolomietlandschap bestaat uit dolomitische kalksteen, ook wel Olifantsklip genoemd, afgewisseld met hoornsteenhoudende lagen en soms dunne schalies.

Talrijke kwartsgangen, op de luchtfoto's gemakkelijk te herkennen, komen in de dolomiet voor. Deze kwartsgangen zijn hydrologisch van betekenis doordat zij de watercirculatie kunnen verhinderen. Evenals elders in dolomietgesteente vindt men hier dolinen, bronnen („eyes”) en ondergrondse waterafvoer. Het dolomietlandschap is op de luchtfoto te herkennen aan zijn typisch reliëf, het veelvuldig voorkomen van vast gesteente aan het oppervlak en de boomloze grasvegetatie. Het grasland wordt getypeerd door „zure” grassen en staat als slecht bekend.

Het rivierlandschap omvat de alluviale gronden langs de Mooirivier en de Loopspruit. Het is op de luchtfoto's te herkennen aan de donkere tinten en aan de afwijkende vegetatie waaronder slechts twee, vlakwortelende, boomsoorten, beide exoten nl. *Salix babylonica* en *Populus canescens*. De landschapelijke verschillen komen ook tot uiting in het aantal boerderijen dat per landschap sterk wisselt.

#### ZUSAMMENFASSUNG

Auf Grund stereoskopisch ausgearbeiteter Luftbilder wurde eine Bodenkartierung vorgenommen von einem Teil des „Highveld” in der Umgebung Potchefstrooms (Süd-Afrikanischer Union). Zur Überprüfung des bodenkundlichen Wertes dieser, durch Luftbildinterpretation erhaltenen geomorphologischen Karte (Tafel 1), wurde diese verglichen mit einer detaillierten Bodenteilaufnahme (Tafel 2) desselben Gebietes. Daraus erwies sich die geomorphologische Karte für die Bodenaufnahme als sehr wertvoll.

Die Umgebung Potchefstrooms wird in 4 Teilgebiete verteilt d.h.: reliefreiche Landschaft, Pedimentlandschaft, Dolomietlandschaft und Fluszländschaft (Tafel 1). Die reliefreiche Landschaft hat ein ziemlich stark hügeliges Gelände mit zwischen den Hügeln, aus tief-verwitterten Schiefer bestehenden flächeren Teilen. Im Luftbilde ist diese Landschaft durch die Vegetation leicht erkenntlich, im höheren Gelände Baum- und Sträucherwuchs nur in Spalten des Quarzitgesteins, Gebirgsgras und *Acacia caffra* auf den niederen Abhängen und oft *Acacia karroo* auf den niedersten Abhängen. Die Pedimentlandschaft nimmt eine Zwischenlage ein zwischen der reliefreichen- und

der Flusslandschaft. Die Pedimente sind entwickelt im Diabas und amygdaloidalen Andesit. Die Vegetation wird hauptsächlich von Gräsern und dem sog. Thorn Veld gebildet. Das Grasland, Themeda Veld oder Sweetveld genannt, gehört zum Besten Süd-Afrikas. Im Thorn Veld dominiert *Acacia karroo*. Das Hauptgestein der Dolomitlandschaft ist dolomitischer Kalkstein oder Olifantsklip, in Abwechslung mit Hornstein führenden Schichten und zuweilen mit dünnem Schiefer.

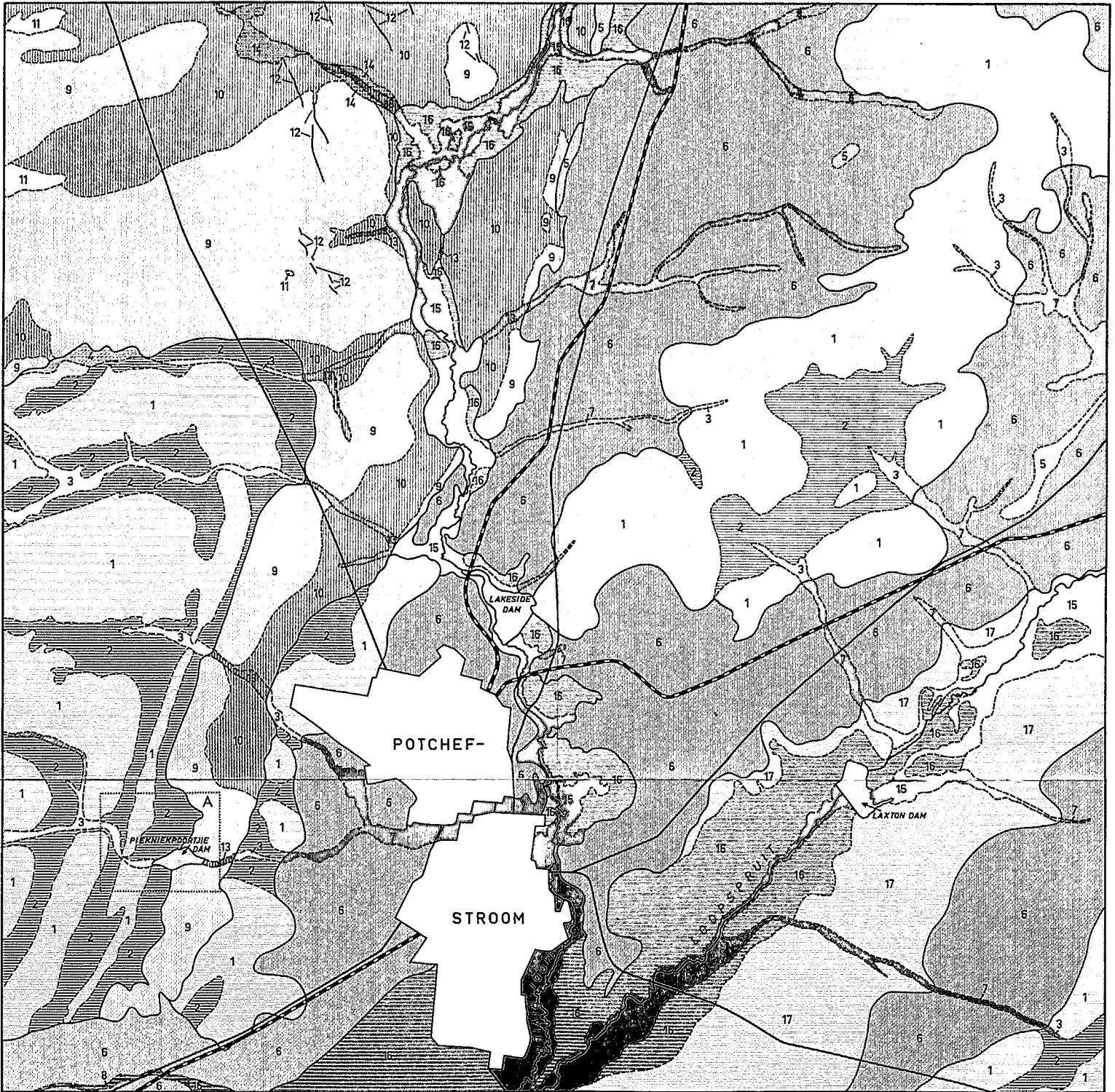
Zahlreiche Quarzgänge, im Luftbild leicht erkenntlich, werden im Dolomit gefunden. Diese Quarzgänge sind von hydrologischer Bedeutung weil sie der Wasserkirkulation verhindern können. Wie anderswo gibt es im Dolomitgestein Dolinen, Brunnen („eyes“) und unterirdischer Abfuhr. Im Luftbild ist die Dolomitlandschaft erkenntlich an ihrer typischen Relief, dem häufigen Vorkommen von Gesteinsaufschlüssen und an der baumlosen Vegetation. Das Grasland wird durch das Vorkommen saurer Gräser charakterisiert und wird nicht sehr geschätzt.

Die Flusslandschaft umfasst die alluvialen Böden entlang der Mooirivier und Loopspruit. Sie ist im Luftbild erkenntlich an den dunklen Abtönungen und an einer abweichenden Vegetation unter der nur zwei, flachwurzelnde, Baumarten vorkommen, die Exoten *Salix babylonica* und *Populus canescens*. Die landschaftlichen Differenzen gelangen auch zum Ausdruck in der landschaftlich stark wechselnden Zahl der Bauernbetriebe.

#### LITERATURE

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# GENERALIZED AIRPHOTO INTERPRETATION MAP OF THE ENVIRONMENTS OF POTCHEFSTROOM, TRANSVAAL



Scale 1:100.000



**LEGEND**

**RIDGE AND VALLEY LANDSCAPE**

- 1 heights
- 2 fairly level parts
- 3 moist valley soils
- 4 fairly dry valley soils

**PEDIMENT LANDSCAPE**

- 5 heights
- 6 pediment
- 7 moist valley soils
- 8 fairly dry valley soils

**DOLOMITE LANDSCAPE**

- 9 fairly high parts
- 10 lower parts
- 11 sink-hole etc.
- 12 veins
- 13 moist valley soils
- 14 fairly dry valley soils

**RIVER LANDSCAPE**

- 15 moist river soils
- 16 fairly dry river soils
- 17 non-irrigated alluvial soils

A area near Pieterkop Dam shown on appendix 2

# GENERALIZED SOIL MAP OF THE ENVIRONMENTS OF PIEKNIKPOORTJIE DAM NEAR POTCHEFSTROOM

AUGER AND SPADE XI  
Maarleveld and van der Merwe  
Appendix 2



## LEGEND

- |  |             |                              |
|--|-------------|------------------------------|
|  | 50-120 cm ) |                              |
|  | > 120 cm )  | brook clay                   |
|  | < 50 cm )   |                              |
|  | 50-120 cm ) | red loam                     |
|  | > 120 cm )  |                              |
|  | < 50 cm )   | grey loam                    |
|  | 50-120 cm ) |                              |
|  | < 50 cm     | mixture of red and grey loam |

- |  |                                 |
|--|---------------------------------|
|  | lava                            |
|  | quartzite                       |
|  | quartzite rubble land           |
|  | crystalline rock rubble land    |
|  | chert                           |
|  | chert rubble land               |
|  | ferricrete underlying grey loam |

