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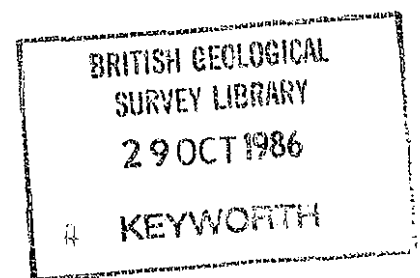
MALAWI  
MINISTRY OF AGRICULTURE  
AND  
NATURAL RESOURCES

GEOLOGICAL SURVEY DEPARTMENT

THE GEOLOGY  
OF THE  
SALIMA -  
MVERA MISSION AREA

by  
M. J. WALTER  
B.Sc., Dip.Th.

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## II. PHYSIOGRAPHY

### (a) Topography and erosion surfaces

There is a wide range of relief in the Salima - Mvera Mission area, with elevations ranging from 472 m (1 550 ft) to 1 561 m (5 123 ft) above sea level. Four physiographic units have been recognized, namely the south-western dissected area, the Rift Valley escarpment, the Lakeshore Plain and Lake Malawi itself (Plate I).

The south-western half of the area is deeply dissected, the summit levels forming an extension of the Lilongwe - Dowa - Dedza plain which rises gently from 1 158 m (3 800 ft) above sea level in the south-west to nearly 1 372 m (4 500 ft) in the north and east. The summit levels are considered to represent the late Cretaceous to early Miocene African erosion surface (Lister, 1967). Above the remnants of the plain a restricted area of higher ground around Thuma Mountain (1 561 m, 5 123 ft) is regarded as a post-Gondwana (early to mid-Cretaceous) residual (Plate II).

In the south-east the dissected African surface is bounded by the fault-controlled Rift Valley scarp zone. Two major escarpments are developed to the west of Chipoka; when traced to the north-west they are displaced to the north-east at several localities (*e.g.*, near Mkwatile Village). Further north-west, in a tract of country extending from Thuma Mountain to Kawangi Hill, fault-bounded ridges with an ESE trend apparently take the place of the scarp zone.

To the north-north-west of Mvera Mission a second scarp zone is developed, but faulting on a variety of trends has resulted in this zone being less continuous than that to the west of Chipoka. The faulting extends eastwards into undulating country between the foot of the zone (at *c.* 1 006 m, 3 300 ft) and the western edge of the Lakeshore Plain (*c.* 671 m, 2 200 ft).

In the north, the Lakeshore Plain maintains the steady decrease in elevation towards Lake Malawi (474 m, 1 550 ft) whilst in the south it abuts against the Chipoka - Dedza escarpment. The plain possibly represents part of the African erosion surface now masked by younger sediments (*cf.* Lister, 1967). Along the lakeshore itself sand bars and spits are locally conspicuous, the Senga Bay raised beach forming a complex of sands up to 30 m (100 ft) above the surrounding plain. Also rising above the plain are several hills and ridges which are regarded as post-Gondwana residuals.

The isobaths for Lake Malawi indicate the presence of scarp-like lineaments on the lake floor; these features are aligned approximately parallel to the present shoreline and are interpreted as faults.

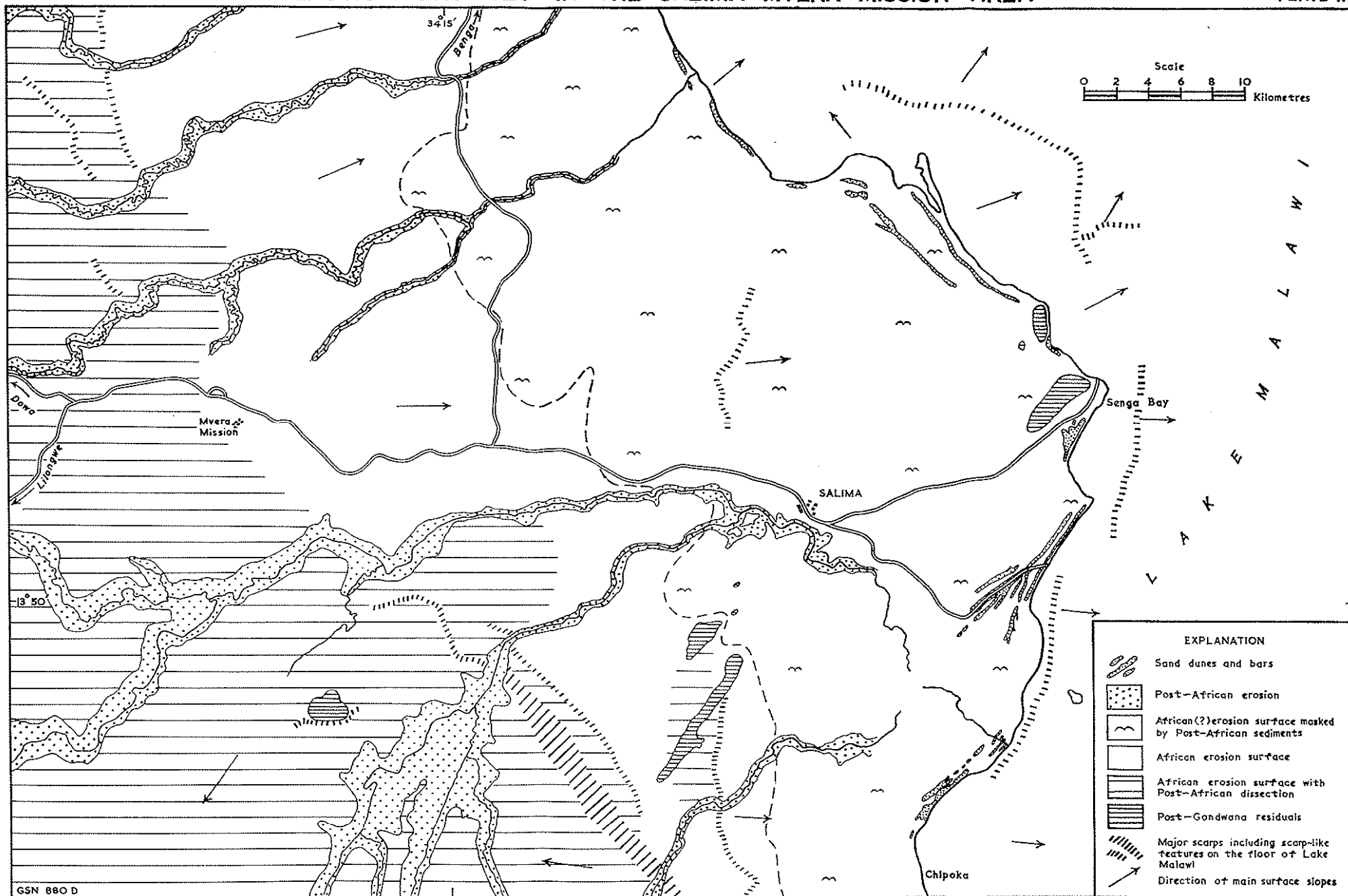
### (b) Drainage

The area is drained by rivers flowing eastwards into Lake Malawi, the more important of which are shown on Plate I.

In the south the Lilongwe, Linthipe and Lifisi Rivers flow in deep gorges through the dissected remnants of the Lilongwe Plain and leave the escarpment on a level with the Lakeshore Plain. Structural control, in particular that due to the persistent NE-trending foliation and the ESE-trending fracture system, is evident to the west of the escarpment, a striking example being the reticulate stream pattern developed in the area south-east of the Linthipe River. In the north-west the variably oriented fractures influence the drainage pattern to a greater extent than do the less constant foliation trends. The broken and step-like

# EROSION SURFACES IN THE SALIMA-MVERA MISSION AREA

PLATE II



nature of the escarpment also results in strongly incised sections of the rivers being separated by comparatively open reaches (*e.g.*, along the Limpimbi River and along tributaries of the Lingadzi River).

Below the Rift Valley escarpment many streams have cut through the veneer of superficial deposits into the underlying Basement Complex rocks, but towards Lake Malawi the superficial deposits are thicker and the bedrock is more rarely exposed. Flow in the lower reaches of the rivers is sluggish and many streams die away into the sandy alluvium before reaching the lake. Only the Lilongwe – Linthipe system, with an extensive catchment behind the escarpment, approaches perennial flow and even this ceases on average for twenty-five days annually.

Over much of the Lakeshore Plain there are no valleys and the river beds lie between banks at the level of the plain or are raised slightly above it as indistinct *levées* bordered by open *dámbo*\* (*e.g.*, along the Linthipe and Chapita Rivers, north of Chipoka). During the rainy season flooding occurs and the rivers deposit their load, building up the surface of the plain (*cf.* Brown and Young, 1965).

### (c) Climate, vegetation and agriculture

The area experiences a tropical continental climate with a single wet season lasting from December to March or April (Brown and Young, 1965). Rainfall varies between 760 mm and 1 140 mm, and the mean annual temperature is in the range 18 to 24°C, dependent upon altitude.

A broad relationship is apparent between topography, climate and natural vegetation, the last-mentioned also being closely related to soil types (*cf.* Brown and Young, 1965). *Brachystegia* hill woodland is predominant throughout much of the hilly country between the dissected edge of the Lilongwe Plain and the Lakeshore Plain. *Brachystegia-Julbernardia* plateau woodland covers only a comparatively small tract in the south-west. Mixed woodlands are possibly favoured by lower altitudes and thicker soils. The Lakeshore Plain supports savanna growth, large baobabs (*Adansonia digitata*) and *Acacia sp.* forming distinctive belts along the main rivers.

Maize, groundnuts and tobacco are grown on the Lilongwe Plain, whilst the Lakeshore Plain is being increasingly cultivated to produce rice, cotton, groundnuts, and maize.

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\* Chichewa: broad, grass covered, swampy valley(s).

higher. The long axis of the anomaly parallels the NE – SW strike of the underlying charnockitic gneisses and calc-silicate rocks. More detailed investigation of this anomaly is currently in progress.

**(g) Groundwater\***

Many of the 161 boreholes known in the area have been drilled as part of the Lakeshore Development Scheme.

The majority of the boreholes extract water from unconsolidated lakeshore sands and gravels. Of the remainder, most draw water from weathered bedrock, although some may be tapping water in fracture zones, particularly in quartzites.

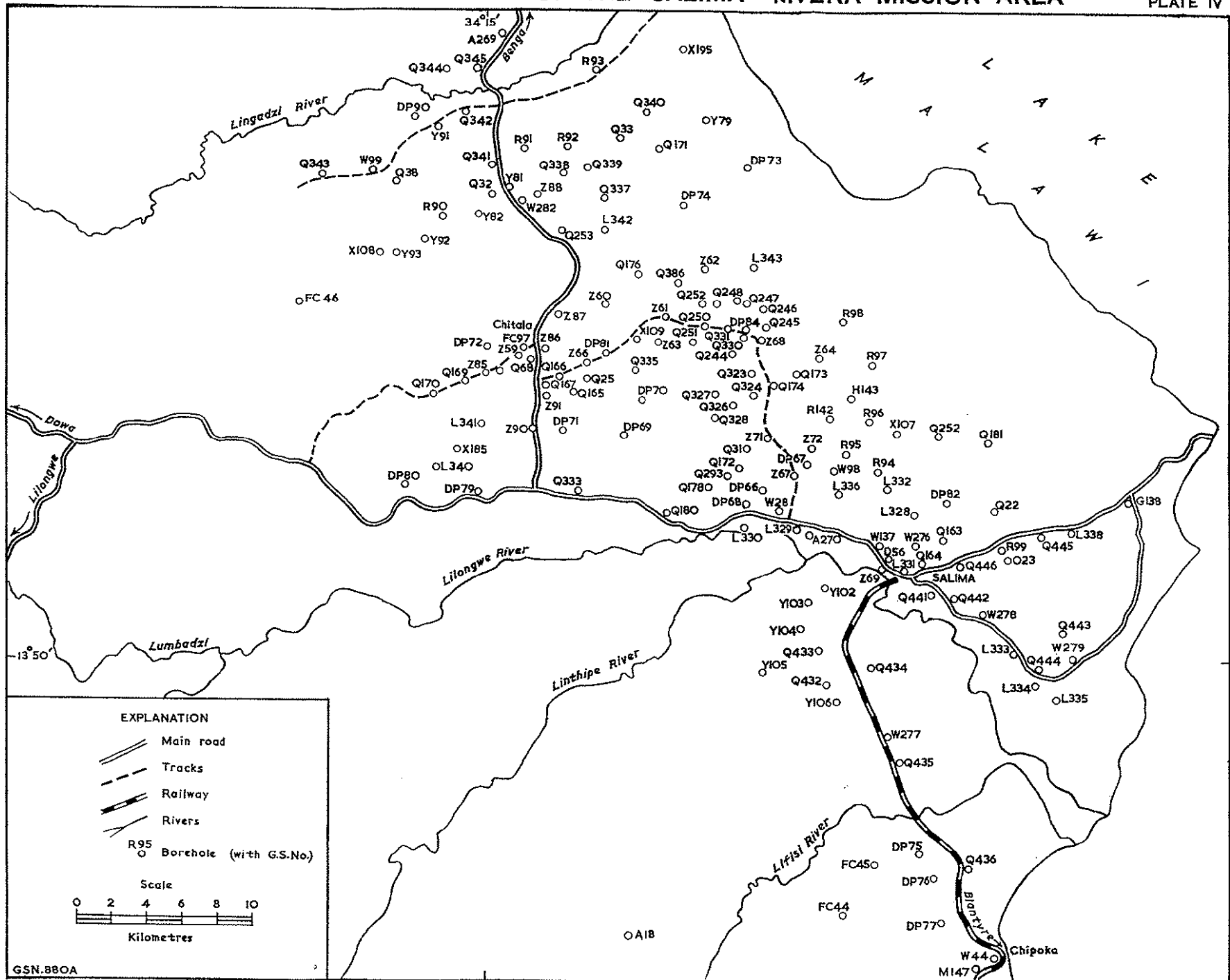
Boreholes drilled up to 1971 to extract groundwater are listed in Table I and their distribution is indicated on Plate IV.

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\* This section, Table I and Plate IV have been compiled by K. E. Wilderspin.

# BOREHOLE LOCATION MAP OF THE SALIMA—MVERA MISSION AREA

PLATE IV



G.S.N.880A

Geological Survey Dept. Malawi 1972

PM/DWL

TABLE I

BOREHOLES DRILLED FOR WATER SUPPLY IN THE SALIMA - MVERA MISSION AREA UP TO 1971

| Ref. No. | Location                | Depth<br>(m) (ft) | Yield<br>(g.p.h.) | Rocks penetrated   | Year<br>Drilled |
|----------|-------------------------|-------------------|-------------------|--------------------|-----------------|
| Z59      | Nkhwali Estate          | 64 210            | 850               | Colluvium, gneiss  | 1939            |
| Z60      | Chikaola                | 59 194            | 240               | Colluvium, gneiss  | 1933            |
| Z61      | Chasamwala              | 38 124            | 735               | Colluvium, gneiss  | 1933            |
| Z62      | Chataika                | 32 105            | 580               | Colluvium, gneiss  | 1933            |
| Z63      | Kaluzu                  | 44 145            | 240               | Weathered gneiss   | 1933            |
| Z64      | Nkuti                   | 53 175            | 480               | Colluvium, gneiss  | 1933            |
| Z65      | Nkuti                   | 39 128            | 850               | Colluvium gneiss   | 1933            |
| Z66      | Kalamba                 | 55 181            | 360               | Weathered gneiss   | 1934            |
| Z67      | Kachenembwe             | 56 184            | 3 000             | Colluvium, gneiss  | 1935            |
| Z69      | Salima Hospital         | 46 152            | 2 400             | Clay, sand, gravel | 1935            |
| Z71      | Jowam                   | 61 200            | 3 000             | Colluvium, gneiss  | 1935            |
| Z72      | Tsoyo                   | 41 135            | 3 000             | Clay, sand, gravel | 1935            |
| Z84      | Nkhwali Estate          | 61 199            | 2 750             | Colluvium, gneiss  | 1938            |
| Z85      | Chitala Station         | 62 202            | 3 000             | Weathered gneiss   | 1939            |
| Z86      | Nkhwali Estate          | 59 193            | 600               | Weathered gneiss   | 1939            |
| Z87      | Kutundu                 | 61 200            | 600               | Colluvium, gneiss  | 1939            |
| Z88      | Tundi                   | 61 200            | 480               | Colluvium, gneiss  | 1939            |
| Z89      | Guwende                 | 53 175            | 3 000             | Weathered gneiss   | 1939            |
| Z90      | Chipunza                | 54 178            | 600               | Weathered gneiss   | 1940            |
| Z91      | Chesalina               | 62 202            | 520               | Weathered gneiss   | 1940            |
| G138     | Salima Airfield         | 43 140            | 540               | Sand, clay         | 1951            |
| M147     | Mikuyu                  | 37 120            | 900               | Biotite gneiss     | 1954            |
| L328     | Simaewa                 | 30 99             | 740               | Sand, gravel       | 1957            |
| L329     | Bibi Salima             | 31 102            | 400               | Weathered gneiss   | 1956            |
| L330     | Kaphatenga              | 29 95             | 1 000             | Weathered gneiss   | 1956            |
| L331     | Salima Primary School   | 32 106            | 1 400             | Sand, gravel       | 1956            |
| L332     | Kampido                 | 46 150            | 600               | Sand, gravel       | 1956            |
| L333     | Matumula                | 44 144            | 730               | Sand, gravel       | 1957            |
| L334     | Mchinga                 | 30 100            | 800               | Sand, gravel       | 1957            |
| L335     | Matenje                 | 30 100            | 800               | Sand, gravel       | 1957            |
| L336     | Moya Mwazawale          | 46 152            | 600               | Colluvium, gneiss  | 1956            |
| L338     | Mikuti                  | 30 100            | 800               | Sand, gravel       | 1957            |
| L340     | Alifco                  | 41 136            | 500               | Weathered gneiss   | 1956            |
| L341     | Kalanzi                 | 32 104            | 840               | Weathered gneiss   | 1956            |
| L342     | Khombedza               | 30 100            | 500               | Colluvium, gneiss  | 1956            |
| L343     | Matumba                 | 37 120            | 600               | Sand, clay         | 1956            |
| W44      | Chipoka Market          | 32 105            | 1 000             | Sand, gravel       | 1959            |
| W98      | Tsoyo                   | 38 125            | 720               | Colluvium, gneiss  | 1959            |
| W99      | Makyoni                 | 31 101            | 411               | Weathered gneiss   | 1959            |
| W137     | Karonga Court           | 30 100            | 720               | Sand, gravel       | 1960            |
| W276     | Garnett                 | 34 111            | 720               | Sand, gravel       | 1960            |
| W277     | Chana                   | 31 103            | 360               | Sand, gravel       | 1960            |
| W278     | Chiunda                 | 31 102            | 720               | Sand, gravel       | 1960            |
| W279     | Ndyathope               | 29 95             | 720               | Sand, gravel       | 1960            |
| W281     | Kambwiri                | 30 100            | 720               | Sand, gravel       | 1960            |
| W282     | Mpanje                  | 34 110            | 320               | Sand, gravel       | 1961            |
| A269     | Chimbe                  | 41 134            | 533               | Muscovite schist   | 1963            |
| A270     | Kwambiri                | 62 203            | 720               | Sand, gravel       | 1963            |
| H142     | Kuti Veterinary Station | 65 213            | 720               | Sand, clay         | 1966            |
| H143     | Kuti Veterinary Station | 71 234            | 880               | Sand, clay         | 1967            |
| D56      | Salima Township         | 96 315            | 6 120             | Sand, gravel       | 1968            |
| Q22      | Kathalama               | 52 170            | 440               | Sand, clay         | 1966            |
| Q23      | Kundaye                 | 32 106            | 250               | Sand, clay         | 1966            |
| Q25      | Matululu                | 55 180            | 720               | Colluvium, gneiss  | 1966            |
| Q31      | Yonamu                  | 56 184            | 480               | Sand, clay         | 1966            |
| Q32      | Adams Farm              | 46 150            | 660               | Colluvium, gneiss  | 1966            |
| Q33      | Mbuna                   | 43 140            | 571               | Weathered gneiss   | 1966            |
| Q38      | Makion                  | 61 200            | 720               | Weathered gneiss   | 1969            |
| Q163     | Kachala                 | 37 123            | 450               | Sand               | 1968            |
| Q164     | Abisai                  | 37 122            | 450               | Sand               | 1968            |
| Q165     | Kalamba                 | 55 180            | 980               | Weathered gneiss   | 1968            |

TABLE 1—continued

| Ref. No. | Location             | Depth |      | Yield<br>(g.p.h.) | Rocks penetrated   | Year<br>Drilled |
|----------|----------------------|-------|------|-------------------|--------------------|-----------------|
|          |                      | (m)   | (ft) |                   |                    |                 |
| Q166     | Guwende              | 54    | 176  | 700               | Weathered gneiss   | 1968            |
| Q167     | Chidowa              | 61    | 200  | 500               | Weathered gneiss   | 1968            |
| Q168     | Chitala Institute    | 57    | 188  | 2 000             | Colluvium, gneiss  | 1968            |
| Q169     | Thupi No. 1          | 61    | 200  | 450               | Colluvium, gneiss  | 1968            |
| Q170     | Thupi No. 2          | 46    | 150  | 450               | Colluvium, gneiss  | 1968            |
| Q171     | Mtanda               | 49    | 160  | 789               | Sand, clay         | 1968            |
| Q172     | Chilali              | 54    | 176  | 720               | Weathered gneiss   | 1968            |
| Q173     | Kuti                 | 47    | 153  | 850               | Weathered gneiss   | 1968            |
| Q174     | Kuti                 | 38    | 126  | 500               | Sand, clay         | 1968            |
| Q176     | Levi                 | 38    | 126  | 720               | Sand, clay         | 1968            |
| Q180     | Nsadzu               | 40    | 130  | 500               | Colluvium, gneiss  | 1968            |
| Q181     | Dambo                | 35    | 116  | 450               | Sand, clay         | 1968            |
| Q243     | Chimuvi              | 60    | 196  | 200               | Weathered gneiss   | 1968            |
| Q244     | Nkuti No. 2          | 52    | 170  | 240               | Weathered gneiss   | 1968            |
| Q245     | Nkuti No. 3          | 50    | 164  | 450               | Sand, clay         | 1968            |
| Q246     | Nkuti No. 4          | 44    | 143  | 450               | Sand, clay         | 1968            |
| Q247     | Nkuti No. 5          | 38    | 125  | 450               | Sand, clay         | 1968            |
| Q248     | Nkuti No. 6          | 38    | 125  | 450               | Sand, clay         | 1968            |
| Q249     | Nkuti No. 7          | 38    | 124  | 720               | Sand, clay         | 1968            |
| Q250     | Nkuti No. 8          | 44    | 145  | 350               | Sand, clay         | 1968            |
| Q251     | Nkuti No. 9          | 53    | 174  | 610               | Sand, clay         | 1968            |
| Q252     | Nkuti No. 10         | 46    | 151  | 450               | Sand, clay         | 1968            |
| Q253     | Somba                | 35    | 115  | 450               | Colluvium, gneiss  | 1968            |
| Q254     | Gremu                | 32    | 106  | 450               | Colluvium, gneiss  | 1968            |
| Q323     | Nkuti area           | 54    | 176  | 520               | Colluvium, gneiss  | 1969            |
| Q324     | Nkuti area           | 60    | 197  | 576               | Colluvium, gneiss  | 1969            |
| Q327     | Nkuti area           | 50    | 165  | 350               | Colluvium, gneiss  | 1969            |
| Q328     | Nkuti area           | 49    | 161  | 480               | Colluvium, gneiss  | 1969            |
| Q330     | Nkuti area           | 54    | 176  | 720               | Sand, clay, gravel | 1969            |
| Q331     | Nkuti area           | 49    | 161  | 570               | Sand, clay, gravel | 1969            |
| Q333     | Naluva               | 34    | 113  | 480               | Weathered gneiss   | 1970            |
| Q335     | Maonga               | 32    | 106  | 480               | Weathered gneiss   | 1969            |
| Q336     | Chikalamba           | 44    | 145  | 720               | Sand, clay         | 1969            |
| Q337     | Khombedza Dispensary | 46    | 150  | 280               | Sand, clay         | 1969            |
| Q338     | Kasonda              | 49    | 160  | 480               | Sand, clay         | 1969            |
| Q339     | Siyasiya             | 38    | 125  | 500               | Sand, clay         | 1969            |
| Q340     | Solomoni             | 52    | 170  | 480               | Colluvium, gneiss  | 1969            |
| Q341     | Sitima               | 37    | 120  | 480               | Colluvium, gneiss  | 1969            |
| Q342     | Kanice               | 37    | 120  | 480               | Colluvium, gneiss  | 1969            |
| Q343     | Masawantanda         | 40    | 130  | 480               | Colluvium, gneiss  | 1969            |
| Q344     | Kolabola             | 37    | 120  | 576               | Sand, clay         | 1969            |
| Q345     | Dumbo's Farm         | 37    | 120  | 360               | Colluvium, gneiss  | 1969            |
| Q432     | Katolera             | 41    | 135  | 480               | Sand, clay         | 1969            |
| Q433     | Kundadza             | 39    | 127  | 480               | Sand, clay         | 1969            |
| Q434     | Katolera             | 37    | 121  | 960               | Sand, clay         | 1969            |
| Q435     | Chapita              | 38    | 125  | 480               | Sand, clay         | 1969            |
| Q436     | Lufidza              | 37    | 121  | 900               | Colluvium, gneiss  | 1969            |
| Q441     | Mkhumphu             | 38    | 125  | 720               | Sand, clay         | 1969            |
| Q442     | Mwambe               | 41    | 136  | 900               | Sand, clay         | 1969            |
| Q443     | Madili Yoswa         | 35    | 115  | 760               | Sand, clay         | 1969            |
| Q444     | Dangali              | 31    | 103  | 720               | Sand, clay         | 1969            |
| Q445     | Ngolowindo Farm      | 34    | 112  | 555               | Sand, clay         | 1969            |
| Q446     | Ngolowindo No. 3     | 34    | 110  | 240               | Sand, clay         | 1969            |
| R90      | Tunsani              | 61    | 200  | 450               | Colluvium, gneiss  | 1970            |
| R91      | Mkombozi             | 46    | 150  | 600               | Weathered gneiss   | 1970            |
| R92      | Mlolangondo Farm     | 40    | 132  | 700               | Sand, clay         | 1969            |
| R93      | Chikwawa Estate      | 46    | 150  | 550               | Sand, clay         | 1969            |
| R94      | Mbalame              | 41    | 134  | 840               | Sand, clay         | 1969            |
| R95      | Kumano               | 46    | 150  | 300               | Sand, clay         | 1970            |
| R96      | Tembwe               | 43    | 140  | 1 200             | Sand, clay         | 1970            |
| R97      | Kuti No. 3           | 62    | 202  | 645               | Sand, clay         | 1969            |
| R98      | Kuti No. 4           | 53    | 173  | 600               | Sand, clay         | 1969            |
| R99      | Ngolowindo           | 34    | 111  | 300               | Sand, clay         | 1969            |

TABLE 1—*continued*

| Ref. No. | Location              | Depth |      | Yield<br>(g.p.h.) | Rocks penetrated  | Year<br>Drilled |
|----------|-----------------------|-------|------|-------------------|-------------------|-----------------|
|          |                       | (m)   | (ft) |                   |                   |                 |
| X105     | Chikombe              | 37    | 123  | 640               | Sand, clay        | 1970            |
| X107     | Tembwe                | 46    | 150  | 1 800             | Colluvium, gneiss | 1970            |
| X108     | Chapata               | 46    | 150  | 2 750             | Colluvium, gneiss | 1970            |
| X109     | Kalambe Farm          | 49    | 160  | 500               | Colluvium, gneiss | 1970            |
| X185     | Thonje School         | 46    | 150  | 1 125             | Weathered gneiss  | 1971            |
| Y79      | Somphe                | 37    | 120  | 2 000             | Sand, clay        | 1970            |
| Y82      | Chivwati              | 55    | 180  | 255               | Colluvium, gneiss | 1970            |
| Y91      | Mduka                 | 52    | 170  | 600               | Colluvium, gneiss | 1970            |
| Y92      | Mthembe               | 46    | 150  | 3 000             | Colluvium, gneiss | 1970            |
| Y93      | Kalembo               | 46    | 150  | 450               | Colluvium, gneiss | 1970            |
| Y102     | Kawanga               | 46    | 150  | 1 200             | Colluvium, gneiss | 1971            |
| Y103     | Mzuzumile             | 46    | 150  | 2 570             | Colluvium, gneiss | 1971            |
| Y104     | Kapiri                | 61    | 200  | 1 800             | Colluvium, gneiss | 1971            |
| Y105     | Chiwaya               | 56    | 185  | 1 000             | Colluvium, gneiss | 1971            |
| Y106     | Mnkanga               | 61    | 200  | 4 500             | Colluvium, gneiss | 1971            |
| DP66     | Kambwiri              | 46    | 150  | 900               | Sand, gravel      | 1971            |
| DP67     | Kuti                  | 43    | 140  | 720               | Colluvium, gneiss | 1971            |
| DP68     | Mbawa                 | 46    | 150  | 1 800             | Colluvium, gneiss | 1971            |
| DP69     | Santhe                | 55    | 180  | 400               | Colluvium, gneiss | 1971            |
| DP70     | Tete                  | 64    | 210  | 550               | Colluvium, gneiss | 1971            |
| DP71     | Mtabwa                | 61    | 200  | 255               | Colluvium, gneiss | 1971            |
| DP72     | Chitala               | 61    | 200  | 150               | Colluvium, gneiss | 1971            |
| DP73     | Chikonya              | 40    | 130  | 3 600             | Sand, clay        | 1971            |
| DP74     | Npiyu                 | 46    | 150  | 280               | Sand, clay        | 1971            |
| DP75     | Kundwe area           | 46    | 150  | 1 500             | Colluvium, gneiss | 1971            |
| DP76     | Luwadzi area          | 46    | 150  | 1 800             | Colluvium, gneiss | 1971            |
| DP77     | Luwadzi area          | 46    | 150  | 720               | Colluvium, gneiss | 1971            |
| DP79     | Kanyanyeza area       | 46    | 150  | 1 800             | Colluvium, gneiss | 1971            |
| DP80     | Maliwa                | 43    | 140  | 900               | Colluvium, gneiss | 1971            |
| DP81     | Mwemba's Farm         | 61    | 200  | 255               | Colluvium, gneiss | 1971            |
| DP82     | Chinyama              | 46    | 150  | 1 285             | Colluvium, gneiss | 1971            |
| DP84     | Settlement area No. 5 | 61    | 200  | 750               | Colluvium, gneiss | 1971            |
| DP90     | Chifundo              | 46    | 150  | 485               | Colluvium, gneiss | 1971            |
| FC44     | Chimoka               | 34    | 110  | 820               | Colluvium, gneiss | 1971            |
| FC45     | Phaka                 | 52    | 170  | 280               | Colluvium, gneiss | 1971            |
| FC46     | Mnjere                | 76    | 250  | 1 200             | Colluvium, gneiss | 1971            |
| FC59     | Chitala Station       | 46    | 150  | 900               | Colluvium, gneiss | 1971            |

Depth in metres calculated to nearest whole metre.