COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS:

1963/107

SOIL AND SCREE DEPOSITS AT WODEN, AUSTRALIAN CAPITAL TERRITORY, AND THEIR RELATIONSHIP TO UNDERGROUND DRAINAGE.

by

E. G. Wilson

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PLATES

SOIL AND SCREE DEPOSITS AT WODEN, AUSTRALIAN CAPITAL TERRITORY, AND THEIR RELATIONSHIP TO UNDERGROUND DRAINAGE

SUMMARY

Deposits of scree, slope wash and soil overlie an undulating surface of weathered volcanics in Areas 2,4,5,6, and 7 in the Woden District of the Australian Capital Territory. The scree is permeable on the upper slopes, but where clayey bands attain their maximum thickness in the lower part of the valley the permeability is low. Scree material has been partly eroded from the upper slopes and this material has been redeposited in the lower part of the valley on the top of the clayey scree as a covering of permeable alluvial outwash. Small areas of scree are all that remain after erosion of the initial deposit in Areas 3 and 9; scree is not present in Area 8. The maximum thickness of scree ~~is~~ 43 feet at a point in Area 2; elsewhere the thickness ~~is between 15 and 25 feet.~~ averages about 20 feet.

Clayey bands limit the downward movement of water through the scree, and the scree material above these bands becomes a perched aquifer charged with water after rain. The alluvial outwash fans that overlie the clayey scree in the lower part of the valley are also perched aquifers and become charged with water from run off that flows across them during rainstorms. Seepages from the perched aquifers produce drainage problems below the 2075 foot contour in the upper Yarralumla Creek valley.

To reduce charging the outwash fans in Areas 4,5,6, and 7, run off from gullies should be led into sealed stormwater channels before spreading out over the lower areas. An outlet for water trapped in perched aquifers can be provided by regular open-jointing of stormwater drains.

A deeper aquifer of fractured volcanic rocks lies below the clayey scree in the central part of the valleys: when water in this aquifer is confined under pressure it becomes a "confined aquifer", and leakage from it will produce springs at points where the overlying clayey scree is more permeable, or is penetrated by excavations. The piezometric surface in the low parts of the upper Yarralumla Creek valley is within a foot or two of the surface and its level is probably controlled by a confined aquifer below the scree. Open-jointing of stormwater drains within the scree is expected to tap leakage from the confined aquifer, and to improve the foundations of arterial roads in the low parts of the valley.

INTRODUCTION

A soil survey carried out by the Commonwealth Scientific and Industrial Research Organisation located considerable deposits of soil and scree in the Woden District (Van Dijk, 1959). Poor drainage was associated with some of these deposits.

In March 1963 the soil and scree were tested for the National Capital Development Commission by Monier Earth Drilling Pty. Ltd. under the supervision of the Bureau of Mineral Resources. Auger-holes were placed along traverses

defined by the supervising geologist; the locations of the holes are marked on Plate 1. The logs of the holes are given in the attached Appendix and diagrammatic cross-sections of the area and individual auger-holes are shown on Plate 2.

The investigation was confined to the superficial deposits of scree, clay soils and alluvial outwash found in the Upper Yarralumla Creek valley so as to assess the general effect of these deposits on underground drainage in the Woden development areas. Investigation of individual small areas of poor drainage was not undertaken as there were many such areas and detailed investigation was not necessary to understand the general problem.

EXTENT AND THICKNESS OF SOIL AND SCREE

Deposits of scree, slope wash and soil have accumulated on an undulating surface of weathered volcanics (Plate 3, Figure 1 and Plate 2). The material on the upper slopes consists of partly indurated scree containing cobble bands and a few boulders. Clay bands are present on the lower slopes within the scree and these bands thicken towards the central part of the valley where clay predominates.

The scree has been dissected by erosion during development of the present land surface. The erosion has reduced the thickness of the scree to only a few feet in the gullies, but on the adjacent rises, 20 feet of scree material may still be present. Fans of sandy outwash have formed below the 2075 foot contour where gullies cut in the scree deposit open out on to gentle slopes and their streams have deposited recently eroded material. The outwash from neighbouring streams coalesces in the central depression below the 2050 foot contour and forms a thin continuous covering of sand, silt, and black soil over the underlying clay soils of the older scree deposit. Outwash occupies most of the north-east corner of Area 6 and a small part in the south-east corner of Area 7; the average thickness is about 4 feet. The total thickness of outwash and clayey scree in the central depression increases from 12 feet at Traverse E to about 20 feet at a point 500 yards further north; this latter thickness is maintained to the north as far as Long Gully Road.

The upper limit of the scree deposit approximates the 2250 foot contour above Areas 6 and 7, and the 2150 foot contour above Area 2; similar material is present below the 2250 foot contour in Areas 4 and 5, but no augering was carried out there. The maximum thicknesses of scree on the slopes were 37'6" at C8 on the slope of Mount Taylor, and 43 feet at F1 in Area 2. On the dissected slopes of Areas 6 and 7, augering along Traverses C and D penetrated scree materials from 10 to 30 feet thick. In Area 9, remnants of the original scree form a bench on the slope between the 1940 and 2000 foot contour and attain a maximum thickness of 12 feet. Small deposits of scree are also present below the 2025 foot contour in Area 3B and below the 2075 foot contour in Area 3A. In Area 8 practically all of the scree material has been removed from over the volcanics that crop out in much of the area; small isolated areas of dense clay soils indicate the former existence of extensive slope deposits. The development of Area 8 is likely to require some excavation of rock during installation of services.

No difficulty was encountered in augering the scree material with a 3 inch Gemco Auger except on the higher slopes where the material was dry and hard. The use of a back-hoe or a mechanical trench-digger for installation of services is expected to prove satisfactory wherever scree deposits and clay soils are encountered.

DRAINAGE

The scree deposits are relatively permeable on the upper slopes, but become less permeable towards the lower part of the valley where clay forms a large part of the scree. The overlying outwash in the central depression is very permeable.

Perched Aquifers

Clayey bands on the slopes act as a barrier to the downward movement of water through the scree, and the more permeable beds overlying these clayey bands become charged with water after rain. Such water-charged beds are referred to as perched aquifers because they are not connected to the main deeper regional aquifer. Seepage of water from the perched aquifers produces many drainage problems below the 2075 foot contour in the upper Yarralumla Creek valley (these seepages are represented by points A and B in Plate 3, Fig. 2).

Permeable sands in the recent alluvial outwash overlie clayey scree of low permeability; when charged with water, these sands also act as perched aquifers and produce seepages in the area represented by C in Figure 2.

The drainage of perched aquifers can be accomplished by open-jointing of stormwater services; regular open-jointing should be carried out throughout Areas 2, 4, 5, 6 and 7; open-jointing is also required below the 2075 foot contour in Area 3A, below the 2025 foot contour in Area 3B, and between the 1940 and 2000 foot contours in Area 9.

The entry of water into the recent alluvial fans below the 2075 foot contour in Areas 4, 5, 6 and 7 would be considerably reduced if run-off from the gullies entered stormwater drains before spreading out across the fans.

Confined Aquifers

Infiltration of water into the volcanics on the hills charges the deeper aquifer of fractured volcanics (D in Fig. 2) that lies below the cap of clayey scree in the central part of the valley. When this water is confined under pressure, leakage from the aquifer may produce springs at points where the cap is more permeable or penetrated by excavations for engineering services (E in Figure 2, Plate 3).

Water may be confined under pressure in the volcanics below the clayey scree between auger-holes E1, 2, and 3 and Long Gully Road. In this area the piezometric surface is close to the surface and would be detrimental to the foundations of arterial roads; lowering of the piezometric surface could be achieved by careful regular open-jointing in stormwater mains along Yarralumla Creek.

Confined aquifers may also be present in both Area 4 and Area 2; however, if open-jointing is carried out as recommended in the section on perched aquifers, additional work should not be required.

Confined aquifers are not expected between Long Gully

Road and "Yamba", but a better assessment of drainage in this area can be made after augering of the soil profiles. Nevertheless, some open-jointing should be provided to facilitate drainage of the soils and to provide firm foundations for arterial roads.

CONCLUSION

General recommendations for improving underground drainage in the Woden area follow.

1. Run-off from Areas 4, 5, 6, and 7 should enter stormwater drains or sealed open channels before spreading out across alluvial fans below the 2075 foot contour.

2. Regular open-jointing of stormwater drains should be installed throughout Areas 2, 4, 5, 6 and 7. Open-jointing is also recommended in Area 3A below the 2075 foot contour, in Area 3B below the 2025 foot contour, and in Area 9 between the 1940 and 2000 foot contours.

Incorporation of these recommendations in the design of stormwater services of the Woden areas is expected to improve underground drainage generally throughout the area; nevertheless, such measures may not solve all local problems because the density of the normal drainage system may not tap sufficient underground water in some small areas. If any minor problems do show up after the above recommendations have been carried out they will be easily solved by the addition of one or two small supplementary drains. These drains should be installed after the area has been examined in the light of the regional hydrology outlined in this report.

REFERENCE

VAN DIJK, D.C. 1959 - Reconnaissance soil survey of the Yarralumla Creek catchment - Proposed extension of the Canberra City District, rep. (unpublished).

APPENDIX

Logs of auger holes in the Woden area augered by Monier Earth Drilling Co. between 22nd and 29th March, 1963. Supervised and logged by E. G. Wilson. Standing water levels were measured on 9th April, 1963. Holes without standing water levels had caved-in or were dry.

Hole number	Depth in feet and inches	Observations
A1	0 - 2'	Dark brown clay soil
	2 - 4'	Grey-brown clay soil
	4 - 7'	Brown clay soil
	7 - 10'	Dense yellow-brown plastic clay
	10 - 12'	Weathered purple volcanics
	Dry hole	
A2	0 - 3'	Yellow soil
	3 - 6'	Dense brown clay
	6 - 10'	Dense yellow-brown clay
	10 - 12'	Dense chocolate-brown clay
	12 - 15'	Weathered purple volcanics
	Caved in	
A3	0 - 2'	Yellow-brown soil
	2 - 4'	Brown clay soil
	4 - 9'	Chocolate-coloured clay soil
	9 - 11'	Dense yellowish clay
	11 - 13'	Dark brown clay with some volcanic fragments.
	Caved in	
B1	0 - 2'	Grey clay soil
	2 - 4'	Dark grey clay soil
	4 - 6'	Yellow-brown clay soil, some gritty bands
	6 - 9'	Dense yellow-brown clay
	9 - 13'	Yellow sandy clay
	13 - 16'	Dense yellow clay
	Water entered the hole at 16 feet	
	16 - 19'6"	Brown silty clay
	19'6" - 25'	Weathered purple volcanics
	Standing water level 2 feet on 9/4/63.	
B2	0 - 2'	Pale grey soil
	2 - 6'	Yellow-brown soil
	6 - 10'	Dense yellow clay
	10 - 18'	Dense brown gritty clay soil; sticks in auger.
	18 - 22'	Deeply weathered purple volcanics
	Water entered the hole at 22 feet	
	22 - 30'	Weathered purple volcanics
	Standing water level 2 feet 8 inches on 9/4/63.	

Hole number	Depth in feet and inches	Observations
B3	0 - 2'	Pale silty soil
	2 - 4'	Brown clay soil
	4 - 7'	Brown clay soil
	7 - 10'	Gritty brown clay soil
	10 - 28'	Deeply weathered purple volcanics
	Bottomed on a "floater" or on rock	
	Standing water level 2 feet 6 inches on 9/4/63.	
B4	0 - 2'	Pale silty soil
	2 - 7'	Dense chocolate coloured clay soil
	7 - 15'	Dense yellow clay
	15 - 20'	Yellow gritty clay soil
	20 - 28'	Weathered pink volcanics
	Dry hole	
C1	0 - 2'	Pale silty soil
	2 - 8'	Dense yellow-brown clay
	8 - 18'	Weathered purple volcanics
	Dry hole	
C2	0 - 2'	Pale silty soil
	2 - 5'	Yellow clay soil
	5 - 12'	Weathered purple volcanics
	Dry hole	
C3	0 - 2'	Pale silty soil
	2 - 4'	Gritty soil
	4 - 8'	Yellow-brown clay soil
	8 - 14'	Weathered purple volcanics
	Dry hole	
C4	0 - 3'	Pale silty soil
	3 - 6'	Gritty soil
	6 - 12'	Dense brown clay with some grit
	12 - 16'	Dense yellow-brown clay
	16 - 20'	Weathered purple volcanics
	Standing water level 2 feet 3 inches on 9/4/63.	
C5	0 - 1'	Light grey soil
	1 - 2'	Gritty sand
	2 - 8'	Yellow gritty scree material
	8 - 12'	Brown gritty scree material with some clay
	12 - 15'	Dark brown scree material with rock fragments
	15 - 18'	Dense yellow-brown clay
	18 - 22'	Dense yellow clay
	Dry hole	
C6	0 - 18'	Yellow-brown gritty scree material
	18 - 20'	Coarse scree
	Bottomed on hard rock ("floater"?)	
	Dry hole	
C7	0 - 20'	Partly consolidated yellow-brown scree material
	20 - 25'	Partly weathered volcanics or volcanic boulders
	Dry hole	

Hole number	Depth in feet and inches	Observation
C8	0 - 6'	Yellow-brown scree material
	6 - 8'	Damp scree material with some brown clay
	8 - 20'	Partly consolidated yellowish scree material
	20 - 27'6"	Hard yellow consolidated scree
	Bottomed on hard rock	
	Dry hole	
D1	0 - 4'	Yellow-brown clay soil with iron Pisolites
	4 - 8'	Yellow-brown gritty scree material
	8 - 18'	Deeply weathered purple volcanics
	18 - 21'	Weathered volcanics, hard augering
	Dry hole	
D2	0 - 2'	Sandy soil
	2 - 10'	Dense yellow clay
	10 - 14'	Weathered purple volcanics
	Dry hole	
D3	0 - 2'	Yellow gritty soil and scree
	2 - 6'	Yellow scree material
	6 - 8'	Coarser scree material, some volcanic boulders
	8 - 14'	Dense yellow clay
	14 - 16'	Dense yellow-brown clay, hard augering
	16 - 18'	Weathered purple volcanics
	Dry hole	
D4	0 - 2'	Pale scree material
	2 - 5'	Grey-brown hard clay
	5 - 12'	Gritty scree material, coarser near the base
	12 - 15'	Weathered purple volcanics
	Dry hole	
D5	0 - 8'	Gritty scree material
	8 - 12'	Yellow clayey scree material
	12 - 16'	Dense yellow-brown clay
	16 - 24'	Yellow-brown gritty scree material with some clay and volcanic fragments.
	Dry hole	
D6	0 - 8'	Yellow gritty scree material
	8 - 15'	Hard consolidated scree material
	15 - 22'	Weathered purple volcanics
	Dry Hole	
D7	0 - 8'	Pale-coloured gritty scree material
	8 - 13'	Hard consolidated scree material with some clay
	13 - 15'	Weathered purple volcanics
	Dry hole	

Hole number	Depth in feet and inches	Observations
D8	0 - 6'	Yellow-brown gritty scree material
	6 - 13'	Yellow clayey scree
	13 - 18'	Weathered purple volcanics
		Dry hole
D9	0 - 8'	Pale coloured wet gritty scree material
	8 - 26'	Yellow wet sandy clay
		Did not penetrate full depth of superficial sediments
		Standing water level 7 feet on 9/4/63.
D10	0 - 2'	Pale sandy soil
	2 - 4'	Clay soil, some grit
	4 - 8'	Gritty yellow-brown clay
	8 - 12'	Gritty yellow consolidated scree
	12 - 18'	Gritty brown consolidated scree
	18 - 32'	Brown gritty clay
	32 - 39'	Weathered volcanics
		Caved - in at 10 feet 3 inches
E1	0 - 4'	Gritty scree material
	4 - 8'	Clayey scree material
	8 - 10'	Dense brown gritty clay
	10 - 11'	Angular volcanic fragments
		Standing water level 8 feet 8 inches on 19/4/63.
E2	0 - 2'	Pale gritty scree
	2 - 6'	Yellow scree material
	6 - 10'	Gritty sand
	10 - 12'	Iron pisolites and sand
	12 - 13'	Wet sand and grit, some pisolites
	13 - 14'4"	Partly weathered volcanics (hard augering)
		Caved - in at 8 feet 11 inches
E3	0 - 2'	Soil and sand
	2 - 6'	Yellow and brown clay
	6 - 6'6"	Slightly weathered volcanics
		Standing water level 2 feet 9 inches on 9/4/63.
E4	0 - 2'	Dark grey soil
	2 - 4'	Brown clay
	4 - 8'	Yellow-brown dense clay
	8 - 10'	Dense yellow clay with some volcanic fragments
		Bottomed in hard rock probably volcanics
		Standing water level 3 feet 7 inches on 9/4/63.
E5	0 - 2'	Yellow clayey sand
	2 - 4'	Brown gritty clay
	4 - 6'	Dense yellow-brown clay
	6 - 8'	Dense yellow clay
	8 - 10'	Brown clay
	10 - 12'	Grey-brown clay
		Water encountered at 12 feet

Hole number	Depth in feet and inches	Observations
	12 - 18'	Wet silty clay
	18 - 20'	Wet silty clay with hard bands some volcanic fragments
		Standing water level 2 feet 7 inches on 9/4/63.
E6	0 - 2'	Yellow clay soil
	2 - 8'	Dense yellow-brown gritty clay
	8 - 10'	Brown clay
	10 - 10'3"	Weathered volcanics
		Standing water level 4 feet 2 inches on 9/4/63.
E7	0 - 2'	Brown sandy soil
	2 - 6'	Dense yellow clay
	6 - 9'6"	Yellow-brown clay
	9'6"- 10'	Weathered volcanics
		Dry hole
E8	0 - 2'	Pisolitic brown clay
	2 - 5'	Dense yellow clay
	5 - 7'6"	Weathered purple volcanics
		Dry hole
F1	0 - 2'	Yellow scree material
	2 - 4'	Yellow-brown scree with some pisolites
	4 - 8'	Brown scree with pisolites
	8 - 14'	Brown clay soil
		Water entered the hole at 11 feet and hole caved-in
	14 - 27'	Dense yellow-brown clay
		Water at 27 feet
	27 - 40'	Silty and sandy mud
	40 - 43'	Gritty mud
		Bottomed in rock or boulders
F2	0 - 2'	Yellow scree soil
	2 - 4'	Scree with iron pisolites
	4 - 6'	Brown clay soil with pisolites
	6 - 9'	Gritty pisolitic band
	9 - 16'	Dense brown clay
	16 - 18'	Gritty soil
	18 - 28'	Dense yellow-brown clay
		Bottomed on hard rock or boulders
		Dry hole
F3	0 - 4'	Pink sandy soil
	4 - 8'	Gritty pisolitic soil
	8 - 12'	Gritty brown clay soil
	12 - 14'	Dense grey-brown clay
	14 - 20'	Yellow gritty scree material with some brown clay
	20 - 30'	Indurated yellow gritty scree (Hard augering)
		Did not penetrate superficial sediments
		Dry hole

PLATE I

NORTH

STROMLO

Taylor 2807

AREA 8

AREA 9

AREA 7

AREA 6

AREA 3B

AREA 3A

AREA 5

AREA 4

AREA 2

Oakey Hill

Reef 2097'

BOUNDARY

TILLOURA

EXPERIMENTAL NURSERY

EQUESTRIAN PARK

GOVERNMENT HOUSE

LAKE DAM

MOLONGLO

YARRALUMLA

PINE PLANTATION

Westbourne Woods Golf Course

GARBAGE DESTRUCTOR

MELROSE

YAMBA

Creek

Yarralumla

CEMETERY

SEPTIC TANK

DISTRICT

YARRALEN

Bare 1987

Swinger

2075

2250

BULLY HILL ROAD

PINE PLANTATION

Scrivener

Federal Golf Course

Club House

RESERVOIR TWL 2208

Red Hill 2368

RESERVOIR TWL 2350

Davidson

MUGGA

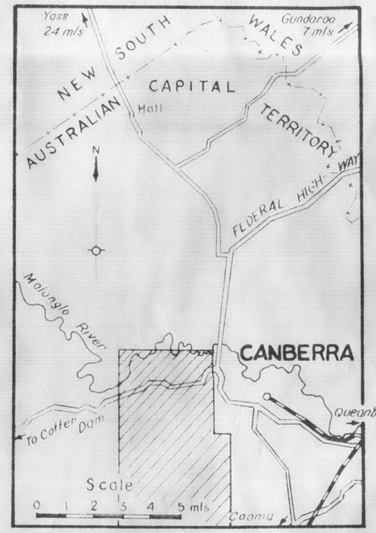
RED HILL

Mugga 2672

MUGGA QUARRY

CITY

LOCALITY SKETCH



DISTRICT BOUNDARY
PROPERTY BOUNDARY
TRANSMISSION LINE
TRUNK WATER MAIN
TRUNK SEWER MAIN
ROAD
ROAD UNFENCED
TRACK
BUILDING, PLANTATION
CONTOUR INTERVAL 25FT.
LIMIT OF OPEN WOODLAND

A——A' *Traverse line and section.*

o 5 *Auger hole and number.*

Boundary of area.

NATIONAL CAPITAL DEVELOPMENT COMMISSION

DISTRICT OF WODEN

1000 0 1000 2000 3000 4000

SCALE OF FEET

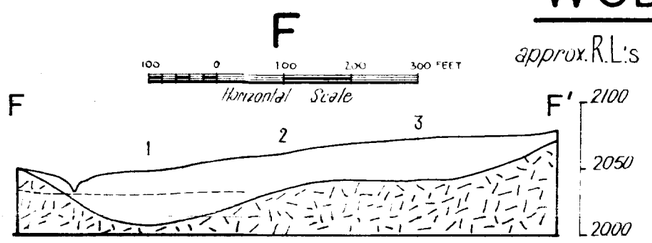
Adapted by Bureau of Mineral Resources, Canberra, June 1963.

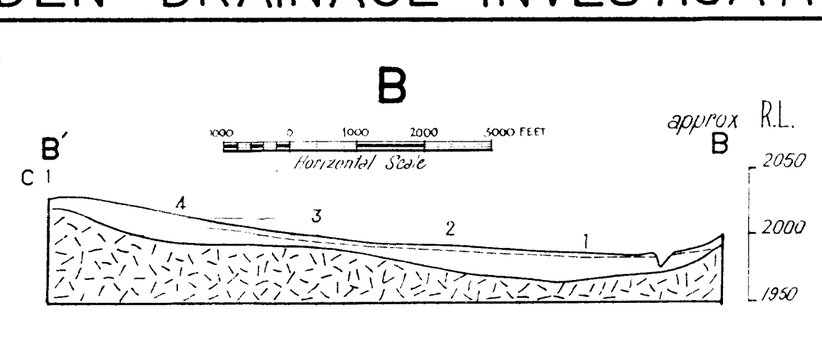
Plan No. 135/16/114

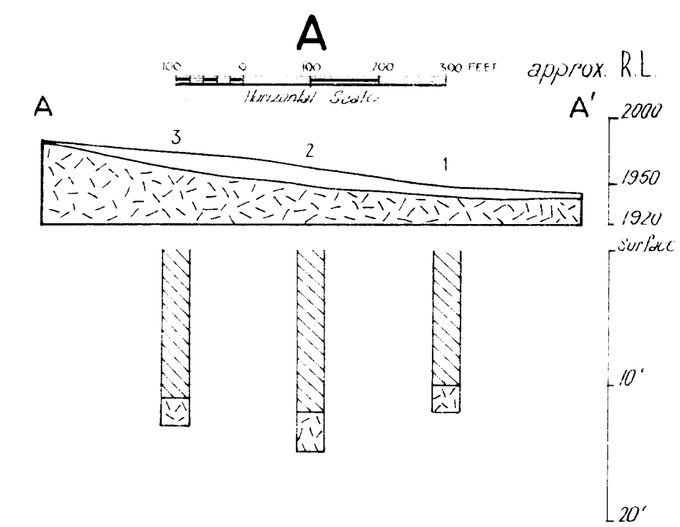
To accompany Records 1963/107

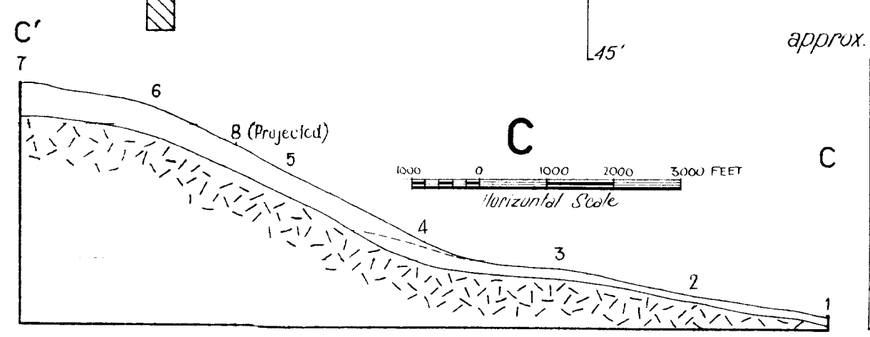
PLATE 2

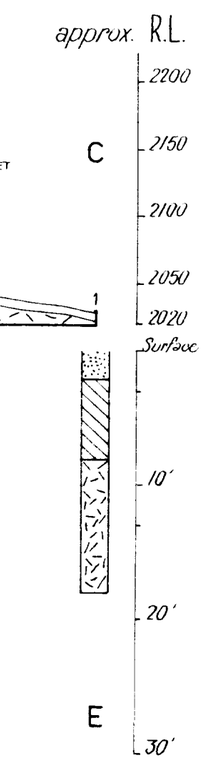
DIAGRAMMATIC CROSS-SECTIONS
WODEN DRAINAGE INVESTIGATION

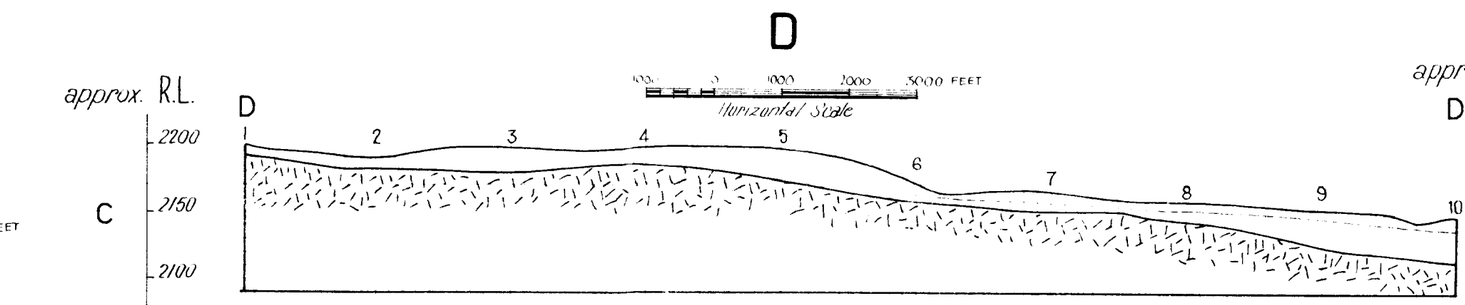


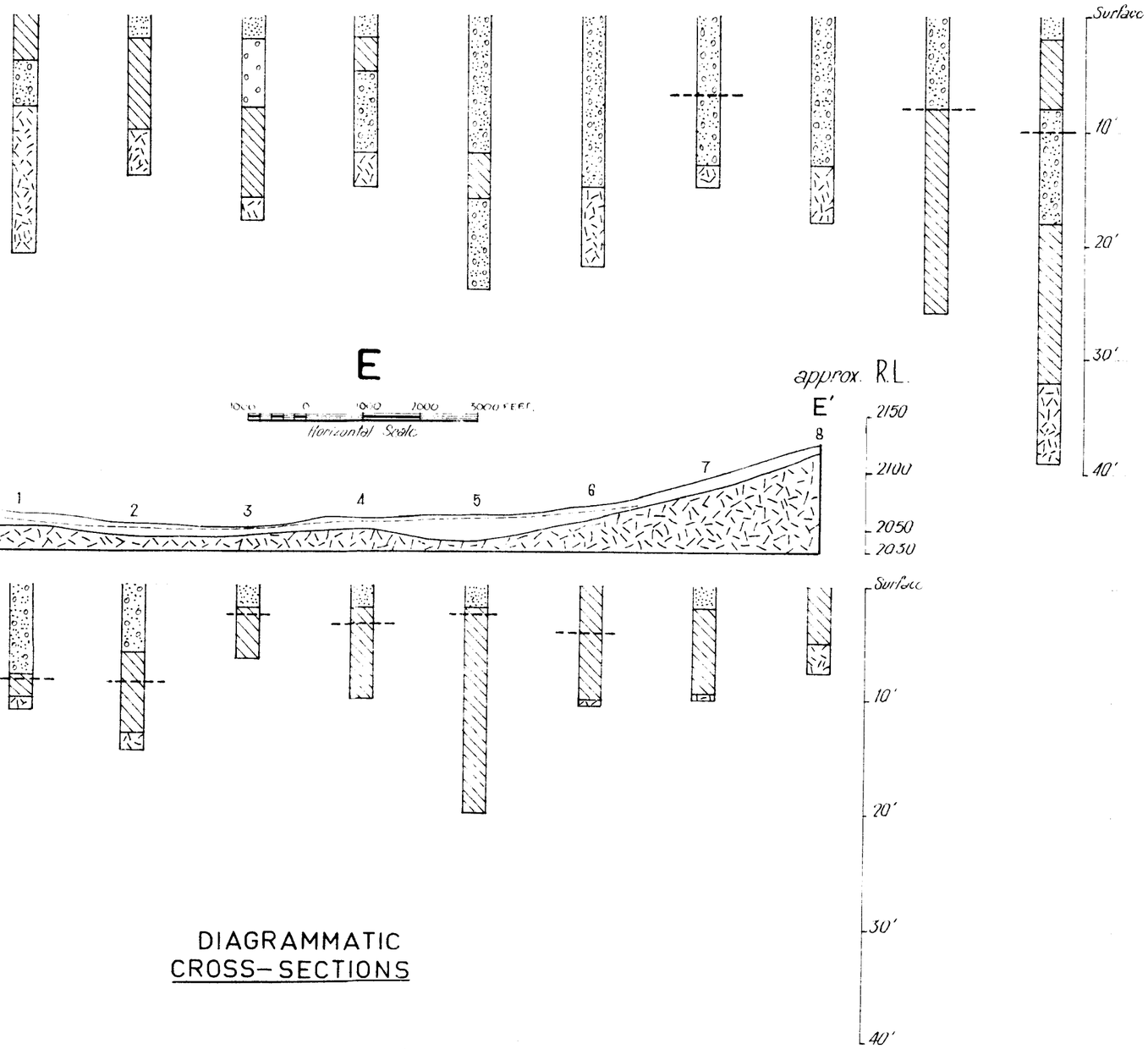












REFERENCE

Superficial deposits		Undifferentiated scree, clay soil and outwash.
		Outwash and soil.
		Coarse permeable scree.
		Clayey scree.
Silurian		Volcanic rocks.
		Approximate piezometric surface. (March 1963)
		Standing water level in auger holes. (March 1963)

DIAGRAMMATIC CROSS-SECTIONS

Bureau of Mineral Resources, Canberra, July 1963.

To accompany Record 1963/107

155/16/109

Figure 1

BLOCK DIAGRAM

Eastern Slope of Mount Taylor

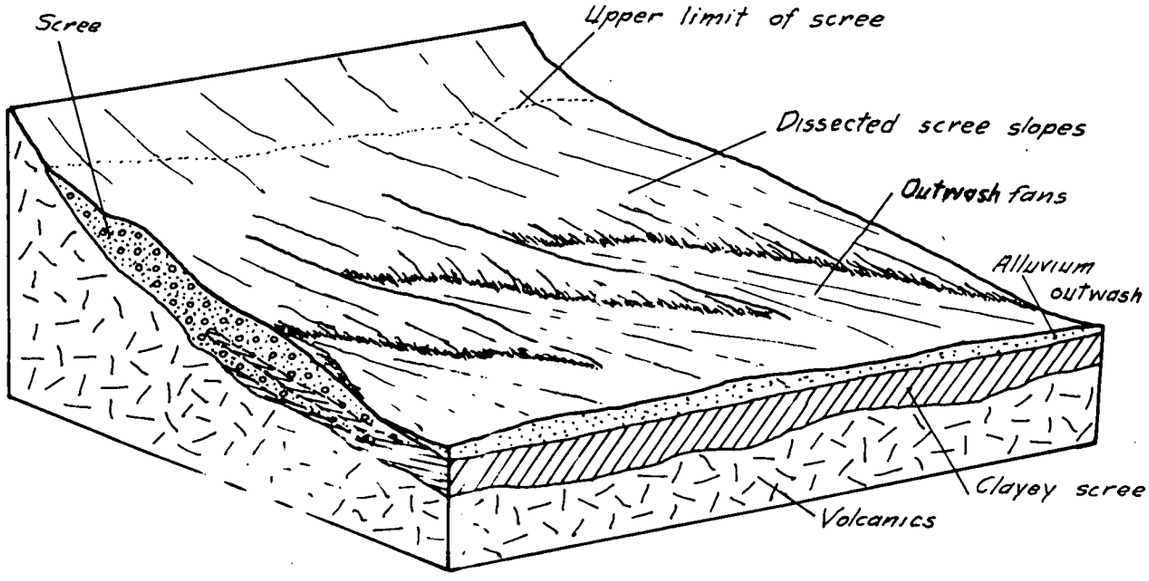


Figure 2

CROSS - SECTION

(Showing movement of underground water)