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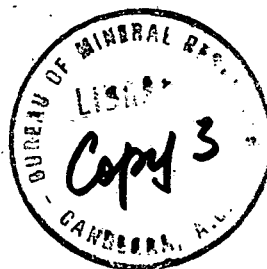
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DEPARTMENT OF
MINERALS AND ENERGY



BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1973/100



ENGINEERING GEOLOGY OF TUGGERANONG TOWN CENTRE, STAGE I,
A.C.T.

by

P.H. Vanden Broek

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SUMMARY

Outcrop-mapping and soils-augering has been completed over the area originally set aside for the Tuggeranong Town Centre. The area is largely underlain by one or other of the two moderately jointed, extensive rhyodacites shown in Plate 1. The variation in the thickness of soil cover has been estimated from information obtained to date and is shown in Plate 2. No major foundation, excavation or groundwater problems are to be expected in the development of the area as a town centre; however, the construction of a water-feature will modify the groundwater regime considerably, and should be taken into account.

INTRODUCTION

At the request of the National Capital Development Commission, the Engineering Geology Subsection of the Bureau of Mineral Resources carried out a detailed geotechnical study of an area set aside for the future town centre at Tuggeranong, A.C.T. (Fig. 1).

This report sets out the progress made on the investigations up to 1st April, 1973.

GEOLOGY

The geology of the area reserved for the Tuggeranong Town Centre and its surrounds was previously mapped by Mendum (1968) and others (see References). As part of this investigation, all outcrops were examined and plotted at the relatively large scale of 1:2400, and reduced to 1:5000 for compilation.

LITHOLOGY

Most of the area is underlain by either a blue-grey or a purple-pink rhyodacite* (Plate 1). A volcanic-rock complex has been exposed to the west of Pine Island Homestead by the Murrumbidgee River; interlayered agglomerate-microgranodiorite and rhyodacite are found in contact with chert and hornfels, and the complex is considered to be an old centre of volcanic activity.

Quartz, rhyolite, and epidote-veined quartz porphyry occur close to, and between the two major north-south faults (Plate 1).

Deposits of river gravel - a mixture of cobbles, gravel, and sand - occur adjacent to and on terraces between 564 and 571 m, that is, from 21-27 m above the bed of the Murrumbidgee River.

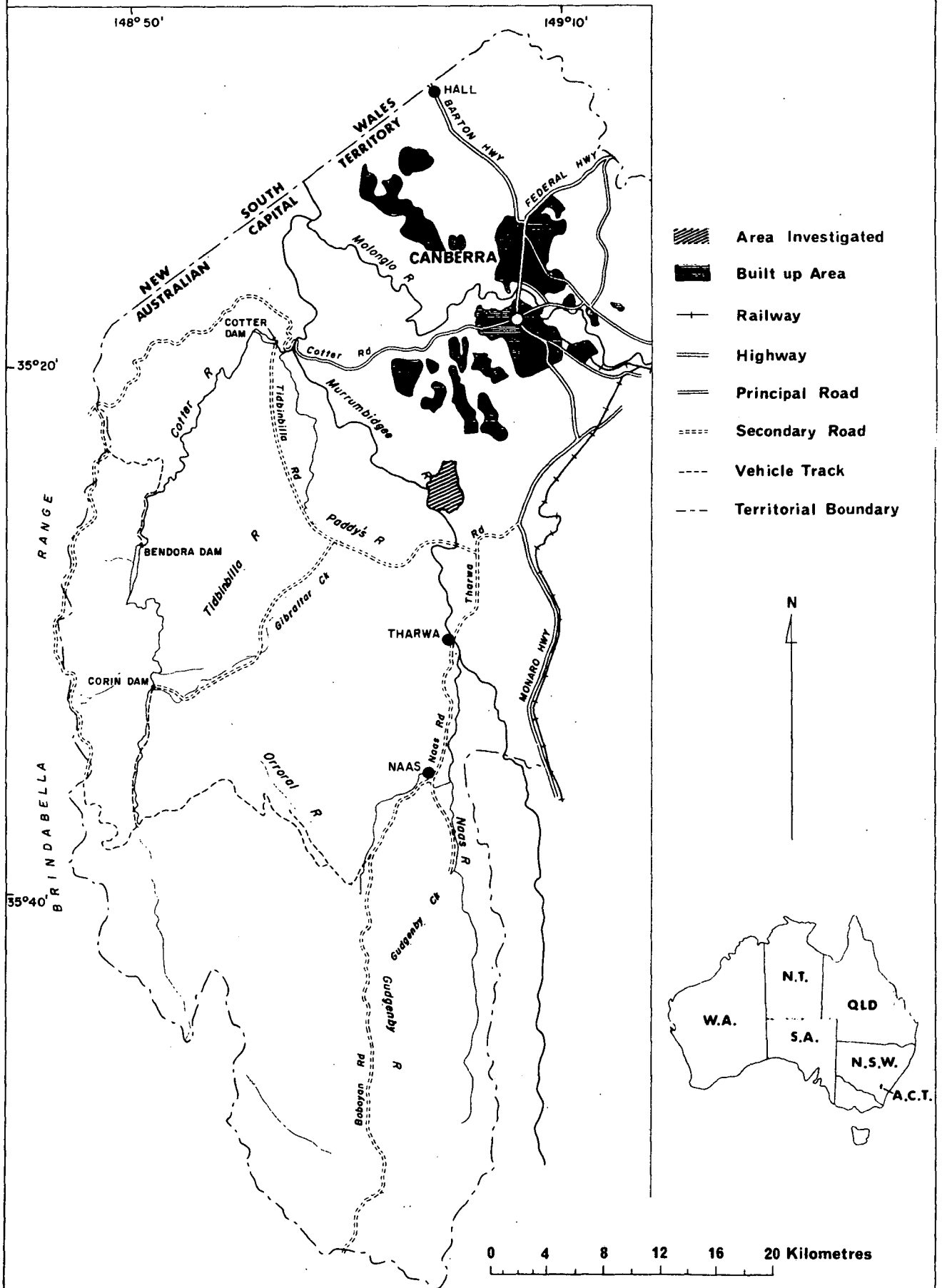
JOINTING

Two major sets of vertical joints strike approximately north and east, while two minor sets of vertical joints have been observed striking 034° and 160° at some localities; horizontal jointing has also been observed (see Purcell, 1971). Joint spacing varies markedly over the area and ranges from a few centimetres to more than a metre. The effect of joints

* See Appendix 1 for definitions of selected underlined terms.

LOCALITY MAP

FIGURE 1



on the permeability of the fractured volcanic rock should be investigated closely during the feasibility and design stages of planning any water-feature.

ENGINEERING GEOLOGY

Both the exposed and the underlying rocks have been altered by weathering. Both the effort required to excavate rock and the bearing capacity of the rock at a particular locality depend largely on the degree of weathering attained and the nature of its distribution; the progress of weathering in rock is to a great extent dependent on the jointing at a particular locality. Terms used to describe weathering are set out in Appendix 2.

Rocks exposed at the surface have been mapped as areas of continuous rock outcrop, scattered outcrop, or scattered boulders (Plate 1).

CONTINUOUS ROCK OUTCROP

Continuous rock outcrop is usually slightly to moderately weathered, though if it is sheared or closely jointed it is likely to be highly or completely weathered; however, shear zones would generally constitute less than one percent of the rock.

SCATTERED ROCK OUTCROP

Areas with scattered rock outcrop usually include patches of rock on the surface and numerous cores of large, relatively unweathered boulders lying within completely weathered rock below the surface.

SCATTERED BOULDERS

Areas with scattered boulders are common and are usually associated with completely weathered rock that may contain cores of less weathered rock; the depth to moderately weathered rock is usually less than in the surrounding boulder-free areas.

NO OUTCROP

Where the rock underlying the area does not crop out, the weathered nature of the rock generally decreases with increasing depth; however, the depth below the surface to rock with a particular degree of weathering is known to vary markedly over short distances.

SOIL

The term soil is used in the general engineering sense, that is "an aggregate of mineral grains that can be separated by such gentle mechanical means as agitation in water"; under this definition, completely weathered rock is regarded as soil. Generally the soil covering the area consists of a moderately developed solum (pedological A and B horizons) overlying alluvium and/or colluvium, heavy residual clay, and completely weathered rock.

Soils have been mapped according to thickness; thickness is determined by the depth to highly weathered rock. Five ranges of soil thickness are mapped in plate 2; the mapping is approximate: its accuracy is limited by the methods from which it was derived, such as augering results, rock-outcrop distribution, weathering characteristics, and photo-interpretation. Although the soil-mapping was not based on a closely spaced grid pattern of auger holes, it nevertheless is well suited to give a guide to the soil conditions for general planning, but it would not be adequate for, nor was it meant for, the prediction of foundation conditions at a particular site.

Column logs of the auger holes drilled in the area are presented graphically in Plate 2.

SEISMIC RESULTS

Four seismic traverses (each comprising 23 geophones spaced at 3-m intervals) were surveyed by the Engineering Geophysics Group to determine the depths below the surface to rocks with varying degrees of weathering (Plate 2). Table 1 sets out a correlation between seismic velocity and rock type.

The results, shown in Plate 2, indicate that considerable thicknesses, about 13 m, of completely to highly weathered volcanic rock in sections C-D, E-F, and G-H overlie relatively fresh rock. Section A-B illustrates the abruptness with which rock condition can change in the sub-surface.

TABLE 1

Correlation between seismic velocity and rock type.

Seismic-velocity layer (m/s)	Soil or rock type	
300 - 600 800 - 1200	Topsoil, subsoil, clay Completely weathered volcanic rock	S O I L
1400 - 1700 2100 - 3000 3000 - 3900 4000 - 5100	Highly weathered rock Moderately weathered volcanic rock Slightly weathered volcanic rock Unweathered volcanic rock	R O C K

GROUNDWATER

No water was struck in any of the auger holes (Plate 2). Several deep observation bores are planned for the area but these have not yet been drilled.

The water-level in an existing bore (Tu 2; Plate 2) is usually about 2 m below groundsurface and corresponds to the water-level of Village Creek.

The water-table beneath the Town Centre area is expected to rise if a lake is formed by damming Tuggeranong Creek. Such a lake would provide a local base-level for groundwater, and the groundwater levels in the surrounding areas would rise gently from the level of the lake; for example, a lake level of 570 metres would place the groundwater-levels well within much of the soil profile as determined from the auger holes.

CONCLUSIONS

1. Investigations to date show that the study area is entirely underlain by volcanic rocks which should provide a good load-bearing stratum, although the thickness of soil (including completely weathered rock) may range to 13 metres.

2. Soils within the area do not present significant engineering problems; however, a heavy clay, rarely more than one metre thick occurs over a large part of the area and may require special consideration in some foundation designs.
3. The groundwater-level within the Town Centre area will rise if a water-feature is developed on Tuggeranong Creek, and will lie well within the soil profile (completely weathered rock).

RECOMMENDATIONS

1. Water-observation bores planned for the area should be installed and the levels should be regularly recorded.
2. Samples of rock weathered to difficult degrees should be tested for unconfined compressive strength by the Geophysical Branch of the Bureau of Mineral Resources.
3. The properties of saturated soils should be determined as a guide to their behaviour when situated below groundwater-level.
4. The leakage properties of jointed volcanic rock should receive close attention in planning a water feature.

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APPENDIX I

GLOSSARY OF SELECTED TERMS

AGGLOMERATE:	Volcanic rock containing rounded or sub-angular fragments greater than 32 mm in diameter
A HORIZON:	The uppermost zone in the soil profile from which soluble salts and colloids have been leached, and in which organic matter has accumulated
B HORIZON:	Lower soil zone underlying A horizon and enriched by deposition or precipitation of material leached from the overlying horizon
CHERT:	Cryptocrystalline variety of silica
GRANITE:	A plutonic rock consisting essentially of alkali feldspar and quartz. Sodic plagioclase, usually oligoclase, is present in small amounts, and other minerals include muscovite, biotite, hornblende, and sometimes pyroxene
GRANODIORITE:	A plutonic rock similar to granite in texture and appearance, but contains about twice as much plagioclase as alkali feldspar
HORNFELS:	A fine-grained, non-schistose, metamorphic rock resulting from contact metamorphism
JOINT:	Fracture in rock
JOINT-SET:	A group of more or less parallel joints
MICROGRANODIORITE:	A fine-grained intermediate plutonic rock consisting dominantly of quartz, calcic oligoclase or andesine, and lesser amounts of orthoclase feldspar
PORPHYRY:	Hypabyssal rock containing phenocrysts of alkali feldspar set in a fine-grained or aphanitic groundmass

RHYODACITE:

The fine-grained equivalent of a
granodiorite

RHYOLITE:

The fine-grained equivalent of a granite

APPENDIX II

WEATHERING - DEFINITION OF TERMS

FRESH:	Rock shows no discolouration or loss of strength
SLIGHTLY WEATHERED:	Rock is slightly discoloured but not noticeably weakened; a two-inch diameter drill core cannot usually be broken by hand across the rock fabric
MODERATELY WEATHERED:	Rock is discoloured and noticeably weakened, but a two-inch drill core cannot usually be broken by hand across the rock fabric; ripping by bulldozer not possible
HIGHLY WEATHERED:	Rock is usually discoloured and weakened to such an extent that a two-inch drill core can readily be broken by hand across the rock fabric. Wet strength generally lower than dry strength; ripping with bulldozer may be possible along joint planes
COMPLETELY WEATHERED:	Rock is discoloured and entirely broken down to an aggregate of particles that has the mechanical property of a soil; the original fabric of the rock is mostly preserved. The properties of the soil depend on the composition of the parent rock; easily ripped by a bulldozer.

TUGGERANONG TOWN CENTRE
OUTCROP GEOLOGY
1:5,000 SCALE
GRID IN FEET

- Continuous rock outcrop
- Scattered rock outcrop
- Scattered boulders
- River gravels
- Quartz
- Layered microgranodiorite and agglomerates
- Blue-grey rhyodacite
- Microgranodiorite
- Rhyolite and granite porphyry
- Purple rhyodacite
- Hornfels
- Established fault, position approximate
- Geological boundary, position approximate
- Geological boundary, position inferred
- Geological boundary, position concealed and inferred
- Joint, vertical
- Joint, with dip 80°
- Road
- Track
- Fence with gate
- Transmission lines
- Contour in metres (three metre intervals)
- Spot height
- Stream
- Erosion gully
- Dam

N

PLATE I

COMMONWEALTH OF AUSTRALIA
BUREAU OF MINERAL RESOURCES
CANBERRA, A.C.T.



TITLE OUTCROP, GEOLOGY		
PROJECT TUGGERANONG TOWN CENTRE		
TO ACCOMPANY RECORD 1973/100	DRAWN BY	DRAWING NUMBER 155/A16/993

TUGGERANONG TOWN CENTRE
SOIL-THICKNESS MAP

SCALE 1:5,000

0 0.1 0.2 0.3 0.4 0.5 Km

Soil Thickness

- 0-1 metres
- 1-2 metres
- 2-3 metres
- 3-4 metres
- over 4 metres

- Seismic traverse
- Auger hole location
- Bore
- Auger log with Unified Soil Classification
- Road
- Track
- Fence with gate
- Transmission lines
- Contours in meters (three metre intervals)
- Spot height
- Stream
- Erosion gully
- Dam

Grid co-ordinates in feet with origin at Stromlo trig station.

UNIFIED SOIL CLASSIFICATION

- Well graded gravels or gravel-sand mixtures, little or no fines*
- Poorly graded gravels or gravel-sand mixtures, little or no fines
- Silty gravels, gravel-sand-silt mixture
- Clayey gravels, gravel-sand-clay mixture
- Well graded sands or gravelly sands, little or no fines
- Poorly graded sands or gravelly sands, little or no fines
- Silty sands, sand-silt-mixtures
- Clayey sands, sand-clay mixtures
- Inorganic silt and very fine sands, rock flour, silty or clayey fine sands or clayey silts with low plasticity
- Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
- Organic silts and organic silty clays of low plasticity
- Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
- Inorganic clays of high plasticity, fat clays
- Organic clays of medium to high plasticity, organic silty clays, organic silts
- Peat and other highly organic soils

NB Horizontal lines between identical symbols represent boundaries between soil colours
*fines - portion of a soil finer than a no. 200 sieve

VERTICAL SOIL SCALE

0 1 2 3 4 5 Metres

SEISMIC TRAVERSES

Showing velocities in metres per second

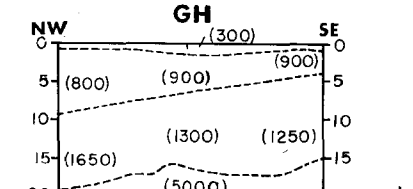
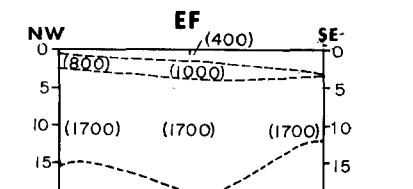
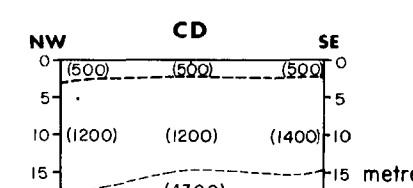
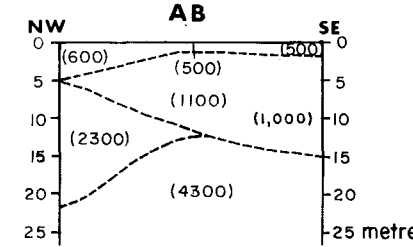


PLATE 2

COMMONWEALTH OF AUSTRALIA
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TITLE
SOIL THICKNESS MAP

PROJECT
TUGGERANONG TOWN CENTRE

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