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Record 1975/111

ENGINEERING GEOLOGICAL NOTES ON THE GOOROMON PONDS AREA, NSW

by

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SUMMARY

The Gooromon Ponds area is underlain mainly by Middle and Upper Silurian sedimentary and volcanic rocks. Intrusives, and probable intrusive rocks similar in appearance to the volcanics, are also present. The intrusive and volcanic rocks are mainly dacite and rhyodacite with some rhyolite and andesite. Sedimentary rocks of Ordovician age occur in the northeastern margin of the area. Residual soils and soils developed on alluvium and colluvium are present. Hydrological data from water-bores indicate considerable variation in water quality and yield, and springs and a few areas of saturated soils require drainage.

The Gooromon Ponds area is generally favourable for urban development, but constraints within the area include steep slopes, poor drainage, hard rock at shallow depth, and, in some places, poor foundation conditions associated with expansive soils or with limestone. There are several areas which are expected to be suitable for waste disposal. Material resources include rock suitable for aggregate and other uses, sand, gravel, and brick shale; some of these resources are already being exploited.

A number of outcrops in the area show interesting geological features and eight localities are recommended for preservation. The steep slopes to the Murrumbidgee River and the residual hills have potential as reserves and recreation areas.

INTRODUCTION

This report presents geological information obtained from a field survey of the Gooromon Ponds area, carried out between December 1973 and February 1974 at the request of the National Capital Development Commission (NCDC). The aim of the investigation was to determine the constraints likely to be imposed on urban development by the geology of the area. A preliminary report was completed in July 1974; amendments to the map and notes have since been made following the study of thin sections of rock samples. The area is in New South Wales adjacent to the northwestern border of the Australian Capital Territory (Fig. 1); it is bounded on the west by the Murrumbidgee River, on the north by the divide between Jeir Creek and Gooda Creek, and on the east by the divide between creeks flowing west into the Murrumbidgee River and northeast into the Yass River. For convenience the area mapped was extended slightly to the north and east beyond the above limits, and it has an area of about 285 km^2.

The geology was mapped on 1:9600 and 1:10 000 topographic maps, which covered about two thirds of the area, and on 1:50 000 black and white aerial photographs. 1:25 000 colour aerial photographs of the southern half of the area were also used for photo-interpretation.

GEOLOGY

Most of the area is underlain by crystalline igneous rocks ranging in composition from rhyolite through rhyodacite and dacite to andesite and quartz andesite. Sedimentary rocks crop out mainly in the north-central and eastern part of the area; they include sandstone, shale, mudstone, limestone, and bedded tuff. All rocks in the area are lower Palaeozoic, and range from Middle Ordovician to Upper Silurian. Most units are thought to be Middle or Upper Silurian, but evidence for the position of the boundary between Middle and Upper Silurian rocks is conflicting. The various rocks have been divided into eleven units on the map (Plate 1); some units have been further subdivided where possible or where significant variations occur within a single rock type. The two unconsolidated units shown on the map are alluvium and colluvium. The salient features of the rock and soil units are described below.

ROCK UNITS

Unit 3 consists of coarse pink rhyodacite which crops out in three separate areas in the western part of the area mapped. The rock consists of phenocrysts of quartz, pale pink plagioclase, altered mafic* minerals, and minor pink orthoclase set in a very fine-grained holocrystalline groundmass of quartz and orthoclase. The large size of the phenocrysts, especially plagioclase, which ranges to 2 cm in diameter, distinguishes the rhyodacite from other rocks of similar composition in the area. Intrusive contacts of the rhyodacite with sedimentary rocks can be seen beside the Murrumbidgee River at co-ordinates 953.515; hornfels has been formed at the contact.

Unit 4 comprises rhyodacite which is extensive in the western half of the area; it is regarded as a southern continuation of the Laidlaw Series in the Yass area (Packham, 1969). It has been divided into two subunits on the basis of colour and changes in microscopic texture. Subunit 4a is pale grey and consists of abundant phenocrysts of quartz, plagioclase (labradorite), biotite, and some orthoclase in a microcrystalline groundmass which appears to be dominantly quartz with some orthoclase. In some places, the biotite is clearly visible as shiny black flaky crystals in hand specimens, but elsewhere it may be partly or wholly altered. Subunit 4b contains the same minerals as 4a, but the rock is dark grey, the groundmass is cryptocrystalline, and the biotite is completely altered. The boundary between subunits 4a and 4b is gradational. Doubts about the origin of units 4 and 5 are indicated by the reference to the geological map (Plate 1) and are due to inconclusive evidence as to whether they are high-level intrusive sills or extrusive volcanics. Subunits 4a and 4b crop out as large boulders and massive rounded exposures of bare rocks, except to the northeast of the Deakin Fault, where outcrops are blocky.

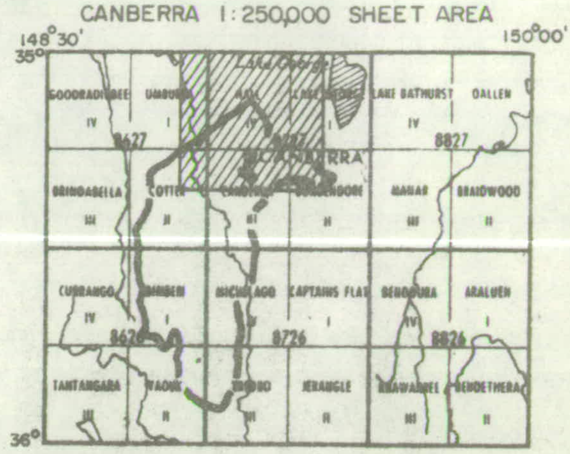
Unit 5 consists of dacite which crops out as a broad band in the eastern half of the area. At least part of it is a southern continuation of the 'Hawkins Porphyry' east of Yass (Sherrard, 1952). The unit has been divided into three subunits on the basis of colour, microscopic texture, and form of outcrop. Subunit 5a is pale grey and consists of phenocrysts of quartz, plagioclase (labradorite), and biotite set in a microcrystalline groundmass of quartz and orthoclase; the biotite is generally unaltered. Subunit 5b is medium-grey, and is distinguished in the field by the large size of the boulders. The texture of subunit 5b is marked by extremely abundant phenocrysts in a cryptocrystalline groundmass; mineralogy is similar to subunit 5a, but the biotite is altered and the plagioclase is andesine. Subunit 5c is dark grey, and the phenocrysts are less abundant than in 5b; however, it is similar to 5b in that the groundmass is cryptocrystalline and the biotite altered.

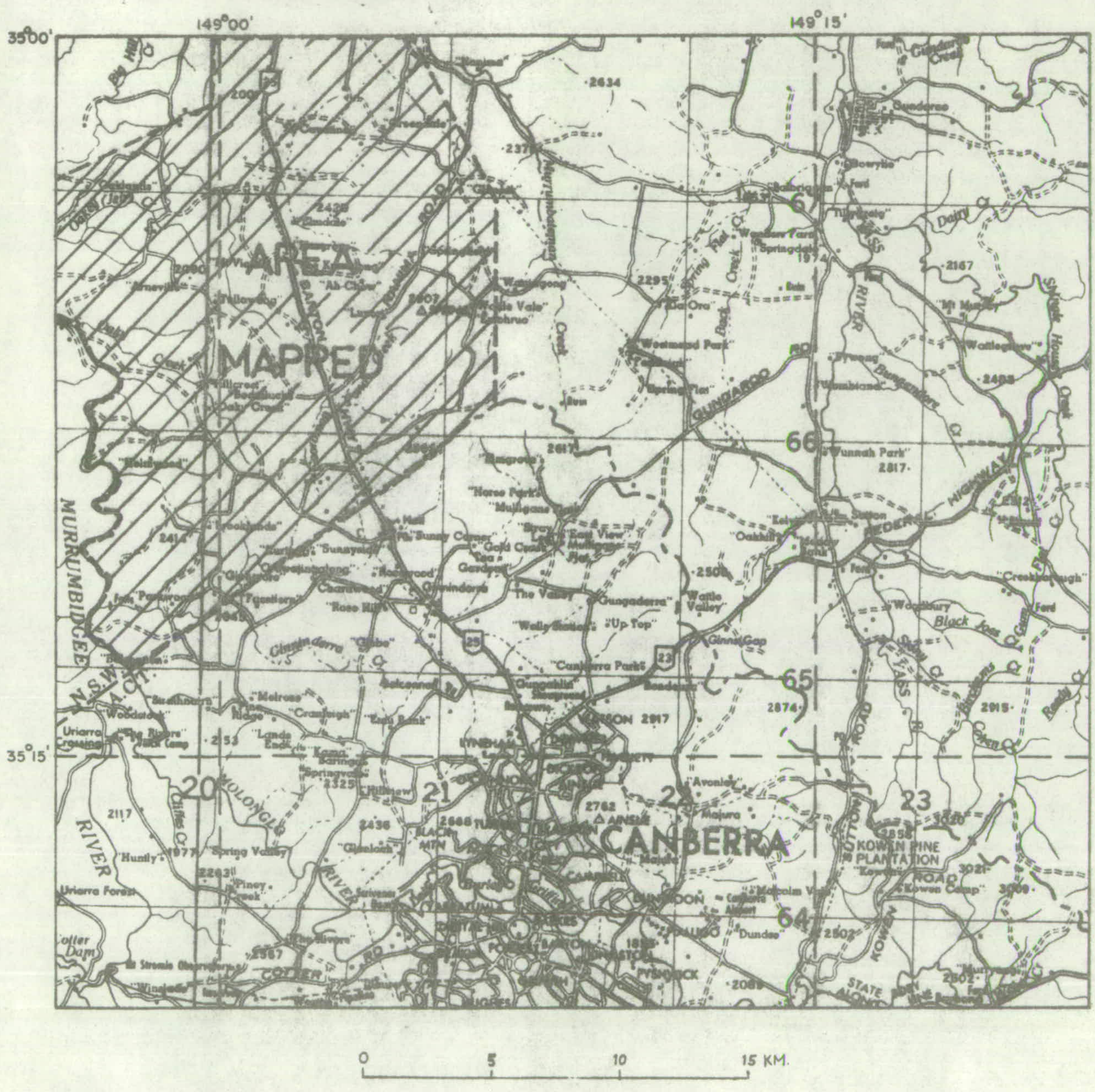
* Mafic is a term referring to the dark minerals such as biotite, hornblende, and pyroxene. These minerals are commonly altered to chlorite, epidote, and iron oxides in the rocks of the Gooromon Ponds area.

Fig. 1

GOOROMON PONDS
LOCALITY MAP

CANBERRA 1:250,000 SHEET AREA





Unit 6 consists of green-grey dacite and dacitic breccia, and occurs near the eastern margin of the area, where it is completely surrounded by sedimentary rocks of unit 12. An intrusive contact between the dacite and sedimentary rock was observed at co-ordinates 112.656, where the dacite consists of phenocrysts of quartz, plagioclase, and altered mafic minerals set in a very fine-grained holocrystalline groundmass similar to the intrusive rhyodacite of unit 3. Dacitic breccia near the intrusive contact appears to be of similar composition and the fine-grained inclusions appear to be hardened shale; however, a volcanic rather than an intrusive origin for the dacitic breccia, and for some other breccias within unit 6, is considered possible because their appearance is similar to that of an extrusive agglomerate.

Unit 7 comprises tuffaceous sandstone, shale, and hornfels, and green-grey dacite of volcanic origin which appears to overlie the tuffaceous sandstone and shale. These rocks occur in the southwest corner of the area mapped. The dacite consists of quartz, plagioclase, and altered mafic minerals in a cryptocrystalline groundmass. The hornfels is adjacent to the intrusive contact of the coarse pink rhyodacite (unit 3).

Unit 8 contains three subdivisions, mostly of volcanic rocks, based partly on lithology and partly on stratigraphic position. The rocks all occur west of the Barton Highway. Subunit 8a is the youngest stratigraphically and comprises pale purple banded rhyolite and rhyodacite. The rhyolite consists of phenocrysts of quartz, plagioclase, orthoclase, and minor altered mafic minerals set in a patchy microcrystalline and cryptocrystalline groundmass. Subunit 8b comprises purple and green-grey dacite consisting of phenocrysts of quartz, plagioclase, and altered mafic minerals. The texture of the groundmass is variable between outcrops, from microcrystalline to cryptocrystalline; the groundmass is mainly potash feldspar (orthoclase). Subunit 8c consists of interbedded mudstone, shale, fine tuff, sandstone, and limestone. Sandstone and tuff at the top of the succession dip to the west beneath subunit 8b. Three fossiliferous limestone* exposures are indicated on Plate 1 by a special map symbol.

Unit 9 consists of white rhyolite, tuff, hornfels, and quartzite, but exposures are sparse and little is known about the rocks of this unit. The lack of exposures may indicate that sedimentary rocks are well represented in the sequence. The hornfels crops out at Bedulluck Trig where it is surrounded by a dacite that is regarded as an intrusive rock (subunit 5c).

* The fossils indicate a possible correlation with the early Upper Silurian Yass Group (D.L. Strusz, pers. comm.).

Unit 10 is a composite group of volcanic rocks cropping out in the eastern half of the area mapped. The topmost subunit, 10a, consists of dacitic tuff, hornfels, sandstone, and shale; exposures are sparse, and possibly other rock units are present within the area shown on the map as 10a. 10b consists of green-grey medium-grained dacitic tuff composed of small and abundant phenocrysts of quartz, plagioclase, and altered mafic minerals set in a cryptocrystalline groundmass. 10c consists mainly of quartz andesite with minor andesite in which quartz is absent. The quartz andesite consists of sparse phenocrysts of plagioclase, altered mafic minerals, and minor quartz set in a microcrystalline groundmass of plagioclase and probably some orthoclase. The rock is generally green-grey except beside the Barton Highway (co-ordinates 042.645), where it is purple. Flow banding is evident in some outcrops. In hand specimen the plagioclase phenocrysts appear to be sparse because alteration of the plagioclase makes them less distinguishable from the groundmass of the rock. 10d consists of green-grey dacite characterized by the large size of some of the boulders on the crest of Spring Range (Figs 2 and 3). The rock is composed of phenocrysts of quartz, plagioclase, and altered mafic minerals set in a microcrystalline groundmass rich in potash feldspar. 10e consists of interbedded dacite and quartz andesite similar to the rocks in subunits 10c and 10d.

Unit 11 occurs in the east of the area, to the east of Spring Range and north of One Tree Hill. It includes dacite, shale, tuff, and limestone. Some of the tuff is medium-grained sandy tuff, some is fine-grained and resembles ashstone, and some contains limestone fragments or small cavities from which limestone fragments have been dissolved. The unit probably correlates with the Middle Silurian Westmead Park Formation (Smith, 1964).

Unit 12 consists of slaty shale and mudstone, and siltstone, and crops out along the eastern margin of the area. Smith (op. cit.) named this Middle Silurian formation the Murrumbateman Creek Formation.

Unit 13 consists of sandstone, shale, mudstone, chert, and siliceous shale, and crops out along the north-eastern margin of the area. Smith (op. cit.) divided these rocks into Middle Ordovician Pittman Formation and Upper Ordovician Picaree Formation. This area was not mapped in detail during the present survey, but, as Smith mapped similar rocks in both formations, the unit has not been subdivided. The siliceous shale is at the base of the Picaree Formation and in a small area near co-ordinates 100.725.

Fig. 2. View looking southwest from the top of Spring Range. Dacite outcrops in foreground show typical form of most of the dacites and rhyodacites in the area (subunit 10d).

Fig. 3. View looking south from the top of Spring Range. Wooded hill in distance is One Tree Hill on ACT/NSW border. Subunit 10d is in foreground.

SOIL UNITS

Only transported soils - alluvium and colluvium - are shown as units (1 and 2 respectively) in Plate 1. Residual soils, developed by weathering of the underlying rock units, comprise soil types associated with the geomorphic history of the area, and their extent and present-day profile are to a large extent controlled by the processes of slope formation in the area.

Residual soils

The residual soils reflect the composition and texture of the underlying rock, especially in the lower part of the B horizon, where they merge into extremely weathered rock. Residual soils on the crystalline rocks are sandy clays; generally they are more clayey at the top of the B horizon, and the upper part of the profile consists of about 15 cm of sandy loam topsoil. Where the underlying rock is shale or mudstone the B horizon is clayey throughout. Most residual soils in the area are duplex soils with a sharp boundary between the A and B horizons. The soil types are mainly red and yellow podzolics; red podzolic soils are present on hill tops and on well-drained slopes, and yellow podzolics occupy lower slopes and depressions. Detailed mapping of the various residual soils and their extent was not carried out, but observations relevant to urban planning have been made wherever necessary.

Transported soils (alluvium and colluvium)

The transported soils have been mapped either as alluvium or colluvium. The alluvium (unit 1) consists of layered soils with differences in composition between layers. The colluvium (unit 2) consists of unsorted and poorly layered deposits of soil and rock fragments, and is found at the foot of steep slopes and is exposed in gullies at the head of watercourses.

The alluvium in the large flat area along Gooromon Ponds Creek contains layers of gravel, pale buff silt, and black earth, which are exposed in the creek banks. Deposits of sticky black organic clay occur along some creeks, e.g., Jeir Creek in the flat area about 2 km east of Adastra homestead. Colluvium at the foot of steep slopes, such as on the western side of Spring Range (Fig. 4), contains boulders and cobbles mixed with finer material and is exposed in a cutting on the Nanima road (co-ordinate 078.656). Farther downslope the colluvium grades into finer-grained material, mainly sandy clay.

HYDROLOGY

Hydrological data in the area were obtained by making an inventory of water-bores and by mapping springs and areas of poor drainage. Samples of water from bores, springs, and creeks were tested for pH and electrical conductivity (Appendix 1). The locations of the bores and sampled springs are shown in Plate 1. The samples springs include most of the permanent ones and those with substantial flow; however, small seepages and patches of saturated soil are common in much of the area. Surface drainage is provided by Gooromon Ponds Creek, Oakey Creek, and Jeir Creek; the lower courses of these below about RL 540 m (1800 ft.) flow almost continuously throughout the year.

The water-bores data indicate that the potentiometric surface is less than 3 m below the surface of the valleys in the eastern two thirds of the area. A bore 2 km east of Spring Trig (co-ordinates 112.651) was drilled in 1972 and, according to the landholder, has been flowing steadily since it was drilled. Seepage from colluvium into dams below the western slopes of Spring Range was reported; the colluvium may have become charged with groundwater by leakage from the fractured-rock aquifer below. Yield from pumped bores ranges from 250 to 10 900 litres per hour (60 to 2400 gallons per hour); the flow from the bore east of Spring Trig on 17 June 1975 was 650 litres/hour (150 gallons /hour). The majority of bores yield from 1300 to 3600 litres per hour (300 to 800 gallons per hour). The chemical quality of the water ranges from water suitable for domestic supply to water too salty for regular irrigation and stock use. The electrical conductivity ranges from 50 to 2100 micromhos per cm, and averages about 1200 micromhos per cm; pH ranges from 5.8 to 8.1.

ENGINEERING GEOLOGY

Geological constraints on urban development attributable to rock type, soil, drainage, and slope stability are discussed below, and Plate 2 shows the areas where these constraints apply.

FOUNDATIONS

Crystalline rocks

Most of the area is underlain by crystalline rocks which in most places are expected to be hard and strong below a shallow (2 m) or moderate (2-5 m) thickness of

Fig. 4. View looking southwest from the western slope of Spring Range. Much of the valley floor in the central part of the photograph is covered by colluvium.

highly and completely weathered rock. Except in narrow deeply weathered fault zones these rocks should provide adequate foundations for all structures. In some places core stones of fresh rock and irregularly weathered profiles may make the preparation of foundations difficult. Lenses of limestone are present in units 8c and 11; however, limestone is to be expected in these units at locations other than those marked in Plate 1.

Sedimentary rocks

The areas underlain by sedimentary rocks should provide good foundations; in many places hard fresh shale and mudstone occur at shallow depth. Except where limestone or deeply weathered fault zones occur, the depth of weathering is expected to be more uniform than in the areas underlain by crystalline rocks. Because difficult conditions may be encountered in founding on limestone, the known exposures of limestone have been shown by a separate symbol in Plates 1 and 2. Foundations on limestone may range from good on solid rock, to poor in cavernous material; the depth of weathering is difficult to predict and is likely to be irregular, commonly producing clay filled pockets in fresh or slightly weathered rock. Foundation investigations in the rock units that are known to contain limestone can be expected to reveal additional areas of limestone.

Soils

Foundation conditions for small structures founded within the soil profile are expected to be good in residual soils derived from crystalline rocks. Experience of similar soils in Canberra indicates that these soils are not sufficiently expansive to cause major difficulties. Difficulties might be experienced, however, in areas of alluvium or colluvium that include expansive clays, silts with poor bearing strength when saturated, or heterogenous colluvium. Further investigation is recommended in these areas, which include the large tract of alluvium where Gooromon Ponds Creek crosses the Barton Highway, and the extensive colluvium on the western side of Spring Range. The permeability of much of this material is low, and poor foundation conditions are commonly associated with groundwater drainage problems.

Foundations set in rock that underlies the colluvial and alluvial soils cannot be assessed at this stage, but the underlying crystalline or sedimentary rocks are expected to provide foundation conditions similar to those described for the particular rock unit.

EXCAVATIONS

Variable depths to hard rock, boulders, and core stones of fresh rock within weathered material are characteristic of areas underlain by crystalline rocks. Where outcrops of crystalline rocks are common, such as on moderate or steep slopes, many excavations will expose fresh or slightly weathered rock at depths of less than 1 metre and blasting will be needed for excavations. Blasting may also be necessary where fresh shale and mudstone is found at shallow depth. In areas covered by alluvium and colluvium, the depth of soil will vary, but should be greater than 2 m in most places, and excavations for engineering services should generally be possible by mechanical means. In gently sloping areas of sedimentary rock where outcrop is sparse, hard rock may underlie soil at depths consistently less than 1 m.

SLOPE STABILITY

There are deep erosion gullies in many places, particularly on the slopes above the Murrumbidgee River where the underlying pale grey rhyodacite decomposes to a material with little clay binding. Excavations of the soil on slopes could induce erosion if remedial measures are not undertaken. No evidence of recent landslides was seen on the steep slopes, although minor slips of weathered rock and residual soils might occur after heavy rains.

Slope stability in rock cuts will depend on the orientation of rock defects such as bedding planes, joints, and shears; very regular joint patterns were observed in some places, and predictions of slope conditions in excavations should be possible there. Any problems posed by rock slopes are expected similar to those encountered in the ACT; however, a much greater risk of instability exists on the slopes of the Murrumbidgee valley.

The stability of slopes in excavations within 1 km of the Murrumbidgee River will require special investigation, as the removal of the soil and rock during the formation of the Murrumbidgee valley has caused all rock defects to open. Movement along some defects during valley formation is known to have taken place and was observed in excavations for the Lower Molonglo Pollution Control Centre (Lang, pers. comm.). A much greater risk of slope instability is to be expected in this area; rock defects, many of which are gently dipping, have been observed on the Murrumbidgee fall, and their intersections with steeply dipping joints provide conditions for potential wedge failure.

DRAINAGE

Most of the area is of sufficient relief to ensure adequate surface drainage, but there are areas of saturated soils, mainly in the north near the headwaters of Jeir Creek and its tributaries. These are associated with low relief and clay soils with low permeability that restrict the movement of groundwater. The colluvial area west of Spring Range, where perched aquifers are likely to be intersected in excavations and cause stability problems, requires investigation. Other areas containing springs, small seepages, and swamps will require drainage if they are to be developed.

Some of the poorly drained soils may lie in the areas with a high potentiometric surface, and probably derive their water from the fractured rock aquifers below, particularly those in the pediment basins to the east of Adastra, to the west of Spring Range, and near Ginnagulla. This type of drainage problem is not uncommon in the region, and would be similar to those encountered at Tuggeranong, to the south of Canberra.

WASTE DISPOSAL

Areas to be set aside for disposal of waste by burial require a sufficient depth of easily excavated material of low permeability, good surface drainage, and to be set well above the water-table. Some of the areas of alluvium and residual soil may fulfil these conditions, but an investigation to locate and test such areas would be necessary. An area which should be considered lies between co-ordinate 000 and 010 east and 560 and 580 north (Plate 2); lack of outcrop in this area indicates deep soil, and its location on the crest of a ridge would ensure adequate surface drainage; however, an investigation would be necessary. Soil in the deep erosion gullies in adjacent areas contain little clay binder, and may not have a sufficiently low permeability to restrict the entry of water or prevent leacheate from percolating down to pollute the groundwater below.

MATERIAL RESOURCES

Some material resources in the area have been, or are being exploited, and comprise sand and gravel, and rock that is quarried for paving slabs. The locations of existing quarries and pits are shown in Plate 1. Potential resources in the area include deposits of silty loam suitable for topsoil; weathered shale suitable for making bricks; dacite and rhyodacite suitable for quarrying and crushing for aggregate; and distinctively coloured dacite and rhyodacite that could be quarried as dimension stone for feature walls.

Topsoil

The most extensive deposits of silty loam are found on terraces a few metres above the Murrumbidgee River; the largest deposit is about 3 km southeast of Dog Trap Crossing, where reserves are estimated at about 200 000 m^3.

Sand

The sand deposits along the Murrumbidgee River, where most of the largest deposits are on the eastern side of the river, have already been extensively worked. Pebbles suitable for pebble gardens have been separated from the sand and screened into size gradings at one deposit.

Road base materials

The principal road gravel quarry is about 150 m west of the Barton Highway opposite The Kurrajong homestead. The material is a fine-grained tuffaceous siltstone that has been used as non-plastic road base. Another smaller quarry in ashstone is located beside the Spring Range road (co-ordinates 105.612). Weathered dacite and rhyodacite might be suitable for plastic road gravel.

Brick shale

Weathered shale suitable for brick-making is likely to be found in the area of shale and mudstone bedrock east of Spring Range; testing of localities by drilling would be required to prove quality and quantity.

Dimension stone

The quarry for paving slabs (Fig. 5) is beside Jeir Creek (co-ordinates 973.692), where pale grey rhyodacite contains regular vertical joints about 10-20 cm apart along which the rock splits into slabs. Fresh pink and purple dacite and rhyodacite (unit 3 and subunits 8a and 8b) may be particularly suitable for use as facing stone on feature walls, or as exposed aggregate.

Rock aggregate

Much of the unweathered dacite and rhyodacite in the area would be suitable for quarrying as aggregate, but would require testing for suitability before being exploited

Fig. 5. Paving slab quarry, Jeir Creek. The rock is rhyodacite (subunit 4a).

Fig. 6. Large boulder of dacite (subunit 10d) on the crest of Spring Range showing vertical banding.

because some material might contain glass or minerals that react with cement. The pale grey rhyodacite and dacite (subunits 4a and 5a), and the volcanic dacites, particularly in subunits 8b and 10d, are probably least likely to have undesirable constituents. Suitable quarry sites would be limited by environmental restrictions and by the excessive thicknesses of weathered rock in many places; drilling would be necessary to prove quality and quantity of materials. Two areas in the pale grey rhyodacite that offer favourable prospects for further investigation as a source of aggregate are shown in Plate 2.

PRESERVATION OF GEOLOGICAL FEATURES

A number of localities in the area show features of geological interest that should be considered for preservation. They are listed below and are shown in Plate 2.

a. Outcrop of fossiliferous limestone opposite The Kurrajong homestead (co-ordinates 034.669). The outcrop consists of boulders of limestone containing numerous easily recognized fossils.

b. Breccia outcrop, 1 km northeast of Spring Trig. (co-ordinates 102.665). This outcrop of volcanic breccia is unusual in that some of the cemented rock fragments which make up the rock are limestone.

c. Banded dacite at Spring Trig (co-ordinates 089.653; Fig. 6). An unusual banding in this outcrop is of interest and may indicate an intrusive origin for the rock.

d. Xenoliths in rhyodacite beside the Murrumbidgee River (co-ordinates 961.615). Xenoliths (inclusions) of coarse pink rhyodacite are of interest in the study of the pale grey rhyodacite in which they occur.

e. Calcareous fine-grained tuff with cavities at Cow Flat Creek (co-ordinates 094.614). The outcrop consists of fine-grained calcareous tuff with numerous small cavities formed by the solution and removal of limestone inclusions.

f. Shale outcrop 2 km northwest of Hall (co-ordinates 064.575). This isolated exposure of shale is surrounded by dacite outcrops, and may prove to be important in the interpretation of the geology of the area.

g. Hornfels near Cavatina homestead (co-ordinates 032.730). The hornfels at this locality was regarded by Sherrard (1952) as evidence that the adjacent dacite, subunit 5b, is intrusive.

h. Fossiliferous shale at Nanima Trig (co-ordinates 075.762). This shale lens is surrounded by volcanic rocks and contains fossils regarded by Sherrard (op. cit.) as Upper Silurian.

RESERVES AND RECREATION AREAS

A number of hills to the east of Barton Highway have potential for preservation as reserves, and, in some areas, may require tree planting to maintain stability on the slopes. Spring Range, Havelock Trig, and the hill to the west of Spring Range appear suitable for this purpose.

The slopes to the Murrumbidgee River are steep, and present problems of soil erosion and rock stability in excavation. Their reservation for recreation would seem appropriate.

CONCLUSIONS

1. A large part of the Gooromon Ponds area is well suited for urban development.

2. The steeper slopes of the Murrumbidgee valley would be adversely affected by soil erosion if developed, and runoff from urban development elsewhere should be controlled as it traverses areas with deep soil profiles susceptible to erosion.

3. Investigation of areas of alluvium and colluvium is required to test foundation conditions and to define the extent of drainage problems.

4. Some of the steeper slopes would be expensive to develop because of hard rock at shallow depths, and would require extensive use of blasting in excavations.

5. A more comprehensive assessment of the resources of engineering materials is required so that quarry sites in areas environmentally suitable for exploitation can be reserved.

6. A selection of areas most likely to provide satisfactory sites for refuse disposal by burial should be made at an early stage, and investigations initiated to test their suitability.

7. Slope instability requires investigation for engineering works within 1 km of the Murrumbidgee River.

8. The steep slopes to the Murrumbidgee River, Havelock Trig, Spring Range, and the hill to the west of Spring Range would be difficult and expensive to develop and should be considered for preservation as reserves and recreation areas.

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APPENDIX 1

HYDROLOGICAL DATA

TABLE 1. WATER-BORE DATA

BORE NO.	CO-ORDINATES	DEPTH (m)	DEPTHS TO AQUIFERS (m)	DEPTH TO W.T.(m)	YIELD 1/hr.	WATER pH	QUALITY E.C. (1 mhos)	STRATA
1	013 706	21.6	4.9,9.4,13.7	4.9	2700	-	-	Dacite
3	041 645	23.5	21.0-23.0	12.2	4100	-	1136	Dacite
4	035 668	32.0	12.2-18.3	6.1	2300	6.8	1200	Sandstone
7	067 586	18.3	8.0-18.0	?	1400	-	-	Dacite
15	074 605	15.8	14-15.8	?	?	-	-	Dacite
99	034 728	26.2	8.2,17.4,25.3	2.7	2300	-	-	Dacite
101	071 726	24.4	16.2,21.3-22.8	3.0	4400	6.7	825	Dacite
104	031 721	15.2	13.4-15.2	2.7	720	7.0	1400	Dacite
146	035 616	?	?	?	?	-	-	Dacite
174	106 706	46.3	24.4,35.4	5.2	500	7.1	650-1150	Shale
273	986 666	14.0	12.8	10.0	900	6.5	650	Dacite
275	979 685	13.3	9.1,13.1	4.9	2700	-	-	Dacite
276	071 722	13.4	10.7-12.0	?	250	7.9	1070	Dacite
279	035 689	16.7	?	1.0	1000	-	-	Shale, Sandstone, Dacite
280	035 689	10.4	?	1.8	9300	-	-	Shale, Sandstone, Dacite
284	023 754	61.0	38.4	6.1	6800	6.6	1900	Dacite
285	998 619	16.2	7.3,9.1-11.0	2.1	1400	-	-	Dacite
286	006 535	18.3	14.6	8.5	700	-	-	Dacite

APPENDIX 1 (cont.)

BORE NO.	CO-ORDINATES	DEPTH (m)	DEPTHS TO AQUIFERS (m)	DEPTH TO W.T.(m)	YIELD 1/hr.	WATER pH	QUALITY E.C. (1 mhos)	STRATA
287	006 535	45.7	?	10.1	1600	-	-	Dacite
288	024 753	51.8	24.4,40.0,47.0	14.6	1400	6.4	1600	Dacite
292	111 651	29.0	14.0,26.5-27.5	1.0+	41500*	6.5	2100	Shale
293	087 600	?	?	?	?	8.1	400	Dacite
294	032 649	91.4	18.9	?	2300	6.8	950	Dacite
295	038 654	85.3	38.4	18.0	4600	6.3	1350	Dacite
296	039 649	76.2	27.4	?	3600	6.4	1300	Dacite
297	066 577	30.5	?	15.0	?	6.8	1750	Dacite
298	997 560	26.2	15.0-26.2	4.6	1800	5.8	250	Dacite
299	032 710	38.1	?	2.4	10900	6.5	1050	Dacite
300	097 696	61.0	?	6.0	?	6.6	2000	Shale
301	095 695	45.7	?	21.3	?	7.0	1200	Shale
302	067 578	?	?	?	?	6.6	50	Dacite
303	018 644	30.5	?	?	5500	-	-	Dacite
305	069 728	51.8	?	?	?	6.6	825	Dacite
306	996 629	?	?	?	?	6.7	800	Dacite
307	012 646	?	?	?	?	6.7	1700	Dacite
308	075 675	?	?	?	?	7.3	1650	Dacite

* Unsubstantiated report from landholder.

Acknowledgement. Some of the water bore data was provided by the New South Wales Water Conservation and Irrigation Commission.

TABLE 2. WATER SAMPLES FROM SPRINGS, CREEKS, AND WELLS

SAMPLE No.	COORDINATES	REMARKS	pH	E.C. (mhos)
1	021 644	Spring on flat terrain	5.6	80
2	037 637	Spring on hill slope	5.5	60
3	039 630	Spring at head of gully	5.5	70
4	053 612	Flowing water in creek	8.0	1050
5	054 613	Stagnant pool in creek	7.0	1500
6	057 615	Pool in creek	7.1	1950
7	078 605	Disused well on gentle slope	6.1	110
8	079 604	Disused well in swampy area	5.6	90
9	083 607	Flowing water in creek	7.9	1050
10	088 604	Disused well in flat area	6.7	2000
11	102 610	Spring in reedy creek bed	6.6	250
12	088 626	Spring on gentle slope	6.9	280
13	083 621	Pool in rocky creek bed	6.9	60
14	039 565	Flowing water in creek	7.8	1100
15	046 607	Flowing water in creek	7.6	1200
16	012 694	Spring on flat terrain	5.7	180
17	978 689	Creek sample	6.7	800
18	988 680	Spring near top of rise	5.9	120
19	015 691	Spring on gentle slope	5.3	100
20	977 697	Spring near hill top	6.1	300
21	037 711	Flowing water in creek	7.5	1300
22	111 650	Spring below dam	6.9	125
23	969 609	Creek sample	7.5	500
24	962 638	Creek sample	8.1	740
25	997 619	Flowing water in creek	7.5	850
26	992 705	Flowing water in grassy creek bed	7.5	1500
27	993 715	Sample from dam near limestone outcrop	8.2	100
28	028 706	Flowing water in creek	7.5	1050

TABLE 2 (cont.)

SAMPLE No.	COORDINATES	REMARKS	pH	E.C. (mhos)
29	028 706	Slow-flowing water in flat creek bed	7.2	1700
30	967 715	Black brackish? surface pool	6.0	190
31	985 661	One of several springs on hillside	7.4	850
32	068 633	Stagnant pool in creek	6.3	110

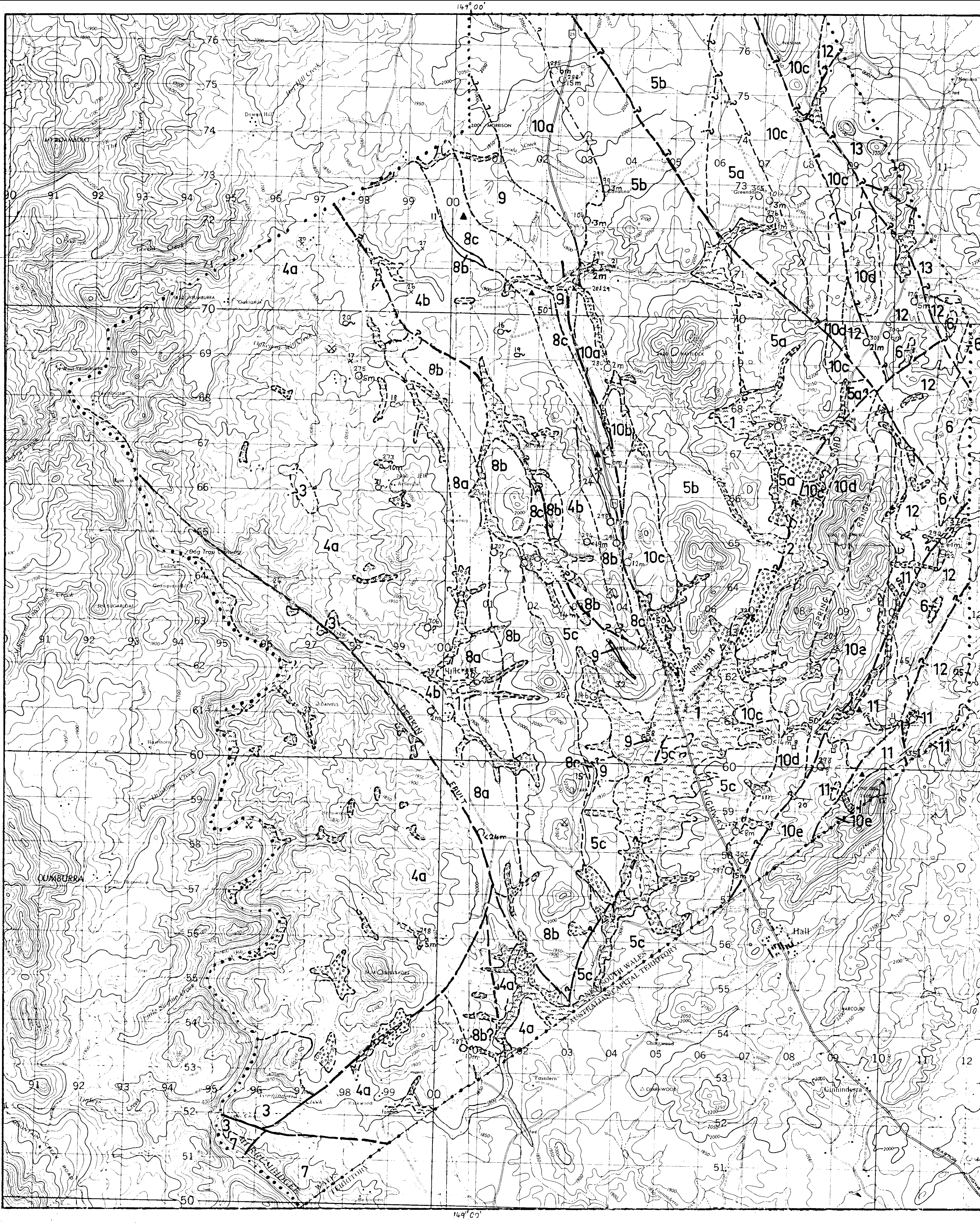

PLATE 1

GEOLOGICAL MAP OF THE GOOROMON PONDS AREA

SCALE 1:50000

1 0 1 2 3 4 Km

TRUE NORTH
GRID NORTH
MAGNETIC NORTH

QUATERNARY	1	Alluvium
	2	Colluvium
UPPER SILURIAN INTRUSIVE	3	Coarse pink rhyodacite
MIDDLE TO UPPER SILURIAN PROBABLE AND POSSIBLE INTRUSIVES	4a	Pale grey rhyodacite
	4b	Dark grey rhyodacite
	5a	Pale grey dacite
	5b	Medium grey dacite
	5c	Dark grey dacite
	6	Dacite, dacitic breccia
UPPER SILURIAN?	7	Dacite, shale, sandstone, hornfels
	8a	Pale purple rhyolite, rhyodacite
	8b	Purple and green-grey dacite
	8c	Mudstone shale, sandstone, tuff, limestone (Yass Series)
MIDDLE TO UPPER? SILURIAN	9	White rhyolite tuff, hornfels, quartzite
	10a	Dacitic tuff, hornfels, sandstone, shale
	10b	Green-grey dacitic tuff
	10c	Quartz andesite, andesite
	10d	Dacite
	10e	Dacite, quartz andesite
MIDDLE SILURIAN	11	Dacite, shale, tuff, limestone (Westmead Park Formation?)
	12	Slaty shale and mudstone, siltstone (Murrumbateman Creek Formation)
MIDDLE TO UPPER ORDOVICIAN	13	Sandstone, shale, mudstone (Pittman & Picaree Formations)

- ▲ Limestone exposure
- 20 Dip and strike of bedding and flow banding
- Geological boundary, position accurate
- Geological boundary, position approximate
- Geological boundary, position inferred or concealed
- Fault, position accurate
- Fault, position approximate
- Fault, position inferred or concealed
- 273 5m Water bore, showing approximate depth in metres to standing water.
- Spring, showing water sample number
- Well, showing water sample number
- Creek water sample locality and number
- Sand workings
- Rock quarry
- Road gravel quarry
- •••• Boundary of area mapped

AMENDMENTS			
No	Description	Author	Checked
A1	Map and legend amended 26/2/75	G.A.M.H.	
A2			
A3			
A4			
A5			

SCALE 1:50,000 as above

Base map/survey Parts of Hall and Umburra 1:50,000 sheets

Geology by G.A.M. Henderson

Compiled and checked G.A.M.H. Project geologist

Checked and approved Senior geologist

Supervising geologist

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

TITLE GEOLOGICAL MAP OF THE GOOROMON PONDS AREA

PROJECT GOOROMON PONDS

To accompany	Drawn by	Drawing No
Record 1975/111	G.A.M.H.	155/A16/1143

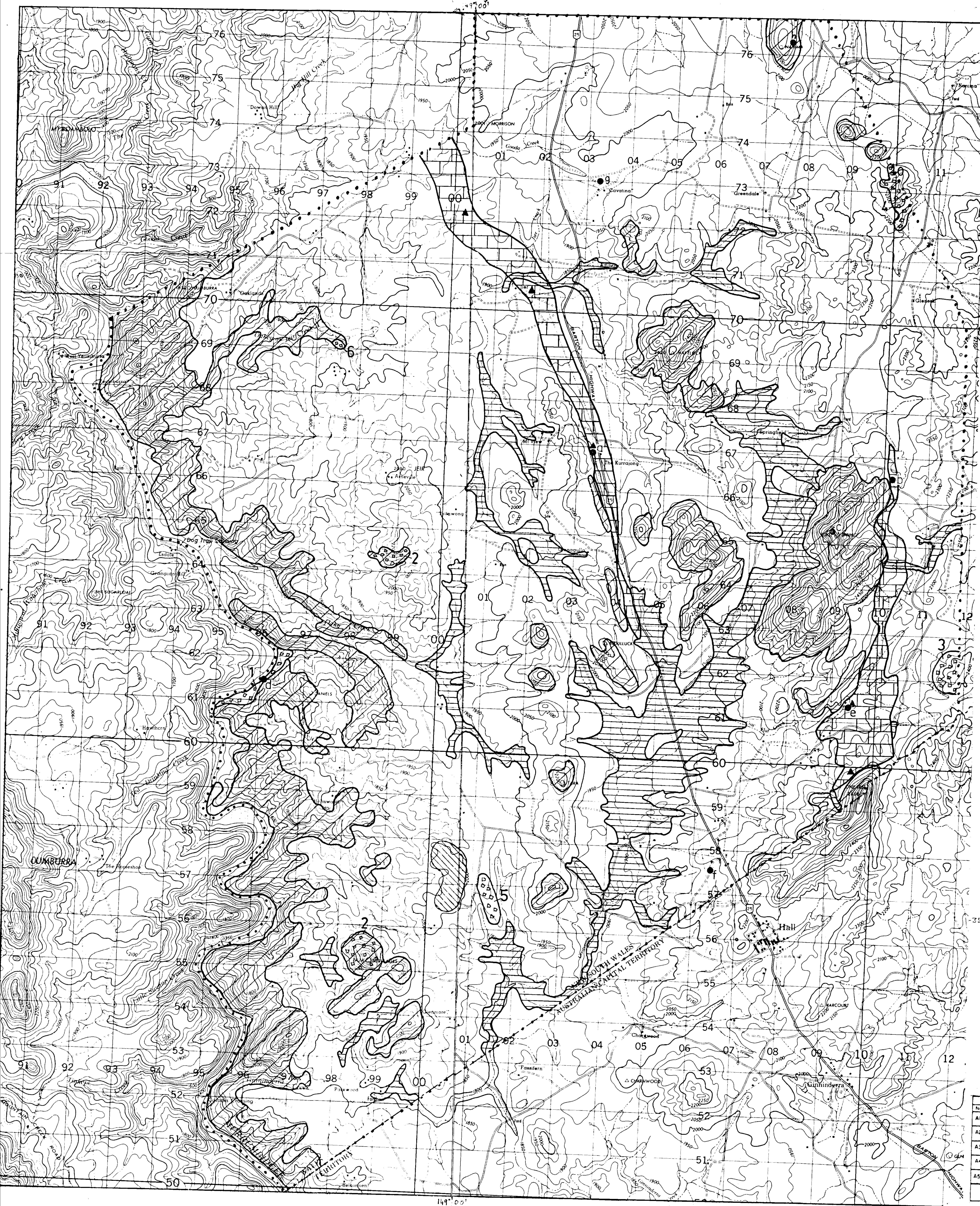

PLATE 2

URBAN CONSTRAINTS MAP GOOROMON PONDS AREA

SCALE 1:50000

0 1 2 3 4 Km.

Most suitable for development. Constraints confined to isolated outcrops of hard rock and local groundwater seepages.

Area showing formations containing some limestone; limestone may be encountered in foundations within this area.

▲ Limestone exposure

Main areas of alluvium and colluvium. Probably suitable for urban development, but investigations required to define areas with drainage and foundation problems.

Areas with slopes generally more than 15%, numerous rock outcrops and shallow soil. Probably not suitable for development.

Areas likely to contain resources of engineering materials, but requiring further investigation.

1. Sand, river gravel and silty loam topsoil
2. Rock for aggregate
3. Brick shale
4. Non-plastic gravel
5. Plastic gravel
6. Paving and facing slabs

Area likely to be suitable for solid waste disposal, but requiring further investigation.

● a Outcrop showing features of particular geological interest and worthy of preservation. Letter symbol refers to description below.

- a Fossiliferous limestone near "The Kurrajong"
- b Volcanic breccia with limestone fragments.
- c Banded dacite at Spring Trig.
- d Xenoliths in rhyodacite
- e Calcareous Tuff at Cow Flat Creek
- f Shale-dacite relationship
- g Hornfels
- h Fossiliferous shale

TRUE NORTH
GRID NORTH
MAGNETIC NORTH

AMENDMENTS			
No	Description	Author	Checked
A1			
A2			
A3			
A4			
A5			

SCALE 1:50,000 as above

Base map/survey Parts of Hall and Umburra 1:50,000 sheets

Geology by G.A.M. Henderson

Compiled and checked G.A.M.H. Project geologist

Checked and approved Senior geologist

Supervising geologist

COMMONWEALTH OF AUSTRALIA
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CANBERRA, A.C.T.

TITLE URBAN CONSTRAINTS MAP, GOOROMON PONDS AREA

PROJECT GOOROMON PONDS

To accompany	Drawn by	Drawing No.
Record 1975/111	G.A.M.H.	I55/A16/1144