DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1973/162

ENGINEERING GEOLOGY OF THE PROPOSED HALLS CREEK URBAN DEVELOPMENT AREA, GUNGAHLIN DISTRICT, A.C.T.

by

P.D. Hohnen

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SUMMARY

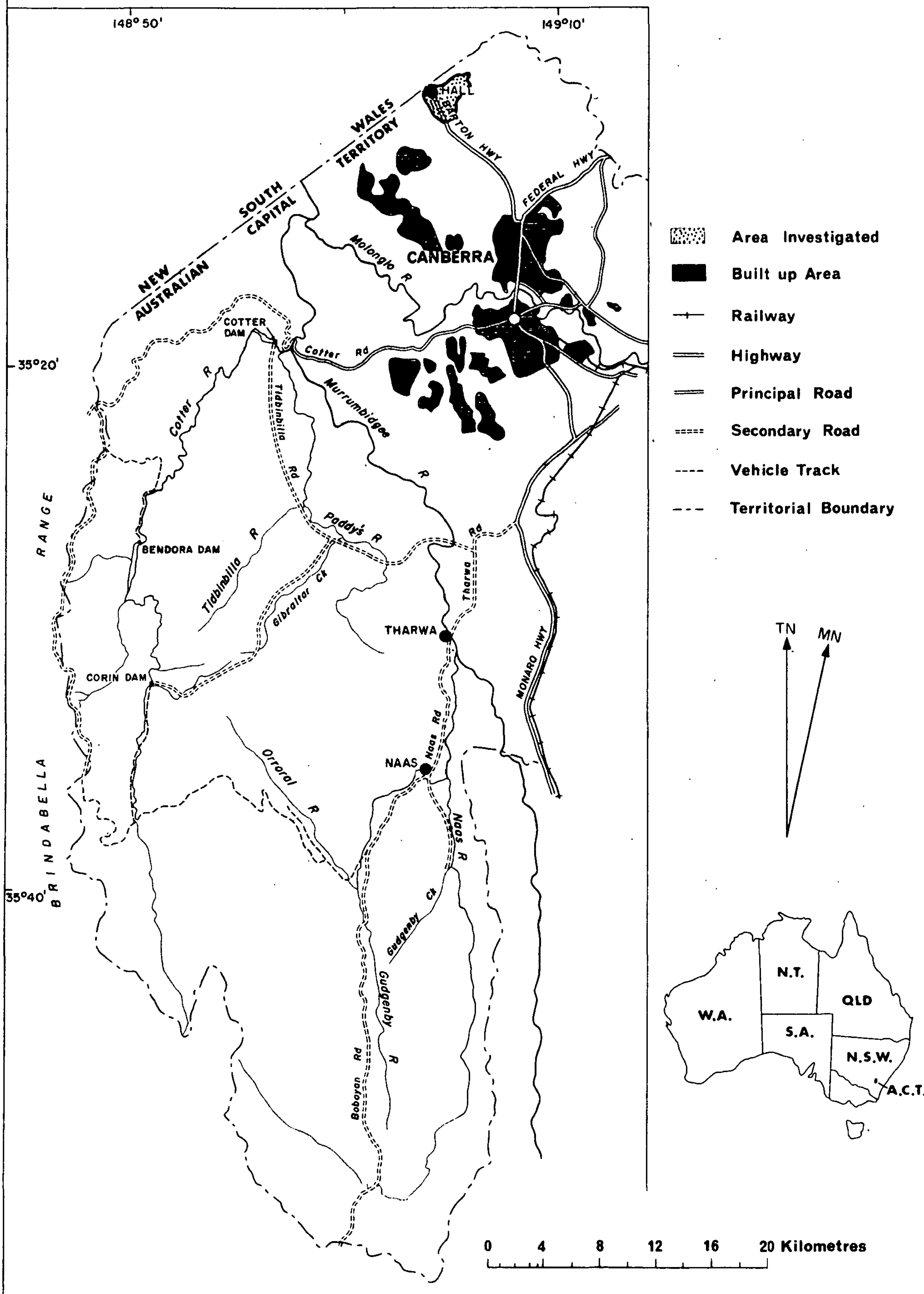
This report examines the geotechnical factors likely to influence the proposed urban development of the broad valley of Halls Creek, A.C.T.

The area is largely underlain by highly to completely weathered volcanic rocks with scattered outcrops of slightly to moderately weathered volcanics on the slopes and valley margins. Up to 9 m of unconsolidated slopewash and alluvium occupy the central area of low relief, and the thickness of soil and completely weathered rock decreases upslope towards the valley margins. Some areas of saturated soils are present on the slopes and in the lower part of the valley, but they do not constitute a serious drainage problem.

Urban development of the area is not expected to encounter any major drainage, foundation or excavation problems; however, some problems of soil drainage will require special treatment, and foundations for multi-storied buildings will require site investigation, particularly in the central part of the valley.

Figure 1

LOCALITY MAP



To accompany Record 1973/162

155/A16/1068 P.B.

INTRODUCTION

The Bureau of Mineral Resources (BMR) was requested by the National Capital Development Commission (NCDC) to carry out a high priority geotechnical investigation for urban development of an area at Hall, A.C.T. (Fig. 1). The request of March 7, 1973 called specifically for comments on the following:

1. sources of plastic and non-plastic gravel;
2. areas of poor bearing strength;
3. areas of high potentiometric surface;
4. limitations on development imposed by 2 and 3;
5. discussions of the types of engineering solutions that might be appropriate in order to develop the area.

PREVIOUS WORK

Relevant information was available from the 1:50 000 geological map of Canberra (Strusz & Henderson, 1971), and a 1:25 000 geological map of Gungahlin being compiled by P.D. Hohnen. Records of water level measurements since 1961 were available for three water bores near Hall.

METHOD OF INVESTIGATION

Geological mapping of rock outcrops in the area was carried out at a scale of 1:2400; the map is presented at a scale of 1:5000 as Plate 4. The major soil types were mapped by interpretation of colour photographs, by inspection of creek banks and gullies, and by augering at 20 sites for undisturbed samples to the depth of auger-refusal. A soils map (Plate 1) was compiled from this information, and the 20 auger hole logs with diagrammatic cross-sections are shown in Plate 3 at an expanded vertical scale.

GROUNDWATER

Piezometers were installed in three of the four auger holes that encountered water; water-level measurements were taken over a period of three months, and are continuing. Springs, seepages, and swampy areas were mapped.

CONSTRAINTS MAP

A constraints map (Plate 2) was compiled showing the lithological and hydrogeological factors that exert constraints upon the design freedoms for urban planning, and comments on their engineering significance are presented.

LITHOLOGY

Halls Creek drains southwestward through a basin-shaped depression, of the type described by van Dijk (1959), as a pediplain basin*. Most of the area is underlain by pyroclastic volcanic rocks, generally rhyodacite in composition, including coarse-grained agglomerate, lapilli tuff, and micro-

*See appendix 2 for explanation of terms underlined crystalline porphyries (Plate 4). A brief outline of the geology of the area is included in Appendix 1. The rocks are folded into a broad syncline that roughly follows the form of the valley; the axis of the syncline follows Halls Creek, and the syncline plunges gently southwest. Within this valley the area of low to gentle relief with slopes generally less than 15 percent has been set aside for urban development (Plate 1).

In the central part of the depression, an area of low relief with slopes generally less than 5 percent, unconsolidated and in places weakly cemented slopewash and some lesser amounts of alluvium attain thicknesses of up to 9 m with yellow podzolic and lesser amounts of red podzolic soils (CL to CH)[X] overlying gleyed podzolics (CH) (Plate 1).

Gentle to undulating slopes, ranging from 5 to 15 percent, rise gradually from the central area towards the low hills to the southeast of the creek, and towards the steeper hills to the northwest. Soils of the gentle slopes consist of yellow and red earths (SC to SM) overlying yellow podzolics with lesser amounts of red podzolic soils (CL to CH); the soils have been developed on mainly transported material. The thin (<30 cm), uppermost layer of slopewash on the northwest margin of the central area shows no development of a soil profile. Both in situ and transported material overlie volcanic rock in various stages of weathering. Patches of humic gley soils occupy poorly drained areas mainly within this area of gentle to undulating slopes (OH). The detailed auger hole logs are set out on Plate 3 and the diagrammatic cross-sections at an expanded vertival scale present a possible continuity of soils.

The higher slopes (>15%) towards the northwest margin of the area contain scattered outcrops of weathered volcanic rock with some boulders (Plate 4) and have a thin cover of lithosols (GM). The steepest slopes are greater than 45 percent and are found in small areas along the northwest margin of the area; they continue to the northwest immediately outside the area of investigation. Rock falls are not expected to occur along these slopes; but any excavations in them should be preceded by slope-stability investigations.

ROCK WEATHERING

The volcanic rocks are hard and strong where fresh, but rock in the area shows all stages of weathering. Completely weathered rock at the surface ranges in thickness from 0.5 m where present on the higher slopes to about 3 m on the gentle to undulating slopes; completely weathered rock is also found below the valley colluvium, but is not expected to be as thick as that beneath the slopes (Plate 3).

The depth to the surface separating highly weathered from moderately weathered rock in the central part of the basin is thought to be up to 9 m, and beneath the gently undulating slopes up to about 7 m. The weathering surface is probably irregular and the depth and degree of weathering

X Symbols refer to the Unified Soil Classification at a particular locality is partly a function of rock texture and the abundance of joints, which tend to accelerate the weathering process by allowing circulating water to ~~move~~ through the rock more freely.

The boulders on the upper slopes generally consist of fresh to slightly weathered rock, and exposed outcrop generally contains weathered material with some cores of fresh rock. The degree of weathering for each outcrop is shown on Plate 4.

GROUNDWATER

Water-levels in two bores within the Halls Creek catchment, about 1.5 km southwest of the area of this investigation (see Fig. 1), have been measured regularly by BMR since 1960 in one case, and since 1971 in the other. Water-levels have ranged from a maximum of 3.62 m below ground surface in one bore to a minimum of 18.0 m in the other. The seasonal variation is between about 2 and 5 m in the bore 1 km from Halls Creek and between 0.3 and 0.5 m in the bore close to the creek. Water-levels in the bore for which we have records dating from 1960, show a rapid annual rise in the potentiometric level during the late winter months and spring, to a maximum in early summer. The level drops sharply in summer and then declines gradually until a minimum level is reached by about mid-winter.

There are three bores within the area of investigation and water-levels in these have been measured once or twice a year by BMR during the past 12 years. Water-levels in these bores have ranged between 7.92 and 12.20 m below the surface.

Soil water was intersected between 2.74 and 3.74 m in three auger holes (12, 7 and 18), and at 7.17 m in hole 20 (Plate 3). The water level in hole 7 rose 35 cm during the night after drilling; the level in hole 12 fell 62 cm during the same period and levels remained almost stationary in the other holes.

Soil water aquifers may be confined between less permeable clays, and as a general rule, the movement of soil water downward through the profile is restricted. A field permeability test on hole 18 found that the coefficient of permeability of a perched aquifer in slopewash at a depth of 3.5 m was a very low 2×10^{-5} cm/sec. A bailing test gave a similar result for hole 7 and even lower rates of recovery were recorded in holes 20 and 12.

Numerous seeps, springs, and swampy areas were mapped, and some of the springs during the very wet winter of 1973 flowed at rates ranging from a few g.p.h. to 4000 g.p.h. As 1973 has brought the highest falls of winter rain recorded in the area in the last 15 years, (1973 rainfall up to 29 August was 604.5 mm) the high seepage flows and generally high soil moisture content must be regarded as abnormal; however, it is the amount of water retained within the soil that is significant, and even in drier years the high soil water content in the humic gley soils and in some of the podzolic soils is likely to be maintained.

TABLE 1: MAIN SOIL TYPES IN HALLS CREEK AREA

Soil types (geological or pedological classification)	Lithosols	Yellow and minor red podzolic soils	Yellow earths and red earths	Gleyed podzolics	Alluvium and slopewash	Humic gleys
Range of total thickness of soil type in soil profile	60 cm	2.5 m	1.5 m	1.2 m	9.0 m	1.0 m
Range of categories according to unified soil classification that are spanned by the pedological type	GM	CL - CH	SC - SM	CH	GP, GM-SM, SC, (CL,SP)	OH
Colour	Light brown	Yellow; orange-yellow; brownish-yellow; red-brown	Brownish yellow or orange	Pale grey to bluish or greenish grey with yellow-brown mottles	Pale brown to yellow-brown; grey and orange	Very dark grey to black
Performance as foundation material for houses under worst normal moisture conditions	Poor to good	Poor	Fair	Very poor	Fair to good, depending on natural cementation	Very poor
Estimated expansiveness of dry soil upon wetting	Low	High	Low to moderate	Very high	Very low	Very high
Natural drainage of soil type	Good	Fair to poor	Fair; intermittently saturated by perched groundwater	Poor; frequently saturated	Good	Very poor saturated for long periods
Measured (in situ) coefficient of permeability (K value)	-	-	-	-	2×10^{-5} cm/sec (1.8×10^{-2} m/day) (hole 18)	-
Above or below standing water-level of shallow bores (9 m) in July 1973	Above	Above	Both, mostly below	Both	Both	Above but fed by seepage during winter months

RELEVANCE TO URBAN PLANNING

SOILS

Logs of the 20 auger holes drilled to study the soils of the area are shown in Plate 3; their characteristics for geotechnical engineering purposes are summarized in Table 1 and their areal distribution is shown on Plate 1.

FOUNDATIONS

No penetrometer, bearing strength, or unconfined strength tests have been carried out on the area. However, it is considered that most soil and alluvium will probably support residential development of single-storied units, provided that adequate foundation drainage is installed. Some settlement might be experienced where multi-storied buildings are situated on soil or on slopewash and alluvium, depending on the type of foundation and bearing pressures involved. Moderately weathered rock may be considered to be the most suitable foundation material for buildings with higher bearing pressures, and while the depth to this material ranges up to 9m, the founding of piles on moderately weathered rock at lesser depths should be possible over much of the area. The feasibility of construction on the humic gley soils should be closely examined; these soils have excessive compressibility and high shrinkage; however, they are not extensive nor very thick, and are not considered a major constraint to development.

The central part of the area shown on the soils map as 'yellow and minor red podzolics, slopewash, and minor alluvium' contains slopewash with fair to good bearing characteristics interbedded with expansive grey clays (gleyed podzolics) with poor bearing characteristics. Footings or piles should therefore be founded on slopewash above or below the grey clay, which usually occurs in only one layer. The slopewash is generally a well-graded fine gravel-sand-silt mixture and is commonly cemented quite strongly; its bearing strength probably ranges up to that of moderately weathered rock.

DRAINAGE

Well defined slopes, combined with soils of moderate permeability, with the notable exception of the small areas of humic gley and gleyed podzolic soils (the latter occur at depths of more than 2 m), allow drainage of the surface and shallow subsurface soils in normal rainfall years. Soil water is naturally channelled into the large erosion gullies of Halls Creek; the walls of these gullies have moderate permeabilities at some levels and this allows seepage of soil water into the gullies. If these gullies are to be back-filled, the fill material should be permeable enough at all levels to handle the seepage, and stormwater drains through the colluvium should provide for inflow of groundwater through perforated pipes or through open joints in the pipeline. Consideration should be given to routing drains through areas of seepage or springs, so that drainage of these areas may also be achieved by perforated pipes or open jointing. The high winter rainfall of 1973 has maintained saturation of the surface soils; the result is that boggy conditions prevail, and are likely to remain during the winter months of low evaporation. These surface soils overlie soils with low permeabilities, and infiltration of water is thereby restricted. Installation of drains should more than offset the effect of the added volume of surface water added to the system by garden watering.

ENGINEERING MATERIALS

Topsoil

There are no large reserves of sandy loam suitable for use in gardens or as topdressing in the Halls Creek area.

Sand

There are no deposits of river sand and gravel in the area, nor of windblown silty sand.

Plastic and non-plastic gravel

Areas likely to contain reserves of plastic gravel are shown on the geological map (Plate 4). There are no deposits of particular value in the area; most of the coarse-grained tuff weathers to material that could probably be used as plastic gravel, but depths of weathering, grading characteristics and plasticity indices would have to be determined before exploitation could be considered.

The ubiquitous occurrence of biotite or altered biotite in the volcanics appears to preclude the possibility of establishing reserves of non-plastic gravel. Grainsize of the weathered material would generally be too fine after working with heavy equipment, and only a few beds of tuff contain abundant large quartz crystals, which would be likely to provide sufficient mechanical strength in the coarse fractions. These beds of tuff occur within the areas outlined as possible plastic gravel reserves on Plate 4.

Rock aggregate

Volcanic rock in the hills to the northwest of the area could be expected to provide suitable rock aggregate, but a more detailed investigation would be required to prove suitability of the material, and to locate a satisfactory quarry site.

EASE OF EXCAVATION

The only areas in which excavation by mechanical means is likely to be impracticable is on the surrounding hillslopes with thin lithosols and scattered outcrops of volcanic rock. Blasting will be required in many places for removal of boulders and fresh to moderately weathered rock; however, the nature of weathering at depths is not predictable and the amount of blasting required will vary from place to place. The nature of the material at a particular outcrop can be gained by reference to the weathering notes on Plate 4, and depending on the depths of excavation required, it is possible to gain some idea of the type of material to be excavated.

CONCLUSIONS AND RECOMMENDATIONS

1. Urban development of the Halls Creek area is not expected to encounter any major drainage, foundation, or excavation problems (Plate 2).

2. There are no areas with potentiometric surfaces higher than about 3.3 m below ground surface.

   (a) The erosion gullies along Halls Creek should be back-filled with permeable materials; if the gullies are to be intersected with stormwater pipes, inflow into the pipes should be facilitated by the provision of some perforated pipes, or by open-jointing of parts of the pipeline. Backfill material in this lower part of the area should consist of semi-permeable material (Plate 3).

   (b) The installation of drains in areas of saturated soils, which are generally humic gleys and adjacent soils, should provide for soil drainage with perforated pipes or through open jointing of sections of the pipeline.

3. Foundations on soil, other than the humic gleys, are not expected to provide difficulties for single-storied residential units; however, special attention should be given to foundations for multi-storied units, and site investigations are recommended. The humic gley soils occupy small areas and are not thick, but if they are to be built on, site investigation is recommended.

4. Excavation for roads and pipelines is not expected to encounter any difficulty in 90 percent of the area; elsewhere, highly weathered volcanic rock and shale will generally be rippable (only small amounts of shale in the area) but moderately weathered volcanic rock will require blasting unless it is very closely jointed. The incidence of moderately weathered or fresher rock in excavations can not be readily estimated, but such rock will be mainly confined to the upper slopes around the margin of the area.

5. Engineering materials in the area include the possible occurrence of plastic gravels in the northwest of the area, and of volcanic rock suitable for aggregate, also in the northwest of the area and the adjacent hills. The assessment of these materials for quality and quantity would be required before exploitation.

ACKNOWLEDGEMENTS

The writer wishes to acknowledge the valuable assistance of G.W.R. Barnes in the field and in preparation of the Correlation of Subsurface Soils map.

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APPENDIX 1

GEOLOGY OF THE HALLS CREEK AREA

The Halls Creek area is underlain by pyroclastic volcanic rocks that range from coarse-grained agglomerate through lapilli tuff to microcrystalline porphyritic rocks (porphyry) containing scattered crystals of plagioclase and quartz up to 2-3 mm across. The coarse-grained tuff and agglomerate are generally dark grey where fresh and are mottled yellow and red or orange where moderately weathered. Fresh fine-grained tuffs are either greenish grey or purplish red; where weathered they are cream or brown. Most of the volcanics are rhyodacites.

The volcanics are folded into a broad syncline with the axis trending roughly along Halls Creek and plunging gently southward. Dips along the ridge to the west of Halls Creek are to the east, while dips on the ridge to the east of the creek appear to be to the west.

No evidence of major faults has been found within the area, but this might be attributable to the paucity of outcrop.

Two small areas of shale and siltstone crop out in the north and east of the area. The shales are interbedded with the volcanics and are tentatively correlated with shales of the Canberra Group that crop out to the east, in the Gungahlin area.

The volcanics show evidence of regional metamorphism to the greenschist facies. Biotite, and much of the hornblende, has been altered to chlorite, and plagioclase is invariably altered. The groundmass of fine-grained porphyritic rocks is generally rich in chlorite. Chalcedony is rarely seen filling vughs in the groundmass of cryptocrystalline porphyry.

The well-developed fracture cleavage that is distinctive of the fine-grained sedimentary rocks and volcanics in the Gungahlin area, is not generally evident in the coarser grained rocks in the Hall area. Only a few outcrops on the low ridge to the east of Halls Creek show an incipient fracture, or axial plane, cleavage. Here, the spacing of the cleavage ranges from a few cm to 15 cm or more. The spacing of the same north-striking cleavage in the Gungahlin area is generally less than 2-3 mm.

APPENDIX 2

EXPLANATION OF TERMS

AGGLOMERATE: pyroclastic volcanic rock comprising clasts (blocks) coarser than 32 mm in diameter.

ALLUVIUM: sediment deposited by running water.

CEMENTED: naturally bonded by chemical precipitate or by clay.

COMPLETELY WEATHERED ROCK: more appropriately referred to as 'extensively weathered rock'. Has soil properties and often shows complete change in appearance from moderately weathered rock. Usually some textural relicts of original rock.

GLEYED PODZOLIC SOILS: these are poorly drained acid soils with strongly differentiated profiles consisting of brownish grey sandy to loamy A horizons with a distinct paler A_2, overlying grey and yellow-grey clay B horizons with coarse ochreous and some reddish mottles. Varying gley features may occur in any part of the profile, but rusty and ochreous root tracings and spotting are usually concentrated in the A horizons. The poor drainage is due either to perching of water, and seepage on the clay subsoil, or deeper seated seepage intermittently affecting most of the profile. The B horizon is dominantly some shade of grey sandy clay to clay, coarsely mottled with bright yellow-brown or brownish yellow and with a few reddish spots. Consistence is plastic to sticky when wet and hard when dry.

HIGHLY WEATHERED ROCK: considerable change in appearance and loss in strength. Material is still a rock but breaks and crumbles easily in the hands.

HUMIC GLEY: acid to neutral, predominantly mineral soils with significant but widely varying amounts of organic matter incorporated in the dark A horizons. These grade into subsoils marked by rusty and ochreous streaks and mottles on a blue-grey matrix. Below this mottled horizon the soil is typically grey to bluish grey and permanently waterlogged. Occasionally the soils are flooded for short periods.

JOINT: naturally occurring planar or curviplanar fracture in rock that is not parallel to a rock fabric.

LAPILLI TUFF: pyroclastic rock comprising clasts of grainsize between 32 mm and 4 mm.

LITHOSOL: lithosols are essentially stony or gravelly soils lacking profile development other than an A_1 (topsoil) owing to organic matter accumulation and structure development in the surface. Normally they are shallow sands, silts, and clayey silts and usually contain a large proportion of coarse-textured material in the form of fragmented rock, which may show some degree of weathering. Stoniness and lack of pedological differentiation are the essential features.

MEDIUM STRONG: rock strength term applying to rocks with an unconfined compressive strength in the range 200-700 Kg cm^2. The rock rings and breaks to a firm hammer blow.

MODERATELY WEATHERED ROCK: change in appearance but with significant loss in strength from fresh rock.

NON-PLASTIC GRAVEL: the word 'gravel' in this term is used in an engineering rather than a geological sense. It is defined as an unconsolidated, well-graded mixture of gravel-sized rock fragments and/or mineral grains such as quartz and feldspars, together with sand and silt, in a feebly plastic soil binder. Gravel derives its strength from mechanical interlock owing to high internal friction of its subangular components and specifications have been designed by the Commonwealth Department of Works for quality control. These specifications are based on the assumption that the performance of 'gravel' is influenced by two characteristics, particle size and plasticity. Non-plastic gravel is used as a surface course underneath a seal and its plasticity index must not exceed 6 and its maximum particle size should not exceed 3.8 cm.

PEDIPLAIN: a plain, widely extending, usually alluviated, formed where pediments coalesce.

PEDIPLAIN BASIN: a gentle depression filled with sediment derived by sheet erosion and/or surficial mass movement, resulting in appreciable lowering of portions of the pediplains. This landscape lowering is probably mainly the result of local surface weathering and erosion in the form of small-scale valley pedimentation. Characteristic landscape forms develop for which the term pediplain basin was introduced (van Dijk, 1959). They are especially found on wide valley pediplains with very gentle gradients which are traversed by the tributaries of smaller streams. A typical example of a pediplain basin occurs in the watershed of Sullivans Creek immediately to the north of Canberra City. The features of a pediplain basin are an ill-defined dendritic drainage pattern, a very low gradient, and a bar or narrowing of the basin-like depression towards the outlet. The basins are generally in a perched position and the channel draining away from it into the major stream often has rapids due to the sudden steepening of gradient.

PEDOLOGICAL: the scientific description of soils.

PLASTIC GRAVEL: 'plastic gravel' is 'gravel' (see above under 'non-plastic gravel') that is used for surfacing unsealed roads and for shoulders on sealed roads. Its plasticity index should not exceed 8 and its maximum particle size should not exceed 3.8 cm in diameter. In general, the 'plastic' variety should have a higher percentage of fine-grained rock and soil material than the 'non-plastic' type because vehicle-traffic tends to remove a considerable portion of the finer grained material.

PODZOLIC SOIL: one which has a strongly differentiated profile with contrasting A and B horizons; light grey-brown sandy silt changes abruptly to red-brown, yellow brown, or mottled, fine sandy clay to heavy clay.

POTENTIOMETRIC LEVEL: level to which groundwater will rise in a piezometer installed to below aquifer.

PYROCLASTIC: composed of fragmental material ejected by volcanoes.

RED EARTH: soil that shows gradual vertical differentation from greyish brown sandy silt to reddish brown fine sandy silt or light clay.

SLIGHTLY WEATHERED: rock that has undergone a change in appearance due to weathering, but which has not suffered a loss in strength.

SLOPEWASH: a loose or cemented, porous, natural aggregate of rock fragments of silt to gravel grainsize that accumulates downslope of steep hillslopes by surficial mass movement.

SOIL: a natural aggregate of mineral grains and/or organic matter that can be separated by such gentle mechanical means as agitation in water.

STRONG a rock strength term applying to rocks with an unconfined compressive strength>1800 Kg/cm^2. The rock is very difficult to break with a hammer and generally requires use of a sledge-hammer.

YELLOW EARTH: these soils are very similar to the red earths, but are predominantly yellow in colour and sometimes have a more pronounced increasing texture gradient down the profile. They are essentially massive, moderately to highly porous, earthy soils with weak profile definition, gradual horizon boundaries, acid reaction and yellow to yellow-brown colour. Typically they are deep and increase in clay content with depth.

UNIFIED SOIL CLASSIFICATION SYSTEM

CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS	More than 1/2 of soil > No 200 sieve size	GRAVELS (More than ½ of coarse fraction> no. 4 U.S. sieve size)	GW	Well graded gravels or gravel-sand mixtures, little or no fines*
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
			GM	Silty gravels, gravel-sand-silt mixture
			GC	Clayey gravels, gravel-sand-clay mixture
		SANDS (More than ½ of coarse fraction> no.4 U.S. sieve size)	SW	Well graded sands or gravelly sands, little or no fines
			SP	Poorly graded sands or gravelly sands, little or no fines
			SM	Silty sands, sand silt-mixtures
			SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS	More than 1/2 of soil < No. 200 sieve size	SILTS AND CLAYS Liquid limit > 50	ML	Inorganic silt and very fine sands, rock flour, silty or clayey fine sands or clayey silts with low plasticity
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticty
		SILTS AND CLAYS Liquid limit > 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils

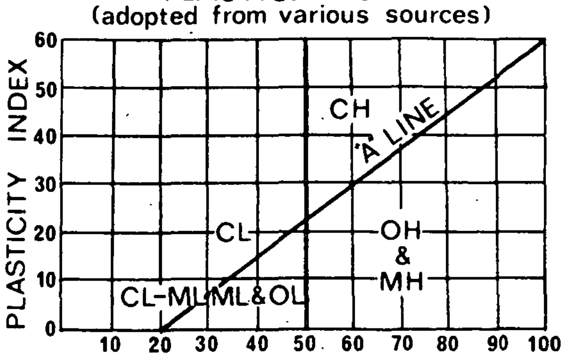
*fines - portion of a soil finer than a no. 200 sieve

GRAIN SIZE CHART

Classification	Range of grain size	
	U.S. Standard Sieve Size	Grain Size in Millimetres
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	305 to 76·2
GRAVEL	3" to No. 4	76·2 to 4·76
coarse	3" to 3/4"	76·2 to 19·1
fine	3/4" to No. 4	19·1 to 4·76
SAND	No. 4 to No. 200	4·76 to 0·074
coarse	No. 4 to No. 10	4·76 to 2·00
medium	No. 10 to No. 40	2·00 to 0·420
fine	No. 40 to No. 200	0·420 to 0·074
SILT & CLAY	Below No. 200	Below 0·074

PLASTICITY CHART

(adopted from various sources)



SOILS MAP OF HALLS CREEK AREA, HALL DISTRICT, A.C.T.

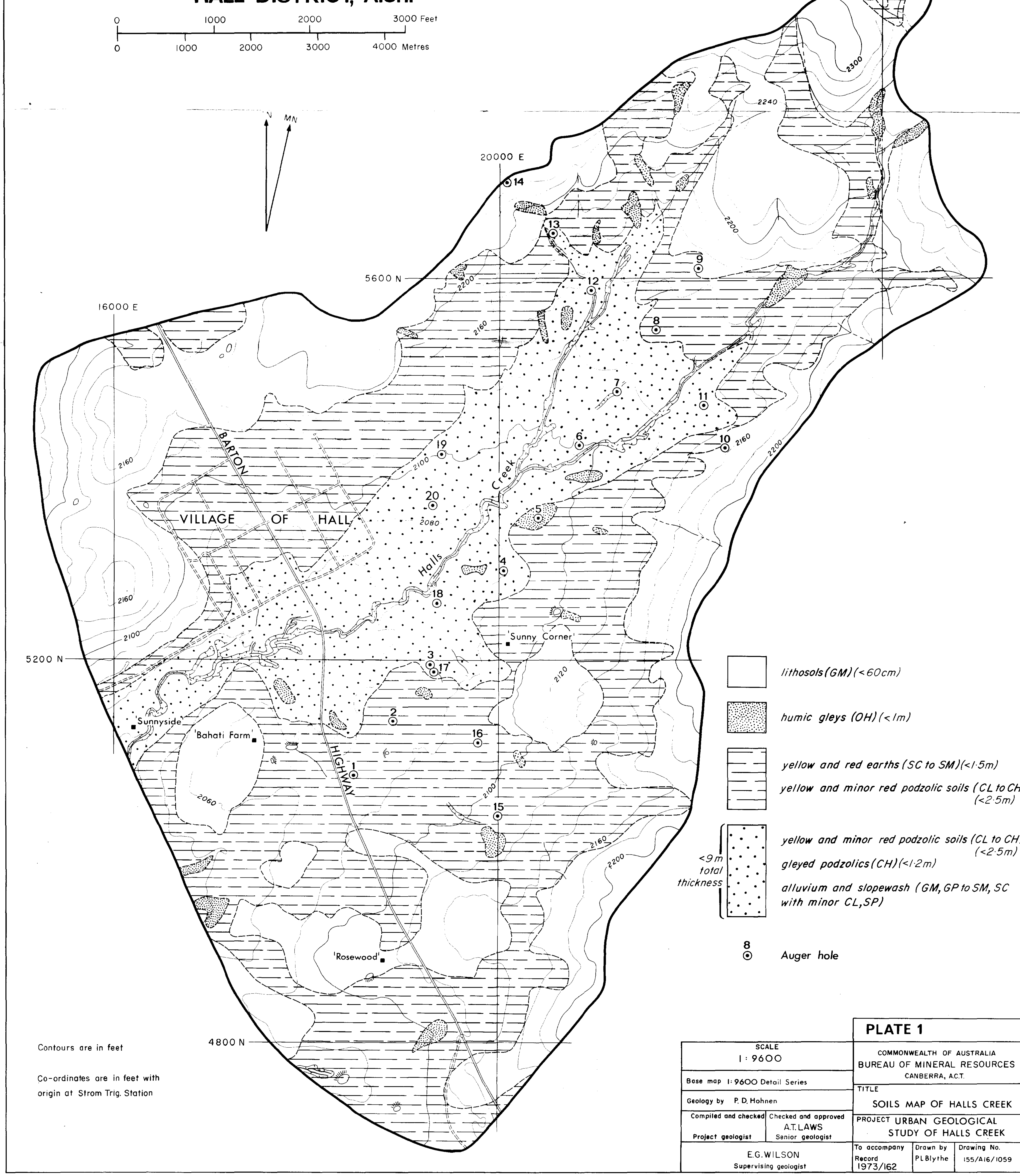
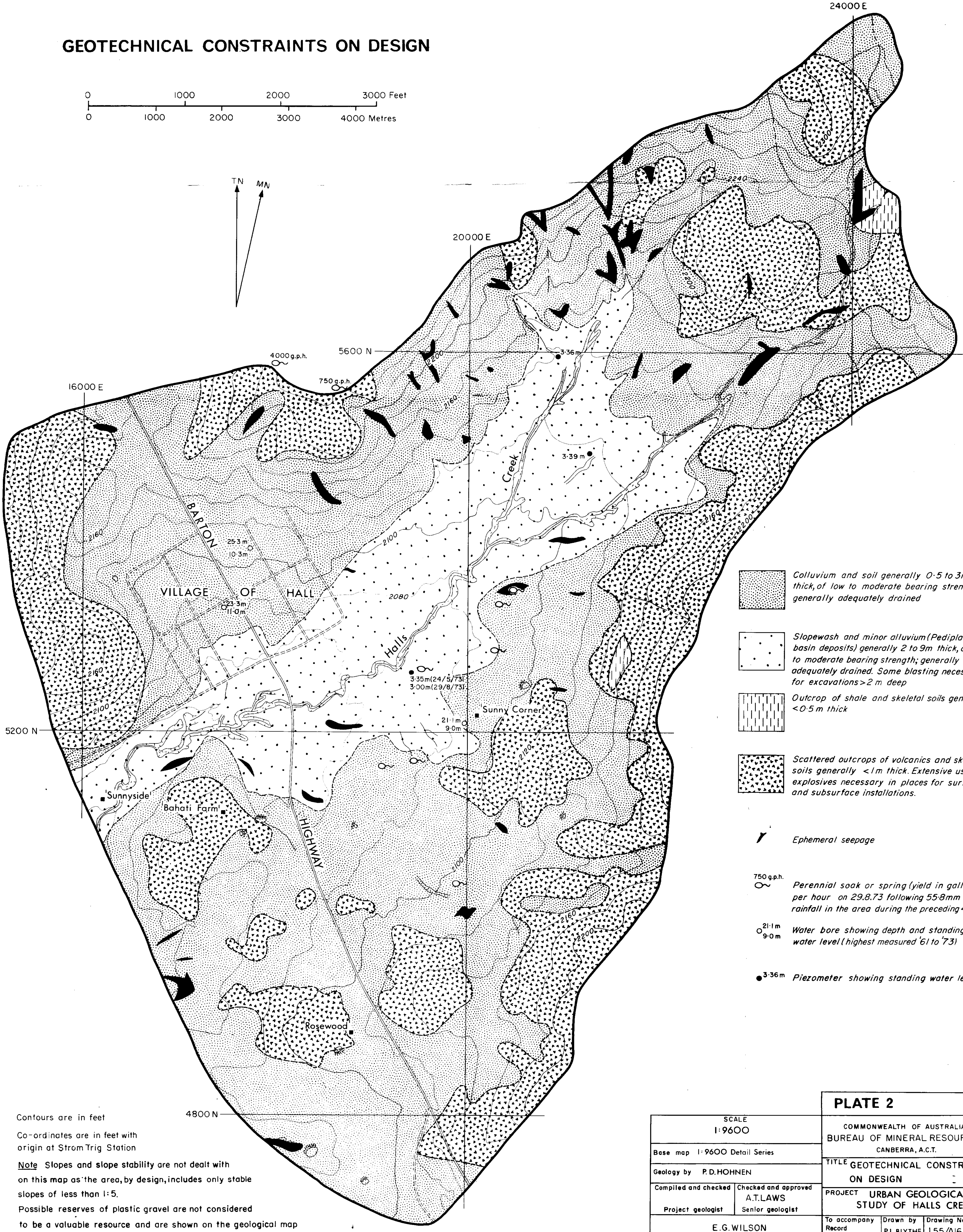


PLATE 1

SCALE 1 : 9600	COMMONWEALTH OF AUSTRALIA BUREAU OF MINERAL RESOURCES CANBERRA, A.C.T.
Base map 1: 9600 Detail Series	TITLE SOILS MAP OF HALLS CREEK
Geology by P. D. Hohnen	
Compiled and checked: Project geologist / Checked and approved: A.T. LAWS Senior geologist	PROJECT URBAN GEOLOGICAL STUDY OF HALLS CREEK
E.G. WILSON Supervising geologist	To accompany Record 1973/162 / Drawn by P.L. Blythe / Drawing No. 155/A16/1059

GEOTECHNICAL CONSTRAINTS ON DESIGN



Colluvium and soil generally 0·5 to 3m thick, of low to moderate bearing strength; generally adequately drained

Slopewash and minor alluvium (Pediplain basin deposits) generally 2 to 9m thick, of low to moderate bearing strength; generally adequately drained. Some blasting necessary for excavations > 2 m deep

Outcrop of shale and skeletal soils generally < 0·5 m thick

Scattered outcrops of volcanics and skeletal soils generally < 1m thick. Extensive use of explosives necessary in places for surface and subsurface installations.

Ephemeral seepage

750 g.p.h. *Perennial soak or spring (yield in gallons per hour on 29.8.73 following 55·8mm of rainfall in the area during the preceding 4 days)*

21·1m / 9·0m *Water bore showing depth and standing water level (highest measured '61 to '73)*

3·36m *Piezometer showing standing water level*

Contours are in feet

Co-ordinates are in feet with origin at Strom Trig Station

Note Slopes and slope stability are not dealt with on this map as the area, by design, includes only stable slopes of less than 1:5.

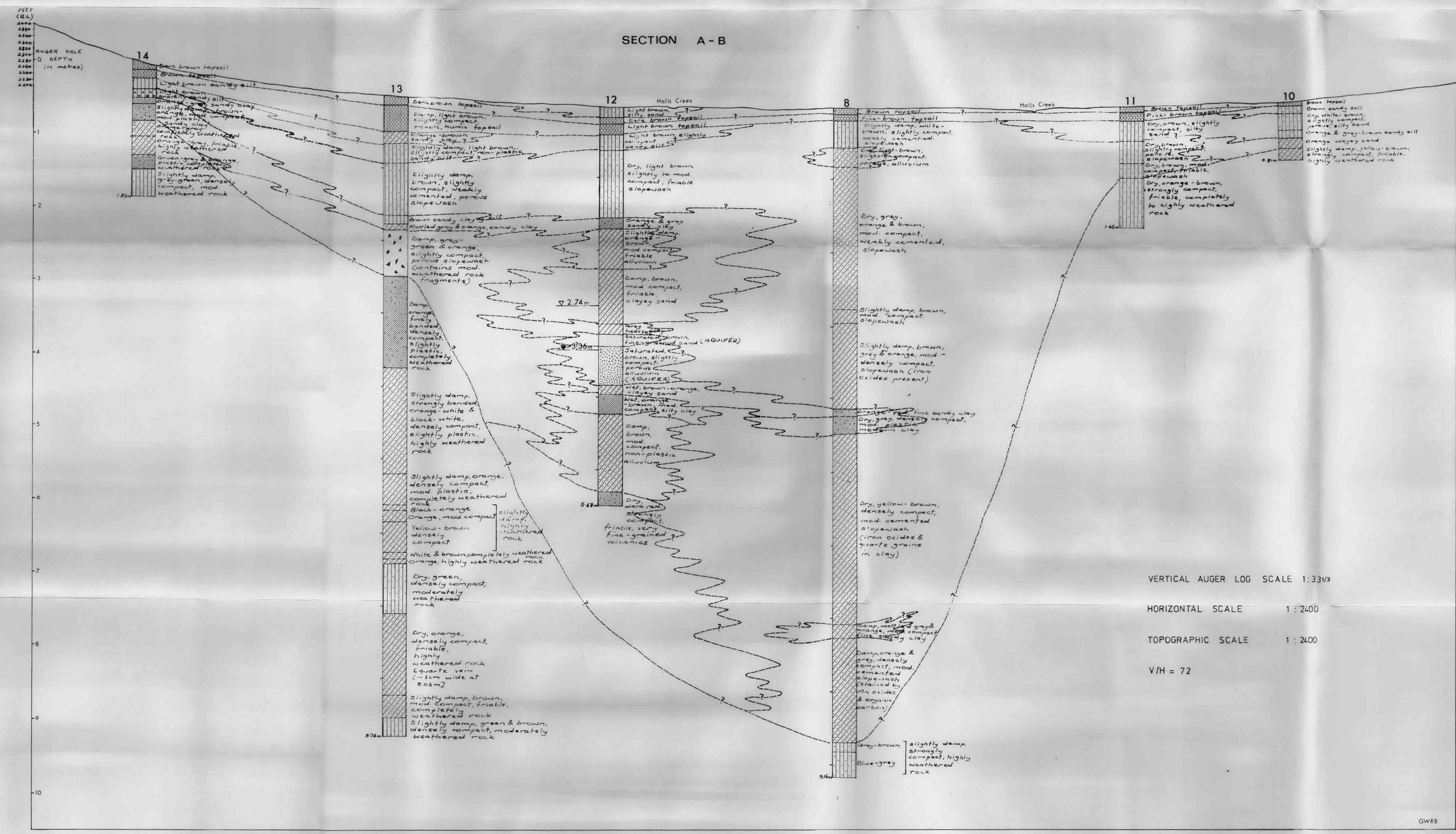
Possible reserves of plastic gravel are not considered to be a valuable resource and are shown on the geological map

PLATE 2

SCALE 1:9600	COMMONWEALTH OF AUSTRALIA BUREAU OF MINERAL RESOURCES CANBERRA, A.C.T.
Base map 1:9600 Detail Series	TITLE GEOTECHNICAL CONSTRAINTS ON DESIGN
Geology by P.D.HOHNEN	
Compiled and checked: Project geologist / Checked and approved: A.T.LAWS Senior geologist	PROJECT URBAN GEOLOGICAL STUDY OF HALLS CREEK
E.G.WILSON Supervising geologist	To accompany Record 1973/162 / Drawn by P.L.BLYTHE / Drawing No. 155/A16/1067

HALL CORRELATION OF SUBSURFACE SOILS, HALLS CREEK, A.C.T.

SECTION A - B



CLASSIFICATION CHART

MAJOR DIVISIONS		SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOILS (More than 1/2 of soil > No 200 sieve size)	GRAVELS (More than ½ of coarse fraction > no. 4 U.S. sieve size)	GW	Well graded gravels or gravel-sand mixtures, little or no fines*
		GP	Poorly graded gravels or gravel-sard mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixture
		GC	Clayey gravels, gravel-sand-clay mixture
	SANDS (More than ½ of coarse fraction > no. 4 U.S. sieve size)	SW	Well graded sands or gravelly sands, little or no fines
		SP	Poorly graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand silt-mixtures
		SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS (More than 1/2 of soil < No. 200 sieve size)	SILTS AND CLAYS Liquid limit < 50	ML	Inorganic silt and very fine sands, rock flour, silty or clayey fine sands or clayey silts with low plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticty
	SILTS AND CLAYS Liquid limit > 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
	SILTS AND CLAYS Liquid limit ~ 50	CI	Inorganic clays of medium plasticity, sandy clays, silty clays

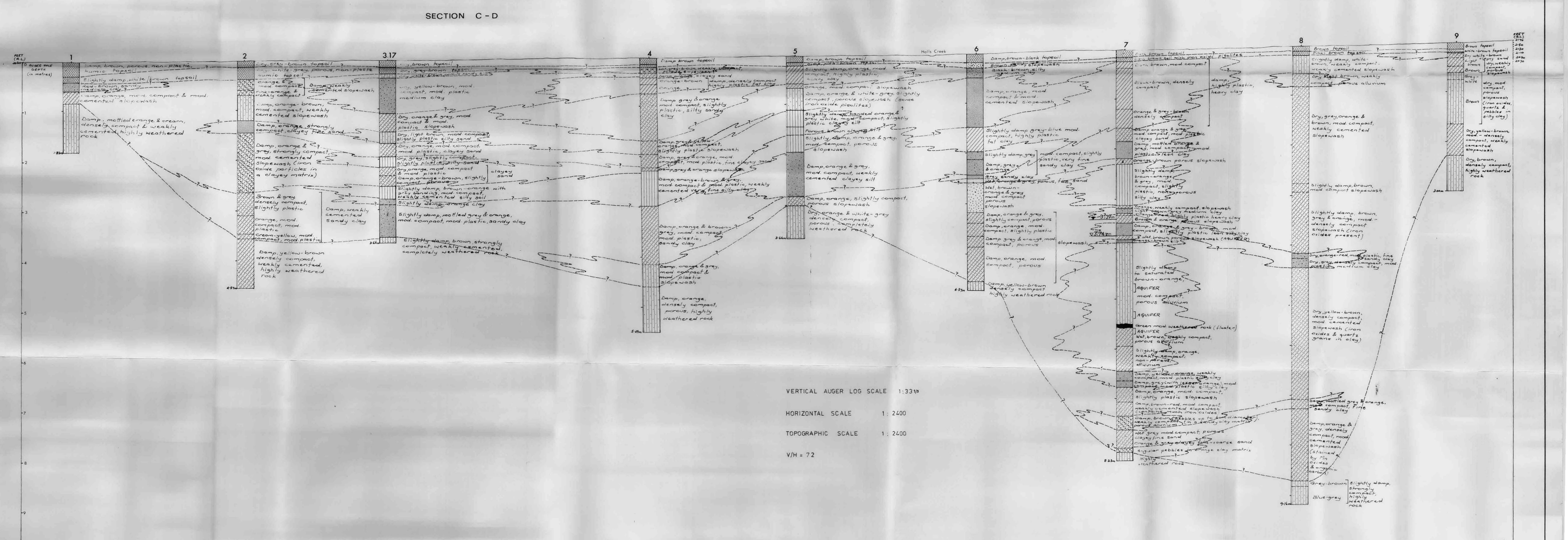
*fines - portion of a soil finer than a no. 200 sieve

▽ 2.74 LEVEL AT WHICH WATER INITIALLY STRUCK (in metres)

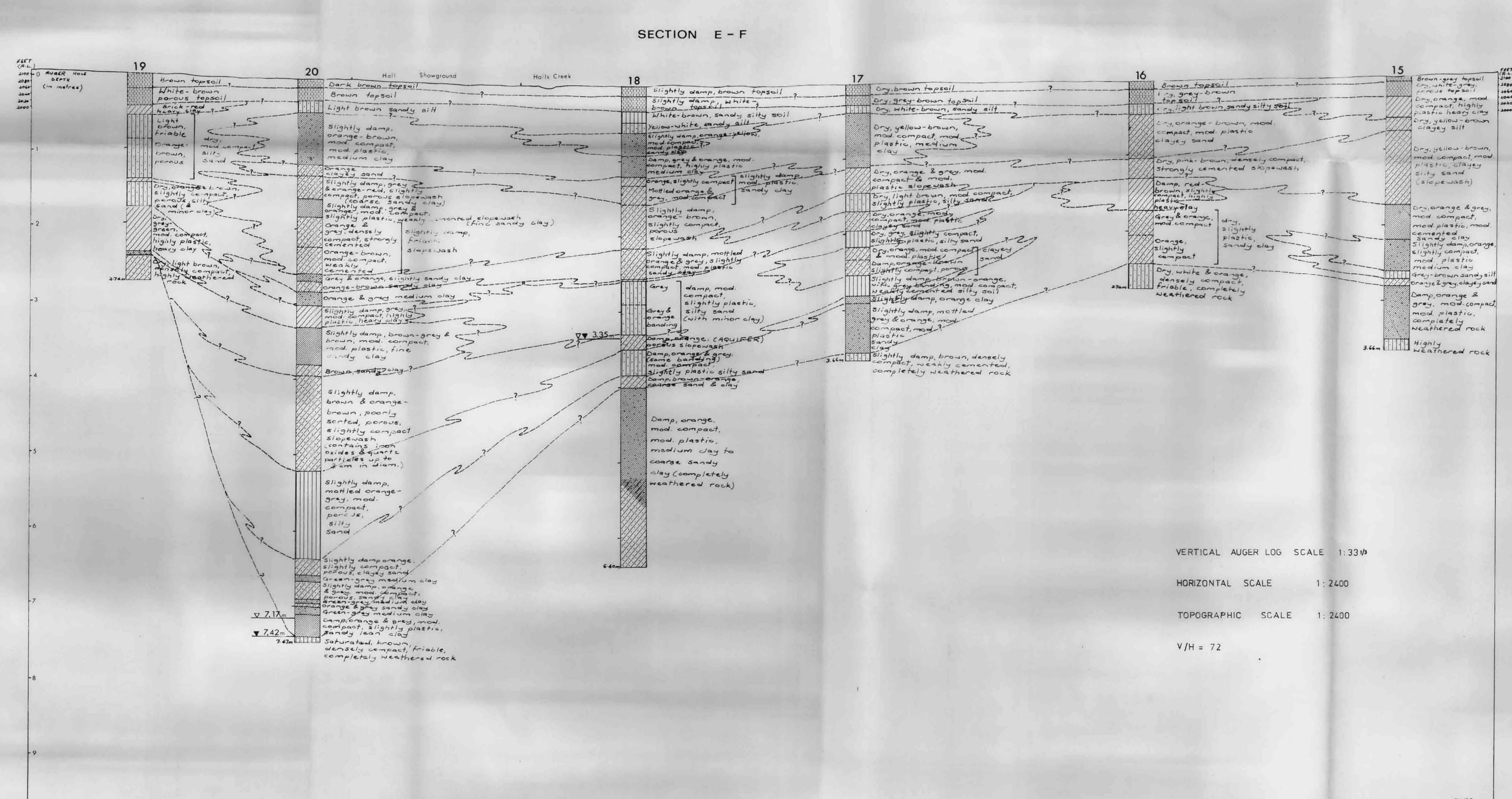
▼ 3.36 STANDING WATER LEVEL (in metres)

NOTE: All stratigraphic correlations shown with a broken line are schematic and give a general idea of relationships of soil units between auger holes

SECTION C - D



SECTION E - F



AUGER HOLE LOCALITY MAP

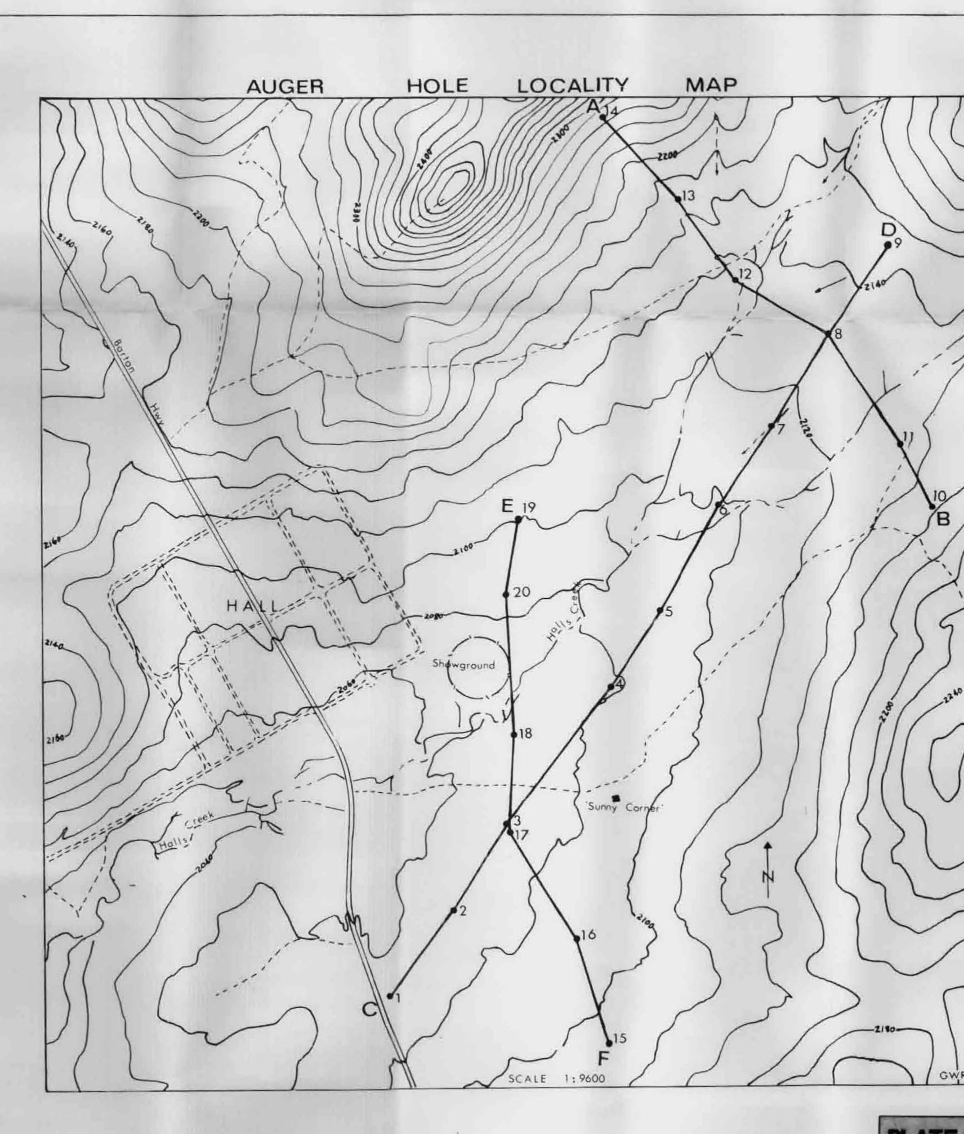


PLATE 3

AMENDMENTS					
No.	DESCRIPTION	AUTHOR	DATE	CHECKED	DATE
A1					
A2					
A3					
A4					
A5					
A6					

SCALE: 0, 75, 150, 225, 300, 375 feet / 0, 23, 46, 69, 92, 115 metres

BASE MAP/SURVEY

SOILS BY: G.W.R. BARNES

CHECKED: P. D. HOHNEN, PROJECT GEOLOGIST

CHECKED AND APPROVED: SENIOR GEOLOGIST

SUPERVISING GEOLOGIST

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

TITLE: CORRELATION OF SUBSURFACE SOILS HALLS CREEK, A.C.T.

PROJECT: URBAN GEOLOGICAL STUDY HALLS CREEK AREA, A.C.T.

TO ACCOMPANY RECORD	DRAWN BY	DRAWING NUMBER
1973/162	G.W.R.B	I55/A16/1019


OUTCROP GEOLOGY OF HALLS CREEK AREA
HALL DISTRICT, A.C.T.
0 500 1000 1500 2000 Feet
0 100 200 300 400 500 600 Metres
TN
MN
VILLAGE OF HALL
BARTON HIGHWAY
Halls Creek
'Sunny Corner'
'Sunnyside'
'Bahati Farm'
'Rosewood'
16000 E
20000 E
24000 E
5600 N
5200 N
4800 N
Dark red, micaceous, fine grained tuff
Fine grained, green to purplish-red porphyritic rhyodacite
Ash-fall and ash flow crystal-lithic tuff
Shale, siltstone and volcaniclastic tuff
Outcrop
Scattered outcrop
Scattered boulders
Fossiliferous outcrop
Dip and strike of bedding
Strike of vertically dipping strata
Dip and strike of joint
Strike of vertical joint
Strike and dip of fault
fr. Fresh
sl.w. Slightly weathered
m.w. Moderately weathered
h.w. Highly weathered
Outcrops and boulders
Possible reserves of plastic gravel
Contours are in feet
Co-ordinates are in feet with origin at Strom Trig. Station
PLATE 4
SCALE 1:5000
Base map 1:9600 Detail Series
Geology by P. D. HOHNEN
Compiled and checked
Project geologist
Checked and approved
A.T. LAWS
Senior geologist
E.G. WILSON
Supervising geologist
COMMONWEALTH OF AUSTRALIA
BUREAU OF MINERAL RESOURCES
CANBERRA, A.C.T.
TITLE OUTCROP GEOLOGY OF HALLS CREEK AREA
PROJECT URBAN GEOLOGICAL STUDY OF HALLS CREEK
To accompany Record 1973/162
Drawn by P.L. BLYTHE
Drawing No. 155/A16/1069