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GEOLOGICAL AND GEOPHYSICAL INVESTIGATIONS OF SITES FOR MAJOR
BUILDINGS, CANBERRA CITY, PARKES, AND CAMPBELL, ACT
1974-5

by

G.A.M. Henderson, G. Jacobson, and F.J. Taylor

*the remaining drill hole sheets for NO 145
are in Record 1978/28*

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SUMMARY

A series of geological and geophysical investigations for major building sites has partly delineated the southern continuation of the City East Fault Zone, previously known from site investigation in Canberra City. The area is one of Silurian sedimentary and volcanic rocks, weathered to various depths and traversed by many faults and shears, and overlain in places by alluvium and/or filled ground. A preliminary assessment of foundation conditions at several possible sites for major public buildings has been made and no major geological constraints are indicated.

INTRODUCTION

At the request of the National Capital Development Commission (NCDC) preliminary geological investigations have been undertaken at several sites proposed for major buildings in Canberra City, Parkes and Campbell (Fig. 1; Plate 1).

The investigations followed an earlier investigation of the City East development area (Dolan and others, 1974), and were concerned with tracing the southern extension of the City East fault zone and with determining any major geological constraints on siting large buildings.

Seismic refraction traverses were done at each of the sites (Plates 2, 3, 4 and 5) and diamond drilling was subsequently undertaken at some sites using the BMR Mayhew rigs. Logs of the drill holes are given in Appendix 1. The BMR drill core is stored in the Core & Cuttings Laboratory, Fyshwick. A summary of the site investigation of Sections 11 and 41, Canberra City, which was done by consultants, is also included in this report.

GENERAL GEOLOGY

STRATIGRAPHY

Rock units

The rocks in the area between City Hill and Campbell (Fig. 1) are mainly of siltstone and mudstone, with minor sandstone, limestone, and tuff, and are assigned to the Middle to Upper Silurian Canberra Group (Strusz & Henderson, 1971). These rocks are overlain to the east by dacite of the Lower Devonian Ainslie Volcanics.

The Canberra Group rocks have been mapped as four units in Plate 1. Relations between the rock units are shown in the diagrammatic geological section (Fig. 2). The lowest rock unit Smc₁ is the City Hill Shale (Opik, 1958) which underlies the eastern slopes of City Hill. The rock is typically blue-grey or green-grey slaty mudstone, and fresh rock generally occurs within about 2 m of the surface. The drill holes at Section 11, adjacent to City Hill, are in the unit. Limestone has been reported in this unit at a locality south of Commonwealth Park now covered by Lake Burley Griffin,



0 3 km

Fig.1 Locality map

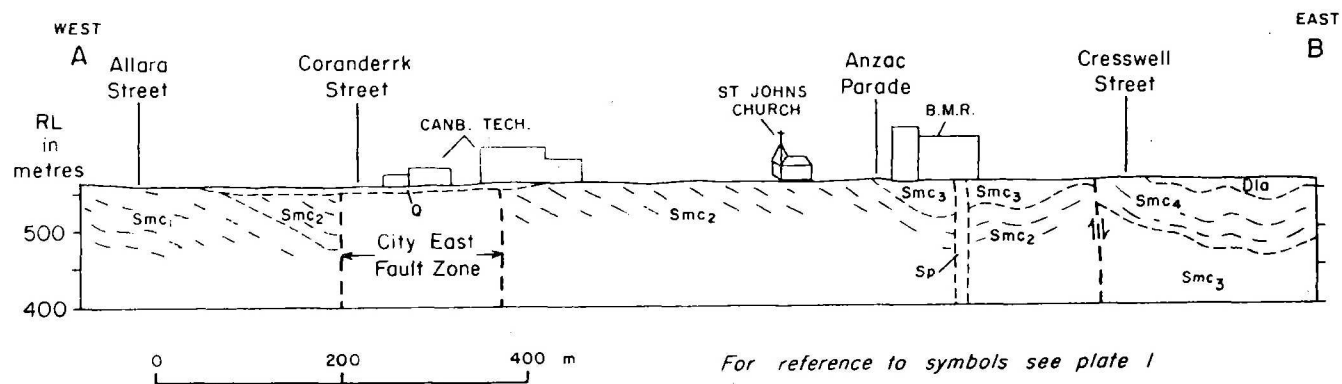
but generally the rock is only in part calcareous, in distinction to the other units described below where limestone and calcareous rocks are more common.

Rock unit Smc_2 is an unnamed formation which overlies Smc_1 and which underlies the area between the Olympic Swimming Pool and St Johns Church. Opik describes a trench along Constitution Avenue revealing shale and mudstone in this section. The unit consists mainly of siltstone and mudstone, with minor sandstone, limestone, tuff, and tuffaceous sediments. The drill holes at Section 41 and Parkes Section 3 are in this unit. Much of the siltstone and mudstone was probably calcareous; however, removal of the calcareous cement by solution has produced an extremely weathered rock to considerable depth, particularly where the rock is faulted, as in the City East Fault Zone where extremely weathered rock persisted to 70 m (Dolan and others, 1974).

Rock unit Smc_3 comprises the lower part of the St Johns Church Beds and consists of tuffaceous and calcareous sediments including sandstone, siltstone, shale, and mudstone; tuff and limestone have also been recorded. Unit Smc_3 is found in the area of the BMR building (Fig. 3) and in drill holes 104, 115 and 156. It overlies Smc_2 , but the position of the contact is not definite; the contact could pass through the southwest corner of the BMR building. Coarse dacite (Sp), which is possibly intrusive because it appears to be discordant with the sedimentary rocks, has been found near the intersection of Constitution Avenue and Anzac Park East.

Rock unit Smc_4 comprises the upper part of the St Johns Church Beds and underlies an area to the east of the BMR building. A fault is indicated by broken drillcore in hole 144 and from seismic traverses; it forms the boundary between Smc_3 and Smc_4 . Smc_4 consists of mudstone, limestone, and minor tuff as in drill holes 145, 103 and 115. The mudstone is shallow-weathered, like the City Hill Shale. The contact between Smc_4 and underlying Smc_3 was reached in drill hole 145 at a depth of 42.6 metres.

Rock unit Smc_4 is overlain to the east by dacite belonging to the Ainslie Volcanics (Dla). The dacite is a dark greenish-grey rock forming the boulders which crop out in the vicinity of the RSL National Headquarters building. The dacite in drill hole 103 overlies calcareous mudstone of Smc_4 at a depth of 25 metres.



Record 1977/59

155/A16/1642

Fig.2 Diagrammatic geological cross-section along Constitution Avenue

Alluvium

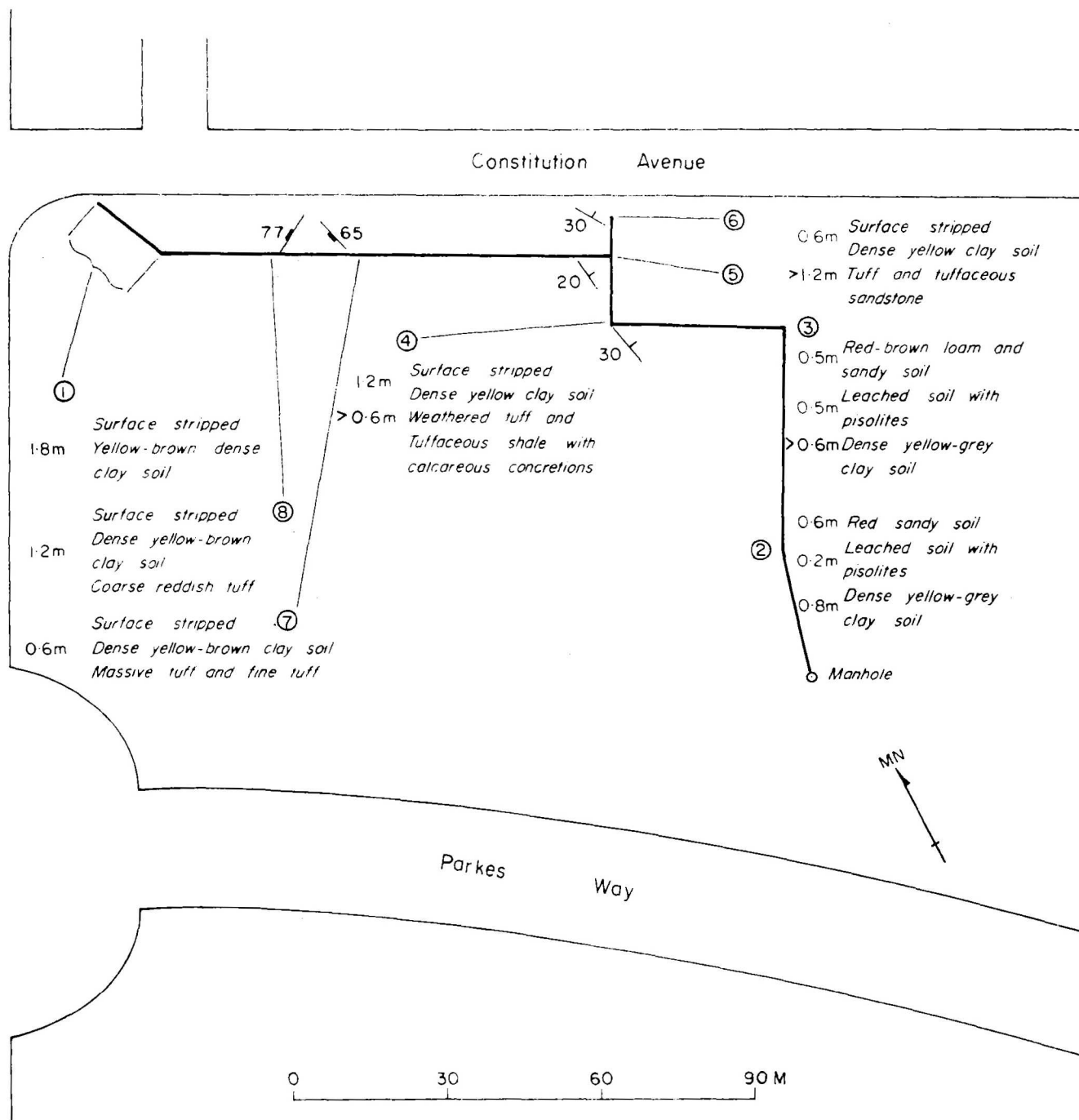
Alluvium of probable Tertiary and Quaternary age (Q) is found in several areas and is up to 5 m thick; it consists of gravel, sand, silt, and clay. The alluvium was deposited originally along a former course of the Molonglo River at about RL 565 m which was abandoned for a new course at a lower level. Later erosion has isolated some of the alluvium on elevated terraces such as at St Johns Church and re-deposited some at lower levels, such as at the Olympic Pool. Quaternary aeolian fine red sand up to 1 m thick occurs as stabilized dunes that trend eastwards from Blundells Cottage to Russell Drive.

Filled ground

Filled ground has not been shown on the geological map, but occurs in places throughout the area. A depth of 1.5 m of fill was proved by augering near the Olympic Swimming Pool (Fig. 4). The top 0.9 m in drill hole 12 east of the BMR building is probably fill associated with landfill material in an erosion gully that crossed Section 4 towards the RSL National Headquarters.

STRUCTURE

Bedding dips to the east at between 12° and 45° in all places where it has been observed. However, there is some minor folding and faulting within most rock units. The relation between bedding and north-striking cleavage in the City East area indicates that the plunge of folds would be to the north in most places. The main fault in the area is the City East Fault which is possibly a zone of numerous sub-parallel faults, rather than a single fault. The fault to the east of Anzac Parade is based on a lithological discontinuity between rock units Smc_3 and Smc_4 , and on discontinuities in seismic sections in sections 4 and 5, Campbell. Brecciated shale and mineralization in drill hole 144 is a further indication of the fault.



Record 1977/59

— Trench

I55/A16/I643

FIG:3 B M R BUILDING, PARKES
GEOLOGY OF STORMWATER DRAIN

Logged by E.G. Wilson

GEOPHYSICAL METHOD AND EQUIPMENT USED

The seismic refraction method (Dobrin, 1952) was used to investigate subsurface conditions. Depths to refracting layers were calculated using intercept times and a modification of the reciprocal method (Hawkins, 1961). This gives depths to intermediate refractors only at shot-points, and the depth to bedrock at each geophone.

A geophone spacing of 4 m was used for these surveys and shots were fired in the centre of each spread and at 2 m and about 50 m beyond each end. Standard 24-channel SIE PSU-19 refraction equipment with 8 Hz GSC-20D geophones was used.

ALTERNATIVE SITES FOR CITY ADMINISTRATION BUILDING

(CANBERRA SECTIONS 11 AND 41)

Three alternative sites for the City administration building were investigated late in 1974. Diamond drilling by Ground Test Pty Ltd has been documented in that company's reports (1974, 1975); logs of the drill holes prepared by BMR geologists are given in Figures 5 and 6 of the present report. Results of a seismic traverse by BMR are given in Plate 2.

The investigation proved hard fresh calcareous mudstone at shallow depths on City Hill with an increasing depth of weathering towards Glebe Park which is traversed by the City East fault zone.

Results of drilling are summarised in the following table which shows the range of depths to a sound foundation level (moderately weathered mudstone) at each of the three alternative sites considered for the proposed building. Also indicated are the ranges of depths of rippable material; from an inspection of the drill cores, slightly weathered mudstone was considered non-rippable.

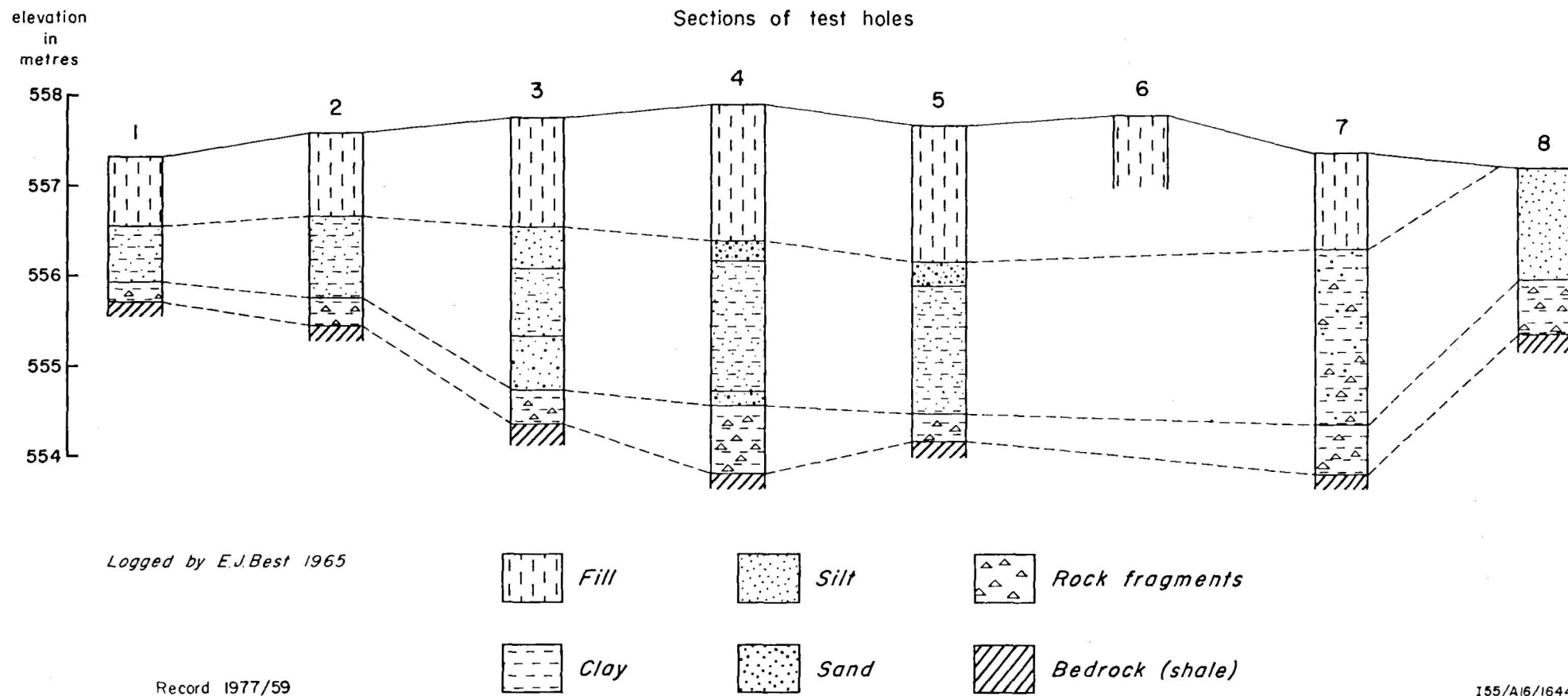


Fig. 4 Alluvial cross-section, Olympic Pool, Canberra

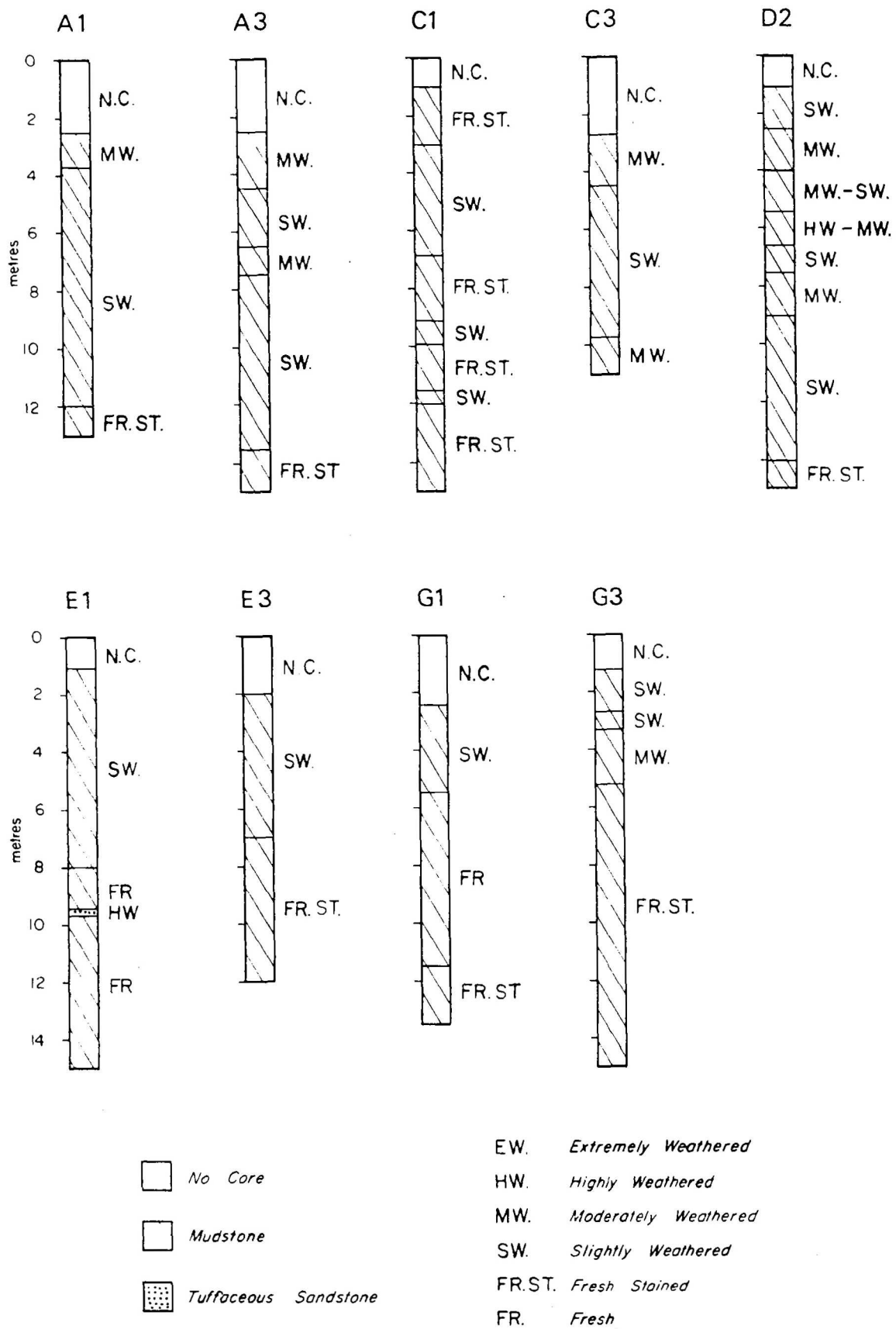


Fig. 5. Logs of drill holes, Section II, Canberra City, August 1974

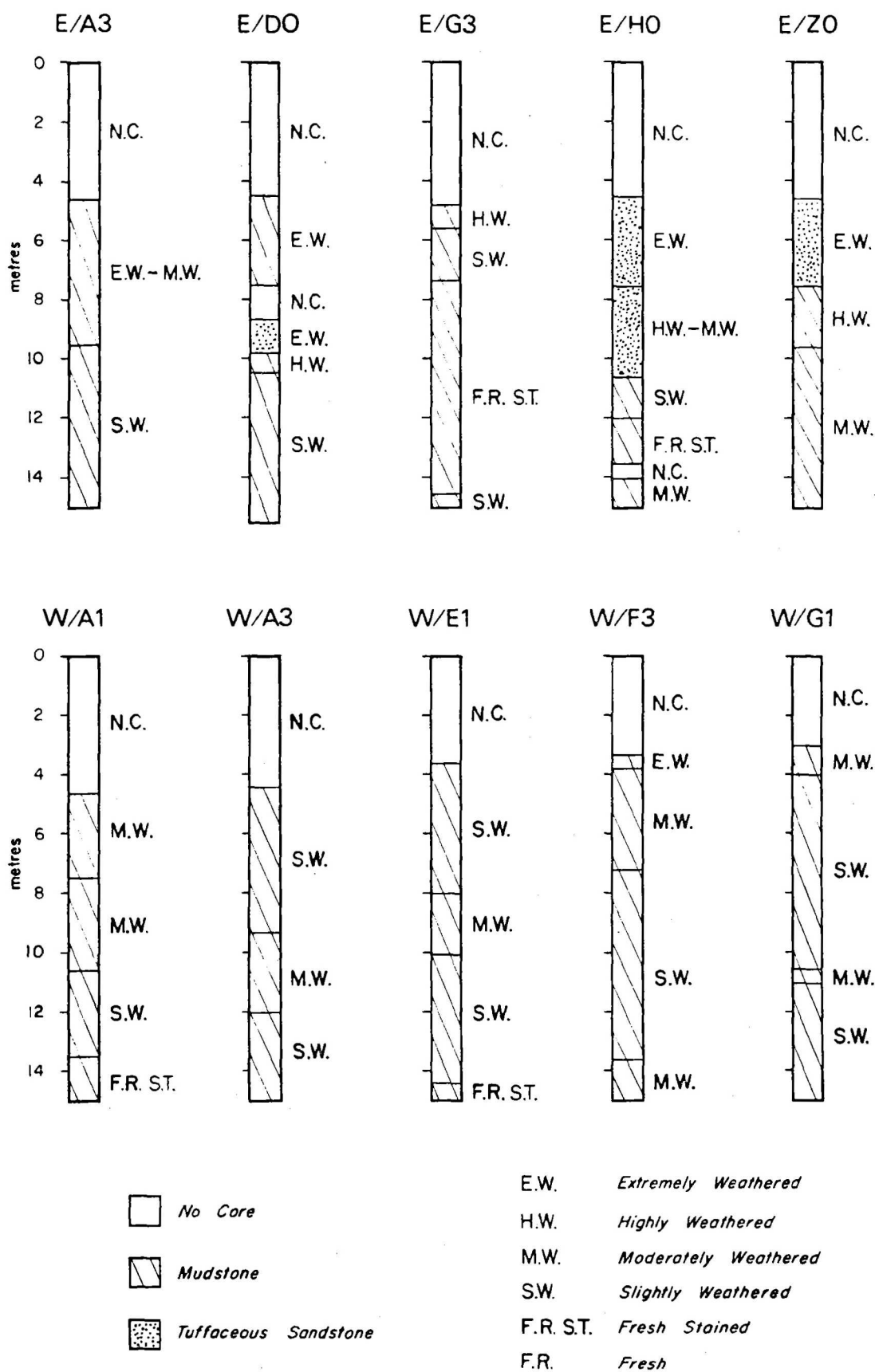


Fig. 6 Logs of drill holes, Section 41, Canberra City, August 1974

Site	Depth to sound foundation (m)		Depth to which rock is rippable (m)	
	Minimum	Maximum	Minimum	Maximum
Section 11	1.1	2.7	1.1	4.6
Section 41 (west)	4.2	5.4	4.2	9.4
Section 41 (east)	4.6	10.6	7.4	15.0

These three alternative sites are all suitable for a large building. A good deal of blasting would be required in an excavation on the Section 11 site. The western site on Section 41 would have more uniform foundation conditions than the eastern site.

SECTION 3, PARKES

Section 3, Parkes, opposite the Canberra College of Technical and Further Education, is being considered by NCDC planners as the site for a major public building. Results of the seismic investigation are shown in Plate 3, and details of diamond drilling are given in Appendix 1.

At this site about 5 m of alluvium overlies weathered mudstone. Fresh limestone occurs beneath the mudstone at a depth of 14 m in drillhole 107, and core losses of 10 and 12 m in drillhole 106 may indicate solution cavities. Foundation depths, i.e. moderately weathered bedrock, are expected to be 6-8 m in general; however, the seismic results indicate that the site is within the City East Fault Zone where zones of deeper weathering are to be expected, and a more detailed site investigation will be required for the design of foundations for a large building.

SECTION 4, PARKES

Section 4, Parkes is another site being considered for a major public building. Results of the seismic investigation are shown in Plate 4 and logs of diamond-drill holes are given in Appendix 2.

At this site several metres of fill and alluvium overlie irregularly weathered rocks of varying lithology including dacite, mudstone, and tuffaceous sandstone. There is some limestone but at considerable depth, and at least one fault passes through the section. Foundation depths are expected to average about 8 m, but could be variable and a foundation investigation will be required for any major building.

SECTION 5, CAMPBELL

Results of the seismic investigation at Section 5, Campbell are shown in Plate 5 and drill logs are given in Appendix 3.

At this site, alluvial gravel several metres thick overlies weathered dacite, shale, siltstone, and sandstone. Deep weathering in the dacite on the west side could present difficulties for foundations, although over most of the site large buildings could be founded on moderately weathered rock at 5-8 m. Artesian water was encountered at a depth of 25 m in drill hole 115; the water flowed at the surface at about 20 l/minute.

A pre-existing earth dam in the southeast of the section has been filled with spoil.

CONCLUSIONS

1. At Section 11, Canberra, hard rock is close to the surface, and blasting would be required for excavation. Both of the investigated sites on Section 41 would have suitable foundations for a large building at depths below 4 m. The westernmost site on Section 41 has more uniform foundation conditions than the eastern site.
2. The City East Fault Zone extends south through Section 3, Parkes, and additional site investigations will be necessary for design of a large building at this locality.
3. At Section 4, Parkes, a major building could be founded at a depth of 8 m; however, foundation rocks are variable in their properties.
4. At Section 5, Campbell, a major building could be founded at 5-8 m; however, foundation rocks are variable over this site.

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APPENDIX 1

LOGS OF DRILL HOLES

HOLE 12

(Logged by G.M. Burton from cuttings except for core from 8.2 to 9.4 m.

Date of hole 2/5/66)

0-0.9	m	Yellow soil including wash and floaters
0.9-4.0	m	Blackish soil and polymict rock fragments
4.0-4.9	m	Weathered fragments of silicified sandstone, siltstone and volcanics
4.9-7.6	m	Heavy yellow clay and rock fragments
7.6-11.6	m	Slightly weathered siltstone and shale
11.6-27.7	m	Slightly weathered partly silicified siltstone and shale
27.7-68.6	m	Fresh to slightly weathered siltstone and shale
End of hole		

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PROJECT BUILDING SITE
LOCATION SECTION 4 PARKES

HOLE NO. 102

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 90°
COORDINATES E39930' N8700'
(Stromlo Grid) E212170m N602652m
DIRECTION
R.L. OF COLLAR 1850' (approx)
564m

SHEET 1. of 2.

Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic Log	Lith and % core recovery	Depth and size of Core	Fracture Log	RQD	Defect Frequency Intercept Angle 0 30 60 80 90	Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) *
NO CORE										
mudstone mw	yellow-brown			2 1/2" core				joints stained with iron and manganese oxides		
sandy mudstone mw	reddish brown		60	5m						
buffaceous sandstone hw	orange to white		65							
mudstone mw	light brown		50							
mudstone cw	stiff orange clay r rock fragments		100							
mudstone mw	orange; grey brown		45							
			65							
mudstone mw	light grey-brown		60					laminated at 20°		
			90							
mudstone sw-mw	light grey-brown		80	10m						
			65							
mudstone sw	light grey-brown		95					joints at 45°		
			100							
mudstone sw	light grey-brown to dark grey		100							
mudstone sw-mw	light grey-brown to dark grey							fault plane?		
mudstone fs-sw	light grey-brown to dark grey		80					joint planes iron stained		
mudstone sw	light grey-brown to dark grey			15m						
			100							
mudstone mw	light grey-brown to dark grey		95							
			90					joints at 30°		
			100							
mudstone mw	light grey-brown to dark grey			20m						

Drill type Mayhew

Feed

Core barrel type Double

tube

Driller BMR

Commenced 20-1-75

Completed 24-1-75

Logged by BPILLANS

Vertical scale 1" = 2.5m

Checked by G.A.M.H.

Notes

Fracture Log — Number of fractures per 25 cm of core. Zones of core loss blocked in
Bedding and Joint Planes — Angles are measured relative to a plane normal to the core axis
Defect Frequency — Number of natural defects (shears, joints, fractures) per 25 cm of
core occurring at specified intercept angle range

Water Level Measurements — ∇ Level when hole in progress at specified depth
 ∇ Level in completed hole on specified date

fs — fresh stained
sw — slightly weathered
mw — moderately weathered
hw — highly weathered
cw — completely weathered

Water Pressure Tests

* Values in lugeons should be read
in conjunction with computation
sheets. Test sections are indicated
by blocked in strips.

Core Photograph Negative No.

Depth (m) Black & White Colour

BUREAU OF MINERAL RESOURCES,
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PROJECT BUILDING SITE
LOCATION SECTION 4, PARKES

HOLE NO. 102

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 90° DIRECTION _____
COORDINATES E39930 N8700 R.L. OF COLLAR 1850 (approx.)
(Stromlo Grid) E212170m N602652m 564m

SHEET 2 OF 2

Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic Log	Lift and % core recovery	Depth and size of Core	Fracture Log	RQD	Defect Frequency Intercept Angle	Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) *
				0 6 12 18			0 30 60 90 90			
calcareous mudstone sw-mw	light grey-brown to dark grey		100	20m				finally bedded at 30°		
mudstone mw-hw	light grey-brown to dark grey			2 1/2" core						
mudstone containing limestone pebbles sw	light grey-brown to dark grey		25					fault?		
fossiliferous limestone sw	dark grey									
NO CORE										
fossiliferous limestone fs-sw	dark grey		100							
fossiliferous limestone fs-sw	dark grey. corals, shelly fossils and polyzoans		100	25m				thin band (5cm.) of reworked (?) tuff at 25.6 m.		
interbedded shale & limestone fs	dark grey							bedded at 30°		
shale with calcareous laminae fr	dark grey.		100							
			100	30m						
END OF HOLE										

Drill type Mayhew
Feed _____
Core barrel type Double tube
Driller BMR
Commenced 20-1-75
Completed 24-1-75
Logged by B. PILHANS
Vertical scale 1"=2.5m
Checked by G.A.M.H.

Notes
Fracture Log — Number of fractures per 25 cm of core. Zones of core loss blocked in.
Bedding and Joint Planes — Angles are measured relative to a plane normal to the core axis.
Defect Frequency — Number of natural defects (shears, joints, fractures) per 25 cm of core occurring at specified intercept angle range.
Water Level Measurements — ✓ Level when hole in progress at specified depth.
✓ Level in completed hole on specified date.

Water Pressure Tests
* Values in lugeons should be read in conjunction with computation sheets. Test sections are indicated by blocked in strips.
Core Photograph Negative No.
Depth (m) Black & White Colour

HOLE NO. 103

ANGLE FROM HORIZONTAL (θ) 90° DIRECTION _____
 COORDINATES E40130' N8470' R.L. OF COLLAR 1860' (approx)
 (Stromlo Grid) E21232m N602582m 567m

SHEET 1 OF 2

[illegible]

HOLE NO. 103

DIRECTION _____
R.L. OF COLLAR 1860' (approx)
567m

SHEET 2 OF 2

[illegible][illegible]

HOLE NO. 104

SHEET 1 OF 2

Drill type <u>Mayhew</u>	Notes	Water Pressure Tests		
Feed		* Values in lugeons should be read in conjunction with computation sheets. Test sections are indicated by blacked in strips.		
Core barrel type <u>Double tube</u>	Fracture Log — Number of fractures per 25 cm of core. Zones of core loss blacked in	Core Photograph Negative No.		
Driller <u>BMR</u>	Bedding and Joint Planes — Angles are measured relative to a plane normal to the core axis	Depth (m)	Black & White	Colour
Commenced <u>5/2/75</u>	Defect Frequency — Number of natural defects (shears, joints, fractures) per 25 cm of core occurring at specified intercept angle range.	.....	.....	.....
Completed <u>10/2/75</u>	Water Level Measurements — $\frac{\text{I}}{\text{II}}$ Level when hole in progress at specified depth	.....	.....	.....
Logged by <u>G.A.M.H.</u>	$\frac{\text{I}}{\text{II}}$ Level in completed hole on specified date	.....	.....	.....
Vertical scale <u>1:100</u>		.....	.....	.....
Checked by		.....	.....	.....

HOLE NO 104

SHEET 2 OF 2

[illegible]

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (°) 30°
COORDINATES 603250 N
211380 EDIRECTION
R.L. OF COLLAR 558 m

SHEET 1 OF 2

Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic Log	Lift and % core recovery	Depth and size of Core	Fracture Log	RQD	Defect Frequency					Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) *
							Intercept Angle							
							0	30	60	80	90			
	NO CORE		0%	2 1/2										
	NO CORE													
ALLUVIUM	Brown clay, sand, and some quartz pebbles.		25%											
	NO CORE			5										
MUDSTONE SW	Grey, hard silty mudstone		85%									Clay filled joints		
MUDSTONE MW-SW	Grey		100%									2-15cm. pieces		
MUDSTONE MW	Yellow brown		100%											
MUDSTONE MW-SW	Grey brown		100%									Bedding dips 40° Clay filled bedding plane partings and joints		
MUDSTONE MW-SW	Grey brown		90%	10										
MUDSTONE SW	Grey		100%									Iron stained joints Fractured 2-20 cm. along joints and bedding plane partings.		
	Grey		50%											
MUDSTONE SW-FRST	Bluish grey, hard, strong		100%	15								Bedding dips 45° Fractures 2-20 cm. along joints and bedding plane partings.		
MUDSTONE FR	Bluish grey, hard, strong		100%											
S.W. MUDSTONE	Bluish grey											19.30 - 20.30 m. Fractured along vertical fault plane Iron stained. Some clay.		

Drill type MAYHEW

Feed Hydraulic

Core barrel type

Wireline

Driller BMR

Commenced 7-4-75

Completed 10-4-75

Logged by G. Jacobson

Vertical scale 1:100

Checked by

Notes

Fracture Log — Number of fractures per 25 cm of core. Zones of core loss blacked in.

Bedding and Joint Planes — Angles are measured relative to a plane normal to the core axis

Defect Frequency — Number of natural defects (shears, joints, fractures) per 25 cm of core occurring at specified intercept angle range.

Water Level Measurements — ∇ Level when hole in progress at specified depth. ∇ Level in completed hole on specified date.Foundation level 6 m.
Rip to 7 m.

Water Pressure Tests

* Values in lugeons should be read in conjunction with computation sheets. Test sections are indicated by blacked in strips.

Core Photograph Negative No.

Depth (m) Black & White Colour

[illegible]

PROJECT SECTION 3, PARKES
LOCATION

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 90°
COORDINATES 603210 N
 211430 E

DIRECTION _____
R.L. OF COLLAR 558

SHEET 1 OF 2

Drill type <u>MAYHEW</u>	Notes	Water Pressure Tests		
Feed <u>Hydraulic</u>		* Values in lugeons should be read in conjunction with computation sheets. Test sections are indicated by blacked in strips.		
Core barrel type <u>Wireline</u>	Fracture Log — Number of fractures per 25 cm of core. Zones of core loss blacked in.	Core Photograph Negative No.		
Driller <u>BMR</u>	Bedding and Joint Planes — Angles are measured relative to a plane normal to the core axis			
Commenced <u>4-4-75</u>	Defect Frequency — Number of natural defects (shears, joints, fractures) per 25 cm of core occurring at specified intercept angle range.	Depth (m)	Black & White	Colour
Completed <u>7-4-75</u>	Water Level Measurements — <u>✓</u> Level when hole in progress at specified depth. <u>✓</u> Level in completed hole on specified date.	-----	-----	-----
Logged by <u>G. Jacobson</u>	Foundation level 6.0m. possibly deeper (12.30m) Rip to 12.30 m.	-----	-----	-----
Vertical scale <u>1:100</u>		-----	-----	-----
Checked by		-----	-----	-----

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 90°

COORDINATES

DIRECTION

R.L. OF COLLAR

SHEET 2. OF 2.

Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic Log	Lift and % core recovery	Depth and size of Core	Fracture Log	RQD	Defect Frequency					Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) *
							Intercept	Angle						
MUDSTONE MW-SW	Reddish brown		100%									Bedding dips 45° 2-3 cm. beds.		
C.W. MUDSTONE	clay and fractured rock											FAULT ZONE 25 cm.		
MUDSTONE SW-FRST	Grey, hard, strong. Silty mudstone.		100%									Bedding dips 40-50°. Fractures average 15 cm. - mainly bedding plane partings, which are clay filled or iron- stained.		
MUDSTONE FR	Bluish grey, hard strong.		100%	25								4-20 cm. pieces		
MUDSTONE SW	Greyish brown.		80%									Bedding dips 45°. Iron stained and clay filled joints.		
END OF HOLE 30.0 m														

Drill type

Feed

Core barrel type

Driller

Commenced

Completed

Logged by

Vertical scale

Checked by

Notes

Fracture Log — Number of fractures per 25 cm of core. Zones of core loss blacked in.

Bedding and Joint Planes — Angles are measured relative to a plane normal to the core axis.

Defect Frequency — Number of natural defects (shears, joints, fractures) per 25 cm of core occurring at specified intercept angle range.

Water Level Measurements — ∇ Level when hole in progress at specified depth. ∇ Level in completed hole on specified date.

Water Pressure Tests

* Values in lugeons should be read in conjunction with computation sheets. Test sections are indicated by blacked in strips.

Core Photograph Negative No.

Depth (m) Black & White Colour

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (°) 90
COORDINATES 502145 N
211520 EDIRECTION _____
R.L. OF COLLAR 551 mSHEET 1 OF 2

Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic Log	Lift and % core recovery	Depth and size of Core	Fracture Log	RQD	Defect Frequency Intercept Angle				Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) *
							0	30	60	90			
	NO CORE			2 1/2									
FILL		Δ Δ											
CLAY	? C.W. MUDSTONE												
SAND											? Fallen in from the top of hole.		
CLAY	? C.W. MUDSTONE												
SAND	Course pebbly sand			5							1 m. of sand recovered - not sure if in place or fallen in.		
	NO CORE												
SAND													
MUDSTONE HW-MW	Purple, firm.										Some fragments of volcanic rock at start.		
	NO CORE												
MUDSTONE MW.	Purple												
MUDSTONE SW	Grey hard, strong.			10							Fossiliferous - fossils etched out in places. Bedding dips 40°. Average fracture spacing 10 cm. Fractures mainly bedding plane partings. Few joints.		
CALCAREOUS MUDSTONE FRST	Bluish grey, hard, strong										Thickly bedded.		
LIMESTONE FR	Bluish grey, hard and strong.			15							Massive, fossiliferous.		
LIMESTONE FR	Bluish grey, hard and strong.										Bedding dips 45°.		
LIMESTONE MW.	Brown										20 cm fracture zone - some slay, solution cavities up to 4 cm		
LIMESTONE FR.	Bluish grey			20 m									

Drill type MAYHEWFeed Hydraulic

Core barrel type _____

WirelineDriller BMRCommenced 1-4-75Completed 4-4-75Logged by G. JacksonVertical scale 1:100

Checked by _____

Notes

Fracture Log — Number of fractures per 25 cm of core. Zones of core loss blocked in.

Bedding and Joint Planes — Angles are measured relative to a plane normal to the core axis.

Defect Frequency — Number of natural defects (shears, joints, fractures) per 25 cm of core occurring at specified intercept angle range.

Water Level Measurements — ✓ Level when hole in progress at specified depth.✓ Level in completed hole on specified date.

Lost circulation at 19.20 m.

Redrilled interval 2.8 - 8.0 m,
after failing to recover core at first
attempt.

Foundation level 8.0 m. Rip to 9.0 m.

Water Pressure Tests

* Values in lugeons should be read
in conjunction with computation
sheets. Test sections are indicated
by blocked in strips.

Core Photograph Negative No.

Depth (m) Black & White Colour

SHEET 2 OF 2

Drill type	Notes <i>Fracture Log — Number of fractures per 25 cm of core. Zones of core loss blacked in.</i> <i>Bedding and Joint Planes — Angles are measured relative to a plane normal to the core axis.</i> <i>Defect Frequency — Number of natural defects (shears, joints, fractures) per 25 cm of core occurring at specified intercept angle range.</i> <i>Water Level Measurements — ∇ Level when hole in progress at specified depth.</i> <i>∇ Level in completed hole on specified date.</i>	Water Pressure Tests		
Feed		* Values in lugeons should be read in conjunction with computation sheets. Test sections are indicated by blacked in strips.		
Core barrel type		Core Photograph Negative No.		
Driller		Depth (m)	Black & White	Colour
Commenced		_____	_____	_____
Completed		_____	_____	_____
Logged by		_____	_____	_____
Vertical scale	_____	_____	_____	_____
Checked by	_____	_____	_____	_____

BUREAU OF MINERAL RESOURCES,
GEOLOGY & GEOPHYSICSPROJECT BUILDING SITE
LOCATION SECTION 5., CAMPBELL

HOLE NO 115.

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 90°
COORDINATES E40080' N9700'
(Stromlo Grid) E212216m N602957m
DIRECTION
R.L. OF COLLAR 1852'
564m

SHEET 1. OF 2.

Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic Log	Lift and % core recovery	Depth and size of Core	Fracture Log	RQD	Defect Frequency Intercept Angle	Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) *
	NO CORE									
SAND AND GRAVEL	Gravel mainly quartz, up to 2cm diam.		15%	3.5m						
SILTSTONE MW	Buff coloured, mod. hard and strong rock		100%	5.3m				Small angular finer grained inclusions at 5.7m.		
			65%	8.1m				Rock very broken		
SILTSTONE FS - SW occasional MW laminae	Pale green-grey, hard, strong rock.		100%	10.0m						
			100%							
			100%							
			100%	12.3m				Banding at 15°		
			100%	12.6m				Bedding at 20°		
			100%	14.8m				Broken zone 0.15m		
SILTSTONE - MUDSTONE FS	Pale grey, hard, strong rock.		100%	20.0m				Bedding at 30°		
			100%							
			100%							

Drill type Mayhew

Feed

Core barrel type Double
tube HQ

Driller B.M.R.

Commenced 12/2/75

Completed 17/2/75

Logged by G.A.M.H.

Vertical scale 1:100

Notes

Fracture Log — Number of fractures per 25 cm of core. Zones of core loss blacked in
Bedding and Joint Planes — Angles are measured relative to a plane normal to the core axis
Defect Frequency — Number of natural defects (shears, joints, fractures) per 25 cm of
core occurring at specified intercept angle range.

Water Level Measurements —  Level when hole in progress at specified depth
 Level in completed hole on specified date

Water Pressure Tests

* Values in lugeons should be read
in conjunction with computation
sheets. Test sections are indicated
by blacked in strips.

Core Photograph Negative No

Depth (m) Black & White Colour

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 90°
 COORDINATES E40080' N9700'
 (Stranale Grid) E212216m N602957m

DIRECTION
 R.L. OF COLLAR 1952'
 564m

SHEET 2 OF 2

Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic Log	Depth and size of Core	Fracture Log	RQD	Defect Frequency Intercept Angle 0 30 60 80 90	Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) "
As above			20.0m						
			100%				Broken zone 0.1m		
			21.3m						
MUDSTONE FR	Pale grey, hard, strong rock.		100%						
			100%				Broken zone 0.2m		
			25.0m				Broken zone 0.1m		
			100%						
			100%						
			100%				Broken zone 0.2m		
			30.0m				Bedding at 25°		
	END OF HOLE								

Artesian
water
Flow at
surface
about
20 litres/
min.

Drill type Mayhew
Feed _____
Core barrel type Double
Tube H.C.
Driller R.M.R.
Commenced 12/2/75
Completed 17/2/75
Logged by G.A.M.H.
Vertical scale 1:100
Checked by _____

Notes

Fracture Log — Number of fractures per 25 cm of core. Zones of core loss blocked in Bedding and Joint Planes — Angles are measured relative to a plane normal to the core axis.

Defect Frequency — Number of natural defects (shears, joints, fractures) per 25 cm of core occurring at specified intercept angle range.

*Water Level Measurements —  Level when hole in progress at specified depth
 Level in completed hole on specified date.*

Water Pressure Tests

* Values in lugeons should be read in conjunction with computation sheets. Test sections are indicated by blacked in strips.

[illegible]

BUREAU OF MINERAL RESOURCES,
GEOLOGY & GEOPHYSICS

PROJECT BUILDING SITE
LOCATION SECTION 5., CAMPBELL

HOLE NO. 111b

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 90°
COORDINATES E 39520' N 9650'
(Stromlo Grid) E 212046m N 602941m
DIRECTION
R.L. OF COLLAR 1865' (approx.)
568m

SHEET 1. OF 2.

Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic Log	Lift and % core recovery	Depth and size of Core	Fracture Log	RQD	Defect Frequency Intercept Angle	Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) *
	NO CORE									
QUARTZ GRAVEL				35m						
DACITE HW-CW	Yellow-brown, coarse-grained, soft, weak rock	✓	45%	5.0m						
		✓								
		✓	35%							
		✓								
		✓								
		✓	40%	10.0m						
		✓								
		✓								
		✓	40%							
		✓								
		✓								
		✓	15%	15.0m						
		✓								
		✓		15.9m						
DACITE HW-CW	Red-brown, coarse-grained, soft, weak rock	✓	20%							
		✓								
		✓		18.9m						
GRAVEL & CLAY	Brown. Gravel derived from decomposed dacite		10%	20.0m						

Drill type Mayhew

Feed

Core barrel type Double tube HQ

Driller BMR

Commenced 17/2/75

Completed 19/2/75

Logged by G.A.M.H.

Vertical scale 1:100

Checked by

Notes

Fracture Log — Number of fractures per 25 cm of core. Zones of core loss blacked in Bedding and Joint Planes — Angles are measured relative to a plane normal to the core axis. Defect Frequency — Number of natural defects (shears, joints, fractures) per 25 cm of core occurring at specified intercept angle range.

Water Level Measurements — ∇ Level when hole in progress at specified depth
 ∇ Level in completed hole on specified date.

Water Pressure Tests

* Values in lugeons should be read in conjunction with computation sheets. Test sections are indicated by blacked in strips.

Core Photograph Negative No.

Depth (m) Black & White Colour

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 90°
COORDINATES E39520' N9650'
(Stromlo Grid) E212046m N602941m
DIRECTION R.L. OF COLLAR 1865' (approx)
568m

Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic Log	Depth and size of Core	Fracture Log	RQD	Defect Frequency Intercept Angle	Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) *
						0 30 60 80 90			
GRAVEL & CLAY	Brown. Gravel derived from decomposed dacite		20.0m						
			10%						
			21.9m						
CLAY	Yellow-brown								
			70%						
			24.3m						
TUFFACEOUS SHALE MW	Pale buff-grey, mod. hard, weak rock. Closely jointed, splits easily on lamination planes.		100%						
			100%						
			250m						
			100%						
			100%						
			100%				Bedding at 25°		
			100%						
			100%						
			65%						
			30.0m						
			100%						
							Bedding at 20°		
			100%						
			100%				Bedding at 10°		
			36.4m						
END OF HOLE									

Drill type <u>Mayhaw</u>	Notes Fracture Log — Number of fractures per 25 cm of core. Zones of core loss blocked in. Bedding and Joint Planes — Angles are measured relative to a plane normal to the core axis. Defect Frequency — Number of natural defects (shears, joints, fractures) per 25 cm of core occurring at specified intercept angle range. Water Level Measurements — ☒ Level when hole in progress at specified depth. ☒ Level in completed hole on specified date.	Water Pressure Tests
Feed		* Values in lugeons should be read in conjunction with computation sheets. Test sections are indicated by blocked in strips.
Core barrel type <u>Double tube HQ</u>		Core Photograph Negative No.
Driller <u>BMR</u>		Depth (m) Black & White Colour
Commenced <u>17/2/75</u>		
Completed <u>19/2/75</u>		
Logged by <u>C.A.M.N.</u>		
Vertical scale <u>1:100</u>		
Checked by		

HOLE NO 145

SHEET 3 OF 15

Notes		Core Photograph Negative No.	
Fracture Log - Number of fractures per 25cm of core. Zones of core loss blocked in		Depth(m)	Black & White Colour
Bedding & Joint Planes - Angles are measured relative to a plane normal to the core axis		-----	-----
Water Level Measurements -  Level when hole in progress at specified depths		-----	-----
 Level in completed hole on specified date		-----	-----
		-----	-----
		-----	-----

BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS		PROJECT <u>BUILDING SITE PROJECT</u> LOCATION <u>SECTION 5, CAMPBELL</u>				HOLE NO. <u>156</u>					
GEOLOGICAL LOG OF DRILL HOLE		ANGLE FROM HORIZONTAL (°) <u>90°</u> COORDINATES <u>212063</u> <u>602998</u>		DIRECTION R.L. OF COLLAR <u>569m</u>		SHEET <u>1</u> OF <u>2</u>					
Rock Type and Degree of Weathering		Description Lithology, colour, strength, etc		Casing Graphic Log	Log	Fracture Log	ROD	Defect Frequency Intercept Angle 0 30 60 80 90	Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) *
		NOT CORED									
Alluvium		stiff brown clay grading into quartz pebbles set in clayey soil matrix, brown to yellow brown			54% 2.50 100%						
Sandstone H.W. (grey)		Medium grained feldspathic, with minor mudstone layers (M.W. - H.W.) yellow brown.			85% 5.5 54%				Zone of qtz.		
Mudstone M.W. - H.W.		Fine-grained, grey-brown. Some grey sandy bands.			100% 8.2 100% 9.2 100%				Bedding of silty seams vertical.		
Sandstone H.W.		grey-brown friable feldspathic sandstone			100% 11.6 11.8				Joint fractures Mn-stained		
Mudstone M.W. - S.W.		Light brown - yellow brown mudstone, with layers of H.W. sandy mudstone.			100% 14.3 16.4				Well jointed and cleaved. All fractures are Mn-stained.		
M.W. - S.W.		Light brown to brown mudstone. Bands of green mudstone.			80% 19.5				Bedding dips at 40°		

Drill type <u>Mayhew</u> Feed <u>Mechanical</u> Core barrel type <u>Triefes 2 1/2</u> <u>double barrel tube</u> Driller <u>L. Keast</u> Commenced <u>5/5/76</u> Completed <u>12/5/76</u> Logged by <u>R. Evans</u> Vertical scale <u>1cm = 1m</u> Checked by	Notes Fracture Log — Number of fractures per 25 cm of core. Zones of core loss blacked in Bedding and Joint Planes — Angles are measured relative to a plane normal to the core axis Defect Frequency — Number of natural defects (shears, joints, fractures) per 25 cm of core occurring at specified intercept angle range. Water Level Measurements — <u> </u> Level when hole in progress at specified depth <u> </u> Level in completed hole on specified date	Water Pressure Tests * Values in lugeons should be read in conjunction with computation sheets. Test sections are indicated by blacked in strips Core Photograph Negative No. Depth (m) Black & White Colour
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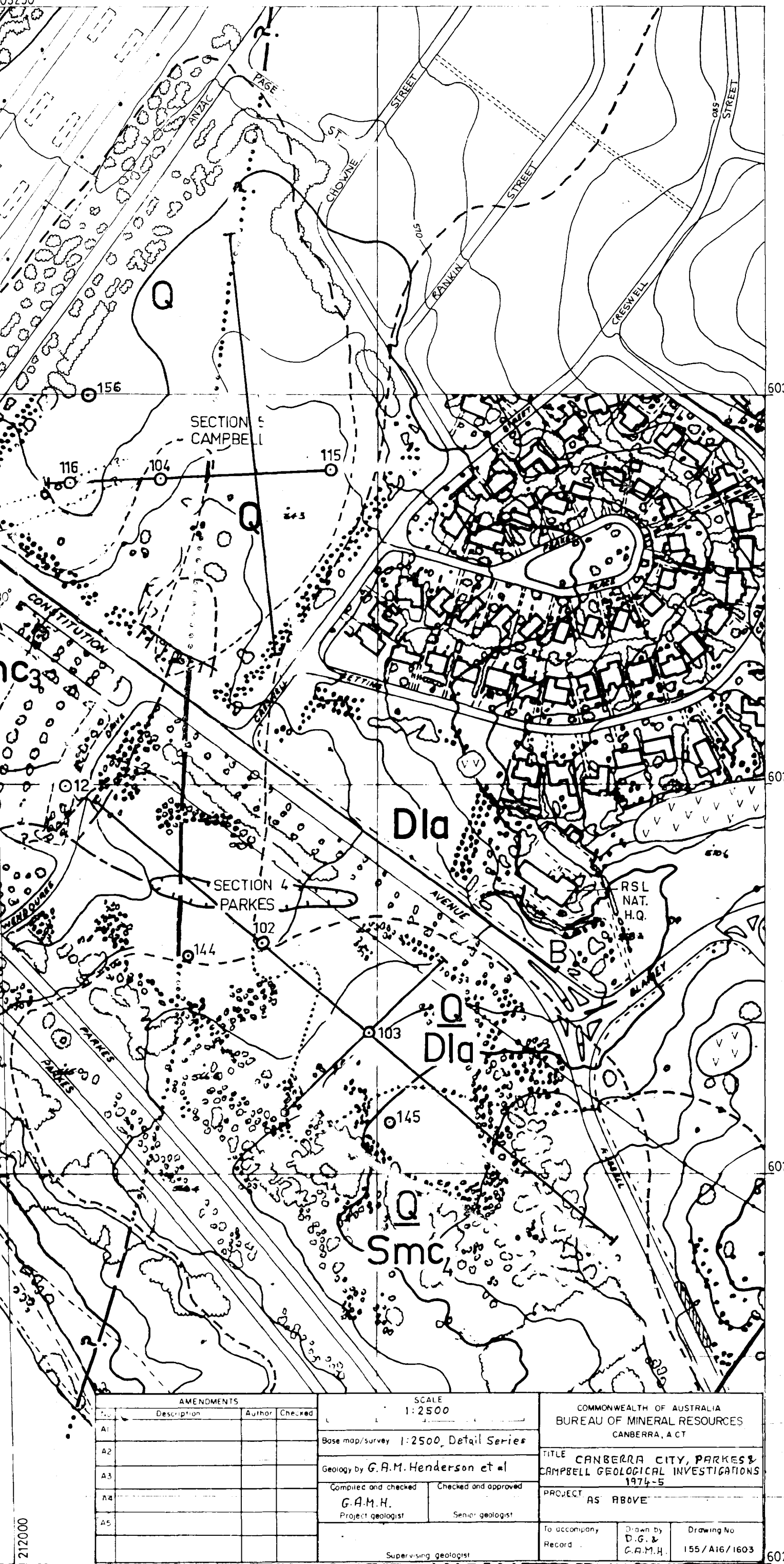
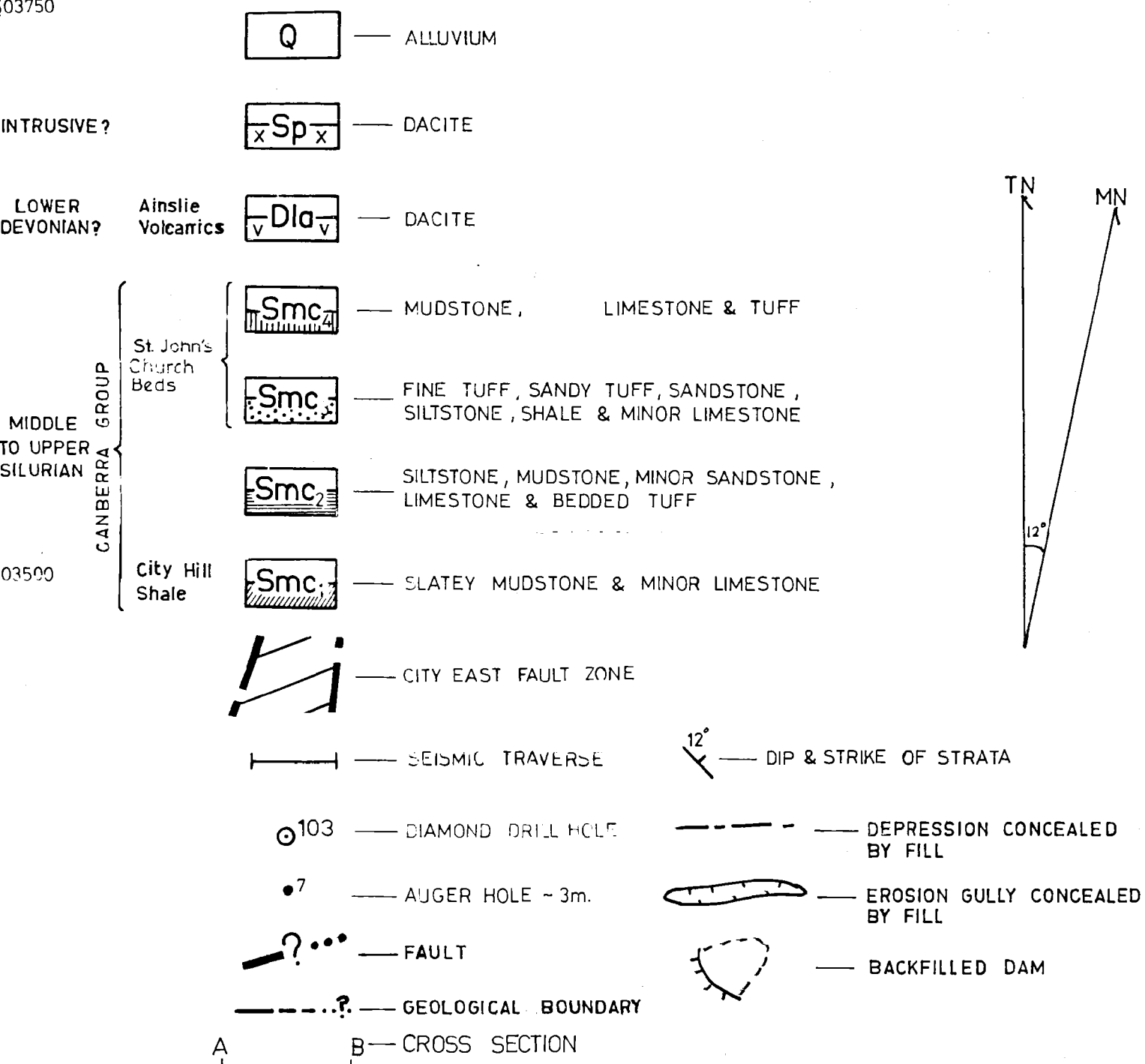
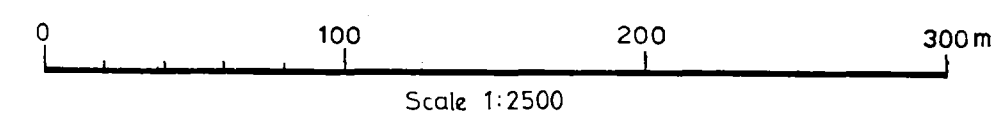
HOLE NO. 156

SHEET 2 OF 2

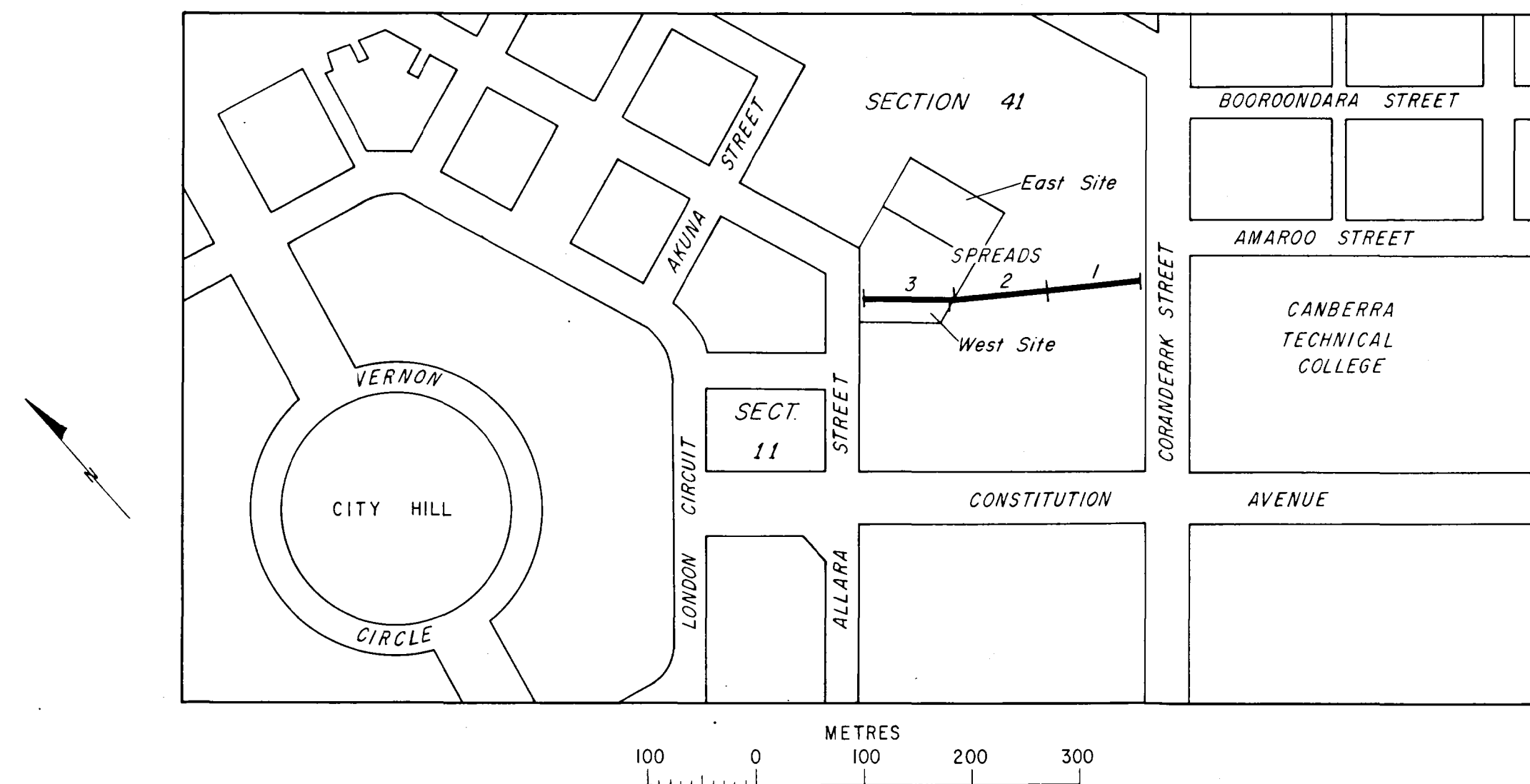
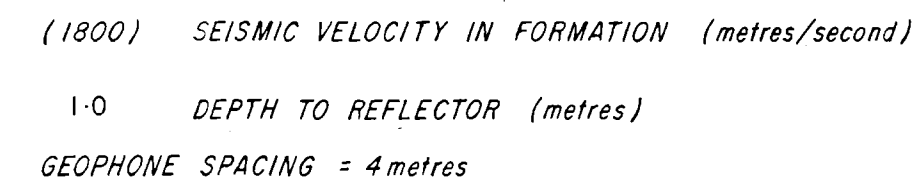
Drill type	Notes	Water Pressure Tests
Feed <u>Mechanical</u>	<i>Fracture Log — Number of fractures per 25 cm of core. Zones of core loss blacked in</i>	* Values in lugeons should be read in conjunction with computation sheets. Test sections are indicated by blacked in strips.
Core barrel type <u>Trie fcs 2½"</u>	<i>Bedding and Joint Planes — Angles are measured relative to a plane normal to the core axis</i>	
<u>Double barrel tube</u>	<i>Defect Frequency — Number of natural defects (shears, joints, fractures) per 25 cm of core occurring at specified intercept angle range.</i>	
Driller <u>L. Keast</u>	<i>Water Level Measurements — ∇ Level when hole in progress at specified depth. $\square$ Level in completed hole on specified date.</i>	Core Photograph Negative No.
Commenced <u>5/5/76</u>		Depth (m) Black & White Colour
Completed <u>12/5/76</u>		-----
Logged by <u>R. Evans</u>		-----
Vertical scale <u>1cm = 1m</u>		-----
Checked by -----		-----

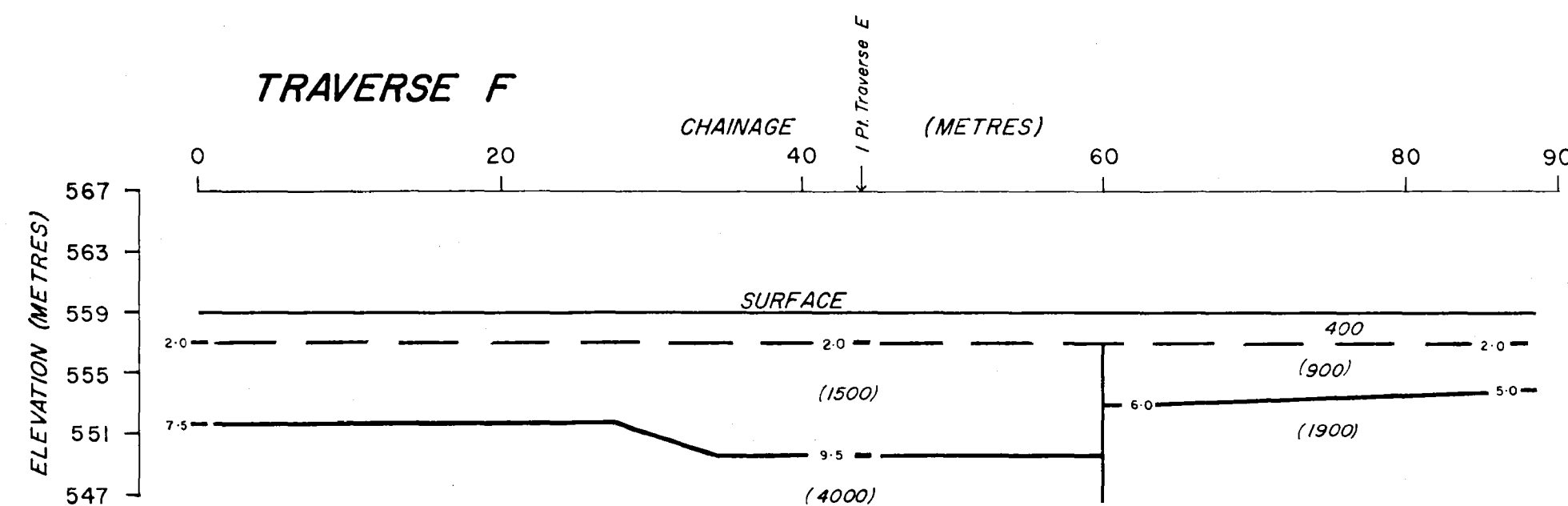
CANBERRA CITY, PARKES & CAMPBELL

GEOLOGICAL INVESTIGATION 1974-5



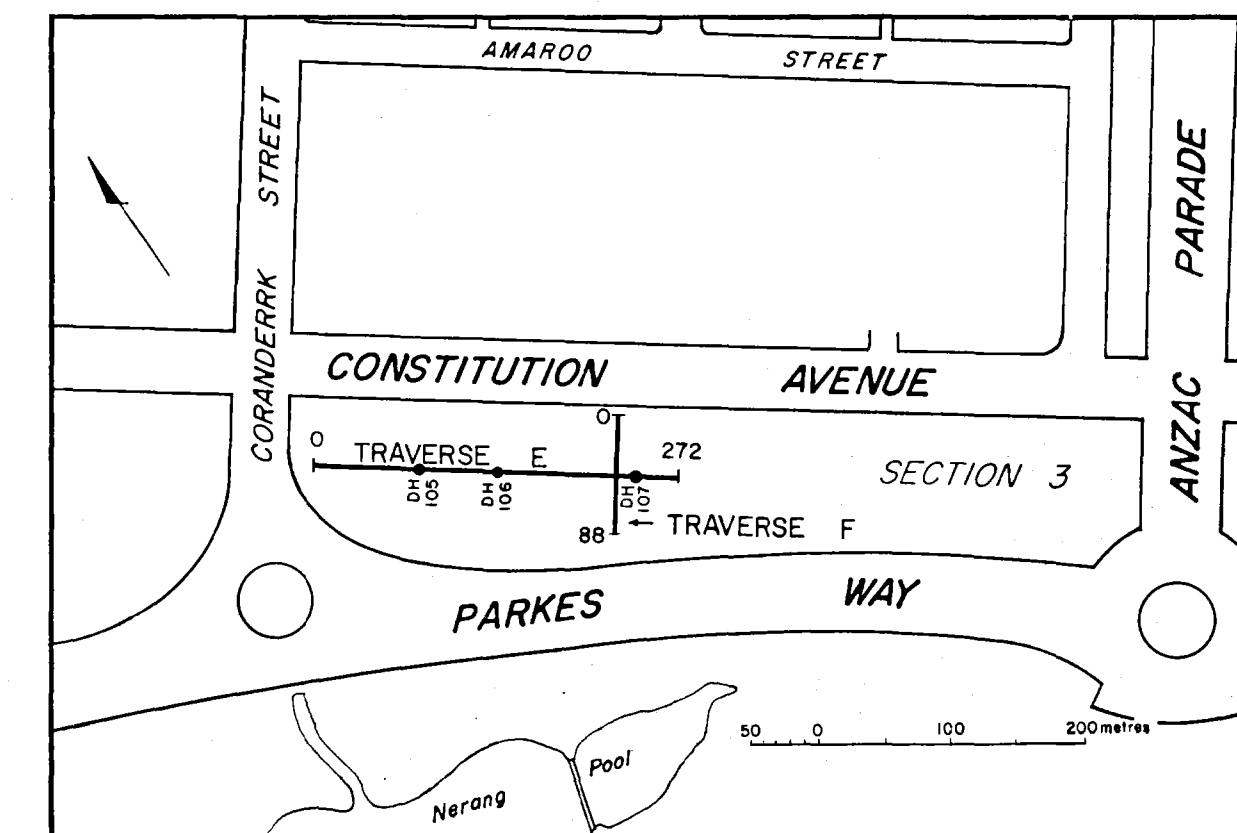
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					PROJECT AS ABOVE	
					To accompany Record	
					Drawing No. 155/A16/1603	

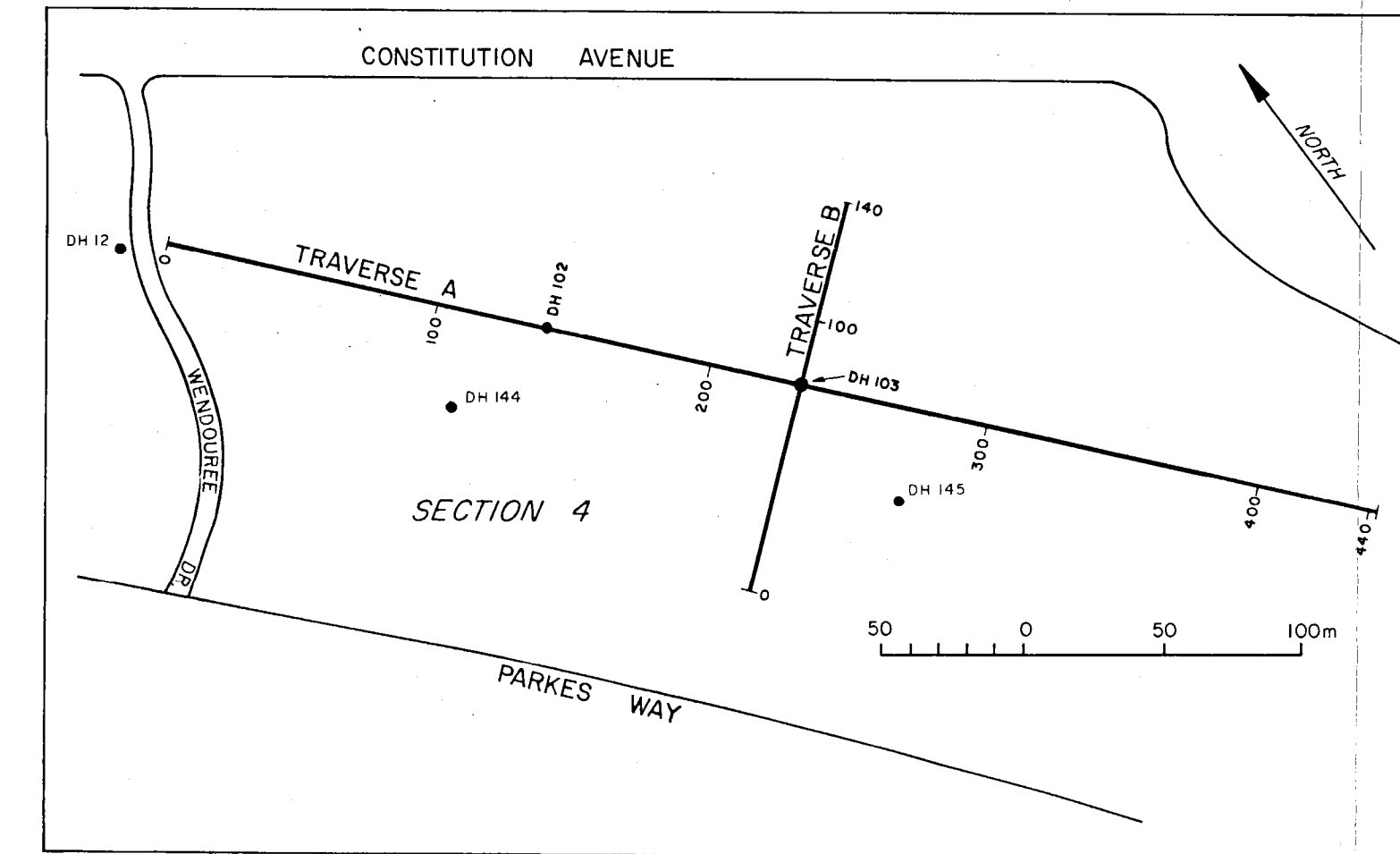
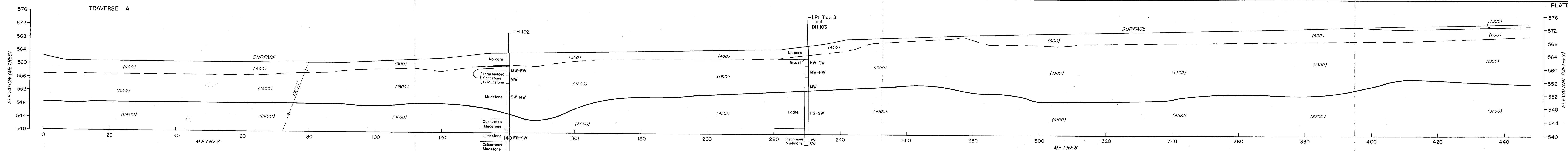




LEGEND

EW	EXTREMELY WEATHERED
HW	HIGHLY WEATHERED
MW	MODERATELY WEATHERED
SW	SLIGHTLY WEATHERED
FS	FRESH STAINED
FR	FRESH
(1500)	SEISMIC VELOCITY IN FORMATION (metres/second)
τ	DEPTH TO REFRACTOR (metres)
	BEDROCK BOUNDARY



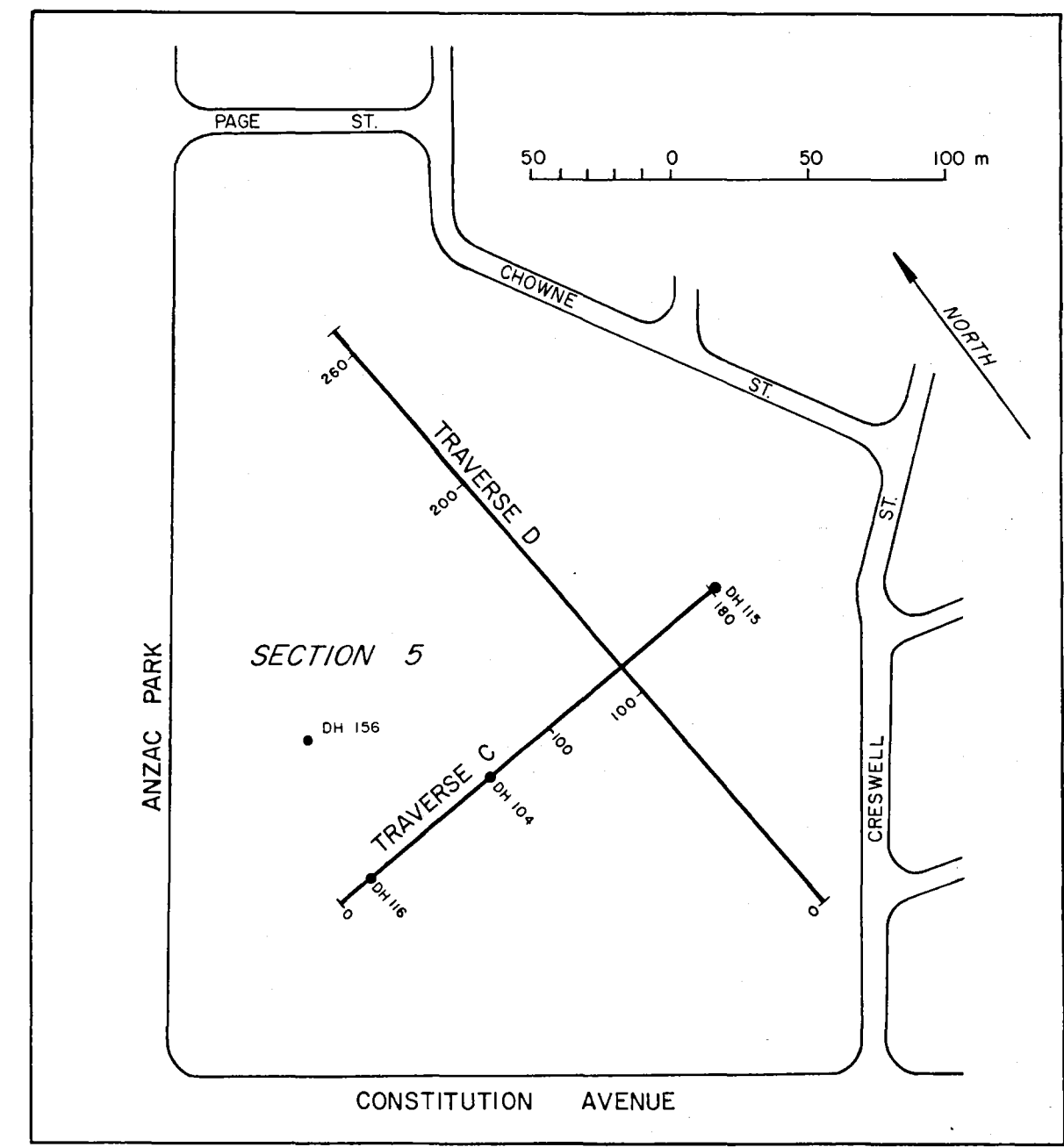
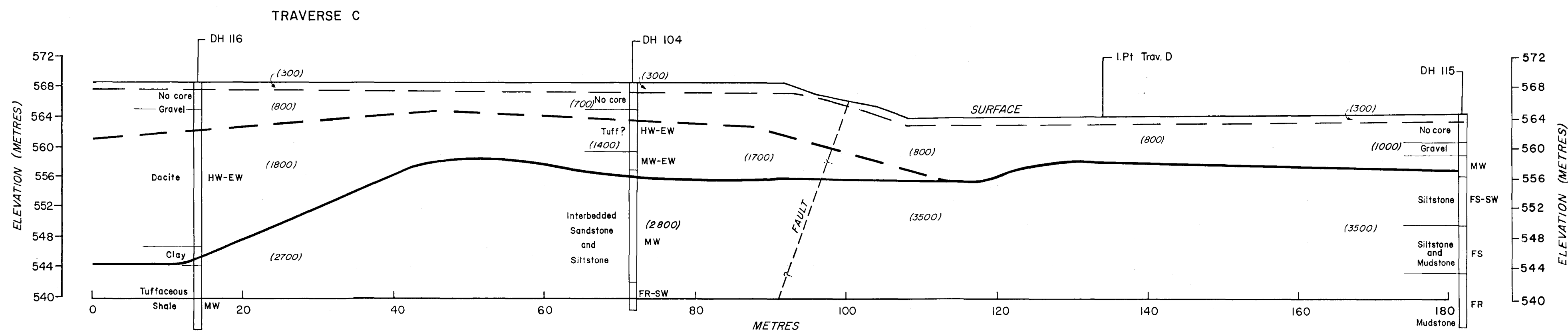
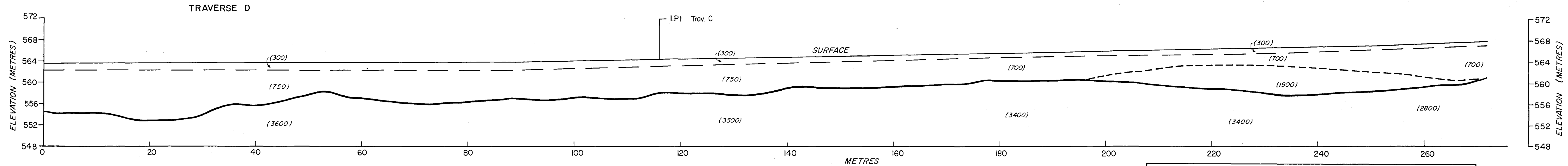


LEGEND

EW EXTREMELY WEATHERED
HW HIGHLY WEATHERED
MW MODERATELY WEATHERED
SW SLIGHTLY WEATHERED
FS FRESH STAINED
FR FRESH
(1500) SEISMIC VELOCITY IN FORMATION (metres)
BEDROCK BOUNDARY

5 0 10 20m

SECTION 4, PARKES
SEISMIC CROSS-SECTIONS



SECTION 5, CAMPBELL
SEISMIC CROSS-SECTIONS