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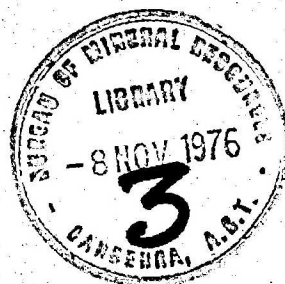


DEPARTMENT OF
MINERALS AND ENERGY

**BUREAU OF MINERAL RESOURCES,
GEOLOGY AND GEOPHYSICS**

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Record 1976/53



FOUNDATION INVESTIGATIONS AT MURRUMBIDGEE BRIDGE
SITE NO. 3, A.C.T., 1975:
ENGINEERING GEOLOGY AND SEISMIC REFRACTION SURVEY

by

D.G. Bennett, R.C. Goldsmith, and E.J. Polak

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- 1 - Geological map
- 2 - Seismic sections of traverses A, B, C, D, E, and F

FIGURES

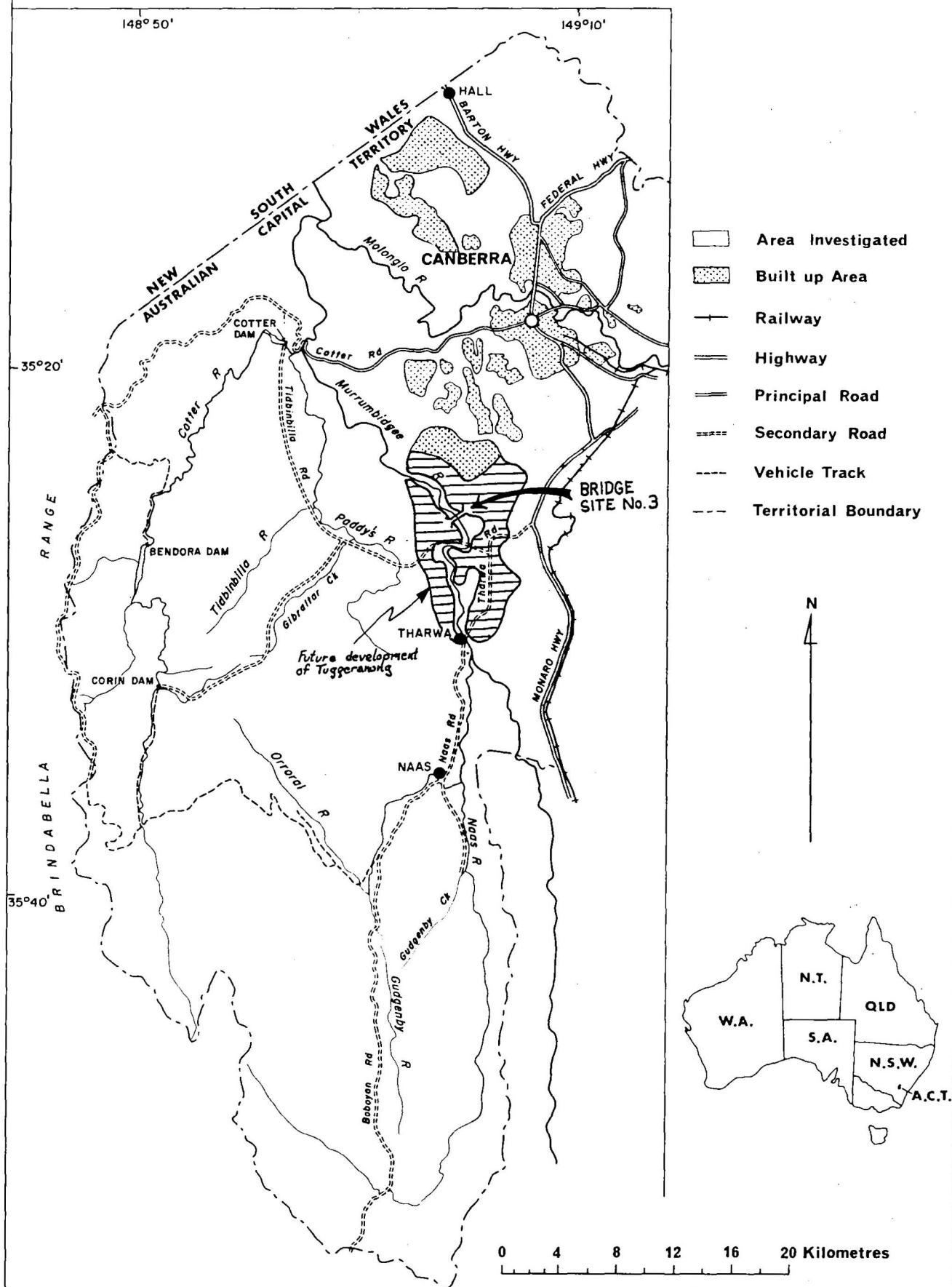
- 1 - Location map
- 2 - Relations of modulus of elasticity to seismic velocity and to compressive strengths of soil types

SUMMARY

A foundation investigation of the proposed Murrumbidgee bridge site no. 3, Tuggeranong, A.C.T., comprised of a seismic refraction survey and geological mapping. The rock at the site is a medium-grained dacite with no major structural defects at the proposed pier locations. Seismic velocities from the deepest refractors ranged from 4100 to 6600 m/s, and the depth to competent rocks - moderately to slightly weathered dacite - ranged from 0.5 to 7 m at the pier locations.

FIGURE 1

MURRUMBIDGEE BRIDGE No.3 LOCATION MAP



INTRODUCTION

A bridge that the National Capital Development Commission (NCDC) is planning across the Murrumbidgee River at site no. 3 will provide the first high-level access to the west bank of Tuggeranong (Fig. 1). NCDC requested the Bureau of Mineral Resources (BMR) to carry out geological and geophysical investigations of the bridge site so as to determine the foundation conditions at each of the proposed pier sites and bridge abutments, and to make the results of the investigation available to the design engineers, Maunsell and Partners.

The geological mapping was carried out by R. Goldsmith, of the Engineering Geology Subsection. The seismic refraction survey was carried out by the Engineering Geophysics Group; six seismic traverses totalling 480 m were surveyed by the geophysical party consisting of D. Bennett, D. Francis, and M Preston-Stanley.

A contractor carried out a diamond drilling program for Maunsell and Partners. Thirteen holes totalling 128 m were completed in December 1975 at the proposed bridge pier sites, and were logged by BMR (see Appendix).

GENERAL GEOLOGY

The Murrumbidgee bridge site no. 3 is located on Upper Silurian volcanic rocks (Plate 1). The rock is a dark grey-green dacite, porphyritic in places, but generally with a medium grain-size (Goldsmith, 1975). Joints and fractures follow no particular trend, but there is one persistent joint set striking between 090° - 115° and dipping between 70° - 90° . Joints are moderately close to closely spaced, but discontinuous and generally tight; no clayey surfaces were apparent. Two shear zones cross the bridge alignment: one, striking 090° , intersects the northern foundation of pier E, and is associated with moderately spaced parallel joints; the other, striking 015° , intersects the northern foundation of pier F (and would be represented by a zone of deeper weathering), and is indicated by closely fractured zones covering 4-5 m² in outcrop and by the seismic profiles. Outcropping rock at the bridge site is moderately to slightly weathered, and is also hard and moderately strong, near the river bed.

Sand and gravel terraces up to 5 m thick occupy both banks up to 5-7 m above the river channel.

SEISMIC REFRACTION SURVEY

Method

The seismic refraction method was used in the investigation (Heiland, 1946). Spreads consisted of 24 geophones placed in a straight line with 2 m geophone spacings, except for two spreads along traverse A in which 4 m spacings were used. Five charges were fired - one in the centre of the spread, one at each end of the spread, and one offset from each end by a distance equal to half of the spread length. The equipment used was 24-channel SIE PSU-19 refraction seismograph with 8 Hz GSC-20D geophones.

Interpretation was based on the reciprocal method (Heiland, 1946, p. 548).

Traverse A was located along the centreline of the bridge on the west bank, and was rotated 10° to the north from the centreline on the east bank. The cross traverses were located at the proposed positions of the bridge pylons on the west bank, but were slightly offset from pylon positions on the east bank.

Results

The results of the survey are shown in Plate 2. Seismic velocities in the area can be correlated with the geology of the site as follows:

- (a) Top layer: soil, sand, and gravel with seismic velocities 600-800 m/s.
- (b) Second layer: weathered dacite with seismic velocities between 1400 and 2900 m/s.
- (c) Third layer: unweathered dacite with seismic velocities between 4700 and 6600 m/s. The dacite along traverses B, F, and the northeastern end of traverse A show zones with slightly lower velocities.

Seismic anisotropy is indicated by differences between the two seismic velocities measured at traverse intersections. The intersections of traverse A with traverses B, C, and F have recorded higher bedrock velocities along the cross traverses; there was no change in velocities at the intersection with traverse E, and a lower velocity along traverse D at the intersection with traverse A. It is generally concluded that higher velocities are measured in directions parallel to the major defects in the rock.

The high velocity of the deepest refractor in the dacite indicates good quality foundation rock. Similar volcanic rocks in adjacent areas with velocities in this range have a modulus of elasticity that ranges between 4.77×10^4 M Pa for 4700 m/s and 9.4×10^4 M Pa for 6600 m/s (Polak, 1963). Figure 2 shows the relation between seismic velocity and modulus of elasticity.

The results will not be accurate in areas with shallow depths of weathering because the seismic record can only be read with accuracy to 1 millisecond; assuming an average velocity of about 1500 m/s in the top layer, an error of 50 percent may occur. In places with a thick top layer - e.g., northeast end of traverse A - the normal error of ± 10 percent will apply.

ENGINEERING GEOLOGY

PIER FOUNDATIONS

Pier locations are shown on the geological plan and on the seismic sections, and the piers are lettered to correspond with the appropriate seismic traverses. Pier G on the east bank of the river has no corresponding traverse.

The depths at which suitable foundation rock will be found have been deduced from the seismic and drilling results and the rock defects that have been mapped in the area. Some variation from the expected depths will be encountered if the excavations for piers expose shear zones or closely spaced joints that were concealed and not observed in mapping the geology of the site.

Pier C

Pier C is located at the intersection of traverses A and C. About 1 m of river sand overlies extremely to highly weathered dacite, but the weathering is irregular as drill hole 3 intersected variably weathered dacite to 5 m. However, drill hole 4 intersected slightly weathered rock at 1.5 m, so competent rock should be encountered within the 1500-2900 m/s velocity layer. The difference in intermediate-layer velocities in traverses A and C, 2900 m/s and 1500 m/s respectively, may result from a greater number of open joints being intersected in the direction of traverse C than in the direction of traverse A.

At the northern end of pier C the depth to competent rock is at least 5 m; based both on drilling and seismic results (if 1500 m/s velocity is the true interpretation). Shallower weathering occurs in the middle section of the pier, where

competent rock is encountered at 1.5 m. At the southern end it is difficult to predict the subsurface conditions, but depth to competent rock is likely to be at most 5 m.

Pier D

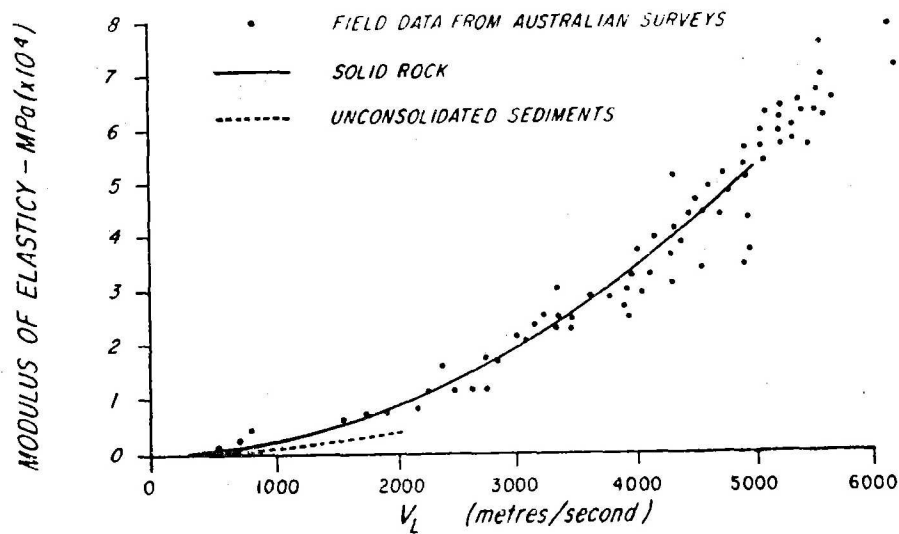
Pier D is located at the intersection of traverses A and D. The pier will be founded on moderately weathered to slightly weathered closely jointed dacite that crops out at the surface at the northern part of the pier and is covered by up to 2 m of alluvium elsewhere. Drill hole 6 intersected moderately weathered rock close to the surface, and closely jointed slightly weathered rock at 2 m. The seismic velocity of fresh rock is 4700 m/s, and the pier will be founded at about 1 m on moderately to slightly weathered dacite.

Pier E

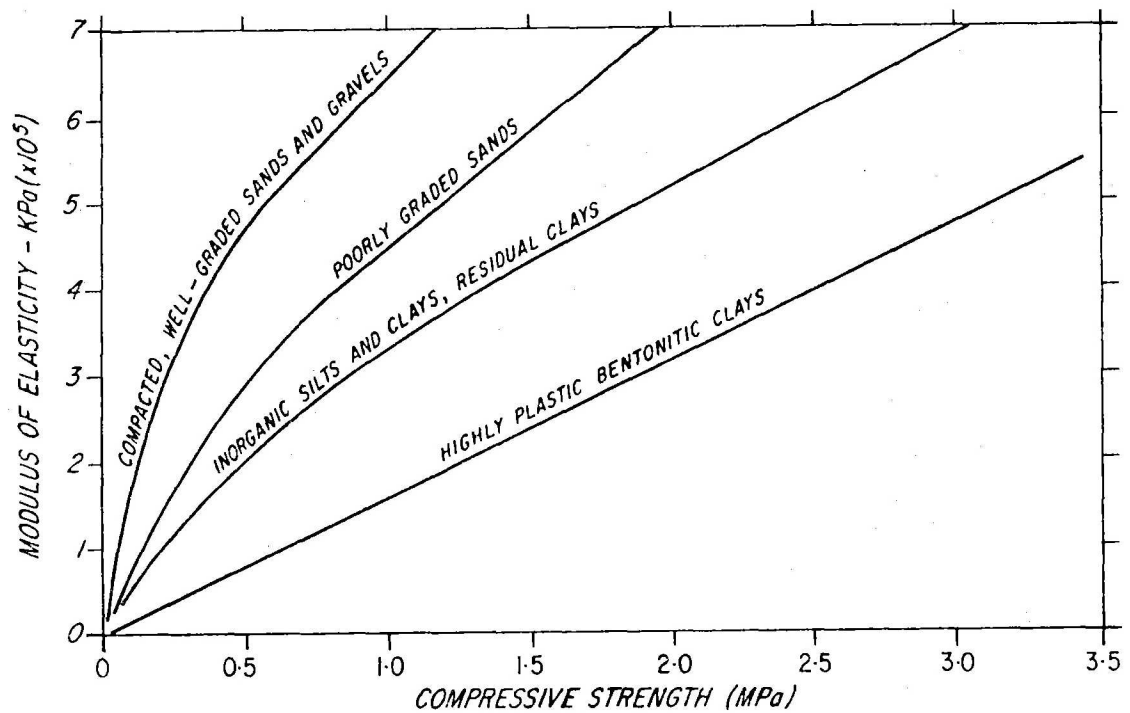
Pier E is offset to the south from traverse A, and is almost on line with traverse E. The pier will be founded on slightly weathered to fresh-stained dacite. A shear zone 1 m wide intersects the northern pier site, and was also intersected in drill hole 9, where much of the core is closely fractured, sheared, and contains abundant chlorite and sericite. Drill hole 10 intersected fresh-stained rock at 3 m. Dacite crops out within a few metres of the northern margin of the pier, but the site is covered by river alluvium, whose thickness of between 5 and 7 m determined from the seismic sections suggests that it may represent a sand-filled scour channel. The dacite has a velocity of 5200 to 5400 m/s, which represents competent rock suitable for foundation.

Pier F

Pier F is also offset to the south from traverse A, and is slightly offset from traverse F. Pier F will be founded on moderately weathered dacite underlying 3 to 4 m of alluvium. Dacite is close to the surface at the southeast margin of the pier. Rock suitable for the foundation will lie in the 1300 to 2900 m/s layer. Drill hole 12 intersected moderately weathered rock at 4 m. The low velocity in the intermediate and high refractors at the southern end of traverse F may indicate a fault or a shear zone. If this zone has continuity with the zone at the eastern end of traverse A, it may represent a low-velocity zone with a bearing of about 010° , that is aligned with a shear zone about 4 m wide mapped on an outcrop in the river bed. The northern portion of this pier may intersect the shear zone, for rock quality in drill hole 12 is better than that in drill hole 11, and deeper excavation to competent rock may be required in the shear zone.



RELATION OF MODULUS OF ELASTICITY TO LONGITUDINAL SEISMIC VELOCITY

RELATION OF MODULUS OF ELASTICITY TO COMPRESSIVE STRENGTH OF SOIL TYPES
(Wilson & Dietrich, 1960)

DYNAMIC PROPERTIES OF ROCKS

Pier G

Pier G is sited on solid outcrops of moderately to slightly weathered dacite. Drill holes 7 and 8 indicate fresh-stained dacite at 50-70 cm, the rock is generally closely fractured with infillings of quartz and chlorite, but the rock mass as a whole is tight and strong. Dominant jointing dips north at about 80° ; no major defects affecting the foundation stability are known at the site, and suitable foundation rock should be found at less than 1 m.

ABUTMENTS

Left

The left abutment is located 12 m northeast of the intersection of traverses A and B, where moderately weathered to slightly weathered or jointed rock with a seismic velocity of 2300-2900 m/s underlies 1-2 m of overburden consisting of soil, slopewash, and extremely to highly weathered dacite. Dacite with a velocity of 4100-6600 m/s at depths between 8 and 10 m is probably a slightly weathered to fresh rock with limonite-stained joints. The nearby drill hole 2 indicates moderately weathered rock at 2-3 m. At this depth the rock mass is moderately strong but joints are open and some would be clay-coated. Competent rock suitable for founding the abutment is expected at a depth of 2-3 m.

Right

The right abutment is located at the eastern end of traverse A, and drill holes 13 and 14 are to the northwest of the abutment. The seismic profile indicates that highly to moderately weathered rock extends to a depth of 20 m, but drill holes 14 and 13 intersected moderately weathered rock at 11.2 m and 7.8 m respectively. This discrepancy is probably due to the intermediate refractor increasing in seismic velocity towards the bedrock interface. Rock suitable for foundation is expected at depths between 8-15 m (deeper towards the southeast).

CONCLUSIONS AND RECOMMENDATIONS

1. The investigation for the Murrumbidgee bridge site no. 3 indicates that bridge piers and abutments at the sites presently proposed would be founded on dacite in which the highest seismic refractor gave velocities of 4700 to 6600 m/s at depths ranging from 0.5 m to 23 m. The average modulus of elasticity of the dacite calculated from seismic velocities is 6.3×10^4 M Pa.

2. Apart from the two shear zones no major geological defects are known to occur at the bridge site, and all piers could be founded on competent rock consisting of moderately to slightly weathered dacite, but at varying depths as set out below:

Left abutment	2-3 m	Right abutment	8-15 m
Pier C	2-5 m	Pier E	3-7 m
Pier D	about 1 m	Pier F	4-6 m
		Pier G	about 1 m

3. During excavation, a geologist should map the foundations to locate and assess the effect of any defects that are present.

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- POLAK, E.J., 1963 - The measurements of relation between and factors affecting the properties of rock. Proc. 4th Aust-NZ Conf. Soil Mech., 220-4.
- WILSON, S.D., & DIETRICH, R.T., 1960 - Effect of consolidation pressure on elastic and strength properties of clay. ASCE Conf. shear strength of Cohesive Soils, Boulder, 419-35.

APPENDIX: GEOLOGICAL LOGS OF DRILL HOLES

BUREAU OF MINERAL RESOURCES,
GEOLOGY & GEOPHYSICS

PROJECT MURRUMBIDGE BRIDGE NO. 3
LOCATION West bank of River, Tuggeranong
ANGLE FROM HORIZONTAL (°) 90° DIRECTION _____
CO-ORDINATES N 586742 E 205169 R. L. OF COLLAR 557.87

HOLE NO. 1
SHEET 1 OF 1

GEOLOGICAL LOG OF DRILL HOLE

Drilling Information					Rock Substance		Rock Mass Defects							
Method	Drilling rate	Casing	Water	Pressure test #. (lugesons)	Lift & % core recovery	Depth (metres)	Graphic log & core loss	Substance description rock type : grain characteristics colour, structure, minor components	Weathering	Point load strength 0-50 50-100 100-150 (MPa)	Defect spacing (cm) 0-25 25-50 50-100 100-200 200-300	R. Q. D.	Defect description thickness, type, inclination, planarity, roughness, coating, strength. Particular General	Rock condition No. (interpretive)
					100	1	V V V V	DACITE - Grey-brown coarse grained, irregular veins of sericite, chlorite	EW MW HW				- Clay coated jt Jts closely spaced HW-EW along faces, clay coated in some places. Dip 30-40°, some 70-90°	
						2		EOH 2.1 m						

HOLE NO. 2

SHEET 1 OF 1

Drill type <u>Gemco</u>	<u>Weathering</u>	<u>Water</u>	Core Photograph Negative No.
Feed <u> </u>	Fr - Fresh	10 Oct. '73 water level date shown	Depth (m)
Core barrel type <u>NMLC</u>	SW - Slightly weathered	Water inflow	Black & White
<u> </u>	MW - Moderately weathered	Partial drilling water loss	Colour
Driller <u> </u>	HW - Highly weathered	Complete drilling water loss	
Commerced <u> </u>	EW - Extremely weathered		
Completed <u>Nov 75</u>	<u>Notes</u>		
Logged by <u>RC Goldsmith</u>	Bedding & Joint Planes — Angles are measured relative to a plane normal to the core axis		
Vertical scale <u>1cm = 1m</u>	* Water Pressure Tests — Values in lugeons should be read in conjunction with computation sheets.		

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (°) 90° DIRECTION _____
CO-ORDINATES N586754 E205186 R. L. OF COLLAR 554.95SHEET 1 OF 1


Drilling Information					Rock Substance		Rock Mass Defects							
Method	Drilling rate	Casing	Water	Pressure test * (megapascals)	Lift & % core recovery	Depth (metres)	Substance description rock type grain characteristics colour, structure, minor components	Weathering	Point load strength 0.3 1.0 3.0 10.0 15.0 (MPa)	Defect spacing (cm)	R & D	Defect description thickness, type, inclination, planarity, roughness, coating, strength. Particular General	Rock condition No (interpretive)	
					100	1	DACITE	HW MW				Rock mass open and fractured. Where MW-HW rock crumbly and joints open and crushed; clay coated at 2.4, 2.15 + 2.85 m.		
					100	2		MW				Scm crush zone = crush zones	Where SW joints open limonite stained, no clay some sandy infillings.	
						3		SW MW HW						
					100	4		MW SW				crushed zone	At base of core rock is crushed and loose joints v. closely sp.	
						5	EOH : 5.0 m.	MW-HW						

Drill type Gemco
Feed _____
Core barrel type NMLC
Driller _____
Commenced _____
Completed Nov. 75
Logged by R. Goldsmith
Vertical scale _____Weathering
Fr - Fresh
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
EW - Extremely weathered

Notes

Bedding & Joint Planes - Angles are measured relative to a plane normal to the core axis
* Water Pressure Tests - Values in megapascals should be read in conjunction with computation sheets

Water



10 Oct '73 water level date shown
Water inflow
Partial drilling water loss
Complete drilling water loss

Core Photograph Negative No.

Depth (m)	Black & White	Colour
_____	_____	_____
_____	_____	_____
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GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (°) 90° DIRECTION
CO-ORDINATES N586749 E205198 R L OF COLLAR 553.64SHEET 1 OF 1

Drilling information						Rock Substance		Rock Mass Defects						
Method	Drilling rate	Casing	Water	Pressure test * (lugons)	Lift & % core recovery	Depth (metres)	Graphic log & core loss	Substance description rock type grain characteristics colour, structure, minor components	Weathering	Point load strength 0.3 1.0 3.0 10.0 30.0 100.0 150(MPa)	Defect spacing (cm) 0.3 1.0 3.0 10.0 30.0 100.0	R O D	Defect description thickness, type, inclination, planarity, roughness, coating, strength Particular General	Rock condition No (interpretive)
					60	1	V V	DACITE Grey-brown, coarse grained, porphyritic.	MW				Core friable and joints open and limonite stained	
					60	2	V V		SW					
					100	3	V V		SW				it dips 80° clay and limonite coating. Rock SW except adjacent to open jts, MW up to 3cm around jts. Closely spaced & mass loose.	
						4	V V							
					100	5	V V		FrSt				From 3.2m rock is hard and strong, joints mostly tight but stained with limonite and minor clay, minor crush zones. Joints dip 0-30° & 70-90°. MW on jt faces. Veins of sericite and quartz.	
						6	V V							
					100	7	V V							
						8	V V							
								ECH 8 m						

Drill type Gemco
Feed
Core barrel type NMHC
Driller
Commenced NOV 75
Completed
Logged by R. Goldsmith
Vertical scale 1m = 1cmWeathering
Fr - Fresh
FrSt - Fresh stained
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
EW - Extremely weathered
Notes
Bedding & Joint Planes - Angles are measured relative to a plane normal to the core axis
* Water Pressure Tests - Values in lugons should be read in conjunction with computation sheetsWater
10 Oct '73 water level date shown
Water inflow
Partial drilling water loss
Complete drilling water lossCore Photograph Negative No
Depth (m) Black & White Colour

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 90° DIRECTION _____
CO-ORDINATES N586778 E205229 R.L. OF COLLAR 546.22

SHEET 1 OF 1

Drilling Information						Rock Substance		Rock Mass Defects								
Method	Drilling rate	Casing	Water	Pressure test * (megapascals)	Lift & % core recovery	Depth (metres)	Graphic log & core loss	Substance description rock type grain characteristics colour, structure, minor components	Weathering	Point load strength 0-3 MPa 3-10 MPa 10-15 MPa 15-30 MPa 30-50 MPa 50-100 MPa 100-300 MPa	Defect spacing (cm)	R.O.D.	Defect description thickness, type, inclination, planarity, roughness, coating, strength. Particular General		Rock condition No (interpretive)	
						100	1 V V	Dacite porphyritic, grey fine grained green-grey band.	MW	1				Rock generally closely jointed and fractured. Joints rough to semi-rough Joints dip 10-15° and 60-70° Closely spaced in places Stains of yellow Fe oxides, coatings of clay.		
						100	2 V V	grey-brown phenocrysts of qtz and plagioclase. Veins of qtz., calcite and chlorite.	SW	2				Rock closely fractured & jointed throughout. Limonite stains on most faces. Core is better quality from 7.3-7.85. No clay visible on joints.		
						100	3 V V		MW	3						
						100	4 V V		SW	4						
						100	5 V V			5						
						100	6 V V			6						
						100	7 V V		MW	7						
						100	8 V V		SW	8						
						100	9 V V		MW	9						
						100	10 V V	SW	10							
						100	11 V V	MW-SW	MW-SW	11			Close jointed and fractured MW on jt. faces with limonite, sericite and chlorite coatings abundant. Joints rough and open, large vertical jt. from 9-10m, irregular. 14.2m crushed seam 10cm.			
						100	12 V V			12						
						100	13 V V		MW-SW	13						
						100	14 V V			14						
						100	15 V V			15						
								Eoh 15.3m								

Drill type Gemco
Feed _____
Core barrel type NMLC
Driller _____
Commenced Nov. 75
Completed _____
Logged by R. Goldsmith
Vertical scale 1cm = 1m

Weathering
Fr - Fresh
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
EW - Extremely weathered

Notes

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

* Water Pressure Tests — Values in lugeons should be read in conjunction with computation sheets

Water

10 Oct. '73 water level date shown

Water inflow

Partial drilling water loss

Complete drilling water loss

Core Photograph Negative No		
Depth (m)	Black & White	Colour
1		
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BUREAU OF MINERAL RESOURCES,
GEOLOGY & GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT MURUMBIDGEE BRIDGE No.3.
LOCATION East bank of River, large rock
outcrop, Pier G.
ANGLE FROM HORIZONTAL (°) 90° DIRECTION
CO-ORDINATES N 586017 E 205252 - R.L. OF COLLAR 546.09

HOLE NO. 7

SHEET 1 OF 1

Drilling Information					Rock Substance										Rock Mass Defects									
Method	Drilling rate	Casing	Water	Pressure test * (lugeons)	Lift & % core recovery	Depth (metres)	Graphic log & core loss	Substance description rock type grain characteristics colour, structure, minor components	Weathering	Point load strength 100 ls (50 MPa)	Defect spacing (cm)	R Q D	Defect description thickness, type, inclination, planarity, roughness, coating, strength Particular General	Rock condition No (interpretive)										
					100	V	Dacite Grey, medium to coarse grained. Chlorite zones. Veins of qtz., calcite and chlorite	MW Fr-st SW Fr-st	100 100 100 100 100	100 100 100 100 100	100 100 100 100 100	100 100 100 100 100	Rock hard & strong especially from 0.7-3.2m. Joints generally tight but infillings of qtz., calcite and chlorite abundant. Stains of Fe oxides on some joint faces. Joints generally dip 50 to 60°. Some horizontal. SW zone at 3-4m where yellow stains on closely fractured rock.											
				100	1	V																		
				100	2	V																		
				100	3	V																		
				100	4	V																		
				100	5	V																		
					100	6		Eoh 5.8m.																

Drill type GEMCO
Feed
Core barrel type NMLC
Driller
Commenced
Completed Nov. 75
Logged by R. Goldsmith
Vertical scale 1cm = 1m

Weathering
Fr - Fresh
Fr-st - Fresh stained
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
EW - Extremely weathered

Notes
Bedding & Joint Planes - Angles are measured relative to a plane normal to the core axis
* Water Pressure Tests - Values in lugeons should be read in conjunction with computation sheets.

Water
10 Oct '73 water level data shown
Water inflow
Partial drilling water loss
Complete drilling water loss

Core Photograph Negative No
Depth (m) Black & White Colour

BUREAU OF MINERAL RESOURCES,
GEOLOGY & GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT MURRUMBIDGEE BRIDGE No.3.
LOCATION East bank of River large rock
outcrop Pier G
ANGLE FROM HORIZONTAL (°) 90° DIRECTION
CO-ORDINATES NS06004 E205256 R. L. OF COLLAR 545.64

HOLE NO. 8

SHEET 1 OF 1

Drilling Information						Rock Substance		Rock Mass Defects						
Method	Drilling rate	Casing	Water	Pressure test * (lugoons)	Lift & % core recovery	Depth (metres)	Graphic log & core loss	Substance description rock type grain characteristics colour, structure, minor components	Weathering	Point load strength 100 is 50(MPa)	Defect spacing (cm)	R. Q. D.	Defect description thickness, type, inclination, planarity, roughness, coating, strength. Particular General	Rock condition No (interpretive)
					100		V	Dacite. Medium grained, grey Phenocrysts of qtz. and feldspar.	MW				Rock generally closely fractured with defect spacing < 10cm Joints tight but generally chlorite or qtz. filled. No clay on surfaces. Veins thin & not common.	
					100	1	V		FrSt	1				
					100	2	V		FrSt	2				
					100	3	V			3				
					100	4	V	Eoh 4m		4			Rock mass as a whole is hard but only moderately strong.	


Drill type Gemco
Feed
Core barrel type NMLC
Driller
Commenced
Completed Nov. 75
Logged by R. Goldsmith
Vertical scale 1cm = 1m

Weathering
Fr - Fresh
FrSt - Fresh stained
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
EW - Extremely weathered
Notes
Bedding & Joint Planes - Angles are measured relative to a plane normal to the core axis.
* Water Pressure Tests - Values in lugoons should be read in conjunction with computation sheets.

Water
10 Oct. '73 water level date shown
Water inflow
Partial drilling water loss
Complete drilling water loss

Core Photograph Negative No
Depth (m) Black & White Colour

SHEET 1 OF 1

Drill type <u>Gemco</u>	Weathering	Water	Core Photograph Negative No
Feed	Fr - Fresh Frst - Fresh stained SW - Slightly weathered		10 Oct. '73 water level date shown
Core barrel type <u>NMLC</u>	MW - Moderately weathered	Water inflow	Depth (m) Black & White Colour
Driller	HW - Highly weathered	Partial drilling water loss	
Commenced	EW - Extremely weathered	Complete drilling water loss	
Completed <u>Nov 75</u>	Notes		
Logged by <u>R. Goldsmith</u>	Bedding & Joint Planes — Angles are measured relative to a plane normal to the core axis.		
Vertical scale <u>1 cm = 1 m</u>	* Water Pressure Tests — Values in lugeons should be read in conjunction with computation sheets		

HOLE NO. 10

SHEET 1 OF 1

Drill type <u>Gemco</u>	Weathering	Water	Core Photograph Negative No		
Feed _____	Fr - Fresh		Depth (m)	Black & White	Colour
Core barrel type <u>NMLC</u>	FrSt - Fresh stained SW - Slightly weathered		_____	_____	_____
_____	MW - Moderately weathered		_____	_____	_____
Driller _____	HW - Highly weathered		_____	_____	_____
Commenced _____	EW - Extremely weathered		_____	_____	_____
Completed <u>Nov. 75</u>	Notes		_____	_____	_____
Logged by <u>R. Goldsmith</u>	Bedding & Joint Planes — Angles are measured relative to a plane normal to the core axis.		_____	_____	_____
Vertical scale <u>1cm = 1m.</u>	* Water Pressure Tests — Values in lugeons should be read in conjunction with computation sheets.		_____	_____	_____
			_____	_____	_____

HOLE NO. 11



SHEET 1 OF 1

Drill type <u>Gemco</u>	Weathering	Water	Core Photograph Negative No.
Feed _____	Fr - Fresh	10 Oct '73 water level date shown	Depth (m)
Core barrel type <u>NMLC</u>	SW - Slightly weathered	Water inflow	Black & White
Driller _____	MW - Moderately weathered	Partial drilling water loss	Colour
Commenced _____	HW - Highly weathered	Complete drilling water loss	
Completed <u>Nov. 75</u>	EW - Extremely weathered		
Logged by <u>R. Goldsmith</u>	Notes		
Vertical scale <u>1cm = 1m</u>	Bedding & Joint Planes — Angles are measured relative to a plane normal to the core axis.		
	* Water Pressure Tests — Values in lugeons should be read in conjunction with compilation sheets.		

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 90° DIRECTION _____
CO-ORDINATES N586863 E205319 R.L. OF COLLAR 555-17

SHEET 1 OF 1

Drill type <u>Gemco</u>	Weathering	Water	Core Photograph Negative No			
Feed -----	Fr - Fresh		10 Oct '73 water level date shown	Depth (m)	Black & White	Colour
Core barrel type <u>NMLC</u>	SW - Slightly weathered		Water inflow	-----	-----	-----
-----	MW - Moderately weathered		Partial drilling water loss	-----	-----	-----
Driller -----	HW - Highly weathered		Complete drilling water loss	-----	-----	-----
Commenced -----	EW - Extremely weathered			-----	-----	-----
Completed <u>Nov. 75</u>	Notes			-----	-----	-----
Logged by <u>R. Goldsmith</u>	Bedding & Joint Planes — Angles are measured relative to a plane normal to the core axis			-----	-----	-----
Vertical scale <u>1cm = 1m</u>	* Water Pressure Tests — Values in lugeons should be read in conjunction with computation sheets.			-----	-----	-----

155/A14/1524

GEOLOGICAL LOG OF DRILL HOLE

Drilling Information					Rock Substance		Rock Mass Defects							
Method	Drilling rate	Casing	Water	Pressure test * (lugesons)	Lift & % core recovery	Depth(metres)	Graphic log & core loss	Substance description rock type - grain characteristics colour, structure, minor components	Weathering	Point load strength 100 IS (MPa)	Defect spacing (cm)	R Q D	Defect description thickness, type, inclination, planarity, roughness, coating, strength. Particular General	Rock condition No (interpretive)
						1				0.3				
						2				1.0				
						3				10.0				
						4				100				
						5				300				
						6				300				
					100	6	V	DACITE	HW					
					100	7	V	Grey.	HW-MW					
					100	7	V	Medium grained						
						8	V	not as porphyritic	MW					
						8	V	as other rocks,						
					100	9	V	irregular texture						
						9	V	with some phenocrysts						
						10	V	of feldspar up to						
						10	V	10mm.						
						11	V							
					100	11	V							
						12	V							
						12	V							
						13	V		SW					
						13		Eoh 13.0m						

MW rock fragments with HW material between.

Weak rock mass, fragmented & loose - some solid core 25cm long, but generally closely fractured & jointed. Clay possibly in some joints, but has been washed out.

Rock mass hard & mod. strong. Joints open - limonite & Mn oxide stained. Veins of sericite eroded by drilling water. Infillings of sericite in some joints.

Drill type Gemco
Feed
Core barrel type NMLC
Driller
Commenced
Completed Nov. 75
Logged by R. Goldsmith
Vertical scale 1cm = 1m

Weathering
Fr - Fresh
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
EW - Extremely weathered

Notes
Bedding & Joint Planes - Angles are measured relative to a plane normal to the core axis
* Water Pressure Tests - Values in lugesons should be read in conjunction with computation sheets.

Water
10 Oct '73 water level date shown
Water inflow
Partial drilling water loss
Complete drilling water loss

Core Photograph Negative No.
Depth (m) Black & White Colour

GEOLOGICAL LOG OF DRILL HOLE

Drilling Information						Rock Substance		Rock Mass Defects						
Method	Drilling rate	Casing	Water	Pressure test * (lugons)	Li B % core recovery	Depth (metres)	Graphic log B core loss	Substance description rock type grain characteristics colour, structure, minor components	Weathering	Point load strength 0.3 1.0 3.0 10.0 15.0 (MPa)	Defect spacing (cm) 0 50 100 200 300	R. Q. D.	Defect description thickness, type, inclination, planarity, roughness, coating, strength Particular General	Rock condition No (interpretive)
						1								
					50	2		SOIL & ALLUVIUM Red sandy clay with rock fragments & rounded qtz. pebbles.						
					40	3		EW rock & soil gravelly sand texture	EW					
					100	4		sand lense 3.2-3.9m (brown)						
					80	5								
					30	6								
					60	7		weathered DACITE + gravelly sand.						
					20	8			EW -HW					
					20	9								
					80	10								
					70	11			HW					
					100	12		DACITE blue-grey, porphyritic veins of calcite & sericite. Even texture pheno- crysts of qtz., plag- ioclase & orthoclase up to 5mm.	MW					
					100	13			SW					
					100	14								
					100	15								
					100	16								
					100	17								
					100	18								
						19		Eoh 18.1m						
						20								

Drill type Gemco
Feed _____
Core barrel type NMLC
Driller _____
Commenced _____
Completed Nov. 75
Logged by R. Goldsmith
Vertical scale 1cm = 1m

Weathering

Fr - Fresh
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
EW - Extremely weathered

Notes

Bedding & Joint Planes - Angles are measured relative to a plane normal to the core axis

* Water Pressure Tests - Values in lugons should be read in conjunction with computation sheets.

Water

10 Oct '73 water level date shown
Water inflow
Partial drilling water loss
Complete drilling water loss

Core Photograph Negative No.

Depth (m) Black & White Colour

MURRUMBIDGEE BRIDGE NO.3 SURFACE GEOLOGY

PLATE I

