DEPARTMENT OF
MINERALS AND ENERGY

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD 1975/57

QUARRY SITE INVESTIGATION AT CAPTAINS FLAT NEW SOUTH WALES 1974

by

G. Jacobson and G. Briscoe

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CONTENTS

SUMMARY

It is planned to stabilize the mine waste dumps at Captains Flat in order to prevent pollution of the Molonglo River by material eroded from the dumps and by the collapse of unstable dump slopes. Large quantities of rock-fill will be used in the stabilization project.

An inspection of possible quarry sites in the Captains Flat area has led to a decision to use the North Quarry as a source of rock-fill for proposed reclamation works. Reserves of about 200 000 m^3 of rock have been proved in a diamond drilling investigation; this is sufficient for the project, and the rock is of adequate quality.

INTRODUCTION

At a meeting of the Joint Government Technical Committee on Mine Waste Pollution of the Molonglo River in May 1974, the Bureau of Mineral Resources (BMR) undertook to inspect possible quarry sites for rock-fill for the proposed reclamation works at Captains Flat (Joint Government Technical Committee, 1974). These works are being undertaken to decrease pollution in the Molonglo River from erosion of the mine waste dumps and collapse of unstable dumps (Fig.1). The inspection of quarry sites followed an earlier reconnaissance appraisal of sources of materials for the project by the Geological Survey of New South Wales (Chesnut, 1974).

About 150 000 m^3 of rock-fill are required for facing the seven tailings dumps (Fig.3) in the mine area. The rock-fill has to be of a quality adequate to withstand weathering by acid waters; the quarry site must be close to the works area; and quarrying must have a minimal environmental effect.

Six possible quarry sites (Fig.3) at Captains Flat were inspected in June 1974. After an interim geological report on these sites, a decision to investigate the North Quarry by diamond drilling was made by the Department of Public Works, New South Wales, which is the design and construction authority responsible for the reclamation works. The drilling program was carried out in November-December 1974.

GENERAL GEOLOGY

The general geology of the Captains Flat area has been described by Oldershaw (1965). The rocks around the mine and town are mainly volcanic and sedimentary rocks of Silurian age.

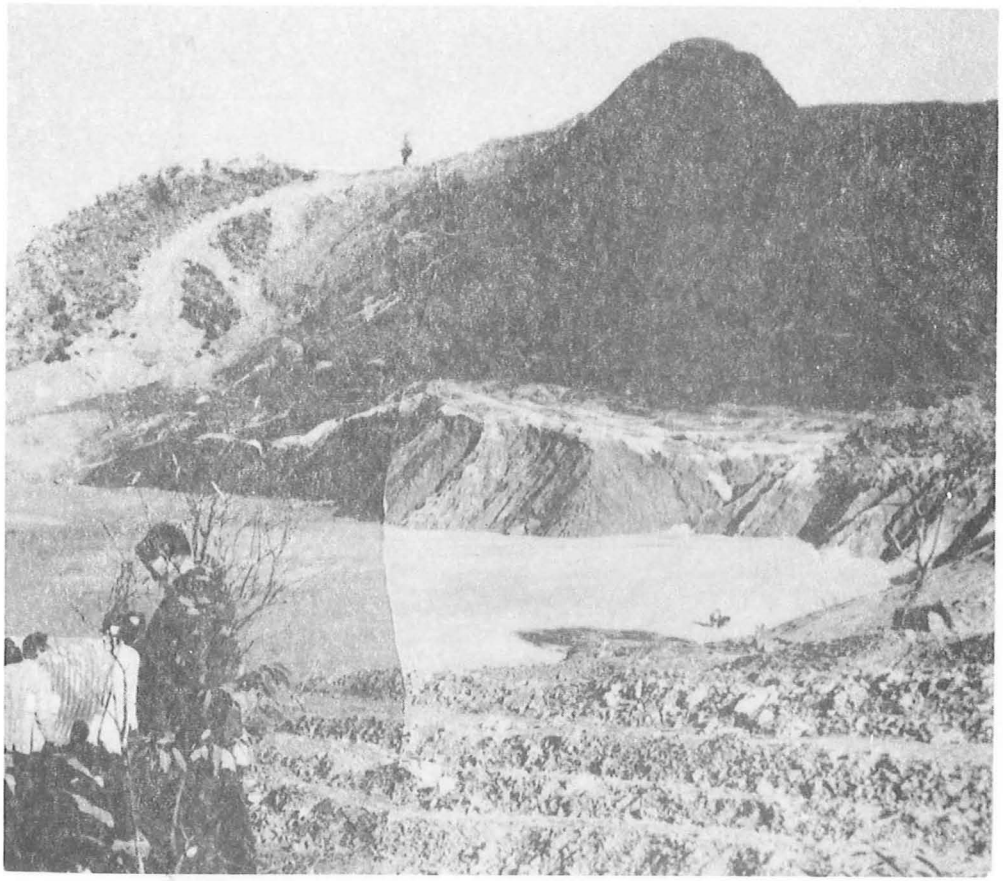


FIGURE 1

TAILINGS DUMP AT CAPTAINS FLAT

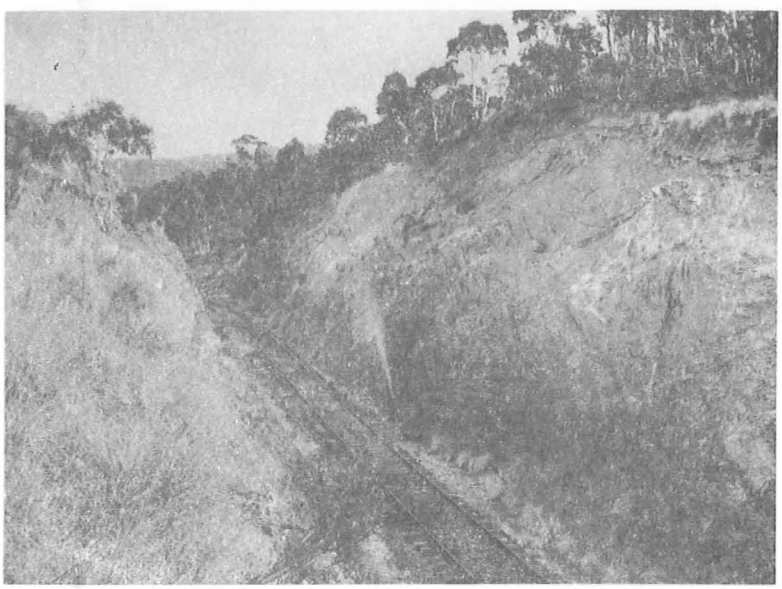


FIGURE 2

METAVOLCANIC ROCKS EXPOSED IN RAILWAY-CUTTING

(Quarry Site 2)

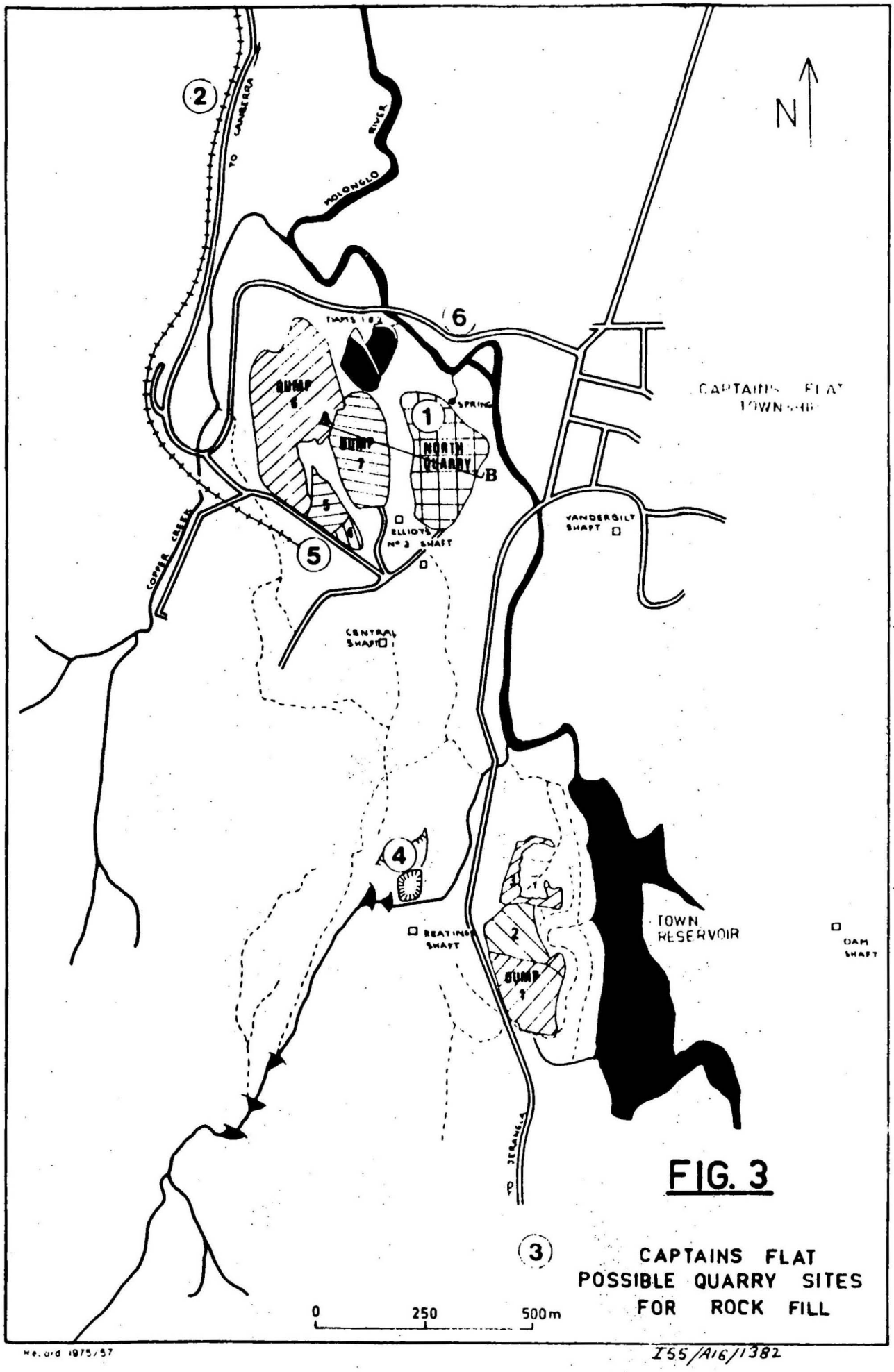


FIG. 3

CAPTAINS FLAT
POSSIBLE QUARRY SITES
FOR ROCK FILL

Record 1975/57

I55/A16/1382

SELECTION OF QUARRY SITE

The main features of the possible quarry sites are summarized in Table 1. Sites 3, 4, and 5 have insufficient reserves to supply the required amount of rock.

Sites 2 and 6

Sufficient reserves are probably available in both sites 2 (Fig.2) and 6, which would have to be opened as quarries for the reclamation project; this, however, would destroy grazing land and create an additional scar on the landscape. Both sites are believed to be on freehold land. The haulage to the works area would be longer from site 2 than from site 6. However, site 6 has the disadvantage that it is adjacent to the main road, and quarrying operations would affect the road traffic.

Site 1 (North Quarry)

Site 1 is the North Quarry, which was originally worked for material to backfill mine workings. The quarry has sufficient reserves but is of mixed lithology with varying degrees of weathering; an appreciable proportion of fines is to be expected. The quarry (Fig.4) is conveniently sited in the project area and re-opening it would be more desirable environmentally than opening a new quarry elsewhere. Quarry operations would be close to the Captains Flat hotel and other buildings.

INVESTIGATION OF THE NORTH QUARRY

Nine angled diamond-drill holes with a total length of 160 m were drilled in the North Quarry. The drill hole locations and cross-sections of the drill holes are shown in Plate 1, and detailed logs of the drill holes are given in Appendix 1. Photographs of the drill core form Appendix 2.

The drilling was done by contractors, Stewart Brothers of Sydney, and the drill core was logged by BMR geologists.

GEOLOGY

The geology of North Quarry is shown in Plate 1. Some fill occurs on the floor of the existing quarry and is up to 4 m thick in places. Beneath this, the quarry rock types are mainly schist in the west side; mainly slate, in the central part; and mainly sandstone on the east side.

Lithology

Schist forms the upper (western) part of the existing quarry and was intersected in drill holes 6 and 8. It is moderately to slightly weathered in the quarry face, and fresh and hard in drill cores.

Slate crops out in the lower part of the quarry face and in the quarry floor; it was intersected in drill holes 2, 4, 5, 6, 7, 8, and 9. The slate is silty and contains thin interbeds of tuffaceous sandstone and tuff which tend to be more weathered than the slate itself. In the present quarry face the slate is moderately weathered in the northern part of the quarry and slightly weathered in the southern part. The slate is probably the most durable rock type in the quarry, and the computation of quarry reserves (see below) is based on the assumption that slate will form most of the available material.

Sandstone forms the eastern part of the existing quarry. It is moderately weathered at the surface, and contains slate interbeds. The petrography of the quarry rocks is described in Appendix 3.

TABLE 1

CAPTAINS FLAT - POSSIBLE QUARRY SITES FOR ROCK-FILL

Quarry Site	Location	Geology	Approximate Reserves m^3	Haulage	Land Ownership	Environmental Factors
1	North Quarry, in mine area	Slate, mica schist, and sandstone, moderately to slightly weathered in existing quarry face. Closely spaced vertically dipping cleavage. Quarry would produce flat fragments with possibly 20 percent fines	At least 150 000	Adjacent to northern dumps: 1 km to southern dumps	Crown	Existing quarry would be used and the appearance of the quarry would suffer little change
2	Railway-cutting 1 km north of mine area (Fig.2)	Jointed metavolcanic rock, slightly weathered at base of cutting, with average 5 m completely to highly weathered overburden and some deeply weathered pockets. Joint spacing 0.5 m, and quarry would produce blocky fragments with possibly 15 percent fines. Rock would require crushing	At least 150 000	1 km to northern dumps; 3 km to southern dumps	Freehold	Quarrying would necessitate spoiling extensive area of lightly timbered grazing land close to main road
3	Road gravel pit 1 km south of mine area, on Jerangle Road	Sheared and altered volcanic-rock, variable from highly to slightly weathered in existing road gravel pit	Limited insufficient height for quarry face	1 km to southern dumps; 3 km to northern dumps	?	Existing pit adjacent to road

Table 1.

Quarry Site	Location	Geology	Approximate Reserves m^3	Haulage	Land Ownership	Environmental Factors
4	South Quarry in mine area	Sheared volcanic rocks, moderately to slightly weathered in existing quarry face. Vertical cleavage. Quarry would produce flat fragments and would be difficult to work as it is above Keatings Collapse	Probably less than 150 000	Adjacent to southern dumps; 1 km to northern dumps	Existing quarry on Crown land; extension might be on freehold land	Existing quarry
5	Railway-cutting at former station	Volcanic rock, moderately to slightly weathered in cutting. Vertical cleavage	Insufficient	Adjacent to northern dumps; 1 km to southern dumps	Crown	
6	Road-cutting on spur east of Molonglo River	Slightly weathered slate. Quarry would produce flat fragments but rock probably better quality than in site 1	At least 150 000	Adjacent to northern dumps; 1 km to southern dumps	Freehold ?	Quarrying would necessitate spoil extensive area of lightly timbered grazing land adja ent to main road

FIGURE 4

NORTH QUARRY, CAPTAINS FLAT (Quarry site 1)

Fracturing

The main fracture planes in the quarry rocks are bedding plane partings which strike north-south and dip close to vertical (Fig. 5). Consequently most of the quarry rock, especially the slate, will fracture into platy fragments. Two orthogonal joint sets have been observed in the slate: strike 050°, dip 25°N; and strike 050°, dip 70°SE. The joints are spaced about 0.5 m apart. Fracture spacings in the drill core are indicated as histograms in the drill-hole logs (Appendix 1), and give an indication of the degree of fracturing to be expected in the rocks when quarried.

Quality of rocks

Visual observation indicates that the slate is the most durable of the three main rock types in the quarry. However, a sample of the slate immersed in sulphuric acid for several months in the BMR laboratory deteriorated considerably and it is likely that there will be some deterioration of the rock after placing the fill. Thin tuff interbeds in the slate have been observed to weather differentially, and the sandstone, which is tuffaceous, is also likely to be susceptible to rapid weathering.

Slate was placed in a trial embankment on one of the tailings dumps in December 1974, and appeared to be of adequate quality (Fig. 6) although with an appreciable proportion of fines.

RESERVES

Reserves have been estimated as follows for a possible quarry down to R.L. 840 as outlined in the cross-sections in Plate 1.

Volume of overburden 40 000 m^3

Volume of adequate rock 210 000 m^3

The required amount of suitable material (150 000 m^3) could probably be obtained above R.L. 845.

CONCLUSIONS AND RECOMMENDATIONS

1. There is no site that could produce first-class rock aggregate within the town area.

2. Three sites 1, 2, and 6 could produce second-class rock; of these, sites 2 and 6 have the better-quality rock, but both would have to be opened as new quarries.

3. North quarry, site 1, has sufficient reserves, and reopening it would have a lesser environmental impact than opening a new quarry. The slate on the lower benches is a more durable rock than the schistose volcanic rock on the upper benches; however, some deterioration of the rock is likely after the fill has been placed.

4. Reopening the North Quarry is recommended.

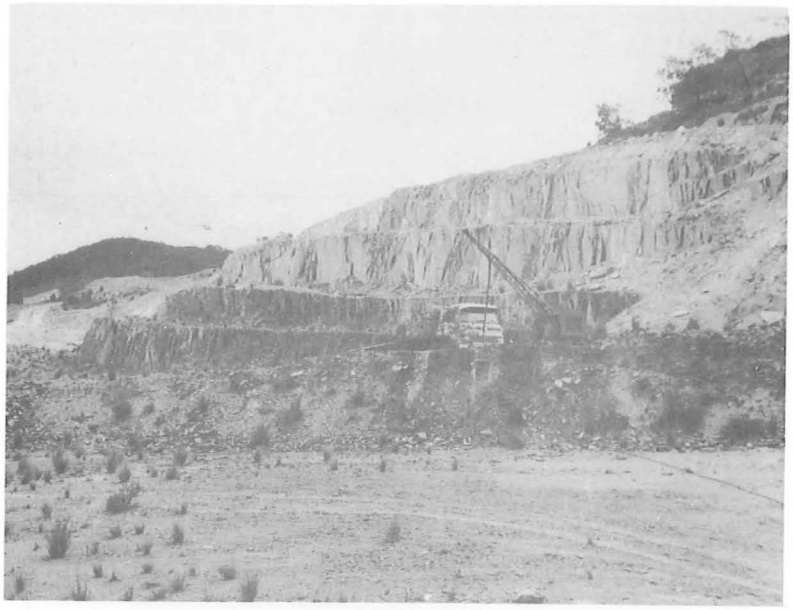


FIGURE 5

NORTH QUARRY SHOWING VERTICAL BEDDING PLANES

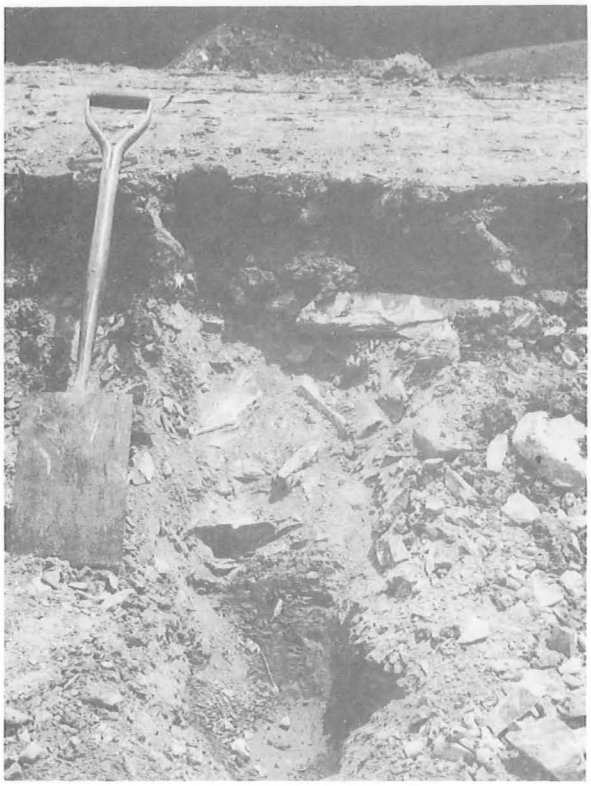


FIGURE 6

SLATE IN TRIAL EMBANKMENT

REFERENCES

CHESNUT, W., 1974 - Rehabilitation of Captains Flat mines dumps: preliminary geological appraisal of sources of extractive construction materials. Geol. Surv. NSW Rep. GS 1974/051 (unpubl.).

JOINT GOVERNMENT TECHNICAL COMMITTEE OF MINE WASTE POLLUTION OF THE MOLONGLO RIVER, 1974 - Mine waste pollution of the Molonglo River. Final report on remedial measures. June 1974. Canberra. AGPS.

OLDERSHAW, W., 1965 - Geological and geochemical survey of the Captains Flat area, New South Wales. Bur. Miner. Resour. Aust. Rep. 101.

APPENDIX 1

LOGS OF DIAMOND-DRILL HOLES

BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT CAPTAINS FLAT, NORTH QUARRY

LOCATION Lower Bench

ANGLE FROM HORIZONTAL (θ) 45° DIRECTION 296°

COORDINATES E 340 165 N 1059 930 R.L. OF COLLAR 859·2

HOLE NO 1

SHEET 1 OF 1

Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Lift and % core recovery	Depth and size of Core	RQD	Structures Joints, veins, seams, faults, etc
FILL (clayey gravel)		50	NMLC		
SLATE M.W.	Light grey – light brown.	100 100	5		Cleavage dips 45° to hole orientation. Main fractures on 45° cleavage plane.
SLATE – M.W. Tuff – E.W.	Buff, broken crushed. Tuff soft.	100 90			
SLATE H.W.–E.W.	Slate is highly weathered Slate and tuff interbedded	100			
SLATE H.W.–E.W.	Buff–light grey, weak	100			
NO	CORE		10		
SLATE M.W.	Grey slate with interbedded buff tuff. Tuff layer 10·52 – 10·99m.	100			Bedding parallel to cleavage
SLATE H.W.–M.W. Tuff H.W.–M.W.	Grey slate, buff tuff Tuff more weathered	96 100			
Quartz clay		75			Fault Zone
Slate HW–MW. Tuff HW–M.W.	Grey slate, buff mid brown tuff.	74	15		Kink banding
Tuff H.W.–E.W. Slate H.W.–M.W.	Tuff weathered to soft sandy material.	96			
Tuff – E.W. Slate M.W., tuff M.W.	Tuff weathered to sandy mat light brown tuff, grey slate	96 100			
	NO CORE				
SLATE H.W.–M.W. Tuff H.W.–M.W.	Interbedded tuff & slate, 75% tuff. 6–20cm interbeds.	100 100			Steeply dipping joints oblique to cleavage. 5cm shear at 19·1m.

END OF HOLE 19·60m

Drill type Mindrill F25
Feed Hydraulic
Core barrel type Triple tube
Driller P.W.D. (N.S.W.)
Commenced Nov. 1974
Completed Nov. 1974
Logged by G. Briscoe
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 25cm 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

M.W. — Moderately Weathered
H.W. — Highly Weathered
E.W. — Extremely Weathered

I55/A16/1316

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
	M/1908 / 6A	

BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT CAPTAINS FLAT, NORTH QUARRY
LOCATION Lower Bench
ANGLE FROM HORIZONTAL (θ) 45° DIRECTION 261°
COORDINATES E 340.125 N 1059.970 R.L. OF COLLAR

HOLE NO 2
SHEET 1 OF 1

Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Lift and % core recovery	Depth and size of Core	RQD	Structures Joints, veins, seams, faults, etc
FILL	Clayey gravel, slate fragments.	NMLC	0		
SLATE M.W.-S.W.	Light grey slate with tuff interbeds ·5-2cm Tuff-buff coloured.	100			Cleavage parallels bedding (45° to drill hole orientation) Oblique joints.
Slate M.W.	Light grey slate & tuff.	100			
SLATE, TUFF M.W.	Light grey-light brown slate, interbedded tuff.	100	5		Joints ironstained & clay filled.
		93			Discordant quartz veins 0·3-1·0cm wide between 6·95-9·3m.
		100			
		100			
		100			
		100	10		
SLATE M.W.	Light brown green slate with mid brown more weathered tuff bands	100			Minor qtz veins
		97			
TUFFACEOUS SANDSTONE? slate & tuff FRST.-S.W.	Light grey, finely banded with iron stained cleavage & joint planes. More weathered (S.W.) at 14·12-15·93m. Tuff bands more weathered.	100			Cleavage parallel to bedding. Minor jointing & faulting normal to cleavage. Cracks in core
		100			
		100	15		
		100			Minor qtz vein - 2cm, discordant
		100			
SLATE & TUFF FR-FRST.	Light-medium grey, strong.	100			
		100			

END OF HOLE 19·10m.

Drill type ACKER N10.
Feed Hydraulic
Core barrel type Triple Tube
Driller P.W.D. (N.S.W.)
Commenced Nov 1974
Completed Nov 1974
Logged by G. Briscoe
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 25cm 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.

M.W. — Moderately Weathered
S.W. — Slightly Weathered
FRST. — Fresh Rock-Stained
FR. — Fresh Rock

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
	M/1908/9A	

I55/A16/1317

Record 1975/57

BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS

PROJECT CAPTAINS FLAT, NORTH QUARRY
LOCATION Lower Bench

HOLE NO 3

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 45° DIRECTION 271°
COORDINATES E 340.145 N 1059.865 R.L OF COLLAR 862.3

SHEET 1 OF 1

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 0 30 60 80 90	Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) *
SLATE M.W. Tuff M.W.–H.W.	Brown grey slate & interbedded pink-yellow tuff. Slate predominate.			-?-?-	0 NMLC						
NO	CORE										
TUFFACEOUS SANDSTONE interbedded slate tuff bands HW–MW	Brown–grey, fine grained slate & yellow pink tuff. Core pieces from 2-20cm smaller pieces also, broken along joint planes, as well as cleavage. Tuff interbeds generally more weathered. Tuffaceous sandstone most abundant. Slate bands to 10cm. Core 4-12cm.				5				Minor kinking. Cleavage parallel to bedding; oblique jointing.		
TUFF, SLATE HW–MW	Core fragments of average size 4cm.				10				Foliated		
TUFFACEOUS SANDSTONE tuff bands MW–SW	Brown tuff bands to 5cm. Pale grey–white tuffaceous sandstone. Medium–dark grey slate. Core sizes 1-10cm.				15				Foliated. Cleavage parallel to bedding. Oblique joints.		
As above FR.ST.	Pale grey tuffaceous sandstone-finc grained, fine slate beds								Qtz veins associated with H.W. M.W. tuff at 19.0m.		
M.W.–S.W.									Qtz vein associated with tuff, subparallel to bedding.		

END OF HOLE 19.58m

Drill type ACKER N10
Feed Hydraulic
Core barrel type Triple Tube
Driller P.W.D. (N.S.W.)
Commenced Nov. 1974
Completed Nov 1974
Logged by G. Briscoe
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 25cm 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

Core was upset by vandals and replaced in boxes by Drilling Supervisor as well as possible.

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
NOT PHOTOGRAPHED.		

I55/A16/1318

BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS

PROJECT CAPTAINS FLAT, NORTH QUARRY
LOCATION Lower Bench

HOLE NO 4

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 45° DIRECTION 291°
COORDINATES E 340 925 N 1059 125 R.L. OF COLLAR 858·7

SHEET 1 OF 1

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 0 30 60 80 90	Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) *
NO CORE					0						
TUFFAC. SST. S.W.	Hard, strong, buff			100 NMLC					Breaks along bedding plane, 45° partings. Ironstained joints, some calcite veins. 1-8cm interbeds		
TUFFAC. SST & SLATE S.W.	Grey - buff,			100							
TUFFAC. SST & SLATE S.W.	Grey buff, hard, strong			100					Bedding dips 50°, breaks mainly along bedding plane partings. Limonite & chlorite coated fractures.		
SLATE S.W.	Thin sandstone interbeds, grey-buff			100	5						
SLATE S.W.	Silty, thin sandstone interbeds			100					Ironstained bedding plane partings. Bedding dips 45°		
SLATE S.W.	"			100					2 thin calcite veins weathered out at 6·95 & 7·12 m.		
SLATE S.W.	Silty, thin tuff interbeds			90					breaks mainly along bedding plane partings, which are ironstained.		
NO CORE									brown silt at 9·05 (? cavity silting).		
SLATE S.W.	Silty			100	10				core broken on 60° joints, at 9·05 and 10·40 m.		
NO CORE									10cm missing core, 3cm qtz (Fault zone)		
SILTSTONE S.W.	Buff			90							
QUARTZ - BROKEN			Q.R.V.	40					20 cm quartz, 23cm missing core		
NO CORE											
QUARTZ BROKEN			Q.R.V.	70							
NO CORE											
SILTSTONE S.W.	Grey-buff			85					12·6 - 13·0 broken core with clay and limonite. Bedding dips 45°.		
SILTSTONE S.W.	Grey, thin tuff interbeds.			100	15				Breaks mainly on bedding plane partings which are 45°, iron-stained.		
SILTSTONE/TUFF S.W. - M.W.	Interbedded tuff is more weathered.			85					10 cm missing core at 16·58m. breaks mainly on bedding plane partings.		
"	Grey			100					- broken core.		
NO CORE											
SILTSTONE F.R.S.T.	Tuff interbeds, grey			85							
SILTSTONE F.R.S.T.	Thin tuff interbeds, grey, hard, strong			95					Breaks on 40° bedding planes.		
END OF HOLE 198·1m											

Drill type Acker N10
Feed Hydraulic
Core barrel type Triple Tube
Driller P.W.D. (N.S.W.)
Commenced NOV. 74
Completed NOV. 74
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 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 25cm 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

S.W. — Slightly Weathered
M.W. — Moderately Weathered
F.R.S.T. Fresh Rock, Stained

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
	M/1105/10 A	

I55/A16/1319

BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS

PROJECT CAPTAINS FLAT, NORTH QUARRY
LOCATION Lower Bench

HOLE NO 5

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 39° DIRECTION 250°
COORDINATES E 340 140 N 1059 830 R L OF COLLAR 866·0

SHEET 1 OF 1

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 0 30 60 80 90	Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) *
	FILL					0 6 12 18+					
SILTY SLATE H.W.–M.W.	Reddish yellow grey slate			100 100	NMLC				1cm qtz-clay vein at 0·8m, parallel to bedding		
	yellow brown clay, slate fragments										
SILTY SLATE H.W.–M.W.	Yellow-grey slate, generally highly weathered. Clay bands 8cm @ 2·36, 10cm @ 3·16m.			80 92							
Silty slate M.W.	grey yellow with interbedded fine sandstone										
SANDSTONE M.W. – with interbeded slate & tuff H.W. – M.W.	Medium–fine grained sandstone, pale–med. grey slate interbeds (<1cm). Brown-yellow friable tuff bands & lenses <4cm.			98 100 100 100 100 100	5 10				Cleavage parallel to bedding, 45° to core. Iron stained on joints and in discontinuous patches 3·75–4·5m, bedding planes & fractures.		
TUFFACEOUS SANDSTONE, & silty slate. M.W–S.W.	Pale to medium grey sandstone, med–fine grained & fine silty slate inter-beds. Brown tuff bands & lenses, fine grained, highly weathered.			100 100 100 100 100 100	15				Cleavage & bedding 45° to core. Oblique joints and discontinuous fractures. Variable weathering in core Core generally more broken where tuff occurs		
TUFFACEOUS SANDSTONE. –Silty slate, tuff.	Grey sandstone & silty slate with brown tuff bands.			100 100 100 100					Core more broken & weathered than above. Iron stained fractures, and tuff bands etched out.		
As above.	Grey brown sandstone & slate										
	END OF HOLE 19·68m.										

Drill type Mindrill F25
Feed Hydraulic
Core barrel type Triple Tube
Driller P W D (N.S.W.)
Commenced Nov 1974
Completed Nov 1974
Logged by G. Briscoe
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

H.W. — Highly Weathered
M.W. — Moderately Weathered
S.W. — Slightly Weathered

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
	M/1908/14A	

J55/A16/1920

Record 1975/57

BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS

PROJECT LOCATION CAPTAINS FLAT, NORTH QUARRY

HOLE NO 6

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 43° DIRECTION 281°

COORDINATES E 340 095 N 1059 875 R.L. OF COLLAR 866.4

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 0 30 60 90	Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) *
	FILL			100							
SLATE M.W.	Moderately strong, greyish brown, silty			70 NMLC 100					Bedding dips 40° – core breaks mainly along bedding plane partings.		
SLATE M.W.–S.W.	"			100					broken & crushed on 60° fault plane		
SLATE M.W.	"			100					Ironstained joints & bedding planes.		
SLATE M.W.–S.W.	Grey–greyish brown.			85	5						
SLATE S.W.	"			100					Breaks mainly along ironstained 45° bedding plane partings.		
SLATE M.W.	Silty, greyish brown.			100					Ironstained and clay filled joints, and bedding plane partings.		
SLATEY SILTSTONE S.W.	Some thin sandstone (tuff?) interbeds.			100	10				Rock gradually becomes courser grained.		
SILTSTONE S.W.	Thin sandstone (tuff) interbeds, grey.								Ironstained fractures		
SILTSTONE S.W. / TUFF	Interbedded, grey-brown								Bedding dips 45°		
SLTST. S.W.	Hard strong, grey								Ironstained fractures		
SCHIST / SILTSTONE	thin siltstone beds										
SCHIST S.W.	Schist is course grained felspathic ? meta tuff.			95							
SCHIST FRST.	Hard strong, grey			100	15						
SCHIST FR.	Grey, hard strong			100					Breaks along Schistosity		
"	"			100							
SCHIST FRST.	"			100					Ironstained fractures		
SCHIST FRST.	"				20m						

Drill type Acker N10
Feed Hydraulic
Core barrel type Triple Tube
Driller P.W.D. (N.S.W.)
Commenced NOV. 74
Completed NOV. 74
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 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.

M.W. – Moderately Weathered
S.W. – Slightly Weathered
F.R.S.T. – Fresh Rock, Stained
F.R. – Fresh Rock

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
	M1/1908/11	

I55/A16/1321

BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS

PROJECT CAPTAINS FLAT, NORTH QUARRY.
LOCATION

HOLE NO 6

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 43° DIRECTION 281°
COORDINATES 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 Intercept Angle 0 30 60 80 90	Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) *
SCHIST S.W.				90					20·46 – 20·60 broken & crushed.		
NO CORE									13 cm. missing core		
	END OF HOLE 20·73m.								at end of hole		

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

S.W. — Slightly Weathered

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
	M/1908/11	

I55/A16/1321

Record 1975/57

BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS

PROJECT CAPTAINS FLAT, NORTH QUARRY
LOCATION Lower Bench

HOLE NO. 7

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 42° DIRECTION 081°
COORDINATES E 340 105 N 1059 830 R.L. OF COLLAR 8650

SHEET 1 OF 1

Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Lift and % core recovery	Depth and size of Core	Fracture Log (0 6 12 18+)	RQD	Defect Frequency Intercept Angle (0 30 60 80 90)	Structures Joints, veins, seams, faults, etc
	NO CORE.		0				
SLATE M.W.	Slate with 30% tuff & (tuffaceous) sandstone beds	65 100 100 100 100	MLC				
SLATE S.W.	Slate with 20% thin (tuffaceous) sandstone beds. Moderately hard & strong, grey.	100 100 100 100 100	5				Breaks mainly along 45° bedding plane partings. A few steeply dipping joints normal to bedding. Fractures generally iron-stained.
NO	CORE						
SLATE M.W.	Greyish brown, with thin sandstone beds	65					
SLATE S.W. – FRST.	Silty slate with 30% thin sandstone beds.	100 100	10				Breaks mainly on 45° bedding plane partings.
Quartz vein – weathered, ironstained							
QUARTZITE FRST.	Hard, strong, grey-blue	100 100					
END	OF HOLE 14·03m.		15m				

Drill type ACKER N10
Feed Hydraulic
Core barrel type Triple Tube
Driller P.W.D. (N.S.W.)
Commenced Nov 1974
Completed Nov 1974
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.

S.W. — Slightly Weathered
M.W. — Moderately Weathered
FRST. — Fresh Rock, Stained

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
	M/1908/22A	

I55/A16/1322

Record 1975/57

BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS

PROJECT CAPTAINS FLAT, NORTH QUARRY
LOCATION Lower Bench

HOLE NO 8

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 40° DIRECTION 257°
COORDINATES E 340 100 N 1059 780 R.L. OF COLLAR 870.2

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 0 30 60 80 90	Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) *
	FILL										
SANDSTONE M.W. SILTY SLATE M.W.	Pale to mid grey fine grained sandstone (possibly tuffaceous), grey - grey brown silty slate. Slate and sandstone as finely interbedded <3 cm. 2.3 - 3.1 m colour contrast greater with green grey slate and white sandstone.			98 98 98 97 87					Iron stained oblique joints, cleavage parallel to bedding - which is at 45° to core. Core fractured with 2cm fragments, quartz at 3.3m.		
	NO CORE.										
SANDSTONE M.W. SILTY SLATE M.W.	Grey - grey brown slate Grey - pale grey fine grained sandstone. Sandstone more abundant.			100 100 98 98 100 100 100	5 10				Massive milky quartz 5.4m - 5.6m. Rock also more weathered adjacent to fault. Cleavage planes parallel to bedding joints, cleavage fractures ironstained.		
	NO CORE.			46							
CLAY	Reddish brown-grey, strongly altered slate and sandstone fragments								Clay filled fault zone		
SLATE. S.W.	Mid grey silty slate.								minor discordant quartz veins		
SANDSTONE and silty slate FR - FRST. tuff - H.W.	Mid grey, fine sandstone and silty slate. Minor thin brown tuff bands, and lenses. Slate more abundant, especially at top.			99 92 100	15				Core breaks often associated with tuff bands. Quartz veins to 2cm width. Qtz filled fault at 16.06 - 16.24m. Oblique iron stained joints. Minor crushed zones 2 - 15cm wide generally core is >12cm.		
SCHIST - FRST. - schistose quartzite.	Green, medium-coarse grained mica - chlorite quartz schist. Clay band grey, with fractured schist 20.0 m (10 cm wide). Quartz chlorite veins at 8.94 - 19.56 m.			100 100	20				Minor ironstaining on cleavage and fractures.		

Drill type ACKER NIO
Feed Hydraulic
Core barrel type Triple Tube
Driller P.W.J. (N.S.W.)
Commenced Dec 1974
Completed Dec. 1974
Logged by G. Briscoe
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

S.W. - SLIGHTLY WEATHERED
M.W. - MODERATELY WEATHERED
H.W. - HIGHLY WEATHERED
FR. - FRESH ROCK
FRST. - FRESH ROCK - STAINED.

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
	M/1908/15A	

I55/A16/1323

BUREAU OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS

PROJECT CAPTAINS FLAT, NORTH QUARRY

LOCATION Lower Bench

HOLE NO 8

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) ... DIRECTION ...

COORDINATES ... 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 Intercept Angle 0 30 60 80 90	Structures Joints, veins, seams, faults, etc	Water Level	Water Pressure Test Losses (Lugeons) *
SCHIST FRST (schistose quartzite)	As on Sheet 1.			100							
SCHIST FR (Schistose quartzite)	Green, medium to course grained mica chlorite-qtz schist.										
	END OF HOLE 23·20m.										

Drill type Acker N10

Feed Hydraulic

Core barrel type Triple Tube

Driller P.W.D. (N.S.W.)

Commenced NOV. 74

Completed NOV. 74

Logged by G. Briscoe

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

F.R. — FRESH ROCK

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

M/1908/15A

C

I55/A16/1323

Record 1975/57

DEPARTMENT OF MINERAL RESOURCES, GEOLOGY & GEOPHYSICS

PROJECT CAPTAINS FLAT, NORTH QUARRY
LOCATION Lower Bench

HOLE NO 9

GEOLOGICAL LOG OF DRILL HOLE

ANGLE FROM HORIZONTAL (θ) 45° DIRECTION 270° mag
COORDINATES E 340 125 N 1059 780 R.L. OF COLLAR 8660

SHEET 1 OF 1

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) *
	FILL			100	0						
SLATE H.W.–M.W.				100							
				100					Breaks mainly on 40° bedding plane partings; ironstained.		
SLATE M.W.	Weak, fractured, grey brown.			100							
				100							
				100	5						
	END OF HOLE 50 m.										

Drill type ACKER N10
Feed Hydraulic
Core barrel type Triple Tube
Driller P.W.D (N.S.W.)
Commenced 4-12-74
Completed 4-12-74
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 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

MW — Moderately Weathered
HW — Highly Weathered

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

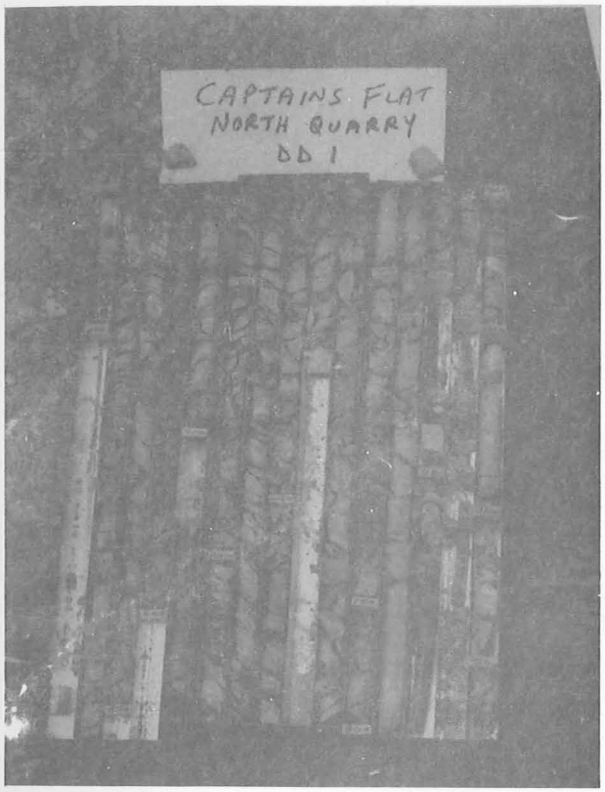
Depth (m)	Black & White	Colour
	M/1908/23	

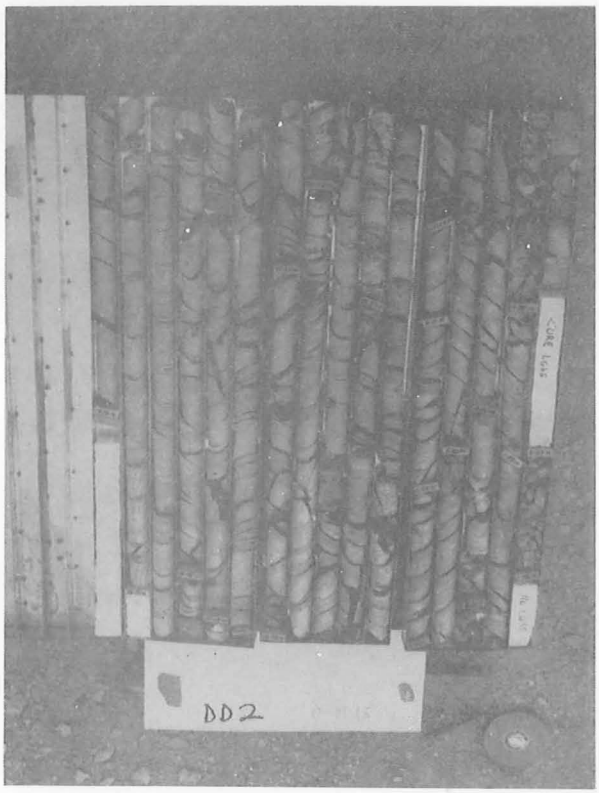
I55/A16/1324

Record 1975/57

APPENDIX 2

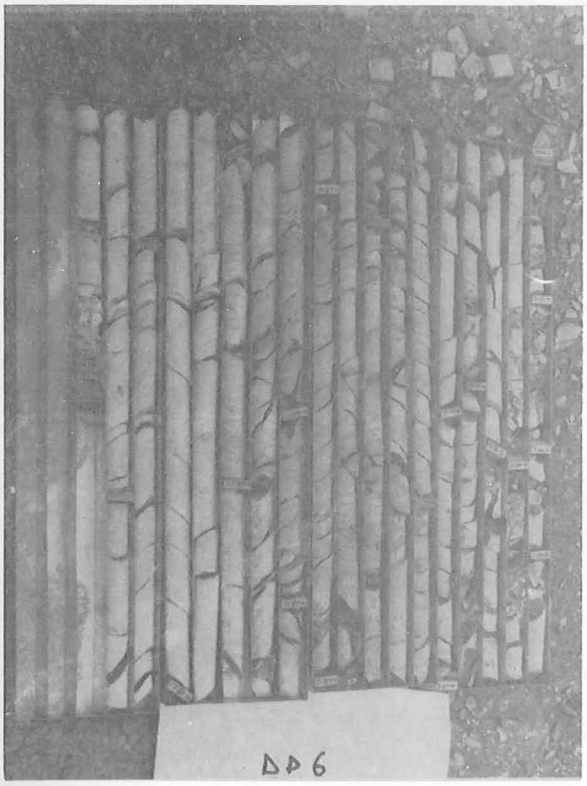
PHOTOGRAPHS OF DIAMOND-DRILL CORE

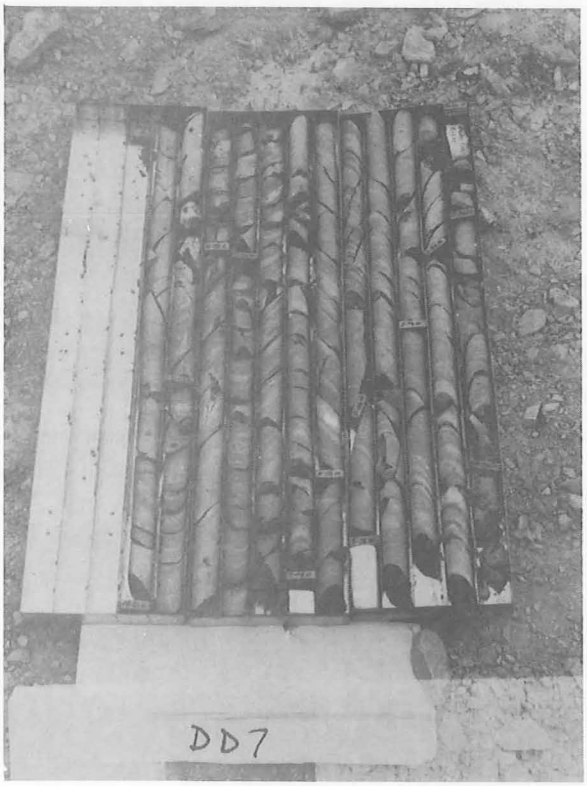

CAPTAINS FLAT
NORTH QUARRY
DD 1

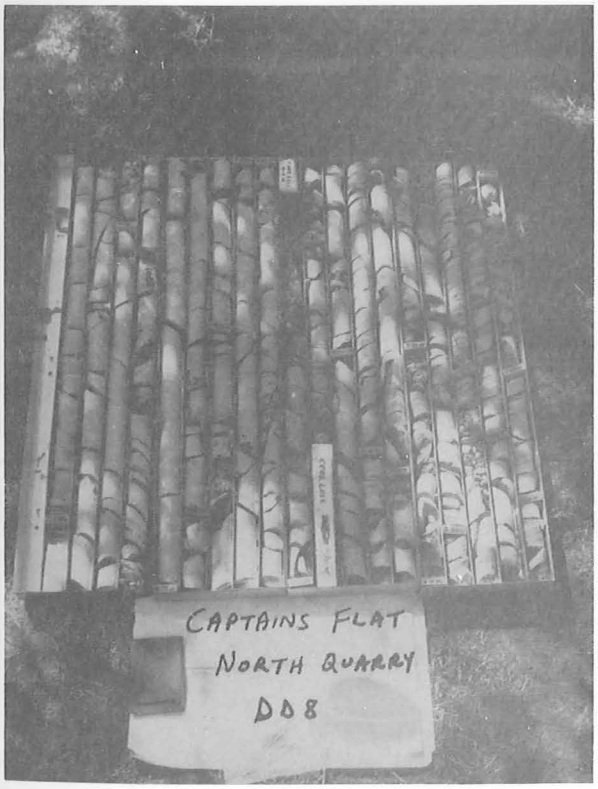

DD2

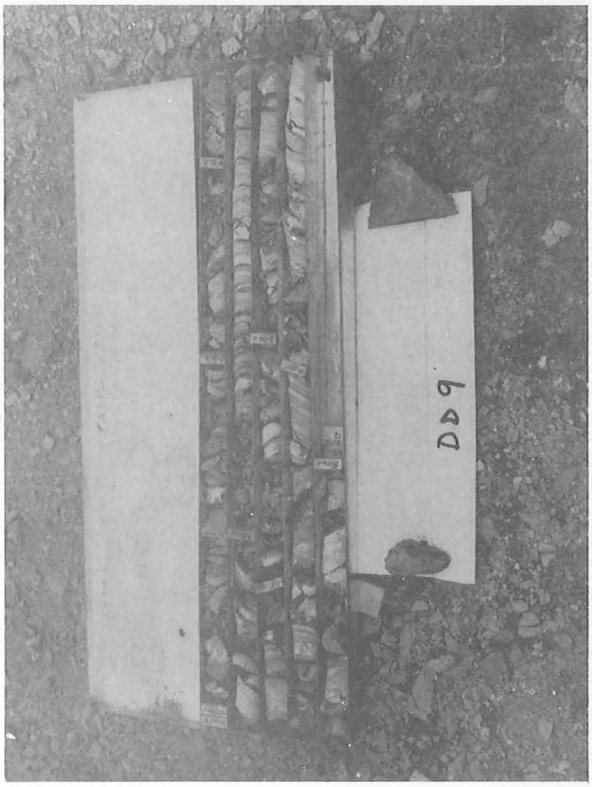

DD4


DD5


DD6


DD7


CAPTAINS FLAT
NORTH QUARRY
DD8


DD9

APPENDIX 3

P E T R O G R A P H Y

by

J.P. Coplecha

APPENDIX 3.

PETROGRAPHY

by

J.P. Ceplecha

The rocks reveal an easterly gradation from porphyroblastic schists through slates to shales. Tuffaceous shales occur within this sequence. The mineral assemblages indicate a low-grade regional metamorphism within the lower greenschist facies.

Sample 74360056 Schist, railway-cutting 1 km north of Captains Flat

The cryptocrystalline groundmass consists of white mica (60%), quartz, and phenocrysts of alkali feldspar (albite) (5-8%) which are part or completely altered to clays. Quartz phenocrysts and aggregates of platy mica are associated with 10-15 percent silicate minerals (e.g. epidote). Clustered fibrous minerals, possibly prehnite (or a zeolite), are found within silicate aggregates and often pseudomorph other minerals.

A solution front throughout the section is marked by the concentration of silicates, secondary mica (clays), and cryptocrystalline quartz. The quartz-albite-epidote-muscovite (± prehnite or zeolite) mineral assemblage represents a basic volcanic rock within the greenschist facies.

Sample 74360057 Schist, North Quarry

The fine-grained groundmass consists of fine-grained white mica (15%) and quartz (50%) aligned parallel to the schistosity. Some of quartz porphyroblasts (20%) and altered feldspar (albite) phenocrysts (5-10%) are fractured. Fine-grained quartz domains occur around the rotated feldspar porphyroblasts. Epidote is an accessory mineral. The rock is a coarse-grained basic volcanic tuff which has undergone metamorphism to the lower greenschist facies.

Sample 74360058 Slate, North Quarry

The cryptocrystalline groundmass consists of white mica (70-75%) parallel to foliation. Small quartz phenocrysts (15-20%) lie parallel to foliation. Minor minerals are albite, clays and chlorite (5%).

Sample 74360130 Shale, North Quarry drill hole 2, depth 17.60 m

The cryptocrystalline groundmass consists of white mica and quartz. Epidote and chlorite are accessory minerals. Clay minerals are abundant within the groundmass.

Sample 74360131 Tuffaceous shale, North Quarry drill hole 4, depth 19.30 m

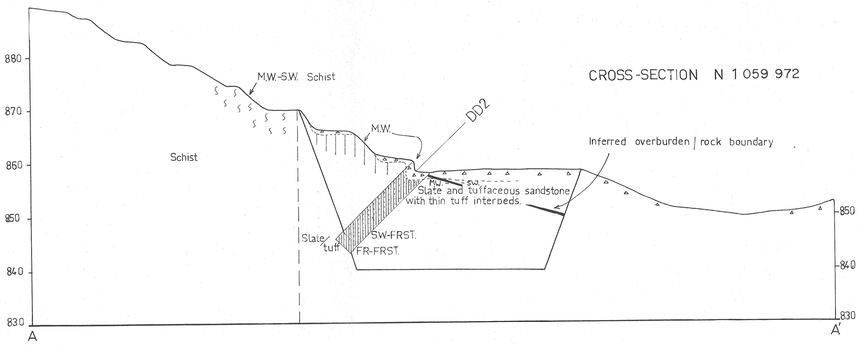
The layered sequence consists of mica-rich and quartz feldspar-rich layers. The fine-grained white mica domain also contains quartz, chlorite, and clays.

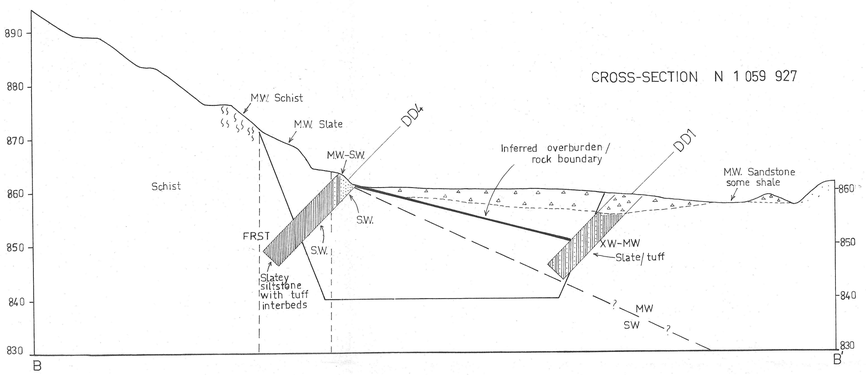
The medium-grained quartz feldspar layers also contain chlorite, and mica with inter-stratified chlorite, platy white mica, and clays. The abundant alkali feldspar and chlorite represent altered tuffaceous material.

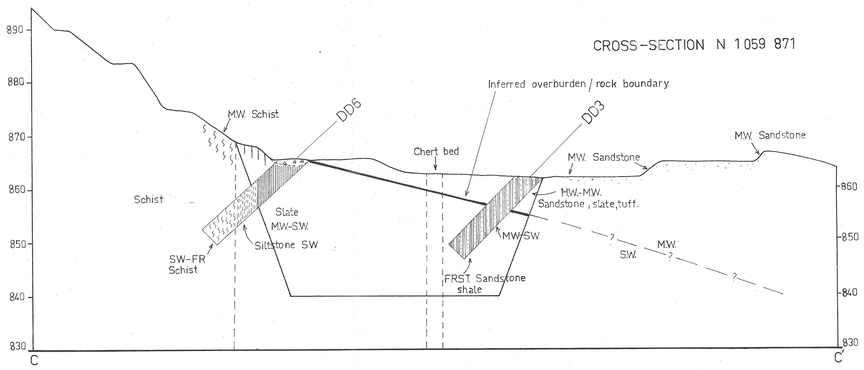
Sample 74360132 Schist, North Quarry drill hole 6, depth 18.10 m

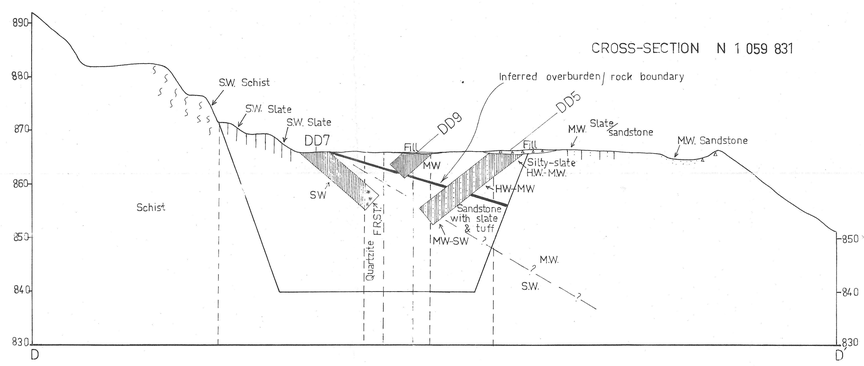
The fine-grained groundmass of quartz (60-65%) and white mica (30%) contains clay minerals and part altered alkali feldspars. Quartz phenocrysts have embayments with partial recrystallization to secondary quartz.

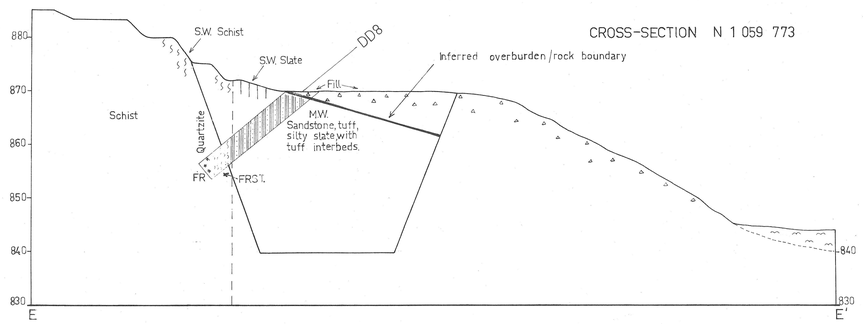
Silicates, mainly epidote (5-10%) occur as small phenocrysts or aggregates of crystals adjacent to altered alkali feldspars.

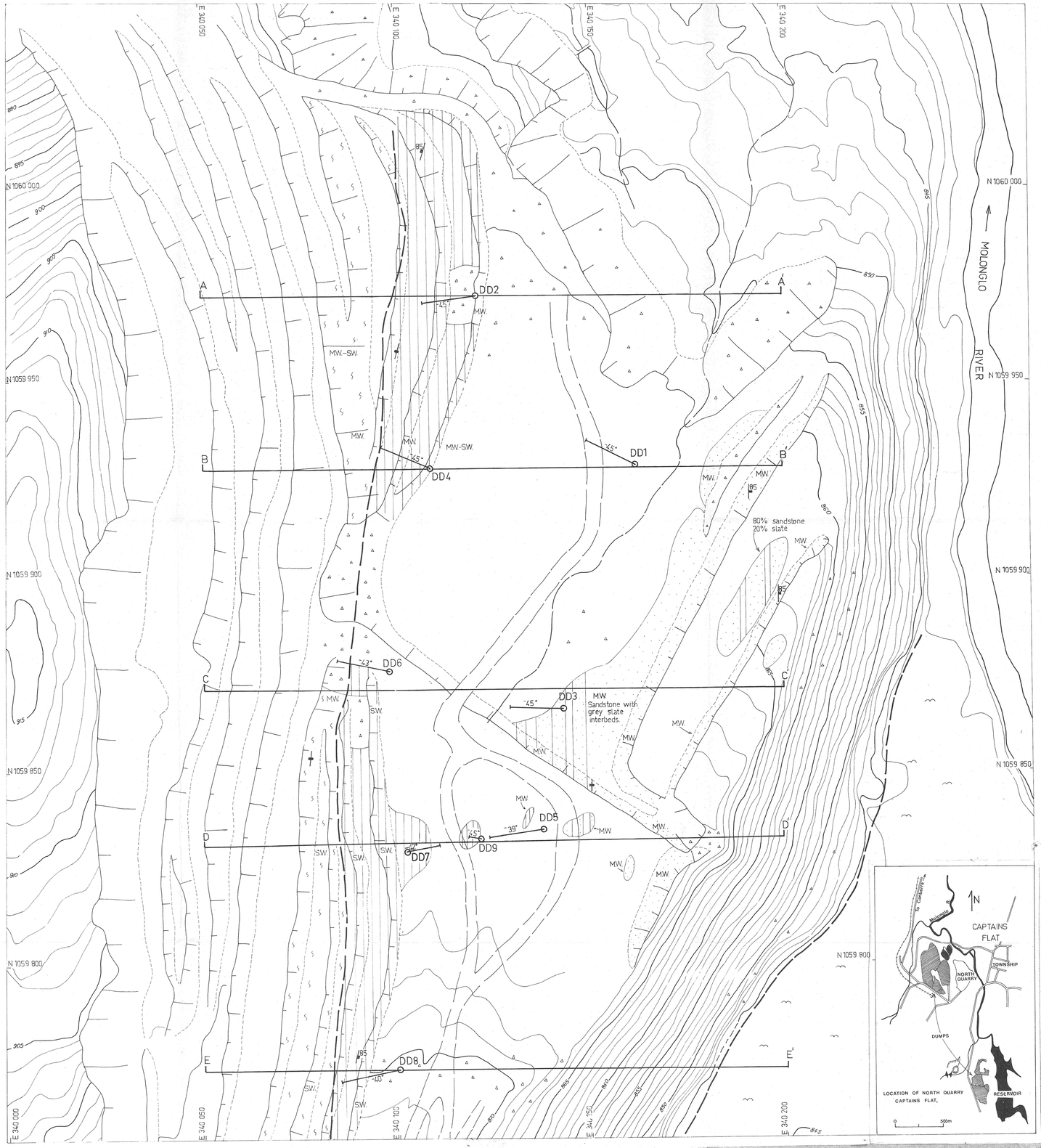












FILL

ALLUVIUM

SANDSTONE

SLATE, SLATEY SILTSTONE

SCHIST

QUARTZITE

X.W. — Extremely Weathered
H.W. — Highly Weathered
M.W. — Moderately Weathered
S.W. — Slightly Weathered
FRST — Fresh Rock-Stained
FR. — Fresh Rock

-45° Drill hole direction & angle from horizontal.

Contours

Track

85 Dip & strike of strata

Vertical strata

Geological Boundary

PLATE 1

SCALE 0 10 30 1:500

BASE MAP/SURVEY
Dept. of Public Works, A.C.T.
Topographical Plan of Captains Flat area.

GEOLOGY BY
G. Jacobson & G. Briscoe

COMPILED AND CHECKED | CHECKED AND APPROVED
PROJECT GEOLOGIST | SENIOR GEOLOGIST
SUPERVISING GEOLOGIST

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

TITLE
NORTH QUARRY, CAPTAINS FLAT
Geological Plan and Sections.

PROJECT

TO ACCOMPANY RECORD 1975/57 | DRAWN BY D.G. | DRAWING NUMBER F55/A16/13/5.