Rept.Bk.No. 73/310

LITTLE PARA DAM - DETAILED GEOLOGICAL MAPPING OF THE GROUT CAP ALIGNMENT

Hds. Yatala and Munno Para

Client: Engineering and Water Supply Department

by

J.C. BEAL
GEOLOGIST

Department of Mines
South Australia —

DEPARTMENT OF MINES
SOUTH AUSTRALIA

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SUMMARY AND CONCLUSIONS

The grout cap will traverse both hillsides between the river level and EL 153 andis to be 4 m wide.

Rock quality to be expected along both sides of the alignment is shown on a large scale geological map together with a tabulation of recommended remedial treatment. Each side will require different treatment, which has been summarised below:-

.....LEFT HAND SIDE - requires blanket removal of the top 3 m in the upper half, and 1 to 1.5 m in the lower half. Selective dental treatment will be necessary on the upper slopes and along the shear zone, and the removal of unstable boulders.

.....RIGHT HAND SIDE - selective picking out and 'popping' of large boulders resting on the quartzite dip slope together with excavation of soil filled trenches. Complete removal of the upper calcrete capping will also be necessary.

Continuous on-site assessment of remedial work by a geologist will probably be required.

INTRODUCTION

The Engineering & Water Supply Department commenced sluicing operations on 5th July, 1973 to remove hillside debris and weathered bedrock along the grout cap alignment. This was completed on 31st August, 1973 and extended over areas from EL.103 to EL.142 (left side) and EL.130 to EL.150 (right side).

Examination of the bedrock and an assessment of treatment required was then carried out.

Operations removed 0 m - 2 m surface material. The silt-charged water, pumped from a temporary dam across the Little Para River, was allowed to drain down slope and re-enter the River. Owing to an unusually wet winter and a large volume of water in the river, there was no silting up of the creek.

METHOD OF APPROACH

Following sluicing, logging stations were painted along the overall centreline of the alignment at approximately 2 m vertical intervals. Coordinates and elevations, provided by the E. & W.S. survey section, were used to produce a geological plan and section. (Figs.1, 2 and 2A).

The geological logging extends from EL 103 - EL 153 (left side) and EL 103 - EL 150 (right side).

GEOLOGY OF GROUT CAP

Sluicing of the right hand alignment exposed the fractured and weathered dip slope surface of quartzite UNIT 12 which lies some 7-10 metres above the slaty dolomite UNIT 11. The contact between these two units is prone to intensive weathering and cavity formation.

The outcrop of Unit 11 is hidden beneath a calcrete capping approximately between EL 152 and EL 156 (not sluiced).

Sluicing of the left hand alignment exposed slates and shaly dolomite (Units 12 & 14). Broadly it may be stated that the upper half of this alignment is in highly weathered, open jointed shaly dolomite and the lower half in moderately weathered more massive slaty dolomite. Strong moderately weathered slate forms steep outcrops half way and at the top of the alignment. They occur respectively between EL 124 to EL 131 and EL 142 to EL 153.

A concise geological statement of the strata along each alignment is difficult and may best be approached by grouping the data into sections and placing them by reference to their survey stations. (See Fig. 1 & Fig. 2):-

LEFT HAND SIDE ALIGNMENT

CREEK – STN.1 Slopewash and alluvium up to 3.0 m thick resting upon moderately weathered, strong to moderately strong dolomite and quartzite. Complete excavation required.

STN.1 – STN.5 Hillslope 40° to 80°. Between stations 1 & 2 a small platform for DH 6 has been excavated. Moderately strong, moderately weathered slaty dolomite with a highly weathered bed of shaly dolomite 1.0 m thick immediately below station 3.

Most joints are closed and tight forming blocks rarely greater than 50 cm x 50 cm x 40 cm and smaller blocks 20cm x 15 cm where the dolomite is more shaly.

Fractures occur sub parallel to the hillslope, between stations 4 & 3, forming unstable masses in the order of 4m high, 0.5 m thick and of uncertain lateral extent. Removal of these masses will be required.

Overhanging blocks occur above Station 2, their removal will increase the safety of working beneath them.

Steep batters approaching vertical could be possible within this section and at the base of the alignment they may coincide with the vertical batters excavated for the outlet duct alignment. If this is the case, care should be taken to avoid placing dam rock fill upon a wide step as this may lead to future differential settlement.

STN.5-9. Hillslope 35°-55°.

Predominantly moderately weathered, strong to moderately strong shaly dolomite.

Highly weathered to completely weathered shaly dolomite, classed as a poorly sorted silty gravel or a silt of low plasticity (GP - GM - ML)* totalling 2.5 m thick occurs between stns. 6 & 7.

Fractures occur sub parallel to the hillslope between stations 5 & 6 and 8 & 9 forming unstable masses which will require removal prior to grout cap emplacement. Their general dimensions are 2 m high, 0.5 m thick and possibly 3-5 m in lateral extent. Following their complete removal the hillslope could be checked for similar parallel fractures being repeated at depth.

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*Unified Soil Classification in Symbols. See Appendix A.

Blocks 60 cm thick overhanging for 80 cm occur at the level of station 8 at the upstream edge of the sluiced area.

These blocks support hillside debris upto 3m thick and their removal will probably initiate a minor rockfall.

STN.9- STN.12.Hillslope 30°-40°.

The lower part of this section is in highly weathered to moderately weathered, weak shaly dolomite with fractures sub parallel to the hillside forming unstable masses 4m high, 50 cm thick and possibly 5m in lateral extent.

Moderately weathered, strong to moderately strong slates - slaty dolomite occur between stations 10 & 12 and are covered by gravel, silt and large boulders approx. 1.5 m x 0.8 m x 0.5 m.

Removal of this hillside debris may expose a bedrock showing a near vertical profile.

Vertical batters here should be stable. Shallower batter angles 75°-80° may be necessary between stations 9 and 10.

STN.12- STN.18 Hillslope 30°-45°

Moderately weathered to highly weathered, weak to moderately strong shaly dolomite with frequent completely weathered horizons from 6 cm - 3.8m thick. These horizons are classed as GP-ML-GM and will require dental treatment prior to grout cap emplacement.

Top 3 metres of the shaly dolomite will need to be removed along most of this section. Fractures have produced block sizes commonly 20 cm x 15 cm x 7 cm to 40 cm x 25 cm x 20 cm.

The strata has been reduced to gravel and small boulders over a width of 2.6 m adjacent to a shear zone. This shear zone is immediately uphill of station 12 and may require dental treatment for some lateral distance along its length. DH 7 shows that this could be a highly permeable zone.

Fractures sub parallel to the hillside occur above station 12 but well to the upstream side of the grout cap alignment. No stability problem is evident although care should be taken if the slate outcrop adjacent to station 12 is cut back or removed. The latter may result in movement of higher ground along these fractures. Batters greater than 70-75^{o} are not advised along this section, particularly as joints occur sub parallel to the grout cap alignment which are open to loose. DH 7 is located 5 metres northwards from station 17.

STN.18 - STN.21 Hillslope 40^{o}-70^{o}

Mainly moderately weathered, strong to moderately strong massive slates. Moderately weathered, weak to moderately strong shaly dolomite occurs at the base of station 18 (1.8 m thick) and between station 20 & 21 (1.5 m thick), where an early access cut has been excavated.

Vertical Batters should be possible along this section.

The bedding here, as for over all the length of the grout cap alignment strikes approximately 017^{o} dipping 40^{o} eastwards.

Right Hand Side Grout Cap Alignment

The general hillslope is from 15°-28°and the quartzite (UNIT 12) strikes 180°to 020°dipping 25°to 30°to eastward. The major joint directions are:-

Strike	Dip
156°	76°W
078°	83°N
215°	77°W

Sluicing has exposed joints penetrating the surface of the quartzite for 0.50 - 1.0 m. Because the hillside is a dip slope bedding planes can be expected to run sub parallel to the hillside and pass beneath the blocks formed from the intersection of the joints. Therefore all blocks should be examined to ascertain the possibility of them resting upon a weathered, fractured surface which could render the blocks unstable causing them to lift under excessive grouting pressures.

CREEK - STATION 3

Fresh to slightly weathered, very strong to moderately strong massive quartzite showing tight-closed, discontinuous fractures. No treatment required.

STN. 3 - STN.10

Mainly fresh - moderately weathered, very strong - moderately strong, massive tightly jointed quartzite. Between these sections there are exceptions to this description.

(a) Around station 4, open joints (3mm - 10 cm) have produced blocks with the dimensions 60cm x 20cm and

30cm deep. Removal of these blocks may expose a sound underlying surface.

(b) Between sections 6 & 7 sluicing has removed highly fractured quartzite to produce a pit 4.0 m x 1.6 m and 0.8 m deep. Poorly sorted gravel and sand (GP-SP) line the pit bottom which will have to be cleaned out down to a sounder bedrock (30-80cm?).

(c) An intensely fractured zone extends from the above pit to Station 8. The small blocks, 25 cm x 10 cm are held loosely to very tightly (not moved by geological pick action) and if their removal is thought necessary, jack hammer and pick may be required. This fractured zone grades uphill into a GP-SP zone.

(d) Joint spacing progressively decreases between station 8-10 although the rock is still massive and sound. Intersecting joints penetrate the quartzite down to 80cm. Shattered quartz veins cross the dignment between these sections and a narrow GP-SP zone runs down the alignment from Station 10 towards station 9.

STATIONS 10-13

Fresh to moderately weathered, very strong to strong quartzite occurs between sections 10-11. Open joints (1mm - 10cm) penetrate the quartzite down to 50 cm and form blocks having average dimensions: 50cm x 40cm x 30cm. Some of the smaller blocks can be prised out by geological pick.

The rate of sluicing increased between stations 11-13 and here the surface rock quality deteriorates.

GP-SP is present between stn.11 and 12 and up to 1.6m above Stn.12, skimming off the top 20-40cm may reveal sounder underlying bedrock.

From here upto station 13 occurs a highly fractured bedrock classed as a GP. Again trimming prior to grout cap emplacement may produce a sounder surface.

Stn.13-Stn.14

Mainly moderately weathered, strong to moderately strong quartzite boulders. Tight to open joints penetrating the quartzite down to 1.0m have formed blocks 1.6m x 1.3 metres. These sound blocks are likely to be unstable, resting upon a weathered inclined surface and care should be taken not to lift them during grouting. The removal of these boulders may be advisable.

Stn.14-Stn.16.

With the exception of an isolated boulder this section is described as a GP-SP derived from highly weathered quartzite. General dimensions of the larger fragments are 20cm x 16cm x 10cm. Shattered quartzite veins traverse the alignment.

Scraping of the surface may be necessary.

Stn.16-19.

Slightly weathered to moderately weathered quartzite dissected by open joints form persistent gravel filled trenches up to 2m wide and 1.2m deep. Boulders have the general dimensions:-

1.3m x 0.75m x 0.6m to 75cm x 60cm x 50cm. These blocks may rest upon a lower bedding plane of GP-SP.

It is suggested that these boulders be removed and that the base of the trenches are cleaned out prior to grout cap emplacement.

Stn.19-24

Highly shattered completely weathered to moderately weathered, weak to moderately strong quartzite described as a GP-SP. Numerous thin quartzite veins traverse the alignment.

The intensity and frequency of jointing decreases slightly towards stn. 24 and scraping of the surface may be sufficient.

Stn.24-Stn.25

Sluicing has exposed a calcrete capping resting upon and enclosing, moderately weathered, strong to moderately strong quartzite boulders.

Complete removal of the calcrete and quartzite boulders is required to allow inspection of the underlying quartzite or shaly dolomite.

Stn.12-EL156 (not sluiced)

Extension of the grout cap or building of the wing of the dam wall along the alignment will require further excavation.

Information from DH3 and exposure trench 2 suggests that moderately weathered and highly weathered shaly dolomite can be expected and also possibly the occurrence of cavities at shallow depths. Trench 2 exposes a

cavity approximately 1.5 square metres in cross sectional area and breaking to ground surface.

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GEOLOGIST

2nd January, 1974

APPENDIX I

Soil and Rock Classification

ENGINEERING CLASSIFICATION OF SOILS

The Unified Soil Classification System

COARSE-GRAINED SOILS — More than 50% of material is larger than No. 200 B.S. sieve size

FIELD INVESTIGATION PROCEDURES (Excluding particles larger than 7·5cm and basing fractions on estimated weights)			GROUP SYMBOL	GROUP NAME and typical materials
GRAVELS More than 50% of the coarse fraction is larger than 2mm. (retained on B.S.7 sieve)	**CLEAN GRAVELS** Little or no fines	Wide range in grain sizes, and substantial amounts of all intermediate particle sizes	GW	GRAVEL, well graded; gravel sand mixtures, little or no fines
		Predominantly one size or a range of sizes, with some intermediate sizes missing	GP	GRAVEL, poorly graded; gravel sand mixtures, little or no fines
	DIRTY GRAVELS Appreciable amount of fines	Non-plastic fines—for identification see ML below	GM	GRAVEL, excess silty fines; poorly graded gravel-sand-silt mixtures
		Plastic fines—for identification see CL below	GC	GRAVEL, excess clayey fines; poorly graded gravel-sand-clay mixtures
SANDS More than 50% of the coarse fraction is smaller than 2mm. (passing B.S.7 sieve)	**CLEAN SANDS** Little or no fines	Wide range in grain sizes, and substantial amounts of all intermediate particle sizes	SW	SAND, well graded; well graded sands, gravelly sands, little or no fines
		Predominantly one size or a range of sizes, with some intermediate sizes missing	SP	SAND, poorly graded; poorly graded sands, gravelly sands, little or no fines
	DIRTY SANDS Appreciable amount of fines	Non-plastic fines—for identification see ML below	SM	SAND, excess silty fines; poorly graded sand-silt mixtures
		Plastic fines—for identification see CL below	SC	SAND, excess clayey fines; poorly graded sand-clay mixtures

FINE-GRAINED SOILS — More than 50% of material is smaller than No. 200 B.S. sieve size

FIELD INVESTIGATION PROCEDURES on fraction smaller than 0·4mm. (passing B.S. 36 sieve)							GROUP SYMBOL	GROUP NAME and typical materials
	SOIL CAST (soil wet)	SOIL THREAD	SHINE	DILATANCY	ODOUR	DRY STRENGTH		
SILTS AND CLAYS Liquid limit less than 50	Forms fragile cast Cracks form when kneaded while moist	Inch crumbly threads easily broken	None to very dull	Distinct	Not significant	None to slight	ML	SILT SOIL, low plasticity; inorganic silts and very fine silty or clayey sands, rock flour
	Cast maybe handled freely without breaking Can be kneaded moist without cracking Material adheres to the hand	Thread can be pointed as fine as a lead pencil but is fragile	Moderate	None to slight	Not significant	Moderate	CL	CLAY SOIL, low plasticity; inorganic clays of low to medium plasticity, gravelly clay, sand, clays, silty clays, lean clays
	Cast fragile to cohesive material will adhere somewhat to the hand	Soft, weak thread	None to very dull	Slight to distinct	Decayed organic matter	Low	OL	ORGANIC SOIL, low plasticity; organic silts and silt clays of low plasticity
SILTS AND CLAYS Liquid limit more than 50	Moderately plastic and cohesive Material adheres somewhat to the hand	Weak to medium thread May be crumbly	Dull	None to slight	Not significant	Moderate Powdered soil feels floury	MH	SILT SOIL, high plasticity; inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	Very plastic and cohesive Material very sticky to the hand Greasy to touch	Very tough thread, can be rolled to a pin point	Very glossy	None	Strong earthy	High to very high Cannot be powdered by finger pressure	CH	CLAY SOIL, high plasticity; inorganic clays of high plasticity, fat clays
	Plastic and cohesive Feels slightly spongy Greasy to touch	Weak to medium thread Often soft and fibrous	Moderate to very glossy	None	Decayed organic matter	Moderate to high Powdered soil may be fibrous	OH	ORGANIC SOIL, high plasticity; organic clays of medium to high plasticity
	Readily identified by colour, odour, spongy feel and frequently by fibrous texture						Pt	PEATY SOIL; Peat and other highly organic soils

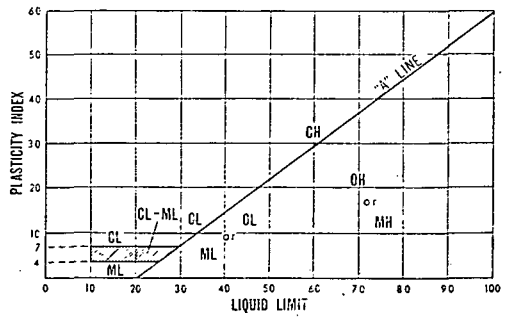
LABORATORY CLASSIFICATION CRITERIA

GRAIN SIZE CURVES to be used to identify soil fractions

Coarse-grained soil classified on basis of percentage of fines, as follows

PERCENT OF FINES	GRAVELS	SANDS
Less than 5	GW GP	SW SP
More than 12	GM GC	SM SC
5 to 12 Borderline cases, use 2 symbols		

GW	$Cu = \frac{D_{60}}{D_{10}}$ Greater than 4; $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM GC	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
	Atterberg limits below "A" line or PI greater than 7	
SW	$Cu = \frac{D_{60}}{D_{10}}$ Greater than 6; $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
SP	Not meeting all gradation requirements for SW	
SM SC	Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
	Atterberg limits below "A" line or PI greater than 7	



PLASTICITY CHART
FOR LABORATORY CLASSIFICATION OF FINE-GRAINED SOILS

NOTE: BOUNDARY CLASSIFICATIONS: Soil possessing characteristics of two groups are shown as a combination of two group symbols, eg. GW-GC, well graded gravel with clay binder.

Based on "The Unified Soil Classification System" United States Department of the Interior, Bureau of Reclamation "Earth Manual" First Edition, Denver COLARADO 1960.

Bull.44 70—641

70—541 Bull.44

ENGINEERING CLASSIFICATION OF ROCK MATERIAL

1. ROCK CONDITION

TERM	ABBRN	DEFINITION
Fresh	(F)	No weathering effects visible to naked eye.
Weathered	(W)	Shows visible effects of chemical decomposition caused by air and groundwater. Can be subdivided:
Slightly weathered	(SW)	- change in appearance but no loss in strength
Moderately weathered	(MW)	- change in appearance but with significant loss in strength.
Completely weathered	(CW)	- has soil properties and often shows complete change in appearance.
Altered	(A)	Shows chemical and physical alteration to rock fabric caused by temperature, pressure or injection of other material.

2. ROCK STRENGTH

Can be correlated with unconfined compressive strength tested in the laboratory.

TERM	ABBRN	Kg cm^2 (p.s.i.)	FIELD TEST
Very weak	VW	70 (1 000)	Breaks and crumbles easily in the hands.
Weak	W	70-200 (1 000-3 000)	Breaks easily with hammer tap. (Normal range of concrete
Medium strong	MS	200-700 (3 000-10 000)	Rings and breaks to firm hammer blow
Strong	S	700-1 800 (10 000-25 000)	(Very difficult to break with (hammer (and requires sledge (
Very strong	VS	>1 800 (>25 000)	

3. USE OF CLASSIFICATION

Note that Condition and Strength terms do not necessarily correspond.

Strength depends on the type of rock while condition depends on external effects, e.g.

Rock Material	Condition	Strength
Granite	Fresh	Strong
Schist	Fresh	Weak

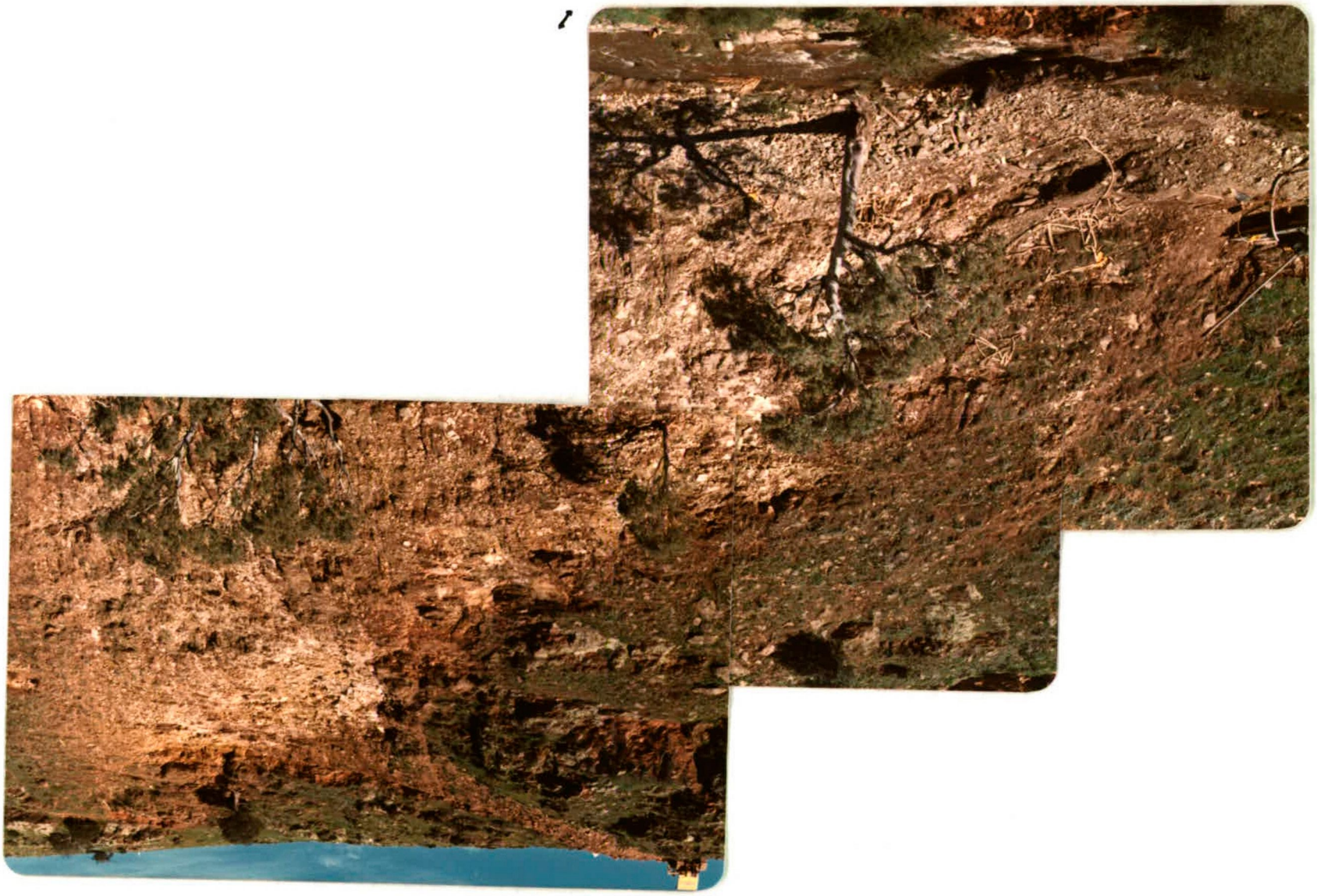
APPENDIX II

Rock Exposure and Core Photographs

LITTLE PARA DAM -
GROUT CAP ALIGNMENT

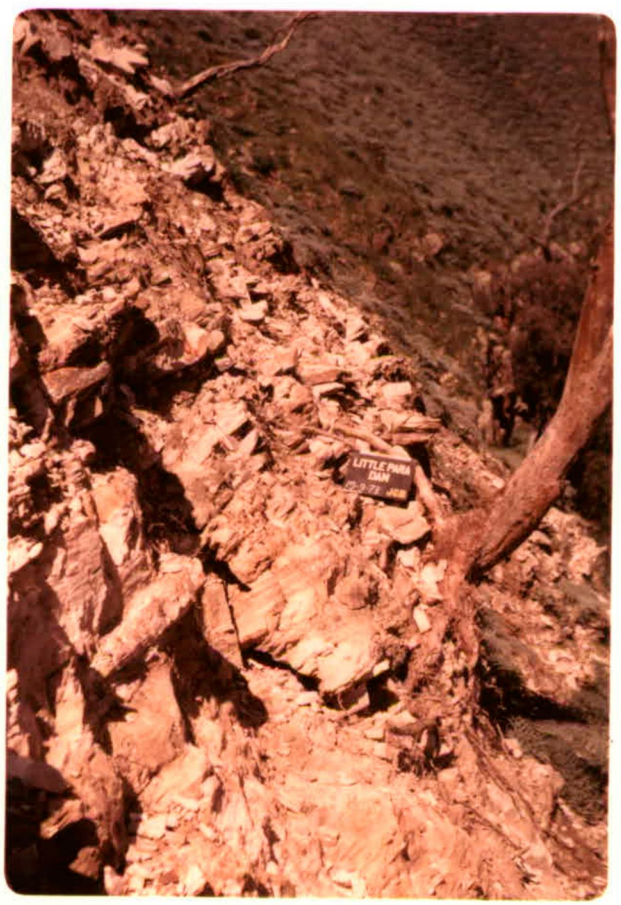
APPENDIX II - List of Photographs

PHOTO NO.	
1	Left Hand Grout Cap Alignment. General View.
2	Left Hand Grout Cap Alignment. Hillside fracture at Stations 9-10.
3	Left Hand Grout Cap Alignment. Hillside fracture at Stations 6-5.
4	Right hand Grout Cap Alignment Calcrete - Quartzite Contact. Station 24.
5	Right hand Grout Cap Alignment Station 24-19. Also DH 2.
6	Right hand Grout Cap Alignment Sluicing operations.
7	Right hand Grout Cap Alignment Trench Formation Stations 18-17.
8	Exposure Trench Number 1. Right hand side of valley. Weathered Shaly Dolomite beneath infilled cavity.
9	Exposure Trench Number 1 downstream side. Cavity formation in Quartzite - Dolomite.
10	Exposure Trench No.1 - southern side Cavity formation in flaggy quartzite.
11-18	Core Photographs of DH Nos.1,2,3,4,5,6,7,15.



2

YATALA SLIDE 10,200



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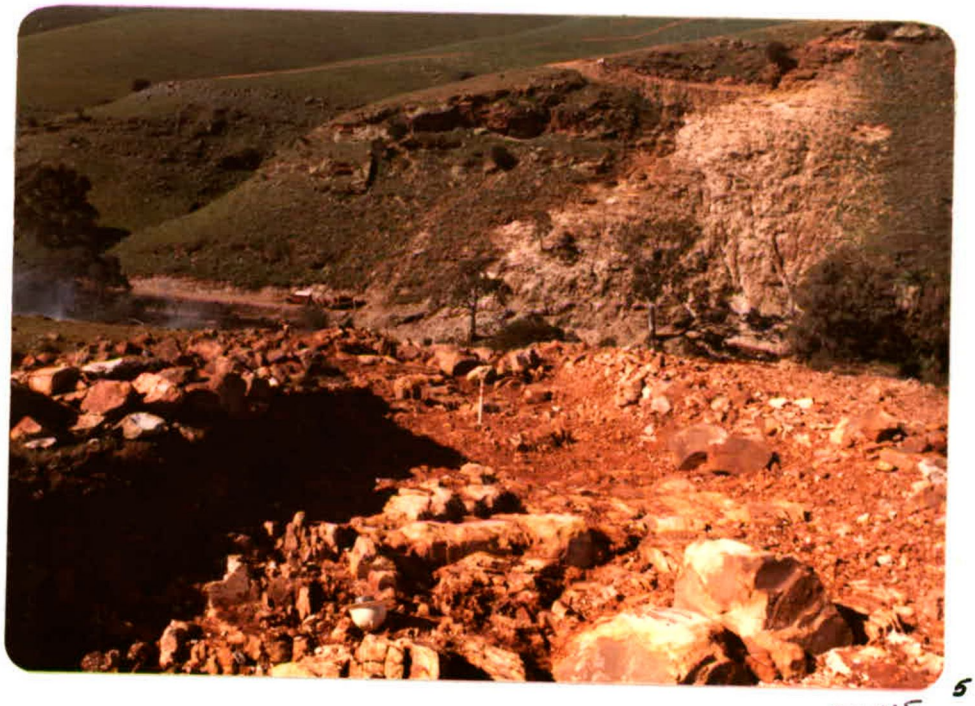
YATALA SLIDE 10,201

4

24419
YATALA



5

24415
YATALA

6

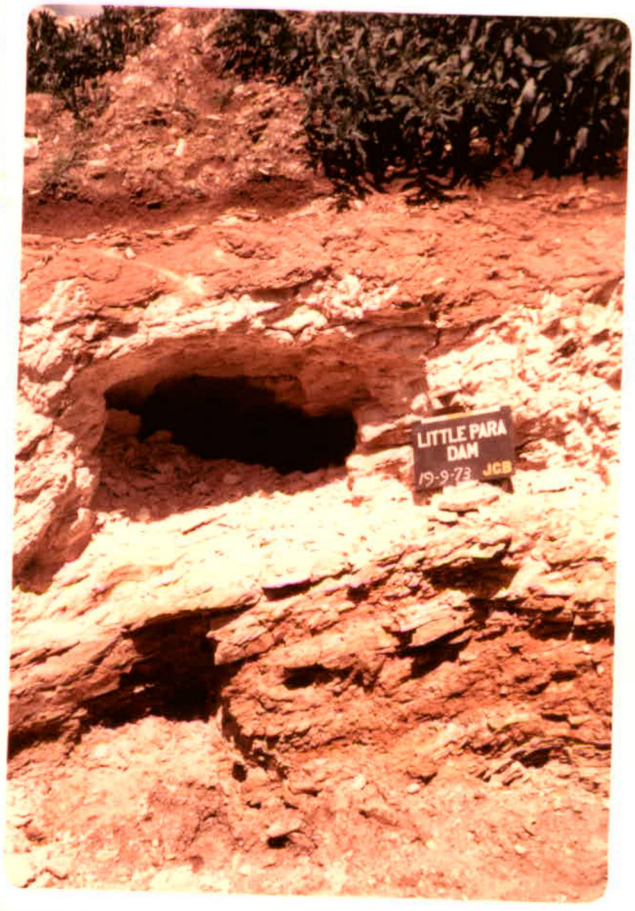
2aa14
YATALA

7

YATALA
SLIDE 10,202

8

YATALA 24421

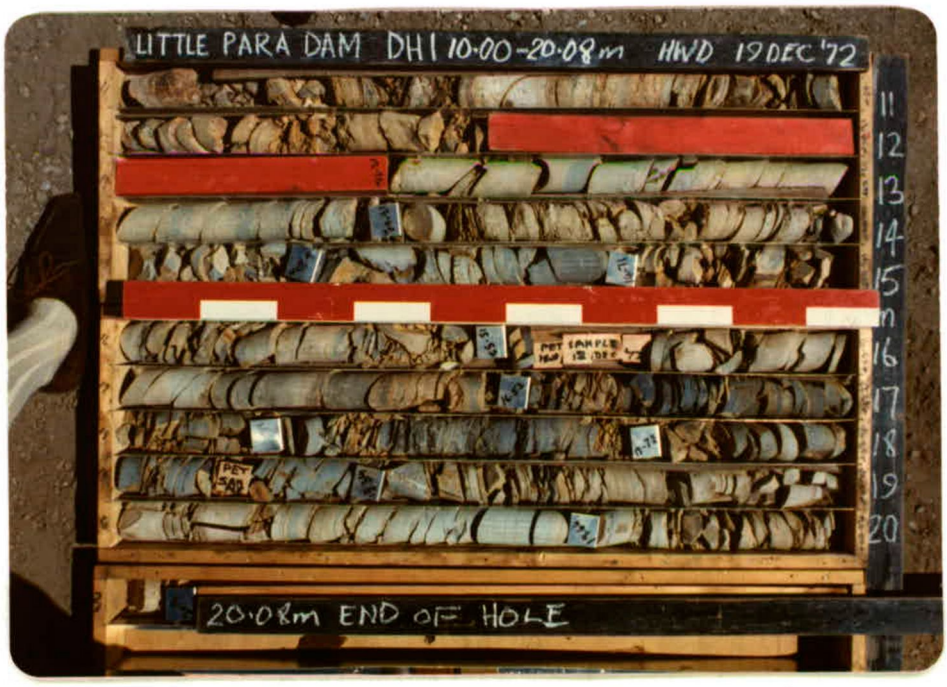


YATALA SLIDE 10,203 9

10

YATALA 23112

MUNNO PARA 23105



MUNNO PARA 23106

MUNNO PARA 23856

MUNNO PARA 23853

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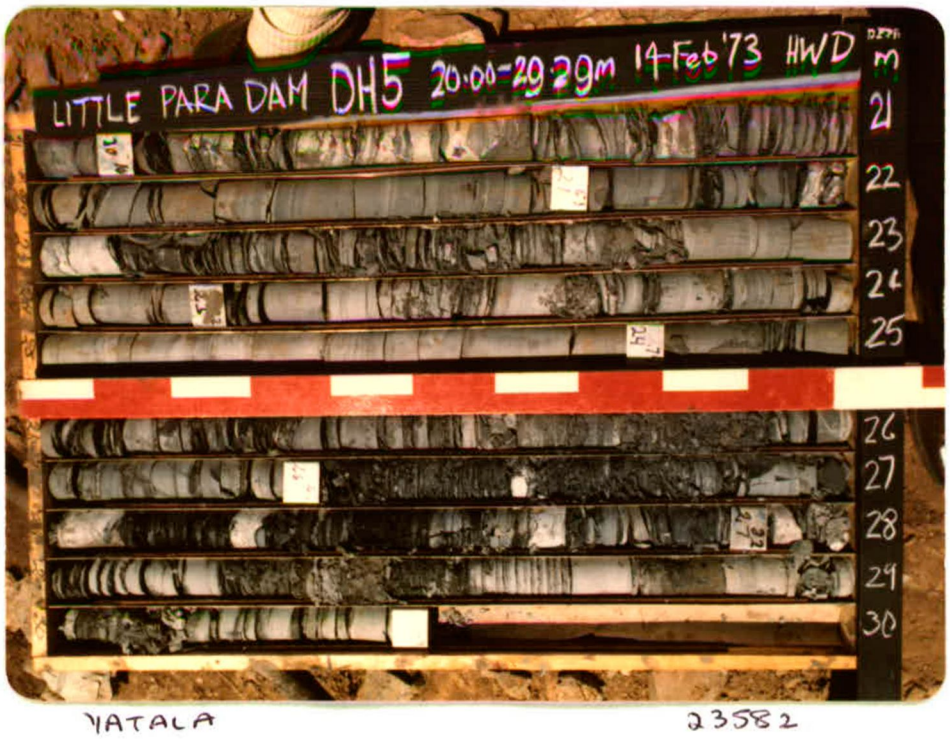
MUNNO PARA 23848

MUNNO PARA 23849

YATALA 23580

YATALA 23581

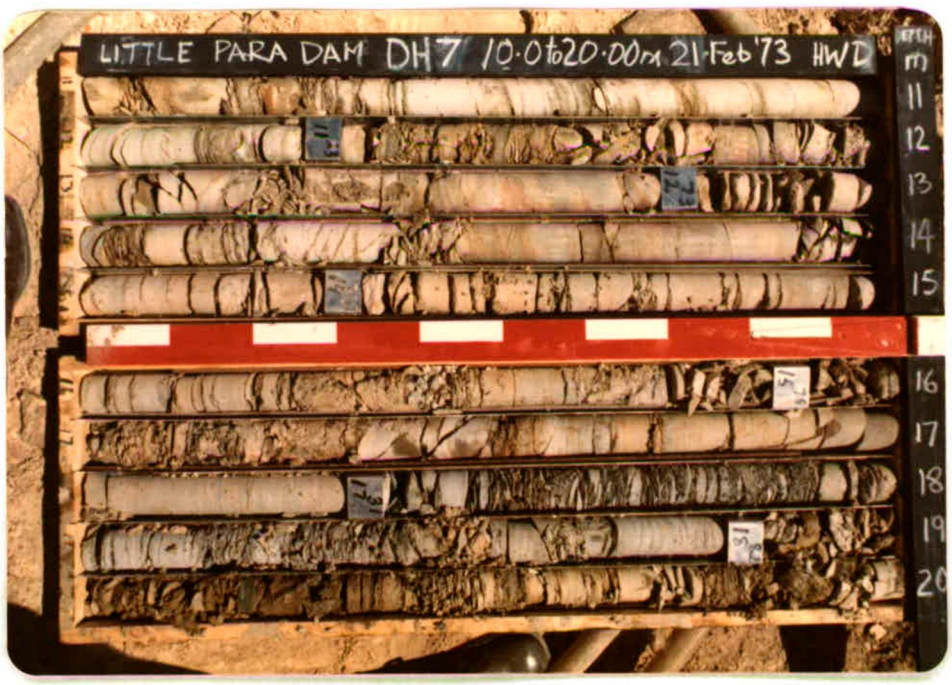


YATALA 23582 15

YATALA 23584

YATALA 23585

YATALA 23588



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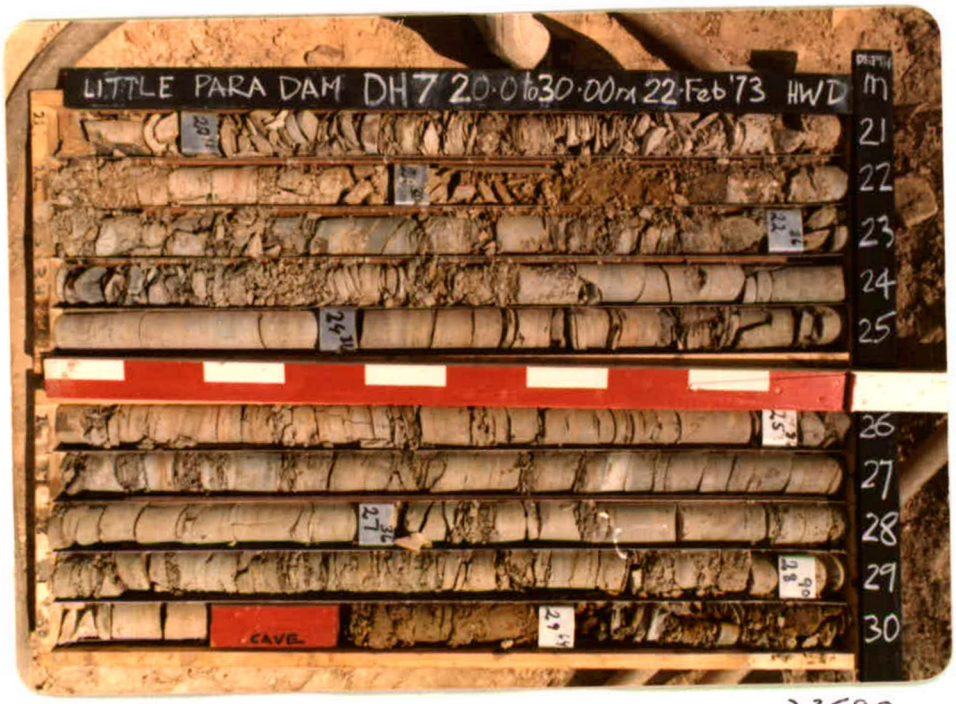


YATALA 23590

YATALA 23591

MUNNO PARA

23845-6

18

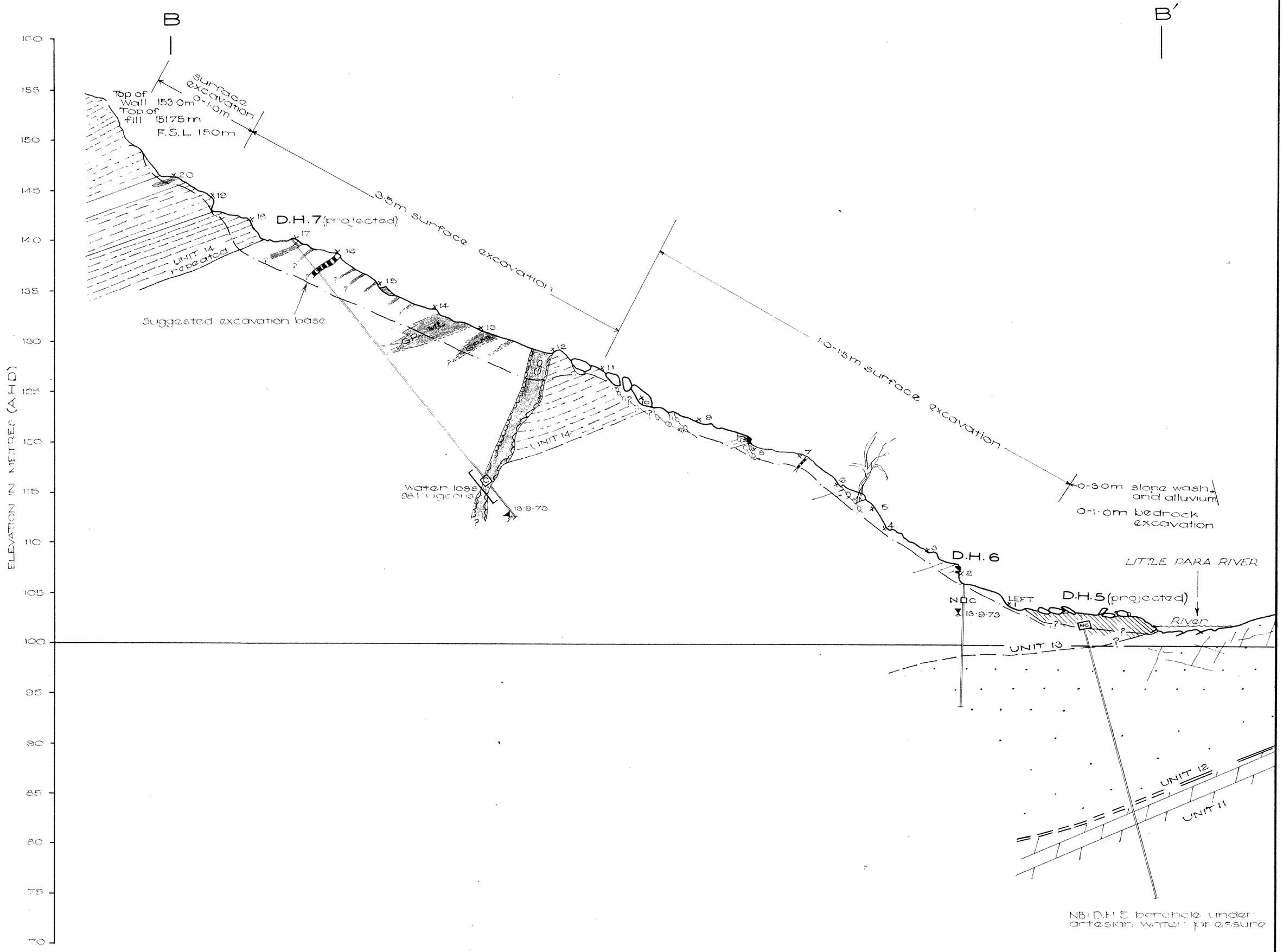
MUNNO PARA

23847


LEGEND
Poorly sorted gravel, poorly sorted sand, low plastic silts
Hillside debris, sluiced debris, alluvium
Shaly Dolomite
Spoil from Trench 1
Slate, or slaty Dolomite
Calcrete capping enclosing quartzite boulders
Massive quartzite, (F-MW) MS-VS. Fractures discontinuous and tight
Quartzite fractured into large tight blocks (MW-HW), MS-W
Quartzite blocks opened along deep joints, (MW-HW), MS-W
E.L. 153 Elevation (contour in metres) Datum: A.H.D.
Possible open bedding plane, beneath boulders
Quartzite, fractured into smaller blocks, tight, low profile. (MW-CW), W-VW
As above, but showing open joints
Highly fractured zone. Small blocks, very tight to fairly loose
Quartz veins. Trench or pit formation
Small cavities along line of hillside fractures associated with unstable rock masses
Overhanging boulders or outcrop
28° Strike and dip of bedding
80° Strike and dip of joint
Shear zone
DH 1 Cored drillhole
+25 Survey station used for geological logging
x M2 Survey pegs along ℄ of exposure trenches
ROCK STRENGTH AND WEATHERING
VW very weak
W weak
MS medium strong
S strong
VS very strong
(F) fresh
(SW) slightly weathered
(MW) moderately weathered
(HW) highly weathered
(CW) completely weathered
(A) altered
TRUE NORTH
GRID NORTH (Aust. National Grid)
1° 19'
N
151 650 mN
151 700 mN
151 750 mN
291 300 mE
291 250 mE
291 200 mE
291 150 mE
291 100 mE
TRENCH 1
TRENCH 2
INSET
SEE INSET
continuation of Dam Crest alignment
℄ of Dam crest - 5 metres wide
LITTLE PARA RIVER
SLATY DOLOMITE
Shear zone
natural outcrop
DH 1
DH 2
DH 3
DH 4
DH 5
DH 6
DH 7
DH 15
LEFT HAND SIDE ALIGNMENT
Station
Rock Quality
Suggested Treatment
Slopewash; sluiced debris; alluvium
Complete removal to bedrock, which should require little treatment
LITTLE PARA RIVER AND ALLUVIALS
Mainly massive quartzite (SW - MW); VS - MS; Joints closed and discontinuous
loose boulders 60x30x20 cm
GP-pit
fracture zone, blocks loose-tight 25x10x30 cm
(HW) gravelly quartzite; boulders 50x40x30 cm with open joints (2 mm-15 cm). Shallow soil horizon still remains
Jointed massive boulders; tight; (HW) fractured quartzite
(HW) and fractured GP
(MW) Boulders (130x75x55 cm) resting upon (?) weathered bedding planes. Potentially unstable. Trench formation upto 150 cm wide and 120 cm deep.
Stations 19 to 20, Quartzite is reduced to GP-SP
(CW-HW); W; Jointed quartzite with fractured quartz veins
Calcrete capping; quartzite capping
Fractured quartzite boulders (F-HW); 200 x 150 x 100 cm max.?; occur along the major part of the alignment. Many appear to sit upon weathered planes parallel to the hillslope and are potentially unstable
Original surface to be retained wherever possible; large boulders may require 'popping' before removal; excess grouting pressures should be avoided. Quartzite UNIT 12 should be grouted early prior to grouting Dolomite UNIT 11 underneath
possible removal
dig out
selective work by jack hammers
Leave natural surfaces undisturbed wherever possible
Inspection and possible complete removal; surface trimming
selective treatment and scraping
surface trimming
Selective treatment of boulders and digging out of trenches
Surface trimming may be sufficient
Complete removal
RIGHT HAND SIDE ALIGNMENT
SCALE IN METRES
SCALE IN FEET
DEPARTMENT OF MINES - SOUTH AUSTRALIA
LITTLE PARA RIVER - GEOLOGICAL INVESTIGATION
GROUT CAP ALIGNMENT - GEOLOGICAL PLAN
ENGINEERING GEOLOGY SECTION
J C Beal
GEOLOGIST
Director of Mines
Drn. J.C.B.
Tcd. D.J.M.
Ckd. A.F.
Exd.
SCALE: 1:250
73-929
Ha2+5
DATE: 14th Dec. 1973

Fig 1

LEFT HAND SIDE ALIGNMENT



NB: D.H.5 borehole under artesian water pressure

NB: For legend see Plan No. 73-929 Fig 2

SCALE

METRES 5 0 5 10 15 20 METRES

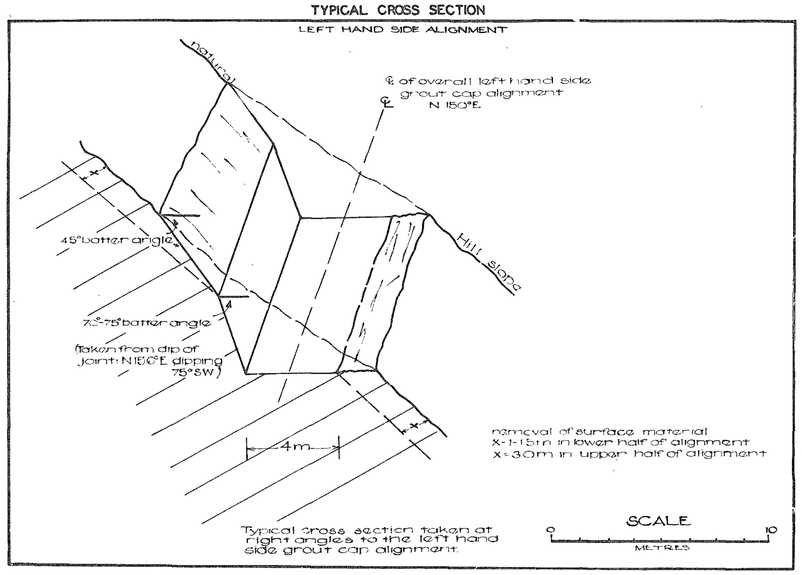
DEPARTMENT OF MINES — SOUTH AUSTRALIA

LITTLE PARA DAM
GEOLOGICAL INVESTIGATIONS
GROUT CAP – GEOLOGICAL CROSS SECTION

ENGINEERING GEOLOGY SECTION	J. C. Beal GEOLOGIST	Drn. J.C.B	SCALE: 1:250
		Tcd. R.B	73-941 Ha 2+5
		Ckd. A.F.	
Director of Mines		Exd.	DATE: 18 Dec. 1973

TYPICAL CROSS SECTION

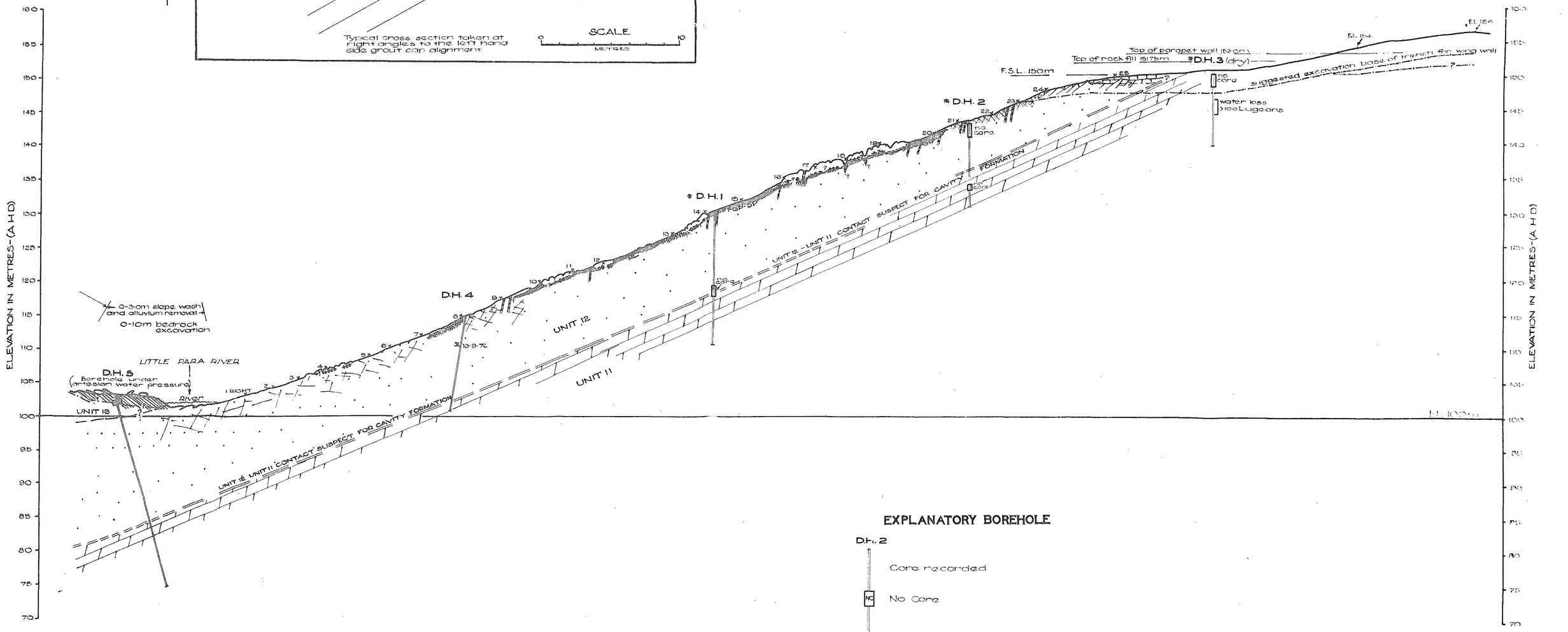
LEFT HAND SIDE ALIGNMENT



B A

RIGHT HAND SIDE ALIGNMENT

A A



EXPLANATORY BOREHOLE

D.H. 2

Core recorded

NC — No Core

C — Cavity recorded during drilling

▼ 13·9·73 Water level at date recorded

* Denotes borehole blocked after sluicing, no record of groundwater level.

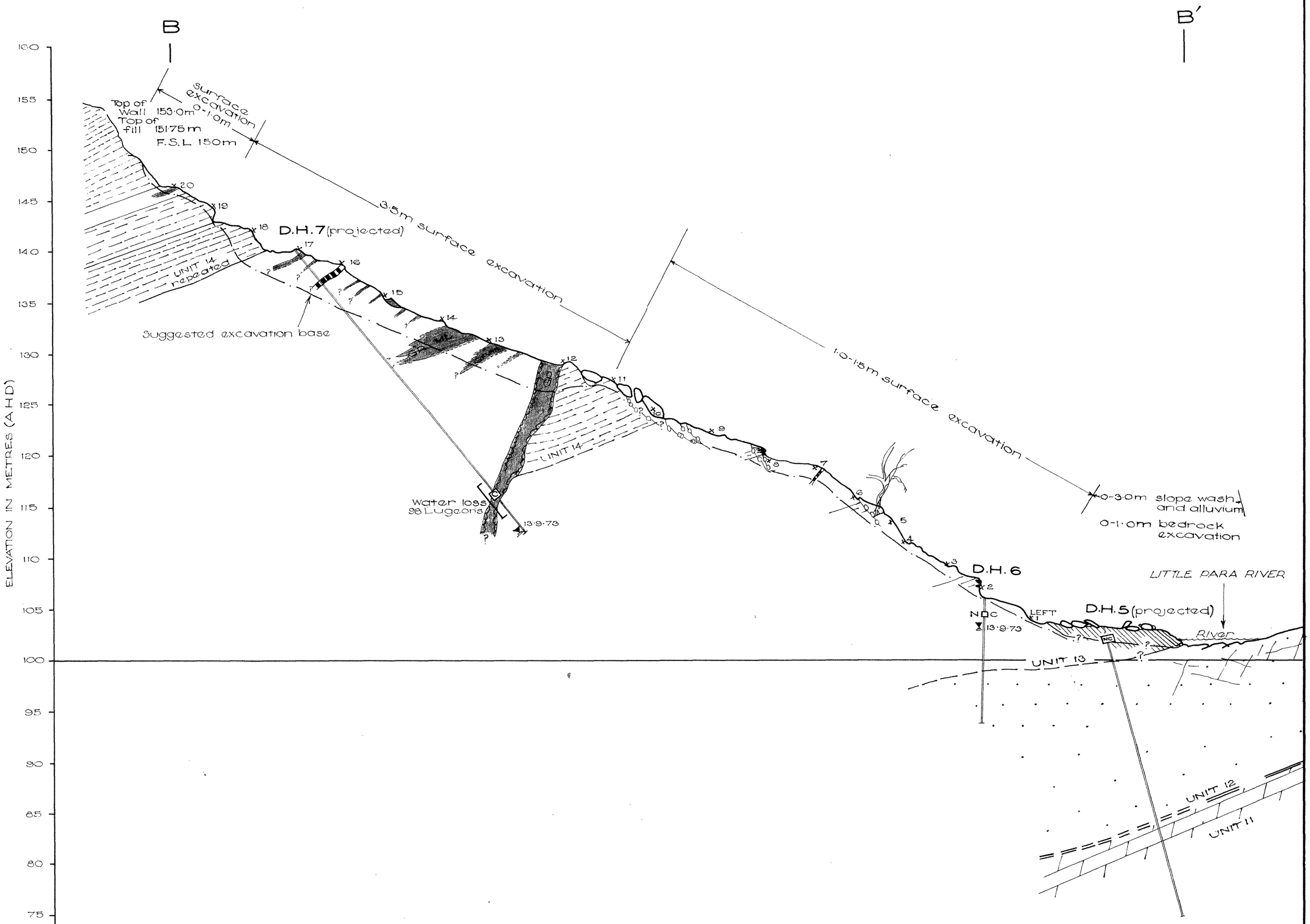
for reference to rock symbols see plan 73-0713

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LITTLE PARA DAM
GEOLOGICAL INVESTIGATIONS
GROUT CAP - GEOLOGICAL CROSS SECTION

ENGINEERING GEOLOGY SECTION	GEOLOGIST	Drn. J.C.B.	SCALE: 1:250
		Tcd. R.B.	73-941 Sht 4 of 5
Director of Mines		Chd. A.F.	
		Esd.	DATE: 17 Dec. 1973

LEFT HAND SIDE ALIGNMENT



SCALE

METRES 5 0 5 10 15 20 METRES

NB: For legend see Plan No. 73-929

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LITTLE PARA DAM
GEOLOGICAL INVESTIGATIONS
GROUT CAP – GEOLOGICAL CROSS SECTION

ENGINEERING GEOLOGY SECTION	J. C. Beal GEOLOGIST	Drn. J.C.B	SCALE: 1:250
		Tcd. R.B	73-941 Ha 2+5
		Ckd. A.F.	
Director of Mines		Exd.	DATE: 18 Dec. 1973

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. DH 1

SERIAL No.

PROJECT. LITTLE PARA DAM

FEATURE. SITE 5 . RIGHT BANK

LOCATION 2/3rds up right abutment.

SECTION 1560 HUNDRED MUNNO PARA

CO-ORDINATES 6151 705·0 . 291 176·0

ANGLE FROM HORIZ. 90° DIRECTION

E.L. Surface 130·40 m

E.L. Collar 130·95 m

Datum AHD

DESCRIPTION OF CORE	② GROUP SYMBOL	① STRENGTH TERM VS S MS W VW SO	CORE SIZE DEPTH R.L. m	LOG	③ FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS% 10 5 50	WATER LEVEL DATE	CASING	DRILL WATER LOSS% 0 100	④ WATER PRESSURE TESTS LUGEONS 0.5 1 5 10 50 100
PROTEROZOIC ADELAIDE SYSTEM Torrensian Series – BURRA GROUP, Undalya Quartzite. UNIT 11 CARBONATES. Impure dolomite Grey, fine-grained dolomite with varying degrees of foliation. Contains up to 10% quartz & opaques. UNIT 12 QUARTZITES Massive, light coloured, feldspathic quartzite.											
No CORE						Zone of intense mechanical weathering. Joints rough, irregular, red brown clay and limonite coatings.					
Sandstone, off-white to red, limonite stained coarse grained with many weathered, Chalky feldspar grains. Grains mainly 0·8 - 1·2 mm. Becoming medium grained. Grains mainly 0·6 mm Rounded quartz and weathered feldspar with a few grains of dark mineral. Petrological sample P.853/72				1		Joints dip 70° to 90°, smooth, planar and 30° to 50°, rough irregular. Red, yellow brown clay & limonite coatings.					
				2		Joints dip 70°. Smooth, planar Grey, high plasticity clay coatings up to 1 mm thick.					
				3		Sheared zone. Numerous, rough irregular intersecting limonite coated joints.					
				4		Rough, limonite coated joints dip 75°.					
				5		Crushed zone, 30 mm, dip 5°					
				6		Crushed zone 30 mm and sheared zone 0·3 m dip 80°.					
White and brown clayey silt soil ML Offwhite sandstone grains mainly 0·1 to 0·2 mm. Light green banding.				7		Crushed seam with clay 50 mm Grey clay seam 10-15 mm dip 80°					
				8		Sheared zone 0·2 m dip 15° Joint dips 60°. Infilled with 10 mm orange clay. Bedding dips 15°. Rough joint.					(214)
				9		Crushed zones, 5 mm dip 30° Sheared zone 0·2 m. Dips 15° parallel bedding. Limonite stained.					
Core becoming more slatey. Quartz-chlorite veins. Limonite stained vesicular "toothy" quartz. Dark grey to brown non calcar. slate.				10		Sheared zone & quartz veins vesicular limonite stained.					
				11		Joints (cleavage) dips 30. Limonite stained, slickensided. Quartz vein & crushed seam.					(214)
Calcareous slate.				12							
NO CORE						Rough irregular joints dip 50° Bedding dips 30°. Joint in quartzite parallel to bedding smooth, planar, limonite stained. Sheared zone 5 mm with calcite and clay, dips 30, parallel cleavage. Sheared zone, 40 mm, dip 30° with clay seam.					
Brownish grey to brown calcareous slate.				13							(419)
Blue, finegrained dolomite				14							
Greenish brown to grey calcareous slate. Pet. Sa. P 854/72 Quartzite band 0·15 m thick.				15		Sheared zones dip 30° parallel to cleavage.					
				16		Sheared zones 10 mm.					(493)
Blue, fine grained dolomite. Cleavage limonite stained. Pet. Sa. P 855/72				17		Sheared zone, joints limonite stained mainly parallel to cleavage, dip 30°. Few crushed seams up to 10 mm.					
				18							
Light green-grey to brown grey fine grained calcareous slate.				19		Limonite stained joints smooth planar, parallel to cleavage dip 30°. Some thin brown clay coatings and thin crushed seams. Few steeply dipping, limonite stained rough irregular joints.					(504)
				20		20·08 End of Hole.					

① ROCK SUBSTANCE
STRENGTH TERM
VS–Very Strong
S–Strong
MS–Medium Strong
W–Weak
VW–Very Weak
SO–Soil properties

CONDITION TERM
Fresh
Decomposed
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System. P854/73 Departmental Sample No.

③ FRACTURE LOG
1 4 16 64 Natural fractures per 30cm of core
30 7·5 2 0·5 Equivalent length of core in cm

④ (1315) Maximum effective pressure (kilo pascals) reached during test.
Min. = Minimum value.

ENGINEERING GEOLOGY SECTION

DRILL No. 15	LOGGED H.W. DIXON
TYPE MINDRILL	DATE 18 Dec '72
DRILLER T. Jarvis	TRACED B.S.G.
START 4 SEPT. '73	CHECKED
FINISH 11 SEPT '73	
SHEET 1 OF 1	DRG. No. S 10101

P.E. No. S5027E MB

Fig 3 No 12

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. DH 2

PROJECT LITTLE PARA DAM

FEATURE GROUT CAP

LOCATION UPPER RIGHT ABUTMENT

SECTION 1560 HUNDRED MUNNO PARA

CO-ORDINATES 6 151 702·2 291 141·0

ANGLE FROM HORIZ 90° DIRECTION

E L Surface 143·80 m

E L Collar 144·50 m

Datum A H D

DESCRIPTION OF CORE	GROUP SYMBOL	STRENGTH TERM	CORE SIZE	DEPTH m	FRACTURE LOG 2 10 50 200	STRUCTURE JOINTS, SHEARS, NEARER SURFACE CRUSHED ZONES	CORE LOSS %	WATER LEVEL	CASING DRILL WATER LOSS	WATER PRESSURE TESTS Lugeons
NO CORE			NMLC 89mm	1		ZONE OF INTENSE MECHANICAL WEATHERING				
Quartzite (H.W.) ML Off white to light grey quartzite. Grains 0·3 to 0·7mm. Feldspathic, (SW) - (MW). Limonite stained Bedding dips 30°				2		Sheared zone 0·1m with silt filled joint 15-20mm. Dips 60° Smooth planar joints dip 70°-80° up to 3mm. CLAY, low plasticity				
Light grey shaly quartzite Limonite stained fractures.				3						
Light grey massive quartzite Dark grey calcareous shales MW				4		Sheared zone 0·1m. Crushed seam 0·05m, dip 10° Sheared zone 0·3m. Bedding plane partings (cleavage) dips 15°				(120)
Light grey quartzite with greenish (chlorite?) banding parallel to bedding Limonite stained.				5						
				6						
				7		Joints smooth planar, limonite stained parallel to banding dip 10°-15° Sheared zone 0·25m dip 10° Quartz vein.				
Brown shaly dolomite with a few seams of (SW) dark grey dolomite. ML				8						(220)
NO CORE				9		Numerous thin crushed & sheared seams parallel to cleavage, dip 20°				
Bluish dark grey shaly dolomite. Fine grained (< 0·1mm). Limonite stained along fractures. MW				10						
				11		sheared seams 5mm. Joints, smooth planar dip 30° parallel to cleavage. Limonite and clay coated.				(296)
				12						

PROTEROZOIC ADELAIDE SYSTEM TORRENSIAN SERIES

UNIT 12 QUARTZITE

UNIT 11 SHALEY DOLOMITE

12·12 m END OF HOLE

① ROCK RESISTANCE
STRENGTH TERM
VS Very Strong
S Strong
MS Medium Strong
W Weak
VS Very Weak
D Soil properties

WEATHERING TERM
Fresh
Slightly
Altered
Alt

② SUBDIVISIONS WITHIN THE ABOVE GROUPS

③ FRACTURE LOG
50 10 2 0·5 length of core in cms
2 10 50 200 Natural Fractures per metre of core
50 10 2 0·5 Equivalent length of core in cm
(50) Kilopascals

ENGINEERING GEOLOGY SECTION

DRILL No. 15
TYPE MINDRILL
DRILLER A. JENSEN
START 12 JAN '73
FINISH 3 JAN '73

LOGGED H. DIXON
DATE 7 MAR. '73
TRACED D.W.W.
CHECKED

SHEET 1 OF 1 DRG No. S10461 Hat2

PE No. S5027E MB

F 9c

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. DH 3

SERIAL No.

PROJECT. LITTLE PARA DAM.

FEATURE. GROUT CAP.

LOCATION TOP RIGHT ABUTMENT

SECTION 1560. HUNDRED MUNNO PARA

CO-ORDINATES 6 151 705·7 . 291 105·0

ANGLE FROM HORIZ. 90° DIRECTION

E. L. Surface 151·55 m

E.L. Collar 152·15 m

Datum A.H.D.

PROTEROZOIC ADELAIDE SYSTEM : TORRENSIAN SERIES

UNIT 11 SHALY DOLOMITE

SOIL

DESCRIPTION OF CORE	GROUP SYMBOL	STRENGTH TERM (1) VS S MS W VW SO	CORE SIZE	DEPTH E.L. m	LOG	FRACTURE LOG (3) 2 10 50 200	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS% 10 5 50	WATER LEVEL DATE	CASING	DRILL WATER LOSS% 0 100	WATER PRESSURE TESTS LUGEONS (4) 0·5 1 5 10 50 100
NO CORE				1			Zone of intense Mechanical and Chemical WEATHERING					
Dark to light grey slaty dolomite (SW)-(MW) with limonite stained cleavages and joints. Micaceous. Weathered to a brown calcareous siltstone. →				2			Irregular, closely spaced limonite stained joints. Sheared zones 20 mm, dip 30° parallel to cleavage. Joints smooth planar, dip 30° parallel to cleavage. Limonite stained. Some grey clay coated.					
				3								
				4								
Dark blue-grey slaty dolomite. Fine grained. (SW) Limonite along cleavage.				5			Small sheared or crushed seams 2-5 mm. Dip 30° parallel to cleavage.					(85)
				6			Sheared and crushed zones 0·1 m – 0·05 m. Dip 20° parallel to cleavage.					
Light brown shaly limestone. Reddish brown limonite stain along prominent cleavage.				7			Few joints, steeply dipping (80°) and limonite stained.					
				8								(218)
				9			Sheared zone 0·05 m. Dip 40°. Joints mainly parallel to cleavage. Dip 20°. Limonite and MnO_2 stained.					
Pale blue-grey-whitish slaty dolomite (SW)				10			Sheared zone 20 mm. Dip 30°					(272)
							10·52 m. END OF HOLE					

① ROCK SUBSTANCE
STRENGTH TERM
VS-Very Strong
S-Strong
MS-Medium Strong
W-Weak
VW-Very Weak
SO-Soil properties

CONDITION TERM
Fresh
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System

③ FRACTURE LOG
50 10 2 0·5 length of core in cms.
2 10 50 200 Natural fractures per metre of core
50 10 2 0·5 Equivalent length of core in cm

④ (350) Maximum effective pressure (Kilopascals) reached during test.
Min. Minimum value.

ENGINEERING GEOLOGY SECTION

DRILL No. 15	LOGGED H. W. DIXON
TYPE MINDRILL	DATE 6-MAR-'73.
DRILLER J. JENSEN	TRACED D.J.M.
START 10 JAN. '73	CHECKED
FINISH 11 JAN. '73	

SHEET 1 OF 1. DRG. No. S10471 Hat 2

P.F. No. S5027E MB

F195

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. DH 4

SERIAL No.

PROJECT. LITTLE PARA DAM

FEATURE. GROUT CAP

LOCATION LOWER RIGHT ABUTMENT.

SECTION 1560. HUNDRED Munno Para

CO-ORDINATES 6,151,721·1 .291, 211·9

ANGLE FROM HORIZ. 60° DIRECTION 020

E.L. Surface 116·15 m

E.L. Collar 116·75 m

Datum AHD

DESCRIPTION OF CORE	GROUP SYMBOL	STRENGTH TERM (1) VS S MS W VW SO	CORE SIZE DEPTH E.L. m	LOG	FRACTURE LOG (3) 2 10 50 200	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS% 10 5 50	WATER LEVEL DATE	CASING	DRILL WATER LOSS % 0 100	WATER PRESSURE TESTS LUGEONS (4) 0·5 1 5 10 50 100
PROTEROZOIC ADELAIDE SYSTEM Torrensian Series BURRA GROUP											
UNIT 12 QUARTZITE											
Off white brownish feldspathic quartzite (SW)						Few rough joints, dip 15°, limonite stained. Bedding indistinct, dip 45° Planar rough joints, dip 85° to 90°					
Light blue-grey quartzite											
Quartzite, mainly angular quartz 0·5 to 0·7 mm with minor feldspar grains, some weathered (CW)						Ptygmatic chlorite band dips 45° 1 to 2 mm wide. Quartz vain, dip 45°					(112)
Fresh blue-grey quartzite						Bedding dips 45°					
NO CORE											
Off white to brownish weathered quartzite. Limonite stained. Massive.						Sheared zone -200mm dips 70° to 80°. Limonite and clay coated. Smooth planar joints, dip 70° and 40°, limonite and clay coated.					(206)
						Sheared zones 0·1m, with crushed seams. Dip 40° Limonite stained, clay coated joints.		15 Feb. 1973			(300)
Chlorite along cleavage or in dendritic pattern. Blue-grey quartzite, limonite stained along some cleavages.						Sheared zones 10 and 30mm, dip 40°.					(308)
Blue-grey-off white banded quartzite. Pyrite along cleavage.						Cleavage chlorite and pyrite coated. Slickensides on cleavage. Numerous small sheared zones up to 0·05m. Dip 40°					
UNIT 11 SHALY DOLOMITE						Sheared zone 0·3m. Dip 60°					(371)
Dark grey to black shaly dolomite, containing mica and pyrite along cleavage.						Crush seam 5mm. Grey pyritic silt. Dip 10°					
						16·08m. END OF HOLE.					

① ROCK SUBSTANCE STRENGTH TERM
VS–Very Strong
S–Strong
MS–Medium Strong
W–Weak
VW–Very Weak
SO–Soil properties

CONDITION TERM
Fresh
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System

③ FRACTURE LOG
50 10 2 0·5 length of core in cms
2 10 50 200 Natural fractures per metre of core
50 10 2 0·5 Equivalent length of core in cm

④ (350) Maximum effective pressure (Kilopascals) reached during test.
Min. = Minimum value.

ENGINEERING GEOLOGY SECTION

DRILL No. 15
TYPE MINDRILL
DRILLER J. JENSEN
START 22 JAN. '73.
FINISH 23 JAN. '73.

LOGGED H. DIXON.
DATE 5 MAR. '73
TRACED D.J.M.
CHECKED

SHEET 1. OF 1. DRG. No. S10472 Hat2

P.F. No. S5027E MB

Fig 6

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. DH 5

SERIAL No

PROJECT. LITTLE PARA DAM

FEATURE. GROUT CAP

LOCATION LOWER LEFT ABUTMENT

SECTION 1560. HUNDRED YATALA

CO-ORDINATES 6. 151. 721·6 . 291 264·1

ANGLE FROM HORIZ. 55° . DIRECTION 270°

E.L. Surface 103·90 m

E.L. Collar 103·90 m

Datum . AHD

DESCRIPTION OF CORE	② GROUP SYMBOL	① STRENGTH TERM (VS, S, MS, W, VW, SO)	CORE SIZE DEPTH E.L. m	LOG	③ FRACTURE LOG (2 10 50 200)	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS% (10 50)	WATER LEVEL DATE	CASING	DRILL WATER LOSS % (0 100)	WATER PRESSURE TESTS ④ LUGEONS (0·5 1 5 10 50 100)
RECENT: SLOPEWASH: Soil and Boulders											
NO CORE			89mm.								
Dark grey slate			1			Cleavage dips 60°					
NO CORE			2	MMLC							
BURRA GROUP / TORRENSIAN SERIES / ADELAIDE SYSTEM / PROTEROZOIC — UNIT 13 SHALY DOLOMITE: Grey brown weathered shaly dolomite. Limonite stained along cleavage.			3			Sheared zone 1m. Dips 20° parallel to cleavage. Zone of intense mechanical & chemical weathering					
NO CORE											
Grey slightly calcareous siltstone with poorly developed cleavage - Contains much chlorite and some pyrite in blebs 0·5 - 1mm. Pet.So.			4			Joints, rough planar dip 10° Chlorite and pyrite coatings, some limonite staining					
						Rough joint dips 70°					
Light grey impure quartzite. Grain size 0·05 - 10mm. Contains much pyrite and chlorite parallel to bedding			5			Sheared zone 0·3m. with 20mm. crushed seam. Dips 15°					
			6			Bedding dips 20°. Slickensides down bedding					(140)
						Sheared zones 0·05 m. dip 5°- 20°					
QUARTZITE pale grey with slaty fracture: Light grey to off-white quartzite. Grains less than 0·5 m. Occasional bands of pyrite and chlorite			7								
			8								
			9			Rough planar joint dips 60°					(242)
			10								
			11								
			12								(191)
			13			Rough planar joint dips 70° Limonite stained					
Light grey quartzite. Grains mainly 0·5 - 1mm. Occasional 0·2mm wide ptygmatic bands of pyrite and chlorite			14			Rough planar joints. Limonite coated Dips 20°					
			15			Rough planar joint, dips 80°					(270)
			16			Rough irregular to planar joints dip 60°					
			17			Sheared zones dip 15° parallel to bedding (cleavage). Chlorite and pyrite on joints					
Light grey quartzite. Contains much chlorite in dendritic patterns			18								(270)
UNIT 12: Light grey sheared quartzite healed with chlorite			19			Sheared zone 0·1m. Dips 20°					
UNIT 11 Dark grey micaceous shale			20			Sheared zone 0·1m, with crushed seam dips 30°					

50 10 2 0·5 length of core in cms

① ROCK SUBSTANCE

STRENGTH TERM
VS–Very Strong
S–Strong
MS–Medium Strong
W–Weak
VW–Very Weak
SO–Soil properties

CONDITION TERM
Fresh
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System

③ FRACTURE LOG
2 10 50 200 Natural fractures per metre of core
50 10 2 0·5 Equivalent length of core in cm

④ (350) Maximum effective pressure (Kilopascals) reached during test.
Min. Minimum value.

ENGINEERING GEOLOGY SECTION

DRILL No. 15
TYPE . MINDRILL
DRILLER J. JENSEN
START. FEB 1973
FINISH 15 FEB 1973

LOGGED . H. DIXON
DATE . 28 FEB 1973
TRACED TJE.
CHECKED

SHEET 1 OF 2. DRG. No. S10473 Hat2

P o S5 27 MB

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. DH 5

SERIAL No

PROJECT. LITTLE PARA DAM

FEATURE. GROUT CAP

LOCATION LOWER LEFT ABUTMENT.

SECTION 1560 HUNDRED YATALA

CO-ORDINATES 6 151 721·6 291 264·1

ANGLE FROM HORIZ. 55° DIRECTION 270°

E.L. Surface 103·90 m

E.L. Collar 103·90 m

Datum AHD

DESCRIPTION OF CORE	GROUP SYMBOL	STRENGTH TERM (VS MS W VW SO)	CORE SIZE DEPTH E.L m	FRACTURE LOG (2 10 50 200)	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS% (10 5 50)	WATER LEVEL DATE	CASING	DRILL WATER LOSS% (0 100)	WATER PRESSURE TESTS LUGEONS (0.5 1 5 10 50 100)
Quartz-chlorite veins contain fine grained pyrite in aggregate up to 5 mm.	BURRA GROUP		NMLC		Quartz chlorite veins 0·5 m. with 50 mm sheared zone					
Dark grey shaly impure dolomite	SHALY DOLOMITE		21		Cleavage developed, smooth with chlorite and pyrite					(131)
Contains pyrite and chlorite along cleavage			22		Few rough joints dip 50°					
					Sheared zone 0·7m parallel to cleavage					
Shows small scale slump structures			23		Small sheared zones 0·1 - 0·15m parallel to cleavage.					
			24		Bedding parallel to or sub-parallel to cleavage.					(228)
Dark grey shaly dolomite			25							
			26		Numerous broad-sheared zones 0·2 - 0·5 m. wide					
			27		Quartz chlorite veins					
Light grey dolomite x					Sheared zones, parallel to cleavage					(276)
Grey clay and silt (some calcareous) with gravel fragments up to 10 mm. GC x			28		Crushed seams 5mm. Dips 5-10° parallel sheared zones					
			29							
			30							
Petrological Sample ..... Contains pyrite and chlorite along cleavage.	UNIT II		31		Sheared zones 0·5 m. Dips 5-10° Crushed seam 10 mm					(517)
Markedly anisotropic. Parts readily along cleavage. Possibly loses strength when wet.			32		Numerous narrow sheared zones 5 - 20 mm wide					
					END OF HOLE 32·40m.					

① ROCK SUBSTANCE STRENGTH TERM
VS–Very Strong
S–Strong
MS–Medium Strong
W–Weak
VW–Very Weak
SO–Soil properties

CONDITION TERM
Fresh
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System

③ FRACTURE LOG
50 10 2 0·5 length of core in cms
2 10 50 200 Natural fractures per metre of core
50 10 2 0·5 Equivalent length of core in cm

④ (350) Maximum effective pressure (Kilopascals) reached during test.
Min. Minimum value.

ENGINEERING GEOLOGY SECTION

DRILL No. 15	LOGGED H DIXON
TYPE MINDRILL	DATE 28 FEB 1973
DRILLER J. JENSEN.	TRACED TJE
START 7 FEB 1973	CHECKED
FINISH 15 FEB 1973	
SHEET 2 OF 2	DRG. No. S10473a Hot 2

Fig 7

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. DH 6
SERIAL No.

PROJECT. LITTLE PARA DAM.
FEATURE. UPSTREAM TOE OF GROUT CAP
LOCATION LEFT BANK

SECTION 1560. HUNDRED YATALA
CO-ORDINATES 6 151 709·9 291 266·7
ANGLE FROM HORIZ. 90° DIRECTION —

E. L. Surface 106·00 m
E.L. Collar 106·70 m
Datum AHD

DESCRIPTION OF CORE	② GROUP SYMBOL	① STRENGTH TERM (VS S MS W VW SO)	CORE SIZE DEPTH E.L. m	LOG	③ FRACTURE LOG (2 10 50 200)	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS% (10 5 50)	WATER LEVEL (DATE)	CASING	DRILL WATER LOSS% (0 100)	④ WATER PRESSURE TESTS LUGEONS (0·5 1 5 10 50 100)
PROTEROZOIC / ADELAIDE SYSTEM / TORRENSIAN SERIES											
UNIT 12 QUARTZITE											
NO CORE											
Quartz feldspar and chlorite vein with limonite and siderite						Quartz chlorite veins 0·1m. Dip 30°					
NO CORE											
UNIT 13 SHALY DOLOMITE: Greenish grey fine grained shaly dolomite. Limonite staining along cleavage						Quartz chlorite veins 0·1m. Dip 30° Irregular joints dip 60° Limonite stained. Sheared zones 10-30mm. Dip 30° Cleavage dips 30° Bedding subparallel. Sheared zone 0·5 m. Dips 0°		1 FEB 1973			
Blue grey massive dolomite											
Grey shaly impure dolomite. Contains chlorite and pyrite						Sheared zone 0·3m. Dips 20-30° Sheared zone. 20-50mm. Dip 30° parallel to cleavage.					(71)
QUARTZITE: Slightly calcareous siltstone						Sheared zone 0·1m. dips 20°. Slicken side dips 10°. Crushed seams on some joints					
Grey to green grey banded and cross-bedded quartzite						Sheared zones 0·1 — 0·5m wide					(140)
Green grey banded quartzite with much chlorite in dendritic pattern.						Cross bedding dips 20°-40°					
Grey to off-white quartzite. Grains 0·2 - 0·5 mm. Steeply dipping limonite cemented joints. Chlorite in 1mm ptygmatic bands						Joints dip 20° Limonite stained. Rough joint dips 80° Chlorite on joint (parallel to cleavage) dips 20°					(209)
						END OF HOLE 12·2 m.					

① ROCK SUBSTANCE STRENGTH TERM
VS-Very Strong
S-Strong
MS-Medium Strong
W-Weak
VW-Very Weak
SO-Soil properties

CONDITION TERM
Fresh
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System

③ FRACTURE LOG
50 10 2 0·5 length of core in cms
2 10 50 200 Natural fractures per metre of core
50 10 2 0·5 Equivalent length of core in cm

④ (350) Maximum effective pressure (Kilopascals) reached during test.
Min. = Minimum value.

ENGINEERING GEOLOGY SECTION

DRILL No. 15
TYPE MINDRILL
DRILLER J. JENSEN
START 1 FEB 1973
FINISH 7 FEB 1973.

LOGGED H. DIXON
DATE 28 FEB 1973
TRACED TJE.
CHECKED

SHEET 1 OF 1
DRG. No. S10474 Ha+2

P.F. No. S5027E MB

Fig 8

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. DH 7
SERIAL No

PROJECT. LITTLE PARA DAM
FEATURE. GROUT CAP
LOCATION UPPER LEFT ABUTMENT
SECTION 1560 HUNDRED YATALA
CO-ORDINATES 6.151.657·1 291 299·9
ANGLE FROM HORIZ. 50° DIRECTION 325°
E L Surface 140·6 m
E L Collar 140·6 m
Datum AHD

DESCRIPTION OF CORE	② GROUP SYMBOL	① STRENGTH TERM	CORE SIZE DEPTH m	③ FRACTURE LOG	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS %	WATER LEVEL DATE	CASING	DRILL WATER LOSS %	④ WATER PRESSURE TESTS LUGEONS
		VS S MS MW W SO		2 10 50 200		0 50			0 100	0·5 1 5 10 50 100

PROTEROZOIC — ADELAIDEAN SYSTEM — TORRENSIAN SERIES — BURRA GROUP

SHALY DOLOMITE — UNIT 13 — Thickened sequence - faulted borehole

NO CORE			
Off white micaceous shaly dolomite Micaceous (SW - MW)	NO CORE	ML	Zone of intense mechanical and chemical weathering Cleavage dips 25°
			Sheared zone 0·6 m.
Grey fine grained dolomite		NMLC	
Cream quartzite with apoque quartz vein - contains galena up to 10 mm		ML	Sheared and crushed zone 0·2 m dip 25° parallel to cleavage
Crushed silty zones (ML)			Numerous sheared and crushed seams 0·1 to 0·2m wide, dip 25° parallel to cleavage
Grey to brown limonite stained shaly dolomite			
Blue-grey dolomite			Sheared zone 0·1m, dips 0°
Grey brown shaly dolomite Micaceous limonite stained cleavage			Sheared zone 0·15m dips 25° parallel to cleavage
Blue-grey fine grained dolomite			Joints roughly planar dip 50° Also joints smooth planar dip 25° parallel to cleavage
		ML	Sheared and crushed zone 0·25m Dip 5°-10°
Grey to brown-grey shaly dolomite. Slightly to moderately weathered. Limonite and MnO_2 stains along cleavage			Joints smooth planar limonite stained dip 25° parallel to cleavage Sheared zones parallel to cleavage
			Sheared zone 0·05 m. dip 0°
			Sheared zone 0·1m dip 25°
Greenish brown shaly fine-grained impure dolomite			Sheared and crushed zones 0·2 m, 0·1 m } dip 20°
Buff to brown medium grained quartzite. Sheared healed carbonate & chlorite			Sheared zones 0·7m dips 20°-30°
Blue grey to greenish non calcareous slate			Rough irregular joints dip 50° Sheared zones up to 0·5 m. Wide. Dip 20° to 30°, parallel to cleavage. Limonite stone stained grey in cleavage.
Grey brown fine grained impure dolomites			

(194) (239) (291)

① ROCK SUBSTANCE STRENGTH TERM
VS-Very Strong
S-Strong
MS-Medium Strong
W-Weak
VW-Very Weak
SO-Soil properties

CONDITION TERM
Fresh
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System

③ FRACTURE LOG
50 10 2 0·5 length of core in cms
2 10 50 200 Natural fractures per metre of core
50 10 2 0·5 Equivalent length of core in cm

④ (350) Maximum effective pressure (Kilopascals) reached during test.
Min. Minimum value

ENGINEERING GEOLOGY SECTION

DRILL No. 15	LOGGED H. DIXON
TYPE MINORILL	DATE 27 FEB 1973
DRILLER J. JENSEN	TRACED TJE
START 19 FEB 1973	CHECKED
FINISH 23 FEB 1973	

SHEET 1 OF 2. DRG. No S10475 Ha+2

P.E. No. S5027E MB

DEPARTMENT OF MINES SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO. DH 7

SERIAL No.

PROJECT. LITTLE PARA DAM.

FEATURE. GROUT CAP

LOCATION UPPER LEFT ABUTMENT.

SECTION 1560. HUNDRED YATALA

CO-ORDINATES 6151 657·1 . 291 299·9

ANGLE FROM HORIZ. 50° . DIRECTION 325°

E. L. Surface 140·6 m

E.L. Collar 140·6 m

Datum AHD

DESCRIPTION OF CORE	GROUP SYMBOL	STRENGTH TERM	CORE SIZE DEPTH E.L. m	LOG	FRACTURE LOG	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	LIFT CORE LOSS %	WATER LEVEL	CASING	DRILL WATER LOSS %	WATER PRESSURE TESTS LUGEONS
	②	① VS S MS W VW SO			③ 2 10 50 200		10 5 50	DATE		0 100	0.5 1 5 10 50 100
Grey brown, shaly dolomite pink stained	ML		21			Sheared zone 0·7m. dip 10°- 20° Steeply dipping joints.					(291)
	ML					Crushed seam. 50 mm, 10° dip					
Rock fragments up to 5mm GM			22			Crushed zone, 0·25m. Dip 10°					
Grey sheared quartzite healed with chlorite						Numerous sheared zones, (10-20 mm) Sheared zone 0·3 m.					
			23								
Greenish grey to brownish grey dolomitic ? slate	ML					Sheared and crushed zone 0·6 m. Dip 10°-20°					
PETROLOGICAL SAMPLE			24								(389)
						Joints, rough irregular, dip 80°-90° Limonite stained					
			25								
Grey to brownish grey (SW) non-calcareous siltstone with moderately developed slaty cleavage											
			26			Many narrow sheared zones parallel or sub-parallel to cleavage. Mainly 10 - 20 mm wide. Often associated with crushed seams (5 - 10 mm) of rock fragments and grey clay					
			27								(451)
			28								
NO CORE Driller reports rods dropped ? cavity			29			Shear Zone.					
						CAVITY					(0)
Contains 2 mm. fragments of H W rock	ML		30			Numerous broad sheared zones up to 0·4 m wide. Associated narrow crushed seams 5 - 10 mm. All dip parallel to or sub parallel to cleavage 10°- 20°					
Grey to brown grey shaly fine grained dolomite			31								(482)
						Most joints smooth planar parallel to cleavage					90·8 l/m
(HW), green-grey			32								
Grey to blue grey shaly dolomite. Some limonite staining along cleavage			33								
Pegmatite			34			Pegmatite (Quartz-feldspar chlorite vein) 10 mm, dips 5-10°					(502)
Grey-blue fine grained dolomite with poorly developed cleavage			35			Joints dip 15° parallel to cleavage Only minor limonite					
						END OF HOLE 35·76 m.					

BURRA GROUP — TORRENSIAN SERIES

UNIT 13 SHALY DOLOMITE

UNIT 13 SLATY DOLOMITE SEQUENCE REPEATED

UNIT 13 SHALY DOLOMITE

① ROCK SUBSTANCE STRENGTH TERM
VS-Very Strong
S-Strong
MS Medium Strong
W-Weak
VW Very Weak
SO Soil properties

CONDITION TERM
Fresh
Weathered
Altered
Not Applicable

② Substances with soil properties remoulded and classified by Unified System

③ FRACTURE LOG
50 10 2 0·5 length of core in cms
2 10 50 200 Natural fractures per metre of core
50 10 2 0·5 Equivalent length of core in cm

④ (350) Maximum effective pressure (Kilopascals) reached during test.
Min. Minimum value.

ENGINEERING GEOLOGY SECTION

DRILL No. 15.	LOGGED H. DIXON
TYPE MINDRILL.	DATE 28 FEB 1973
DRILLER J. JENSEN.	TRACED TJE.
START. 19 FEB 1973.	CHECKED
FINISH 23 FEB 1973.	

SHEET 2. OF 2. DRG No S 10475a Hat2

RE No. 55027E MB

Fig 9

DEPARTMENT OF MINES SOUTH AUSTRALIA

HOLE NO. D.H.15

SERIAL No.

LOG OF DIAMOND DRILL HOLE

PROJECT LITTLE PARA DAM

FEATURE SPILLWAY

LOCATION TOP OF LEFT ABUTMENT

SECTION 1560 HUNDRED YATALA AND MUNNO PARA

CO-ORDINATES 6 151 631·5 / 291 317·7

ANGLE FROM HORIZ 65° DIRECTION 290°G.N. Datum AHD

E.L. Surface 156·50 m

E.L. Collar 157·20 m

DESCRIPTION OF CORE	GROUP SYMBOL	STRENGTH TERM	CORE SIZE	DEPTH m	FRACTURE LOG	STRUCTURES JOINTS, SEPTA, SEAMS, SHEARS, ZONES, CRUSHED ZONES	CORE LOSS %	WATER LEVEL	CASING DRILL WATER LOSS %	WATER PRESSURE TESTS LUGEONS
					2 10 50 200			DATE		

PROTEROZOIC ADELAIDE SYSTEM Torrensian Series – Burra Group

UNIT 14 Slates Gray siliceous siltstones with slaty fracture and shaly partings

NO CORE

Shaly siltstone. CREAM GREY BROWN WHERE (SW)

NO CORE

SHALY SILTSTONE. PALE GREY (SW–MW)

Joint surfaces limonite coated. Fractures clean.

Fractures coincide with shaly partings. 0°–10° to core axis; smooth Limonite coated

SILICEOUS SILTSTONE (SLATE) pale grey (SW) with shaly pale partings

Shale

0°–10° fracture (parallel to bedding?) 3–4 fracture, rough; 90° to core axis

Shale-grey-dark grey (M.W.) pale brown where iron stained

Two Quartz veins 3cm; 2cm; 20°–40° to core axis

Fractures subparallel to bedding and 0–30° to core axis. Limonite coated and thin clay development on most surfaces.

Quartz vein 1cm possible shear plane 3cm at 9·70 m.

Shear zone? 10·50m–11·50m

NO CORE

CL

Broken

Fractures sub-parallel to bedding

SILICEOUS SILTSTONE pale grey (SW)

Fractures 0°–20° to core axis, uneven; limonite coated

Shale. Pale grey (SW–MW)

Fractures sub parallel to bedding 0°–30° to core axis

Siliceous siltstone 15·95 to 16·0m and 17·30 to 17·40m.

Surface coated with limonite and thin clay development

(170) (97) (148) (296) (392)

1 ROCK SUBSTANCE

STRENGTH TERM: VS Very Strong; S Strong; MS Medium Strong; W Weak; VW Very Weak; SO Soil properties

CONDITION TERM: Fresh; Weathered; Altered; Applicable

2 Substances with soil properties remoulded and classified by Unified System

3 FRACTURE LOG: 2 10 50 200 Natural Fractures per metre of core; 50 10 2 0·5 Equivalent length of core in cm

4 (σ50) Maximum effective pressure (Kilopascals) reached during test. Min Minimum value

50 10 2 0·5 length of core in cms

ENGINEERING GEOLOGY SECTION

DRILL No.

TYPE MINDRILL

DRILLER J. JENSEN

START 4 May '73

FINISH 8 May '73

LOGGED J.C. BEAL

DATE 9 AUG. '73

TRACED G.M

CHECKED

SHEET 1 OF 2.

DRG No S10476 Hat 2

PF No S5027E MB

DEPARTMENT OF MINES SOUTH AUSTRALIA

HOLE NO. DH 15

SERIAL No.

LOG OF DIAMOND DRILL HOLE

PROJECT LITTLE PARA DAM

FEATURE. SPILLWAY

LOCATION TOP OF LEFT ABUTMENT

SECTION 1560 HUNDRED YATALA AND MUNNO PARA

CO-ORDINATES 6 151 631·5 / 291 317·7

ANGLE FROM HORIZ. 65° DIRECTION 290°GN

E.L. Surface 156·50 m

E.L. Collar 157·20 m

Datum AHD

DESCRIPTION OF CORE	GROUP SYMBOL	STRENGTH TERM	CORE SIZE / DEPTH m	FRACTURE LOG 2 10 50 200	STRUCTURES JOINTS, VEINS, SEAMS, SHEARED ZONES, CRUSHED ZONES	CORE LOSS %	WATER LEVEL DATE	CASING DRILL WATER LOSS %	WATER PRESSURE TESTS LUGEONS
TORRENSIAN SERIES UNIT 14 Shale (silty) pale grey green pale brown where iron stained (SW-MW)	CL		20		Possible shear zones 2 cm. Fractures subparallel to bedding 0°-10° to core axis Limonite coated with clay development.			(392)	
			21	Broken					
			22		Between 22·50 & 24·10 uneven fractures subparallel to core axis, limonite coated				
			23					(118) (min)	
UNIT 13 Shaly dolomite cream grey to pale brown. (HW-MW)	ML								
CAVITY			24						
			25		Fractures subparallel to bedding 0-10°				

E·O·H 25M.

① ROCK SUBSTANCE STRENGTH TERM
VS Very Strong
S Strong
MS Medium Strong
W Weak
VW Very Weak
SO Soil properties

WEATHERING TERM
Fresh
Weathered
Altered
Kaolin
Min Maximum

② Substances with soil properties reclassified by Unified System

③ FRACTURE LOG
50 10 2 0·5 length of core in cms
2 10 50 200 Natural fractures per metre of core
50 10 2 0·5 Equivalent length of core in cm

④ (-50) Minimum size of core for water pressure test (Kilonewtons)
Maximum size of core for water pressure test

ENGINEERING GEOLOGY SECTION

DRILL No.
TYPE MINDRILL
DRILLER J. JENSEN
START 4 May 1973
FINISH 8 May 1973

LOGD J.C.BEAL
DATE 9 Aug. '73
TRACED G.M.
CHECKED

SHEET 2 OF 2. DRG. No. S10476a Hat 2

P.F. No S5027E MB

Fig 10