

1980/43. Investigation of proposed reservoir site, Lauderdale

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*Abstract*

The investigation of a proposed 9 Ml concrete reservoir has shown that the site is underlain by a quartz sandstone and siltstone sequence and its weathering products. The seismic refraction survey and trenching has indicated that ripping in conjunction with blasting will be required for excavations in excess of about two metres. Proposed cuts are likely to remain stable and the proximity of the inferred geological fault will not affect the safety of the reservoir.

INTRODUCTION

The Clarence Municipal Council requested the Department of Mines to undertake a geological investigation at the site of a proposed 9 Ml concrete reservoir [EN387498] on the hillside to the north of the junction of South Arm Road and Acton Road, Lauderdale (fig. 1). Concern was expressed about the proximity of the site to a geological fault indicated on the published geological map (Leaman, 1973). Information was also sought on the likely nature of the material to be excavated.

The investigation concentrated on the second of two alternative sites and involved reconnaissance mapping, logging of backhoe trenches, and a seismic refraction survey. This report describes the results of the investigation.

RESULTS OF INVESTIGATION

According to the published geological map (Leaman, 1973), the proposed reservoir site is underlain by sediments of Permian age. Scattered outcrop and boulders of quartz sandstone and siltstone occur close to the site. The surface soils comprise silty and sandy clay [CL-CH].

Detailed descriptions of materials encountered in the trenches are presented in Appendix 1. The siting and excavation of these trenches was not at the request of or under the supervision of the Department of Mines, having been dug prior to the Department's involvement with the project.

Two seismic refraction traverses were carried out using a Bison seismograph. The location of traverses and interpreted profiles are given in Figure 1. Depth determinations were calculated by the critical distance and reciprocal methods. The seismic velocities and interpreted materials are given in Table 1. The interpretations are based on a knowledge of the local geology, material encountered in trenches and from experience elsewhere in similar geological conditions.

Table 1. SEISMIC VELOCITIES AND INTERPRETED MATERIALS

Seismic velocity (average) (m/s)	Layer thickness (m)	Interpreted material
500	<0.25 - 2.5	Silty and sandy clay (CL-CH) topsoil and residual soil, and EW-HW sandstone fragments in a clay matrix.
1500/2000	11 m + (min)	SW-HW rock; quartz sandstone and siltstone.

## DISCUSSION

### *Rock mass*

The investigation has confirmed that the site is underlain by a sandstone/siltstone sequence of rocks assigned to the Permian age. Trenching has indicated that the rocks dip to the south-west at about 15 - 20°. Other defects comprise two steeply dipping joint sets. The joints are widely spaced (generally greater than one metre), tight, and approximately at right angles to each other and the bedding plane. The thickness of bedding could not be determined at the site, but an indication can be obtained from nearby road cuts.

### *Excavation conditions*

Assuming the proposed 9 Ml concrete reservoir is to be founded entirely on bedrock requiring a cut of some seven metres (maximum), then this will involve the excavation of about 6500 m<sup>3</sup> of material.

The top or surface layer, interpreted from the seismic refraction survey (V average = 500 m/s) and observed from trenching, is likely to be readily excavated by scrapers or similar machinery. The depth of this layer varies from 0.25 m - 2.5 m (fig. 1).

The next layer of material (V average = 1500/2000 m/s) will almost certainly require blasting. The rock mass, as seen in trenches, is in part, only slightly weathered and has widely spaced tight joints making ripping difficult. However, similar materials exposed in a nearby road cutting along South Arm Road [EN382493] shows massive quartz sandstone beds (generally between 0.5 - 2.0 m) intercalated with siltstone beds of similar thickness. The frequency of the less resistant siltstone beds will ultimately determine the amount of rippable material. Ripping, where possible, may be easier from west to east because of the westerly dip of the beds. The actual depth to which this material extends is unknown, but a minimum thickness in the order of 12 m has been calculated, assuming a velocity of 3500 m/s for a lower layer.

### *Stability of cuts*

Cuts in these materials are normally very stable, even where steep. Where the joint frequency is high, block falls on a small scale are likely on exposure to weathering. The quartz sandstone beds remain stable, but the siltstone has a tendency to weather differentially.

### *Significance of geological fault*

The fault as indicated on the geological map appears to be immediately to the south-west of the proposed reservoir site (fig. 1). Much of the faulting in south-east Tasmania was initiated during the Jurassic and continued into the Tertiary period. There is no known reactivation of faulting in this area. The fault was not actually located and there was no apparent increase in joint frequency over the site which is a common indicator of the proximity of faulting.

## SUMMARY OF CONCLUSIONS

The detailed conclusions are presented in previous sections of this report and only a summary of the conclusions is given here.

The site is underlain by a quartz sandstone-siltstone sequence of rocks assigned to the Permian age.

On the present information it appears that ripping in conjunction with blasting will be required for cuts in excess of about 2.0 m.

The stability of cuts to the estimated seven metres depth (maximum) is not anticipated to be a problem.

The proximity of the geological fault is also of little concern to the safety of the reservoir.

#### REFERENCE

LEAMAN, D.E. 1973. Geological atlas 1:50 000 series. Zone 7 Sheet 82 (8312S). Hobart. *Department of Mines, Tasmania.*

[13 November 1980]

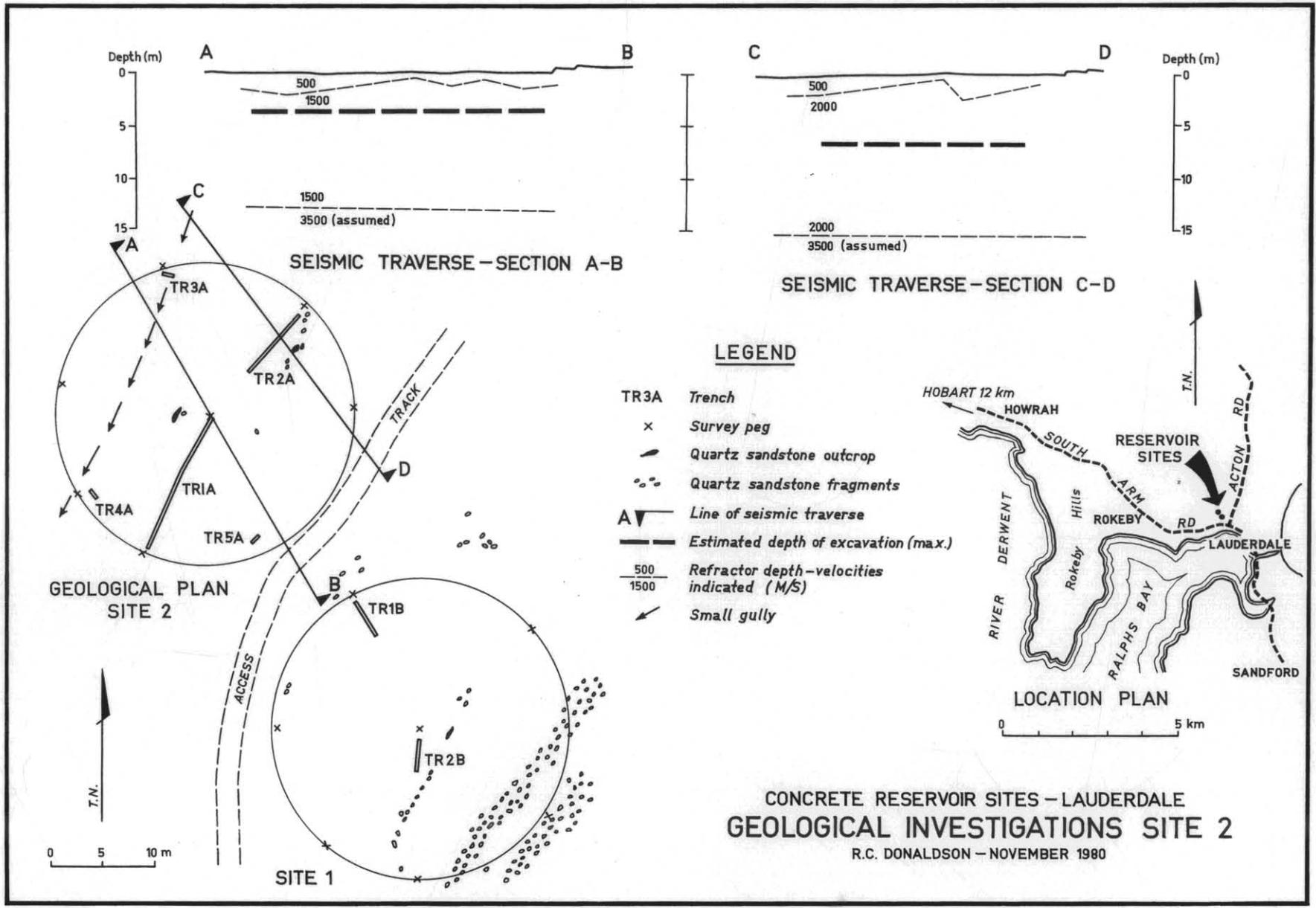


Figure 1.

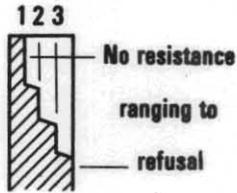
5 cm

CONCRETE RESERVOIR SITES - LAUDERDALE  
 GEOLOGICAL INVESTIGATIONS SITE 2  
 R.C. DONALDSON - NOVEMBER 1980

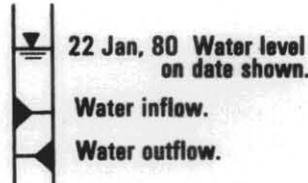
# EXPLANATION SHEET FOR ENGINEERING LOGS

## Borehole and excavation log

### Penetration



### Water



### Notes - samples and tests

- U50 Undistributed sample 50mm diameter.
- D Disturbed sample.
- N Standard penetrometer blow count for 300mm.
- N\* SPT + sample.

### Material classification

Based on Unified Soil Classification System. In Graphic Log materials are represented by clear contrasting symbols consistent for each project.

### Moisture content

- D Dry, looks and feel dry.
  - M Moist, no free water on hand when remoulding.
  - W Wet, free water on hand when remoulding.
  - LL Liquid limit.
  - PL Plastic limit.
  - PI Plasticity Index.
- eg. M > PL - Moist, moisture content greater than the plastic limit.

### Consistency

- |     |             | hand penetrometer (kPa) |
|-----|-------------|-------------------------|
| VS  | Very soft.  | < 25                    |
| S   | Soft.       | 25 - 50                 |
| F   | Firm.       | 50 - 100                |
| St  | Stiff.      | 100 - 200               |
| VSt | Very stiff. | 200 - 400               |
| H   | Hard.       | > 400                   |
| Fb  | Friable.    |                         |

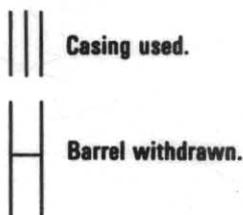
Notes: X on log is test result  
— is range of results.

### Density index

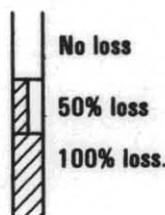
- |    |               | %        |
|----|---------------|----------|
| VL | Very loose.   | 0 - 15   |
| L  | Loose.        | 15 - 35  |
| MD | Medium dense. | 35 - 65  |
| D  | Dense.        | 65 - 85  |
| VD | Very Dense    | 85 - 100 |

## Cored borehole log

### Case - lift



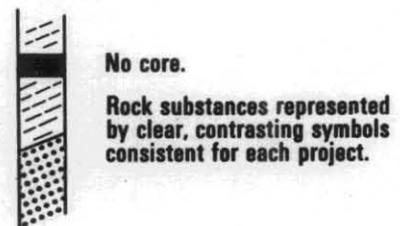
### Fluid loss



### Lugeons

Lugeon units (pL) are a measure of rock mass permeability. For a 46 to 74mm diameter borehole 1 Lugeon is defined as a rate of loss of 1 litre per metre per minute. 1 Lugeon is roughly equivalent to a permeability of  $1 \times 10^{-4}$  mm/sec.

### Graphic log



### Weathering

- Fr Fresh.
- SW Slightly weathered.
- HW Highly weathered.
- EW Extremely weathered.

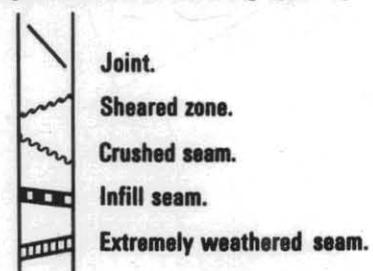
### Strength

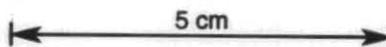
- |    |                 | point load strength index $I_{5(50)}$ (MPa) |
|----|-----------------|---|
| EL | Extremely low.  | < 0.03                                      |
| VL | Very low.       | 0.03 - 0.1                                  |
| L  | Low.            | 0.1 - 0.3                                   |
| M  | Medium.         | 0.3 - 1                                     |
| H  | High            | 1 - 3                                       |
| VH | Very high.      | 3 - 10                                      |
| EH | Extremely high. | > 10  |

Note: X on log is test result.

### Significant defects

Significant defects shown graphically.



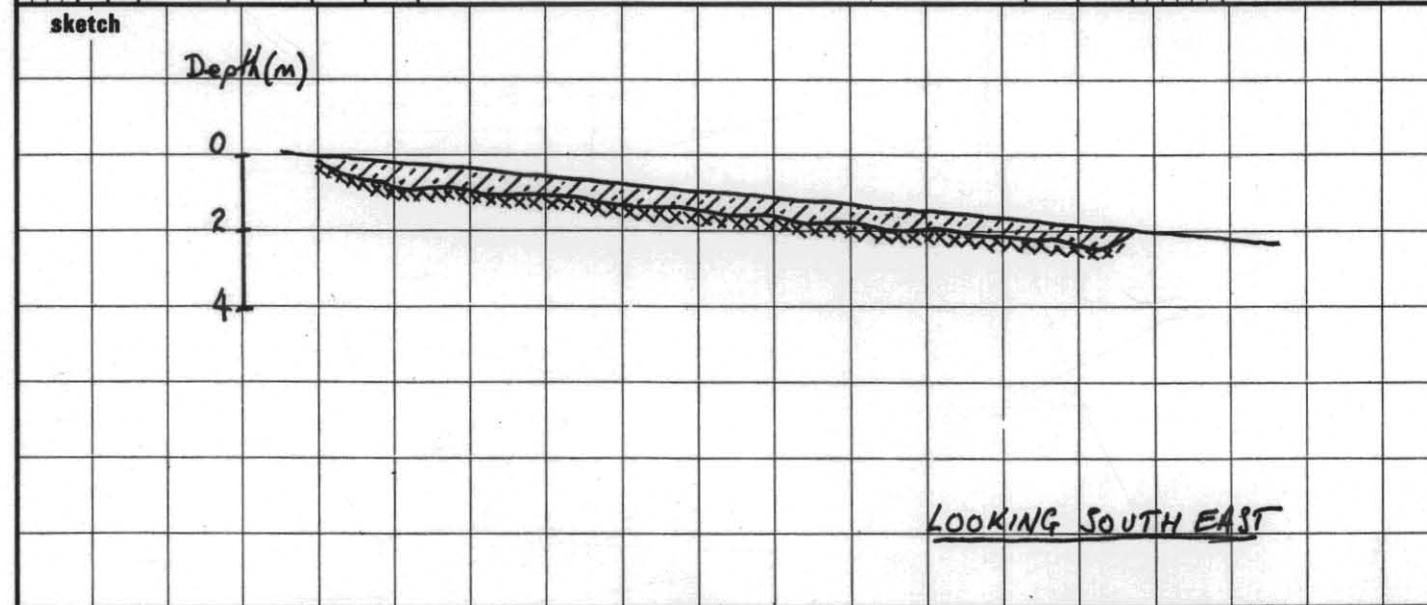


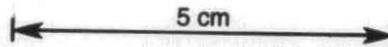
excavation no. 1A  
sheet 1 of 1

# ENGINEERING LOG - EXCAVATION

project **RESERVOIR INVESTIGATION** location **LAUDERDALE**  
 co-ordinates **EN387498** exposure type **Backhoe pit.** pit commenced  
 R.L. equipment pit completed  
 excavation dimensions **21m x 0.4m x 0.7m deep.** operator logged by **R.C. Donaldson**  
 checked by **A.T. Moon.**

penetration 1 2 3	support water	notes samples, tests	metres		graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa	structure, geology
			R.L.	depth							
	NONE	NONE		0.5		CL-CH	Silty sandy CLAY: medium to high plasticity, grey and yellow-brown, sand fine to medium, slight dilatancy, some H.W-S.W. sandstone rock fragments to 150 mm.	D	V.S.T.		TOPSOIL, RESIDUAL CLAY WITH WEATHERED BEDROCK FRAGMENTS
				1			Trench terminated at 0.5-0.7 m on SANDSTONE: grey and yellow brown, fine to medium grained, S.W-H.W., medium to high strength.				BED ROCK Joints are tight, near vertical, strike to the N.E and N.W. Bedding dips at 15°-20° to the S.W.

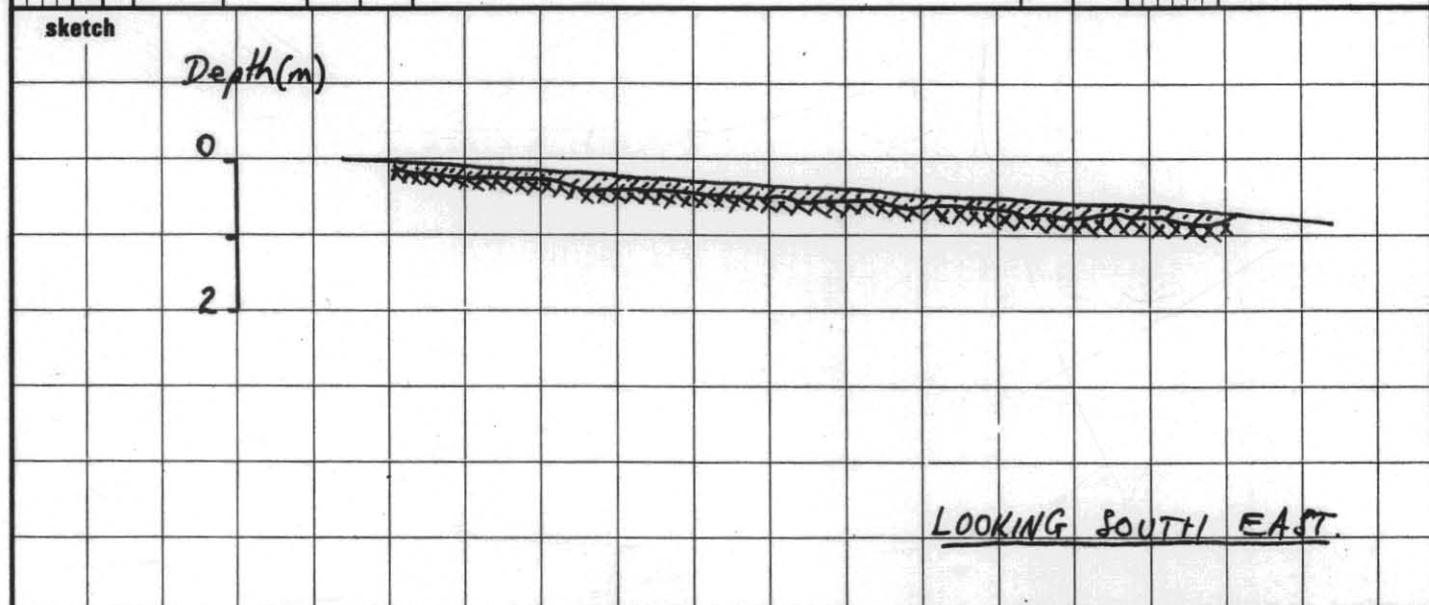




# ENGINEERING LOG - EXCAVATION

project **RESERVOIR INVESTIGATION** location **LAUDERDALE**  
 co-ordinates *refer figure 1.* exposure type **Backhoe pit.** pit commenced  
 equipment  
 R.L. logged by **R.C. Donaldson**  
 excavation dimensions operator checked by **A.T. Moon.**  
**11m x 0.9m x 0.25m deep.**

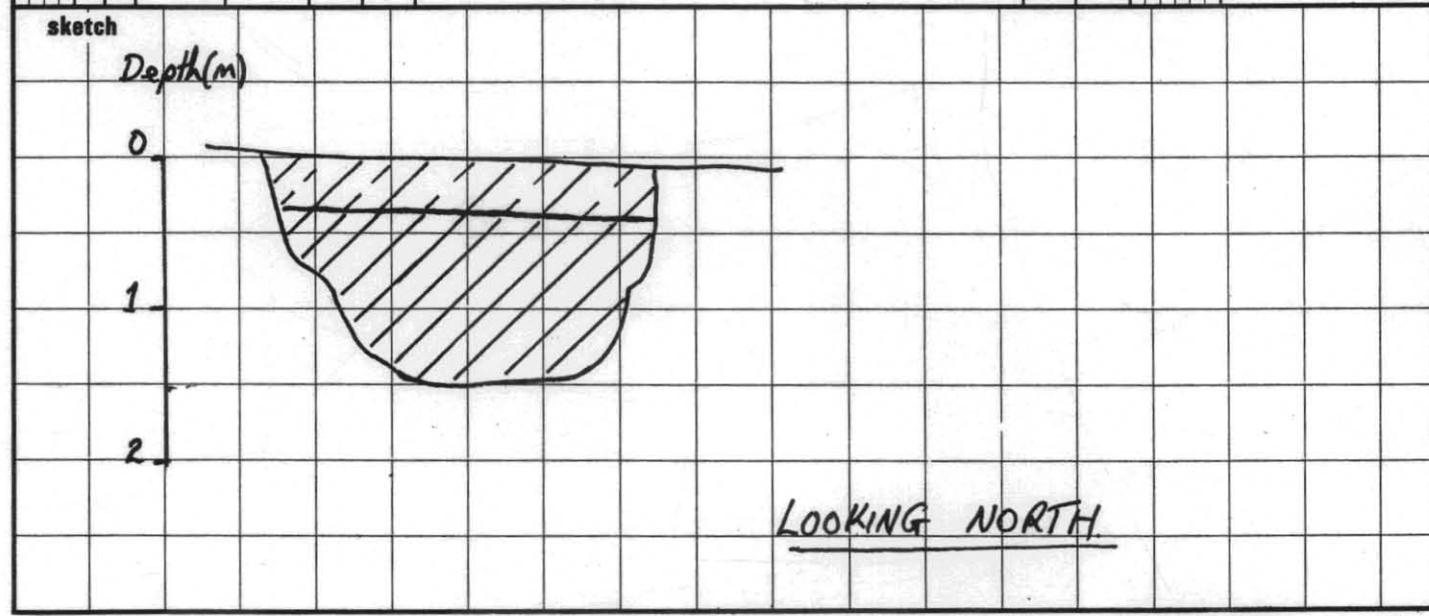
penetration 1 2 3	support water	notes samples, tests	metres		graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa 25 50 100 200 400	structure, geology
			R.L.	depth							
	NONE			0.25		CL CH	Silty sandy CLAY: medium to high plasticity, grey and yellow-brown, sand fine to medium, slight dilatancy, some H.W-SW. sandstone rock fragments to 100mm.	D	V.St		* TOPSOIL, RESIDUAL CLAY AND WEATHERED BEDROCK FRAGS.
				0.5			Trench terminated at 0.25m. on SANDSTONE: grey and yellow-brown, fine to medium grained, SW-H.W., medium to high strength.				BEDROCK. Joints are tight, near vertical, main set strike to N.E., 2nd set strike to N.W.



# ENGINEERING LOG - EXCAVATION

project **RESERVOIR INVESTIGATION** location **LAUDERDALE.**  
 co-ordinates *refer figure 1.* exposure type **Backhoe pit.** pit commenced  
 R.L. equipment pit completed  
 excavation dimensions operator logged by **R. C. Donaldson**  
 checked by **A. T. Moon.**  
**2 m x 0.4 m x 1.4 m deep.**

penetration 1 2 3	support water	notes samples, tests	metres		graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa 25 50 100 200 400	structure, geology	
			R.L.	depth								
	NONE	NONE		1		CL Sandy CLAY: medium to high plasticity, grey, sand fine to medium, some silt, some charcoal and organic matter, many fine roots and root fibres. CH Sandy CLAY: high plasticity, grey and yellow brown, sand fine to medium (quartz)	D	V.St.		X	TOPSOIL	
				2		Reason for termination of pit at 1.4m unknown.						RESIDUAL CLAY



# ENGINEERING LOG - EXCAVATION

project **RESERVOIR INVESTIGATION** location **LAUDERDALE**

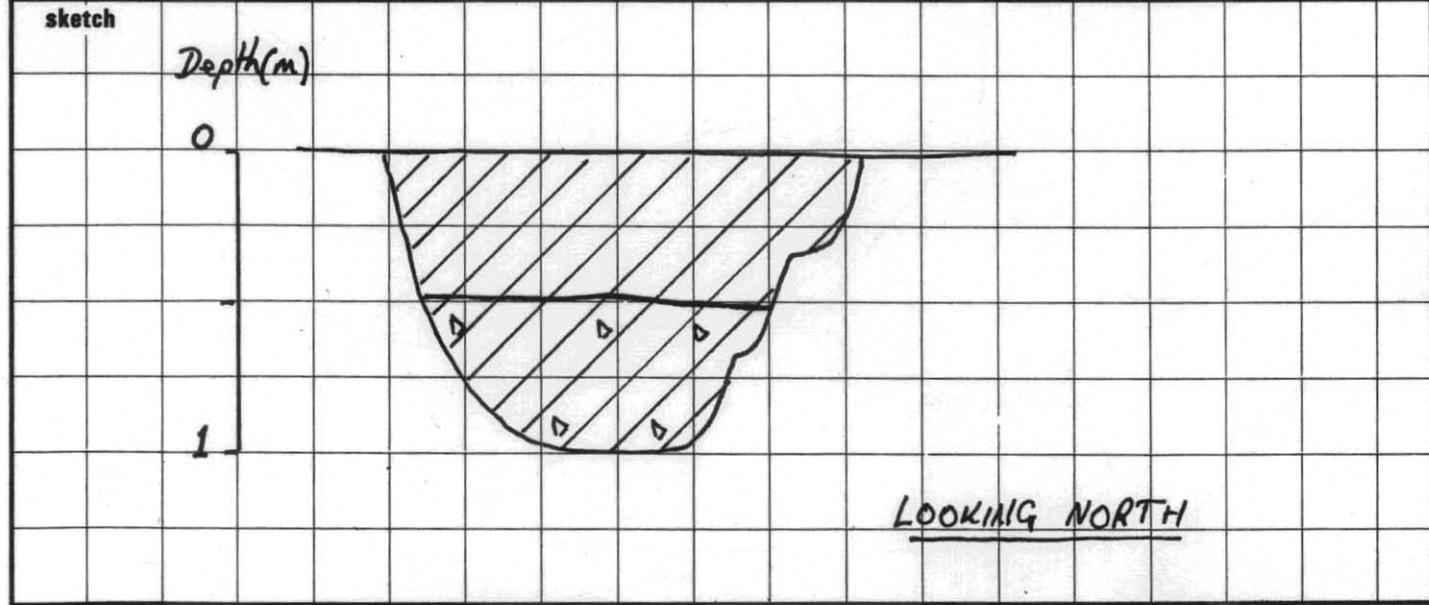
co-ordinates **refer figure 2** exposure type **Backhoe pit** pit commenced

R.L. \_\_\_\_\_ equipment \_\_\_\_\_ pit completed \_\_\_\_\_

excavation dimensions **1.8m x 0.4m x 1.0m deep.** operator \_\_\_\_\_ logged by **R.C. Donaldson**

checked by **A.T. Moon.**

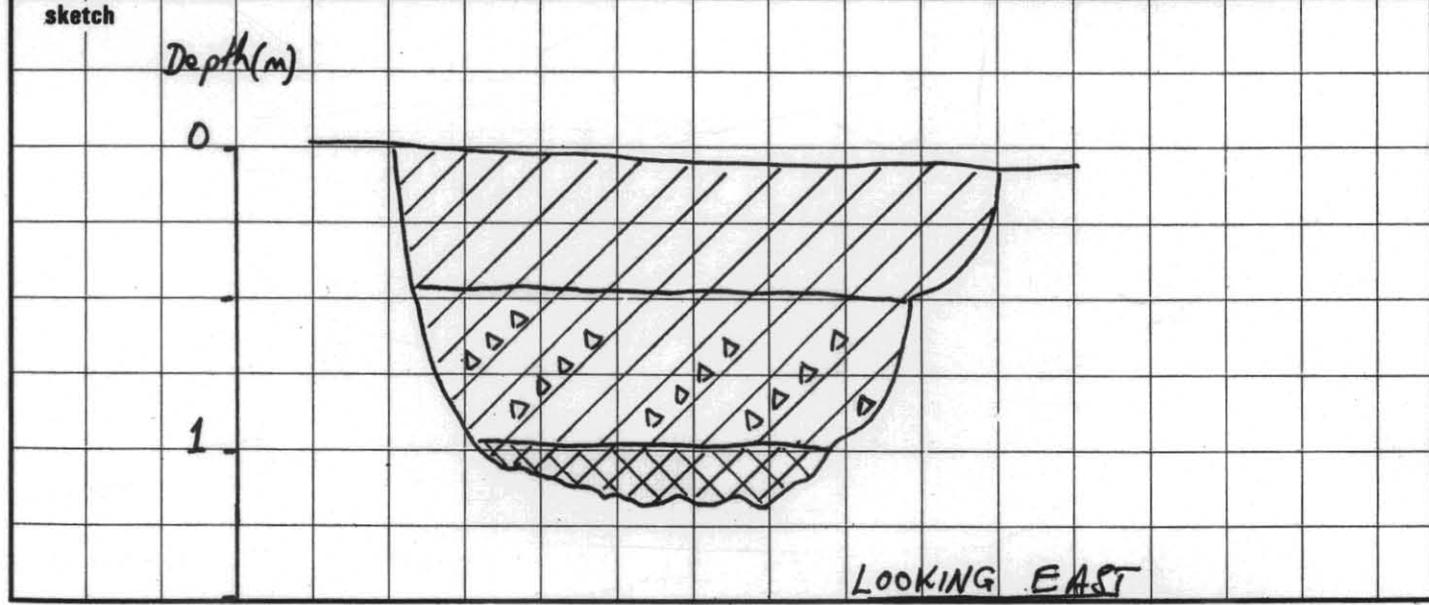
penetration 1 2 3	support water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa			structure, geology
									25	50	100	
	NONE	NONE	0-5	[diagonal hatching]	CH	Sandy CLAY: high plasticity, grey-brown, sand fine to medium, trace charcoal fragments, many fine roots and root fibres.	D	V.St.				TOPSOIL - highly fissured.
			1	[diagonal hatching]	CH	Sandy CLAY: high plasticity, grey and yellow brown, sand fine to medium, some rock fragments of H.W. sandstone to 40 mm	D	H				RESIDUAL CLAY - fissured.
				[cross-hatching]		Pit terminated at 1.0m on S.W.-H.W. SANDSTONE of medium to high strength.						BEDROCK.



# ENGINEERING LOG - EXCAVATION

project **RESERVOIR INVESTIGATION** location **LAUDERDALE**  
 co-ordinates refer figure 1. exposure type **Backhoe pit.** pit commenced  
 R.L. equipment  
 excavation dimensions **2.2m x 0.4m x 1.2m deep.** operator  
 pit completed  
 logged by **R.C. Donaldson**  
 checked by **A.T. Moon.**

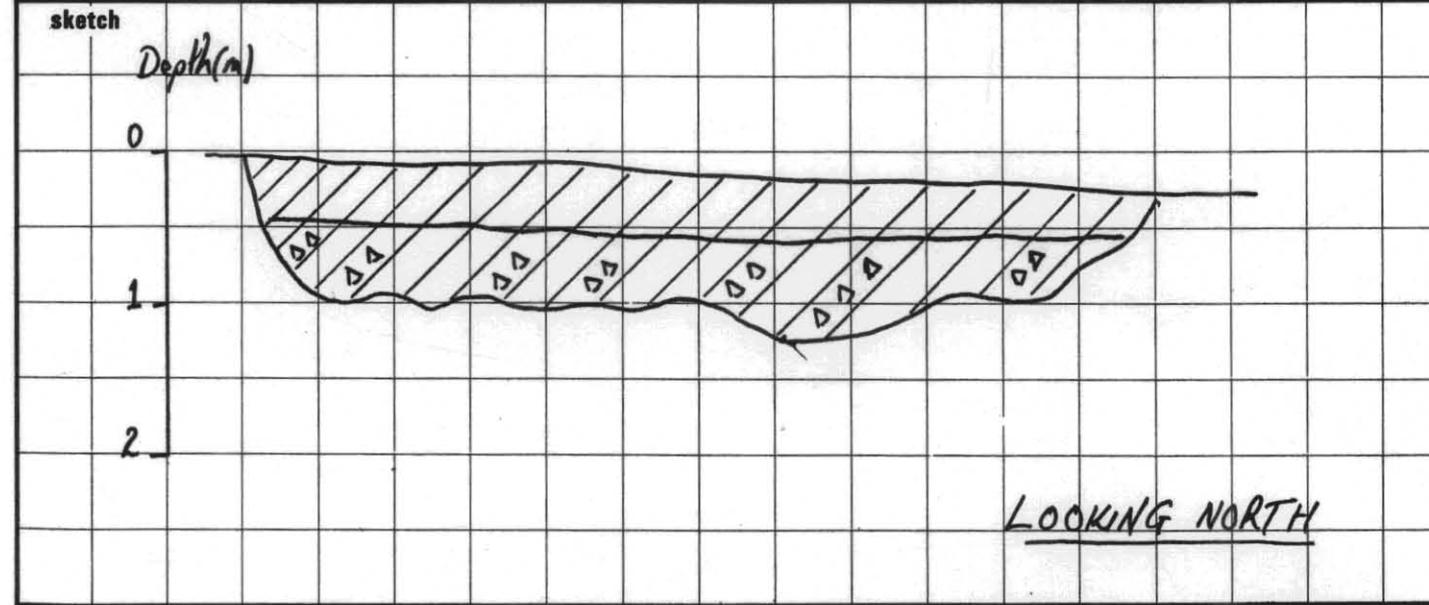
penetration 1 2 3	support water	notes samples, tests	metres		graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa 25 50 100 200 400	structure, geology
			R.L.	depth							
	NONE	NONE		0.5		CH	Sandy CLAY: high plasticity, grey-brown, sand fine to medium, some E.W.-H.W. sandstone fragments to 30mm., trace charcoal fragments, many fine roots.	D	H		TOPSOIL
	NONE	NONE		1		CH	Sandy CLAY: high plasticity, yellow brown, sand fine to medium, with 40% rock fragments of SANDSTONE - yellow, fine to medium grained, E.W.-H.W., low to medium strength, up to 150mm across.	D	H		RESIDUAL CLAY GRADING INTO SANDSTONE (BEDROCK)
							SANDSTONE: fine to medium grained, mottled yellow-white, H.W.-S.W., medium to high strength.				BEDROCK.
							Pit terminated on H.W.-S.W. SANDSTONE at 1.2m				



# ENGINEERING LOG - EXCAVATION

project **RESERVOIR INVESTIGATION** location **LAUDERDALE**  
 co-ordinates *refer figure 1* exposure type **Backhoe pit.** pit commenced  
 equipment  
 R.L. operator  
 excavation dimensions **6m x 0.4m x 1.3m deep** pit completed  
 logged by **R.C. Donaldson**  
 checked by **A.T. Moon.**

penetration 1 2 3	support water	notes samples, tests	metres R.L. depth	graphic log classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa				structure, geology
								25	50	100	200	
				CH	Sandy <u>CLAY</u> : high plasticity, grey brown, sand fine to medium, some E.W-H.W. sandstone fragments to 200 mm., trace organic matter.	D	V. St to H.					TOPSOIL
	NONE	NONE	0.5	CH	Sandy <u>CLAY</u> : high plasticity, grey and yellow brown, sand fine to medium, with upto 40% rock fragments of <u>SANDSTONE</u> : yellow brown, E.W-H.W., low to medium strength, upto 200 mm across.	D	V. St to H.					RESIDUAL CLAY GRADING INTO BEDROCK.
			1		Pit terminated at 1.0 m on <u>SANDSTONE</u> : fine to medium grained, grey and yellow-brown, E.W-H.W., medium to high strength.							BEDROCK.



ENGINEERING LOG - EXCAVATION

project RESERVOIR INVESTIGATION location LAUDERDALE  
 co-ordinates refer figure 1 exposure type Backhoe pit pit commenced  
 R.L. excavation dimensions 2.2m x 0.4m x 0.9m deep equipment operator  
 logged by R.C. Donaldson  
 checked by A.T. Moon.

penetration 1 2 3	support water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa 25 50 100 200 400	structure, geology
	NONE		0.5	CH	CH	Sandy CLAY: high plasticity, grey-brown, sand fine to medium, some E.W.-H.W. sandstone fragments to 50mm., trace organic matter.	D	H		TOP SOIL
	NONE		0.5	CH	CH	Sandy CLAY: high plasticity, grey and yellow brown, sand fine to medium, with 30-40% fragments of SANDSTONE: E.W.-H.W. low to high strength, up to 200mm across.	D	H		RESIDUAL CLAY GRADING INTO BEDROCK.
						SANDSTONE: fine to medium grained, mottled grey and yellow brown, S.W.-H.W. low to high strength.				H.W.-S.W. SANDSTONE (BEDROCK)
			1			Pit terminated at 0.9m on S.W. to H.W. SANDSTONE.				

