

DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
ENGINEERING DIVISION

HIGH SCHOOL, PORT PIRIE

Pt. Sec/ 960, 1067, Hundred of Pirie

REPORT ON GEOLOGICAL INVESTIGATIONS

Client: Public Buildings Department

by

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ENGINEERING GEOLOGY SECTION

Rept.Bk.No. 73/157
G.S. No. 5162
D.M. No. 333/73
Egg.Geol. 1973/8

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SUMMARY AND CONCLUSIONS

Three cable tool holes have been drilled to investigate foundation conditions at the Port Pirie High School.

The drilling indicated a near horizontal succession of unconsolidated sediments showing some lateral variation. The sequence was as follows:-

St. Kilda Formation - 0.0 to 3.95 metres. Soft to firm clay, high to low plasticity (CH/CL) and medium dense sand. Some silt. Yellow to grey colour.

Glanville Formation - 3.95 to 6.8m. Shelly sand with excess clayey fines (SC), loose to medium dense, and clay soil, low plasticity (CL), very soft to stiff.

Hindmarsh Clay - 6.8 to greater than 30 metres. Clay soil, medium to high plasticity, (CH). Sandy and silty, mottled. Stiff to hard with scattered patches of lime. Some layers of sand with excess clayey fines (SC), loose to medium dense.

Groundwater was cut in both the St. Kilda and Glanville Formations and rose to near the surface. The water was saline and varied in level with the tides.

The St. Kilda Formation and the top 2-3 metres of the Glanville Formation apparently have a very low bearing capacity. The sands below this depth are more dense and would be suitable for foundations for a relatively light building (up to 2 storey).

For a multi-storey building the Hindmarsh Clay should prove a suitable material for the founding of end bearing or friction piles.

* Terms underlined and in brackets are defined in the Appendix.

INTRODUCTION

Drilling to determine foundations conditions for the proposed redevelopment of Port Pirie High School was requested by Mr. A. Dankauskis of the Public Buildings Department. The High School is located on the south side of Mary Elie Street, near the junction with Wandearah Road in Port Pirie (see Fig.1). It lies on section 960 (C.H.1) and section 1067 (C.H.2 & C.H.3).

Three cable tool holes were drilled. C.H. 1 was 30 metres in depth, C.H.2 and C.H.3 were 20 metres in depth. All holes penetrated well into the Hindmarsh Clay Formation. The drilling was carried out using the standard techniques of continuous open tube sampling, with a sealed tube and Standard Penetration Test taken every 2 metres. The drilling commenced on the 11th April 1973 and was completed on the 18th April 1973. All holes were backfilled.

The most recent previous investigation in Port Pirie was carried out at the Port Pirie Hospital (Trudinger 1969).

Geological logs of the holes are given in the Appendix. A site plan with the hole locations (Fig.1) and a geological section (Fig.2) are included.

SITE GEOLOGY

The three cable tool holes indicated a near horizontal succession of sediments of Pleistocene and Recent age. The results are summarized in Table 1. The division into formations follows that used by Trudinger (1969).

There is some variation between the holes in the position of sand layers etc. within the formations. It is reasonable to expect some horizontal variation (e.g. lenses) in sediments of shallow water marine or estuarine nature such as the Glenville and St. Kilda Formations.

Table 1. Summary of Geological Sequence.

Average Depth (m)	Average Thickness (m)	Geological Unit & Age	Description	Engineering Properties	Consistency & Moisture Content.
0 to 0.38m	0.38m	Fill	Bitumen then angular gravel fragments in matrix of silt soil (ML) with sand and clay. Some plant remains.		Material is <u>loose</u> , damp.
0.68-3.95m	3.57m	St. Kilda Formation (Recent) (Estuarine)	Clay Soil, low to high plasticity (CL-CH) with some sand and silt content. Sand with excess silty & clayey fines (SM-SC). Colour is yellow, brown & light grey colour. Some plant remains.		Clay is <u>soft</u> or <u>very soft</u> to <u>firm</u> or <u>stiff</u> towards the bottom. Sand is <u>medium dense</u> . Moisture content varies from greater than to less than the plastic limit in the clays.
3.95-6.8m	2.85m	Glanville Formation (Pleistocene) (Marine)	Sand with excess clayey fines (SC) and clay soil, low plasticity (CL). Some silt content. Colour yellow to grey. Sand is shell fragments some to gravel size or (towards the base) well rounded quartz grains.		The sand is <u>loose</u> to <u>medium dense</u> . Moisture content moist to wet. Clay is <u>very soft</u> to <u>stiff</u> . Moisture content varies from greater than to less than the plastic limit.
6.8 - Beyond base of hole.	Greater than 15.5m.	Hindmarsh Clay Formation (Pleistocene)	Most commonly a clay soil, medium to high plasticity (CH). Occasionally a clay soil, low to medium plasticity, (CL). Generally a fair sand & silt content. Some bands of sand, poorly graded with excess clayey, fines (SC). Colour is red-brown to grey mottled. Many lumps of lime are present as discrete modules or as patches grading into the surrounding clay.		The clay is generally <u>stiff</u> to <u>hard</u> . In layers with greater moisture content it is soft to <u>firm</u> . Moisture content is mostly much less to less than the plastic limit, occasionally it is close to the plastic limit. The sands are <u>loose</u> to <u>medium dense</u> , moist to wet:

GROUNDWATER

Water was cut in both the St. Kilda and Glanville Formations and also in the sandy layers near the top of the Hindmarsh Clay. The water levels rose to within a metre of the top of the hole. Some variation in water level due to the tides was noted.

DISCUSSION

The top 2 metres of the St. Kilda Formation gave Standard Penetration Test values of N=0 and has a very low bearing capacity. The rest of the St. Kilda Formation and the Glanville Formation yielded S.P.T. values of about N=6 to N=10. The presence of saline groundwater rising to within a metre of the surface should be noted.

The Hindmarsh Clay gives values of N=8 to 10 at its top rising to N=20 at about 13 metres depth and N=45 at 30 metres depth. Within the Hindmarsh Clay there are some S.P.T. values anomalously high at N=40 to 60 (e.g. C.H.1, 13.7 metres, N=46). These are almost certainly due to the patches of limestone scattered through the clay. Foundations for a multi-storey building could be located in the Hindmarsh Clay.

RSR:JL
5th July, 1973

R. S. Robertson
R.S. Robertson
Geologist

Engineering Geology Section

REFERENCE

Trudinger, J.P. (1969) Port Pirie Hospital-Extensions. Geological Investigations Progress Report No.1. S.Aust. Dept. Mines unpublished report. Bk.No, 69/62.

APPENDIX

LOG OF CABLE TOOL HOLE

HOLE NO. C.H. 1

SERIAL NO.

PROJECT HIGH SCHOOL

FEATURE FOUNDATIONS

LOCATION PORT PIRIE

SEC 960 HD PIRIE

CO-ORDS

El. Collar m

El. Surface m

Datum

GEOLOGICAL NOTES AND CLASSIFICATION	DEPTH m	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification, U.S.B.R. Earth Manual 2nd Edition 1966	WATER LEVEL	MOISTURE CONTENT	FIELD TEST DATA								
							BLOWS PER 30 cm	SOIL TEST PENETROMETER Units *							
							4	0	16	32	64	1	2	3	4
RECENT ST. KILDA FORMATION	0		ML	Silt soil, low plasticity. Brown with some sand, gravel, plant remains.	10-15 a.m. 11-4-73	D LS									
	1		SM	Sand, excess silty fines. Dark colour. Some gravel.		D MD									
	2		SM/SC	Sand, with excess silty and clayey fines. Dark colour.		W									
	3		CH	Clay soil, high plasticity. Light grey brown.		W F									
PLEISTOCENE GLANVILLE FORMATION	4		CL	Clay soil, low to medium plasticity. Some silt content. Red brown colour, some grey patches.	10-00 a.m. 11-4-73	M ST									
	5		SC	Sand, excess clayey fines. Some gravel size fragments. Yellow to grey colour.		W L MD									
	6		SC	Sand, excess clayey fines. Few gravel size fragments. Yellow and grey mottled.		W L MD									
PLEISTOCENE HINDMARSH CLAY	7		SC	Clay soil, low to medium plasticity. Some silt and sand content. Red brown with some grey patches.	3-00 p.m.	M St									
	8		SC												
	9		SC												

WATER LEVELS	MOISTURE CONTENT	CONSISTENCY (Clays)	COMPACTNESS (Sils)	RELATIVE DENSITY (Sands)	TYPE OF SAMPLE	* These values refer to clay soils only and provide an indication of their consistency.
7 Dec 66 Water level (date) WC Water Cut	H — Humid D — Damp M — Moist W — Wet S — Saturated LL — Liquid Limit PL — Plastic Limit	VS — Very Soft S — Soft F — Firm St — Stiff V.St. — Very Stiff H — Hard	Ls — Loose MC — Moderately Compact C — Compact VC — Very Compact	VL — Very Loose L — Loose MD — Medium Dense D — Dense VD — Very Dense	OPEN TUBE A Shoe D Shoe SEALED TUBE WITH NUMBER A 1 2 3 4 5 STANDARD PENETRATION TESTS 9 (2,3,4) Total blows for 0.3m (in 0.1m increments)	ENGINEERING GEOLOGY SECTION DRILL NO. 23 TYPE DM 500 DRILLER A. Sturak START FINISH SHEET 1 OF 4 DRG. NO. S10334 Ga.I
						LOGGED BY R.S. Robertson DATE 2 May '73 TRACED R.B. CHECKED

DEPARTMENT OF MINES - SOUTH AUSTRALIA						HOLE NO. CH 1													
LOG OF CABLE TOOL HOLE						SERIAL NO.													
PROJECT HIGH SCHOOL			SEC 960 HD PIRIE			El. Collar m.													
FEATURE FOUNDATIONS			CO-ORDS			El. Surface m.													
LOCATION PORT PIRIE						Datum													
GEOLOGICAL NOTES AND CLASSIFICATION	DEPTH m	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification, U.S.B.R. Earth Manual 2nd Edition 1966	WATER LEVEL	Casing	MOISTURE CONTENT	FIELD TEST DATA											
								Consistency				Compact Density				BLOWS PER 30 cm			
PLEISTOCENE HINDMARSH CLAY			SC	Sand, well rounded quartz grains. Some mica flakes.				WMD											
	10																		
			CH	Some lumps of lime.				WMD											
	11																		
			CH	Clay soil, medium to high plasticity, small amount of sand and silt. Red-brown to grey-mottled				WMD											
	12																		
			CH	Clay soil, medium to high plasticity. Little sand and silt. Mottled red-brown to grey.				WMD											
	13																		
			CH	Clay soil, medium to high plasticity. Little sand and silt. Mottled red-brown to grey.				WMD											
	14																		
		CH	Clay soil, medium to high plasticity. Little sand and silt. Mottled red-brown to grey.				WMD												
15																			
		CH	Clay soil, medium to high plasticity. Little sand and silt. Mottled red-brown to grey.				WMD												
16																			
		CH	Clay soil, medium to high plasticity. Little sand and silt. Mottled red-brown to grey.				WMD												
17																			
		CH	Clay soil, medium to high plasticity. Little sand and silt. Mottled red-brown to grey.				WMD												
18																			
		SC	Sand with excess clayey fines. Mottled red-brown to grey.				WMD												

WATER LEVELS	MOISTURE CONTENT	CONSISTENCY (Clays)	COMPACTNESS (Sils)	RELATIVE DENSITY (Sands)	TYPE OF SAMPLE	* These values refer to clay soils only and provide an indication of their consistency.
	H — Humid D — Damp M — Moist W — Wet S — Saturated LL — Liquid Limit PL — Plastic Limit	VS — Very Soft S — Soft F — Firm St — Stiff V.St — Very Stiff H — Hard	Ls — Loose MC — Moderately Compact C — Compact VC — Very Compact	VL — Very Loose L — Loose MD — Medium Dense D — Dense VD — Very Dense	OPEN TUBE A Shoe D Shoe SEALED TUBE WITH NUMBER [A 1 2 3 4 5] STANDARD PENETRATION TESTS 9 (2,3,4) Total blows for 0.3m (in 0.1m increments)	ENGINEERING GEOLOGY SECTION DRILL NO. 23 TYPE DM 500 DRILLER A. Sturak START FINISH LOGGED BY R.S.R. DATE 2 May 1973 TRACED R.D. CHECKED SHEET 2 OF 4 DRG. NO. S10334 a Gal.

PF No S6676 b MB

LOG OF CABLE TOOL HOLE

PROJECT **HIGH SCHOOL**
 FEATURE **FOUNDATIONS**
 LOCATION **PORT PIRIE**

SEC **960** HD **PIRIE**
 CO-ORDS

HOLE NO. C.H. 1

SERIAL NO.

El. Collar m

El. Surface m

Datum

GEOLOGICAL NOTES AND CLASSIFICATION		EL.	DEPTH m	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification, U.S.B.R. Earth Manual 2nd Edition 1966	WATER LEVEL	Casing	MOISTURE CONTENT	Consistency	Compact Density	FIELD TEST DATA								
												BLOWS PER 30 cm		SOIL TEST PENETROMETER Units *						
												4	8	16	32	64	1	2	3	4
PLEISTOCENE HINDMARSH CLAY	Sand - well rounded quartz grains. Black organic spots.		CH	Clay soil, medium to high plasticity. Some sand and silt content. Mottled red brown to grey.																
End of Bore 30.15 metres.																				

WATER LEVELS	MOISTURE CONTENT	CONSISTENCY (Clays)	COMPACTNESS (Sils)	RELATIVE DENSITY (Sands)	TYPE OF SAMPLE	* These values refer to clay soils only and provide an indication of their consistency.		
Water level (date) 7 Dec. '66 WC Water Cut	H — Humid D — Damp M — Moist W — Wet S — Saturated LL — Liquid Limit PL — Plastic Limit	VS — Very Soft S — Soft F — Firm St — Stiff V.St — Very Stiff H — Hard	Ls — Loose MC — Moderately Compact C — Compact VC — Very Compact	VL — Very Loose L — Loose MD — Medium Dense D — Dense VD — Very Dense	OPEN TUBE A Shoe D Shoe SEALED TUBE WITH NUMBER [A 1 2 3 4 5] STANDARD PENETRATION TESTS [9 12 3 4] Total blows for 0.3m (in 0.1m increments)	ENGINEERING GEOLOGY SECTION		
						DRILL NO. 23 TYPE D.M. 500 DRILLER A. Sturak START FINISH	LOGGED BY R.S.R. DATE 2 May 1973 TRACED R.B. CHECKED	
						SHEET 4 OF 4	DRG. NO. 510334c Ga I.	

LOG OF CABLE TOOL HOLE

HOLE NO. CH 2

SERIAL NO.

PROJECT: HIGH SCHOOL

FEATURE: FOUNDATIONS

LOCATION: PORT. PIRIE

SEC 1067 HD PIRIE

CO-ORDS

El. Collar m

El. Surface m

Datum

GEOLOGICAL NOTES AND CLASSIFICATION		DEPTH m	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification, U.S.B.R. Earth Manual 2nd Edition 1966	WATER LEVEL	MOISTURE CONTENT	CONSISTENCY	COMPACTNESS	RELATIVE DENSITY	TYPE OF SAMPLE	FIELD TEST DATA	
											BLOWS PER 30 cm	SOIL TEST PENETROMETER	
											4 8 16 32 64	Units *	
RECENT ST. KILDA FORMATION	Lime rich lumps Roots etc. Marine? Fair lime content Plant remains. Well rounded brown limestone pebble.	0		CH	Fill Bitumen then gravel with clay and Sand.	10-15 am 14 Apr 1973 WC	D						
		1		CH	Clay soil, high plasticity. Some sand and silt. Yellow grey colour. Plant remains.		W S-F						
		2			Yellow grey with large red brown patch.		W						
		3			Dark grey.		W S-F						
PLEISTOCENE GLANVILLE FORMATION	Sand is shell fragments. Marine sediment. Some lime lumps.	4		CL	Clay soil, low to medium plasticity. Small silt content. Brown colour.	1:30 pm 14 April 1973 WC	M S+						
		5		SC	Sand with excess clayey fines. Some gravel size. Light yellow colour.		W MD						
		6		CL	Clay soil, low to medium plasticity. Fair silt content. Yellow grey colour.		M S+						
PLEISTOCENE Hindmarsh Clay	Sand is well rounded quartz grains and a few mica flakes.	7		CH	Clay soil, high plasticity. Some silt content. Red brown to grey mottled.	WC	M S+						
		8		SC	Sand excess clayey fines. Brown colour. Sand increases in amount & becomes coarser.		W L						

WATER LEVELS	MOISTURE CONTENT	CONSISTENCY (Clays)	COMPACTNESS (Silt)	RELATIVE DENSITY (Sands)	TYPE OF SAMPLE	* These values refer to clay soils only and provide an indication of their consistency.	
Water level (date) 7 Dec 66 WC Water Cut	H — Humid D — Damp M — Moist W — Wet S — Saturated LL — Liquid Limit PL — Plastic Limit	VS — Very Soft S — Soft F — Firm St — Stiff V.St — Very Stiff H — Hard	Ls — Loose MC — Moderately Compact C — Compact VC — Very Compact	VL — Very Loose L — Loose MD — Medium Dense D — Dense VD — Very Dense	OPEN TUBE A Shoe D Shoe SEALED TUBE WITH NUMBER A 1 2 3 4 5 STANDARD PENETRATION TESTS 9 (12,3,4) Total blows for 0.3m (in 0.1m increments)	ENGINEERING GEOLOGY SECTION DRILL NO. 23 TYPE DM 500 DRILLER A. Sturak START FINISH SHEET 1 OF 3	
LOGGED BY RS. Robertson DATE TRACED GJT CHECKED DRG. NO. S10335 Gal							

LOG OF CABLE TOOL HOLE

HOLE NO. CH 2

SERIAL NO.

PROJECT HIGH SCHOOL

FEATURE FOUNDATIONS

LOCATION PORT PIRIE

SEC 1067 HD PIRIE

CO-ORDS

El. Collar m

El. Surface m

Datum

GEOLOGICAL NOTES AND CLASSIFICATION		EL.	DEPTH	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification, U.S.B.R. Earth Manual 2nd Edition 1966	WATER LEVEL	CASING	MOISTURE CONTENT	CONSISTENCY	COMPACT DENSITY	FIELD TEST DATA	
												BLOWS PER 30 cm.	SOIL TEST PENETROMETER Units *
PLEISTOCENE Hindmarsh Clay	Quartz sand.		10		SC	Relatively little clay. Medium to coarse sand. Brown colour.						W L	7 (223)
			11		CH	Clay soil, medium to high plasticity. Mottled red brown to grey. Some sand and silt content.						M St	A 196
	Sand is well rounded quartz grains.		12		SC	Sand with excess clay and silt fines. Mottled brown to grey.						M L- M.O.	12 (228)
			13		CH							M St	
	Lime lumps and considerable lime content.		14			Clay soil, medium to high plasticity. Fair sand content. Red brown, grey and white mottled.						V. St	A 27
	Sand well rounded quartz grains.		15									H	46 (12.17.17)
		16			CH							M	
	Less lime content.		17			Clay soil, medium to high plasticity. Considerable sand and silt content. Mottled red brown to grey.						H	26 (7.8.11)
			18										

WATER LEVELS	MOISTURE CONTENT	CONSISTENCY (Clays)	COMPACTNESS (Silts)	RELATIVE DENSITY (Sands)	TYPE OF SAMPLE	* These values refer to clay soils only and provide an indication of their consistency.
	H — Humid D — Damp M — Moist W — Wet S — Saturated LL — Liquid Limit PL — Plastic Limit	VS — Very Soft S — Soft F — Firm St — Stiff V. St — Very Stiff H — Hard	Ls — Loose MC — Moderately Compact C — Compact VC — Very Compact	VL — Very Loose L — Loose MD — Medium Dense D — Dense VD — Very Dense	OPEN TUBE A Shoe D Shoe SEALED TUBE WITH NUMBER [A 2 3 4 5] STANDARD PENETRATION TESTS 9 (2.3.4) Total blows for 0.3m (in 0.1m increments)	ENGINEERING GEOLOGY SECTION DRILL NO. 23 TYPE D.M. 500 DRILLER A. Sturak START FINISH SHEET 2 OF 3
					LOGGED BY RS Robertson DATE TRACED G.J.T. CHECKED ORG. NO. S10335 a Gal	

DEPARTMENT OF MINES — SOUTH AUSTRALIA										HOLE NO. CH 2							
LOG OF CABLE TOOL HOLE										SERIAL NO.							
PROJECT HIGH SCHOOL FEATURE FOUNDATIONS LOCATION PORT PIRIE			SEC 1067 HD. PIRIE CO-ORDS			El. Collar m El. Surface m Datum		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="2" style="text-align: center;">FIELD TEST DATA</th> </tr> <tr> <td style="text-align: center;">BLOWS PER 30 cm</td> <td style="text-align: center;">SOIL TEST PENETROMETER Units *</td> </tr> <tr> <td style="text-align: center;">4 8 16 32 64</td> <td style="text-align: center;">1 2 3 4</td> </tr> </table>				FIELD TEST DATA		BLOWS PER 30 cm	SOIL TEST PENETROMETER Units *	4 8 16 32 64	1 2 3 4
												FIELD TEST DATA					
BLOWS PER 30 cm	SOIL TEST PENETROMETER Units *																
4 8 16 32 64	1 2 3 4																
GEOLOGICAL NOTES AND CLASSIFICATION			DEPTH m	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification, U.S.B.R. Earth Manual 2nd Edition 1966		WATER LEVEL	MOISTURE CONTENT	CONSISTENCY							
PLEISTOCENE Hindmarsh Clay Less lime content A few black organic spots.			19	CH	M VSr	Clay soil, medium to high plasticity. Some sand and silt content. Mottled red brown to grey.		-H	VSr	H							
			20														
			21	End of Bore 20-25													
			22														
			23														
			24														
			25														
			26														
			27														
			28														

WATER LEVELS	MOISTURE CONTENT	CONSISTENCY (Clays)	COMPACTNESS (Sils)	RELATIVE DENSITY (Sands)	TYPE OF SAMPLE	* These values refer to clay soils only and provide an indication of their consistency.	
	H — Humid	VS — Very Soft	LS — Loose	VL — Very Loose	OPEN TUBE	ENGINEERING GEOLOGY SECTION	
	D — Damp	S — Soft	MC — Moderately Compact	L — Loose	SEALED TUBE WITH NUMBER		
	M — Moist	F — Firm	C — Compact	MD — Medium Dense		DRILL NO. 23 TYPE D.M. 500 DRILLER A Sturak START FINISH	LOGGED BY R.S. Robertson DATE TRACED G.J.T. CHECKED
	W — Wet	St — Stiff	VC — Very Compact	D — Dense	STANDARD PENETRATION TESTS	SHEET 3 OF 3 DRG. NO. S10335 b Gal	
	S — Saturated	V.St — Very Stiff		VD — Very Dense	9 (2,3,4) Total blows for 0.3m (in 0.1m increments)		
	LL — Liquid Limit	H — Hard					
	PL — Plastic Limit						

LOG OF CABLE TOOL HOLE

HOLE NO. CH. 3.

SERIAL NO.

PROJECT: HIGH SCHOOL
 FEATURE: FOUNDATIONS
 LOCATION: PORT PIRIE.

SEC 1067 HD PORT PIRIE.

CO-ORDS

El. Collar m'

El. Surface m

Datum

GEOLOGICAL NOTES AND CLASSIFICATION		EL.	DEPTH m	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification, U.S.B.R. Earth Manual 2nd Edition 1966	WATER LEVEL	MOISTURE CONTENT	CONSISTENCY	COMPACTNESS	RELATIVE DENSITY	TYPE OF SAMPLE	FIELD TEST DATA	
												BLOWS PER 30 cm	SOIL TEST PENETROMETER UNITS *	
												4 8 16 32 64	1 2 3 4	
RECENT ST. KILDA FORMATION					CH	Fill. Bitumen and gravel with sand and clay.	8.40							
					CH	Clay soil, high plasticity Yellow grey colour. Some plant remains, some sand and silt.	8.30							
					CH	Grey colour. Very little sand or silt.								
PLEISTOCENE GLANVILLE FORMATION					CH	Clay soil, medium to high plasticity. Small amount of sand and silt. Light green-grey colour. ↓ lower plasticity, more sand and silt content.								
					SC	Sand, excess clayey fines. Light grey colour.								
					ML	Silt soil, low plasticity. Considerable sand and clay content. Red brown colour.								
					SC	Sand excess clayey and silty fines. Red brown colour.								
PLEISTOCENE HINDMARSH CLAY.					CH	Clay soil, medium to high plasticity. Considerable sand and silt content. Red brown colour, some grey patches.								

WATER LEVELS	MOISTURE CONTENT	CONSISTENCY (Clays)	COMPACTNESS (Silts)	RELATIVE DENSITY (Sands)	TYPE OF SAMPLE	* These values refer to clay soils only and provide an indication of their consistency.
Water level (date) WC Water Cut	H — Humid D — Damp M — Moist W — Wet S — Saturated LL — Liquid Limit PL — Plastic Limit	VS — Very Soft S — Soft F — Firm St — Stiff V.St — Very Stiff H — Hard	Ls — Loose MC — Moderately Compact C — Compact VC — Very Compact	VL — Very Loose L — Loose MD — Medium Dense D — Dense VD — Very Dense	OPEN TUBE A Shoe D Shoe SEALED TUBE WITH NUMBER A 1 2 3 4 5 STANDARD PENETRATION TESTS 9 (2,3,4) Total blows for 0.3m (in 0.1m increments)	ENGINEERING GEOLOGY SECTION DRILL NO. 23 TYPE PM.500 DRILLER A. Sturak START FINISH SHEET 1 OF 3 DRG. NO. S10336 Gal
						LOGGED BY R.S.R. DATE 30 May '73 TRACED R.B. CHECKED

LOG OF CABLE TOOL HOLE

HOLE NO. CH 3.

SERIAL NO.

PROJECT HIGH SCHOOL
FEATURE FOUNDATIONS
LOCATION PORT PIRIE

SEC 1067 HD PIRIE
CO-ORDS

El Collar m
El. Surface m
Datum

GEOLOGICAL NOTES AND CLASSIFICATION	EL.	DEPTH m	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification, U.S.B.R. Earth Manual 2nd Edition 1966	WATER LEVEL	Casing MOISTURE CONTENT	Consistency	Compact Density	FIELD TEST DATA	
										BLOWS PER 30 cm	SOIL TEST PENETROMETER Units *
PLEISTOCENE HINDMARSH CLAY Some lime lumps. Lime lumps. Considerable lime content.				CH	Clay soil, high plasticity. Only small sand and silt content. Red brown colour.					F	A 108
		10			CH	Clay soil, high plasticity. Some sand content. Mottled red brown to grey.				M S+	13(4.4.5)
		11								W S	
		12				Very small sand and silt content.				VS	A 226
		13								W VS	
		14			CH	Clay soil, medium to high plasticity. Fair sand and silt content. Mottled grey and red brown.				M VS+	23(7.9.7)
		15				Softer layer.				VS+	A 218
		16								M S+	21(6.8.7)
		17								W F	A 99
		18								M S+	26(8.8.10)
										VS+	A 82

WATER LEVELS	MOISTURE CONTENT	CONSISTENCY (Clays)	COMPACTNESS (Sils)	RELATIVE DENSITY (Sands)	TYPE OF SAMPLE	* These values refer to clay soils only and provide an indication of their consistency.
Water level (date) 7 Dec. '66. WC Water Cut	H — Humid D — Damp M — Moist W — Wet S — Saturated LL — Liquid Limit PL — Plastic Limit	VS — Very Soft S — Soft F — Firm St — Stiff V.St — Very Stiff H — Hard	Ls — Loose MC — Moderately Compact C — Compact VC — Very Compact	VL — Very Loose L — Loose MD — Medium Dense D — Dense VD — Very Dense	OPEN TUBE A Shoe D Shoe SEALED TUBE WITH NUMBER A 1 2 3 4 5 STANDARD PENETRATION TESTS 9 (2,3,4) Total blows for 0.3m (in 0.1m increments)	ENGINEERING GEOLOGY SECTION DRILL NO. 23 TYPE D.M. 500 DRILLER A. Sturak START FINISH SHEET 2 OF 3 DRG. NO. S10336 a Ga 1

LOG OF CABLE TOOL HOLE

HOLE NO. C.H.3.

SERIAL NO.

PROJECT HIGH SCHOOL

FEATURE FOUNDATIONS

LOCATION PORT PIRIE

SEC 1067 HD PIRIE

CO-ORDS

El. Collar m

El. Surface m

Datum

GEOLOGICAL NOTES AND CLASSIFICATION		DEPTH m	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME Unified Soil Classification, U.S.B.R. Earth Manual 2nd Edition 1966	WATER LEVEL	Casing	MOISTURE CONTENT	CONSISTENCY	Compact Density	FIELD TEST DATA	
											BLOWS PER 30 cm	SOIL TEST PENETROMETER Units *
PLEISTOCENE HINDMARSH CLAY	Lime lumps.	19		CH	Clay soil, medium to high plasticity. Some sand and silt content. Mottled red brown to grey. Some yellow patches.			M	VS	20(6.7.7)		A81
		20										
		21			End of hole 20.40metres							
		22										
		23										
		24										
		25										
		26										

WATER LEVELS	MOISTURE CONTENT	CONSISTENCY (Clays)	COMPACTNESS (Silt)	RELATIVE DENSITY (Sands)	TYPE OF SAMPLE	* These values refer to clay soils only and provide an indication of their consistency.
7 Dec '66 Water level (date) WC Water Cut	H — Humid D — Damp M — Moist W — Wet S — Saturated LL — Liquid Limit PL — Plastic Limit	VS — Very Soft S — Soft F — Firm St — Stiff V.St — Very Stiff H — Hard	Ls — Loose MC — Moderately Compact C — Compact VC — Very Compact	VL — Very Loose L — Loose MD — Medium Dense D — Dense VD — Very Dense	OPEN TUBE A Shoe D Shoe SEALED TUBE WITH NUMBER A 1 2 3 4 5 STANDARD PENETRATION TESTS 9 (2,3,4) Total blows for 0.3m (in 0.1m increments)	ENGINEERING GEOLOGY SECTION DRILL NO. 23 TYPE D.M. 500 DRILLER A. Sturak START FINISH SHEET 3 OF 3 DRG. NO. S10336 b Gal.

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:	LABORATORY CLASSIFICATION CRITERIA
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	
	DIRTY GRAVELS Appreciable amount of 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	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
		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	Cu = $\frac{D_{60}}{D_{10}}$ Greater than 6 Cc = $\frac{D_{30}^2}{D_{10} D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for SW
	DIRTY SANDS Appreciable amount of 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	
		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		

FIELD INVESTIGATION PROCEDURES on fraction smaller than 0.4mm. (passing B.S.36 sieve)								GROUP SYMBOL	GROUP NAME and typical materials
SILTS AND CLAYS Liquid limit less than 50	SOIL CAST (soil wet)	SOIL THREAD	SHINE	DILATANCY	ODOUR	DRY STRENGTH	ML	SILT SOIL, low plasticity; inorganic silts and very fine silty or clayey sands, rock flour	
	Forms fragile cast Cracks form when kneaded while moist	Thick crumbly thread; easily broken	None to very dull	Distinct	Not significant	None to slight	CL	CLAY SOIL, low plasticity; inorganic clays of low to medium plasticity, gravelly clay, sand, clays, silty clays, lean clays	
	Cast may be handled freely without breaking Can be kneaded moist without cracking Material adheres to the hand	Thread can be pointed as fine as a hair Pinch cut is fragile	Moderate	None to slight	Not significant	Moderate	OL	ORGANIC SOIL, low plasticity; organic silts and silt clays of low plasticity	
	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	MH	SILT SOIL, high plasticity; inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
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	CH	CLAY SOIL, high plasticity; inorganic clays of high plasticity, fat clays	
	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	OH	ORGANIC SOIL, high plasticity; organic clays of medium to high plasticity	
	Plastic and cohesive Feels slightly spongy Greasy to touch	Weak to medium thread Often soft and fibrous	Medium to very glossy	None	Decayed organic matter	Moderate to high Powdered soil may be fibrous	Pt	PEATY SOIL: Peat and other highly organic soils	
	Readily identified by colour, odour, spongy feel and frequently by fibrous texture								

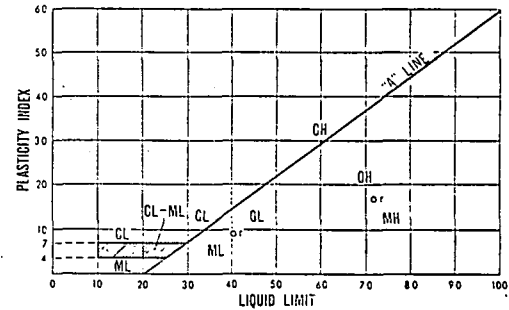
GRAIN SIZE CURVES to be used to identify soil fractions	
Coarse-grained soil classified on basis of percentage of fines, as follows	PERCENT OF FINES GRAVELS SANDS Less than 5 SW SP More than 12 GM GP 5 to 12 Borderline cases, use 2 symbols

LABORATORY CLASSIFICATION CRITERIA	
Cu = $\frac{D_{60}}{D_{10}}$ Greater than 4 Cc = $\frac{D_{30}^2}{D_{10} D_{60}}$ Between 1 and 3	
Not meeting all gradation requirements for GW	
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	
Cu = $\frac{D_{60}}{D_{10}}$ Greater than 6 Cc = $\frac{D_{30}^2}{D_{10} D_{60}}$ Between 1 and 3	
Not meeting all gradation requirements for SW	
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	

GRAIN SIZE CURVES to be used to identify soil fractions

PLASTICITY CHART
FOR LABORATORY CLASSIFICATION OF FINE-GRAINED SOILS

PERCENT OF FINES Losses less than 5 More than 12 5 to 12	GRAVELS SW SP GM GC SM SC	LABORATORY CLASSIFICATION CRITERIA	
		$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4 $C_c = \frac{D_{30}^2}{D_{10} \cdot D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for GW	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 6 $C_c = \frac{D_{30}^2}{D_{10} \cdot D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for SW
		Atterberg limits below "A" line or PI less than 4 Atterberg limits below "A" line or PI greater than 7	Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols



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 COLORADO 1960.

SITE PLAN

MARY ELY STREET

WANDEARAH ROAD

CH.1

CH.2

C.H.3

A'

SCALE

METRES 0 10 20 30 40 50 60 METRES
FEET 0 45 90 135 180 FEET

LEGEND

- CH.2 Cable Tool Hole
- Line of section
- Proposed Building
- Existing Building

SPENCER GULF

HIGH SCHOOL

PORT
PIRIE

To Pt Broughton

To Pt. Germain

To Gladstone

ORIENTATION MAP

Fig. 1

Compiled: R.S.R.		DEPARTMENT OF MINES - SOUTH AUSTRALIA	Scale: 1:100
Drn. R.B.	Ckd. A.F.	PORT PIRIE HIGH SCHOOL REDEVELOPMENT	Date: 26 June 1973
		SITE PLAN AND ORIENTATION MAP	Drg. No. 73-470 GdI

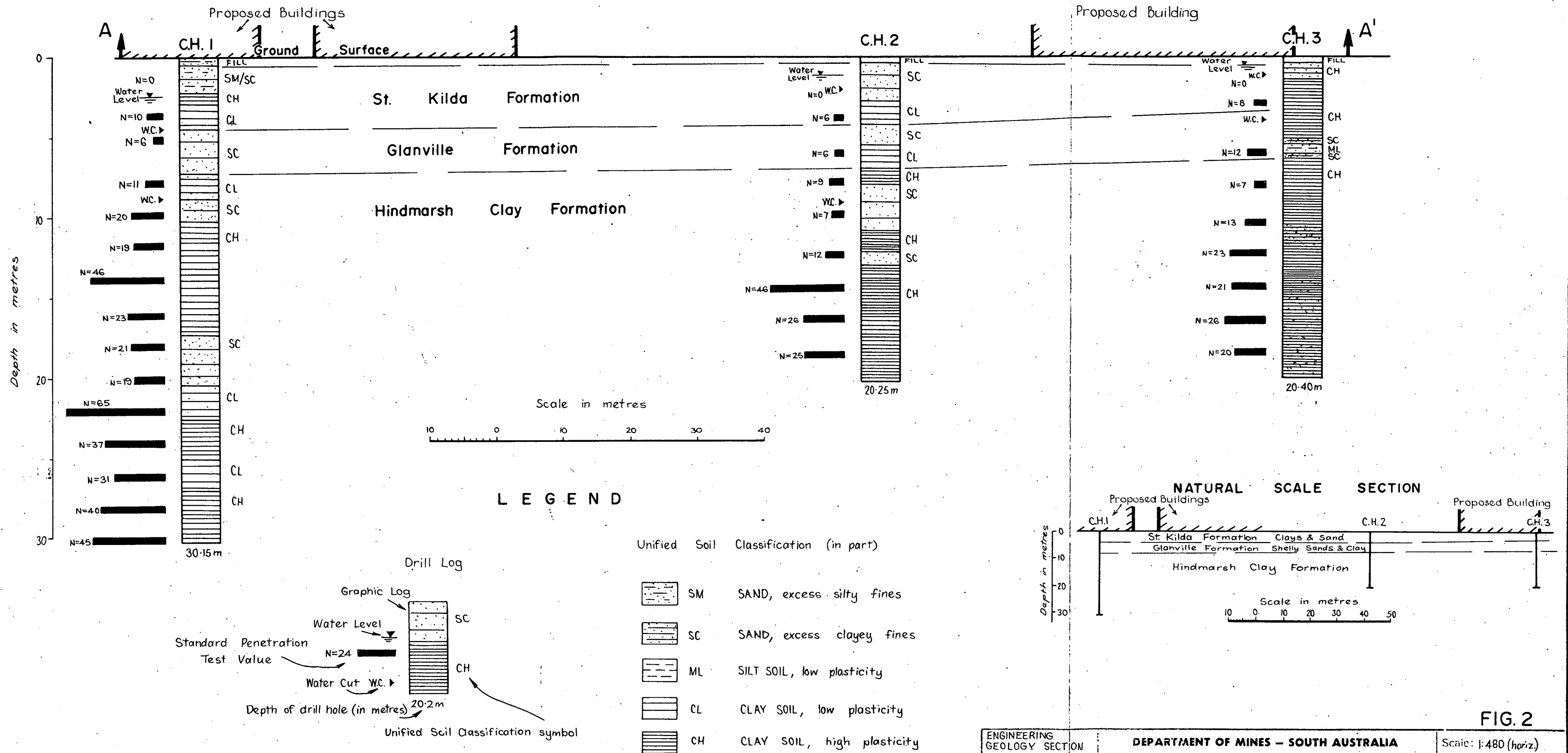


FIG. 2

ENGINEERING GEOLOGY SECTION	DEPARTMENT OF MINES - SOUTH AUSTRALIA	Scale: 1:480 (horiz.)
Compiled: R.S. Robertson	PORT PIRIE HIGH SCHOOL GEOLOGICAL SECTION A A'	Date: 21st June '73
Drn. D.J.M. Ckd. A.F.		Drg. No. 73-454 Gal