

1983/50. Subsurface investigation of a proposed house site at Hillwood,
East Tamar

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Abstract

A proposed house site at Hillwood was examined. The site was very wet, and with what appeared to be several permanent seepages. A limited subsurface investigation comprising two auger holes was undertaken. These holes showed that over one metre of highly plastic clay soil overlay dolerite or dolerite boulders. The clay soil is highly expansive, and seasonal soil movement and drainage problems can be anticipated at this site. A strengthened raft foundation is recommended for the house.

INTRODUCTION

A proposed house site at Hillwood was first examined on 29 June at the request of G.B. Austin of Concept Drafting Pty Ltd. The block is situated behind the Hillwood Post Office store [DQ981341]. The proposed house site is on the north-east section of the block on a low sloping rock bench, the bench falling steeply to the Hillwood Jetty Road along the block's southern boundary. The block has very poor natural drainage with seepages appearing on the west side of the proposed house site and along the front of the block.

As the block was so wet and the winter rains had not really started on the first visit, and as the thickness of the black clay overlying the rock surface was not known, a limited subsurface investigation was recommended to the owner, Mr C. Penno.

SUBSURFACE INVESTIGATION

Drilling

The pegged house site is situated on the north-east section of the block, with a curved drive planned from Post Office Road to the front of the house. Two holes were auger drilled on 25 August using the trailer mounted Triefus drill rig.

Two clay samples were collected from Hole 1 and tested for Atterberg limits, field moisture content and linear shrinkage, and X-rayed for composition.

Hole 1 was drilled 8.9 m south-east of the north-west corner peg of the proposed house. Hole 2 was to be drilled near the south-east corner of the house, but the ground was so saturated that the drill became bogged, and drilling at this site was not possible. Hole 2 was eventually drilled near the proposed driveway, 6.8 m south-west of the north-west corner peg.

Geology

The lithological logs of the two drill holes are included as Appendix 1.

Three soil layers were encountered in Hole 1. The top layer was 0.2 m of black organic clay (OH), which was highly plastic and very moist. This surface soil was underlain by a layer of brown-yellow sticky clay (CH).

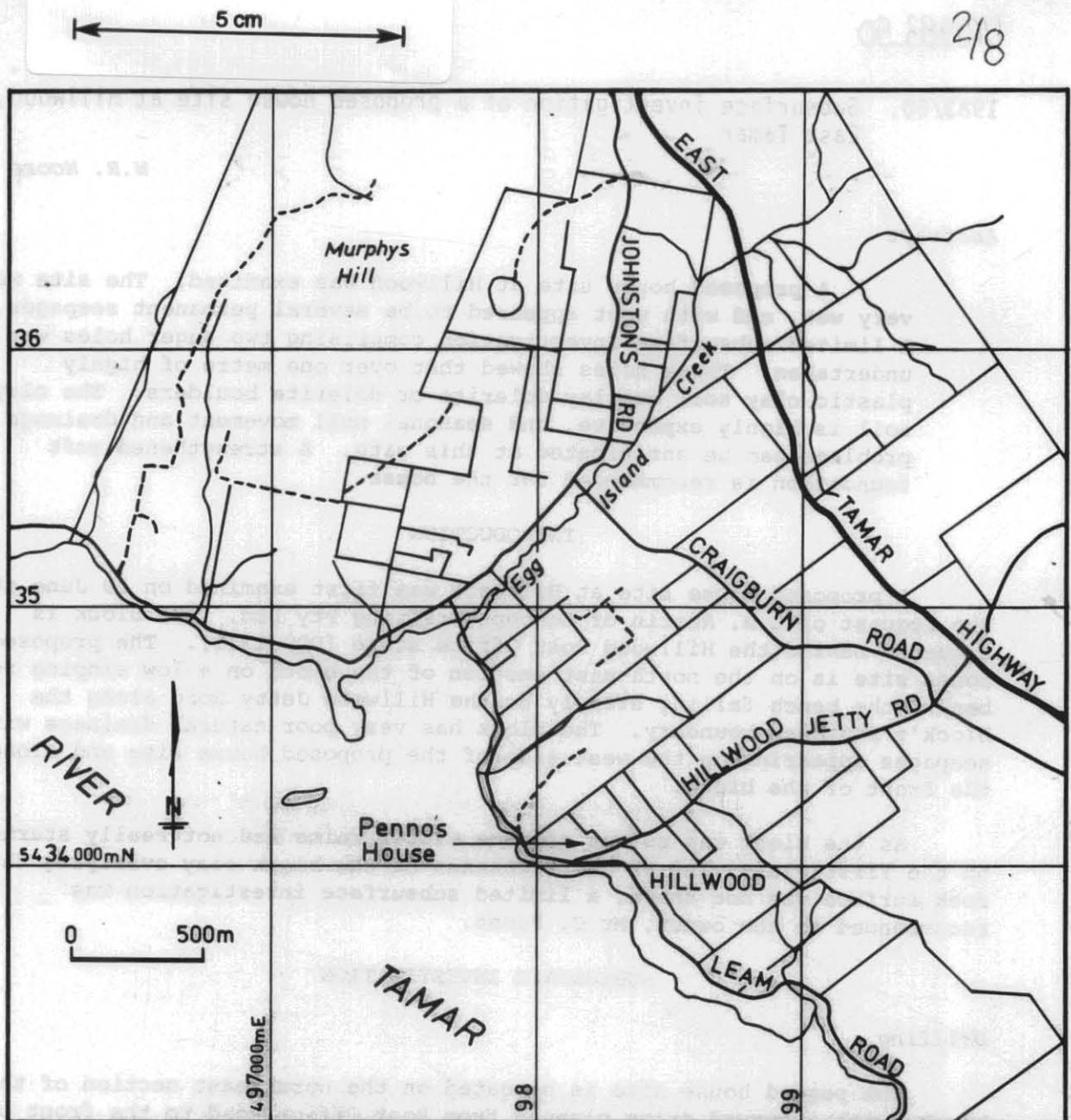


Figure 1. Location of house site, Hillwood

This was 0.9 m thick and the clay was very moist and highly plastic. At 1.1 m depth there was a sharp transition into a brown-yellow flecked clay showing remnant igneous texture. This clay is thought to be derived from the weathering of dolerite, and appeared dry and firm compared with the overlying water-saturated layers. The drill could not penetrate below 1.2 m and appeared to be grinding on rock outcrop or large boulders. Clay samples were collected at 0.9 m and 1.1 m, from the B and C soil horizons.

The same sequence of three soil layers was encountered in Hole 2 and the drill refusal depth was 1.1 m on dolerite or large dolerite boulders.

SOIL LABORATORY RESULTS

The soil laboratory results are given in Table 1 and shown graphically in Figure 2. The natural moisture content of the two samples tested was high, with the 53% for the subsoil horizon thought to be reflecting the poor natural drainage of this block. Both clay samples have high plasticity indices of 99 and 82, with considerable linear shrinkages of 25% and 23%.

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The XRD analysis of the sample showed that the expansive montmorillonite clay group is present in moderate amounts, as is the less expansive kaolinite.

Table 1. SOIL TESTING RESULTS

Sample No.	Depth (m)	Field moisture content (%)	Plastic limit	Liquid limit	Plasticity index	Linear shrinkage (%)	XRD results
1	0.9	53	32	131	99	25	
2	1.1	42	30	112	82	23	Montmorillonite (moderate) Kaolinite (moderate)

CONCLUSIONS

- (1) A highly expansive clay soil is present at this house site and the thickness of the clay is 1.1 to 1.2 m above dolerite boulders or *in situ* dolerite.
- (2) The seasonal soil moisture content fluctuates to the base of the wet, soft clay subsoil layer at 0.9 m depth, and will probably extend to the boulder or rock interface in periods of severe drought.
- (3) Even though the clay soil layer appears to be thin, considerable seasonal heave movements can be anticipated at the site. From the properties of the clay tested, these soils appear to be equivalent to some of the most expansive soils shown in Table 2.3 and Figures 2.3 and 2.4 in Holland (1981). Clay with similar properties found elsewhere in the Tamar Valley has caused houses to crack (Moore, 1983).
- (4) Even though the third soil layer is clay with a remnant ghost igneous texture of dolerite, it was not possible to establish from the drilling if the drill was stopped by *in situ* dolerite or by large dolerite boulders.
- (5) The poor drainage of the block is thought to be the result of groundwater draining from the higher ground behind the block to the dolerite interface, and surfacing (in the form of permanent seepages and soaks) at the break in slope of the rock bench on which the block is situated.

RECOMMENDATIONS

- (1) If strip footings and pillar foundations are to be considered for the proposed house, these will have to be dug down to the dolerite rock surface. As this surface has not been established with certainty by this investigation further investigation by a backhoe will be required and the exposed footing examined by a foundation engineer or engineering geologist.
- (2) A concrete raft type of foundation is considered to be more suitable for such expansive soil and the moist conditions of this block. This raft will have to be strengthened and adequately designed to with-

stand the considerable soil movement anticipated at this site.

- (3) The site will have to be adequately drained to minimise seasonal fluctuations in the soil moisture content. If, as is thought, the wet seepage areas are the result of groundwater movement from the slope behind, this could be a difficult operation and will require careful design and construction of a drainage system for the whole block as well as the proposed house site.

REFERENCES

HOLLAND, J.E. 1981. *The Design, performance and repair of house foundations*. Swinburne College Press : Melbourne.

MOORE, W.R. 1983. Subsurface investigation of cracked houses in the Mowbray area, Launceston. *Unpubl.Rep.Dep.Mines Tasm.* 1983/24.

[3 October 1983]

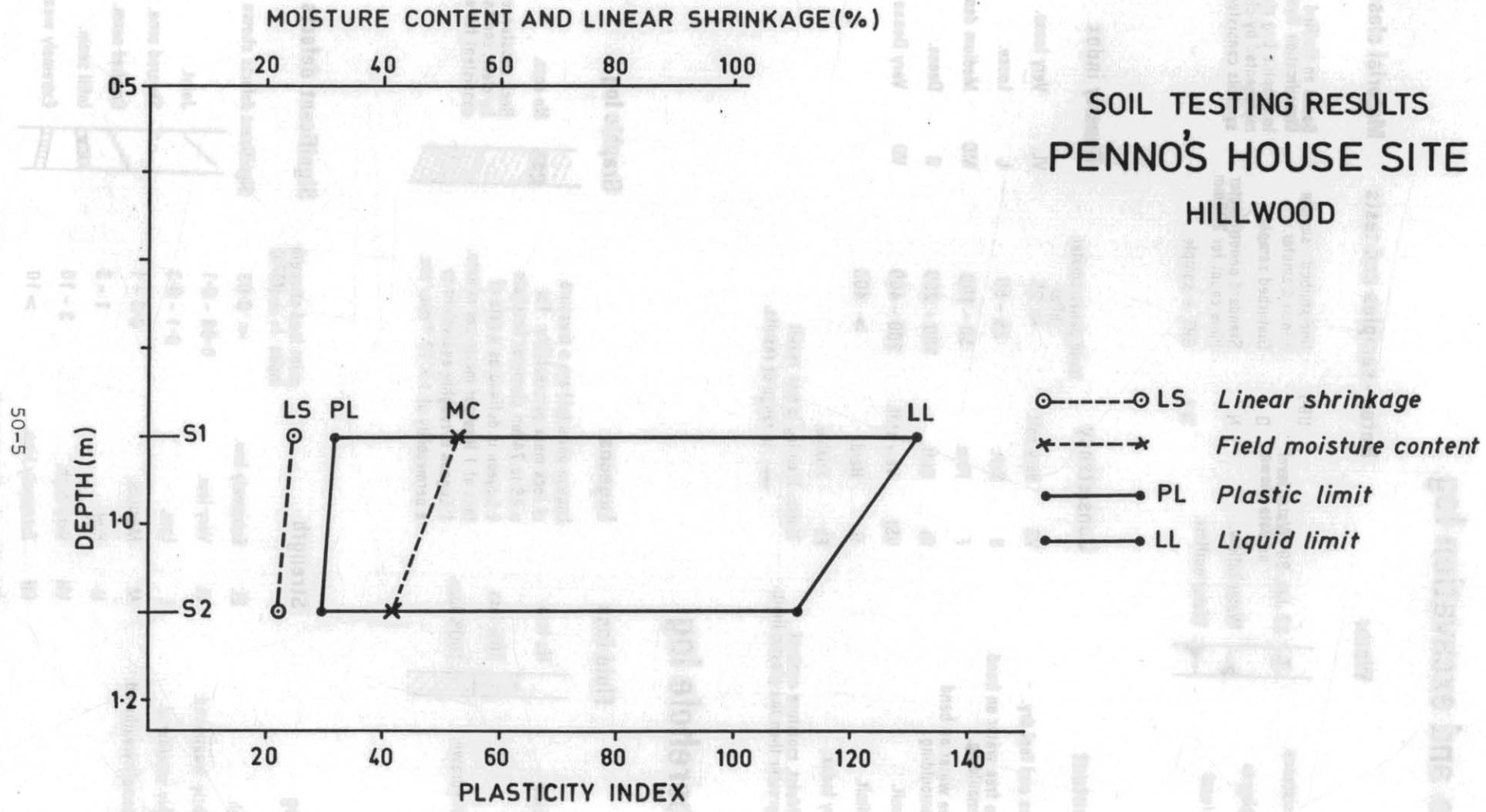


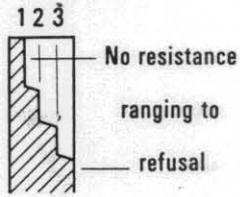
Figure 2. Soil testing results, Hillwood.

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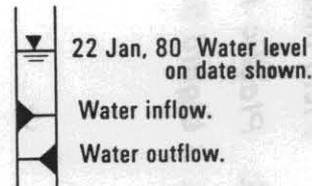
EXPLANATION SHEET FOR ENGINEERING LOGS

Borehole and excavation log

Penetration



Water



Notes - samples and tests

- U50 Undisturbed 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

- VS Very soft.
- S Soft.
- F Firm.
- St Stiff.
- VSt Very stiff.
- H Hard.
- Fb Friable.

hand penetrometer (kPa)

- < 25
- 25 - 50
- 50 - 100
- 100 - 200
- 200 - 400
- > 400

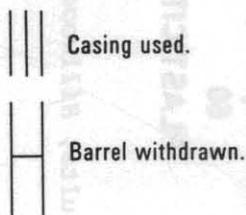
Notes: X on log is test result
— is range of results.

Density index

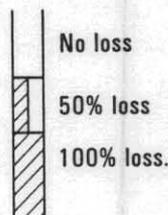
- | | | % |
|----|---------------|----------|
| VL | Very loose. | 0 - 15 |
| L | Loose. | 15 - 35 |
| MD | Medium dense. | 35 - 65 |
| D | Dense. | 65 - 85 |
| VD | Very Dense | 85 - 100 |

Cored borehole log

Case - lift



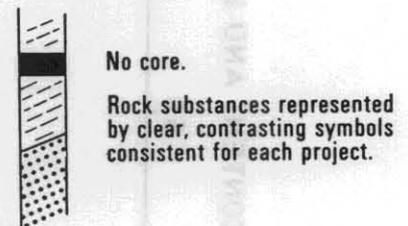
Fluid loss



Lugeons

Lugeon units (μL) 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 1×10^{-4} mm/sec.

Graphic log



Weathering

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

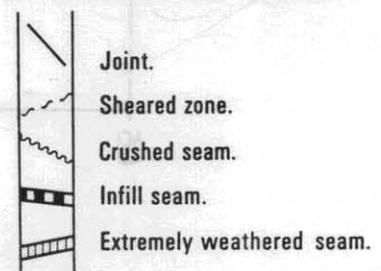
Strength

- | | | 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.

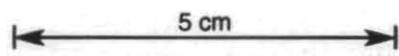


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ENGINEERING LOG - BOREHOLE

project	Penno's house site	location	Post Office Road, Hillwood
co-ordinates	DQ981341	drill type	Triefus
R.L.	10 m	drill method	Auger
inclination	vertical	drill fluid	None
bearing	-	hole commenced	25.9.83
		hole completed	25.9.83
		drilled by	B.E. Cox
		logged by	W.R.M.
		checked by	R.C.D.

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 Hole collapsed immediately					OH	CLAY. Dark grey, organic, highly plastic.				Soil-A horizon
			0.5			CH	CLAY. Yellow-brown, highly plastic, saturated.	V M	V S		Soil-B horizon
		1									
		2	1.0				CLAY. Brown flecked, igneous ghost texture, highly plastic.	D	St		Soil-C horizon
		See Table 1					Drill refused to penetrate. Appeared to be grinding on bedrock or large boulders.				Dolerite or dolerite boulders.



ENGINEERING LOG - BOREHOLE

borehole no. 2
sheet 1 of 1

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project	Penno's house site		location	Post Office Road, Hillwood	
co-ordinates	DQ981341		drill type	Triefus	
R.L.	10 m		drill method	Auger	
inclination	vertical		drill fluid	None	
bearing	-		hole commenced	25.9.83	
			hole completed	25.9.83	
			drilled by	B.E. Cox	
			logged by	W.R.M.	
			checked by	R.C.D.	

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 Hole collapsed immediately			OH	CLAY. Dark grey, organic, highly plastic.				Soil-A horizon
		0.5	CH	CLAY. Yellow-brown, highly plastic, saturated.	V M	V S		Soil-B horizon	
		1.0			CLAY. Brown flecked, igneous ghost texture, highly plastic.	D	St		Soil-C horizon
					Drill refused to penetrate. Appeared to be grinding on bedrock or very large boulders.				Dolerite or dolerite boulders

