

1984/45. Stability assessment of land at Opossum Road, Launceston

W.L. Matthews

Abstract

The slope stability of some land at Opossum Road has been investigated. Two slope profiles were measured and two auger holes were drilled. The residual strength of soil samples from the two holes was determined by laboratory testing in a shear box.

Stability analyses indicate that there is risk of landslip movements affecting some of the steeper sections of the block. However it is considered that a flatter section of the slope, close to Opossum Road, may provide a suitable house site where landslip risk is minimal.

INTRODUCTION

Mr G. Winder has begun purchasing a one hectare block of land fronting on to Opossum Road above the H.E.C. substation. The land has been zoned as Class 4 on the landslip zone map of the Tamar Valley *i.e.* there are signs of old landslips on the land or there are old landslips nearby. The land slopes from a low plateau to the flood plain of Jinglers Creek [EN151085]. There are flattish zones on the slopes which have previously been mapped as old landslip areas. On nearby slopes in similar situations, there are occasional recently active slips, and from surface inspection there is obviously some risk of further movements on the land under investigation.

Subsurface investigations were suggested to examine the nature of the material underlying the site and also to collect material to test the shear strength of selected samples to aid in determining the likelihood of further movements.

DRILLING

Two possible house sites occur on the block and holes were drilled at or near these points. In each case a hole was augered to 9.1 m and the augered material was examined. A further hole was drilled less than one metre away from the first hole at each location and undisturbed samples were collected from selected intervals. Logs of these holes are appended.

STRENGTH TESTS

In the case where old landslips are present it would seem most appropriate to adopt the use of residual strength measurements when undertaking stability analyses in such an area. If an old landslide has occurred, a slip surface has most likely formed, and to analyse such situations, study of the literature suggests that most workers in the field use residual cohesion and friction angle measurements.

Undisturbed material collected in the sampling tubes was placed in a shear box and sheared under varying loads until reliable residual strength factors were obtained. Three samples, two from Hole 1 and one from Hole 2, have been tested, each sample requiring about seven days repeated shearing under different loads. The results of these rests are given over:

Hole No.	*Depth of samples (m)*	*c´r (kPa)*	*φ´r (degrees)*
1	3.0	3	10.9
1	8.2	7	10.4
2	6.7	2	18.5

Each sample has a low cohesion value and the samples from Hole 1 have a low friction angle. The one sample tested from Hole 2 has a higher friction angle. However the sediments are flat-lying and similar materials occur in Holes 1 and 2. The lower strength material tested from Hole 1 is also likely to occur in Hole 2.

STABILITY ANALYSIS

A.T. Moon has undertaken slope stability analyses for the two cross-sections shown in Figure 2. Residual strength parameters have been used in the analyses. Cousins' stability charts were used to indicate the likely position of the critical circles and Bishop's simplified method was used for detailed analysis. Some of the slip circles considered are shown in Figure 2.

The analyses of Section 1 (including Hole 1) indicate that the slope is likely to be unstable and landslip movements could occur during wet winters. A value of 3kPa was used for residual cohesion as previous experience of testing and back analysis and a study of the literature indicates that it is unwise to assume any value higher than this and laboratory testing can easily result in an overestimate of this parameter. Extensive testing and back analysis of similar clays in other parts of the world indicates that a value of 3kPa for residual cohesion is a reasonable assumption. The residual friction angle was assumed to be 10^{o}.

The analyses of Section 2 (including Hole 2) were carried out using two sets of parameters. Residual cohesion was assumed to be 3kPa in both sets of analyses. If the residual friction angle is assumed to be 18^{o} (the test result from Hole 2) analyses indicate that the slope would be stable, even under the worst groundwater conditions. However, this analysis assumes that there is no lower strength material (as tested from Hole 1) anywhere in the vicinity of Section 2. As discussed earlier, this is an unreasonable assumption and so the worst case of Section 2 landslips occurring entirely in the lower strength material (friction angle 10^{o}), was also considered. These analyses indicated that under the worst groundwater conditions the slope may be only marginally stable.

CONCLUSIONS

Because of the higher slope angle in the vicinity of Hole 1, there is obviously a greater prospect of this area becoming unstable. The stability analysis supports this and building in the area is not recommended.

The flat area in the vicinity of Hole 2 is surrounded by lower sloping land and although it has the structure of an old landslip and there is obviously some risk of landslip affecting the area, it is considered that the risk is low enough not to make the building of a house in the area too risky under most circumstances that are likely to prevail. Ensuring good drainage, avoiding cuts around the slopes below the house site and maintaining a tree or vegetation cover will aid in maintaining the present stability. The area regarded as suitable for the building of a dwelling is shown on Figure 1. [26 June 1984)

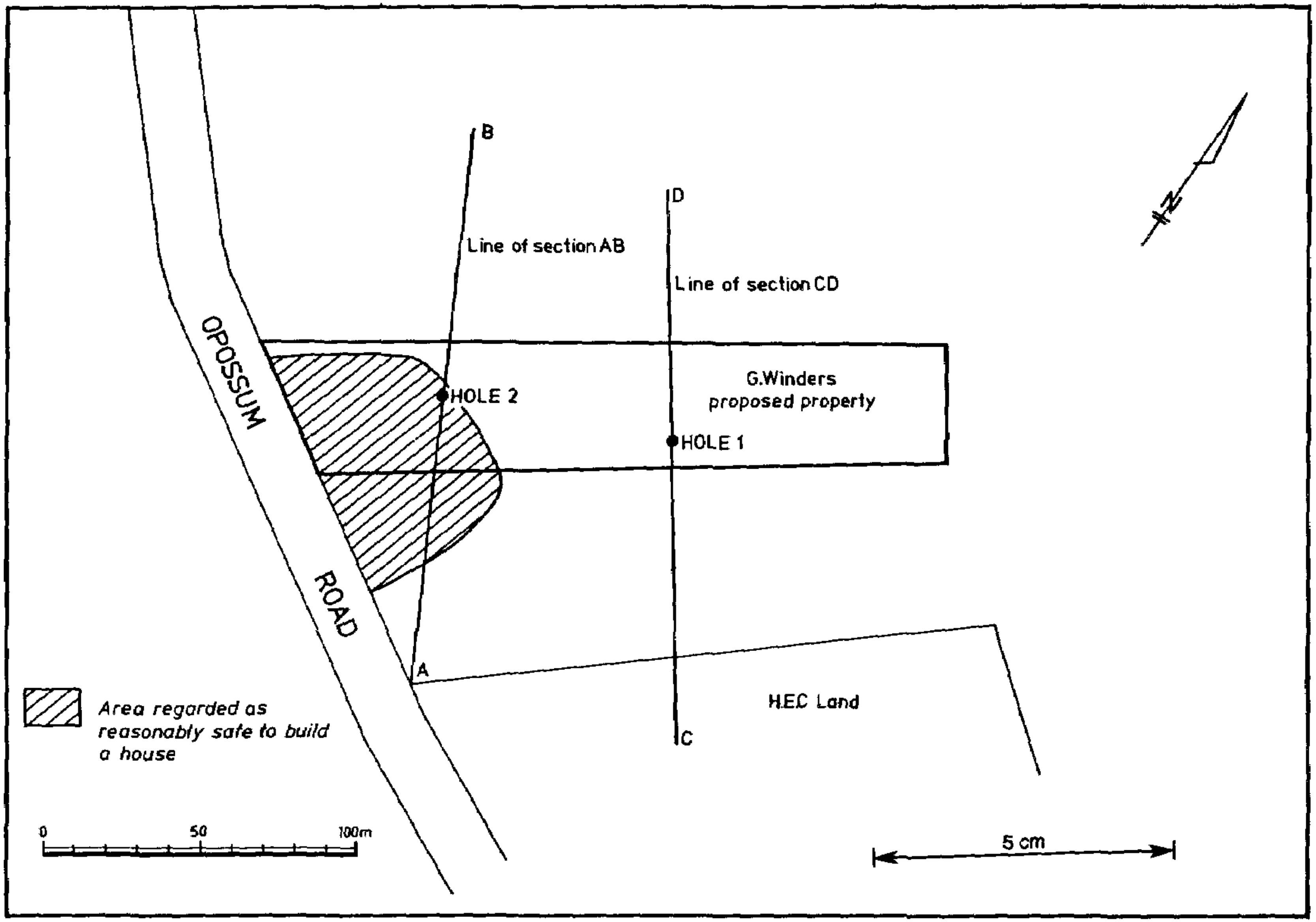


Figure 1. *Location map showing auger holes and section lines.*

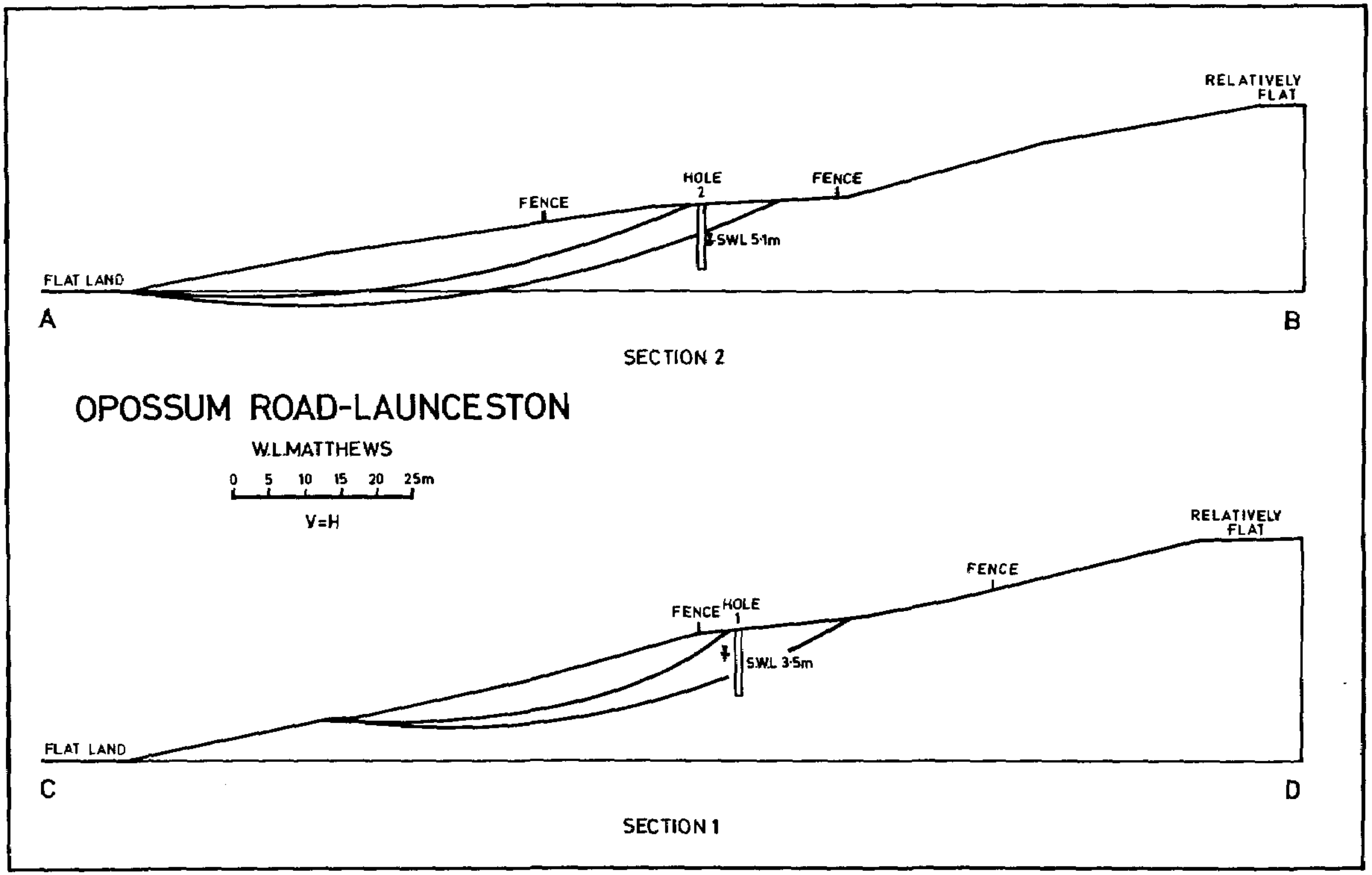


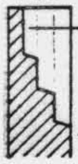
Figure 2. *Cross-sections used in stability analysis, showing some of the slip circles considered.*

EXPLANATION SHEET FOR ENGINEERING LOGS

Borehole and excavation log

Penetration

1 2 3



No resistance

ranging to

refusal

Water

22 Jan, 80 Water level on date shown.

Water inflow.

Water outflow.

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

		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

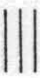
▬ is range of results.

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



Casing used.

Barrel withdrawn.

Fluid loss

No loss

50% loss

100% 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

No core.

Rock substances represented by clear, contrasting symbols consistent for each project.

Weathering

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

Strength

		point load strength index $I_{s(50)}$ (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.

Joint.

Sheared zone.

Crushed seam.

Infill seam.

Extremely weathered seam.

TASMANIA DEPARTMENT OF MINES

6/7

ENGINEERING LOG – BOREHOLE

borehole no. 1
sheet 1 of 1

project STABILITY ASSESSMENT
location G. UINDERS LAND OPOSSUM RD., L'TON

co-ordinates
R.L.
inclination Vertical
bearing

drill type PROLINE
drill method Auger AND TUBE SAMPLE
drill fluid —

hole commenced 23/5/84
hole completed 23/5/84
drilled by B COX
logged by L. MATTHEWS
checked by

penetration 1 2 3	support	water	notes samples, tests	R.L.	depth (metres)	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa (25 50 100 200 400)	structure, geology
					0–1			Clayey sand, red-brown, somewhat plastic, moist				
					1			Gravelly sandy clay, light brown, dolerite boulders up to 6 cm in diameter, moist.				
					2			Gravelly sandy silty clay, darker brown, fragmental, moist.				
		▽	c'r 3 kPa, φ'r 10.9°		3			Clay, blue, plastic, moist.				
					4			Silty clay, light brown.				
					5			Sandy silty clay, light grey, moist.				
			WS		6			Sandy clay.				
					7			Clay, dark blue, moist, fairly stiff.				
			LL 93, PL 28, LS 20, c'r 7 kPa, φ'r 10.4°		8							
					9			Clay, some sand, red-brown.				

5 cm

TASMANIA DEPARTMENT OF MINES

ENGINEERING LOG – BOREHOLE

7/7

borehole no. 2

sheet 1 of 1

project STABILITY ASSESSMENT

location G. WINDER'S LAND OPOSSUM RD, LTON

co-ordinates

R.L.

inclination VERTICAL

bearing

drill type PROLINE

drill method AUGER AND TUBE SAMPLING

drill fluid

hole commenced 23/5/84

hole completed 23/5/84

drilled by B. COX

logged by L. MATTHEWS

checked by

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa 25 50 100 200 400	structure, geology
								Clay, red-brown				
								Clay, dark grey, stiff				
								Clay, some sand, grey, iron oxide staining				
								Silty clay, iron oxide stained				
								Silty clay, grey and brown				
		▽						Silty clay, grey-brown, soft				
								Silty clay, brown				
			LL 102 PL 29 LS 21 C'r 2kPa Φ'r 18.5°					Silty clay, grey-brown				
		WS						Clayey sand, light brown				

5 cm