Tasmania

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Investigation of house cracking at Beach Road, Legana

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Introduction

A house was built at 82 Beach Road, Legana, in about 1970. In 1993 attempts were made to repair structural damage to the house, which was apparently caused by earth movements. Examinations by the building inspector for the West Tamar Council and by a geologist from Mineral Resources Tasmania (MRT) resulted in conclusions that the property was being affected by landslip. At a later stage, the West Tamar Council requested that an investigation of the property be undertaken.

Although the most likely cause of damage to the home was landslip, local residents suggested that it may have been due to poor foundation construction. The investigations that were undertaken were designed to prove more definitely whether the property was subject to active landslide movement or not. The area is underlain by Tertiary-age sediments and sloping land around the River Tamar is commonly affected by landslip.

Previous information

The area had been zoned as part of the landslip risk zoning undertaken for the whole Tamar Valley and issued in 1974. The zoning shows the area between Beach Road and the River Tamar to be in Class V (active landslip and adjacent areas) and Class IV (old landslip and adjacent areas). A narrow strip of Class III land (land underlain by soft sediments on slopes of 7° or greater) occurs on the lower side of the road and this zone extends up the slope above the road. Although it is difficult to identify the exact position of the house on the zone map, it appears that the house has been built in an area of Class IV land, but very close to a Class V area.

The latest zoning for the area (1996) is very similar to the 1974 version. Proposals to develop land adjacent to the property to the north have resulted in recommendations that the land not be developed because of the landslip risk, although a property some 100 metres to the north (on the lower side of the road) was regarded as reasonably safe to develop for housing.

Investigations

The investigations resulted in the auger drilling of five holes on the property to a maximum depth of nine metres and the installation of 50 mm PVC pipe into the holes to measure standing water levels and to place devices to measure approximately where the PVC pipe is distorted, if affected by a landslip movement. Brief descriptions of the material encountered in the auger holes are given in Appendix 1 with the approximate positions shown on Figure 1.

Water levels and signs of distortion in the PVC pipe have been monitored from time to time over a period of about three years. It was apparent at the time of monitoring the holes on 8 March 1996 that some distortion of the PVC pipe in three of the holes had taken place, suggesting movement. The depth of these distortions was about 5.8 m from surface in hole 1, 6.5 m from surface in hole 3, and about 6.6 m from surface in hole 5.

At the time of the inspection of 8 October 1996, there were signs of cracks in the soil across the lot and these were almost certainly due to a landslip movement.

During the monitoring of 2 August 1996, the weight in hole 2 used to detect distortion in the pipe was stuck on the bottom of the hole suggesting that the landslide movement was at this depth. However at a later time the weight was found to be free. It may have been stuck originally at the bottom due to sediment entry into the hole. There is little doubt that the other three holes had distortion and that this distortion is most likely due to landslip movement. This, combined with the visible signs of cracks in the soil behind the house, virtually confirmed that an active landslip occurs on the property.

Other information

There is a strong seepage on the property which comes out on the northern side of the house, with water accumulating on the downhill side of the house in a low zone with poor drainage. This low feature probably resulted from a previous landslip movement as the land rises on the shoreline side, thus blocking the

surface flow of the water away from the area. The water in the seepage has a high salt content and this is also the case for water in all of the boreholes. Conductivities were measured for water from all holes and these are listed in Table 1. Conductivity value can be used to estimate approximate values of salt content if that value is multiplied by about 0.7. Field conductivities range from 7000 to 17 000 microsiemens per centimetre or about 5000–12 000 milligrams per litre dissolved salts. Groundwater in a number of localities in the Tamar region is known to have moderate to high salt content. A sample of water was collected from hole 5 for chemical analysis; the results of this are shown in Table 2.

Engineering properties for this material have not been measured as the investigation was largely conducted to detect actual movement rather than predict it. Clayey material similar to that in other landslide areas was encountered during the drilling and these clays, when subjected to shear strength tests, exhibit low values.

[4 September 1998]

Table 1

Water levels and conductivity in boreholes, 82 Beach Road Legana

	Hole 1	Hole 2	Hole 3	Hole 4	Hole 5
Total depth (m)	7.45	8.60	8.25	3.25	8.27
Conductivity (S/cm)					
3 March 1995	12 000	13 500	7 200	13 000	17 000
Water levels (m)					
3 March 1995	2.01	2.01	3.78	2.98	1.16
8 March 1996	1.70	1.95	3.20	1.85	0.85
1 May 1996	1.67	1.90	3.00	dry	0.75
20 June 1996	1.60	1.90	2.80		0.63
2 August 1996	1.50	1.85	1.90		0.60
8 October 1996	1.50	2.00	1.70	1.75	0.60
21 November 1997	1.54	1.85	2.28	1.75	0.60
29 November 1997	1.70	1.83			0.53
19 March 1998	1.84	2.00	3.40	2.00	0.70

Table 2

Analysis of water sample collected from hole 5, 17 February 1995

pH	5.9
Conductivity (S/cm)	18 090
Carbonate (mg/l)	<5
Bicarbonate (mg/l)	59
Chloride (mg/l)	6 180
Sulphate (mg/l)	340
Calcium (mg/l)	240
Magnesium (mg/l)	640
Iron (mg/l)	<0.1
Aluminium (mg/l)	<0.2
Potassium (mg/l)	29
Sodium (mg/l)	2 930
Fluoride (mg/l)	<0.3
Nitrate (mg/l)	12 590
Total dissolved solids (mg/l)	3 190
Permanent hardness (mg/l)	48
Alkalinity (mg/l)	48

APPENDIX 1

Logs of drill holes

Hole 1

0	– 0.6 m	Light grey-brown silty soil, dry.
0.6	– 1.2 m	Brown sandy clay, hard and dry.
1.2	– 1.5 m	Grey-brown plastic clay.
1.5	– 2.1 m	Mid-brown plastic sandy silty clay.
2.1	– 3.4 m	Light brown silty clay, soft 2.4–2.7 m, harder 2.7–3.1 m (iron oxide?).
3.4	– 5.2 m	No return except for a little water.
5.2	– 7.0 m	Light grey to brown clayey, sandy, watery sediment.
7.0	– 7.9 m	Dark brown clay, carbonaceous with light grey clay and sand bands.

Water struck about 3.4 m or perhaps in soft band at 2.4–2.7 m.

Hole 2

0	– 0.1 m	Bitumen pavement.
0.1	– 0.75 m	Light grey and brown sandy silty clay, plastic, moist.
0.75	– 1.5 m	Light grey, some brown silty clay, plastic.
1.5	– 1.8 m	Light grey silty clay.
1.8	– 3.4 m	Light brown and grey silty clay.
3.4	– 4.3 m	Brown and grey silty clay.
4.3	– 5.5 m	Brown and grey plastic clay.
5.5	– 9.0 m	Dark grey silty clay.

No return from about 4.6 m while drilling. Hard zone about 4.9 m, then very soft to 6.7 m. Hard zone at 7.3 m with remainder of hole fairly hard.

Hole 3

0	– 0.3 m	Brown sandy silt.
0.3	– 0.75 m	Grey sand.
0.75	– 1.5 m	Grey and brown sandy silty clay.
1.5	– 2.4 m	Light brown silty clay, plastic.
2.4	– 3.4 m	Red-brown silty clay, plastic.
3.4	– 4.0 m	Red-brown silty clay.
4.0	– 8.5 m	No return while drilling. On removing augers mainly liquid brown silty clay, some red clay zones on augers. Hole ended in red clay with some black carbonaceous patches.

Soft drilling patches in zone 5.2–7.0 m.

Hole 4

0	– 0.6 m	Brown-grey silty sand.
0.6	– 1.5 m	Brown silty clay, plastic, moist.
1.5	– 1.8 m	Brown silty clay, plastic, moist, friable.
1.8	– 2.8 m	Brown plastic clay.
2.8	– 3.4 m	Light brown grey silty clay.
3.4	– 5.2 m	Sandy clay – liquid.
5.2	m	Red-brown clay on auger end.

Hole 5

0	–	0.3 m	Grey silty clay soil, moist.
0.3	–	1.5 m	Grey plastic clay, moist.
1.5	–	2.4 m	Light brown silty clay, plastic.
2.4	–	5.2 m?	Brown plastic clay.
5.2?	–	8.5 m	Brown and dark grey silty clay

No return from about 2.4 m while drilling soft at 2.8–3.1 m, hard and soft zones 3.4–5.2 m.

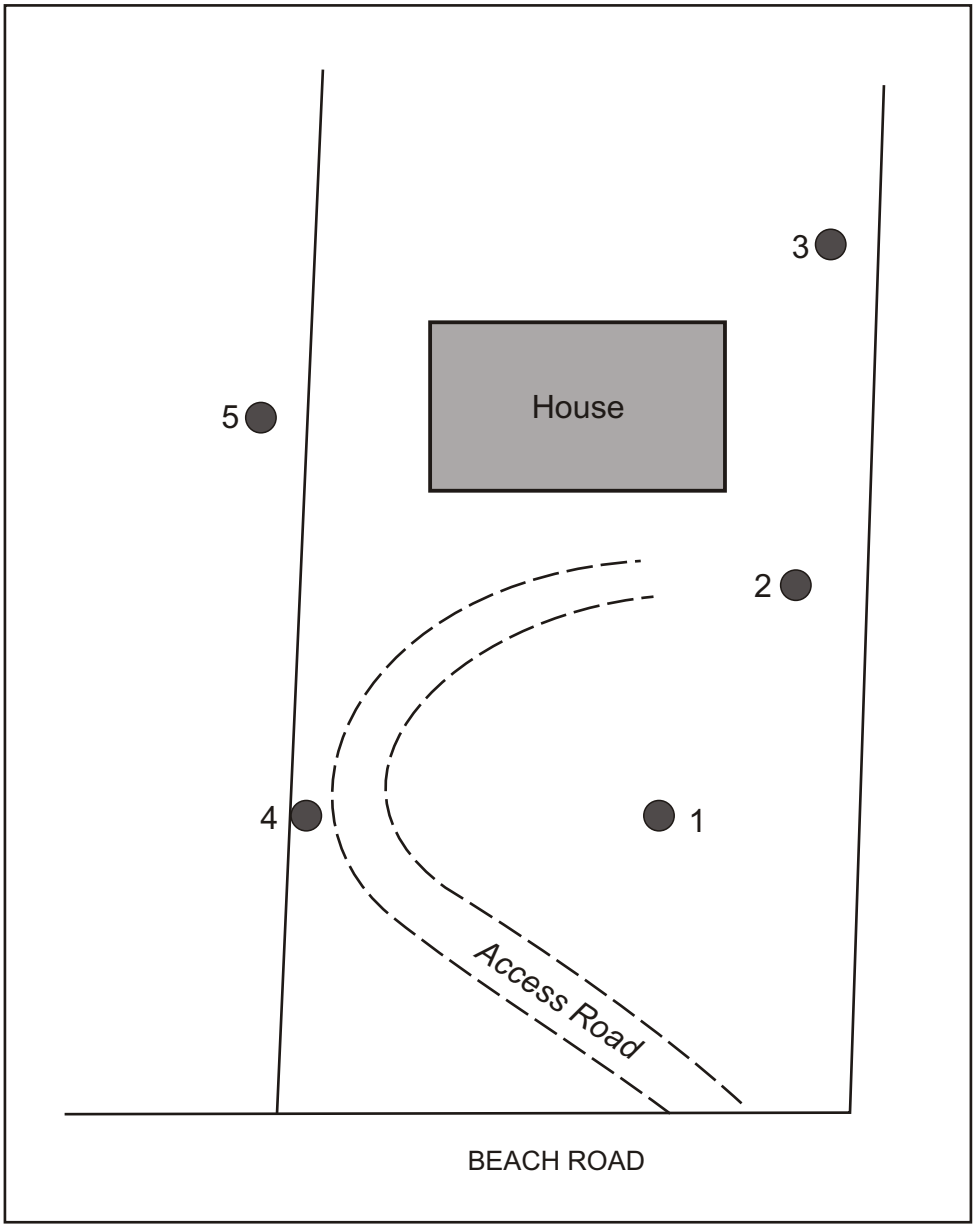

Figure 1

Sketch plan of borehole locations, 82 Beach Road