

1982/22. Slope stability investigation of H.M. Archer's proposed subdivision at Windermere

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Abstract

An area proposed for subdivision into three blocks, located north of Windermere Road one kilometre west of the East Tamar Highway, was examined to determine the landslide potential. The area comprises a narrow stream valley with bordering slopes ranging between 4 and 16 degrees. The surface soil is silt, underlain by clay and sandy clay. Because of the steepness of some of the slopes and the occurrence of underlying clay, it is recommended that building be restricted to two areas. Two house blocks could be sited on the western side of the stream valley, with building confined to the ridge, while one house block could be sited on the eastern side of the valley, with building confined to a low-sloping area of 4°, thought to have been produced by an old landslide. Precautions are detailed for all three building sites.

INTRODUCTION

At the request of H.M. Archer, the author first visited the proposed subdivision on 24 February 1982, and because of the obvious slope stability problems of the locality, arranged to meet Mr Archer on the site on 25 March. The boundaries of the subdivision, the number of proposed blocks, and the location of the houses on each block were discussed. Mr Archer indicated that he proposed to subdivide the area into three blocks, each with one house site. Two of these blocks were located on the western half of the subdivision and one on the eastern half, with the stream separating the two halves. Septic tanks would be required for each house.

LOCATION AND TOPOGRAPHY

The proposed subdivision is located on the northern side of Windermere Road approximately one kilometre from the junction of the East Tamar Highway and Windermere Road [EQ033263].

The area covered by the subdivision comprises the two slopes bordering a small stream valley between two south-trending ridges (fig. 1). The valley is narrow, with the stream possessing little to no flood plain on the valley floor. Short steep slopes of 15-16° border the incised stream. These slopes flatten with a noticeable change in slope to long slopes of 12-13° on the western side of the stream and 8-9° on the eastern side (fig. 1).

On the upper western side of the valley the 12-13° slope flattens to 8-9°, and changes in form to a convex slope. This convex slope forms the end of a wide spur with south and south-easterly slope directions. It is in this area that two house sites are to be located in the proposed subdivision, as indicated by Mr Archer.

On the eastern side of the stream the slopes are more complex because of the presence of a very old landslide, the heel of which is marked by a low bank outside the subdivision's boundary. This landslide is thought to have formed the relatively flat area with a low slope of 4°, and the 8-9° slope lower down the western side of the valley.

Another feature of the eastern slope is the small steep bank of 16°

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at the break of slope with the 4° sloping area. The origin of this feature is not certain, but there is a possibility that it was a small parasitic slip that has been modified by time and its use as a logging skidder. It is on this relatively shallow sloping area that the third house site is to be located, as indicated by Mr Archer.

GEOLOGY

No good outcrops were found on the site, but weathered dolerite and ironstone boulders occur on the ground surface. No basalt boulders or what was considered to be recognisable basalt on visual examination were found.

The soil is a light grey silt (MH) and appears to be underlain by clay and sandy clay of the Launceston Beds of Tertiary age. Poor exposures of these sediments occur up the stream outside the subdivision and in nearby road banks. One exposure occurs on the low bank formed by the heel of the landslide, where 0.7 m of grey silt (MH) soil is underlain by 0.5 m of light brown, soft, fine-grained sand with clay (SC) with a clay percentage estimated at greater than 10%. Soil shrinkage cracks were very noticeable on the subdivision site. The silty soil and underlying clay and sandy clay appear similar to those found elsewhere in Windermere (Matthews, 1976; Moore, 1981).

SLOPE STABILITY

Regional zoning

On the Department of Mines Tamar Valley Landslip Zone Map, the western ridge of the subdivision is shown as a Zone III area, which is defined as a potential landslip zone. The remainder of the subdivision, except for the small strip adjoining the Windermere Road, is shown as Zone IV, which is defined as old landslips and adjacent areas with no building without specialised investigation and design. The Zone III area along the front of the site coincides approximately with a line joining the rear fence line of the two neighbouring blocks, on which homes have been built.

Western section of the subdivision

The most stable area in the western section is the spur ridge and its flanks, which have slopes of 8-9°. The slope steepens below this area, with slope angles up to 13°. Although there is no direct evidence of prior landslide movement, the potential for slope failure must be high, with slopes up to 13° underlain by clay. Previous slope movements are postulated in the area to explain the presence of dolerite and ironstone boulders on the ground surface; these may have been transported by old gravity slides from the Doctors Rise area to the north where dolerite and ironstone crop out. This explanation has been used elsewhere in the Tamar Valley to explain the presence of dolerite and ironstone boulders, but recycling from Tertiary gravel beds appears an equally likely explanation for their origin.

Previous subsurface investigation and testing of clay similar to that thought to be present at Archer's indicated that these clays are highly plastic with a considerable shrinkage, and possess a low shear strength (Matthews, 1976). Such clays are prone to slope failure, and failures on slopes of 12° and lower are known to have occurred in the Tamar Valley. Therefore it is considered unwise to site any house on these 12-13° slopes, and buildings should be limited to the ridge area (fig. 1). As the access roads to the proposed blocks have to climb the steeper slope, bank cutting on these roads should be kept to a minimum. A joint access road near the

existing boundary fence of the neighbouring block with two branches to the blocks when the spur area is reached would be preferable to separate access roads.

Eastern section of the subdivision

The slip of which the heel scarp is exposed appears to be large and is probably a rotational slide with a single slip circle failure plane. It appears to have been stable for a very long time, and many of its features have been so modified through subsequent erosion that they cannot be distinguished with any great degree of certainty. It is thought that the stream has cut into the toe on the frontal section of the old slip - the area with slopes of 8-9° - to form a narrow V-shaped incised section of its valley with slopes of 15-16°. This undercutting has not resulted in any further reactivation of the old landslip.

The feature on the south-east edge of the 4-6° slope with a short, steep slope of 16° is possibly a small parasitic slump modified to become a logging skidder. If this is the correct explanation for this feature, its movement was not induced by the stream deepening its valley.

The old landslide appears to be older than the incised stream valley. It is thought that if this old landslide was a shallow translational type, this incising would have reactivated the slide, giving it a valley collapse type of appearance. Because of this non-reactivation and the general symmetrical appearance, the slip is thought to be a simple rotational slide with a single failure plane or zone. To attempt to prove this hypothesis would have involved considerable subsurface investigation, including diamond drilling, in order to attempt to find the slip plane or failure zone.

Such investigations are expensive and are often found to be inconclusive and, in the author's opinion, are not warranted for one house site. Although there is an inherent risk of placing a house on what is considered to be an old landslide, this slide has been stable for such a long time that this risk is within acceptable limits, in the author's opinion, given that the weight of the house is so small compared with total volume of the slide, which extends beyond the boundaries of the subdivision.

As this area must remain in a Zone IV landslip area, special precautions must be taken as defined by the definition of such a zone. These precautions include that only a single storied house should be built, with all septic tank overflow and stormwater piped to the stream. The house should be sited as far back from the scarp marking the break in slope as is possible and convenient for the type of house to be built. If a swimming pool is to be built, this should preferably be an above ground type so that leakage is detectable. Care should be taken in siting the driveway and bank undercutting should be restricted to the minimum for this driveway. Trees and shrubs should be planted on the slope areas and the amount of lawn kept to a minimum on these areas, to reduce the amount of watering required.

CONCLUSIONS

From surface features, an old landslide is recognised on the eastern side of the stream. This feature has been modified by erosion such that its limits and features are not definitive. Dolerite and ironstone boulders on the ground surface of the spurs are possibly transported by gravity slides from the Doctors Rise area.

The proposed subdivision has a silty surface soil which appears to be underlain by clay and sandy clay. Considerable soil shrinkage was evident by the ground cracking. The clay and sandy clay are considered to be sensitive to slope failure on slopes as steep as those found on the lower slopes of the site.

The most stable area on the western side of the stream is the west flank of the ridge, with slopes of 8°. This area remains a Zone III landslide zone area, but there appears to be enough suitable land for two building blocks on this area. The remainder of the western section of the subdivision is considered too steep to build on, with slopes of 12-13° steepening to 16° near the stream.

Most of the area on the eastern side of the stream is considered to be part of an old landslide and is a Zone IV area. This landslide is considered to be very old and is thought to be of the rotational type, rather than a shallow translation type. On the low sloping (4°) area there is a risk that this old landslide could be reactivated, but if the house is sited back from the break in slope and several precautions are accepted, this risk can be kept to a minimum, and is considered to be within acceptable limits.

RECOMMENDATIONS

- (1) The subdivision be cut up into three blocks, two on the western side of the stream and the third on the eastern side, with the stream as the mutual boundary.
- (2) No future further subdivision of these blocks be permitted beyond the proposed three.
- (3) On each block one house be sited in the area outlined on Figure 1.
- (4) The overflow of the septic tanks and stormwater from the three future houses be piped to the stream and off the steeper slopes.
- (5) Considerable thought be given to the access routes for each of the house sites so that undercutting of the banks is kept to a minimum on the steeper slopes. On the western blocks a common joint access road rather than two separate roads to the permitted building area would be preferable. On the eastern block, an S-shaped access may be required because no undercutting of the toe area of the old slip, the 9° slope, should be contemplated.
- (6) The position of the house on the eastern block be in the northern area of the block on the 4° slope area. The weight of the house and all water soakage should be kept to a minimum on this site, with only above ground pools recommended. As many trees as possible should be planted on the lower slopes of 8-9° and 15-16°.
- (7) For all three blocks Building Regulations Statutory Rules No. 135, Division 5, Sections 41-42, should apply.

REFERENCES

MATTHEWS, W.L. 1976. Test pits on R. Ambrose's property at Windermere. *Unpubl.Rep.Dep.Mines Tasm.* 1976/32.

MOORE, W.R. 1981. Slope stability of Lot 1, R. & C.S. Adams' subdivision, Windermere. *Unpubl.Rep.Dep.Mines Tasm.* 1981/52.

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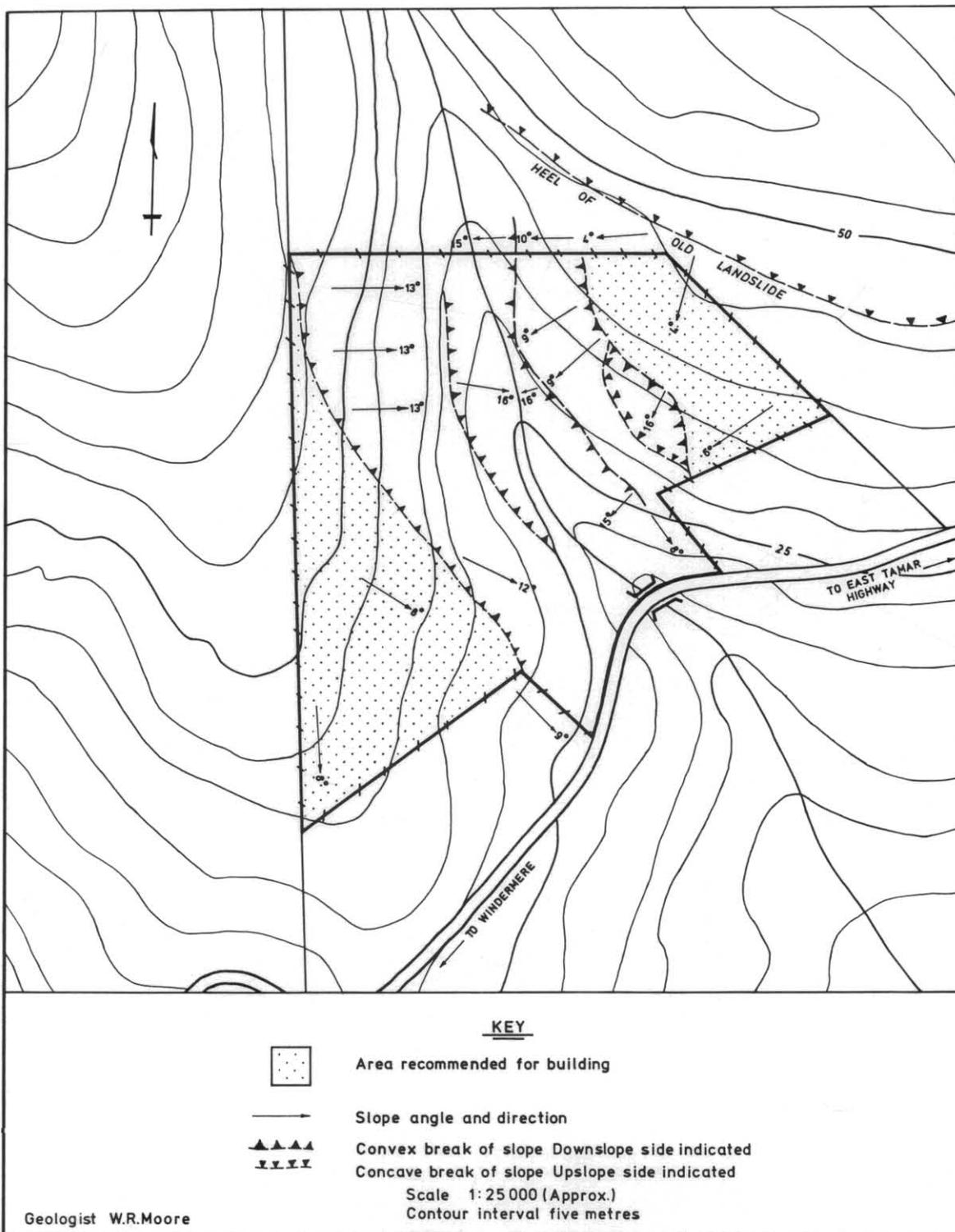


Figure 1. Slope map of proposed subdivision, Windermere.

