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1986/31. Erosion problems at a proposed subdivision at Shannuk Drive, West Hobart.

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Abstract

Land at the end of Shannuk Drive is badly affected by gully and tunnel erosion and the problem should be corrected before wide scale subdivision is undertaken. The property is underlain by Triassic sandstone and shale, and some of the soil produced by weathering of these materials has strong dispersive properties. It is expected that the remedial action will include remoulding of the surface, extensive drainage, and revegetation. The soil conservation section of the Department of Agriculture should be consulted in devising the remedial measures.

INTRODUCTION

G. R. Howes and Company have a proposal to subdivide about seven hectares of land at the end of Shannuk Drive and uphill from Knocklofty Terrace. The land varies from steep to moderately steep and has been quarried extensively during the early development of Hobart to provide building stone. A valley extends up into the land, around which extensive erosion has taken place in the form of tunnel and gully erosion. The Hobart City Council has shown some concern regarding this problem and as a result the developer requested an examination to make assessments of the stability of the land as well as the erosion. After a surface inspection, test pits were dug to examine subsurface materials and to ascertain the depth of unconsolidated soil over bedrock.

RELIEF AND GEOLOGY

The whole subdivision slopes towards the north-east. In the steepest parts above the end of Shannuk Drive and near the northern boundary, the slope angle is greater than 20°, while towards the south-western boundary there are much flatter zones. Some fifteen quarries of varying size have resulted in the development of vertical cliffs. Overburden and waste material from the quarries have been dumped downslope from them, creating irregular surfaces. Where erosion is most serious in the central part of the valley, the surface is very irregular and takes the form of badland topography.

The whole area is underlain by rocks of Triassic age with a south-western dip in the general range of 6-14 degrees. These rocks consist of interbedded sandstone and shale, the sandstone being the rock quarried as a building stone. The sandstone is dominantly quartz-rich and varies in grain size from fine to medium. Sometimes it is exposed in massive beds with cross bedding, while other exposures are of thinly-bedded sandstone with abundant mica. The sandstone contains some clay. Soil derived from weathering of this sandstone has some plasticity. The shale is usually thinly bedded and weathers with a hackly surface. It is dominantly brownish green in colour but red horizons are present. The rock weathers to produce a clay-rich soil.

The massive sandstone beds tend to be the only horizons that crop out naturally around the slopes. The shale and thinly-bedded sandstone bands tend only to be seen in man-made excavations or in the base of erosion features. Despite the lack of continuous outcrop up the slope, it appears

that there is a dominantly massive sandstone sequence at the bottom of the land near Knocklofty Terrace. This is overlain by a zone of dominantly shale and siltstone with minor sandstone horizons, followed by a zone of dominantly sandstone with a few shale bands. Towards the top of the land there is almost entirely sandstone with shale either rare or absent.

Considerable depths of soil and unconsolidated material overly bedrock, particularly around the centre of the valley, where the overburden attains a thickness of four metres or more. Sand, silt, and clay comprise these deposits.

SOIL CONDITIONS AND STABILITY

Recent erosion covers roughly one third of the area proposed for subdivision, as shown on Figure 1. This plan shows only an approximate outline, as the area has not been surveyed. Outside this area, the nature of the land surface indicates that erosion has affected other areas in the past but has been stabilised by vegetation. There is little obvious sign of mass movement as in landslip, except for a small slump on a steep bank of the valley on the vacant lot extending the property to Knocklofty Terrace. The major part of the erosion is due to tunnel erosion, vertical collapses into the tunnels, and gully erosion. In and near the centre of the valley the gullying has extended some three to four metres below the normal surface level.

The erosion probably started with the clearing of the slopes to make access for the quarries, together with the dumping of spoil material on the surface creating poor surface drainage. This kind of erosion is usually related to dispersive material under the surface, and with the movement of water through it, fine particles move with the water creating larger voids and eventually channels. The channels become larger and eventually the surface collapses. This has probably been the mode of formation of the deep gullies. Peripheral to the deep gully erosion are numerous examples of tunnel erosion at various stages of development. Clearing of the land and disruption of the drainage is likely to increase the rate of spread of this process.

TEST PITS

Test pits were dug at a few locations to examine the depth to bedrock, identify bedrock, and collect a few samples for further examination. Because of the steepness and irregular surface, only a few locations could be easily reached by the machine.

In situ bedrock was encountered in all of the test pits at depths of one metre or more. In Pits 4 and 5 the bedrock was about one metre below the surface, in Pits 2, 3 and 6 about 1.5 m, while in Pit 1 it is over two metres below the surface.

X-ray diffraction examination has been undertaken on some of the material from the pits. Montmorillonite, illite, kaolinite and quartz have been identified in a mixture of the clay size and fine silt size material. The following results were obtained for the peak intensity.

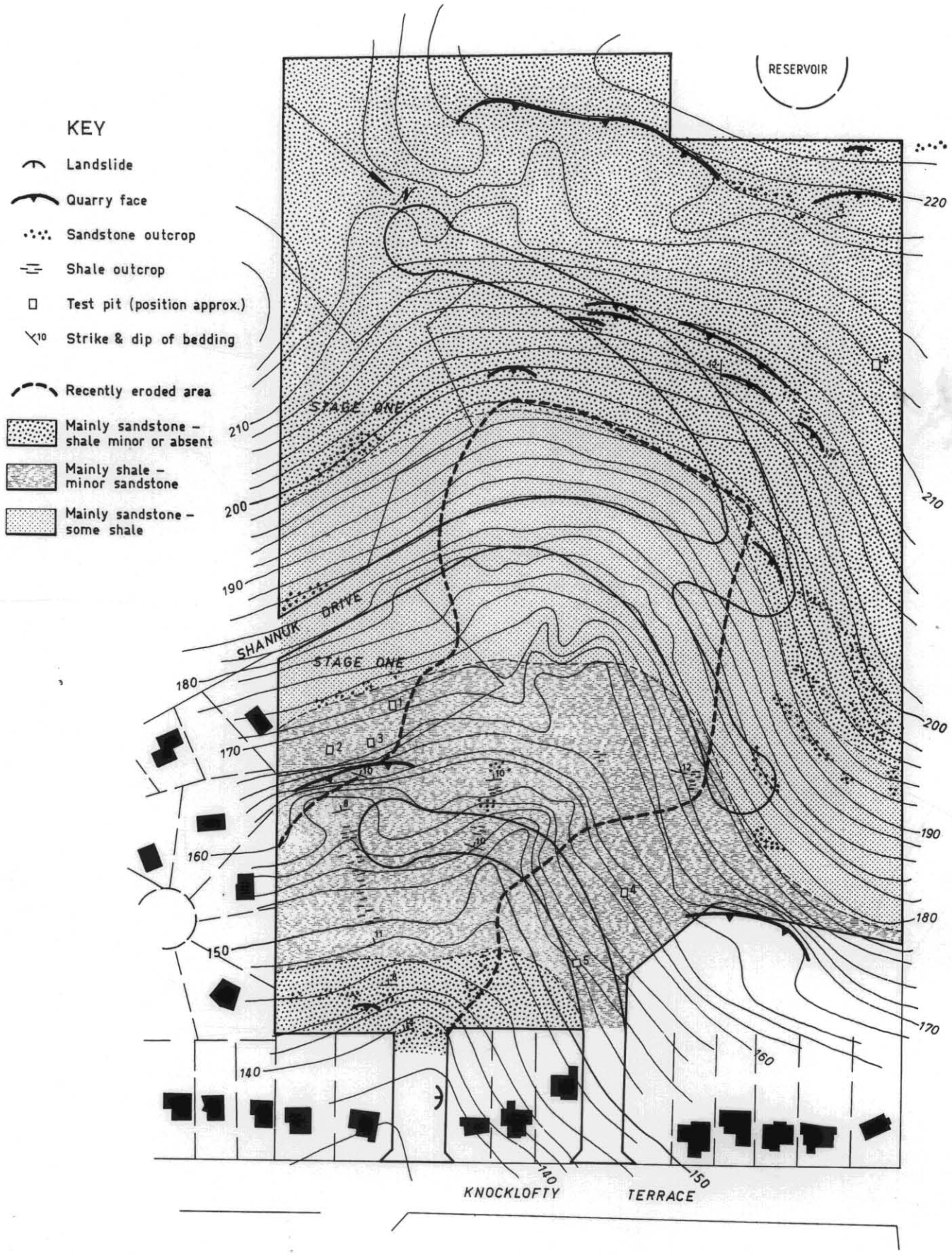

Figure 1. *Location map, showing test pits and geology.*

5 cm

Pit No.	Depth (m)	Montmorillonite	Illite	Kaolinite	Quartz
1	0.3-1.3	very low	high	high	high
1	1.3-2.2	moderate	very high	low	high
2	0 -1.3	absent	very high	low	high
3	0.3-1.3	moderate	high	high	high
5	0.3-1.0	moderate	very high	low	high
6	0.3-1.0	very high	high	high	high

The peak intensity is directly related to the proportion of that mineral in the sample. For example there is a much lower proportion of montmorillonite in the sample from Pit 5 than in Pit 6.

The identification of clay minerals gives a guide to the expansiveness of the soil if thick clay-rich sediments underlie the site, and whether particular attention should be given to foundation design. Montmorillonite in particular and illite are expansive clays.

Samples from the same levels were subjected to simple dispersion tests. The lower sample from Pit 1 and the sample from Pit 5 were strongly dispersive, while the other samples have the property developed to a lower degree.

RECOMMENDATIONS AND CONCLUSIONS

The erosion in the area should be corrected before any wide scale subdivision is undertaken. With clearing and changing of drainage patterns the problem is likely to extend. The test pits below Shannuk Drive level show that the potential for the erosion to extend to this area is present because of the deep layer of dispersive material below the surface at some locations. It would be possible, in some circumstances, for tunnel erosion to develop under houses placed in these locations. A line of sandstone outcrops in the upper parts of these lots may afford some protection if houses were built in these areas and foundations extended down to bedrock. The upper portion of Stage 1 is much steeper land and part has been previously cleared. Some erosion has taken place and parts of it appear to have deep soil.

The higher portion of the land, with the generally lower slope angle, is mainly underlain by sandstone and has less risk of being affected by erosion but even here some care should be taken with vegetation removal.

The central portion of the land needs major correction. As already stated the problem is not one of landslide (although under particular circumstances these could develop) but of tunnel and gully erosion. The soil conservation section of the Department of Agriculture deal with this

problem on rural land and should be consulted with regard to this problem. A plan needs to be devised to ensure that houses are not going to be undermined. It is expected this would entail remoulding the land surface to a smooth, even slope, combined with extensive drainage and revegetation.

The quarry faces are quite high in some cases and would present a hazard in a subdivision. Some means of reducing this hazard should be investigated.

Expansive clays are present in the area and where deep clay-rich soils occur, consideration should be given to this in foundation design.

[28 August 1986]