BRIEF BACKGROUNDS

LANDSLIDE RISK IN QUEENSLAND

By Warwick Willmott

Landslides occur when the inherent strength of soil or weathered rock is no longer sufficient to resist the forces of gravity acting on the materials. Such a situation can develop from the gradual accumulation of loose materials on a slope, gradual weathering of rocks near the surface, removal of support of tree roots after forest clearing, or increased groundwater pressures from reduced transpiration following clearing or exceptional rainfall events.

Slopes of marginal stability under natural conditions can become prone to extensive landslides if conditions are changed, such as by clearing of forest cover, undercutting by road or house construction, or by increase of water inflows such as from gardens or leaking dams or swimming pools.

Most moderate to steep slopes in eastern Queensland, where rainfall is sufficient to give periodic high groundwater pressures, have the potential for some landslide instability. This is generally limited to small slides on the flanks or heads of gullies where there are deeper accumulations of soil and weathered rock, and potential for saturation from groundwater seepages.

However there are places where particular combinations of slope, geology, and groundwater regime give rise to much greater potential instability, and extensive landsliding if conditions are changed. Examples of places where this is known to have significantly affected rural land or urban development are described below.

It should be noted that under some geological conditions very gently sloping or even almost flat land can be subject to sliding, so slope angle alone is not a good guide to instability.

Dissected plateaux underlain by horizontal basalt lavas.

Basalt weathers to deep soils, commonly with shrinking and swelling clay minerals, which give increased risk of failure in gully heads and flanks. More importantly, the soils and weathered rock hillside debris (colluvium) accumulate on the sides of the plateaux, particularly on benches which result from erosion of less resistant basalt flows. The horizontal layering of the flows directs groundwater percolating downwards, laterally outwards onto these benches, often saturating the loose colluvium. In high rainfall events the groundwater pressure in the colluvium can rise to such an extent that the strength is reduced below the critical level for failure. Such critical groundwater pressures can develop more easily on cleared land through reduced transpiration, and the strength of the material is also reduced from reduced tree root support. There are very extensive failures on some of these cleared benches.

Such problems have been encountered on the basalt plateaux of Tertiary age in southeast Queensland, particularly Tamborine, Beechmont, Springbrook, Lamington, Border Ranges, Toowoomba Escarpment, Mount Mee, Mapleton-Maleny and Buderim. A number of studies of these areas have been undertaken to

identify landslide prone locations ahead of increasing urban development. Other smaller basalt plateaux elsewhere in Queensland may have similar problems. Localised slides are known on the Atherton Tableland, but are not widespread because dissection is not so advanced.

Dissected slopes underlain by horizontal, interbedded hard and soft sedimentary rocks.

This is a situation similar to the benched slopes on basalt lavas. The layers of soft sediments (shale, siltstone) weather more readily, giving benches on the hillsides between cliff lines formed by more resistant sandstone. Groundwater directed laterally out on to the benches by the horizontal strata saturates clay derived from the weathered shale. Again this may fail if the groundwater pressure rises to such an extent that the strength is reduced below a critical level. Very extensive instability can occur where such benches have been cleared.

This situation is widespread in the upper Lockyer Valley, where slopes in the foothills of the Main Range underlain by interbedded shale, siltstone and sandstone of the upper part of the Marburg Sub Group have been extensively cleared. The problem may exist to a lesser extent locally along the western fringe of the higher rainfall belt of eastern Queensland where such rocks outcrop in hilly terrain.

Deeply weathered rocks in very high rainfall areas

In high rainfall, tropical areas, many rocks can weather to considerable depths to materials of a soft consistency. Moreover by hillside creep and small movements on steeper slopes such materials can give rise to considerable accumulations of loose unconsolidated colluvium in gullies between ridges. Under the rain forest cover usual in such situations, the slopes are marginally stable, but if cleared the colluvium in the gully situations can fail. In artificial excavations the weathered rock as well as the colluvium can fail if undercut.

This situation occurs in much of the high rainfall areas of the Wet Tropics underlain by weathered rocks of the Hodgkinson Formation/Barron River Metamorphics, and to a lesser extent , granite. On the Cairns Hillslopes there have been instability problems from undercutting of colluvium and weathered rock in road and house construction. There may also be problems of this nature in the Mackay hinterland although none are prominent.

Bands of basalt or greenstone in steeply inclined meta-sedimentary strata.

Between the NSW border and Rockhampton in eastern Queensland there are many steeply inclined sequences of sedimentary, meta-sedimentary and volcanic rocks. Although exhibiting few exceptional instability problems, bands of basalt or greenstone (metamorphosed basalt) within them commonly weather to deep soils with greater potential for sliding, particularly if the balance of forces is changed by clearing.

Such a situation is known in deeply weathered basalt bands of the Amamoor beds in the Mary Valley between Kenilworth and Gympie, which have been cleared on steep slopes for pineapples and other agriculture. Similar local situations could occur elsewhere in this general region.

Local moderate to steep slopes on unconsolidated sediments of Tertiary age

In the Tertiary period interbedded clays and minor sandstones were deposited in a number of small basins in eastern Queensland. These sediments have remained soft and relatively unconsolidated, and usually are poorly exposed in flat to undulating topography. However where there are local moderate to steep slopes, such as beside gullies or major streams, these soft sediments can easily fail, if groundwater pressures rise, or other disturbances occur, such as undercutting for urban construction.

There have been a number of failures of this kind affecting houses at Oxley in Brisbane. Fortunately sufficiently steep slopes are rare in these geological units.