



**Figure 2.8** Shallow planar translational debris slide in regolith overlying more competent weathered bedrock. Slide debris spilled onto road which has been subsequently cleared. Erosion and minor slipping in soil road fill is visible in foreground. (Location: Waindina River catchment, north east of Waivaka village)

refer to many such slides which occurred following heavy rain associated with cyclones Wally and Kina. Discontinuities remaining as relict features within the weathered regolith also exert an important control on the development and shape of translational slides. For example, Howorth *et al.* (1993) and Lawson (1993) describe a number of slides in natural and man-made slopes where weathered debris had slid along slickensided planar surfaces related to pre-existing joint or shear surfaces within the parent rock mass. The effect of relict discontinuities was also confirmed by the limited fieldwork undertaken in the present study (Figure 2.9). *Wedge failures* are a particular type of translational failure involving a 'wedge' of rock or weathered debris sliding along two steeply-dipping intersecting discontinuities. It is possible that more extensive field surveys may show these relict discontinuities to be more significant in the initiation of translational debris slides, particularly the deeper slides, than was hitherto appreciated.

Unlike rotational slumps, translational slides will continue moving so long as the planar failure surface is sufficiently inclined and the shear resistance along this surface remains lower than the driving force. They tend, therefore, to continue moving until arrested by a marked shallowing of ground slope angle. Translational slides are frequently triggered when slopes are over-steepened by erosion or excavation, as is evidenced by many such slides associated with steep road cuts (Figure 2.10). Slides in weathered rock debris on steep mountain slopes are frequently triggered by intense rainfalls or earthquake shocks. With sufficient water content, the translational slides on these steep slopes may grade into extremely rapid debris flows.

Creep is considered by Lawson (1993) to constitute a particular category of 'slide' movement but controversy remains over its status with respect to landslide classification. It is usually defined as comprising extremely slow, spatially diffuse movements which are not concentrated on discernable shear surfaces (Hutchinson, 1988). It is not in the strict sense, therefore, a slide movement. Varnes (1978) considers it a variety of flow whereas Hutchinson considers it to be a separate category of movement and recognises four main varieties - *superficial creep*; *mass creep*; *pre-failure or progressive creep*; and *post-failure creep*.

*Superficial creep* is confined to surface layers (generally less than 1 m depth) which suffer seasonal changes in volume. In non-periglacial environments such as Fiji, these movements arise from soil moisture changes in both fine and coarse-grained regolith with movement rates generally less than 10 mm/year. Daily temperature changes may also contribute to this form of creep.

*Mass creep* occurs at depths below that of superficial creep in clay (including clay regolith) and rock. It is more related to the engineering concept of creep as it occurs at essentially constant stress, well below the ultimate strength of the material involved. Direct measurements of mass creep are rare.

*Pre-failure (progressive) creep* involves accelerating movements which reflect progressive development of shear surfaces, presaging overall shear failure (landsliding). It is of great importance as it provides a warning of impending failure and a chance of predicting it (from progressive creep curves) if identified and measured at potentially vulnerable sites. Pre-failure creep has been recognised in a wide variety of rock types including residually