Module 9. DEBRIS SLIDES AND DEBRIS FLOWS

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Shallow (failure planes 1-3 m deep), rapid (up to approximately 10 m s^{-1}) mass movements of soil, sediment, and organic matter are common in the Andrews Forest, as they are elsewhere in western Oregon and similar steep wet landscapes. Terminology for these processes has changed somewhat over the years; we use *debris slide* to refer to processes operating on hillslopes and *debris flow* to refer to processes in stream channels. Commonly debris slides continue their movement down channels. We make the slope-channel distinction because of the different implications for the ecosystem, sediment routing, and land management.

Effects of land management on these processes and the role of mass movements of different types in natural systems on sediment production, routing, and ecosystem disturbance have been important research themes at Andrews Forest since early efforts to document these processes mainly in the context of small-watershed studies (Fredriksen, 1970). Inventory of debris slides and flows for the 1950-1975 period revealed that (1) these are natural processes under forest cover, (2) the landscape can be broadly zoned into areas with different susceptibility to sliding, (3) recently (<20 yr) clearcut areas had soil erosion rates by slides that exceeded uncut forest rates by several fold, and (4) road rights-of-way had soil erosion rates about 30 times forest rates (Dyrness, 1967; Swanson and Dyrness, 1975). These findings parallel results of similar inventories elsewhere in slide-prone landscapes.

The occurrence of numerous debris slides and debris flows in the February 1996 flood prompted updating of these inventory records. The extent of slides and flows in forested parts of the watershed were similar in 1996 and 1964-1965, which, along with similarities of discharge from the low-elevation experimental watersheds, suggests that these events had similar effects on soil moisture conditions. The near absence of logging and road construction in the watershed since 1970 made it possible to examine effects of about 25 yr of passive watershed restoration from past forestry land use and glimpse into future effects of establishment of Late Successional Reserves as part of the Northwest Forest Plan. The rate of sliding from clearcut areas was much lower in the 1996 storm, possibly because the greater age of cutting units permitted recovery of root strength and site hydrologic processes and perhaps because unstable sites had failed in earlier storms. The 91 inventoried debris flows occurring in the 1946-1996 period took place in only 12 yr and 75% occurred in 1964-1965 and 1996 (Snyder, 2000). Inventoried debris slides occurred mainly in the lower elevation parts of the landscape (Fig. 9.1) where slopes are steep, soils contain expansive clays, early land-use practices were most extensive, and snowmelt during warm rain events has the greatest potential to create extreme soil-water conditions.

From an ecologic perspective we have been interested in how debris flows create disturbance patches and leave refuges in stream networks (Fig. 9.1). Note that the stream networks of some tributary watersheds have been thoroughly scoured by debris flows. However, most tributary watersheds contain first-order and in some cases larger channels that were not scoured, thus providing relatively intact stream and riparian ecosystems to serve as refuges through the 1996 flood and sources of organisms for recolonization of severely disturbed stream reaches.

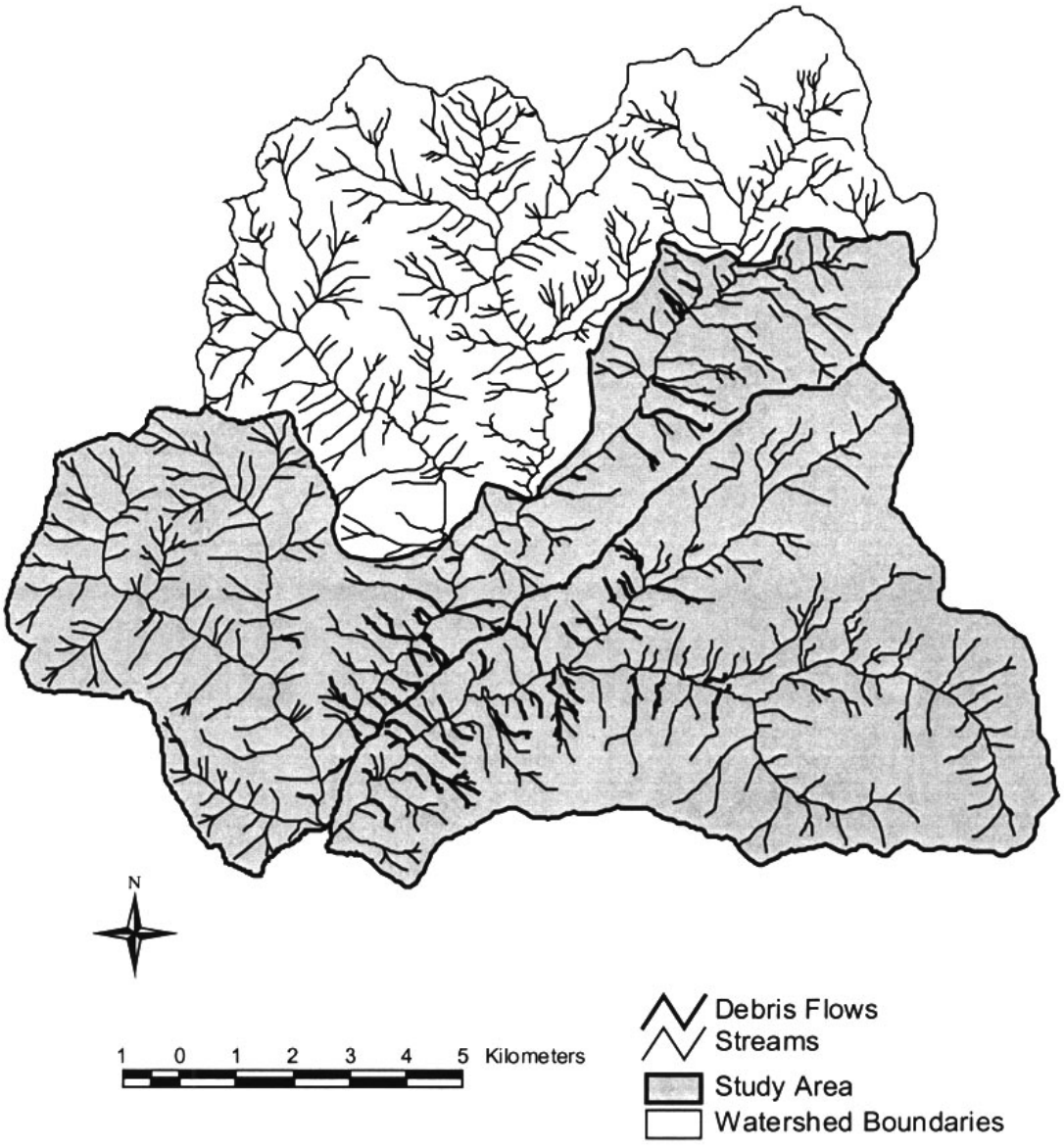

Figure 9.1. Debris flowpaths of Lookout Creek and part of the upper Blue River for 1946-1996 (Snyder, 2000).