



DISCUSSION

Storms in January and February 1969 produced widespread soil slips and debris flows in southern California that caused considerable physical damage and resulted in at least 24 deaths (Campbell, 1975; Kojan and others, 1972; Rice and Foggini, 1971; Scott, 1971). Virtually all the 1969 debris flows began as failures of slabs of saturated surficial material during the time of high-intensity rainfall. For an analysis of storm conditions leading to the formation of these landslides, see Campbell (1975).

Only a few landslides other than soil slips formed in the mapped area during the spring of 1969. A few slump failures developed, most of which were reactivated pre-1969 landslides or new failures of landslide material within a part of a pre-1969 landslide deposit.

The accompanying map gives an inventory of the 1969 soil-slip scars and debris-flow channels and deposits in part of the Santa Clara River valley area. The map was prepared by interpretation of morphological features visible on high-quality black-and-white stereoscopic aerial photographs taken in August 1967 and July 1969 (scale 1:32,000). Only those features visible on the photographs were used in the determination of the nature and extent of the surficial units; only brief, widely scattered field checks were made.

The map does not distinguish between areas of soil-slip scars, routes of subsequent debris flows, or areas of debris-flow deposition—all are included together. Most of the distinguishable debris-flow scars and deposits were confined to first- through third-order stream basins (Strahler, 1962), although some of the distinguishable largest flows are in higher-order basins. Most of the material transported by debris flows will eventually be transported onto major valley floors by fluvial flow.

Recognition and accuracy of delineation of the surficial deposits depends on: (1) age—the younger the feature, the more visible its morphology; (2) extent of areas concealed by deep shadow; (3) sun angle at time of photography; (4) height and density of vegetation; and (5) degree to which man has modified the landscape. Generally, the younger landslides have clearer, more distinctive landslide morphology. With increasing age a landslide is progressively modified and tends to blend with the normal morphology of the surrounding landscape; consequently the viewer's ability to recognize and delineate the landslide is diminished. Recognition based on surface features ceases completely with full integration of the landslide into the surroundings. Field observations also commonly fail to detect landslides largely or entirely integrated into the landscape. Such eroded landslides generally are recognized only in artificial exposures such as those produced by hillside grading operations.

Readily visible features of many landslides are the scarp and crown line. Distal and lower lateral limits are commonly difficult to identify on aerial photographs because: (1) erosion has modified or removed the distal part; (2) vegetation or shadow obscures the topographically low areas; or (3) the toe and lower lateral margins never formed distinctive morphology (some "incipient" landslides have well-defined scarps but did not develop distal parts).

Some large composite landslides, measured in square miles of areal extent, are difficult to recognize simply because they are so large. Such large landslides commonly contain obvious small satellite landslides that tend to attract attention away from the larger landslide. Landslides smaller than about 300 ft in maximum dimension were difficult to see on the photographs; those suspected of being landslides are marked by a query and are not bounded by contact lines. Areas with morphological features suggestive of but not definitely known to be landslides are queried. Some landslides too narrow to be shown accurately at the scale of this map are indicated by a single arrow. Within large landslides, internal satellite landslides and scarps are shown where they could be identified. Bedrock is not labeled.

References cited

Campbell, R. H., 1975, Soil slips, debris flows, and rainstorms in the Santa Monica Mountains and vicinity, southern California: U. S. Geol. Survey Prof. Paper 851, 57 p.

Kojan, Eugene, Rice, R. M., and Foggini, G. T., III, 1972, Prediction and analysis of debris landslide incidence by photogrammetry, Santa Ynez Mountains, California: Internat. Geol. Cong., 24th, Montreal, Abs. of Program, p. 393.

Rice, R. M., and Foggini, G. T., III, 1971, Effect of high-intensity storms on soil slippage on mountainous watersheds in southern California: Water Resources Research, v. 7, p. 1485-1496.

Scott, K. M., 1971, Origin and sedimentology of 1969 debris flows near Glendora, California, in Geological Survey research 1971: U. S. Geol. Survey Prof. Paper 750-C, p. C242-C247.

Strahler, A. N., 1952, Dynamic basis of geomorphology: Geol. Soc. America Bull., v. 63, p. 923-938.

Weber, F. H., Jr., Cleveland, G. B., Kahle, J. E., Kiessling, E. F., Miller, R. V., Mills, M. F., Morton, D. M., and Clineck, Blaise, 1976, Geology and mineral resources study of southern Ventura County, California: California Div. Mines and Geology Prelim. Rept. 14, 102 p. (In press).