

**SUMMARY**

Landslides caused an estimated minimum of \$55 million damage to public and private property in San Mateo County as a consequence of 1998 winter storms. Hundreds of hillslope failures occurred throughout the county, most during the week of February 2. The most common types of damaging failures were earthflows and earth slumps, (\$38 million) in La Honda, Moss Beach, Pacifica, Daly City, and Portola Valley. The pre-existing Polhemus landslide (earth slump) in San Mateo was reactivated. Earth slumps involved in shoreline retreat in the Daly City, Pacifica, Tunitas Creek, and Moss Beach (Half Moon Bay area) are included in this assessment.

Damage from debris flows especially affected the southwestern part of the county, which includes the Tunitas Creek, San Gregorio and Pescadero watersheds. Debris flows were widespread and abundant on natural slopes west of Skyline Ridge. Debris flows were present, but rare, on natural slopes east of Skyline Ridge and were observed in the Alpine Road, Crystal Springs, San Bruno Mountain, and Point San Pedro areas, and along the extent of the county's coastal sea cliffs. Slopes that sustained debris flows were overlain by a variety of vegetative cover, including grasslands, scrub, and redwood forest, as well as cut-and-fill slopes in developed residential areas. Debris flows occurred on slopes underlain by Pliocene and Pleistocene Santa Clara gravels, Miocene basaltic rock, Pliocene to Eocene clastic rocks (mudstone, siltstone, and sandstone), Cretaceous sandstone and mudstone, and Mesozoic Franciscan melange (argillite matrix melange).

Most of the damaging debris flows were triggered on February 2-3 between 11:30 pm and 12:30 am west of Skyline Ridge and around 2:00 am east of Skyline Ridge. Cut-and-fill failures in residential areas of Portola Valley and San Bruno were also triggered while the rainfall was exceeding the debris-flow threshold for natural slopes. The near synchronicity of debris-flow activity in suburban areas as well as on natural hillslopes, in conjunction with the rare occurrence of debris flows on natural slopes near suburban areas, indicates that the debris-flow threshold was exceeded in several parts of the county during the February 2-3 storm. A storm on February 7 also triggered debris flows in the southwestern part of the county. One fatality was caused by a debris flow in Loma Mar.

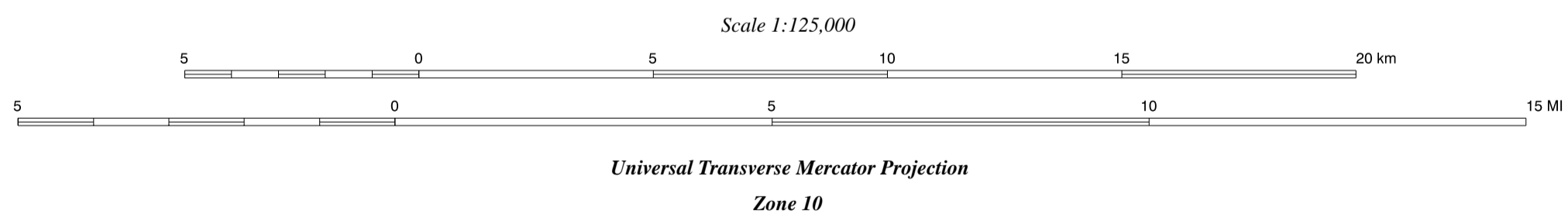
Damage due to earth slumps occurred primarily during the first 3 weeks of February. Slides that were initiated during this period continued to be active into March, but with much decreased rates of deformation. These include the Scenic and Recreation Drive landslides in La Honda, the Polhemus Road landslide in San Mateo, the Tunitas Creek and Beach landslides in Half Moon Bay, the Avalon Drive and Sea View Way landslides of Daly City, and the Espanade landslide (sea cliff erosion) of Pacifica. These hillslope failures are underlain primarily by Pliocene and Pleistocene sandstone and siltstone (La Honda, Tunitas Creek, Moss Beach, Daly City) and by Franciscan melange (Pacifica and Polhemus Road). Three of the major damaging earth slumps occurred where preexisting landslide morphology had been mapped (La Honda, Polhemus Road, and Daly City).

The losses incurred due to structural damage associated with hillslope failures during the February storms of 1998 were estimated from information provided by the San Mateo County Building and Planning Department. In addition, an aerial reconnaissance flown on April 22, 1998, over parts of San Mateo County, and a field reconnaissance in those areas identified by the county as having sustained damage augmented information provided by the county. Approximately \$26 million in damage has been estimated to public property and \$20 million to private property, for a total of about \$45 million for the county. At least two homes were destroyed, 31 homes red-tagged, 17 homes yellow-tagged and 45 homes damaged by slope failures of various kinds. "Tagged" structures are those that have been either condemned (red) or in need of significant repair (yellow). Municipal and county building inspection departments are commonly responsible for such determinations. The distribution of damaged structures was most strongly influenced by the distribution of development in hillslope areas. Because much of western San Mateo County is rural and undeveloped, few damaging events were recorded, although hillslope failures were widespread. The damage in that region tended to be concentrated along the transportation routes, where most residences are located. Major road repairs on State highway 92 and highway 84 have been estimated at about \$10 million, bringing the total direct costs to the county to approximately \$55 million. Highway 84 was closed for 4 weeks following the February 2 storm with only one lane open at three localities as of August 2, 1998. The County estimated \$8-12 million road damage due to hillslope failures; damage to State highways was more extensive.

We thank Bill Cameron, San Mateo County Planning Department, for providing information on the location and costs associated with damaging hillslope failures.

**EXPLANATION**

● Location of damaging landslide. The number identifies the landslide in the database. Data on file with authors, USGS, Menlo Park, California and Golden, Colorado.

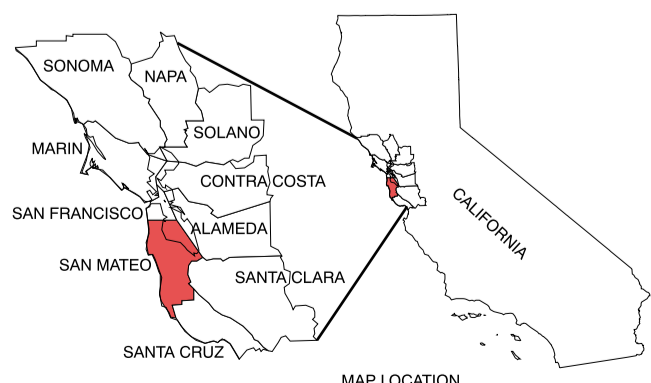


**MAP SHOWING LOCATIONS OF DAMAGING LANDSLIDES IN SAN MATEO COUNTY, CALIFORNIA, RESULTING FROM 1997-98 EL NIÑO RAINSTORMS**

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Digital data prepared using ARC/INFO 7.1.2 running under Solaris 2.6 on a UNIX workstation. Map formatted using Adobe Illustrator 8.0 running under Mac OS 8.6.

Shaded relief base derived from Graham, S.E., and Pike, R.J., 1997, Shaded Relief Map of the San Francisco Bay Region, California, U.S. Geological Survey Open-File Report 97-745-B.

Any use of trade, product or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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This map was produced on request, directly from digital files, on an electronic plotter. It is also available as a PDF file at <http://greenwood.cr.usgs.gov>

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