GEOLOGIC MAP GM-15

STATE OF WASHINGTON

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SLOPE STABILITY MAP OF THURSTON COUNTY, WASHINGTON

By

ERNEST R. ARTIM

Prepared in cooperation with
UNITED STATES GEOLOGICAL SURVEY

1976

For sale by Department of Natural Resources, Olympia, Washington

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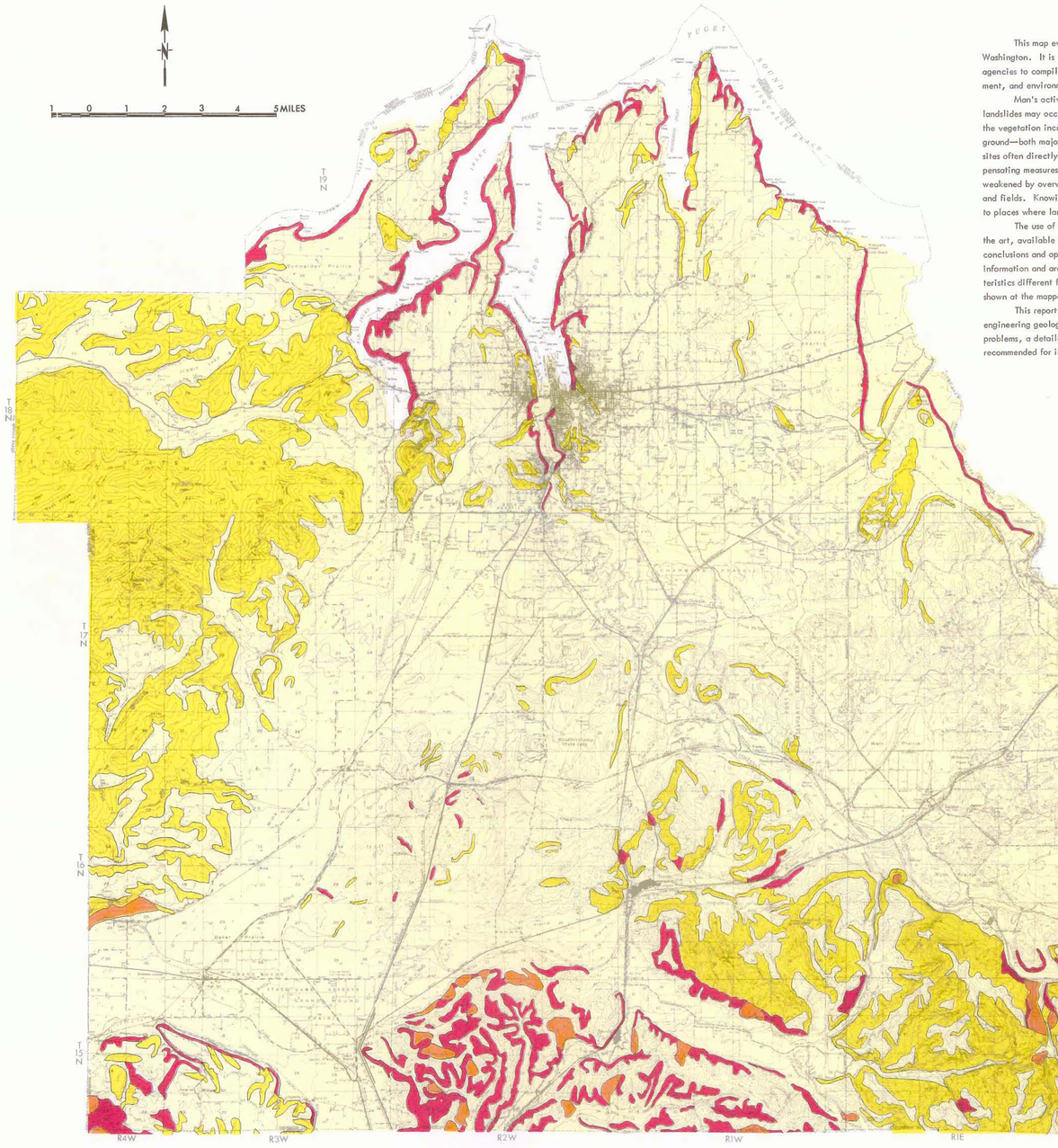

This map evaluates the relative stability of natural slopes in Thurston County, Washington. It is part of continuing cooperative efforts by state, local, and federal agencies to compile and present data useful for land use planning, resource development, and environmental protection.

Man's activities often modify natural physical processes to the extent that landslides may occur in areas that have been stable over many centuries. Clearing the vegetation increases the amount of erosion and percolation of rain water into the ground—both major causes of slope instability. Construction of roads and housing sites often directly produce oversteepening of natural slopes without providing compensating measures to stabilize the slopes. Otherwise firm earth materials may be weakened by overwatering from septic-tank drainfields and from irrigation of lawns and fields. Knowing the location of potentially unstable areas can guide planners to places where land use regulations are needed most to avert damage from landslides.

The use of the map in evaluation of slope stability is limited by the state of the art, available information in literature, and a general field investigation. The conclusions and opinions made in this report are based on the presently available information and are made for land use pre-planning purposes only. Stability characteristics different from those shown occur locally, but are too limited in area to be shown at the mapped scale.

This report and map were not intended to be, nor should they be used as, an engineering geology report for any given site. In areas of potential slope stability problems, a detailed soils engineering and geology report by private consultants is recommended for individual site evaluations.

A landslide is the downward and outward movement of slope materials composed of natural rock, soils, artificial fills, vegetation, or a combination of these materials. Landslides occur when the pull of gravity on slope materials overcomes the frictional resistance of the slope materials to downward movement. In Thurston County, many factors affect the stability of slopes:

1. Type of earth materials: Surficial deposits such as glacial outwash or unconsolidated soft sediments will move downslope easier than consolidated or partly consolidated sediments.
2. Ground shaking: Strong shaking during earthquakes, large-scale explosions, or vibrations of heavy machinery can jar and loosen surface materials and consolidated or unconsolidated sediments, thus making them less stable.
3. Water: Landsliding is generally more frequent in areas of seasonally high rainfall because the addition of water to earth materials commonly decreases their resistance to sliding.
4. Steepness of slopes: New landslides occur more readily on steeper slopes; however, low natural slopes may be indicative of old landslides, which can be reactivated.
5. Proximity to areas undergoing active erosion: Rapid undercutting and downcutting along stream, lake, and ocean shores make slopes in these areas particularly susceptible to landsliding.
6. Type of vegetation: Trees with deep penetrating roots tend to maintain the stability of slopes by mechanical effects and contribute to the drying of slopes by absorbing part of the ground water.

The area mapped is separated into 4 classes of relative slope stability: (1) areas that are inferred to be stable, (2) areas that probably are stable under natural conditions, but may become unstable if modified by man's activities, (3) areas inferred to be unstable, and (4) areas that are older landslides which should be considered to be unstable land unless and until proven otherwise.

The investigation for this map and report is divided into three general stages. The first stage consisted of a thorough research of available literature pertaining to the geology and problems related to the geology of Thurston County. The second stage was accomplished during the spring and summer of 1973 and consisted of a general field investigation, which also included examining the test data made available by private consulting firms, and an air-photo geology investigation. The field investigation involved delineating areas of potential hazard based on established criteria by visual examinations, test data, and previous field work. The air-photo geology was used to supplement confirmation of potential hazard areas. The third stage consisted of the preparation of the map and report using the information gathered during the first and second stages. The third stage was completed in the summer of 1973. Factors taken into consideration prior to assigning the following classifications were such items as landforms, steepness of slopes, physical nature of the surficial and underlying earth materials, physical setting, slope moisture, vegetation, and existing test data.

EXPLANATION

Class 1 areas are believed to be stable. These areas have slopes that are generally less than 15 percent, but may be greater than 15 percent in local areas of low relief and low ground-water concentration. Class 1 areas include mostly rolling uplands underlain by very stable material, such as young glacial till, mantled in places by a thin layer of sandy gravel or other permeable material; also included are flood plains, deltas, alluvial fans, and some beach deposits. Class 1 areas marginal to the base of steep slopes of class 3 areas may be threatened by potential landsliding from above.

Class 2 areas are believed to be stable under natural conditions, but may become unstable if disturbed by man's activities. These areas generally have slopes that are steeper than 15 percent, but the slope angle may be smaller than 15 percent in some areas of less stable geologic materials. Class 2 areas are usually located where: (1) well drained sand and gravel occur, mostly on valley sides that lack known slope failures; (2) slopes greater than 15 percent are underlain by glacial till; and (3) bedrock occurs and is overlain, in some places, by a thin mantle of glacial material. Local minor modifications in slope for small buildings and narrow roads will probably result in little or no hazard unless proper engineering practices are ignored; however, because of potential instability problems in areas of class 2 slopes, geological and engineering studies to evaluate stability should precede significant development.

Class 3 areas are inferred to be unstable because of the underlying geologic materials, slopes are generally greater than 15 percent to 30 percent, and old or recently active landslides commonly occur. These slopes include local areas of saturated sand on top of an impermeable layer at the base of the slope. Class 3 areas also include known locations of recently active rapid downslope movement. Most of these slides generally occur during periods of heavy rains. These slope failures include a few landslides of moderate size, but the most common occurrences are of slumping, slicing, and falling of relatively small amounts of earth material. Most class 3 areas are along steep valley sides, along the shoreline of Puget Sound, and in areas underlain by inherently weak geologic materials. Thorough geologic and engineering investigations are imperative if class 3 areas are to be modified or developed safely.

Class 4 areas are inferred to be locations of former landslides; these landslides include relatively large slumps, flows, and slides of soil, rock, and debris. They have occurred since retreat of glaciers from the region (about 13,000 years ago), and may become reactivated by man's activities, or by a natural process. These areas should be considered unstable land unless and until proven otherwise.

Base map from U.S. Geological Survey 15-minute quadrangle sheets: Shelton, Olympia, Anderson Island, Rochester, Tenino, Yelm, and Ohop Valley.