WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND EARTH RESOURCES

Slope stability of the Centralia-Chehalis area, Lewis County, Washington

By

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The Centralia-Chehalis study area encompasses approximately 620 square kilometers (250 square miles) of west-central Lewis County, Washington. The area is characterized by the broad north-south trending Chehalis River Valley with tributary valleys branching into the surrounding hills. The hills have slopes ranging from gentle to very steep. Annual rainfall is about 1.3 meters (50 inches).

The hillsides are underlain by Eocene (Fig. 1) and Oligocene fine grained marine sedimentary rocks. In the southwestern part of the area Miocene basalt caps the older siltstones and sandstones. In the southern half of the area Pliocene(?) nonmarine sedimentary rocks crop-out. Overlying much of the flat upland areas are early Pleistocene unconsolidated deposits. The Chehalis Valley is underlain by late Pleistocene glacial outwash from continental glaciers that flowed south from Canada and occupied the Puget Sound area, and recent alluvium. Landslides of late Pleistocene and Holocene age are found on slopes throughout the report area.

Previous studies of the Centralia-Chehalis area include geologic investigations by Snavely and others (1958) and by Weigle and Foxworthy (1962). Snavely focused mainly on the Tertiary bedrock units while Weigle and Foxworthy give major emphasis to the quaternary sediments and their ground-water characteristics. Landslides were mapped in both reports. Snavely found that the landslides occurred in Holocene and possibly late Pleistocene times. They occur in fine grained marine sediments, particularly in the siltstones of the Skookumchuck formation in the hills east and west of Centralia, and in the semiconsolidated nonmarine sediments overlain by the Logan Hill formation along the sides of the Newaukum River Valley, southeast of Chehalis. Weigle and Foxworthy also mapped landslides in their water resources bulletins. Extensive landslides occur along the sides of the Newaukum Valley, southeast of Chehalis. Weigle and Foxworthy reiterated Snavely's conclusion that the nonmarine sediments underlying the Logan Hill formation became plastic at the contact between the two units, causing the extensive failures along the sides of the Newaukum River Valley.

Data for this report were obtained primarily from aerial photographs, reconnaissance field checking and literature review. Black and white 1969 and 1976 high altitude (scale approximately 1:60,000) and 1974 low altitude photographs (scale approximately 1:12,000) were used. Reconnaissance field checking was conducted during October and November 1977.

The investigation revealed numerous old landslides. Old landslides are here defined as those occurring before local recorded history. These landslides presently have undisturbed old growth timber, muted surface morphology, and no signs of recent activity. These landslides probably occurred sometime near the close of the Pleistocene or in the early part of the Holocene Epoch. They are

predominately large (160 acres, 65 hectares) slump or flow type landslides. According to Snavely and others (1958, p. 78) they were caused by rapid erosion of the poorly consolidated Tertiary and Quaternary rocks that produced oversteepened undercut slopes and "subsequent failures along these slopes by landsliding and soil creep modify the topography". The old landslides show almost no signs of reactivation or recent movement. Only on a portion of one old landslide north of Centralia was recent movement found, and this is probably associated with road construction. The reason that most old landslides are now relatively stable is assumed to be that their past movement has brought them to the point of stability. Some old landslides, however, appear to be the result of constant slow movement (creep) by the surficial material over a period of thousands of years. These may still be active, but such a slow rate of movement is not detectable in the recent vegetation. These areas are found particularly in the steep forested areas east and west of Centralia.

Fig. 1. Geologic Time Scale (Cenozoic only).

EPOCH	Years b.p.* (in millions)
Holocene	.01
Pleistocene	1.5 - 2.0
Pliocene	7
Miocene	26
Oligocene	37 - 38
Eocene	53 - 54
Paleocene	65

* Before present

Very few recent landslides were identified. Almost all of the recent landslides observed are associated with roads or road construction. Most are less than one acre in size and not mappable at the scale of the accompanying map (1:62,500). If there are landslides in the heavily forested areas, they were not observed on the photos, were too small to be mapped, or were not identified in the field because of remoteness and inaccessibility. Most of the landslides identified were the result of road-fill failure or a road cut that lessened support of a slope. In most failures the road cut was at greater than a 2:1 slope.

Throughout the study area most slopes appear to be stable. Few broken foundations, tilted or bowed trees, distorted ground surface or other signs of instability were observed. Areas with slopes of less than 30 percent are mapped as Stable. These are areas where the natural conditions (geology, soils, and slope) are not conducive to failure.

Areas with slopes of greater than 30 percent are mapped as Intermediate. These slopes may have a potential for landsliding, largely because of steepness of slope, or possible undercutting by hillside streams which can reduce the stability of stream banks. In the areas mapped as Intermediate, additional water contributed by septic systems, and watering of lawns may reduce the natural stability. Also, undercutting of slopes by roads and foundations may reduce the equilibrium between the angle of slope and natural hydrologic conditions. Engineering studies are recommended if high-density development is proposed in an Intermediate area and should be required if septic systems are proposed for the development.

Areas mapped as Unstable are found in only two areas. One along Lincoln Creek, and the second north of Claquato and west of Centralia. These areas were observed to have characteristics of recent instability and should be avoided. If development is necessary, engineering and geologic studies and hazard-mitigating design should be required.

In some areas of the study region the land surface has been significantly altered by man causing stability prediction to be uncertain because of the change in the natural conditions. These areas are mapped as Modified and include the Centralia Coal Mine and the slopes east of the Yard Birds Shopping Center, north of Chehalis city center.

Delineation of landslides, unstable areas, intermediate areas, and stable areas are presented at a scale that indicates general areas, not specific sites. The smallest area that is represented on the map is approximately 40 acres (16 hectares). Included in all classes are smaller areas that may not be consistent with the mapped classification but may actually be more or less stable than indicated.

Because of the small map scale and the relatively little time for field investigations, the map should be used only as a general guide for hazard identification. The following are the recommendations and limitations suggested for each slope category:

1. Map unit S. Stable area - areas considered to be stable because of low or no slope. Cut slopes should be less than 1:1.

2. Map unit I. Intermediate slopes - areas that appear to be stable under natural conditions but, because of a greater than 30 percent slope, may have a potential for slope instability. These areas are probably suitable for low density development. Cut slopes should be generally less than 2:1. Engineering studies should be required if high-density development is proposed.

3. Map unit U. Unstable areas - areas observed to be unstable in natural conditions. Steepness of slope, geologic factors, or both resulted in observable unstable conditions. Engineering studies should be required if development is proposed.

4. Map unit Ols. Old landslides - these areas were not generally observed to be unstable but, because of the nature of subsurface materials, low-density development is recommended. Engineering studies should be required if natural slopes are over 30 percent. Cut slopes should not be greater than about 2:1, unless engineering studies have recommended otherwise.

5. Map unit Ls. Recent landslides - areas observed to have recent movement. Development or alteration of slope may cause reactivation. No development recommended.

6. Map unit M. Modified - areas significantly altered by man's activities, slope stability uncertain.

References Cited

Snavely, P.D. Jr.; Brown, R.D. Jr.; Roberts, A.E.; Rau, W. W.: 1958, Geology and Coal resources of the Centralia-Chehalis District, Washington. U.S.G.S. Bull. 1053, 159 p.

Weigle, J.M.; Foxworthy, B.L.: 1962, Geology and ground-water resources of west-central Lewis County, Washington. Water Supply Bull. #17, 248 p.

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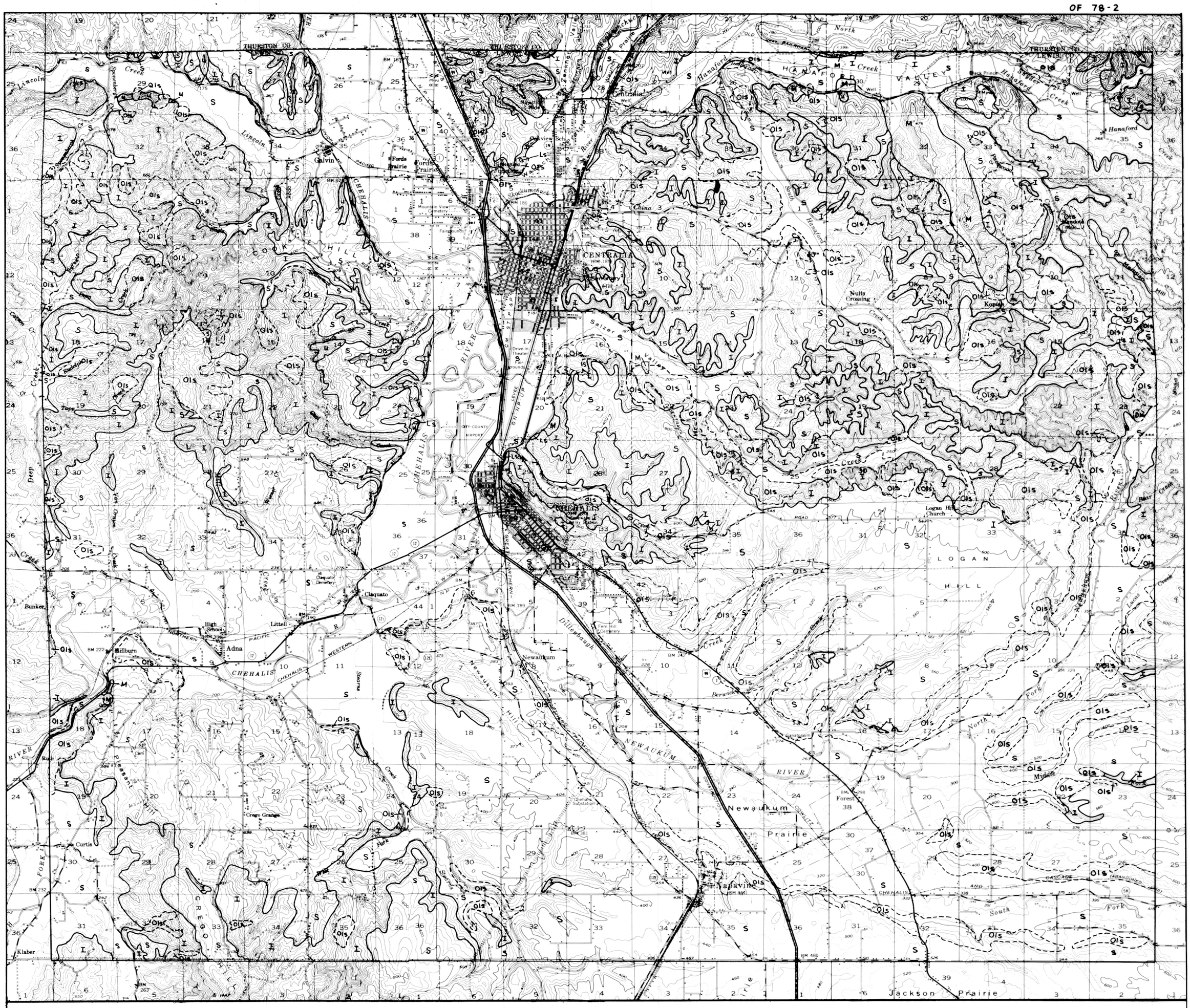

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SCALE 1:62500

CONTOUR INTERVAL 40 FEET
DASHED LINES REPRESENT 20-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

WASHINGTON
QUADRANGLE LOCATION

EXPLANATION

S

Stable

Areas of little or no slope.

I

Intermediate

Stable under natural conditions. Geologic and engineering studies recommended for proposed high density development areas.

U

Unstable

Areas unstable under natural conditions. Engineering studies should be required for proposed development.

Ls

Landslides

Areas of recent down slope movement. No development recommended.

Ols

Old Landslides

Areas considered generally stable, but engineering studies recommended for slopes over 30 percent.

M

Modified Land
Stability Undetermined