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GEOLOGY AND EARTH RESOURCES DIVISION
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SLOPE STABILITY OF CLARK COUNTY

by

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The investigation of the slope stability and landslide hazards of Clark County was conducted in cooperation with the Clark County Regional Planning Council as part of a three-part study involving geologic hazards and sand and gravel resources within the county. The identification of landslides is included in this part of the study. Conditions were analyzed and the geologic properties controlling landslides were used to identify areas possibly susceptible to future landsliding. Base maps are U.S. Geological Survey and have scales of 1:24,000 or 1:62,500. Units shown on the maps are (1) stable areas (no color); (2) areas of potential instability (colored yellow), (3) recent landsliding (red); (4) older landslides (orange).

Landslides within Clark County are of two ages. Recent landslides have vegetational differences from the surrounding area and (or) have visible scars. These landslides are younger than 150-200 years. Older landslides show no difference in vegetation from the surrounding area. They are older than 150-200 years, but may show evidence of recent movement within the old slide debris.

Clark County contains two physiographic provinces. The mountain province is characterized by steep topography and is composed of volcanic rocks. The plains province has flat or moderate topography and is composed of unconsolidated sediments. Because of these geologic differences, each province displays somewhat different slope stability problems.

The Plains Province

The plains province is bounded by the Columbia River on the south and west, and the mountains on the north and east. It includes the Fourth Plains, and Mill Plain areas, the cities of Vancouver, Ridgefield, La Center, Highland, Battle Ground, Camas, and Washougal. The geologic materials forming the province are weathered to unweathered silts, sands and gravels, and basaltic lava flows. The Troutdale Formation of Pliocene age is found throughout the province but is overlain in areas near Washougal and Camp Juliana by the basaltic Boring Lava, and in the western part of the province by Pleistocene

silts, sands, and gravels. Recent deposits of alluvium are found in channels and flood plains of the Columbia and East Fork of the Lewis Rivers, as well as in most smaller streams and creeks.

Few recent landslides were found in the Plains province. Most of the recent failures identified were in Pleistocene deposits along the banks of the East Forks of the Lewis and Columbia Rivers. Other recent landslides occurred along banks of small streams. The mechanisms resulting in the recent landslides are active undercutting of stream banks and the loss of internal strength by saturation of unconsolidated deposits. These recent landslides are unstable and should be avoided or thoroughly investigated prior to commitment for any future change in land use.

Ancient landslides identified in the plains province were usually in association with deposits of Boring Lava overlying the Troutdale Formation. The largest of the older landslides, found along the Washougal River, has this association. Older slides found on Prune Hill and Camp Juliana also have the Boring Lava overlying the Troutdale sediments. The cause of these slides was probably very complex but a determining factor was the loss of support (or internal failure) of the Troutdale Formation.

Other older landslides are found east of Woodland, along Lacamas Creek, and the Washougal River. The sliding probably resulted from failure of weak interbed zones in the bedrock east of Woodland and of the silt and clay-rich deposits along Lacamas Creek and the Little Washougal River.

Most of the older landslide deposits are now stable. There may be, however, small areas within the old debris that have now reactivated. An example is the Collins slide on County Road No. 11. It is located in old landslide debris along the south side of the Washougal River. Because of the potential instability of ancient landslide debris, detailed engineering and geologic studies should be required prior to development.

The areas within the plains province mapped as potentially unstable are similar in geology and topography to recent landslides. The potentially unstable areas are usually steep stream and river banks and heads of drainages. These slopes are undergoing active erosion by the processes of valley widening and headward erosion. Creep (the slow downslope movement of soil or coluvium) is also occurring on these slopes.

Detailed engineering and geologic studies should be required of these areas. Development on the slopes could cause slumping or sliding by contributing water, weight, and (or) loss of support.

The Mountain Province

The mountain province extends along the eastern part of the county from the Washougal River on the south to Lake Merwin and Yale Lake on the north. The area has mostly rugged topography except for the Chelachie and Yalcot prairies. The province is underlain by volcanic rock of Eocene Age (55 to 57 million years b.p.) and Pleistocene sediments. The northern portion of the province has been modified by glaciation and glacial drift overlies much of the area.

Because of the remoteness and lack of population pressures, only landslides were identified and mapped. Very few recent landslides were observed. Most recent slides were man-caused (logging road related). A few large older slumps and debris flows were identified in the province. These now appear to have stabilized. Additional areas of potential instability were not mapped, but they are usually confined to heads of drainages, oversteepened slopes, and steep stream banks.

As in the plains province, old landslide debris and unstable slopes should be approached with caution. In the mountain province, however, most development is limited to logging and road building. As logging roads are usually the primary cause of most sliding, they should be restricted, if possible, to ridge tops, stream bottoms, and slopes under 30°. Use of modern road building techniques and proper placement of waste materials should be emphasized.

Summary

The county is divided into two physiographic provinces. In the plains province, four slope stability units were identified. They included older landslides, recent landslides, areas susceptible to landsliding or potentially unstable, and stable areas.

Of the four classes of slope stability, only the stable areas need little or no direct attention. The other slopes, however, require special action. Recent and active landslides should be avoided. The potentially unstable slopes and older landslides should have detailed geologic and engineering studies conducted. If special care is not taken in the development of these areas, conditions may arise that would cause failure or slippage of the slopes. Septic systems, watering of lawns, and redirection of surface water could add to the supply of ground water. Saturation of otherwise stable materials by increased ground water may cause loss of internal strength, resulting in landsliding.

Slopes throughout the county may also fail because of ground shaking and

vibrations caused by earthquakes. Because of the lack of knowledge in earthquake predictions of magnitude and location of epicenter, it is impossible to determine slope stability based on earthquakes. A few generalities, however, can be stated. An earthquake of low magnitude and intensity may cause only slopes that are already unstable to fail. Older landslide debris, recent landslides, and potentially unstable slopes would be affected during low or middle magnitude and intensity earthquakes. During an earthquake of the highest magnitude, any slope may become unstable particularly if the epicenter were in or near Clark County.

The slope stability maps are an attempt to outline, generally, areas where landslides and slope stability problems occur. The maps are not a substitute for site investigations. They are not only meant for use as a tool by the Regional Planning Council in their land use planning. The maps cover approximately 600 square miles, and boundaries drawn on the maps are, in some cases, approximations. There may be areas included within some boundaries that do not fall into that unit. Some areas were too small to outline by themselves or may have been overlooked. Therefore, these maps should only be used as a guide to the slope stability of Clark County for planning purposes.

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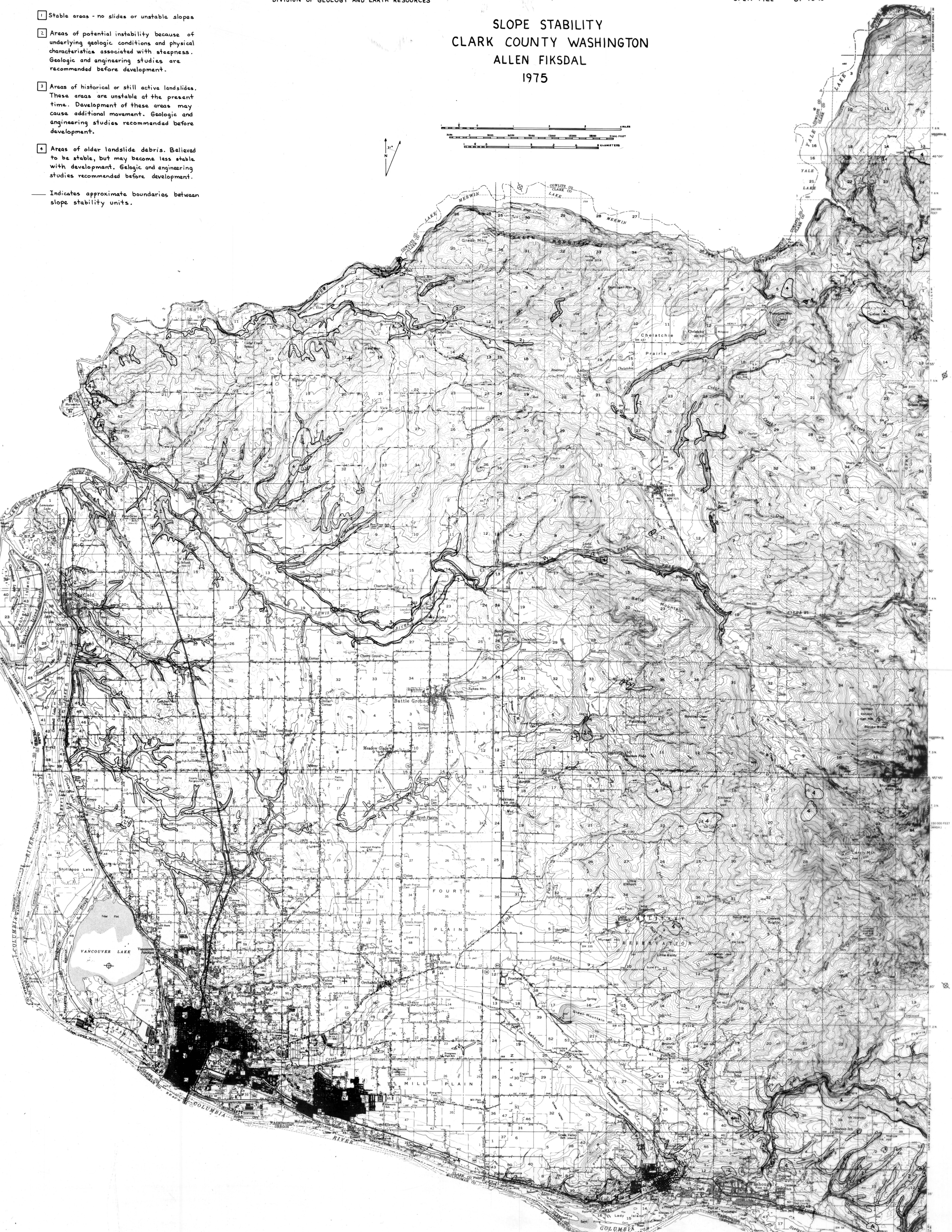
EXPLANATION

[1] Stable areas - no slides or unstable slopes

[2] Areas of potential instability because of underlying geologic conditions and physical characteristics associated with steepness. Geologic and engineering studies are recommended before development.

[3] Areas of historical or still active landslides. These areas are unstable at the present time. Development of these areas may cause additional movement. Geologic and engineering studies recommended before development.

[4] Areas of older landslide debris. Believed to be stable, but may become less stable with development. Gelogic and engineering studies recommended before development.

—— Indicates approximate boundaries between slope stability units.