GARRARD CREEK WATERSHED

LANDSLIDE HAZARD ZONATION PROJECT

Lewis, Grays Harbor, and Pacific Counties, Washington

Prepared by
Gabriel Legorreta Paulín and Venice Goetz

Forest Practices Division,
Adaptive Management Program

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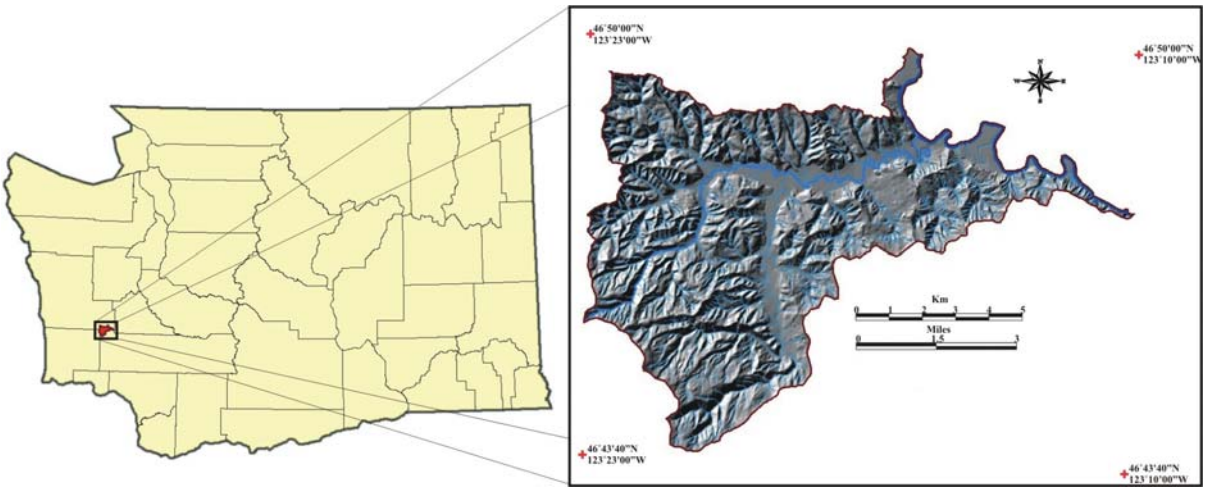
Forest Practices Division
PO Box 47012
Olympia, WA 98504-7012
Phone: 360-902-1400
Fax: 360-902-1428

Web sites: http://www.dnr.wa.gov/forestpractices/lhzproject
http://www.dnr.wa.gov/forestpractices/adaptivemanagement



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Project Summary

The ***Garrard Creek watershed administrative unit*** (WAU) is located on the northern extent of the Coast Ranges physiographic province and covers 20795.8 acres (about 32.5 mi^2). This analysis divides the watershed into 11 mass wasting landforms that are assigned slope stability hazard ratings from low to very high. During this study, 539 landslides covering 1075.7 acres were mapped using aerial photos and LiDAR (light detection and radar) imaging, with limited field verification. Mapped landforms (summarized in Table 1) include some of the high hazard units defined in the Washington State Forest Practices Rules. These are: inner gorges, bedrock hollows, convergent headwalls, scarps of active deep-seated landslides, and outsides of meander bends. All the above rule-identified landforms except "outsides of meander bends" were "upgraded" to be flagged as having "very high" hazard Non-rule-identified inner gorges and steep gradient hillslopes with >64% slopes were also found to have a "very high" hazard rating. Moderate hazard ratings were given to moderate gradient hillslopes (41-64%). Other geomorphic landforms such as flats (0-10%), ridge tops and ridge noses, and low gradient hillslopes (11-40%) were found to have a low hazard rating. The overall hazard rating for Garrard Creek WAU was found to be moderate.

Land-form number	Name of landform	Landform slope stability hazard rating	Slope of land-form	Total area of landform in acres	No. of delivering landslides in landform	Comment
#1	Inner Gorges	Very High	>70%	1593	74	Rule-identified feature
#2	Bedrock Hollows	Very High	>70%	45	8	Rule-identified feature
#5	Convergent Headwalls	Very High	>70%	60	2	Rule-identified feature
#7	Active Scarps of Deep-seated Landslides	Very High	>54%	20	7	Unique feature
#9	Meander Bends & Overbank Deposits	High	0-24%	302	10	Rule-identified feature
#10	Non-rule-identified Inner Gorges	Very High	30-70%	109	5	Unique feature
#11	Steep Gradient Hillslopes	Very High	>64%	962	65	Unique feature
#12	Moderate Gradient Hillslopes	Moderate	41-64%	3963	55	Unique feature
#14	Flats	Low	<10%	2998	30	Protocol
#15	Ridge Tops and Noses	Low	<10%	469	0	Protocol
#16	Low Gradient Hillslopes	Low	11-40%	10274	17	Protocol
	Totals			**20796**	**273**	

Table 1. Summary of the eleven landforms mapped in the Garrard Creek WAU.

1. Introduction and Summary of Methods

1.1. Use of this report

The purpose of this mass wasting assessment is to identify non-federal, non-tribal areas within the Garrard Creek watershed assessment unit (WAU) that have landforms[1] with moderate or high risk of landslides due to the effects of forest management (roading, clearcutting, thinning, yarding, etc.). Maps of these watershed-specific landforms (Maps A1 and A2 herein) will be used by the Department of Natural Resources region staff to identify those forest practice applications (see Chapter 222-20 WAC) that will require a site investigation prior to assigning the class of forest practice relative to potential unstable slopes and landforms (Chapter 222-16-050). Additionally, these maps are designed to be used by land managers to assist in developing harvest strategies.

This is a reconnaissance study and its level of resolution must be kept in mind when using this document and Maps A1 and A2. For example, analysis of individual landslides or slopes is not an appropriate use of this report nor should it be used exclusively for zoning purposes. Moreover, the report was prepared according to the schedule necessary to produce a statewide screening tool as quickly as reasonably possible. For this reason, it is likely that some landslides or landforms may have been inadvertently omitted, some benign features may be improperly mapped as landslides, and some data may have been miscoded.

This assessment was conducted using aerial photographs, various maps, and field observations. Information was collected and compiled from these sources in a manner designed to respond to the critical questions or to suggest areas where more detailed information is necessary. The objective of the data collection was to generate information sufficient to establish:

- A generalized characterization of mass wasting processes active in the basin;
- Portions of the landscape sharing similar physical characteristics relating to mass-movement behavior;
- The relative potential for mass wasting within each landscape unit.

1.2. Previous Investigations

Other landslide studies have been conducted in the vicinity of Garrard Creek WAU. A landslide inventory map was prepared in 2003 by Washington State DNR (Hanell, 2003) that included the northern quarter of the Garrard Creek WAU and adjacent areas north and southwest of it.

Fiksdal (1978) stated that the area was affected by numerous old landslides in a report of slope stability in Centralia-Chehalis area. His observations revealed that almost all of the observed recent landslides were associated with road and road construction. Two geologic investigations conducted

1 The LHZ project landforms include not only those defined in the Forest Practices rules (WAC 222-16-050) but others that may be unique to the watershed or that are listed in the protocol. The landforms used in this study that are defined in the Forest Practices rules are inner gorges, bedrock hollows, convergent headwalls, and the outsides of meander bends . These will be referred to as “rule-identified landforms” in this report.

by Snavely et al. (1958) and by Foxworthy (1962) show that rapid erosion and landslide processes occur on poorly consolidated Tertiary and Quaternary rocks. One example is Skookumchuck Formation where landslides occurred (Snavely et al., 1958).

In 1999, the Washington State Department of Transportation (DOT) identified the following risks in adjacent areas north of the Garrard Creek watershed. The area between Oakville and Rochester (Figure 1) was described as an area that tends to be flooded annually and to have soil erosion problems as a result of torrential rain, high waters of the Chehalis at flood stage, and landslides (Washington State Department of Transportation, 1999). On December 3, 2007, during a winter storm, the Interstate highway I-5 was closed between Rochester and Grand Mound due to falling trees and torrential rain followed by flooding and landslides.

Introduction to Mass Wasting Processes and Terminology

For the purposes of this study, most slopes that failed below the rooting depth of the trees are categorized as deep-seated, consistent with the Forest Practices Board Manual. Those deep-seated landslides that moved rapidly and clearly delivered sediment are included in the analyses of sediment delivery.

Six types of mass wasting process were identified in the Garrard Creek watershed related to forest practices:

1. Shallow undifferentiated landslides
2. Debris flows
3. Debris slides
4. Deep-seated landslides
5. Earthflows
6. Rock falls

1.3. Summary of Methods

This assessment follows the Landslide Hazard Zonation Inventory Protocol dated November 30, 2006 (http://www.dnr.wa.gov/forestpractices/lhzproject/lhz_protocol_v2_1_final.pdf), with minor modification.

Aerial Photographs – Four sets of 1:12,000 aerial photographs from 1962 to 1999, and one set of 1:63,360 photos from 1976 were analyzed with a mirror stereoscope with 3x magnification (Table 2). Other photo flight years were available from DNR's collection in Olympia, but these five photo sets were the most complete, spanned a large time frame, and were sufficient to develop a large landslide inventory. In addition, 2003-2005 digital color ortho-photographs with 0.5m (1.5 foot) pixel size were used as a layer during GIS analysis and mapping.

Year	Scale	Image	Flight Number	County	Comment
1962 and 1964	1:12,000 to 1:13,000	Black and white	LSW64 1 to 10 GH-62 47 to 56	Lewis Grays Harbor	Complete coverage
1970 and 1972	1:12,000	Black and white	LP-70 207 to 214 GH-72 473 to 508	Lewis Grays Harbor	Complete coverage Partial coverage
1976	1:63,360	Black and white	SW-H-76 5W 29 to 31	Lewis	Complete coverage
1993	1:12,000	Black and white	SW93 33-37 to 39-46 SW93 32-36 to 39-46 SW93 32-36 to 31-36	Lewis Grays Harbor Pacific	Partial coverage Partial coverage Complete coverage
1999	1:12:000	color	SW-C99 24-54 to 53-45 SW-C99 24-54 to 53-44 SW-C99 25-44 to 53-44	Lewis Grays Harbor Pacific	Partial coverage Partial coverage Complete coverage

Table 2. Photographic surveys used in this study.

Slope failures observed on the stereo photos were classified and catalogued according to mass wasting feature types. These include shallow-undifferentiated landslides, debris flows, debris slides and avalanches, rock topples and falls, snow avalanches, and deep-seated landslides (including earthflows).

The mapped landslides were also categorized according to their relative level of certainty as questionable, probable, or definite. Features with some combination of distinct head scarps, lateral margins, scoured run-outs, over-steepened toes, obvious deposits with hummocky topography, or vegetation patterns that indicate landslide disturbance were considered to be definite landslides. Features that were more subdued or concealed by vegetation could not be identified with the same level of certainty and were thus considered to be "probable" landslides. Features that resemble degraded landslides but could have been formed by non-mass wasting processes were considered questionable landslides (following the recommendations of Wieczorek, 1984). Features shown on aerial photographs as small holes or gaps in the canopy were not mapped in the landslide inventory because they may represent wind-throw holes, disease pockets, or bedrock, rather than true landslides. Also, the holes or gaps were not field-verifiable, especially on old aerial photos. The aerial photographs were also used to determine land-use, based on forest stand age when the landslide was first observed.

GIS, DEM, LIDAR, and GIS-derived products – Following stereo air-photo analysis, all observed landslides were hand-drawn on mylar overlays and mapped directly into GIS. The GIS mapping was accomplished by "heads-up" digitizing the landslides onto a GIS base map with streams, roads, sections and townships, geology, ortho-photographs, the USGS 10-meter Digital Elevation Model (DEM), DEM-derived contours, slopes, and hillshades layers. Landslides mapped in the Garrard Creek WAU are presented on Map A-1 and itemized on Appendix A, the Landslide Inventory.

At the time of this survey, LiDAR (Light Detection and Ranging) data was available for about 21.7% of the study area. In these areas, the topographic resolution is about 1.8 m (6 ft). The remaining area of the map base has a maximum resolution of about 10 m (33 ft). The 10m DEM resolution was used to determine the slope gradient of shallow and deep-seated landslides. Slope gradients for shallow landslides were determined by using the maximum DEM-derived slope angle within each landslide initiation polygon. For deep-seated landslides, the average slope angle over the entire landslide polygon was calculated. Powell (2007) and Bilderback (2006) found that the average slope gradient

for deep-seated landslides provides the quickest and the most reasonable representation of pre-failure slope surface compared to the other GIS slope measurement methods.

It should be emphasized that all slope gradient and elevation estimates for landslides identified on high-resolution air-photos were not accurately estimated by the 10m DEM due to raster data smoothing. As grid pixel size increases, slope smoothes. The effect of pixel size in slope estimation is greater in terrain with high relief than terrain with low relief. (Claessens et al., 2005; Wilson et al., 2000; Wolock and McCabe, 1995; Zhang and Montgomery, 1994). DEM-derived slope gradients are underestimated by at least 10% relative to field-measured gradients (Dragovich et al., 1993, cited by Bilderback and Brunengo, 2007). Despite these limitations, the 10m DEM was used in place of field measurements for the sake of expeditiousness to estimate the gradients of landslides.

Mass wasting map units – As part of the LHZ project, landforms derived from physical attributes of the landscape were mapped. The landforms chosen are intended to predict areas within the WAU that pose hazards for mass wasting. Landforms were determined using a combination of aerial photographs, the 10 m DEM, elevation data, slope gradient, hillshade image, slope convergence data from the DNR SLPSTAB model (Shaw and Johnson, 1995), and geologic data (from USGS and DNR 1:100,000 geologic maps) mass wasting map units that include rule-identified landforms (inner gorges, bedrock hollows, etc.) and analyst observations. The landforms mapped in the Garrard Creek WAU are presented on Map A-2 and described in Appendix B, Landform Descriptions. Each landform was assigned a landslide frequency rate (LFR), a landslide area rate for delivery (LAR), and an overall hazard rating (low, moderate, or high) as called for by the LHZ Protocol. [www.dnr.wa.gov/forestpractices/lhzproject/lhz_protocol_v2.1_final.pdf].

2. Study area: Physical Setting Pertinent to Mass-Wasting Interpretations

2.1. Study area, Topography, and Climate

The Garrard Creek WAU covers 20795.8 acres and lies within Lewis, Grays Harbor, and Pacific counties, Washington. The watershed is located in the Willapa Hills physiographic province, which is considered to be the northern extent of the Coast Ranges physiographic province. The study area is characterized by hilly and steep terrain with elevations from 40 ft to 2251 ft and slopes between 0% (inner valleys of relatively flat plains) and 166.4% (mountainous terrain). Garrard Creek is a tributary of the Chehalis River, which flows into the Pacific Ocean (Figure 1).

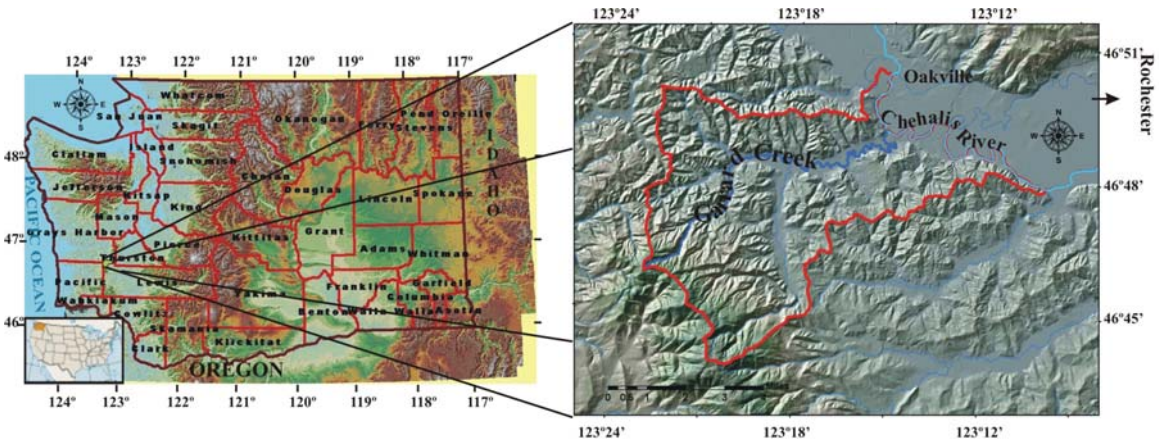

Figure 1. Location and general terrain of Garrard Creek watershed.

2.2. Climate

The three closest weather stations: Oakville (the station is located 1.1 miles NE from the study area), Brooklyn (the station is located 5.7 miles W from the study area), and Elma (the station is located 11.8 miles NW from the study area) were used to characterize climatic conditions in the Garrard Creek watershed (Figure 2). Climatic conditions are characterized by mild and relatively short dry summers (only about 5% of the annual precipitation falls between June and August), while winters are wet (Figures 3 to 5). The study area has a mean annual precipitation of approximately 90 to 120 in (Grialou et al., 2000; Daly and Weisburg, 1997), the bulk of which falls as rain during seasonal storms between October and April. During the winter, between 17 in and 27 in can fall during a single month (Western Regional Climate Center, 2008). Winter precipitation levels are high and heavy and tend to produce landslides. Figure 6 shows the variation of precipitation for some years and periods from the closest weather stations in the study area. Some years and some periods were much wetter than average (e.g., 1950, 1954, 1959–64, 1971-72, 1974-76, 1982–84, the late 1990s), and others were relatively dry (1952, 1957–58, 1985-1989, 1992-1994) (data from Western Regional Climate Center, http://www.wrcc.dri.edu; and OSU Spatial Climate Analysis Service, PRISM precipitation maps, http://mistral.oce.orst.edu/www/mapserv). During the storm event of December 1-4, 2007, heavy and/or intense precipitation was recorded at the Elma and Brooklyn stations (4.77 and 3.55 in/24hr respectively) (Weyerhaeuser Company, 2008). However, very few new landslides were observed during field reconnaissance after the storm event.

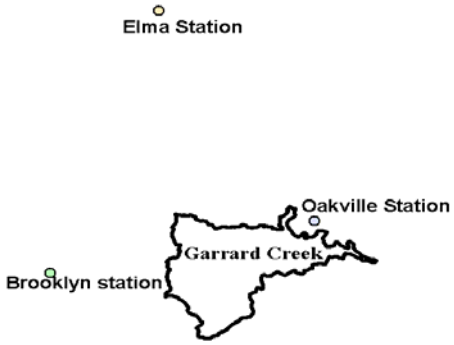

Figure 2. Location of weather stations.

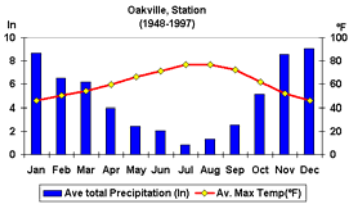

Figure 3. Annual precipitation and temperature of Oakville station. The station is located 1.1 miles NE from the study area (Western Regional Climate Center, 2008).

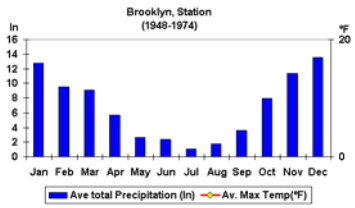

Figure 4. Annual precipitation and temperature of Brooklyn station. The station is located 5.7 miles W from the study area (Western Regional Climate Center, 2008).

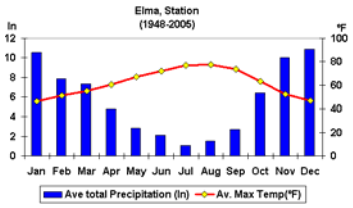

Figure 5. Annual precipitation and temperature of Elma station. The station is located 11.8 miles NW from the study area (Western Regional Climate Center, 2008).

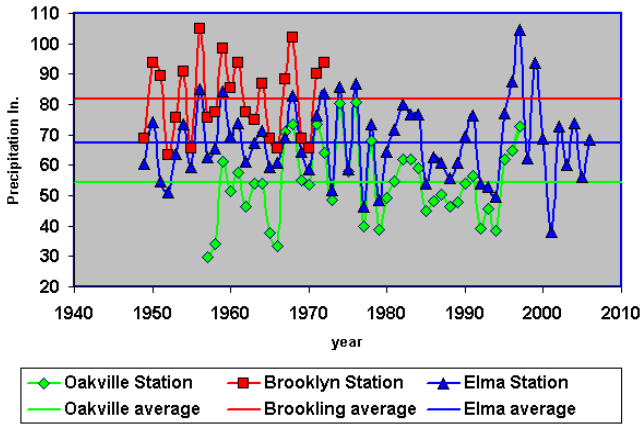

Figure 6. Record of total annual precipitation from representative weather stations near Garrard Creek WAU, from water years 1949 to 2006.

2.3. Geology

The geology in Garrard Creek WAU includes rocks that range from early Tertiary (Eocene) to Quaternary in age. Figure 7 shows the distribution and proportion of the four geologic formations and unconsolidated Quaternary sediments within the watershed.

The oldest unit in the study area is the Crescent Formation (18.7% of the total area). The Crescent Formation, erupted on mid-ocean ridges to oceanic islands and forms the crustal foundation of the Coast Ranges. The formation consists of a very thick sequence of submarine and sub-aerial tholeiitic basalts flows and flow breccia, accompanied by subordinate felsic igneous rocks. Formed in a continental margin rift setting between ~60 – 45 Ma, the formation was accreted to the edge of North America about ~46–42 Ma (Babcock and others, 1992; Logan, 1987).

The Skookumchuck Formation covers 5229 acres (25.1% of the total area) of the study area, and consists of Middle to upper Eocene near-shore marine to non-marine sedimentary rocks. The formation is composed of micaceous feldspathic sandstone, siltstone, shale, carbonaceous siltstone, claystone, and coal. Locally, the formation is interbedded with tuffaceous and volcanic rocks and minor conglomerate (Logan, 1987; Snavely et al., 1958).

The McIntosh Formation (Middle to upper Eocene) covers 10.7% of the study area. The marine sedimentary rocks of this formation consist of laminated to massive tuffaceous siltstone, claystone, shale, and massive to cross-bedded micaceous feldspathic sandstone. In the lower part of this formation, basaltic sandstone and arkose sandstone are commonly interbedded with basalt flows, tuffs, tuff breccias, and conglomerates (Logan, 1987; Snavely et al., 1958).

The dominant geologic unit in Garrard Creek WAU is the Lincoln Creek Formation (Upper Eocene to Oligocene). This formation covers 33.6% of the study area and is composed of tuffaceous, basaltic marine sandstone and siltstone with associated continental deposits that were derived from volcanic rocks and pyroclastic material (Snavely et al., 1958).

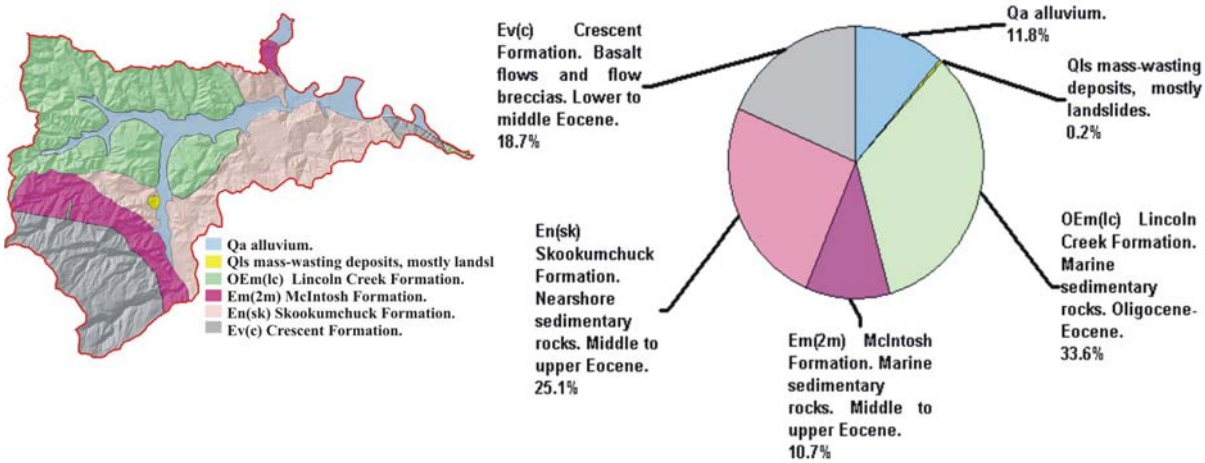

Figure 7. Spatial distribution of geologic units at Garrard Creek WAU.

Bedrock of the Garrard Creek WAU affects the distribution and geomorphology of landslides. The rocks can be categorized on a strength or resistance scale, inferred from the distribution and the ways they affect landforms. About 80% of mapped landslides are located in Lincoln Creek, Crescent, and Skookumchuck Formations. Also, most of the deep-seated landslides are found in these formations. Earthflows are prone to occur in the weak marine sedimentary rocks of Lincoln Creek, Skookumchuck, and McIntosh Formation.

3. Summary of Landslide Inventory

During the Garrard Creek WAU review, a representative sample of 539 mass-wasting features was inventoried from aerial photography, LiDAR imagery, and field investigations (Form A-1). Of the landslides identified during this mass-wasting assessment, 46.94% were mapped as shallow undifferentiated failures; 12.80% were debris flows; 2.23% were debris slides; 33.40% were deep-seated landslides; 4.27% were earthflows; and 0.37% were debris rock topples and falls (Table 3). The resulting mass-wasting coverage is displayed as Map A-1. Pertinent attributes of individual features were recorded on data sheets, Appendix A, Form A-1. Of the 539 inventoried mass-wasting features, 41% were identified as definitive, 43.04% as probable, and 15.96 as questionable.

Based on landslide mapping and land use associated with the landslides, it was found that over 43% of the inventoried mass wasting features were located in mature (>50 years old) and sub-mature timber (15-50 years old). Land use was determined for each feature (Appendix C).

Mass Wasting Type	Number of Mass Wasting Features Mapped	Area (acres) of Mass Wasting Features	Percentage of Total Landslides
Shallow Undifferentiated landslides	253	96.59	46.94
Debris flows	69	15.25	12.80
Debris slide/avalanche	12	10.03	2.23
Deep-seated landslides	180	444.42	33.40
Earthflow	23	509.18	4.27
Rock Topples and Falls	2	0.19	0.37
Total	539	1075.66	100.00

Table 3. Summary of the type and number of LHZ Protocol-specified mass-wasting features mapped in the Garrard Creek WAU.

4. Landforms Descriptions (Form A2)

The distribution of the 11 landform units identified in the Garrard Creek watershed are shown on Map A-2 and are described in Forms A-2, Appendix B. These units have been delineated based on areas having similar mass wasting potential, potential to deliver to public resources, and/or potential to impact public safety. Mass wasting potential was determined primarily by landslide process, failure density, lithology, geomorphology, hydrogeology, and topography. The following sections briefly describe the characteristics of each landform with additional information provided in Appendix B. Rule-identified landforms have been given a standardized numbering system as part of the Landslide Hazard Zonation (LHZ) Protocol. Since not all rule-identified landforms occur in a given watershed, there may be gaps in landform numbering. Landslide hazard ratings have been summarized on Form A-4 (Appendix D).

LANDFORM #1: Inner Gorges – Rule-identified landform with a very high mass wasting and delivery potential. In the Garrard Creek WAU, this landform covers 592.73 acres. Inner gorges in Garrard Creek are both asymmetrical and symmetrical and may occur intermittently in lateral extent. Slopes are generally greater than 70% although these gorge systems may fail on convergent to planar slopes of <65%. About 77% of the mapped landform area is located on hillslopes with slopes greater than 40%. Most inner gorges are located within the Lincoln Creek Formation (60%), the Crescent Formation (18%), and the Skookumchuck Formation (12%). Over-steepened walls of inner gorges within unconsolidated surficial deposits and/or weathered soil-bedrock interface can fail as debris slides, slope ravel, or small rotational slumps and can produce debris flows. Ninety-six percent (96%) of all landslides are found along inner gorges slopes, most in mature and submature timber.

LANDFORM #2: Bedrock Hollows – Rule-identified landform with high mass wasting and high delivery potential. Bedrock hollows are also called colluvium-filled bedrock hollows, zero-order basins, swales, bedrock depressions, or simply hollows. Bedrock hollows are long, pointed ellipse or round, inverted spoon-shaped features. These features are primarily found on convergent slopes but can also be found on planar slopes. They are often found up-gradient from inner gorges and on steep slopes (>70%). However, bedrock hollow failures can occur on less steep terrain. In Garrard Creek WAU, this landform covers 45.22 acres. Ninety-one percent of mapped bedrock hollows are located on slopes greater than 40%. All mapped slope failures (9) within bedrock hollows are located in mature timber and submature timber. Most of the mapped bedrock hollows are within the Lincoln Creek Formation (54%), the Crescent Formation (22%), and the McIntosh Formation (20%).

LANDFORM #5: Convergent Headwalls – Rule-identified landforms with high mass wasting and high delivery potential. This landform covers 59.96 acres. Convergent headwalls have steep slopes (>70%) and occur in the Lincoln Creek Formation in the western part of the watershed. About 90% of the landform areais located on slopes greater than 40%. All mapped slope failures within convergent headwalls are located in mature timber and submature timber.

LANDFORM #7: Active Scarps of Deep-seated Landslides – This landform encompasses active head and lateral scarps of deep-seated landslides and has a very high mass wasting and delivery potential. In Garrard Creek WAU this landform covers 19.72 acres. There is a high potential for additional secondary landsliding within the entire area (headscarp, body, and toe) of active deep-seated landslides due to streams cutting through the features. About 78% of the landform area is located on slopes greater than 40%. Slope failures within active scarps of deep-seated landslides are located in mature timber, submature timber, and young stands. Almost all of the mapped active head and lateral scarps of deep-seated landslides are located on weak and weathered sedimentary rocks of near shore and marine origin. Active head and lateral scarps of deep-seated landslides are located in the Lincoln

Creek Formation (36%), the McIntosh Formation (30%), and the Skookumchuck Formation (30%)--and few in the volcanic rocks of the Crescent Formation (4%).

LANDFORM #9: Meander Bends – Rule-identified landform with a high mass wasting and high delivery potential. In Garrard Creek WAU, slope failures occur from stream undercutting of outer edges of meander bends along valley walls or high terraces of an unconfined meandering stream. The meander bends landform covers 301.69 acres and includes places where meander bend slopes have failed directly into the Chehalis River as shallow landslides and small slumps. Included in this landform are all areas where instability and delivery could occur along the stream banks and places where instability has occurred but the river is no longer present due to meandering. For this reason, the landform is over-represented on the map by using a buffer polygon around the Chehalis River. About 96% of the mapped landform area is located on slopes lower than 40%. Agriculture and residential use occurs on alluvial deposits along the meander bend landform; rarely is the landform subject to forest practices.

Landform #10: Non-Rule-Identified Inner Gorges – Non-rule-identified landform with a high mass wasting and delivery potential. The mapped non-rule-identified inner gorge landform covers 109.2 acres. This landform represents both asymmetrical and symmetrical non-rule-identified inner gorges that may occur intermittently in lateral extent. In this landform, shallow landslides commonly occur along inner gorge walls. Five slope failures are mapped within non-rule identified inner gorges in the Garrard Creek WAU. Most of the failures are located in mature timber and submature timber. Half of the mapped landform area is located on slopes greater than 40%. Most non-rule-identified inner gorges are found in the Skookumchuck Formation (88%), with 8% occurring in the Lincoln Creek Formation (8%), and 4% in the Crescent Formation.

LANDFORM # 11: Steep Hillside Slopes (>64%) – Very high mass wasting hazard and delivery potential. The steep hillside slopes landform covers 962.16 acres. All slope forms[2] (convergent, divergent, and planar) are represented. This landform contains other high hazard landforms (e.g. inner gorges and bedrock hollows) that are the initiation points for many debris slides and debris flows. One hundred and seventeen (117) slope failures are mapped within this landform. About 80% of these are located in mature and submature timber. The remaining failures are related to roads, clear cuts, and young stands. About 86% of the mapped landform area is located on hillslopes with slopes greater than 64%. Steep hillside slopes are located in the Lincoln Creek Formation (41%), the Crescent Formation (33%), and the McIntosh Formation (19%).

LANDFORM # 12: Moderate Gradient Hillslopes (41-64%) – Moderate mass wasting hazard and delivery potential. The moderate gradient hillslopes landform covers 3963.39 acres. It includes all slope forms (convergent, divergent, and planar) that range between 41% and 64%. One hundred and fifty six (156) slope failures are mapped in this landform. About 82% of these are located in mature and submature timber. The remaining failures are related to roads, clear cuts, and young stands. About 88% of the mapped landform area is located on hillslopes with slopes greater than 40%. Steep hillside slopes are located in the Lincoln Creek Formation (43%), the Crescent Formation (23%), the McIntosh Formation (17%), and the Skookumchuck Formation (15%).

2 The slope forms used in this study are defined in the Forest Practices Board Manual (2004).

LANDFORM #14: Flats – Low mass wasting and delivery potential. This map unit includes slope forms that are mostly gentler than 10%. The landform consists of dominantly lowland landforms such as valley bottoms, floodplains, and flat terrace surfaces, and includes the meander bends adjacent to Garrard Creek. Land use in these areas is either residential or related to agriculture. The flat areas landform occurs in Quaternary alluvium deposits (62%), the Skookumchuck Formation (24%), the Lincoln Creek Formation (10%), and the McIntosh Formation (4%).

The flat areas of this landform are the recipient of debris and alluvial deposits. The mass wasting that occurs in this landform is basically bank erosion along Garrard Creek and although there is a high mass wasting potential during peak flows and high delivery potential as these slopes are adjacent to the stream, the area of these slope failures is so small compared with the larger area of the whole landform, that the resulting calculations render the landform low hazard. Additionally none of these slope failures are associated with forest practices. Thirty-one slope failures are mapped within the flat landform along the river margin but the overall landform has low landslide potential, due to most slopes <10%, and covers 2998.19 acres.

LANDFORM #15: Ridge and Hill Tops – Low mass wasting and delivery potential. This landform includes all ridge tops and ridge noses with gradients between 0% and 10% and covers 469.41 acres. No shallow landslides were identified in this landform. Landslides have occurred below and adjacent to some of these low gradient ridge tops, but these are excluded from this landform. Ridge and hill tops areas are located in the Skookumchuck Formation (46%), the Lincoln Creek Formation (32%), the Crescent Formation (18%), the McIntosh Formation (4%), and in Quaternary alluvium deposits (1%).

LANDFORM #16: Low Gradient Hillslopes (11-40%) – Low mass wasting and delivery potential. The low gradient hillslopes landform covers 10274.11 acres and includes all slope forms (convergent, divergent, and planar) and gradients between 11% and 40%. Seventy-eight slope failures (78) are mapped within this landform. Mainly these slope failures (78.21%) are located in submature and mature timber. The remaining failures are related to clear cuts, young stands, and roads. Low gradient hillslopes areas are in the Lincoln Creek Formation (33%), the Skookumchuck Formation (32%), the Crescent Formation (22%), the McIntosh Formation (10%), and in Quaternary alluvium deposits (3%).

5. Hazard Rating

Each landform identified on Map A-2 and described in Appendix B was assigned an overall Hazard Rating based on landslide frequency rate (LFR) and a landslide area rate for delivery (LAR). The hazard rating (low, moderate, or high) is then assigned as called for by the LHZ Protocol [www.dnr.wa.gov/forestpractices/lhzproject/lhz_protocol_v2.1_final.pdf]. Hazard ratings for mass-wasting landforms were determined by the following: 1) rule-identified status (WAC 222-16-050), 2) the Landslide Frequency Rate (LFR) and Landslide Area Rate for Delivery (LAR), 3) the professional judgment of the analyst, and 4) an interpretation of deep-seated landslide hazard. The Landslide Area Rate for Delivery is the area of delivering landslides normalized to the period of study and the area of each landform. The resulting values are multiplied by one million for easier interpretation. Limited application suggests that Landslide Area Rates for Delivery less than 76 are low hazard, rates of 76 to 150 are moderate hazard, rates of 151 to 799 are high hazard, and rates greater than 799 are very high hazard (Lingley, 2004). Note that higher Landslide Area Rates for Delivery can be achieved by reducing the area of the Landform. While this may appear to be 'data gerrymandering', it helps limit the area of high-hazard landforms to those areas that are actually demonstrated to have high hazard. The Landslide Frequency Rate is calculated similarly; however the number of delivering landslides is used instead of the area of delivering landslides. Deep-seated landslides are not included in the calculations for Form A-4. As of the writing of this report, the qualitative rating system below is used (Table 4). Landform hazard ratings in the Garrard Creek WAU are summarized in Appendix D, Form A-4.

Qualitative Ratings	Landslide Frequency Rate (LFR)	Landslide Area Rate for Delivery (LAR)
Low	< 100	<76
Moderate	100 to 199	76 to 150
High	200 to 999	151 to 799
Very High	>999	>799

Table 4. Qualitative rating system for the LFR and LAR.

6. Note on Confidence in Work Products

The confidence in this mass wasting assessment is moderate. This rating is based on the Landslide Hazard Zonation Project design to provide a watershed administrative unit overview of slope stability in a timely manner with minimal field verification. As a consequence of the project design, fieldwork and the number of aerial photograph sets examined are held to reasonable minimums. Omissions are due to the limited field verification of individual features, particularly in remote, limited access, and heavy canopy forested areas.

It is critical for the reader to understand that while these decisions are sufficient to characterize aspects of the slope failure as functions of forest management, this assessment would be entirely insufficient and misleading if it is used as a stand alone document for protecting private and public resources or for land use planning. Keep in mind that this is only a reconnaissance study, and undoubtedly, some landslides have been accidentally omitted and some benign features may be improperly mapped as landslides.

In addition, there are several sources of systematic error that could reduce the confidence in the work products of this analysis, those being omission, misinterpretation, accuracy, and precision. Omission occurs when mass wasting features are not identified on aerial photographs or in the field due to canopy cover, gaps in the aerial photo record, quality of aerial photos, or interpreter errors.

Misinterpretation occurs when a mass-wasting feature is identified but incorrectly classified or data are transposed, and where unrecognized software/file instability occurs. Accuracy involves the degree to which the physical parameters of a mass-wasting feature are correctly measured, and precision describes how variability within an assessment can be controlled when making multiple measurements over varying time and spatial scales. This mass wasting assessment was primarily conducted with aerial photographs, and as a result, there is a likelihood that errors of omission occurred primarily in areas covered by mature forest canopies, steep north facing slopes always in shadow (Brardinoni et al., 2003).

Because many deep-seated landslide features are quite large, remain heavily vegetated during movement, and may not have obvious scars visible through the vegetation canopy, misinterpretation is more likely. A detailed study in Cowlitz County, Washington, suggests that up to 25 percent of inferred deep-seated landslides identified from aerial photograph analysis are misinterpreted (Wegmann, 2003). Confidence in work products related to classification of deep-seated landslide processes in this WAU is high due to visibility (minimal tree density) and completeness of photo coverage.

Another important source of potential error in this assessment is in the accuracy and precision of measurements of mass wasting features. Because very few landslides were actually visited in the field, it is not possible to report the degree to which location and measurement error in the GIS environment compares to on-the-ground field measurements. Similarly, measurements of slope angle from digital elevation models typically misrepresent the true hill slope angle. Given these sources of error, the confidence in the precise location and accuracy of measurements of individual landslides is considered moderate.

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8. References

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Appendix A – Landslide Inventory: Form A-1

slide_id	lsi_process	certainty	ls_size	landslide area (acres)	id_date	id2_date	photo_num	landform	WAU LSI Landform	slp_shp	gradient	delivery	land use	geo_unit	deep-Seated activity	deep-seated type	Comments
2	1	D	2	0.030	1964		LSW10-63	1		1	64.88	Y	4	OEm(lc)			Shallow-undifferentiated landslide. Stream and railroad Adj.
7	1	D	3	0.249	1964		GH 62 55-5	9		2	11.60	Y	9	Qa			Meander bend failure. Failure no longer adjacent to river due to meander migration.
10	1	P	4	0.458	1964		GH 62 55-5	9		2	12.38	Y	9	Qa			Meander bend failure. Failure no longer adjacent to river due to meander migration.
13	1	P	4	0.566	1964		GH 62 55-3	10		1	42.67	Y	4	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
14	1	P	3	0.233	1964		GH 62 55-3	12		2	41.53	Y	4	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
15	1	P	3	0.142	1964		GH 62 55-3	1		2	70.97	Y	4	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
20	1	P	3	0.236	1964		LSW7-65	16		1	36.94	Y	2	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
24	1	D	3	0.355	1964		LSW7-63	11		2	60.27	Y	4	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
29	1	P	3	0.053	1964		GH 62 53B 2	14		2	1.04	Y	2	Qa			Meander bend failure. Failure no longer adjacent to river due to meander migration.
33	1	D	3	0.104	1964		LSW4-33	16		2	23.65	Y	1	Em(2m)			Bank failure.
40	1	D	3	0.201	1964		LSW2-43	1		1	53.56	Y	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
41	1	D	2	0.026	1964		LSW2-43	14		2	0.00	Y	9	Qa			Meander bend failure.
42	1	D	2	0.028	1964		LSW2-43	14		2	0.00	Y	9	Qa			Bank failure.
44	1	D	1	0.012	1964		LSW2-43	14		2	0.00	Y	9	Qa			Meander bend failure. Failure no longer adjacent to river due to meander migration.
53	1	Q	4	0.469	1964		LSW1-40	7		2	45.89	P	3	Em(2m)			Shallow-undifferentiated landslide.
54	1	D	2	0.087	1964		LSW1-40	1		1	78.96	Y	1	Em(2m)			Shallow-undifferentiated landslide. Stream Adj.
61	1	P	3	0.290	1964		LSW7-65	11		1	69.34	Y	4	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
62	1	P	3	0.122	1964		LSW7-65	11		1	80.81	Y	4	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
1002	2	D	1	0.019	1970		LP-70 214-46-51	1		1	53.32	Y	4	OEm(lc)			Shallow debris flow. Stream and railroad Adj.
1004	2	P	2	0.033	1970		LP-70 214-46-51	1		1	67.51	Y	4	OEm(lc)			Steep slope segment along which a probable shallow debris flow occur.

Appendix A – Landslide Inventory: Form A-1

1007	1	P	2	0.047	1970		LP-70 214-46-51	12		1	36.10	P	4	OEm(lc)			Steep slope segment along which shallow-undifferentiated landslide occur.
1008	1	P	1	0.006	1970		LP-70 214-46-51	1		1	68.95	Y	4	OEm(lc)			The polygon delineates an inner gorge along which shallow debris flow may occur.
1012	1	D	4	0.968	1970		LP-70 214-46-51	11		4	86.90	Y	2	Qa			Area along which shallow undifferentiated landslides may occur. Co-existence of shallow undifferentiated landslides, debris flow, and fluvial erosion is not discarded.
1013	2	P	3	0.115	1970		LP-70 214-46-51	1		1	59.70	Y	4	Ev(c)and Qa			The polygon delineates an inner gorge along which shallow debris flow may occur
1017	1	P	4	0.538	1970		LP-70 214-45-49	12		4	43.18	P	4	Ev(c)			Area along which shallow undifferentiated landslides may occur. Co-existence of shallow undifferentiated landslides, debris flow, and fluvial erosion is not discarded.
1020	2	P	3	0.105	1970		LP-70 214-45-49	11		1	75.46	Y	4	Ev(c)			The polygon delineates an inner gorge along which shallow debris flow may occur.
1025	2	D	2	0.086	1970		LP-70 214-44-51	1		1	55.41	Y	4	Ev(c)			The polygon delineates an inner gorge along which shallow debris flow may occur.
1031	2	P	2	0.044	1970		LP-70 214-44-51	7		1	43.49	Y	4	En(sk)			The polygon delineates an inner gorge along which shallow debris flow may occur.
1032	2	D	3	0.219	1970		LP-70 214-44-51	7		1	30.08	Y	4	En(sk)			The polygon delineates an steep hillslope along which shallow debris flow may occur.
1034	4	D	5	41.966	1970		LP-70 214-44-51	7		2	56.34	Y	3	En(sk)	DI	RO	Dormant deep-seated landslide. Possible insets of small deep-seated landslides.
1035	2	D	2	0.094	1970		LP-70 214-44-51	1		1	74.11	Y	3	En(sk)			The polygon delineates an inner gorge along which shallow debris flow may occur. The inner gorge is inside of a probable deep-seated landslide.
1036	3	D	3	0.110	1970		LP-70 214-44-51	7		1	22.44	Y	3	En(sk)			Inner gorge along which shallow debris slide may occur. The landslide polygon is inside of a probable deep-seated landslide.
1038	1	D	4	0.442	1970		LP-70 214-44-51	9		2	11.28	Y	4	Qa			Meander bend failure. Failure no longer adjacent to river due to meander migration.
1039	1	D	4	0.457	1970		LP-70 214-44-51	9		2	11.82	Y	1	Qa			The polygon delineates an area affected by bank failure.
1040	2	P	2	0.065	1970		LP-70 214-44-51	1		1	68.50	Y	4	En(sk)			Inner gorge along which shallow debris flow may occur. The inner gorge is inside of a probable deep-seated landslide.
1042	2	P	2	0.086	1970		LP-70 214-44-51	10		1	51.72	Y	4	En(sk)			The polygon delineates an inner gorge along which shallow debris flow may occur.
1052	1	D	3	0.301	1970		LP-70 214-43-53	9		2	5.45	Y	1	Qa			Meander bend failure. Failure no longer adjacent to river due to meander migration.
1055	1	D	4	0.849	1970		LP-70 214-43-53	9		2	24.59	Y	1	Qa			Meander bend failure. Failure no longer adjacent to river due to meander migration.

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1060	2	D	3	0.225	1970		LP-70 214-43-53	12		1	43.61	Y	4	En(sk) and Qa			The polygon delineates a stream along which a shallow landslide may occur.
1063	1	P	4	0.739	1970		LP-70 214-43-53	16		1	31.87	Y	4	En(sk)			The polygon delineates a hillslope along which shallow-undifferentiated landslides occur.
1065	2	D	3	0.181	1970		LP-70 214-43-53	1		1	49.24	Y	4	En(sk)			The polygon delineates an inner gorge along which shallow landslide may occur.
1071	1	P	4	0.953	1970		LP-70 220-43-51	12		2	52.38	Y	4	En(sk)			Steep slope segment along which a shallow-undifferentiated landslide occur. Co-existence of shallow undifferentiated landslides.
1073	1	P	3	0.268	1970		LP-70 220-43-51	12		1	59.58	Y	1	En(sk)			The polygon delineates a steep slope segment along which shallow-undifferentiated landslide occur.
1074	2	P	3	0.182	1970		LP-70 220-43-51	12		1	64.13	Y	1	En(sk)			The polygon delineates an inner gorge along which shallow debris flow may occur.
1081	2	P	2	0.034	1970		LP-70 220-43-51	1		1	92.56	Y	4	En(sk)			The polygon delineates an inner gorge along which shallow debris flow may occur.
1083	1	P	5	1.809	1970		LP-70 220-43-51	16		2	37.45	Y	4	En(sk)			Hillslope segment along which shallow-undifferentiated landslide occur. The co-existence of shallow undifferentiated landslides, and cut river bank erosion is not discarded.
1084	1	Q	5	1.514	1970		LP-70 220-43-51	16		2	21.27	Y	4	En(sk)			Polygon along which shallow-undifferentiated landslide may occur. The co-existence of shallow undifferentiated landslides, and cut river bank erosion is not discarded.
1089	1	D	3	0.068	1970		LP-70 220-42-51	14		2	6.79	Y	9	Qa			Meander bend failure. Failure no longer adjacent to river due to meander migration.
1091	2	D	3	0.227	1970		LP-70 220-42-51	1		1	72.20	Y	2	En(sk)			The polygon delineates an inner gorge along which shallow debris flow may occur.
1092	2	D	3	0.144	1970		LP-70 220-42-51	12		1	55.52	Y	1	En(sk)			The polygon delineates an inner gorge along which shallow debris flow may occur.
1093	2	P	3	0.159	1970		LP-70 220-42-51	1		1	61.14	Y	5	En(sk)			The polygon delineates an inner gorge along which shallow debris flow may occur.
1094	2	D	2	0.074	1970		LP-70 220-42-51	11		1	78.01	Y	4	En(sk)			The polygon delineates stream along which shallow debris flow may occur.
1096	2	P	4	0.456	1970		LP-70 220-42-51	12		1	57.92	Y	4	Qa			Steep hillslope along which shallow debris flow may occur.
1114	4	P	5	5.665	1970		LP-70 220-41B-44	16		1	33.03	Y	4	OEm(lc)	RE	I	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1117	1	D	3	0.364	1970		LP-70 220-41B-44	14		2	2.81	Y	1	Qa			Meander bend failure.
1123	2	P	2	0.044	1970		LP-70 220-41B-44	16		1	23.83	Y	4	En(sk)			Stream along which shallow debris slide may occur.
1125	2	D	4	0.448	1970		LP-70 220-41B-43	10		1	44.40	Y	4	OEm(lc)			Stream along which shallow debris slide may occur.

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1126	2	D	3	0.203	1970		LP-70 220-41B-43	1		1	56.76	Y	4	OEm(lc)			The polygon delineates an inner gorge along which shallow debris slide may occur.
1127	4	D	5	9.349	1970		LP-70 220-41B-43	7		2	43.70	Y	4	En(sk)	DI	RO	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1141	1	D	2	0.087	1970		LP-70 220-41B-41	1		2	48.89	Y	5	En(sk)			Area along which a shallow-undifferentiated landslide may occur.
1146	2	P	3	0.208	1970		LP-70 220-41B-41	1		1	72.14	Y	4	En(sk)			The polygon delineates an inner gorge along which shallow debris flow may occur.
1147	1	D	5	1.678	1970		LP-70 220-41B-41	11		2	90.16	Y	4	En(sk)			Area along which a shallow-undifferentiated landslide may occur.
1150	4	D	5	12.244	1970		LP-70 220-41B-41	12		2	57.38	Y	4	OEm(lc) and En(sk)	DI	RO	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1162	1	D	2	0.067	1970		LP-70 220-40B-43	14		2	2.09	Y	9	Qa			Meander bend failure.
1163	1	P	3	0.125	1970		LP-70 220-40B-43	14		2	1.57	Y	9	Qa			Meander bend failure. Failure no longer adjacent to river due to meander migration.
1164	1	P	3	0.174	1970		LP-70 220-40B-43	14		2	3.98	Y	9	Qa			Meander bend failure. Failure no longer adjacent to river due to meander migration.
1168	1	P	3	0.198	1970		LP-70 220-40B-43	11		1	65.18	Y	1	OEm(lc)			The polygon outlines an area affected by shallow-undifferentiated landslide.
1169	1	P	3	0.187	1970		LP-70 220-40B-43	12		1	53.39	Y	1	OEm(lc)			The polygon outlines an area affected by shallow-undifferentiated landslide.
1192	1	P	3	0.208	1970		LP-70 220-40B-37	16		1	31.04	P	4	Em(2m)			Area affected by shallow-undifferentiated landslide.
1193	1	Q	4	0.709	1970		LP-70 220-40B-37	11		1	90.88	P	4	Em(2m)			Area affected by shallow-undifferentiated landslide.
1197	3	Q	5	3.342	1970		LP-70 220-40B-37	15		4	14.06	Y	5	Em(2m)			Area affected by shallow debris slide.
1200	1	P	4	0.614	1970		LP-70 220-40B-36	11		1	87.42	Y	9	Em(2m) and En(sk)			Area affected by shallow-undifferentiated landslide.
1201	1	D	3	0.182	1970		LP-70 220-40B-36	16		2	29.20	Y	9	Em(2m)			Bank failure.
1203	1	D	3	0.145	1970		LP-70 220-40B-36	11		3	65.52	Y	9	Em(2m)			Bank failure.
1204	1	P	4	0.742	1970		LP-70 220-40B-36	12		3	59.10	Y	9	Em(2m)			Bank failure.
1211	4	P	5	8.370	1970		LP-70 221-39-58	12		2	46.25	Y	4	OEm(lc)	DD	RO	Area affected by a dormant deep-seated landslide.
1217	3	D	2	0.087	1970		LP-70 221-39-58	11		1	66.94	Y	4	OEm(lc)			The polygon delineates a stream along which shallow debris flow may occur.
1218	1	D	2	0.078	1970		LP-70 221-39-58	14		3	1.65	Y	9	Qa			Meander bend failure. Failure no longer adjacent to river due to meander migration.
1251	1	D	3	0.400	1970		LP-70 221-39-58	14		2	1.65	Y	9	Qa			Shallow-undifferentiated landslides.
1265	4	P	5	13.724	1970		LP-70 221-39-55	16		2	31.85	Y	3	En(sk)	DD	RO	The polygon outlines an area affected by a dormant deep-seated landslide.

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1266	4	P	5	12.062	1970		LP-70 221-39-55	12		2	29.24	Y	3	En(sk)	DD	RO	The polygon outlines an area affected by a dormant deep-seated landslide.
1270	4	P	5	5.662	1970		LP-70 221-39-55	15		2	24.18	Y	4	En(sk)	DD	RO	The polygon outlines an area affected by a dormant deep-seated landslide.
1277	4	P	5	33.414	1970		LP-70 221-39-50	12		2	42.08	Y	3	Em(2m)	DI	RO	The polygon outlines an area affected by a dormant deep-seated landslide.
1279	1	P	3	0.185	1970		LP-70 221-39-50	12		2	64.62	Y	3	Ev(c)			Hillslope where shallow-undifferentiated landslides occur.
1281	1	D	2	0.086	1970		LP-70 221-39-50	11		1	73.18	Y	3	Ev(c)			Steep slope where shallow-undifferentiated landslides occur.
1282	1	D	2	0.097	1970		LP-70 221-39-50	12		1	58.96	Y	3	Ev(c)			Hillslope where shallow-undifferentiated landslides occur.
1283	1	Q	1	0.016	1970		LP-70 221-39-50	12		1	38.83	Y	3	Ev(c)			Hillslope where shallow-undifferentiated landslides occur.
1284	4	P	5	10.694	1970		LP-70 221-39-50	16		2	22.87	P	5	Ev(c)	DD	RO	The polygon outlines an area affected by a dormant deep-seated landslide.
1293	1	P	5	2.730	1970		LP-70 221-38B-42	5		1	81.46	Y	4	Ev(c)			Steep slope where shallow-undifferentiated landslides occur.
1299	1	Q	3	0.384	1970		LP-70 221-38B-42	12		1	72.25	Y	3	OEm(lc)			Steep slope where shallow-undifferentiated landslides occur.
1303	1	P	4	0.665	1970		LP-70 221-38B-42	12		1	92.48	Y	4	OEm(lc)			Steep slope where shallow-undifferentiated landslides occur.
1306	1	P	5	2.193	1970		LP-70 221-38B-42	11		1	77.71	P	5	OEm(lc)			The polygon outlines an area affected by shallow-undifferentiated landslides.
1307	1	P	5	2.400	1970		LP-70 221-38B-42	1		1	102.34	P	5	OEm(lc)			The polygon outlines an area affected by shallow-undifferentiated landslides.
1310	4	P	5	87.114	1970		LP-70 221-39-40	16		2	25.92	P	3	En(sk)	DI	RO	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1312	1	D	4	0.642	1970		LP-70 221-38B-40	12		2	91.29	P	3	Em(2m)			Steep slope where shallow-undifferentiated landslides occur.
1313	1	D	4	0.889	1970		LP-70 221-38B-40	12		5	91.90	Y	2	Em(2m)			Steep slope where shallow-undifferentiated landslides occur.
1316	2	P	1	0.005	1970		LP-70 221-38B-40	12		1	55.07	P	5	Em(2m)			Steep slope where shallow-undifferentiated landslides occur.
1320	3	P	3	0.265	1970		LP-70 221-38B-38	11		1	81.86	P	3	Ev(c)			Steep slope where shallow-undifferentiated landslides occur.
1321	3	P	5	1.261	1970		LP-70 221-38B-38	11		1	96.41	P	5	Ev(c)			Steep slope where shallow-undifferentiated landslides occur.
1322	3	Q	3	0.243	1970		LP-70 221-38B-38	1		2	56.45	Y	3	Ev(c)			Steep slope where shallow-undifferentiated landslides occur.
1323	1	P	3	0.402	1970		LP-70 221-38B-38	12		5	102.40	P	3	Ev(c)			
1326	1	P	3	0.289	1970		LP-70 221-38B-38	10		1	58.41	P	5	Ev(c)			Steep slope where shallow-undifferentiated landslides occur.
1330	4	P	5	22.557	1970		LP-70 221-38B-36	12		2	42.87	P	4	Ev(c)	DI	RO	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.

1331	1	P	2	0.068	1970		LP-70 221-38B-36	11		1	70.21	P	4	Ev(c)			Steep slope where shallow-undifferentiated landslides occur.
1332	1	P	2	0.094	1970		LP-70 221-38B-36	12		1	59.03	P	4	Ev(c)			Hillslope where shallow-undifferentiated landslides occur.
1334	1	D	3	0.375	1970		LP-70 221-38B-38	1		1	70.56	Y	4	Ev(c)			Steep slope where shallow-undifferentiated landslides occur.
1339	1	P	4	0.519	1970		LP-70 207-36-54 / GH-72-473 48-4	11		1	90.37	Y	3	OEm(lc)			Steep slope where shallow-undifferentiated landslides occur.
1340	1	P	3	0.191	1970		LP-70 207-36-54 / GH-72-473 48-4	11		1	90.06	Y	3	OEm(lc)			Steep slope where shallow-undifferentiated landslides occur.
1341	1	P	3	0.329	1970		LP-70 207-36-54 / GH-72-473 48-4	12		1	99.78	I	3	OEm(lc)			Steep slope where shallow-undifferentiated landslides occur.
1343	1	P	3	0.313	1972		GH-72-473 48-2	11		2	100.69	P	3	Ev(c)			Steep slope where shallow-undifferentiated landslides occur.
1345	3	P	3	0.246	1972		GH-72-473 48-2	1		2	90.14	P	3	Em(2m)			Steep slope where shallow debris landslides occur.
1347	1	Q	2	0.102	1972		GH-72-473 48-4	11		1	78.59	Y	5	OEm(lc)			Steep slope where shallow-undifferentiated landslides occur.
1351	2	P	3	0.275	1972		GH-72-473 48-4	11		1	55.24	I	1	OEm(lc)			Steep slope where shallow-undifferentiated landslides and/or debris flow occur.
1353	4	D	5	19.195	1972		GH-72-473 48-4	16		1	27.97	P	5	OEm(lc)	DI	I	Area affected by a dormant indistinct deep-seated landslide. Field reconnaissance 8-1-07
1356	4	D	5	26.323	1972		GH-72-473 48-4	7		2	61.13	I	4	OEm(lc)	DI	RO	Area affected by a dormant indistinct deep-seated landslide. Field reconnaissance 8-1-07
1357	4	D	5	56.887	1972		GH-72-473 48-6	12		2	17.45	I	4	OEm(lc)	DI	RO	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1358	7	P	4	14.259	1972		GH-72-473 48-6	16		2	24.31	P	3	OEm(lc)	DI	EF	The polygon outlines an area affected by a dormant indistinct earthflow.
1359	4	P	5	46.097	1972		GH-72-473 48-6	16		2	24.40	P	3	OEm(lc)	DI	RO	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1360	7	P	4	21.019	1972		GH-72-473 48-6	15		2	16.12	I	3	OEm(lc)	DI	EF	The polygon outlines an area affected by a dormant indistinct earthflow.
1361	7	Q	5	74.800	1972		GH-72-473 48-6	15		2	20.11	P	3	OEm(lc)	DD	EF	The polygon outlines an area affected by a dormant distinct earthflow.
1362	4	P	5	45.657	1972		GH-72-473 48-6	12		2	46.17	I	3	OEm(lc)	DI	RO	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1363	4	Q	3	1.848	1972		GH-72-473 48-8	12		2	46.73	P	5	OEm(lc)	DI	I	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1365	7	P	5	79.793	1972		GH-72-473 48-8	12		2	32.68	P	3	OEm(lc)	DD	EF	The polygon outlines an area affected by a dormant distinct earthflow
1368	7	P	5	24.558	1972		GH-72-473 48-4	11		2	59.10	P	3	OEm(lc)	DD	EF	The polygon outlines an area affected by a dormant distinct earthflow.

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1369	1	P	4	0.554	1972		GH-72-473 48-4	1		2	92.45	P	4	OEm(lc)			Steep slope where shallow-undifferentiated landslides occur.
1371	1	P	3	0.178	1972		GH-72-473 48-4	1		2	105.23	P	4	OEm(lc)			Steep slope where shallow-undifferentiated landslides occur.
1374	1	P	3	0.168	1972		GH-72-473 48-4	1		1	76.99	P	4	OEm(lc)			Steep slope where shallow-undifferentiated landslides occur.
1380	1	P	4	0.479	1972		GH-72-473 49-6	1		2	74.45	P	4	OEm(lc)			Steep slope where shallow-undifferentiated landslides occur.
1381	1	P	4	0.717	1972		GH-72-473 49-6	12		1	90.96	P	3	OEm(lc)			Steep slope where shallow-undifferentiated landslides occur.
1382	1	P	4	0.596	1972		GH-72-473 49-6	1		1	68.92	P	3	OEm(lc)			Steep slope where shallow-undifferentiated landslides occur.
1383	1	P	3	0.328	1972		GH-72-473 49-6	12		1	82.89	P	3	OEm(lc)			Steep slope where shallow-undifferentiated landslides occur.
1385	4	Q	5	48.079	1972		GH-72-473 49-6	12		2	28.02	Y	2	OEm(lc)	DI	I	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1387	1	P	4	0.664	1970		GH-72-475 50-6	11		2	93.30	P	3	OEm(lc)			Hillslope where shallow-undifferentiated landslides occur.
1391	4	P	5	38.796	1972		GH-72-475 50-6	16		2	34.43	I	3	OEm(lc)	DI	I	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1395	1	P	4	0.493	1972		GH-72-475 50-6	12		2	89.71	I	3	OEm(lc)			Hillslope where shallow-undifferentiated landslides occur.
1402	1	P	4	0.452	1972		GH-72-475 50-6	12		1	60.06	P	3	OEm(lc)			Hillslope where shallow-undifferentiated landslides occur.
1403	1	P	3	0.251	1972		GH-72-475 50-6	12		1	53.56	P	3	OEm(lc)			Hillslope where shallow-undifferentiated landslides occur.
1405	4	Q	5	3.764	1972		GH-72-475 51-6	16		2	33.38	P	3	OEm(lc)	DI	I	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1406	4	P	5	7.123	1972		GH-72-475 51-6	1		2	70.06	P	3	OEm(lc)	RE	I	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1411	4	P	5	16.491	1972		GH-72-475 51-6	12		2	46.78	P	3	OEm(lc)	RE	I	The polygon outlines an area affected by a relict indistinct deep-seated landslide.
1412	2	P	3	0.201	1972		GH-72-475 51-6	1		1	41.75	P	3	OEm(lc)			The polygon delineates an inner gorge along which shallow debris flow may occur.
1418	1	D	3	0.109	1972		GH-72-508 52-4	12		2	54.20	P	3	OEm(lc)			Hillslope where shallow-undifferentiated landslides occur.
1419	1	D	3	0.245	1970		GH-72-508 52-4	11		2	75.34	P	3	OEm(lc)			Steep slope where shallow-undifferentiated landslides occur.
1426	1	D	3	0.292	1970		GH-72-508 52-4	11		2	68.09	Y	4	En(sk)			Steep slope where shallow-undifferentiated landslides occur.
1428	7	P	5	120.780	1972		GH-72-508 53A-6	15		2	28.75	P	4	Em(2m) and En(sk)	DI	EF	The polygon outlines an area affected by a dormant indistinct earthflow
1432	4	P	3	2.628	1970		LP-70 214-46-51	11		2	59.32	P	3	Ev(c)and Qa	DI	RO	Dormant indistinct deep-seated landslide. Stream and railroad Adj.
1433	4	D	5	40.906	1970		LP-70 214-44-51	12		2	37.11	P	4	En(sk)	DD	RO	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.

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1436	4	P	4	11.501	1970		LP-70 214-44-51	12		2	31.01	P	4	En(sk)	DD	RO	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1438	4	D	5	13.294	1970		LP-70 214-44-51	16		2	28.33	Y	4	En(sk)	DI	RO	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1439	4	Q	5	68.966	1970		LP-70 214-44-51	16		2	26.25	P	3	En(sk)	RE	I	The polygon outlines an area affected by a relict deep-seated landslide.
1440	4	P	5	22.751	1970		LP-70 220-43-53	15		2	34.99	P	3	En(sk)	DI	RO	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1442	1	P	3	0.154	1970		LP-70 220-41B-43	1		2	69.20	P	4	En(sk)			
1443	4	P	5	11.299	1970		LP-70 220-41B-43	15		2	15.86	Y	3	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1444	4	P	5	7.135	1970		LP-70 221-39-58	12		2	47.77	Y	3	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1445	4	P	4	2.545	1970		LP-70 221-39-58	16		2	31.76	Y	1	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1446	4	P	4	1.525	1970		LP-70 221-39-58	16		2	14.78	Y	1	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1447	4	P	4	2.022	1970		LP-70 221-39-58	16		2	25.98	Y	1	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1448	4	P	5	14.350	1970		LP-70 221-39-58	12		2	42.41	Y	4	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1449	2	D	3	0.177	1970		LP-70 221-39-58	1		2	73.84	Y	1	OEm(lc)			Steep slope along which debris flow and shallow undifferentiated landslides occur.
1450	4	D	3	2.669	1970		LP-70 221-39-55	16		2	35.13	Y	3	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1451	4	D	2	1.315	1970		LP-70 221-39-55	12		2	55.90	Y	3	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1452	4	D	2	1.982	1970		LP-70 221-39-55	12		2	45.70	Y	3	En(sk)	DI	RO	Dormant indistinct deep-seated landslide.
1453	4	D	3	1.316	1970		LP-70 221-39-55	16		2	17.74	Y	3	En(sk)	DI	RO	Dormant indistinct deep-seated landslide.
1454	4	P	5	14.266	1970		LP-70 221-39-55	16		2	27.19	Y	4	En(sk)	DI	RO	Dormant indistinct deep-seated landslide.
1455	4	D	5	7.703	1970		LP-70 221-39-55	12		2	44.52	Y	4	En(sk)	DI	RO	Dormant indistinct deep-seated landslide.
1456	4	D	5	7.629	1970		LP-70 221-39-55	12		2	33.04	Y	4	En(sk)	DI	RO	Dormant indistinct deep-seated landslide.
1457	4	D	5	4.923	1970		LP-70 221-39-55	12		2	35.38	Y	4	En(sk)	DI	RO	Dormant indistinct deep-seated landslide.
1458	4	D	5	6.597	1970		LP-70 221-39-55	12		2	46.05	Y	4	En(sk)	DI	RO	Dormant indistinct deep-seated landslide.
1459	4	D	4	4.408	1970		LP-70 221-39-55	12		2	29.29	Y	4	En(sk)	DI	RO	Dormant indistinct deep-seated landslide.
1460	4	D	2	1.024	1970		LP-70 221-39-55	11		2	76.79	Y	4	En(sk)	DI	RO	Dormant indistinct deep-seated landslide.
1461	4	P	5	4.908	1970		LP-70 220-40B-36	12		2	56.39	Y	3	Em(2m)	DI	RO	Dormant indistinct deep-seated landslide.
1462	7	P	4	3.054	1970		LP-70 220-40B-36	12		2	50.31	Y	3	Em(2m)	DI	EF	The polygon outlines an area affected by a dormant indistinct earthflow.
1463	7	D	4	4.297	1970		LP-70 220-40B-36	12		2	40.39	Y	4	Em(2m)	DI	EF	The polygon outlines an area affected by a dormant indistinct earthflow.
1464	7	D	5	15.497	1970		LP-70 220-40B-36	12		2	39.95	Y	4	Em(2m)	DI	EF	The polygon outlines an area affected by a dormant indistinct earthflow.
1465	1	D	3	0.294	1970		LP-70 221-39-53	16		2	41.27	Y	4	Em(2m)			Hillslope where shallow-undifferentiated landslides occur.

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1466	1	D	4	0.424	1970		LP-70 221-39-53	11		2	98.41	Y	4	Em(2m)			Hillslope where shallow-undifferentiated landslides occur.
1467	4	P	5	14.072	1970		LP-70 221-39-53	12		2	27.22	Y	4	Ev(c) and Em(2m)	DI	I	Dormant indistinct deep-seated landslide.
1469	4	P	5	13.031	1970		LP-70 221-39-53	12		2	51.54	Y	4	Em(2m)	DI	I	Dormant indistinct deep-seated landslide.
1470	4	P	5	22.458	1970		LP-70 221-39-53	12		2	54.37	Y	4	Ev(c) and Em(2m)	DI	I	Dormant indistinct deep-seated landslide.
1471	4	P	2	1.322	1970		LP-70 221-39-53	11		2	84.00	Y	4	Em(2m)	DI	I	Dormant indistinct deep-seated landslide.
1472	4	P	5	7.962	1970		LP-70 221-39-53	16		2	36.24	Y	4	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1473	4	P	4	1.480	1970		LP-70 221-39-53	11		2	87.82	Y	4	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1474	4	P	4	2.985	1970		LP-70 221-39-53	12		2	65.11	Y	4	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1475	4	P	3	1.450	1970		LP-70 221-39-53	12		2	63.80	Y	4	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1476	4	P	3	2.522	1970		LP-70 221-39-50	11		2	55.90	Y	4	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1477	4	P	5	11.503	1970		LP-70 221-39-50	12		2	46.75	Y	4	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1478	4	P	3	4.385	1970		LP-70 221-39-50	1		2	65.23	Y	4	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1479	4	P	4	3.544	1970		LP-70 221-39-50	12		2	60.53	Y	4	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1480	4	P	5	6.446	1970		LP-70 221-39-50	11		2	61.75	Y	4	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1481	1	Q	2	0.066	1972		GH-72-508 53A-6	16		2	24.17	P	3	En(sk)			Hillslope where shallow-undifferentiated landslides occur.
1482	1	Q	3	0.132	1972		GH-72-508 53A-6	16		2	28.63	P	3	En(sk)			Hillslope where shallow-undifferentiated landslides occur.
1483	1	Q	3	0.146	1972		GH-72-508 53A-6	16		2	31.92	P	3	En(sk)			Hillslope where shallow-undifferentiated landslides occur.
1484	1	Q	2	0.078	1972		GH-72-508 53A-6	16		2	25.39	P	3	En(sk)			Hillslope where shallow-undifferentiated landslides occur.
1485	4	Q	3	1.183	1972		GH-72-508 53A-6	16		2	22.74	Y	3	En(sk)	DI	I	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1486	2	D	3	0.322	1972		GH-72-508 53A-6	12		1	84.26	Y	4	OEm(lc)			The polygon delineates a steep slope segment along which shallow debris flow occur. 1970 aerial photos showed probable debris deposits which is extended as lobate toe at the base.
1487	4	P	5	25.817	1972		GH-72-508 54-5	16		2	35.76	Y	3	En(sk)	DI	I	Dormant indistinct deep-seated landslide.
1488	4	P	5	7.205	1972		GH-72-508 54-5	12		2	48.87	Y	4	En(sk)	DI	I	Dormant indistinct deep-seated landslide.
1489	2	D	4	0.548	1972		GH-72-508 54-5	12		1	81.31	Y	3	En(sk)			The polygon delineates an inner gorge along which shallow debris flow may occur. The gorge is inside of a probable deep-seated landslide.
1490	4	D	4	4.302	1972		GH-72-508 54-5	7		2	61.81	Y	3	En(sk)	DI	RO	Dormant indistinct deep-seated landslide. Possible inset of multiple small shallow landslides. Stream and railroad Adj.
1491	4	D	4	2.423	1972		GH-72-508 54-5	7		2	72.50	Y	3	En(sk)	DI	RO	Dormant indistinct deep-seated landslide. Possible inset of multiple small shallow landslides. Stream and railroad Adj.

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1492	4	D	5	9.935	1972		GH-72-508 54-5	7		2	52.74	Y	3	En(sk)	DI	RO	Dormant indistinct deep-seated landslide. Possible inset of multiple small shallow landslides. Stream and railroad Adj.
1493	4	P	4	5.398	1972		GH-72-508 54-5	16		2	29.04	Y	3	En(sk) and Qa	RE	I	Relict landslide.
1494	4	Q	5	24.464	1972		GH-72-508 52-4	12		2	39.94	Y	3	OEm(lc)	DI	I	Dormant indistinct deep-seated landslide.
1495	4	P	4	4.158	1972		GH-72-508 52-4	12		2	44.59	Y	3	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1496	4	P	3	3.761	1972		GH-72-475 50-6	12		2	28.79	Y	3	OEm(lc)	DI	I	Dormant indistinct deep-seated landslide.
1497	4	P	5	6.928	1972		GH-72-475 50-6	11		2	58.66	Y	3	OEm(lc)	DI	I	Dormant indistinct deep-seated landslide.
1498	2	P	3	0.234	1972		GH-72-473 49-8	2		2	63.94	Y	4	OEm(lc)			The polygon delineates an inner gorge along which shallow debris flow may occur.
1499	3	Q	5	1.747	1970		LP-70 221-38B-42	1		2	106.19	Y	2	OEm(lc)			The polygon delineates a slope segment along which shallow slide may occur.
1500	3	Q	5	1.773	1970		LP-70 221-38B-42	1		2	107.94	Y	2	OEm(lc)			The polygon delineates a slope segment along which shallow slide may occur.
1501	4	P	4	3.202	1970		LP-70 221-38B-42	1		2	81.47	Y	3	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1503	7	P	5	48.275	1970		LP-70 221-38B-42	16		2	15.16	Y	3	OEm(lc)	DI	EF	Dormant indistinct earth flow.
1504	1	P	5	1.418	1970		LP-70 221-38B-42	11		2	15.23	Y	3	OEm(lc)			Hillslope where shallow-undifferentiated landslides occur.
1505	1	P	5	1.078	1970		LP-70 221-38B-42	1		1	80.88	Y	3	OEm(lc)			Hillslope where shallow-undifferentiated landslides occur.
1506	4	P	4	5.111	1970		LP-70 221-38B-42	12		2	46.04	Y	3	OEm(lc)	DI	I	Dormant indistinct deep-seated landslide.
1507	4	P	4	4.251	1970		LP-70 221-38B-42	16		2	23.81	Y	4	OEm(lc)	DI	I	Dormant indistinct deep-seated landslide.
1508	1	P	5	1.190	1970		LP-70 221-38B-42	12		5	53.78	Y	4	OEm(lc)			Hillslope where shallow-undifferentiated landslides occur.
1509	7	P	4	5.162	1970		LP-70 221-38B-42	1		2	40.90	Y	3	OEm(lc)	DI	EF	The polygon outlines an area affected by a dormant indistinct earthflow.
1510	4	P	5	4.402	1970		LP-70 221-38B-42	11		2	60.60	Y	4	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1511	4	P	5	6.093	1970		LP-70 221-38B-42	12		2	34.06	Y	4	En(sk) and OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1512	2	D	3	0.121	1970		LP-70 221-38B-42	1		1	61.86	Y	3	OEm(lc)			The polygon delineates a steep slope segment along which shallow debris flow occur.
1513	4	P	2	1.881	1972		GH-72-473 49-4	1		2	90.59	Y	4	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1514	4	P	3	2.211	1972		GH-72-473 49-4	12		2	54.20	Y	4	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1515	4	P	3	2.919	1972		GH-72-473 49-4	12		2	39.29	Y	4	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1516	3	P	4	0.589	1972		GH-72-473 48-6	11		2	67.40	Y	4	OEm(lc)			The polygon delineates a slope segment along which shallow slide may occur.
1517	4	P	3	1.706	1972		GH-72-473 48-4	12		2	38.41	Y	4	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1518	1	D	4	0.600	1972		GH-72-473 48-4	1		1	76.38	Y	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.

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1519	1	D	3	0.173	1972		GH-72-473 48-4	1		2	74.27	Y	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
1520	1	D	3	0.258	1972		GH-72-473 48-4	11		2	96.15	Y	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
1521	1	D	3	0.156	1972		GH-72-473 48-4	1		2	87.98	Y	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
1522	1	D	3	0.152	1972		GH-72-473 48-4	5		1	78.25	Y	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
1523	1	D	5	1.267	1970		LP-70 221-38B-40	11		1	74.03	Y	4	OEm(lc)			Shallow-undifferentiated landslide.
1524	1	D	5	1.291	1970		LP-70 221-38B-40	1		1	85.24	Y	4	OEm(lc)			Shallow-undifferentiated landslide.
1526	1	D	4	0.782	1970		LP-70 221-38B-40	1		1	89.02	Y	4	Ev(c)			Shallow-undifferentiated landslide.
1527	1	D	4	0.862	1970		LP-70 221-38B-40	11		1	81.67	Y	4	Ev(c)			Shallow-undifferentiated landslide.
1528	1	D	4	0.794	1970		LP-70 221-38B-40	12		2	69.81	Y	4	Ev(c)			Shallow-undifferentiated landslide.
1529	4	Q	5	20.237	1970		LP-70 221-38B-40	12		2	48.86	Y	2	Ev(c) and OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide.
1531	1	D	2	0.087	1970		LP-70 221-38B-40	11		2	84.05	Y	3	OEm(lc)			Shallow-undifferentiated landslide.
1532	4	D	5	6.262	1972		GH-72-473 48-2	7		2	53.34	P	2	OEm(lc)	DI	I	Field check. Active landslide. Cracks along road.
1533	4	D	5	17.527	1972		GH-72-473 48-2	7		2	54.84	P	4	OEm(lc)	DI	I	Field check. Active landslide. Cracks along road.
1534	4	Q	5	11.457	1972		GH-72-473 48-2	12		2	48.95	P	4	OEm(lc)	RE	I	The polygon outlines an area affected by a relict deep-seated landslide.
1535	4	D	3	0.715	1972		GH-72-473 48-2	11		2	69.50	P	3	OEm(lc)	DI	RO	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
1536	1	D	3	0.242	1972		GH-72-473 48-2	12		2	79.11	Y	3	OEm(lc)			Shallow-undifferentiated landslide.
1537	1	D	3	0.295	1972		GH-72-473 48-2	12		1	77.04	Y	3	OEm(lc)			Shallow-undifferentiated landslide.
1538	1	D	4	0.439	1972		GH-72-473 48-2	16		1	63.32	Y	3	OEm(lc)			Shallow-undifferentiated landslide.
1539	1	D	4	0.422	1972		GH-72-473 48-2	11		2	74.07	Y	3	OEm(lc)			Shallow-undifferentiated landslide.
1540	4	Q	4	3.006	1970		LP-70 207-36-54	5		2	52.85	P	3	OEm(lc)	DI	I	Dormant indistinct deep-seated landslide.
1541	4	D	3	2.669	1970		LP-70 207-36-54	11		2	63.80	Y	3	OEm(lc)	DI	I	Dormant indistinct deep-seated landslide.
1542	4	D	4	2.877	1970		LP-70 207-36-54	16		2	38.01	Y	3	OEm(lc)	DI	I	Dormant indistinct deep-seated landslide.
1543	4	D	5	4.165	1970		LP-70 207-36-54	11		2	56.74	Y	4	OEm(lc)	DI	I	Dormant indistinct deep-seated landslide.
1544	4	D	5	7.177	1970		LP-70 207-36-54	12		2	49.60	Y	4	OEm(lc)	DI	I	Field check.
1545	4	D	4	3.504	1970		LP-70 221-38B-38	12		2	34.89	Y	3	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide.
1546	4	D	5	1.845	1970		LP-70 221-38B-38	12		2	43.78	Y	3	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1547	4	D	5	3.828	1970		LP-70 221-38B-38	16		2	29.91	Y	3	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide.
1548	2	D	3	0.120	1970		LP-70 221-38B-38	1		1	77.22	Y	4	Ev(c)			Steep slope where debris flow and shallow-undifferentiated landslides occur.
1549	4	Q	5	11.132	1970		LP-70 221-38B-38	11		2	44.60	Y	4	Ev(c) and Em(2m)	RE	I	Relict deep-seated landslide.

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1550	4	D	5	3.118	1970		LP-70 221-38B-38	11		2	82.87	Y	3	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1551	4	D	5	6.491	1970		LP-70 221-38B-38	12		2	55.26	Y	2	Ev(c)	DD	RO	Dormant distinct deep-seated landslide.
1552	4	D	5	16.380	1970		LP-70 221-38B-38	12		2	48.37	Y	2	Ev(c)	DD	RO	Dormant distinct deep-seated landslide.
1553	4	D	5	3.833	1970		LP-70 221-38B-38	12		2	34.68	Y	4	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide.
1554	4	D	3	0.974	1970		LP-70 221-38B-38	12		2	45.79	Y	4	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide.
1555	4	D	4	2.194	1970		LP-70 221-38B-38	7		2	30.39	Y	4	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide.
1556	4	D	5	6.285	1970		LP-70 221-38B-38	11		2	60.16	Y	3	Ev(c)	DD	RO	Dormant distinct deep-seated landslide.
1557	4	D	4	4.515	1970		LP-70 221-38B-38	11		2	49.33	Y	3	Ev(c)	DD	RO	Dormant distinct deep-seated landslide.
1558	4	P	5	10.066	1970		LP-70 221-38B-38	11		2	54.27	Y	4	Ev(c)	RE	I	Relict deep-seated landslide.
1559	4	D	5	13.587	1970		LP-70 221-38B-38	11		2	71.24	Y	4	Ev(c)	RE	I	Relict deep-seated landslide.
1560	2	D	5	5.203	1970		LP-70 221-38B-38	16		2	65.95	Y	4	Ev(c)			Steep slope where shallow-undifferentiated landslides occur.
1561	1	D	4	0.686	1972		LP-70 221-38B-38	1		2	60.42	Y	4	Ev(c)			Shallow-undifferentiated landslide.
1562	4	D	5	3.331	1970		LP-70 221-38B-38	12		2	47.80	Y	3	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1563	4	D	4	1.663	1970		LP-70 221-38B-38	12		2	54.67	Y	2	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1564	4	D	4	6.447	1970		LP-70 221-38B-38	12		2	58.31	Y	3	Ev(c)	DD	RO	Dormant distinct deep-seated landslide.
1565	4	D	4	1.079	1970		LP-70 221-38B-38	12		2	69.50	Y	3	Ev(c)	DD	RO	Dormant distinct deep-seated landslide.
1566	4	D	4	2.071	1970		LP-70 221-38B-38	1		2	71.69	Y	4	Ev(c)	DD	RO	Dormant distinct deep-seated landslide.
1567	4	D	3	2.160	1970		LP-70 221-38B-38	12		2	47.12	Y	4	Ev(c)	DD	RO	Dormant distinct deep-seated landslide.
1568	4	D	5	2.087	1970		LP-70 221-38B-38	11		2	65.98	Y	4	Ev(c)	DD	I	Dormant distinct deep-seated landslide.
1569	2	D	3	0.144	1970		LP-70 221-38B-38	11		1	79.44	Y	4	Ev(c)			Steep slope where debris flow and shallow-undifferentiated landslides occur.
1570	4	D	5	1.605	1970		LP-70 221-38B-38	11		2	55.50	Y	4	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1571	4	D	4	0.838	1970		LP-70 221-38B-38	12		2	30.84	Y	4	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1572	4	D	4	0.629	1970		LP-70 221-38B-38	12		2	44.42	Y	4	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1573	1	D	4	0.535	1972		LP-70 221-38B-38	11		2	111.48	Y	4	Ev(c)			Shallow-undifferentiated landslide.
1574	4	D	3	0.250	1970		LP-70 221-38B-38	11		2	64.17	Y	4	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1575	4	D	3	0.376	1970		LP-70 221-38B-38	12		2	65.38	Y	4	Ev(c)	DI	I	Dormant indistinct deep-seated landslide.
1576	4	D	4	0.883	1970		LP-70 221-38B-38	11		2	72.39	Y	4	Ev(c)	DD	RO	Dormant distinct deep-seated landslide.
1577	4	D	4	1.653	1970		LP-70 221-38B-38	12		2	45.17	Y	4	Ev(c)	DD	RO	Dormant distinct deep-seated landslide.
1578	4	D	3	1.088	1970		LP-70 221-38B-38	11		2	92.39	Y	4	Ev(c)	DD	RO	Dormant distinct deep-seated landslide.
1579	1	D	4	0.904	1972		LP-70 221-38B-38	12		1	53.73	Y	4	Ev(c)			Shallow-undifferentiated landslide.
1580	2	D	2	0.079	1970		LP-70 221-38B-38	16		1	27.27	Y	3	Ev(c)			Steep slope where shallow-undifferentiated landslides occur.

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1581	2	D	2	0.056	1970		LP-70 221-38B-38	12		1	45.09	Y	3	Ev(c)			Steep slope where shallow-undifferentiated landslides occur.
1584	4	D	4	1.427	1970		LP-70 221-38B-36	11		2	49.45	Y	4	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide.
1585	4	D	3	1.353	1970		LP-70 221-38B-36	12		2	41.51	Y	4	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide.
1586	4	D	4	3.380	1970		LP-70 221-38B-36	16		2	29.77	Y	4	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide.
1587	4	Q	5	2.654	1970		LP-70 221-38B-36	11		2	66.40	Y	4	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide.
1588	4	P	5	8.891	1970		LP-70 221-38B-36	12		2	50.15	Y	4	Ev(c)	DI	RO	Dormant distinct deep-seated landslide.
1589	4	P	5	6.610	1970		LP-70 221-38B-36	12		2	52.89	Y	4	Ev(c)	DI	RO	Dormant distinct deep-seated landslide.
1590	4	D	4	1.632	1970		LP-70 221-38B-36	11		2	50.93	Y	4	Ev(c)	DD	RO	Dormant distinct deep-seated landslide.
1591	2	D	3	0.137	1970		LP-70 221-38B-36	11		2	69.15	Y	4	Ev(c)			Steep slope where shallow-undifferentiated landslides occur.
1592	4	D	3	0.361	1970		LP-70 221-38B-36	1		2	56.73	Y	4	Ev(c)	DI	RO	Dormant distinct deep-seated landslide.
1593	1	Q	4	0.486	1970		LP-70 221-38B-36	1		2	80.34	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
1594	4	P	4	2.868	1970		LP-70 221-38B-34	11		2	67.61	Y	1	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide.
1595	4	P	3	0.956	1970		LP-70 221-38B-34	12		2	58.67	Y	3	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide.
1596	4	D	3	1.606	1970		LP-70 221-38B-34	12		2	55.36	Y	3	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide.
1597	1	P	3	0.285	1970		LP-70 221-38B-34	12		2	69.66	Y	2	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
1598	1	P	3	0.121	1970		LP-70 221-38B-34	11		2	86.25	Y	2	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
1599	1	P	4	0.543	1970		LP-70 221-38B-34	11		1	85.13	Y	2	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
1600	4	P	2	0.777	1970		LP-70 221-38B-34	11		2	63.94	Y	4	Ev(c)	DI	RO	Dormant distinct deep-seated landslide.
1601	2	D	3	0.218	1970		LP-70 221-38B-34	12		1	65.93	Y	4	Ev(c)			The polygon delineates an inner gorge along which shallow debris flow may occur.
1602	1	Q	4	0.801	1970		LP-70 221-38B-34	1		2	79.46	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
1603	4	D	3	2.053	1970		LP-70 221-38B-34	12		2	56.85	Y	4	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide.
1604	1	P	5	3.106	1970		GH-72-473 47-2	1		2	82.59	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream outlet.
1605	1	P	5	1.932	1970		GH-72-473 47-2	1		2	67.00	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream outlet.
1606	2	D	3	0.168	1970		LP-70 221-38B-42	12		1	40.79	Y	3	OEm(lc)			Hillslope where debris flow occur.
1607	2	D	3	0.183	1970		LP-70 221-38B-36	11		1	80.55	Y	3	OEm(lc)			Hillslope where debris flow occur.
1608	2	D	2	0.045	1970		LP-70 221-38B-40	12		1	36.38	Y	2	Ev(c)			Debris flow
1609	1	D	4	0.536	1970		lLP-70 220 43-53	9		2	14.00	Y	9	Qa			
2002	7	P	5	160.910	1976		SW-H-76 SW-30	12		2	28.44	P	3	En(sk)	DI	EF	The polygon outlines an area affected by a dormant indistinct earthflow.
2008	2	D	3	0.232	1976		SW-H-76 SW-30	11		1	104.61	Y	1	OEm(lc)			The polygon delineates a steep slope segment along which debris flow occur.
2009	2	D	1	0.018	1976		SW-H-76 SW-30	1		1	46.74	Y	3	Ev(c)			The polygon delineates a steep slope segment along which debris flow occur.

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2010	2	D	3	0.156	1976		SW-H-76 SW-30	12		1	45.49	Y	3	Em(2m)			The polygon delineates a steep slope segment along which debris flow occur.
2011	2	D	2	0.043	1976		SW-H-76 SW-30	16		1	13.35	Y	1	OEm(lc)			The polygon delineates a steep slope segment along which debris flow occur.
3002	4	P	5	9.069	1964		LSW10-63	12		2	29.97	P	9	OEm(lc)	RE	I	Relict deep-seated landslide. Railroad and stream Adj.
3003	4	P	3	1.642	1993		LEW SW93 39-4619	12		2	48.88	P	3	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide. Stream and railroad Adj.
3004	4	P	3	1.268	1993		LEW SW93 39-4619	15		2	20.75	P	5	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide. Stream and railroad Adj.
3006	1	D	3	0.199	1993		LEW SW93 39-4619	11		2	75.69	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream and railroad Adj. Field check.
3007	1	D	3	0.266	1993		LEW SW93 39-4619	11		2	83.74	Y	4	Ev(c) and Qa			Rock falls, debris slide. Stream and railroad Adj. Field check.
3008	1	P	3	0.178	1993		LEW SW93 39-4619	11		2	79.21	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream and railroad Adj.
3009	1	P	3	0.220	1993		LEW SW93 39-4619	12		2	61.29	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream and railroad Adj.
3011	4	P	5	17.721	1964		LSW10-63	11		2	44.83	P	4	OEm(lc) and Ev(c)	DI	RO	Dormant indistinct deep-seated landslide. Stream and railroad Adj.
3019	1	D	4	0.499	1993		GH SW93 44-220	11		1	91.43	Y	3	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
3030	1	P	3	0.359	1993		GH SW93 20-43-222	11		2	83.77	Y	3	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
3032	1	D	3	0.179	1993		GH SW93 20-43-222	7		1	93.26	Y	3	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
3033	1	P	4	0.620	1993		GH SW93 20-43-222	12		2	60.24	Y	4	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
3034	1	Q	2	0.089	1993		GH SW93 20-43-222	12		2	53.41	Y	4	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
3035	1	Q	3	0.303	1993		GH SW93 20-43-222	12		2	64.51	Y	5	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
3037	1	Q	3	0.107	1993		GH SW93 20-43-220	16		2	39.32	Y	3	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
3045	1	Q	3	0.155	1993		GH SW93 20-42-186	10		1	41.94	Y	4	Em(2m)			Shallow-undifferentiated landslide. Stream Adj.
3046	1	Q	3	0.293	1993		GH SW93 31-41-5	12		2	50.46	P	3	En(sk)			Shallow-undifferentiated landslide.
3054	1	D	3	0.191	1993		GH SW93 31-41-5	2		1	58.24	P	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3059	1	P	3	0.151	1993		GH SW93 31-41-3	2		1	64.79	P	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3063	1	D	3	0.380	1993		GH SW93 31-41-1	11		1	102.37	P	3	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
3065	1	D	3	0.113	1993		GH SW93 31-41-1	1		2	73.36	Y	3	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
3067	1	P	3	0.372	1993		GH SW93 31-40-43	11		2	68.63	P	5	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3068	1	D	3	0.192	1993		GH SW93 31-40-43	12		1	59.14	Y	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3069	1	D	2	0.073	1993	1993	GH SW93 31-40-43	1		1	92.03	Y	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3071	1	Q	3	0.288	1993		GH SW93 31-40-43	11		2	90.70	P	3	OEm(lc)			Shallow-undifferentiated landslide
3072	1	D	2	0.033	1993		GH SW93 31-40-43	14		2	0.00	Y	9	Qa			Meander bend failure.

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3075	1	P	3	0.140	1993		GH SW93 31-40-43	11		1	78.28	P	5	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3083	1	Q	3	0.215	1993		GH SW93 31-40-43	12		2	44.41	P	3	OEm(lc)			Shallow-undifferentiated landslide.
3084	1	D	3	0.410	1993		GH SW93 31-40-43	12		1	65.65	P	3	OEm(lc)			Shallow-undifferentiated landslide.
3086	1	Q	3	0.275	1993		GH SW93 31-40-43	11		2	69.55	P	3	OEm(lc)			Shallow-undifferentiated landslide.
3090	1	P	4	0.574	1993		GH SW93 31-40-41	2		2	77.88	P	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3091	7	Q	5	121.742	1993		GH SW93 31-40-41	12		2	30.98	I	3	OEm(lc)	RE	EF	Area affected by an earthflow. Interpretation based on 1993 fly and hillshade
3092	7	P	5	55.860	1993		GH SW93 31-40-41	16		2	20.58	I	2	OEm(lc)	RE	EF	The polygon outlines an area affected by an earthflow. Interpretation based on 1993 fly and hillshade
3093	7	Q	5	83.126	1993		GH SW93 31-40-41	16		2	18.45	I	3	OEm(lc)	RE	EF	The polygon outlines an area affected by an earthflow. Interpretation based on 1993 fly and hillshade
3098	1	Q	3	0.241	1993		LEW SW93 33-40-125	1		4	54.01	Y	5	Ev(c)			Shallow-undifferentiated landslide.
3099	1	D	4	0.469	1993		GH SW93 31-39-81	1		1	82.47	Y	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3101	1	P	3	0.234	1993		GH SW93 31-39-81	2		1	86.93	P	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3102	1	Q	3	0.121	1993		GH SW93 31-39-81	1		2	60.65	P	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3105	1	D	3	0.274	1993		GH SW93 31-39-81	11		2	103.62	P	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3107	1	D	3	0.401	1993		GH SW93 31-39-81	11		2	98.96	Y	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3110	1	D	3	0.228	1993		GH SW93 31-39-79	1		1	62.46	Y	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3111	4	Q	5	23.094	1993		GH SW93 31-39-79	16		2	21.54	P	3	OEm(lc)	DI	I	Dormant indistinct deep-seated landslide. Road Adj.
3118	1	P	3	0.320	1993		LEW SW93 33-39-93	12		2	38.14	Y	3	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
3120	1	Q	3	0.312	1993		LEW SW93 33-39-91	11		4	76.08	I	5	Em(2m)			Shallow-undifferentiated landslide. Road Adj.
3126	1	P	4	0.651	1993		LEW SW93 33-39-89	11		1	111.50	P	3	Ev(c			Shallow-undifferentiated landslide. Stream Adj.
3128	1	Q	3	0.213	1993		LEW SW93 33-39-89	12		1	53.60	P	3	Ev(c			Shallow-undifferentiated landslide. Stream Adj.
3139	1	D	3	0.378	1993		GH SW93 31-38-113	1		1	52.47	Y	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3153	1	P	2	0.085	1993		GH SW93 31-38-113	1		1	66.89	P	2	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3155	1	P	3	0.200	1993		GH SW93 31-38-113	1		2	54.11	P	2	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3158	1	P	4	0.437	1993		GH SW93 31-38-111	1		1	88.28	Y	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3163	1	P	3	0.217	1993		GH SW93 31-38-111	1		1	82.45	Y	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3164	1	D	3	0.219	1993		LEW SW93 33-38-56	1		1	62.97	Y	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3165	1	P	3	0.107	1993		LEW SW93 33-38-56	1		1	71.32	Y	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3167	1	P	2	0.075	1993		LEW SW93 33-38-56	11		1	78.70	Y	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3176	1	Q	3	0.370	1993		LEW SW93 31-38-52	11		1	76.98	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
3178	1	P	3	0.237	1993		LEW SW93 31-38-52	12		1	45.99	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.

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3180	1	Q	3	0.405	1993		LEW SW93 31-38-52	2		1	88.78	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
3181	1	Q	4	0.532	1993		LEW SW93 31-38-52	7		1	55.48	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
3183	1	Q	3	0.208	1993		LEW SW93 31-38-52	16		1	49.80	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
3197	1	P	4	0.415	1993		GH SW93 31-37-144	1		1	55.85	Y	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3198	1	D	3	0.410	1993		GH SW93 31-37-144	1		1	41.82	Y	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3199	1	P	4	0.484	1993		GH SW93 31-37-144	1		1	84.20	Y	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3200	1	D	2	0.049	1993		GH SW93 31-37-144	2		1	60.34	Y	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3202	1	P	3	0.230	1993		GH SW93 31-37-144	12		1	53.60	Y	2	OEm(lc)			Shallow-undifferentiated landslide.
3203	1	P	4	0.501	1993		GH SW93 31-37-144	1		1	94.59	P	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3218	1	Q	3	0.398	1993		LEW SW93 33-37-25	11		1	74.51	Y	4	Ev(c)			Shallow-undifferentiated landslide.
3221	1	P	3	0.297	1993		LEW SW93 33-37-25	12		1	57.23	P	4	Ev(c)			Shallow-undifferentiated landslide.
3222	4	Q	5	21.765	1993		LEW SW93 33-37-25	11		2	53.12	P	4	Ev(c)	RE	I	Relict deep-seated landslide.
3223	1	D	2	0.096	1993		PAC SW93 32-36-233	11		1	72.79	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
3224	1	D	3	0.363	1993		PAC SW93 32-36-233	12		1	54.96	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
3225	1	D	2	0.067	1993		PAC SW93 32-36-233	12		1	42.32	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
3226	1	D	2	0.063	1993		PAC SW93 32-36-233	1		1	56.53	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
3227	1	P	3	0.121	1993		PAC SW93 32-36-233	1		1	71.96	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
3228	1	P	3	0.155	1993		PAC SW93 32-36-233	12		2	50.59	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
3229	1	P	3	0.117	1993		PAC SW93 32-36-233	12		1	49.29	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
3230	1	P	3	0.117	1993		PAC SW93 32-36-233	12		1	58.30	Y	4	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
3232	2	D	1	0.001	1993		GH SW93 18-45-183	16		1	35.10	Y	3	Ev(c)			Shallow debris flow occur.
3233	2	D	1	0.013	1993		GH SW93 18-45-183	1		1	52.30	Y	3	Ev(c)			Shallow debris flow occur.
3234	2	D	1	0.006	1993		GH SW93 18-45-183	2		1	43.64	Y	3	Ev(c)			Shallow debris flow occur.
3235	2	Q	1	0.002	1993		GH SW93 18-44-221	16		1	15.47	Y	3	En(sk)			Shallow debris flow occur.
3236	2	P	1	0.012	1993		GH SW93 18-44-221	16		1	24.90	Y	3	En(sk)			Shallow debris flow occur.
3237	4	P	4	1.918	1993		GH SW93 18-44-221	16		2	28.84	P	4	En(sk)	RE	I	Relict deep-seated landslide.
3238	7	P	5	105.364	1993		GH SW93 20-42-184	16		2	38.79	P	4	Em(2m) and En(sk)	DI	EF	The polygon outlines an area affected by a dormant indistinct earthflow
3239	7	P	5	50.953	1993		GH SW93 20-42-184	11		2	40.56	P	4	En(sk)	DI	EF	The polygon outlines an area affected by a dormant indistinct earthflow. Stream and railroad Adj.

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3240	7	P	5	14.016	1993		GH SW93 20-42-184	16		2	23.10	P	4	En(sk)	DI	RO	Dormant indistinct deep-seated landslide. Stream and railroad Adj.
3243	7	Q	5	22.085	1993		GH SW93 31-41-5	16		2	22.46	Y	3	En(sk)	DI	EF	The polygon outlines an area affected by a dormant indistinct earthflow.
3244	1	P	4	1.003	1993		GH SW93 31-41-5	11		2	108.61	P	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3245	1	Q	4	0.498	1993		GH SW93 31-40-43	11		2	64.11	P	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3246	1	P	3	0.320	1993		GH SW93 31-39-81	11		2	84.48	Y	3	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3247	1	P	3	0.213	1993		GH SW93 31-38-111	1		2	80.22	Y	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3248	1	P	5	2.033	1993		GH SW93 31-38-111	11		2	113.07	Y	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
3249	4	D	3	0.620	1993		GH SW93 31-37-144	11		2	80.90	Y	4	OEm(lc)	AR	RO	Active deep-seated landslide. Stream Adj.
3250	4	D	3	0.882	1993		LEW SW93 39-43-27	11		2	68.13	Y	3	En(sk)	AR	RO	Active deep-seated landslide. Stream Adj.
3251	1	P	2	0.082	1993		LEW SW93 33-40-127	16		2	18.13	Y	3	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
3252	4	P	3	1.188	1993		LEW SW93 33-39-89	16		2	29.72	Y	3	Ev(c)	AR	I	Active deep-seated landslide. Stream Adj.
3253	4	P	5	18.794	1993		LEW SW93 33-39-91	12		2	51.45	Y	3	Em(2m)	DI	I	Dormant indistinct deep-seated landslide.
4003	1	D	4	0.513	1999		LEW SW-C-99 55-54-26	11		2	94.62	Y	9	OEm(lc)			Shallow-undifferentiated landslide. Stream and railroad Adj.
4005	1	P	3	0.244	1999		LEW SW-C-99 55-54-26	12		1	61.87	Y	2	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
4008	1	D	4	0.559	1999		LEW SW-C-99 55-54-26	1		2	98.59	Y	3	Ev(c) and Qa			Rock falls, debris slide. Stream and railroad Adj. Field check.
4015	1	Q	2	0.042	1999		LEW SW-C-99 55-52-142	1		1	44.86	Y	3	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
4016	1	D	3	0.263	1999		LEW SW-C-99 55-52-142	11		2	86.44	Y	3	Ev(c)			Shallow-undifferentiated landslide.
4019	1	D	2	0.064	1999		LEW SW-C-99 55-52-142	7		2	18.93	P	3	En(sk)			Shallow-undifferentiated landslide.
4022	1	D	3	0.256	1999		GH SW-C-99 55-51-173	10		1	42.21	P	3	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
4023	1	P	2	0.034	1999		GH SW-C-99 55-51-173	1		1	74.35	Y	3	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
4032	1	D	2	0.051	1999		GH SW-C-99 55-50-234	1		1	81.80	Y	2	Em(2m)			Shallow-undifferentiated landslide.
4035	2	D	2	0.060	1999		GH SW-C-99 56-49-5	11		1	65.78	Y	2	Em(2m)			Shallow debris flow. Road Adj.
4037	1	Q	2	0.052	1999		GH SW-C-99 56-49-3	16		5	15.37	I	4	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
4039	1	D	2	0.032	1999		GH SW-C-99 56-49-1	11		3	70.80	Y	3	OEm(lc)			Shallow-undifferentiated landslide.
4041	1	D	2	0.068	1999		GH SW-C-99 56-49-1	16		1	38.94	Y	3	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
4047	1	Q	2	0.079	1999		GH SW-C-99 56-49-1	1		2	66.35	Y	3	En(sk)			Shallow-undifferentiated landslide. Stream Adj.

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4054	1	P	3	0.151	1999		GH SW-C-99 56-48-65	12		1	41.35	Y	4	OEm(lc)			Shallow-undifferentiated landslide. Stream Adj.
4062	1	P	3	0.107	1999		LEW SW-C-99 24-48-254	12		1	58.13	Y	4	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
4064	1	Q	2	0.063	1999		LEW SW-C-99 24-48-252	1		2	36.38	Y	4	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
4076	1	D	3	0.390	1999		LEW SW-C-99 24-47-259	11		3	111.22	Y	1	Ev(c)			Shallow-undifferentiated landslide.
4077	1	P	3	0.362	1999		LEW SW-C-99 24-47-259	1		1	73.45	Y	1	Ev(c)			Shallow-undifferentiated landslide.
4081	1	D	2	0.062	1999		LEW SW-C-99 24-47-257	1		1	122.00	Y	4	Ev(c)			Shallow-undifferentiated landslide.
4088	1	P	2	0.062	1999		GH SW-C-99 53-46-5	1		1	76.18	Y	3	OEm(lc)			Shallow-undifferentiated landslide.
4090	4	Q	5	8.270	1999		GH SW-C-99 53-46-5	12		2	34.33	P	3	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide. Stream Adj.
4093	4	P	5	7.719	1999		GH SW-C-99 53-46-3	12		2	41.75	P	4	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide. Stream Adj.
4094	4	Q	5	24.403	1999		LEW SW-C-99 25-46-50	12		2	32.43	P	2	Em(2m)	RE	I	Relict landslide.
4096	1	Q	3	0.110	1999		LEW SW-C-99 25-46-48	12		1	46.47	Y	3	Em(2m)			Shallow-undifferentiated landslide. Stream Adj.
4099	1	P	2	0.098	1999		LEW SW-C-99 25-46-44	11		1	65.65	Y	3	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
4100	1	D	3	0.238	1999		LEW SW-C-99 25-46-44	11		2	71.73	Y	3	Ev(c)			Shallow-undifferentiated landslide. Stream Adj.
4119	1	P	2	0.083	1999		LEW SW-C-99 25-45-79	11		4	69.74	P	5	Em(2m)			Shallow-undifferentiated landslide. Stream Adj.
4129	1	Q	2	0.086	1999		PAC SW99 25-44-167	12		5	60.20	I	1	Em(2m)			Shallow-undifferentiated landslide.
4130	1	D	3	0.134	1999		PAC SW99 25-44-167	11		4	83.00	Y	1	Em(2m)			Shallow-undifferentiated landslide.
4131	2	D	3	0.160	1970	1999	LEW SW-C-99 55-54-26	12		2	47.15	Y	3	Ev(c)			Debris flow. Stream and railroad Adj.
4132	4	P	4	3.664	1999		LEW SW-C-99 55-54-26	11		2	79.19	Y	4	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide. Stream and railroad Adj.
4133	4	P	5	53.065	1999		LEW SW-C-99 24-52-142	16		2	31.94	P	3	En(sk)	DI	I	Dormant indistinct deep-seated landslide. Stream Adj.
4134	1	Q	3	0.306	1999		LEW SW-C-99 55-51-173	1		2	69.21	Y	2	En(sk)			The polygon delineates an area along which Shallow-undifferentiated landslide may occur.
4135	2	P	2	0.053	1970	1999	LEW SW-C-99 55-51-173	12		1	47.65	Y	2	En(sk)			The polygon delineates an area along which shallow debris flow may occur.
4136	1	P	2	0.076	1999		LEW SW-C-99 55-51-173	1		2	16.27	Y	2	En(sk)			Shallow-undifferentiated landslide. Stream Adj.

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4137	1	D	3	0.107	1999		LEW SW-C-99 55-51-173	1		2	67.72	Y	2	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
4138	4	D	3	0.896	1999		LEW SW-C-99 55-51-173	12		2	32.67	Y	2	En(sk)	AR	RO	Active recent deep-seated landslide. Stream Adj.
4139	4	P	5	8.041	1999		LEW SW-C-99 55-51-173	16		2	27.55	Y	2	En(sk)	DI	I	Dormant indistinct deep-seated landslide. Stream Adj.
4140	2	D	3	0.156	1999		LEW SW-C-99 24-50-196	1		1	65.84	Y	4	En(sk)			The polygon delineates an inner gorge along which shallow debris flow occur.
4141	4	P	5	9.634	1999		LEW SW-C-99 24-48-250	12		2	45.46	Y	4	Em(2m)	DI	I	Dormant indistinct deep-seated landslide. Stream Adj.
4143	2	Q	4	0.605	1999		LEW SW-C-99 24-47-257	16		1	27.16	Y	3	Em(2m)			Shallow debris flow.
4144	2	P	4	0.500	1999		LEW SW-C-99 24-47-257	11		1	87.60	Y	3	Em(2m)			Shallow debris flow.
4145	1	P	3	0.276	1999		LEW SW-C-99 24-47-257	11		2	86.72	Y	3	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
4146	1	P	3	0.181	1999		LEW SW-C-99 24-47-257	2		2	81.66	Y	3	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
4147	1	P	4	0.761	1999		LEW SW-C-99 24-47-259	11		2	104.75	Y	1	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
4148	2	P	2	0.092	1999		LEW SW-C-99 25-46-48	1		1	64.82	Y	3	Ev(c)			Shallow debris flow.
4149	4	P	5	7.264	1999		LEW SW-C-99 25-46-44	16		2	33.68	Y	2	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide. Stream and railroad Adj.
4150	4	D	3	0.617	1999		LEW SW-C-99 55-53-56	11		2	66.46	Y	3	Ev(c)	AR	RO	Active recent deep-seated landslide. Stream Adj.
4151	4	P	3	5.512	1999		LEW SW-C-99 55-53-56	11		2	58.29	Y	3	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide. Stream and railroad Adj.
4152	2	D	2	0.057	1999		LEW SW-C-99 55-53-56	1		1	55.56	Y	3	Ev(c)			Shallow debris flow.
4153	2	D	2	0.056	1999		LEW SW-C-99 55-53-56	1		1	71.40	Y	3	Ev(c)			Shallow debris flow.
4154	2	Q	1	0.010	1999		LEW SW-C-99 55-51-173	10		1	31.50	Y	3	En(sk)			Shallow debris flow.
4155	2	Q	2	0.037	1999		LEW SW-C-99 55-51-173	10		1	36.51	Y	3	En(sk)			Shallow debris flow.
4156	2	Q	1	0.014	1999		LEW SW-C-99 55-51-173	10		1	50.55	Y	3	En(sk)			Shallow debris flow.
4157	2	Q	1	0.014	1999		LEW SW-C-99 55-51-173	1		1	55.78	Y	3	En(sk)			Shallow debris flow.

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4158	2	Q	1	0.020	1999		LEW SW-C-99 55-51-173	1		1	37.53	Y	3	En(sk)			Shallow debris flow.
4159	2	P	1	0.009	1999		LEW SW-C-99 55-51-173	1		1	41.82	Y	3	En(sk)			Shallow debris flow.
4160	2	P	2	0.027	1999		LEW SW-C-99 55-51-173	1		1	64.65	Y	3	En(sk)			Shallow debris flow.
4161	2	Q	1	0.016	1999		LEW SW-C-99 55-51-173	1		1	43.99	Y	3	En(sk)			Shallow debris flow.
4162	2	Q	2	0.037	1999		LEW SW-C-99 55-51-173	10		2	39.78	Y	1	En(sk)			Shallow debris flow.
4163	1	P	5	1.246	1999		LEW SW-C-99 55-51-173	12		2	53.93	Y	1	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
4164	1	P	2	0.076	1999		LEW SW-C-99 55-51-173	11		2	67.30	Y	1	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
4165	1	P	3	0.253	1999		LEW SW-C-99 55-51-173	16		2	38.31	Y	1	En(sk)			Shallow-undifferentiated landslide. Stream Adj.
4166	4	Q	4	2.488	1999		LEW SW-C-99 56-49-1	16		2	16.10	Y	3	OEm(lc)	RE	I	Relict deep-seated landslide.
4167	4	P	3	4.990	1999		LEW SW-C-99 55-47-121	12		2	21.02	Y	9	OEm(lc)	DI	I	Dormant indistinct deep-seated landslide.
4168	4	P	3	5.073	1999		LEW SW-C-99 25-46-51	12		2	50.95	Y	2	En(sk)	DI	I	Dormant indistinct deep-seated landslide.
4169	4	P	3	5.473	1999		LEW SW-C-99 25-46-51	12		2	38.54	Y	2	En(sk)	DI	I	Dormant indistinct deep-seated landslide.
4170	4	P	3	1.795	1999		LEW SW-C-99 53-46-7	12		2	46.89	Y	4	OEm(lc)	DI	I	Dormant indistinct deep-seated landslide.
4171	4	P	3	4.521	1999		LEW SW-C-99 53-46-7	12		2	54.07	Y	4	OEm(lc)	DI	I	Dormant indistinct deep-seated landslide.
4172	1	P	5	5.060	1999		LEW SW-C-99 53-45-15	1		2	57.01	Y	3	OEm(lc)			Shallow-undifferentiated landslide.
4173	4	D	5	11.223	1999		LEW SW-C-99 53-45-17	16		2	77.88	Y	4	OEm(lc)	DD	RO	Dormant distinct deep-seated landslide.
5001	3	D	3	0.216	1970	2005	Orthophoto 2003-2005	11		2	81.93	Y	3	OEm(lc)			Rock falls, debris slide. Stream and railroad Adj.
5004	1	D	2	0.079	2005		Orthophoto 2003-2005	9		2	3.34	Y	2	Qa			Meander bend failure.
5005	1	D	2	0.055	2005		Orthophoto 2003-2005	9		2	4.31	Y	4	Qa			Meander bend failure.
5009	1	D	4	0.455	2005		Orthophoto 2003-2005	9		2	14.71	Y	4	Qa			Meander bend failure.
5011	1	D	2	0.072	2005		Orthophoto 2003-2005	9		2	3.34	Y	9	Qa			Meander bend failure.

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5014	1	P	4	0.429	2005		Orthophoto 2003-2005	16		2	9.24	Y	9	Qa			Meander bend failure.
5024	1	D	2	0.100	2005		Orthophoto 2003-2005	14		2	1.17	Y	9	Qa			Meander bend failure.
5030	4	D	4	4.438	1964	2005	Orthophoto 2003-2005	16		2	25.69	Y	1	En(sk)	DD	RO	Dormant indistinct deep-seated landslide.
5031	1	P	3	0.229	2005		Orthophoto 2003-2005	11		2	63.03	I	5	En(sk)			Shallow-undifferentiated landslide.
5032	1	D	1	0.003	2005		Orthophoto 2003-2005	14		2	0.00	Y	9	Qa			Meander bend failure.
5033	1	D	1	0.005	2005		Orthophoto 2003-2005	14		2	0.00	Y	9	Qa			Meander bend failure.
5034	1	D	1	0.019	2005		Orthophoto 2003-2005	14		2	2.34	Y	9	Qa			Meander bend failure.
5035	1	P	3	0.160	2005		Orthophoto 2003-2005	14		2	0.00	Y	9	Qa			Meander bend failure.
5036	1	D	1	0.013	2005		Orthophoto 2003-2005	14		2	0.00	Y	9	Qa			Meander bend failure.
5038	1	D	1	0.015	2005		Orthophoto 2003-2005	14		2	0.00	Y	9	Qa			Meander bend failure.
5039	1	D	1	0.020	2005		Orthophoto 2003-2005	14		2	0.00	Y	9	Qa			Meander bend failure.
5040	1	D	2	0.022	2005		Orthophoto 2003-2005	14		2	0.52	Y	9	Qa			Meander bend failure.
5041	1	D	2	0.056	2005		Orthophoto 2003-2005	14		2	2.61	Y	9	Qa			Meander bend failure.
5044	3	P	3	0.149	2005		Orthophoto 2003-2005	11		4	75.53	I	3	Ev(c)			Shallow-undifferentiated landslide.
5045	1	D	1	0.006	2005		Orthophoto 2003-2005	14		2	0.00	Y	9	Qa			Meander bend failure.
5046	1	D	2	0.059	2005		Orthophoto 2003-2005	14		2	0.00	Y	9	Qa			Meander bend failure.
5047	1	D	2	0.031	2005		Orthophoto 2003-2005	14		2	1.17	Y	9	Qa			Meander bend failure.
5048	1	D	1	0.009	2005		Orthophoto 2003-2005	14		2	0.00	Y	9	Qa			Meander bend failure.
5049	1	D	2	0.058	2005		Orthophoto 2003-2005	14		2	0.00	Y	9	Qa			Meander bend failure. Failure no longer adjacent to river due to meander migration.
5050	1	D	2	0.035	2005		Orthophoto 2003-2005	14		2	0.00	Y	9	En(sk)			Bank failure. Failure no longer adjacent to river due to meander migration.
5051	1	D	1	0.017	2005		Orthophoto 2003-2005	14		2	0.00	Y	9	En(sk) and Qa			Meander bend failure. Failure no longer adjacent to river due to meander migration.
5052	1	D	2	0.053	2005		Orthophoto 2003-2005	14		2	0.00	Y	9	Qa			Meander bend failure. Failure no longer adjacent to river due to meander migration.

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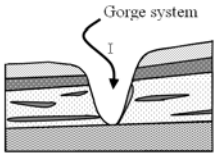
5055	1	D	3	0.399	2005		Orthophoto 2003-2005	14		2	87.22	P	3	Em(2m)			Shallow-undifferentiated landslide.
5067	8	D	2	0.096	2005		Orthophoto 2003-2005	7		2	75.63	P	3	OEm(lc)			Rock outcrop. Stream Adj.
5068	8	P	2	0.099	2005		Orthophoto 2003-2005	7		4	58.45	P	3	OEm(lc)			Rock outcrop.
6003	7	Q	5	417.124	1994		Hillshade images	16		2	19.20	P	3	En(sk)	DI	EF	Area affected by a dormant indistinct earthflow. Interpretation based on 1956-1994 hillshade.
6004	7	Q	5	72.444	1994		Hillshade images	15		2	13.07	P	3	En(sk)	DI	EF	Area affected by a dormant indistinct earthflow. Interpretation based on 1956-1994 hillshade.
6005	4	P	5	28.489	1994		Hillshade images	11		2	52.23	Y	4	En(sk) and OEm(lc)	DI	I	Area affected by a dormant indistinct deep-seated landslide. Interpretation based on 1956-1994 hillshade.
6006	4	Q	5	39.818	1994		Hillshade images	12		2	36.34	P	4	En(sk) and OEm(lc)	DI	I	Area affected by a dormant indistinct deep-seated landslide. Interpretation based on 1956-1994 hillshade.
6007	4	Q	5	10.315	1994		Hillshade images	16		2	33.48	Y	3	En(sk)	DI	RO	Area affected by a dormant indistinct deep-seated landslide. Interpretation based on 1956-1994 hillshade.
6008	7	Q	5	44.026	1964		LSW5-45	12		2	33.85	P	3	OEm(lc)	DI	EF	Area affected by a dormant indistinct earthflow.
6009	2	P	5	1.156	1994		Hillshade images	10		1	41.15	Y	4	OEm(lc)			The polygon delineates an inner gorge along which shallow debris flow may occur. Interpretation based on 1956-1994 hillshade.
6010	4	P	5	39.426	1994		Hillshade images	16		2	28.91	Y	1	OEm(lc)	DI	RO	Area affected by a dormant indistinct deep-seated landslide. Interpretation based on 1956-1994 hillshade.
6011	4	Q	5	83.896	1994		Hillshade images	16		2	24.45	Y	4	OEm(lc)	DI	RO	The polygon outlines an area affected by a dormant indistinct deep-seated landslide. Interpretation based on 1956-1994 hillshade.
6012	4	Q	5	52.844	1964		LSW4-39	12		2	34.94	Y	3	OEm(lc)	DI	RO	Area affected by a dormant indistinct deep-seated landslide. Interpretation based on 1956-1994 hillshade.
6014	4	Q	4	2.869	1994		Hillshade images	11		2	85.16	Y	4	OEm(lc)	DI	RO	Area affected by a dormant indistinct deep-seated landslide. Interpretation based on 1956-1994 hillshade.
6015	4	Q	5	5.338	1994		Hillshade images	16		2	32.52	P	1	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide. Stream Adj. Interpretation based on 1956-1994 hillshade.
6016	4	Q	5	19.393	1994		Hillshade images	12		2	27.46	Y	4	OEm(lc)	DI	RO	Area affected by a dormant indistinct deep-seated landslide. Interpretation based on 1956-1994 hillshade.
6017	4	P	5	10.382	1970		LP-70 221-39-58	12		2	43.62	Y	4	OEm(lc)	DD	RO	The polygon outlines an area affected by a dormant deep-seated landslide.
6018	4	Q	5	20.499	1970		LP-70 221-39-58	16		2	25.35	Y	4	OEm(lc)	DI	RO	The polygon outlines an area affected by a dormant indistinct deep-seated landslide.
6019	4	P	5	127.976	1994		Hillshade images	16		2	23.67	Y	3	OEm(lc)	DI	RO	Dormant indistinct deep-seated landslide. Interpretation based on 1956-1994 hillshade.

Appendix A – Landslide Inventory: Form A-1

6020	7	Q	5	39.483	1970		LP-70 220-40B-39	16		2	26.71	P	4	En(sk) and OEm(lc)	DI	EF	Dormant indistinct earthflow. Submature timber and agriculture at the landslide body
6021	4	Q	5	136.970	1970		Hillshade images	12		2	40.97	Y	2	OEm(lc)	DI	I	The polygon outlines an area affected by nested dormant indistinct deep-seated landslides.
6022	4	P	5	15.176	1970		LP-70 221-39-50	11		4	62.33	Y	3	Ev(c)	DD	RO	The polygon outlines an area affected by a dormant deep-seated landslide.
6023	4	P	5	45.497	1994		Hillshade images	16		2	32.51	Y	4	Ev(c)	DI	RO	The polygon outlines an area affected by a dormant deep-seated landslide. Interpretation based on 1956-1994 hillshade.
6024	4	Q	5	6.087	1994		Hillshade images	12		2	41.42	Y	4	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide. Interpretation based on 1956-1994 hillshade.
6025	4	Q	4	4.084	1994		Hillshade images	12		2	47.74	Y	3	Ev(c)	DI	RO	Dormant indistinct deep-seated landslide. Interpretation based on 1956-1994 hillshade.
6026	4	Q	5	74.766	1994		Hillshade images	16		2	20.80	Y	4	En(sk)	DI	I	Dormant indistinct deep-seated landslide. Interpretation based on 1956-1994 hillshade.

Appendix B – Landform Descriptions: Form A-2



Form A-2 Descriptions of Landforms for the Garrard Creek Watershed

Landform #1 – Inner Gorges (>70%) – Very High Hazard

Description of Mass Wasting Unit: Rule-identified inner gorges are steep (>70%) walled canyons or gullies eroded by stream action with evidence of mass wasting along their sidewalls. Inner gorges may be either symmetrical or asymmetrical in profile and are commonly intermittent in lateral extent. They are occasionally scoured by debris flows during storm events. Many asymmetrical inner gorges are found in the Lincoln Creek Formation. A 10% break in slope usually separates the upper margin of the inner gorge feature from the surrounding slope forms.

Slopes: >70%
Slope Shape: Convergent to planar
Material: Near-shore and marine sedimentary rocks, basalt flows, and flow breccias (Lincoln Creek, McIntosh, Skookumchuck, and Crescent Formations).
Elevation: 70 ft to 2083 ft
Total Area: 1593 acres

Mass Wasting Process: This landform contains primarily shallow undifferentiated landslides (60.42%) and debris slides (28.13%) with a few debris flows. Inner gorges have been formed by a combination of stream incision, scoured by debris flows, and sidewall failures. Over-steepened walls of inner gorges commonly fail as debris slides, slope ravel, or small rotational landslides that can produce debris flows. Debris flows scour the walls of inner gorges and over-steepen them, which leads to further destabilization and landsliding. Small sediment plumes were observed on aerial photos at the mouth of tributaries to Garrard Creek. These plumes suggest mass wasting or soil erosion in the upper reaches, likely within the inner gorges.

Forest Practice Sensitivity and Trigger Mechanisms: Timber harvest within this landform could potentially increase slope failure due to declining root strength. Root strength of trees within and adjacent to inner gorges has been found to be a factor in controlling rates of mass wasting (Krogstad, 1995). Roads and landings can destabilize slopes by undercutting and over-steepening slopes. Side cast and road (or landing) fill can also over-steepen slopes and can add weight; roads and landings can also capture runoff water or shallow groundwater, channeling it to point locations that saturate road or landing fill triggering landslides.

Mass Wasting Potential: **Very High** based on 74 slope failures in a landform covering 1592.73 acres. This landform has a Landslide Frequency Rating of 1032.47 with roads and 990.61 without road-related landslides.

Delivery Potential/Criteria: **Very High.** The Landslide Area Rate of Delivery for this landform with road-related landslides is 403.80 based on 74 “delivering” landslides totaling 28.94 acres and without road-related landslides it is 366.88 based on 71 “delivering” landslides totaling 26.30 acres.

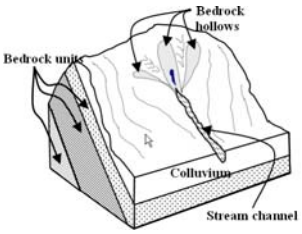
Overall Hazard Potential Rating: **Very High** based on the LHZ Protocol, Table 5.

Confidence: Moderate level of confidence based on gaps in air photo coverage and 10m DEM inaccuracies.

Comments: Depending on DEM resolution and local terrain conditions, slope values were found to be lower or higher than the actual slopes. As a result of slope variability, there may be rule-identified inner gorges included in other landform classes (e.g. non-rule identified inner gorges, steep gradient hillslope, or moderate gradient hillslope). Due to DEM resolution and underlying geologic materials, upper inner gorge boundaries may include not only abrupt terrain with bedrock hollows, but also hillslopes with gentler slopes. Some inner gorges are highly confined streams that are actively down-cutting but there may be breaks of gentler slopes along the valley. Shallow landslides and deep-seated landslides were observed along the inner gorge walls. Similarly, some bedrock hollows smaller 0.5 acres have been included within this landform.

Form A-2 Descriptions of Landforms for the Garrard Creek Watershed

Landform #2 – Bedrock Hollows (>70%) – Very High Hazard



Description of Mass Wasting Unit: Rule-identified bedrock hollows are steep (>70% at the steepest point), shallow spoon-shaped or elongate areas of convergent topography with concave profiles. These features may exist on any steep hillslope and within other landforms and seldom contain channels but commonly drain directly into inner gorges or other channels downslope. Colluvial debris that accumulates in these steep convergent areas is prone to saturation by shallow ground water, which makes bedrock hollows highly susceptible to slope failures. Bedrock hollows typically experience episodic evacuation of debris by shallow-rapid mass movement followed by slow refilling with colluvium. Unless they have recently experienced emptying by a landslide, hollows are partially or completely filled with colluvial soils that are typically deeper than soils on adjacent spurs and planar slopes.

Slopes: Generally > 70%
Slope Shape: Convergent to planar
Material: Near-shore and marine sedimentary rocks, basalt flows, and flow breccias (Lincoln Creek, McIntosh, Skookumchuck, and Crescent Formations).
Elevation: 148 ft to 1791 ft
Total Area: 45 acres

Mass Wasting Process: Soil saturation, loss of root strength, and/or over-steepened slopes in bedrock hollows can trigger debris slides or other shallow landslides. In the Garrard Creek WAU, this landform contains primarily shallow undifferentiated landslides (77.78%) and debris slides (22.22%). Bedrock hollows that are completely filled with colluvium may show no surface concavity. Many hollows have no surface water, but those that have been evacuated by landslides may contain seeps and springs.

Forest Practice Sensitivity and Trigger Mechanisms: Timber harvest within this landform could potentially increase slope failure due to declining root strength. Vegetation roots usually provide an apparent cohesion (Selby, 1993) that reinforces stable conditions for soils. Roads and landings can destabilize slopes by undercutting and/or over-steepening them. Side cast and road (or landing) fill can also over-steepen slopes and can add weight; roads and landings can also capture runoff water or shallow groundwater, channeling it to point locations that saturate road or landing fill, triggering landslides.

Mass Wasting Potential: **Very High** based on 8 slope failures in a landform covering 45.22 acres. This landform has a Landslide Frequency Rating of 3991.6 with roads and 3931.6 without road-related landslides.

Delivery Potential/Criteria: **Very High.** The Landslide Area Rate of Delivery for this landform based on 8 "delivering" landslides totaling 1.62 acres is 795.90 and is the same for both road-related and non-road-related landslides.

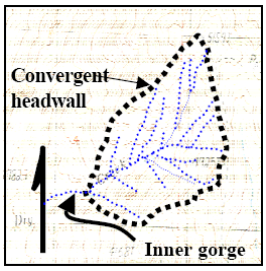
Overall Hazard Potential Rating: **Very High** based on the LHZ Protocol, Table 5.

Confidence: Moderate level of confidence based on photo coverage gaps, DEM inaccuracies, and limited field verification.

Comments: Due to mapping constraints and poor DEM resolution, several small (<0.5 acres) bedrock hollows were included in adjacent landforms #1, 11, and 12 (inner gorges, steep gradient hillslopes, and moderate gradient hillslopes, respectively).

Form A-2 Descriptions of Landforms for the Garrard Creek Watershed

Landform #5 – Convergent Headwalls - High Hazard



Description of Mass Wasting Unit: Steep (>70%) headwall basins are located at the upper end of drainage systems. Convergent headwalls contain bedrock hollows and inner gorges which are usually separated by steep ridges. Slope geometry within this landform concentrates both surface and groundwater which produce areas of positive pore pressures during intense or extended precipitation events.

Slopes: >70%
Slope Shape: Convergent
Material: Marine sedimentary rocks (Lincoln Creek Formation).
Elevation: 316 ft to 770 ft
Total Area: 60 acres

Mass Wasting Processes: The highly convergent shape of the slopes in this landform, coupled with thin soils (due to frequent slides), allows rapid onset of surficial and subsurface storm water flow. Therefore, headwalls are prone to landslides. During storm events, debris slides or debris flows may form in the bedrock hollows or inner gorges contained in the convergent headwalls. Steep convergent headwalls with long slopes in Sec 12, T.15N., R.15 have thick sandy soils with old stumps still present. In the field, the slopes show only evidence of soil creep. Nevertheless, during intense or prolonged storms, these areas could fail due to their steep and convergent shape.

Forest Practice Sensitivity and Triggering Mechanisms: Timber harvest, road construction, and/or landing construction on steep convergent slopes in poorly consolidated colluvium and deeply weathered bedrock can increase slope instability. Timber harvest within this landform could potentially increase slope failure potential due to declining root strength. Vegetation roots usually provide an apparent cohesion (Selby, 1993) that reinforces stable conditions for soils. Roads and landings can destabilize slopes in steep convergent headwalls by undercutting and over-steepening slopes. Sidecast and road (or landing) fill can over-steepen and add weight to slopes; roads and landings can also capture runoff water or shallow groundwater and channel it to point locations that saturate road or landing fills and/or thin soils draping bedrock, triggering landslides.

Mass Wasting Potential: Very High based on 2 slope failures in a landform covering 59.96 acres. This landform has a Landslide Frequency Rating of 741.26 and is the same for both road-related and non-road-related landslides.

Delivery Potential/Criteria: High. The Landslide Area Rate of Delivery for this landform based on 2 “delivering” landslides totaling 2.88 acres is 1068.26 and is the same for both road-related and non-road-related landslides.

Overall Hazard Potential Rating: Very High based on LHZ Protocol and standard Forest Practices Rules.

Confidence: Moderate based on air photo quality and gaps in coverage, limited field observations, and poor DEM accuracy.

Comments: Due to poor DEM resolution, this landform may contain un-mapped inner gorges and bedrock hollows.

Form A-2 Descriptions of Landforms for the Garrard Creek Watershed

Landform # 7 – Active Scarps of Deep-seated Landslides – Very High Hazard

Description of Mass Wasting Unit: This unit consists of head scarps and lateral scarps with slopes greater than 54% of previously failed deep-seated landslides. The landslides within this landform display evidence of recent movement such as fresh head scarps, tension cracks, and distinct lateral boundaries (side scarps). Poorly lithified bedrock slopes are located at the head of deep-seated landslides and usually contain secondary shallow landslides. In addition, landslide bodies may have stepped and hummocky topography which is dissected by multiple drainages.

Slopes: 53% to 113%
Slope Shape: Convergent to planar
Material: Near shore and marine sedimentary rocks, basalt flows, flow breccias (Lincoln Creek, McIntosh, Skookumchuck, and Crescent Formations).
Elevation: 193 ft to 1188 ft
Total Area: 20 acres

Mass Wasting Process: Although the entire landslide mass may be moving, more often mass-wasting is localized as shallow and smaller deep-seated landslides within the larger feature. Active head and lateral scarps of deep-seated landslides are composed of unconsolidated material (fractured and deeply weathered bedrock) that can absorb large quantities of water which increases their susceptibility to continued failure. Active tension cracks affecting roads are observed beyond active deep-seated landslides headscarps (e.g. Sec. 13, T. 15N., R. 06W.).

Forest Practice Sensitivity and Triggering Mechanisms: Road construction or widespread timber harvest may trigger reactivation of dormant or relict deep-seated landslides or parts of them that are marginally stable. Roads and landings can destabilize slopes by undercutting and over-steepening them and can also capture runoff water or shallow groundwater channeling it to point locations that saturate road or landing fill, triggering landslides. Additional material such as side cast and road (or landing) fill can also over-steepen slopes and can add weight. Timber harvest within this landform could potentially increase slope failure due to declining root strength. Vegetation roots usually provide an apparent cohesion (Selby, 1993) that reinforces stable conditions for soils.

Mass Wasting Potential: **Very High** based on 7 slope failures in a landform covering 19.72 acres. This landform has a Landslide Frequency Rating of 7888 and is the same for both road-related and non-road-related landslides.

Delivery Potential/Criteria: **Very High.** The Landslide Area Rate of Delivery for this landform based on 7 "delivering" landslides totaling 0.81 acres is 913.86 and is the same for both road-related and non-road-related landslides.

Overall Hazard Potential Rating: **Very High** based on LHZ Protocol, Table 5.

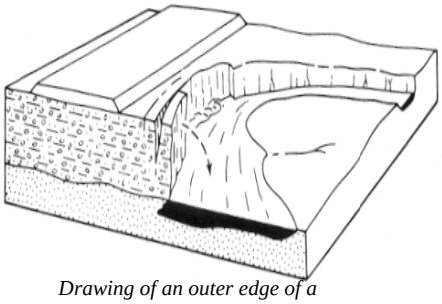
Confidence: Moderate based on air photo quality and gaps in coverage, limited field observation, and poor DEM accuracy.

Comments: Active deep-seated landslides mapped as unique landforms involve only about 0.094% (19.72 acres) of the land area, but it is important to remember that many dormant and relict deep-seated landslides were not mapped as a landform because of their probable and questionable status.

Form A-2 Descriptions of Landforms for the Garrard Creek Watershed

Landform #9 - Meander Bends. High Hazard.

Description of Mass Wasting Unit: This landform represents unstable slopes created by undercutting the outer edges of meander bends along valley walls or high terraces of the Chehalis River within the Garrard Creek WAU. Meander bends are susceptible to shallow landsliding including debris avalanching and small scale slumping, and deep-seated landsliding.



Drawing of an outer edge of a meander bend (Forest Practices Board Manual, 200? Give year).

Slopes: 0 to 24%
Slope Shape: Convergent to planar
Material: Alluvium
Elevation: 40 ft to 191 ft
Total Area: 302 acres

Mass Wasting Processes: Meander bends may contact the toes of alluvial deposits found along the Chehalis River within Garrard Creek WAU. The landform contains slope failures that occur from (commonly) stream undercutting at the toe of the slope which causes over-steepening and instability. The resulting slope failures are usually shallow landslides that deliver sediment into the river and its floodplain. As the river migrates back and forth across the alluvial floodplain through time, the meanders travel downstream impacting the adjacent areas on both sides of the river. Typically slope failures are found on the outsides of meanders bends but can also occur along straight banks after high flows.

Forest Practice Sensitivity and Trigger Mechanisms: Any changes of root strength, water concentration or channeling, or yarding damage within this landform can increase the likelihood of landsliding. Water concentration, sidecast, and loading from landings can cause instability by adding weight or over-steepening the slopes. Sediment delivery from slope failures on this landform into Garrard Creek and the Chehalis River is imminent.

Mass Wasting Potential: High based on 10 slope failures in a landform covering 301.69 acres. This landform has a Landslide Frequency Rating of 736.59 and is the same for both road-related and non-road-related landslides.

Delivery Potential/Criteria: High. The Landslide Area Rate of Delivery for this landform based on 10 “delivering” landslides totaling 3.5 acres is 257.47 and is the same for both road-related and non-road-related landslides.

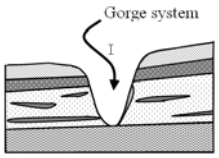
Overall Hazard Potential Rating: High based on LHZ Protocol, Table 5.

Confidence: Moderate based on the number of landslides located in this landform, good photo coverage but limited field observation due to location and poor DEM accuracy.

Comments: The mapped representation of this landform was drawn to include not only meander bends but all streamside areas along the Chehalis River at a thickness of the widest observed landslide. The reason for this is that rivers migrate and an outside meander bend has potential to occur anywhere where the river goes. In spite of this, this landform is mostly associated with agricultural and residential land use.

Form A-2 Descriptions of Landforms for the Garrard Creek Watershed

Landform #10 – Non-Rule-identified Inner Gorges –High Hazard



Description of Mass Wasting Unit: This non-rule-identified landform contains characteristics similar to rule-identified inner gorges but has convergent slopes of 30-70%. They appear as gentle-walled canyons or gullies on DEM slope maps and seem eroded by stream action but with evidence of mass wasting along their sidewalls. Non-Rule-identified inner gorges may be either symmetrical or asymmetrical in profile and are commonly intermittent in lateral extent. (Note: this landform may contain rule-identified landforms such as inner gorges and bedrock hollows).

Slopes: 30% to 70%
Slope Shape: Convergent to planar
Material: Near-shore and marine sedimentary rocks, basalt flows, and flow breccias (Lincoln Creek, Skookumchuck, and Crescent Formations).
Elevation: 117 ft to 1467 ft
Total Area: 109 acres

Mass Wasting Process: This landform contains shallow undifferentiated landslides and debris slides.
Forest Practice Sensitivity and Trigger Mechanisms: Root strength within and adjacent to inner gorges has been found to be a factor in controlling rates of shallow mass wasting (Krogstad, 1995). Trees on the edges of inner gorges can have roots extending into the gully slopes providing slope stability. Roads and landings can destabilize slopes by undercutting and over-steepening slopes and side cast and road (or landing) fill can also over-steepen slopes by adding material and weight. Roads and landings can capture runoff water or shallow groundwater, channeling it to point locations that saturate road or landing fill, triggering landslides.

Mass Wasting Potential: High based on 5 slope failures in a landform covering 109.2 acres. This landform has a Landslide Frequency Rating of 1017.46 with roads and 813.96 without road-related landslides.

Delivery Potential/Criteria: Very High. The Landslide Area Rate of Delivery for this landform with road-related landslides is 455 based on 5 “delivering” landslides totaling 2.24 acres and without road-related landslides it is 396.16 based on 4 “delivering” landslides totaling 1.95 acres.

Overall Hazard Potential Rating: High based on the LHZ Protocol, Table 5.

Confidence: Moderate level of confidence based on the number of landslides in this landform and limited field verification due to access issues.

Comments: The majority of this landform is based on slope angles drawn from computer-generated DEM’s which are known by field testing to be inaccurate. As a result, there may be non-rule-identified inner gorges mapped as adjacent Landform #11 and 12 (steep gradient hillslope or as moderate gradient hillslope, respectively) and rule-identified features such as inner gorges and bedrock hollows may be included in this landform.

Form A-2 Descriptions of Landforms for the Garrard Creek Watershed

Landform # 11 – Steep Gradient Hillslopes (>64%) - Very High Hazard

Description of Mass Wasting Unit: This landform consists of high-relief uplands with steep slopes greater than 64% that are convergent to planar in shape, with some areas of divergence. The landform is located between or around mapped rule- and non-rule-identified inner gorges, convergent headwalls, and bedrock hollows but could actually contain them. Within the mapped extent of this landform 14% of the slopes are gentler than 64%. Head scarps and the bodies of relict or dormant deep-seated landslides are also found within this landform.

Slopes: 64% and greater
Slope Shape: Broadly convergent to planar.
Material: Near-shore and marine sedimentary rocks, basalt flows, and flow breccias. (Lincoln Creek, McIntosh, Skookumchuck, and Crescent Formations).
Elevation: 105 ft to 2014 ft
Total Area: 962 acres

Mass Wasting Processes: Shallow and deep-seated landslides occur on steep slopes mantled with thin soils, and commonly slide at the soil-bedrock interface. Landslides can be initiated on all slope forms (convergent, divergent, and planar) in this landform, but areas where surface or groundwater is concentrated are particularly susceptible. Rock types within this watershed are commonly weak and/or affected by weathering, which contributes to mass wasting on these slopes.

Forest Practice Sensitivity and Trigger Mechanisms: Timber harvest, road and landing construction, and other activities on these steep slopes may increase the potential for landslides. Timber harvest can reduce root strength on these slopes and increase pore-water pressure in the soil by loss of canopy interception and evapo-transpiration. Roads and landings can destabilize steep slopes by undercutting and over-steepening them and sidecast and road (or landing) fill can also load slopes excessively. Furthermore, undrained road ditches of can capture surface runoff and shallow groundwater, a situation that can cause fill saturation or that of adjacent thin soils, which can trigger landslides.

Mass Wasting Potential: **Very High** based on 69 slope failures in a landform covering 962.16 acres. This landform has a Landslide Frequency Rating of 1593.63 with road-related landslides and 1455.06 without road-related landslides.

Delivery Potential/Criteria: **Very High.** The Landslide Area Rate of Delivery for this landform with road-related landslides is 665.85 based on 66 “delivering” landslides totaling 28.83 acres and without road-related landslides it is 572.32 based on 61 “delivering” landslides totaling 24.78 acres.

Overall Hazard Potential Rating: **Very High** based on the LHZ Protocol, Table 5.

Confidence: Moderate based on the number of landslides located in this landform, good photo coverage, limited field observation, and 10m DEM inaccuracies.

Comments: The mapped outline of this landform is based on slope angles drawn from 10m DEMs; thus, its boundaries may be under-represented or over-represented depending on local terrain conditions. Consequently, this landform may contain unmapped inner gorges and bedrock hollows.

Form A-2 Descriptions of Landforms for the Garrard Creek Watershed

Landform # 12 – Moderate Gradient Hillslopes (41 to 64%) – Moderate Hazard

Description of Mass Wasting Unit: This landform includes all slope forms (convergent, divergent, and planar) that have a gradient between 41% and 64%. The landform is a transition map unit between high-relief uplands with steep slopes, and flat areas. The landform could actually contain other high hazard landform (e.g. rule- and non-rule-identified inner gorges, or bedrock hollows). It also may contain head scarps and part of landslide bodies of relict or dormant deep-seated landslides, as well as other landslide types.

Slopes: 41 to 64%
Slope Shape: Variable (**c**onvergent, planar, and divergent).
Material: Near-shore and marine sedimentary rocks, basalt flows, and flow breccias (previously mapped landslides, Lincoln Creek, McIntosh, Skookumchuck, and Crescent Formations).
Elevation: 60 ft to 2085 ft.
Total Area: 3963 acres.

Mass Wasting Process: Shallow and deep-seated landslides, as well as earth flows occur within this landform. As a transitional landform between uplands with steep slopes and flat areas, this landform has the potential to trigger landslides and to contribute to the bulk volume of mass wasting. Shallow landslides that are initiated on high-relief uplands could actively down-cut the moderate gradient hillslopes landform because rock types within this landform tend to be weak and/or affected by weathering, which contributes to mass wasting.

Forest Practice Sensitivity and Trigger Mechanisms: Timber harvest, road construction, and/or landing construction on slopes between 41 to 64% can increase slope instability. Roads and landings can also capture runoff water or shallow groundwater and channel it to point locations that saturate fill and/or unconsolidated deposits, triggering slope failures.

Mass Wasting Potential: **Moderate** based on 57 slope failures in a landform covering 3963.39 acres. This landform has a Landslide Frequency Rating of 319.59 with roads and 313.99 without road-related landslides.

Delivery Potential/Criteria: **Moderate.** The Landslide Area Rate of Delivery for this landform with road-related landslides is 107.13 based on 55 “delivering” landslides totaling 19.11 acres and without road-related landslides it is 107.10 based on 54 “delivering” landslides totaling 19.10 acres.

Overall Hazard Potential Rating: **Moderate** based on the LHZ Protocol, Table 5.

Confidence: Moderate level of confidence based on incomplete flight years, DEM data inaccuracies, and limited field observations.

Comments: The mapped outline of this landform is based on slope angles drawn from 10m DEMs; thus, its boundaries may be under-represented or over-represented depending on local terrain conditions. Consequently, this landform may contain unmapped inner gorges and bedrock hollows. Forty-five percent (45%) and 30% of all mapped deep-seated landslides and earth flows in the watershed, respectively, are found in this landform. Many areas that appeared as probable or questionable deep-seated landslides and earth flows were omitted from the map due to the uncertainties.

Form A-2 Descriptions of Landforms for the Garrard Creek Watershed

Landform #14 - Flats - Low Hazard

Description of Mass Wasting Unit: This map unit includes all valley and stream bottoms, flat terraces, prairies, major stream flood plains, and wetlands with gradients between 0 % and 10% that exhibit a low landslide potential, and/or are not likely to deliver sediment to a public resource or adversely impact public safety.

Slopes:	0% to 10%
Slope Shape:	Broadly convergent to divergent.
Material:	Alluvium, near-shore and marine sedimentary rocks, basalt flows, and flow breccias (Quaternary Alluvium, previously mapped landslides, Lincoln Creek, McIntosh, Skookumchuck, and Crescent Formations).
Elevation:	40 ft to 2041 ft
Total Area:	2998 acres

Mass Wasting Process: Shallow landslides and mass wasting processes within this landform occur adjacent to streams. Small (< 0.5 acres) meander bends were lumped into this landform. The area affected by meander bends is small and unlikely to yield large landslides.

Forest Practice Sensitivity and Trigger Mechanisms: Roads may be a triggering mechanism for erosion within this landform if slopes are undercut within weak sedimentary rocks. Soil erosion occurs in this landform on very gentle slopes.

Mass Wasting Potential: Low based on 29 slope failures in a landform covering 2998.19 acres. This landform has a Landslide Frequency Rating of 214.94 and is the same for both road-related and non-road-related landslides.

Delivery Potential/Criteria: Low. The Landslide Area Rate of Delivery for this landform based on 29 “delivering” landslides totaling 2.05 acres is 15.22 and is the same for both road-related and non-road-related landslides.

Overall Hazard Potential Rating: Low based on the LHZ Protocol, Table 5.

Confidence: Moderate level of confidence based on incomplete flight years, DEM data inaccuracies, and limited field observations.

Comments: Problems of interpolation were resolved by lumping low gradient hillslopes (Landform #16) into the flat areas landform (Landform #14). Consequently, Landform #14 may contain unmapped low gradient hillslopes in Sec. 10, T. 15N., R. 04W.

Form A-2 Descriptions of Landforms for the Garrard Creek Watershed

Landform #15 - Ridge Tops and Noses– Low Hazard ()

Description of Mass Wasting Unit: This map unit includes all ridge tops, ridge noses, and small rises with gradients between 0 % and 10%. The small rises are located in flat lowland areas and exhibit a low landslide potential, and/or are not likely to deliver sediment to a stream, impact public safety, or impact a public resource.

Slopes: 0% and 10%
Slope Shape: Variable (**c**onvergent, planar, and divergent).
Material: Alluvium, near-shore and marine sedimentary rocks, basalt flows, and flow breccias. (Quaternary Alluvium, Lincoln Creek, McIntosh, Skookumchuck, and Crescent Formations).
Elevation: 40 ft to 2041 ft.
Total Area: 469 acres.

Mass Wasting Process: Deep-seated landslide and earth flows occur within this landform or encroach upon it from adjacent areas. Due to very gentle slopes, shallow landslides are rare.

Forest Practice Sensitivity and Trigger Mechanisms: Road construction and/or landing construction on this landform may cause mass wasting on slopes below.

Mass Wasting Potential: Low. No shallow landslides were identified in a landform covering 469.41 acres. This landform has a Landslide Frequency Rating of zero and is the same for both road-related and non-road-related landslides.

Delivery Potential/Criteria: Low. The Landslide Area Rate of Delivery for this unit is 0 and is the same for both road-related and non-road-related landslides.

Overall Hazard Potential Rating: Low based on the LHZ Protocol, Table 5.

Confidence: Moderate level of confidence based on limited photo coverage and few field observations.

Comments: This landform was mapped using DEM slope percent maps and may contain areas of steeper slopes (>10%) due to the inaccuracy of the available DEM data. Due to DEM resolution inaccuracies, some areas may have been included within this landform that have slopes greater than 10%. Some ridge tops were lumped into low gradient hillslopes (Landform #16) – due to their small size (< 0.5 acres). Some large ridge tops around the watershed boundary were also lumped into this landform because they cover small areas within the watershed boundary.

Form A-2 Descriptions of Landforms for the Garrard Creek Watershed

Landform # 16 - Low Gradient Hillslopes – Low Hazard

Description of Mass Wasting Unit: This map unit generally encompasses all slope shapes and gradients between 11% and 40% that exhibit a low landslide potential, and/or are not likely to deliver sediment to a stream, impact public safety, or impact a public resource.

Slopes: 11% and 40%
Slope Shape: Variable (**c**onvergent, planar, and divergent).
Material: Alluvium, near-shore and marine sedimentary rocks, basalt flows, and flow breccias. (Quaternary Alluvium, previously mapped landslides, Lincoln Creek, McIntosh, Skookumchuck, and Crescent Formations).
Elevation: 60 ft to 2249 ft.
Total Area: 10269 acres.

Mass Wasting Process: Shallow and deep-seated landslides, as well as earth flows can occur with this landform. These landslides can occur after storm events and are commonly associated with the weak nature of the underlying bedrock.

Forest Practice Sensitivity and Trigger Mechanisms: Mass wasting on these naturally stable slopes is unlikely, but could occur as the result of road and landing construction. Slope failure by increases in pore-water pressure, and undercutting and over-steepening slopes could occur. The majority of landslides (47.44%) were located in the sub-mature timber.

Mass Wasting Potential: High based on 17 slope failures in a landform covering 10274.11 acres. This landform has a Landslide Frequency Rating of 36.77 and is the same for both road-related and non-road-related landslides.

Delivery Potential/Criteria: Low. The Landslide Area Rate of Delivery for this landform based on 17 “delivering” landslides totaling 9.99 acres is 21.60 and is the same for both road-related and non-road-related landslides.

Overall Hazard Potential Rating: Low for the entire unit based on the LHZ Protocol, Table 5.

Confidence: Moderate level of confidence based on incomplete flight years, DEM data inaccuracies, and limited field observations.

Comments: This landform was mapped using DEM slope percent maps and may contain areas of steeper slopes due to the inaccuracies of the available DEM data. This landform may include parts of probable and questionable dormant indistinct deep-seated landslides as well as earth flows with relatively gentle gradients (<40%). It is important to understand that some of these features may become activated with even minor climatic and/or land-use perturbation, and have the potential to deliver sediment to fish-bearing streams and other public resources.

Appendix C – Mass Wasting Descriptions: Form A-3

Mass Wasting Summary: Totals							
Activity	Shallow Landslides	Debris Flows	Debris Avalanches / Slides	Deep-Seated Landslides	Earthflows	Rock topples and falls	Total
1 = clearcut (timber 0-5 yrs)	16	7	0	7	0	0	30
2 = young stands (timber 5-15 yrs)	15	4	2	13	1	0	35
3 = submature timber (15-50 yrs)	81	29	6	63	15	2	196
4 = mature timber (>50 years)	89	27	2	91	7	0	216
5 = road	12	2	2	4	0	0	20
6 = partial cut	0	0	0	0	0	0	0
7 = yarding	0	0	0	0	0	0	0
8 = alpine	0	0	0	0	0	0	0
9 = other-e.g., housing, agric.	40	0	0	2	0	0	42
Totals	253	69	12	180	23	2	539

Mass Wasting Summary: Landform 1 - Inner Gorges							
Activity	Shallow Landslides	Debris Flows	Debris Avalanches / Slides	Deep-Seated Landslides	Earthflows	Rock topples and falls	Total
1 = clearcut (timber 0-5 yrs)	2	1	0	0	0	0	3
2 = young stands (timber 5-15 yrs)	6	1	2	0	0	0	9
3 = submature timber (15-50 yrs)	18	13	2	2	1	0	36
4 = mature timber (>50 years)	29	11	0	4	0	0	44
5 = road	3	1	0	0	0	0	4
6 = partial cut	0	0	0	0	0	0	0
7 = yarding	0	0	0	0	0	0	0
8 = alpine	0	0	0	0	0	0	0
9 = other-e.g., housing, agric.	0	0	0	0	0	0	0
Totals	58	27	4	6	1	0	96

Appendix C – Mass Wasting Descriptions: Form A-3

Mass Wasting Summary: Landform 2 - Bedrock Hollows							
Activity	Shallow Landslides	Debris Flows	Debris Avalanches / Slides	Deep-Seated Landslides	Earthflows	Rock topples and falls	Total
1 = clearcut (timber 0-5 yrs)	0	0	0	0	0	0	0
2 = young stands (timber 5-15 yrs)	0	0	0	0	0	0	0
3 = submature timber (15-50 yrs)	4	1	0	0	0	0	5
4 = mature timber (>50 years)	3	1	0	0	0	0	4
5 = road	0	0	0	0	0	0	0
6 = partial cut	0	0	0	0	0	0	0
7 = yarding	0	0	0	0	0	0	0
8 = alpine	0	0	0	0	0	0	0
9 = other-e.g., housing, agric.	0	0	0	0	0	0	0
Totals	7	2	0	0	0	0	9

Mass Wasting Summary: Landform 5 - Convergent Headwalls							
Activity	Shallow Landslides	Debris Flows	Debris Avalanches / Slides	Deep-Seated Landslides	Earthflows	Rock topples and falls	Total
1 = clearcut (timber 0-5 yrs)	0	0	0	0	0	0	0
2 = young stands (timber 5-15 yrs)	0	0	0	0	0	0	0
3 = submature timber (15-50 yrs)	1	0	0	1	0	0	2
4 = mature timber (>50 years)	1	0	0	0	0	0	1
5 = road	0	0	0	0	0	0	0
6 = partial cut	0	0	0	0	0	0	0
7 = yarding	0	0	0	0	0	0	0
8 = alpine	0	0	0	0	0	0	0
9 = other-e.g., housing, agric.	0	0	0	0	0	0	0
Totals	2	0	0	1	0	0	3

Appendix C – Mass Wasting Descriptions: Form A-3

Mass Wasting Summary: Landform 7 - Active Scarps of DSLS							
Activity	Shallow Landslides	Debris Flows	Debris Avalanches / Slides	Deep-Seated Landslides	Earthflows	Rock topples and falls	Total
1 = clearcut (timber 0-5 yrs)	0	0	0	0	0	0	0
2 = young stands (timber 5-15 yrs)	0	0	0	1	0	0	1
3 = submature timber (15-50 yrs)	3	0	1	4	0	2	10
4 = mature timber (>50 years)	1	2	0	4	0	0	7
5 = road	0	0	0	0	0	0	0
6 = partial cut	0	0	0	0	0	0	0
7 = yarding	0	0	0	0	0	0	0
8 = alpine	0	0	0	0	0	0	0
9 = other-e.g., housing, agric.	0	0	0	0	0	0	0
Totals	4	2	1	9	0	2	18

Mass Wasting Summary: Landform 9 - Meander Bends							
Activity	Shallow Landslides	Debris Flows	Debris Avalanches / Slides	Deep-Seated Landslides	Earthflows	Rock topples and falls	Total
1 = clearcut (timber 0-5 yrs)	3	0	0	0	0	0	3
2 = young stands (timber 5-15 yrs)	1	0	0	0	0	0	1
3 = submature timber (15-50 yrs)	0	0	0	0	0	0	0
4 = mature timber (>50 years)	3	0	0	0	0	0	3
5 = road	0	0	0	0	0	0	0
6 = partial cut	0	0	0	0	0	0	0
7 = yarding	0	0	0	0	0	0	0
8 = alpine	0	0	0	0	0	0	0
9 = other-e.g., housing, agric.	4	0	0	0	0	0	4
Totals	11	0	0	0	0	0	11

Appendix C – Mass Wasting Descriptions: Form A-3

Mass Wasting Summary: Landform 10 - Non-rule Identify Inner Gorges							
Activity	Shallow Landslides	Debris Flows	Debris Avalanches / Slides	Deep-Seated Landslides	Earthflows	Rock topples and falls	Total
1 = clearcut (timber 0-5 yrs)	0	1	0	0	0	0	1
2 = young stands (timber 5-15 yrs)	0	0	0	0	0	0	0
3 = submature timber (15-50 yrs)	1	3	0	0	0	0	4
4 = mature timber (>50 years)	2	3	0	0	0	0	5
5 = road	1	0	0	0	0	0	1
6 = partial cut	0	0	0	0	0	0	0
7 = yarding	0	0	0	0	0	0	0
8 = alpine	0	0	0	0	0	0	0
9 = other-e.g., housing, agric.	0	0	0	0	0	0	0
Totals	4	7	0	0	0	0	11

Mass Wasting Summary: Landform 11 - Steep Gradient Hillslopes (>65%)							
Activity	Shallow Landslides	Debris Flows	Debris Avalanches / Slides	Deep-Seated Landslides	Earthflows	Rock topples and falls	Total
1 = clearcut (timber 0-5 yrs)	5	2	0	1	0	0	8
2 = young stands (timber 5-15 yrs)	3	1	0	0	0	0	4
3 = submature timber (15-50 yrs)	25	2	3	11	1	0	42
4 = mature timber (>50 years)	21	4	2	25	1	0	53
5 = road	7	0	1	0	0	0	8
6 = partial cut	0	0	0	0	0	0	0
7 = yarding	0	0	0	0	0	0	0
8 = alpine	0	0	0	0	0	0	0
9 = other-e.g., housing, agric.	3	0	0	0	0	0	3
Totals	64	9	6	37	2	0	118

Appendix C – Mass Wasting Descriptions: Form A-3

Mass Wasting Summary: Landform 12 - Moderate Gradient Hillslopes (41-64%)							
Activity	Shallow Landslides	Debris Flows	Debris Avalanches / Slides	Deep-Seated Landslides	Earthflows	Rock topples and falls	Total
1 = clearcut (timber 0-5 yrs)	4	2	0	0	0	0	6
2 = young stands (timber 5-15 yrs)	4	2	0	10	0	0	16
3 = submature timber (15-50 yrs)	21	5	0	24	5	0	55
4 = mature timber (>50 years)	22	4	0	45	2	0	73
5 = road	1	1	0	1	0	0	3
6 = partial cut	0	0	0	0	0	0	0
7 = yarding	0	0	0	0	0	0	0
8 = alpine	0	0	0	0	0	0	0
9 = other-e.g., housing, agric.	1	0	0	2	0	0	3
Totals	53	14	0	82	7	0	156

Mass Wasting Summary: Landform 14 - Flats (0-10%)							
Activity	Shallow Landslides	Debris Flows	Debris Avalanches / Slides	Deep-Seated Landslides	Earthflows	Rock topples and falls	Total
1 = clearcut (timber 0-5 yrs)	0	0	0	0	0	0	0
2 = young stands (timber 5-15 yrs)	0	0	0	0	0	0	0
3 = submature timber (15-50 yrs)	0	0	0	0	0	0	0
4 = mature timber (>50 years)	0	0	0	0	0	0	0
5 = road	0	0	0	0	0	0	0
6 = partial cut	0	0	0	0	0	0	0
7 = yarding	0	0	0	0	0	0	0
8 = alpine	0	0	0	0	0	0	0
9 = other-e.g., housing, agric.	30	0	0	0	0	0	30
Totals	30	0	0	0	0	0	30

Appendix C – Mass Wasting Descriptions: Form A-3

Mass Wasting Summary: Landform 15 - Ridge tops & Noses (0-10%)							
Activity	Shallow Landslides	Debris Flows	Debris Avalanches / Slides	Deep-Seated Landslides	Earthflows	Rock topples and falls	Total
1 = clearcut (timber 0-5 yrs)	0	0	0	0	0	0	0
2 = young stands (timber 5-15 yrs)	0	0	0	0	0	0	0
3 = submature timber (15-50 yrs)	0	0	0	2	3	0	5
4 = mature timber (>50 years)	0	0	0	1	1	0	2
5 = road	0	0	1	1	0	0	2
6 = partial cut	0	0	0	0	0	0	0
7 = yarding	0	0	0	0	0	0	0
8 = alpine	0	0	0	0	0	0	0
9 = other-e.g., housing, agric.	0	0	0	0	0	0	0
Totals	0	0	1	4	4	0	9

Mass Wasting Summary: Landform 16 - Low Gradient Hillslopes (11-40%)							
Activity	Shallow Landslides	Debris Flows	Debris Avalanches / Slides	Deep-Seated Landslides	Earthflows	Rock topples and falls	Total
1 = clearcut (timber 0-5 yrs)	2	1	0	6	0	0	9
2 = young stands (timber 5-15 yrs)	1	0	0	2	1	0	4
3 = submature timber (15-50 yrs)	8	5	0	19	5	0	37
4 = mature timber (>50 years)	7	2	0	12	3	0	24
5 = road	0	0	0	2	0	0	2
6 = partial cut	0	0	0	0	0	0	0
7 = yarding	0	0	0	0	0	0	0
8 = alpine	0	0	0	0	0	0	0
9 = other-e.g., housing, agric.	2	0	0	0	0	0	2
Totals	20	8	0	41	9	0	78

Appendix D – Landform Hazard Rating Table: Form A-4

Landforms Including Road-related Landslides												
Landforms	**Landform 1 (Inner Gorges)**	**Landform 2 (Bedrock Hollows)**	**Landform 5 (Convergent Headwalls)**	**Landform 7 (Active Scarps-DSLS)**	**Landform 9 (Meander Bends/Overbank deps/Surge Plains)**	**Landform 10 (Non-rule Identified Inner Gorges)**	**Landform 11 (Steep Gradient Hillslopes >65%)**	**Landform 12 (Moderate Gradient Hillslopes 41-64%)**	**Landform 14 (Flats 0-10%)**	**Landform 15 (Ridge Tops and Noses)**	**Landform 16 (Low Gradient Hillslopes 11-40%)**	**Total WAU**
Years	45	45	45	45	45	45	45	45	45	45	45	45
Landform Area (acres)	1593	45	60	20	302	109	962	3963	2998	469	10274	20795.7744
Number of Landslides (excluding deep-seated landslides)	74	8	2	7	10	5	69	57	29	0	17	278
Landslide Frequency Rate (Number of slides/Landform Area/Years) x 10^6	1032.47	3931.60	741.26	7888.00	736.59	1017.46	1593.63	319.59	214.94	0.00	36.77	297.07
Number of 'Delivering' Landslides	74	8	2	7	10	5	66	55	29	0	17	273
Area of 'Delivering' Landslides (acres)	28.94	1.62	2.88	0.81	3.50	2.24	28.83	19.11	2.05	0.00	9.99	99.96
Landslide Area Rate for Delivery (Delivering Landslide Area/Landform Area/Years) x 10^6	403.80	795.90	1068.26	913.86	257.47	455.00	665.85	107.13	15.22	0.00	21.60	106.82
Overall Rating	**Very High**	**Very High**	**Very High**	**Very High**	**High**	**Very High**	**Very High**	**Moderate**	**Low**	**Low**	**Low**	**Moderate**

Appendix D – Landform Hazard Rating Table: Form A-4

Landforms Without Road-related Landslides												
Landforms	**Landform 1 (Inner Gorges)**	**Landform 2 (Bedrock Hollows)**	**Landform 5 (Convergent Headwalls)**	**Landform 7 (Active Scarps-DSLS)**	**Landform 9 (Meander Bends/Overbank dep/Surge Plain)**	**Landform 10 (Non-rule Identified Inner Gorges)**	**Landform 11 (Steep Gradient Hillslopes >65%)**	**Landform 12 (Moderate Gradient Hillslopes 41-64%)**	**Landform 14 (Flats 0-10%)**	**Landform 15 (Ridge Tops and Noses)**	**Landform 16 (Low Gradient Hillslopes 11-40%)**	**Total WAU**
Years	45	45	45	45	45	45	45	45	45	45	45	45
Landform Area (acres)	1593	45	60	20	302	109	962	3963	2998	469	10274	20796
Number of Landslides (excluding deep-seated landslides)	71	8	2	7	10	4	63	56	29	0	17	267
Landslide Frequency Rate (Number of slides/Landform Area/Years) x 10^6	990.61	3931.60	741.26	7888.00	736.59	813.96	1455.06	313.99	214.94	0.00	36.77	285.31
Number of 'Delivering' Landslides	71	8	2	7	10	4	61	54	29	0	17	263
Area of 'Delivering' Landslides (acres)	26.30	1.62	2.88	0.81	3.50	1.95	24.78	19.10	2.05	0.00	9.99	92.97
Landslide Area Rate for Delivery (Delivering Landslide Area/Landform Area/Years) x 10^6	366.88	795.90	1068.26	913.86	257.47	396.16	572.31	107.10	15.22	0.00	21.60	99.35
Overall Rating	**High**	**Very High**	**Very High**	**Very High**	**High**	**High**	**Very High**	**Moderate**	**Low**	**Low**	**Low**	**Moderate**