3.3 Landslide

Multnomah County has many moderate to steep slopes across its area, but especially in the far western and eastern portions of the county and upland canyons along the Sandy River. Areas with slopes are those most vulnerable to different types of land movement. Advances in LIDAR technology[55] (a laser-based ground sensing process) mapping have allowed the showing of even ancient landslides across the county, including in locations now covered by trees.

Unincorporated Multnomah County has the greatest risk from landslides among the participants of this plan, followed by the Cities of Gresham and Troutdale. The communities and districts in largely low-lying north-central portions of the county have limited exposure to landslide risk. The City of Portland, although not part of this plan, has extensive landslide risk in the Portland Hills.

Landslides can be small localized events that disrupt transportation routes or other infrastructure, or catastrophic events that threaten lives and homes. Western Oregon, because of its topography and wet climate, is much more susceptible to landslide hazards than Eastern Oregon.

As with many hazards in Multnomah County, local risk is increased by the large population and development and infrastructure in areas with high potential for future slides. Continuing growth could put additional people, structures and infrastructure in risk areas, although local jurisdictions have limited development in and around steep slopes to reduce that risk.

Figure 62 - A home in Dodson, in eastern unincorporated Multnomah County, damaged by landslide in 1996. The house later burned down during the 2017 Eagle Creek Fire.

There are different types of landslides. Most simply, a landslide is any downslope movement of rock, soil, or other debris–but it can also be a fast moving flow, spread across gentle slopes, or a fall of vertical rock or boulders. Geological factors that impact the likelihood and effect of landslides are the composition of materials in soil, such as water, rock and sand, and the steepness of slopes.

Extreme rain events are the most common cause of landslides in Multnomah County. The 1996 flood season triggered over 700 documented landslides in Portland alone, nearly half of the total number of recorded landslides in the most recent study inventory. The risk of rain-driven landslides can be further increased by wildfire, which can strip

[55] Lidar stands for light detection and ranging, and is a process that can make extremely precise ground measurements by sending out a laser light and evaluating how long it takes to reflect back to the source. [American Geosciences Institute]

the landscape of vegetation that holds topsoil together and alter soil chemistry, making it less able to absorb water. These effects can cause long-term landslide risk over many years.

It is also expected that a significant earthquake event will cause widespread landslides, with impacts heavily determined by whether or not soils are wet at the time of the earthquake.

Fast moving debris slides can be caused by volcanic eruptions. These dangerous events are called lahars, and information about them is in the chapter on Volcano.

Landslide Types

The Oregon Department of Geology and Mineral Industries (DOGAMI) has analyzed Multnomah County's risk and vulnerability to landslides[56], dividing risk into three types.

Deep landslides occur mostly below the roots of trees and can be hundreds of feet deep, depending on the soil and rock characteristics of the slide area. DOGAMI analysis considers any slide deeper than 15 feet below the surface to be deep. Deep landslides occur due to processes below the ground, including earthquake, rock geology and groundwater effects. Once formed, deep landslides will continue to be a risk area for resumed landslides for hundreds or even thousands of years, and can be reactivated by earthquake, extreme rainfall, or careless development practices. Deep landslides are typically much larger than shallow landslides and therefore create more risk of loss of life when they occur in populated areas. The 2014 Oso Landslide in Washington that killed 43 people was a deep landslide.

Shallow landslides occur within the zone of forest roots and are usually less than 10 feet deep. DOGAMI analysis considers any slide shallower than 15 feet below the surface to be shallow. Shallow landslides are most likely to occur because of heavy rain or sudden snowmelt. The saturation causes a loosening of soil and gravity pulls the soil, rocks and other debris downhill. Areas with shallow landslides have characteristics (soil type, slope angle) that make them susceptible to future landslides, but shallow slides themselves are not likely to be continuous or to become reactivated. Shallow landslides can vary widely in impact, depending on the size of the slope, the triggering event, and if development is in the path.

Debris flow fans are the areas where debris arrives in a flow and spreads out as it reaches the mouth of a canyon or channel. Areas with these deposits are at risk from future additional deposits of debris in further slides that would threaten development or infrastructure that has been built on top of the old deposits.

[56] DOGAMI has also produced a story map fully describing statewide landslide hazards and how they are mapped.

Other Landslide Classifications – Slides, Flows, Spreads and Topples/Falls

Oregon Geology Fact Sheet | Landslide Hazards in Oregon

Landslides affect thousands of Oregonians every year. Protect yourself and your property by knowing landslide types, their triggers and warning signs, how you can help prevent landslides, and how to react when one happens.

9,500 landslides were reported in Oregon in winter 1996 -97 ▸

Common landslide triggers in Oregon
- intense rainfall
- rapid snow melt
- freeze/thaw cycles
- earthquakes
- volcanic eruptions
- human
  - changing the natural slope
  - concentrating water
- combinations of the above

COMMON LANDSLIDE TYPES	TRIGGERS AND CONDITIONS	EXAMPLES
SLIDES — downslope movement of soil or rock on a surface of rupture (failure plane or shear-zone). Commonly occurs along an existing plane of weakness or between upper, relatively weak and lower, stronger soil and/or rock. The main modes of slides are translational and rotational. *translational* *rotational*	Slides are commonly triggered by heavy rain, rapid snow melt, earthquakes, grading/removing material from bottom of slope or adding loads to the top of the slope, or concentrating water onto a slope (for example, from agriculture/landscape irrigation, roof downspouts, or broken water/sewer lines). Slides generally occur on moderate to steep slopes, especially in weak soil and rock.	*translational slide* *rotational slide* *(most slides are combinations of translational and rotational movement)*
FLOWS — mixtures of water, soil, rock, and/or debris that have become a slurry and commonly move rapidly downslope. The main modes of flows are unchannelized and channelized. Avalanches and lahars are flows. *unchannelized flows– left: earth flow; right: debris avalanche* initiation, transportation, deposition *channelized flow*	Flows are commonly triggered by intense rainfall, rapid snow melt, or concentrated water on steep slopes. Earth flows are the most common type of unchannelized flow. Avalanches are rapid flows of debris down very steep slopes. A channelized flow commonly starts on a steep slope as a small landslide, which then enters a channel, picks up more debris and speed, and finally deposits in a fan at the outlet of the channel. Debris flows, sometimes referred to as rapidly moving landslides, are the most common type of channelized flow. Lahars are channelized debris flows caused by volcanic eruptions.	*debris avalanche (unchannelized flow)* *earth flow (unchannelized flow)* *channelized debris flow* *lahar aftermath (note the flow height indicated by stained trees)*
SPREADS — extension and subsidence of commonly cohesive materials overlying liquefied layers.	Spreads are commonly triggered by earthquakes, which can cause liquefaction of an underlying layer. Spreads usually occur on very gentle slopes near open bodies of water.	*spread*
TOPPLES / FALLS — rapid, nearly vertical, movements of masses of materials such as rocks or boulders. Toppling failures are distinguished by forward rotation about some pivotal point below or low in the mass. *topple* *fall*	Topples and falls are commonly triggered by freeze-thaw cycles, earthquakes, tree root growth, intense storms, or excavation of material along the toe of a slope or cliff. Topples and falls usually occur in areas with near vertical exposures of soil or rock.	*topple* *fall*

Landslide diagrams modified from USGS Landslide Fact Sheet FS2004-3072. Photos — Translational slide: Johnson Creek, OR (Landslide Technology). Rotational slide: Oregon City, OR, January 2006. Debris avalanche flow: Cape Lookout, OR, June 2005 (Ancil Nance). Earth flow: Portland, OR, January 2006 (Gerrit Huizenga). Channelized debris flow: Dodson, OR, 1996 (Ken Cruikshank, Portland State University). Lahar: Mount St. Helens, WA, 1980 (Lyn Topinka, USGS/Cascades Volcano Observatory). Spread: induced by the Nisqually earthquake, Sunset Lake, Olympia, WA, 2001 (Steve Kramer, University of Washington). Fall: Portland, OR (DOGAMI). Topple: I-80 near Portland, OR, January 2006 (DOGAMI).

Oregon Department of Geology and Mineral Industries 800 NE Oregon St., Suite 965 Portland, OR 97232 971-673-1555 www.OregonGeology.com

LAST REVISED 11-12-2008

Figure 63 - DOGAMI Landslide Hazards in Oregon Fact Sheet

Five-Year Report, 2017-2022

Minor landslides were a common event during extremely rainy periods over the last five years, causing brief interruptions to transit routes. However, a major landslide occurred near the unincorporated Multnomah County community of Dodson on January 13, 2021, killing one person.

This tragedy occurred when a car was swept from the Interstate Highway 84 Frontage Road during the night of a heavy rain event. This stretch of highway runs through extremely steep portions of the Columbia River Gorge that had seen extreme landslides in the 1996 flood season and have a long geological record of slides. The slopes above the site also contained burned over areas from the 2017 Eagle Creek Fire, further increasing the probability and potential severity of a land movement event.

Figure 64 – Aftermath of the 2021 Dodson landslide. Photo Multnomah County Sheriff's Office

This event was a 15-foot high flow of mud, rocks and logs. After the slide, Dodson was evacuated for three days until it was determined by geologists that there was no imminent risk of another debris flow event. No homes were damaged by this event.

This loss of life underlined the high risk of additional landslides in areas where landslides have previously occurred, the concurrent risk of landslides during heavy rain events and the increased risk lasting years after wildfire.

The effects of smaller slides were primarily to city or county roads in areas with identified steep slopes. These smaller slides also coincided with periods of high rain.

Figure 65 - Minor 2017 winter landslide on the East Historic Columbia River Highway. Photo Multnomah County Sheriff's Office

Landslide Data

In 2017, DOGAMI released a *Landslide Hazard and Risk Study of Central and Western Multnomah County*, providing the most up-to-date information about probable locations of future landslides and vulnerability from landslide to all of the participating cities in this plan as well as the Port of Portland and most of the area served by the Columbia Corridor Drainage Districts. DOGAMI also published a *Landslide Inventory for Eastern Multnomah County* in 2017, using the same high-quality LIDAR data to identify historic slide deposits. The Eastern Multnomah inventory did not include a vulnerability analysis, but completed risk mapping for the entire county to use in planning, risk identification and communication, and response.

The updated landslide inventory data has been added to DOGAMI's Statewide Landslide Information Database for Oregon (SLIDO), which continues to be the single most comprehensive resource for statewide landslide information.

DOGAMI also received a grant in 2022 to study probabilities of post-wildfire land movement in the Portland Metropolitan region. Characteristics of post-fire land movement have been better studied in drier climates with more frequent fires, and this study will provide needed additional analysis of risks to wet climates.

Climate Change Impacts

Because landslide occurrence is so tied to extreme precipitation, climate projections for increased intensity and duration of heavy rainfall should be considered as a significant future threat to cause more frequent and extreme landslides. Projected increases in precipitation are found in the Flood chapter.

Wildfires are also a factor in increasing the risk and severity of landslides, and are another hazard significantly impacted by climate change. Wildfire burn areas impact soil cohesion and water absorption for many years. Projected increases in burned areas are found in the Wildfire and Wildfire Smoke chapter.

3.3.1 Landslide Impacts, Location and Extent

The highest density of recorded landslides in Multnomah County has been in the Portland West Hills, where slides have occurred on both sides of the ridgeline as well as in canyons within the range. That susceptibility exists with less intensity in the northwest corner of the county, along roads in unincorporated Multnomah County.

A large number of landslides in the inventory have also occurred on the north-facing slope of the Columbia River Gorge from around the Corbett community to the county's eastern boundary with Hood River County. Other areas with significant slide history in this planning area are along the Historic Columbia River Highway on the Sandy River in Troutdale and unincorporated Multnomah County, and at Highway 30 and Newberry Road in western unincorporated Multnomah County.

The historical points shown below are records from a 150-year period and are primarily shallow landslide events.

An interactive version of this map can be found here (Landslide Inventory – Historic Landslide Records (points))

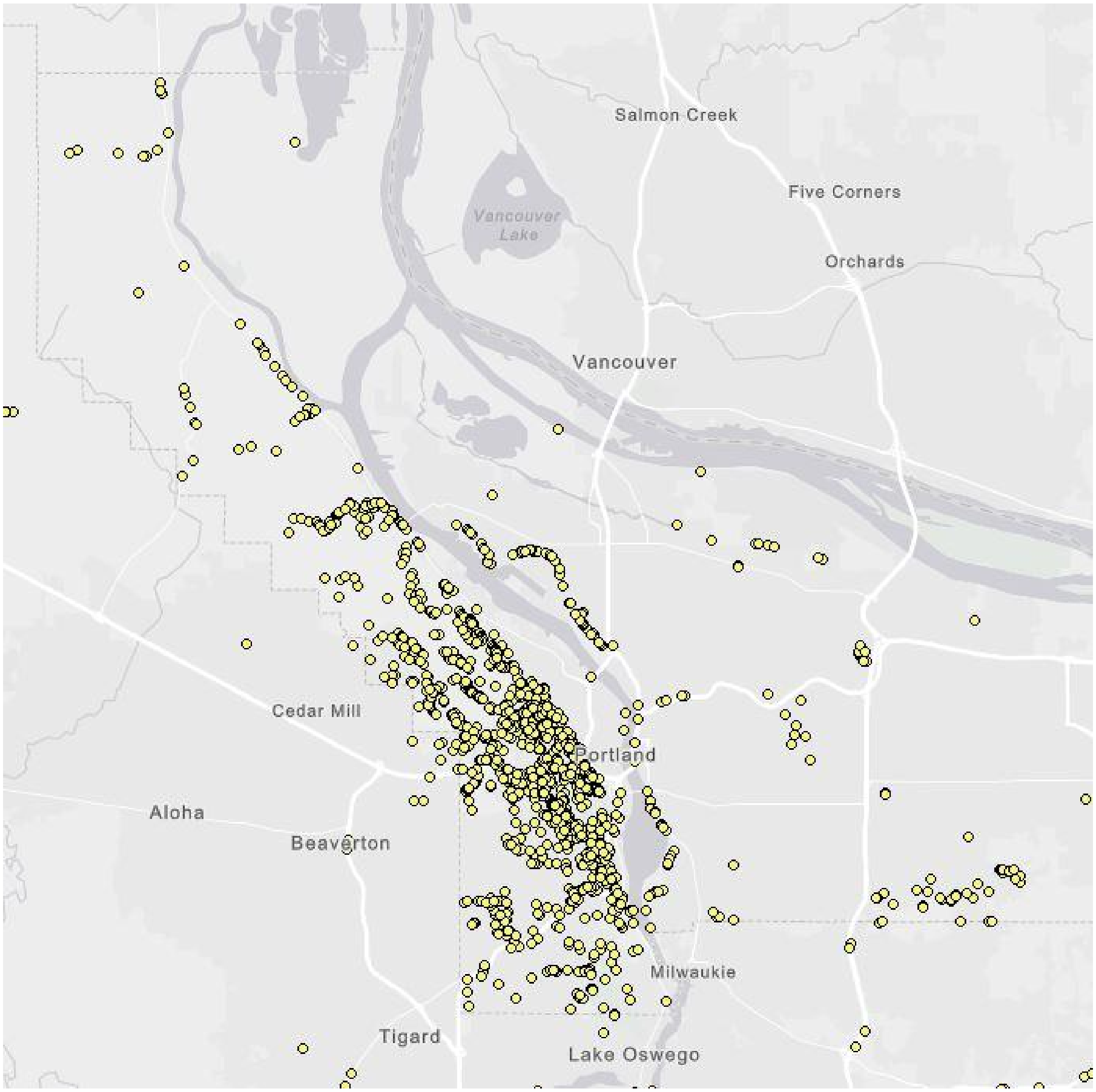

Figure 66 - Map showing locations of landslides over the last 150 years in Western and Central Multnomah County. Map from DOGAMI SLIDO site.

An interactive version of this map can be found here (Landslide Inventory – Historic Landslide Records (points))

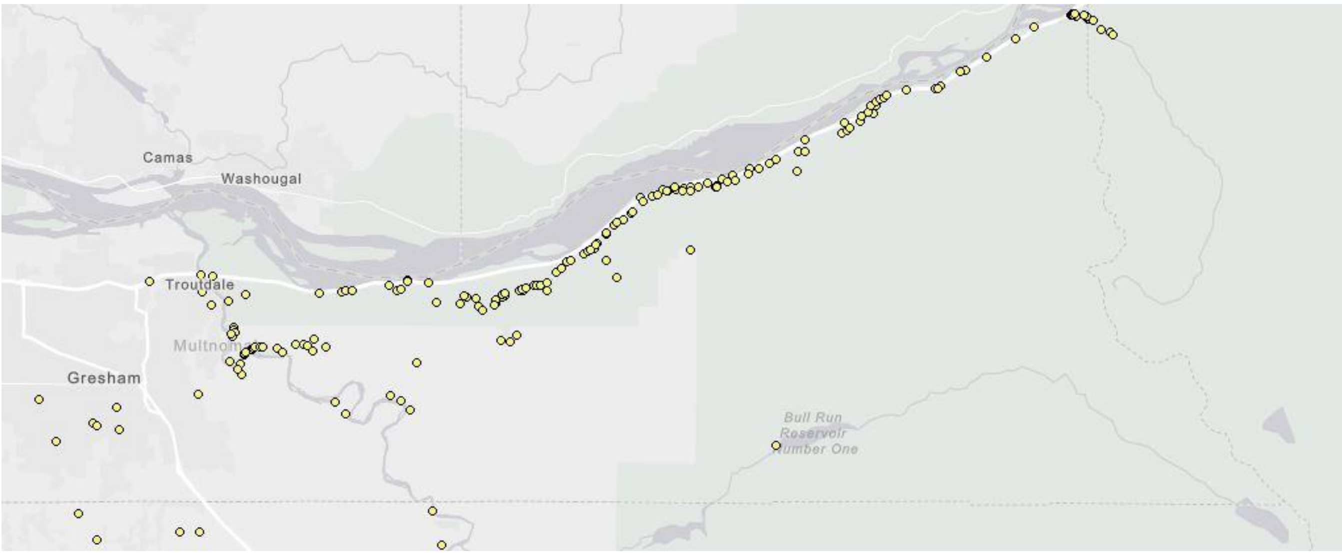

Figure 67 - Map showing locations of landslides over the last 150 years in Eastern Multnomah County. Map from DOGAMI SLIDO site.

Through the use of LIDAR, geologists can also see evidence in ground formations where deep landslides have previously occurred, even from thousands of years ago. Areas shown to have deep landslide deposits from past slides are the areas at the highest risk of future deep landslides. The largest areas of these landslide deposits are in the northwestern most corner of the county, the Columbia River Gorge, and steep slopes above the Sandy River.

An interactive version of this map can be found here (Landslide Inventory – Deposits)

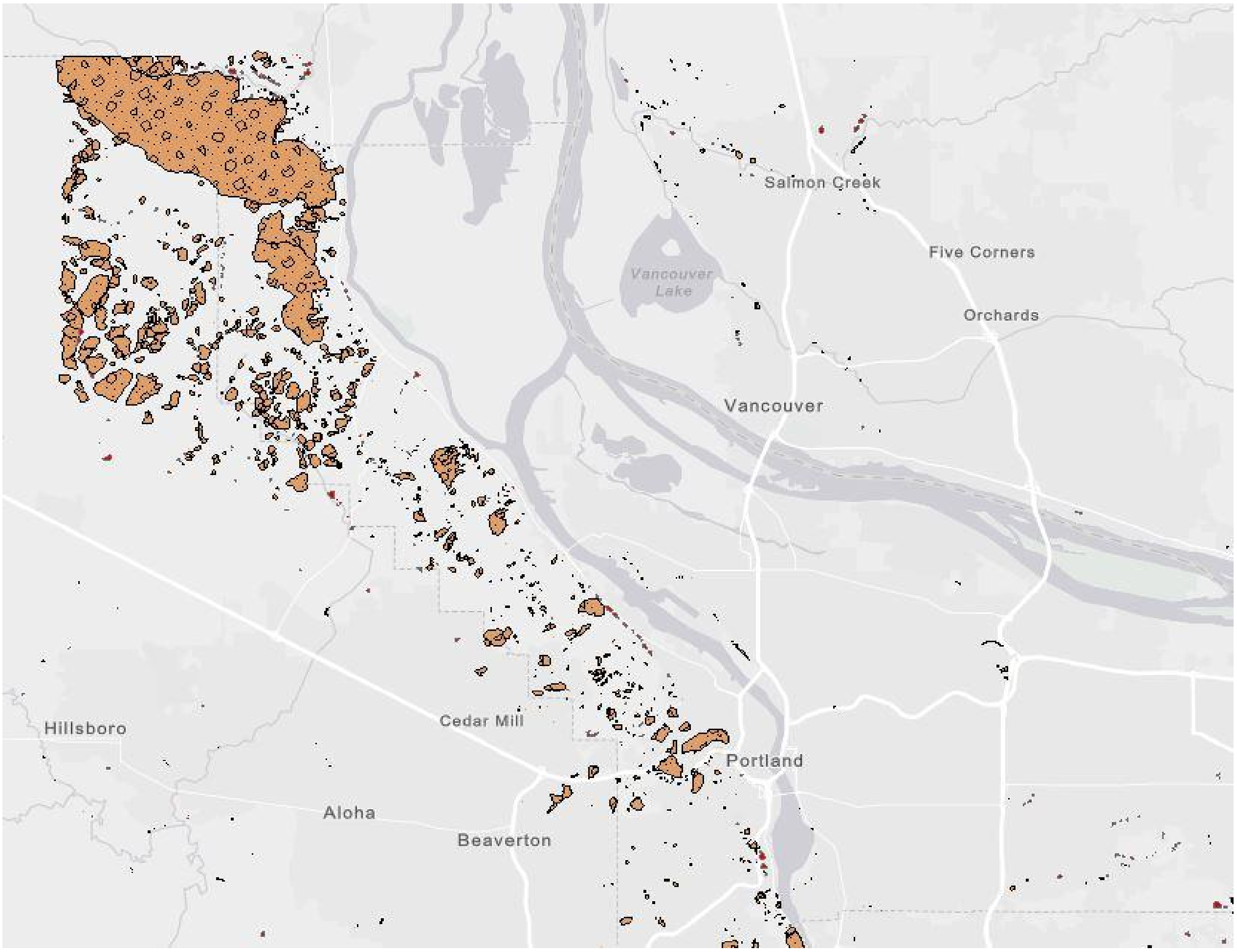

Figure 68 - Map showing locations of historic deep landslide deposits in Western and Central Multnomah County. DOGAMI SLIDO Map

An interactive version of this map can be found here (Landslide Inventory – Deposits)

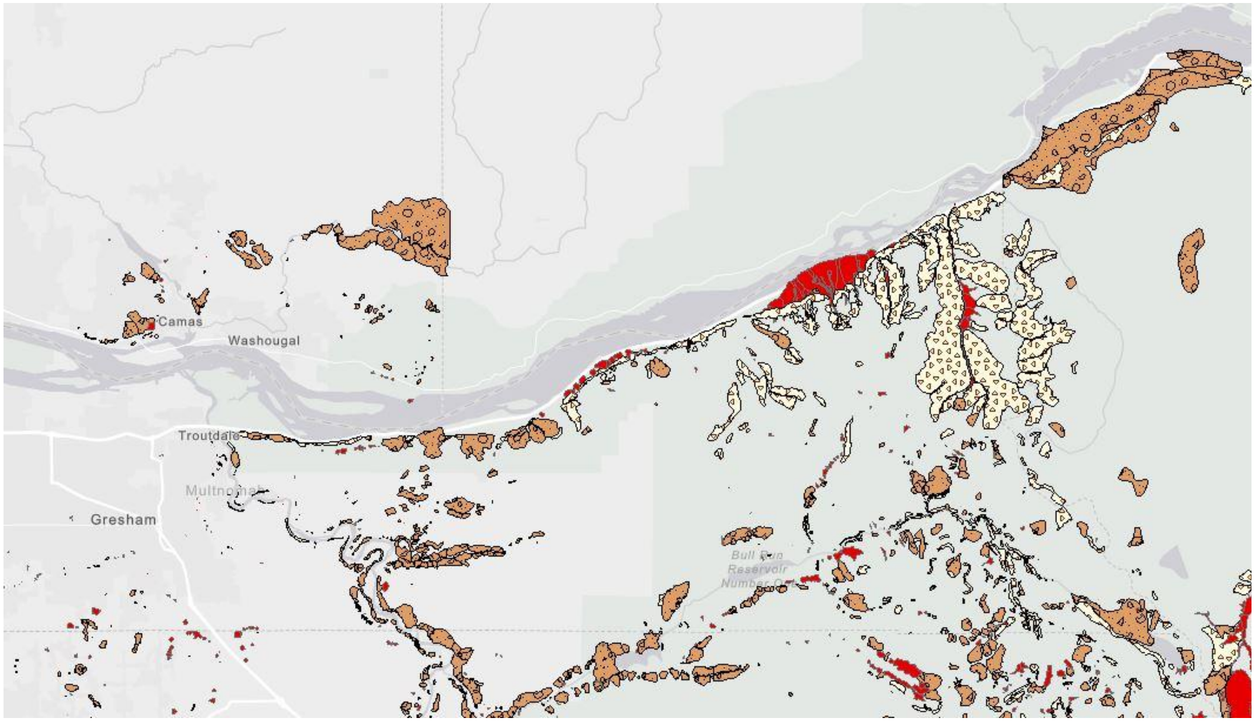

Figure 69 - Map showing historic deep landslide deposits in Eastern Multnomah County. The red areas are alluvial fans, where debris spreads out at the confluence with rivers, lakes and streams. The lightest colored areas are Talus-Colluvium deposits, which are rocky. DOGAMI SLIDO map

Combining this geological data with recent landslide records gives the most complete picture of the extent of overall landslide risk in the County. Many parts of the county have no historical record of landslides nor show evidence of historic landslide deposits. These areas may still have potential for shallow landslides, because of their soil types and slopes. Those additional areas can be seen in the overall susceptibility mapping, shown later in this section.

The following tables show the portion of susceptibility each community in this plan has across the three identified risk levels. This analysis gives an idea of which planning areas are most at risk from landslide. The total percentage includes the entirety of each area, so areas with low susceptibility are not predicted to be subject to landslide.

The area served called the Airport Neighborhood is defined as such under City of Portland Risk Reporting Areas. There is no analysis of areas within the boundaries of the Port of Portland or the Columbia Corridor Levee Districts, but the Airport neighborhood, and other low-lying areas such as the Cities of Wood Village and Fairview, can be used to estimate vulnerability.

Another limitation of this analysis is that it only includes locations in the Central and Western portion of unincorporated Multnomah County. Areas in Eastern Multnomah County have very high susceptibility to both shallow and deep landslides. Even without including that high-risk area, Unincorporated Multnomah County has, by far, the highest percentage of area in both shallow and deep high-risk zones.

In developing landslide risk studies, DOGAMI uses a classification of low, medium and high susceptibility to both shallow and deep landslides.
For shallow landslides, this risk classification is based on:

- Historical landslide inventory data points
- Measurable slope stability characteristics

The complex analysis of slope stability breaks locations into values of 'considered stable' (low), 'considered potentially unstable' (medium) and 'considered potentially unstable or considered unstable' (high)[57].

Classification of deep landslides is based on:
- Historical geological evidence of landslide (observable deposits)
- The type of rock formation or soil classification at a location
- Areas where different rock formations come in contact and a weaker layer supports a heavier layer
- The angle of the slope
- Where the direction of the potential movement matches the direction of previous landslides

Table 30 – Shallow Landslide Risk by Percentage of Jurisdiction – (DOGAMI IMS-57 – Landslide Hazard and Risk Study of Central and Western Multnomah County)

Planning Area	Percentage of Area by Risk Zone		
	Low	Moderate	High
Airport	92%	7%	2%
Fairview	74%	20%	6%
Gresham	70%	19%	11%
Troutdale	71%	20%	9%
Wood Village	77%	18%	5%
Unincorporated Multnomah County (West/Central)	56%	22%	22%

57 Repetition of 'considered potentially unstable' is due to where breaks were made in the categorical scale. The high risk locations include areas at higher risk than medium locations, but still not with severe enough risk to be 'considered unstable'.

An interactive version of this map can be found here (Landslide Susceptibility – Susceptibility to Shallow Landslides)

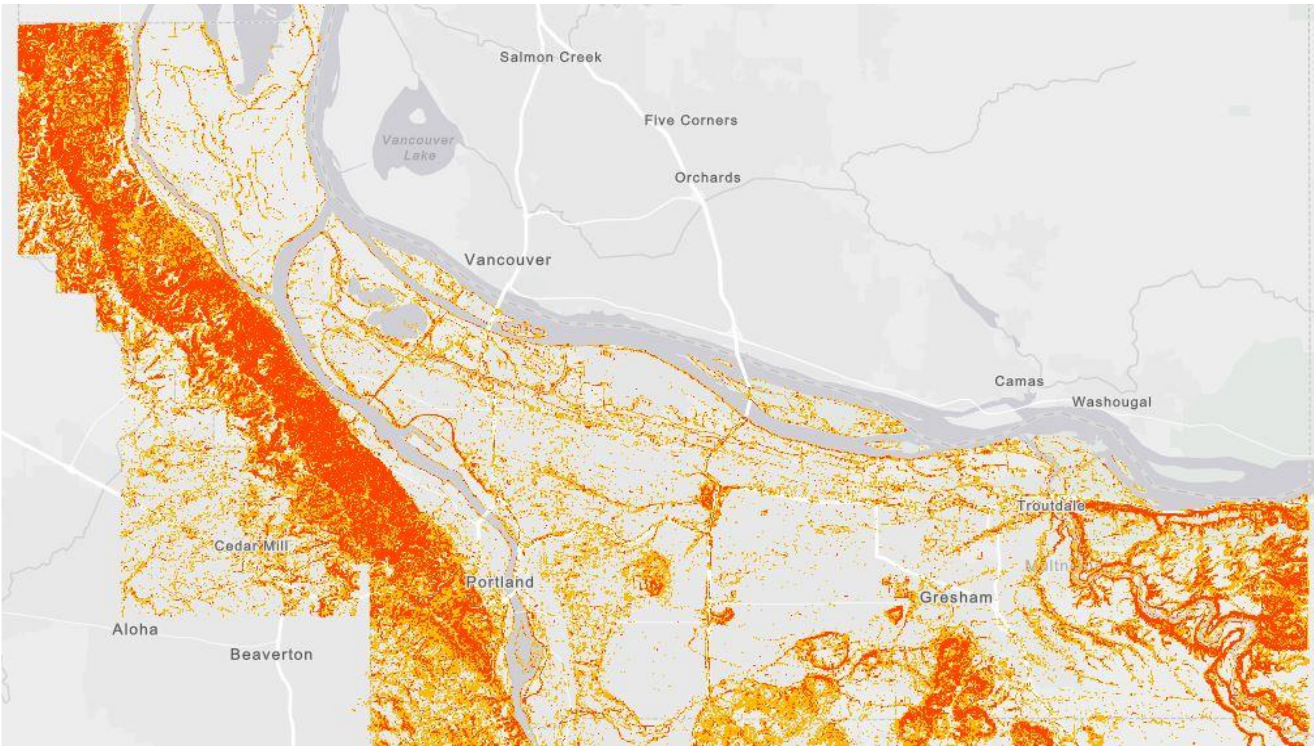

Figure 70 - Map showing location of shallow landslide risk across Western and Central Multnomah County. Dark orange indicates high susceptibility, orange is moderate susceptibility and light orange is low susceptibility. Areas with no color were determined to have no shallow landslide risk. Map DOGAMI SLIDO site.

Table 31 – Deep Landslide Risk by Percentage of Jurisdiction – (DOGAMI IMS-57 – Landslide Hazard and Risk Study of Central and Western Multnomah County)

Planning Area	Percentage by Zone		
	Low	Moderate	High
Airport	100%	0%	0%
Fairview	100%	0%	0%
Gresham	95%	4.5%	0.5%
Troutdale	96%	2.5%	1.5%
Wood Village	100%	0%	0%
Unincorporated Multnomah County (West/Central)	65%	21%	14%

An interactive version of this map can be found here (Landslide Susceptibility – Susceptibility to Deep Landslides)

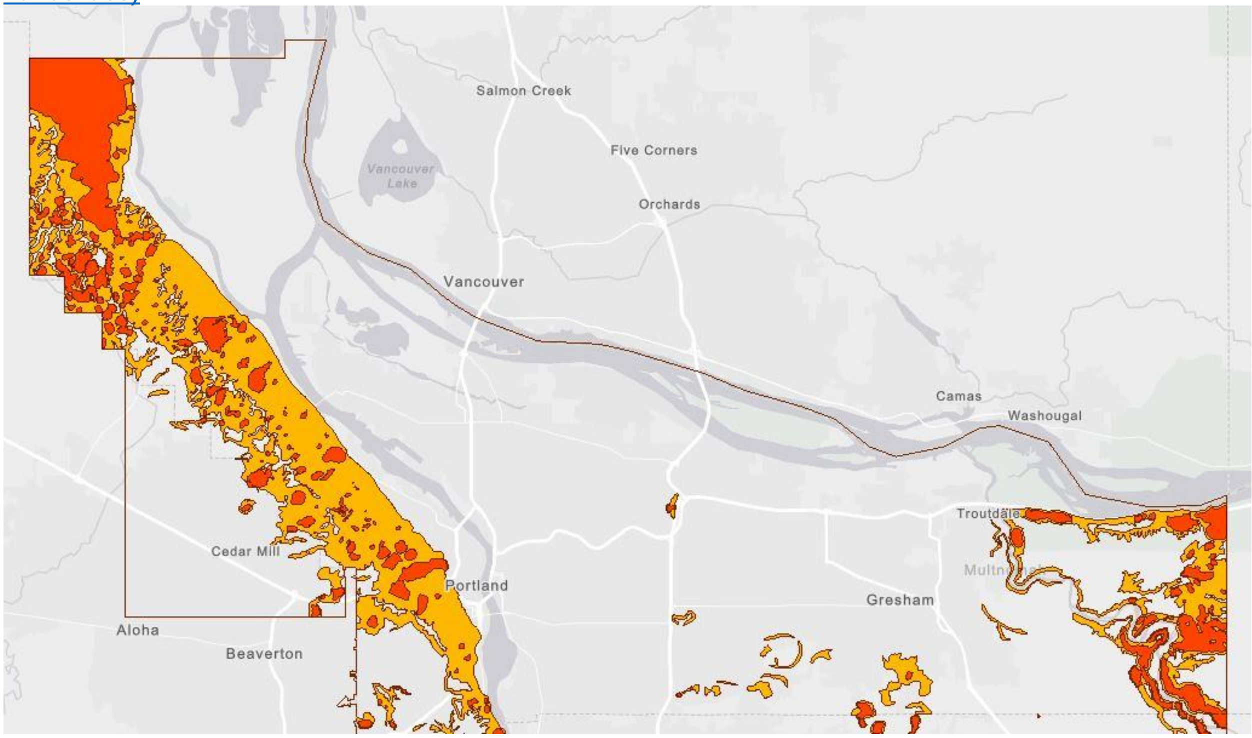

Figure 71 - - Map showing location of deep landslide risk across Western and Central Multnomah County. Red indicates high susceptibility and orange is moderate susceptibility. Areas with no color have low deep shallow landslide risk. Map DOGAMI SLIDO site.

Landslides Triggered by Earthquake

A large earthquake will also trigger landslides. These landslides will most likely occur in the same areas already identified as prone to landslides. If the earthquake is big enough, many landslides will occur at once, reducing the effectiveness of evacuation and response. Landslide susceptibility maps have been considered when identifying updated regional emergency transportation routes.

3.3.2 Landslide Probability and History

Landslides tend to occur in the same places repeatedly over time, where geological characteristics make soils fundamentally more prone to movement. Landslides are often triggered by external rain and snow or seismic events. This hazard can also be made worse by development impacts that add water to a slide area, reduce vegetation, and change slope characteristics by removing or altering soil. It is possible that many years may go by between deep or shallow landslide events in a single location, and periods of calm may suddenly end by rapid accumulations of continuing or new landslides.

DOGAMI's accumulation of historical landslide occurrences in the City of Portland over the last 150 years indicates an average of eight to nine major landslides per year. However, the real expected rate of landslides are much more clustered around storm events and, more rarely, large-scale geological events like earthquakes and volcanoes. 891 of the 1,700 (about 52%) landslide records in the inventory occurred during the winter of 1996, in a single extreme rain and flood event.

This predictability creates a method for establishing risk that can combine existing geological characteristics with historical deposits to provide an effective accounting of all locations with likelihood of landslide. Although these areas of susceptibility can be determined, it remains difficult to pinpoint exactly where or when a landslide will occur, so mitigation strategies are most likely to be effective when they limit development in high-hazard areas and prevent the changing of stormwater runoff patterns.

Areas with any evidence of previous deep slides were classified as high risk for future deep slides. The other factors were used to group areas into moderate or low risk in areas without evidence of previous deep slides.

History

Landslides have occurred for millennia in this region and are a natural part of long-term geological processes in the region. A huge landslide occurred on the Washington side of the Columbia River Gorge over 500 years ago near where the City of Cascade Locks lies now in Hood River County. The Bonneville Dam in Eastern Multnomah County sits within the location of the slide.

The Bonneville Landslide was so large, it dammed the Columbia River, forming a temporary lake, and covered an area of six square miles with slide deposits while overlapping three other previous landslide deposits. It is unknown if deaths were caused by this slide, but it profoundly altered the landscape, creating a miles-long stretch of rapids when the river flow was naturally restored and causing the formation of sandy beaches downstream[58].

Figure 72 - Columbia River Gorge photo overlaid with an outline of the Bonneville Landslide. Image by Dan Coe, Washington Geological Survey/Washington Department of Natural Resources.

[58] Landslide blocks the Columbia River in about 1450, Washington State Department of Archaeology and Historic Preservation, David Wilma, June 2006

The March 2014 Oso Landslide in northern Washington was a catastrophic example of the threat of deep landslides when development occurs in locations below areas with landslide characteristics and evidence of previous deep slides. The slide killed 43 people, destroyed about 40 structures and buried about a mile of state highway. The slide occurred during a period of extreme rainfall (150-200 percent of normal) when the ground was already saturated. As with the Bonneville Landslide, the sheer amount of debris – about 19 million tons – dammed the local river, and created a temporary lake that flooded homes upstream. Research after the slide revealed evidence of similar past slides ranging from 500-6,000 years old[59].

Figure 73 - 2014 Oso Landslide photo. Photo Jonathan Godt, US Geological Survey

Table 32 – Landslide History of Multnomah County (Federally Declared Disasters Shaded)

Date	Location	Description
Feb. 1918	Dodson-Warrendale, Oregon	Massive debris flow that initiated in canyon east of St. Peters Dome and flowed northward; covered the highway in 10–12 feet of debris. Estimated 500,000 to 1 million cubic yards of material deposited.
Dec. 1964	Statewide	DR-184. Heavy rains and flooding, with landslides, on December 24, 1964.
Mar. 1972	Near Portland, Oregon	Mud and rockslide on I-5; three motorists injured.
1964, 1972, and 1975	Columbia Gorge, Oregon	Flooding and debris flow events described in a report as coming from a verbal source for the noted years, but no supporting documents.

[59] Oso Landslide – Five Years Later, US Geological Survey, March 20, 2019

Date	Location	Description
Oct. 1984	I-84 near Cascade Locks, Oregon	Rockslide; fatalities: two children; cost of stabilizing the slide area: $4 million.
Dec. 1987	John B. Yeon State Park	A debris flow event removed a footbridge over McCord Creek.
Sep. 1990	Near Troutdale, Oregon	Landslide injured four highway workers.
Feb. 1996	Dodson-Warrendale, Portland Metro area, Oregon	DR-1099. Heavy rains and rapidly melting snow contributed to thousands of landslides and debris flows across the state; many occurred on clear-cuts that damaged logging roads; I-84 closed at Dodson-Warrendale; 700 landslides in the Portland metro area.
Apr. 1997	I-84 at Milepost 35	A debris flow event on April 20, 1997, covered both lanes of eastbound I-84 for approximately nine hours.
Jan.- Feb. 1999	Northwest Oregon	Widespread flooding on smaller rivers and streams; numerous landslides and mudslides. Historic Columbia River Highway east of the Sandy River Bridge covered with slides coming from the cliffs above.
Nov. 2001	I-84 near Milepost 35	Multiple debris flows on November 28, 2001; they occurred in the drainage basin after five days of heavy rainfall. These flows originated in the steep cliffs south of the drainage basin. Approximately 200,000 cubic yards of debris was deposited.
Dec. 2003-Jan. 2004	Statewide	DR-1510. Winter storms with landslides. Much of the Portland area shut down.
May 2006	Statewide	DR-1632. Statewide impacts from storms, floods, landslides and mudslides.
Dec. 2007-Jan. 2008	Western Oregon	DR-1824. Severe winter storms, record and near-record snow, landslides and mudslides.
Jan. 2011	Statewide	DR-1956. Severe winter storm, flooding, mudslides, landslides and debris flows.
Jun. 2014	Historic Columbia River Highway	A landslide closed the Historic Columbia River Highway just west of the Stark Street bridge. ODOT estimated the slide to be about 1,000 cubic yards of rock.
Dec. 2015	Western Oregon	DR-4258. Severe winter storms, straight-line winds, flooding, landslides and mudslides.
Jan. 2021	Multnomah County	Long-term heavy rains caused a fatal landslide in a burned over area in Dodson, in unincorporated Multnomah County.

3.3.3 Landslide Vulnerability

Landslides can move very fast, impacting people and property in many ways and posing risk to life safety. Landslides can block and damage roadways as they dump debris on roadways or as roadways themselves slide downhill. Even ground displacements of a few inches can result in pipe failures and building or road damages.

Less common larger landslides can affect several buildings and homes, or entire neighborhoods; major roads or highways, including bridges, overpasses and viaducts; or major utility lines. Large landslides can have significant economic impact, in the range of tens of millions of dollars. Occupants of buildings or vehicles may be injured or killed by landslides of even small size.

DOGAMI’s analysis showed that in the Western and Central portions of Multnomah County, 6,700 people and $1.65 billion in land and buildings are located on existing landslides. Many historical landslide points are located on public lands where there may be less infrastructure, but would threaten recreational users and natural resources.

The tables below show the exposure to high-risk shallow and deep landslide zones. The study shows the number of people, structures, critical facilities, and roads potentially impacted in each area. The study uses a 'worst-case' scenario, considering a time with maximum ground saturation, so these estimates are intended to be extreme. The study does not quantify the severity of damage in each location, only identifying the total amount of community assets in these locations.

Table 33– Vulnerability to Shallow Landslide by Jurisdiction – (DOGAMI IMS-57 – Landslide Hazard and Risk Study of Central and Western Multnomah County)

Jurisdiction	Population in High Risk Zone	Percentage of Population in High Risk Zone	Structures in High Risk Zone	Total Building Value in High Risk Zone (millions)
Fairview	171	1.94%	236	S6.75
Gresham	2,572	2.44%	4,955	$115.15
Troutdale	489	3.07%	596	$8.87
Wood Village	93	2.41%	120	$1.33
Unincorporated Multnomah County (West/Central)	1,564	10.00%	4,799	$160.71

Table 34– Critical Facility and Infrastructure Vulnerability to Shallow Landslide by Jurisdiction – (DOGAMI IMS-57 – Landslide Hazard and Risk Study of Central and Western Multnomah County)

Jurisdiction	Roads in High Risk Zone (miles)	Percentage of Roads in High Risk Zone	Critical Buildings in High Risk Zone
Fairview	0.21	0.47%	10
Gresham	1.28	0.40%	47
Troutdale	0.47	0.69%	6
Wood Village	0.12	0.01%	0
Unincorporated Multnomah County (West/Central)	11.96	74.53%	19

Table 35– Vulnerability to Deep Landslide by Jurisdiction – (DOGAMI IMS-57 – Landslide Hazard and Risk Study of Central and Western Multnomah County)

Jurisdiction	Population in High Risk Zone	Percentage of Population in High Risk Zone	Structures in High Risk Zone	Total Building Value in High Risk Zone (millions)
Fairview	0	0%	0	$0
Gresham	14	0.01%	6	$1.40
Troutdale	42	0.27%	29	$1.46
Wood Village	0	0%	0	$0
Unincorporated Multnomah County (West/Central)	1,117	28.82%	858	$1075.02

Table 36– Critical Facility and Infrastructure Vulnerability to Shallow Landslide by Jurisdiction – (DOGAMI IMS-57 – Landslide Hazard and Risk Study of Central and Western Multnomah County)

Jurisdiction	Roads in High Risk Zone (miles)	Percentage of Roads in High Risk Zone	Critical Buildings in High Risk Zone
Fairview	0	0%	0
Gresham	0.31	0.10%	0
Troutdale	1.19	1.75%	0
Wood Village	0%	0%	0
Unincorporated Multnomah County (West/Central)	25.93	7.65%	0

Infrastructure Impacts

The area not included in the vulnerability study in Eastern Multnomah County has high potential for structural damage, loss of life, and infrastructure damage. Interstate Highway 84 is a route connecting the Portland Metropolitan Area to communities in the Columbia River Gorge and Northeastern Oregon. Deep landslide deposits shown in the Eastern Multnomah County inventory would severely impact the highway and alternate routes in numerous locations. The area is also a key railroad corridor.

Impacts to US Highway 30 were included in the study, but should still be emphasized as a highly vulnerable and critical route, as a key connection from the Portland Metropolitan Area to Columbia River communities to the west.

The Bull Run Watershed lies in an area with geological evidence of previous landslides and has steep slopes that could be the sites of future slides. A landslide into the reservoir system could damage roads and equipment and introduce large amounts of sediment into the water supply that would temporarily restrict its use and harm habitat values. Aquifer wells in the northern part of the county are in locations with little susceptibility to large landslides, but surface infrastructure and pipes could be damaged by smaller slides.

Landslide damage to power poles could cause long-term localized power outages that could endanger those with medical needs