Hazard Type
LAHAR
Probability of Occurrence
LOW
Vulnerability
HIGH
Risk
MODERATE

Chapter 4.6
Volcanic Hazard Profile

Introduction

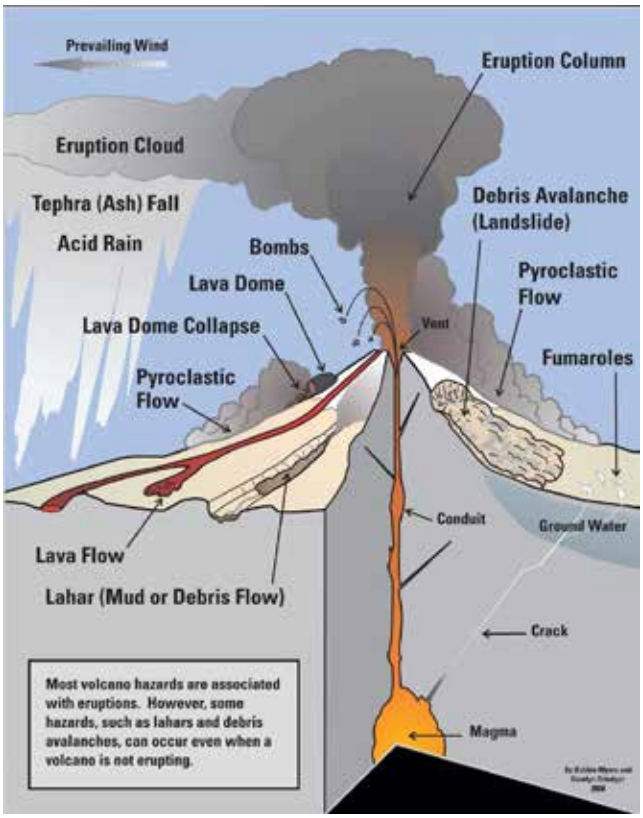
The May 18, 1980 Mount St. Helen's eruption killed 57 people and caused over $1 billion in damage. Both this major volcanic eruption and the mountain's activity leading up to and following it provide ample evidence of Cascade volcanoes' ability to reawaken with destructive force and severely impact Pacific Northwest communities. The Cascade Range extends from British Columbia to northern California, containing over a dozen active volcanoes. Washington State is home to five: Mount Baker, Glacier Peak, Mount Rainier, Mount St. Helens, and Mount Adams. Each can generate ash plumes, lahars (mud or debris flows), lava, pyroclastic flows, and debris avalanches. In the last 4,000 years, 11 Cascade volcanoes erupted an estimated 100 times; a rate of two events per century.[1]

Thurston County is within range of two of the most active and hazardous volcanoes in the United States. The faces of Mount Rainier and Mount St. Helens are located only 22 and 39 miles, respectively, from the southeast corner of the county. The proximity of these volcanoes places the county at risk to volcanic hazards. While these volcanoes pose a low risk for ash fall, Mount Rainier presents a moderate risk for a lahar within the Nisqually Valley.

Hazard Identification

Gas, ash, ballistic projectiles, rock fragments, and magma are forced to the surface from rising pressures within and below the volcano. Many volcanic events such as pyroclastic flows, lava flows, landslides, and explosive blasts can devastate an area of tens of miles or greater from the source of the eruption (Figure 4.6.1). Although these events can destroy almost everything in their path, it is unlikely these impacts will extend beyond the boundary of Mount Rainier National Park.[2]

Figure 4.6.1: Volcanic Hazards



Graphic courtesy of USGS.

An explosive eruption could create an ash plume that could deposit ash across Thurston County, although the predominant wind direction would likely carry the bulk of ash east of the Cascades. A volcanic event could also trigger a massive debris avalanche or mudflow, known as a lahar. A lahar could originate on the flanks of the mountain and flow downhill, creating a path of destruction and inundation as far as the Nisqually River Delta. These two volcanic hazards pose the greatest risk to the county and are described in this hazard profile.

1. Tephra Hazard

Tephra – the most widespread and frequent volcanic hazard – is the term for any type and size of rock fragment that travels in an airborne path from a forceful volcanic eruption. Cascade volcanoes can produce a hazardous column of suspended debris that subsequently falls to the ground in the direction of prevailing winds (Figure 4.6.1). A tephra plume can travel for hundreds of miles and deposit ash in significant quantity. Both the thickness of the deposition and the size of the particles decrease with increasing distance from the site of eruption. Ash particles are less than 0.08-inch diameter.

Figure 4.6.2: Removal of ash from Mount St. Helens near the Yakima Airport

Graphic courtesy of the Yakima Herald

Severity

It's plausible that Thurston County could receive ash fall from Mount Rainier or other Cascade volcanoes under the right wind conditions. The severity of the hazard depends on the depth and geographic extent of ash deposition. Ash

can travel great distances and cover areas over hundreds or thousands of square miles. The 1980 eruption of Mount St. Helens projected an ash column 15 miles into the atmosphere. Over the course of the day of the eruption, winds blew nearly 540 million tons of ash to the east.[3] Fallout from the ash created complete darkness in Spokane, nearly 250 miles away; dropping one half inch of ash only a few hours after the start of the eruption.

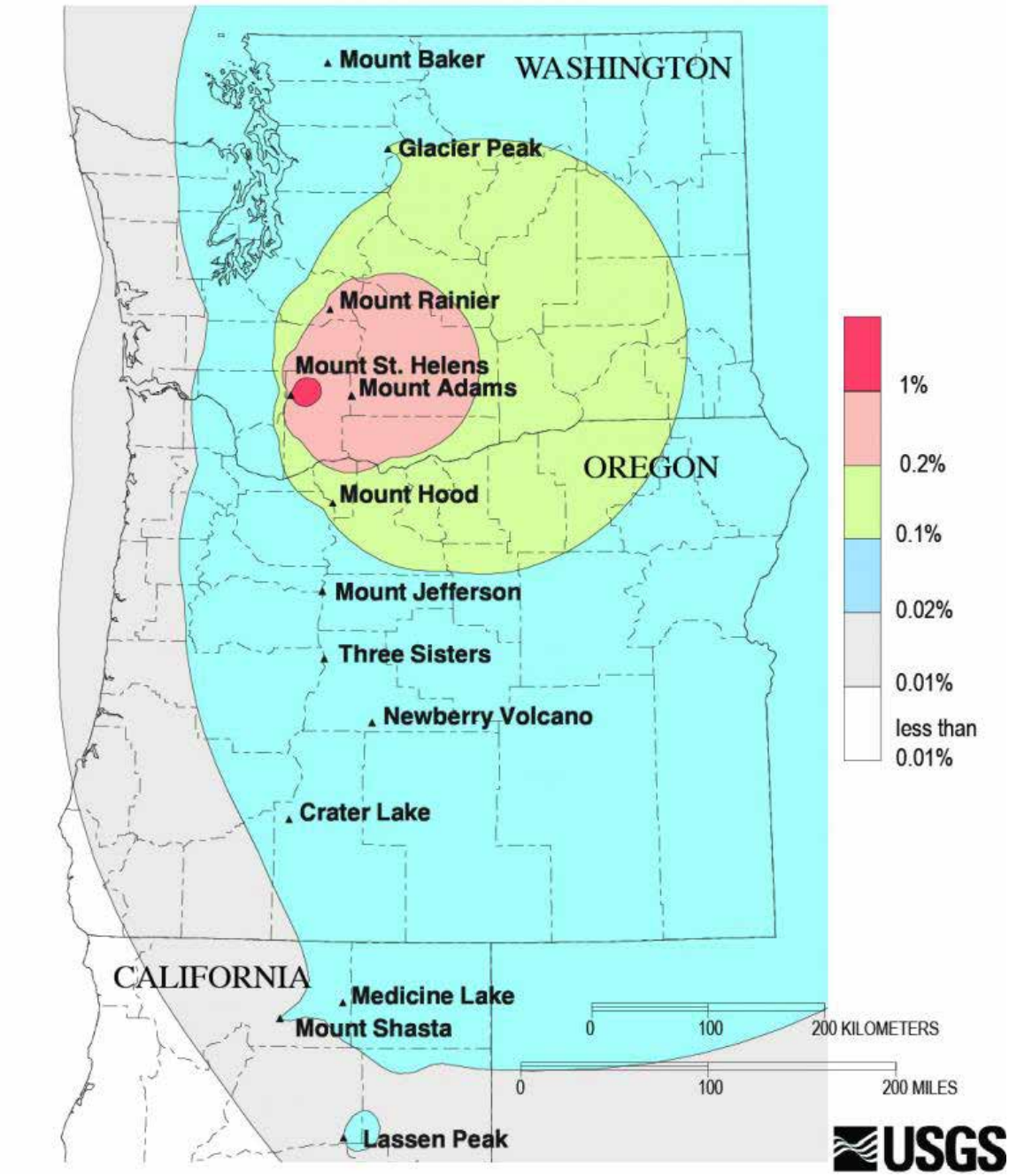
Impacts

A quarter inch or more of ash fall will disrupt nearly every mode of transportation. Ash fall obscures visibility and wet ash creates hazardous driving conditions. Aircraft is especially vulnerable as it can disable engines, therefore air transportation would be grounded in the affected area while conditions pose a hazard. Inhalation of ash particles can cause respiratory irritation and pose more serious problems for people with respiratory diseases; but this can be mitigated by simply avoiding exposure. Ash can destroy crops, reduce livestock access to pastures, contaminate lakes and streams, clog stormwater systems, and damage exposed motors and outdoor mechanical systems. Three inches of ash begins to exceed load capacities of some building rooftops and can cause structural failure. Failure may also occur with lower depths of ash when combined with excess precipitation. Wet ash is known to cause power lines to short. Ash removal and disposal would likely be the greatest cost to both the public and private sectors. The 1980 eruption of Mount St. Helens posed a major nuisance for communities in Eastern Washington. In Yakima, ash removal took 10 weeks and cost $2.2 million.[4]

Probability of Occurrence

The United States Geological Survey (USGS) reports that Mount Rainier has only produced moderate quantities of ash in past eruptions. The eruptions of Mount St. Helens in 1980 deposited a scant layer of ash in Thurston County, but the fallout did not pose a significant hazard to the region. Thurston County winds prevail from the south and west, therefore ash is more likely to disperse east of Cascades. If Mount Rainier or Mount St. Helens were to erupt, a resultant ash plume would require an easterly wind to deposit ash in Thurston County. The USGS calculated a 0.02 percent annual probability for a significant ash deposit of one centimeter or greater for the southeastern tip of the county and 0.01 percent for most of the county and its most populated areas (Figure 4.6.3).[5] There is a low probability of a volcanic tephra event impacting Thurston County.

Figure 4.6.3: Probability of Cascades Tephra Hazard



Annual probability of the deposition of 1 centimeter (0.4 inch) or more of tephra (ash) from eruptions in the Cascade Range. Graphic courtesy of USGS.

2. Lahar Hazard

Steep Cascade volcanoes and their lower elevation valleys are ideal settings for massive debris flow- and mudflow-disasters because of the immense quantity of ice, water, rock, and sedimentary materials available that can suddenly mobilize downslope under the action of gravity. Such events, triggered by volcanoes, are known as lahars. The USGS describes a lahar:

> A lahar is a flowing mixture of water-saturated debris that moves downslope under the force of gravity. Debris flows consist of material varying in size from clay to blocks several tens of meters in maximum dimension. When moving, they resemble masses of wet concrete and tend to flow downslope along channels or stream valleys. Debris flows are formed when loose masses of unconsolidated wet debris become unstable. Water may be supplied by rainfall or by melting of snow or ice. Debris flows may be formed directly if lava or pyroclastic flows are erupted onto snow and ice. Debris flows may be either hot or cold, depending on their manner of origin and temperature of their constituent debris.[6]

Figure 4.6.4: Lahar originating in the Mount St. Helens crater after an explosive eruption on March 19, 1982

Graphic courtesy of USGS.

The scientific literature for Cascade lahars identifies several size and origin classifications. Lahars can be either large or small. The USGS has summarized two types of Mount Rainier lahar origination events that could pose a hazard to communities within the Nisqually River valley:

Meltwater Generated Lahar - A volcanic eruption can produce an explosive event which releases a mixture of hot gases and rock debris, known as a pyroclastic flow. A pyroclastic flow behaves almost like a fluid and flows down the topography of the mountain. This hot churning debris flow swiftly melts snow and ice and subsequently mixes with the meltwater to form a lahar. Such lahars are often preceded by volcanic events or seismic activity which can provide some warning of an impending eruption. Geological evidence indicates that several of Mount Rainier's past lahars were formed by this phenomenon.

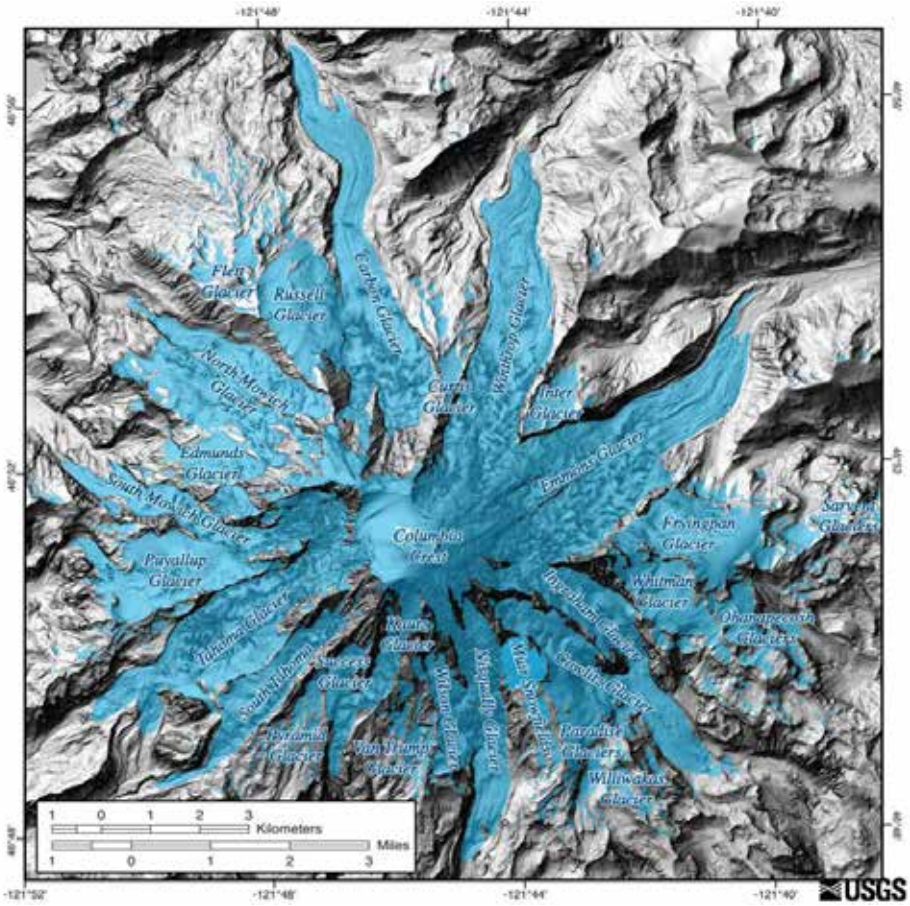
Landslide Generated Lahars - Landslides can occur on the flanks of Mount Rainier that can displace significant volumes of earth and water to form a substantial lahar. Magma can rise and force pressure against the internal structures of a mountain causing deformation and destabilization of the mountain's edifice. A modern example of this type of effect occurred with the bulge that formed on the north flank of Mount St. Helens in the months preceding the May 18, 1980 eruption. This bulge eventually collapsed creating one of the largest known landslides in modern times. Earthquakes can also initiate a landslide of unstable structures. Landslides can also occur from an eventual failure of a rock mass's cohesive strength. Rocks can be weakened by the chemical action of acidic fluids that are created from volcanic gases, heat, and ground water. Over time, this acidic fluid infiltrates the rock and eventually converts the hard volcanic rock into weak, clay-rich rock. This process is called hydrothermal alteration or metamorphism. These altered rocks and water-saturated clay-rich deposits could eventually slough away from the mountain from the force of a volcanic eruption. These landslides can rapidly transform into a lahar. Many large scale lahars on Mount Rainier have formed in this fashion. Hydrothermally altered rock landslides have also produced lahars without the trigger of a volcanic eruption. One such lahar, known as the 500-year-old Electron Mudflow, is believed to have originated without a volcanic eruption. No eruptive volcanic deposits have been discovered that coincide with the age of this lahar. This lahar deposited debris as high as 20 feet thick, and contains remnants of an old-growth forest in the vicinity of the City of Orting in Pierce County.

Severity

At 14,410 feet, Mount Rainier is the highest peak in the Cascade Range. It is estimated to contain nearly one cubic mile of glacial ice, more than all the other Cascade volcanoes combined (see Figure 4.6.5).[7] The sheer volume, mass, rate of speed, and churning contents of a massive debris flow could destroy virtually all human made structures in its path. Past Cascade lahars surged nearly 45 to 50 miles per hour at steep slopes and were 100 feet or more thick. Scientists have identified more than 60 lahars originating from Mount Rainier in the past 10,000 years. Deposits of past lahars are found in all the valleys that originate on Mount Rainier's flanks.[8] The Washington State Hazard Mitigation Plan states that more than 150,000 people live on historic lahar deposits in the Puget Sound lowlands. The USGS rates the risk of a large lahar from Mount Rainier to the surrounding Western Washington population, as the Puget Sound Region's greatest volcanic hazard.

Scientific research and mapping of hydrothermally altered rocks on Mount Rainier's high altitude slopes suggests that the west flank of the mountain, including the head of the Puyallup River, has the greatest potential for generating large landslides that are likely to initiate far-reaching lahars.[9] The Puyallup River valley, and to a lesser extent, the Nisqually River valley, whose basin also includes weakened rock, are at the most risk from large landslide-generated lahars. Lahars generated by eruptions could descend any of the mountain's valleys.[10]

Figure 4.6.5: Glaciers of Mount Rainier overlaid on base map LIDAR image



Steep Cascade volcanoes, rich with glaciers, and their lower elevation valleys are ideal settings for massive debris flow- and mudflow-disasters. Graphic courtesy of USGS.

Scientists with the USGS have studied artifacts from past lahars to predict future impacts. Deposits are analyzed to determine the type, frequency, and magnitude of past events. Through these studies, scientists predicted a potential inundation hazard in the lower Nisqually River valley caused by a lahar entering and possibly flowing beyond Alder Reservoir. Because Alder Dam exists for power generation, Alder Lake is never empty. Scientists are concerned that a lahar entering the reservoir could either cause dam failure or catastrophically displace a significant volume of the stored water.

Volcanologists consider a Case 1 lahar originating from Mount Rainier, the most appropriate scenario for hazard mitigation planning.[11] This type of lahar event is best historically represented by the Electron Mudflow. The risk of this lahar type exceeds that of all smaller but more frequent flows. In addition, the risk is increased by a potential to occur without a major volcanic eruption, which may not afford downstream populations an early warning. A non-eruptive event could be initiated by non-magmatic seismic activity, by steam eruptions, or just by gravity in places where a failure plane has been loosened by clay and hydrothermal fluids.

The Alder Dam and the Alder Lake Reservoir, owned and operated by Tacoma Power for power generation, creates uncertainty about the potential lahar flow dynamics downstream from the dam. This dam is vulnerable to a Case 1 lahar. The travel time of a Case 1 flow from the edifice of Mount Rainier to the reservoir may be less than two hours. High reservoir water levels do not offer sufficient capacity to contain the volume of the lahar flow. Scientists report that the reservoir is most vulnerable to failure caused by a wave of translation, because the relatively confined valley upstream can convey a large lahar without great volume loss.[12] A wave of translation would likely cause water to overtop the dam and send waves of water downstream from the reservoir. Smaller lahars entering the reservoir may not pose immediate risks for downstream flooding, but could increase the rate of sedimentation for the dam and thereby shorten its term of operation.

The 1999 Tacoma Power "Emergency Action Plan for the Nisqually Hydroelectric Project FERC Project No. 1862 [LaGrande and Alder Dams)" includes the following excerpt:

> *Another possible [hazard] event is that of a lahar or mudflow originating from Mt. Rainier. Travel time of a lahar or mudflow to Alder lake is estimated between 0.5 and 4.2 hours. Most lahars having sufficient volume to cause a significant rise in the lake level will travel in less than 2 hours. Because of the rapid nature of the inflow, it is not possible to affect any meaningful advance spill to increase reservoir capacity. An advance spill of 20,000 cubic feet per second for one hour will only yield approximately half-foot of reservoir capacity at full lake. Therefore, should*

lake levels rise rapidly (>3 feet/hour) no spill is recommended and evacuation to an observation post should be made. The combined outflow of both a large spill and overtopping may be more adverse than would result from overtopping only. In the unusual case of a lahar causing more gradual rise in inflow, spill could be implemented, but is not recommended unless reduction in spill can be made remotely. Rapid evacuation should be planned prior to local operation of the spillway.

There are no lahar sensors on the southwest flank of Mount Rainier to provide notice of a lahar emerging in the Nisqually River valley, but sensors and gauges at the Alder Dam would provide indication of changes in the level of water at the reservoir. Tacoma Power will notify multiple state and local emergency response agencies if failure of the Alder or LaGrande dams appeared imminent. Residents within the Nisqually River valley could evacuate to higher ground if given sufficient warning of a catastrophic dam failure. The Alder and LaGrande Sequential Dam Failure Flood Inundation zones approximate the USGS's extent of the inundation zone for a Case 1 lahar in the Nisqually River valley (Map 4.6.1).

Should a Case 1 lahar adversely affect the Alder Dam, flood inundation could occur at the Nisqually River bridge at SR507 (McKenna, Pierce Co.) in two hours and 30 minutes. The inundation would peak at this same location in four hours and 36 minutes.[13]

Impacts

Case 1 lahars could be high in consequence and pose a major hazard to human life and property in the Nisqually River Valley. Upriver from the reservoir, people and animals could be severely burned by such flows carrying hot debris. Downriver, buildings and other structures in the path of a debris flow can be buried or carried away. Because of their relatively high density and viscosity, these flows can move and even carry away vehicles and other objects as large as bridges. The following major bridges/routes are located within the Case 1 inundation zone and could be adversely impacted or destroyed: State Route 507 Bridge between Yelm and McKenna, Old Pacific Highway, and I-5. There are also three railroad bridge crossings: The Tacoma Rail Mountain Division railroad, the Yelm Prairie Line (non-operational), and the BNSF Railway mainline near I-5. The Centralia City Light Yelm Hydroelectric Project plant would also be adversely impacted from a Case 1 lahar.

Because debris flows are confined to areas down-slope and down-valley from their points of origin, people can avoid them by seeking high ground. The debris-flow hazard decreases gradually down-valley from possible source volcanoes, but more abruptly with increasing altitude above valley floors. People seeking to escape flows should climb valley sides rather than try to outrun the flows in valley bottoms. During eruptive activity or precursors to eruptions, local government officials may ask for prompt evacuation of areas likely to be affected.

Probability of Occurrence

The historical occurrences of lahars are classified by size. The largest lahar, historically represented by the Osceola mudflow, is designated a Case M lahar for a maximum lahar event. Scientists offer this scenario as "low probability and high consequence," with the implication that the risk may be unacceptable at even very small probabilities.[14] This lahar is estimated to occur about every 10,000 years. When compared with other historic lahars from postglacial times, scientists consider this maximum lahar a statistical outlier. There is no geologic record of a Case M lahar affecting Thurston County.

A Case I lahar is estimated to have a recurrence interval of approximately every 500 to 1,000 years. The Washington State Hazard Mitigation Plan indicates there is a one in 100 to one in 500 annual probability of occurrence of lahar inundating the Nisqually River. The probability of a Case 1 lahar is low.

Lahar Historical Occurrences and Impacts

Lahars originating from Mount Rainier are historically a relatively common occurrence. They vary in size and magnitude and are unpredictable. No significant lahars have impacted Thurston County in modern times. Past Nisqually River valley lahars are known to have flowed down the slopes of Mount Rainier all the way to the Puget Sound. The USGS provides the following short history of major lahar events originating from Mount Rainier:

> *The largest lahar originating from Mount Rainier is known as the Osceola Mudflow. This cohesive lahar occurred about 5,600 years ago, and was at least 10 times larger than any other known lahar from Mount Rainier. It was caused by a large debris avalanche composed mostly of hydrothermally-altered material, and may have been triggered by magma forcing its way into the volcano. Osceola deposits cover an area of about 550 square kilometers (212 square miles) in the Puget Sound lowland, extending at least as far as the City of Kent, and to Commencement Bay, now the site of the Port of Tacoma. The communities of Orting, Buckley, Sumner, Puyallup, Enumclaw, and Auburn are also wholly or partly located on top of deposits of the Osceola Mudflow and, in some cases, of more recent debris flows as well.*

At least six smaller debris avalanches have spawned lahars in the past 5,600 years. One of these, the Electron Mudflow, which was derived from a slope failure on the west flank of Mount Rainier about 600 years ago, has not been correlated with an eruption. The Electron Mudflow was more than 30 yards deep where it entered the Puget Sound lowland at the community of Electron. Its deposits at Orting are as much as 6 yards thick and contain remnants of an old-growth forest.

Large non-cohesive lahars at Mount Rainier are associated with volcanism. About 1,200 years ago, a lahar of this type filled valleys of both forks of the White River to depths of 20 to 30 meters (60 to 90 feet) and flowed 100 km (60 miles) to Auburn. Hot rock fragments flowing over glacier ice and snow generated huge quantities of melt water, which mixed with the rock debris to form lahars. Less than 2,200 years ago, another lahar of similar origin, named the National Lahar, inundated the Nisqually River Valley to depths of 30-120 feet and flowed all the way to Puget Sound. More than a dozen lahars of this type have occurred at Mount Rainier during periods of volcanism in the past 6,000 years.[15]

Figure 4.6.6: Remnants of a lahar on the Toutle River

Graphic courtesy of USGS.

Lahar Hazard Exposure Analysis

Delineation of the Lahar Hazard Area

The USGS produced a map for the inundation zone for a Case I lahar. Map 4.6.2 shows the lahar hazard area for Thurston County. On the lower Nisqually River below Alder Dam, the inundation area shown downstream from Alder Dam is a sub-case of the Case I lahar. Inundation could result from dam failure caused by lahar impact, displacement by the lahar of some of the water impounded by the Alder Lake and LaGrande reservoirs, or possible continuation of the lahar past the dam site. Some part of a Case I lahar may be impounded by the reservoir. Thus, without dam failure, lahar-related inundation downstream from Alder Dam would most probably affect less area than shown in Map 4.6.2. Approximately 9,828 acres (2.1 percent in Thurston County lie within the Case I Lahar hazard area. Tables 4.6.1 and 4.6.2 show the total acres, by jurisdiction and special district, within the Case 1 lahar hazard area.

Communities Most Vulnerable to a Lahar

Based on the Case 1 lahar scenario, properties along the Nisqually River Valley are the most susceptible to lahar hazards. Following the Nisqually River southeast to northwest, the following general vicinities and communities along the Nisqually River may be most affected under this scenario:

- Properties north of Clear Lake along Peissner Road SE and Hobson Road SE
- Properties north east of Bald Hills Rd near Cook Road SE and Dan Cook Street SE
- McKenna Elementary School (Pierce County), Yelm Community School District
- Wa He Lut Indian School
- Properties between the Nisqually River and the Yelm Urban Growth Area Boundary near Bridge Street SE and Flume Road SE
- Properties northeast of Yelm in the northeast section of the Nisqually Pines residential community near Port Orford Boulevard SE, Heather Lane SE, and Briar Street SE
- The City of Centralia Power Plant off Mud Run Road (eight employees and family members live on site) [16]
- Properties on the Nisqually Indian Reservation adjoining the Nisqually River migration zone
- Virtually all properties in the Nisqually Valley from Durgin Road SE north to the Puget Sound.

Population and Employment in the Hazard Area

A major Tephra fall could affect the entire county. As a result, tephra hazard area tables were not developed. The "total" columns in the Population and Assets tables provided for the lahar hazard provides information in assessing the population and assets at risk from a countywide tephra fallout.

Approximately 2,000 residents (0.7 percent) and 600 employees (0.4 percent) live and work in the area designated as at risk for a Case 1 lahar. Estimates of the region's population and employment in the lahar hazard area is summarized in Tables 4.6.3 through 4.6.6. The population and employment in the tephra fall hazard zone is represented by the "total" columns. These tables assess an aspect of current and future vulnerability by providingdata on the number of people living and working within the hazard area as compared to total population, by jurisdiction, in the years 2015 and 2040.

Residential Dwellings in the Hazard Area

Presently, nearly 900 or 0.8 percent of residential dwelling units are in the lahar hazard area. By 2040, that number is expected to grow to 1,000. Tables 4.6.7 and 4.6.8 show estimates of the region's dwelling units in the lahar hazard area in the years 2015 and 2040.

Inventory of Assets and Dollar Value in the Hazard Area

Estimates of the region's structures and their contents in the lahar hazard area are summarized in tables 4.6.9 and 4.6.10. A combined $70 million in residential, commercial/industrial, and government/ institutional assets are within the Case 1 lahar hazard area.

Essential Facilities and Infrastructure in Hazard Area

A lahar could destroy or damage facilities that may be critical for responding to the disaster and for maintaining a safe environment and public order, particularly roads, rail lines and bridges. The event would also likely impact wired communication infrastructure, power lines; water storage, purification, and pumping facilities. Approximately 26 centerline miles of state- and county-owned roads in Thurston County are within the Case 1 lahar hazard area. Table 4.6.11 lists the type and number of essential facilities located in the hazard area.

Summary Assessment

Under certain meteorological conditions, a tephra fall could adversely affect the entire county. The fallout could produce hazardous travel conditions, disrupt a range of utilities, and result in significant cleanup and recovery costs. The region's vulnerability is rated as moderate; however, the probability of a major ash fall is low, therefore overall the risk of ash fall to the Thurston County region is low.

A lahar could pose immediate danger to the nearly 2,000 residents and 600 people that work in the lahar hazard zone. Although no lahar warning system exists for the upper Nisqually River Valley, the Tacoma Power Alder and La Grande Dam warning system could notify appropriate authorities to initiate evacuation efforts for downstream residents. Thurston County Emergency Management could notify area residents and businesses with its emergency notification system and local emergency personnel could be deployed to help people evacuate to higher ground. Nearly 900 residential properties may be at risk to lahar impacts. Surface transportation routes across the Nisqually River could be closed or destroyed and affect the mobility of the entire Puget Sound Region. The combination of these impacts suggests that the region is highly vulnerable. In summary, the overall risk of a Case 1 lahar is moderate, as an event of this magnitude has a low probability of occurrence.

Summary Risk Assessment for Tephra Fall and Case 1 Lahar Hazards in the Thurston Region

VOLCANIC HAZARD	PROBABILITY OF OCCURRENCE	VULNERABILITY	RISK
Tephra (Ash) Fall	Low	Moderate	Low
Lahar	Low	High	Moderate

Table 4.6.1: Case 1 Lahar Hazard Area by Jurisdiction

Jurisdiction		Lahar Hazard Area Total Acres	Lahar Hazard Area In Hazard Area Acres	Lahar Hazard Area In Hazard Area %
Bucoda	**Total**	**380**	**0**	**0.0%**
Lacey	City	10,778	0	0.0%
	UGA	10,416	0	0.0%
	Total	**21,193**	**0**	**0.0%**
Olympia	City	12,089	0	0.0%
	UGA	3,887	0	0.0%
	Total	**15,976**	**0**	**0.0%**
Rainier	City	1,105	0	0.0%
	UGA	320	0	0.0%
	Total	**1,425**	**0**	**0.0%**
Tenino	City	922	0	0.0%
	UGA	65	0	0.0%
	Total	**987**	**0**	**0.0%**
Tumwater	City	11,354	0	0.0%
	UGA	2,875	0	0.0%
	Total	**14,229**	**0**	**0.0%**
Yelm	City	3,634	0	0.0%
	UGA	2,396	8	0.3%
	Total	**6,030**	**8**	**0.1%**
Grand Mound UGA	**Total**	**983**	**0**	**0.0%**
Chehalis Reservation[1]	**Total**	**833**	**0**	**0.0%**
Nisqually Reservation[1]	**Total**	**2,147**	**638**	**29.7%**
Total Cities		**40,261**	**0**	**0.0%**
Total UGAs[2]		**20,943**	**8**	**0.0%**
Total Reservations[1]		**2,979**	**638**	**21.4%**
Rural Unincorporated County[3]		**406,934**	**9,182**	**2.3%**
Thurston County Total		**471,117**	**9,828**	**2.1%**

Explanations: Lahar Hazard includes the inundation zone for the USGS Case I Lahar scenario.
1. Data are for the Thurston County portion of reservation only.
2. Urban Growth Area (UGA): Unincorporated area designated to be annexed into city limits over 20 years to accommodate urban growth.
3. Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

Table 4.6.2: Case 1 Lahar Hazard Area by Special District

Jurisdiction	Lahar Hazard Area Total Acres	In Hazard Area Acres	In Hazard Area %
Fire Protection Districts			
1,11 West Thurston Reg. Fire Authority	100,131	0	0.0%
2, 4 S.E. Thurston Reg. Fire Authority	56,030	2,074	3.7%
3 Lacey	36,820	3,950	10.7%
5, 9 McLane-Black Lake	51,828	0	0.0%
6 East Olympia	19,677	0	0.0%
8 South Bay	20,974	0	0.0%
12 Tenino	19,914	0	0.0%
13 Griffin	14,864	0	0.0%
16 Gibson Valley	18,038	0	0.0%
17 Bald Hills	13,926	1,592	11.4%
School Districts			
Centralia[1]	12,851	0	0.0%
Griffin	21,355	0	0.0%
North Thurston	47,081	3,673	7.8%
Olympia	49,894	0	0.0%
Rainier	35,550	0	0.0%
Rochester[1]	55,061	0	0.0%
Tenino	70,500	0	0.0%
Tumwater	73,845	0	0.0%
Yelm[1]	104,853	5,934	5.7%
Other Districts			
Intercity Transit	64,390	2,681	4.2%
LOTT Clean Water Alliance[2]	16,016	0	0.0%
Port of Olympia	471,117	9,828	2.1%
Thurston County PUD	471,117	9,828	2.1%

Explanations: Lahar Hazard includes the inundation zone for the USGS Case I Lahar scenario.
1. Data are for Thurston County portion of the district only.
2. Includes the sewered area.

Table 4.6.3: Case 1 Lahar Hazard Area, Population by Jurisdiction, 2015 and 2040

		2015 Population Estimate			2040 Population Forecast		
		Total	In Hazard Area		Total	In Hazard Area	
Jurisdiction		#	#	%	#	#	%
Bucoda	**Total**	**565**	**0**	**0.0%**	**1,215**	**0**	**0.0%**
Lacey	City	46,230	0	0.0%	55,160	0	0.0%
	UGA	33,980	0	0.0%	59,030	0	0.0%
	Total	**80,210**	**0**	**0.0%**	**114,190**	**0**	**0.0%**
Olympia	City	51,020	0	0.0%	71,840	0	0.0%
	UGA	11,920	0	0.0%	16,770	0	0.0%
	Total	**62,940**	**0**	**0.0%**	**88,610**	**0**	**0.0%**
Rainier	City	1,880	0	0.0%	2,810	0	0.0%
	UGA	110	0	0.0%	640	0	0.0%
	Total	**1,990**	**0**	**0.0%**	**3,450**	**0**	**0.0%**
Tenino	City	1,730	0	0.0%	3,675	0	0.0%
	UGA	15	0	0.0%	110	0	0.0%
	Total	**1,745**	**0**	**0.0%**	**3,785**	**0**	**0.0%**
Tumwater	City	22,370	0	0.0%	37,350	0	0.0%
	UGA	3,270	0	0.0%	8,960	0	0.0%
	Total	**25,640**	**0**	**0.0%**	**46,310**	**0**	**0.0%**
Yelm	City	8,170	0	0.0%	25,080	0	0.0%
	UGA	1,420	10	0.7%	5,690	10	0.2%
	Total	**9,590**	**10**	**0.1%**	**30,770**	**10**	**0.0%**
Grand Mound UGA	**Total**	**1,285**	**0**	**0.0%**	**1,990**	**0**	**0.0%**
Chehalis Reservation[1]	**Total**	**70**	**0**	**0.0%**	**190**	**0**	**0.0%**
Nisqually Reservation[1]	**Total**	**605**	**45**	**7.4%**	**705**	**50**	**7.1%**
Total Cities		**131,970**	**0**	**0.0%**	**197,120**	**0**	**0.0%**
Total UGAs[2]		**52,000**	**10**	**0.0%**	**93,190**	**10**	**0.0%**
Total Reservations[1]		**670**	**40**	**6.0%**	**890**	**50**	**5.6%**
Rural Unincorporated County[3]		**82,770**	**1,970**	**2.4%**	**102,470**	**2,250**	**2.2%**
Thurston County Total		**267,400**	**2,000**	**0.7%**	**393,700**	**2,300**	**0.6%**

Source: Thurston Regional Planning Council Population Forecast, 2015
Explanations: Lahar Hazard includes the inundation zone for the USGS Case I Lahar scenario. Numbers may not add due to rounding.
1. Data are for the Thurston County portion of reservation only.
2. Urban Growth Area (UGA): Unincorporated area designated to be annexed into city limits over 20 years to accommodate urban growth.
3. Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

Table 4.6.4: Case 1 Lahar Hazard Area, Population by Special District, 2015 and 2040

Jurisdiction	2015 Population Estimate Total #	2015 Population Estimate In Hazard Area #	2015 Population Estimate In Hazard Area %	2040 Population Forecast Total #	2040 Population Forecast In Hazard Area #	2040 Population Forecast In Hazard Area %
Fire Protection Districts						
1,11 West Thurston	22,010	0	0.0%	31,120	0	0.0%
2, 4 S.E. Thurston	24,650	850	3.4%	50,770	990	1.9%
3 Lacey	91,660	1,000	1.1%	128,070	1,100	0.9%
5, 9 McLane-Black Lake	15,890	0	0.0%	20,770	0	0.0%
6 East Olympia	11,140	0	0.0%	14,810	0	0.0%
8 South Bay	11,820	0	0.0%	15,380	0	0.0%
12 Tenino	6,230	0	0.0%	9,530	0	0.0%
13 Griffin	5,060	0	0.0%	5,700	0	0.0%
16 Gibson Valley	590	0	0.0%	1,130	0	0.0%
17 Bald Hills	4,090	140	3.4%	5,440	190	3.5%
School Districts						
Centralia[1]	490	0	0.0%	1,180	0	0.0%
Griffin	5,950	0	0.0%	6,710	0	0.0%
North Thurston	99,300	1,010	1.0%	138,340	1,110	0.8%
Olympia	66,140	0	0.0%	87,700	0	0.0%
Rainier	5,210	0	0.0%	13,800	0	0.0%
Rochester[1]	14,060	0	0.0%	18,080	0	0.0%
Tenino	9,850	0	0.0%	15,510	0	0.0%
Tumwater	39,500	0	0.0%	63,820	0	0.0%
Yelm[1]	26,900	1,010	3.8%	48,530	1,200	2.5%
Other Districts						
Intercity Transit	176,450	70	0.0%	269,860	90	0.0%
LOTT Clean Water Alliance[2]	120,960	0	0.0%	249,110	0	0.0%
Port of Olympia	267,400	2,000	0.7%	393,700	2,300	0.6%
Thurston County PUD	267,400	2,000	0.7%	393,700	2,300	0.6%

Source: Thurston Regional Planning Council Population Forecast, 2015
Explanations: Lahar Hazard includes the inundation zone for the USGS Case I Lahar scenario.
1. Data are for Thurston County portion of the district only.
2. Includes the sewered area for 2015 and the Lacey-Olympia-Tumwater Urban Area for 2040.

Table 4.6.5: Case 1 Lahar Hazard Area, Employment by Jurisdiction, 2014 and 2040

		2014 Employment Estimate			2040 Employment Forecast		
		Total	In Hazard Area		Total	In Hazard Area	
Jurisdiction		#	#	%	#	#	%
Bucoda	**Total**	**90**	**0**	**0.0%**	**200**	**0**	**0.0%**
Lacey	City	25,610	0	0.0%	41,180	0	0.0%
	UGA	5,620	0	0.0%	8,520	0	0.0%
	Total	**31,230**	**0**	**0.0%**	**49,700**	**0**	**0.0%**
Olympia	City	53,350	0	0.0%	74,950	0	0.0%
	UGA	1,800	0	0.0%	2,230	0	0.0%
	Total	**55,150**	**0**	**0.0%**	**77,180**	**0**	**0.0%**
Rainier	City	455	0	0.0%	690	0	0.0%
	UGA	25	0	0.0%	80	0	0.0%
	Total	**480**	**0**	**0.0%**	**770**	**0**	**0.0%**
Tenino	City	870	0	0.0%	1,505	0	0.0%
	UGA	0	0	-	5	0	0.0%
	Total	**870**	**0**	**0.0%**	**1,510**	**0**	**0.0%**
Tumwater	City	22,350	0	0.0%	33,720	0	0.0%
	UGA	760	0	0.0%	1,420	0	0.0%
	Total	**23,110**	**0**	**0.0%**	**35,140**	**0**	**0.0%**
Yelm	City	3,830	0	0.0%	11,490	0	0.0%
	UGA	430	0	0.0%	670	0	0.0%
	Total	**4,260**	**0**	**0.0%**	**12,160**	**0**	**0.0%**
Grand Mound UGA	**Total**	**1,115**	**0**	**0.0%**	**1,375**	**0**	**0.0%**
Chehalis Reservation[1]	**Total**	**760**	**0**	**0.0%**	**1,550**	**0**	**0.0%**
Nisqually Reservation[1]	**Total**	**975**	**10**	**1.0%**	**1,865**	**10**	**0.5%**
Total Cities		**106,560**	**0**	**0.0%**	**163,730**	**0**	**0.0%**
Total UGAs[2]		**9,740**	**0**	**0.0%**	**14,300**	**0**	**0.0%**
Total Reservations[1]		**1,740**	**10**	**0.6%**	**3,410**	**10**	**0.3%**
Rural Unincorporated County[3]		**15,880**	**550**	**3.5%**	**18,270**	**570**	**3.1%**
Thurston County Total		**133,900**	**600**	**0.4%**	**199,700**	**600**	**0.3%**

Source: Thurston Regional Planning Council Population Forecast, 2015
Explanations: Lahar Hazard includes the inundation zone for the USGS Case I Lahar scenario. Numbers may not add due to rounding.
1. Data are for the Thurston County portion of reservation only.
2. Urban Growth Area (UGA): Unincorporated area designated to be annexed into city limits over 20 years to accommodate urban growth.
3. Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

Table 4.6.6: Case 1 Lahar Hazard Area, Employment by Special District, 2014 and 2040

Jurisdiction	2014 Employment Estimate Total #	2014 Employment Estimate In Hazard Area #	2014 Employment Estimate In Hazard Area %	2040 Employment Forecast Total #	2040 Employment Forecast In Hazard Area #	2040 Employment Forecast In Hazard Area %
Fire Protection Districts						
1,11 West Thurston	6,290	0	0.0%	8,480	0	0.0%
2, 4 S.E. Thurston	6,710	140	2.1%	15,170	140	0.9%
3 Lacey	34,540	400	1.2%	54,170	410	0.8%
5, 9 McLane-Black Lake	3,630	0	0.0%	4,350	0	0.0%
6 East Olympia	1,960	0	0.0%	2,350	0	0.0%
8 South Bay	1,830	0	0.0%	2,250	0	0.0%
12 Tenino	1,500	0	0.0%	2,210	0	0.0%
13 Griffin	990	0	0.0%	1,060	0	0.0%
16 Gibson Valley	150	0	0.0%	180	0	0.0%
17 Bald Hills	470	20	4.3%	570	30	5.3%
School Districts						
Centralia[1]	120	0	0.0%	170	0	0.0%
Griffin	1,110	0	0.0%	1,190	0	0.0%
North Thurston	42,280	400	0.9%	66,290	410	0.6%
Olympia	48,850	0	0.0%	65,910	0	0.0%
Rainier	980	0	0.0%	1,860	0	0.0%
Rochester[1]	4,630	0	0.0%	6,230	0	0.0%
Tenino	2,340	0	0.0%	3,320	0	0.0%
Tumwater	25,670	0	0.0%	38,080	0	0.0%
Yelm[1]	7,850	160	2.0%	16,580	170	1.0%
Other Districts						
Intercity Transit	115,570	20	0.0%	176,500	30	0.0%
LOTT Clean Water Alliance[2]	91,010	0	0.0%	162,020	0	0.0%
Port of Olympia	133,900	600	0.4%	199,700	600	0.3%
Thurston County PUD	133,900	600	0.4%	199,700	600	0.3%

Source: Thurston Regional Planning Council Population Forecast, 2015
Explanations: Lahar Hazard includes the inundation zone for the USGS Case I Lahar scenario.
1. Data are for Thurston County portion of the district only.
2. Includes the sewered area for 2014 and the Lacey-Olympia-Tumwater Urban Area for 2040.

Table 4.6.7: Case 1 Lahar Hazard Area, Residential Units by Jurisdiction, 2015 and 2040

		2015 Dwelling Estimate			2040 Dwelling Forecast		
		Total	In Hazard Area		Total	In Hazard Area	
Jurisdiction		#	#	%	#	#	%
Bucoda	**Total**	**245**	**0**	**0.0%**	**535**	**0**	**0.0%**
Lacey	City	19,840	0	0.0%	24,400	0	0.0%
	UGA	13,500	0	0.0%	23,930	0	0.0%
	Total	**33,340**	**0**	**0.0%**	**48,330**	**0**	**0.0%**
Olympia	City	24,170	0	0.0%	35,610	0	0.0%
	UGA	4,850	0	0.0%	7,100	0	0.0%
	Total	**29,020**	**0**	**0.0%**	**42,710**	**0**	**0.0%**
Rainier	City	775	0	0.0%	1,140	0	0.0%
	UGA	50	0	0.0%	290	0	0.0%
	Total	**825**	**0**	**0.0%**	**1,430**	**0**	**0.0%**
Tenino	City	755	0	0.0%	1,855	0	0.0%
	UGA	5	0	0.0%	40	0	0.0%
	Total	**760**	**0**	**0.0%**	**1,895**	**0**	**0.0%**
Tumwater	City	9,970	0	0.0%	16,870	0	0.0%
	UGA	1,420	0	0.0%	3,820	0	0.0%
	Total	**11,390**	**0**	**0.0%**	**20,690**	**0**	**0.0%**
Yelm	City	3,000	0	0.0%	9,820	0	0.0%
	UGA	550	0	0.0%	2,280	0	0.0%
	Total	**3,550**	**0**	**0.0%**	**12,100**	**0**	**0.0%**
Grand Mound UGA	**Total**	**415**	**0**	**0.0%**	**740**	**0**	**0.0%**
Chehalis Reservation[1]	**Total**	**20**	**0**	**0.0%**	**65**	**0**	**0.0%**
Nisqually Reservation[1]	**Total**	**200**	**20**	**10.0%**	**255**	**20**	**7.8%**
Total Cities		**58,770**	**0**	**0.0%**	**90,230**	**0**	**0.0%**
Total UGAs[2]		**20,790**	**0**	**0.0%**	**38,190**	**0**	**0.0%**
Total Reservations[1]		**220**	**20**	**9.1%**	**320**	**20**	**6.3%**
Rural Unincorporated County[3]		**34,250**	**880**	**2.6%**	**41,730**	**950**	**2.3%**
Thurston County Total		**114,000**	**900**	**0.8%**	**170,500**	**1,000**	**0.6%**

Source: Thurston Regional Planning Council Population Forecast, 2015
Explanations: Lahar Hazard includes the inundation zone for the USGS Case I Lahar scenario. Numbers may not add due to rounding.
1. Data are for the Thurston County portion of reservation only.
2. Urban Growth Area (UGA): Unincorporated area designated to be annexed into city limits over 20 years to accommodate urban growth.
3. Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

Table 4.6.8: Case 1 Lahar Hazard Area, Residential Units by Special District, 2015 and 2040

	2015 Dwelling Estimate			2040 Dwelling Forecast		
	Total	In Hazard Area		Total	In Hazard Area	
Jurisdiction	#	#	%	#	#	%
Fire Protection Districts						
1,11 West Thurston	8,480	0	0.0%	11,930	0	0.0%
2, 4 S.E. Thurston	9,800	340	3.5%	20,190	380	1.9%
3 Lacey	38,110	480	1.3%	54,160	500	0.9%
5, 9 McLane-Black Lake	6,490	0	0.0%	8,670	0	0.0%
6 East Olympia	4,510	0	0.0%	6,010	0	0.0%
8 South Bay	4,940	0	0.0%	6,370	0	0.0%
12 Tenino	2,580	0	0.0%	4,200	0	0.0%
13 Griffin	2,580	0	0.0%	2,910	0	0.0%
16 Gibson Valley	240	0	0.0%	440	0	0.0%
17 Bald Hills	1,770	60	3.4%	2,370	80	3.4%
School Districts						
Centralia[1]	200	0	0.0%	470	0	0.0%
Griffin	3,030	0	0.0%	3,430	0	0.0%
North Thurston	41,820	490	1.2%	59,460	500	0.8%
Olympia	29,690	0	0.0%	41,150	0	0.0%
Rainier	2,190	0	0.0%	5,690	0	0.0%
Rochester[1]	5,260	0	0.0%	6,670	0	0.0%
Tenino	4,130	0	0.0%	6,720	0	0.0%
Tumwater	16,940	0	0.0%	27,630	0	0.0%
Yelm[1]	10,780	410	3.8%	19,260	470	2.4%
Other Districts						
Intercity Transit	76,200	30	0.0%	119,200	40	0.0%
LOTT Clean Water Alliance[2]	53,760	0	0.0%	111,730	0	0.0%
Port of Olympia	114,000	900	0.8%	170,500	1,000	0.6%
Thurston County PUD	114,000	900	0.8%	170,500	1,000	0.6%

Source: Thurston Regional Planning Council Population Forecast, 2015
Explanations: Lahar Hazard includes the inundation zone for the USGS Case I Lahar scenario.
1. Data are for Thurston County portion of the district only.
2. Includes the sewered area for 2015 and the Lacey-Olympia-Tumwater Urban Area for 2040.

Table 4.6.9: Case 1 Lahar Hazard Area, Valuation of Buildings and Contents by Jurisdiction, 2014

		Residential			Commercial/Industrial			Government/Institutional		
		Total	In Hazard Area		Total	In Hazard Area		Total	In Hazard Area	
Jurisdiction		Mil. $	Mil. $	%	Mil. $	Mil. $	%	Mil. $	Mil. $	%
Bucoda	**Total**	**12**	**0**	**0.0%**	**1**	**0**	**0.0%**	**3**	**0**	**0.0%**
Lacey	City	2,394	0	0.0%	914	0	0.0%	602	0	0.0%
	UGA	1,715	0	0.0%	69	0	0.0%	273	0	0.0%
	Total	**4,109**	**0**	**0.0%**	**983**	**0**	**0.0%**	**875**	**0**	**0.0%**
Olympia	City	2,695	0	0.0%	1,199	0	0.0%	1,941	0	0.0%
	UGA	785	0	0.0%	27	0	0.0%	26	0	0.0%
	Total	**3,480**	**0**	**0.0%**	**1,226**	**0**	**0.0%**	**1,967**	**0**	**0.0%**
Rainier	City	76	0	0.0%	5	0	0.0%	30	0	0.0%
	UGA	5	0	0.0%	0	0	-	1	0	0.0%
	Total	**81**	**0**	**0.0%**	**5**	**0**	**0.0%**	**31**	**0**	**0.0%**
Tenino	City	50	0	0.0%	12	0	0.0%	67	0	0.0%
	UGA	1	0	0.0%	0	0	-	0	0	-
	Total	**51**	**0**	**0.0%**	**12**	**0**	**0.0%**	**67**	**0**	**0.0%**
Tumwater	City	1,209	0	0.0%	528	0	0.0%	556	0	0.0%
	UGA	130	0	0.0%	13	0	0.0%	7	0	0.0%
	Total	**1,339**	**0**	**0.0%**	**541**	**0**	**0.0%**	**563**	**0**	**0.0%**
Yelm	City	357	0	0.0%	105	0	0.0%	140	0	0.0%
	UGA	49	0	0.0%	6	0	0.0%	13	0	0.0%
	Total	**406**	**0**	**0.0%**	**111**	**0**	**0.0%**	**153**	**0**	**0.0%**
Grand Mound UGA		**34**	**0**	**0.0%**	**13**	**0**	**0.0%**	**5**	**0**	**0.0%**
Chehalis Reservation[1]		**1**	**0**	**0.0%**	**4**	**0**	**0.0%**	**0**	**0**	**-**
Nisqually Reservation.[1]		**16**	**0**	**0.0%**	**3**	**0**	**0.0%**	**0**	**0**	**-**
Total Cities		**6,793**	**0**	**0.0%**	**2,763**	**0**	**0.0%**	**3,338**	**0**	**0.0%**
Total UGAs[2]		**2,719**	**0**	**0.0%**	**128**	**0**	**0.0%**	**325**	**0**	**0.0%**
Total Reservations[1]		**17**	**0**	**0.0%**	**6**	**0**	**0.0%**	**0**	**0**	**-**
Rural Unincorp. County[3]		**4,977**	**58**	**1.2%**	**113**	**5**	**4.4%**	**1,033**	**6**	**0.6%**
Thurston County Total		**14,506**	**59**	**0.4%**	**3,010**	**5**	**0.2%**	**4,696**	**6**	**0.1%**

Source: Thurston Regional Planning Council Population Forecast, 2015
Explanations: Lahar Hazard includes the inundation zone for the USGS Case I Lahar scenario. Numbers may not add due to rounding.
1. Data are for the Thurston County portion of reservation only.
2. Urban Growth Area (UGA): Unincorporated area designated to be annexed into city limits over 20 years to accommodate urban growth.
3. Rural unincorporated county is the portion of the unincorporated county that lies outside UGA and Reservation boundaries.

Table 4.6.10: Case 1 Lahar Hazard Area, Valuation of Buildings and Contents by Special District, 2014

	Residential			Commercial/Industrial			Government/Institutional		
	Total	In Hazard Area		Total	In Hazard Area		Total	In Hazard Area	
Jurisdiction	Mil. $	Mil. $	%	Mil. $	Mil. $	%	Mil. $	Mil. $	%
Fire Protection Districts									
1,11 West Thurston	979	0	0.0%	57	0	0.0%	216	0	0.0%
2, 4 S.E. Thurston	1,073	25	2.3%	133	0	0.0%	202	2	1.0%
3 Lacey	4,823	27	0.6%	1,008	5	0.5%	896	5	0.6%
5, 9 McLane-Black Lake	1,121	0	0.0%	31	0	0.0%	676	0	0.0%
6 East Olympia	743	0	0.0%	14	0	0.0%	49	0	0.0%
8 South Bay	939	0	0.0%	13	0	0.0%	47	0	0.0%
12 Tenino	277	0	0.0%	17	0	0.0%	73	0	0.0%
13 Griffin	430	0	0.0%	3	0	0.0%	26	0	0.0%
16 Gibson Valley	20	0	0.0%	0	0	-	1	0	0.0%
17 Bald Hills	176	6	3.4%	6	0	0.0%	7	0	0.0%
School Districts									
Centralia[1]	17	0	0.0%	0	0	-	1	0	0.0%
Griffin	498	0	0.0%	3	0	0.0%	26	0	0.0%
North Thurston	5,394	28	0.5%	1,292	5	0.4%	969	5	0.5%
Olympia	3,990	0	0.0%	960	0	0.0%	2,344	0	0.0%
Rainier	241	0	0.0%	11	0	0.0%	34	0	0.0%
Rochester[1]	539	0	0.0%	42	0	0.0%	187	0	0.0%
Tenino	462	0	0.0%	21	0	0.0%	81	0	0.0%
Tumwater	2,155	0	0.0%	546	0	0.0%	877	0	0.0%
Yelm[1]	1,208	32	2.6%	135	1	0.7%	176	2	1.1%
Other Districts									
Intercity Transit	9,247	4	0.0%	2,865	0	0.0%	4,172	1	0.0%
LOTT Clean Water Alliance[2]	6,724	0	0.0%	2,498	0	0.0%	2,443	0	0.0%
Port of Olympia	14,506	59	0.4%	3,010	5	0.2%	4,696	6	0.1%
Thurston County PUD	14,506	59	0.4%	3,010	5	0.2%	4,696	6	0.1%

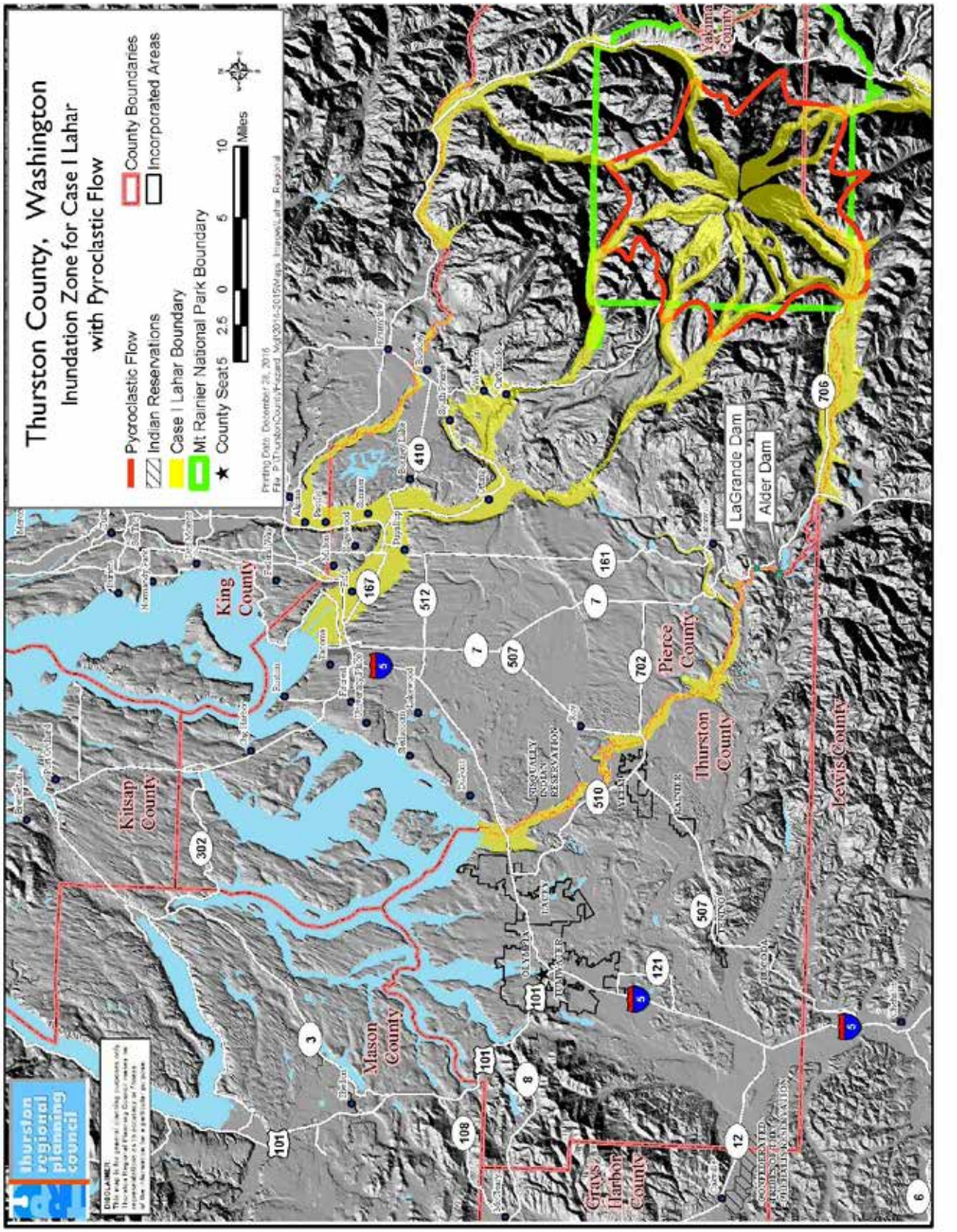
Source: Thurston Regional Planning Council Population Forecast, 2015
Explanations: Lahar Hazard includes the inundation zone for the USGS Case I Lahar scenario.
1. Data are for Thurston County portion of the district only.
2. Includes the sewered area.

Table 4.6.11: Essential Facilities in Case 1 Lahar Hazard Area

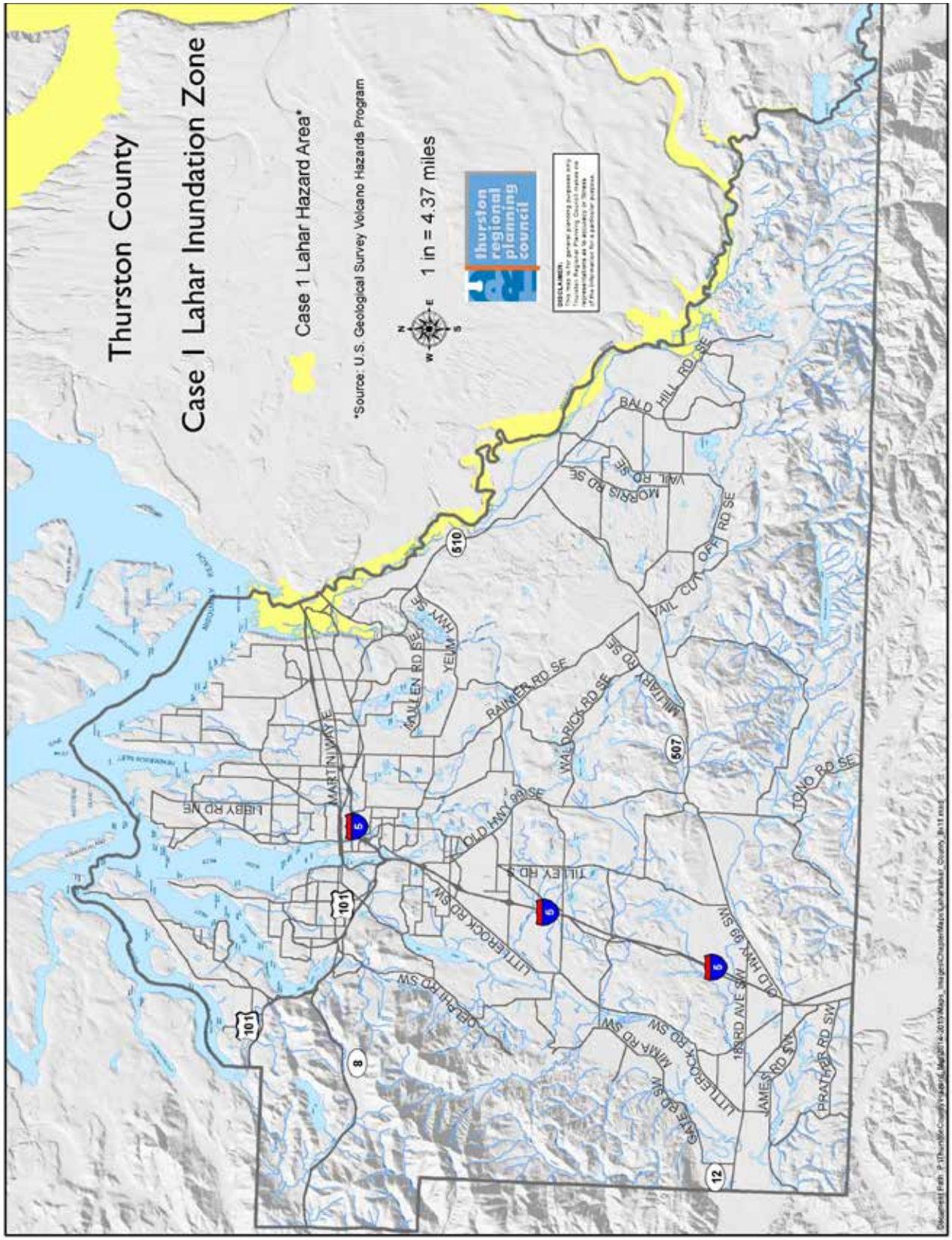
Facility Type	Total #	In Hazard Area #	In Hazard Area %
Medical Care			
Adult Family Home	124	0	0.0%
Assisted Living	14	0	0.0%
Dentist	110	0	0.0%
Dialysis Center	3	0	0.0%
Funeral Home	6	0	0.0%
Hospital	2	0	0.0%
Nursing Home	7	0	0.0%
Pharmacy	42	0	0.0%
Primary Care	91	0	0.0%
Urgent Care	6	0	0.0%
Government			
Court Services	3	0	0.0%
Cultural Significance	2	0	0.0%
Detention/Corrections	1	0	0.0%
Fairgrounds	35	0	0.0%
Fire Service	53	0	0.0%
Government Services	56	0	0.0%
Health and Human Services	2	0	0.0%
Law and Justice	4	0	0.0%
Law Enforcement	8	0	0.0%
Port Facilities	35	0	0.0%
Public Education	344	2	0.0%
Public Higher Education	52	0	0.0%
Public Works	33	0	0.0%
Solid Waste	20	0	0.0%
Transit	4	0	0.0%
Utilities	238	5	2.1%
Transportation (Centerline Miles)			
Roads	2,210	26	1.2%
Intercity Transit Routes	157	3	1.7%
Rural Transit Routes	96	0	0.0%

Explanations: Lahar Hazard includes the inundation zone for the USGS Case I Lahar Scenario.

Map 4.6.1: Inundation Zone for Case I Lahar (Puget Sound Region) with Pyroclastic Flow



Map 4.6.2: Inundation Zone for Case I Lahar Thurston County, Washington



Endnotes

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[14] Oral Communication from William E. Scott, Geologist, Cascades Volcano Observatory, U.S. Geological Survey, October 7, 2008.

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