

# 6

## IA 6 – Volcano

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# Table of Contents

<b>1</b>	<b>Purpose</b> .....	<b>IA 6-1</b>
<b>2</b>	<b>Policies</b> .....	<b>IA 6-1</b>
<b>3</b>	<b>Situation and Assumptions</b> .....	<b>IA 6-2</b>
<b>4</b>	<b>Concept of Operations</b> .....	<b>IA 6-9</b>
<b>5</b>	<b>Roles and Responsibilities</b> .....	<b>IA 6-9</b>
5.1	Primary Agency: Oregon Emergency Management .....	IA 6-9
5.2	Supporting Agencies .....	IA 6-10
5.3	Adjunct Agencies .....	IA 6-10
<b>6</b>	<b>Hazard Specific Information – Volcano</b> .....	<b>IA 6-10</b>
6.1	Definition .....	IA 6-10
6.2	Frequency .....	IA 6-11
6.3	Territory at Risk .....	IA 6-12
6.4	Effects .....	IA 6-12
6.5	Predictability .....	IA 6-13
<b>7</b>	<b>Supporting Documents</b> .....	<b>IA 6-13</b>
<b>8</b>	<b>Appendices</b> .....	<b>IA 6-13</b>

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IA 6 Tasked Agencies	
<b>Primary Agencies</b>	Oregon Emergency Management
<b>Supporting Agencies</b>	Department of Geology and Mineral Industries Oregon Department of Transportation Building Codes Division Water Resources Department Oregon Health Division Oregon Military Department Department of Administrative Services Department of Environmental Quality
<b>Adjunct Agencies</b>	American Red Cross The Salvation Army Civil Air Patrol Oregon Voluntary Organizations Active in Disaster (ORVOAD)

## 1 Purpose

- The purpose of this annex is to provide a framework for the coordination of state resources to help ensure the safety of life and property following a volcanic eruption or event.
- This annex identifies the major response and recovery activities undertaken by the listed state and adjunct agencies in response to a volcanic event.
- More specific information on volcanic eruption as a hazard in Oregon can be found in the Natural Hazards Mitigation Plan located at: <http://opdr.uoregon.edu/stateplan>

## 2 Policies

- Activation
  - Procedures in this annex will be implemented as outlined in the Oregon Emergency Operations Plan, Basic Plan.
  - Procedures in this annex may be automatically implemented under the following conditions:
    - ≡ When determined necessary by OEM and the Department of Geology and Mineral Industries.
    - ≡ When any area in Oregon or surrounding states experiences a volcanic event that may impact the state.

- This annex identifies the major response and recovery activities undertaken by state and adjunct agencies in response to a volcanic event which may impact the Citizens of Oregon.

### 3 Situation and Assumptions

- Considerations

- Oregon's vulnerability to volcanic events varies statewide. The Cascade Mountains, poses the greatest threat for volcanic activity. Those regions include: Mount Hood, which most recently erupted about 200 years ago, the Three Sisters, and Mt. Jefferson, which has not erupted for about 15,000 years, but is not considered to be extinct. Other Oregon volcanic areas include Crater Lake and Newberry Volcano.
- Oregon can experience impacts of volcanic activity that occurs in neighboring states as well. Areas of concern include Washington State volcanoes Mount Adams, Mount Rainier and most notably Mount St. Helens. In California, volcanoes close to the border, Mount Shasta, Lassen Volcanic Park, and Medicine Lake Volcano could impact Southern Oregon.
- Three main natural hazards occur as a result of Volcanic Eruption: ash fall, lava flows, and pyroclastic flows and surges.
- Post-eruptive hazards include: lahars and debris flows, and landslides (debris avalanches),
- Each eruption will be a unique combination of hazards; not all of them will be present in all eruptions and the degree of damage will vary. It is important to know that during an active period for a volcano many individual eruptions may occur and each eruption may vary in intensity and length.
- Hazard characteristics of Individual Oregon and surrounding state volcanoes:

≡ **Crater Lake:** The most recent eruption was about 5,000 years ago and occurred within the caldera. No eruptions have occurred outside the caldera for 10,000 years.

This potentially active volcanic center is contained within Crater Lake National Park. The west half of the caldera is considered the most likely site of future activity. Effects from volcanic activity (ashfall, lava flows, etc.) are likely to remain within the caldera. If an

## IA 6. Volcano

eruption was centered outside the caldera, pyroclastic flows and lahars could affect valleys up to a few dozen miles from the erupting vent. The probability of another caldera-forming eruption is very low as is the probability of eruptions occurring outside the caldera.

- ≡ **Mount Jefferson:** The last eruptive episode at Mount Jefferson was about 15,000 years ago. Research indicates that Mount Jefferson should be regarded as dormant, not extinct.

The steep slopes of the volcano provide the setting for possible debris flows and lahars, even without an eruption. These would be confined to valleys, generally within 10 miles of the volcano.

A major eruption, however unlikely in the short term, could generate pyroclastic flows and lahars that would travel up to a few dozen miles down river valleys. There are two reservoirs that could be affected by pyroclastic flows from a major eruption: Detroit Lake and Lake Billy Chinook. An explosive eruption could spew ash for hundreds of miles in the downwind direction.

Many smaller volcanoes are located between Mount Jefferson and Mount Hood to the north and Three Sisters to the south. Eruptions from any of these would be very localized, primarily erupting cinders and ash to form a cinder cone.

- ≡ **Mount Hood:** The last major eruption of Mount Hood occurred in approximately 1805. There were two other minor periods of eruptions during the last 500 years, the last in the mid-1800s.

Typically, these involved some lava flow near the summit, pyroclastic flows, and lahars, but little ashfall. The volcano is most likely to erupt from the south side, based on recent history, it should be assumed eruptions could be centered anywhere on the mountain.

A large eruption could generate pyroclastic flows and lahars that could inundate the entire length of the Sandy and White River Valleys. An eruption from the north flank could affect the Hood River Valley.

## IA 6. Volcano

Mount Hood's proximity to the Portland metropolitan area, the presence of major east-west highways, the Bull Run Reservoir which supplies water to a majority of Portland area residents, and the ski and summer recreation areas make Mount Hood the greatest potential volcanic hazard to Oregonians. In addition, a large volume of debris and sediment in lahars could affect shipping lanes in the Columbia River or the operation of the Bonneville and The Dalles dams.

- ⌘ **Newberry Volcano:** Newberry Volcano is a different type of volcano than the stratovolcanoes of the Cascade Range. It is a shield volcano, with broad, relatively gently sloping flanks. It is about 600,000 years old, and has had thousands of eruptions both from the central vent area and along its flanks.

The most recent eruption was 1,300 years ago, but it has been active at other times in the past 10,000 years.

Future eruptions are likely to include lava flows, pyroclastic flows, lahars, and ashfall. Most effects from these activities would be felt within, or up to a few miles beyond, the existing caldera. Ash could fall a few dozen miles from the eruptive center.

- ⌘ **Three Sisters:** North Sister has probably been inactive for at least 100,000 years; Middle Sister last erupted between 25,000 and 15,000 years ago, and South Sister had a very small ongoing uplift, which began in 1996 and became undetectable by 2003.

The uplift was about one inch a year and likely indicated movement of a small amount of magma. Currently, there is no indication that the uplift will ever develop into a volcanic eruption. However, that possibility cannot be ruled-out.

Future eruptions at South Sister (and possibly Middle Sister) are likely to include lava flows, pyroclastic flows, and lahars. The possibility exists for lahars to travel many miles down valley floors, if an eruption melts a large amount of snow and ice. Ashfall would likely be contained within 20 miles of the vent.

- ⌘ **Other Oregon Volcanic Areas:** On the scale of geologic time, there are other parts of Oregon that may



## IA 6. Volcano

see eruptions. However, on a human time scale, the probability of an eruption outside the Cascades is so low as to be negligible.

Other potential eruptive centers include the smaller peaks in the Cascades, such as Belknap in Central Oregon, which had a lava flow about 1,400 years ago. Most of these basaltic volcanoes are active for only brief periods, so forecasting an eruption for any specific site is impossible. However, eruptions of this type will likely continue in the Cascades, with the most recent one being in 1851, near Lassen Peak, California. These eruptions are typically not explosive, consisting mostly of lava flows concentrated in a small area.

There is a very low probability that volcanic activity would resume in south-central and southeastern Oregon. Cinder cones as recent as 5,000 years ago erupted in this Basin and Range Province.

≡ Washington Volcanoes

- **Mount Saint Helens:** The May 18, 1980 eruption included a debris avalanche as part of the volcanic edifice collapsed. This caused a lateral blast of rock, ash, and gas that devastated areas to the north of the volcano. Lahars rushed down the Toutle and Cowlitz River valleys reaching the Columbia River and halting shipping for some time. All other river valleys on the volcano experienced smaller lahars. Pyroclastic flows devastated an area up to five miles north. Ashfall deposits affected people as far away as Montana, and ash circled the earth in the upper atmosphere for over a year.

Except for the debris avalanche and lateral blast, the events of May 18, 1980 are typical of a Mount St. Helens' eruption and can be expected to occur again.

The primary hazards that will affect Oregon are lahars that will affect the Columbia River, and ashfall. Since the major eruptive activity in the early 1980's Mount Saint Helens has experienced two episodes of dome building

## IA 6. Volcano

activity. Another eruption from Mount Saint Helens is very likely in the near future.

- **Mount Adams:** Even though Mount Adams has been less active during the past few thousand years than neighboring Mounts St. Helens, Rainier, and Hood, it assuredly will erupt again. Future eruptions will probably occur more frequently from vents on the summit and upper flanks of Mount Adams than from vents scattered in the volcanic fields beyond. Large landslides and lahars that need not be related to eruptions probably pose the most destructive, far-reaching hazard of Mount Adams.
- **Mount Rainier:** since about A.D. 1820, one or two small eruptions, several small debris avalanches, and many small lahars (debris flows originating on a volcano) have occurred.

Likely an eruption would include tephra falls, pyroclastic flows and pyroclastic surges, ballistic projectiles, and lava flows. Debris avalanches, lahars, and floods commonly accompany eruptions, but can also occur during dormant periods.

#### ☞ California Volcanoes

- **Medicine Lake Volcano (MLV)** is a very large shield-shaped volcano located in northern California where it forms part of the southern Cascade Range of volcanoes. It has erupted nine times during the past 5,200 years, most recently 950 years ago. This record represents one of the highest eruptive frequencies among Cascade volcanoes and includes a wide variety of different types of lava flows and at least two explosive eruptions that produced widespread fallout.

Judging from its long eruptive history and its frequent eruptions in recent geologic time, MLV will erupt again. Although the probability of an eruption is very small in the next year (one chance in 3,600), the consequences of some types of possible eruptions could be severe.

## IA 6. Volcano

Furthermore, the documented episodic behavior of the volcano indicates that once it becomes active, the volcano could continue to erupt for decades, or even erupt intermittently for centuries, and very likely from multiple vents scattered across the edifice.

Owing to its frequent eruptions, explosive nature, and proximity to regional infrastructure, MLV has been designated a “high threat volcano” by the USGS National Volcano Early Warning System assessment. Volcanic eruptions are typically preceded by seismic activity, but with only two seismometers located high on the volcano and no other USGS monitoring equipment in place, MLV is at present among the most poorly monitored Cascade volcanoes.

- **Mount Shasta:** Eruptions during the last 10,000 years produced lava flows and domes on and around the flanks of Mount Shasta, and pyroclastic flows from summit and flank vents extended as far as 20 kilometers from the summit. Most of these eruptions also produced large mudflows, from Mount Shasta.

Such eruptions will most likely produce deposits of lithic ash, lava flows, domes, and pyroclastic flows. Lava flows and pyroclastic flows may affect low- and flat-lying ground almost anywhere within about 20 kilometers of the summit of Mount Shasta, and mudflows may cover valley floors and other low areas as much as several tens of kilometers from the volcano.

On the basis of its past behavior, Mount Shasta is not likely to erupt large volumes of ash in the future; areas subject to the greatest risk from air-fall tephra are located mainly east and within about 50 kilometers of the summit of the volcano.

- **Lassen Peak:** In May 1915, Lassen Peak, California, the southern-most active volcano in the Cascade Range, erupted explosively. Avalanches, mudflows, and flows of hot ash and

## IA 6. Volcano

gas devastated nearby areas, and volcanic ash fell as far away as 200 miles to the east. The Lassen area remains volcanically active, and the volcano hazards demonstrated in 1915 still can threaten not only nearby areas but also more distant communities.

**■ Planning Assumptions**

- This plan assumes a hazardous geologic occurred that has unleashed one or more volcanic hazard (pyroclastic flow, lahar, ash cloud, lava flow, and/or debris avalanche).
- For a variety of reasons, hazardous magmatic eruptions at Cascade Range volcanoes will likely be preceded by weeks or more of unrest.
- A volcanic eruption can trigger a number of other events, such as landslides, hazardous material releases and spills, and conflagration fires.
- Public utilities and private infrastructure (such as power, water, sewer, natural gas networks, phone lines and towers) may be damaged and unusable immediately following a volcanic event.
- Roads, bridges and highways may become impassible following a significant volcanic event.
- Volcanic ash may be a hazard to highway and air transportation, making movement of supplies and emergency assistance difficult.
- Ash particles in the air can cause a health hazard.
- Oregon citizens may be without food, water, shelter, heat, sanitary facilities and transportation for extended periods of time.
- Communities may become overwhelmed by influx of displaced citizens who need alternate housing or shelter because of damaged communities.
- Public safety resources (including personnel) may suffer damage, injury or death causing a shortage of resources to assist with response and recovery efforts.

## 4 Concept of Operations

- In accordance with the Emergency Operations Plan for the State of Oregon, the Emergency Coordination Center (ECC) will likely be fully activated.
- Tasking priorities for state resources will be determined in conjunction with local officials and the State ECC and as indicated in local volcano coordination plans.
- Oregon Emergency Management will have the lead on coordination of resources requested from local officials.
- Requested equipment, materials, supplies and personnel will be secured through State resources and/or mutual aid agreements, or purchasing.
- State supporting agencies will respond to the ECC as required to provide response and recovery resources to local governments upon assignment from the ECC Operations Officer.

## 5 Roles and Responsibilities

### 5.1 Primary Agency: Oregon Emergency Management

- Activation and setup of the ECC in accordance with the state Emergency Operations Plan (EOP);
- Serve as liaison between County and State; and State and the Federal Emergency Management Agency (FEMA), and other federal agencies.
- Determine the nature and scope of the disaster/emergency and provide ongoing assessment of identifiable resources needed;
- Establish and maintain contact with State Support and Adjunct agencies;
- Establish and maintain contact with county emergency managers or other local officials;
- Coordinate an integrated State effort to provide assistance to the affected area(s);
- Provide situation reports to the Governor's Advisory Council or designated representatives;
- Present coordinated and accurate information to the public via the State's Public Information Officer (PIO);

- Coordinating the acquisition and distribution of resources to support response.
- Coordinate with the Federal government on supplemental disaster assistance necessary to preserve life and property, and on recovery assistance.
- Activating, if necessary, the Emergency Management Assistance Compact (EMAC) for interstate assistance.

## 5.2 Supporting Agencies

- Oregon Department of Geology and Mineral Industries (DOGAMI)
- Oregon Department of Transportation (ODOT)
- Building Codes Division
- Water Resources Division (WRD)
- Department of Human Services / Public Health (DHS)
- Oregon Military Department (OMD)
- Department of Administrative Services (DAS)
- Department of Environmental Quality (DEQ)

## 5.3 Adjunct Agencies

- American Red Cross (ARC)
- The Salvation Army
- Civil Air Patrol
- Oregon Voluntary Organizations Active in Disaster (ORVOAD)

**Note:** Responsibility details for State agencies can be found in the Roles & Responsibilities (ESF) section of the updated State of Oregon Emergency Operations Plan (EOP).

# 6 Hazard Specific Information – Volcano

## 6.1 Definition

An eruption from the earth's interior producing lava flows and violent explosions issuing rock, gas and debris.

Oregon's vulnerability to volcanic events varies statewide. The Cascade Mountains, which separate Western Oregon from Central Oregon, poses the

IA 6. Volcano

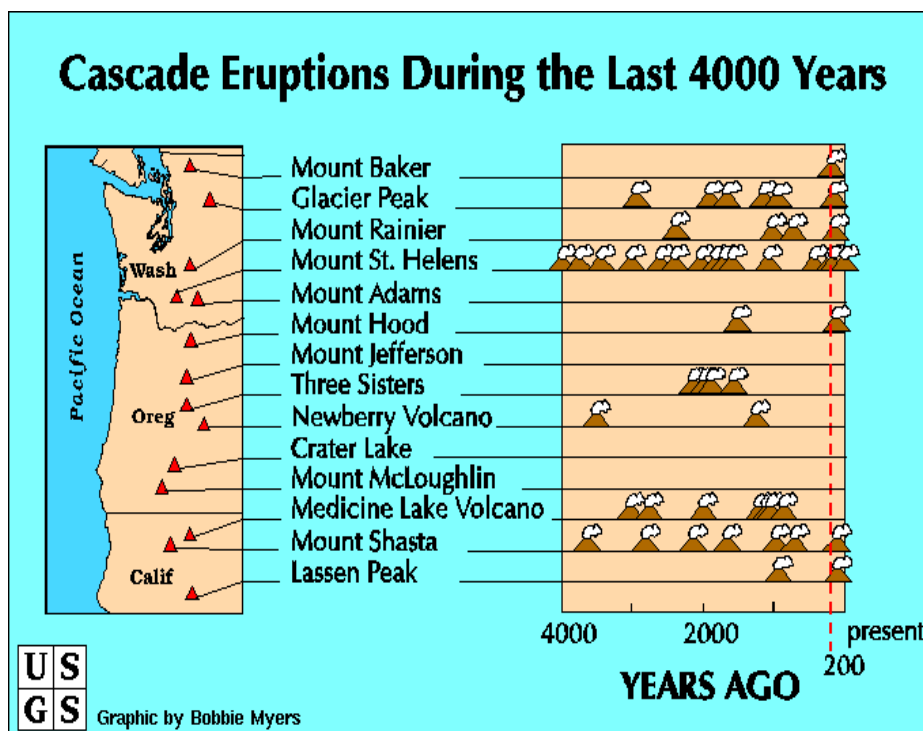
greatest threat for volcanic activity. Those regions that include the Cascade Mountains are most vulnerable to the effects of a volcanic event. Within the State of Oregon, there are several volcanoes that may pose a threat of eruption; these include Mount Hood, which most recently erupted about 200 years ago, the Three Sisters, and Mt. Jefferson, which has not erupted for about 15,000 years, but is not considered to be extinct.

Deschutes County is most vulnerable in the Central Oregon Region because the region’s most populous city, Bend, is located here and the greatest numbers of “composite” volcanic mountains are located near the county’s population centers. Klamath and Jefferson counties are also vulnerable within this region. Other regions are also vulnerable to damage from volcanic eruptions. If Mt. Hood erupted, the Northern Willamette Valley/Portland Metro Region and the Mid-Columbia Region would both be impacted. Because of Mt. Hood’s proximity to Portland, the Columbia River, the I-84 freeway, and major dams on the Columbia River, the potential for a large disaster exists.

**6.2 Frequency**

Volcanic eruptions occur relatively rarely. Eruptions in the Cascades have occurred at an average rate of 1-2 per century during the last 4000 years, and future eruptions are certain.

**Figure 1 Location and History of Oregon Volcanoes**



### 6.3 Territory at Risk

The primary areas affected include the regions immediately surrounding the Cascade Range. However, depending on the type of activity that occurs at a volcano, hazardous areas may extend well beyond its immediate flanks. For example, lahars can rush down river valleys more than 100 kilometers from a volcano and volcanic ash can spread thousands of kilometers downwind from an erupting volcano. Moreover, tiny liquid droplets of sulfuric acid erupted into the stratosphere can change our planet's climate temporarily, thus affecting the whole world.

### 6.4 Effects

Violent volcanic outbursts are characterized by clouds of poisonous gasses, rivers of lava and volcanic ash that can spread over wide areas. Major eruptions can result in heavy layers of ash covering widespread land areas. Volcanic activity can also trigger tsunamis, landslides, floods and fires.

Figure 2 Effect of an Eruption of Mt. Hood

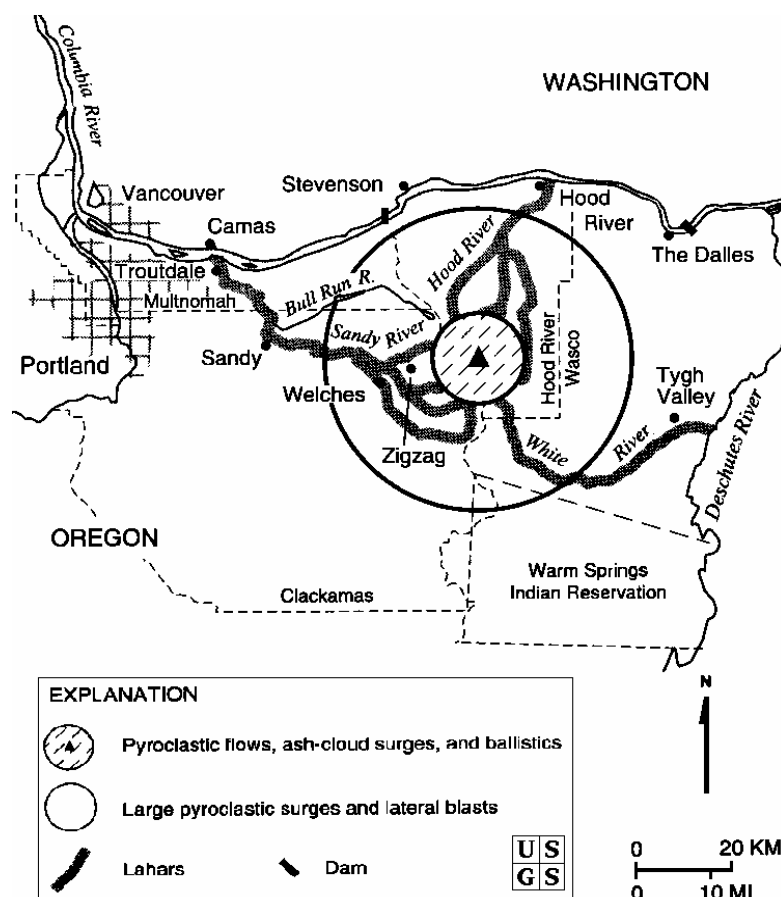



Figure 2 Active and Potentially Active Volcanoes in Oregon



**Active and Potentially Active Volcanoes in the United States**

**Oregon**



Volcano	Eruption type(s)	Number of eruptions in the past 200 years	Latest activity (in years before present or year(s) A.D.)	Remarks
Mount Hood	Ash, dome	2?	1865	Occasional seismic swarms
Mount Jefferson	Ash, lava	0	More than 50,000 years ago	Debris flows in 1934, 1955; young basaltic flows in nearby area.
Three Sisters	Ash, lava	0	950?	Debris flows in this century.
Crater Lake	Ash, lava, dome	0	4,000 years ago	Largest known eruption from Cascade Range volcano. Catastrophic, caldera-forming eruption 7,000 years ago; post-caldera lava and domes.
Newberry Crater	Ash, lava	0	600	Latest eruption was obsidian flow.

*From: Wright and Pierson, 1992, USGS Circular 1073*

## 6.5 Predictability

Volcanoes often show signs that they are getting ready to erupt days to months in advance. Seismic activity, ground movements, and gas emissions at Cascade volcanoes are monitored by Cascade Volcano Observatory in order to detect subtle changes that may herald the next eruption. Seismic activity is continuously monitored under the auspices of the USGS Volcano Hazards and Geothermal Studies Program through Cascade Volcano Observatory, the USGS in Menlo Park, California, and the University of Washington Geophysics Program in Seattle, Washington.

## 7 Supporting Documents

- Mt. Hood Coordination Plan
- Oregon Hazard Mitigation Plan, Volcanic Hazard Chapter
- Central Cascades Volcano Coordination Plan

## 8 Appendices

- None at this time

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