CENTRAL CASCADES VOLCANO COORDINATION PLAN

Coordinating Efforts among Governmental Agencies in the Event of Volcanic Unrest in the Central Cascades, Oregon

Cover Sheet

Prepared by:
The Central Cascades Facilitating Committee

May 31, 2007
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FOREWORD

Oregon Emergency Management sincerely appreciates the cooperation and support from the agencies and local jurisdictions that have contributed to the development and publication of the **Central Cascades Volcano Coordination Plan**.

The plan provides vital Central Cascade volcanic event response and recovery information that will greatly enhance the hazard planning efforts of seven counties, the Confederated Tribes of Warm Springs and multiple state and Federal agencies. The Plan supports and complements local response plans, the National Response Plan, the and the *Oregon State Emergency Management Plan*

The *Central Cascades Volcano Coordination Plan* is an important element in a coordinated effort to enhance our region's preparedness for emergencies and disasters. This plan embraces the philosophy and vision of a *Disaster Resistant and Resilient State* and will empower local communities to minimize the impacts of volcanic activity on people, property, the environment and the economy of the Pacific Northwest.

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PURPOSE

The purpose of this plan is to coordinate the actions that various agencies must take to minimize the loss of life and damage to property before, during, and after hazardous geologic events at Central Cascades volcanoes. The plan strives to ensure timely and accurate dissemination of notifications and public information. The plan also includes the necessary legal authorities as well as statements of responsibility of County, State and Federal agencies.

INTRODUCTION

Volcanoes dominate the skyline in many parts of the Pacific Northwest, although their fiery past is often unrecognized. These familiar snow-clad peaks are part of a 1,000-mile-long chain of volcanoes, the Cascade Range, which extends from northern California to southern British Columbia. Seven of those volcanoes have erupted since the birth of this nation about 230 years ago. These include Mount Baker, Glacier Peak, Mount Rainier, Mount St. Helens, Mount Hood, Mount Shasta, and Lassen Peak. These and many others could erupt again. Many people do not consider the Cascade volcanoes to be hazardous because the time between eruptions is often measured in centuries or millennia, and volcanic activity is not part of our everyday experience. However, the vast destructive power unleashed by the 1980 eruption of Mount St. Helens reminds us of what can happen when they do erupt. As populations increase in the Pacific Northwest, areas near the Cascade volcanoes are being developed and recreational use is expanding. Consequently, more and more people and property are at risk from future volcanic activity.

The Central Cascades extends from Mount Jefferson in the north to Diamond Peak in the south. The most active volcanoes in this stretch have been Three Sisters and Newberry. The last eruptive period in the Three Sisters area was 1000-2000 years ago. The most recent eruption (Big Obsidian Flow) in Newberry was 1300 years ago. Recently ground uplift (bulge) and anomalous water chemistry have been recorded west of Three Sisters. Because there are no written chronicles of past major eruptions, most of our information about the Central Cascades past comes from geologic study of deposits produced during those eruptions. We also use observations of recent eruptions at other similar volcanoes around the world to help us understand how future eruptions of the Central Cascades volcanoes may develop and to help delineate areas that are likely to be at risk during future eruptions.

The geologically recent history of volcanism in Central Cascades region, the ongoing ground uplift near Three Sisters and increasing growth in the region prompted the development of the Central Cascades Volcano Coordination Plan by emergency managers from seven counties, the Confederated Tribes of Warm Springs, and the State of Oregon, Federal Emergency Management Agency (FEMA), the U.S. Forest Service/Willamette and Deschutes (USFS), and the U.S. Geological Survey (USGS).

VOLCANIC HISTORY AND HAZARDS

The Cascade Range in central Oregon, from Mount Jefferson to Diamond Peak, is composed of hundreds of individual volcanoes that lie among the major volcanic centers of Mount Jefferson, Three Sisters, and Newberry Volcano. The area has witnessed numerous eruptions during the past 14,000 years (Fig. 1). Some future eruptions will be focused at the long-lived composite volcanoes in these major centers. Composite volcanoes host a wide array of eruption types and sizes over life spans of hundreds of thousands of years. In contrast, new mafic (also called basaltic or monogenetic) volcanoes could be born almost anywhere in the range. They produce chiefly lava flows and falls of bombs and cinders near vents and modest amounts of ash or tephra that fall out from eruption clouds farther downwind. Each of the major volcanic centers represents a specific set of eruptive characteristics and history, and each poses a variety of potential hazards from future eruptions (see Appendix A for definitions of terms in bold). The key aspects of each center are summarized below, followed by a discussion of the broad field of mafic volcanoes within which the major centers lie. Past eruptive events help to define zones of potential hazards during future eruptions; these are shown in a volcano-hazard map (Fig. 2).

Mount Jefferson

Of the 13 volcanic centers in the Cascade Range, Mount Jefferson has been the least active in the recent geologic past. In fact, the volcano has been dormant for more than 15,000 years, but is still considered capable of erupting in the future. Mount Jefferson has hosted large explosive eruptions in the past that blanketed areas near present Lake Billy Chinook with more than 1 meter (3 feet) of pumice and showered tephra over a broad area of the western United States. Eruptions also generated **pyroclastic flows** of ash and pumice that moved rapidly down valleys near the volcano and melted snow and ice to form **lahars**, or volcanic debris flows, that traveled even farther down the Deschutes and North Santiam river valleys. Lahars in the North Santiam valley nearly reached Salem. Past eruptions have also produced **lava flows** and **lava domes**, the latter of which can collapse during their growth and produce pyroclastic flows and lahars. The steep upper parts of the volcano could also be susceptible to landslides, or **debris avalanches**, that could be triggered by renewed volcanic activity. Such avalanches bury valleys near the volcano and can transform to lahars that travel much farther down valley.

Unlike other major volcanic centers in central Oregon, all valleys that drain Mount Jefferson contain large reservoirs, Detroit Reservoir on the North Santiam and Lake Billy Chinook on the Deschutes River. If water levels are lowered, such impoundments can provide traps for avalanches and lahars. But, if full, they can compound downstream problems. Large avalanches or lahars that enter full reservoirs can generate waves that overtop dams and cause downstream flooding or endanger the integrity of the dam itself.

Three Sisters

Unlike other major Cascade volcanic centers, the Three Sisters center contains two young composite volcanoes, South Sister and Middle Sister, rather than one. The third sister, North Sister, and other nearby conspicuous volcanoes such as Mount Bachelor are large mafic volcanoes. Broken Top is a composite volcano that has not erupted for tens of thousands of years. Eruptions about 2000 years ago from vents on South Sister produced conspicuous blocky lava flows, such as Rock Mesa. These eruptions also produced a modest amount of pumice and ash that blanketed downwind areas. Probably no more than 1 or 2 centimeters (less than one inch) of ash fell in the area now occupied by Bend. Similar, but larger, eruptions occurred during the last ice age, which ended about 12,000 years ago, and had more widespread effects. Such eruptions occurred from both Middle Sister and South Sister. Three eruptions during the past one-half million years have been significantly larger and produced pyroclastic flows that swept over present-day Bend and Sisters. Fortunately such eruptions are rare—the last one occurred more than 200,000 years ago—and there is no sign that the Three Sisters system is capable of producing such an eruption during our lifetimes.

Owing to the prevailing westerly winds in central Oregon, areas east of Three Sisters have the greatest probability of being affected by **tephra falls** from future eruptions. Eruptions that produce higher eruption clouds and greater volumes of tephra will affect progressively larger areas. Although seldom life threatening, ash fall can greatly disrupt life. Darkness and swirling clouds of ash limit visibility and affect transportation *(see "USGS Fact Sheet 027-00, Volcanic Ashfall—A "Hard Rain" of Abrasive Particles" in Appendix)*. If wet, ash creates slippery conditions on roads. Ash is electrically conductive, especially if wet, and abrasive, so it can severely affect electrical and mechanical systems. Ash is also extremely dangerous to aircraft in flight.

The three major drainage systems that head in the Three Sisters area are all potentially at risk from lahars during future eruptions (Fig. 2). The location and size of lahars will depend on the site of the eruption and its character.

- Separation Creek and White Branch lead to several small communities in the McKenzie valley, including McKenzie Bridge and Blue River, which could be in the paths of lahars flowing westward. Large-volume lahars could reach communities farther west. Oregon Highway 126 and municipal water and hydroelectric facilities could be affected by lahars and excess sediment in the McKenzie.
- Broad basins in the upper Deschutes valley, such as those occupied by Sparks, Elk, and Lava lakes, provide traps for lahars and sediment moving south, as do Wickiup and Crane Prairie Reservoirs.
- The Sisters area represents the largest concentration of residents and development in a lahar-hazard zone. The city lies less than 30 kilometers (19 miles) downstream from Middle and South Sisters along Whychus Creek. Below Sisters, Whychus Creek flows into a deep canyon and joins the Deschutes River.

Eruptions that disrupt watersheds by removing vegetation and adding large quantities of sediment from tephra fall, pyroclastic flows, debris avalanches, and lahars, typically initiate a period of years to decades during which streams carry increased sediment loads and channels become unstable and migrate. Such effects propagate downstream and can disrupt channels and flood plains far from where direct impacts of eruptions end. The Springfield-Eugene area along the lower McKenzie River and Sunriver and Bend along the Deschutes River below Wickiup Reservoir could be vulnerable to such events in the years following eruptions. Similarly the Tumalo Creek watershed that supplies part of Bend's municipal water, although not likely to be affected directly by volcanic flows, is likely to receive ash fall from any eruption in the Three Sisters area.

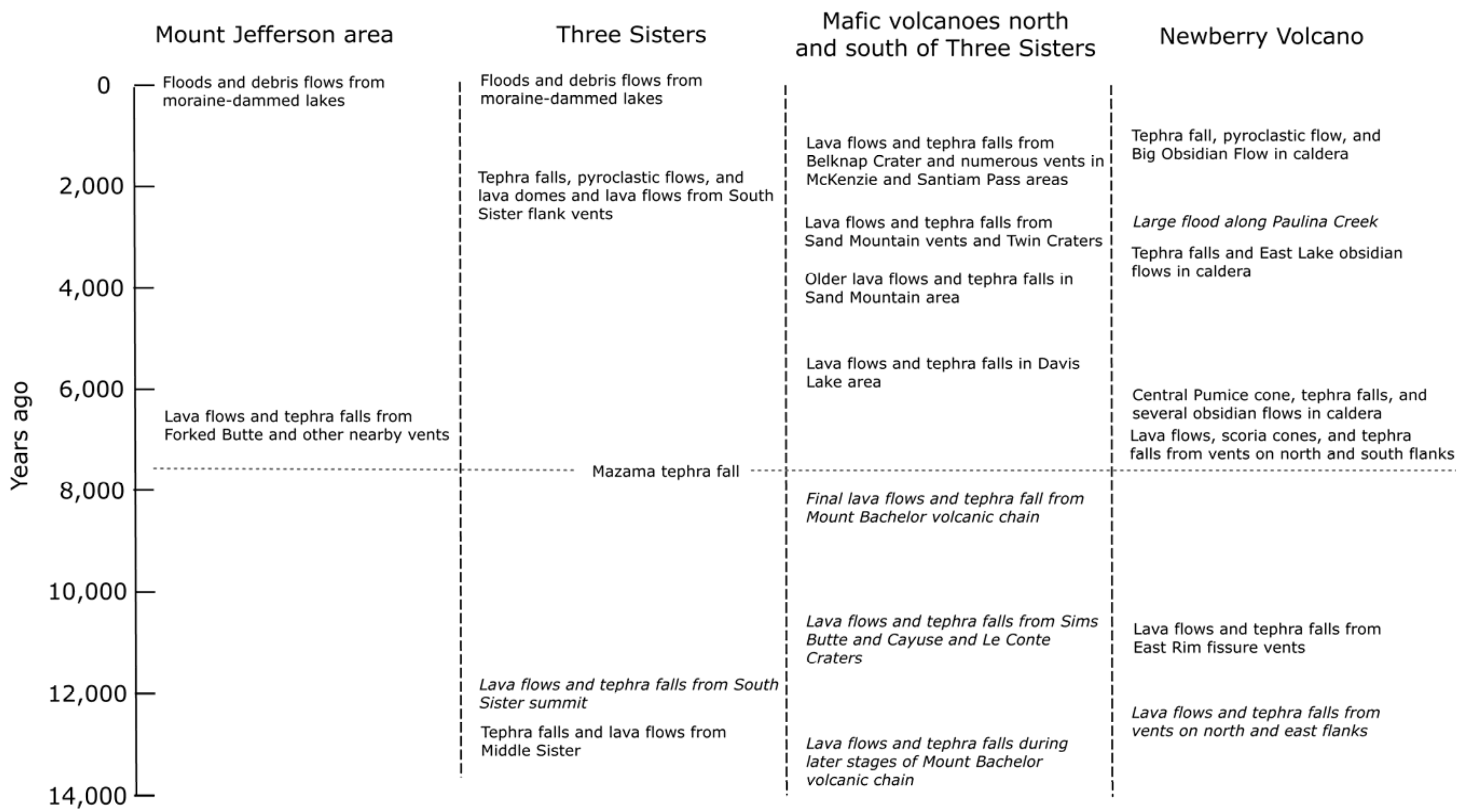

Figure 1. Eruptive and major debris-flow and flood events in the central Cascades of Oregon during the past 14,000 years. The events printed in italics are poorly dated, so their ages are less well known than those in normal font. The Mazama tephra fall was produced by the cataclysmic eruption of Mount Mazama that created Crater Lake.

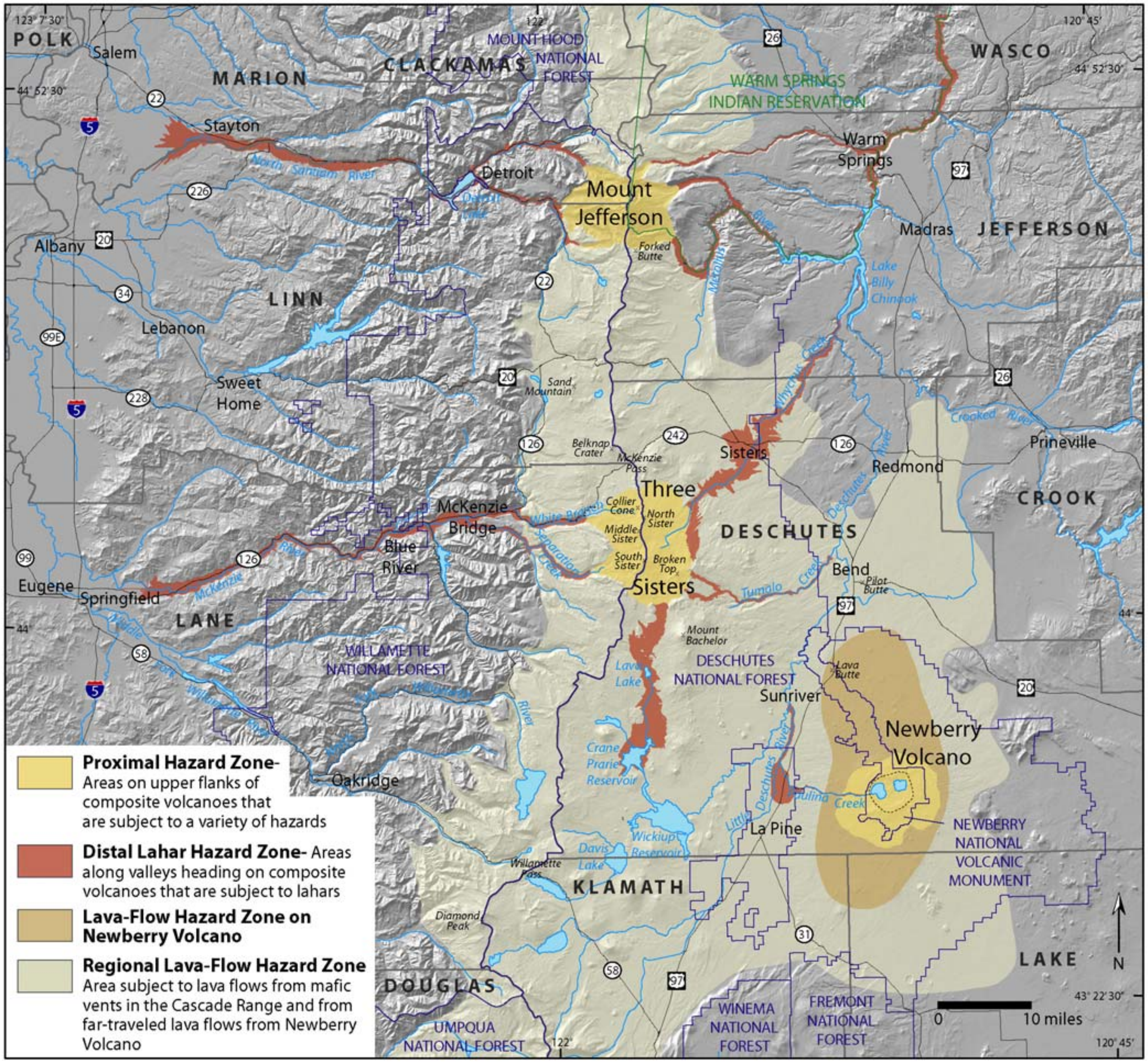

Figure 2.
Volcano hazards in central Oregon.
Hazard zones are modified from the USGS hazard assessments for Mount Jefferson, Three Sisters, and Newberry Volcano listed in references.

Newberry Volcano

Newberry Volcano is among the largest and most voluminous of Cascade volcanoes. Even though it is not of great height, it is very broad. The edifice covers more than 1300 square kilometers (500 square miles). Beyond the edifice, Newberry lava flows cover an additional 700 square kilometers (270 square miles), and reach about 25 kilometers (16 miles) north of Redmond. Hundreds of volcanic vents occur on the flanks of Newberry, many arranged in linear arrays, or rift zones, that extend far down the flanks. The youngest rift-zone eruption occurred about 7,000 years ago. During that time lava flows issued from numerous vents, including Lava Butte, which lies about 22 kilometers (14 miles) from the volcano's summit at the north end of the rift zone. Lava flows from Lava Butte temporarily dammed the Deschutes River and traveled more than 8 kilometers (5 miles) from the butte. Lava fountains and small explosive eruptions that created cinder cones, such as Lava Butte, and downwind blankets of cinders and ash, preceded most lava flows.

Potential future eruptions from rift zones on the north flank of Newberry represent the most credible lava-flow threat to a large settled area in the United States outside of Hawai'i. Most of the City of Bend east of the Deschutes River is built on lava flows from Newberry. Lava flows advance relatively slowly compared to rapid flows such as lahars and pyroclastic flows, so they rarely threaten human life. But an advancing lava flow ensures almost total destruction owing to burial and incineration. Once lava begins to flow from a vent, scientists are typically able to forecast which areas downslope are at greatest risk.

Newberry has also produced some notable explosive eruptions. Most of these originated from vents located in the broad depression, or caldera, that forms the summit of the volcano. Eruptions as recently as 1300 years ago generated thick tephra falls and pyroclastic flows. Larger events are known in the more distant geologic past at Newberry, including some that transported tephra over broad areas of the western United States and sent pyroclastic flows down the volcano's flanks. The presence of the summit caldera and closed basins within it create conditions favorable for accumulation of heavier-than-air volcanic gases, notably carbon dioxide, which could lead to dangerous conditions were increased emission of gas to occur during volcanic unrest or eruption.

Two lakes in the caldera create the possibility of rising magma interacting with water to generate strong explosions that would affect areas in the caldera and on the upper flanks. In addition, one of the lakes, Paulina, drains into Paulina Creek, a tributary of the Little Deschutes River. As has happened in the past, rapid release of water from the lake could produce lahars or floods that inundate the Paulina Prairie area north of La Pine.

Fields of Mafic Volcanoes

Hundreds of geologically young volcanoes composed of cinders, ash, and lava flows dot the central Oregon landscape among the major volcanic centers. Many, such as Collier Cone on the north flank of Middle Sister, lie near one of the composite volcanoes; others lie far from one. Some are small cones; others, such as Mount Bachelor, are large shield volcanoes that stand more than 1000 meters (3300 feet) above their bases and can be more than 10 kilometers (6 miles) wide. The youngest mafic volcano in the region is Belknap Crater, north of McKenzie Pass, which formed about 1500 years ago. Geologic evidence suggests that the eruptions that formed these features may have lasted for centuries in the case of the largest cones to weeks to months for smaller ones. In some cases, vents in linear chains as long as 10 kilometers (6 miles) were erupting concurrently, or nearly so. Since the last ice age waned, about 12,000 years ago, vents of mafic volcanoes have been concentrated in a narrow zone about 80 kilometers (50 miles) long, extending from south of Mount Bachelor to north of Santiam Junction. A few scattered vents in the area between Davis Lake and Oregon Highway 58 and a few south of Mount Jefferson were also active during this time period.

Future eruptions of mafic volcanoes are possible anywhere in the broad central Cascades region, although eruptions are probably more likely to occur in the greater Three Sisters area, judging from the volcanic history of the past 14,000 years. Tephra from eruptions of mafic volcanoes will affect areas chiefly east of the Cascade crest. Tephra falls from ongoing eruptions of mafic volcanoes, which could last months to years or even longer, would represent a chronic nuisance in Deschutes County. Once an eruption begins, ultimate extent of lava flows will depend on vent location, local topography, and the total volume and rate of lava erupted, but scientists will be able to make forecasts about areas at greatest risk. Fortunately most future lava-flow eruptions in the central Cascades will occur away from populated areas. Impacts are more likely to affect forests and stream channels. Less likely to be affected are major highways and power-line corridors.

Current Unrest at Three Sisters

Since late 1997, a broad dome-shaped area about 20 kilometers (12 miles) in diameter centered 5 kilometers (3 miles) west of South Sister has been slowly rising (Fig. 3). At its center the average rate of uplift was about 3 cm (a little more than 1 inch) per year until 2004, when the rate slackened. Such activity is known from many volcanic areas around the world and is thought to be caused by intrusion of magma, or molten rock, at depth. The anomalous chemical and isotopic composition of spring water in the uplift area is also consistent with magmatic intrusion. However, at least some of the chemical anomalies were first noted in the late 1980s, more than 7 years before the current episode of uplift began. Scientists think that either (1) intrusion similar to the present has occurred episodically in the past, or (2) the current intrusion represents a pronounced increase in rate over a longer-term, much lower rate. In either case, the outcome of the ongoing intrusion is unknown. Possibilities range from the rate of intrusion gradually waning and reappearing at some time in the future, to the ongoing intrusion eventually leading to an eruption. If the system were to head toward eruption, the rate of unrest would increase dramatically and be recorded on monitoring networks, but significant uncertainty would surround forecasts of the location, timing, and scale of activity.

The onset of a swarm of hundreds of small earthquakes in March 2004 between South and Middle Sisters suggests that seven years of deformation had progressed to the point where the accumulated strain began causing small amounts of rock breakage or slippage on faults. Since then there have been only a modest number of small earthquakes. The ability to accurately locate the small earthquakes in such swarms is essential if we are to learn more about the character of the intrusion, so efforts are underway to increase the number of seismometers and the effectiveness of the seismic network. Improving the ability to monitor the pattern and rate of uplift or other ground deformation in real time is a more expensive process. It requires installation of a large number of continuous Global Positioning System receivers located throughout the area of uplift and in adjacent areas.

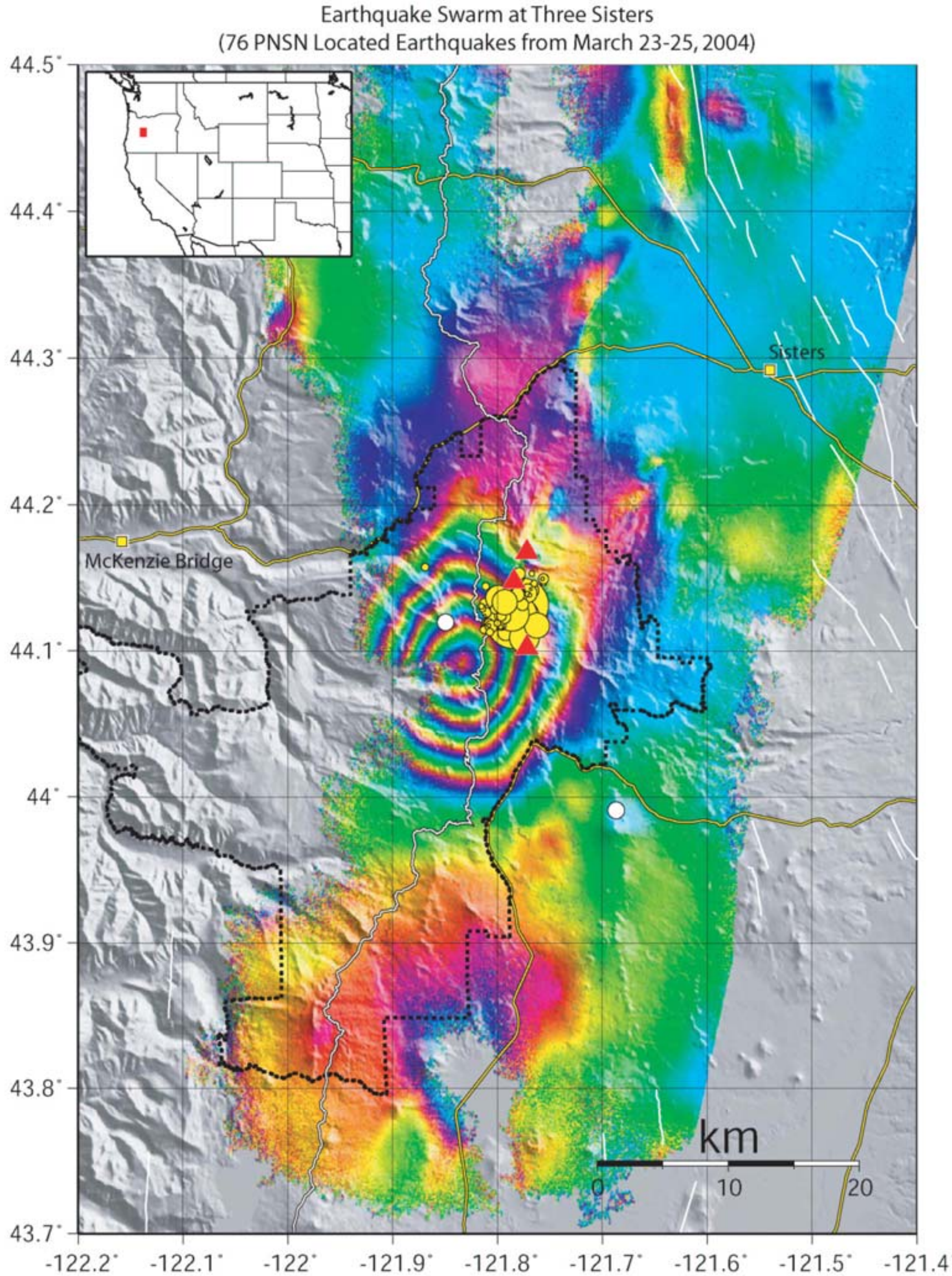

Figure 3**.** Area of uplift near Three Sisters from 1997-2002 mapped by satellite radar interferometry (INSAR). Map shows characteristic bull's eye pattern of uplift; each rainbow band corresponds to 28mm (little over one inch) of range change between the ground and satellite. Yellow dots are epicenters of earthquakes of March 2004 swarm located by the Pacific Northwest Seismic Network; all earthquakes were less than magnitude 2. White dots are continuous GPS stations; red triangles are North, Middle, and South Sister; black dashed line is boundary of Three Sisters Wilderness Area; white on black line is Pacific Crest Trail; white lines are geologically recent faults; yellow lines are highways.

Status of Volcano Monitoring in the Central Oregon Cascades
Techniques for monitoring active or potentially active volcanoes focus on three areas—earthquakes (seismicity), ground deformation, and volcanic gases. Magma intruding a volcanic system breaks rock and causes slippage on faults, thereby creating earthquakes; it adds material at depth and heats and pressurizes ground water, thereby bowing up the ground surface; and it releases volcanic gases, mainly water vapor, carbon dioxide, and sulfur dioxide. Heat and volcanic gases from magma warm and add telltale chemicals to the ground water, which affects the composition of spring water throughout the area. Some monitoring occurs in real-time or near real-time as data are telemetered from field sites to base stations; other monitoring is done on a periodic basis and requires visits to the field or gathering data from satellites.

Earthquakes in central Oregon are detected and located in real-time by the Pacific Northwest Seismic Network at the University of Washington, a cooperative undertaking of the university, USGS, and University of Oregon. Compared to areas that have frequent earthquakes, the station spacing in central Oregon is relatively large, so only earthquakes greater than magnitude (M) 1 or 2 are able to be located routinely. Six stations added in the Three Sisters area since ongoing uplift was recognized in 2001 have reduced the magnitude threshold for location there to about M 0.5 to 1, if all stations are operating. Two additional stations are planned for summer 2007. In addition, a cache of instruments at USGS Cascades Volcano Observatory is available to rapidly augment the existing network should conditions warrant.

Continuous Global Positioning System (CGPS) receivers are able to track ground deformation in real time for a single point on Earth's surface. At present CGPS receivers at Redmond, Mount Bachelor, and two near the center of the ongoing uplift operate in real time. Such a sparse network is of limited use in understanding the complex nature of ground deformation in a volcanic environment. Additional instruments are planned. Broader regional coverage is afforded by periodic USGS surveys (typically annual or every few years; more often if conditions warrant) of an array of benchmarks in the Three Sisters and Newberry areas by temporary deployment of GPS instruments. Both areas also have a system of precisely surveyed lines along roads or trails that are used for tiltleveling, a procedure that is capable of measuring slight crustal movements. Another technique called InSAR uses satellite radar data to detect crustal movements over broad areas. It discovered the uplift in the Three Sisters area but has had limited use since, owing to problems with the satellite. Its utility should improve with launch of new satellites.

USGS scientists measure output of volcanic gases by airborne surveys. Flights to central Oregon volcanoes are made every few years in order to develop baseline information; additional flights occur as conditions warrant. During times of increased concern, flights could occur as often as atmospheric conditions allow. Annual sampling and chemical and isotopic analysis of spring water from the area permit a broad regional view of how magmatic intrusion is affecting the chemical composition of shallow ground water.

By combining the results of these and other techniques and an understanding of a volcano's past behavior, the goal of volcano monitoring is to issue forecasts as accurately as possible about the state of a volcanic system and the probability for the onset of potentially hazardous conditions.

Once an eruption has begun, monitoring information is used to forecast the character and expected outcome of the eruption, as well as its end.

NOTE: **The USGS-Cascade Volcano Observatory (CVO) maintains summary volcano information on its public website** http://vulcan.wr.usgs.gov/

Warning time and duration of eruption—long or short?

At volcanoes around the world, the amount of warning time between the first appearance of volcanic unrest and the onset of a hazardous eruption has ranged from about one day to several years. At Redoubt Volcano in Alaska, increased steaming was noted in early November 1989; but seismic activity remained low until December 13, about 25 hours before the onset of a major explosive eruption. Three more explosive events on December 15 were followed by six months of dome growth and dome collapse until activity ceased in early summer of 1990. At Soufriere Hills Volcano on the island of Montserrat, British West Indies, the initial seismic unrest in January 1992 preceded the first eruption by three years. The first small steam explosion in July 1995 was followed by the appearance of a lava dome in September of that year. Pyroclastic flows from the growing dome began spilling into surrounding valleys in March 1996, leading to the gradual destruction of Plymouth, the capital city, and surrounding towns and farmland over the next two years. Dome growth and periodic explosions continue at Montserrat today (2007).

For a variety of reasons, hazardous magmatic eruptions in the Central Cascades will probably be preceded by weeks or more of unrest. Chief among those reasons is that volcanoes in the Central Cascades have been dormant for more than 1000 years; the conduit system that conveys magma to the surface has solidified and will have to be fractured and reopened for the next magma to reach the surface. In the Cascade Range, two volcanoes have produced magmatic eruptions during the twentieth century. At Mount St. Helens, the climactic eruption of May 18, 1980, was preceded by increased seismicity, ground deformation and steam eruptions that began in late March of that year. But the onset of lava dome-growth in 2004 followed just two weeks of seismicity and intense, localized ground deformation. At Lassen Peak in California, small steam and ash explosions began on June 30, 1914, and continued sporadically for almost a year before the onset of large magmatic eruptions in May 1915.

References and Additional Reading

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Walder, J.S., Gardner, C.A., Conrey, R.M., Fisher, B.J., and Schilling, S.P., 1999, Volcano hazards in the Mount Jefferson region, Oregon: U.S. Geological Survey Open-File Report 99-24, 14 p., two plates, scale 1:100,000.

Internet Resources

Pacific Northwest Seismic Network
http://www.ess.washington.edu/recenteqs/latest.htm

Smithsonian Institution Global Volcanism Program
http://www.volcano.si.edu/

USGS Volcano Hazards Program
http://volcanoes.usgs.gov/

Volcanic ash—what it can do and how to prevent damage
http://volcanoes.usgs.gov/ash/

Volcanic ashfall—how to be prepared for an ashfall
http://emd.wa.gov/5-prog/prgms/eq-tsunami/vol-ash-english.pdf

EFFORTS TO MONITOR VOLCANIC UNREST

In response to developing volcanic unrest in the Central Cascades, a USGS response team expects to:

1. ***Establish a temporary volcano observatory*** with the USFS and USGS, **most likely at Willamette and/or Deschutes National Forest headquarters in Eugene and Bend, respectively**, with best location as determined by the event. The observatory will maintain close contact with emergency managers and will be sited to allow efficient daily helicopter access to the volcano. The primary function of the USGS response team is to monitor all volcanic developments and to provide eruption-forecasting and hazard-assessment information to support decisions by public officials.
2. ***Install additional monitoring instruments*** to collect and analyze visual, seismic, lahar-detection, deformation, and gas-emission data. As an important element of redundancy, critical seismic data will be received and analyzed at the Pacific Northwest Seismic Network at the University of Washington, the USGS Cascades Volcano Observatory, and the local temporary volcano observatory.

Event Notification

In 2006 the USGS adopted a single system for characterizing the level of hazardous activity at U.S. volcanoes. The system is a means to communicate the status of a volcano in a clear, direct form to non-volcanologists and to prompt people and organizations potentially at risk to seek further information or to decide upon mitigation measures. The system employs a set of general terms, the latter two of which, Watch and Warning, are used in a manner similar to that used by the National Weather Service for hazardous meteorological phenomena and thus familiar to emergency managers and the public. As part of the system, color codes (described in a later section) are used to provide quick information about volcanic-ash hazards to the aviation sector. They are part of an integrated worldwide warning system that follows procedures sanctioned by the International Civil Aviation Organization (ICAO) and that in the United States involves the Federal Aviation Administration (FAA) and National Weather Service (NWS).

Description of Volcano Alert Levels

The USGS ranks the alert level at a U.S. volcano using the terms **Normal, Advisory, Watch,** and **Warning** (table 1). These levels reflect conditions at the volcano and the expected or ongoing hazards. Assigning an alert level depends upon monitoring data and interpretation of changing phenomena. Alert levels are not always followed sequentially and escalate or de-escalate depending on volcanic behavior. Volcano-alert notices are accompanied by explanatory text to give fuller explanation of the observed phenomena and to clarify hazard implications to affected groups. Updates that describe the ongoing activity are issued on a regular basis, at increasing frequency at higher activity levels.

Volcanic events are different enough that it is not possible to predetermine a detailed set of geophysical and geochemical criteria for each level that would be applicable universally. The alert-level definitions are guidelines for scientists to use to gauge the level of hazardous activity and for public officials and the public to consider when deciding what actions they need to take. Note that **Watch** is used for both heightened precursory unrest and for minor eruptive activity because both states bear close watching but do not have immediate, major hazardous effects. Because the size, style, and reach of eruptions can vary substantially, a higher level (**Warning**) is needed to highlight very hazardous eruptive activity.

Normal: *Typical background activity of a volcano in a noneruptive state*
This level applies to inactive, non-erupting volcanoes, with allowance for periods of increased steaming, seismic events, deformation, thermal anomalies, or detectable levels of degassing as long as such activity is within the range of typical non-eruptive phenomena seen at a volcano during its monitoring history (or at similar types of volcanoes).

Advisory: *Elevated unrest above known background activity*
This level is declared when a volcano is exhibiting signs of elevated unrest above known background levels. Progression toward eruption is by no means certain. After a change from a higher level, **Advisory** means that volcanic activity has decreased significantly but continues to be closely monitored for possible renewed increase.

Watch: *Heightened or escalating unrest with potential for eruptive activity OR a minor eruption underway that poses limited hazards*
This level is declared for two situations: (1) when a volcano is exhibiting heightened or escalating unrest with potential for eruptive activity (not necessarily imminent) or (2) when a minor eruption is underway with limited hazardous impact. When changing from **Advisory**, this level implies increased potential for an eruption (timeframe variable). When changing from **Warning**, this level signifies that the volcano is still showing signs of heightened activity that may lead to renewed highly hazardous activity or that the volcano has settled into minor eruptive activity with limited hazards.

Warning: *Major or highly hazardous eruption underway or imminent*
This level is declared by the USGS when a major or highly hazardous eruption appears to be imminent or is confirmed or suspected to be underway. Owing to remoteness or poor weather conditions, some eruptions may not be confirmed visually or by satellite imagery, but ground-based monitoring data may strongly suggest that eruptive activity is occurring; in such cases, the accompanying information will say that a “suspected” rather than a “confirmed” eruption is underway. Accompanying information will indicate in as much detail as possible the eruption’s time of onset, duration, size, intensity or explosivity, and impact on the landscape and atmosphere. When the major eruptive period ends or settles into milder, less hazardous activity, the level is downgraded.

Information Statement: *Notable event at a volcano, not necessarily eruptive*
Phenomena such as prominent steam plumes, small avalanches and rock falls, minor mudflows, changes in appearance of a lake in a volcanic crater, and minor seismic activity may occur while a volcano is at a **Normal** level. Most such events are short-lived and lack recognizable precursors and do not necessarily suggest volcanic unrest or major flank instability that would warrant a crisis response. However, owing to public and media inquiries that often result from a notable event, the USGS along with other involved agencies will attempt to verify the nature and extent of the event and issue explanations in the form of an **Information Statement**. An **Information Statement** also may be issued periodically to provide commentary about a significant event or change occurring within higher alert levels.

Aviation Color Codes

Eruptions threaten aviation safety when plumes of volcanic ash are explosively erupted and disperse as airborne clouds in flight paths of jet aircraft. Numerous instances of aircraft flying into volcanic-ash clouds have demonstrated both the economic costs and life-threatening potential of this hazard. The accepted mitigation strategy is to avoid encounters of aircraft with ash clouds, which requires that pilots, dispatchers, and air-traffic controllers quickly learn of occurrences of explosive eruptions and the whereabouts of airborne ash clouds globally.

For the aviation sector, in accord with recommended ICAO procedures, the USGS issues color-coded activity levels **– Green, Yellow, Orange,** and **Red –** focused on ash hazards (table 2). Color-codes are especially suitable for the aviation sector because pilots, dispatchers, and air-traffic controllers planning or executing flights over broad regions of the globe quickly need to ascertain the status of numerous volcanoes and determine if continued attention, re-routing, or extra fuel is warranted. As with the **Watch** term, **Orange** is used for both heightened precursory unrest and minor eruptive activity, and there are two levels (**Orange** and **Red**) to cover the range of eruption size and impact.

All Volcano Advisories, Watches, and Warnings will include the "Aviation Color Code," clearly identified as such to differentiate it from other hazard statements. In most cases, the term and aviation-specific color code will move together (e.g., **Normal** and **Green**; **Advisory** and **Yellow**; **Watch** and **Orange**; **Warning** and **Red**). However, there may be occasions when activity at a volcano poses a hazard to the aviation sector that is significantly lower than hazards posed to ground-based communities. In those cases, the aviation color code will be lower than what is normally associated with the alert term. An example is a large lava flow heading towards a town (Volcano **Warning** in effect) that is unlikely to produce any ash in flight routes or near an airport (Aviation Color Code **Orange**). Conversely, an ash plume that does not yield significant ash fall onto ground communities but does drift into air routes might warrant a Volcano **Watch** and Aviation Color Code **Red**.

Table 1. VOLCANO ALERT LEVELS	
NORMAL	Volcano is in typical background, noneruptive state or, *after a change from a higher level,* volcanic activity has ceased and volcano has returned to noneruptive background state.
ADVISORY	Volcano is exhibiting signs of elevated unrest above known background level or, *after a change from a higher level,* volcanic activity has decreased significantly, but continues to be closely monitored for possible renewed increase.
WATCH	Volcano is exhibiting heightened or escalating unrest with increased potential of eruption, timeframe uncertain, **OR** eruption is underway but poses limited hazards.
WARNING	Hazardous eruption is imminent, underway, or suspected.

Table 2. AVIATION COLOR CODES	
GREEN	Volcano is in typical background, noneruptive state or, *after a change from a higher level,* volcanic activity has ceased and volcano has returned to noneruptive background state.
YELLOW	Volcano is exhibiting signs of elevated unrest above known background level or, *after a change from a higher level,* volcanic activity has decreased significantly but continues to be closely monitored for possible renewed increase.
ORANGE	Volcano is exhibiting heightened or escalating unrest with increased potential of eruption, timeframe uncertain, **OR** eruption is underway with no or minor ash emission *[plume height specified, if possible]*.
RED	Eruption is imminent with significant emission of ash into the atmosphere likely or eruption is underway or suspected with significant emission of ash into the atmosphere *[plume height specified, if possible]*.

ORGANIZATION AND RESPONSIBILITIES

CENTRAL CASCADES FACILITATING COMMITTEE (FAC)

The FAC has been established to maintain preparedness during times of volcanic quiescence and to review plan implementation after an incident has ended. It is composed of members from each jurisdiction with statutory responsibility for emergency response (Table 3). Additional agencies (Associate Members in Table 3) may also attend meetings of the FAC. The FAC may be called together by any member who identifies a need for coordinated discussions. The FAC will be responsible for maintaining the plan, including exercises, as needed. Oregon Emergency Management has the responsibility to assemble the FAC for an annual review of this plan. Although agencies represented on the FAC will be involved in management of volcanic incidents in the Central Cascades, the FAC itself does not have a response role. Onset of volcanic activity will trigger FAC notification and a conference call among members.

[Table 3. FAC Membership]

Members shall include	**Associate Members may include**
Crook County Emergency Services **Deschutes County Emergency Services** **Jefferson County Emergency Services** **Klamath County Emergency Services** **Lane County Emergency Services** **Linn County Emergency Services** **Marion County Emergency Services** **Oregon Emergency Management** **Oregon Department of Transportation** **Oregon Military Department** **Oregon State Police** **Oregon Department of Geology and Mineral Industries** **U.S. Geological Survey** **U.S. Forest Service/Willamette** **U.S. Forest Service/Deschutes** **DHS/FEMA Region X** **Confederated Tribes of Warm Springs**	**Oregon State Parks** **Public Health Alert Network** **Department of Environmental Quality** **Other concerned jurisdictions, agencies and/or organizations**

TRANSITION FROM THE FAC TO INCIDENT COMMAND

The FAC will recommend to the affected agencies and Oregon OEM that an Incident Command organization be established if the level of volcanic activity goes beyond the mission or capabilities of the FAC (Fig 4). The determination to activate an Incident Command organization for a volcanic incident in the Central Cascades will terminate FAC activities until after-action activities at the close of the recovery phase.

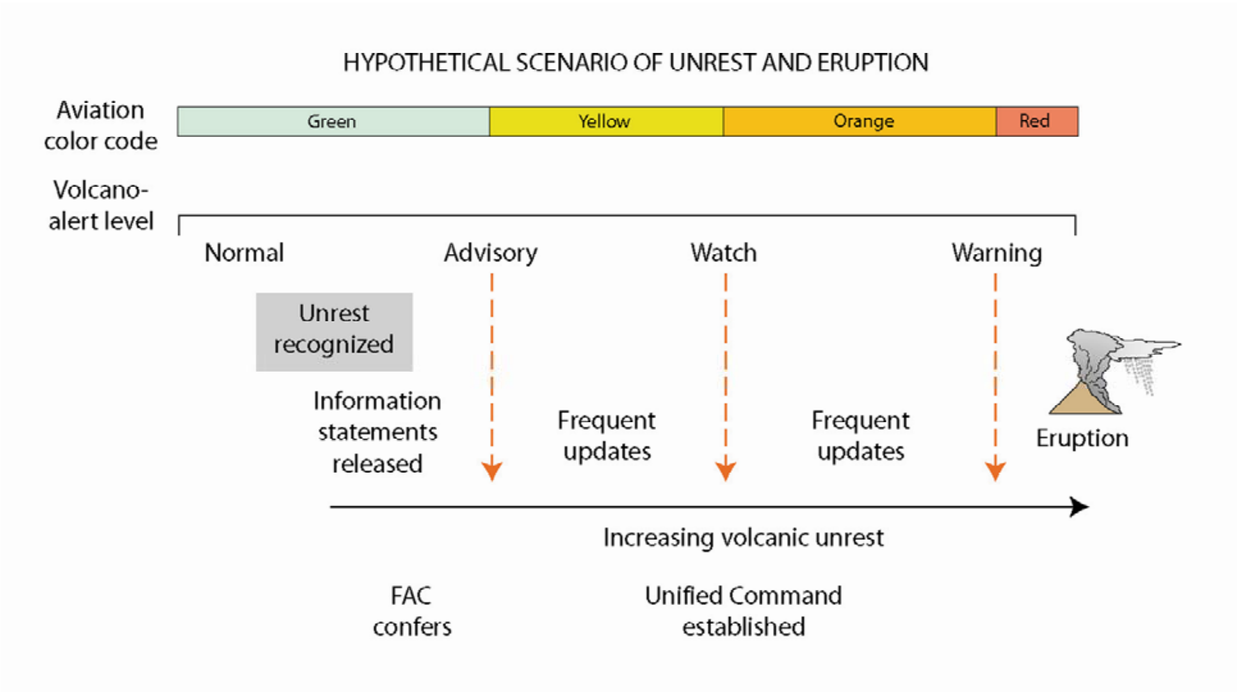


Figure 4.

INCIDENT MANAGEMENT

Interagency Organizations

The overriding principle in a volcanic emergency is that preservation of human life takes precedence over protection of property. Federal, State and/or local jurisdictional authorities may protect life and property by, among other actions, closing high-risk areas to public access, or evacuating local residents from hazard zones.

During a response, each agency and organization will provide resources and administrative support, and will conduct operations within an Incident Command System (ICS) structure. Interagency operations will be conducted under a Unified Command structure. County emergency management agencies, Oregon Emergency Management (OEM), and the US Department of Homeland Security's (DHS) Federal Emergency Management Agency (FEMA) have primary responsibilities for coordinating local, regional, State and Federal responses, respectively. The responsibilities of local, State and Federal agencies are summarized in Table 4. The authorities under which these agencies operate are described in Appendix C.

Table 4. Responsibilities and contact information for members of the Central Cascades FAC

Jurisdiction and Responsibilities	Contact Information (phone)
LOCAL GOVERNMENT Local jurisdictions are responsible for the overall direction and control of emergency activities undertaken within their jurisdictions. Each County may activate their emergency operations center.	**Crook County 541-447-6398** **Deschutes County 541-617-3303** **Jefferson County 541-475-6520** **Klamath County 541-883-5130 x215** **Lane County 541-682-6744** **Linn County 541-967-3950** **Marion County 503-365-3133**
STATE GOVERNMENT The Governor, the Governor's cabinet, composed of Directors of State agencies or their representatives, and staff from the State Emergency Management Agency, are responsible for the conduct of emergency functions and will exercise overall direction and control of state government operations	**Oregon Emergency Management** **Emergency Coordination Center (ECC) Salem** **503-378-2911** **Oregon Department of Geology and Mineral Industries (DOGAMI) Portland, OR 971-673-1555** **Oregon Military Department**
FEDERAL GOVERNMENT The **Federal Emergency Management Agency (**FEMA; part of DHS) is responsible for federal agency coordination and operations of the Regional Response Coordination Center (RRCC) The **U.S. Geological Survey** (USGS) will conduct field operations and monitoring, and provide information regarding the status of the volcano. The USGS may locate with the USFS or with an appropriate county. The **U.S. Forest Service** (USFS) is responsible for management of lands within the Deschutes and Willamette National Forests.	**FEMA Region 10,** **Bothell, WA** **425-487-4600** **U.S. Geological Survey** **Cascades Volcano Observatory, Vancouver, WA, 360-993-8973** **U.S. Forest Service** **Deschutes National Forest, Bend, OR 541-383-5300** **Willamette National Forest, Eugene, OR 541-225-6300**
SOVEREIGN TRIBAL NATIONS	**Confederated Tribes of Warm Springs 541-553-1634**

Incident Command System

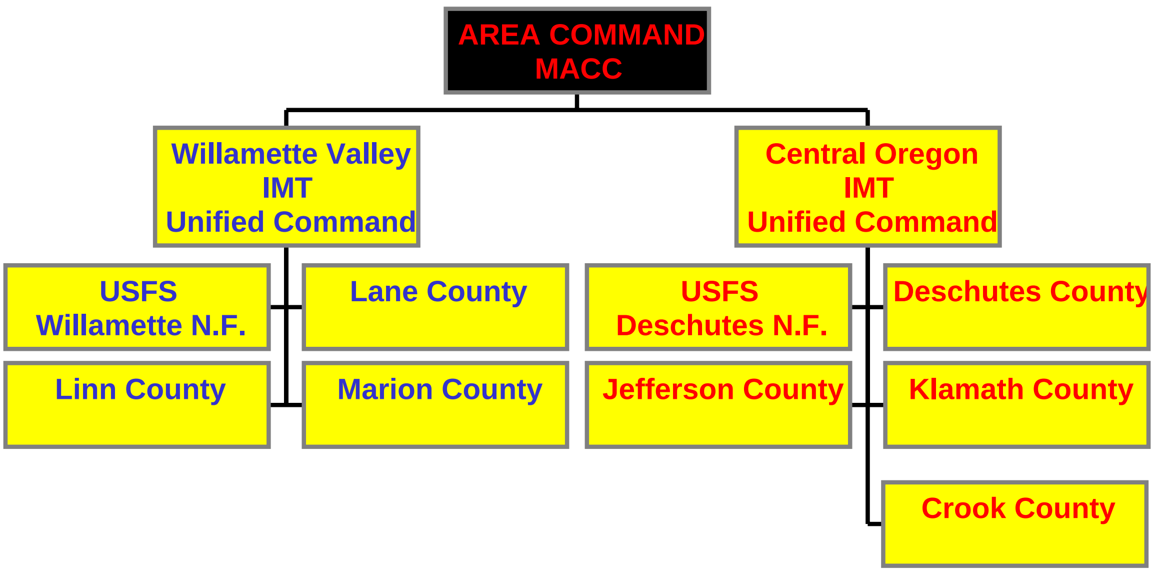
A volcano-related incident demands coordinated response. The Incident Command System (ICS) shall be used to establish incident goals, priorities, and strategies, to coordinate incident resource management, and to provide incident support for eruptions, lahars, or other significant volcanic events. The Incident Commander will provide initial strategic guidance and decisions on emergency needs until a Unified Command organization can be established (see next section). S/he has ultimate responsibility for management of assigned resources to effectively accomplish stated objectives and strategies pertaining to a volcanic event in the Central Cascades. In the event of a volcanic eruption or if the prediction of an eruption is eminent, the Incident Command organization will function most effectively as a unified command with more than one Incident Commander serving multiple agencies. The Incident Commander will have key positions filled as soon as possible to meet known and projected incident needs.

Unified Command

Unified Command is a multi-agency expansion of the Command function of ICS, allowing principal agencies with geographic, functional, and/or statutory responsibility to establish common incident strategy, objectives, and priorities. This process does not remove agency authority, responsibility, or accountability. As any volcanic event requiring activation of an ICS organization will involve multiple agencies, jurisdictions, and potential incident management complexities, a Unified Command organization shall be established as soon as possible.

For a volcanic incident in the Central Cascades, Unified Command will likely comprise USGS, USFS, FEMA, affected local jurisdictions, and the Confederated Tribes of Warm Springs. The location of the Unified Command Incident Command Post (ICP) will depend on which volcano is active and on what flank. Possible locations could be the USFS facilities in Bend or Eugene.

<u>CENTRAL CASCADES VOLCANO COORDINATION PLAN</u>
INCIDENT COMMAND ORGANIZATION
for a POTENTIAL or IMMENENT ERUPTION



Cooperating Agencies that may be part of Unified/Area Command:
(Multiple-Agency Coordination Center: MACC)

Oregon Emergency Management
Oregon Military Department
Oregon Department of Geology and Mineral Industries
DHS/FEMA Region X
Oregon Department of Transportation
Oregon State Police
U.S. Geological Survey
Confederated Tribes of Warm Springs

AGENCY RESPONSIBILITIES

Local Divisions or Departments of Emergency Management

Information about the status of a volcano would normally be transmitted from the USGS through Oregon Emergency Management (OEM) to county Emergency Management agencies (DEMs). The DEMs would then relay the information to local jurisdictions and agencies. As needed, the county DEMs would:

a) Implement Emergency Operations Plans, maintain and activate Emergency Operations Centers (EOC).
b) Provide local public warnings and information.
c) Activate the Emergency Alert System (EAS).
d) Assist Incident Commander(s).
e) Participate in establishing a unified command structure.
f) Support a regional coordination center.
g) Provide Public Information Officer(s) (PIOs) Information Office Field Representative (IOFR) for a Joint Information Center (JIC.)
h) Assist the USGS in establishing a temporary volcano observatory.
i) Provide for the welfare of citizens affected by a volcanic event.
j) Initiate and coordinate local declarations of emergency or requests for assistance from mutual aid partners, state and/or federal resources.
k) Implement response and recovery plans in their jurisdiction.
l) Provide information and training on volcano-hazard response to emergency workers and the public.
m) Assess volcanic risks as part of a comprehensive Hazard Identification and Vulnerability Analysis.

State Emergency Management: OEM

Oregon Emergency Management (OEM), through its 24-hour Oregon Emergency Response System (OERS), is responsible for providing alert and warning to local jurisdictions within the state. Additionally, OEM/OERS will notify specific state and federal agencies that have a response role during a volcanic event. OEM would then work with other entities in order to coordinate resources to support local and state agency response.

OEM's responsibilities in support of this plan include:

a) Coordinating the acquisition and distribution of resources to support response.
b) Developing plans and procedures.
c) Acting as the central point of contact for local government requests for specific State and Federal disaster related assets and services.
d) Activating and staffing the State Emergency Coordination Center (ECC) /Emergency Operations Center (EOC).
e) Supporting EAS activations by local jurisdictions as necessary by serving as a backup activation point.
f) Supporting DOGAMI public information efforts.
g) Coordinating with the Federal government on supplemental disaster assistance necessary to preserve life and property, and on recovery assistance.
h) Activating, if necessary, the Emergency Management Assistance Compact (EMAC) for interstate assistance.

i) Deploying County Liaison Officers to affected jurisdictions.
j) Calling the yearly meeting of the FAC to review and update this plan.

U. S. Geological Survey

The Disaster Relief Act of 1974 (PL 93-288) assigns to the U. S. Geological Survey (USGS) the responsibility of providing timely warnings of volcanic eruptions and related activity. This responsibility is achieved by monitoring active and potentially active volcanoes, assessing their hazards, responding to crises, and conducting research on how volcanoes work. More specifically, these activities include:

a) Issuing timely warnings of potential geologic hazards to responsible emergency management authorities and to the populace affected via the media and the CVO web site.
b) Monitoring volcanic unrest, tracking its development, forecasting eruptions, and evaluating the likely hazards.
c) Deploying staff and monitoring equipment during times of volcanic activity.
d) Establishing a temporary volcano observatory located so as to provide ready access to the volcano for the USGS hazard-assessment team and ready access to the hazard-assessment team for technical assistance to the emergency managers and the JIC. (See Appendix D for temporary volcano observatory requirements.)

U. S. Forest Service

The U.S. Forest Service (USFS) manages public lands on and around the Central Cascades volcanoes. Authorities include land management responsibilities related to use, management and protection of these lands. Roles and responsibilities during a disaster or emergency include protection of life, property and natural forest resources on USFS-managed lands. Control of access and use of national forest lands is regulated by the USFS in coordination with adjoining landowners and agencies. USFS responsibilities include:

a) Restricting access to hazard areas within the Willamette and/or Deschutes National Forests
b) Providing for employee and National Forest visitor safety
c) Coordinating with Oregon Department of Transportation (ODOT) on road closures
d) Providing facility for USGS and staff in a location appropriate to the event
e) Providing Public Information Officer(s) (PIOs) for a Joint Information Center (JIC.)
f) Other activities necessary based on volcanic conditions

Federal Emergency Management Agency

The Federal Emergency Management Agency (FEMA) roles and responsibilities during a disaster are governed by the Robert T. Stafford Disaster Assistance and Emergency Relief Act, as amended, 42 USC 5121, et seq., and the National Response Plan (FRP) of Public Law 93-288, as amended. The primary disaster relief responsibility of FEMA is to coordinate and deliver assistance and support to state and local governments when requested. This is typically through the Governor as a Request for a Presidential Disaster Declaration. A volcanic eruption would be handled in much the same way as any other natural disaster. FEMA's responsibilities include:

a) Monitoring situations with the potential for widespread impacts.

b) Coordinating Federal level emergency planning, management, mitigation and assistance functions of Federal agencies in support of State and local efforts.
c) Providing and maintaining the Federal and State National Warning System (NAWAS).
d) Providing liaison staff to the Unified Command organization and the State ECC.
e) Following a Presidential Disaster Declaration:
    1. Establishing a Joint Field Office.
    2. Coordinating public information activities for all federal agencies and disseminating releases to the news media.
    3. Coordinating state requests for Federal or military assistance.
    4. Coordinating Federal Assistance operations and programs.

How to cope--Logistical problems during volcanic crises

Volcanic crises pose problems to communities that may not exist during other types of catastrophes. Below are two problems that are inherent in volcanic crises. Appendix G lists some publications describing case studies.

***Uncertainty*:** Once a volcano shows signs of life, it is not clear whether or when it could produce a major hazardous eruption. In 1975, Mount Baker, Washington, increased the steam output from its summit crater for a few months, and then subsided with no indication of magma movement. Popocatepetl Volcano near Mexico City has periodically threatened nearby communities since 1993, causing nearby villagers to evacuate more than once, only to return after large eruptions fail to take place. At St. Pierre in Martinique (French West Indies), local authorities in 1902 opted not to evacuate in spite of four months of seismicity and steam explosions at Mont Pelée, five miles to the north. On May 8, a major eruption produced a pyroclastic flow that destroyed the town and killed 29,000 residents. In 1982, in response to earthquake swarms and uplift at Long Valley, California, the USGS issued a notice of potential volcanic hazard. Activity subsided and the USGS was branded the “U.S. Guessing Society” by local residents. Authorities in these circumstances are generally in a “no-win” situation. Their best hope of maintaining public trust is to convey the uncertainty inherent in volcanic crises, and to maintain extremely close and open relations with community leaders.

***Controlling access*:** During the crisis at Mount St. Helens in March and April, 1980, volcano-watchers would bypass road blocks to view the volcano, stage illegal climbs to the summit, even land helicopters at the summit to film advertisements. The difficulty in controlling access to the mountain was compounded by the checkerboard pattern of public and private land ownership, and the network of logging roads**. Unlike at Mount St. Helens, access control around Central Cascades volcanoes could necessitate traffic restrictions on major regional thoroughfares, such as state highways 22, 126, 58, 242, and U.S. routes 20 and 97.**

CONCEPT OF OPERATIONS

This plan is based on the premise that each agency with responsibility for preparedness, response or recovery activities has, or will develop, an operations plan or Standard Operating Guidelines that cover its organization and emergency operations. Since the Central Cascades are located within the Willamette and Deschutes National Forests, under the management of the USFS, the Forest Supervisors for the Willamette and Deschutes National Forests are the officials responsible for managing the lands surrounding the Central Cascades, including during times of emergency. The USFS practices coordinated management of incidents with surrounding landowners and expects to do so in a volcanic event as well, consistent with the Unified Command discussion above. This plan establishes a mechanism for coordination of each agency's efforts.

The Concept of Operations can be defined with respect to the three phases of a volcanic emergency: (1) *preparedness* (2) *response* and (3) *recovery*.

PREPAREDNESS PHASE (When volcanoes are in repose)

Members of the FAC shall prepare emergency plans and programs to ensure continuous readiness and response capabilities. The FAC shall meet yearly to:

1. **Coordinate, write, revise, and exercise this plan**
2. **Develop and evaluate alert and warning capabilities for the volcanic hazard risk areas**
3. **Review public education and awareness requirements and implement an outreach program on volcano hazards.**

RESPONSE PHASE

Members of the FAC shall:

1. **Confer whenever any member deems it necessary.**
2. **Share information on the current activity of Central Cascades volcanoes and coordinate data relating to hazard assessment, evaluation and analysis.**
3. **Coordinate any needed public information and/or establish a JIC for this purpose.**
4. **Assess the need for ICS organizations and recommend activation if necessary.**

RECOVERY PHASE

Member of the FAC shall:

Conduct an After Action Review of the event and make changes to this plan as necessary.

NOTIFICATION LIST FOR CENTRAL CASCADES EVENTS

- **USGS**
  - USFS
  - FEMA
  - Oregon ECC
  - Federal Aviation Administration (FAA) Seattle and Portland Offices
  - NWS Offices in Portland, Pendleton, and Medford

- **USFS**
  - Internal Notifications (Special Agent, Unit Managers)
  - Northwest Interagency Coordination Center (NWCC)
  - Central Oregon Interagency Dispatch
  - Confederated Tribes of Warm Springs
  - National Weather Service (NWS) Portland
  - US Army Corps of Engineers (Portland District)
  - Bonneville Power Administration (BPA)
  - Bureau of Reclamation
  - Others as appropriate, such as special use permittees, recreation residence permittees, recreation site concessionaires,
  - Eugene Water and Electric
  - Pacific Gas and Electric
  - Midstate Power
  - Pacific Power
  - Central Oregon Fire Management
  - Irrigation Districts

- **State EOCs**
  - State agencies
  - Counties
  - FEMA Region 10
  - Neighboring states
  - Others as appropriate

- **County EOCs**
  - Internal agencies as appropriate
  - Cities
  - Others as appropriate

- **Joint Information Center (JIC)**
  - Media (following coordination among the FAC members)
  - Others as appropriate

ORGANIZATION AND RESPONSIBILITIES ACCORDING TO LEVELS OF UNREST

Following are the suggested responsibilities and tasks of jurisdictions and agencies at the various volcano alert levels.

A. FOLLOWING A VOLCANO ADVISORY:

1. **Local jurisdictions and agencies:**
    - Convene the FAC
    - Review plans and procedures for response to the volcanic hazard threat.
    - Designate staff that will be responsible for filling positions in the local ICS and/or Unified Command Structure as requested, including a JIC.
    - Provide orientation sessions on current plans and organizational structure.
    - Update call-up procedures and listings for response staff.
    - Conduct briefings as needed.

2. **Oregon OEM**
    - Convene the FAC
    - Review internal plans and procedures
    - Implement notifications.
    - Provide technical assistance to local jurisdictions.
    - Coordinate with Emergency Support Function agencies that may be called upon to provide assistance.
    - Coordinate mutual aid agreements with neighboring states.
    - Evaluate the need for assistance from additional agencies.
    - Evaluate resource requirements.
    - Issue advisories and state-level policies in consultation with the FAC.
    - Conduct hazard specific training.
    - Conduct briefings as necessary.

3. **USGS**
    - Convene the FAC.
    - Monitor the status of the volcano and determine the need for additional instrumentation and/or other resources.
    - Issue alert-level notifications and updates.
    - Consider establishing a temporary field observatory.
    - Conduct briefings as necessary.

4. **USFS**
    - Convene the FAC
    - Provide public information and education
    - Evaluate need for access control and implement as needed.
    - Evaluate the need for air space controls and implement as needed.
    - Authorize placement of additional instrumentation as needed.

5. **FAC**
   - Discuss and evaluate developing events and information.
   - Review this plan.
   - Disseminate public information.
   - Consider recommending the USFS implement an Incident Command System organization.

B. FOLLOWING A VOLCANO WATCH:

1. **Local jurisdictions and agencies:**
   - Establish local Incident Command organization which will be Unified Command with other jurisdictions.
   - Conduct surveys on resource availability and reaffirm prior commitments.
   - Test communications systems and assess communications needs.
   - Begin procurement of needed resources.
   - Assign IOFR's to the JIC as needed.
   - Provide briefings and direction to all response personnel.
   - Request all assigned personnel to stand by for orders to activate the jurisdiction's emergency plan.
   - Coordinate support requirements for USGS field observatory.
   - Take readiness and precautionary actions to compress response time and to safeguard lives, equipment and supplies.

2. **Oregon OEM**
   - Implement plans for state level communications support for the affected area.
   - Coordinate joint public education programs.
   - Increase, as needed, the staffing at the ECC.
   - Establish a Joint Information Center (JIC) and support local government with IOFR information
   - Ensure state agencies are alerted to potential problems and review their operational responsibilities.
   - Assign liaison(s) to local Incident Command and/or Unified Command organization upon request.

3. **USGS**
   - Establish field observatory if not already established.

4. **USFS**
   - Provide space for the Unified Command structure. (Facilities for Unified Command structure will be "off-site" from the event and in all likelihood in a city or municipality. If the intent is for the USFS to take care of this fiscally, let's say that, other wise any jurisdiction can provide this as deemed appropriate by the incident.)
   - Identify staff to support Unified Command structure.

5. FAC

- Consider recommending USFS implement an Incident Command System organization if not already established.
- Consider requesting the participation of the Mobilization Incident Commander (MIC) of the Incident Management Team (IMT).

C. *FOLLOWING A VOLCANO WARNING:*

1. Local jurisdictions and agencies:

- Fully mobilize a local Unified Incident Management Organization that has been pre-identified with emphasis on IOFR and Planning Section Chief (PSC) personnel. All assigned personnel and activate all or part of the Central Cascades Coordination Plan.
- Activate Comprehensive Emergency Management Plans.
- Continually broadcast emergency public information.
- Coordinate emergency response activities in each jurisdiction in accordance with Unified Command procedures.
- Ensure Incident Command Post (ICP) is adequately staffed and equipped.
- Consider requesting state mobilization and possible activation of an IMT.

2. Oregon OEM

- Activate the State of Oregon Emergency Management Plan (Volume II Emergency Operations Plan)
- Coordinate interstate mutual aid.
- Coordinate Federal response.

3. USGS

- Monitor status of volcanic activity in the hazard area.
- Issue alert-level notifications and updates.
- Provide Liaison to the Unified Command Structure to provide on-going information and advice.

4. USFS

Implement plans to participate directly in the following coordinated response operations within the affected areas:

- Fire
- Evacuation
- Security
- Access Control
- Search and Rescue
- Alert and Notification
- Provide personnel for Unified Command Structure
- Support operations, logistics and planning functions with personnel and resources.

5. FEMA

- Activate the National Response Plan.
- Administer disaster relief programs following declaration of Emergency or Major Disaster by the President.
- Coordinate Federal response efforts.

6. Federal Aviation Administration (FAA)

- Issue airspace alert warning of restricted or prohibited space.
- Coordinate use of affected airspace by aircraft involved in emergency response.

PREPAREDNESS AND EDUCATION

No living person in the Northwest has experienced an eruption in the Central Cascades; nor has any local official or scientist yet dealt with significant levels of activity at these volcanoes. When renewed volcanic activity strikes, it is vital that public officials and citizens alike know what actions to take to protect life and property.

Of great importance is the need for emergency managers, local officials and scientists to be familiar and comfortable with their roles in the event of volcanic unrest. Development of specific plans like this one is only a first step. The plan must be reviewed regularly and revised to meet the changing needs of the region's rapidly growing communities and increased recreation usage. Although a volcanic eruption in the Cascades may be a once-in-a-lifetime event, those individuals charged with public safety must train themselves and their organizations through exercising the plan in order to ensure that coordination will be smooth and seamless.

Residents of central Oregon will be able to receive information provided in partnership by the USGS and government agencies. The goals of this effort will be educating citizens, public officials and businesses on and around the Central Cascades of the hazards, vulnerabilities and preparedness steps associated with the volcano.

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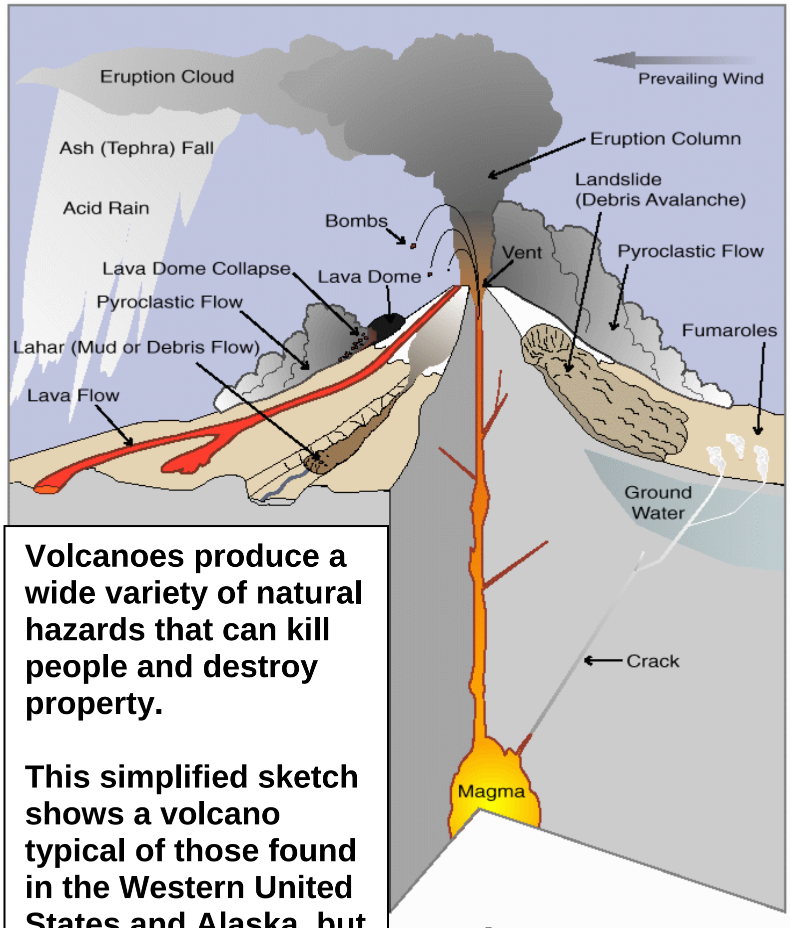
APPENDIX A: What Are Volcano Hazards

Selection from U.S. Geological Survey Fact Sheet 002-97 http://pubs.usgs.gov/fs/fs002-97/



Volcanoes produce a wide variety of natural hazards that can kill people and destroy property.

This simplified sketch shows a volcano typical of those found in the Western United States and Alaska, but many of these hazards also pose risks at other volcanoes, such as those in Hawai`i.

Some hazards, such as lahars and landslides, can occur even when a volcano is not erupting.

DEFINITIONS

Lava Flows and Domes

Lava is molten rock that flows onto the earth's surface.

Lava flows move downslope away from a vent and bury or burn everything in their paths.

Lava domes form when lava piles up over a vent.

Pyroclastic Flows

Pyroclastic flows are high-speed avalanches of hot rock, gas, and ash that are formed by the collapse of lava domes or eruption columns. They can move up to 100 miles per hour and have temperatures up to 1500°F. They are lethal, burning, burying, or asphyxiating all in their paths.

Tephra

Explosive eruptions blast lava fragments (**tephra**) and gas into the air. Tephra can also be carried aloft in billowing ash clouds above pyroclastic flows. Large fragments fall to the ground close to the volcano, but smaller fragments (**ash**) can travel hundreds to thousands of miles downwind.

Debris Avalanches and Lahars

Debris avalanches are rapid landslides of rock, soil and overlying vegetation, snow or ice. **Lahars** are fast-moving slurries of rock, mud, and water that move down river valley. Lahars form when pyroclastic flows melt snow or ice, or by the mobilization of loose debris on the flanks of volcanoes. Both lahars and debris avalanches can bury, move, or smash objects in their path.

APPENDIX B: AUTHORITIES

Federal – United States

Public Law 93-288 Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1974 as amended
Public Law 920 Federal Civil Defense Act of 1950 as amended
Public Law 96-342 The Improved Civil Defense Act of 1980
Public Law 84-99 Flood control and Coastal Emergencies
Federal Response Plan 1999
Flood Control Act of 1950
Department of Transportation Act of 1966
Federal Aviation Administration Act of 1958
Federal Energy Regulation Commission Order 122
USFS Incident Management Team Delegation of Authority Letter

State of Oregon

Oregon Revised Statute Chapter 401
Oregon Administrative Rules Chapter 104
Oregon Emergency Management Plan, Volume II , 2001
Emergency Management Assistance Compact (EMAC)

Local Government

Each of the counties has established authorities governing emergency management and operations.

APPENDIX C: FIELD VOLCANO OBSERVATORY REQUIREMENTS

The following is a rough guide to USGS requirements for a field observatory in, or close to, an established EOC. There is flexibility in these requirements. For example, if necessary, the USGS could set up operations in a temporary structure (e.g., trailer in the parking lot) if government owned or leased office space is not available. The bottom line is: The USGS can probably adapt to most situations, especially for the first few weeks of an incident. If an Incident/Unified Command structure has been established, USGS staff would work with the Logistics Section for facilities, supplies, and other support needed to establish a field observatory.

Space Requirements:

Space requirements can be separated into 5 areas; (1) Roof or tower space for mounting radio communications antennas; (2) an "operations" room that would be the focus of the real-time monitoring activities and coordination of field work; (3) an area where staff could set up desks and computers for data analysis, preparations for field activities, and hold staff meetings; (4) storage space for items such as batteries, spare parts and helicopter sling equipment; and (5) a media area separate from the other work areas.

1) *Antennas*: Real-time data from the volcano will be radio-telemetered to our field observatory. We will need space to mount approximately ten (10) yagi antennas, with a minimum of 4 feet separation between antennas. Line-of-sight access to the volcano is necessary as well as being within 100-foot proximity of the Operations room.
2) *Operations Room*: Approximately 300 sq. ft of space required. All data are funneled into the Operation room for coordination and display. Voice radios for communication with field crews as well as telephones for both voice and data are necessary in the Operations room. Space requirements should also take into account that it will be available to the media for photo opportunities and backdrops for interviews during slow periods of activity.
3) *Staff Office Area*: Approximately 400 sq. ft. of space required. Staff will use this area not only for office functions but also to store limited field supplies, rock samples, equipment, etc. The Staff area should be sufficiently large so as to contain some chairs, desks, tables and still have room to hold a meeting of 15-20 people. Close proximity to Operations Room desirable and phones desirable.
4) *Storage Space*: Approximately 300 sq. ft. of space required. A secure area for field equipment, supplies (batteries, concrete mix, water jugs, spare parts, etc.) and materials that is separate from the Operations Room and Staff Office Area. This could be commercial leased space but would need to be in close proximity to Operations.
5) *Media Area*: It is anticipated that a suitable media briefing area at the proximal EOC will already be in place. If none exists, the more physically separated from the Operations and Staff offices, the better.

Communication requirements:

- Six (6) standard voice phone lines (1 for fax, 2 ‘hot’ lines, 1 for recorded volcano information, and 2 for normal use)
- Two (2) standard lines for data communications. Either dial-up access to the USGS computer network or remote colleagues dialing into the temporary observatory’s computer network.

Concurrent with setting up the observatory, USGS will negotiate the installation of a dedicated relatively high-speed data link between the observatory and the nearest Department of Interior facility.

Power requirements:
Observatory equipment does not draw large current loads, but does require reliable power. Approximately 15 computers (approx. 5kW), Doppler radar (1kW), plus radio and other equipment will be supported. If reliable commercial AC power is not available, it will be necessary to obtain an emergency generator and quality uninterruptible power supply(s) (UPS)

Doppler radar:
Doppler radar may be deployed to support operations. It requires a 6’ x 6’ secure roof area capable of supporting about 300 lbs. Line-of-sight access to the volcano is essential for proper operation of the system. Ideally, the radar would be located within a few hundred feet of the Operations room. The radar requires about 1kw of power.

Parking:
Workers will travel frequently between the volcano, a local heli-pad, motel rooms, etc. Convenient parking for 8-10 vehicles will support efficient operations.

APPENDIX D: GLOSSARY OF ACCRONYMS and ABBREVIATIONS

CVO: Cascades Volcano Observatory

DEM: (local) Department (or Division) of Emergency Management

JFO: (FEMA/State) Joint Field Office

DoD: Department of Defense

DOGAMI: (Oregon) Department of Geology and Mineral Industries

EAS: Emergency Alert System

ECC: Emergency Coordination Center

EMAC: Emergency Management Assistance Compact

EOC: Emergency Operations Center

ERT: Emergency Response Team

ESF: Emergency Support Function

FAA: Federal Aviation Administration

FAC: (Central Cascades) Facilitating Committee

FEMA: Federal Emergency Management Agency

HIVA: Hazard Identification Vulnerability Assessment

ICS: Incident Command System

IMT: Incident Management Team

ICP: Incident Command Post

IOFR: Information Office Field Representative

JIC: Joint Information Center

MACC: Multi-Agency Coordination Center

NRP: National Response Plan

NAWAS: (FEMA's) NAtional WArning System

NWCC: NorthWest Coordination Center

NWS: National Weather Service

ODOT: Oregon Department of Transportation

OEM: Oregon Emergency Management

OERS: Oregon Emergency Response System

OSP: Oregon State Police

PNSN: Pacific Northwest Seismograph Network

RRCC: (FEMA) Regional Response Coordination Center

SOG: Suggested Operating Guidelines

UPS: Uninterruptible Power Supply

USFS: U.S. Forest Service

USGS: U.S. Geological Survey

APPENDIX E: JOINT INFORMATION CENTER PURPOSE AND STRUCTURE

Coordination of Information Flow

The purpose of the Joint Information Center (JIC) is to coordinate the flow of information about volcanic activity and related response issues among agencies, and to provide a single information source for the media, general public and businesses. The JIC is an element of the Emergency Operations Center(s) (EOC) where the emergency response is being coordinated. Communications between agencies and to the media/public must be rapid, accurate and effective. A JIC provides a forum for the necessary information exchange. Public information between and from all responding agencies, EOCs, political jurisdictions, and the media is handled through this one center, thereby allowing the coordination of information from all sources, and reducing or eliminating conflicting information and rumors. Temporary and alternate media offices will be identified. All participants will be encouraged to facilitate an efficient flow of information from the JIC.

A JIC may be necessary in one or more of the following circumstances:

- Multiple local, state and/or Federal agencies are involved in an incident.
- The volume of media inquiries overwhelms the capacities of the Public Information Officer(s) (PIOs) within the EOC.
- A large-scale public phone team effort must be mounted over an extended period of time.

When conditions warrant, or when a Volcano Watch (or Warning) is declared, a JIC will be activated by the FAC or Unified Command. A JIC must have:

- Office space for the PIOs,
- Facilities for communication by phone, fax and email
- Briefing rooms
- Easy access for the media
- Proximity to restaurants or available food service
- Security

Recommended Structure of JIC during Volcanic Incidents

A. Potential Participants:

Oregon Emergency Management
US Geological Survey
US Forest Service
Counties on the FAC
DOGAMI
FEMA
Others as required or conditions dictate

B. Operating Assumptions

1. All information will be coordinated among the JIC staff in order to ensure timely and accurate information flow to the public, to quell rumors and to prevent impediments to the response effort.
2. The JIC will operate under the Incident Command System
3. The JIC will adjust its size and scope to match the size and complexity of the incident.
4. State and local agencies may be requested to provide staff for the JIC, including augmentation.

APPENDIX F: REFERENCES AND WEB SITES

References:

Central Cascades
?? (see Appendix B)

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Web Sites:

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FEMA	http://www.fema.gov
Confederated Tribes of Warm Springs	http://www.warmsprings.com/
DOGAMI	http://www.oregongeology.com/
Oregon Department of Transport.	http://www.odot.state.or.us/home/
Oregon Emergency Management	http://egov.oregon.gov/OOHS/OEM/
USFS-Deschutes National Forest	http://www.fs.fed.us/r6/centraloregon/
USFS-Willamette National Forest	http://www.fs.fed.us/r6/willamette/
USGS-Cascades Volcano Observatory (CVO)	http://vulcan.wr.usgs.gov/