



## **Mt Rainier Volcanic Hazards Response Plan**

July 1999

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## I. Introduction

Mt. Rainier ~ at 14,410 feet, the highest peak in the Cascade Range ~ is an intermittently active volcano with a voluminous cap of ice and snow. This tremendous, steep-sided mass of rock and ice, with its great topographic relief, poses a variety of geologic hazards, not only during the inevitable future eruptions, but also during the intervening periods of repose. Serious hazard to the greatest number of people is from lahars (volcanic mudflows). Prehistoric lahars, some of which flowed all the way to Puget Sound, repeatedly buried the large valleys that drain Mt. Rainier. More than 100,000 people now live on the deposits of lahars emplaced within the past 6,000 years.

It is virtually certain that Mt. Rainier will erupt again and that lahars, either eruption-related or not, will inundate valley-floor areas that are now densely populated, causing severe social and economic impacts. The timing, of course, is uncertain. There is no way to know whether Mt. Rainier's next massive lahar will be generated soon or decades from now. For many people, concern about such an eventual catastrophe is diminished by the uncertainty about timing, by ignorance of Mt. Rainier's geologic record, or by the beauty of the area and the substantial economic investment in areas at risk.

Is there a way to enjoy the benefits of these valleys in complete safety? Unlikely. However, warnings of impending hazardous events, emergency-response planning, public education, appropriate mitigation measures and plans for post-incident recovery can lessen the impacts of an inevitable volcanic event. This report is a plan for thoughtfully addressing and preparing for a volcanic-hazard crisis at Mt. Rainier prior to being under the pressure of an impending or current catastrophe. Although much of the planning and implementation of mitigation and emergency-response measures is necessarily the province of a consortium of municipal, county, state and federal agencies, there is a critical role for personal responsibility as well. Government agencies will do all they can to protect citizens, but individuals must be prepared to get themselves out of harms' way and to be self-sufficient for a period of time.

## **II. Work Group Approach**

### **A. History of Plan ~ Development Effort**

Because of its size and unique geographical location, bordering six counties in Washington State and the fact that it is a National Park, Mt. Rainier created some very interesting challenges in terms of the approach to take in preparing a regional response plan to any volcanic or lahar activity.

Early discussions, involving the scientists from the United States Geological Survey and employees of the Pierce County Department of Emergency Management, concluded that any effort to develop a plan would have to include a wide range of government entities from the federal, state and local communities. Pierce County is the principle county in which the mountain resides.

It was decided that such a group would be brought together, co-chaired by the Director of the Pierce County Department of Emergency Management and the Chief Park Ranger from Mt. Rainier National Park. The list of potential participants was established and quarterly meetings were planned.

The original concept for the work group was to design an operational response plan which would deal with what the mountain might do in some kind of volcanic or lahar event. It quickly became evident to the work group that the issue would not be that simple. The knowledge or education level on the mountain and what it has or could do in the event of any volcanic activity was low, not only among the work group members, but also among the greater political and elected officials involved and the general population. Therefore, it was apparent from the beginning that a strong public education initiative would also be necessary. The work group also decided early on that a section of the report should deal with mitigation issues that should be examined as part of the effort to minimize the response component. Near the end of the work group's effort it was decided that there should also be a recovery section that deals with developing a plan to restore the community following any kind of event involving the mountain.

### **B. Organizational Roles in Plan Development**

#### ***B.1. Operations***

This group consists of local and state law enforcement, fire and emergency medical officials, emergency management personnel from the affected counties and state, federal agencies such as the National Park, U.S. Forest Service and the Federal Emergency Management Agency. The group has developed the working plan to deal with emergency events, evacuations, security, search and rescue and all related components. This is obviously the biggest task undertaken and involves a significant amount of coordination and planning.

#### ***B.2. Public Education***

It was very surprising to discover the level of knowledge on the hazards that the mountain represents to the communities that surround it. There was and is a strong assumption by people that the mountain is 'extinct', or at worse 'dormant.' The public education effort has been led by the USGS and their excellent Public Education unit and has involved countless public presentations on the mountain to community clubs, political groups, fairs and any other outreach programs made available. It also has included a scientific approach which involves the schools and the education related venues that have expressed interest in this subject. It is recognized that this must be a long-term effort that may even involve additions or modifications to school curriculum in order to address the long-term education issue for future generations.

### ***B.3. Mitigation***

The question of addressing hazards, (people and facilities) in the path of possible mudflows, is extremely complex and controversial to say the least. The flanks of Mt. Rainier are undergoing extreme development pressure as the entire Puget Sound region continues to experience explosive growth issues. The responsibility for land use planning outside of the National Park includes many levels of government including the counties, cities throughout the valleys, subdivisions of the counties such as Port Districts and Indian Tribal Lands. All act independently to decide where and how to develop the properties located within their jurisdictions. There currently is not strong support to limit development, although Pierce County has adopted a policy that limits the types of development in identified mountain hazard areas. There are even some who feel that the current mountain planning effort is diminishing their property values and creating a fear mentality surrounding the mountain.

### ***B.4. Recovery***

Restoring the community following any disaster is always a very difficult process. This issue is even more important due to the potential widespread damage that the mountain could unleash. There are some within the emergency management community that feel that this is the single most important issue in dealing with a disaster. The work group will continue to study and address this issue into the future.

The collaborative nature of the Mt. Rainier Work Group has been an excellent forum to address these complex and difficult issues involving Mt. Rainier. It has provided a strong venue for ideas to be expressed, solutions to be agreed upon involving a wide range of government entities, and has created an outstanding network of individuals educated to, familiar with and, most importantly, concerned about what Mt. Rainier may do in our future. This process has strengthened our community and fostered relationships that will encompass more than just the issues surrounding the mountain.

### III. Synopsis of Mt. Rainier Volcanic Hazards

It is axiomatic that a volcano's past behavior is the best guide to its future behavior. At Mt. Rainier, geologists have uncovered a rich history of volcanic events from the study of the deposits of numerous eruptions and lahars that have occurred since the latest ice age (roughly, during the past 10,000 years). This record gives critical information about the types, magnitudes and frequencies of past events, and shows which areas were affected by them. It provides the basis for a hazard assessment, including hazard-zone maps (U.S. Geological Survey Open-File Report 98-428; **see section VIII**).

It is commonly difficult to grasp the significance of a hazard with which one has no personal experience. The potential hazards from Mt. Rainier are no exception. The written history of Mt. Rainier encompasses the period since about A. D. 1820, during which time one or two small eruptions, many small lahars and several small debris avalanches occurred. Our knowledge of the longer post-ice-age record makes it clear that the written historic record is simply too brief to guide us in estimating the future behavior of this half-million-year-old volcano. Interestingly, Native-American oral traditions record apparent eruptions and lahars.

Pumice-bearing tephra deposits from 11 different eruptions that occurred at Mt. Rainier within the past 10,000 years have been found on the volcano's flanks. Tephra deposits represent the fallout from clouds of rock fragments that drift downwind from an explosively erupting volcano, Pumice-bearing tephra layers are produced by eruptions of gas-rich magma (molten rock). These deposits are appreciably less extensive and thinner at comparable distances from their source than are many of the pumiceous tephra deposits from Mt. St. Helens, including the May 18, 1980, tephra deposit. Thus they indicate that Mt. Rainier is a moderate ~ as opposed to voluminous ~ tephra producer. Nevertheless, communities 100 km (60 miles) downwind from Mt. Rainier's summit ~ most likely east of the volcano: for example, Yakima and Ellensburg ~ could easily receive several millimeters (3 inches or so) of ash from a pumice-producing eruption of Mt. Rainier.

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Eleven known pumice-producing eruptions in 10,000 years suggest an average recurrence interval of about 900 years. However, the 11 eruptions were not evenly spaced through time, so it is impossible to predict when the next one will occur. Further, there are at least 25 non-pumice-bearing tephra layers that are found between the pumice layers. Some, if not all, of this non-pumiceous tephra was produced by eruptions of gas-poor magma, or by eruptions driven by steam instead of magma. In the aggregate, these pumice-bearing and non-pumice-bearing tephra layers indicate that small to moderate eruptive events have recurred, on average, every few hundred years at Mt. Rainier during the past 10,000 years.

In addition to producing tephra, magmatic eruptions of Mt. Rainier can produce lava flows or pyroclastic flows (fast-moving, hot, lethal avalanches of volcanic fragments and gas). The direct effects of such flows are to be expected on and near the steep flanks of Mt. Rainier, largely within the boundaries of Mt. Rainier National Park (**Figure III-1**).

Much more far-reaching destruction can result from lahars that originate at Mt. Rainier. Deposits of at least 55 lahars within the last 10,000 years have been identified in the large valleys draining Mt. Rainier.

Lahars look and behave like flowing wet concrete owing to their characteristically high concentration of entrained sediment (commonly less than or equal to 60 volume percent). Because they are gravity flows, they become channeled into valleys. Led by a steep front charged with boulders, logs and any other available debris, they quickly fill pre-existing channels and spread across the adjacent flood plains, destroying mature forests and any human-made structures in their paths, including bridges, dams, roads, pipelines and buildings.

The depth and speed of a lahar depend on its size, its sediment concentration and the valley configuration. At Mt. Rainier, most of the large lahars are inferred to have traveled as fast as 50 miles/hr at depths of 100 ft or more in confined valleys and at a lower velocity and lesser depth in the wide, populated valleys of the Puget Lowland. For example, remnant valley-wall deposits indicate that the Electron lahar was approximately 50 ft deep in its passage through the mile-wide Puyallup valley 1 1/4 miles upstream from Orting (**Figure III-1**). However, the Electron lahar was about 180 ft deep 6 miles farther upstream, where the main part of the canyon is only about 1/4 miles wide.

Inasmuch as lahars seek valley bottoms, people can quickly climb or drive to safety in many cases by simply evacuating the floor of a well-defined valley before the lahar arrives. People need go no farther than high ground adjacent to the valley. The critical issues are: knowing when evacuation is necessary; and being prepared for safe, timely evacuation.

Lahars of greatest concern are believed to originate in two different ways: (1) by transformation from huge avalanches of water-saturated, clay-rich debris set in motion by massive, gravity-driven failures of the volcano's flanks and (2) by incorporation of loose sediment from the volcano's flanks in surges of eruption-generated meltwater.

The largest lahars in the post-ice-age record of Mt. Rainier started as enormous debris avalanches originating from sudden collapse of a flank of the volcano. Their deposits are notably clay-rich, implying that they contain abundant hydrothermally altered debris from within the volcano. Hot acidic (hydrothermal) fluids percolating through the steep Mt. Rainier edifice are effective at converting parts of its volcanic deposits to weak, water-saturated clay. From time to time, a large weakened sector of the volcano's flank collapses, forming a huge debris avalanche that transforms to a voluminous lahar that may flow for tens of miles. Absence of geologic evidence substantiating coincidence of some of the large flank-collapse lahars with eruptions suggests that some may have occurred with no attendant eruptive activity. They may have been triggered by intrusion of magma into the edifice, by earthquakes or hydrothermal-system explosions, or a volcano flank may have simply collapsed when it became sufficiently destabilized by progressing hydrothermal alteration. A critical implication from a hazard-mitigation standpoint is that a massive lahar from Mt.

Rainier may occur without the kinds of warning usually associated with an impending eruption.

At least 6 and possibly as many as 13 clay-rich, flank-collapse lahars inundated the lower reaches of the big valleys draining Mt. Rainier during the past 5,600 years. Thus, the big flank-collapse lahars are a high-magnitude, low frequency set ~ designated Case I (**Figure III-1**) ~ with an approximate recurrence interval of 500 to 1,000 years. The youngest of these is the Electron lahar, which inundated most of the Puyallup River valley about 500 years ago.

One much larger, post glacial, flank-collapse lahar has been identified. Known as the Osceola Mudflow, it occurred about 5,600 years ago and was between 10 and 20 times the volume of the Electron lahar. It originated as a massive collapse of Mt. Rainier's summit and upper northeast flank. The Osceola Mudflow filled valleys of the White River system north and northeast of Mt. Rainier, covered more than 80 sq. mi. of the Puget Lowland, and extended into Puget Sound from what are now the Puyallup and Duwamish River valleys. Considered as 'worst-case' or 'maximum lahar' (only one lahar of this size is known to have occurred in 10,000 years), lahars of this magnitude have been assigned a recurrence interval of 10,000 years.

Eruption-related lahars form a set of intermediate magnitude and frequency; they are designated Case II lahars (**Figure III-1**). Their relatively granular deposits, full of volcanic fragments, suggest that they originated as surges of meltwater that entrained loose sediment from the volcano's flanks and drainages. The abundance of such lahars in the geologic record suggests an average recurrence time of 100 to 500 years. Some were large enough to inundate the lower reaches of the big valleys draining Mt. Rainier, and a few are known to have reached Puget Sound. Most, if not all, of those large enough to affect populated areas in the major valleys were probably eruption-related, although the eruptions were not necessarily large.

Numerous smaller lahars and debris avalanches on the volcanic edifice and in the upper reaches of the valleys draining it comprise a set of flows of low magnitude and high frequency. They are designated Case III lahars (**Figure III-1**) and their average recurrence time is less than 100 years. The lahars in this group commonly originate from storm-generated runoff or glacial outburst floods. These events are a significant hazard in and near Mt. Rainier National Park, but have little significance for the populated lower reaches of the big valleys draining Mt. Rainier.

## **IV. Situation**

### **A. Situation**

With millions of people now living in the Puget Sound and Western-Washington region, the threat of Mt. Rainier's hazards is increased. The fact that development and population are on the rise in the river valleys that drain off of Mt. Rainier reinforces the need for actions such as warnings of impending hazardous events, emergency-response planning, public education, appropriate mitigative measures and plans for post-incident recovery.

### **B. Population**

Both permanent residents and visitors could be effected by the hazards of Mt. Rainier. The beauty of the Puget Sound and the Western-Washington region attracts many people and encourages them to either take up residence or continue to visit the area.



### ***B.1. Resident Population***

As of July 13, 1999, Pierce County had a resident population of approximately 700,000. All of these people can potentially be affected by the hazards of Mt. Rainier.

An exact number of people who may be affected by the lahars generated by Mt. Rainier cannot be determined due to the changing size and nature of both the population and the lahars themselves. However, the following communities in the Carbon, Nisqually, Puyallup and White River Valleys ~ and the Puget Sound region ~ all have the potential to be partially or totally affected:

- **Bonney Lake:** Population of 10,060
- **Buckley:** Population of 3,980
- **Carbonado:** Population of 649
- **DuPont:** Population of 1,755
- **Eatonville:** Population of 1,915
- **Edgewood:** Population of 10,700
- **Fife:** Population of 5,155
- **Fircrest:** Population of 5,935
- **Lakewood:** Population of 63,820
- **Milton:** Population of 4,785
- **Orting:** Population of 3,825
- **Pacific:** Population of 195 (Portion located in Pierce County)
- **Puyallup:** Population of 30,740
- **Roy:** Population of 370
- **Ruston:** Population of 745
- **South Prairie:** Population of 485
- **Steilacoom:** Population of 6,240
- **Sumner:** Population of 8,495
- **Tacoma:** Population of 187,200
- **University Place:** Population of 29,550
- **Wilkeson:** Population of 430

In total, the unincorporated population of Pierce County was estimated at 316,566 and the incorporated population was estimated at 383,434.

As of April 1, 1998, Lewis County had a resident population of approximately 68,600. The majority of these citizens live in the central and western parts of the county and so are not likely to be directly effected by the hazards from Mt. Rainier. However, several

unincorporated communities in the headwaters of the Cowlitz River Valley would be directly affected by hazards from Mt. Rainier, including:

- **Glenoma:** Population of 744\*
- **Randle:** Population of 2,968\*
- **Packwood:** Population of 2,944\*

based on 1997 estimates

## ***B.2. Business and Visitor Population***

Pierce County is a diverse county culturally, economically, geographically and socially. Due to this diversity, Pierce County has several attractions that bring in millions of visitors each year. The Visitor and Convention Bureau estimates that Pierce County hosts approximately 2.5 million overnight visitors annually. Individually, Mt. Rainier National Park hosts approximately 2 million visitors and the Western Washington (Puyallup) Fair has approximately 1.5 million visitors each year. A few other main attractions located in Pierce County are the Crystal Mountain Resort, Point Defiance Park, Point Defiance Zoo and Aquarium, Port of Tacoma, Tacoma Dome and the World Trade Center-Tacoma. In addition, Pierce County has several convention centers, higher education facilities, museums and recreation centers.

Pierce County's population also includes a large number of businesses. Pierce County's location along the Puget Sound and easy access to the Pacific Ocean makes it an ideal center for commerce. Several of the large business communities located within the Tacoma-Pierce County area include:

- The **Port of Tacoma** is the sixth largest container port in North America and among the top 25 container ports in the world.
- The **Intel Corporation** located a manufacturing and research plant in DuPont in 1995 and currently employs 1,500 people. Seven hundred new positions were expected to be added by the end of 1998. By the year 2001, Intel expects to employ approximately 6,000 people.
- The three large military installations in Pierce County (**Fort Lewis, McChord Air Force Base** and **Madigan Army Medical Center**) station 25,600 military personnel and 8,100 civilians, as well as attract many visitors.
- **The Boeing Company** is the largest non-government employer for the Tacoma-Pierce County area. Boeing has a \$400 million plant located in Frederickson, which employs approximately 1,000 people, and another 9,900 Boeing employees commute to plants located in nearby counties.

Lewis County in the Upper Cowlitz River Valley is largely rural, where over 6,500 people live in areas at risk to lahars and other geologic hazards. In addition, the area hosts another 350,000 to 400,000 visitors during the summer tourist season each year (June through October, or about 3,000 to 5,000 people per day; Mt. Rainier National Park and Mt. St. Helens National Monuments records, 1995-1997.) A much smaller but still substantial number of people visit the area for autumn hunting and winter skiing. Moreover, US Highway 12 supports a significant transient population in approximately 1,700,000 vehicles a year (U.S. Forest Service study) and related commerce because it is one of the few transportation corridors across the Cascade Range.

Permanent residents live and work in developments and private sector infrastructure that exceed \$300 million in assessed value (1997 Lewis County Auditor data) as well as facilities built by federal and state governments that exceed several tens of millions of dollars in additional investment. Among the more valuable facilities at risk are the highway system and associated support structures, two lumber mills, two U.S. Forest Service District compounds with associated vehicles and equipment, and a number of small businesses (Banks and others, 1998). Two elementary schools and a high school are also at risk.

The visitor and business population is highly variable and is dependent on several factors. Due to the changing nature of the visitor population, it is difficult to make specific plans when dealing with a disaster or threatening event. However, the realization that the counties surrounding Mt. Rainier have a large number of visitors should be kept in mind throughout the planning process.

### **C. The Road Network**

The road network of Pierce County is a complex system of state, county, local and private roads. The state route highways and interstates are the most heavily traveled roads in Pierce County.

#### **C.1. Pierce County Roads**

The state routes in Pierce County consist of the following:

- D. **Interstate Route No. 5:** Extends northerly from the Washington-Oregon border through Tacoma and continues on to the international United States-Canada border.
- E. **State Route No. 7:** Begins in downtown Tacoma following Pacific Avenue in a southward direction and extends to the Pierce-Lewis county border.
- F. **State Route No. 16:** Begins at a junction with Interstate Route No. 5 at Tacoma, extends northwesterly by way of the Tacoma Narrows Bridge, and ends at a junction with State Route No. 3 outside of Pierce County.
- G. **State Route No. 161:** Begins at a junction with State Route No. 7 near La Grande, extends northeasterly through Eatonville and on to Puyallup, then to a junction with State Route No. 18 outside of Pierce County.
- H. **State Route No. 167:** Begins at a junction with Interstate Route No. 5 near Tacoma, extends easterly through the Puyallup/Sumner area and extends northerly to the Auburn/Kent area outside of Pierce County.
- I. **State Route No. 410:** Begins at a junction with State Route No. 167 at Sumner, extends easterly through Buckley on past the boundaries of Pierce County.
- J. **State Route No. 512:** Begins at junction with State Route No. 5, south of Tacoma, extends easterly to a junction with State Route No. 7, south of Tacoma, and continues on to a junction with State Route No. 167 near Puyallup.
- K. **Interstate Route No. 705:** Begins at a junction with Interstate Route No. 5 in Tacoma and extends northerly to a junction with Schuster Parkway in the Tacoma central business district.

#### **C.2. Lewis County Roads**

The road network in eastern Lewis County is made up of federal (National Forest System and U.S. Highway), state, county and private roads.

Routes in eastern Lewis County include the following:

- **State Route No. 7:** Extends south from the Pierce-Lewis county border (near Elbe) to the town of Morton, where it meets U.S. Highway 12.
- **U.S. Highway 12:** Extends from Interstate 5, eastward through Lewis County and White Pass.
- **State Route No. 123:** Begins at junction with U.S. Highway 12, and extends north to Cayuse Pass and State Route No. 410. Provides access to southeastern portion of Mt. Rainier National Park.
- **State Route 131:** Begins at U.S. Highway 12 (in Randle) and extends south to National Forest roads 23 and 25. Provides access to Mt. St. Helens National Volcanic Monument and the Gifford Pinchot National Forest.

## L. Terrain

With an elevation of 14,410 feet (4,392 meters), Mt. Rainier is the tallest of the Cascade Volcanoes. With 26 named glaciers, Mt. Rainier is also the most heavily glaciated Cascade Volcano and ranks third in total volume.

The Carbon, Cowlitz, Nisqually, Puyallup and White Rivers all begin on the high slopes of Mt. Rainier and run down into the lowland drainage basins. The White River borders Pierce County on the north and is connected to the Puyallup River by way of the Stuck River between Puyallup and Sumner. The Nisqually River borders the county on the south and flows all the way to the Puget Sound. The Carbon and Puyallup Rivers join near Orting and continue to flow into Commencement Bay. The Cowlitz River drains to the southwest, providing a connection between Mt. Rainier and the Columbia River. These rivers are the sources of interaction between the events occurring on Mt. Rainier and the population of the Puget Sound region.

Mostly glaciers and exposed rock cover the higher elevations of Mt. Rainier's slopes. In the lower elevations, Mt. Rainier is covered largely by old growth forests and flowered meadows.

## **M. Shelter**

It is the policy of Pierce County to coordinate mass care efforts with the American Red Cross Tacoma-Pierce County Chapter (ARC-TPC Chapter) to provide prompt disaster relief to victims of major disasters in the county, including sheltering. The ARC policy is to provide emergency shelter for 72 hours to all who have a need. After 72 hours, only those who can prove that they have a permanent place of residence will continue to receive ARC assistance.

The ARC-TPC Chapter, in cooperation with the Salvation Army and other volunteer groups, manages the emergency shelter program. This includes identification and inventory of shelters, opening and closing shelters, registration of persons coming to the shelters, medical care, feeding, and the accountability of personnel occupying shelters. The Pierce County Department of Human Services coordinates long-term shelter needs in cooperation with the ARC-TPC Chapter and other health services. It is the national policy of ARC to not allow animals and pets into the shelters, other than animals used to assist the physically impaired. The Tacoma-Pierce County Humane Society may assist evacuees with the care of pets.

## **N. Communications**

In the event of a major volcanic event at Mt. Rainier, an interruption of normal communications channels is assumed. In addition, those communications resources that remain in operation will be taxed beyond their capability. Communication during a major volcanic event will be that of two forms: 1) communications between responding organizations, and 2) communications to the media and the public.

Effective communication begins with well-defined, non-technical language. Each career field (i.e. scientists, civil authorities and business professionals) often times has its own lingo, which is understood by members of that field but leads to confusion for those who are unfamiliar with that field. Therefore, communications should be based on using language that is familiar to all those involved, including the average citizen. During times of emergency, civil authorities have found that the use of a Joint Information Center (JIC) is an efficient way to coordinate the flow of information between groups.

Communications between responding agencies and the public will be dispatched mainly by using the media. Local television and radio news stations will be kept updated, since the media is the largest source of information the public uses and will be the most effective source in order to protect lives and property. When communicating to the media and the public, it is vital to choose a qualified media-savvy spokesperson. The information given must be clear, precise, complete, non-technical, factual and timely. It must be presented in a way that satisfies the media and the public and makes them feel as if no significant information has been withheld.

## **O. Response Organizations**

The organizations involved in responding to a major volcanic event at Mt. Rainier will place emphasis on the Unified Command Structure. All responding agencies, both state and local, shall provide adequate support and equipment in accordance with agency and state policy. These response organizations can be categorized under the direction and control element or as field operations.

First, the direction and control element will be the Regional Advisory Group (RAG) that will consist of state, federal and local officials. Alternates or representatives to the RAG may be emergency services coordinators or directors, chiefs or coordinators of law enforcement, fire, search and rescue, medical care, public health, MASS care, USGS, Mt. Rainier National Park, WA EMD, FEMA, resources and support elements and related liaison personnel. Local

authorities will use the established Emergency Management System in Washington State and the local effected jurisdictions in conjunction with established mutual aid agreements to direct and control emergency operations within their areas of jurisdiction.

Second, field operations will be directed by the Unified Command Structure and may consist of law enforcement, fire, medical, public works, search and rescue, and emergency management from all of the affected jurisdictions.

Agencies involved in response include all local jurisdictions listed above, Washington State Patrol, Department of Health, Military Department/National Guard, Department of Transportation, Federal Aviation Administration, Department of Social and Health Services, Department of Corrections, the US Forest Service and the National Weather Service.

## **V. Monitoring, Notification Protocol and Warning Systems**

### **A. Monitoring**

Nearly all eruptions of recently inactive volcanoes are preceded by measurable changes in seismicity, ground deformation, or other physical or chemical parameters. At volcanoes like Mt. Rainier, these changes reflect processes that occur as the magma forces its way upward through several miles of the earth's crust in to order to erupt at the surface. Forcible opening of a pathway through solid rock generates intense swarms of earthquakes, mostly too small to feel but easily detected by seismographs. Thus, continuous, long-term monitoring (around the clock, year-in and year-out) to detect volcanic unrest at Mt. Rainier is provided by a network of seismographs employed by the Pacific Northwest Seismograph Network (PNSN). The PNSN, which is operated by the University of Washington in cooperation with the U.S. Geological Survey (USGS), will be the most likely organization to detect the first indications of volcanic unrest at Mt. Rainier.

In response to developing volcanic unrest at Mt. Rainier, a USGS Cascades Volcano Observatory (CVO) response team expects to establish and staff a temporary volcano observatory at the Washington Emergency Management Emergency Operations Center at Camp Murray, located in Pierce County, in order to be readily accessible to emergency managers and to have efficient daily helicopter-supported access to the volcano. The primary function of the USGS/CVO response team will be to monitor all aspects of the volcanic developments and provide the best possible, current, eruption-forecasting and hazard-assessment information to support public-safety decisions by emergency-management officials.

Monitoring and hazard assessment by the USGS/CVO response team will include collection and analysis of visual-observation, seismic, lahar-detection, deformation-measurement, and gas-emission data. Monitoring networks will be amplified as appropriate to evaluate hazards and assure necessary redundancy. As an important element of redundancy, critical seismic data will be received and analyzed at both the University of Washington by the PNSN and the temporary volcano observatory at the Washington Emergency Management EOC by the USGS/CVO response team.

## B. Event Notification

Dual notification schemes are planned for volcanic hazards at Mt. Rainier. One is directed toward emergency response on the ground and the other toward ash hazard to aircraft in flight.

### **B.1. Notification for Ground Hazard**

For emergency response on the ground, USGS/CVO issues statements through the Washington Emergency Management Division (WEMD). WEMD transmits the notifications, as appropriate, to state and federal agencies (including FAA, FEMA, local Weather Service forecast office), adjacent states (including British Columbia Provincial Emergency Program) and counties. The counties then transmit the notifications as appropriate to their own emergency management agencies, cities, city government organizations, special-purpose districts and citizens.

Event notification for hazard on the ground (for example, from ash fall, pyroclastic flows, lava flows, lahars) may occur under two distinctly different circumstances: (1) in response to unexpected short-lived events; (2) in response to developing volcanic unrest that may culminate in hazardous volcanic activity. The former is handled through information statements, the latter through staged alert levels.

**B.1.1. INFORMATION STATEMENT** *Describes short-lived events that may or may not be hazardous or gives commentary on status of volcano.*

Unusual events such as steam bursts (with or without minor ash fall), small avalanches, rock falls, minor lahars, thunderstorms, and slash burning often attract media and public interest and inquiry. These events do not fit into any other information category. Most such volcano-related events are usually short-lived and some may be hazardous. As they are normally unexpected, there is usually no opportunity to provide warning or arrange evacuation. Thus, persons in proximity to such an event are at some personal risk and will need to make their own safety decisions.

Information about a discrete natural event may come from any source. For example, the seismic signature of a local rockfall may be detected and reported by the PNSN or the rockfall itself may be observed and reported by NPS personnel. Owing to frequent public and media inquiries that result from such events, USGS-CVO along with other involved agencies will attempt to verify the nature and extent of the event, issuing commentary as appropriate in information statements.

Information statements may also be issued to provide commentary about notable events occurring within any staged alert level during volcanic unrest.

Sample Information Statement:

No. 90-10

U.S. GEOLOGICAL SURVEY AND UNIVERSITY OF WASHINGTON

Vancouver and Seattle, Washington

VOLCANIC AND SEISMIC ACTIVITY AT MT. ST. HELENS

Reported at 1700, Wednesday, December 20, 1990

At 1259 PST today, a small explosion occurred on the lava dome at Mt. St. Helens. The explosion was marked by a strong seismic signal which decreased after several minutes to

low levels and continued for several hours. Pilots reported a light gray plume to 23,000 feet. Strong winds aloft carried the plume to the south-southwest and minor ashfall was reported as far as ten miles southwest of the volcano. The explosion did not cause a mud or water flow event.

This event is one of a family of small explosions that have occurred on the dome since August 1989. These explosions occur without recognizable warning, have significant effect only within the crater and are likely to recur.

### **B.1.2. STAGED ALERT LEVELS**

A system of staged alert levels (notice of volcanic unrest, volcano advisory and volcano alert) indicates the level of concern and the anticipated immediacy of hazardous volcanic activity. Alert-level notifications will be accompanied by brief explanatory text to clarify hazard implications as fully as possible. Updates may be issued to supplement any alert-level statement.

Alert-level assignments depend upon observations and interpretations of changing conditions. Some volcanic events may not be preceded by obvious changes, or the observed changes may not be well understood; thus, surprises are possible and uncertainty about timing and nature of anticipated events is likely. Alert levels are not always followed sequentially.

#### **B.1.2.1. NOTICE OF VOLCANIC UNREST** *First recognition of conditions that could lead to a hazardous event.*

This alert level is declared by USGS-CVO when significant abnormal conditions are recognized that could be indicative of an eventual hazardous volcanic event. The most likely such abnormal condition would be sustained, elevated seismic activity, which would be detected by the PNSN. A notice of volcanic unrest expresses concern about the potential for hazardous volcanic activity but does not imply immediate hazard. Among the possible outcomes are: (1) abnormal condition is determined not to indicate an eventual hazardous volcanic event (for example, seismic activity is determined to be caused by rock fracturing (faulting) in the crust well beneath or away from the volcanic edifice), leading to cancellation of the notice of volcanic unrest; 2) abnormal activity stops, leading to cancellation of the notice of volcanic unrest; 3) conditions evolve so as to indicate progress toward hazardous volcanic activity, leading to issuance of a volcano advisory or volcano alert.

Hypothetical Notice of Volcanic Unrest:

U.S. GEOLOGICAL SURVEY AND UNIVERSITY OF WASHINGTON

Vancouver and Seattle, Washington

NOTICE OF VOLCANIC UNREST AT MT. RAINIER

Reported at 0800, Wednesday, April 1

An unusual flurry of earthquakes has been underway beneath Mt. Rainier since early yesterday. The earthquakes are small, mostly less magnitude 1.5; the only earthquake larger than magnitude 2, with  $M=2.2$ , occurred at 0538 (PDT) today. Nearly 60 earthquakes have been recorded so far, and the rate of occurrence has gradually increased from an average of about 1 earthquake per hour early yesterday to about 3 per hour this morning. Most are located in a diffuse zone centered beneath Mt. Rainier at a depth of about 4 to 6 km (2.5 to 4 miles) below sea level. For comparison, earthquakes beneath Mt. Rainier seldom exceed a few per month and most are located at a depth approximately equivalent to sea level. While the possibility of an eventual eruption is a concern, the intensity of this



flurry is currently far less than that to be expected before an eruption, and there is insufficient evidence so far to clearly indicate whether or not an eruption is a likely eventual outcome.

**B.1.2.2 VOLCANO ADVISORY** *Hazardous volcanic event likely but not expected immediately.*

This alert level is declared by USGS-CVO when monitoring and evaluation indicate that processes are underway that have significant likelihood of culminating in hazardous volcanic activity, but when the evidence does not indicate that a life- or property-threatening event is to be expected within the next few hours or days. This alert level is used to emphasize heightened concern about potential hazard. Among the possible eventual outcomes are: (1) symptoms of volcanic unrest stop or decrease, leading either to cancellation of the volcano advisory or to a downgrade of alert level to notice of volcanic unrest; (2) conditions evolve so as to indicate that a life-threatening volcanic or hydrologic event is expected within no more than a few days or is actually underway, leading to issuance of a volcano alert. Volcano advisory statements, supplemented by updated volcano advisory statements as conditions evolve will clarify as fully as possible current understanding of the hazard implications.

Hypothetical Volcano Advisory:

U.S. GEOLOGICAL SURVEY AND UNIVERSITY OF WASHINGTON

Vancouver and Seattle, Washington

VOLCANO ADVISORY FOR MT. RAINIER

Reported at 1300, Monday, April 6

The swarm of earthquakes that began on March 31 beneath Mt. Rainier has gradually increased in intensity. Earthquakes large enough to be located have now increased to an average rate of about 15 per hour and include a few low-frequency volcanic earthquakes. About 10 percent now exceed magnitude 2; the largest, M=2.8, occurred on April 5 at 1817 (PDT). Most of the earthquakes are located within a diffuse zone centered beneath Mt. Rainier at a depth of about 4 to 6 km (2.5 to 4 miles) below sea level, but approximately 15 percent occur in a narrow zone extending upward into the volcano. So far, weather conditions have prevented measurements to detect ground deformation, but clearer weather this morning permitted a gas-measurement flight which showed a high discharge (still to be determined, but probably several thousand tons per day) of carbon dioxide. The earthquakes and gas emission, together, are compelling evidence that magma is forcing its way upward through the shallow Earth's crust beneath Mt. Rainier and could eventually erupt.

In the short term, the rising magma may cause shallow explosions of the ground water that saturates the volcano. This may generate light ash falls and avalanches of rock and ice from steep slopes within and near Mt. Rainier National Park.

Accumulation of rising magma within Mt. Rainier could destabilize a flank of the volcano, causing it to collapse and generating a massive lahar that could inundate one or more of the valleys that drain Mt. Rainier. An eruption, either with or without such a flank collapse, may produce pyroclastic flows or lava flows in and near Mt. Rainier National Park, far-reaching ash fall, and meltwater-generated lahars that could inundate any or all of the major valleys draining the volcano.

**B.1.2.3 VOLCANO ALERT** *Hazardous volcanic event underway or expected within a few hours or days.*

This alert level is declared by USGS-CVO when monitoring and evaluation indicate that precursory events have escalated to the point where a volcanic event with attendant volcanologic or hydrologic hazards threatening to life and property is either underway or is expected within a few hours or days. Depending upon further developments, a volcano alert will be maintained, updated, downgraded to a volcano advisory, or canceled. A volcano alert statement will indicate, in as much detail as possible, the time window, place and expected impact of an anticipated hazardous event. Updated volcano alert statements will amplify hazard information as dictated by evolving conditions.

Hypothetical Volcano Alert:

U.S. GEOLOGICAL SURVEY AND UNIVERSITY OF WASHINGTON

Vancouver and Seattle, Washington

VOLCANO ALERT FOR MT. RAINIER

Reported at 0700, Thursday, May 13

An intense burst of shallow earthquakes, ranging in magnitude up to  $M=3.3$ , began at approximately 2300 yesterday (May 12), and rapid ground deformation was recorded by tiltmeters at Gibraltar Rock and Liberty Ridge beginning at 0500 this morning. A helicopter flight at first light showed a new small lava mound or dome at Columbia Crest. Seismicity continues to be intense, including numerous low-frequency volcanic earthquakes. The new lava may be the gas-poor tip of ascending magma that first reached the surface this morning; gas-rich magma that could erupt explosively may reach the surface within a few hours or days. Its eruption may produce pyroclastic flows or lava flows in and near Mt. Rainier National Park, far-reaching ash fall, and meltwater-generated lahars that could inundate any or all of the major valleys draining the volcano.

## ***B.2. Notification for Ash Hazard to Aircraft***

Ash plumes from volcanic eruptions can travel hundreds or thousands of miles from their sources. Even when the concentration of ash is so low that it is of little interest or concern to populations on the ground, it can severely impact aircraft, especially large commercial jet aircraft. Consequently, NOAA, FAA and USGS are developing a separate plan for interagency communication about atmospheric ash hazard. Under this plan, USGS/CVO will issue, to the appropriate NOAA, FAA and Canadian agencies, separate notices about anticipated or existing atmospheric-ash hazard. Those notices will be given in the terms of the already-established level-of-concern color code for atmospheric ash hazard to aircraft:

**GREEN** ~ Volcano is quiet; no eruption is anticipated.

**YELLOW** ~ Volcano is restless; eruption is possible but not known to be imminent.

**ORANGE** ~ Small explosive eruption(s) either imminent or occurring; ash plume(s) not expected to reach 25,000 feet above sea level.

**RED** ~ Major explosive eruption imminent or occurring; large ash plumes expected to reach at least 25,000 feet above sea level.

## **C. Warning Systems**

As long as people continue to live in the lahar-inundation zones, the best hope for reducing casualties from Mt. Rainier lahars is timely evacuation of endangered valley floors. There are systems for detection and notification, and citizens must be prepared for timely evacuation.

The USGS/CVO monitoring and hazard-assessment team that responds to symptoms of rising magma beneath Mt. Rainier is, in fact, a warning system. In conjunction with the PNSN, the team will use every available tool to track the progress toward eruption and to identify and characterize eruptions as they occur. The team expects to detect any significant eruption or lahar related to eruptive or magmatic activity and to issue notices accordingly. In addition, escalating symptoms of an impending eruption may permit evacuation decisions, particularly in communities closer to the volcano, before the eruption actually occurs.

However, as previously noted, a clay-rich, flank-collapse lahar may originate either with or without associated magmatic activity that would signal enhanced watchfulness. Such a lahar might be triggered by a regional earthquake or a steam explosion, or might even occur spontaneously. In the absence of symptoms detected well in advance, there will be no activated monitoring and hazard-assessment team on watch to assess events and issue notices.

The travel time for a large flank-collapse lahar to some of the communities closer to Mt. Rainier (for example, Orting, Elbe, Packwood) may be an hour or less, and even less time may be available between detection of the lahar and its arrival. Decreased lahar velocity as the valleys broaden downstream gives slightly more time for response in the larger urban areas closer to Puget Sound (for example, Puyallup, Sumner, Fife). Reduction of casualties from such an unexpected event would require an automatic detection system combined with procedures for clear warning, public understanding of the hazard and practiced response by the citizens.

The following critical concerns about a lahar-detection and notification system cannot be overstressed:

- State, county and local government agencies must be prepared for a long-term (possibly many decades) commitment to planning, public education, evacuation drills and system maintenance and testing.
- Such a system would reduce, not eliminate, the risk in lahar-inundation zones. Its presence would not make expanded development safe.

A likely strategy is to first identify a potential lahar-generating event (either a volcanic eruption or a volcano-flank collapse), then to confirm either the presence or the absence of active lahars in the major drainages and, finally, to issue notification so that appropriate evacuations can be initiated.

### ***C.1. Detection of Potential Lahar-Generating Events***

A volcano-flank collapse of sufficient volume (many tens of millions of cubic meters) to produce a catastrophic lahar is expected to produce a distinct signal, which will be recorded by PNSN seismographs both on and beyond Mt. Rainier. The PNSN, which now automatically locates and determines the size of earthquakes with magnitude larger than  $M=2.5$ , and can rapidly send E-mail and pager notification to others, is not currently designed for rapid identification, location and notification of mass-movement events such as rock falls, avalanches and flank collapses. However, existing technology is currently being adapted to detect and issue automatic notification of very large ground-shaking events of unspecified origin on Mt. Rainier. This would provide notice that a lahar-generating event may have occurred, but confirmation of the presence or absence of lahars in specific drainages would come subsequently from a lahar-detection system.

### ***C.2. Detection of Lahars***

Lahars would be detected instrumentally, using arrays of acoustic flow monitors. In 1989, the USGS developed an acoustic flow monitor (AFM) that monitors high-frequency ground motion generated by lahars or other debris flows. (**See Appendix 2 for more information on lahars**). AFMs were first tested during the 1990 eruptions of Redoubt Volcano, Alaska. Since then, they have been evaluated at Mt. St. Helens and Tahoma Creek at Mt. Rainier, Washington; Jiangjia Ravine, Yunnan Province, China; Merapi Volcano, Indonesia; Cotopaxi Volcano, Ecuador; and Pinatubo Volcano, Philippines. Field observations of active lahars show consistent correspondence between distinct, elevated AFM signals and passing lahars (**Figure V-1**). AFMs have low power requirements and have proven robust in detecting lahars and other debris flows. Because an AFM measures ground vibration produced by a passing lahar, it can be located outside of the inundation area. Thus, unlike systems that depend on destruction of a trip wire by the lahar itself, the AFM survives and continues to transmit useful information throughout the duration of the lahar event.

An effective, comprehensive, lahar-detection system for Mt. Rainier would require between 30 and 40 AFM stations forming networks in the upper reaches of the Puyallup, Carbon, Nisqually, White and Cowlitz Rivers, and their major tributaries draining the volcano. Each AFM station consists of a microprocessor-based data logger that measures the amplitude, frequency and duration of ground vibrations detected by an exploration-class geophone. When measurements exceed programmed thresholds, the data are radioed to a base-station computer. Software analyzes the incoming data and triggers an automatic unequivocal notice when a significant lahar is detected. (**See Figure V-1**)

### ***C.3. Notification***

A two-stage notification system should be planned: (1) a notice that is issued when a potential lahar-generating event explosive eruption or sustained, high-amplitude seismic event on Mt. Rainier is detected; and (2) a valley-specific alert issued upon instrumental confirmation of a catastrophic lahar in one or more major drainages. Presumably, a rapid, pre-planned evacuation from the threatened valley(s) would ensue.

An automatic system must be used to evaluate data and generate notices and alerts by radio or phone line when predetermined thresholds are exceeded. Except during volcanic unrest when intense around-the-clock monitoring by a team of volcanologists is underway, the time from initiation of a lahar to its arrival in a populated valley-floor area is insufficient for analysis of the data by scientists before notices or alerts are issued. The automated notices of potential lahar-generating events and valley-specific alerts of lahar(s) in progress must be transmitted to an agency with an established 24-hour emergency-response mandate and facilities for rapid dissemination of emergency messages.

### ***C.4. Pilot Lahar-Detection System***

Installation of a smaller, two-year, pilot lahar-monitoring system for the Puyallup River valley is under way as a cooperative project of the USGS and the Pierce County Department of Emergency Management. The pilot is expected to provide valuable experience before a more comprehensive monitoring effort is undertaken. Eventually the pilot system could be incorporated in the comprehensive lahar-monitoring system.

The Puyallup Valley and its tributary, the Carbon River Valley, are the most appropriate for the pilot because the Puyallup is the most urbanized of the valleys subject to inundation by Case I lahars, which have an average recurrence time of approximately 500-1,000 years. A Case I lahar, occurring today, could destroy all or parts of Orting, Sumner, Puyallup, Fife, the Port of Tacoma and possibly Auburn (**Figure III-1**).

The pilot system is expected to incorporate seismic detection and automatic notification of potential lahar-generating events on Mt. Rainier and instrumental confirmation and automatic notification of a lahar in either the Puyallup or Carbon River Valley.

A major component of the pilot lahar-detection system is a network of five AFM stations located within tens to hundreds of meters from the active flood plain in each of the two valleys above their confluence. Two AFM stations in each valley are located above flood level but within the expected inundation zone of a significant lahar. Those stations, then, will serve as 'deadmen' devices whose destruction by a major lahar would be noted by the system. The other three stations in each valley are located above the anticipated lahar-inundation limit with the expectation that they will monitor ground vibrations and transmit data throughout passage of a lahar. Data from all stations are transmitted by radio to a base-station computer located in a Pierce County 24-hour emergency-dispatch center. Software, currently under development, analyzes the incoming data and triggers an automatic unequivocal notice when a significant lahar is detected.

The AFM arrays are located approximately midway between Orting and Mt. Rainier's summit in the two valleys. Flow modeling for the Puyallup Valley and empirical data from debris flows around the world suggest that the front of a Case I lahar in either the Carbon or Puyallup River Valleys might reach Orting in approximately 30 to 50 minutes after its passage through and detection by either one of the AFM arrays.

Installation of the pilot lahar-detection system hardware was completed in Fall 1998. A lengthy (possibly year-long) period of testing, shakeout and software refinement by the USGS will be necessary before the system is truly operational. Concurrently, the PNSN is designing its system for automatic seismic detection and notification of potential lahar-generating events. In mid-2000, after refinement and documentation of the lahar-detection system and training of Pierce County Personnel, the Pierce County Department of Emergency Management will take over the system.

## **A. Direction and Control Operations**

### ***A.1. Introduction***

This section establishes policies and procedures and assigns responsibilities accordingly to ensure the effective direction and control of emergency operations associated with preparing for and responding to a volcanic eruption or other hazardous geologic event at Mt. Rainier. It places emphasis on a unified system involving select local, state and federal agencies, elements of the private sector, and on the use of special facilities essential to enhancing operational response. It also provides information about emergency communication, alerting and notification procedures, and public education.

### ***A.2. Regional Advisory Group (RAG)***

The direction and control element will be the Regional Advisory Group (RAG), which will consist of state, federal and local officials. It may include representatives (or their alternates) such as emergency management coordinators or directors, chiefs or coordinators of law enforcement, fire, search and rescue, medical care, public health, MASS care, USGS, Mt. Rainier National Park, WA EMD, FEMA, resources and support elements and related liaison personnel. The RAG receive support and information from a special staff section consisting of communications and warning, situation analysis, emergency public information specialists and scientists with specific knowledge regarding the event.

#### **A.2.1. Unified Command**

Field operations will be directed by the Unified Command Structure, which may consist of law enforcement, fire, medical, public works and emergency management from all of the affected jurisdictions. The Unified Command Structure is depicted in **Figure VI-1**.

### **A.3. Objectives**

The objectives of direction and control operations are to ensure the effective direction and control of emergency forces involved in preparing for and responding to a volcanic eruption or other hazardous geologic event. Specifically this will include:

- Exercising overall operational control and/or coordination of emergency operations in support of local Emergency Management Systems.
- Coordination and/or maintaining liaison with appropriate federal, state and local governmental agencies and applicable segments of the private sector.
- Requesting and allocating resources and other support.
- Establishing priorities and adjudicating any conflicting demands for support.
- Coordinating inter-jurisdictional mutual aid.
- Activating communications systems.
- Preparing and disseminating emergency public information.
- Disseminating warning of an impending volcanic eruption.
- Coordinating the movement and hosting of persons in the event evacuation is ordered.
- Collecting, evaluating and disseminating damage and other essential data.

### **A.4. Situation**

The potential threat of an eruption or unexpected landslide-generated lahar from Mt. Rainier raises serious policy issues. These include the commitment of resources to achieve a higher state of readiness, the implementation of precautionary measures such as restricting movement into or within the area, and the dissemination of warning and other public information. In addition, response to an eruption could involve lifesaving operations by several jurisdictions, state agencies, private organizations and the federal government. Consequently, the State EOC, established at Camp Murray in Tacoma, Washington, will be utilized for receipt and dissemination of information, alerting and mobilizing, and for control and coordination of emergency operations.

In the event of a major volcanic event at Mt. Rainier, an interruption of normal communications channels is assumed. In addition, those communications resources that do remain in operation will be taxed beyond their capability. To direct and control response to a disaster of this magnitude, normal communications systems must be augmented in order to obtain resiliency, ensure interface and provide a means of contacting facilities and agencies outside the affected area.

It is imperative that alerting and notification procedures be developed and maintained to ensure that organizations and individuals designated to respond to a potential or actual event can be alerted and notified of the situation.

It is anticipated that the public will actively seek information about the event and safety procedures. Most will comply with instructions from official sources. Demand for information during an emergency will be reduced if good education programs for residents and visitors have been instituted and kept current well prior to the actual event. Prompt release of accurate and current information to the public will assist the emergency response by reducing confusion, panic and spread of rumors.

## **A.5. Concept of Operations**

### **A.5.1. General**

The following elements will provide direction and coordination of emergency response in support of local governments and responding state and federal agencies.

An Emergency Operations Center (EOC) will provide communications and house the Unified Command Staff of local, state, federal and private organizations needed to gather information and support and coordinate operations within the disaster area. The staff will be organized under the Incident Command System. The EOC will be established at Camp Murray in Tacoma, Washington, if conditions permit. Other alternate sites may be established if needed.

### **A.5.2. Specific Operational Concepts**

***First priority will be given to life safety.***

Local Authorities will use the established Emergency Management System in Washington State and the local affected jurisdictions in conjunction with established mutual aid agreements to direct and control emergency operations within their areas of jurisdiction. The RAG will meet as needed and as often as events dictate at Notice of Volcanic Unrest. The Unified Command shall be established and become operational once levels of activity warrant a multi-agency response.

Mutual aid agreements will be in effect, and plans should provide for automatic implementation at the later stages of **Volcano Advisory** or **Volcano Alert**. In order to compress response time, consideration will be given where possible to advance commitment of resources and early procurement and stockpiling of supplies such as:

- Special air filters and plastic covers for vehicles and equipment.
- Face masks and eye goggles for personnel.
- Pre-staging of rescue personnel and equipment.
- Pre-identification and supply of shelter and shelter supplies.

In addition, consideration should be made for accelerated installation of communications and warning devices, and movement of supplies, equipment, critical facilities and people out of the area of greatest hazard.

All responding agencies, both state and local, shall provide adequate support and equipment in accordance with agency and state policy. They will also provide protective devices for personnel and air filtration devices for mobile and other motorized equipment. After 72 hours, all logistical requirements will be processed through the Unified Command Structure.

In accordance with the State RCW 38.52 and by county policy, local governments shall use the Incident Command System (ICS) to manage their response to an event (**Figure VI-1**). The Unified Command Structure may begin operations out of the State EOC at Camp Murray. Logistics, Plans and Finance Sections may work from the same location.

The RAG will coordinate all public information release with affected local jurisdictions in an attempt to maintain consistent and timely release of information and to educate the population and visitors regarding emergency procedures (**See Section VII**).

Areas of closure will be designated and access control will be applied as dictated by developing conditions of volcanic unrest, or upon the onset of an emergency in a no-warning situation. Areas will be determined by information provided to the Unified Command from the RAG. Closure zones will be subject to change as the hazard perception changes, following an eruption or lahar and based on current geologic conditions. Roadblocks, barricades and roving patrols will be used to enforce the closure.

Airspace restrictions will be applied if an eruption or lahar is imminent or upon the onset of an emergency in a no-warning situation.

The decision to evacuate will be made by local authorities via information provided by the Unified Command Group.

Evacuation with warning will be carried out along pre-established corridors from the valley population centers to high ground on either side of the affected valleys.

In a no-warning situation, the population would be directed to high ground by the most expedient route and then directed to holding areas and then to shelters.

Local law enforcement and fire personnel will evacuate themselves and notify as many persons as possible by use of radio and loudspeaker announcements to evacuate. County and WSP units will establish traffic corridors for the evacuees and keep all outbound lanes clear and moving to the holding areas; i.e., school, mall, church or other large areas for parking many vehicles.

Search, rescue and recovery operations may be established at Thun Field in Pierce County or other sites as determined by Operations Section of the Unified Command. County Law Enforcement will be the lead agency for conducting SAR operations. Resources may include law enforcement, fire & EMS resources, trained volunteer search and rescue teams, military and federal response teams; all of whom will report to the Operations Section of the Unified Command.

Local fire districts and municipal police departments may conduct rescue operations as they become aware of situations and if they have the ability to respond safely. However, all such responses should be coordinated through the Operations Command Post to avoid duplication and to help establish priorities for the staged resources. Communications will be in accordance with Mt. Rainier Communications Plan.

All air operations will be coordinated from the Air Operations Branch located at the Operations Command Post.

### **A.5.3. EOC Operations**

When the level of volcanic unrest intensifies to the point that specific jurisdictions are recognized at risk, local authorities may open their own EOCs and begin preparations for local-area response. The State EOC and the RAG will keep local authorities informed and updated on a regular basis. Local EOC and emergency management agencies will coordinate activity and response with and through the Unified Command and the State EOC (**Figure VI-1**).

### **A.5.4. Hazardous Volcanic Event Likely, But Not Imminent (Volcano Advisory)**

The perception of a potential hazardous event likely, but not imminent, based on increased geologic activity, dictates a level of increased preparedness to cope with an actual event. The level of activity and response will be decided upon by the local and state authorities based on information and advice given to them by the RAG. These actions may include:



- Increased staffing and levels of EOC operation.
- Development and testing of alerting and notification procedures for response organizations.
- Development and delivery of hazard information to the public.
- Increased PIO function with supporting infrastructure of phones and space.
- Conducting training and exercises.

If the threat of an event increases significantly, all emergency plans and procedures will be reviewed and updated and other planned readiness and precautionary measures, such as closures and evacuations, will be undertaken as warranted by the situation. Time permitting, training and exercises will be conducted.

#### **A.5.5. Hazardous Volcanic Event Imminent or Underway (Volcano Alert)**

Upon receipt of official notification that an event is imminent or underway, local EOCs will be activated to full operational levels in the potentially affected areas. If essential, jurisdictions will declare a local emergency and the Governor will proclaim a State of Emergency. Necessary readiness measures will be completed. All forces and resources will be mobilized. Public information will be released and evacuations, if not already initiated, will begin. Airspace control and restrictions will be imposed.

#### **A.5.6. Hazardous Volcanic Event Occurs Without Warning**

In response to an unanticipated event, local authorities will activate EOCs. If not already accomplished, a local emergency will be declared and a State of Emergency will be proclaimed. All forces and resources will be mobilized. Evacuation, search and rescue and other essential lifesaving operations will be implemented. If not already accomplished, airspace control and restriction will be imposed. Priorities will be established and conflicting demands for support will be adjudicated by the Unified Command Structure.

### **B. Fire Operations**

#### ***B.1. Introduction***

This section describes Fire and Special Operations Branches in support of fire and law enforcement search and rescue operations. It assigns responsibilities and provides suggested actions and responses to problems associated with a volcanic eruption or other hazardous geologic event. It also addresses the implementation of mutual aid and other support, which can reasonably be expected from state and federal agencies, depending upon the magnitude of the occurrence. Local government will use the ICS system, per RCW 38.52. The established Unified Command will be the overall controlling and directing organization within the affected disaster area.

#### ***B.2. Objectives***

The objectives of fire and special operations are:

- Assist in dissemination of warning and hazard information.
- Assist in evacuation.
- Suppress and control fires.

- Implement initial disaster medical care at casualty collection points (CCPs).
- Assist in relocation of persons threatened by fire or volcanic or seismic events.
- Establish and enforce fire prevention measures to reduce vulnerability of buildings and their surrounding areas to fires.
- Provide and coordinate decontamination of response personnel and public from hazardous materials contamination.
- Provide Special Operations Branch personnel to Unified Command Law Enforcement Branch for search and rescue operations.
- Coordinate and direct medical triage, care and transport of injured from CCPs.

### ***B.3. Situation***

Fire and rescue resources will be needed in response to a significant volcanic event. Fires may be produced directly by eruptive materials, and indirectly by lightning, gas main rupture and downed electrical lines. During the summer, dispersal of population, dry terrain and foliage, extensive use of wood siding and shake roofs on buildings, and limited water supplies will create many threats to lives and property should an event occur. During the winter, limited accessibility, poor visibility and the additional possibility of increased avalanches and flooding after an eruption are major considerations. Fire operations will be supplemented by state and federal agencies and by mutual aid resources.

A warning prior to an eruption would permit relocation of personnel and resources and thus considerably enhance fire and medical capability.

Fire and rescue response will be affected by:

- Time of occurrence.
- Time of year.
- Magnitude of event.
- Effects on communications.
- Ability to alert and deploy personnel.
- Effects of airborne volcanic ash on mobile motorized equipment.
- Effects of ground movement or lahars on water mains.
- Congested roads due to evacuation and impassable roads due to lahars or flooding.
- Other response operations in impacted area.
- Availability of fuel and other supplies.
- Availability of compatible communication equipment to coordinate response with other agencies.

### ***B.4. Concept of Operations***

Operational response to a volcanic hazard threat will be contingent upon events indicated below.

#### **B.4.1. Hazardous Volcanic Event Likely, But Not Imminent (Volcano Advisory)**

During a period of increased volcanic unrest, fire agencies will prepare for an event by reviewing and updating appropriate plans, standard operating procedures (SOPs) and checklists. They will inventory resources and check alerting, mobilization and communications plans. They will identify staging and mobilization areas and establish routes to be used by emergency equipment. They will review established ICS and Unified Command Structures for this event. They will provide a liaison to the RAG.

#### **B.4.2. Hazardous Volcanic Event Imminent or Underway (Volcano Alert)**

Upon receipt of official notification that an event is imminent, or underway, fire agencies will, in accordance with local plans, alert and mobilize all available personnel. They will determine the magnitude of the problem, determine what resources are available and what additional resources may be needed, and advise the Fire Mobilization Area Coordinator at the Unified Command.

They will also ensure that intake filters are installed on fire and other motorized equipment, and that respirators or other air filtering breathing apparatus, including dust masks, are available for their personnel.

Responders' families in hazard areas will be evacuated and cared for.

#### **B.4.3. Event Occurs Without Warning**

Upon notification that an event has occurred, fire agencies will, if they have not already done so, alert and mobilize all personnel. Specific activities will be directed via the local Incident Command Structure in coordination with the area Unified Command. They will then implement immediate lifesaving and rescue operations in concert with fire, law enforcement and search and rescue operations. They will conduct required fire fighting operations and perform disaster medical care at established CCPs. Augmentation of resources will be provided to the operational area fire zone coordinator through established plans.

### **C. Law Enforcement**

#### **C.1. Introduction**

This section addresses general procedures for law enforcement to ensure public order and restore essential services in a response to the occurrence of a hazardous event at Mt. Rainier. It also provides guidelines for law enforcement and supporting agencies associated with evacuation operations and control of access to hazardous areas. Implementation procedures for mutual aid and support, which can be expected from state and federal agencies, depending on the magnitude of the event, are also identified. Government agencies working at the local level have primary responsibility for protection of life and property and responsibility for developing specific plans to do so.

#### **C.2. Objectives**

The overall objectives of law enforcement and traffic control operations are:

- Mobilize, deploy and organize for law enforcement and traffic control operations.
- Assist in alerting and notifying the affected population.
- Report conditions, needs, damage assessment, and other vital information including road closures, bridge failures, collapsed buildings, casualty estimates and any other situation that would normally require emergency response.

- Provide traffic and crowd control in support of evacuation plans and in cooperation with other state and county agencies having similar responsibilities.
- Provide security and crowd control support at MASS care facilities, multipurpose staging areas, casualty collection points, storage areas, vacated areas, key facilities and vital institutions.
- Establish perimeter access control to facilitate ingress and egress for authorized personnel. Maintain liaison with search and rescue units to ensure proper deployment and control of trained and spontaneous volunteers.
- Assist in establishing a multipurpose staging area for incoming mutual aid, supplies, equipment, food and medical resources.

### **C.3. Situation**

Mt. Rainier attracts a large tourist population to its recreational areas. The size of the tourist population fluctuates with the seasons and days of the week. The rivers that head on Mt. Rainier flow west towards Puget Sound through heavily populated valleys with many different jurisdictions and municipalities. The magnitude of evacuation and access control operations would depend mainly on the size of the tourist population and the time at which an eruption, or other hazardous event, is expected to occur. If evacuation is required of multiple river valleys, a large number of people will have to be moved in a very short period of time.

### **C.4. Concept of Operations**

#### **C.4.1. Hazardous Volcanic Event Likely, But Not Imminent (Volcano Advisory)**

During a period of increased geologic activity, law enforcement and appropriate supporting agencies will prepare for a volcanic eruption, or other hazardous event, by reviewing and updating appropriate plans, SOPs and emergency checklists. They will inventory their resources, and check alerting, mobilization and communications procedures. They will review pre-identified evacuation routes and identify where perimeter control points will be established

If the threat of a hazardous event increases significantly, law enforcement agencies will confirm or if necessary, modify the locations of access control points. They will conduct a detailed survey of available resources needed for major law enforcement functions and traffic control. Availability of the following resources will be determined:

- Helicopters and other search and rescue equipment.
- Transportation for special populations.
- Tow trucks.
- Barricades and signs.

Agencies should attain a level of preparedness that would enable them to quickly initiate evacuation and access control operations. Key tasks will be to disseminate public information and to procure resources needed for law enforcement and traffic control functions. If it becomes necessary, wilderness areas may be closed in cooperation with NPS and USFS due to the difficulty of warning or evacuation.

#### **C.4.2. Hazardous Volcanic Event Imminent or Underway (Volcano Alert)**

Upon receipt of official notification that an event is imminent or underway, in accordance with local plans, agencies will alert and mobilize required personnel and implement evacuation of potentially affected areas using warning devices (loudspeakers, sirens) from air and or surface vehicles. This will require coordination with other local and state agencies to establish traffic control points and ensure an orderly and timely evacuation of residents and all other persons using pre-identified evacuation routes. Transportation assistance may be provided for schools, hospitals, health care facilities, the elderly and handicapped, and persons without access to automobiles as needed and if time and resources permit. After evacuation, perimeter access controls will be initiated for security purposes.

#### **C.4.3. Event Occurs Without Warning**

Should an event occur without warning, the local municipalities within the hazard zone will use all means available to warn the public and evacuate as many persons as possible to high ground. County Sheriff and State Patrol units will keep the pre-identified evacuation routes open and prevent any unauthorized access into the hazard areas.

Evacuees will be directed to collection points for later routing to shelters and reunion with other displaced family members. The public will have to be responsible for its own movement out of the hazard area, as time is insufficient to organize special transportation needs.

#### **C.4.4. Organization and Responsibilities**

The Sheriff of the affected county is the Chief Law Enforcement Officer in command of local and responding mutual aid forces. The Sheriffs' Office is the lead agency for search and rescue operations in the hazard area.

Municipal Police Chiefs are the Chief Law Enforcement Officer within the incorporated cities in the affected area and are responsible for evacuation of their populations.

The Washington State Patrol is the primary mutual aid agency for rapid response into the affected area for traffic control and perimeter security in direct assistance to the Sheriff of the affected area.

### **D. Evacuation and Movement**

#### ***D.1. Participants***

##### **D.1.1. Joint Primary Agencies**

Pierce County Department of Emergency Management

United States Geological Survey

Public Safety Answering Points

Pierce County Sheriff's Department

Washington State Patrol

Orting Police Department

Sumner Police Department

Puyallup Police Department

Fife Police Department

Carbonado, South Prairie and Wilkeson Fire and Police Departments

### **D.1.2. Support Agencies**

Cities of Bonney Lake, Buckley, Edgewood, Milton and Tacoma

American Red Cross Tacoma-Pierce County Chapter

KIRO NewsRadio 710 AM

Local Grocers and Water Purveyors

## ***D.2. Introduction***

### **D.2.1. Mission**

The Valley Evacuation Plan was developed by emergency services, government representatives and other stakeholders from the Carbon and Puyallup River valleys. The task was to identify methods for warning, emergency route identification and procedures for the movement and evacuation of affected persons as quickly and safely as possible.

### **D.2.2. Purpose**

This plan identifies an organized method to remove the residents of the Carbon and Puyallup River valleys to safety with minimal delay and confusion resulting from a threatening situation caused by volcanic and/or seismic activity on Mt. Rainier.

### **D.2.3. Scope**

The Valley Evacuation Plan applies to persons located in the Carbon and Puyallup River valleys at the time of volcanic or seismic activity originating on Mt. Rainier that necessitates the movement and evacuation of those persons. These persons include residents, workers, tourists and emergency responders.

Using the experience and knowledge of the planning representatives this plan outlines broad objectives that will provide the greatest protection of life that can be achieved with the resources available.

### **D.2.4. Organization**

All movement and evacuation operations will follow the principles of the National Interagency Management System (NIMS), called the incident command system (ICS), and establish a unified command comprising representatives of lead agencies.

## ***D.3. Policies***

### **D.3.1. Authorities**

This plan was created as a collaborative effort to meet a widely acknowledged need for coordination of evacuation activities along the Carbon and Puyallup River valleys. The Valley Evacuation Planning Group comprises representatives from law enforcement, fire service, emergency management, schools, volunteer relief agencies, emergency dispatch

and military disciplines along with the United States Geologic Survey (USGS) and National Park Service (NPS).

The Revised Code of Washington (RCW) 38.52 and Washington Administrative Code (WAC) 118.30 directly address the structure of governmental emergency management organizations and their responsibilities. RCW 38.52 provides the framework for mutual aid agreements and mandates the use of the incident command system in any multi-jurisdictional, multi-agency emergency response. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288, as amended) addresses the federal government's authority in providing disaster response and recovery assistance.

Due to the multi-jurisdictional, multi-agency and inter-disciplinary nature of this plan, there are too many existing emergency policies on the local level to list in this section. The aggregate of these policies is, in some way, reflected in both the Concept of Operations and the Responsibilities of this plan.

### **D.3.2. Limitations**

The information and procedures included in this plan have been prepared utilizing the best information and planning assumptions available at the time of preparation. There is no guarantee implied by this plan that in emergency or disaster situations a perfect response will be practical or possible. This plan should be used as a guideline with consideration given to the unique needs of each and every situation.

## ***D.4. Situation***

### **D.4.1. Emergency/Disaster Conditions and Hazards**

Mt. Rainier is an episodically active volcano that towers more than 14,400 feet above expanding suburbs in the valleys that lead to nearby Puget Sound. Geologic study indicates that Mt. Rainier has repeatedly produced lahars that would be catastrophic today owing to intense development in the valleys. Comparable future lahars are to be expected.

### **D.4.2. Planning Assumptions**

- a. The residents of the valleys are expected to be self-sufficient for at least three days following a disaster. To the extent practicable, immediate basic needs will be provided by the benefit of pre-disaster preparedness.
- b. People will spontaneously evacuate areas when there is actual or perceived danger.
- c. Loss of life and property will occur in the event of a catastrophic lahar.
- d. It is assumed that evacuations last more than a few hours.
- e. As response resources may be depleted or unavailable and essential systems may be rendered dysfunctional, the emergency responders can only make every reasonable effort to respond based on the situation, information and resources available at the time the situation occurs.
- f. Transportation routes will be overwhelmed with people attempting to get to higher ground. The stalemate will hinder the access of first responders to assist in traffic flow.
- g. Debris may make streets and highways impassable and leave people stranded.

h. Support agencies and incorporated cities and towns will perform tasks and expend resources under their own authorities, including implementation of mutual aid agreements, in addition to resources received under the authority of this plan.

i. Pierce County will not have all of the resources, either in type or in quantity, that may be required for the movement and evacuation of a large and widespread population. Pierce County will endeavor to cooperate with the state Emergency Management Division (EMD) in the procurement of needed resources.

## ***D.5. Concepts of Operations***

### **D.5.1. General**

The design and installation of the Mt. Rainier Lahar Warning System was a collaborative effort with the United States Geological Survey and the Pierce County Department of Emergency Management. It is a system for automatic detection and notification of an unanticipated lahar.

Acoustic flow monitors (AFMs), developed by USGS scientists, are strategically placed throughout the Carbon and Puyallup River valleys. The design of the AFMs and supporting technology filter lahar type ground vibrations from those of large earthquakes or floods.

Computers located at the Law Enforcement Support Agency (LESA) and the state EMD receive and decipher signals from the AFMs. The detection of a lahar sets a series of actions into motion, which differ from those actions taken in other emergency or disaster situations.

### **D.5.2. Emergency Management Concepts**

Field and emergency operations center (EOC) operations will adhere to the principles and guidelines described in the National Interagency Management System (NIMS). A unified command will be established comprising operations chiefs of the responding agencies whether it is for field or EOC activities.

The Pierce County EOC will activate upon lahar detection and remain operational throughout the response and recovery phases unless events mandate otherwise.

The Pierce County Department of Emergency Management Comprehensive Emergency Management Plan (CEMP) and CEMPs of affected incorporated cities and towns outline, in greater detail, their respective actions during emergencies or disasters.

### **D.5.3. Direction and Control**

Direction and control provides for effective supervision, authority and cooperative functioning of emergency management activities undertaken with a large scale evacuation of this nature. It ensures continued operations during and after the lahar event.

Coordinated field command and operations implemented by a unified command structure are critical to safe and rapid evacuation of residents in the Carbon and Puyallup River valleys. Effective coordination is dependent on continued communications among field operations personnel and the EOCs.

The EOCs support field activities and coordinate resource requests.



#### **D.5.4. Emergency Operations Facilities**

The primary Pierce County EOC is located in the basement of the County-City Building, 930 Tacoma Avenue S, Tacoma WA 98402-2102. Alternate locations will be determined as needed.

Pierce County EOC operational procedures are described in the Pierce County EOC Plan, July 1998 (published separately).

Individual jurisdictional EOCs will open in support of field evacuation activities.

#### **D.5.5. System Activation**

The AFMs transmit the signal of an encroaching lahar. The signal is received at LESA and the State EMD.

LESA and the State EMD alert identified agencies (**see Attachment A ~ Figure VI-3**).

#### **D.5.5. Public Warning and Information**

There are two primary warning systems for the transmission of lahar warnings. One is a combination of sirens and radio transmitters strategically placed in the river valleys. The other is the emergency alert system (EAS).

Upon receipt of the impending lahar, jurisdictions will activate a siren system. Subsequent to an aggressive public education campaign, residents will know to tune in to 95.3 FM to receive warning and evacuation information.

The transmitter will broadcast emergency warnings to people to evacuate off the valley floors as quickly as possible. Emergency information will follow warnings as time allows.

The EAS is the other primary warning system which will be activated and transmit emergency warning information. The Pierce County EOC is the lead agency in the development and transmission of warning messages. LESA assists in the development and transmission whenever the Pierce County EOC cannot initiate the process. The EAS transmitter is housed at LESA and maintained by the Pierce County DEM. (**See Attachment B**)

KIRO NewsRadio (710 AM) broadcasts EAS messages generated from the central Puget Sound area. It is recommended that this frequency be monitored along with other local news broadcasters.

Both of these warning systems will activate for the fastest dissemination of warning information.

Secondary warning methods such as public address systems and door-to-door dissemination may be used. The use of these secondary methods will be limited. They are inefficient and require personnel who would be involved in the actual evacuation and movement of people to be redirected for this activity.

#### **D.5.7. Evacuation and Movement**

It is anticipated that affected people will begin evacuation upon hearing the evacuation siren and or warning information transmitter over 95.3 FM or 710 AM or learning of it through other means. The desired result is to get people off the valley floor as soon as, and as safely as, possible.

Evacuation and movement of nursing homes, hospitals and other facilities are the responsibility of the individual establishments. Emergency services personnel will not be available to assist in these activities.

Upon the receiving the warning of a lahar, the cities of Bonney Lake, Buckley, Edgewood, Milton and Tacoma will initiate activities to receive arriving evacuees. Those activities include pre-identifying a collection site, assisting in evacuee registration, shelter site identification and setup, coordinating counseling and spiritual support and providing for long-term displacement of persons.

#### *Law Enforcement*

The cities of Orting, Sumner, Puyallup and Fife Police Departments have the responsibility for the evacuation of persons in their respective cities. If time and resources allow, police units will make rapid evacuation announcements using loudspeakers. PCSD units in the valleys will provide the same announcements in unincorporated Pierce County if time and resources allow.

Pierce County Sheriff's Department and Washington State Patrol have responsibility for keeping evacuation routes open, keeping traffic moving away from the valleys and preventing traffic jams. Traffic direction will not be restricted. It is understood that traffic flow will take on a nature of its own and will frequently limit itself to one direction. All PCSD and WSP units will respond to the evacuation route closest to current positions. These units will keep traffic moving as smoothly as possible and to direct evacuees to predetermined collection sites.

Carbonado, South Prairie and Wilkeson fire and police departments will assist in the evacuation of persons in their respective jurisdictions, as resources will allow.

#### *Evacuee Registration*

Persons are to arrive at the predetermined collection sites, as identified by individual jurisdictions and register with authorities. These authorities will be highly visible (wearing vests, helmets or other identifiers). (**see Attachment C, Figure VI-4: Map of Lahar Evacuation Routes for evacuation routes, collection sites and shelter locations.**)

Registration forms and other pertinent forms are under development.

#### *Fire Services*

Fire services will assist in the evacuation process to the extent possible. Fire suppression and rescue responsibilities will take priority.

#### *American Red Cross*

Shelters will be opened in close proximity to evacuee collection sites and remain open as long as services are needed.

### **D.6. Responsibilities**

#### *Pierce County Department of Emergency Management*

Rapid activation of the Pierce County EOC with adequate staffing and operational levels as appropriate.

Develop and transmit accurate and consistent warning information in the form of EAS messages or other media dissemination.

Coordinate jurisdictional EOCs and field resource support requests.

Maintain AFMs installed in the Carbon and Puyallup River valleys.

Maintain computers installed at LESA.

*United States Geological Survey*

Maintain the software supporting the lahar warning system technology.

Serve as scientific consultants for the warning system project.

*Public Safety Answering Points*

Provide expeditious warning to identified agencies (**see Attachment A**).

Provide dispatch service to field units throughout the evacuation process.

*Pierce County Sheriff's Department*

Direct traffic flow and maintain open evacuation routes.

Provide evacuation assistance for persons in unincorporated Pierce County.

*Washington State Patrol*

Maintain open highways and direct traffic flow.

Support PCSD evacuation activities if resources allow.

*Incorporated Cities Police Departments (Orting, Wilkeson, Sumner, Puyallup and Fife)*

Direct persons to appropriate evacuation routes.

Direct traffic and maintain flow.

*Cities of Bonney Lake, Buckley, Edgewood, Milton and Tacoma*

Provide reception services and support for evacuees.

*American Red Cross Tacoma-Pierce County Chapter*

Provide expeditious shelter openings in proximity to collection sites.

Maintain open shelters as long as necessary.

Maintain adequate staffing and support for all open shelter locations.

*KIRO NewsRadio (710 AM)*

Promptly broadcast EAS messages generated by the Pierce County EOC.

Accurately relay additional information provided by the Pierce County Emergency Public Information Officer.

*Local Grocers and Water Purveyors*

Support the human needs of evacuees in local communities with the stocking of food, water and hygiene supplies.

#### ***D.7. References***

Pierce County Department of Emergency Management Comprehensive Emergency Management Plan.

Pierce County EOC Plan.

City of Bonney Lake Comprehensive Emergency Management Plan.

City of Edgewood Comprehensive Emergency Management Plan.

City of Sumner Comprehensive Emergency Management Plan.

City of Puyallup Comprehensive Emergency Management Plan.

American Red Cross Disaster Plan.

#### ***D.8. Terms and Definitions***

Lahar ~ An Indonesian word for a flowing mass of mingled volcanic debris and water (Webster's Ninth New Collegiate Dictionary).

#### ***D.9. Attachments***

Attachment A ~ Figure VI- 3. First Responder Notification Tree (Pages 23- 24)

Attachment B ~ Emergency Alert System Pierce County Activation Procedures

Attachment C ~ Figure VI-4. Map of Lahar Evacuation Routes

### **E. Search and Rescue**

#### ***E.1. Introduction***

This section describes search and rescue (SAR) operations, possible problem areas, and courses of action in response to a volcanic, or other hazardous, event at Mt. Rainier. It also addresses implementation of mutual aid, other support and the procedures for acquiring this assistance. It describes those SAR operations that are primarily the Sheriff's responsibility, as compared to rescue operations that occur within the jurisdiction of fire protection districts. As addressed in this section, SAR support and assistance is available from Washington State EOC, from the Federal Government US&R program and from the US military. Local volunteer SAR teams are essential to augment operational and support functions.

#### ***E.2. Objectives***

To carry out a coordinated effort of search and rescue operations and support and to ensure the safety of persons who are not injured, but who require evacuation or other assistance, while maintaining the highest degree of safety for rescue personnel.

#### ***E.3. Situation***

The scale of search and rescue operations to be carried out after an event, whether forecasted or unanticipated, may be monumental. The ability to deploy personnel and to respond will be directly affected by:

- Time of occurrence
- Season of the year
- Current weather
- Magnitude of event
- Ability of mobilized personnel
- Effect of airborne ash on mobile equipment and personnel
- Road conditions
- Actions of people
- Loss of power
- Fire potential in dry season
- Potential flooding
- Adequate logistical support
- Communication and control

#### ***E.4. Concept of Operations***

Search and rescue operations in this plan interact directly with evacuation and access control operations. In the case of a forecast event, search and rescue will be mobilized ahead of time to carry out operations in concert with evacuations and during the actual occurrence of the event. In an unanticipated event, potential victims must get out of the hazard area on their own or get to a safe area and await rescue from the SAR response team.

Local fire districts will assist with evacuation and conduct rescue operations within their jurisdictions, if within their capabilities and in coordination with the overall SAR mission commander. This will reduce duplication and ensure the safest possible response for both victim and rescue personnel.

The general concept of SAR operations require that SAR coordinators direct a coordinated response to minimize loss of life, reduce confusion and redundancy, and rescue and recover disaster victims in the most efficient manner with the closest, most qualified resources. To this end, SAR coordinators will:

- Be decisive in directing and utilizing manpower and other resources.
- Prioritize response; risk areas with high potential loss of life should be high priority.
- Assure a safe and orderly search and rescue operation.
- Be responsive to families or relatives who may have lost loved ones.
- Carry out the SAR responsibility throughout the entire effected area under one unified effort.

- Provide information to the media and public about ongoing SAR operations.

#### **E.4.1. Hazardous Volcanic Event Imminent or Underway (Volcano Alert)**

Upon receipt of official notification that an eruption or other hazardous volcanic event is imminent or is occurring, search and rescue forces will:

- Be alerted and directed to mobilize to the primary staging area at the Operations Command Post.
- Respond to specific mission assignments as directed by the SAR Mission Coordinator.
- Assist with evacuations where possible and as needed.
- Preposition support equipment.
- Utilize respirators and other air filtering breathing devices and eye protection as needed.

#### **E.5. Available SAR Resources**

- County Sheriff SAR Coordinators  
Manage, direct and respond, rescue and recovery operations.
- Volunteer SAR Teams (state and local)  
Wilderness, remote response, rescue and recovery, swiftwater.
- Fire Service Special Operations Teams  
Urban and municipal response, and medium to heavy rescue, swiftwater.
- Military (federal and state)  
Support, logistics and response as appropriate.
- Federal Response Teams (US&R Task Forces)  
Urbanized areas, recon, recovery, response, heavy rescue.
- National Park Rangers  
Wilderness, remote region response, logistics and planning support.
- USFS Employees  
Wilderness, remote regions response, mapping, plans, logistical support.

### **F. Agency Responsibilities and Tasks**

Following are the detailed responsibilities and tasks of jurisdictions and agencies at the various levels of notification.

#### **F.1. Local Jurisdictions and Agencies**

**Following a Notice of Volcanic Unrest:**

- Identify agency member to the Regional Advisory Group (RAG).
- Complete plans and procedures for response to the Mt. Rainier volcanic hazards threat.
- Designate individuals who will be responsible for filling positions in the local ICS and/or Unified Command Structure as requested.
- Provide orientation sessions on updated plans and organizational structure.

- Establish call-up procedures for all staff.

**Hazardous Volcanic Event Likely, But Not Imminent During a period of increased geologic activity (Volcano Advisory):**

- Designate a liaison to the Unified Command Structure.
- Update personnel lists.
- Conduct surveys on resource availability and reaffirm prior commitments.
- Test communications systems and stockpile additional hardware.
- Hold exercises for all emergency operations.
- Begin procurement of needed resources.
- Provide information specialist to support the Unified Command PIO.
- Provide briefings and direction to all response personnel.
- Request all assigned personnel to standby for orders to activate emergency plan.
- Take readiness and precautionary actions to compress response time and to safeguard lives, equipment and supplies.

**Upon receipt of official notification that a volcanic or other hazardous event is imminent or occurring (Volcano Alert):**

- Fully mobilize all assigned personnel and activate all or part of the Mt. Rainier hazard plan.
- Continually broadcast emergency public information.
- Direct and control emergency response activities in each jurisdiction in accordance with ICS procedures.
- Assign liaison personnel to the Unified Command Structure.

**F.1.2. State Agencies**

*Washington State Military Department ~ Emergency Management Division*

**Following a Notice of Volcanic Unrest:**

- Complete internal plans and procedures.
- Provide planning and technical assistance to local jurisdictions.
- Coordinate with other Emergency Support Functions (ESF) agencies that will provide assistance.
- Coordinate mutual aid agreements with neighboring states.
- Arrange for assistance from federal agencies.
- Determine resource requirements.
- Issue advisories and state level policies in consultation with the RAG.

- Prepare and conduct training exercises.

**Hazardous Volcanic Event Likely, But Not Imminent (Volcano Advisory):**

- Convene a meeting of the RAG.
- Implement plans for state-level communications support within the affected area.
- Support public education programs.
- Increase, as needed, the staffing at the EOC; support local government with PIO information.
- Ensure that state agencies are alerted to potential problems and review their operational responsibilities.
- Assign liaison to local unified command when activated by the RAG.

**Hazardous Volcanic Event is imminent or underway (Volcano Alert):**

- Coordinate the state response to the emergency.
- Coordinate interstate mutual aid.
- Coordinate federal response.

*Washington State Patrol*

At all notification levels:

- Provide traffic control for the evacuation.
- Assist in access control.
- Assist local law enforcement with security and law and order.

*Military Department/National Guard*

At all notification levels, provide support in the following areas:

- Fire
- Security
- Evacuation
- Search and Rescue
- Disaster Medical Care
- Disaster Public Health
- MASS Care Sheltering
- Coroner Services
- Public Works



- Environmental Concerns

#### *Department of Transportation*

At all notification levels:

- Support traffic control, evacuation, access control and SAR operations.
- Keep roads free of snow and debris.
- Clear evacuation and access routes of debris.

#### *Department of Social and Health Services*

At all notification levels:

- Coordinate state agency support to MASS care services.
- Coordinate with American Red Cross and others in the operation for sheltering and other care centers and provide personnel and resources to the centers.

#### *Department of Corrections*

At all notification levels:

- Provide labor force if required

### **F.1.3. Federal Agencies**

#### *Federal Emergency Management Agency*

At all notification levels:

- Coordinate federal response

#### *Federal Aviation Administration*

At all notification levels:

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

#### *US Geological Survey*

At all notification levels:

- Monitor the status of seismic and geologic activity in the hazard area.
- Issue alert-level notifications and updates.
- Provide liaison to the RAG in order to provide ongoing information and advice.

#### *National Park Service and US Forest Service*

Implement plans to participate directly in the following coordinated response operations within the affected areas at all notification levels:

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

#### *National Weather Service*

At all notification levels:

- Provide weather forecasts, including wind conditions to the RAG and Unified Command Structure.
- Issue flood warnings.

## **VI. Operations**

### **A. Direction and Control Operations**

#### ***A.1. Introduction***

This section establishes policies and procedures and assigns responsibilities accordingly to ensure the effective direction and control of emergency operations associated with preparing for and responding to a volcanic eruption or other hazardous geologic event at Mt. Rainier. It places emphasis on a unified system involving select local, state and federal agencies, elements of the private sector, and on the use of special facilities essential to enhancing operational response. It also provides information about emergency communication, alerting and notification procedures, and public education.

#### ***A.2. Regional Advisory Group (RAG)***

The direction and control element will be the Regional Advisory Group (RAG), which will consist of state, federal and local officials. It may include representatives (or their alternates) such as emergency management coordinators or directors, chiefs or coordinators of law enforcement, fire, search and rescue, medical care, public health, MASS care, USGS, Mt. Rainier National Park, WA EMD, FEMA, resources and support elements and related liaison personnel. The RAG receive support and information from a special staff section consisting of communications and warning, situation analysis, emergency public information specialists and scientists with specific knowledge regarding the event.

##### **A.2.1. Unified Command**

Field operations will be directed by the Unified Command Structure, which may consist of law enforcement, fire, medical, public works and emergency management from all of the affected jurisdictions. The Unified Command Structure is depicted in **Figure VI-1**.

### **A.3. Objectives**

The objectives of direction and control operations are to ensure the effective direction and control of emergency forces involved in preparing for and responding to a volcanic eruption or other hazardous geologic event. Specifically this will include:

- Exercising overall operational control and/or coordination of emergency operations in support of local Emergency Management Systems.
- Coordination and/or maintaining liaison with appropriate federal, state and local governmental agencies and applicable segments of the private sector.
- Requesting and allocating resources and other support.
- Establishing priorities and adjudicating any conflicting demands for support.
- Coordinating inter-jurisdictional mutual aid.
- Activating communications systems.
- Preparing and disseminating emergency public information.
- Disseminating warning of an impending volcanic eruption.
- Coordinating the movement and hosting of persons in the event evacuation is ordered.
- Collecting, evaluating and disseminating damage and other essential data.

### **A.4. Situation**

The potential threat of an eruption or unexpected landslide-generated lahar from Mt. Rainier raises serious policy issues. These include the commitment of resources to achieve a higher state of readiness, the implementation of precautionary measures such as restricting movement into or within the area, and the dissemination of warning and other public information. In addition, response to an eruption could involve lifesaving operations by several jurisdictions, state agencies, private organizations and the federal government. Consequently, the State EOC, established at Camp Murray in Tacoma, Washington, will be utilized for receipt and dissemination of information, alerting and mobilizing, and for control and coordination of emergency operations.

In the event of a major volcanic event at Mt. Rainier, an interruption of normal communications channels is assumed. In addition, those communications resources that do remain in operation will be taxed beyond their capability. To direct and control response to a disaster of this magnitude, normal communications systems must be augmented in order to obtain resiliency, ensure interface and provide a means of contacting facilities and agencies outside the affected area.

It is imperative that alerting and notification procedures be developed and maintained to ensure that organizations and individuals designated to respond to a potential or actual event can be alerted and notified of the situation.

It is anticipated that the public will actively seek information about the event and safety procedures. Most will comply with instructions from official sources. Demand for information during an emergency will be reduced if good education programs for residents and visitors

have been instituted and kept current well prior to the actual event. Prompt release of accurate and current information to the public will assist the emergency response by reducing confusion, panic and spread of rumors.

## **A.5. Concept of Operations**

### **A.5.1. General**

The following elements will provide direction and coordination of emergency response in support of local governments and responding state and federal agencies.

An Emergency Operations Center (EOC) will provide communications and house the Unified Command Staff of local, state, federal and private organizations needed to gather information and support and coordinate operations within the disaster area. The staff will be organized under the Incident Command System. The EOC will be established at Camp Murray in Tacoma, Washington, if conditions permit. Other alternate sites may be established if needed.

### **A.5.2. Specific Operational Concepts**

***First priority will be given to life safety.***

Local Authorities will use the established Emergency Management System in Washington State and the local affected jurisdictions in conjunction with established mutual aid agreements to direct and control emergency operations within their areas of jurisdiction. The RAG will meet as needed and as often as events dictate at Notice of Volcanic Unrest. The Unified Command shall be established and become operational once levels of activity warrant a multi-agency response.

Mutual aid agreements will be in effect, and plans should provide for automatic implementation at the later stages of **Volcano Advisory** or **Volcano Alert**. In order to compress response time, consideration will be given where possible to advance commitment of resources and early procurement and stockpiling of supplies such as:

- Special air filters and plastic covers for vehicles and equipment.
- Face masks and eye goggles for personnel.
- Pre-staging of rescue personnel and equipment.
- Pre-identification and supply of shelter and shelter supplies.

In addition, consideration should be made for accelerated installation of communications and warning devices, and movement of supplies, equipment, critical facilities and people out of the area of greatest hazard.

All responding agencies, both state and local, shall provide adequate support and equipment in accordance with agency and state policy. They will also provide protective devices for personnel and air filtration devices for mobile and other motorized equipment. After 72 hours, all logistical requirements will be processed through the Unified Command Structure.

In accordance with the State RCW 38.52 and by county policy, local governments shall use the Incident Command System (ICS) to manage their response to an event (**Figure VI-1**). The Unified Command Structure may begin operations out of the State EOC at Camp Murray. Logistics, Plans and Finance Sections may work from the same location.

The RAG will coordinate all public information release with affected local jurisdictions in an attempt to maintain consistent and timely release of information and to educate the population and visitors regarding emergency procedures (**See Section VII**).

Areas of closure will be designated and access control will be applied as dictated by developing conditions of volcanic unrest, or upon the onset of an emergency in a no-warning situation. Areas will be determined by information provided to the Unified Command from the RAG. Closure zones will be subject to change as the hazard perception changes, following an eruption or lahar and based on current geologic conditions. Roadblocks, barricades and roving patrols will be used to enforce the closure.

Airspace restrictions will be applied if an eruption or lahar is imminent or upon the onset of an emergency in a no-warning situation.

The decision to evacuate will be made by local authorities via information provided by the Unified Command Group.

Evacuation with warning will be carried out along pre-established corridors from the valley population centers to high ground on either side of the affected valleys.

In a no-warning situation, the population would be directed to high ground by the most expedient route and then directed to holding areas and then to shelters.

Local law enforcement and fire personnel will evacuate themselves and notify as many persons as possible by use of radio and loudspeaker announcements to evacuate. County and WSP units will establish traffic corridors for the evacuees and keep all outbound lanes clear and moving to the holding areas; i.e., school, mall, church or other large areas for parking many vehicles.

Search, rescue and recovery operations may be established at Thun Field in Pierce County or other sites as determined by Operations Section of the Unified Command. County Law Enforcement will be the lead agency for conducting SAR operations. Resources may include law enforcement, fire & EMS resources, trained volunteer search and rescue teams, military and federal response teams; all of whom will report to the Operations Section of the Unified Command.

Local fire districts and municipal police departments may conduct rescue operations as they become aware of situations and if they have the ability to respond safely. However, all such responses should be coordinated through the Operations Command Post to avoid duplication and to help establish priorities for the staged resources. Communications will be in accordance with Mt. Rainier Communications Plan.

All air operations will be coordinated from the Air Operations Branch located at the Operations Command Post.

### **A.5.3. EOC Operations**

When the level of volcanic unrest intensifies to the point that specific jurisdictions are recognized at risk, local authorities may open their own EOCs and begin preparations for local-area response. The State EOC and the RAG will keep local authorities informed and updated on a regular basis. Local EOC and emergency management agencies will coordinate activity and response with and through the Unified Command and the State EOC (**Figure VI-1**).

### **A.5.4. Hazardous Volcanic Event Likely, But Not Imminent (Volcano Advisory)**

The perception of a potential hazardous event likely, but not imminent, based on increased geologic activity, dictates a level of increased preparedness to cope with an actual event. The level of activity and response will be decided upon by the local and state authorities based on information and advice given to them by the RAG. These actions may include:

- Increased staffing and levels of EOC operation.
- Development and testing of alerting and notification procedures for response organizations.
- Development and delivery of hazard information to the public.
- Increased PIO function with supporting infrastructure of phones and space.
- Conducting training and exercises.

If the threat of an event increases significantly, all emergency plans and procedures will be reviewed and updated and other planned readiness and precautionary measures, such as closures and evacuations, will be undertaken as warranted by the situation. Time permitting, training and exercises will be conducted.

#### **A.5.5. Hazardous Volcanic Event Imminent or Underway (Volcano Alert)**

Upon receipt of official notification that an event is imminent or underway, local EOCs will be activated to full operational levels in the potentially affected areas. If essential, jurisdictions will declare a local emergency and the Governor will proclaim a State of Emergency. Necessary readiness measures will be completed. All forces and resources will be mobilized. Public information will be released and evacuations, if not already initiated, will begin. Airspace control and restrictions will be imposed.

#### **A.5.6. Hazardous Volcanic Event Occurs Without Warning**

In response to an unanticipated event, local authorities will activate EOCs. If not already accomplished, a local emergency will be declared and a State of Emergency will be proclaimed. All forces and resources will be mobilized. Evacuation, search and rescue and other essential lifesaving operations will be implemented. If not already accomplished, airspace control and restriction will be imposed. Priorities will be established and conflicting demands for support will be adjudicated by the Unified Command Structure.

### **C. Fire Operations**

#### **B.1. Introduction**

This section describes Fire and Special Operations Branches in support of fire and law enforcement search and rescue operations. It assigns responsibilities and provides suggested actions and responses to problems associated with a volcanic eruption or other hazardous geologic event. It also addresses the implementation of mutual aid and other support, which can reasonably be expected from state and federal agencies, depending upon the magnitude of the occurrence. Local government will use the ICS system, per RCW 38.52. The established Unified Command will be the overall controlling and directing organization within the affected disaster area.

#### **B.2. Objectives**

The objectives of fire and special operations are:

- Assist in dissemination of warning and hazard information.

- Assist in evacuation.
- Suppress and control fires.
- Implement initial disaster medical care at casualty collection points (CCPs).
- Assist in relocation of persons threatened by fire or volcanic or seismic events.
- Establish and enforce fire prevention measures to reduce vulnerability of buildings and their surrounding areas to fires.
- Provide and coordinate decontamination of response personnel and public from hazardous materials contamination.
- Provide Special Operations Branch personnel to Unified Command Law Enforcement Branch for search and rescue operations.
- Coordinate and direct medical triage, care and transport of injured from CCPs.

### ***B.3. Situation***

Fire and rescue resources will be needed in response to a significant volcanic event. Fires may be produced directly by eruptive materials, and indirectly by lightning, gas main rupture and downed electrical lines. During the summer, dispersal of population, dry terrain and foliage, extensive use of wood siding and shake roofs on buildings, and limited water supplies will create many threats to lives and property should an event occur. During the winter, limited accessibility, poor visibility and the additional possibility of increased avalanches and flooding after an eruption are major considerations. Fire operations will be supplemented by state and federal agencies and by mutual aid resources.

A warning prior to an eruption would permit relocation of personnel and resources and thus considerably enhance fire and medical capability.

Fire and rescue response will be affected by:

- Time of occurrence.
- Time of year.
- Magnitude of event.
- Effects on communications.
- Ability to alert and deploy personnel.
- Effects of airborne volcanic ash on mobile motorized equipment.
- Effects of ground movement or lahars on water mains.
- Congested roads due to evacuation and impassable roads due to lahars or flooding.
- Other response operations in impacted area.
- Availability of fuel and other supplies.
- Availability of compatible communication equipment to coordinate response with other agencies.

### ***B.4. Concept of Operations***

Operational response to a volcanic hazard threat will be contingent upon events indicated below.

#### **B.4.1. Hazardous Volcanic Event Likely, But Not Imminent (Volcano Advisory)**

During a period of increased volcanic unrest, fire agencies will prepare for an event by reviewing and updating appropriate plans, standard operating procedures (SOPs) and checklists. They will inventory resources and check alerting, mobilization and communications plans. They will identify staging and mobilization areas and establish routes to be used by emergency equipment. They will review established ICS and Unified Command Structures for this event. They will provide a liaison to the RAG.

#### **B.4.2. Hazardous Volcanic Event Imminent or Underway (Volcano Alert)**

Upon receipt of official notification that an event is imminent, or underway, fire agencies will, in accordance with local plans, alert and mobilize all available personnel. They will determine the magnitude of the problem, determine what resources are available and what additional resources may be needed, and advise the Fire Mobilization Area Coordinator at the Unified Command.

They will also ensure that intake filters are installed on fire and other motorized equipment, and that respirators or other air filtering breathing apparatus, including dust masks, are available for their personnel.

Responders' families in hazard areas will be evacuated and cared for.

#### **B.4.3. Event Occurs Without Warning**

Upon notification that an event has occurred, fire agencies will, if they have not already done so, alert and mobilize all personnel. Specific activities will be directed via the local Incident Command Structure in coordination with the area Unified Command. They will then implement immediate lifesaving and rescue operations in concert with fire, law enforcement and search and rescue operations. They will conduct required fire fighting operations and perform disaster medical care at established CCPs. Augmentation of resources will be provided to the operational area fire zone coordinator through established plans.

### **D. Law Enforcement**

#### **C.1. Introduction**

This section addresses general procedures for law enforcement to ensure public order and restore essential services in a response to the occurrence of a hazardous event at Mt. Rainier. It also provides guidelines for law enforcement and supporting agencies associated with evacuation operations and control of access to hazardous areas. Implementation procedures for mutual aid and support, which can be expected from state and federal agencies, depending on the magnitude of the event, are also identified. Government agencies working at the local level have primary responsibility for protection of life and property and responsibility for developing specific plans to do so.

#### **C.2. Objectives**

The overall objectives of law enforcement and traffic control operations are:

- Mobilize, deploy and organize for law enforcement and traffic control operations.
- Assist in alerting and notifying the affected population.



- Report conditions, needs, damage assessment, and other vital information including road closures, bridge failures, collapsed buildings, casualty estimates and any other situation that would normally require emergency response.
- Provide traffic and crowd control in support of evacuation plans and in cooperation with other state and county agencies having similar responsibilities.
- Provide security and crowd control support at MASS care facilities, multipurpose staging areas, casualty collection points, storage areas, vacated areas, key facilities and vital institutions.
- Establish perimeter access control to facilitate ingress and egress for authorized personnel. Maintain liaison with search and rescue units to ensure proper deployment and control of trained and spontaneous volunteers.
- Assist in establishing a multipurpose staging area for incoming mutual aid, supplies, equipment, food and medical resources.

### ***C.3. Situation***

Mt. Rainier attracts a large tourist population to its recreational areas. The size of the tourist population fluctuates with the seasons and days of the week. The rivers that head on Mt. Rainier flow west towards Puget Sound through heavily populated valleys with many different jurisdictions and municipalities. The magnitude of evacuation and access control operations would depend mainly on the size of the tourist population and the time at which an eruption, or other hazardous event, is expected to occur. If evacuation is required of multiple river valleys, a large number of people will have to be moved in a very short period of time.

### ***C.4. Concept of Operations***

#### **C.4.1. Hazardous Volcanic Event Likely, But Not Imminent (Volcano Advisory)**

During a period of increased geologic activity, law enforcement and appropriate supporting agencies will prepare for a volcanic eruption, or other hazardous event, by reviewing and updating appropriate plans, SOPs and emergency checklists. They will inventory their resources, and check alerting, mobilization and communications procedures. They will review pre-identified evacuation routes and identify where perimeter control points will be established

If the threat of a hazardous event increases significantly, law enforcement agencies will confirm or if necessary, modify the locations of access control points. They will conduct a detailed survey of available resources needed for major law enforcement functions and traffic control. Availability of the following resources will be determined:

- Helicopters and other search and rescue equipment.
- Transportation for special populations.
- Tow trucks.
- Barricades and signs.

Agencies should attain a level of preparedness that would enable them to quickly initiate evacuation and access control operations. Key tasks will be to disseminate public information and to procure resources needed for law enforcement and traffic control functions. If it becomes necessary, wilderness areas may be closed in cooperation with NPS and USFS due to the difficulty of warning or evacuation.

#### **C.4.2. Hazardous Volcanic Event Imminent or Underway (Volcano Alert)**

Upon receipt of official notification that an event is imminent or underway, in accordance with local plans, agencies will alert and mobilize required personnel and implement evacuation of potentially affected areas using warning devices (loudspeakers, sirens) from air and or surface vehicles. This will require coordination with other local and state agencies to establish traffic control points and ensure an orderly and timely evacuation of residents and all other persons using pre-identified evacuation routes. Transportation assistance may be provided for schools, hospitals, health care facilities, the elderly and handicapped, and persons without access to automobiles as needed and if time and resources permit. After evacuation, perimeter access controls will be initiated for security purposes.

#### **C.4.3. Event Occurs Without Warning**

Should an event occur without warning, the local municipalities within the hazard zone will use all means available to warn the public and evacuate as many persons as possible to high ground. County Sheriff and State Patrol units will keep the pre-identified evacuation routes open and prevent any unauthorized access into the hazard areas.

Evacuees will be directed to collection points for later routing to shelters and reunion with other displaced family members. The public will have to be responsible for its own movement out of the hazard area, as time is insufficient to organize special transportation needs.

#### **C.4.4. Organization and Responsibilities**

The Sheriff of the affected county is the Chief Law Enforcement Officer in command of local and responding mutual aid forces. The Sheriffs' Office is the lead agency for search and rescue operations in the hazard area.

Municipal Police Chiefs are the Chief Law Enforcement Officer within the incorporated cities in the affected area and are responsible for evacuation of their populations.

The Washington State Patrol is the primary mutual aid agency for rapid response into the affected area for traffic control and perimeter security in direct assistance to the Sheriff of the affected area.

### **D. Evacuation and Movement**

#### ***D.1. Participants***

##### **D.1.1. Joint Primary Agencies**

Pierce County Department of Emergency Management

United States Geological Survey

Public Safety Answering Points

Pierce County Sheriff's Department

Washington State Patrol

Orting Police Department

Sumner Police Department

Puyallup Police Department

Fife Police Department

Carbonado, South Prairie and Wilkeson Fire and Police Departments

### **D.1.2. Support Agencies**

Cities of Bonney Lake, Buckley, Edgewood, Milton and Tacoma

American Red Cross Tacoma-Pierce County Chapter

KIRO NewsRadio 710 AM

Local Grocers and Water Purveyors

## ***D.2. Introduction***

### **D.2.1. Mission**

The Valley Evacuation Plan was developed by emergency services, government representatives and other stakeholders from the Carbon and Puyallup River valleys. The task was to identify methods for warning, emergency route identification and procedures for the movement and evacuation of affected persons as quickly and safely as possible.

### **D.2.2. Purpose**

This plan identifies an organized method to remove the residents of the Carbon and Puyallup River valleys to safety with minimal delay and confusion resulting from a threatening situation caused by volcanic and/or seismic activity on Mt. Rainier.

### **D.2.3. Scope**

The Valley Evacuation Plan applies to persons located in the Carbon and Puyallup River valleys at the time of volcanic or seismic activity originating on Mt. Rainier that necessitates the movement and evacuation of those persons. These persons include residents, workers, tourists and emergency responders.

Using the experience and knowledge of the planning representatives this plan outlines broad objectives that will provide the greatest protection of life that can be achieved with the resources available.

### **D.2.4. Organization**

All movement and evacuation operations will follow the principles of the National Interagency Management System (NIMS), called the incident command system (ICS), and establish a unified command comprising representatives of lead agencies.

## ***D.3. Policies***

### **D.3.1. Authorities**

This plan was created as a collaborative effort to meet a widely acknowledged need for coordination of evacuation activities along the Carbon and Puyallup River valleys. The Valley Evacuation Planning Group comprises representatives from law enforcement, fire service, emergency management, schools, volunteer relief agencies, emergency dispatch

and military disciplines along with the United States Geologic Survey (USGS) and National Park Service (NPS).

The Revised Code of Washington (RCW) 38.52 and Washington Administrative Code (WAC) 118.30 directly address the structure of governmental emergency management organizations and their responsibilities. RCW 38.52 provides the framework for mutual aid agreements and mandates the use of the incident command system in any multi-jurisdictional, multi-agency emergency response. The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288, as amended) addresses the federal government's authority in providing disaster response and recovery assistance.

Due to the multi-jurisdictional, multi-agency and inter-disciplinary nature of this plan, there are too many existing emergency policies on the local level to list in this section. The aggregate of these policies is, in some way, reflected in both the Concept of Operations and the Responsibilities of this plan.

### **D.3.2. Limitations**

The information and procedures included in this plan have been prepared utilizing the best information and planning assumptions available at the time of preparation. There is no guarantee implied by this plan that in emergency or disaster situations a perfect response will be practical or possible. This plan should be used as a guideline with consideration given to the unique needs of each and every situation.

## ***D.4. Situation***

### **D.4.1. Emergency/Disaster Conditions and Hazards**

Mt. Rainier is an episodically active volcano that towers more than 14,400 feet above expanding suburbs in the valleys that lead to nearby Puget Sound. Geologic study indicates that Mt. Rainier has repeatedly produced lahars that would be catastrophic today owing to intense development in the valleys. Comparable future lahars are to be expected.

### **D.4.2. Planning Assumptions**

- a. The residents of the valleys are expected to be self-sufficient for at least three days following a disaster. To the extent practicable, immediate basic needs will be provided by the benefit of pre-disaster preparedness.
- b. People will spontaneously evacuate areas when there is actual or perceived danger.
- c. Loss of life and property will occur in the event of a catastrophic lahar.
- d. It is assumed that evacuations last more than a few hours.
- e. As response resources may be depleted or unavailable and essential systems may be rendered dysfunctional, the emergency responders can only make every reasonable effort to respond based on the situation, information and resources available at the time the situation occurs.
- f. Transportation routes will be overwhelmed with people attempting to get to higher ground. The stalemate will hinder the access of first responders to assist in traffic flow.
- g. Debris may make streets and highways impassable and leave people stranded.

h. Support agencies and incorporated cities and towns will perform tasks and expend resources under their own authorities, including implementation of mutual aid agreements, in addition to resources received under the authority of this plan.

i. Pierce County will not have all of the resources, either in type or in quantity, that may be required for the movement and evacuation of a large and widespread population. Pierce County will endeavor to cooperate with the state Emergency Management Division (EMD) in the procurement of needed resources.

## ***D.5. Concepts of Operations***

### **D.5.1. General**

The design and installation of the Mt. Rainier Lahar Warning System was a collaborative effort with the United States Geological Survey and the Pierce County Department of Emergency Management. It is a system for automatic detection and notification of an unanticipated lahar.

Acoustic flow monitors (AFMs), developed by USGS scientists, are strategically placed throughout the Carbon and Puyallup River valleys. The design of the AFMs and supporting technology filter lahar type ground vibrations from those of large earthquakes or floods.

Computers located at the Law Enforcement Support Agency (LESA) and the state EMD receive and decipher signals from the AFMs. The detection of a lahar sets a series of actions into motion, which differ from those actions taken in other emergency or disaster situations.

### **D.5.2. Emergency Management Concepts**

Field and emergency operations center (EOC) operations will adhere to the principles and guidelines described in the National Interagency Management System (NIMS). A unified command will be established comprising operations chiefs of the responding agencies whether it is for field or EOC activities.

The Pierce County EOC will activate upon lahar detection and remain operational throughout the response and recovery phases unless events mandate otherwise.

The Pierce County Department of Emergency Management Comprehensive Emergency Management Plan (CEMP) and CEMPs of affected incorporated cities and towns outline, in greater detail, their respective actions during emergencies or disasters.

### **D.5.3. Direction and Control**

Direction and control provides for effective supervision, authority and cooperative functioning of emergency management activities undertaken with a large scale evacuation of this nature. It ensures continued operations during and after the lahar event.

Coordinated field command and operations implemented by a unified command structure are critical to safe and rapid evacuation of residents in the Carbon and Puyallup River valleys. Effective coordination is dependent on continued communications among field operations personnel and the EOCs.

The EOCs support field activities and coordinate resource requests.

### **D.5.4. Emergency Operations Facilities**

The primary Pierce County EOC is located in the basement of the County-City Building, 930 Tacoma Avenue S, Tacoma WA 98402-2102. Alternate locations will be determined as needed.

Pierce County EOC operational procedures are described in the Pierce County EOC Plan, July 1998 (published separately).

Individual jurisdictional EOCs will open in support of field evacuation activities.

#### **D.5.5. System Activation**

The AFMs transmit the signal of an encroaching lahar. The signal is received at LESA and the State EMD.

LESA and the State EMD alert identified agencies (**see Attachment A ~ FigureVI-3**).

#### **D.5.5. Public Warning and Information**

There are two primary warning systems for the transmission of lahar warnings. One is a combination of sirens and radio transmitters strategically placed in the river valleys. The other is the emergency alert system (EAS).

Upon receipt of the impending lahar, jurisdictions will activate a siren system. Subsequent to an aggressive public education campaign, residents will know to tune in to 95.3 FM to receive warning and evacuation information.

The transmitter will broadcast emergency warnings to people to evacuate off the valley floors as quickly as possible. Emergency information will follow warnings as time allows.

The EAS is the other primary warning system which will be activated and transmit emergency warning information. The Pierce County EOC is the lead agency in the development and transmission of warning messages. LESA assists in the development and transmission whenever the Pierce County EOC cannot initiate the process. The EAS transmitter is housed at LESA and maintained by the Pierce County DEM. (**See Attachment B**)

KIRO NewsRadio (710 AM) broadcasts EAS messages generated from the central Puget Sound area. It is recommended that this frequency be monitored along with other local news broadcasters.

Both of these warning systems will activate for the fastest dissemination of warning information.

Secondary warning methods such as public address systems and door-to-door dissemination may be used. The use of these secondary methods will be limited. They are inefficient and require personnel who would be involved in the actual evacuation and movement of people to be redirected for this activity.

#### **D.5.7. Evacuation and Movement**

It is anticipated that affected people will begin evacuation upon hearing the evacuation siren and or warning information transmitter over 95.3 FM or 710 AM or learning of it through other means. The desired result is to get people off the valley floor as soon as, and as safely as, possible.

Evacuation and movement of nursing homes, hospitals and other facilities are the responsibility of the individual establishments. Emergency services personnel will not be available to assist in these activities.

Upon the receiving the warning of a lahar, the cities of Bonney Lake, Buckley, Edgewood, Milton and Tacoma will initiate activities to receive arriving evacuees. Those activities include pre-identifying a collection site, assisting in evacuee registration, shelter site identification and setup, coordinating counseling and spiritual support and providing for long-term displacement of persons.

#### *Law Enforcement*

The cities of Orting, Sumner, Puyallup and Fife Police Departments have the responsibility for the evacuation of persons in their respective cities. If time and resources allow, police units will make rapid evacuation announcements using loudspeakers. PCSD units in the valleys will provide the same announcements in unincorporated Pierce County if time and resources allow.

Pierce County Sheriff's Department and Washington State Patrol have responsibility for keeping evacuation routes open, keeping traffic moving away from the valleys and preventing traffic jams. Traffic direction will not be restricted. It is understood that traffic flow will take on a nature of its own and will frequently limit itself to one direction. All PCSD and WSP units will respond to the evacuation route closest to current positions. These units will keep traffic moving as smoothly as possible and to direct evacuees to predetermined collection sites.

Carbonado, South Prairie and Wilkeson fire and police departments will assist in the evacuation of persons in their respective jurisdictions, as resources will allow.

#### *Evacuee Registration*

Persons are to arrive at the predetermined collection sites, as identified by individual jurisdictions and register with authorities. These authorities will be highly visible (wearing vests, helmets or other identifiers). (**see Attachment C, Figure VI-4: Map of Lahar Evacuation Routes for evacuation routes, collection sites and shelter locations.**)

Registration forms and other pertinent forms are under development.

#### *Fire Services*

Fire services will assist in the evacuation process to the extent possible. Fire suppression and rescue responsibilities will take priority.

#### *American Red Cross*

Shelters will be opened in close proximity to evacuee collection sites and remain open as long as services are needed.

### **D.6. Responsibilities**

#### *Pierce County Department of Emergency Management*

Rapid activation of the Pierce County EOC with adequate staffing and operational levels as appropriate.

Develop and transmit accurate and consistent warning information in the form of EAS messages or other media dissemination.

Coordinate jurisdictional EOCs and field resource support requests.

Maintain AFMs installed in the Carbon and Puyallup River valleys.

Maintain computers installed at LESA.

*United States Geological Survey*

Maintain the software supporting the lahar warning system technology.

Serve as scientific consultants for the warning system project.

*Public Safety Answering Points*

Provide expeditious warning to identified agencies ([see Attachment A](#)).

Provide dispatch service to field units throughout the evacuation process.

*Pierce County Sheriff's Department*

Direct traffic flow and maintain open evacuation routes.

Provide evacuation assistance for persons in unincorporated Pierce County.

*Washington State Patrol*

Maintain open highways and direct traffic flow.

Support PCSD evacuation activities if resources allow.

*Incorporated Cities Police Departments (Orting, Wilkeson, Sumner, Puyallup and Fife)*

Direct persons to appropriate evacuation routes.

Direct traffic and maintain flow.

*Cities of Bonney Lake, Buckley, Edgewood, Milton and Tacoma*

Provide reception services and support for evacuees.

*American Red Cross Tacoma-Pierce County Chapter*

Provide expeditious shelter openings in proximity to collection sites.

Maintain open shelters as long as necessary.

Maintain adequate staffing and support for all open shelter locations.

*KIRO NewsRadio (710 AM)*

Promptly broadcast EAS messages generated by the Pierce County EOC.

Accurately relay additional information provided by the Pierce County Emergency Public Information Officer.

*Local Grocers and Water Purveyors*



Support the human needs of evacuees in local communities with the stocking of food, water and hygiene supplies.

#### ***D.7. References***

Pierce County Department of Emergency Management Comprehensive Emergency Management Plan.

Pierce County EOC Plan.

City of Bonney Lake Comprehensive Emergency Management Plan.

City of Edgewood Comprehensive Emergency Management Plan.

City of Sumner Comprehensive Emergency Management Plan.

City of Puyallup Comprehensive Emergency Management Plan.

American Red Cross Disaster Plan.

#### ***D.8. Terms and Definitions***

Lahar ~ An Indonesian word for a flowing mass of mingled volcanic debris and water (Webster's Ninth New Collegiate Dictionary).

#### ***D.9. Attachments***

Attachment A ~ Figure VI- 3. First Responder Notification Tree (Pages 23- 24)

Attachment B ~ Emergency Alert System Pierce County Activation Procedures

Attachment C ~ Figure VI-4. Map of Lahar Evacuation Routes

### **E. Search and Rescue**

#### ***E.1. Introduction***

This section describes search and rescue (SAR) operations, possible problem areas, and courses of action in response to a volcanic, or other hazardous, event at Mt. Rainier. It also addresses implementation of mutual aid, other support and the procedures for acquiring this assistance. It describes those SAR operations that are primarily the Sheriff's responsibility, as compared to rescue operations that occur within the jurisdiction of fire protection districts. As addressed in this section, SAR support and assistance is available from Washington State EOC, from the Federal Government US&R program and from the US military. Local volunteer SAR teams are essential to augment operational and support functions.

#### ***E.2. Objectives***

To carry out a coordinated effort of search and rescue operations and support and to ensure the safety of persons who are not injured, but who require evacuation or other assistance, while maintaining the highest degree of safety for rescue personnel.

### ***E.3. Situation***

The scale of search and rescue operations to be carried out after an event, whether forecasted or unanticipated, may be monumental. The ability to deploy personnel and to respond will be directly affected by:

- Time of occurrence
- Season of the year
- Current weather
- Magnitude of event
- Ability of mobilized personnel
- Effect of airborne ash on mobile equipment and personnel
- Road conditions
- Actions of people
- Loss of power
- Fire potential in dry season
- Potential flooding
- Adequate logistical support
- Communication and control

### ***E.4. Concept of Operations***

Search and rescue operations in this plan interact directly with evacuation and access control operations. In the case of a forecast event, search and rescue will be mobilized ahead of time to carry out operations in concert with evacuations and during the actual occurrence of the event. In an unanticipated event, potential victims must get out of the hazard area on their own or get to a safe area and await rescue from the SAR response team.

Local fire districts will assist with evacuation and conduct rescue operations within their jurisdictions, if within their capabilities and in coordination with the overall SAR mission commander. This will reduce duplication and ensure the safest possible response for both victim and rescue personnel.

The general concept of SAR operations require that SAR coordinators direct a coordinated response to minimize loss of life, reduce confusion and redundancy, and rescue and recover disaster victims in the most efficient manner with the closest, most qualified resources. To this end, SAR coordinators will:

- Be decisive in directing and utilizing manpower and other resources.
- Prioritize response; risk areas with high potential loss of life should be high priority.
- Assure a safe and orderly search and rescue operation.
- Be responsive to families or relatives who may have lost loved ones.

- Carry out the SAR responsibility throughout the entire effected area under one unified effort.
- Provide information to the media and public about ongoing SAR operations.

#### **E.4.1. Hazardous Volcanic Event Imminent or Underway (Volcano Alert)**

Upon receipt of official notification that an eruption or other hazardous volcanic event is imminent or is occurring, search and rescue forces will:

- Be alerted and directed to mobilize to the primary staging area at the Operations Command Post.
- Respond to specific mission assignments as directed by the SAR Mission Coordinator.
- Assist with evacuations where possible and as needed.
- Preposition support equipment.
- Utilize respirators and other air filtering breathing devices and eye protection as needed.

#### **E.5. Available SAR Resources**

- County Sheriff SAR Coordinators  
Manage, direct and respond, rescue and recovery operations.
- Volunteer SAR Teams (state and local)  
Wilderness, remote response, rescue and recovery, swiftwater.
- Fire Service Special Operations Teams  
Urban and municipal response, and medium to heavy rescue, swiftwater.
- Military (federal and state)  
Support, logistics and response as appropriate.
- Federal Response Teams (US&R Task Forces)  
Urbanized areas, recon, recovery, response, heavy rescue.
- National Park Rangers  
Wilderness, remote region response, logistics and planning support.
- USFS Employees  
Wilderness, remote regions response, mapping, plans, logistical support.

## **F. Agency Responsibilities and Tasks**

Following are the detailed responsibilities and tasks of jurisdictions and agencies at the various levels of notification.

### ***F.1. Local Jurisdictions and Agencies***

#### **Following a Notice of Volcanic Unrest:**

- Identify agency member to the Regional Advisory Group (RAG).
- Complete plans and procedures for response to the Mt. Rainier volcanic hazards threat.
- Designate individuals who will be responsible for filling positions in the local ICS and/or Unified Command Structure as requested.
- Provide orientation sessions on updated plans and organizational structure.
- Establish call-up procedures for all staff.

#### **Hazardous Volcanic Event Likely, But Not Imminent During a period of increased geologic activity (Volcano Advisory):**

- Designate a liaison to the Unified Command Structure.
- Update personnel lists.
- Conduct surveys on resource availability and reaffirm prior commitments.
- Test communications systems and stockpile additional hardware.
- Hold exercises for all emergency operations.
- Begin procurement of needed resources.
- Provide information specialist to support the Unified Command PIO.
- Provide briefings and direction to all response personnel.
- Request all assigned personnel to standby for orders to activate emergency plan.
- Take readiness and precautionary actions to compress response time and to safeguard lives, equipment and supplies.

#### **Upon receipt of official notification that a volcanic or other hazardous event is imminent or occurring (Volcano Alert):**

- Fully mobilize all assigned personnel and activate all or part of the Mt. Rainier hazard plan.
- Continually broadcast emergency public information.
- Direct and control emergency response activities in each jurisdiction in accordance with ICS procedures.
- Assign liaison personnel to the Unified Command Structure.

### **F.1.2. State Agencies**

**Following a Notice of Volcanic Unrest:**

- Complete internal plans and procedures.
- Provide planning and technical assistance to local jurisdictions.
- Coordinate with other Emergency Support Functions (ESF) agencies that will provide assistance.
- Coordinate mutual aid agreements with neighboring states.
- Arrange for assistance from federal agencies.
- Determine resource requirements.
- Issue advisories and state level policies in consultation with the RAG.
- Prepare and conduct training exercises.

**Hazardous Volcanic Event Likely, But Not Imminent (Volcano Advisory):**

- Convene a meeting of the RAG.
- Implement plans for state-level communications support within the affected area.
- Support public education programs.
- Increase, as needed, the staffing at the EOC; support local government with PIO information.
- Ensure that state agencies are alerted to potential problems and review their operational responsibilities.
- Assign liaison to local unified command when activated by the RAG.

**Hazardous Volcanic Event is imminent or underway (Volcano Alert):**

- Coordinate the state response to the emergency.
- Coordinate interstate mutual aid.
- Coordinate federal response.

*Washington State Patrol*

At all notification levels:

- Provide traffic control for the evacuation.
- Assist in access control.
- Assist local law enforcement with security and law and order.

*Military Department/National Guard*

At all notification levels, provide support in the following areas:

- Fire
- Security
- Evacuation
- Search and Rescue
- Disaster Medical Care
- Disaster Public Health
- MASS Care Sheltering
- Coroner Services
- Public Works
- Environmental Concerns

#### *Department of Transportation*

At all notification levels:

- Support traffic control, evacuation, access control and SAR operations.
- Keep roads free of snow and debris.
- Clear evacuation and access routes of debris.

#### *Department of Social and Health Services*

At all notification levels:

- Coordinate state agency support to MASS care services.
- Coordinate with American Red Cross and others in the operation for sheltering and other care centers and provide personnel and resources to the centers.

#### *Department of Corrections*

At all notification levels:

- Provide labor force if required

### **F.1.3. Federal Agencies**

#### *Federal Emergency Management Agency*

At all notification levels:

- Coordinate federal response

#### *Federal Aviation Administration*

At all notification levels:

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

#### *US Geological Survey*

At all notification levels:

- Monitor the status of seismic and geologic activity in the hazard area.
- Issue alert-level notifications and updates.
- Provide liaison to the RAG in order to provide ongoing information and advice.

#### *National Park Service and US Forest Service*

Implement plans to participate directly in the following coordinated response operations within the affected areas at all notification levels:

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

#### *National Weather Service*

At all notification levels:

- Provide weather forecasts, including wind conditions to the RAG and Unified Command Structure.
- Issue flood warnings.

## **VII. Public Information**

### **A. Volcanic crises are times of great uncertainty**

Restless volcanoes can challenge public officials more than most other natural hazards because they present multiple uncertainties about when eruptive or other hazardous activity will begin, how long it will last, and who will be affected. Unlike floods and earthquakes, volcanic eruptions are seldom singular events; unrest is often prolonged over a period of months to years with no predictable end. Sometimes, volcanic unrest may never culminate in an eruption. Even without eruption, the uncertainty associated with volcanic unrest can cause a major psychological and economic impact on the population.

Volcanoes commonly produce multiple hazards, each of which requires the vigilant attention of authorities and the public. For example, volcanic ash can fall over vast areas and disturb the routines of people living even at great distances from the volcano. The paths of lahars can be more closely estimated, but their timing and size remain unpredictable. At Mt. Rainier, the risk of possible landslides adds uncertainty, even when the volcano is quiet.

The possibility of multiple hazards and the wide range of uncertainties in timing and duration require that authorities and populations at risk, both close to and far from the volcano, be knowledgeable about volcanic hazards so that they can be flexible in their response.

## **B. Public perceptions of volcanic hazards**

### ***B.1. The eruptions of Mt. St. Helens are a fading memory.***

During the early 1980's, much of the population of the Pacific Northwest learned first-hand about volcanic phenomena while observing the eruptions of Mt. St. Helens. However, the large influx of people to the Pacific Northwest since then and the passage of time have diluted that experience. Today, people at risk may respond to volcanic hazards with little knowledge, and a range of attitudes that include panic, curiosity, indifference and fatalism.

### ***B.2. Television, videos and some educational materials can create misconceptions.***

Educational and adventure TV and videos emphasize colorful Hawaiian-style lava eruptions. This emphasis can be misleading to populations in the northwest because Hawaiian volcanic activity bears little resemblance to the behavior of Cascade volcanoes. At this writing, there are inadequate resources for proper teaching of hazards at northwest volcanoes and the risk from lahars. This issue is being addressed in the Public Awareness Plan found in **section VIII-B**.

### ***B.3. Civil authorities must understand volcanic hazards so that they can be prepared personally and professionally.***

When civic leaders are knowledgeable about hazards, they are better prepared to make responsible decisions about land-use and emergency-response plans, and carry out appropriate measures during actual volcanic unrest. During volcanic unrest, there will be a sharp increase in the number of citizens, institutions and businesses anxious to learn about volcanic hazards, and the job of educating them will fall in part to civil authorities. Thus, it is important for civil authorities to familiarize themselves with Mt. Rainier, its eruptive style and the hazards it poses.

## **C. Effective communication between scientists and officials**

### ***C.1. Civil authorities, business interests and scientists benefit from discussions about communication.***

Scientists and civil authorities often gather after volcanic crises to analyze their responses and suggest improvements for future mutual endeavors. Some of their comments are noted below. The suggestions in this section were taken from discussions with scientists and public officials, from the United Nations Educational, Scientific and Cultural Organization (UNESCO) document 'Reducing Volcanic Risk', from the International Association of Volcanology and Chemistry of Earth's Interior's (IAVCEI) recommendations for professional conduct during volcanic crises, and from papers at the IAVCEI-sponsored *Cities on Volcanoes* meeting held during June-July, 1998. Four major precepts derived from these sources are:

- Develop and maintain a pre-crisis rapport between scientists and public officials.



- Build effective communication with non-technical, well-defined language.
- Strive for consensus among involved scientists regarding likely hazards.
- Publicly discuss hazards, uncertainties and levels of acceptable risk.

### ***C.2. Develop and maintain a pre-crisis rapport between scientists and public officials.***

Communication between scientists, civil authorities and business leaders is optimized when each understands the needs of others and the limits of information that can be provided. These groups must develop a dialog *before* an emergency arises so that they can communicate effectively during a crisis.

### ***C.3. Build effective communication with well-defined, non-technical language.***

There is a 'language of science' and a 'language of human affairs', and all too often a language barrier exists between the two. Civil authorities and business interests speak of a need for certainty: 'yes' or 'no' answers, while scientists speak in terms of probabilities. Sheriff Les Nelson of Cowlitz County commented during the volcanic crisis at Mt. St. Helens that getting a straight answer out of the scientists was 'like trying to corner a rat in a round house'. Too often, terms and abbreviations used by groups of scientists and civil authorities are confusing and unfamiliar to each other. Effective communication between scientists and public officials begins with well-defined, non-technical language.

### ***C.4. Strive for consensus among involved scientists regarding likely hazards.***

Civil authorities at a seminar held by UNESCO after the eruption of La Soufriere, Island of Guadeloupe, West Indies in 1976 noted that the most important action scientists could take on important scientific issues was to *develop a single collective opinion by consensus*. Scientists do not always agree on interpretation of observations and data or may make conflicting predictions. Public officials should be informed of such disagreement by a single source of information, away from the media. Scientists and civil authorities who speak without a unified voice risk losing the attention of the public. Multiple sources of scientific information, if made public, can cause confusion and complicate emergency responses.

### ***C.5. Publicly discuss hazards, uncertainties and levels of acceptable risk.***

IAVCEI recommends that public officials engage local citizens and media in discussions about what level of risk they are willing to accept before precautionary measures are taken. The greater awareness of these hazards that the general public and officials have, the greater this mutual support can be parlayed into necessary mitigative action. Civil authorities and business interests who understand hazard are more likely to get involved in both personal and community preparations. Public understanding of volcanic hazards increases the successful implementation of emergency response plans. When people are knowledgeable about all likely scenarios, they are less likely to perceive lack of expected volcanic activity as a 'false alarm', and are more likely to remain attentive to scientific and civil authorities.

## **D. Communication with the news media and public:**

### ***D.1. Work with the media to enlist their support; provide alternatives.***

IAVCEI recommends that scientists work with the media to develop comprehensive public education materials about volcanic hazards. Such materials include daily written reports, updates, group field trips, group interviews and an informative internet site. Frequent group press briefings assist the media and reduce time constraints on scientists and public officials; they encourage accurate and consistent reporting. During a crisis, reports should be provided to the news media soon after public officials have had time to understand the contents and implications and to formulate a response. Each member of the information center must be cognizant of each other's roles and agree to refer questions to appropriate spokespersons.

Scientists at the 1995 eruption of Ruapehu in New Zealand found it important to time their news releases to accommodate the deadlines of the media. When authorities did otherwise, they lost the attention of the media and mistakenly encouraged reliance on other reports that were conflicting but available, or that were innocuous but less relevant to the crisis at hand.

During emergencies, civil authorities have found that a joint information center (JIC) is an efficient way to coordinate the flow of information among groups. The structure of a JIC is described in **Section E**.

### ***D.2. Choose qualified media-savvy spokespersons; direct access to scientists is problematic.***

IAVCEI recommends that the scientific team 'should choose one or two scientifically qualified media-savvy spokespersons', who can provide high quality and consistent information. All media contacts should be coordinated through these spokespersons.

According to the UNESCO document, the news media is sometimes allowed free access to scientists and civil authorities. Advantages include making it evident to the public that information is coming directly from knowledgeable authorities and that no important information is being filtered. The news media are less tempted to consult less knowledgeable 'authorities' with this approach. Disadvantages include situations where scientists or local authorities do not speak with a single voice and contradict, or appear to contradict each other. This policy can take significant amounts of time from scientists and emergency response personnel who have other tasks monitoring and responding to the unrest.

### ***D.3. Information must be clear, complete, non-technical, factual and timely.***

Information must be presented in a way that indicates that all significant facts are given. Confusion results when scientific terms are not understood by civil authorities or the public, and when information transmitted by the news media is incomplete or distorted. Rumors will almost certainly crop up and the sooner and more consistently they are addressed, the better.

## **E. Joint Information Center ~ Purpose and Structure**

### ***A Joint Information Center coordinates information flow:***

The purpose of a Joint Information Center (JIC) is to coordinate the flow of information about the state of the volcano and related response issues among agencies, and to provide a single information source for the media, business community and general public. The JIC is an element of the Emergency Operations Center (EOC) where the emergency response is coordinated. Communication among agencies, and to the media and public must be rapid,

accurate and effective, and a JIC provides a forum for the necessary information exchange. Public information among and from all responding agencies, emergency operations centers, political jurisdictions and the media are handled through this one center, thereby allowing the coordination of information from all sources, and reducing or eliminating conflicting information and rumor. Temporary media offices at the Washington Emergency Management Division (WEMD) should encourage an efficient flow of information from the JIC.

The establishment of a JIC may be necessary under one or more of the following circumstances:

Multiple local, state and federal agencies are involved in the information dissemination about a possible volcanic crisis.

The volume of media inquiries appears to overwhelm the capabilities of the public information officers within the emergency operations center.

A large-scale public phone-team effort must be maintained over an extended period of time.

When conditions warrant, or when a Volcano Advisory (**see section V-B**) is declared, a JIC will be established. The JIC will be administered by the Washington Military Department Office of Emergency Management and will most likely be located at the EOC facilities at Camp Murray or at another designated facility if necessary. The JIC facility must have office space for the public information officers, facilities for communication by FAX, phone, email, Internet connections, briefing rooms, easy access for the media, available food service and security.

## **F. Recommended Structure for JIC during an Incident**

### ***F.1. Potential Participants:***

Washington State Emergency Management Division

U.S. Geological Survey

National Park Service

U.S. Forest Service

Washington Department of Natural Resources

Pierce County Department of Emergency Management

King County Office of Emergency Management

Lewis County Department of Public Services ~ Emergency Management Division

Thurston County Emergency Management

Others as required

## ***F.2. Operating Assumptions***

- a. All information will be coordinated among the response staff to ensure timely and accurate information flow to the public, to quell rumors, and to expedite the response effort.
- b. Joint Information Center (JIC) will operate a briefing and news release schedule, possibly around the clock to accommodate the press/media corps.
- c. JIC will operate under the incident command system.
- d. The Joint Information Center will adjust its size and scope to match the size and complexity of the event.
- e. Each agency participating in the Response/Recovery Operation will designate at least one public information officer or representative to serve in the JIC.
- f. Public Information Officers in the JIC will perform functions for their own agencies as well as service in positions with the various JIC functional groups.

Agency specific activities might include:

- Printing a news release on their own letterhead that announces key decisions and actions.
- Providing information to main agency headquarters such as news releases, videotapes and incident fact sheets.
- Providing guidance on public information issues from an agency's expertise and knowledge.

## ***F.3. Organization***

- a. The agencies with principal involvement will provide Public Affairs Leads and Deputy Leads for the Joint Information Center Command Decision Desk.
- b. The Decision Desk will designate a Joint Information Center Manager and Deputy Manager.
- c. Five major functional areas need to be staffed:
  - Information Production, Creative Services, Writing and Research.
  - Interagency Coordination/including liaison to Incident Command Staff and Incident Operations Center.
  - Media Contact/including Rapid Response.
  - Public Affairs Officer (PAO) Liaison/including Community Relations and remote media site locations.
  - PAO Support and Logistics/including posting and distributing of key information within the JIC.

## ***F.4. Location of Facilities***

- a. The JIC will be set up as closely as possible to, and preferably co-located with, the unified command post.
- b. The scope of the event could require separate buildings for the JIC and for a media briefing/press conference facility.

## ***F.5. Staffing***

- a. Staffing levels will be flexible, ranging from as few as 4 to 6 people to as many as 60.
- b. Staffing should start with agencies conducting the response. Additional staff should be sought from other state and federal agencies as needed.

## **VIII. Public Education and Long-term Maintenance of Public Awareness & Preparedness**

### **A. The Message ~ Learn, Inquire and Plan**

The Public Awareness Team has developed a three-pronged message to encourage public understanding of hazards, and involvement in community, business and personal preparations. This message or one with similar language is used consistently in all resources provided for the public, business interests, educators, public officials and the media. The committee recommends that this message be used in future resources.

**Learn:** Learn about volcanic hazards and how they affect your community. Determine whether you live, work, or go to school in a volcanic hazard zone

**Inquire:** Find out what steps local officials have taken to prepare for volcanic events. Ask public officials how they advise you to respond

**Plan:** Develop plans for your family and business so that you are prepared for natural hazards and emergencies

### **B. Long-term Public Awareness Plan**

During 1998, the Mt. Rainier Working Group Public Awareness Team developed a plan to enhance public awareness of volcanic hazards in the long term. This entails development and maintenance of a supply of materials for the public, public officials, educators and the media. We anticipate that the plan will be updated and revised on an 'as needed' basis. Readers are invited to contact the source agencies listed to obtain these products and services for professional and personal preparation.

#### ***B.1. Resources for public officials, business interests, educators, the public and media***

##### **B.1.1. General public and business interests**

(See list of Information Contacts at end of chapter for names, addresses and telephone numbers of sources)

#### **1. Washington State Department of Natural Resources (WaDNR) Division of Geology Library ~ Library Special collection: 'Practical responses to volcanic hazards'**

**Description:** A collection of publications that describes how communities around the world have been affected by and have responded to volcanic eruptions. Some publications are scientific; others are anecdotal accounts by public officials with their advice for how others might respond when faced with similar events. The collection includes literature about impacts on community infrastructure, psychological responses, engineering specifications for withstanding ash fall, successful techniques for ash removal, health risks, and hazards from the volcanoes of Washington State. This is a selection from a much larger collection that in 1998 contained about 2,000 entries on volcano issues. The collection is being continually updated. Materials can be selected by topic. Photo reproduction is available at a nominal fee.

**Source:**

Washington State Department of Natural Resources (WaDNR)

Division of Geology Library

1111 Washington St. SE

Olympia, WA. 98504-7007

**Contact:**

Connie Manson, Senior Librarian

**Date of Availability:** Available now

Hours: Monday through Friday 8:00-4:30

**Agency commitments:** The WaDNR Division of Geology library staff will continue the search for new materials and make acquisition as resources allow.

**2. 'Annotated bibliography of practical responses to volcanic hazards'**

**Description:** This is an annotated bibliography of select technical literature available in the WaDNR library collection referred to above. It is designed for business interests, the public and others who need technical information about preparing for and responding to volcanic eruptions. The bibliography also contains a list of other resources including web sites, educational materials and source agencies. The bibliography should be updated when required by the presence of new materials.

**Source:**

WaDNR ~ Division of Geology Library

(Address above)

**Date of Availability:** 2000

**Agency Commitments:** WaDNR and the USGS will update the bibliography when new resources make the present edition sufficiently obsolete.

**3. Brochures about Washington volcanoes ~ hazards and suggested responses**

**Description:** We envision a series of brochures that includes a brief history of each volcano, an explanation of hazards associated with each and advice from local emergency officials about how to respond.

**Source:**

State and local emergency management agencies; Forest Service, USGS.

**Date of Availability:** Unknown (between 2000 and 2003)

**Agency commitments:** The public awareness team will explore the interest of local emergency management and land-use agencies and seek their involvement in this venture. The format and content will depend on the desires of project participants.

**4. Automatic dispersal of information**

**Description:** The public awareness team is pursuing placement of information about volcanic emergencies in telephone books in western Washington.

**Source:**  
Telephone books

**Date of Availability:** 2000

**Agency Commitments:** USGS will pursue inclusion of information in appropriate phone books. USGS will investigate other means of passively making information available to the public.

## 5. Speaker's Bureau

**Description:** The team is assembling a list of speakers willing to make presentations for public, business and professional groups. Speaker specialties will range from volcanic processes and hazards to emergency response advice

**Source:**  
USGS, WaDNR, local emergency response agencies.

**Date of Availability:** 1999

**Agency Commitments:** USGS, WaDNR and local emergency response personnel will be available to the public and professional groups for presentations.

## 6. Website links

**Description:** Linked Websites increase availability of a variety of information about volcano history and hazards, hazard zonations, emergency preparations and educational materials. See agency and web site listing in 'Information Contacts' following this section

**Source:**  
USGS, NPS, PCDEM, others.

**Date of Availability:** Available now

**Agency Commitments:** USGS, NPS, PCDEM and perhaps others will continue to pursue website links that improve availability of information.

## 7. National Park Service interpretative work

**Description:** Interpretative staff at Mt. Rainier National Park have developed a plan for including 'geohazards' information in all their interpretative activities.

**Source:**  
National Park Service (NPS)

**Date of Availability:** Available now (ongoing)

**Agency Commitments:** During 1998, staff at Mt. Rainier developed a plan for interpreting geohazards to visitors at Mt. Rainier. During the next five years, they will implement the plan by interpreting geohazards information in their walks, exhibits and presentations. USGS will continue to assist in providing the most up-to-date information about Mt. Rainier geologic history and hazards through training and resource materials.

### B.1.2 Public officials

## **1. 'Living with a volcano in your back yard: Mt. Rainier volcanic hazards ~ a prepared presentation for use by public officials and educators'**

**Description:** This 38-slide presentation with expanded captions is compiled by the U.S. Geological Survey (USGS) at the request of the Mt. Rainier Volcanic Hazards Working Group. It is designed for public officials and educators who want to teach about the volcanic hazards at Mt. Rainier. It can be used in total, edited for specific audiences, or used as part of a larger presentation.

**Source:**  
USGS

**Date of Availability:** Available now

**Agency Commitments:** USGS has made the presentation available to agencies who have been involved in the Working Group and beyond on the basis of availability. USGS will pursue additional means of distribution such as the Internet and other contemporary digital formats.

## **2. Training of Public Information Officers about Volcanic Hazards**

**Description:** Members of the Public Awareness Team will provide presentations to local groups of Public Information Officers and will pursue more formal training for larger groups that are likely to share a role in addressing volcanic unrest. Several Pierce County PIO offices have received information already; we envision enlarging this program in other counties in the future. Readers with interest should contact the offices listed below.

**Source:**  
George Crawford, Washington Military Department Emergency Management Division (WEMD); Richard Schroedel, Pierce County Dept. of Emergency Management (PCDEM).

**Date of Availability:** Available now

**Agency commitments:** Training will be done on request; team members will pursue additional opportunities.

## **3. Mt. Rainier Traveling Community Exhibit**

**Description:** The Mt. Rainier traveling community exhibit is a four-panel table-top exhibit that explains Mt. Rainier volcanic processes, hazards and hazard zones. The exhibit has been displayed at more than 100 libraries and emergency response fairs since it was developed in 1996. Three copies exist; all are available on request for display at schools, libraries, and professional and community events.

**Source:**  
USGS

**Date of Availability:** Available now

**Agency Commitments:** USGS commits to printing and maintaining clean and updated copies when necessary. USGS will strive to have three copies available for public use.

## **4. Seminars and workshops for civil authorities and business interests**

**Description:** The agencies below seek opportunities to participate in professional forums where volcanic hazards and appropriate responses can be discussed.



**Source:**

USGS, WaDNR, PCDEM

**Date of Availability:** Available now

**Agency Commitments:** USGS, WaDNR and county emergency management agencies will pursue opportunities to present information about volcanic hazards and suggested responses.

**B.1.3 Educators****1. Poster: 'Living with a volcano in your back yard ~ Mt. Rainier volcanic hazards'**

**Description:** Color poster and reverse-side activity guide was assembled by the USGS, National Park Service (NPS) and area teachers from Orting, Washington. It explains volcanic processes and hazards at Mt. Rainier. Poster is delivered folded. Activities on reverse side may be photocopied freely and distributed to students.

**Source:**

USGS, local emergency management agencies.

**Date of Availability:** Available now

**Agency Commitments:** USGS is printing the poster; USGS and WaDNR will advertise its availability.

**2. Curriculum: 'What to do with a volcano in your back yard'**

**Description:** This is an activity and curriculum containing information about Mt. Rainier volcano and volcanic processes. The educator's guide contains activities, information, graphics and digital data for educators. The educator's guide is being written by the USGS, NPS and a group of teachers in the vicinity of Mt. Rainier.

**Source:**

USGS, Mt. Rainier National Park, WEMD.

**Date of Availability:** 2000

**Agency Commitments:** The agencies above will see the educator's guide through to completion, advertise its availability and distribute to a select number of schools.

**3. Workshop for Educators: 'Living with a volcano in your back yard'**

**Description:** This two-day workshop is offered annually to elementary through college level educators. Participants take field trips, do lab experiments and receive teaching resources. The class is offered in an abbreviated form on request.

**Source:**

USGS

**Date of Availability:** Available in summer

**Agency Commitments:** USGS intends to offer the workshop annually or more frequently as resources allow and interest exists.

**4. State-wide curriculum about volcanic hazards**

**Description:** This is a natural offshoot of our work with educators at Mt. Rainier and is a longer-term goal. We continue to pursue leads for involvement and funding by appropriate authorities and anticipate further work on the issue during 1999.

**Source:**

USGS and educational and agency partners.

**Date of Availability:** Unknown

**Agency Commitments:** USGS will seek partners.

**5. Multiple hazards education**

**Description:** The same areas that are at risk from volcanic hazards are also at risk from earthquakes and flooding and landslides. We plan to explore ways to better integrate volcanic hazards into multi-hazards education and to provide a more accurate representation of hazards for any given area.

**Source:**

USGS, WaDNR

**Date of Availability:** Available (in part) now

**Agency Commitments:** USGS and WaDNR will continue to pursue methods for making hazard assessments interdisciplinary.

**B.1.4. Media**

**1. Press Packets**

**Description:** Packets of materials about volcanic hazards and suggested emergency responses for the media are an idea yet to be fully explored. It is possible that such a packet would not be assembled until volcanic unrest made it necessary.

**Source:**

USGS, WaDNR, PCDEM, others

**Date of Availability:** Unknown

**Agency Commitments:** The above agencies will pursue a recommendation on the necessity of press packets.

**B.1.5. Time-line**

**Time-line for Completion of Products and Services**

	Available	1998	1999	2000	2001	Unknown
<b>General Public</b>						
Library Collection	X					
Bibliography of practical responses				X		
Brochures about WA volcanoes						X
Automatic dispersal of information				X		
Speaker's Bureau			X			
Web site links	X					
National Park Service interpretive work	X					

<b>Public Officials</b>						
'Living with a volcano...' prepared talk	X					
PIO volcanic hazards training	X					
Mount Rainier community exhibit	X					
Seminars for civil authorities	X					
<b>Educators</b>						
'Living with a volcano...' poster	X					
'What to do with a volcano...' curriculum				X		
'Living with a volcano...' workshop	X					
State-wide volcanic hazards curriculum						X
Interdisciplinary hazards education	X					
<b>Media</b>						
Press packets						X

### C. Information Contacts

#### Mt. Rainier Geologic Hazards and Emergency Preparedness

American Red Cross	(703) 206-7090
Tacoma/Pierce County Chapter	(253) 474-0300
Lewis County Chapter	(360) 748-4607
Thurston/Mason County Chapter	(360) 352-8575
Yakima Valley Chapter	(509) 457-1690
Federal Emergency Management Agency (FEMA)	(800) 480-2520
Region 10 (WA, OR, ID, AK)	(425) 487-4600
U.S. Geological Survey (USGS)	
Cascades Volcano Observatory	(360) 993-8900
Locate publications, maps, data.	(800) USA-MAPS
USGS Volcano Hazards Program	
Mt. Rainier National Park	(360) 569-2211
Washington State Dept of Natural Resources (Geology & Earth Resources)	(360) 902-1450
DNR-DGER Library 1111 Washington St. SE Olympia, WA	(360) 902-1472 Hours: 8 - 4:30, M-F
State of Washington Military Dept, Emergency Management Division	(253) 512-7000
	(800) 562-6108
Pierce County Dept. of Emergency Management	(253) 798-7470
Lewis County Dept. of Public Services ~ Emergency Management Division	(360) 740-1151
King County Office of Emergency Management	(206) 296-3830
Thurston County Emergency Management	(360) 754-3360
Disaster Educators of Puget Sound/WSU Coop Extension/King County	(206) 296-3425 Preparedness tapes available 24 hours, or ext 63425, 8:30 - 4:30,

Volcanic Hazard Mitigation  
Emergency and Disaster Planning  
Information  
Natural Hazard Center at University  
of Colorado, Boulder

M-F  
(800) 325-6165

## **D. For Additional Reading**

### ***D.1. Volcanic processes and hazards at Mt. Rainier***

*(For general reading, see Volcanic Hazard Fact Sheets in back of plan.)*

#### **Scientific publications:**

Driedger, C.L., Faust, L., Lane, L. Smith, M., Smith R., 1998, **Mt. Rainier ~ The volcano in your back yard, poster and activity guide for educators**: U.S. Geological Survey miscellaneous publication, 2p.

This poster and reverse-side activity guide are intended for middle and elementary school students. Activities are presented thematically and include learning from the past, enjoying the present, planning for the future, and listening for information. The poster is available free from the USGS Cascades Volcano Observatory in folded and flat formats.

Driedger, C.L., Faust, L., Living with a volcano in your backyard: ('Mt. Rainier Traveling Community Exhibit' ~ tabletop exhibit for loan)

This 32 square-foot exhibit can be displayed on a 5-foot long table. Content includes Mt. Rainier volcanic hazards with brief information about past geologic history. The exhibit has been displayed at more than 100 location in communities at risk since 1996.

Hoblitt, R. P., Walder, J.S., Driedger, C.L., Scott, K. M., Pringle, P.T., Vallance, J. W., 1998, **Volcano Hazards from Mt. Rainier, Washington, Revised 1998**: U.S. Geological Survey Open-File Report 98-428, 11 p., 1 pl.

This report (1) explains types of hazardous geologic phenomena that could occur at Mt. Rainier, (2) shows areas that are most likely to be affected, and (3) estimates the likelihood that those areas will be affected.

Scott, K. M., Vallance, J. W., Pringle, P. T., 1995, **Sedimentology, Behavior and Hazards of Debris Flows at Mt. Rainier, Washington**: U.S. Geological Survey Professional Paper 1547, 56 p., 1 pl.

Defines the origins, magnitude and frequency of debris flows with particular reference to volcanic hazards. Risk analysis, design or planning cases and hazard zonation is described in hydrologic and hydraulic terms for land-use planners and civil engineers.

Scott, K. M., Vallance, J. W., 1995, **Debris Flow, Debris Avalanche and Flood Hazards At and Downstream from Mt. Rainier, Washington**: U.S. Geological Survey Hydrologic Investigations Atlas HA-729, 9 p., 2 maps.

This map and accompanying text portrays areas most at risk from lahars originating at Mt. Rainier. Areas at risk have been delineated based on the extent of three different types of past lahars, including origin by landslide, by excessive melt water during volcanic eruption and by floods of glacial origin. The publication is the basis for lahar hazard zones displayed on the Mt. Rainier hazard assessment.

Scott, K.M., Wolfe, E.W., Driedger, C.L., 1998, **Mt. Rainier ~ Living with Perilous Beauty**: U.S. Geological Survey Fact Sheet 065-97, 4 p.

Four-page summary of the Mt. Rainier Hazard Assessment (USGS Open File Report 98-428) designed for the general public. Discusses volcanic processes at Mt. Rainier, displays schematic maps and suggests general steps which encourage personal preparation for a volcanic emergency.

#### **Educational products:**

Driedger, C.L., Wolfe, E.W., Scott, K.M., 1998, **Living with a volcano in your backyard: Mt. Rainier volcanic hazards ~ A prepared presentation for use by public officials and educators**: U.S. Geological Survey open-file report 98-519, 38 slides, 16 p.

Krafft, Maurice, 1995, **Understanding Volcanic Hazards**: produced by United Nations Educational Scientific and Cultural Organization (UNESCO) and International Association of Volcanology and Chemistry of Earth's Interior (IAVCEI), **25-minute video**.

This video features stunning images of erupting volcanoes and graphically shows how volcanic activity can affect people, their property and the land on which they live. The program focuses on volcanic hazards including ash falls, hot ash flows, mudflows, volcanic landslides, volcanic tsunamis, lava flows and volcanic gases. Dramatic film footage illustrates each of these threats in detail.

U.S. Geological Survey, 1996, **Perilous Beauty ~ The Hidden Dangers of Mt. Rainier: 29-minute video**.

This 29-minute video uses computer animation, eruption footage, interviews with scientists and vivid aerial ground shots of the mountain to show how mudflows from Mt. Rainier can affect communities in Western Washington

#### ***D.2. Volcanic Emergencies ~ Preparations and Responses***

Blong, R. J., 1984, **Volcanic Hazards ~ A Sourcebook on the Effects of Eruptions**, Academic Press, Orlando Florida, 424 p.

This book details the effects of eruptions on people, their possessions, their lifestyles and environments. A 'bible' of information on volcanic hazards. It should be of interest to planners, engineers, emergency services personnel, volcanologists, geologists and concerned citizens (i.e. everyone). Easy-to-read, with large reference section.

Casadevall, Thomas J., editor, 1994, **Volcanic Ash And Aviation Safety: Proceedings of the First International Symposium on Volcanic Ash and Aviation Safety**. (Held in Seattle, WA 07/91) U.S. Geological Survey Bulletin 2047, 450 p.

Contains 70 Technical Reports on all aspects of ash and aviation. Section Headings include: volcanoes and ash clouds, damage and impacts, communications and procedures, meteorology and ash-cloud monitoring, and detection and tracking.

Edmondson, Betty L., 1981, **Impact of the Eruptions on City Government**: Proceedings of Workshop on Volcanic Hazards, Sacramento, CA, 8 p.

Federal Emergency Management Agency, Region X, 1984, Bentley, Forrest G., Chief Researcher, **The Mitigation of Ash Fall Damage to Public Facilities: Lessons Learned from the 1980 Eruption of Mt. St. Helens, Washington**. 70 p.

Covers: types of damage to public facilities, ash clearance problems experienced by local governments, cost-effective methods for prevention and reduction of ash damage, clearance of ash, and the degree of ash cleanup required to protect public health and safety. Includes: sewer systems, potable water systems, roads and streets, ash disposal sites, airports, drainage and irrigation systems, outdoor areas, vehicles and engines, building roofs, public buildings, electrical facilities, electronic equipment, electric motors, aircraft components and jet engines.

Newhall, C., Aramaki, S., Barberi, F., Blong, R., Calvache, M., Cheminee, J.L., Punongbayan, R., Seibe, C., Simkin, T., Sparks, S., Tjetjep, W., **On the Professional Conduct of Scientists During Volcanic Crises**: submitted to Bulletin of Volcanology, September, 1998

This report takes an in-depth look at appropriate conduct for scientists during volcanic emergencies, especially regarding communication among scientists, public officials, the general public and the media. Much of the advice is derived from situations at previous volcanic crises where the success of the emergency response hinged upon well-planned, respectful, effective communications.

Novak, Terry and Zais, Richard, 1981, **How to Manage Your Ash**, Public Management, January/February 1981, p.12-15.

This brief four-page document describes how local managers in Spokane and Yakima responded to ash fall from Mt. St. Helens in 1980. Authors describe steps taken by management to inform public, to monitor effect of ash fall on public facilities, and to require individuals and institutions to take responsibility for cleanup.

**Reducing Volcanic Risk**, 1997, produced by International Association of Volcanology and Chemistry of Earth's Interior (IAVCEI) and United Nations Educational Scientific and Cultural Organization (UNESCO), **20-minute video**.

This video shows how people can lower their risk from volcanic activity by identifying hazard areas, monitoring volcanoes and developing an emergency plan. Footage of volcanoes from around the world shows how these steps save lives when used. The video also describes the critical elements of emergency plans that made the difference between life and death for tens of thousands of people.

United Nations Educational Scientific and Cultural Organization (UNESCO), 1985, **Volcanic Emergency Management**, UNESCO document GE.85-02770 11/85, 86 p., 1 map.

This publication states some general principles of organization and practices needed to deal with volcanic emergencies. It reviews the nature of volcanic hazards, the problems of assessing hazards and predicting the onset of eruptions, measures that can be taken to mitigate risk, and measures that can be taken to protect life and property against destructive volcanic phenomena. It includes information on pre-emergency planning and coordination, perception of and response to risk, decision-making, and difficulties encountered. This information has been assembled from past experiences worldwide.

Warwick, Richard A., 1981; **Four Communities Under Ash After Mt. St. Helens**: Program on Technology, environment and man, monograph no. 34, Institute of Behavioral Science, University of Colorado, 146 p.

This publication presents results of investigations of impacts on and responses to volcanic ash fall in eastern Washington and western Montana after the eruptions of Mt. St. Helens in 1980. It documents the range of effects and actions taken.

## **IX. Mitigation Measures TO BE PUBLISHED**

**X. Recovery**  
**TO BE PUBLISHED**  
**XI. Mt. Rainier Plan Viability**  
**TO BE PUBLISHED**

**Glossary of Terms and Acronyms**

<b>AFM</b>	Acoustic flow monitor
<b>ARC</b>	American Red Cross
<b>ash</b>	Sand-sized or smaller volcanic fragments
<b>ash fall</b>	Airborne ash that falls from an eruption cloud and the resulting deposit
<b>CCP</b>	Casualty Collection Points
<b>CVO</b>	Cascades Volcano Observatory, U.S. Geological Survey
<b>debris avalanche</b>	A rapidly moving landslide that occurs when a section of a volcanic cone collapses catastrophically under the force of gravity
<b>DNR</b>	Department of Natural Resources
<b>EOC</b>	Emergency Operations Center
<b>EMS</b>	Emergency Medical Services
<b>earthquake</b>	A sudden motion or trembling in the earth caused by abrupt release of strain
<b>FAA</b>	Federal Aviation Administration
<b>FEMA</b>	Federal Emergency Management Administration
<b>flood plain</b>	A flat or nearly flat lowland that borders a stream and that may be covered by its waters during flood stages
<b>gas emission</b>	Discharge of volcanic gases, predominantly water vapor, carbon dioxide and sulfur dioxide
<b>ground deformation</b>	Displacement of the ground surface resulting from stress. In volcanoes, ground deformation is commonly caused by movement of magma
<b>ground water</b>	Subsurface water
<b>hydrologic</b>	Water-related; refers, with respect to Mt. Rainier hazards, to lahars or floods originating from events on the volcano
<b>hydrothermal</b>	Refers, within active volcanoes, to circulating ground water that has been heated and acidified by contact with hot rocks and vapor emissions from cooling magma
<b>hydrothermal alteration</b>	Refers, within active volcanoes, to conversion of volcanic rocks to clay and other minerals through chemical reaction with circulating hot acidic water
<b>IAVCEI</b>	International Association of Volcanology and Chemistry of Earth's Interior's
<b>ICS</b>	Incident Command System
<b>intrusion</b>	The process of injection of magma into pre-existing rock
<b>lahar</b>	A mixture of water and volcanic fragments that surges downstream like rapidly flowing concrete
<b>lava</b>	Molten rock at the earth's surface
<b>lava dome</b>	A steep-sided mass, partly or completely solidified, of viscous lava extruded from a volcanic vent
<b>lava flow</b>	Mass or stream of molten rock that flows on the earth's surface under the influence of gravity; also, the solidified product of such a stream
<b>magma</b>	Molten rock within the earth; contains dissolved gas; may also contain gas bubbles and suspended crystals; forms lava or tephra upon eruption at the earth's surface
<b>NOAA</b>	National Oceanic and Atmospheric Administration
<b>NPS</b>	National Park Service
<b>PIO</b>	Public Information Officer
<b>PNSN</b>	Pacific Northwest Seismograph Network, Geophysics Program, University of Washington, Seattle

<b>pyroclastic flow</b>	A hot mixture of volcanic rock fragments (pyroclasts) and gases that, driven by gravity, flows down a volcano's flank at high speed
<b>pumice</b>	Light-weight, foam-like volcanic fragment
<b>RAG</b>	Regional Advisory Group
<b>rockfall</b>	The precipitous descent of a detached mass of rock from a cliff or steep slope
<b>SAR</b>	Search and Rescue
<b>seismicity</b>	The number, size and location of earthquakes in a region during a specific time
<b>seismograph</b>	An instrument that detects and records vibrations of the earth
<b>tephra</b>	Collectively, all fragmental rock material ejected during a volcanic explosion or eruption
<b>USFS</b>	United States Forest Service
<b>UNESCO</b>	United Nations Educational, Scientific and Cultural Organization
<b>USGS</b>	U.S. Geological Survey
<b>US&amp;R</b>	Urban Search and Rescue
<b>volcanic edifice</b>	Refers, at Mt. Rainier, to the steep cone higher than approximately 7,000 feet above sea level
<b>volcanic unrest</b>	Refers to occurrence of symptoms, such as elevated seismicity, ground deformation, or gas emission, that commonly precede volcanic eruptions
<b>WEMD</b>	Washington Emergency Management Division

## Appendix 1 ~ Disaster Preparedness

The Pacific Northwest has experienced volcanic activity in the past and will certainly experience it in the future. The more scientists look, the more evidence they find of frequent volcanic eruptions that have rocked our region in the past. We don't know *when* or *how severely* we will be affected, but we can strive to be prepared. The primary tool to assist your survival of a catastrophic natural event is the knowledge of what to do before, during and after one occurs. We also need to acknowledge that the lives of people who live in areas at risk will be disrupted during periods of volcanic restlessness *even when no actual eruption occurs*.

**Learn: Learn whether you live, work, or go to school in a volcanic hazard zone. Learn about all volcanic processes that affect your community**

**Inquire: Ask local officials how they advise you to respond ~ before a real emergency. Ask what emergency management plans are in place**

**Plan: Develop an emergency plan with your family or business to help you during any natural disaster**

This information is organized to help you prepare for *any* emergency and is taken from the American Red Cross Emergency Preparedness Checklist and the Federal Emergency Management Agency's (FEMA) fact sheet on volcanoes (see reference list). Information about preparations and behavior during and after volcanic eruptions follows, and is taken from these same sources as well as from USGS Earthquake Information Bulletin, July-August 1980, vol. 12, No. 4, p. 161. This information is current as of March 1999; readers may want to review the websites of these agencies (Red Cross, FEMA, USGS), listed in the references section at the end of this

## Develop a Family Disaster Plan



- Meet with household members to discuss the potential dangers of volcanic eruptions, landslides, lahars (volcanic mudflows), earthquakes, floods and other emergencies. Explain how to respond to each.
- Pick a safe meeting place where the family can reunite during or after an emergency, in case you cannot return home after a disaster. Talk about details such as: How do you plan to get to the meeting place? How do you plan to take care of pets?
- Pick one out-of-state and one local friend or relative for family members to call if separated during a disaster (it is often easier to call out-of-state than within the affected area). Each family member should have these phone numbers on a card in their wallet or purse, and know how to call.
- If you have children in school, discuss with the school faculty what they plan to do during emergencies such as volcanic eruptions or earthquakes. Also, identify any special needs that may arise with elderly or disabled persons.
- Keep family records in a water and fire-proof container; be prepared to take this with you if an evacuation becomes necessary. Store duplicates off location.
- Have family members take first-aid and CPR classes.

### **Assemble a Disaster Supplies Kit for your home, vehicle, work and school**

Geologic events such as volcanic eruption or lahars are likely to affect a great number of people over a large area and emergency crews will probably be overwhelmed for a while. Thus, emergency response personnel recommend that you plan on taking care of your family, unassisted, for at least 72 hours (3 days). In reviewing the following list of supplies, remember that you may need to bring these with you in an evacuation; store them in an easy-to-carry container such as a backpack or duffel bag.

#### **Home Kit ~ include:**

- A map showing routes to a safe meeting place you have chosen.
- A card to leave in house with information about intended destination.
- Information provided by local authorities about responding to emergencies.
- A supply of water (one gallon per person per day). Store water in sealed, unbreakable containers. Identify the storage date and replace every six months.
- A supply of non-perishable packaged or canned food and a manual can opener.
- A change of clothing, rain gear and sturdy shoes.
- Gloves, dust masks and goggles for each family member.
- A battery or hand-cranked/solar-powered radio, flashlight with extra bulb and plenty of extra batteries.
- Blankets or sleeping bags and plastic trash bags (to help keep them dry).
- A first aid kit and manual, and list of family physicians.
- Personal hygiene items and prescription medications.
- Credit cards and cash, and an extra set of car keys.

- A list of important family information: phone numbers, account numbers, the style and serial numbers of medical devices such as pacemakers, etc.

#### **Vehicle Kit ~ include:**

- Map of area, preferably with safety zones and evacuation routes marked from home, work and school.
- Bottled water and non-perishable, high-energy foods such as granola bars, raisins or dried fruit and peanut butter.
- A change of clothing, rain gear and sturdy shoes.
- A battery or solar-powered radio, flashlight with extra bulb and plenty of extra batteries.
- Gloves, dust masks and goggles.
- Blanket or sleeping bag.
- Tool kit for your vehicle.
- First aid kit and manual.
- Jumper cables, shovel, flares.
- Fire extinguisher (5 lb., A-B-C type).
- Tire repair kit and pump. Also, periodically check the inflation of your spare tire.
- Personal medications.
- Emergency phone numbers.

In addition, if a volcanic eruption appears to be imminent, also carry in your car:

- Spare air filter.
- Spare oil (4-5 quarts) and oil filter.
- Spare windshield wiper blades and windshield washing fluid.
- Spare fuel filter and fan belts.

### **Appendix 2 ~ Volcanic Eruptions**

Lahars and ash fall are discussed here because they are the hazards most likely to affect large populations.

#### **LAHARS**

When heavy rains or waters from rapidly melting glaciers or snowpack mix with loose material on a volcano, the deposits are transformed into lahars, dense but fluid mixtures similar in consistency to wet concrete. Lahars can flow at speeds of up to 50 miles per hour on steep slopes of the volcano and 20-30 miles per hour in valleys beyond the volcano's flanks. Lahars often incorporate and carry large boulders and logs. Lahars pose a threat to anything in their paths, including bridges, roads, dams, pipelines and buildings. Lahar hazards are greatest in stream channels or river valleys with headwaters on volcano slopes.

### ***BEFORE A LAHAR OCCURS, YOU SHOULD:***

- Learn whether you live, work, have a business, or go to school in a lahar hazard zone. Contact the USGS to obtain this information.
- Contact local officials and ask them to advise you on how to respond. Ask for information about volcanic hazards and about availability of a map of evacuation routes out of the area. If officials have not developed a plan or designated evacuation routes, devise a plan that will get you and your family to high ground (100 feet or more above the valley floor, depending on distance from the volcano) as quickly as possible. Remember that traffic congestion can occur during an emergency; your best evacuation may be on foot.
- Learn how much time you can expect to have once a warning is given before a lahar arrives in your area. The USGS and emergency management agencies can provide this information.
- Prepare a plan with your family and business so that you can respond quickly and effectively to an emergency.

### ***WHEN EVACUATING AN AREA SUBJECT TO LAHARS:***

- Follow the instructions of local public officials concerning evacuation timing and routes.
- Look upstream before crossing a highway bridge. Consider the relative safety of crossing a bridge while a lahar is approaching or moving beneath it and remaining where you are.
- Stay out of areas defined as a Restricted Zone by government officials. Lahars and flash floods, wild fires and even deadly hot pyroclastic flows can reach you, even if you cannot see the volcano during an eruption.

## **VOLCANIC ASH FALL**

Explosive volcanic eruptions commonly produce large quantities of fine ash that can be carried by winds hundreds or even thousands of miles from the source. A dense ash cloud commonly blocks sunlight and results in total darkness lasting up to several hours. Electrical service may be interrupted because ash deposits can cause short circuiting and weigh down and break power lines.. Heavy ash fall may interfere with radio, television and telephone communications. In addition, volcanic ash is very abrasive and can cause severe damage to computer equipment and other electronic components, and to motor vehicles operating in ash if proper (and frequent) maintenance does not occur. Wet ash fall accumulations of four-inch thickness have caused the collapse of building roofs. Areas within a few miles of a volcano may experience the fall of stones large enough to seriously injure or kill people. Heavy falls of ash seldom last more than a few hours ~ only rarely do they last a day or more.

### ***BEFORE AN ASH FALL, YOU SHOULD:***

- Learn whether you are at risk from ash fall in your community.
- Assemble a disaster supplies kit for your home, vehicle, work and school; include extra medication, oxygen or other necessities for people with respiratory difficulties. Contact your physician for additional and updated health information. Consult the lists of items recommended for home and vehicle.

### ***IF YOU ARE IN AN AREA EXPERIENCING ASH FALL, YOU SHOULD:***

- Stay indoors if possible. If you are outside, seek shelter such as a car or building.

- Close all doors, windows and dampers. Consider additional sealing around edges.
- Wear a dust mask and goggles when outdoors (A damp cloth to filter the ash may substitute if masks are not available).
- Put all machinery inside barn or garage, or at least cover the machinery with a tarp.
- Bring animals and livestock into closed shelters; get clean water and food to them as soon as possible.
- Keep pets indoors, but if they do go out, brush or vacuum them before letting them back inside.
- If at all possible, simply avoid driving in heavy ash fall ~ ash can be slippery when wet and the chance of accidents will be increased because of poor visibility.
- Listen to radio or television for the latest emergency information. Identify local channels and frequencies. Stations in unaffected areas are less inclined to provide emergency information.
- Retreat to basement or leave building for shelter of a car or another structure if ash accumulation on the roof of your building exceeds four inches when wet, or ten inches when dry.
- If your safety can be assured, remove ash from roof to prevent accumulations exceeding several inches.

### ***Vehicle Care***

**Operation and maintenance of motor vehicles in areas where ash fall has occurred can be challenging. The Federal Emergency Management Agency (FEMA) has compiled specific suggestions for minimizing damage to vehicles (FEMA, 1984). These ideas are listed below. Consult FEMA's website for updated information about car care during ash fall.**

- Avoid driving in heavy ash conditions unless absolutely required. The more dense the ash fall, the more urgent the requirement should be for driving.
- If driving in dense ash is required, drive slowly such that volcanic ash does not rise in the air and further reduce visibility. You almost can't go slowly enough! Leave plenty of distance between you and the vehicle ahead. Use headlights on low beam.
- Change oil often. Change at 50-100 mile intervals in heavy dust (less than 50 feet visibility) and every 500 to 1,000 miles in light dust (less than 200 feet visibility). Lubricate all chassis components at each oil change.
- Clean air-filters by back-flushing filter paper with compressed air (30 psi). Caution: Blow elements from the inside (clean side) to the outside (dirty side). DO NOT strike filters against anything; air clean only. If unsure, have a qualified mechanic perform the air filter service. Inspect filters for dents or torn paper. Clean the inside of filters and the filter cover with a damp cloth before reinstalling filter. Reinstall filter in housing and tighten on cover very tight, approximately one full turn with pliers after tightening. Do not exceed one full turn with pliers or you may damage the system.
- DO NOT install hose from carburetor air intake (air clean) to inside of car. Outside dust and ash will be drawn into the vehicle.
- Wrapping the air cleaner element with a silk stocking or cheese cloth is of questionable value. It does not improve air cleaner filtration and may cause malfunctions if installed

incorrectly. Rags, or other intended filtering material, should not be placed over the carburetor inlet inside the air cleaner element; serious damage to the engine and/or loss of control of the vehicle may result

- Cover passenger compartment vent inlet (located at base of windshield and usually under the hood) with thick, loosely-woven felt-type material to filter air brought into vehicles. With vent filter in place, keep the heater blower (fan) on high. Blower will slightly pressurize inside of vehicle and reduce dust coming in through body gaps or holes. If a vent filter is NOT installed, keep air conditioner and heater blowers off or recirculate air.
- Have service garage clean wheel brake assemblies every 50-100 miles for very severe road conditions, or every 200-500 miles for heavy dust conditions.
- Have service garage clean alternator winding with compressed air after heavy accumulation or every 500-1,000 miles or after severe dust exposure.
- Wash engine compartments with garden hose or steam cleaner. Be sure to seal off air intakes and electrical components before cleaning.
- Commercial truck filters can be installed to increase the filtering capacity of the cleaner. However, this is expensive and should only be attempted by trained garage mechanics or experienced personnel. This would be beneficial for vehicles operating continuously in extreme dust conditions.
- Air filter restriction gauges can be installed by qualified mechanics. The gauge will tell you when your air filter requires servicing in order to avoid over-servicing.
- In addition, be aware that when it rains, ash on roadways can be very slick; drive as you would in hazardous winter conditions.
- Be alert for updated information that supersedes the advice above.

#### ***AFTER THE ASH FALL IS OVER YOU SHOULD:***

- Keep children, pets and people with respiratory problems indoors.
- Wear dust mask and goggles any time you must go outside.
- Remove accumulations of ash from roofs, clearing lowest-pitched (flat) roofs first; be very careful when working on a roof.
- In the weeks and months following heavy ash fall, affected watersheds near a volcano may begin to wash tremendous volumes of sediment downstream, causing river beds to rise. People living near such rivers should be prepared for this gradual change and the increasing risk of flooding that accompanies it.

### **Appendix 3 ~ References**

American Red Cross and FEMA (Federal Emergency Management Agency) joint publications:

*Emergency Preparedness Checklist* (Nov.1991, Brochure #ARC 4471)

*Your Family Disaster Plan* (February 1992, Brochure #ARC 4466)

*Your Family Disaster Supplies Kit* (March 1992, Brochure #ARC 4463)

Banks, N., Jones, S., Moore, R., Scott, K. and Vallance, J., 1998, Report to the USGS Urban Hazards Initiative on the Reconnaissance Geologic Hazards Studies In the Upper Cowlitz River Valley, Lewis County, Washington: unpublished U.S. Geological Survey report, 14 p.

FEMA (1984), *The mitigation of ashfall damage to public facilities: Lessons learned from the 1980 eruption of Mt. St. Helens, Washington*. FEMA, Region X, 70 p.

Johnston, D. M. (1998, in prep.), *Physical and social impacts of past and future volcanic eruptions in New Zealand*, Ph.D. Thesis, Massey University, Palmerstone North, New Zealand., 288 p.

Pierce County Department of Emergency Management (DRAFT of 5/98), *Mt. Rainier: An Emergency Preparedness Guide*.

Telephone Utilities of Washington, Inc. (October 1996), *Earthquakes ~ Be Prepared*

U.S.G.S., *Earthquake Information Bulletin*, July ~ August 1980 v.12, no.4, p.161

*Volcanic emergency management*, UNDRO/UNESCO Publication, November 1985.