Case Study:

The societal impacts from the eruption of Mount Saint Helens May 18th, 1980

Benjamin Sellers
Due: 11-26-02
GG. 300

Preface

Location: Washington, United States
Latitude: 46.20 N Longitude: 122.18 W
Height: 2,549 meters or 8,364 feet - 9,677 feet before May 18, 1980
Type: Stratovolcano

The problem with volcanic eruptions has to do with there unpredictability and overall capability. A volcano is very unpredictable, even when it is heavily monitored there is no sure way to predict an exact time, however the field of volcanology is advancing in technology and knowledge to aid in this problem. Also, the capability of a volcano when compared to other natural disasters is very subtle and versatile. The versatility of destruction ranges from an eruption to a mudflow or from a landslide to ash plumes large enough to carry ash massive distances which in turn creates many other of its own significant problems. The subtle capability of volcano lies in its unpredictability, like only being able to make an educated guess for an eruption time it is even a greater challenge to predict the times and geometric characteristics of its secondary effects. This next information may be unrelated preliminary information, to the specific impact of Mt. St. Helens but it is an absolute necessity that the uneducated individual becomes educated; this is the best defense against an eruption.

Pyroclastic density currents (PDC) can be created in seconds, with an unpredictable path of destruction and can propagate at speeds of 100 - 300 meters a second. Lahars are much the same, there creation is unpredictable as well as there geometric path and are commonly compared to “quickly moving rivers of cement”. The dangers secondary effects pose to a location can be as great the initial blast or eruption. Pyroclastic currents and lahars are not the only secondary effects that cause problems, actually there are so many that it would take much to long to explain them all. So we will limit this subject to ones dealing directly with the eruption of Mt. St. Helens.

Along with lahars and PDC’s there are ash plumes, debris avalanches and volcanic gases. Ash plumes create massive amounts of tephra fallout creating all sorts of instrumental problems. Starting locally with tephra fall out effects, structures roof systems can collapse devastating a whole locations roof system. Also, ash plays havoc with sewage, water treatment and even the human respiratory system. Ash removal is a very expensive and extensive task for civil works to deal with.

Debris avalanches are caused by a certain sector collapse of the volcano. When this sector collapses it reallocates the failed material to a different location. The failed material can total amounts ranging from .3 km^3 to 20 km^3, and spread distances of 5 to 120 km. With this much failed material suddenly transported to a different area, that certain location usually ends up devastated and in many cases the effected topography is completely changed.

When considering societal impacts that occur from natural disasters first we must remember that the only reason they occur is because of human presence. Without any human or products of humanity around we would have no reason to assess societal impacts. The direct impact on society from natural disasters reflects from its prior mental and physical preparation to the event. Some cases of natural disasters come totally unforeseen and others are heavily monitored before and after the event had occurred. When it comes to human preparation for volcanic eruptions before 1980 the United States had not dealt with any eruptions within its own territory that would have a significant effect on densely populated areas. Mount Saint Helens posed new and formidable dilemmas for a range of associations, from civil defense agencies to local psychological programs. From the physiological aspect of the effects on humans there was quite a diverse range of emotions manifested from this event prior to the large eruption; confusion, fright and anticipation just to name a few.

Volcanic crisis management is the process involving two major phases; these phases have been explained in great detail from the encyclopedia insert titled *Volcanic Crises Management* (2000, Cruz-Reyna, Meli, Quaas). Summarizing, they breakdown and explain in great detail the universal procedures that are taken during a volcanic catastrophe and offer helpful insight to help aid future events. Within this insert they created a great outline for the assessment of volcanic crisis management. I have reproduced this same outline below.

1. Pre-event (or pre-critical phase) phase (preparedness measures):
    - Risk assessment, hazard and risk mapping, and postulation of expected scenarios
    - Volcano monitoring
    - Emergency planning

2. Critical phase (operational measures):
    - Alert, communication, and information procedures
    - Response-implementation of emergency measures
    - Defining the end of the critical phase

Outline Reproduced from *Encyclopedia of Volcanoes*, *"Volcanic Crises Management", p. 1201*

This is what is to be expected out of our volcanic crisis management teams, it is there duty to fulfill these obligations in ordinance with the 1974 mandate from congress made the Geological Survey the lead Federal agency responsible for providing reliable and timely warnings of volcanic hazards to State and local authorities. Now that the physical and sociological processes have been described sufficiently we shall proceed on with the actual case study of how they were put to the test in the eruption of Mt. St. Helens May 18th 1980.

<u>Case Study: the sociological impacts of the May 18th, 1980 eruption of Mt. St. Helens</u>

***Events will be ordered by western-pacific time**

Pre-eruption Phase (March 20 - May 18th 8:31 am*)

As noted in the preface, during the pre-eruption state of a volcano there are a few sub-procedures that the volcanic management teams run through.

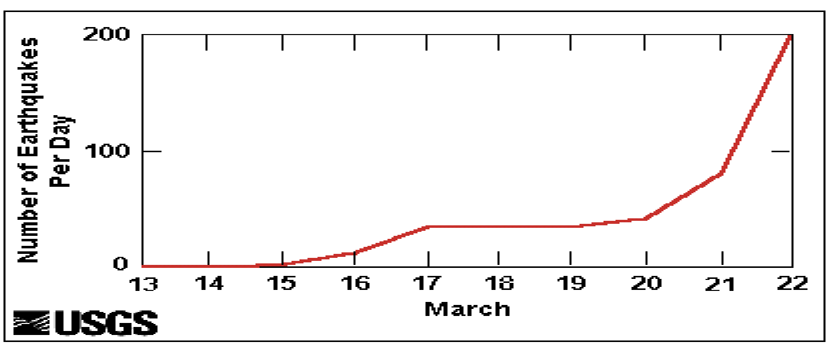
Pre-event (or pre-critical phase) phase (preparedness measures):

- **Volcano monitoring**
- **Risk assessment, hazard and risk mapping, and postulation of expected scenarios**
- **Emergency planning**

Volcano monitoring

March 20, University of Washington and USGS seismologists recorded a 4.2 magnitude earthquake, from this point on there was seismic monitoring 24 hours a day 7 days a week.

March 21 – 23, a meeting was held to discuss a number of issues. The number of earthquakes that were growing more frequent over the past few days, the safety of proximal structures and the need to close the area of upper slops to avoid a snow avalanche.



Risk assessment, hazard and risk mapping, and postulation of expected scenarios

March 25, the risk assessment began with the arrival of a USGS scientist and Mt St. Helens expert named Donal Mullineaux. Once Mullineaux arrives a coordination center was started at the USFS headquarters in Vancouver.

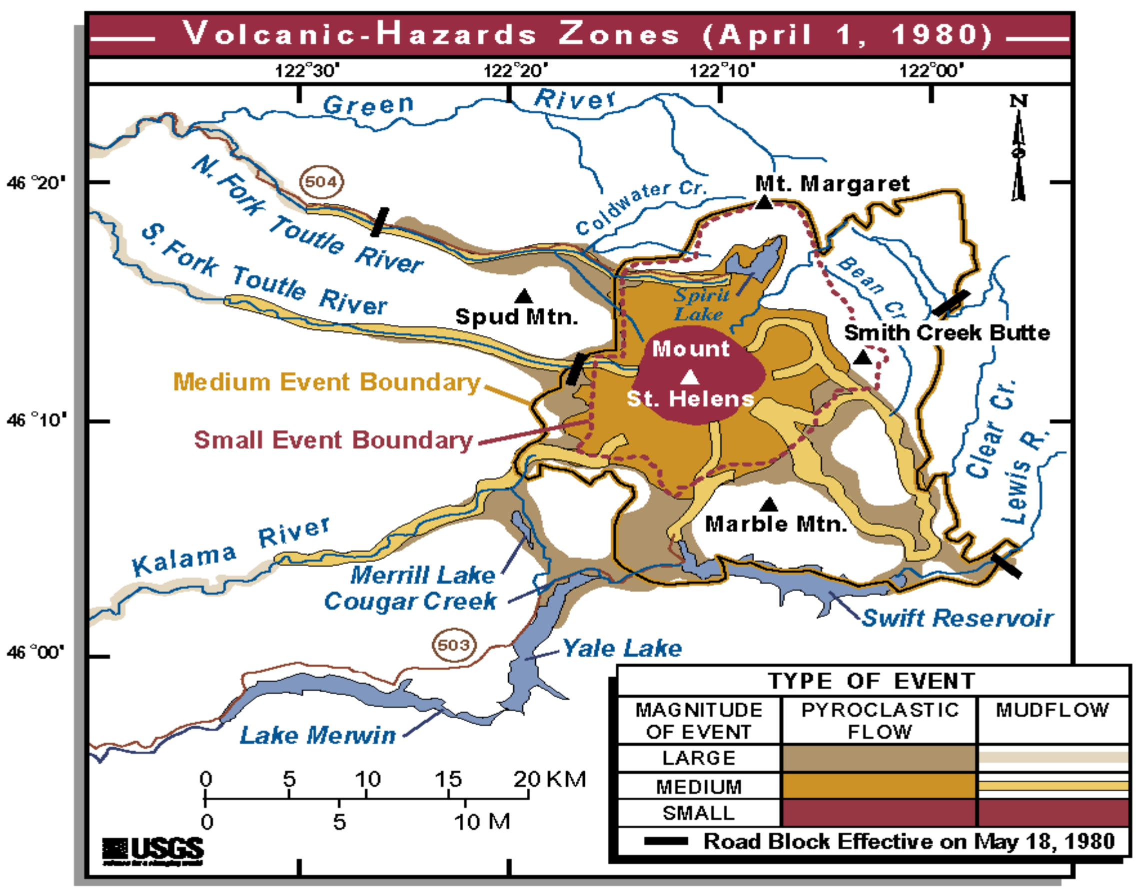
March 26, representatives from the government and private business sectors gather for a meeting with Mr. Mullineaux, Mullineaux then informs the group of the potential forms of eruptions and secondary volcanic hazards that Mt. St. Helens posed. After the meeting USFS, State, and county officials felt they needed to extend the area of closure beyond the immediate flanks of the volcano.

March 27, **8:00 a.m**., an official announcement of a hazard warning for Mt. St. Helens was publicized. **12:36 p.m.** Mt St. Helens had its first eruption within the last century.

After the triggering of the first explosion a group of about 30 scientists were working on creating the different zones that posed hazardous. This was followed by daily conferences that included the scientists, USFS reps., State reps. and other land managers of Mt. St. Helens.

March 31, a volcanic-hazards assessment was set before another meeting that was aimed directly at public safety.

April 1, A large-scale volcanic-hazards map created for public-safety agencies. A news release was publicized impart from USGS, scientists informed readers and viewers of what they might expect from a large eruption.



Emergency planning

April 9, The “Mount St. Helens Contingency Plan” was issued by the USFS that included volcanic-hazards and geo-technical issues.

Late April, various meetings occurred where officials considered the possibility of the bulge on the northern flank exploding, however no certain dates or times could be established.

The actual reaction from the public

"No one would listen," (Moser, 1980) Skamania County Sheriff Bill Closner said of property owners and sightseers in the Mount St. Helens danger zone before May 18th’s massive eruption in an article released just 10 days after the event. Also, Closner admits "It didn't matter what we did". "People were going around, through and over the barricades. As you know, people were climbing right up to the rim of the crater." and "Maps were being sold showing back country roads around the barricades". Sheriff Closner goes on to explain that the road barricades were occasionally vandalized and/or damaged up to the time of the eruption. Denying access to private land created a wave of tension between land owners and the state government and local authorities alike.

News reports of confrontation and threats from land owners not to pay taxes forced Governor Dixie Ray to allow private land owners access under strict limitations. The first organized entry was held on Saturday May 17th with one scheduled at 10:00 a.m. May 18th as well.

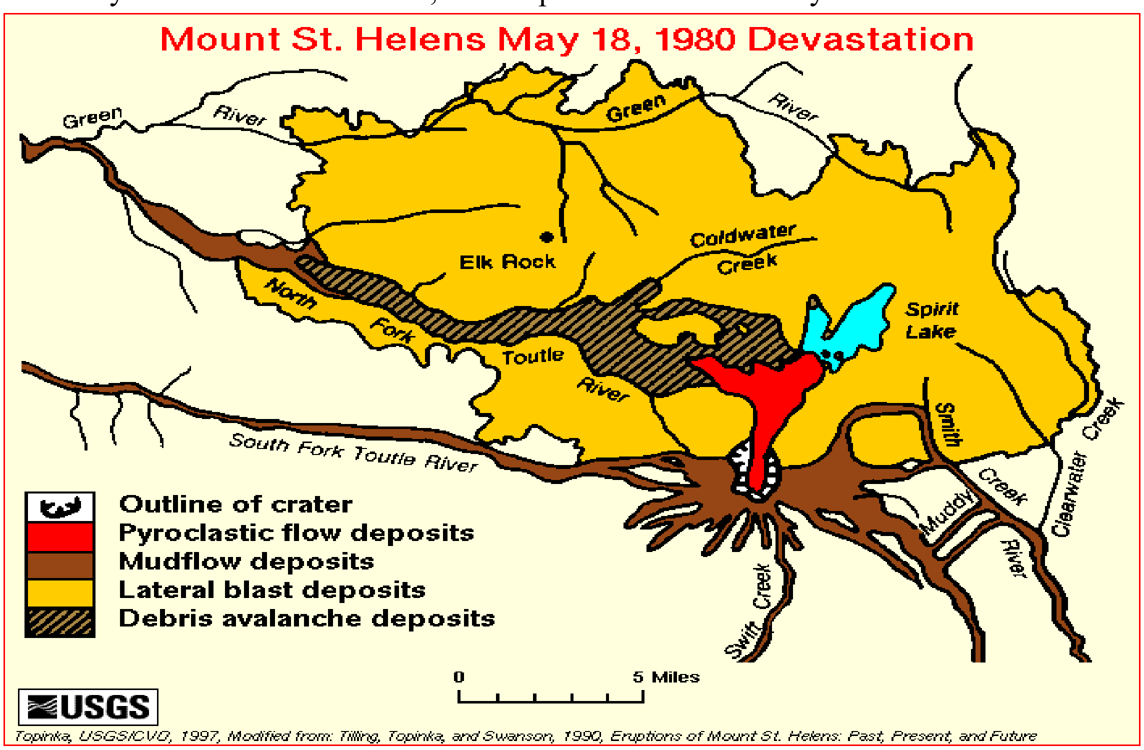
“Sheriff Closner said it was impossible for local agencies to keep the public out of the danger zone because of the web of logging roads throughout the area. "Only the U.S. Army could have kept the people out" Closner said. "As it turned out, the worst thing that could have happened, did," Closner said.” (Moser, 1980).

Mount Saint Helens was once a marvelous mountain with a snow capped summit and thousands of surrounding acres of pristine Pacific-Northwest foliage. This picture depicts how MSH would have looked prior to the eruption of May 18th.

Eruption Phase (8:32 am – 4:16pm)

A 5.1 magnitude earthquake strikes and the northern flank of the mountain fails, subsequently creating a large debris avalanche. The avalanche was rushing 70 to 150 miles per hour and buried the North Fork of the Toutle River under an average of 150 feet of debris. The volcanic plume column grew to an altitude of 16km which dispersed due to westerly winds.

This map needs to be used for reference. I will explain exactly what effects that these secondary volcanic effects caused, this map shows to where they were located.



Debris Avalanche

About 10 seconds elapsed between the triggering earthquake and the onset of the northern flank collapse. This was the largest debris-avalanche ever recorded in history, it moved at speeds of 110 to 155 miles an hour with a total volume of 2.5 km^3. (Ui, 2000) Part of the avalanche surged through Spirit lake, however a great portion flowed 13 miles down the Toutle river. In all, the avalanche covered 24 square miles, and raised Spirit Lake's water elevation by around 200 feet. The effects of the debris avalanche on civil works involved two direct effects.

"1. Public and private buildings and attendant facilities on the shore of Spirit Lake were obliterated. Nearly all these properties were related to recreation on the lake and in the surrounding area.

2. State Highway 504 was permanently buried from timberline on Mount St. Helens to the end of the debris avalanche in the valley of the North Fork. Toutle River, a length of some 32km. Two of the seven bridges the State lost in the valley were in this section of highway. In addition, many kilometers of private logging roads and five private and two U.S. Forest Service bridges were destroyed. "

The structural design of civil works and other buildings affected by the debris avalanche was not an issue, the only thing that would have saved these buildings is a more logical use of land-use planning that would have restricted building at these locations.

Pyroclastic currents and flows

There were at least 17 incidences of pyroclastic flows on May 18th, composed mostly of magamtic debris. The deposits formed a "fan-like" pattern of sheets, tongues and lobes with a total volume of .05 $mile^3$. The deposits where studied after the eruption for a temperature range, scientists estimated that the flows ranged from a temperature of 570 to 785 degrees Fahrenheit.

Lahars (Mudflows)

Approximately 8:50 a.m., just a few minutes after the debris avalanche the lahars began at the upper portion of the South Fork of the Toutle river. However, the most destructive lahars didn't begin for several more hours. The later lahars clogged the Columbia river navigational channel, stopping any ocean shipping. Also, there were substantial lahars that swept down the southeast flank of Mt. St. Helens. Swift Creek, Pine Creek and Muddy river drainages dumped about 18 million cubic yards of material into Swift Reservoir. However, the reservoir was intentionally kept low as a precaution to flooding a valley downstream. Just four bridges managed to withstand the mudflows, greatly due to there raised elevation compared to the rest.
Lahars had the largest effect on the civil transportation system, interstate 5 traffic was detoured for 12 hours for example. In the chart below it shows the overall damage from lahars on the roads and railways.

	Highways and Roads (km)	Railways (km)
State of Washington	48	0
U.S. Forest Service	38	0
Cowlitz County	16	0
Private	198	27
Total	300	27

Figure Reproduced from ***SOURCE***

- **Lateral Blast**

After the debris avalanche had moved a massive amount of material off the surface of the upper part of Mt. St. Helens, this triggered the almost instant expansion of pressurized steam and gas. The blast's initial velocity was around 220 mph which accelerated to a speed of 670 mph. The lateral blast wiped out all vegetation and most of the soil from the face of the volcano within a radial distance of 13km. The lateral blast caused extensive damage to roads, recreational areas and logging camps as well.

Post-Eruption Phase (4:17 pm on…)

The initial reaction to the eruption caused devastating consequences to the tourism industry. This was only a temporary problem and despite its troubled economy by the summer of 1983 the number of people visiting Mt. St. Helens was up by 15% than the years previous to the eruption.

Total damage cost from the May 18th eruption to this day remains difficult to determine. Early estimates range around $2-3 billion, primarily reflecting the timber, civil works and agricultural losses. However it is now believed that total cost was more in the region of $1.1 billion with a supplementary $951 million has been calculated in disaster relief. Other indirect costs caused by the eruption were also a major problem with both the social and economic spheres. Unemployment in the immediate region of Mount St. Helens skyrocketed 10 times of normal average. Many residents were reported to be suffering from stress and emotional problems during the aftermath of the eruption and extra funding was requested by the psychological sphere.

The Salvation Army became aware that temporary housing and food was going to be needed by those fleeing the flooding and damage caused by the eruption of Mount Saint Helens. Temporary beds were set up at the Salvation Army Corps, volunteers from the Salvation Army provided relief and assistance.

"Legislation passed by Congress in 1974 made the Geological Survey the lead Federal agency responsible for providing reliable and timely warnings of volcanic hazards to State and local authorities. Under this mandate, and recognizing the need to maintain systematic surveillance of Mount St. Helens' continuing activity, the USGS established a permanent regional office at Vancouver, Washington, after the May 18, 1980, eruption. On May 18, 1982, the office at Vancouver was formally designated the David A. Johnston Cascades Volcano Observatory (CVO), in memory of the Survey volcanologist killed 2 years earlier. Staffed by about 90 permanent and part-time employees-geologists, geophysicists, hydrologists, geochemists, technicians, and supporting personnel-the CVO not only maintains a close watch on Mount St. Helens, but also serves as the headquarters for monitoring other volcanoes of the Cascade Range in Washington, Oregon, and northern California. " (*Swanson, 1990)*

Conclusion

In conclusion Mount Saint Helens has its pros and cons, like any other situation. The cons are numerous; however major incidents include 57 people dead, civil works devastation and millions of acres of national forest destroyed. The pro's may be few, but weighted towards the cons in my opinion may be as great. The knowledge we have extracted from this eruption is priceless, we have no way to measure the life we have saved from the information and research that has been conducted solely on this single eruption sequence. Also, it was very fortunate that the eruption happened on a clear Sunday morning. If not, who knows how many people would have been working close to the mountain during the week, or if the eruption would have happened at night, how much could the scientists observe of the eruption, the loss of data I presume would have been substantial.

Works Cited:

Cruz-Reyna, Meli & Quaas. (2000). Volcanic Crises Management. *Encyclopedia of Volcanoes,* (1199 – 1214). San Diego: Academic Press

Moser, Pat. (1980). *'No one would listen,' county sheriff laments.* Retrieved November 22, 2002 from

Tilling, Topinka & Swanson. (1990). *Eruptions of Mount St. Helens: Past, Present, and Future.* Retrieved November 22, 2002 from http://vulcan.wr.usgs.gov/Volcanoes/MSH/Publications/MSHPPF/MSH_past_present_future.html

Ui, Tadahide, (2000). Debris Avalanches. *Encyclopedia of Volcanoes,* (617 – 627). San Diego: Academic Press