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JUL 1 4 1980

MEMORANDUM FOR: Robert E. Jackson, Chief
Geosciences Branch, DE

THRU: Richard B. McMullen, Acting Leader
Geology Section, GSB, DE

FROM: Harold E. Lefevre, Geologist
Geology Section, GSB, DE

Philip S. Justus, Geologist
Geology Section, GSB, DE

SUBJECT: MEETINGS WITH THE TROJAN NUCLEAR PLANT LICENSEE AT PORTLAND, OREGON AND FIELD TRIP TO MOUNT ST. HELENS VOLCANO AND VICINITY

PLANT NAME: Trojan Nuclear Plant
LICENSING STAGE: Operating Reactor
DOCKET NUMBER: 50-344
RESPONSIBLE BRANCH: Operating Reactors Branch No. 3; C. Trammell, PM

Attached is a report describing the activities of two members of the Geosciences Branch (P. S. Justus and H. E. Lefevre) in the Portland, Oregon-Trojan Nuclear Plant - Mount St. Helens, Washington area during the period June 17 through June 19, 1980. Our activities included meetings with the Trojan licensee (Portland General Electric Company), the U. S. Geological Survey, the U. S. Forest Service, the Federal Emergency Management Agency (FEMA), and other organizations as well as an overflight and land reconnaissance of the Mount St. Helens and vicinity. Appended to the report is (1) a Bulletin released by the Federal Coordinating Office (FEMA) at Vancouver, Washington describing the current volcanic hazards at Mount St. Helens, (2) a compilation of the maps and literature obtained through various agencies relative to the volcano and its effect upon man and the environment and (3) a glossary of selected volcanological terms mentioned in the trip report. The maps and literature are available for consultation at the Geosciences Branch. The GSB has been placed on the FEMA mailing list for forthcoming issuances of the Technical Information Bulletins. As warranted by relevance, GSB will issue periodic updates of the bulletins received.

H. E. Lefevre

Harold E. Lefevre, Geologist
Geology Section, GSB

Philip S. Justus, Geologist
Geology Section, GSB

Attachments: As stated

cc: See next page

OFFICE ➔						
SURNAME ➔						
DATE ➔						

NRC FORM 318 (9-76) NRCM 0240 ☆ U.S. GOVERNMENT PRINTING OFFICE: 1978 - 265 - 769

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cc: w/attachments
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DATE	7/11/80	7/11/80	7/[illegible]/80			

GEOSCIENCES BRANCH TRIP REPORT OF JUNE 17-19, 1980

TROJAN NUCLEAR PLANT
PORTLAND GENERAL ELECTRIC CO.
DOCKET NO. 50-344

Purpose of Meetings and Field Trip

The Trojan Nuclear Plant area has been subjected to volcanism and related phenomena (seismicity and flooding) since reactivation of Mount St. Helens on March 20, 1980. In order to assess the effect of these recent events on the Trojan plant and to gain some insight into the potential extent of future volcanic activity, discussions were held with the representatives of several organizations including the Trojan licensee on June 17 and 18 and with the U. S. Geological Survey, the Federal Emergency Management Agency (FEMA), the U. S. Forest Service, and the State of Washington (Department of Emergency Services) on June 19. A field trip of the Mount St. Helens area was made by air on June 18 and by auto on June 19 in order to observe the impact of the recent volcanic-related phenomena on the Trojan plant and adjacent area.

Meetings with Trojan Licensee

On June 17 and 18, meetings were held at Portland General Electric Company's (PGE) Portland office with the Licensee, PGE's geologic and volcanic consultants, and NRC representatives attending. A list of those present at these meetings is appended. H. Lefevre and W. Bivins represented the NRC. Discussion items included:

1. PGE's volcanic hazards appraisal notification procedures including interaction between PGE's consultants (Foundation Services, Incorporated) and the U. S. Geological Survey.

2. Volcanic ash sampling program and ash analysis
3. Volcanic ash distribution and isopach maps.
4. Effect of the May 18, May 25 and June 12 volcanic-associated events on the Trojan plant vicinity including ash fall, seismicity, flooding, and channel-filling of the Toutle, Cowlitz and Columbia Rivers.
5. Comparability of the Pine Creek-Muddy River mudflows volume to mudflow volume estimate provided in U. S. Geological Survey Bulletin 1383-C.

Following the meeting of June 18, P. Justus (NRC) and R. Morris (USGS) joined H. Lefevre and W. Bivins and made an aerial reconnaissance of the Mount St. Helens area, including the vicinity of the Trojan plant. We gained, through direct observation, valuable information regarding the impact of volcano-related phenomena on engineered structures located at considerable distances from the volcanic source. Other than minor ashfall (fractions of an inch) only Columbia River channel filling resulting from the May 18 eruption has affected the area in the vicinity of the Trojan plant. According to W. Bivins, NRC Hydrologist, this channel filling would have had no impact on the Trojan facility, had it been operating.

Meetings with the U. S. Geological Survey

On June 19, 1980, a meeting was held at the Vancouver, Washington field offices of the U. S. Geological Survey-first with Dr. Donal R. Mullineaux and later with Dr. Pete Rowley. Drs. Mullineaux and Rowley constitute a portion of the USGS contingency of geologists and geophysicists (approximately 40) monitoring the present activity, evaluating the accumulating data, and mapping the effects of the post May 18 volcanic events. P. Justus and H. Lefevre of NRC and R. Morris of the USGS (Reston, VA) participated both at the meetings/discussions with the USGS, FEMA, and other State and Federal agencies and the auto reconnaissance of the Columbia, Cowlitz and Toutle River areas. Dr. Mullineaux is responsible for

the volcanic hazards evaluation aspects at Mount St. Helens while Pete Rowley serves as the USGS spokesman through the coordinated FEMA efforts to the news media, governmental agencies and other interested parties regarding (1) ever-changing status both of Mount St. Helens activity and (2) the geologic and seismologic investigations at the volcano. The most relevant information gathered from Don Mullineaux and Pete Rowley as it relates to our continuing assessment of the Trojan Nuclear Plant includes the following:

1. May 18, 1980 Event- The May 18, 1980 north slope event consisted of a massive avalanche, followed by an unusually-large horizontal (lateral) blast and debris flow-pyroclastic flow. Volume estimates of the event are unconfirmed, but range up to 0.6 cubic mile of debris.
2. Instability of North Slope - As evidenced by numerous domes and plugs the northern half of the volcano, during the geologic past, has been less stable than the southern half.
3. Instrumentation - Geodimeters, tilt meters, and seismometers are installed throughout the Mount St. Helens area and are continuously monitored for changes in reference markers which may be indicators of the changing behavior of the volcano.
4. Mudflows-Pyroclastic Flow Volume - Based upon an assessment of past events (pyroclatic flow of 2,500 to 3,000 years ago) the largest single mudflow that might be expected to enter Swift Reservoir (located on the Lewis River south of the volcano) would be approximately 100,000 acre feet (USGS Bulletin 1383 C, 1978, p. C15). The May 18, 1980 eruption resulted in a mudflow extending down the valleys of Pine Creek and Muddy River on the east and southeast flanks of the volcano and converging at the Lewis River depositing from 11,000 to 15,000 acre-feet of debris into the upper portion of Swift Reservoir. This inflow resulted in a 6 in. rise in the

reservoir level which had been lowered sufficiently to accommodate mudflows well in excess of the volume (100,000 acre feet) suggested in the 1978 USGS bulletin. Don Mullineaux suggests that the previous mudflow estimate of 100,000 acre feet still appears reasonable, however, a larger volume may result from an event (massive avalanche-lateral blast-debris and pyroclastic flow) similar to the event that occurred on May 18. Volume estimates cannot be anticipated for such an event but would be developed on a case-by-case basis.

Discussions with FEMA, U. S. Forest Service, and the State of Washington

Brief discussions were held with representatives of FEMA (Richard Buck), U. S. Forest Service (Paul Rea and B. Johnson) and the State of Washington, Dept. of Emergency Services (James Thomas) in order to familiarize ourselves with the interaction of these and other agencies in the timely dissemination (through FEMA) of vital information (including geologic and seismological) to the public. The FEMA representative stated that mechanics for coordinating the Federal effort operated smoothly and the cooperation extended by the various Federal, State, and Local governmental agencies was commendable. We were particularly impressed with the rapid, accurate method of accumulation and distribution of geologic-seismologic-volcanologic information to the media through daily press conferences, telephone communication and the continual issuance of printed information through multi-discipline bulletins. H. Lefevre (at the meeting of June 18, 1980) was impressed by the continuing communication between the Trojan licensee's volcano-hazards consultants (Foundation Sciences, Incorporated), the U. S. Geological Survey, and Pacific Power and Light Company (operators of the hydro-generating facilities on the Lewis River). This cooperation resulted in the alerting of the Trojan licensee prior to the June 12, 1980 eruption which deposited ash at Portland and other areas to the

south and southeast of the volcano. There was no ash fall at the Trojan plant as a result of this eruption.

Ground Reconnaissance of June 19, 1980

By auto, P. Justus, H. Lefevre, W. Bivins and R. Morris traveled from Vancouver, Washington northward on the east side of the Columbia River, to Kelso at the confluence of the Cowlitz and Columbia Rivers, then to Castle Rock where the Cowlitz and Toutle Rivers merge. From Castle Rock we traveled northeastward on Route 504 to two bridge locations along the Toutle River. We observed (1) the widespread, but thin and erratic volcanic ash deposits, (2) mud flows along the valleys of the Cowlitz and Toutle Rivers, (3) flood high-water (mud) marks around homes and at the Castle Rock fairgrounds, (4) bridges partially destroyed by flood waters and (5) log jams and debris. Of particular interest was the observation that the volcanic ash was negligible to absent along Interstate 5 at the Kalama-Columbia River juncture-directly east of the Trojan Nuclear Plant.

Summary

It appears that all that can be done is being done, geologically, by the Trojan licensee, Portland General Electric Company (PGE), in acquiring, receiving, assembling, correlating, and utilizing data and information relative to those volcanic-related hazards that may impact the Trojan Nuclear Plant some 33 miles southwest of Mount St. Helens. Portland General Electric Company, through its consultants- Foundation Sciences, Inc., Drs. Howard Coombs and A. R. McBirney and others, in conjunction with the vast data gathering and interpretative organization assembled under FEMA (including the U. S. Geological Survey, the Corps of Engineers, and the U. S. Forest Service) at the Federal Coordinating office at Vancouver, Washington-is kept well informed of the status of the Mount St. Helens activity. PGE is constantly appraised of

ash emissions, the direction of high altitude winds, and the magnitude of seismic events. In addition, PGE is conducting field and laboratory geologic studies as well as a long-term ash sampling and analysis program. At the present time we consider the geologic and seismologic monitoring of Mount St. Helens, principally through the USGS and the University of Washington, to be completely satisfactory, providing the Trojan licensee, through its consultants, the best possible timely information relative to the status of Mount St. Helens, its potential for future eruptions and consequent possibility for impact on the Trojan Nuclear Plant. Additionally, the volcanic-related phenomena to date (including floods, ashfall, seismicity and river channel filling) have had no impact on the operation of the Trojan Nuclear Plant.

Mount St. Helens is located within the Gifford Pinchot National Forest which is administered by the U. S. Forest Service. In this role, the Forest Service has the primary responsibility for controlling emergencies occurring within the confines of its forests. Since widespread emergencies such as floods and fires frequently occur within their lands the Forest Service (unlike many other Federal agencies) is apparently well-suited for handling an event such as the Mount St. Helens eruption.

Attachment A

TROJAN NUCLEAR POWER PLANT
PORTLAND GENERAL ELECTRIC CO.
DOCKET NO. 50-344

MEETINGS AND FIELD TRIPS OF JUNE 17-19, 1980

List of Attendees

	June 17	18	19
NRC			
W. Bivins	-	X[1,2]	X[3]
P. Justus	-	X[2]	X[3]
H. Lefevre	X[1]	X[1,2]	X[3]
State of OR			
D. Hull	-	X	-
USGS			
R. Morris	-	X[2]	X[3]
PGE			
S. Christensen	X	X	-
R. Halicki	X	X	-
J. Lentsch	X	X	-
K. Murakami	-	X	-
G. Zimmerman	X	-	-
PGE Consultants			
H. Coombs	X	X	-
R. Kienle	X	X	-
A. McBirney	X	X	-

[3]Meeting w/USGS and others at Vancouver, WA & Auto Trip

[2]Mount St. Helens Overflight

[1]Meeting with PGE and consultants

FEDERAL COORDINATING OFFICE
federal emergency management agency

MOUNT ST. HELENS
TECHNICAL INFORMATION
NETWORK

Thursday, May 29,1980

BULLETIN #4 -"Current Volcanic Hazards at Mount St.Helens,Washington"

The following description of the continuing and potential hazards associated with the eruption of Mt.St.Helens was prepared by Dwight R. Crandell, of the U.S.Geological Survey.

The text accompanying the map describes five types of hazards - ashfall, mudflow, pyroclastic flow, lateral blast and lava.

ASHFALL HAZARD

The volcano began erupting ash in large quantity early 5/25 after only minor activity since 5/19. Thus, Mt. St. Helens is still in an explosive eruptive phase and we should expect similar eruptions in the future. Eventually we expect either a coarser grained pumice and ash to be erupted or the magma to form a dome within the present crater. The formation of a dome in the crater also could be accompanied by the eruption of ash, but probably on a smaller scale than the eruptions of 5/18 and 5/25. At present (5/25) we don't know whether this change will take days or weeks.

In the event of a maximum expectable pumice-ash eruption, we anticipate that the distance-thickness relations would be as shown on the volcanic-hazards map. These amounts could fall in any direction from the volcano, but are more likely to fall

in southeasterly-easterly-northeasterly directions than to the opposite points of the compass. The actual ash-fallout sector will be determined by directions and strengths of winds at altitudes reached by the ash column at the time of the eruption.

MUD FLOW HAZARD

The debris flow that now forms the floor of the Upper North Toutle Valley appears to be stable, in the opinion of soil-mechanics experts who have examined it. The possibility of piping, or of sudden liquefaction during a strong earthquake appears to be negligible in view of the slope of the deposit and its poorly sorted texture. Mudflows may occur as streams cut down through the debris-flow deposit, but these probably will be of small volume in the immediate future, and will not reach the heights or distances of the 5/18 - 5/19 mudflows. The principal danger zone of such mudflows will be in the North Toutle River Valley.

Mudflows can also be caused by pyroclastic flows which occur during heavy rainfall, or which move down snow-covered flanks of the volcano. Mudflows caused in this way could occur in any valley which heads at the volcano, but are most likely in the North and South Toutle, Pine Creek and Muddy River Valleys because these valleys are the most probable routes of pyroclastic flows.

Mudflow hazard zones are not shown in the portions of valleys within the pyroclastic-flow hazard zones, but mudflow-hazard zones

should be regarded as extending up to the flanks of the volcano.

In the longer term, increased discharge into Spirit Lake by streams in its drainage basin could occur during periods of very heavy precipitation and/or rapid snow melt. It is possible that water would enter the lake faster than seepage through the debris flow could carry it away. In this situation, it is possible that the lake would rise to the top of the valley fill west of the lake and spill over. If this occurred, mudflows could form in the North Toutle Valley, but it is not possible now to predict their size.

PYROCLASTIC-FLOW HAZARD

Pyroclastic flows can be formed during the eruption of pumice and ash or during the eruption of a dome. The largest and longest pyroclastic flows could be expected during the eruption of coarse pumice, and would occur at the same time that a large eruption column was rising above the volcano. The maximum probable extent of pyroclastic flows is shown on the hazards map. Pyroclastic flows of this kind are most probable in the North and South Toutle Valleys and in the Muddy-Pine Creek Valleys because of the present configuration of the crater rim. They are less likely, although possible, in areas southwest and south of the volcano.

Pyroclastic flows probably would also occur during the eruption of a dome. These could be formed as the steep and unstable flanks of the dome crumble and avalanche, or are disrupted by

earthquakes and volcanic explosions. Pyroclastic flows of this type probably will not extend more than 10 miles from the dome in the North Toutle Valley, and would not occur in the other valleys because of the present shape of the crater rim.

LATERAL BLAST HAZARD

The present situation at the volcano suggests that another lateral blast of the force of the blast on 5/18 is not likely. It is possible, however, that the eruption of a dome within the crater would be accompanied by lateral blasts which could carry rock debris outward at very high velocity. The present shape of the crater suggests that lateral blasts from a growing dome would initially be directed northward. Blasts in other directions would be deflected upward by the crater walls. If a dome grew to a height above the crater rim, lateral blasts could also affect the west, south or east sides of the volcano.

The wedge-shaped blast-hazard zone extending northward from the crater is based on the low rim of the crater in that direction, and on the distance to which rock debris was transported by a lateral blast at Sugar Bowl Dome about 1,200 years ago. This distance was about 6 miles; a safety factor of 100 percent was added, so the limit of the zone all around the volcano is shown at a distance of 12 miles.

It is possible that magma could move into the volcano at

some point east, south or west of the existing crater. This probably could be detected by surveying those flanks of the volcano, and perhaps also by visual observation, as was the case of the north flank bulge of 3/27-5/18. Surveying has been resumed. No such bulge or other sign of instability on the other flanks of the volcano has been detected.

LAVA-FLOW HAZARD

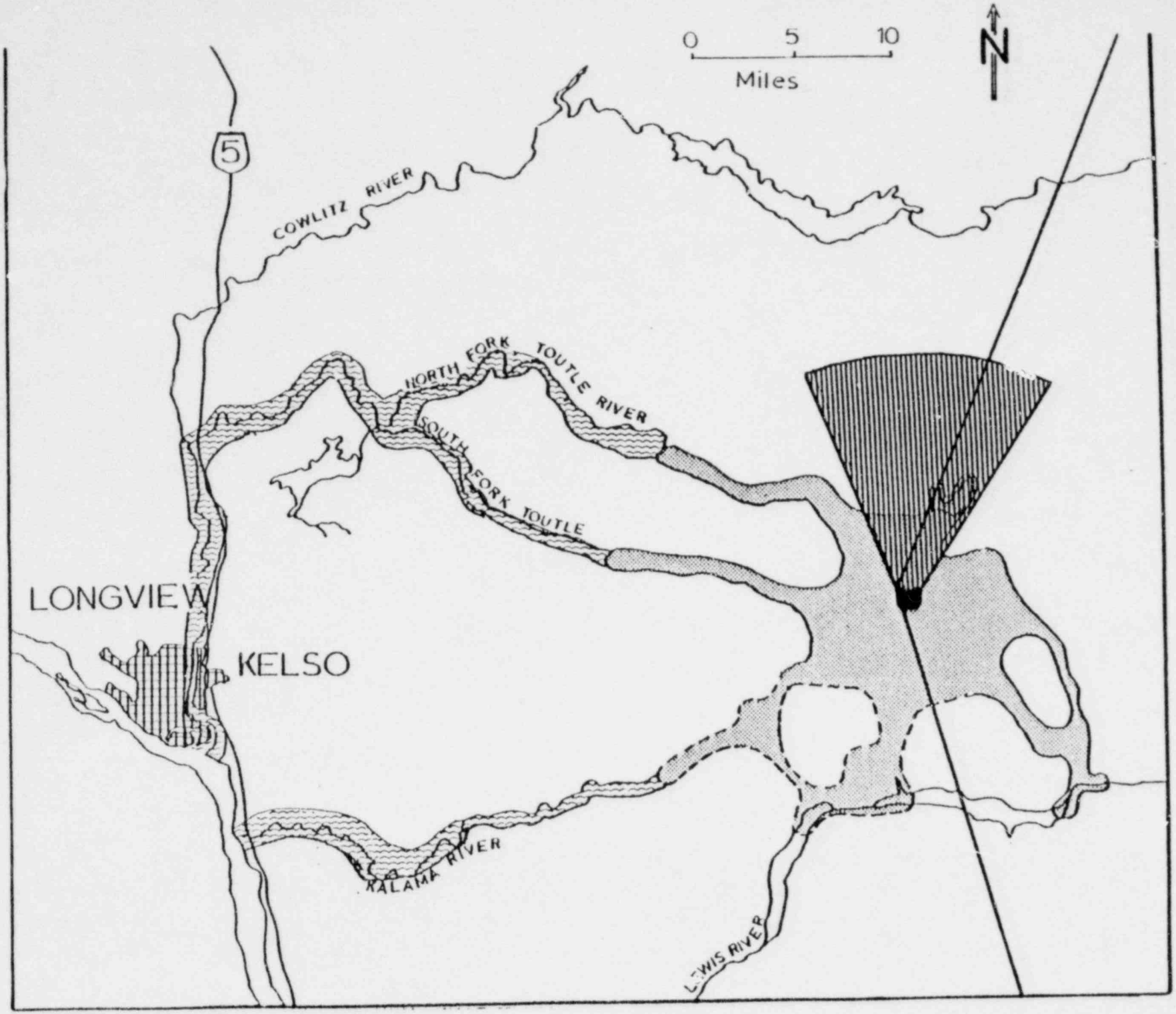
Explosive eruptions of dacite, like those of 5/18 and 5/25, typically are not accompanied by lava flows. If molten rock is erupted, it probably will be relatively viscous, and will tend to pile up around the vent and form a dome rather than a lava flow.

The past history of the volcano suggests that as this eruption progresses, the magma being erupted may be more fluid, and may form lava flows, but these are not anticipated in the next few weeks or months.

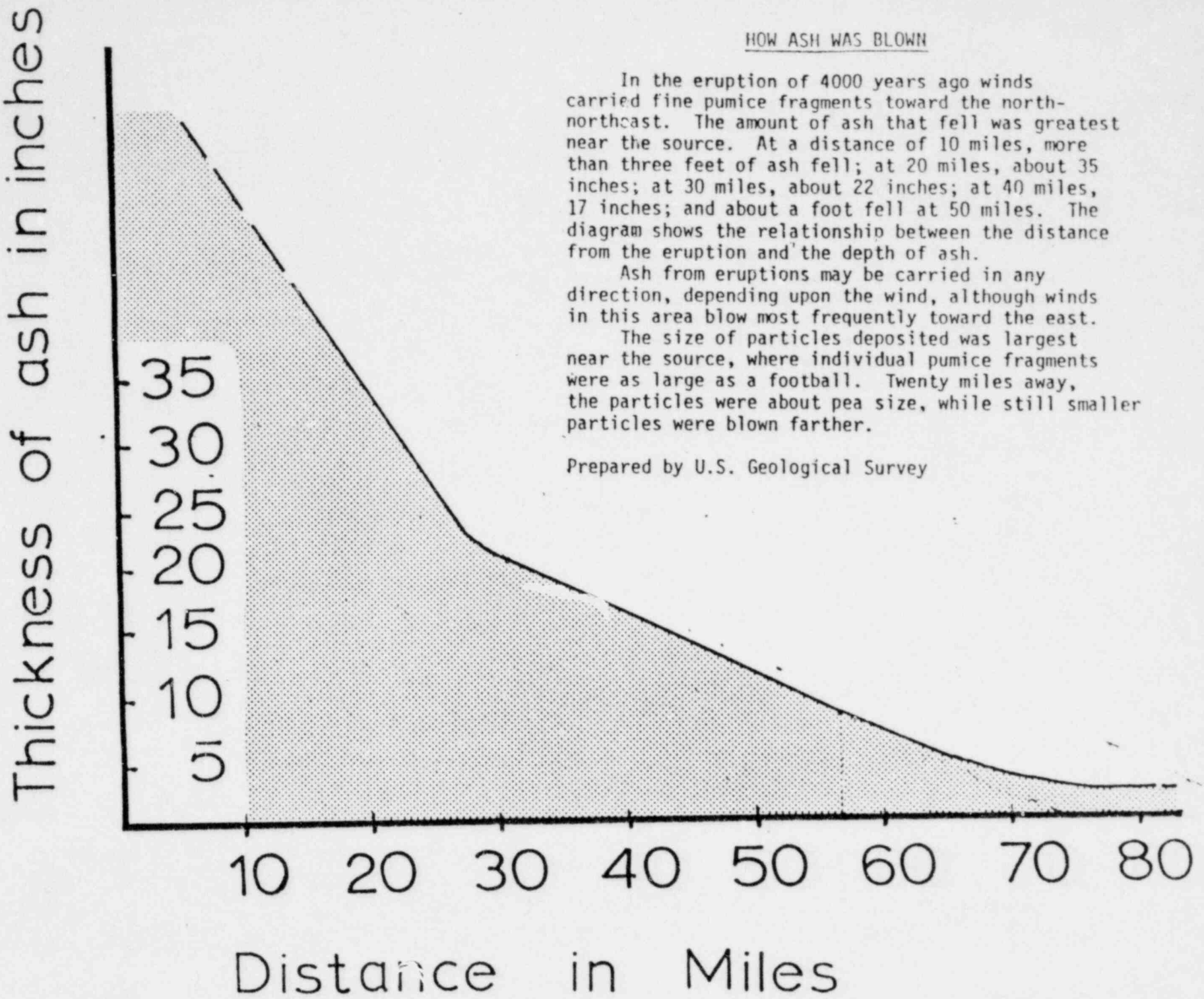
H A Z A R D M A P

PYROCLASTIC FLOWS	 High Risk  Moderate Risk
MUDFLOWS AND FLOODS	
LATERAL BLAST	
Sector toward which winds blow most frequently	

PREPARED BY U.S. GEOLOGICAL SURVEY



PREPARED BY U.S. GEOLOGICAL SURVEY



HOW ASH WAS BLOWN

In the eruption of 4000 years ago winds carried fine pumice fragments toward the north-northeast. The amount of ash that fell was greatest near the source. At a distance of 10 miles, more than three feet of ash fell; at 20 miles, about 35 inches; at 30 miles, about 22 inches; at 40 miles, 17 inches; and about a foot fell at 50 miles. The diagram shows the relationship between the distance from the eruption and the depth of ash.

Ash from eruptions may be carried in any direction, depending upon the wind, although winds in this area blow most frequently toward the east.

The size of particles deposited was largest near the source, where individual pumice fragments were as large as a football. Twenty miles away, the particles were about pea size, while still smaller particles were blown farther.

Prepared by U.S. Geological Survey

Geosciences Branch File on

MT. ST. HELENS SITUATION

List of Maps and Literature Gleaned from Vancouver, WA offices of U. S. Geological Survey and National Forest Service on June 19, 1980 and received (mail) on July 7, 1980.

Maps

Gifford Pinchot National Forest, USDA, 1973, 1:126,770, shows Mt. St. Helens, Mt. Ranier, Mt. Adams, Mt. Hood, drainage, sections, roads, checkerboard forest pattern

Mount St. Helens and Vicinity, Wash-Oreg., USGS Special Edition; April, 1980, 1:100,000 shows topography by contours at 50 m intervals, drainage, sections, roads

Mt. St. Helens Closure Map, Gifford Pinchot National Forest, Forest Service, USDA, June 11, 1980, shows red and blue restricted zones and text of closure order.

Local Agency Brochure

Volcano, Volcano, Volcano, A Citizens Guide, Emergency Action Plan; Clark County, WA Public Information Division

State Agency Flier

Warning, Mt. St. Helens is an Active Volcano; Washington State Dept. of Emergency Services

Federal Emergency Management Agency Handouts

Mt. St. Helens Technical Information Network Bulletins:

Bulletin	Title	Date
-	Welcome to the Mt. St. Helens Technical Information Network, 2 p.	June 1, 1980
1	The Nature of Mt. St. Helens Ash, 2 p.	n.d.
2b	Driving and Vehicle Maintenance in Heavy Ash Areas, 3 p.	May 30, 1980
3	Precautions in Handling Volcanic Ash, 3 p.	May 27, 1980
4	Current Volcanic Hazards at Mount St. Helens, Washington, 8 p.	May 29, 1980

Bulletin	Title	Date
5	Volcanic Ash Could Reduce Insect Populations..Temporarily, 3 p.	May 30, 1980
6	Advice for Farmers from Washington State University-Tractors and Water Pumps, 2 p.	June 1, 1980
7	Ash Particles and Home Clean-Up Problems Advice from the University of Idaho, 2 p.	May 30, 1980
8	Physical and Chemical Characteristics of the Mt. St. Helens Deposits of May 18, 1980, 4 p.	June 2, 1980
9	Volcanic Ash Advice to Berry Growers, 2 p.	June 2, 1980
10	Center for Disease Control (CDC) Community Based Health Surveillance Program (Update), 4 p.	June 3, 1980
11	Poultry-Bees-Livestock, 5 p.	June 5, 1980
12	Foodstuffs and Volcanic Ashfall, 2 p.	June 5, 1980
13	Research Into the Free Crystalline Silica Content of Mount St. Helens Ash, 4 p.	June 6, 1980
14	Protecting Children from Volcanic Ash-Related Health Hazards, 3 p.	June 6, 1980
15	Volcanic Ash and Your Water Supply, 4 p.	June 7, 1980
16	Health and Medical Update, 4 p.	June 8, 1980
17	Insurance Concerns, 4 p.	June 9, 1980
18	Health and Medical Update, 11 p.	June 10, 1980
19	Controlling Blowing Dust from Volcanic Ash, 4 p.	June 16, 1980
20	Health and Medical Update, 4 p.	June 16, 1980
26	Volcanic Ash Effects on Municipal Water Supply and Sewage Treatment Plants	June 26, 1980
27	Air Quality Monitoring Network for Volcanic Ash	June 26, 1980
28	Volcanic Hazards Analysis	June 27, 1980
30	Management Approaches to Dust Exposure Control	June 28, 1980

FEMA News Releases

Numbers 56-60, 16-17 June 1980, mainly give Disaster Hotlines for resident's in Washington, Oregon, Idaho, 1p. each

U. S. Army Corps of Engineers News Release

June 18, 1980, Announces Columbia River dredging operations and restoration of Cowlitz River, 1 p.

U. S. Small Business Association News Releases

Numbers 18-20, June 18, 1980, announce branch offices openings

U. S. Geological Survey Daily Newsbriefs

Reports of 9-am news briefings of 17, 18, 19 June 1980, 1 p. each

Forest Service News Releases

June 4th release announces procedure for securing permits to work in restricted zones
June 13th release announces Ass't. Secy, USDA, visit

Forest Service Emergency Planning Document

Mt. St. Helens Contingency Plan, April 1980, 46 pp.

Glossary of Selected Volcanological Terms

avalanche - downslope movement of pulverized flank of volcano en masse but without cohesion; includes previously solidified or consolidated lava and pyroclastics, soil and forest cover mobilized by the lateral blast

debris flow - downslope movement of solidifed or consolidated lava and pyroclastics and/or soil and forest cover of various size grades (must have fractions larger than cobbles) as a cohesive mass; cohesion is provided by water and/or fluids (cf. mud flow)

dome - domal-shaped or bulbous extrusion of viscous lava on volcano surface, usually in crater floor.

lateral blast - sudden release of gas pressure and heat directed nearly horizontally through the crater rim and flank of the volcano; as opposed to the usual energy release directed vertically through the crater or vent area.

mud flow - downslope movement of predominantly clay-or-silt-sized particles as a cohesive mass; cohesion is provided by water and/or fluids (cf. debris flow in which larger particles predominate)

plug - volcanic vent filling usually by solidified magma and/or by solidified lava and conslidated pyroclastics.

pyroclastic flow - fragments of previously formed volcanic material and/or solid and semi-solid material emanating from a volcano entrained within volcanic gas and ash which moves as a viscous fluid (when water is added it may become a debirs or mud flow depend upon the size fractions of the constituents).