# THE ECONOMIC EFFECTS OF THE ERUPTIONS OF MT. ST. HELENS

Report to the Committee on Ways and Means of the U.S. House of Representatives on Investigation No. 332-110 Under Section 332 of the Tariff Act of 1930

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United States International Trade Commission / Washington, D.C. 20436

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UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C.

Investigation 332-110

Study of the Economic Effects of the Eruption of Mount St. Helens

AGENCY: United States International Trade Commission

ACTION: At the request of the Committee on Ways and Means, United States House of Representatives, and in accordance with the provisions of section 332 of the Tariff Act of 1930, as amended, the Commission has instituted investigation No. 332-110, for the purpose of studying the economic effects of the eruption of Mount St. Helens on the Pacific Northwest and on the United States. The report will include information on:

(1) the effect on imports and exports;
(2) the effect on agricultural production and marketing and on manufacturing and investment;
(3) the effect on the transportation system; and
(4) any long-term detrimental effect to the inhabitants of the region and to the ecosystem.

To the extent feasible, the Commission intends to use such data as are available from other Federal agencies, so as to avoid duplication.

EFFECTIVE DATE: June 18, 1980

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WRITTEN SUBMISSIONS: Since there will be no public hearing scheduled for this study, written submissions are invited from interested parties concerning any phase of the study. Commercial or financial information which a submitter desires the Commission to treat as confidential must be submitted on separate sheets of paper, each clearly marked "Confidential Business Information" at the top. All submissions requesting confidential treatment must conform with the requirements of section 201.6 of the Commission's Rules of Practice and Procedure (19 C.F.R. 201.6). All written submissions, except for confidential business information, will be made available for inspection by interested persons. To be insured of consideration by the Commission in this study, written statements should be submitted at the earliest practicable date, but no later than August 1, 1980. All submissions should be addressed to the Secretary at the Commission's office in Washington, D.C. 20436.

By Order of the Commission:

Kenneth R. Mason
Secretary

Issued: June 18, 1980

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## EXECUTIVE SUMMARY

The immediate economic effects of the recent eruptions of Mt. St. Helens have been small in relation to the economy of the Pacific Northwest and, in relation to the U.S. economy, virtually insignificant. There has been little overall impact on the area's imports and exports, despite the fact that specific activities such as agriculture (including timber production) and shipping experienced immediate, short-term losses. The long-term effects depend primarily upon the volcano's future activity. If volcanic activity continues for a significant period, there may be a reduction in investment, and a lower rate of growth in the region. However, if Mt. St. Helens returns to a dormant state the long-term impact will be minimal, with a probable growth in tourism due to the unique nature of the mountain.

The strongest and most violent of the eruptions was the one on May 18. The three major physical effects--the mudflows, the pyroclastic blast, and the ash fallout--each has had distinct economic consequences. The blast blew down 120,000 acres of forest. The mudflows, along with knocking down bridges and roads, let loose tons of silt blocking transport along the Columbia River, killing fish, and destroying their habitat. The ash fallout caused crop losses and forced many manufacturing facilities to close for hours and some for days.

The subsequent eruptions were of a lesser magnitude and resulted largely in more ash being carried by winds to sections of the country west, south, and northeast of the volcano.

The estimated losses and repair/cleanup costs, as currently reported, 1/ are as follows:

| | Value (Million dollars) |
|---|---|
| Timber and related losses | 695 |
| Agricultural losses | 192 |
| Fishery losses | 95 |
| Dredging Columbia River | 44 |
| Damage to public roads and bridges | 112 |
| Cleaning ash from roads | 75 |
| Total | 1,213 |

1/ Data were compiled from reports of the Forest Service, U.S. Department of Agriculture; the Washington, Oregon, and Idaho State Departments of Agriculture; the Washington Department of Fisheries; the Washington Game Department; the Corps of Engineers, U.S. Department of the Army; the Washington Office of Financial Management; the Federal Emergency Management Agency; the U.S. Department of Transportation; the Oregon Department of Transportation; and the Pacific Northwest River Basin Commission.

The resolution of the Committee on Ways and Means of the House of Representatives requested the U.S. International Trade Commission to investigate the economic impact of the Mt. St. Helens' eruptions on the Pacific Northwest and the United States. The effects of the eruptions are summarized below.

(1) The effects on industry and tourism

The agricultural, forestry, and manufacturing activities of the region experienced only temporary disruptions owing to the eruptions with most of the nonagricultural and forestry production returning to nearly normal levels within a matter of days.

On a sectoral basis, forestry and forest products, the leading industrial sector of the region, incurred the largest dollar losses. Although a number of plants shut down for brief periods, and salvage operations have begun on the downed timber only to a limited extent, the overall output of the forestry products industry of the Pacific Northwest has suffered little, if any, reduction.

Agricultural production was not appreciably affected, with 1980 losses equivalent to about 3.5 percent of total 1979 output. Although animal and animal products, tree fruits, and especially hay, suffered losses, the fulfillment of forecasts for bumper crops of wheat, apples, and barley could result in an overall increase in agricultural production when compared with 1979 levels.

The fishery sector experienced substantial damage, as the mudflows and floods killed large numbers of fish, damaged hatcheries, and spoiled fish habitat. Further, the adverse effects are likely to be felt for several years. Over the longer term, however, the recovery prospects for much of the fish habitat, and as a consequence the fish population, are considered good.

The remainder of the manufacturing sector suffered relatively minor losses in the form of a number of short-term plant closings, ash-related damage to capital and operating equipment, and increased preventive maintenance. There is some concern, however, that the long-term abrasive effect of the ash could be serious. Federal programs offering various forms of financial assistance to affected companies and workers are available to offset some of these losses.

The tourist industry in the Pacific Northwest has been depressed as a result of the ash fallout and resulting negative publicity. Efforts being made to allay the fears of potential visitors and to attract tourists to the region seem to have had some success as the summer progressed.

Owing to the unpredictable nature of possible future volcanic activity of Mt. St. Helens, the principal long-term consequence of the eruptions will be to raise the level of uncertainty regarding future investment decisions affecting the region. As a result, regional investment may be lower than otherwise would have been the case. However, should Mt. St. Helens return to a dormant state, the long-term effects of the eruptions are likely to be small.

(2) The effects on international trade

The effect of the eruption on U.S. imports and exports is expected to be minimal. The principal consequences to the region, which in 1979 accounted for about 7 percent of U.S. exports and 4 percent of U.S. imports, are possibly a slight reduction in agricultural exports and a temporary diversion of port traffic owing to the relatively brief blockage of the Columbia River, a major U.S. waterway. The expected bumper harvest of agricultural crops, however, could well offset the possible export losses. Exports of manufactures have been largely unaffected, while imports have experienced only a temporary inconvenience owing to the reallocation of port traffic.

(3) The effects on the transportation system

The main effect on transportation was the closure of the Columbia River to oceangoing vessels. By August, however, the river's channel had been returned to 95 percent of its normal depth. Consequently, the number of ships carrying imported cargo on the river in August 1980 almost equaled the number on the river during August 1979. The extensive road network and the large number of bridges in the immediate vicinity of Mt. St. Helens which were destroyed by the May 18 blast are being repaired or replaced. Aside from this damage to the access routes of the Mt. St. Helens' area, the region's transportation system was untouched except for ashfall.

(4) The effects on the inhabitants and on the ecology of the region

Aside from the deaths and injuries caused by the May 18 blast, the short-term human health effects appear to be minor. There is some concern, however, that long-term exposure to the volcanic ash could cause lung diseases, such as silicosis. Particularly vulnerable in this regard are agricultural and forestry workers employed in areas of heavy ashfall. The situation is being closely monitored by health officials.

Another major concern is the potential for flooding of the Cowlitz River in the Castle Rock-Kelso areas this fall and winter. The Cowlitz River has lost about 90 percent of its carrying capacity as a result of sedimentation caused by the May 18 eruption and associated mudflows, and it is unable to carry the runoff expected from fall and winter rains. However, dredging of the Cowlitz River and construction of flood-control devices on the Toutle River are underway, thus reducing the potential for floods.

## INTRODUCTION

On June 18, 1980, the U.S. International Trade Commission began an investigation (No. 332-110) of the effects of the Mt. St. Helens' eruptions on the economy of the Pacific Northwest 1/ and of the United States. The investigation was requested by the Committee on Ways and Means, U.S. House of Representatives in a letter and resolution of June 4, 1980 (app. A). The Commission's notice of investigation was issued June 18, 1980, posted in the Commission's offices in Washington, D.C., and in New York City, and published in the Federal Register of June 25, 1980 (45 F.R. 42899). Public hearings were not held in connection with the study.

Sources for the investigation were written submissions from interested parties, field trips, and personal, written, and telephone contacts with Federal, State, and local Government agencies, port officials, civic associations, trade associations, and industry representatives. Since there are many studies and/or reports, completed and in preparation, which focus on a particular aspect of the eruptions of Mt. St. Helens and its consequences, a partial listing of them has been included in appendix B.

Mt. St. Helens is located in southwestern Washington State, 45 miles north of Portland, Oreg., and approximately 100 miles south of Seattle. It is one of a chain of volcanos in the Cascade Mountain Range which extends from northern California to British Columbia (fig. 1). Because geologists have been able to identify many previous periods of violent volcanic activity at Mt. St. Helens, it has long been considered one of the most active and potentially violent in the United States. Prior to 1980, the most recent activity was from 1831 to 1856, when several other Cascade volcanos erupted as well.

Most geologists believe that most volcanos are created where the plates of the earth's crust come together. As the plates shift, melted rock may be released through weakened spots to form new volcanos or through passages in existing volcanos. Violent eruptions occur when the passageways to the volcano's cap from the high-pressure areas below the earth's surface become clogged. If sufficient pressure mounts, an explosion occurs in which heat, ash, rock, and gases may be expelled.

The early signs that Mt. St. Helens was returning to activity in 1980 were a series of earthquakes, the first of which occurred on March 20, approximately 20 miles north of the volcano. Gradually over the next week the centers of the earthquakes moved closer to the volcano, indicating that melted rock, magma as it is called, was flowing toward a potential eruption.

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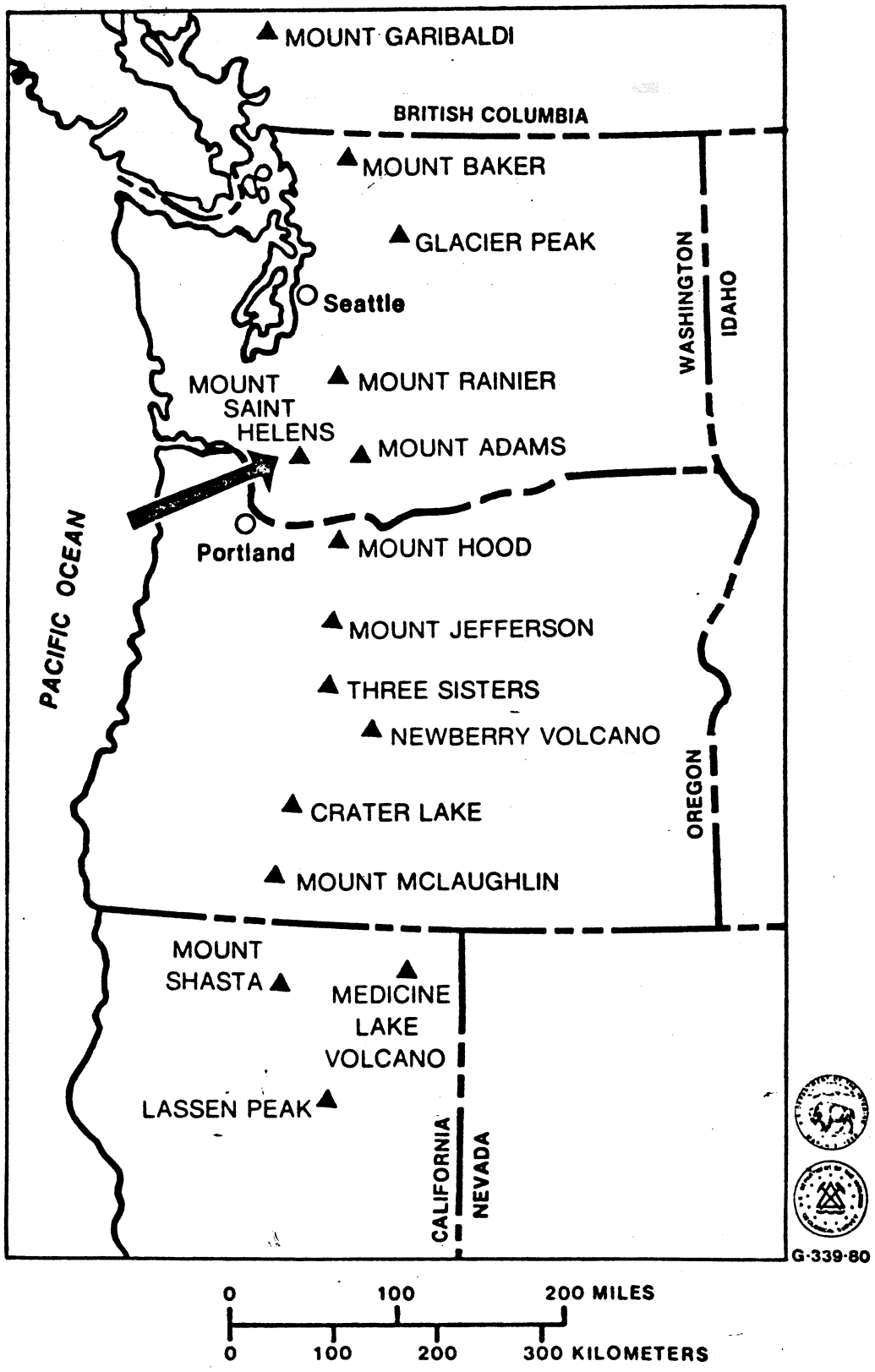
1/ The States of Washington, Oregon, and Idaho.

Figure 1.--Volcanos in the Cascade Mountain Range.




Source: Geologic Survey, U.S. Department of Interior.

In early April, scientists noticed a large and growing bulge caused by pressure from within on the north side of Mt. St. Helens. By May 18, when two strong earthquakes centered at Mt. St. Helens loosened the bulge, the protrusion had extended over 300 feet. As the north face of the mountain began to collapse, pressure was vented laterally from the area formerly occupied by the bulge and three, more or less simultaneous, events occurred.

First, the material from the collapsing bulge slid down the north face of the volcano, mixing with water from Spirit Lake, the Toutle River, and from melted snow and glaciers. This combination of earth and water formed massive mudflows which followed the drainage system down the Toutle and Cowlitz Rivers, and into the Columbia River. Along the Toutle and Cowlitz the mudflows and associated floods scoured the river banks leaving mud, sediment, logs, and other debris some of which eventually contributed to a shoal blocking the Columbia River. 1/

Second, a "pyroclastic blast" or mixture of mountain debris and hot volcanic gases traveling at speeds up to 150 miles an hour, shot out from the area of the displaced bulge, and destroyed most of the forest in a fan-shaped area extending 20 miles north of the mountain.

Third, a large vertical cloud of ash was emitted 11 miles into the atmosphere and was carried east along with the prevailing winds to eastern Washington State, northern Idaho, and west and central Montana. The coarsest ash particles landed within 100 miles of the mountain while finer ash material fell as far east as Oklahoma. The finest particles are still airborne and are expected to remain so for years.

In five subsequent major eruptions of lesser magnitude, the blasts were principally directed vertically with only ashfall as their primary consequence. On May 25, the ash was carried by winds to the west, on June 12 to the south, and on July 22, August 7, and August 15 to the northeast. Figures 2, 3, and 4 show the blast, mudflow, and ash-affected areas.

With regard to the future of Mt. St. Helens, scientists are unable to predict the probability, magnitude, and timing of continued volcanic activity. They have observed, however, a pattern of gas emissions and harmonic tremors which preceded by several hours five of the six eruptions. As a result, people working in the immediate vicinity of Mt. St. Helens were forewarned and removed to avoid further loss of life. There is also a growing concensus among geologists that the magnitude of future volcanic activity will tend to be closer to the five later eruptions than to the first.

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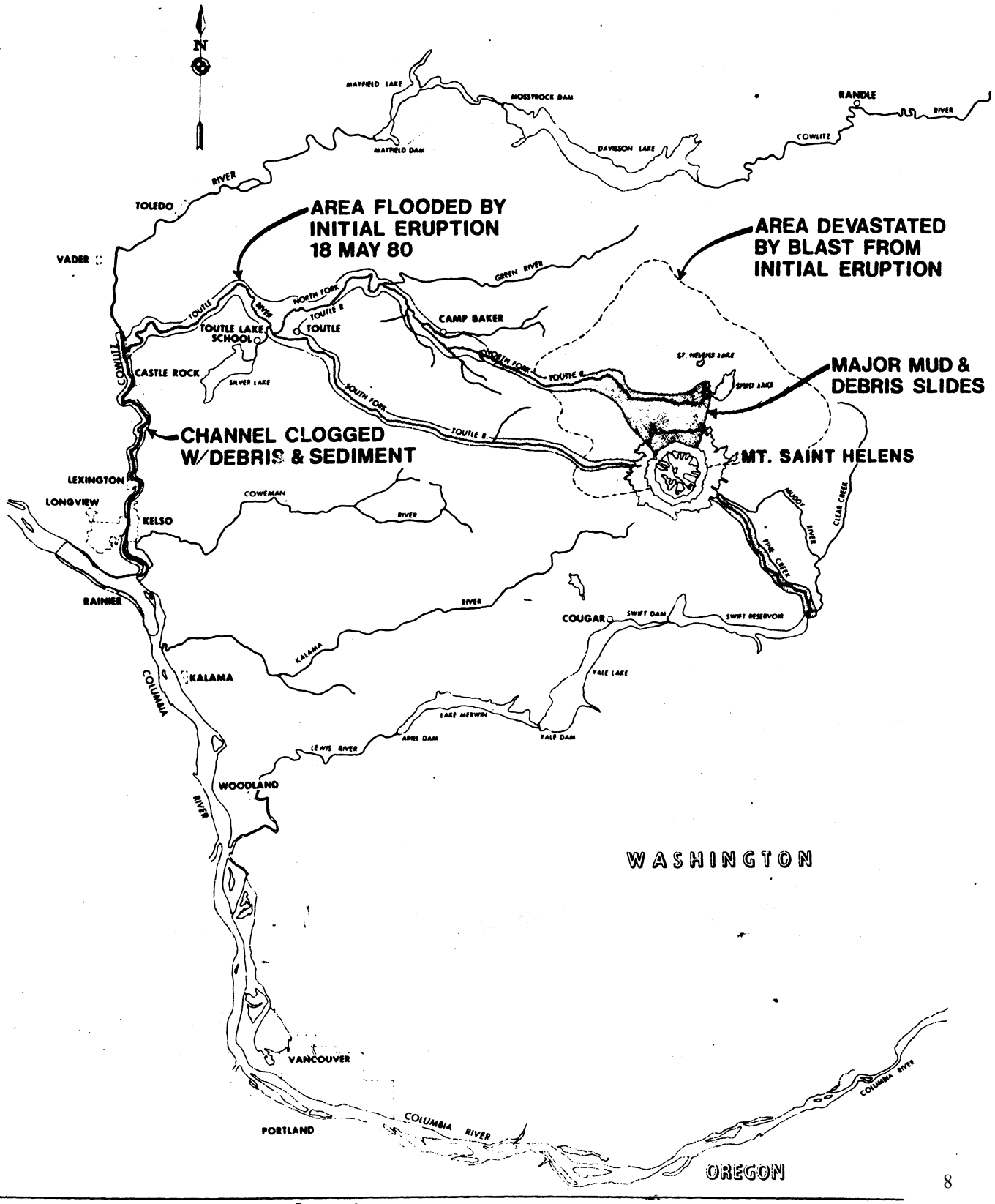
1/ Pine Creek and the Muddy River, which lie to the southeast of Mt. St. Helens, were damaged by mudflows; a number of bridges and other structures were damaged or destroyed as well.

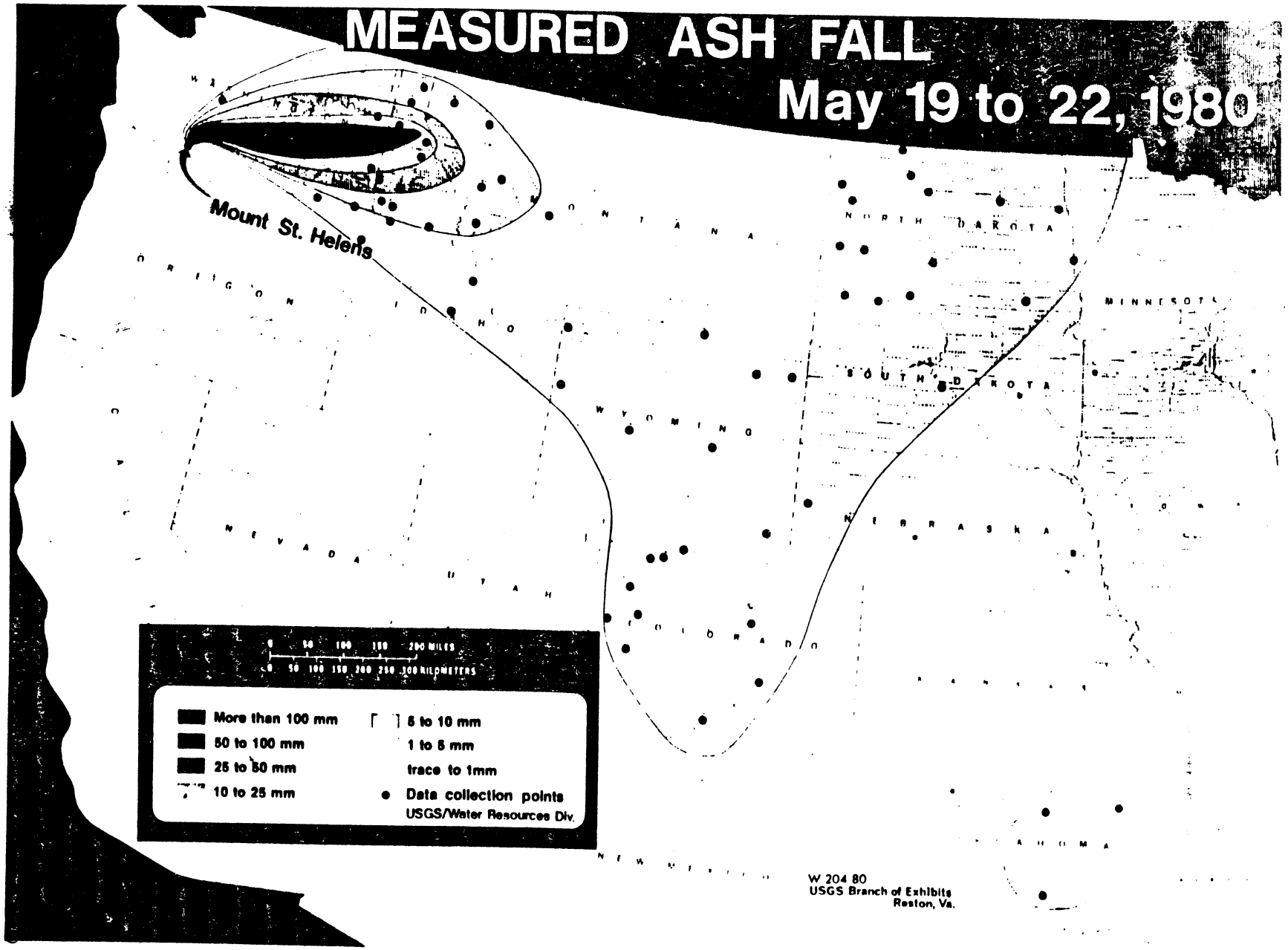
Figure 2.--Blast, mudflow, and flood areas from the May 18, 1980, eruption of Mt. St. Helens.





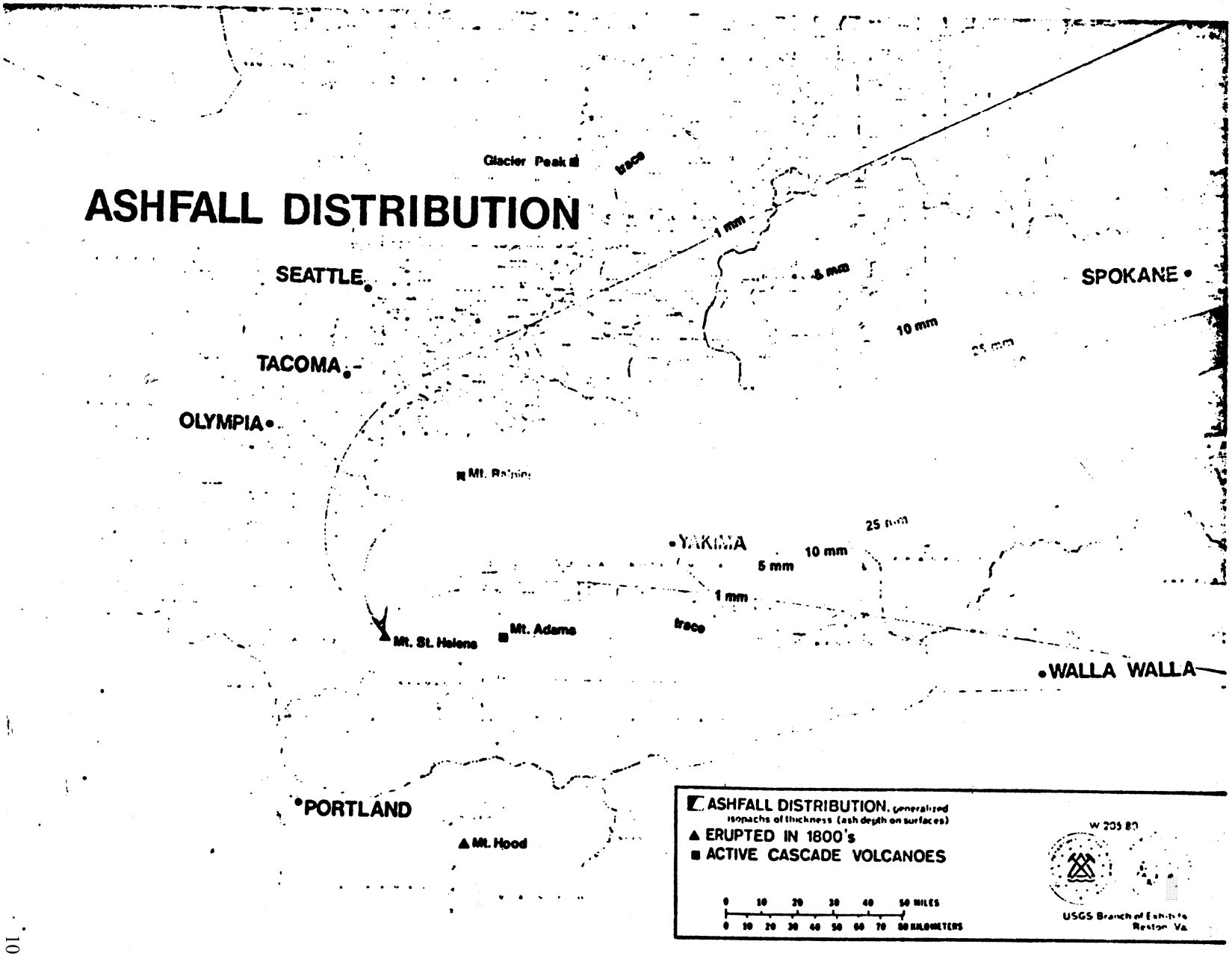

Source: U.S. Army Corps of Engineers.

Figure 3.--Measured ashfall resulting from the May 18, 1980, eruption of Mt. St. Helens.




Source: Geologic Survey, U.S. Department of Interior.

Figure 4.--Washington ashfall distribution from the May 18, 1980, eruption of Mt. St. Helens.




Source: Geologic Survey, U.S. Department of Interior.

## THE EFFECTS OF THE ERUPTIONS ON INDUSTRY AND TOURISM

Forestry, agriculture, fisheries, manufacturing, and tourism are all important in the economy of the Pacific Northwest. This section of the report discusses the actual and potential effects of the eruptions of Mt. St. Helens on these industries on a sector-by-sector basis.

### Effects on Forestry and Forest Products

#### Introduction

The Pacific Northwest region possesses some of the most productive forests of the United States as well as of the world. About half of the region is forest land with 54 percent of Washington, 49 percent of Oregon, and 41 percent of Idaho covered with forests.

Of the nearly 75 million acres of forests in the region, about 56 million acres are classified as commercial forest lands with Washington accounting for nearly 18 million acres, Oregon for about 24 million acres, and Idaho for nearly 14 million acres.

The total net sawtimber inventory of the Pacific Northwest for 1977, the most recent year for which data are available, amounted to nearly 900 billion board feet (International 1/4 inch Rule) and which is equivalent to about 35 percent of the Nation's sawtimber or 45 percent of its softwood sawtimber.

Ownership of commercial forest land in the Pacific Northwest is principally by the Federal Government, followed by industry, other private owners, the State, and other public ownership.

During 1960-77, Federal- and State-owned lands were the source of about 45 to 50 percent annually of the timber harvested. During this period, the annual harvest of timber in the Pacific Northwest trended upward from 14.0 billion board feet in 1960 to 18.8 billion board feet in 1973, then decreased somewhat before rising to 15.9 billion board feet in 1977,the latest year for which data are available. Oregon supplied the bulk of the harvest during this period, ranging from a high of 60 percent in 1960 to a low of 47 percent in 1977; Washington supplied on an average of about 40 percent with Idaho contributing about 10 percent or less.

#### Production

Historically, forest products 1/ have been the leading output of the Pacific Northwest. In 1976, the latest year for which data are available, such production in the region ranked first in both Washington and Oregon and second in Idaho. Of the total value of goods produced in 1976--$34.5 billion--forest products totaled $11.8 billion, as seen in the following table.

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1/ The term forest products here includes SIC Major Group 24, Lumber and Wood Products, and SIC Major Group 26, Paper and Allied Products.

Production of forest products and of all products in the Pacific Northwest, 1976

(In billions of dollars)

| Item | Washington | Oregon | Idaho | Total |
|---|---|---|---|---|
| Lumber and wood products | 3.2 | 5.0 | 0.8 | 9.0 |
| Paper and allied products | 1.7 | 1.0 | 1/ | 1/ 2.8 |
| Total | 4.9 | 6.0 | 1/ .8 | 1/ 11.8 |
| All products | 18.8 | 12.2 | 1/ 3.4 | 1/ 34.5 |

1/ Data withheld to avoid disclosure.

Source: Compiled from official statistics of the U.S. Department of Commerce.

As to specific categories of forest products, the Pacific Northwest is the leading producer of such major items as softwood plywood and softwood lumber as well as a producer of importance of wood pulp and paper and board. Currently, the region accounts for about 53 percent of the Nation's production of softwood plywood, about 43 percent of its softwood lumber, about one-eighth of its wood pulp, and about one-tenth of its paper and board.

Exports

Although the primary market for the forest products of the Pacific Northwest is domestic, exports of such products are of considerable importance to the region. In 1976, for instance, an estimated $1.4 billion, one-third of the value of the region's total exports, were forest products. Exports of lumber and wood products for that year, which totaled an estimated $1.2 billion for the region, ranked second for Washington, first for Oregon, and fourth for Idaho. In 1979, exports of forest products totaled an estimated $2.7 billion, nearly double such exports in 1976, with lumber and wood products supplying the bulk, as seen in the following tabulation:

| Item | Washington | Oregon | Idaho 1/ | Total 1/ |
|---|---|---|---|---|
| | Million dollars | | | |
| Lumber and wood products | 1,232 | 972 | 60 | 2,264 |
| Paper and allied products | 302 | 122 | 2/ | 2/ 424 |
| Total | 1,534 | 1,094 | 2/ 60 | 2/ 2,688 |

1/ Estimated.
2/ Data withheld to avoid disclosure.

The leading forest products exported from the Pacific Northwest, as shown in the following table, are softwood logs, softwood lumber, wood chips, and softwood plywood.

Exports of leading forest products from the Pacific Northwest, by customs districts, 1979

| Type of product | Customs district | | |
|---|---|---|---|
| | Seattle | Portland | Total |
| | Million dollars | | |
| Softwood logs | 989 | 489 | 1,478 |
| Softwood lumber | 1/ 148 | 170 | 318 |
| Wood chips | 17 | 133 | 150 |
| Softwood plywood | 7 | 72 | 79 |
| Total | 1,161 | 864 | 2,025 |

1/ Estimated.

Source: Compiled from official statistics of the U.S. Department of Commerce, and the Forest Service, U.S. Department of Agriculture.

During the 1960's exports of these products boomed but during the 1970's, with some fluctuation, exports trended upward at a much reduced rate. Although both the Portland and the Seattle customs districts are utilized for the export of these products, the latter district handles the greater share of such exports. Japan is the principal export market for these products. The leading ports for exports of logs are Tacoma and Aberdeen, Wash., and Portland and Astoria, Oreg.

During 1977-79, the five leading commodities, in terms of value, exported through the Portland customs district were wheat, Douglas-fir logs, wood chips, certain Douglas-fir lumber, and hemlock logs. The value of such exports and their share of total U.S. exports through all ports are shown in the following table.

U.S. exports of the 5 leading products through the Portland customs district, 1977-79

| Item | Customs value | | | Share of total U.S. exports | | |
|---|---|---|---|---|---|---|
| | 1977 | 1978 | 1979 | 1977 | 1978 | 1979 |
| | Million dollars | | | Percent | | |
| Wheat | 608 | 1,092 | 1,414 | 23 | 25 | 27 |
| Douglas-fir logs | 139 | 201 | 292 | 43 | 47 | 46 |
| Wood chips | 125 | 114 | 133 | 70 | 73 | 67 |
| Certain Douglas-fir lumber | 61 | 60 | 132 | 69 | 76 | 83 |
| Hemlock logs | 105 | 101 | 124 | 27 | 22 | 19 |

Source: Compiled from official statistics of the U.S. Department of Commerce.

Exports of forest products through the Seattle customs district for 1977-79 were concentrated on log exports, which ranked among the top five export categories for those years. The value of such exports and their share of total U.S. exports through all ports are shown as follows:

| Item | Customs value | | | Share of total U.S. exports | | |
|---|---|---|---|---|---|---|
| | 1977 | 1978 | 1979 | 1977 | 1978 | 1979 |
| | Million dollars | | | Percent | | |
| Hemlock logs | 288 | 345 | 510 | 73 | 77 | 79 |
| Douglas-fir logs | 172 | 213 | 332 | 53 | 49 | 52 |

Damage appraisal

The May 18 eruption of Mt. St. Helens laid waste to perhaps as much as 120,000 acres of forest land. Most of the damage was done by the pyroclastic blast, a high velocity lateral discharge consisting of a mass of earth and rocks, accompanied by a cloud of hot ash and gases with temperatures which may have approximated 1,000 degrees centigrade. Substantial damage was also caused by the enormous mudflows (consisting of hot mixtures of earth, rocks, and water) which poured down Mt. St. Helens' drainage systems. As the mudflows moved downstream they scoured riverbanks of standing timber and ripped out bridges and roads.

Estimates of damage to the timber resources and related losses (including repair/replacement costs to access roads, buildings, and so forth) currently total about $695 million, with the bulk of the loss--some $652 million--in timber. Of the down and damaged timber, about 70 percent is privately held 1/ and the remainder divided about equally between Federal and State ownership. In terms of ownership of the forest areas damaged by the May 18 blast, privately owned timberlands constitute about 60 percent, Federal lands about 35 percent, and the remainder State lands.

1/ A small share of the loss of privately owned timber and related facilities and equipment may be recovered under various provisions of State and Federal tax statutes. For instance, Revenue Rule 80-175 of the Internal Revenue Service provides for the nonrecognition of gain from proceeds received from the voluntary sale of timber downed by high winds, earthquake, or volcanic eruption when the proceeds are used to purchase other standing timber.

A small share of the loss of such privately owned equipment and facilities may be recovered through insurance; standing timber, however, generally is not insured.

Approximately 3.2 billion board feet of timber are believed to have been destroyed or blown down by the pyroclastic blast or uprooted and washed downstream by the mudflows. About half of this timber is Douglas-fir with the remainder consisting of hemlock and other whitewood species. The downed timber included stands of various age groups--overmature, mature, and plantations.

To provide a frame of reference for appraisal of the magnitude of the downed timber, the current loss of 3.2 billion board feet should be compared with the annual loss owing to disease, insects, and fire in the Pacific Northwest of about 4 to 5 billion board feet and to the 10 to 12 billion board feet which were harvested because of the 1962 Columbus Day storm that hit northern California, Oregon, Washington, and then Canada. Another frame of reference is the total annual cut of softwood timber in the United States: about 56 to 58 billion board feet cut annually with Washington, Oregon, and Idaho supplying about 12 percent, 14 percent, and 3 percent, respectively.

In regard to the salvage possibilities of the downed timber, available estimates vary from a low of about 20 percent to a high of about 80 percent of the preblast volume of the stands; however, it appears that substantially less than 50 percent may be salvaged. The force of the pyroclastic blast virtually destroyed many acres of timber and left many others with badly shattered and broken trees. Even those downed trees which appear to be essentially intact may have suffered extensive splintering, shake damage, microscopic tissue damage, or other types of structural failure. 1/ Another possible type of damage may be the extent and depth of penetration of ash particles into the wood of the downed trees. The incidence of the various types of damage is unknown at this time. As the areas of the downed timber are harvested with extensive laboratory tests being made on samples of the downed timber, a clearer picture will emerge of the extent and seriousness of the various types of damage that occurred.

Effects on production of forest products

The effect of the Mt. St. Helens' eruptions upon the output of the forest products industries of the Pacific Northwest and upon the United States has been minimal. Immediately after the May 18 blast, a few mills were shut down for a short time, one or two shifts or 1 or 2 days, principally owing to ash-related problems. One mill was closed down because all roads leading to it were cut by mudflows or ashfall.

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1/ The Forest Service has initiated a wood quality research program to determine the condition and quality of timber in the blast blowdown area. The amounts and types of breakage and other timber quality factors are being investigated.

For the long term, however, there are problems facing various forest products firms in securing their logs. Companies which had been logging in the down area now must procure their logs from other sources available to them. For instance, those firms owning timberlands have begun to cut on lands that had not been scheduled for cutting until a later date. Those firms which had been securing their logs from the blast area and now have no other timberlands available may have difficulty in purchasing logs.

The consensus, however, appears to be that the large amount of downed timber will not be harvested at a rate exceeding the normal rate for the region; i.e., as the blast timber is harvested, logging cutbacks will occur elsewhere in the region. Although the downed timber has caused fluctuations in the market prices of logs, such variations have been outweighed in large measure by the downward pressure on market prices generated by the depressed level of housing starts and of the economy in general.

There are a number of problems of a somewhat extended nature affecting the future output of forest products from the vicinity of Mt. St. Helens. Foremost, perhaps, is the need to remove the wood before it rots. All dead timber, of course, presents serious disease and insect hazards not only affecting the harvest of such timber but also the risk of spreading to nearby green timber. Depending upon species, the harvest will have to be completed within 18 months to perhap 3 years. There is a substantial fire hazard as well because of the extensive acreage of dead trees, both standing and down, and both with and without branches and twigs intact. 1/ Such areas present a significant forest fire hazard not only to the dead trees but also to adjacent stands of green timber.

The presence of ash on the ground or on the logs or in the wood presents serious problems in harvesting of the logs and their processing into products. The ash, being gritty in nature, is quite abrasive and causes extensive wear on chain saws, chipper knives, and other wood cutting and slicing equipment, thus appreciably raising the costs of logging and of manufacture. Further, the presence of ash particles also would seriously limit the utilization of the log for processing into those products where the ash particles would adversely affect the utility or the appearance of the end product.

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1/ The Forest Service reports that there are widely scattered small fires burning in logs and debris under ash in an area approximating 34,000 acres; also, approximately the same level of fire activity is expected for the future unless strong east winds create conditions which increase fire intensity and rate of spread.

A number of local communities have been adversely affected by the ban on activities within the restricted zones around Mt. St. Helens. Not only have logging operations been severely curtailed, 1/ but so have recreational activities such as hiking and camping. Those communities supplying goods and services for such activities have been hard hit.

Another problem of concern to many people dependent upon the forests in the vicinity of Mt. St. Helens is the drive to designate extensive areas of the blast zone as a wilderness area. The purpose of such set-asides is to preserve these areas for scientific research into the many and varied geological events resulting from the May 18 eruption. Excessively large areas set aside for this purpose, it is maintained, would result in loss of valuable timber and timberland with the accompanying adverse impact on the regional market. There would be the loss of jobs for woods workers and the dead timber left on the ground would create an incubator for disease and insect infestation, as well as contribute to a serious forest fire hazard.

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1/ Timber-cutting crews are operating in the Mt. St. Helens' area as the volcanic hazard permits. Such crews are required to operate under a ready-alert system which requires 2-way radios and immediate transportation out of the area to be on hand.

## Effects on Agriculture and Agricultural Products

### Introduction

The Pacific Northwest possesses some of the most productive agricultural land of the United States, and owing to its climate, the region is ideally suited to the production of certain specialty crops. Nearly 45 percent of the region is devoted to cropland or grassland pasture with 51 percent of Idaho, 40 percent of Oregon, and 35 percent of Washington devoted to agricultural production.

For certain crops the Pacific Northwest accounts for almost all of U.S. production (e.g., filberts, hops, dried peas and lentils, bushberries, and certain grass and field seeds--crimson clover, chewings and red fescue, bentgrass, and ryegrass). For other crops such as apples, cherries, pears, mint, and potatoes, the region accounts for 30 percent or more of U.S. production. In 1979, agricultural production in the region accounted for about 9 percent of the region's gross product of $64 billion.

### Production

Agricultural production in the Pacific Northwest trended steadily upward during 1977-79. In 1979, total agricultural production in the Pacific Northwest was approximately $5.8 billion, or nearly 27 percent higher than in 1977, accounting for nearly 9 percent of the region's gross product. The State of Washington accounted for 42 percent of the agricultural production in the region in 1979, Idaho 31 percent, and Oregon 27 percent. Production of animals and animal products is the most important agricultural commodity group in each of these States, followed by wheat and barley except for the State of Washington where vegetable, fruit, and nut crops lead wheat and barley, as shown in the following table.

Agricultural production in the Pacific Northwest, total and by major commodity groups, 1977-79

(In millions of dollars)

| State and year | Vegetable, fruit, and nut crops | Wheat and barley | Animal products | Hay | Other | Total |
|---|---|---|---|---|---|---|
| Washington: | | | | | | |
| 1977 | 475.8 | 570.6 | 468.7 | 126.0 | 242.8 | 1,883.9 |
| 1978 | 542.3 | 494.7 | 572.5 | 122.6 | 522.4 | 2,254.5 |
| 1979 | 1/ 552.8 | 1/ 504.4 | 1/ 698.7 | 1/ 172.1 | 1/ 499.8 | 1/ 2,427.8 |
| Oregon: | | | | | | |
| 1977 | 171.8 | 236.4 | 344.1 | 126.2 | 156.5 | 1,035.0 |
| 1978 | 216.4 | 200.0 | 433.7 | 127.7 | 276.6 | 1,254.0 |
| 1979 | 1/ 229.5 | 1/ 237.4 | 1/ 591.9 | 1/ 151.8 | 1/ 312.5 | 1/ 1,523.7 |
| Idaho: | | | | | | |
| 1977 | 26.5 | 279.8 | 476.5 | 231.0 | 286.3 | 1,300.1 |
| 1978 | 42.4 | 326.0 | 618.2 | 217.8 | 405.7 | 1,510.1 |
| 1979 | 1/ 32.2 | 1/ 343.0 | 2/ 740.0 | 1/ 207.2 | 1/ 491.1 | 1/ 1,804.5 |

1/ Preliminary. 2/ Estimated.



Source: Compiled from official statistics of the U.S. Department of Agriculture.

## Exports

In 1976, the last year for which data are available, an estimated $850 million, or one-seventh of the Pacific Northwest's total exports, were agricultural products. The leading agricultural products exported from the region are wheat and flour and vegetables and vegetable preparations. In 1976, these two product groups ranked first and second in each of the States with regard to their importance as agricultural exports.

It is estimated that agricultural exports accounted for 23 percent of farm sales in Washington, 22 percent of farm sales in Idaho, and 18 percent of farm sales in Oregon in 1976.

## Damage appraisal and effects of the eruptions on production of agricultural products

The effects of the eruptions of Mt. St. Helens on agricultural production in the Pacific Northwest have been minimal, thus far. Short-term losses are estimated at about $192 million for the region, equivalent to approximately 3.5 percent of the total value of agricultural production for the region in 1979. The heaviest losses occurred to the animal and animal products sector, to hay, and to tree fruits, as shown in the following table.

Estimated agricultural losses resulting from the eruption of Mt. St. Helens in the Pacific Northwest, by State

(In millions of dollars)

| Commodity | Washington | Oregon | Idaho | Total |
|---|---|---|---|---|
| Livestock, dairy, and sheep | 38 | - | - | 38.0 |
| Hay | 35 | .2 | - | 35.2 |
| Tree fruits | 25 | - | - | 25.0 |
| Wheat and barley | 19 | - | - | 19.0 |
| Peas and lentils | 10 | - | 5 | 15.0 |
| Misc. horticultural crops | 17 | 11.5 | - | 28.5 |
| Bees | 1 | - | - | 1.0 |
| Machinery | 30 | - | - | 30.0 |
| Total | 175 | 11.7 | 5 | 191.7 |

Source: Reports of the Washington, Oregon, and Idaho State Departments of Agriculture.

Although individual farmers were adversely affected by the various eruptions of Mt. St. Helens, it is possible that the total value of agricultural production in the region may be higher in 1980 than it was in 1979 because of the large wheat and barley crops and the possibility of a near record apple crop. Also, the drought in the central United States may cause prices for nearly all farm products to increase this year. This general rise in farm price levels may also result in damage estimates from the eruptions being increased.

Animal and animal products.--It is estimated that this sector incurred nearly $38 million in losses from the eruptions. Almost all of the losses were confined to the State of Washington and occurred in part because farmers were not able to deliver their products to market. For example, it has been reported that dairy farmers dumped milk during the week following the eruptions of May 18 and of May 25 because delivery trucks could not reach the farms and because air filters on the milk-holding tanks clogged. However, the bulk of the $38 million is estimated as potential losses because of livestock needing longer periods of time to obtain market weight and owing to lower milk production because of the ash-caused decreased palatability and poor quality of the pasture and the first hay crop this year. Only a small part of the total loss is attributed to livestock deaths, primarily to sheep and cattle. Most of these deaths resulted from the animals drowning during the flooding along the Toutle and Cowlitz Rivers following the May 18 eruption.

Hay.--Hay is the principal crop which was adversely affected by the eruptions. At the time of the May 18 eruption, much of the first hay cutting was ready for harvest. Losses are estimated at more than $35 million with the loss being confined almost entirely to the State of Washington. It is estimated that half of the first cutting of hay in Washington was damaged or destroyed by the ash (the first cutting usually accounts for about 40 percent of the entire crop). The ash has lowered the quality and palatability of the hay, hence, livestock do not readily eat it. Therefore, many farmers have purchased hay from areas that were not affected by the eruptions to mix with the ash-contaminated hay so that the livestock will accept it. This has also caused their operating costs to increase sharply. Hence, these farmers are at a competitive disadvantage when compared with farmers that are not in the affected areas.

It has been reported that the second cutting of alfalfa hay was excellent on those fields that were disced after the eruptions. On those fields that were not disced, however, the alfalfa hay is not doing nearly as well. It is believed, however, that generally the quality of the second and subsequent cuttings will be very good.

Tree fruits.--Losses to tree fruits are estimated at $25 million, primarily to apples. Cherries, prunes, and pears were also affected by the ash but only to a minor extent. The ash is believed to have been in part responsible for the larger than normal apple drop in June in parts of the Yakima Valley. However, it is believed that weather conditions were also a major factor in the larger drop. On the other hand, industry sources report that the Washington apple crop may reach a near record since the apples that remain on the trees are much larger than would be expected for this time of the season in the Yakima Valley and because of a larger than normal fruit set in the other apple-producing areas of Washington. Although about 40 percent of the cherry crop was lost due to splitting this year, the splitting resulted from excess moisture and not from the ash. Growers are somewhat concerned that the pear crop, although showing little sign of damage at present, may be affected adversely owing to ash clinging to the blossom end of the fruit at harvest time, thus causing discoloration and lowering the final grade of the fruit.

Wheat and barley.--Total losses to wheat, barley, and other small grains are estimated at $19 million, and reflect potential losses owing to reduced yield more than actual losses. Most of the actual losses were to spring planted grains such as spring wheat and barley that were suffocated in the heaviest ashfall areas. Estimates (based on August 1 growing conditions) put Washington's winter wheat crop production--which was virtually unaffected by the eruptions--at 135.0 million bushels--up more than one-third from the amount of production in 1979. Winter wheat accounts for more than 90 percent of the State's wheat output.

Estimates of losses to spring wheat production from plants being suffocated are not available. However, spring wheat production in Washington is estimated at 15.6 million bushels in 1980--down one-third from the previous crop. It should be noted, however, that this production is from 410,000 acres, or 45 percent fewer acres than the number of acres in 1979.

Washington's barley production in 1980 is estimated at 28.0 million bushels, or nearly 65 percent higher than output in 1979, although acreage planted only increased by 3.7 percent from 1979 to 1980.

Other crops.--There was also some damage to other crops such as dried legumes (peas and lentils) and miscellaneous horticultural crops (i.e., vegetables, berries, and seed crops). Damage to dried legumes is estimated at about $15 million. Damage varied from field to field depending on the height of the plants at the time of the ashfall. In addition to the damage from the ashfall, producers of dried legumes face substantial losses as a result of poor weather conditions and disease problems.

Berry crops were also affected by the May 25 and June 12 eruptions. Losses are estimated at more than $8 million, primarily to strawberries. The principal effect of the ash on strawberries was reduced quality for processed berries. Although the ash can be washed off the berries at an increased expense, a very fine residue remains which precludes the processed berries from being graded "A" or "B" by the U.S. Department of Agriculture.

Farm labor.--Direct effects on farm labor generally are believed to be negligible. Immediately following the eruptions field work was curtailed in the affected areas resulting in field workers losing some work time--especially strawberry workers. However, the cherry harvest, which began in June and was completed in July, required substantially increased hand labor in order to cull the split cherries and to pick the near record crop. It is believed that a substantial number of apple pickers will also be needed this fall to harvest the possible near record apple crop. Hence, total farm workers income in the Pacific Northwest is not expected to be adversely affected by the eruptions.

Indirect effects of the eruptions on the employment of farm labor are not known at present. However, various Federal and State agencies are monitoring farm workers to determine if the ash has had or will have any detrimental effects on farm workers--especially on their health.

Other losses.--The extent of losses to machinery is a major unknown. At present, losses to farm machinery, primarily for repairs, and the cost of increased preventive maintenance are estimated at $30 million. Routine maintenance such as changing air and fuel filters and changing oil has been greatly accelerated to prevent damage from the ash. In the heaviest ashfall areas it is recommended that routine maintenance be performed at least twice as often as normal. The ash is very abrasive to moving machinery parts. Machinery which operates close to the ground is particularly susceptible to rapid ash-caused wear (as hay producers have discovered, to their dismay). Dried legume producers are particularly concerned, since their crops must be cut close to the ground. Producers of forage and grass seeds are also concerned since their crops not only have to be cut off close to the ground and placed in windrows to dry but they also have to use expensive combines to harvest the seed from windrows.

Long-term losses to agriculture as a result of the eruptions are not known but it is believed that such losses will be negligible. The most likely long-term losses will be increased maintenance costs and premature equipment failure because of prolonged exposure to the ash. It is believed that the ash can be incorporated into the existing soil with only minor difficulty on almost all of the affected farmland. The incorporation of the ash is not expected to significantly affect soil composition since most of the soil types in the region are of volcanic origin and the ash is basically composed of inert material. The salinity of the ash may cause some problems in the drier areas of the Pacific Northwest. In the humid areas the salinity of the ash may result in the ground water containing slightly higher salt levels than currently found in irrigation water in the region. It is anticipated that normal rainfall will leach most of the salts from the soil quickly. Hence, increased salinity should not cause any prolonged adverse effects.

Although 25 to 30 farms along the Toutle and Cowlitz Rivers were covered by mud deposits of 1 foot to 8 feet as a result of the mudflows from the May 18 eruption, it is believed that many of the farmers will farm over the deposits. Therefore, there will be little, if any, loss of farmland.

The eruption of Mt. St. Helens is expected to provide some long-term benefits to agriculture in those areas receiving ash since the ash does contain some trace elements and mineral nutrients that are necessary for plant growth. In addition, the ash will help to loosen the soil which will allow better root penetration by plants and better moisture penetration which will help enhance plant growth.

## Effects on Fisheries and Fishery Products

### Introduction

Commercial fishing, principally for salmon, and sport fishing and associated recreation activities are important to the economy of the Pacific Northwest. The importance of commercial fishing has declined in recent decades as dams have been built on the major river system in the region, the Columbia River and its tributaries, thus restricting the movement of migratory fish such as salmon. Fish hatcheries have been built to attempt to offset the effects of the dams on the fish population.

### Production

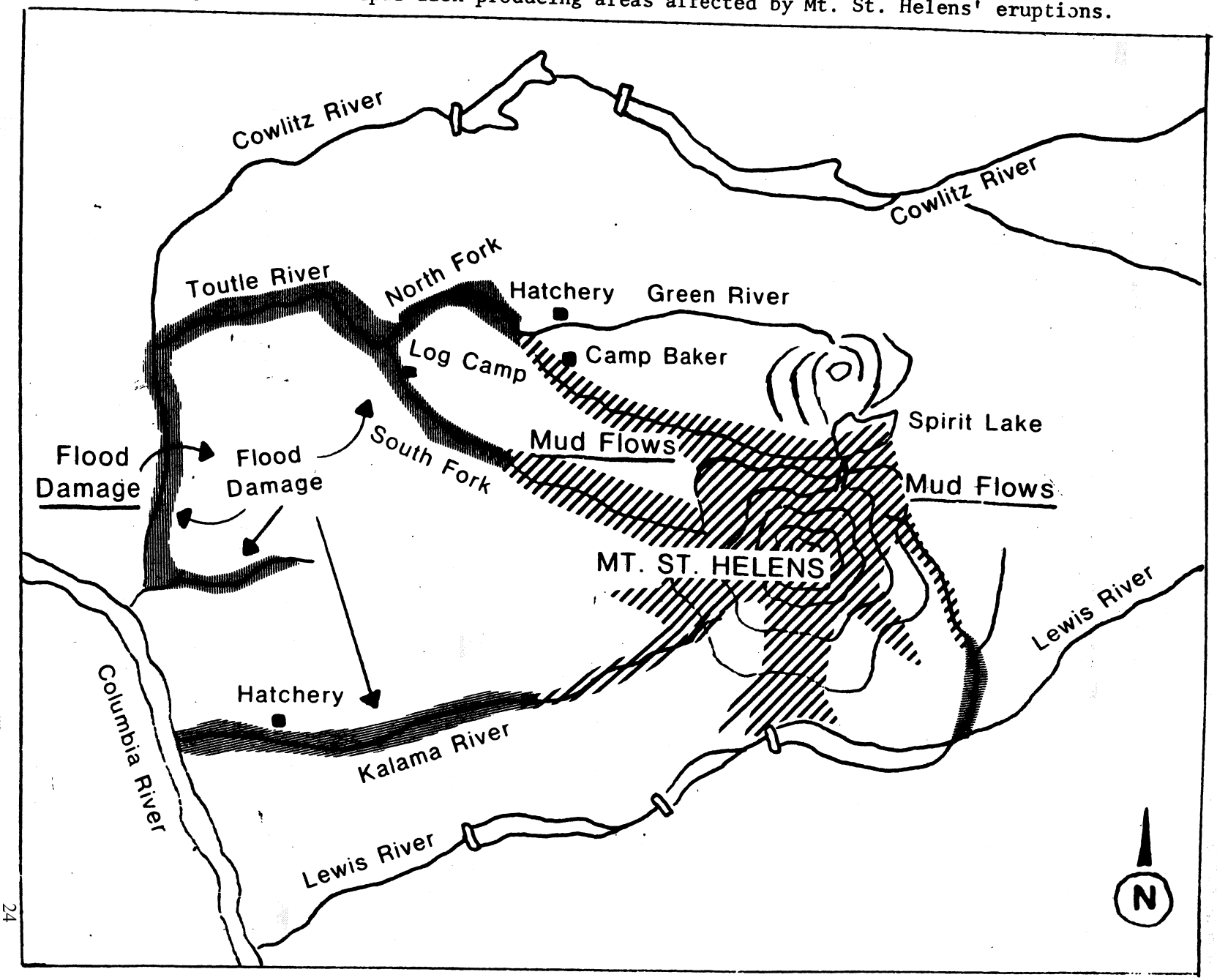
In 1979, commercial fishery production in the Columbia River system was valued at more than $7 million with the principal commercial fish being salmon, sturgeon, smelt, shad, and steelhead trout. All of these species are also valued as sportfish, as are rainbow and cutthroat trout. In terms of commercial value, chinook and silver salmon are by far the most important species, as indicated in the following tabulation of commercial Columbia River landings in 1979:

| Type | Quantity (1,000 pounds) | Value (1,000 dollars) |
|---|---|---|
| Chinook salmon | 2,943 | 4,575 |
| Silver salmon | 1,038 | 1,657 |
| Sturgeon | 518 | 528 |
| Smelt | 1,187 | 119 |
| Shad | 453 | 98 |
| Steelhead trout | 249 | 90 |
| Total | 6,388 | 7,067 |

In addition, there is a sportfish catch of steelhead trout and sturgeon that is much larger than the commercial catch, as well as a large sportfish catch of salmon and smelt.

The Columbia River tributaries that drain Mt. St. Helens--the Toutle, Cowlitz, Kalama, and Lewis Rivers (fig. 5)--are of major importance as to breeding habitats to the salmon, smelt, and steelhead trout and as a source for about one-third of the State's sportfish catch of steelhead trout. The salmon hatcheries on these rivers normally account for about one-fourth of Washington's salmon hatchery output. Sturgeon and shad, on the other hand, tend to inhabit the Columbia River proper or migrate into tributaries other than those draining the Mt. St. Helens' watershed.

Figure 5.--Principal fish-producing areas affected by Mt. St. Helens' eruptions.




Source: Department of Fisheries, State of Washington.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The above data on landings represent only those salmon caught in the Columbia River and which are believed to account for less than 5 percent of total commercial U.S. salmon landings. A large but unknown volume of salmon originating in the Columbia River system is also caught in the ocean by American and foreign fishermen.

Exports

Although salmon have been a major export item to Japan in recent years, such exports were not expected to continue at the same level during 1980-81. Prices for frozen salmon declined considerably in 1979 and early 1980 because inventories from the 1979 U.S. catch both in Japan and the United States were extremely large and because catches in Alaska in the 1980 season again were large.

Damage appraisal and effects of the eruptions on production of fishery products

The damaging effects of the May 18 eruption of Mt. St. Helens on the Columbia River fishery were substantial and resulted primarily from the mudflows and floods. 1/ The eruption adversely affected the entire Mt. St. Helens' drainage system, to varying degrees; these effects are discussed in the following section of the report.

Direct fish kill.--Virtually all fish in the Toutle and in the Cowlitz Rivers from its junction with the Toutle downstream to the Columbia River were killed following the May 18th eruption. Salmon was the principal fish impacted, with the major kill consisting of the young salmon that were on their way downstream at the time of the eruption.

The Washington Department of Fisheries estimates a loss of about 12 million juvenile salmon. The salmon losses include all the salmon in the affected rivers at the time--wild fish, fish released from the Cowlitz hatchery just prior to the May 18 eruption, all the fish in the flooded-out Toutle hatchery on the Green River, and about 400,000 young salmon that were lost when they were forced through the turbines of a dam on the Lewis River when the reservoir was sharply lowered to stave off possible flooding on the river.

The dredging of the ship channels in the Columbia and Cowlitz Rivers is also believed to have killed many fish. Normally there is no dredging in May and early June because this is a time of fish migration, but large scale dredging was carried out this spring during the emergency.

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1/ Almost all of the damage to the Columbia River fishery is believed to have been caused by the May 18 eruption of Mt. St. Helens. Subsequent eruptions are believed to have had little effect.

Fish in the Columbia River undoubtedly were adversely affected by turbid waters and by the raised water temperatures caused by the eruption. The count of fish passing Bonneville Dam showed a small decline after the May 18 eruption. It is not known, however, whether the decline was due to the eruption or to other factors. It is believed that sturgeon, shad, and smelt moved down the Columbia River from the turbid area below the Cowlitz to cleaner waters nearer the mouth of the Columbia following the May 18 eruption, and hence they were not harmed by the eruption.

Damage to hatcheries.--Fish hatcheries located on the streams draining Mt. St. Helens normally supply a large part of the salmon in the Columbia River system. The May 18 eruption of Mt. St. Helens severely damaged the salmon hatchery on the Green River near where the Green River enters the Toutle River. Another hatchery, on the Kalama River, received only minor damage. The large hatchery on the Cowlitz River, being upstream of the Toutle River, escaped damage.

All hatcheries in the region have had their costs increased as a result of the necessity of cleaning up the ash that had entered their systems, and they face possible future costs to repair ash abrasion to equipment. There have also been costs associated with moving fish from one location to another.

Hatcheries on the Kalama River face the problem of frequent influxes of ash following rainstorms and ash blown into the system by wind. Since there are no reservoirs on the Kalama that permit the ash to settle out of the river water the hatcheries have been operating under adverse conditions. To date, young fish have been surviving well; however, a few adults have met unexplained deaths.

Damage to fish habitat.--The May 18 eruption destroyed fish habitat in the waters north of Mt. St. Helens. Spirit Lake (a sport fishing and recreation center) was partially filled with volcanic debris, as was most of the Toutle River. In addition, mud flows in the Toutle and Cowlitz Rivers destroyed much of the fish habitat. The Washington State Game Department estimates that the eruption of May 18 heavily damaged or destroyed 26 lakes and moderately damaged 27 others and destroyed 154 miles of resident trout streams. Another 142 lakes and 1,029 miles of resident trout streams received little or no damage but currently are inaccessible due to road closures in the Gifford Pinchot National Forest.

Rivers and lakes not affected by mudflows and floods were, however, impacted by ashfall. In the first 15 miles from the volcano, the heat and heavy deposits of mud and ash destroyed almost all aquatic life. From 15 to 40 miles out the damaging agent was the ash, a grainy pumice, like oats; it was porous and hence did not smother the insects on the stream and river bottoms as did the finer ash farther out. It should be noted, however, that insects and aquatic invertebrates necessary in the food chain of fish are being found in waters spotchecked throughout most of the range of the ashfall. A few small fish have been seen in small creeks not far from the blast area and some water vegetation has survived as well.

At the time of heavy sedimentation, young salmon were able to survive in the ash-laden water for only a few hours. Young trout in hatcheries as far away as Yakima apparently were weakened from the sedimentation and a few died. Although the water has cleared considerably in the Toutle and Cowlitz Rivers, there is still a danger from glasslike particles of ash cutting the gills of young fish.

Large fish are able to survive the sharp particles of ash and many negotiated the Cowlitz when it was in particularly poor condition. While the rivers have cleared considerably, they are not in a condition suitable for fish to spawn. The fish need river bottoms of pebbles or gravel in order to spawn, and many of the old river beds are believed to be covered with at least 18 inches of silt—many of the old resting pools are also filled with silt.

Injury to commercial and sports-fishing interests.--The Washington Department of Fisheries estimates that the juvenile salmon killed by the May 18 eruption of Mt. St. Helens would have produced about 358,000 adult salmon during 1981-84, which would have been worth about $8 million to the fishery (on the basis of current prices paid to fishermen). The Washington State Game Department estimates recreational fishing losses to the economy at $22 million in 1980 and more than $87 million before populations recover, including costs of motels, gasoline, fishing tackle, and so forth.

Long-term effects.--Long-term losses to the Columbia River fishery as a result of the eruptions are not known, but it is believed that such losses will be small. The major loss will be the decrease in fish habitat and thus in the size of the fish population that it can support. Fish habitat was destroyed by the mudflows down the Toutle and Cowlitz Rivers and by sedimentation in the Columbia River. In addition, the dredging of the Columbia and Cowlitz Rivers is destroying additional habitat since the silt dredged is being deposited in the marshes along the river banks. These marshes are a primary source of nutrients for fish. In addition, the construction of temporary debris-retaining structures and settling basins on the Toutle River will affect fish habitat.

It is believed, however, that much of the fish habitat that was damaged or destroyed will recover in time and that the various fish species will resume their natural migrations in and out of the region. To speed up this process, it is expected that various fish species will be transferred to help repopulate the Mt. St. Helens' area from hatcheries in areas that were not affected by the eruptions.

It is also anticipated that beneficial nutrients from the volcanic ash will enter the water system and become available to aquatic organisms. The ash is composed predominantly of silica--the basic component of the diatoms which are a major base in the food chain of young salmon and other small fish.

## Effects on Manufacturing

### Introduction

An assessment of the immediate effects of the eruptions of Mt. St. Helens on manufacturing activities suggests that the losses to income and damage to equipment of individual manufacturers were small. However, while the individual losses were not great, they were suffered in one form or another by almost all manufacturers within the paths of the ash fallouts in the affected areas of Washington and Oregon.

The principal long-term effect of the change of Mt. St. Helens to an active volcano has been the uncertainty it has created with regard to future investment in the region. One of the main selling points of the area to potential investors was its clean air, "quality of life" image. The prospect of intermittent air quality alerts resulting from ash fallout has tarnished that image, at least temporarily. Nonetheless, if the volcanic activity were to cease soon, it is quite possible that the long-run effect, like that of the short run, will be small. On the other hand, if Mt. St. Helens continues to erupt ash, investors may go elsewhere.

### Short-term effects

Causes and affected areas.--Manufacturing in the Pacific Northwest, as elsewhere, is predominately an urban activity. More that 60 percent of manufacturing employment is found in the region's nine Standard Metropolitan Statistical Areas (SMSA's). None of these SMSA's are close enough to the volcano to be considered in danger of receiving a pyroclastic blast or of being inundated by lava flows. Rather, the physical effects most likely to disrupt the normal economic activity of the SMSA's are those resulting from ash fallouts.

The location of an SMSA in relation to Mt. St. Helens, the direction of the wind, the force of a volcanic blast, and the amount and type of material expelled into the atmosphere all help to explain which SMSA's were affected by ash in the previous eruptions. During the very powerful eruption on May 18, for example, when the generally prevailing west to east wind flow predominated, ash was carried in heavy amounts hundreds of miles to the smaller SMSA's to the east, especially Spokane and Yakima. During the following weaker eruptions, on May 25 and June 12, ash was carried west and south affecting primarily the Portland SMSA. Ash from subsequent eruptions went northeast, leaving manufacturing activities unaffected. Had some of the later eruptions been of the force and magnitude of the first, other SMSA's, such as Salem and Eugene-Springfield to the south of Portland would have been affected. Seattle-Everett, the largest SMSA, which lies 100 miles to the north of Mt. St. Helens, was unaffected by all the eruptions. The following table indicates the vulnerability of each of the SMSA's to the volcano's ash fallouts based upon its location and prevailing winds. Seattle is likely in the future, as in the past, to remain unscathed. Yet it is not entirely safe. Although Portland enjoys a low statistical probability of being affected, it has received ash fallouts on two of the previous major eruptions. Thus, the right combination of events can result in ash finding its way to any of the cities in the region. This fact contributes to a climate of uncertainty which affects economic decisions.

Population and employment in manufacturing in 1978, distance and relationship to winds from Mt. St. Helens, and amount of ash fallout in 1980, by SMSA's

| Standard Metropolitan Statistical Area and State | 1978 population 1/ | 1978 employment in manufacturing 1/ | Miles and direction from Mt. St. Helens | Approximate percentage of time winds blow toward SMSA from Mt. St. Helens 2/ | Amount of ash fallout | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | May 18 | May 25 | June 12 | July 22 | Aug. 7 |
| | Number | Number | | | | | | | |
| Seattle-Everett, Washington | 1,467,600 | 157,027 | 105 miles north | 3 | 0 | 0 | 0 | 0 | 0 |
| Portland, Oregon | 1,190,600 | 107,000 | 45 miles south | 12 | 0 | 1/2" | 1/2" | 0 | 0 |
| Tacoma, Washington | 436,900 | 20,999 | 70 miles north | 3 | 0 | 3/ | 0 | 0 | 0 |
| Spokane, Washington | 319,600 | 17,449 | 250 miles northeast | 45 | 3/4" | 0 | 0 | 0 | 0 |
| Eugene-Springfield, Oregon | 269,300 | 21,000 | 160 miles southwest | 12 | 0 | 0 | 0 | 0 | 0 |
| Salem, Oregon | 237,000 | 14,600 | 95 miles southwest | 12 | 0 | 0 | 0 | 0 | 0 |
| Yakima, Washington | 159,300 | 7,944 | 90 miles northeast | 45 | 1" | 0 | 0 | 3/ | 3/ |
| Boise, Idaho | 152,700 | 9,091 | 350 miles southeast | 29 | 3/ | 0 | 0 | 0 | 0 |
| Richland-Kennewick, Washington | 128,000 | 9,459 | 145 miles east | 39 | 3/ | 0 | 0 | 0 | 0 |

1/ "Employment and Payrolls in Washington State by County and by Industry," Employment Security Department, Washington State Government, May 15, 1980. First National Bank of Oregon, "Economic Profile, Oregon and Standard Metropolitan Statistical Areas," June 1980. "County Profiles of Idaho," Idaho Division of Economic and Community Affairs, 1980.

2/ Crandell, Dwight R., and Donal R. Mullineaux, "Potential Hazards From Future Eruptions of Mount Saint Helens Volcano," Washington, Geological Survey Bulletin, 1383-C, p. C21. The full description of the figure from which the data in this column were taken reads: "Approximate percentage of time, annually, that the wind blows toward various sectors in Western Washington. Percentages are rounded averages of frequencies determined at various altitudes between 3,000 and 16,000 m at Salem, Oregon, and Quillaynte, Wash. (Winds Aloft Summary of The Air Weather Service, U.S. Air Force, available from National Climatic Center, Asheville, N.C.)."

3/ Trace.



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Degree and types of losses to manufacturing activities.--All of the more than 25 manufacturing firms and associations contacted in the heavily affected areas of Portland, Yakima, and Spokane suffered some kind of income loss. 1/ Nevertheless, because individual losses were not large, overall short-term damages to the manufacturing sector of the region were small.

Losses generally were of three types. First, it was often necessary to close down production for at least one shift and in some cases for several days during and after the ash fallout. The shutdowns occurred both to protect workers from unnecessary exposure to the ash and also to prevent damage to filtration systems and machinery. Most reported that the occurrence was similar in effect to a "severe snowstorm," and, as in a snowstorm, lost production was made up on normally nonworking days and shifts.

Second, capital equipment was damaged by the abrasive effect of the ash. Especially vulnerable were establishments, such as lumber mills and transportation firms with large exposed mechanical equipment, the effective life of which may be seriously reduced. The extent of this damage may not be fully apparent for several years.

The third type of loss arose from the need to incur increased investment costs to install improved filtration systems or to change procedures in order to prevent employees from inadvertently bringing ash into the production areas on clothing. Especially vulnerable here are establishments with a high need for cleanliness, such as instrument manufacturers, pulp and paper mills, and food-processing plants. These precautionary changes will help to reduce the future ash fallout costs should the latter continue to be a problem.

Three company examples might help to illustrate the situation:

1. Tektronics, an Oregon-based manufacturer of oscilloscopes had to close three manufacturing facilities for 10 hours and change air filters. Officials of the company, which had sales of $847 million in 1979, described the total cost as minimal.

2. Reichold Chemicals' urea plant in Saint Helens, Oreg., was closed for 1 day and company officials expect to invest about $250,000 for a new, more effective air filtering system for the plant's compressors. Reichold's sales in 1979 were $879 million.

3. Valley Evaporation Co. of Yakima, Wash., reported having to close one of its fruit and vegetable dehydrating plants for 3 days. There were also problems with some of the company's vehicles and with the plant's air filtration systems. The estimated additional cost to the company was $25,000. Total sales last year were around $15 million.

1/ These firms and associations were selected on the recommendations of State and Federal Government and other officials.

Aid to offset losses.--The Federal Government has several programs which will reduce the cost to employers and employees of the ash fallouts. The Small Business Administration provides low-interest, long-term loans of up to $500,000 for small Washington and Oregon businesses sustaining substantial economic injury. Also, employees of firms temporarily shutdown are eligible for food stamps, unemployment compensation, and so forth. Finally, some companies' losses can be shared with the Government by way of reduced income-tax liabilities.

Summary of short-term effects.--In sum, the short-term macroeconomic effect of the additional costs to manufacturers caused by the eruptions of Mt. St. Helens do not appear at this time to be significant either for the region or for the United States as a whole. In addition to being relatively small, many of the adverse economic effects of the damages will be ameliorated by the inflows of government money in the form of grants and loans and by Federal tax policy.

## Long-term effects

On the basis of experience so far, few investors have been frightened away from the region by the possibility of further eruptions. Were Mt. St. Helens to return to a dormant state, the long-term effects of the activity experienced so far will be minimal. However, the effects could rapidly escalate in severity if Mt. St. Helens should remain active in the weeks, months, or even years to come.

Difficulty in predicting long-term effects.--Precise estimates of the long-term effects of the eruptions of Mt. St. Helens are difficult and are likely to remain so for some time. One reason for this is the impossibility of predicting future volcanic activity. In this regard, answers to such questions as whether there will be more ash eruptions, and in what quantities and areas it will fall, are crucial to predicting future economic effects. Furthermore, even if these questions could be answered, it would also be essential to know the implications of further volcanic activity for different sectors of the economy.

The result of these combined uncertainties is to raise the level of risk associated with investments in the region. Conventional finance theory states that when such risk is increased, investment will tend to go elsewhere or at least seek a higher return, thereby lowering regional long-term economic growth prospects. The extent to which these areas in the weeks, months, and years to come will be perceived as more risky than other areas for prospective investment is difficult to estimate. Even for the present, the situation, as reflected in the prices and ratings of securities in the region, is not clear. For example, in spite of the fact that the national bond rating institutions have not downgraded the regional issues, local bond brokers estimate that municipalities and school districts close to the volcano have had to raise the yields of their recent 20-year bond issues by 0.1 to 0.5

percentage points to attract buyers. 1/ Also, the recommendations to buy the stocks of the major regional banks were downgraded by one national brokerage firm because of the Mt. St. Helens' eruptions. Nonetheless, the prices of the stock of these banks, after falling in June, have either returned to, or surpassed, their preeruption levels.

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1/ At least part of the perceived uncertainty facing municipalities is a result of the extraodinary emergency expenditures they have had, and will continue to have. An Aug. 8, 1980, report from the Federal Emergency Management Agency (FEMA) estimated these expenditures for affected municipalities in the State of Washington as follows:

| Extraordinary expense item | Total (1,000 dollars) | 75 percent FEMA reimbursement amount (1,000 dollars) |
|---|---|---|
| Debris clearance | 21,165 | 15,874 |
| Protective measures to prevent imminent danger | 1,333 | 1,000 |
| Road systems (non-Federal) | 46,667 | 35,000 |
| Water control facilities | 133 | 100 |
| Public buildings | 634 | 476 |
| Public utilities | 28,000 | 21,000 |
| Private non-profit agencies e.g., hospitals | 133 | 100 |
| Other | 774 | 581 |
| Total | 98,839 | 74,131 |

In spite of reimbursement by the Federal Government of 75 percent of these cost, and in spite of other Federal and State assistance programs such as the Federal Highway Trust Fund, the municipalities still have a large burden to bear. Not only are 25 percent of the above eligible expenses not reimbursed by FEMA, but there is also an estimated $25 million in expenses that the Federal Government does not include in the reimbursable category of expenses. Furthermore, there is some concern that the total amount of damage will not be known for many years. Many feel, for example, that the abrasive effect of the ash on water systems over the next few years will be severe, and one Washington State government official estimated potential additional cost at $100 million.

Risk and economic transition.—If the belief persists that investments in the Pacific Northwest are relatively risky, the metropolitan areas most likely to be affected are those which have recently experienced a gradual shift of resources from traditional natural-resource-based industries to newer, high-technology growth industries. Portland is an SMSA where such a change can be observed. Located 45 miles south of Mt. St. Helens, Portland is the closest to the volcano of the larger SMSA's. The following table shows the distribution of manufacturing employment by industry and gives the growth rates from 1972 to 1979. Over the 8-year period, the economy has diversified, as evidenced by the relative growth in employment, into the manufacture of products such as electrical equipment, instruments, machinery, and transportation equipment, while industries related to wood and lumber products have been relatively stagnant.

Many of the firms in the growth industries can be described as "footloose" in the sense that they have chosen to locate in Portland for reasons other than accessibility to the local market and local natural resources. Instead, most have located in Portland because of the city's reputation for its high quality of life, including a clean environment and easy access to abundant recreational facilities.

Since clean, high-technology manufacturing investment is desired throughout the country, companies in those industries enjoy a wide choice of investment locations. The increase in uncertainty caused by Mt. St. Helens may cause such firms to reconsider investment previously planned for Portland. Already, one semiconductor and computer hardware manufacturer has announced that it is postponing a $70 million investment in Vancouver, Wash. (located within the Portland SMSA), and some feel that other firms are similarly reconsidering plans to invest in the area. However, most local officials, economists and others contacted in connection with this study thought the postponement of the Vancouver investment was unwarrented and many felt, contrary to the company's announcement, that the decision to delay may be due to non-Mt. St. Helens related factors. Those same people noted that two other electronics firms have reconfirmed their intention to invest in Vancouver, Wash.

These differences of opinion among informed people in the region point out the difficulty inherent in specifying the probable response by investors to the increased long-term risk posed by Mt. St. Helens. All that can be said for certain is that a sense of uncertainty is now widespread.

Summary of the long-term effects.--The long-term effects of the eruption of Mt. St. Helens are yet to be determined by Mt. St. Helens' future activity. If Mt. St. Helens soon returns to a state of dormancy, the long-term effects of the eruptions experienced so far will be small. However, should Mt. St. Helens remain active, the long-term economic effects on the region could be severe.

Portland SMSA manufacturing employment and growth rate, 1972-79

| | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1972-79 Total growth |
|---|---|---|---|---|---|---|---|---|---|
| | Thousands | | | | | | | | Percent |
| Manufacturing, total | 87.9 | 95.7 | 98.6 | 90.2 | 93.9 | 98.9 | 107.7 | 115.0 | 32 |
| Durable goods | 57.2 | 64.2 | 67.1 | 60.4 | 63.3 | 67.7 | 77.4 | 82.9 | 45 |
| Lumber and wood products | 9.8 | 10.6 | 10.2 | 9.1 | 10.4 | 10.6 | 10.9 | 10.3 | 5 |
| Veneer and plywood | 3.1 | 3.3 | 3.1 | 2.9 | 3.1 | 2.8 | 2.6 | 2.5 | -19 |
| Other wood products | 6.7 | 7.3 | 7.1 | 6.2 | 7.2 | 7.8 | 8.3 | 7.8 | 16 |
| Furniture and fixtures | 2.7 | 2.7 | 2.1 | 2.0 | 2.2 | 2.2 | 2.3 | 2.0 | -26 |
| Stone, clay, glass and concrete products | 2.3 | 2.3 | 2.3 | 2.2 | 2.3 | 2.3 | 2.5 | 2.7 | 17 |
| Primary metals | 6.4 | 7.4 | 8.1 | 7.3 | 7.0 | 7.2 | 7.7 | 8.2 | 28 |
| Blast furnaces, iron and steel foundry | 3.9 | 4.4 | 4.9 | 4.7 | 4.2 | 4.4 | 4.8 | 5.3 | 36 |
| Nonferrous metals | 2.5 | 3.0 | 3.2 | 2.6 | 2.8 | 2.8 | 2.9 | 2.9 | 16 |
| Fabricated metals | 7.1 | 7.7 | 8.5 | 8.1 | 8.2 | 9.2 | 10.5 | 10.8 | 42 |
| Fabricated structural metal | 3.1 | 3.3 | 3.4 | 3.3 | 3.3 | 3.6 | 4.1 | 3.9 | 26 |
| Other fabricated metal | 4.0 | 4.4 | 5.1 | 4.8 | 4.9 | 5.6 | 6.4 | 6.9 | 72 |
| Machinery | 7.6 | 9.0 | 9.4 | 8.9 | 8.9 | 9.8 | 11.0 | 12.3 | 62 |
| Electrical equipment and supplies | 3.2 | 3.6 | 3.6 | 2.4 | 2.5 | 3.1 | 4.3 | 6.4 | 100 |
| Transportation equipment | 6.7 | 7.6 | 8.3 | 7.2 | 8.1 | 8.2 | 10.0 | 10.5 | 56 |
| Instruments and related products | 9.6 | 11.5 | 13.0 | 11.8 | 12.3 | 13.7 | 16.7 | 18.2 | 89 |
| Miscellaneous manufacturing | 1.8 | 1.8 | 1.6 | 1.4 | 1.5 | 1.4 | 1.5 | 1.5 | -16 |
| Nondurable goods | 30.7 | 31.5 | 31.5 | 29.8 | 30.6 | 31.2 | 30.3 | 32.1 | 4 |
| Food and kindred products | 9.8 | 9.5 | 9.4 | 9.1 | 8.7 | 8.6 | 8.3 | 8.8 | -10 |
| Textile mill products | 2.5 | 2.5 | 2.5 | 2.3 | 2.4 | 2.4 | 2.4 | 2.3 | - 8 |
| Apparel | 3.4 | 3.6 | 3.5 | 3.1 | 3.3 | 3.1 | 3.1 | 3.3 | - 3 |
| Paper and allied products | 7.4 | 7.5 | 7.6 | 7.2 | 7.6 | 7.7 | 6.3 | 6.9 | - 7 |
| Printing and publishing | 4.2 | 4.5 | 4.7 | 4.5 | 4.8 | 5.2 | 5.6 | 6.0 | 43 |
| Chemicals and allied products | 1.7 | 1.8 | 1.8 | 1.8 | 1.8 | 1.9 | 2.0 | 1.9 | 11 |
| Other nondurable goods | 1.7 | 2.1 | 2.0 | 1.8 | 2.0 | 2.3 | 2.6 | 2.9 | 64 |

Source: Oregon Employment Division.

## Effects on Tourism

According to statistics from the Washington State Department of Revenue, the tourist industry revenues, as measured by State tax receipts for hotel and motel rooms, have decreased greatly in May and June 1980 compared with the corresponding months of 1979, as shown in the following tabulation:

| Area | Percentage change, 1980 from 1979 | | |
|---|---|---|---|
| | January-February | March-April | May-June |
| Spokane | +9 | 30 | -26 |
| Yakima | -31 | 9 | -64 |

Similarly, an accounting firm's survey of 35 hotels and motels in Portland, Oreg. shows a decrease of about 15 percent in the room occupancy level this June compared with last June. Officials contacted in the convention and visitors centers of Spokane, Yakima, and other regional tourist centers attributed these late spring and early summer problems primarily to the ash fallout and the negative publicity that ensued from the first eruptions. They also noted that other factors may have played a contributory role such as the bad weather experienced by the region in June 1980, high gasoline prices, and the national economic recession.

The same officials felt however that late July and August revenues from tourism had increased to a level closer to last year's. Although no statistics could be provided to substantiate this, the consensus was that by late summer the nationwide recession was having a more serious effect on tourism in the Pacific Northwest than Mt. St. Helens was. In fact, it is increasingly commented by area tourist officials that Mt. St. Helens is becoming an asset for tourism. For example, the U.S. Forest Service, which established observation booths 40 miles from Mt. St. Helens, reported having more than 4,000 visitors per day in August 1980. Many feel that Mt. St. Helens may soon parallel Mt. Lassen in California and Volcan Irazu in Costa Rica as an often-visited volcano attraction enhancing the Northwest's tourist appeal.

# THE EFFECTS OF THE ERUPTIONS ON INTERNATIONAL TRADE

## Introduction

The effects of Mt. St. Helen's eruptions on international trade are likely to be small. The principal effects expected are a minor reduction of agricultural exports and a temporary redistribution of port traffic owing to the blockage of the Columbia River. The losses to Columbia River ports are being largely captured by other ports. Exports of forestry products and of manufactures and imports generally are likely to be unaffected.

## The Pacific Northwest Region in International Trade

The three States making up the Pacific Northwest--Idaho, Oregon, and Washington--play a significant role in U.S. international trade. In 1979, approximately 7 percent of U.S. exports and 4 percent of U.S. imports were accounted for by the region.

The three States are particularly important in the export of several commodities and products, such as wheat, flour, lumber, wood products, oscilloscopes, and passenger aircraft. In table 1 (app. C), summary data on exports and a comparison with other States of the export position of the three States in both manufacturing and agriculture is provided.

In addition to being an area from which many exports originate, two of the country's major port systems are located in the region. One of these, located along the Puget Sound, stretches from the Canadian border to Tacoma, Wash., and the other, along the Columbia River, extends from Astoria to Portland, Oreg. The latter is the largest export port (as measured by tonnage) on the west coast. Table 2 lists the major ports in each system and describes their relative sizes in terms of total tonnage of exports and imports. The two port systems, along with the region's international airports, correspond to the region's two customs districts; the Seattle customs district includes the Puget Sound ports plus the Seattle-Tacoma and Spokane Airports, and the Portland customs district includes the Columbia River ports and Portland International Airport. Tables 3-10 show the amounts of various import and export items that passed through these customs districts.

## Export Losses

As mentioned above, the loss of exports attributable to the eruptions of Mt. St. Helens is small. The main source of loss was the ash damage to crops in the three States, which was discussed previously. It is difficult to estimate the value of the lost agricultural exports; recent data on agricultural exports by state of origin do not exist and the constant flux of non-Mt. St. Helens-related supply and demand factors tends to obscure the relatively minor effects attributable to the volcanic eruptions. For example, on the supply side, a bumper harvest is expected for this year's crops. As a result, overall exports may rise despite the volcano's eruptions. On the demand side, the embargo on trade with Iran, the ceiling placed on exports of grains to the Soviet Union, and other more subtle changes in tastes and markets also may overshadow the Mt. St. Helens' effect.

Of the agricultural commodities mentioned in the preceding section, the two most seriously affected sectors, animals and animal products and hay, are not large export items. Of the other crops, such as tree fruits, wheat, barley, and so forth, wheat, most of which is exported, has the greatest potential to contribute to an export reduction. However, the bumper crop mentioned above and the large wheat stockpiles currently in existence suggest that U.S. wheat shipments will not decrease as a result of Mt. St. Helens' activities.

With regard to exports which could not be shipped because of the blockage of the Columbia River, available data indicate that this was at most a temporary problem. Table 11 shows that shipments of grain, the largest Columbia River export item out of the port of Portland, increased 21 percent during the first 7 months of 1980 compared with the amount of shipments in 1979. Although the tonnage shipped in May was comparatively low, June and July shipments were quite high, indicating a rapid return to normal levels.

## Import Losses

In spite of the temporary inconvenience caused by the blockage to the Columbia River, overall U.S. imports have not suffered, nor have their patterns been altered significantly. The main effect was a reallocation of import traffic among ports and some associated inconvenience. The Columbia River ports at Longview, Vancouver, and Portland suffered most, while certain other ports (especially on the Puget Sound) were among the beneficiaries.

The extent of the diversions from one port to another is difficult to estimate. Import statistics for the U.S. customs districts and from the various ports are unhelpful for this purpose because diverted cargoes are often transported overland to their original destination where they are "imported" statistically. For example, in the first few weeks after the May 18 eruption, a Norwegian ship carrying containerized cargo destined for Portland offloaded instead at Astoria at the mouth of the Columbia River. The cargo was then transported by truck to Portland where it statistically "entered" the United States.

An alternative reliable measure of the extent to which imports have been diverted is provided by the Customs office record of vessels arriving with import cargo in the Portland/Vancouver, Longview, and Astoria areas, shown in the following tabulation:

| Area | Period | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | May 25-31 1979 | May 25-31 1980 | June 1979 | June 1980 | July 1979 | July 1980 | Aug. 1979 | Aug. 1980 |
| Portland/Vancouver | 21 | 4 | 97 | 67 | 96 | 72 | 109 | 102 |
| Longview | 9 | 4 | 42 | 30 | 37 | 24 | 26 | 28 |
| Astoria | 11 | 9 | 46 | 41 | 30 | 47 | 33 | 36 |

As seen in the above tabulation, vessel arrivals for the last week of May 1980 were very few compared with the last week of May 1979. Arrivals for June and July, although closer to the 1979 levels, were still mostly below them. By August, however, traffic had returned essentially to normal. By implication, imports have also probably returned to normal levels.

## THE EFFECTS OF THE ERUPTION ON TRANSPORTATION

The damage Mt. St. Helens inflicted on the transportation network of the Pacific Northwest can be divided into two broad categories. One is widespread, generally caused by ashfall, and was quickly cleared. The other, which was caused by the blast, mudslides, and floods, is far narrower in scope, confined to the area near and adjacent to Mt. St. Helens, but will take months, or perhaps years, to repair. Included in the latter category is the damage to roads and bridges and the blockage of the Columbia River.

### The Columbia River Ports

Certainly the most serious single effect of the eruption of Mt. St. Helens on transportation systems was the closing of the Columbia River. After the Mississippi and the St. Lawrence, the Columbia is the country's third most traveled river. Because it provides inexpensive bulk transportation through the grain-growing and forestry-products regions of the Pacific Northwest, the Columbia River is vital to the region's economy. The segment from Portland to the sea is a major international shipping channel serving four ports: Portland, Astoria, Vancouver, and Longview. Upstream from Portland, the Columbia joins with the Snake River and cuts through the Columbia Basin--the region's wheat-growing center.

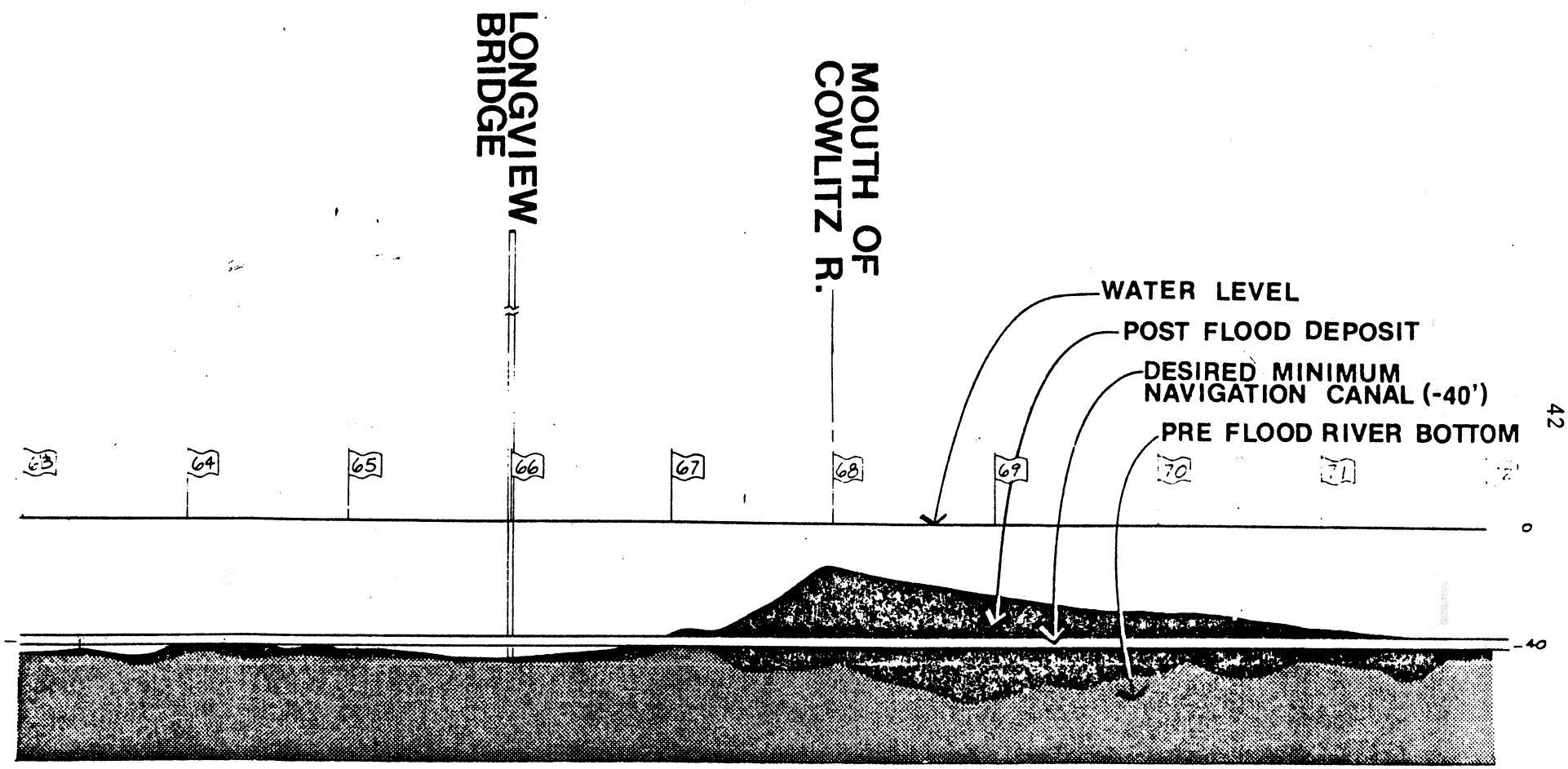
#### Blockage

When the north face of Mt. St. Helens was blown off in the explosion of May 18, the resultant mudslides in the Toutle River valleys caused debris-laden floods throughout the Toutle and Cowlitz Rivers. The Cowlitz feeds into the Columbia just upstream from the town of Longview and downstream from the ports of Kalama, Vancouver, and Portland. The sediment-carrying flood on the Cowlitz reached the Columbia at an incoming tide. When the Cowlitz's flooded waters lost speed as they mixed with the tidal Columbia, they could no longer carry nearly as much sediment. Consequently somewhere between 40 million and 60 million cubic yards of volcanic material were deposited in the Columbia River in the 10 miles centered on the Cowlitz's confluence with the Columbia (fig. 6). The navigable channel depth of 40 feet was significantly lessened between Columbia River mile 67--1 mile downstream from the junction of the Columbia and the Cowlitz--and river mile 72--4 miles upstream from the junction. Since there was an incoming tide during the hours that the debris was actually deposited in the Columbia, far more of the material was deposited upstream of the confluence than downstream. Thus the port of Longview, just downstream of the junction, was unaffected.

A sizable proportion of what had been the north face of Mt. St. Helens washed into the Columbia ship channel. The volcanic debris formed a 10-mile long, 25-foot high mound in the Columbia. The depth of the channel was reduced from 40 feet to, at its shallowest, 14 feet.

Upstream from the town of Longview, where the Cowlitz flows into the Columbia, are the ocean ports of Kalama, Vancouver, and Portland. Portland is the fifth largest and the fastest growing port on the Pacific Coast. In May 1979, a year before the eruption, the three affected ports handled 337 million dollars' worth of cargo. They thus accounted for more than 75 percent of

Figure 6.--Columbia River longitudinal profile.




Source: Portland district, Corps of Engineers, U.S. Department of the Army.

oceanborne commerce in the customs district of Portland, for more than 8 percent of ocean trade on the Pacific Coast, and for nearly 2 percent of all U.S. shipping trade.

The volcano trapped 32 oceangoing ships upstream of Longview. Of these, eight were either based in the area or scheduled to remain on the Columbia River for an extended time. Thus, the closing of the channel actually involuntarily delayed 24 ships. These 24 ranged in size from a containership, drawing less than 21 feet of water, to a grain-carrying ship with a 36-foot draft.

The main short-term economic impact of the blockage has been on the revenues of the affected ports. Portland and Vancouver, located upriver from the shoal, suffered most, but Longview, even though it has been open to all shipping since the eruption, also suffered. Using the revenues of the port of Portland as a case in point, port authorities expect to see a 1980 shortfall of about $1.4 million below preeruption estimates. However, since these estimates had been based on expected 1980 traffic growth, it is possible that this year's revenue will still be equal to or greater than last year's. It might be noted that the $1.4 million estimated loss is considerably reduced from an earlier loss estimate of $6 million. As the situation improves, the expected loss may continue to decrease.

The long-term effect of the blockage is difficult to assess. It results from the fear that future volcanic eruptions could entrap or damage a visiting vessel. This primarily psychological deterrent to shipping might damage the ports' plans to diversify their activities. The port of Portland, for example, fears that it may lose some of its larger containerized-cargo market. Modern, and very costly to run, containerships are particularly wary of entrapment in the river. Already, one container line that formerly called on Portland has cancelled its stop. Other lines, however, like the consortium of Japanese container lines, are returning and officials are optimistic that this "fear effect" will not last for long.

Dredging

On May 20, less than 2 days after the formation of the shoal in the Columbia, the U.S. Army Corps of Engineers began to clear the channel. In order to restore it to its normal operational depth of 40 feet, the dredges had to remove an estimated 22 million cubic yards of volcanic debris from the Columbia. Furthermore, a failure to dredge sufficiently, leaving the Columbia River with an inadequate cross section for its flow, would greatly increase the cost of maintaining the channel in the future, since the changed flow pattern would also change the pattern of sedimentation. Thus, although only about 2 million cubic yards need to be dredged to allow ships to pass through the channel, an additional 20 million cubic yards need to be dredged to stabilize the channel. The estimated cost of the whole dredging operation is $44 million.

The Corps of Engineers assembled every available dredge on the Pacific Coast to work on the Columbia and its tributaries. By May 23, 5 days after the eruption, four dredges were at work in the Columbia channel. An additional two had arrived by the second week in June, and by the end of June two more were at work in the channel.

The dredges have had minor problems. The material to be dredged is very abrasive, resulting in excessive wear to the dredges. The sediment is also much denser than the sand that the dredges are accustomed to handling, and is packed more tightly. The total effect of all of these is that the dredges are only half as productive as normal, and this increased difficulty in handling volcanic material is the main element in pushing the estimated cost of restoring the Columbia ship channel from the initial estimate of $25 million to the present estimate of $44 million.

By May 23, 5 days after the eruption, the Columbia River was partially open again. Six ships, all drawing less than 21 feet of water, passed the shoal. Each day thereafter, 1- or 2-hour "windows" were designated during which ships traveling in both directions were allowed to pass the shoal. The "windows" were always at high tide, so that the largest ships possible could pass the shoal--there are somewhere between 4 and 7 more feet of water in the Columbia at high tide than at the mean low-water benchmark from which channel depth is formally measured. The "windows" were restricted to a small part of the day because, for each "window," the pipeline dredges had to disconnect their pipelines running across the channel from the dredge to the shore. The "windows," therefore, were restricted to a very small part of the day.

Each day larger and larger ships were allowed to pass the shoal: 21-foot draft on May 23; 27-foot a week later; 33-1/2-foot by the fifth of June; and 37-foot ships by June 14, by which date the channel had been dredged to a depth of 31 feet. On that day a 36-foot draft vessel, the last of the ships trapped in Portland harbor, passed the shoal.

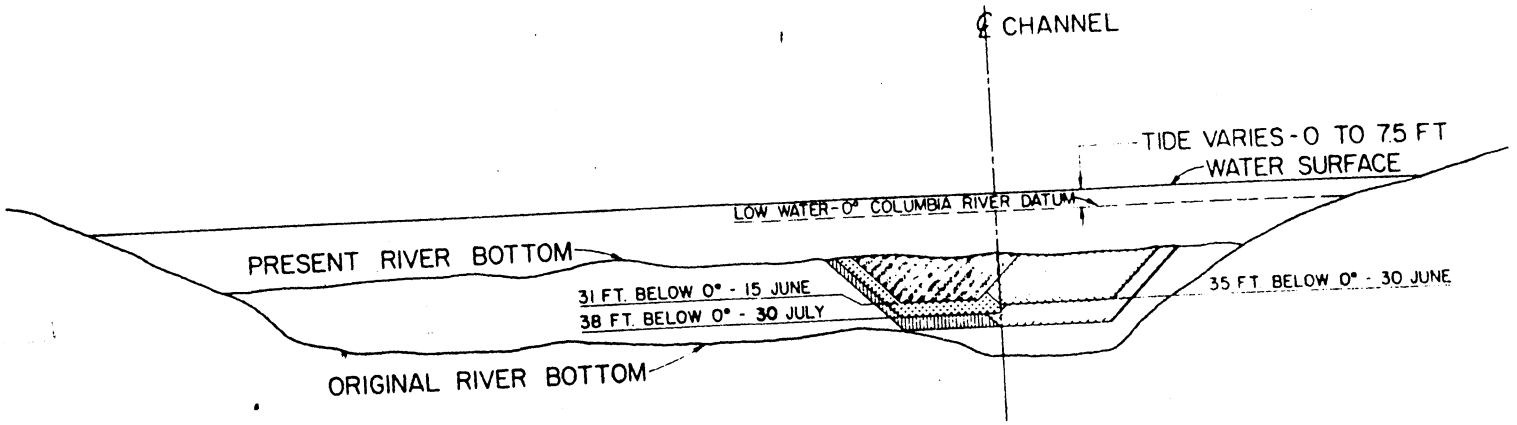
By the end of June, the Corps of Engineers had the channel dredged to a depth of 35 feet. By June 20, the channel was officially open to all ships. By September, the Corps plans to have the channel back to its original depth--40 feet--and by October to its original width--600 feet; and all volcano-related dredging will, the Corps hopes, be finished by the end of March 1981 (fig. 7).

The Columbia River was completely blocked for less than a week. Traffic resumed to some extent 5 days after the eruption. The largest ship in the port of Portland at the time of the eruption could navigate the Columbia channel by the middle of June. Thus, the Columbia River ports were capable of normal operation less than a month after the eruption. The physical damage to the Columbia River is costly to repair--$44 million--but it was of relatively short duration.

Figure 7.--Cross section view of Columbia River at Longview.

| | | |
|---|---|---|
| PHASE I HOPPER DREDGES | 200' CHANNEL-SOUTH SIDE, DEPTH 31 FT. BELOW 0º | 15 JUNE |
| PHASE II PIPELINE DREDGES | 300' CHANNEL-NORTH SIDE, DREDGE TO 35 FT. BELOW 0º | 30 JUNE |
| PHASE III PIPELINE DREDGES | 300' CHANNEL-SOUTH SIDE, DREDGE TO 38 FT. BELOW 0º | 30 JULY |
| PHASE IV PIPELINE DREDGES | 300' CHANNEL-NORTH SIDE, DREDGE PROJECT DEPTH | 30 SEPT |
| PHASE V PIPELINE DREDGES | SOUTH SIDE-DREDGE FULL PROJECT DIMENSIONS | 30 NOV |
| PHASE VI PIPELINE DREDGES | RESTORE ADEQUATE RIVER CROSS-SECTION SOUTH OF NAVIGATION CHANNEL | 31 MAR 1981 |



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Source: Portland district, Corps of Engineers, U.S. Department of the Army.

It might be noted that the ports were not completely avoided by arriving ships during the months that they were affected. In the 33 days following the eruption, 73 vessels entered the Columbia River port of entry areas of Portland and Longview; this is approximately half of the traffic in the same period in 1979, as shown in the following table.

Import-cargo vessel entrances into Columbia River ports, by specified periods, May 19-June 20, 1979 and May 19-June 20, 1980

| Period | Area of Portland | Area of Longview | Area of Astoria | Total |
|---|---|---|---|---|
| May 19-24: | | | | |
| 1979 | 23 | 12 | 7 | 42 |
| 1980 | 3 | 5 | 15 | 23 |
| May 25-31: | | | | |
| 1979 | 21 | 9 | 11 | 41 |
| 1980 | 4 | 4 | 9 | 17 |
| June 1-7: | | | | |
| 1979 | 16 | 13 | 5 | 34 |
| 1980 | 15 | 5 | 12 | 32 |
| June 8-14: | | | | |
| 1979 | 17 | 12 | 11 | 40 |
| 1980 | 14 | 9 | 8 | 31 |
| June 15-20: | | | | |
| 1979 | 23 | 7 | 10 | 40 |
| 1980 | 8 | 6 | 9 | 23 |
| Total: | | | | |
| 1979 | 100 | 53 | 44 | 197 |
| 1980 | 44 | 29 | 53 | 126 |

Source: U.S. Army Corps of Engineers.

It appears that the effective physical damage to the Columbia River reduced its ports' cargo-handling volume by 50 percent for 1 month, representing a loss of about 4 percent of all the cargo that would have otherwise passed through the ports in 1980.

## Cowlitz River

In addition to the Columbia, the Corps of Engineers also has contracted to dredge the Cowlitz. But the Cowlitz River channel was only 8 feet deep and extended upstream of the confluence with the Columbia for only 5 or so miles. The dredging operations on the Cowlitz have very little to do with the water transportation network in the area but are instead designed for flood control. But the floods on the Cowlitz and Toutle Rivers--both past and future--have affected and will affect the road transportation network northeast of Longview.

## Roads and Bridges

Some 25-odd bridges in the immediate vicinity of Mt. St. Helens were destroyed by the mudslides and floods of May 18. Bridge damage was essentially limited to two small drainage systems--the tributaries of the Toutle River, which is west of the mountain, and of the Lewis River, southeast of the mountain.

Sixteen bridges were destroyed on National Forest Service land, the largest being a high steel-girder bridge on forest road N90 over the east end of the Swift Reservoir. In addition to the bridges destroyed in and around the national forest, nine more bridges were knocked out along the Toutle River. Seven of these nine bridges, were on State Route 504, which used to run up the north fork of the Toutle to Spirit Lake and the lower slopes of Mt. St. Helens. The largest bridge in the area, the 304-foot Toutle River bridge on Interstate 5, was not damaged by the eruption and subsequent flood--although grave fears for it were expressed in the first few days after the eruption.

The Burlington Northern railroad bridge over the Toutle just east of its junction with the Cowlitz is unharmed, although it was closed to traffic during the flood. Aside from the trackage destroyed of the railroads in the Weyerhaeuser Corp.'s St. Helens tree farm, there was no damage to the rail system in the area around Mt. St. Helens.

The number of miles of road destroyed by the blast, mudslides, and floods is surprisingly large. This land is forested, consisting of overmature and mature timber as well as plantations. The land is crisscrossed with logging roads--from three to seven different roads per square mile. And, of course, within the area of tree blowdown few of these roads remain intact. Furthermore, the extent of these roads that will have to be rebuilt will not be known until it is determined how much of the downed timber is salvageable.

Aside from private roads, there was significant damage to the public road network. Within the Gifford Pinchot National Forest itself, 63 miles of road were obliterated by blast and mudslide. A mile of State Route 411, 40 miles away on the west bank of the Cowlitz, had to be cut away in order to allow floodwaters trapped in a 40-acre patch to the west of the road to drain. Cost to repair Route 411 is projected at $2.2 million.

But by far the heaviest damage was to State Route 504. From Castle Rock, Route 504 runs to the town of Toutle, and then it used to run along the north fork of the Toutle River until, after entering the National Forest, it reached

Spirit Lake. From Spirit Lake the road ran up the lower slopes of Mt. St. Helens to the treeline. Where the road ended at the treeline is now the north lip of the volcano's crater. Washington State estimates that 40 miles of Route 504 must be rebuilt at a cost, including bridges, of approximately $50 million.

Both the bridge across the Toutle on Interstate 5 and the highway leading to and from it are facing a vastly increased flood risk, since the Cowlitz and Toutle River channels are now largely filled with mud. To protect the interstate, the area around the bridge may require regrading--that is, raised--at an estimated cost of $25 million.

The total cost estimate for repairing the volcano's local damage done by mudslides and floods to the public road and bridge network in the area is $112 million.

In addition to the damage mentioned above, the volcano has also covered roads in four States with a significant layer of ash. The ash-producing eruptions have covered about 38,000 miles of highways, rural roads, and city streets with a layer of ash deep enough to require special cleaning methods. Ash clearing is slow and expensive. The ash is very light and conventional road-clearing methods just blow it around. The final bill for clearing ash off of roads will probably be between $70 and $80 million.

In addition to covering the roads, the ash also markedly increases wear on motor vehicles; it is extremely abrasive. Thus, vehicles operating in areas of ash must keep ash out of all moving parts and lubrication films or their engines will deteriorate quickly. Maintenance guidelines have been distributed by all major motor vehicle manufacturers. Essentially, the manufacturers recommend nothing more than an increased frequency of normal maintenance procedures--frequent oil changes and improved air filters. Reliable estimates of the increased maintenance costs required by the ash are not yet available. But the recommended maintenance procedures do seem to work; aside from police cruisers that were driven on the days of and immediately after ashfall, few vehicles have been reported to have been ruined by the ash.

## Aviation

The effect of ash on aviation has been small. Airborne ash, however, is very dangerous to airplanes; an L-100 transport had all of its turbines either destroyed or heavily damaged in less than 5 minutes of exposure to airborne ash. The Federal Aviation Administration (FAA) routed aircraft around ash clouds during the four eruptions of Mt. St. Helens on May 18, May 25, June 12, and July 22. During this time the FAA restricted aircraft operations at various airports in the Washington-Oregon area. Larger airports which were affected were Portland International, Spokane International, Moses Lake, and Yakima. About 200 smaller airports were probably also affected by the ash. The FAA restricted aircraft operations at Portland International Airport for a 21-hour period on May 25 and for shorter periods on June 12 and July 23. The FAA also has established restricted airspace for a 10-mile radius around the volcano.

## Summary of Effects on Transportation

The cost of restoring the transportation network will be more than $210 million. But aside from this cleanup and repair expense the adverse effects generally seem to be small. There is an economic loss, on the order of magnitude of $10 million or so, associated with the partial closure of the Columbia River ports. There may be long-term damage to the ports if shippers should prove to be leery of sending their vessels up the Columbia channel, but there have been few reported long-term shifts of shipping traffic away from the Columbia River ports.

Aside from the Columbia River ports, the volcano did virtually no damage to any major commercial routes that lasted for longer than it took to sweep the ash off the roads. All of the destroyed roads were utilized primarily for local commercial use, as well as for personal and recreational purposes, not for general commercial ones. So, in the long run, the effect of the eruption of Mt. St. Helens on the general transportation system of the Pacific Northwest amounts to the costs of cleanup and repairs--amounting to more than $210 million. But the eruption has caused no permanent shifts in the types of transportation utilized by either people or for commodities, and imposed few economic costs on the transportation section other than the immediate, physical costs of repairing damage.

## THE EFFECTS OF THE ERUPTIONS ON THE INHABITANTS AND ON THE ECOLOGY OF THE REGION

The eruption of Mt. St. Helens has given cause for great interest and concern about the effects the eruptions had or will have on the inhabitants and on the ecology of the region. This section discusses how the eruption has affected or might affect the physical and mental health of the inhabitants, the air quality, the water quality, the wildlife, and the topography of the region.

### Physical Health Effects

The most serious human health effect of the eruption of Mt. St. Helens on the population of the area was the confirmed death of 30 people and the probable deaths of 38 more who are presently listed as missing. At this time, it is believed that the ashfall from Mt. St. Helens will not pose a threat to the health of the general population. Although the suspension of the ash in the air causes irritation and discomfort, serious health problems appear unlikely to develop. The possibility of health problems, however, cannot be ruled out and medically vulnerable members of the population are being urged to undertake preventive measures.

At this time, it is difficult to evaluate the longrun health risk because it is dependent on many unknown factors which include (1) the concentration and size of the ash particles in the air, (2) the chemical content of these particles, (3) the duration of exposure, (4) future volcanic activity, (5) weather patterns, (6) wind speed and direction, (7) population densities, and (8) terrain. Furthermore, experience has shown that the long-term effects of exposure to any natural or synthetic chemical cannot be predicted with accuracy over a time period possibly as long as 20 to 30 years.

Although a short period of exposure to respirable dust will not induce any serious health threats, inhalation of volcanic ash over a period of several years may pose future medical problems. Approximately 50 percent of the airborne ash particles are believed to be less than 10 microns (.0004 inches) in size, and thus some of the ash is small enough to penetrate the defenses of the respiratory system and reach the air sacs of the lungs. Such deep penetration of the lungs by foreign particles may lead to industrial bronchitis and silicosis. The nature of the lung disease that may develop from this type of exposure is dependent on the composition of the ash. Both silicosis and industrial bronchitis are predominantly occupational diseases contracted by industrial workers after years of exposure to dust in a confined indoor situation. Therefore previous experience regarding exposure time and development of the diseases probably has limited utility.

Industrial bronchitis is a bronchial condition that is caused by the inhalation of dust particles over a long period of time. All types of respirable dust can cause industrial bronchitis. The condition is characterized by an inflamation of the bronchi, and symptoms can include chest pains, a narrowing of the air passages, shortness of breath, the coughing up of mucous or perhaps even blood, and loss of strength. When industrial bronchitis patients are no longer exposed to the irritating dust there may be great improvement in their condition, and perhaps even complete recovery.

Silicosis on the other hand, is a very serious disease that may develop after long periods of exposure to certain types of inhalable silica. It is severely debilitating and, in an industrial setting, it is known that silicosis may develop after 5 to 20 years of daily exposure to high concentrations of free crystalline silica. Also, exposure to free crystalline silica, even in small amounts, is cumulative and therefore very dangerous. The disease is similar to emphysema and is characterized by a scarring of the lungs that causes shortness of breath, coughing, loss of strength, an inability to engage in strenuous physical activities and, in some cases, eventually death. The damage caused by silicosis is permanent. It is chronic and there is no cure. Furthermore, there is evidence that silicosis predisposes some people to the development of pulmonary tuberculosis.

Preliminary tests show that the respirable ash is not more than 6 percent free crystalline silica by weight--a relatively low concentration. Such silica crystals, being jagged in shape, can scratch the lung tissue, causing irreparable damage. Of the 6-percent free crystalline silica present in the ash, two-thirds (4 percent of the total ash) is in the form of cristobalite and one-third (2 percent of the total ash) is in the form of alfa quartz. Although both these types of free crystalline silica can cause silicosis, cristobalite is the more dangerous form.

Although ash-induced silicosis and industrial bronchitis do not threaten the general population of the region at this time, there is some concern about certain occupational groups such as loggers who are exposed to high levels of dust for extended periods of time. There is also some concern about asthmatics and heavy smokers as well as others who are particularly susceptible to lung problems. These people as well as the general population, when being exposed to an ash-laden atmosphere, are being urged to wear National Institute of Occupational Safety and Health (NIOSH) approved masks which, when worn properly, block out as much as 99 percent of the inhalable dust.

Many health studies are currently in progress, and many more are being planned. Currently, the major studies are being conducted by the Center for Disease Control (CDC), in conjunction with other agencies. The CDC has been continually monitoring admissions since early May in several regional hospitals and periodically reports their findings.

The CDC, in conjunction with NIOSH, is presently monitoring selected farm workers to determine the amount of ash exposure they receive. The same agencies are also studying the respiratory health of timber workers near Mt. St. Helens; medical data on some 400 Washington loggers will be analyzed along with data from a control group of loggers in ash-free areas. The CDC, in coordination with the Washington State Health Department, is currently evaluating mortality data. Also, under the auspices of the CDC, a telephone survey of asthmatic children currently is being conducted by the Washington Thoracic Society and the University of Washington. The CDC is also planning to study patients with chronic bronchitis, as well as adult asthmatics. NIOSH is continuing its chemical analysis of the ash and is publishing its updated findings accordingly. Aside from the data produced by NIOSH, the CDC is receiving air quality reports from the EPA. In addition to the above health studies, there are many more that are either pending or being carried out by private agencies and universities.

## Psychological Health Effects

The long-term psychological effects of Mt. St. Helens on the local residents and on the general population are extremely difficult to evaluate. While few studies in the United States have dealt with the human response to the problems associated with an erupting volcano, experts believe that the feelings experienced by area residents will parallel human reactions to other natural disasters. Victims experience feelings of frustration, helplessness and loss of control over their daily lives. Common psychological reactions include phobias, insomnia, anorexia, depression, and paranoia. Such reactions may develop in varying degrees depending upon the intensity and duration of stress. Disaster victims often overcome these negative feelings by becoming active in reconstruction efforts, sharing the experience with others, and learning the scientific facts of the situation.

Although the psychological effects upon the population resulting from the eruptions of Mt. St. Helens exhibit many similarities to those resulting from other natural disasters, the volcano poses a number of problems unique in the experience of the United States. In the areas surrounding Mt. St. Helens, emotional stress is evident as a result of loss of life, property, and income; disturbance of the social fabric of the community; uncertainty about the future; and concern over potential health hazards. In particular, the cleanup of the ash has proved to be a difficult and frustrating task. The dust has permeated virtually all buildings and is interfering with daily tasks such as housekeeping. If the mountain continues to be active for an extended period of time the daily routines of area residents could be significantly altered. Should the residents be continually plagued by volcano-related problems, mental stress may well result in migration from the area. Because the distressing conditions at Mt. St. Helens may persist for an extended period, long-term mental health problems are a serious concern. Preliminary results from ongoing studies, for instance, reveal that inhabitants who are threatened by possible fall flooding are experiencing feelings of anxiety. Others who live outside the potential flood zone, even though they received heavy ashfall, are generally recovering from the disaster. It might be noted that crisis calls to mental health clinics have dropped off significantly since June.

## The Effects of Airborne Ash and Volcanic Gases

The long-term effect on air quality in the region as a whole should be slight. The principal impact on air quality was from airborne ash; however, Mt. St. Helens also emitted poisonous gases. By the first week of July, monitoring stations were reporting conditions not much different from those of a dusty summer. However, in certain areas, problems over the short term could be quite annoying, although not likely dangerous.

Chemical analysis, showing the ash to be essentially inert, has alleviated the initial fear that the ash was toxic. The health hazard--although the extent is unknown--is thought to be slight, varying with concentration, duration of exposure, and degree of exposure. All of these are highly individual and difficult to quantify. The annoyance is much clearer. The crucial variable in determining the degree of annoyance is particle size, which varies from the size of sand to that of talcum powder. Portland, for

example, received the powder type of ash, while Yakima, in Eastern Washington, had to deal with a sandy type of ashfall. The sand-type ash can be cleared away with relative ease, while the powder presents much more difficulty. On a dry day, any gust of wind can send clouds of dust into the air. The particles are extremely light and extremely abrasive, in many ways similar to finely crushed glass. This size of ash gets inside machinery and homes and creates cleaning and maintenance problems which can be frustratingly difficult.

How long this condition will persist is unknown. Rainfall does not seem to rinse much of the ash away. The fine ash, unlike the sand type, coagulates when wetted. At present Portland is issuing pollution alerts on dry days. These alerts were designed to be a measure of industrial pollutants, and it is not known whether the ash presents the same dangers.

The effect of the ash on soils varies, depending on the particle size. The mechanical properties of the fine ash could impede water seepage and aeration of the soil. The sand-type ash can simply be turned over into the soil. The chemical effect, over the long term, should be beneficial. The ash could provide the soil with nutrients, although the ash lacks nitrogen. The magnitude of this effect is not known, although studies of other volcanos have demonstrated a connection between ashfall and increased growth and fertility.

There was some concern that the ash which was blown into the atmosphere might act as a shield, blocking radiation and thus reducing the amount of sunlight and heat available for plant growth. Scientists believe that the amount of ash ejected so far will have only a slight adverse affect on the climate. It is estimated that the atmospheric ash will not reduce surface temperatures by more than one-tenth of a degree Farenheit.

The ash takes an extremely long time to disintegrate (on the order of thousands of years). It is uncertain how dangerous the ash is, but the annoyance and frustration it causes over the next few years will be very apparent. The effect of the winter rains on the ashfall will allow a more definitive assessment of how long some of these problems might persist.

Poisonous gases were also ejected from the volcano. Although during and after the blast certain gases were in potentially dangerous concentrations around the volcano, these gases are now no threat to health. For the most part they are expected to have little or no continuing effect on the environment. The only exception is sulfur dioxide which since June 2 has been emitted at a rate of up to 2,000 tons per day, with large fluctuations, at a level of 9,000 to 12,000 feet. This could reappear as acid rain over some area downwind, perhaps about 100 to 150 miles to the east. To place this in perspective, at times the volcano is emitting four to five times the amount of sulfur dioxide emitted by the average industrial plant, although at a much higher altitude. The combination of these factors makes the significance of the sulfur dioxide emission unclear.

## The Effects on Water Quality

Water quality was affected by the eruption in two ways, chemically and mechanically. The chemical composition of the water in the region should not be significantly affected beyond the very short term, while the mere presence of ash may cause problems lasting somewhat longer. In neither case are any ramifications of long-term significance seen.

For a few weeks after the major eruption, the surface water of the area contained higher than normal concentrations of manganese and boron, although neither threatened humans or crops. The manganese stained laundry and gave water an off-taste, but it had no other known effects. The boron might have threatened some crops, but the mechanics of water distribution in the area meant that the chemical would be sufficiently diluted before it reached the crop roots.

Acidity in surface water did increase, but only slightly. Again, this water should be so diluted by the time it is used that acidity should present few problems. The soluble parts of the ash dissolve rapidly, so that the degree of increase in acidity falls off rapidly with each succeeding leaching. A slight increase in acidity in lakes and streams after rains is expected in the future, but the changes will not be significant. It might be noted that the U.S. Geological Service has established a network of more than 50 stations to monitor water quality.

A more annoying and mechanical problem is the physical presence of ash in the water. This problem forced some sewage treatment plants to shutdown operations for several days after the eruptions. The nuisance of turbidity (suspended particles) in the drinking water may last for as long as 5 years. In areas of significant ashfall it is possible that future rains might cause ash to lodge in storm drains and thus contribute to flooding.

At least two cities, Longview and Yakima with approximately 80,000 residents, have been unable to utilize their normal sources of surface water from the Columbia and Natchez Rivers for drinking water owing to the plugging of mechanical intakes by mud and sediment. This situation could become more widespread if erosion continues to cause large amounts of silt to be deposited in the rivers and streams.

## The Effects on Wildlife

Although the long-term effects on animals are not yet fully known, it appears that wildlife populations outside of the immediate blast area are expected to recover quickly from losses. Within the blast area itself, damage will be more long term in nature. Furthermore, although there currently is no health threat to animals, the development of future health problems cannot be ruled out.

It is estimated by the Washington State Game Department that 1,551,000 animals and 441,200 game fish were or will be lost because of the eruption. Among the casualties were an estimated 5,250 elk, 6,000 deer, 200 bears, 100 mountain goats, and 15 cougars. No species is expected to suffer any long-term reductions in population.

The blast site itself will probably not serve as a good wildlife habitat for many years to come. The blast destroyed 195 square miles of habitat, 154 miles of trout streams, and 26 lakes. It will be more than a century before the blast area is again covered with the coniferous forest which provided a distinct type of habitat. The alterations in the blast site habitat will have a long-term effect on the composition of animal populations in the immediate area. Food and especially cover will be scarce for years to come. Insects, vital links in the food chain, will reenter the blast area faster than mammals; sightings have already been made. Although some large animals have also been sighted in the blast zone, they are not expected to stay in such exposed areas. Small animals are, however, expected to return over the next few years as the ground vegetation takes hold.

In the long run, wildlife in ash-covered areas may suffer some chronic health damage from the ashfall, but this seems unlikely to become a widespread problem. Respiratory damage to grazing animals is a major concern, but this usually develops only after years of exposure to airborne dust, and presently this length of exposure does not seem likely. The ash does not appear to be harmful when ingested by grazing animals, but it can injure fish. The ash is extremely sharp and can severely lacerate the gills, causing injury or death. The fish population is among the most severely affected, and losses could be apparent for several years to come.

## The Effects on the Topography

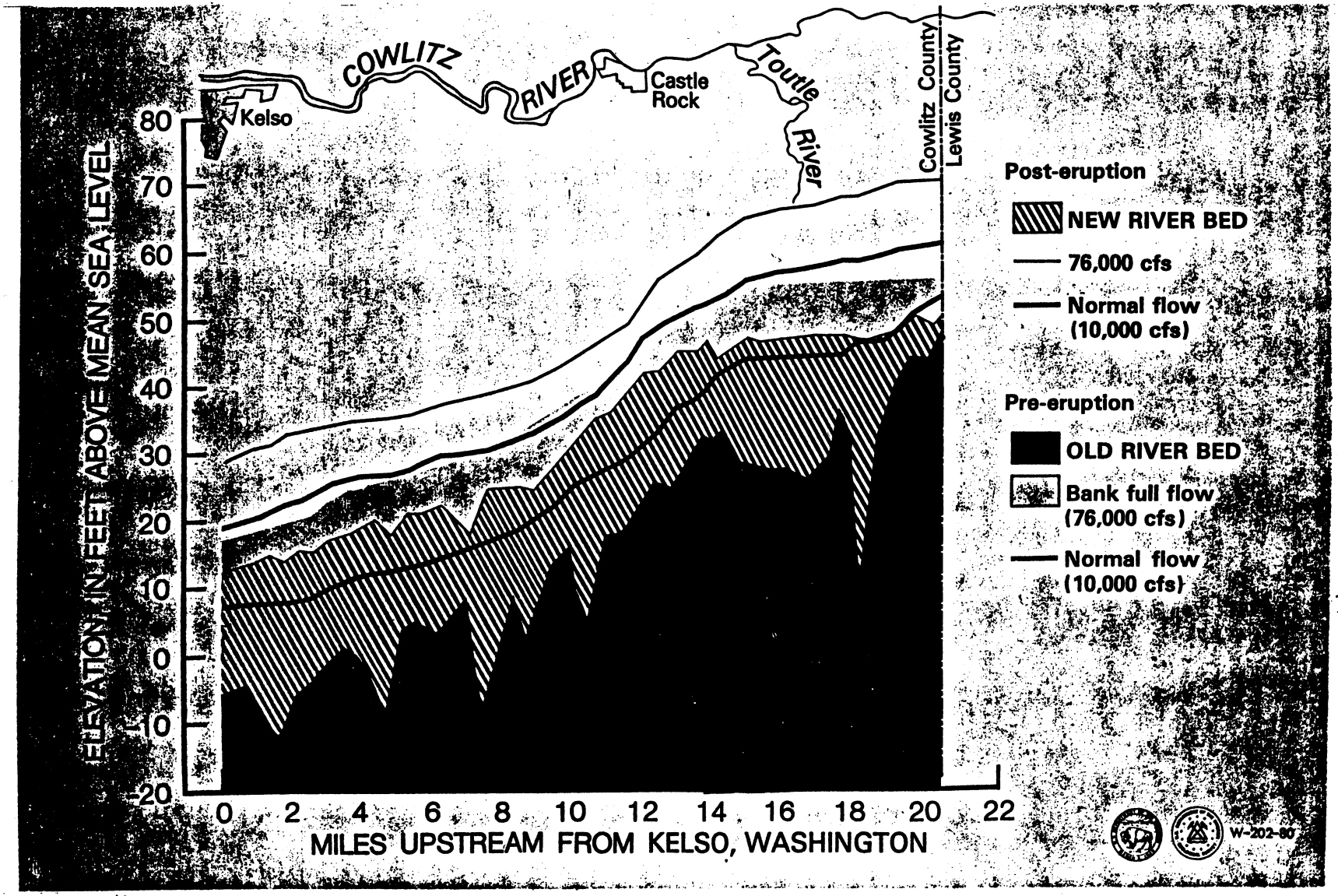
The landscape of the area around Mt. St. Helens has been greatly affected by the eruption. The blast blew approximately 1.5 cubic kilometers off the top of the mountain and devastated a 6-mile radius of land to the north and northwest. The consequences of this are difficult to measure, but it is clear that the region will not recover for decades.

Mudflows were a major product of the eruption. Much of the north and south forks of the Toutle River were destroyed. The Muddy River also experienced extensive damage. Many other rivers and streams around the mountain, such as the Green River and the Cowlitz River, had increased silt and sediment deposited, and thus their capacity for waterflow and navigation reduced.

The havoc the blast played with the river system has significant consequences: some immediately serious, others merely annoying. The immediate danger is flooding. As a result of mudflows into the Toutle and the Cowlitz, some communities are threatened. Prior to the eruption, the lower 20 miles of the Cowlitz had a water-carrying capacity of 70,000 cubic feet per second (cfs). This has been reduced to 7,000 cfs, resulting in the river being near flood stage now (figs. 8 and 9). The U.S. Army Corps of Engineers is dredging and performing other flood protection activities, but their success is not assured prior to the fall and winter rains.

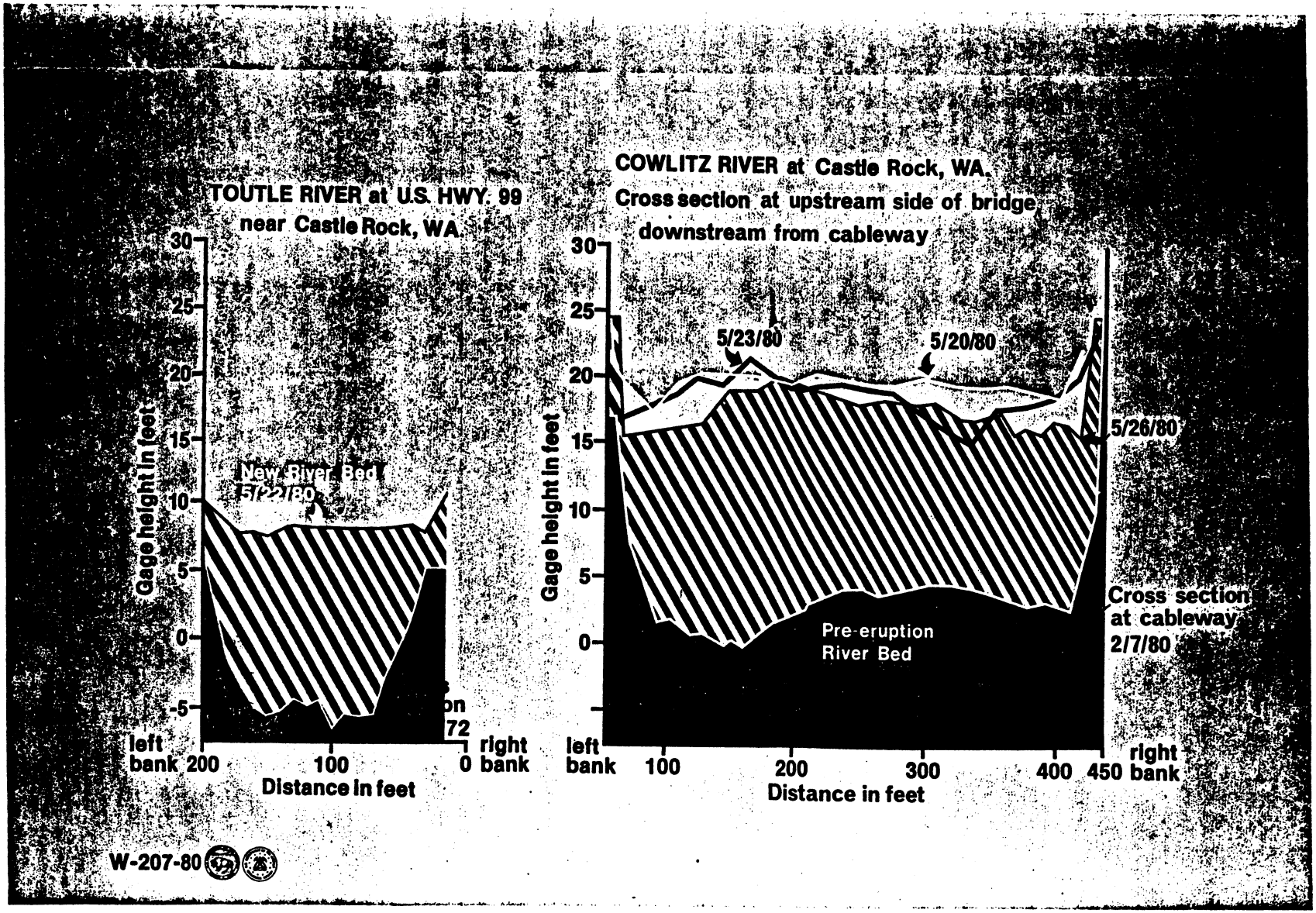
Erosion is a serious, long-term danger. In the blast area the devastation was virtually complete. The ground was stripped of vegetation and the natural barriers to erosion were destroyed. Immediately after the blast there was evidence of erosion on the hillsides. As the hillsides erode, increasing amounts of soil and rock will enter the already overburdened

Figure 8.--Toutle and Cowlitz Rivers: Longitudinal view of deposition in stream channels resulting from May 18, 1980, eruption of Mt. St. Helens.




Source: Geologic Survey, U.S. Department of Interior.

Figure 9.--Toutle and Cowlitz Rivers: Cross section views of deposition in stream channel resulting from May 18, 1980, eruption of Mt. St. Helens.




Source: Geologic Survey, U.S. Department of Interior.

rivers. Dredging could prove a long-term necessity. Authorities in the area are unsure just how to combat the complex erosion problem. Extensive seeding of grasses is reported to be underway as well as construction of settling basins to entrap the eroded material; both methods are intended to prevent further deposits in the Cowlitz and Columbia Rivers, but there is disagreement as to the effectiveness of these measures. This is a massive problem, and the diversity of ownership in the region means that programs are being adopted with varying degrees of speed.

The erosion problems outside of the devastated area are localized, but still significant. The sides of streams and rivers were scoured of vegetation by mudflows and floods. This scouring will contribute to the future erosion of the stream banks and the surrounding areas.

# APPENDIX A

LETTER AND RESOLUTION FROM COMMITTEE ON WAYS AND MEAN, U.S. HOUSE OF REPRESENTATIVES, REQUESTING AN INVESTIGATION OF THE ECONOMIC EFFECTS OF THE ERUPTION OF MT. ST. HELENS; AND THE COMMISSION'S NOTICE OF INVESTIGATION

June 4, 1980



The Honorable Catherine Bedell
Chairman
United States International
Trade Commission
701 E Street
Washington, D.C. 20436

Dear Madame Chairman:

On behalf of the Committee on Ways and Means, I would like to request that the International Trade Commission conduct a section 332 study on the economic effects of the eruption of Mount St. Helens and any further volcanic activity on the economy of the Pacific Northwest and of the United States.

Attached is a resolution approved by the Committee defining the parameters of the requested study. We would appreciate if the study could be finished no later than September 15, 1980. If other United States agencies and departments have relevant information, we hope that you will work closely with them in order to avoid duplication.

Thank you for your assistance in this request.

Sincerely,

Al Ullman
Chairman

AU:las

# RESOLUTION

Requesting the United States International Trade Commission to conduct a study of the economic effects of the eruption of Mount St. Helens and any further volcanic activity on the economy of the Pacific Northwest and of the United States, including:

(1) the effect on imports and exports;

(2) the effect on agricultural production and marketing and on manufacturing and investment;

(3) the effect on the transportation system;

(4) any long-term detrimental effect to the inhabitants or to the ecology of the region;

Pursuant to 19 USC 1331(g), the Committee on Ways and Means requests the United States International Trade Commission to conduct such a study.

To the extent feasible, the International Trade Commission should use such accurate data as is available from other United States agencies or departments so as to avoid duplication in data-gathering.

**UNITED STATES INTERNATIONAL TRADE COMMISSION**
**Washington, D.C.**

**Investigation 332-110**

**Study of the Economic Effects of the Eruption of Mount St. Helens**

**AGENCY:** United States International Trade Commission

**ACTION:** At the request of the Committee on Ways and Means, United States House of Representatives, and in accordance with the provisions of section 332 of the Tariff Act of 1930, as amended, the Commission has instituted investigation No. 332-110, for the purpose of studying the economic effects of the eruption of Mount St. Helens on the Pacific Northwest and on the United States. The report will include information on:

(1) the effect on imports and exports;
(2) the effect on agricultural production and marketing and on manufacturing and investment;
(3) the effect on the transportation system; and
(4) any long-term detrimental effect to the inhabitants of the region and to the ecosystem.

To the extent feasible, the Commission intends to use such data as are available from other Federal agencies, so as to avoid duplication.

EFFECTIVE DATE: June 18, 1980

FOR FURTHER INFORMATION CONTACT: Mr. Lowell Grant, or Mr. Edward Furlow, Agriculture, Fisheries, and Forest Products Division, U.S. International Trade Commission, Washington, D.C. 20436 (Telephone 202-523-0035 or 202-523-0234).

WRITTEN SUBMISSIONS: Since there will be no public hearing scheduled for this study, written submissions are invited from interested parties concerning any phase of the study. Commercial or financial information which a submitter desires the Commission to treat as confidential must be submitted on separate sheets of paper, each clearly marked "Confidential Business Information" at the top. All submissions requesting confidential treatment must conform with the requirements of section 201.6 of the Commission's Rules of Practice and Procedure (19 C.F.R. 201.6). All written submissions, except for confidential business information, will be made available for inspection by interested persons. To be assured of consideration by the Commission in this study, written statements should be submitted at the earliest practicable date, but no later than August 1, 1980. All submissions should be addressed to the Secretary at the Commission's office in Washington, D.C. 20436.

By Order of the Commission:

Kenneth R. Mason
Secretary

Issued: June 18, 1980

# APPENDIX B

## RESEARCH AND REPORTS IN PROGRESS CONCERNING THE ERUPTION OF MT. ST. HELENS

Mr. Roger D. Akre
Washington State University
Effects on insects.

Dr. Anderson
University of New Mexico
Measurement of the effects of Mt. St. Helens tephra on lakes, using automated sediment traps.

Dr. Avent
California State University
Ground-base thermal infrared surveys of Mt. St. Helens.

Battelle Memorial Institute
Mr. Ronald A. Perry, research coordinator
Citizen information and threat perception.

Mr. Breckenridge
Idaho Bureau of Mines and Geology
Baseline depositional environments of Mt. St. Helens tephra in northern Idaho.

Dr. Leo K. Bustad
Washington State University
Biomedical effects of the ash.

Center for Disease Control
Dr. Henry Falk
Hospital surveillance study.
Moses Lake health questionnaire.

Center for Disease Control/National Institute of Occupational Safety and Health
Dr. Donald Dollberg and Dr. Charles Geraci
Round-robin program for analysing crystalline silica content of the ash.
Respiratory study on area loggers.

Center for Disease Control/Washington State Health Department
Evaluation of mortality data.
Case-control study of patients with respiratory diseases associated with ash exposure.

Center for Disease Control/Washington State Thoracic Society/University of Washington
Telephone survey of asthmatic children.

Dr. Crown
Washington State University
Quantitative characterization of trace gases in the Mt. St. Helens volcanic plume.

Dr. Don A. Dillman and Dr. James F. Short
Washington State University
Telephone survey of 1,500 east Washington residents to ascertain (1) how they found out about the eruption, (2) how the eruption effected their daily lives, and (3) the likelihood of their moving out of the region if another eruption occurs.

Dr. Drabek
University of Denver
Search and rescue mission in natural disasters and remote settings.

Dr. Easterbrook
Washington State University
Investigation of pyroclastic debris, mudflows, magnetism, and morphology.

Dr. James Engibous
Washington State University
Effect of ash on soils and crops.

Dr. Elden H. Franz
Washington State University
Examining the transients in the ecosystem development associated with the initial nitrogen cycle on volcanic debris during colonization.

Dr. Hallagan
Washington State University
Estimating the cost of community ash cleanup.

Dr. Hooper
Washington State University
The chemical and petrographic analysis of the ash in eastern Washington, northern Idaho, and western Montana.

Dr. Kartez
Washington State University
Adaptive response to transportation service interruption.

Mr. Knowles
Idaho Bureau of Mines and Geology
Election microbe analysis and distribution of the volcanic ash in northern Idaho.

Mr. Robert K. Koppe
Washington State University
Airborne particle levels resulting from the May 18th blast.

Library of Congress Congressional Research Service
Ms. Karla Perri
General assessment of damage to industries and the environment. Original dated 5/28/80 - being updated continually.

Dr. Morisawa
SUNY/Binghamton
Drainage development on Mt. St. Helens.

National Institute of Occupational Safety and Health
Dr. James A. Merchant, research coordinator
Vitro studies of the volcanic ash concerning mutagenesis and the effect on macrophages.
Ash composition study.

Pacific Northwest River Basins Commission
Research program on the Columbia River estuary.

Dr. James Pennebaker
University of Virginia
Psychological study of area resident's response to the eruption.

Portland State University
Studying how the population in ash-affected areas has adjusted its transportation patterns.

Dr. R. L. Preston
Washington State University
Effects on livestock.

Dr. Quamar
University of Montana
Ground-based infrared survey of Mt. St. Helens

Dr. Rasmussen
Oregon Graduate Center
Collection and analysis of the ash for desorption of trace gases.

Dr. Roberts
Washington State University
Preception and behavior concerning health and housing.

Mr. William R. Schimdt
Air Surveillance and Investigation Section
U.S. Environmental Protection Agency, Region X
Ash analysis and airborne particle count.

Mr. Donald R. Scott
University of Idaho
Comparing catches of coded male moths of succeeding years with 1974-77 data.
Determining the population of Lygus species in 1980 and succeeding years and then comparing this data to 1977-79 data.

Mr. T. Searinen
University of Arizona
Agency response to the eruption.

Dr. Ronald R. Soren
Washington State University
Geological aspects of the ash fall in Pullman, WA and vicinity.

Dr. Eric Stauber
University of Idaho
Short term effects on wildlife.

Dr. Stoiber
Dartmouth College
Studying the gas emmissions.

Dr. Turekian
Yale University
Natural radionuclide measurements of Mt. St. Helens effusive materials.

United States Army Corps of Engineers, Portland District
Mt. St. Helens Recovery Operations, Draft Environmental Impact Statement,
July 1980

U.S. Department of Agriculture - Forest Service
Mount St. Helens Briefing Paper,
Continually updated report on effects on Gifford Pinchot National Forest.

U.S. Geological Survey
Continuing its research on Mt. St. Helens.

R. R. A. Warrick
Clark University
Agency and individual response to the ash fall. The effects of the ash on utilities, business, and farmers.

Dr. R. S. Yeats
Oregon State University
Conducting a geological study of the fractures that have occurred in the earth's crust due to the eruptions.

# APPENDIX C

## STATISTICAL TABLES

Table 1.--Selected data on exports of agricultural and manufactured products in the Pacific Northwest, 1976 and fiscal year 1977

| State | Rank among 50 States in exports of-- | | Share of manufacturing jobs dependent on exports of the State's manufactured products | Agricultural exports as a share of the State's total exports 3/ |
|---|---|---|---|---|
| | Agricultural products 1/ | Manufactured products 2/ | Percent | Percent |
| Idaho | 28 | 44 | 7 | 20 |
| Oregon | 32 | 26 | 12 | 20 |
| Washington | 18 | 8 | 16 | 25 |

1/ Data are for fiscal year 1977.
2/ Data are for calendar year 1976.
3/ Based on sales.

Source: U.S. Department of Commerce, State Export Series, 1978.

Table 2.--International trade through ports of the Pacific Northwest, 1978

(In millions of short tons)

| Port | Imports | Exports | Total |
|---|---|---|---|
| Puget Sound: | | | |
| Tacoma, Wash | 2.4 | 5.7 | 8.1 |
| Seattle, Wash | 5.2 | 2.7 | 7.9 |
| Anacortes, Wash | 6.4 | .1 | 6.5 |
| Port Angeles, Wash | .8 | 1.8 | 2.6 |
| Everett, Wash | .6 | 1.5 | 2.1 |
| Bellingham, Wash | .6 | .1 | .7 |
| Olympia, Wash | 1/ | .4 | .4 |
| Port Townsend, Wash | .2 | 0 | .2 |
| Columbia River: | | | |
| Portland, Oreg | 2.0 | 9.6 | 11.6 |
| Longview, Wash | .7 | 5.1 | 5.8 |
| Vancouver, Wash | 1.0 | .5 | 1.5 |
| Astoria, Oreg | .1 | 1.0 | 1.1 |
| Kalama, Wash | .1 | .2 | .3 |

1/ Less than 50,000 short tons.

Source: Seattle and Portland customs districts, U.S. Army Corps of Engineers.

Table 3.--U.S. imports of the 15 leading items through the Portland customs district, 1977-79

| TSUSA item No. | Description | 1977 | | | 1978 | | | 1979 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Rank | Imports through Portland | Ratio of imports through Portland to total U.S. imports | Rank | Imports through Portland | Ratio of imports through Portland to total U.S. imports | Rank | Imports through Portland | Ratio of imports through Portland to total U.S. imports |
| | | | Million dollars | Percent | | Million dollars | Percent | | Million dollars | Percent |
| 692.1010 | 4-wheeled passenger cars, new, 4 cylinders and under | 1/ 1 | 1/ 612 | 1/ 9 | 1 | 848 | 12 | 1 | 855 | 10 |
| 417.1240 | Aluminum oxide (alumina) or alumina | 2/ 2 | 2/ 147 | 2/ 29 | 2 | 154 | 26 | 2 | 175 | 29 |
| 692.2040 | Chassis for automobile trucks, gasoline | 3/ 3 | 3/ 70 | 3/ 10 | 3 | 112 | 10 | 3 | 155 | 12 |
| 692.1015 | 4-wheeled passenger cars, new, over 4 but not over 6 cylinders | 1/ | 1/ | 1/ | 4 | 76 | 4 | 4 | 117 | 6 |
| 608.9530 | Iron or steel sheets, coated, not alloyed, valued over 10 cents per pound | 5 | 23 | 4 | 6 | 37 | 4 | 5 | 38 | 4 |
| 772.5115 | Pneumatic tires, truck and bus, new | 4 | 24 | 6 | 7 | 30 | 6 | 6 | 31 | 5 |
| 692.3004 | New tractors, power takeoff HP, 20-PTO HP or more, not over 30-PTO HP | - | - | - | 4/ 5 | 4/ 39 | 4/ 31 | 7 | 31 | 33 |
| 668.0600 | Parts of machines making cellulosic pulp, paper, or paperboard | 5/ | 6/ | 7/ | 5/ | 6/ | 7/ | 8 | 21 | 24 |
| 176.3420 | Palm oil, crude | 8/ 6 | 8/ 20 | 8/ 17 | 9 | 19 | 50 | 9 | 21 | 44 |
| 609.8015 | Iron or steel wide flange shapes or sections, not alloyed, not advanced, 3 inches and over, other | 12 | 10 | 7 | 12 | 15 | 8 | 10 | 18 | 6 |
| 700.6035 | Footwear, except U.S. type, oxford height, rubber/fabric, for men, youths, and boys | 30 | 5 | 13 | 16 | 11 | 11 | 11 | 18 | 21 |
| 475.0510 | Crude petroleum, shale, etc., including reconstituted, testing under 25 degrees A.P.I | 9 | 13 | 1 | - | - | - | 12 | 16 | 7/ |
| 700.3515 | Footwear, athletic, leather, not elsewhere specified, for men, youths, and boys | 20 | 7 | 3 | 18 | 10 | 4 | 13 | 13 | 6 |
| 608.8440 | Steel sheets, not shaped, etc., not cold-rolled, not plated, not alloyed | 11 | 11 | 3 | 8 | 22 | 5 | 14 | 13 | 3 |
| 176.1720 | Coconut oil, crude | 9/ 15 | 9/ 8 | 9/ 3 | 14 | 14 | 79 | 15 | 13 | 4 |
| | All other | - | [illegible] | - | - | 689 | - | - | 787 | - |
| | Total | - | 1,545 | - | - | 2,076 | - | - | 2,323 | - |

See footnotes on p. 75.

Footnotes for table 3.

1/ TSUSA items 692.1010 and 692.1015 were derived from TSUSA item 692.1020 (pt.) as of Jan. 1, 1978.
2/ TSUSA item 417.1240 was derived from TSUSA item 417.1200 (pt.) as of Jan. 1, 1978.
3/ TSUSA item 692.2040 was derived from TSUSA item 692.2000 (pt.) as of Jan. 1, 1978.
4/ TSUSA item 692.3004 was derived from TSUSA item 692.3003 (pt.) as of Jan. 1, 1979. No trade reported in 1977.
5/ Not available.
6/ Less than $500,000.
7/ Less than 0.5 percent.
8/ TSUSA item 176.3420 was derived from TSUSA item 176.3400 (pt.) as of Jan. 1, 1978.
9/ TSUSA item 176.1720 was derived from TSUS item 176.1700 (pt.) as of Jan. 1, 1978.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Note.--Because of rounding, figures may not add to the totals shown.

Table 4.--U.S. exports of the 15 leading items through the Portland customs district, 1977-79

| Schedule B No. | Description | 1977 | | | 1978 | | | 1979 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Rank | Exports through Portland | Ratio of exports through Portland to total U.S. exports | Rank | Exports through Portland | Ratio of exports through Portland to total U.S. exports | Rank | Exports through Portland | Ratio of exports through Portland to total U.S. exports |
| | | | Million dollars | Percent | | Million dollars | Percent | | Million dollars | Percent |
| 130.6540 | Wheat, not donated for relief or charity | 1 | 608 | 23 | 1 | 1,092 | 25 | 1 | 1,414 | 27 |
| 200.3510 | Douglas-fir, logs and timber | 1/ | 140 | 43 | 2 | 201 | 47 | 2 | 292 | 46 |
| 200.1500 | Wood chips, other than waste | 3 | 125 | 70 | 3 | 114 | 73 | 3 | 133 | 67 |
| 202.1640 | Douglas-fir (rough), in least dimension, 2 inches but under 5 inches | 1/ | 55 | 69 | 5 | 60 | 76 | 4 | 132 | 83 |
| 200.3514 | Western hemlock, logs and timber | 1/ | 105 | 26 | 4 | 101 | 22 | 5 | 124 | 19 |
| 202.1660 | Douglas-fir (rough), in least dimension 5 inches and over | 1/ | 31 | 67 | 8 | 34 | 70 | 6 | 73 | 81 |
| 240.2020 | Plywood with a face ply of Douglas-fir | 1/ | 31 | 72 | 6 | 45 | 88 | 7 | 71 | 88 |
| 120.1400 | Whole cattle hides | 10 | 34 | 7 | 7 | 40 | 6 | 8 | 42 | 5 |
| 252.8520 | Paper and paperboard, base stock for milk cartons and similar containers | 13 | 18 | 20 | 15 | 16 | 18 | 9 | 39 | 31 |
| 130.1000 | Barley | 7 | 41 | 26 | 12 | 25 | 35 | 10 | 37 | 40 |
| 252.7810 | Kraft linerboard | 12 | 27 | 10 | 9 | 33 | 11 | 11 | 33 | 9 |
| 200.3512 | Port Orford cedar logs | 14 | 17 | 84 | 10 | 25 | 86 | 12 | 24 | 91 |
| 200.3508 | Spruce, logs and timber | 1/ | 7 | 28 | 27 | 8 | 12 | 13 | 21 | 16 |
| 200.3518 | Other pine logs | 1/ | 2 | 28 | 14 | 16 | 31 | 14 | 20 | 27 |
| 712.5032 | Oscilloscopes and oscillographs, and parts thereof | 1/ | 9 | 12 | 11 | 25 | 29 | 15 | 19 | 17 |
| | All other | - | 550 | - | - | 583 | - | - | 592 | - |
| | Total | - | 1,800 | - | - | 2,417 | - | - | 3,067 | - |

1/ Not available.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Note.--Because of rounding, figures may not add to the totals shown.



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Table 5.--U.S. imports of the 15 leading items through the Seattle customs district, 1977-79

| TSUSA item No. | Description | 1977 | | | 1978 | | | 1979 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Rank | Imports through Seattle | Ratio of imports through Seattle to total U.S. imports | Rank | Imports through Seattle | Ratio of imports through Seattle to total U.S. imports | Rank | Imports through Seattle | Ratio of imports through Seattle to total U.S. imports |
| | | | Million dollars | Percent | | Million dollars | Percent | | Million dollars | Percent |
| 475.1010 | Crude petroleum, including reconstituted, and shale oil, testing 25 degrees A.P.I. or more | 1 | 1,068 | 3 | 1 | 786 | 3 | 1 | 1,107 | 3 |
| 475.1505 | Natural gas, methane, and mixtures (including liquefied, synthetic, or substitute natural gas) | 2 | 462 | 24 | 2 | 468 | 24 | 2 | 579 | 21 |
| 692.1010 | 4-wheeled passenger cars, new, 4 cylinders and under | 1/ 3 | 1/ 400 | 1/ 6 | 3 | 327 | 5 | 3 | 421 | 5 |
| 692.2040 | Chassis for automobile trucks, gasoline | 2/ 5 | 2/ 143 | 2/ 20 | 4 | 217 | 20 | 4 | 247 | 19 |
| 202.0340 | Lumber, spruce, dressed or worked, including flooring, excluding siding and molding | 4 | 187 | 22 | 5 | 212 | 18 | 5 | 213 | 16 |
| 252.6500 | Standard newsprint paper | 7 | 133 | 7 | 6 | 177 | 8 | 6 | 201 | 9 |
| 446.0550 | Natural rubber, dry form | 8 | 112 | 19 | 9 | 119 | 19 | 7 | 166 | 20 |
| 417.1240 | Aluminum oxide (alumina) or alumina | 3/ 6 | 3/ 143 | 3/ 28 | 7 | 163 | 28 | 8 | 160 | 26 |
| 692.1015 | 4-wheeled passenger cars, new, over 4 but not over 6 cylinders | 1/ | 1/ | 1/ | 10 | 104 | 5 | 9 | 118 | 6 |
| 200.8520 | Wood shingles and shakes, red cedar | 11 | 60 | 49 | 11 | 81 | 54 | 10 | 103 | 67 |
| 694.6000 | Aircraft and spacecraft parts, n.e.s | 18 | 38 | 13 | 14 | 61 | 32 | 11 | 101 | 33 |
| 800.0035 | U.S. products, n.e.s., returned from export, without being advanced in value, etc., by manufacturing, etc., while abroad | 12 | 59 | 3 | 8 | 141 | 6 | 12 | 89 | 3 |
| 250.0281 | Wood pulp, sulphate or soda bleached softwood, n.e.s., except screenings | 4/ 10 | 4/ 67 | 4/ 9 | 16 | 58 | 8 | 13 | 79 | 8 |
| 692.0310 | Automobile trucks, except truck tractors, gasoline, APTA | 5/ 15 | 5/ 52 | 5/ 4 | 13 | 66 | 4 | 14 | 79 | 7 |
| 692.1035 | 4-wheeled passenger cars, new, except piston engine type | 1/ | 1/ | 1/ | 50 | 18 | 21 | 15 | 75 | 31 |
| | All other | - | 2,806 | - | - | 3,630 | - | - | 4,204 | - |
| | Total | - | 5,734 | - | - | 6,627 | - | - | 7,944 | - |

1/ TSUSA items 692.1010, 692.1015, and 692.1035 were derived from TSUSA item 692.1020 (pt.) as of Jan. 1, 1978.
2/ TSUSA item 692.2040 was derived from TSUSA item 692.2000 (pt.) as of Jan. 1, 1978.
3/ TSUSA item 417.1240 was derived from TSUSA item 417.1200 (pt.) as of Jan. 1, 1978.
4/ TSUSA item 250.0281 was derived from TSUSA items 250.0280 and 250.0285 (pt.) as of Jan. 1, 1978.
5/ TSUSA item 692.0310 was derived from TSUSA item 692.0300 (pt.) as of Jan. 1, 1978.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Note.--Because of rounding, figures may not add to the totals shown.

Table 6.—U.S. exports of the 15 leading items through the Seattle customs district, 1977-79

| Schedule B No. | Description | 1977 | | | 1978 | | | 1979 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Rank | Exports through Seattle | Ratio of exports through Seattle to total U.S. exports | Rank | Exports through Seattle | Ratio of exports through Seattle to total U.S. exports | Rank | Exports through Seattle | Ratio of exports through Seattle to total U.S. exports |
| | | | Million dollars | Percent | | Million dollars | Percent | | Million dollars | Percent |
| 694.4062 | Passenger transports (over 33,000 pounds empty weight), new | 1 | 902 | 54 | 1 | 1,462 | 70 | 1 | 2,771 | 67 |
| 694.4068 | Other nonmilitary airplanes (including passenger/cargo combinations), new | 3 | 177 | 87 | 3 | 305 | 100 | 2 | 547 | 100 |
| 130.3465 | Yellow corn, not donated for relief or charity | 1/ | 7 | 2/ | 6 | 189 | 4 | 3 | 517 | 7 |
| 200.3514 | Western hemlock, logs and timber | 1/ | 288 | 72 | 2 | 345 | 77 | 4 | 510 | 79 |
| 200.3510 | Douglas-fir, logs and timber | 1/ | 172 | 53 | 5 | 213 | 49 | 5 | 332 | 52 |
| 694.4065 | Cargo transports (over 33,000 pounds empty weight), new | 13 | 45 | 67 | 7 | 142 | 100 | 6 | 245 | 76 |
| 110.4620 | Whole or eviscerated salmon | 6 | 106 | 90 | 4 | 216 | 80 | 7 | 167 | 55 |
| 692.2985 | Other parts, chassis, bodies and parts, n.s.p.f., motor vehicles | 1/ | 83 | 2 | 9 | 101 | 3 | 8 | 115 | 4 |
| 694.6506 | Other parts for aircraft and spacecraft | 8 | 63 | 4 | 10 | 77 | 4 | 9 | 108 | 4 |
| 692.1030 | On-the-highway, 4-wheeled passenger automobiles, including ambulances and hearses, over 6 cylinders | 1/ | 18 | 3 | 11 | 76 | 3 | 10 | 103 | 4 |
| 130.6540 | Wheat, not donated for relief or charity | 5 | 146 | 6 | 8 | 125 | 3 | 11 | 102 | 2 |
| 120.1400 | Whole cattle hides | 11 | 55 | 11 | 12 | 71 | 11 | 12 | 85 | 10 |
| 112.1940 | Other canned salmon | 18 | 30 | 89 | 15 | 39 | 85 | 13 | 81 | 95 |
| 250.0284 | Wood pulp suitable for paper making, special alpha and dissolving grades | 10 | 57 | 18 | 13 | 57 | 19 | 14 | 77 | 22 |
| 618.0300 | Unwrought aluminum, other than alloys of aluminum | 1/ | 12 | 26 | 26 | 24 | 37 | 15 | 73 | 52 |
| | All other | - | 2,600 | | - | 2,958 | - | - | 3,798 | - |
| | Total | - | 4,762 | - | - | 6,399 | - | - | 9,632 | - |

1/ Not available.
2/ Less than 0.5 percent.

Source: Compiled from offieial statistics of the U.S. Department of Commerce.

Note.—Because of rounding, figures may not add to the totals shown.

Table 7.--U.S. imports of the 15 leading items through the Portland customs district, January-May 1979 and January-May 1980

(In thousands of dollars)

| TSUSA item No. | Description | January-May 1979 | January-May 1980 |
|---|---|---|---|
| 692.1010 | 4-wheeled passenger cars, new, 4 cylinders and under | 370,131 | 417,236 |
| 417.1240 | Aluminum oxide (alumina) or alumina | 70,811 | 97,704 |
| 692.2042 | Chassis for automobile trucks, except truck tractors gas fueled, not over 6,000 pounds g.v.w | 1/ 54,201 | 76,545 |
| 692.1015 | 4-wheeled passenger cars, new, over 4 but not over 6 cylinders | 63,154 | 41,167 |
| 772.5115 | Pneumatic tires, truck and bus, new | 13,836 | 16,075 |
| 608.1300 | Sheets, other than alloy iron or steel, valued over 10 cents per pound | 2/ | 14,634 |
| 692.3404 | New tracters, 20-PTO horsepower or more, but less than 30-PTO horsepower | 1/ 10,207 | 12,750 |
| 607.6700 | Sheets, other than alloy iron or steel, not pickled and not cold rolled | 2/ | 11,697 |
| 700.6005 | Footwear, U.S. type, oxford height, rubber/fabric, for men, youths, or boys | 2/ | 11,044 |
| 609.8015 | Steel wide flange shapes or sections not alloyed, not advanced, 3 inches and over, other | 7,186 | 9,947 |
| 700.3515 | Footwear, athletic, leather, n.e.s., for men, youths, and boys | 3,808 | 8,589 |
| 700.6035 | Footwear, excluding U.S. type, oxford height, rubber/fabric, for men, youths, and boys | 7,209 | 7,565 |
| 700.6015 | Footwear, U.S. type, oxford height, rubber/fabric, for women and misses | 2/ | 6,627 |
| 668.0600 | Parts of machines for making cellulosic pulp, paper, or paperboard | 2,889 | 6,084 |
| 685.4009 | Office telephone-answering machines capable of battery operation | 3,270 | 5,686 |
| | All other | 328,653 | 346,714 |
| | Total | 935,355 | 1,090,064 |

1/ Estimated.
2/ Not available.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 8.--U.S. exports of the 15 leading items through the Portland customs district, January-May 1979 and January-May 1980

(In thousands of dollars)

| Schedule B No. | Description | January-May 1979 | January-May 1980 |
|---|---|---|---|
| 130.6540 | Wheat, not donated for relief or charity | 559,615 | 723,392 |
| 200.3510 | Douglas-fir | 129,144 | 157,799 |
| 200.1500 | Wood chips other than waste | 50,558 | 90,147 |
| 202.1640 | Douglas-fir (lumber), in least dimension 2 inches but under 5 inches | 46,209 | 85,323 |
| 200.3514 | Western hemlock | 49,479 | 60,546 |
| 240.2020 | Plywood with a face ply of Douglas-fir | 31,965 | 34,671 |
| 202.1660 | Douglas-fir (lumber), in least dimension 5 inches and over | 27,723 | 28,175 |
| 618.0300 | Unwrought aluminum, other than alloys of aluminum | 11,242 | 23,679 |
| 252.7810 | Kraft linerboard | 9,101 | 21,520 |
| 252.8520 | Paper and paperboard, base stock for milk cartons and similar containers | 14,931 | 20,632 |
| 130.4040 | Other grain sorghum | 1/ | 20,175 |
| 130.1000 | Barley | 1/ | 14,191 |
| 252.6500 | U.S. standard newsprint | 1/ | 12,464 |
| 607.0845 | Other carbon steel and iron, waste and scrap | 8,462 | 11,460 |
| 120.1400 | Whole cattle hides | 21,211 | 11,121 |
| | All other | 272,043 | 252,803 |
| | Total | 1,231,683 | 1,568,100 |

1/ Not available.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Note.--Because of rounding, figures may not add to the totals shown.

Table 9.--U.S. imports of the 15 leading items imported through the Seattle customs district, January-May 1979 and January-May 1980

(In thousands of dollars)

| TSUSA item No. | Description | January-May 1979 | January-May 1980 |
|---|---|---|---|
| 475.1010 | Crude petroleum, shale oil, including reconstituted, testing 25 degrees A.P.I. and over | 372,454 | 701,503 |
| 475.1505 | Natural gas, methane A mixtures (including liquefied, synthetic or substitute natural gas) | 239,206 | 372,874 |
| 692.1010 | 4-wheeled passenger cars, new, 4 cylinders and under | 147,059 | 295,922 |
| 692.2042 | Chassis for automobile trucks, except truck tractors, gas fueled, not over 6,000 pounds g.v.w | 1/ 106,673 | 123,467 |
| 417.1240 | Aluminum oxide (alumina) or alumina | 65,140 | 88,921 |
| 252.6500 | Standard newsprint paper | 85,236 | 85,404 |
| 446.0550 | Natural rubber, dry form | 85,013 | 77,215 |
| 694.6200 | Other parts of aircraft and spacecraft, if certified for use in civil aircraft | 1/ 39,381 | 56,382 |
| 202.0340 | Lumber, spruce, dressed or worked, including flooring, excluding siding, molding, and hardwood flooring | 92,243 | 45,567 |
| 660.6100 | Nonpiston-type aircraft engines, if certified for use in civil aircraft | 2/ | 44,973 |
| 692.1015 | 4-wheel passenger cars, new, over 4 but not over 6 cylinders | 62,146 | 41,514 |
| 250.0281 | Wood pulp, sulphate or soda bleached softwood, n.e.s., excluding screenings | 31,185 | 37,946 |
| 200.8520 | Wood shingles and shakes, red cedar | 38,653 | 35,730 |
| 800.0035 | U.S. products, n.e.s., returned from export, without being advanced in value, etc., by manufacture, etc., while abroad | 36,103 | 32,442 |
| 692.5070 | Motorcycles over 490 but not over 790 cubic centimeters | 36,888 | 29,232 |
| | All other | 1,718,942 | 1,762,930 |
| | Total | 3,156,321 | 3,832,023 |

1/ Estimated.
2/ Not available.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Note.--Because of rounding, figures may not add to the totals shown.

Table 10.--U.S. exports of the 15 leading items through the Seattle customs district, January-May 1979 and January-May 1980

(In thousands of dollars)

| Schedule B No. | Description | January-May 1979 | January-May 1980 |
|---|---|---|---|
| 694.4062 | Passenger transports over 33,000 pounds empty weight, new | 837,394 | 1,613,301 |
| 130.3465 | Yellow corn | 120,654 | 256,764 |
| 200.3514 | Western hemlock | 192,695 | 242,743 |
| 200.3510 | Douglas-fir | 130,664 | 158,456 |
| 694.4065 | Cargo transports over 33,000 pounds empty weight, new | 91,999 | 111,757 |
| 618.0300 | Unwrought aluminum, other than alloys of aluminum | 31,901 | 85,101 |
| 694.4068 | Other nonmilitary airplanes over 33,000 pounds empty weight, new | 362,094 | 79,484 |
| 694.6506 | Other parts for aircraft and spacecraft | 39,998 | 57,805 |
| 130.4040 | Other grain sorghum | 20,783 | 53,033 |
| 692.2985 | Other parts, chassis and bodies, n.s.p.f | 54,641 | 43,259 |
| 112.1940 | Other canned salmon | 20,007 | 35,383 |
| 250.0284 | Woodpulp, special Alpha and dissolving grades | 24,259 | 34,712 |
| 120.1400 | Whole cattle hides | 36,930 | 34,455 |
| 202.2220 | Hemlock, rough | 21,410 | 32,096 |
| 692.1030 | On-the-highway 4-wheeled passenger cars, including ambulances and hearses, over 6 cylinders | 41,421 | 31,606 |
| | All other | 1,538,701 | 1,826,378 |
| | Total | 3,565,552 | 4,696,333 |

Source: Compiled from official statistics of the U.S. Department of Commerce.

Note.--Because of rounding, figures may not add to the totals shown.

Table 11.--Grain tonnage exported from the Port of Portland, by months, January-July of 1976-80

(In thousands of short tons)

| Item | 1976 | 1977 | 1978 | 1979 | 1980 |
|---|---|---|---|---|---|
| January | 151.3 | 214.8 | 170.4 | 303.6 | 379.9 |
| February | 137.5 | 270.8 | 261.3 | 249.1 | 478.1 |
| March | 118.1 | 195.4 | 252.7 | 290.0 | 287.0 |
| April | 25.8 | 170.6 | 256.4 | 204.1 | 400.8 |
| May | 98.5 | 293.4 | 248.4 | 533.9 | 176.2 |
| June | 119.2 | 236.0 | 189.8 | 215.5 | 390.6 |
| July | 67.8 | 166.0 | 162.5 | 242.6 | 354.6 |
| Total | 718.2 | 1,547.0 | 1,541.5 | 2,038.8 | 2,467.2 |
| Percentage change from preceding year | - | 115 | 0 | 32 | 21 |

Source: Executive Director's Report to the Port of Portland Commission for August 1980.