

BEFORE THE BOARD OF COUNTY COMMISSIONERS
FOR MULTNOMAH COUNTY, OREGON

RESOLUTION NO. 05-073

Adopting the Multnomah County Natural Hazard Mitigation Plan

The Multnomah County Board of Commissioners Finds:

- a. The Federal Stafford Act requires the creation of a local natural hazard mitigation plan.
- b. The plan analyzes groups of natural hazards that have historically occurred in the County and makes a projection of where such hazards may occur in the future.
- c. The plan takes into consideration County activity in the areas of zoning, land use planning, and conservation.
- d. The plan determines the magnitude of damage that such future hazards may inflict.
- e. The plan determines what infrastructure is at risk of such hazards.
- f. The plan describes mitigation projects which, when carried out, will lessen the chance for damage or destruction due to a natural disaster or emergency.
- g. The plan allows the County to apply for Pre Disaster Mitigation funding.

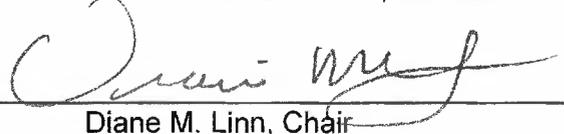
The Multnomah County Board of Commissioners Resolves:

1. To adopt the attached Multnomah County Natural Hazard Mitigation Plan.
2. To submit the Plan for approval to the State of Oregon and the Federal Emergency Management Agency.
3. To create a Hazard Mitigation Committee for the purpose of plan implementation and ongoing plan maintenance.

ADOPTED this 5th day of May, 2005.



BOARD OF COUNTY COMMISSIONERS
FOR MULTNOMAH COUNTY, OREGON


Diane M. Linn, Chair

AGNES SOWLE, COUNTY ATTORNEY
FOR MULTNOMAH COUNTY, OREGON

By 
Agnes Sowle, County Attorney

**MULTNOMAH COUNTY
NATURAL HAZARD MITIGATION PLAN
(NH-MIT PLAN)**



IN PARTNERSHIP WITH THE CITIES OF:

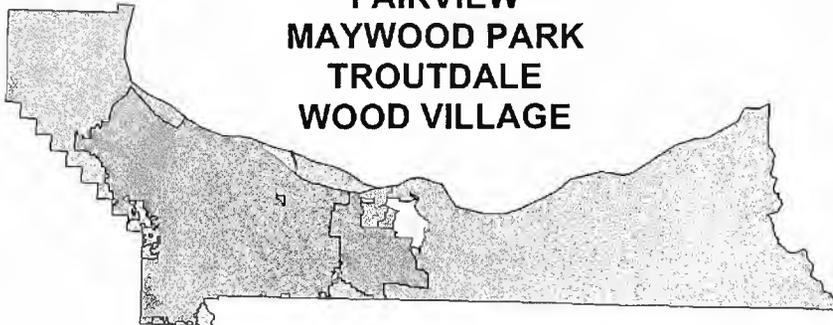
GRESHAM

FAIRVIEW

MAYWOOD PARK

TROUTDALE

WOOD VILLAGE



MULTNOMAH COUNTY NATURAL HAZARD MITIGATION PLAN (NH-MIT PLAN)

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Executive Summary

The Natural Hazard Mitigation Plan is required of jurisdictions under the Stafford Act. This act outlines what content needs to be in a Hazard Mitigation Plan, as well as it also outlines an enhanced mitigation system, in which the State of Oregon has initiated a work plan and local governments are required to submit a Natural Hazard Mitigation Plan. Multnomah County Office of Emergency Management created a plan for all jurisdictions within its borders except the City of Portland which opted to create its own. This plan contains three areas: a Jurisdiction Profile, a Hazard Analysis, and Mitigation Projects.

The Jurisdiction Profile provides descriptive elements in order to give those not from this area a sense of what our communities look like. In addition, it demonstrates our activity in zoning, land use planning, and conservation.

The Hazard Analysis examines groups of natural hazards historically and projects possible activities in the future. The result of the analysis shows what the magnitude of a hazard's yield of damage may be, as well as what infrastructure systems are at risk.

Finally, the combination of a Jurisdiction Profile and Hazard Analysis results in Mitigation Projects. These identify how to mitigate a hazard, lessening the chance for damage or destruction of an infrastructure system during a natural disaster or emergency.

The result of this plan for Multnomah County and its municipalities is:

1. Eligibility for Pre Disaster Mitigation Grants.
2. Better preparation in the response and recovery from the effects of a Natural Hazard, and
3. Ability to create lasting partnerships with the public, business & industry, and the different tiers of governmental administration.

Introduction

This plan is created in partnership with the Cities of Gresham, Fairview, and May wood Park, Troutdale, and Wood Village; the City of Portland has opted to create its own plan.

In addition Multnomah County has coordinated as many Mitigation Projects as possible with Clackamas County in order to maximize mitigation efforts.

Plan Development Process

This plan was developed with input from the business and industry partners of a local CAER/HELP Group and information gathered during the execution of Project Impact's segment, "Conducting a Hazard Assessment in your Community" In addition, this plan includes data taken from the Metro GIS Consortium as well as Tetrattech's Risk Assessment of Multnomah County. Finally, the following list of individuals also contributed to this plan:

- Gregg Larson, Boeing- Technical Information
- Donna Rae Query, LSI- Technical Information
- June Ann Cole, Fujitsu- Technical Information
- Dave Barnes, Boyd's Coffee- Technical Information
- Cindy Kolomechuk, Clackamas County- Draft & Concept Review/ Consultation
- Gene Juve, City of Gresham- Technical Information
- Scott Voetberg, City of Gresham, DES- Technical Information
- Larry & Leann Griifis, Gresham- Plan Input
- Bob Cochran, City of Fairview-Technical Information/ Plan Input
- Daryl Ault , Fairview- Technical Information
- Bob Gallagher, City of Troutdale- Technical Information/ Plan Input
- Carl Malone, City of Wood Village- Technical Information/ Plan Input
- Ron & Sandly Sleeth, Wood Village- Plan Input
- Stephen Federson, Troutdale- Plan Input
- Art Winslow, City of Maywood Park- Technical Information/ Plan Input
- Lorne & Shannon Hofeld, Corbett- Technical Information/ Plan Input
- Bruce & Kathleen Reiter, Corbett- Technical Information/ Plan Input
- Patty Rueter, City of Portland- Technical Information
- Bob Isaacson, Port of Portland- Technical Information/ Plan Input
- Jeane Fears, Sauvie Island Grange- Technical Information/ Plan Input
- Don Posvar, Sauvie Island Rural Fire Protection District, Fire Chief- Corbett- Technical Information/ Plan Input
- Bob White, Sauvie Island- Technical Information/ Plan Input
- Matt O'Connor, Multnomah County GIS- Technical Input
- Matt Krusemark, Multnomah County GIS - Technical Information/ Plan Input
- Don Newell, Multnomah County Transportation- Technical Information/ Plan Input
- Terry Howard, Multnomah County IRIS- Technical Information/ Plan Input
- Tom Simpson, Multnomah County OEM, Director- - Technical Information/ Plan Input
- Scott Salmon, Multnomah County OEM- - Technical Information/ Plan Input

- Doug McGillivray, Multnomah County OEM- - Technical Information/ Plan Input
- Karen Schilling, Manager, Multnomah County Land Use Planning – Plan Input

A series of 16 meetings were organized in Sauvie Island, Maywood Park, Gresham, and Corbett. In these meetings, the methodology of the hazard analysis and the historical significance of the associated hazards was discussed in order to garner support from the constituents of the represented areas. Furthermore, the final four meetings were conducted explicitly for the identification of hazard mitigation projects that would be associated with this plan.

Implementation through Existing Programs

Multnomah County addresses statewide planning goals and legislative requirements through its Comprehensive Land Use Plan, Capital Improvement Plans, and County Building Codes.

The Natural Hazard Mitigation Plan provides a series of recommendations - many of which are closely related to the goals and objectives of existing planning programs. Multnomah County will have the opportunity to implement recommended mitigation action items through existing programs and procedures.

Upon adoption of the mitigation plan, the county will assist local municipalities in developing their natural hazard mitigation goals and actions by providing the Multnomah County Natural Hazard Mitigation Plan as a baseline of information on the natural hazards that impact the county. These goals and action items will help local governments, as well as the Multnomah County Land Use & Planning Division address Statewide Land-use Planning Goal 7.

Goal 7 assists communities in protecting life and property from natural disasters and hazards through planning strategies that restrict development in areas of known hazards. Goal 7 requires that local governments base development plans on inventories of known areas of natural disasters and hazards and that the intensity of development be limited by the degree to which the natural hazard occurs within the areas of proposed development. Local jurisdictions and the county can use periodic review as an avenue to update the Goal 7 comprehensive plan element and to integrate mitigation into zoning and planning documents.

The County Land Use & Planning Division is responsible for administering the building codes in conjunction with their local municipalities' equivalents. After the adoption of the mitigation plan, they will work with the State Building Code Office to make sure that the county adopts, and is enforcing, the minimum standards established in the New State Building Code.

In addition, the Hazard Mitigation Committee will work with other agencies at the state level to review, develop and ensure building codes that are adequate to mitigate or prevent damage by natural hazards. This is to ensure that life-safety criteria are met for new construction. The goals and action items in the mitigation plan may be achieved through activities recommended in the county's Capital Improvement Plans (CIP). Various county departments develop CIP plans, and review them on an annual basis. Upon annual review of the CIPs, the Hazard Mitigation Committee will work with the county departments to identify areas that the hazard mitigation plan action items are consistent with CIP planning goals and integrate them where appropriate.

Within six months of formal adoption of the mitigation plan, the recommendations listed above will be incorporated into the process of existing planning mechanisms at the county level.

The meetings of the Emergency Management Forum will provide an opportunity for committee members to report back on the progress made on the integration of mitigation planning elements into county planning documents and procedures

Coordinating Body

A newly formed Hazard Mitigation Committee will be responsible for coordinating implementation of plan action items and undertaking the annual review process. It shall meet no less than quarterly. The County Chair will appoint representatives from the following areas for two year terms:

- An elected official from the cities represented in the Plan.
- business community
- insurance
- Rural Community Planning Organization
- Urban Citizen's Involvement Committee
- A city manager or public works department director
- Fire Department

The Committee will be convened and staffed by County Emergency Management. A Chair will be elected by the Committee for a one year term. In order to make this committee as broad and useful as possible, the County Emergency Management Director will engage other relevant organizations and agencies in hazard mitigation. In addition the Committee may appoint sub-committees to carry out its activities.

Annual Review Process

This Plan will be evaluated on an annual basis to determine the effectiveness of programs, and to reflect changes in land development or programs that may affect mitigation priorities.

The Committee will review the goals and action items to determine their relevance to changing situations in the county, as well as changes in State or Federal policy, and to ensure they are addressing current and expected conditions. The Committee will also review the risk assessment portion of the Plan to determine if this information should be updated or modified, given any new available data.

Any coordinating organizations responsible for the various action items will report on the status of their projects, the success of various implementation processes, difficulties encountered, success of coordination efforts, and which strategies should be revised.

The Committee will submit the Plan to the elected bodies covered by the Plan for approval by resolution.

Every five years the updated plan will be submitted to the State Hazard Mitigation Officer and the Federal Emergency Management Agency for review.

Continued Public Involvement

Multnomah County and its municipalities are dedicated to involving the public directly in review and updates of the Plan. Committee meetings will be advertised and open to the public. The meetings will provide the public a forum for which it can express its concerns, opinions, or ideas about the Plan.

Copies of the Plan will be distributed to each municipality covered by the Plan. It will include the address and the phone number for comments. In addition, copies of the plan and any proposed changes will be posted on the county website.

Geography

Multnomah County is the smallest county in Oregon, with only 465 square miles. It is bounded by Columbia County and the Columbia River on the north, Washington County on the west, Clackamas County on the south, and Hood River County on the east. Multnomah County is a mix of highly dense urban settings within the city limits of Portland in the west and open, rural land outside the urban growth boundary. It contains the Columbia Gorge National Scenic Area and Mt. Hood in the east and the largest commercial district within the State of Oregon. Most of the eastern portion of the county is covered with timber and is sparsely populated.

Multnomah County is one of four counties that make up the Portland Metropolitan area. This highly urbanized area contains portions of Multnomah, Clackamas and Washington Counties in Oregon and Clark County in Washington. Multnomah County contains Oregon's first and fourth largest cities.

Climate

The climate of the Multnomah County is relatively mild throughout the year, characterized by cool, wet winters and warm, dry summers. The climate closely resembles the Mediterranean climates that occur in California, although Oregon's winters are wetter and cooler. Growing seasons in Multnomah County are long, and moisture is abundant during most of the year (although summer irrigation is common). Like most of western Oregon, the County's winters are filled with rain and gray skies. Typical distribution of precipitation includes about 50 percent of the annual total from December through February, lesser amounts in the spring and fall, and very little during summer. Rainfall tends to vary inversely with temperatures -- the cooler months are the wettest, the warm summer months the driest.

Population/Demographics

US CENSUS DATA Quick Facts:

- Multnomah County Population, 2000 660,486
- Multnomah County Unincorporated Population, 2000 14,155
- Population, percent change, 1990 to 2000 13.1%
- Persons under 5 years old, percent, 2000 6.4%
- Persons under 18 years old, percent, 2000 22.3%
- Persons 65 years old and over, percent, 2000 11.1%
- White persons, percent, 2000 79.2%
- Black or African American persons, percent, 2000 5.7%
- American Indian and Alaska Native persons, percent, 2000 1.0%
- Asian persons, percent, 2000 5.7%
- Native Hawaiian and Other Pacific Islander, percent, 2000 0.4%
- Persons reporting some other race, percent, 2000 4.0%
- Persons reporting two or more races, percent, 2000 4.1%
- Female persons, percent, 2000 50.5%
- Persons of Hispanic or Latino origin, percent, 2000 7.5%
- White persons, not of Hispanic/Latino origin, percent, 2000 76.5%
- High school graduates, persons 25 years and over, 1990 324,329
- College graduates, persons 25 years and over, 1990 92,601
- Housing units, 2000 288,561
- Homeownership rate, 2000 56.9%
- Households, 2000 272,098
- Persons per household, 2000 2.37
- Households with persons under 18, percent, 2000 29.1%
- Median household money income, 1997 model-based estimate \$38,225
- Persons below poverty, percent, 1997 model-based estimate 12.2%
- Children below poverty, percent, 1997 model-based estimate 17.6%

History

Multnomah County was created on December 22, 1854. It was the thirteenth county created in Oregon Territory. The land was taken from the eastern portion of Washington County and the northern part of Clackamas County. The borders have remained relatively unchanged to the present. Multnomah County was created when the people living in Portland found it difficult to travel to Hillsboro to conduct business at the county seat of Washington County. They also thought that they were paying too much in taxes to support the farmers in the rural areas surrounding Portland. In 1854, Portland businessmen petitioned the Territorial Legislature for a new county and Multnomah County was created at the subsequent session. The county was named after the Multnomah Indians who were part of the Chinook Indian Tribe that lived on the eastern tip of what is now Sauvie Island in the Columbia River. The City of Portland was chartered in 1851 and made the county seat in 1854. The Multnomah County Commissioners met for the first time on January 17, 1855.

Economy & Industry

The principal industries of Multnomah County are manufacturing, transportation, wholesale and retail trade, and tourism. Tourism attractions in Multnomah County include the Oregon Museum of Science and Industry, Oregon Zoo, Oregon Historical Center, Portland Art Museum, Rose Test Gardens, and Japanese Gardens in Portland, and Multnomah Falls, and hiking and camping in the Columbia River Gorge. The Port of Portland, established in 1891, ranks third in total waterborne commerce on the West Coast. Portland is one of the five largest auto import ports in the nation and is the West Coast's leading exporter of grain and lumber. Portland International Airport is one of the fastest growing airports on the West Coast, serving as a northwest regional hub and gateway to the Pacific Rim.

Future Development.

Due to the existence of the urban growth boundary additional outward expansion of the urbanized portions of the county are limited. In addition many rural areas are under the management of the Federal Government via the Forest Service and the Columbia Gorge National Scenic Area. Most development that occurs is redevelopment of existing commercial properties (such as the Pearl District in NW Portland, open space within the cities of Wood Village and Fairview, the closed Reynolds Metals facility in Troutdale). New housing development still occurs though in-fill is common.

Jurisdiction Details

1. Population: 660,486
2. Designated a "Disaster Resistant Jurisdiction"? Yes
3. Previous Hazard Mitigation Plan published? Unknown
4. Major River/Watersheds:

Multnomah County has within its boundaries the:

- Sandy River
- Willamette River
- Johnson Creek
- Tanner Creek
- Moffet Creek
- McChord Creek
- Tryon Creek
- Columbia River

Currently there are four identified watersheds in Multnomah County:

- The Beaver Creek Watershed
- Johnson Creek Watershed
- Sandy River Watershed
- Bull Run Reservoir Watershed

5. The community has adopted the following related ordinances:

Storm Water Management:	Yes
Zoning:	Yes
Steam Maintenance:	Yes
Subdivision:	Yes
Erosion Control:	Yes
Flood Plain Management:	Yes
Elevation certificates maintained:	Yes

6. National Flood Insurance Program community? Yes
7. Does the jurisdiction have a current land use plan? Yes
8. Zoned Community? Yes

9. Established building codes? Yes.

10. Utilities provided by:

Electric: Portland General Electric and Pacificorp

Water: City Portland Water Bureau, Lusted, Powell Valley, Rockwood, and Corbett Water Districts

Sewage Treatment: Conducted through cities or special districts.

Natural Gas: Northwest Natural

Telephone: Qwest, Verizon, Comcast

Hazard Analysis

This Section serves to identify each hazard/threat confronting the jurisdiction. Hazards will be grouped into the following categories:

- Flooding
- Landslides, or Debris Flows
- Earthquake
- Volcano
- Wildfires & Urban Interface Fires
- Winter Storms
- Severe Weather

The development of Mitigation Projects centers on the prioritization of the three basic Strategies:

1. Life Safety, safeguarding and sustaining human life.
2. Property Preservation, protecting critical infrastructures, thus ensuring sustainable communities.
3. Environmental Conservation, enabling supportive environments and healthy ecosystems.

Each hazard will be analyzed as follows:

1. Hazard Definition
2. Hazard Description
3. Hazard History & Costs
4. Risk Assessment
5. Severity Score (this scoring was developed by the State of Oregon Office of Emergency Management)
6. Jurisdiction Vulnerabilities
7. Hazard Mitigation Goals & Objectives
8. Prior and On-going Mitigation Projects
9. Mitigation Projects Prioritization & Budget Estimation

FLOODING

1. General Definition.

Flooding is simply an overflowing of water onto normally dry land and is one of the most significant and costly of natural disasters. Flooding tends to occur in the Fall to early Spring because of the "Pineapple Express" and is typified by rapid snow melt in the lower elevations due to an increase in ambient air temperature, and precipitation temperature.

2. Description.

Flooding occurs when climate (or weather patterns), geology, and hydrology combine to create conditions where water flows outside of its usual course. In Multnomah County, geography and climate conditions combine to create chronic seasonal flooding conditions. Precipitation Flooding is most common from October through April, when storms from the Pacific Ocean, 60 miles away, bring intense rainfall to the area. Multnomah County receives approximately 40 inches of rain on average each year most of which occurs during these seven months. Rain totals are measured for the 'water year', from October 1st of one year to September 30th the following year. During the rainy season, monthly rainfall totals average far higher than other months of the year. The average annual precipitation for Portland is 36.30 inches. Approximately 81% of this precipitation falls during the seven months between October and April. The consistent, drenching precipitation of the rainy season saturates Multnomah County and often fills the Willamette River and its tributaries. When rivers and streams rise and exceed their channel capacity, water spills out onto the surrounding floodplain. Multnomah County typically experiences flooding after more than three days of heavy rainfall (i.e., saturated conditions). Climatic Conditions - low-level snows and prolonged ice events - have significant impacts on flooding events in Multnomah County. The 1996 flood was greatly exacerbated by a multi day freeze and snowfall that preceded the rain. The frozen ground limited absorption of the rainfall (for more information on snow and ice events see *Severe Winter Storm* below).

Two types of flooding primarily affect Multnomah County: riverine flooding and urban flooding. In addition, any low-lying area has the potential to flood. Flooding of developed areas may occur when the amount of rainfall and runoff exceeds a storm water system's (ditch or sewer) capability to remove it. Riverine flooding, the over bank flooding of rivers and streams, is the largest single form of flooding in Multnomah County. Rivers and streams in the County regularly overflow their banks and inundate low-lying areas. The natural processes of riverine flooding add sediment and nutrients to fertile floodplain areas. Flooding in large river systems typically

results from large-scale weather systems that generate prolonged rainfall over a wide geographic area, causing flooding in hundreds of smaller streams, which then drain into the major rivers. Shallow area flooding is a special type of riverine flooding. FEMA defines shallow flood hazards as areas that are inundated by the 100- year flood with flood depths of only 1 to 3 feet. These areas are generally flooded by low velocity sheet flows of water. Urban Flooding As land is converted from fields or woodlands to roads and parking lots, it loses its ability to absorb rainfall. The percentage of urbanized land is growing each year. Urbanization of the watershed changes the hydrologic systems of the basin. Heavy rainfall collects and flows faster on impervious concrete and asphalt surfaces. The water moves from the clouds, to the ground, and into streams at a much faster rate in urban areas. Adding these elements to the hydrological systems can result in floodwaters that rise very rapidly and peak with what is often violent force. During periods of urban flooding, streets can become swift moving rivers and basements can fill with water. Storm drains often back up with vegetative debris causing additional, localized flooding.

3. Hazard History & Cost

Significant historic flooding has been recorded for the Willamette and Columbia River basins in 1861, 1880, 1881, 1894, 1909, 1913, 1927, 1928, 1942, 1946, 1948, 1961, 1964/1965, and 1996. Historic flood inundation levels for the Willamette River at Portland occurred in 1894 (35.1 feet above flood stage warning, 1948 (31.6 feet), 1964 (29.8 feet), 1974 (25.7), and 1996 (30.2 feet). Major past events include floods in 1948 on the Lower Columbia River in the Portland/Vancouver area that caused about 25 deaths in December 1964 And January 1965 that forced the evacuation of thousands, destroyed scores of bridges and secondary roads, caused the Willamette River at downtown Portland to have a flood stage of 29.8 feet, caused \$157 million in damages, and caused 17 deaths; and statewide floods in 1996 that caused 5 deaths, forced thousands into shelter, destroyed hundreds of homes, caused damages in excess of \$280 million, and forced the City of Portland to erect makeshift barriers to prevent flood waters from moving into the downtown area. The Floods of 1996 also caused landslides, or debris flows, that closed I-84 and forced the evacuation of Dodson and Warrendale. Twenty-seven counties, including Multnomah, were eventually covered by a disaster declaration due to the 1996 floods.

Many residents who have suffered damage rebuild in the same vulnerable areas, only to be flooded again. These properties are termed repetitive loss properties, and are troublesome because they continue to expose lives and property to flooding and landslides.

4. Risk Assessment.

The Hazard Analysis endeavors to apply a quantitative approach to comparing the hazards that threaten the County in order to develop a relative hazard, or risk assessment.

Using a scale of 1 (one) to 10 (ten) with ten being the greatest severity, each hazard is rated in the following categories:

- History (Weight Factor=2)
This is an analysis of the records of occurrences of previous major emergencies or disasters that affected the County.
- Vulnerability (Weight Factor=5)
The percentage of the population and property likely to be effected by a hazard.
- Maximum Threat (Weight Factor=10)
The maximum percentage of population and property that could be impact under a worst-case scenario.
- Probability (Weight Factor=7)
The likelihood of occurrence within a specified period of time.

By multiplying the severity rating by the weight factors a sub score for the history, vulnerability, maximum threat, and probability for each hazard is achieved. Adding the sub score will produce a total score for that hazard.

The Risk Assessment for Flood:

	CNTY	MPARK	FVIEW	TDAL	WVILL	COG
HX	20	2	20	20	10	20
VULN.	50	5	50	50	50	50
MXTHRT	100	10	100	100	20	100
PROB.	70	7	70	70	7	70
TOTAL	240	24	240	240	87	240

HX=History/VULN= Vulnerability/ MXTHRT=Maximum Threat/ PROB=Probability

CNTY=County/MPARK=Maywood Park/FVIEW=Fairview/TDALE=Troutdale/WVILL=Wood Village/COG=Gresham

5. Severity Score.

The Severity Score factors the elements of risk: History (H), Vulnerability (V), Maximum Threat (MT) and Probability (P) to create an index which allows for the prioritization of mitigation activities based on the level of risk.

The Severity Score for Floods for Multnomah County is: 240

The Severity Score for Floods for Maywood Park is: 24

The Severity Score for Floods for Fairview is: 240

The Severity Score for Floods for Troutdale is: 240

The Severity Score for Floods for Wood Village is: 87

The Severity Score for Floods for Gresham is: 240

$H + V + MT + P = \text{Severity Score}$

6. Jurisdiction Vulnerabilities.

a. Population

634 people reside in flood areas.

b. Critical Facilities

(1) Approximately **36** percent of the community's critical facilities are vulnerable.

(2) Definition / Description:

Critical facilities include police stations, fire stations, hospitals, shelters, and other facilities that provide important services to the community. These facilities and their services need to be functional after a flood.

(3) The specific critical facilities vulnerable in Multnomah County are:

- 3 County Law Enforcement Buildings
- 3 County Correctional Facilities
- 8 Critical County Facilities

c. *Infrastructure Lifelines*

(1) Approximately **11** percent of the community's infrastructure lifelines are vulnerable.

(2) Definition / Description:

Lifelines are the connections between communities and outside services. They include water and gas lines, transportation systems, electricity, and communication networks. Floods can cause pipes to break open, power lines to fall, roads and railways to crack or move, and radio and telephone communication to cease. Disruption to transportation makes it especially difficult to bring in supplies or services. All lifelines need to be usable after a flood to allow for rescue, recovery, and rebuilding efforts and to relay important information to the public. Residents in Multnomah County commute frequently by automobiles and public transportation such as buses and light rail. Floods can greatly damage bridges and roads, hampering the movement of people and goods. T

(3) The specific infrastructure lifelines vulnerable in Multnomah County are:

- 1 Airport
- 31 Bridges
- 8 Rail Network Carriers
- 13 Arterials, Secondary, and Side Road Networks.

d. *Public Infrastructure*

(1) Approximately **26** percent of the community's public infrastructure is vulnerable.

(2) Definition / Description:

Public infrastructure is defined as facilities that support the underlying community. During times of emergency or disaster these

facilities become crucial in providing support and services, which allow the continuity of business, government, and society. Damaged infrastructure strongly affects the economy of the community – it disconnects people from work, school, food, and leisure, and separates businesses from their customers and suppliers.

(3) The specific public infrastructure vulnerable in Multnomah County are:

- 40 County Support Facilities
- 1 Water Providers and Distribution Support Facilities

e. Private Economy and Business Sector

(1) Approximately 2 percent of the community’s private economy and business sector is vulnerable.

(2) Definition / Description:

Flooding activity can cause great loss to businesses; both large-scale corporations and small retail shops. When a company is forced to stop production for just a day, the economic loss can be tremendous, especially when its market is at a national or global level. Landslide and flooding activity can create economic loss that presents a burden to small shop owners who may have difficulty recovering from their losses.

(3) The specific private economy and business sector vulnerable in Multnomah County are:

- 1 Grocery Stores
- 5 Restaurants
- 17 Private Businesses/Corporations

7. Mitigation Project Goals & Objectives.

PROJECT NAME	Annual Drainage Checks
GOAL	Maintain public and private drainage systems.
OBJECTIVES	Ensure that ditches, storm water facilities, and culverts are inspected and cleared prior to the wet season each year.
STRATEGY	Property Preservation, Environmental Conservation

PROJECT NAME	Elevated Structures
GOAL	Adopt stricter elevation requirements for development within the floodplain.
OBJECTIVES	Evaluate elevation requirements for new residential and nonresidential structures in the unincorporated floodplain area. Currently, residential structures must be elevated to one foot above the 100-year base flood elevation. Non-residential structures must be at or above the 100-year base flood elevation. Raise the base elevation requirement for new residential construction to two or three feet above base flood elevation, or greater. An increased elevation standard is one activity the County can engage in to receive credit from the NFIP Community Rating System program.
STRATEGY	Life Safety, Property Conservation

8. Prior and On-going Mitigation Projects

None at this time.

9. Mitigation Projects Prioritization & Budget Estimation

PRIORITY	PROJECT NAME	ESTIMATED COST
1	Annual Drainage Checks	\$1,000
2	Elevated Structures	\$15,000

LANDSLIDES, OR DEBRIS FLOWS

1. General Definition.

Landslides or debris flows are generally earth and debris that have become loose due to the combination of gravity and loose natural anchoring.

2. Description.

Landslides, or debris flows, often go hand-in-hand in Multnomah County, since flood conditions often precede a landslide/ debris flow event.

Landslides are a serious geologic hazard in almost every state in America. Nationally, landslides cause 25 to 50 deaths each year. The best estimates of the direct and indirect costs of landslide damage in the United States range between \$1 billion to \$2 billion annually. In Oregon, a significant number of locations are at risk to dangerous landslides. While not all landslides result in private property damage, many landslides impact transportation corridors, fuel and energy conduits, and communication facilities. They can also pose a serious threat to human life.

Landslides can be broken down into two categories: (1) rapidly moving; and (2) slow moving. Rapidly moving landslides (debris flows and earth flows) present the greatest risk to human life, and persons living in or traveling through areas prone to rapidly moving landslides are at increased risk of serious injury. Rapidly moving landslides have also caused most of the recent landslide-related injuries and deaths in Oregon. A rapidly moving debris flow in Douglas County killed five people during the storms of 1996. Slow moving landslides can cause significant property damage, but are less likely to result in serious human injuries.

3. Hazard History & Cost

In 1996, landslides caused 5 deaths, forced thousands into shelter, destroyed hundreds of homes, caused damages in excess of \$280 million. The Floods of 1996 also caused landslides, or debris flows, that closed I-84 and forced the evacuation of Dodson and Warrendale. Twenty-seven counties, including Multnomah, were eventually covered by a disaster declaration due to the 1996 floods.

Many residents who have suffered damage rebuild in the same vulnerable areas, only to be flooded again. These properties are termed repetitive

loss properties, and are troublesome because they continue to expose lives and property to flooding and landslides.

4. Risk Assessment.

The Hazard Analysis endeavors to apply a quantitative approach to comparing the hazards that threaten the County in order to develop a relative hazard, or risk assessment.

Using a scale of 1 (one) to 10 (ten) with ten being the greatest severity, each hazard is rated in the following categories:

- History (Weight Factor=2)
This is an analysis of the records of occurrences of previous major emergencies or disasters that affected the County.
- Vulnerability (Weight Factor=5)
The percentage of the population and property likely to be effected by a hazard.
- Maximum Threat (Weight Factor=10)
The maximum percentage of population and property that could be impact under a worst-case scenario.
- Probability (Weight Factor=7)
The likelihood of occurrence within a specified period of time.

By multiplying the severity rating by the weight factors a sub score for the history, vulnerability, maximum threat, and probability for each hazard is achieved. Adding the sub score will produce a total score for that hazard.

The Risk Assessment for Landslide is:

	CNTY	MPARK	FVIEW	TDAL	WVILL	COG
HX	20	2	2	2	2	20
VULN.	50	5	5	5	5	50
MXTHRT	100	10	10	10	10	100
PROB.	70	7	7	7	7	70
TOTAL	240	24	24	24	24	240

HX=History/VULN= Vulnerability/ MXTHRT=Maximum Threat/ PROB=Probability

CNTY=County/MPARK=Maywood Park/FVIEW=Fairview/TDAL=Troutdale/WVILL=Wood Village/COG=Gresham

5. Severity Score.

The Severity Score factors the elements of risk: History (H), Vulnerability (V), Maximum Threat (MT) and Probability (P) to create an index which allows for the prioritization of mitigation activities based on the level of risk.

The Severity Score for Floods for Multnomah County is: 240

The Severity Score for Floods for Maywood Park is: 24

The Severity Score for Floods for Fairview is: 24

The Severity Score for Floods for Troutdale is: 24

The Severity Score for Floods for Wood Village is: 24

The Severity Score for Floods for Gresham is: 24

$H + V + MT + P = \text{Severity Score}$

6. Jurisdiction Vulnerabilities.

a. Population

634 people reside in flood/slide areas.

b. Critical Facilities

(1) Approximately **36** percent of the community's critical facilities are vulnerable.

(2) Definition / Description:

Critical facilities include police stations, fire stations, hospitals, shelters, and other facilities that provide important services to the community. These facilities and their services need to be functional after a landslide.

(3) The specific critical facilities vulnerable in Multnomah County are:

- 3 County Law Enforcement Buildings
- 3 County Correctional Facilities
- 8 Critical County Facilities

c. *Infrastructure Lifelines*

(1) Approximately 11 percent of the community's infrastructure lifelines are vulnerable.

(2) Definition / Description:

Lifelines are the connections between communities and outside services. They include water and gas lines, transportation systems, electricity, and communication networks. Landslides can cause pipes to break open, power lines to fall, roads and railways to crack or move, and radio and telephone communication to cease. Disruption to transportation makes it especially difficult to bring in supplies or services. All lifelines need to be usable after a landslide to allow for rescue, recovery, and rebuilding efforts and to relay important information to the public. Residents in Multnomah County commute frequently by automobiles and public transportation such as buses and light rail. A landslide and/or debris flow can greatly damage bridges and roads, hampering the movement of people and goods. The Bonneville Dam, located in the Columbia River Gorge of Multnomah County, may be subjected to landslides and/or debris flows as a result of vulnerable areas nearby. Landslides around the gorge rim are numerous. There are many active slide sites, and their stability is uncertain.

(3) The specific infrastructure lifelines vulnerable in Multnomah County are:

- 1 Airport
- 31 Bridges
- 8 Rail Network Carriers
- 13 Arterials, Secondary, and Side Road Networks.

d. *Public Infrastructure*

(1) Approximately 26 percent of the community's public infrastructure is vulnerable.

(2) Definition / Description:

Public infrastructure is defined as facilities that support the underlying community. During times of emergency or disaster these facilities become crucial in providing support and services, which

allow the continuity of business, government, and society. Damaged infrastructure strongly affects the economy of the community – it disconnects people from work, school, food, and leisure, and separates businesses from their customers and suppliers.

(3) The specific public infrastructure vulnerable in Multnomah County are:

- 40 County Support Facilities
- 1 Water Providers and Distribution Support Facilities

e. Private Economy and Business Sector

(1) Approximately 2 percent of the community’s private economy and business sector is vulnerable.

(2) Definition / Description:

Landslide and flooding activity can cause great loss to businesses; both large-scale corporations and small retail shops. When a company is forced to stop production for just a day, the economic loss can be tremendous, especially when its market is at a national or global level. Landslide and flooding activity can create economic loss that presents a burden to small shop owners who may have difficulty recovering from their losses.

(3) The specific private economy and business sector vulnerable in Multnomah County are:

- 1 Grocery Stores
- 5 Restaurants
- 17 Private Businesses/Corporations

7. Mitigation Project Goals & Objectives.

PROJECT NAME	Annual Drainage Checks
GOAL	Maintain public and private drainage systems.
OBJECTIVES	Ensure that ditches, storm water facilities, and culverts are inspected and cleared prior to the wet season each year.
STRATEGY	Property Preservation, Environmental Conservation

PROJECT NAME	Anti-Slide Community Design
GOAL	Implement construction and subdivision design that can be applied to steep slopes to reduce the potential adverse impacts from development.
OBJECTIVES	Where appropriate, reduce the number of building sites and corresponding disruption of the natural contour and vegetation; Remove access from alleys on the uphill side of a street; Reduce driveway cuts into the hillside; Adjust the building setback from property lines to minimize building site cuts and fills; Regulate the amount of vegetation cleared off hillside lots; Require erosion control techniques, such as the temporary use of hay bales, diversion dams, or other physical changes to control storm runoff during road and site construction; and Reduce water input into slopes from building roof drains, storm drains, and surface runoff.
STRATEGY	Life Safety, Property Preservation, Environmental Conservation

PROJECT NAME	Community Landslide Protection
GOAL	Protect existing development in landslide-prone areas
OBJECTIVES	Provide information to residents on landslide prevention. Publications such as FEMA's Homeowner's Landslide Guide for Hillside Flooding, Debris Flows, Erosion, and Landslide Control and Hillside Drainage Flyer have some ideas about reducing landslide susceptibility; Encourage easements to restrict certain activities on landslide-prone properties. Easements foregoing the right to develop a property can be either sold or granted to the County or other organizations by property owners; Investigate land purchasing programs; Use Transfer of Development Rights to transfer development rights of a landslide hazard area by deed, easement, or other legal instrument authorized by local law to another parcel of land that is not prone to landslides; Construct debris flow diversions to protect existing properties; and Use and publicize the Oregon Department of Forestry's debris flow warning system.
STRATEGY	Life Safety, Property Preservation, Environmental Conservation

PROJECT NAME	Land slide mapping
GOAL	Improve knowledge of landslide hazard areas and understanding of vulnerability and risk to life and property in those areas.
OBJECTIVES	Continue mapping county landslide and debris flow areas. Identify the location and extent of hazard areas and establish a factual base to support implementation of future measures; and Analyze the risk of these areas to life, property, and infrastructure.
STRATEGY	Life Safety, Property Preservation, Environmental Conservation

PROJECT NAME	Land use planning
GOAL	Limit activities in identified landslide hazard areas through regulation and public outreach.
OBJECTIVES	Use the hazard identification and mapping processes to determine where to regulate. For example, develop a system; such as Salem's graduated response table, to determine where regulation should occur; Coordinate with property owners to reduce risk in landslide hazard areas; Provide information on hazard location to future residents; and Show hazard susceptibility on deeds.
STRATEGY	Life Safety, Property Preservation, Environmental Conservation

8. Prior and On-going Mitigation Projects

PROJECT NAME	Buy-out of private property in slide zones
GOAL	Purchase of private property to avoid further risk to life and property destruction.
OBJECTIVES	To buy-out private property of individuals who reside in habitual slide areas, to prevent further claims and risks to life and property. Procured property will in turn be utilized as green space.
STRATEGY	Life Safety, Property Preservation
STATUS	<u>COMPLETE</u>

9. Mitigation Projects Prioritization & Budget Estimation

PRIORITY	PROJECT NAME	ESTIMATED COST
1	Annual Drainage Checks	\$3,000
2	Land slide mapping	\$400
3	Land use planning	\$12,000
4	Community Landslide Protection	\$15,000
6	Anti-Slide Community Design	\$25,000

EARTHQUAKE

1. General Definition

An earthquake is a naturally induced shaking of the ground, caused by the fracture and sliding of rock within the Earth's crust. The magnitude is determined by the dimensions of the rupturing fracture (fault) and the amount of displacement that takes place. The larger the fault surface and displacement, the greater the energy. In addition to deforming the rock near the fault, this energy produces the shaking and a variety of seismic waves that radiate throughout the Earth.

2. Description

Northwest Oregon, including Multnomah County, is subject to what geologists term, 'the Triple Threat' of earthquakes. The three types of earthquakes which may be experienced by Oregon are: Lower Plate(deep) earthquakes. These quakes range from 6.0-7.5 on the Richter scale. These quakes originate at depths of 28-37 miles. Such earthquakes characteristically lack aftershocks. Crustal (shallow) earthquakes are generally between the 5.7 to 6.3 ranges on the Richter scale and originate at depths of 0-19 miles. These earthquakes usually have associated aftershocks. Subduction zone (along plates) are termed 'giant' or 'great' quakes, which range from 8.0 to 9.5 on the Richter scale. In the Northwest, subduction quakes could occur in the Cascadia subduction zone along the Juan de Fuca Plate. They occur as strains built up from centuries of plate convergence are suddenly released. Ground motions resulting from a subduction zone earthquake would cause relatively strong shaking over very large areas of the Pacific Northwest, including the Puget Sound and Willamette Valley regions. Recent evaluation of the earthquake threat in Oregon indicates the area may experience a 'great' subduction zone earthquake. Damage from this type of quake would be major to catastrophic. Soils mapping of the area from Hillsboro to Gresham, identifies a potential for major damage. This area has mostly silt -type soil that is subject to liquefaction (a process that takes place during an earthquake which causes sands and silts to lose strength and behave as viscous fluids rather than solids.)

3. Hazard History & Costs

The Metro 1999 study cites research indicating that "major geologic structures capable of magnitude (*M*) 7 earthquakes" underlie the Portland study area. Since 1820, 7000 earthquake have been documented in Oregon. Fifty-six significant earthquakes occurred in or near the Portland study area between 1872 and 1999. Severe earthquakes occurred in 1877, 1880, 1953, 1962, and 1993. Strong Pacific Northwest

earthquakes also include an *M* 7.4 North Cascades event, and *M* 6.8 earthquake in 1873, a 1949 *M* 7.1 event near Olympia, Washington, a 1965 *M* 6.5 event in Seattle-Tacoma, and a 2001 Nisqually quake that caused over \$2 Billion in property damage. Regional earth quakes, such as the deep, intra-plate Nisqually Earthquake of 2001 are felt widely in northwest Oregon

4. Risk Assessment

The Hazard Analysis endeavors to apply a quantitative approach to comparing the hazards that threaten the County in order to develop a relative hazard, or risk assessment.

The following categories are used in conducting this hazard analysis.

- *History (Weight Factor=2)*
This is an analysis of the records of occurrences of previous major emergencies or disasters that affected the County.
- *Vulnerability (Weight Factor=5)*
The percentage of the population and property likely to be effected by a hazard.
- *Maximum Threat (Weight Factor=10)*
The maximum percentage of population and property that could be impact under a worst-case scenario.
- *Probability (Weight Factor=7)*
The likelihood of occurrence within a specified period of time.

By adding the severity rating by the weight factors associated with the categories above, a sub score for the history, vulnerability, maximum threat, and probability for each hazard can be achieved. Adding the sub score will produce a total score for that hazard.

The Risk Assessment for Earthquake is:

- a. *History: 20*
- b. *Vulnerability: 50*
- c. *Maximum Threat: 100*
- d. *Probability: 70*

THIS IS A COUNTY WIDE EVENT

5. Severity Score.

The Severity Score factors the elements of risk: History (H), Vulnerability (V), Maximum Threat (MT) and Probability (P) to create an index which allows for the prioritization of mitigation activities based on the level of risk.

The Severity Score for Earthquake for Multnomah County is: 240

$H + V + MT + P = \text{Severity Score}$

20 + 50 + 100 + 70 = 240

6. Jurisdiction Vulnerabilities.

a. Population

Approximately **100** percent of the community's population is vulnerable.

b. Critical Facilities

(1) Approximately **100** percent of the community's critical facilities is vulnerable.

(2) Definition / Description:

Critical facilities include police stations, fire stations, hospitals, shelters, and other facilities that provide important services to the community. These facilities and their services need to be functional after an earthquake event. Many critical facilities are housed in older buildings that are not up to current seismic codes. In Multnomah County, critical facilities are identified as the following; City Halls, Fire Stations, Police/Law Enforcement locations, Hospitals, Correctional facilities, Airports, and County Facilities.

(3) The specific critical facilities vulnerable in Multnomah County are:

- 4 County Law Enforcement Buildings
- 5 Municipal Administration Bldgs. (City Halls)
- 7 County Correctional Facilities
- 19 Critical County Facilities
- 3 Municipal Police Departments

c. *Infrastructure Lifelines*

(1) Approximately **100** percent of the community's infrastructure lifelines are vulnerable.

(2) Definition / Description:

Lifelines are the connections between communities and outside services. They include ground transportation systems, rail networks, and airports. Ground shaking and amplification can cause pipes to break open, power lines to fall, roads and railways to crack or move, and radio and telephone communication to cease. Disruption to transportation makes it especially difficult to bring in supplies or services. All lifelines need to be usable after an earthquake to allow for rescue, recovery, and rebuilding efforts and to relay important information to the public. Residents in Multnomah County commute frequently by automobiles and public transportation such as buses and light rail. An earthquake can greatly damage bridges and roads, hampering the movement of people and goods. Damaged infrastructure strongly affects the economy of the community – it disconnects people from work, school, food, and leisure, and separates businesses from their customers and suppliers. The Bonneville Dam located in the Columbia River Gorge of Multnomah County, may be subjected to strong ground shaking as a result of moderate to very large earthquakes nearby. Landslides around the gorge rim are numerous. There are many active slide sites, and their stability during an earthquake is uncertain.

(3) The specific infrastructure lifelines vulnerable in Multnomah County are:

- 1 Airport
- 31 Bridges
- 8 Rail Network Carriers
- 430 Arterials, Secondary, and Side Road Networks.

d. *Public Infrastructure*

(1) Approximately **100** percent of the community's public infrastructure is vulnerable.

(2) Definition / Description:

Public infrastructure is defined as facilities that support the underlying community. During times of emergency or disaster these facilities become crucial in providing support and services, which allow the continuity of business, government, and society.

(3) The specific public infrastructure vulnerable in Multnomah County are:

- 112 County Support Facilities
- 24 Child Care Centers
- 15 Assisted Living Centers
- 8 Water Providers and Distribution Support Facilities

e. *Private Economy and Business Sector*

(1) Approximately **100** percent of the community's private economy and business sector is vulnerable.

(2) Definition / Description:

Seismic activity can cause great loss to businesses; both large-scale corporations and small retail shops. When a company is forced to stop production for just a day, the economic loss can be tremendous, especially when its market is at a national or global level. Seismic activity can create economic loss that presents a burden to small shop owners who may have difficulty recovering from their losses.

(3) The specific private economy and business sector vulnerable in

Multnomah County are:

- 9 Bakeries
- 4 Food Caterers
- 46 Contract Food Service Providers

- 34 Grocery Stores
- 20 Hardware Stores
- 146 Restaurants
- 806 Private Businesses/Corporations

7. Mitigation Project Goals & Objectives.

PROJECT NAME	Contractor Partnerships
GOAL	Develop public/private partnerships with building contractors and architects to pursue specific retrofitting projects.
OBJECTIVE	Develop incentives (tax incentives or public recognition) for private contractors and architects to work on retrofitting public buildings and other infrastructure. This may help to minimize the funding shortage issue that has caused a number of high risk sites to remain without retrofitting.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	County Damage Assessment Program
GOAL	Improve local capabilities to perform earthquake building safety evaluations and to record and manage building inventory data.
OBJECTIVE	Offer periodic training in ATC-20 and ATC-21 procedures for earthquake building safety evaluations and encourage local building officials and other public and private officials (facilities, maintenance, engineering, architecture) to attend; Encourage development of a countywide building inventory database; and Foster coordination between county and city building officials.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Earthquake Insurance Program
GOAL	Encourage purchase of earthquake hazard insurance.
OBJECTIVE	Provide earthquake insurance information to customers.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Earthquake Mapping of Multnomah County
GOAL	Expand earthquake hazard mapping for Multnomah County and improve technical analysis of earthquake hazards.
OBJECTIVE	Complete mapping of the earthquake hazard throughout Multnomah County; Update Multnomah County earthquake HAZUS data to improve accuracy of the vulnerability assessment for Multnomah County; Encourage local government officials to use Metro's earthquake hazards reports and reference the earthquake maps when making

	land use decisions; and Conduct risk analysis incorporating HAZUS data and the created hazard maps using GIS technology to identify risk sites and further assist in prioritizing mitigation activities and regulating land use.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Infrastructure Seismic Survey /Assessment
GOAL	Ensure schools and universities, government infrastructure, and critical facilities meet current seismic standards.
OBJECTIVE	Develop an inventory of schools, universities, and critical facilities that do not meet current seismic standards. In addition, conduct an in-depth analysis of Bonneville Dam vulnerability to seismic shakes, as well as an assessment of the possible liquefiable nature of alluvium remaining in the dam foundation and the stability of nearby landslides
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Nonstructural Hazard Mitigation
GOAL	Reduce nonstructural hazards in homes, schools, businesses, and government offices.
OBJECTIVE	Provide training to government building and school facility managers and teachers on securing bookcases, filing cabinets, light fixtures, and other objects that can cause injuries and block exits; Encourage facility managers, business owners, and teachers to refer to FEMA's practical guidebook: Reducing the Risks of Nonstructural Earthquake Damage; Conduct periodic safety inspections of nonstructural seismic hazards; Encourage homeowners to use Is Your Home Protected from Earthquake Disaster? A Homeowner's Guide to Earthquake Retrofit (IBHS) for economic and efficient mitigation techniques; and Organize retrofitting classes for homeowners, building professionals, and contractors. Refer to Project Impact Seattle for more ideas.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Structural Mitigation
GOAL	Pursue regulatory mandates for structural mitigation of critical facilities for the earthquake threat.
OBJECTIVE	Mandate that government buildings, critical facilities, bridges, and roads be retrofitted to stricter seismic standards. Also, encourage the state legislature to mandate retrofitting activities
STRATEGY	Life Safety, Property Preservation

8. Prior and On-Going Mitigation Projects

None to date.

(1) Mitigation Projects Prioritization & Budget Estimation

PRIORITY	PROJECT NAME	ESTIMATED COST
1	Infrastructure Seismic Survey /Assessment	\$15,000
2	Structural Mitigation	\$15,000
3	County Damage Assessment Program	\$10,000
4	Nonstructural Hazard Mitigation	\$10,000
5	Earthquake Mapping of Multnomah County	\$15,000
6	Earthquake Insurance Program	\$5,000
7	Contractor Partnerships	\$27,000

VOLCANO

1. General Definition

Volcano eruptions result in flows of lava, debris, emissions of toxic gases and extensive deposits of airborne particles and ash.

2. Description

Multnomah County and the Pacific Northwest lie on the “Ring of Fire,” an area of very active volcanic activity surrounding the Pacific Basin. Volcanic eruptions occur regularly along the Ring of Fire, in part, because of the movement of the Earth’s tectonic plates. The Earth’s outermost shell, the lithosphere, is broken into a series of slabs known as tectonic plates. These plates are rigid, but they float on a hotter, softer layer in the Earth’s mantle. As the plates move about on the layer beneath them, they spread apart, collide, or slide past each other. Volcanoes occur most frequently at the boundaries of these plates and volcanic eruptions occur when the hotter, molten materials, or magma, rise to the surface. The primary threat to lives and property from active volcanoes is from violent eruptions that unleash tremendous blast forces, generate mud and debris flows, and produces flying debris and ash clouds. The immediate danger area in a volcanic eruption generally lies within a 20- mile radius of the blast site. However, impacts can extend 100 miles or more from the eruption site. Although there are no active volcanoes in Multnomah County, there are a number of active volcanoes within the 100-mile danger area that do pose a threat to county residents and property. The threat they pose is associated primarily with ash fall. Population growth in Multnomah County and the Pacific Northwest near the region’s many volcanoes has led scientists to identify the volcanoes of the Cascades Range as having the greatest potential.

3. Hazard History & Costs

There are five major volcanoes in the Cascade region that are in relative proximity and pose a potential threat to Multnomah County. They include Mount St. Helens, Mount Hood, Mount Rainier, Mount Adams, and Mount Jefferson. Of the five, all are known or suspected to be active and most have geological records that indicate past histories of explosive eruptions with large ash releases. Only Mount Hood has no geological evidence of large explosive events, though it still poses a threat of ash releases to Multnomah County. Mount Hood and Mount St. Helens pose the greatest threat to Multnomah County in terms of potential impact, and are described in more detail below.

Mount Hood is located about 50 miles southeast of Portland. It has been recurrently active over the past 50,000 years. It has had two significant eruptive periods in recent times; one about 1,500 years ago and another about 200 years ago. While Mount Hood has shown no recent signs of volcanic activity, scientists predict the next eruption will consist of small explosions generating pyroclastic flows, ash clouds, and lahars (mud and debris flows).

Mount St. Helens, located in southwestern Washington about fifty miles northeast of Portland, is fifty thousand years old. Over the past 521 years, it has produced four major explosive eruptions and dozens of smaller eruptions.

The May 18, 1980 eruption was followed by five smaller explosive eruptions over a period of five months. A series of 16 dome-building eruptions through October 1986 constructed the new, 880 foot high, lava dome in the crater formed by the May 18, 1980 eruption. An historic eruption occurring in 1480 A.D. was about five times larger than the May 18, 1980 eruption.

The May 18, 1980 eruption of Mount St. Helens was preceded by about two months of precursor activity, including dome building, minor earthquakes, and venting of gasses. The lateral blast, debris avalanche, and mudflows associated with the eruption caused extensive loss of life and widespread destruction of property. The eruption triggered a Richter magnitude 5.1 earthquake about one mile beneath the volcano. In the six-year period after the initial eruption, hundreds of small ash emissions at Mount St. Helens occurred. The eruption of Mount St. Helens took the lives of 57 people and nearly 7,000 big game animals. All birds and most small mammals in the area were killed, as were twelve million Chinook and Coho salmon fingerlings that perished when their hatcheries were destroyed. Damage to the built environment within the immediate hazard vicinity included twenty-seven bridges, about two hundred homes, more than 185 miles of highways and roads, and fifteen miles of railways. Ash from the eruption column and cloud spread across the United States in three days and circled around the Earth in fifteen days. Detectable amounts of ash were noted in an area covering 22,000 square miles. Debris flows quickly filled the Toutle and Cowlitz Rivers and ultimately flowed into the Columbia River at Longview, Washington. The debris blocked the main shipping channel in the Columbia, stranded ships in port, and closed the ports of Portland, Vancouver, and Kalama for over a month. Several water and sewage treatment facilities were also damaged or destroyed. The estimated damage attributed to the eruption was \$1.1 billion. A few millimeters of ash fell onto Multnomah County during small events on May 25, June 12, and October 16-18, 1980. The May 25 event left ash covering buildings, vehicles, lawns, streets, and agricultural fields.

For days, even weeks afterward, residents and government officials worked to clear away the fine powder. Local hospitals treated a large number of patients suffering from respiratory problems attributed to the ash. They handed out surgical masks to help filter the ash, but the masks were largely ineffective. Residents and government officials worked aggressively to remove the ash deposits by flushing them into storm drains or sweeping them up and hauling them to landfill sites. Parks and outdoor swimming pools were particularly hard hit. Pools had to be drained and the filters cleaned. Ash also worked its way into equipment causing premature failures or requiring unscheduled maintenance.

4. Risk Assessment

The Hazard Analysis endeavors to apply a quantitative approach to comparing the hazards that threaten the County in order to develop a relative hazard, or risk assessment.

The following categories are used in conducting this hazard analysis.

- History (Weight Factor=2)
This is an analysis of the records of occurrences of previous major emergencies or disasters that affected the County.
- Vulnerability (Weight Factor=5)
The percentage of the population and property likely to be effected by a hazard.
- Maximum Threat (Weight Factor=10)
The maximum percentage of population and property that could be impact under a worst-case scenario.
- Probability (Weight Factor=7)
The likelihood of occurrence within a specified period of time.

By adding the severity rating by the weight factors associated with the categories above, a sub score for the history, vulnerability, maximum threat, and probability for each hazard can be achieved. Adding the sub score will produce a total score for that hazard.

The Risk Assessment for Volcano is:

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- a. *History*: **20**
- b. *Vulnerability*: **50**
- c. *Maximum Threat*: **100**

d. *Probability* **70**

5. Severity Score

The Severity Score factors the elements of risk: History (H), Vulnerability (V), Maximum Threat (MT) and Probability (P) to create an index which allows for the prioritization of mitigation activities based on the level of risk.

The Severity Score for Volcano for Multnomah County is: 240

H + V + MT + P = Severity Score

20 + 50 + 100 + 70 = 240

6. Jurisdiction Vulnerabilities

a. Population

Approximately **100** percent of the community's population is vulnerable.

b. Critical Facilities

(1) Approximately **100** percent of the community's critical facilities are vulnerable.

(2) Definition / Description

Critical facilities include police stations, fire stations, hospitals, shelters, and other facilities that provide important services to the community. These facilities and their services need to be functional after a volcanic event. Many critical facilities are housed in older buildings that are not up to current seismic codes, and they may fail in volcanic related seismic activity.

(3) The specific critical facilities vulnerable in Multnomah County are:

- 4 County Law Enforcement Buildings
- 5 Municipal Administration Buildings (City Halls)
- 7 County Correctional Facilities
- 19 Critical County Facilities
- 3 Municipal Police Departments

c. *Infrastructure Lifelines*

(1) Approximately **100** percent of the community's infrastructure lifelines are vulnerable.

(2) Definition / Description

Lifelines are the connections between communities and outside services. They include ground transportation systems, rail networks, and airports. Ground shaking and amplification, tied to volcanic activity can cause pipes to break open, power lines to fall, roads and railways to crack or move, and radio and telephone communication to cease.

Disruption to transportation makes it especially difficult to bring in supplies or services. All lifelines need to be usable after a volcanic event to allow for rescue, recovery, and rebuilding efforts and to relay important information to the public. In Multnomah County, the following lifelines have been identified as: Highways and Interstates, Bridges, Airports, and Rail Roads..

(3) The specific infrastructure lifelines vulnerable in Multnomah County are:

- 1 Airport
- 31 Bridges
- 8 Rail Network Carriers
- 430 Arterials, Secondary, and Side Road Networks.

d. *Public Infrastructure*

(1) Approximately **100** percent of the community's public infrastructure is vulnerable.

(2) Definition / Description

Public infrastructure is defined as facilities that support the underlying community. During times of emergency or disaster these facilities become crucial in providing support and services, which allow the continuity of business, government, and society.

(3) The specific public infrastructure vulnerable in Multnomah County is:

- 112 County Support Facilities
- 24 Child Care Centers
- 15 Assisted Living Centers
- 8 Water Providers and Distribution Support Facilities

e. *Private Economy and Business Sector*

(1) Approximately **100** percent of the community's private economy and business sector is vulnerable.

(2) Definition / Description

Volcanic eruptions can disrupt the normal flow of commerce and daily human activity without causing severe physical harm or damage. Ash that is a few inches thick can halt traffic, and cause rapid wear of machinery, clog air filters, block drains, creeks, water intakes, and impact agriculture. Removal and disposal of large volumes of deposited ash can also have significant impacts on government and business. The interconnectedness of the region's economy can be disturbed after a volcanic eruption. The Mount St. Helens' May 1980 eruption demonstrated the negative affect on the tourism industry. Conventions, meetings, and social gatherings were canceled or postponed in cities and resorts throughout Washington and Oregon in areas not initially affected by the eruption.

(3) The specific private economy and business sector vulnerable in Multnomah County are:

- 9 Bakeries
- 4 Food Caterers
- 46 Contract Food Service Providers
- 34 Grocery Stores
- 20 Hardware Stores
- 146 Restaurants
- 806 Private Businesses/Corporations

d. Mitigation Projects Goals & Objectives

PROJECT NAME	Ash Effect on Infrastructure
GOAL	Identify critical facilities and industries that may be affected by ash falls and collaborate with them on ash fall emergency response
OBJECTIVE	Collaborate and exchange experiences and knowledge among facility managers of critical industries in the county to reduce the impact of ash fall on their sites.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Volcanic Ash Modeling
GOAL	Map and model ash fall.
OBJECTIVE	Map and model ash fall to assist in interpreting potential scenarios that could impact Multnomah County.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Volcano Alert & Warning Information
GOAL	Collaborate with USGS-CVO and related agencies to create ash fall warning messages that are more appropriate for Multnomah County.
OBJECTIVE	Collaborate with USGS-CVO, FAA, National Weather Service, law enforcement offices, and the media to develop a warning message framework that is more appropriate for the county so that communities and individuals have a clear sense of how to respond.
GOAL ACHIEVED	Life Safety, Property Preservation

PROJECT NAME	Volcano Awareness
GOAL	Increase understanding of volcanic eruptions and their potential impact to Multnomah County through a visual guide.
OBJECTIVE	Play the USGS volcanic eruption videotape at schools, community centers, critical facilities, and major businesses.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Volcano Response/Recovery Programs
GOAL	Strengthen response and recovery programs and develop and implement public education programs for volcanic eruption hazards.
OBJECTIVE	Determine critical activities that must be implemented for varying degrees of ash fall. Develop basic public education materials that describe volcanic eruption hazards, potential impacts, and appropriate response and mitigation activities. Create volcanic eruption hazard scenarios for Multnomah

	County to determine potential problems the county may face with varying amounts of ash fall.
STRATEGY	Life Safety, Property Preservation

(1) Prior and On-Going Mitigation Projects

None to date.

d. Mitigation Projects Prioritization & Budget Estimation

PRIORITY	PROJECT NAME	ESTIMATED COST
1	Volcano Alert & Warning Information	\$15,000
2	Volcano Response/Recovery Programs	\$15,000
3	Ash Effect on Infrastructure	\$10,000
4	Volcano Awareness	\$15,000
5	Volcanic Ash Modeling	\$5,000

WILDFIRES & URBAN INTER-FACE FIRES

1. General Definition

Wildfire is a rapid, persistent chemical reaction that releases heat and light, especially the exothermic combination of a combustible substance with oxygen. Wildfires present a significant potential for disaster in the southwest, a region of relatively high temperatures, low humidity, low precipitation and during the spring, moderately strong daytime winds. Combine these severe burning conditions with people or lightning and the stage is set for the occurrence of large, destructive wildfires.

2. Description

Fires are a natural part of the ecosystem in Oregon but present a substantial hazard when threatening life and property in growing communities. Although wildfires are more common to the arid areas of Eastern Oregon, there is still potential for losses due to wildland-urban interface fires in Multnomah County. Wildfire is defined as any fire occurring on wildlands that requires suppression response. The wildfire hazard is often characterized by an increased fire risk in the urban interface zone. The interface is the urban-rural fringe where homes and other structures are built into a densely forested or natural landscape. If left unchecked, it is likely that fires in these areas will threaten lives and property.

3. Hazard History

To date there have been no major losses due to wild land/ urban interface fires in Multnomah County since records have been kept. Thus, while the area has been spared the impacts of fires, it is prudent to expect that such a fire represents a threat and could occur in Multnomah County. While no specific events have impacted Portland a number of significant wildfires/ urban interface fires occurred during 2002 & 2003 in the national forests (Deschutes and Ochoco) west and south of Multnomah County. These necessitated road closures on Highway 20. The recent sever wild land /urban interface fires illustrate this point. In 1991, the Multnomah Falls fire did serve as a wake-up call to the hazard and reality of an urban interface fire to residents of Corbett & Bridal Veil.

c. *Infrastructure Lifelines*

(1) Approximately 12 percent of the community's infrastructure lifelines are vulnerable.

(2) Definition / Description:

Lifelines are the connections between communities and outside services. They include ground transportation systems, air, and rail networks. Urban-interface fires and forest fires can cause power lines to fall, roads and railways to be closed, and radio and telephone communication to cease. Disruption to transportation makes it especially difficult to bring in supplies or services. All lifelines need to be usable after and/or during a urban-interface fire and forest fires, to allow for rescue, recovery, and rebuilding efforts and to relay important information to the public.

(3) The specific infrastructure lifelines vulnerable in Multnomah County are:

- 9 Bridges
- 47 Arterials, Secondary, and Side Road Networks.

d. *Public Infrastructure*

(1) Approximately 0 percent of the community's public infrastructure is vulnerable.

(2) Definition / Description:

Public infrastructure is defined as facilities that support the underlying community. During times of emergency or disaster these facilities become crucial in providing support and services, which allow the continuity of business, government, and society. Damaged infrastructure strongly affects the economy of the community – it disconnects people from work, school, food, and leisure, and separates businesses from their customers and suppliers.

(3) The specific public infrastructure vulnerable in Multnomah

4. Risk Assessment

The Hazard Analysis endeavors to apply a quantitative approach to comparing the hazards that threaten the County in order to develop a relative hazard, or risk assessment.

The following categories are used in conducting this hazard analysis.

- History (Weight Factor=2)
This is an analysis of the records of occurrences of previous major emergencies or disasters that affected the County.
- Vulnerability (Weight Factor=5)
The percentage of the population and property likely to be effected by a hazard.
- Maximum Threat (Weight Factor=10)
The maximum percentage of population and property that could be impact under a worst-case scenario.
- Probability (Weight Factor=7)
The likelihood of occurrence within a specified period of time.

By adding the severity rating by the weight factors associated with the categories above, a sub score for the history, vulnerability, maximum threat, and probability for each hazard can be achieved. Adding the sub score will produce a total score for that hazard

The Risk Assessment for Wildfire/Urban Interface is:

	CNTY	MPARK	FVIEW	TDALE	WVILL	COG
HX	20	2	2	20	2	2
VULN.	50	5	5	50	5	5
MXTHRT	100	10	10	100	10	10
PROB.	70	7	7	70	7	7
TOTAL	240	24	24	240	24	24

HX=History/VULN= Vulnerability/ MXTHRT=Maximum Threat/ PROB=Probability

CNTY=County/MPARK=Maywood Park/FVIEW=Fairview/TDALE=Troutdale/WVILL=Wood Village/COG=Gresham

5. Severity Score

The Severity Score factors the elements of risk: History (H), Vulnerability (V), Maximum Threat (MT) and Probability (P) to create an index which allows for the prioritization of mitigation activities based on the level of risk.

The Severity Score for Floods for Multnomah County is: 240

The Severity Score for Floods for Maywood Park is: 24

The Severity Score for Floods for Fairview is: 24

The Severity Score for Floods for Troutdale is: 240

The Severity Score for Floods for Wood Village is: 24

The Severity Score for Floods for Gresham is: 240

$H + V + MT + P = \text{Severity Score}$

6. Community Vulnerabilities

a. Population

3100 residents could be affected by a Wildfire/Urban Interface fire.

b. Critical Facilities

(1) Approximately **10** percent of the community's critical facilities is vulnerable.

(2) Definition / Description:

Critical facilities include police stations, fire stations, hospitals, shelters, and other facilities that provide important services to the community. These facilities and their services need to be functional during/after an urban-interface fire and/or forest fire event.

(3) The specific critical facilities vulnerable in Multnomah County are:

- 4 Fire Stations

County are:

e. *Private Economy and Business Sector*

(1) Approximately ***less than one*** percent of the community's private economy and business sector is vulnerable.

(2) Definition / Description:

Urban-interface fire and forest fire activity can cause great loss to businesses; both large-scale corporations and small retail shops. When a company is forced to stop production for just a day, the economic loss can be tremendous, especially when its market is at a national or global level. Urban-interface fire activity can create economic loss that presents a burden to small shop owners who may have difficulty recovering from their losses.

(3) The specific private economy and business sector vulnerable in Multnomah County are:

- 3 Grocery Stores
- 6 Restaurants

7. Mitigation Project Goals & Objectives

PROJECT NAME	Firefighting Water Resources
GOAL	Inventory alternative firefighting water sources and encourage the development of additional sources.
OBJECTIVE	Advocate for water storage facilities with fire-resistant electrical pump systems in developments outside of fire protection districts that are not connected to community water or hydrant system. Maintain access roads and ramps to manmade natural water sources.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Interface Development Requirements
GOAL	Encourage creation and adoption of wildland interface maps to direct development requirements that assist wildfire.
OBJECTIVE	Identify and establish a data-collection mechanism in coordination with county, state, and local governments, fire agencies, the insurance industry, and the National Fire Protection Association. Using collected data and research,

	assess the nature and scope of the wildland/urban interface fire problem in the county.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Urban-Interface Fire Education
GOAL	Develop and implement, or enhance existing outreach and education programs aimed at mitigating wildfire hazards and reducing or preventing the exposure of citizens, public agencies, private property owners, and businesses to natural hazards.
OBJECTIVE	Outreach Visit urban interface neighborhoods and rural areas and conduct education and outreach activities; Conduct specific community-based demonstration projects of fire prevention and mitigation in the urban interface. Establish neighborhood “drive-through” activities that pinpoint site specific mitigation activities. Fire crews can give property owner’s personal suggestions and assistance; and Perform public outreach and information activities at Washington County fire stations by creating “Wildfire Awareness Week” activities. Fire stations can hold open houses and allow the public to visit, see the equipment, and discuss wildfire mitigation with the station crews. Education Encourage communities in the wildland/urban interface to develop public awareness programs and land use development policies that ensure specific recommendations for wildfire mitigation policies, programs, and community-based activities will be implemented; and Develop a “preventative approach” campaign by educating the public on hazardous human activities that must be regulated and controlled because of the danger of starting fires, including residential pile burning and industrial slash burning, campfires, smoking, and the use of fireplaces without spark arrestors.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Urban-Interface Fire Prevention Committee
GOAL	Increase communication, coordination, and collaboration between wildland/urban interface property owners, local and county planners, and fire prevention crews and officials to address inherent risks in wildland/urban interface areas, available prevention/protection measures, and federal mitigation assistance programs.
OBJECTIVE	Encourage local zoning and planning entities to work closely with landowners and/or developers who choose to build in the wildland/urban interface to identify and mitigate conditions that aggravate wildland/urban interface wildfire

	hazards, including: - Limited access for emergency equipment due to width and grade of roadways; - Inadequate water supplies and the spacing, consistency, and species of vegetation around structures; - Inadequate fuel breaks, or lack of defensible space; - Highly flammable construction materials; - Building lots and subdivisions that are not in compliance with state and local land use and fire protection regulations; and – Inadequate entry/escape routes. Require all new homes and major remodels involving roofs or additions that are located in the interface to have fire resistant roofs. Provide education and training to the public to assess if their homes meet fire safety performance standards. Encourage the public to evaluate access routes to rural homes for firefighting vehicles and to develop passable routes if they do not exist.
STRATEGY	Life Safety, Property Preservation

8. Prior & On-Going Mitigation Projects

None at this time.

d. Mitigation Projects Prioritization & Budget Estimation

PRIORITY	PROJECT NAME	ESTIMATED COST
1	Interface Development Requirements	\$15,000
2	Firefighting Water Resources	\$15,000
3	Urban-Interface Fire Education	\$10,000
4	Urban-Interface Fire Prevention Committee	\$15,000

WINTER STORMS

1. General Definition

Winter storm is defined as a cold wind accompanied by blowing snow; freezing rain or sleet, cold temperatures, and possibly low visibility and drifting snow. The storms often make roads impassable. Residents, travelers and livestock may become isolated or stranded without adequate food, water and fuel supplies short. The conditions may overwhelm the capabilities of a local jurisdiction. Winter storms are considered deceptive killers as they indirectly cause transportation accidents, and injury and death resulting from exhaustion/overexertion, hypothermia and frostbite from wind chill, and asphyxiation; house fires occur more frequently in the winter due to lack of proper safety precautions.

(1) Description

Multnomah County is subject to a number of severe local storms such as freezing rain, high winds, snow and hail. An ice storm (freezing rain) can occur when rains fall out of warm moist upper layers of atmosphere into a cold, dry layer near the ground. The rain freezes on contact with the cold ground and accumulates on exposed surfaces. This occurs every few years and usually lasts a day to several days. The cold combined with freezing rain can cause a destructive ice build-up. In addition, high winds have contributed to wide spread disruption and destruction within Multnomah County.

d. Hazard History.

Destructive storms, producing heavy snow and paralyzing ice, have occurred throughout Multnomah County's history, most notably in 1937 and 1950. A serious storm in February 1937 resulted in the death of five people in the Portland area. Record snowfalls in Portland created snowdrifts up to 25 feet in height, and a low temperature of 17 degrees Fahrenheit. Schools and businesses were closed and flood damage was reported in downtown Portland basements as the snow melted. All major highways were closed, shutting off the main transportation arteries for travel and business.

The "Friday the 13th" storm produced "devastating wind and snow" over a five day period in January 1950. During the night of January 12, the temperature fluctuated "wildly, accompanied by thunder" and heavy snow. The temperature dropped about 20 degrees, then rose 20 degrees, and then dropped another 20 degrees within a 5-hour time span. Snow melted and then refroze as it hit the ground, creating dangerously icy roads.

Power lines were knocked down, communications were severed, and roads and schools were closed.

Records kept since 1892 document a number of significant snow events in Multnomah County.

January 1950

There were three severe storms in January 1950, with very little time separating them. Their net effect was a nearly continuous storm. The storm had severe effects on infrastructure, residents, and businesses across the state. Deep snow drifts closed all highways west of the Cascades and through the Columbia River Gorge. Sleet that turned to freezing rain caused unsafe conditions on highways and damaged trees and power lines. During a severe sleet event on January 18, hundreds of motorists were stranded in the Columbia River Gorge. The stranded motorists had to be rescued by train, even though all rail traffic had considerable difficulty and many delays in getting through the Gorge. Freezing rain downed many trees and power lines, creating widespread power outages across northwestern Oregon. Hundreds of thousands of dollars in damage to public and private property occurred.

January/February 1937

While the January/February 1937 storm had statewide impacts, heavy snowfalls were largely confined to the western slopes of the Cascades and the Willamette Valley. Deep snowdrifts blocked major highways and most minor roads in northern Oregon and the Cascade mountain passes for several days.

December 1919

The December 1919 snowstorm was the third heaviest snowfall producing storm to hit Oregon on record. The Columbia River froze over, closing the river to navigation from the confluence with the Willamette River upstream. The snowstorm affected nearly every part of the state, with heavy snow falling over a widespread area.

January 1909

A six-day storm in January 1909 brought many locations more snow than is normally accumulated in an entire year.

December 1892

From December 20 to 23, 1892, substantial snow fell across most of northern Oregon, with the greatest snowfall reported over northwestern Oregon, where storm totals ranged from 15 to 30 inches.

d. **Risk Assessment**

The Hazard Analysis endeavors to apply a quantitative approach to comparing the hazards that threaten the County in order to develop a relative hazard, or risk assessment.

The following categories are used in conducting this hazard analysis.

- History (Weight Factor=2)
This is an analysis of the records of occurrences of previous major emergencies or disasters that affected the County.
- Vulnerability (Weight Factor=5)
The percentage of the population and property likely to be effected by a hazard.
- Maximum Threat (Weight Factor=10)
The maximum percentage of population and property that could be impact under a worst-case scenario.
- Probability (Weight Factor=7)
The likelihood of occurrence within a specified period of time.

By adding the severity rating by the weight factors associated with the categories above, a sub score for the history, vulnerability, maximum threat, and probability for each hazard can be achieved. Adding the sub score will produce a total score for that hazard.

The Risk Assessment for Winter Storms is:

- a. *History: 12*
- b. *Vulnerability: 35*
- c. *Maximum Threat: 100*
- d. *Probability: 56*

THIS IS A COUNTY WIDE EVENT

e. **Severity Score**

The Severity Score factors the elements of risk: History (H), Vulnerability (V), Maximum Threat (MT) and Probability (P) to create an index which allows for the prioritization of mitigation activities based on the level of risk.

The Severity Score for Winter Storm is: 203

H + V + MT + P = Severity Score

12 + 35 + 100 + 56 = 203

6. Jurisdiction Vulnerabilities

a. *Population*

Approximately **100** percent of the community's population is vulnerable.

b. *Critical Facilities*

(1) Approximately **100** percent of the community's critical facilities is vulnerable.

(2) Definition / Description

Critical facilities include police stations, fire stations, hospitals, shelters, and other facilities that provide important services to the community. These facilities and their services need to be functional after and during severe weather.

(3) The specific critical facilities vulnerable in Multnomah County are:

- 4 County Law Enforcement Buildings
- 5 Municipal Administration Bldgs. (City Halls)
- 7 County Correctional Facilities
- 19 Critical County Facilities
- 3 Municipal Police Departments

c. *Infrastructure Lifelines*

(1) Approximately **100** percent of the community's infrastructure lifelines are vulnerable.

(2) Definition / Description:

Lifelines are the connections between communities and outside services. They include water and gas lines, transportation systems, electricity, and communication networks. Severe weather can cause pipes to break open, power lines to fall, roads and railways to crack or move, and radio and telephone communication to cease. Disruption to transportation makes it especially difficult to bring in supplies or services. All lifelines need to be usable after and during severe weather to allow for rescue and recovery efforts and to relay important information to the public.

(3) The specific infrastructure lifelines vulnerable in Multnomah County are:

- 1 Airport
- 31 Bridges
- 8 Rail Network Carriers
- 430 Arterials, Secondary, and Side Road Networks

d. Public Infrastructure

(1) Approximately 100 percent of the community's public infrastructure is vulnerable.

(2) Definition / Description:

Public infrastructure is defined as facilities that support the underlying community. During times of emergency or disaster these facilities become crucial in providing support and services, which allow the continuity of business, government, and society.

(3) The specific public infrastructure vulnerable in Multnomah County are:

- 112 County Support Facilities
- 24 Child Care Centers
- 15 Assisted Living Centers
- 8 Water Providers and Distribution Support Facilities

e. *Private Economy and Business Sector*

(1) Approximately **100** percent of the community’s private economy and business sector is vulnerable.

(2) Definition / Description

Severe weather can cause great loss to businesses; both large-scale corporations and small retail shops. When a company is forced to stop production for just a day, the economic loss can be tremendous, especially when its market is at a national or global level. Severe weather can create economic loss that presents a burden to small shop owners who may have difficulty recovering from their losses.

(3) The specific private economy and business sector vulnerable in Multnomah County are:

- 4 Food Caterers
- 46 Contract Food Service Providers
- 34 Grocery Stores
- 20 Hardware Stores
- 146 Restaurants
- 806 Businesses/Corporations

f. Mitigation Project Goals & Objectives

PROJECT NAME	Debris Management Program
GOAL	Develop and implement, or enhance strategies for debris management for severe winter storm events
OBJECTIVE	Develop coordinated management strategies for de-icing roads, plowing snow, clearing roads of fallen trees, and clearing debris from public and private property.
STRATEGY	Life Safety, Property Preservation, Environmental Conservation

PROJECT NAME	Landscape Winterization
GOAL	Develop and implement programs to keep trees from threatening lives, property, and public infrastructure from severe winter storm events.
OBJECTIVE	Partner with responsible agencies and organizations to develop landscaping and tree programs that have less impact on above ground utility lines and roads. Develop partnerships between utility providers and County and local

	public works agencies to document known hazard areas and minimize risks.
STRATEGY	Life Safety, Property Preservation, Environmental Conservation

PROJECT NAME	Severe Weather Public Education
GOAL	Increase public awareness of severe winter storm mitigation activities.
OBJECTIVE	Collect existing information on public education materials for protecting life, property, and the environment from severe winter storm events. Identify and collect additional information and programs as necessary. Distribute educational materials to Multnomah County residents and public and private sector organizations.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Severe Weather Mapping
GOAL	Map and publicize locations around the county that have the highest incidence of extreme weather.
OBJECTIVE	Identify a responsible agency for central collection and reporting of storm data. Data collected should include: 1. Records of ice and snow in localities throughout the county. 2. Maps of the locations within the county most vulnerable to snow and ice, including roads, bridges, and utility lines. 3. Injury and property damage estimates, including locations. Identify a responsible agency to collect and transfer data to the National Climate Data Center, Oregon Climate Service, FEMA, or any other agency concerned with the incidence of storms, to help establish and maintain baseline and historic records of storm events. Identify public infrastructure and facilities subject to closures due to snowfall and ice hazards during winter storms.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Underground power system initiative.
GOAL	Increase the use of underground utilities where possible.
OBJECTIVE	Support/encourage electrical utilities to use underground construction methods where possible to reduce power outages from severe winter storms.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Gravel storage
GOAL	Decrease deployment time of gravel and deicer vehicles.
OBJECTIVE	During severe weather gravel stockpiles can become frozen when they are left exposed to the elements. The

	construction of a pole barn would keep gravel protected from rain, snow and ice and speed deployment of the material into the field.
STRATEGY	Life Safety, Property Preservation

7. Prior & On-Going Mitigation Projects

None at this time.

g. Mitigation Projects Prioritization & Budget Estimation

PRIORITY	PROJECT NAME	ESTIMATED COST
1	Debris Management Program	\$15,000
2	Gravel Storage	\$325,000
2	Landscape Winterization	\$15,000
3	Severe Weather Mapping	\$15,000
4	Severe Weather Public Education	\$10,000
5	Underground power system initiative.	\$15,000.

SEVERE WEATHER

1. General Definition

7. Description

Multnomah County is subject to a number of severe local storms such high winds that occur when a low pressure from pulls air from east side of Oregon through the Columbia River Gorge and into the valley area. In addition, high winds have contributed to wide spread disruption and destruction within Multnomah County.

h. Hazard History.

The "Friday the 13th" storm produced "devastating wind and snow" over a five day period in January 1950. During the night of January 12, the temperature fluctuated "wildly, accompanied by thunder" and heavy snow. The temperature dropped about 20 degrees, then rose 20 degrees, and then dropped another 20 degrees within a 5-hour time span. Snow melted and then refroze as it hit the ground, creating dangerously icy roads. Power lines were knocked down, communications were severed, and roads and schools were closed.

January 1950

There were three severe storms in January 1950, with very little time separating them. Their net effect was a nearly continuous storm. The storm had severe effects on infrastructure, residents, and businesses across the state. Deep snow drifts closed all highways west of the Cascades and through the Columbia River Gorge. Sleet that turned to freezing rain caused unsafe conditions on highways and damaged trees and power lines. During a severe sleet event on January 18, hundreds of motorists were stranded in the Columbia River Gorge. The stranded motorists had to be rescued by train, even though all rail traffic had considerable difficulty and many delays in getting through the Gorge. Freezing rain downed many trees and power lines, creating widespread power outages across northwestern Oregon. Hundreds of thousands of dollars in damage to public and private property occurred.

i. **Risk Assessment**

The Hazard Analysis endeavors to apply a quantitative approach to comparing the hazards that threaten the County in order to develop a relative hazard, or risk assessment.

The following categories are used in conducting this hazard analysis.

- History (Weight Factor=2)
This is an analysis of the records of occurrences of previous major emergencies or disasters that affected the County.
- Vulnerability (Weight Factor=5)
The percentage of the population and property likely to be effected by a hazard.
- Maximum Threat (Weight Factor=10)
The maximum percentage of population and property that could be impact under a worst-case scenario.
- Probability (Weight Factor=7)
The likelihood of occurrence within a specified period of time.

By adding the severity rating by the weight factors associated with the categories above, a sub score for the history, vulnerability, maximum threat, and probability for each hazard can be achieved. Adding the sub score will produce a total score for that hazard.

The Risk Assessment for Severe Weather is:

- a. *History: 12*
- b. *Vulnerability: 35*
- c. *Maximum Threat: 100*
- d. *Probability: 56*

THIS IS A COUNTY WIDE EVENT

7. Severity Score

The Severity Score factors the elements of risk: History (H), Vulnerability (V), Maximum Threat (MT) and Probability (P) to create an index which allows for the prioritization of mitigation activities based on the level of risk.

The Severity Score for Severe Weather is: 203

H + V + MT + P = Severity Score

$$12 + 35 + 100 + 56 = 203$$

6. Jurisdiction Vulnerabilities

a. Population

Approximately 100 percent of the community's population is vulnerable.

b. Critical Facilities

(1) Approximately 100 percent of the community's critical facilities is vulnerable.

(2) Definition / Description

Critical facilities include police stations, fire stations, hospitals, shelters, and other facilities that provide important services to the community. These facilities and their services need to be functional after and during severe weather.

(3) The specific critical facilities vulnerable in Multnomah County are:

- 4 County Law Enforcement Buildings
- 5 Municipal Administration Bldgs. (City Halls)
- 7 County Correctional Facilities
- 19 Critical County Facilities
- 3 Municipal Police Departments

c. Infrastructure Lifelines

(1) Approximately **100** percent of the community's infrastructure lifelines are vulnerable.

(2) Definition / Description:

Lifelines are the connections between communities and outside services. They include water and gas lines, transportation systems, electricity, and communication networks. Severe weather can cause pipes to break open, power lines to fall, roads and railways to crack or move, and radio and telephone communication to cease. Disruption to transportation makes it especially difficult to bring in supplies or services. All lifelines need to be usable after and during severe weather to allow for rescue and recovery efforts and to relay important information to the public.

(3) The specific infrastructure lifelines vulnerable in Multnomah County are:

- 1 Airport
- 31 Bridges
- 8 Rail Network Carriers
- 430 Arterials, Secondary, and Side Road Networks

d. Public Infrastructure

(1) Approximately **100** percent of the community's public infrastructure is vulnerable.

(2) Definition / Description:

Public infrastructure is defined as facilities that support the underlying community. During times of emergency or disaster these facilities become crucial in providing support and services, which allow the continuity of business, government, and society.

(3) The specific public infrastructure vulnerable in Multnomah County are:

- 112 County Support Facilities
- 24 Child Care Centers
- 15 Assisted Living Centers
- 8 Water Providers and Distribution Support Facilities

e. *Private Economy and Business Sector*

(1) Approximately **100** percent of the community's private economy and business sector is vulnerable.

(2) Definition / Description

Severe weather can cause great loss to businesses; both large-scale corporations and small retail shops. When a company is forced to stop production for just a day, the economic loss can be tremendous, especially when its market is at a national or global level. Severe weather can create economic loss that presents a burden to small shop owners who may have difficulty recovering from their losses.

(3) The specific private economy and business sector vulnerable in Multnomah County are:

- 4 Food Caterers
- 46 Contract Food Service Providers
- 34 Grocery Stores
- 20 Hardware Stores
- 146 Restaurants
- 806 Businesses/Corporations

7. Mitigation Project Goals & Objectives

PROJECT NAME	Debris Management Program
GOAL	Develop and implement, or enhance strategies for debris management for severe winter storm events
OBJECTIVE	Develop coordinated management strategies for de-icing roads, plowing snow, clearing roads of fallen trees, and clearing debris from public and private property.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Landscape Winterization
GOAL	Develop and implement programs to keep trees from threatening lives, property, and public infrastructure from severe winter storm events.
OBJECTIVE	Partner with responsible agencies and organizations to develop landscaping and tree programs that have less impact on above ground utility lines and roads. Develop

	partnerships between utility providers and County and local public works agencies to document known hazard areas and minimize risks.
STRATEGY	Life Safety, Property Preservation, Environmental Conservation

PROJECT NAME	Severe Weather Public Education
GOAL	Increase public awareness of severe winter storm mitigation activities.
OBJECTIVE	Collect existing information on public education materials for protecting life, property, and the environment from severe winter storm events. Identify and collect additional information and programs as necessary. Distribute educational materials to Multnomah County residents and public and private sector organizations.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Severe Weather Mapping
GOAL	Map and publicize locations around the county that have the highest incidence of extreme weather.
OBJECTIVE	Identify a responsible agency for central collection and reporting of storm data. Data collected should include: 1. Records of ice and snow in localities throughout the county. 2. Maps of the locations within the county most vulnerable to snow and ice, including roads, bridges, and utility lines. 3. Injury and property damage estimates, including locations. Identify a responsible agency to collect and transfer data to the National Climate Data Center, Oregon Climate Service, FEMA, or any other agency concerned with the incidence of storms, to help establish and maintain baseline and historic records of storm events. Identify public infrastructure and facilities subject to closures due to snowfall and ice hazards during winter storms.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Underground power system initiative.
GOAL	Increase the use of underground utilities where possible.
OBJECTIVE	Support/encourage electrical utilities to use underground construction methods where possible to reduce power outages from severe winter storms.
STRATEGY	Life Safety, Property Preservation

PROJECT NAME	Gravel storage
GOAL	Decrease deployment time of gravel and deicer vehicles.
OBJECTIVE	During severe weather gravel stockpiles can become

	frozen when they are left exposed to the elements. The construction of a pole barn would keep gravel protected from rain, snow and ice and speed deployment of the material into the field.
STRATEGY	Life Safety, Property Preservation

8. Prior & On-Going Mitigation Projects

None at this time.

9. Mitigation Projects Prioritization & Budget Estimation

PRIORITY	PROJECT NAME	ESTIMATED COST
1	Debris Management Program	\$15,000
2	Gravel Storage	\$325,000
2	Landscape Winterization	\$15,000
3	Severe Weather Mapping	\$15,000
4	Severe Weather Public Education	\$10,000
5	Underground power system initiative.	\$15,000.

Summary of Mitigation Projects By Prioritization

Priority	Project	Cost	Hazard Category
1	Annual Drainage Checks	1,000	Flooding, landslides, debris flows
1	Infrastructure Seismic Survey /Assessment	15,000	Earthquakes
1	Volcano Alert & Warning Information	15,000	Volcano
1	Interface Development Requirements	15,000	Fires
1	Debris Management Program	15,000	Severe Weather, Winter Storms
Priority 1 Subtotal		61,000	
2	Land slide mapping	400	Flooding, landslides, debris flows
2	Structural Mitigation	15,000	Earthquakes
2	Volcano Response/Recovery Programs	15,000	Volcano
2	Firefighting Water Resources	15,000	Fires
2	Gravel Storage	325,000	Severe Weather, Winter Storms
Priority 2 Subtotal		370,400	
3	Land use planning	12,000	Flooding, landslides, debris flows
3	County Damage Assessment Program	10,000	Earthquakes
3	Ash Effect on Infrastructure	10,000	Volcano
3	Urban-Interface Fire Education	10,000	Fires
3	Landscape Winterization	15,000	Severe Weather, Winter Storms
Priority 3 Subtotal		57,000	
4	Community Landslide Protection	15,000	Flooding, landslides, debris flows
4	Nonstructural Hazard Mitigation	10,000	Earthquakes
4	Volcano Awareness	15,000	Volcano
4	Urban-Interface Fire Prevention Committee	15,000	Fires
4	Severe Weather Mapping	15,000	Severe Weather, Winter Storms
Priority 4 Subtotal		70,000	
5	Elevated Structures	15,000	Flooding, landslides, debris flows
5	Earthquake Mapping of Multnomah County	15,000	Earthquakes
5	Volcanic Ash Modeling	5,000	Volcano
5	Severe Weather Public Education	10,000	Severe Weather, Winter Storms
Priority 5 Subtotal		45,000	

6	Anti-Slide Community Design	25,000	Flooding, landslides, debris flows
6	Earthquake Insurance Program	5,000	Earthquakes
6	Underground power system initiative.	15,000	Severe Weather, Winter Storms
Priority 6 Subtotal		45,000	
7	Contractor Partnerships	27,000	Earthquakes
Priority 7 Subtotal		27,000	
Grand Total		675,400	

Summary of Vulnerabilities and Assessments

Vulnerabilities					
Hazard	Population	Critical Facilities	Infrastructure Lifelines	Public Infrastructure	Private Economy and Business Sector
Flood	634	36%	11%	26%	2%
Earthquake	100%	100%	100%	100%	100%
Volcano	100%	100%	100%	100%	100%
Wildland Fires	3100	10%	12%	0%	<1%
Winter Storms	100%	100%	100%	100%	100%
Land Slide	634%	36%	11%	26%	2%
Severe Weather	100%	100%	100%	100%	100%

Assessment Score					
Hazard	History	Vulnerability	Maximum Threat	Probability	Total
Flood	20	50	100	70	240
Earthquake	20	50	100	70	240
Volcano	20	50	100	70	240
Wildland Fires	12	35	100	56	203
Winter Storms	12	35	100	56	203
Landslide	20	50	100	70	240
Severe Weather	12	35	100	56	203