

Marion County Natural Hazards Mitigation Plan

Report for:
Marion County
Emergency Management
5155 Silverton Road NE
Salem, OR 97305

Prepared by:
Mid-Willamette Valley
Council of Governments
105 High Street S.E.
Salem, Oregon 97301-3667

Oregon Natural
Hazards Workgroup
1209 University of Oregon
Eugene OR 97403-1209
Phone: (541) 346-3588
Fax: (541) 346-2040
<http://www.uoregon.edu/~csco>

December 5, 2005



□

Special Thanks & Acknowledgements

Project Managers:

Mark Fancey, Mid-Willamette Valley Council of Governments
Judith Ingram Moore, Mid-Willamette Valley Council of Governments

Oregon Natural Hazards Workgroup:

Andre LeDuc, Director

Project Team:

David Reesor, Manager
Robert Richardson
Alison Thayer
Tina Nunez

Geographic Information Systems (GIS) Maps:

The Mid-Willamette Valley Council of Governments GIS Department, Marion County GIS, and City of Salem GIS developed the maps included in this plan. The contributions from these departments were essential in illustrating the extent and potential losses associated with the natural hazards affecting the county.

Burnie Pearson, GIS Specialist, Marion County

Sara Coffey, GIS Specialist, Marion County

Juan Carlos Torres, GIS Specialist, Mid-Willamette Valley Council of Governments

Peter Gutowsky, Senior Planner, City of Salem Community Development Department – Natural Resources Section

The information on the maps in this plan was derived from Marion County and City of Salem GIS. The maps depicted herein are illustrative and should be used for planning purposes only. The data used in these maps came from different sources. The MWVCOG has not field verified any of the source data or confirmed their spatial accuracy. Therefore, maps depicted herein should not be used for site-specific analysis.

Funding Acknowledgements:

Funding for this project was made possible through a Federal Emergency Management Agency Emergency Management Performance Grant.

Marion County
Natural Hazards Mitigation Action Plan

Table of Contents

Volume I: Mitigation Action Plan

Executive Summary: Five-Year Action Plan.....	i
Section 1: Introduction.....	1-1
Section 2: Community Profile.....	2-1
Section 3: Risk Assessment.....	3-1
Section 4: Mitigation Plan Mission, Goals, and Action Items.....	4-1
Section 5: Plan Implementation, Maintenance and Public Participation.....	5-1

Volume II: Hazard-Specific Information

Section 6: Flood.....	6-1
Section 7: Landslide.....	7-1
Section 8: Wildfire.....	8-1
Section 9: Severe Winter Storm.....	9-1
Section 10: Windstorm.....	10-1
Section 11: Drought.....	11-1
Section 12: Earthquake.....	12-1
Section 13: Volcanic Eruption.....	13-1

Volume III: Resources

Appendix A: Multi-Hazard Mitigation Resource Directory	A-1
Appendix B: Public Participation Processes	B-1
Appendix C: Approaches for Economic Analysis	C-1
Appendix D: List of Acronyms	D-1

Section 1: Introduction

Introduction.....	2
Phase I of the Marion County Natural Hazards Mitigation Plan.....	2
Why Develop a Mitigation Plan?	3
Whom Does the Mitigation Plan Affect?	3
Natural Hazard Land Use Policy in Oregon	4
State Support for Natural Hazard Mitigation.....	4
Plan Methodology	5
Volume II: Hazard-Specific Information.....	7
Volume III: Resources	7

Introduction

Marion County, the fifth most populous county in Oregon, is located in the heart of the Willamette Valley, with the Willamette River as its western boundary and the Cascade Range on the east. These natural features contribute to the beauty of the county and region, but also make the environment and population vulnerable to natural disaster situations. The county is subject to flooding, earthquakes, landslides, wildfires, severe winter storms, windstorms, and volcanic activity. It is impossible to predict exactly when these disasters will occur, or the extent to which they will affect the county. With careful planning and collaboration among public agencies, private sector organizations, and citizens within the community, however, it is possible to minimize the losses that can result from natural disasters.

Marion County experienced several significant natural disasters during the 1990s. On March 25, 1993, at 5:34 AM, a 5.6 magnitude earthquake occurred near the town of Scotts Mills, which is approximately 32 miles south of Portland and 21 miles northeast of Salem. Although considered moderate, in terms of magnitude/intensity and damage, it was Marion County's largest earthquake in recent recorded history and caused an estimated \$25-30 million in damages. No serious injuries were reported.

Marion County most recently experienced large-scale destruction during the severe weather events in February 1996 and December 2004/January 2005. In February 1996, the Willamette River and its tributaries swelled beyond the 100-year flood level, causing flooding in both rural and urban areas. Prolonged precipitation accompanied by an early snowmelt caused very unstable soil conditions, resulting in many landslides and debris flows in the county. The damage to Marion County businesses, residences, and infrastructure was estimated at about \$24 million.¹

Phase I of the Marion County Natural Hazards Mitigation Plan

During the summer of 2003, Marion County obtained an Emergency Management Performance Grant to complete Phase I of the Marion County Natural Hazards Mitigation Plan. During this phase, the county contracted with the Mid-Willamette Valley Council of Governments (MWVCOG) and the Oregon Natural Hazards Workshop (ONHW) to identify known hazards, compile a community profile and other background information, and complete vulnerability assessments for known hazards.

In October 2003, the county joined with Polk, Yamhill, Linn, Benton, and Lane counties to submit a competitive planning grant

application to FEMA to continue the natural hazards planning process for each of the six counties. The grant will provide funding to complete Phase II of the Marion County Natural Hazards Mitigation Plan.

Why Develop a Mitigation Plan?

The rising cost of natural disasters has led to a renewed interest in identifying effective ways to reduce vulnerability to disasters. Natural hazard mitigation plans assist communities in reducing risk from natural hazards by identifying resources, information, and strategies for risk reduction, while helping to guide and coordinate mitigation activities throughout the county.

The plan provides a set of action items to reduce risk from natural hazards through education and outreach programs, the development of partnerships, and implementation of preventative activities such as land use or watershed programs.

The resources and information within the Mitigation Plan: (1) establish a foundation for coordination and collaboration among agencies and the public in Marion County; (2) identify and prioritize future mitigation projects; and (3) assist in meeting the requirements of federal assistance programs. The mitigation plan works in conjunction with other county plans, including the County Comprehensive Land Use and Emergency Operations Plans.

What is natural hazard mitigation? *Natural hazard mitigation is the development and implementation of activities designed to reduce or eliminate losses resulting from natural hazards.*

Whom Does the Mitigation Plan Affect?

The Marion County Natural Hazards Mitigation Plan affects unincorporated urban areas, and the rural, unincorporated areas of the county. Map 1 shows cities, urban unincorporated areas, and major roads and rivers in Marion County. While this plan does not establish requirements for the cities in the county, it does provide them with a framework for planning for natural hazards. The resources and background information in the plan is applicable countywide, and the goals and recommendations can lay groundwork for local mitigation plans and partnerships.

Natural Hazard Land Use Policy in Oregon

Planning for natural hazards is an integral element of Oregon's statewide land use planning program, which began in 1973. All Oregon cities and counties have comprehensive plans and implementing ordinances that are required to comply with the statewide planning goals. The continuing challenge faced by local officials and state government is to keep this network of coordinated local plans effective in responding to the changing conditions and needs of Oregon communities.

This is particularly true in the case of planning for natural hazards where communities must balance development pressures with detailed information on the nature and extent of hazards. Oregon's land use program has given its communities and citizens a unique opportunity to ensure that natural hazards are addressed in the development and implementation of local comprehensive plans.

In 1996, FEMA estimated that Oregon saved about \$10 million a year in flood losses because of strong land-use planning. Statewide land use planning Goal 7: Areas Subject to Natural Disasters and Hazards calls for local plans to include inventories, policies, and ordinances to guide development in hazard areas. Goal 7, along with other land use planning goals, has helped to reduce losses from natural hazards.

State Support for Natural Hazard Mitigation

All mitigation is local, and the primary responsibility for development and implementation of risk reduction strategies and policies lies with local jurisdictions. Local jurisdictions, however, are not alone. Partners and resources exist at the state and federal levels. Numerous Oregon state agencies have a role in natural hazards and natural hazard mitigation. Some of the key agencies include:²

- **Oregon State Police - Office of Emergency Management (OEM)** is responsible for disaster mitigation, preparedness, response, recovery, and the administration of federal funds after a major disaster declaration;
- **Building Codes Division (BCD)** and local counterparts, are responsible for construction and for some hazards that are building-specific in their occurrence (such as earthquakes); also included are provisions for expansive soils, and damage assessment of buildings after an earthquake;
- **Oregon Department of Forestry (ODF)** is responsible for all aspects of wildland fire protection on private, state, and in Western Oregon, BLM forestlands and administers forest practices regulations, including landslide mitigation, on non-federal lands;³
- **Oregon Department of Geology and Mineral Industries (DOGAMI)** is responsible for geologic hazard characterization, public education, the development of partnerships aimed at reducing risk, and exceptions (based on science-based refinement of tsunami

inundation zone delineation) to state mandated tsunami zone restrictions; and

- **Department of Land Conservation and Development (DLCD)** is responsible for planning-based hazard management including implementation of land use planning and Goal 7 (natural hazards), with attention given to hazard assessments and hazard mitigation.

Plan Methodology

Information in the Mitigation Plan is based on research from a variety of sources. The research methods and various contributions to the plan include:

Executive Summary: Five-Year Action Plan

Input from the steering committee:

The steering committee, comprised of representatives from county departments and the American Red Cross, met eight times over the course of nine months. The steering committee developed the plan's mission statement and goals; contributed to the development of mitigation action items; and continually reviewed the plan.

Stakeholder interviews:

Stakeholders consisted of the fire districts within Marion County, all of the county's incorporated cities, major employers within the county, school districts, Chemeketa Community College, Willamette Education Service District, Marion Soil and Water Conservation District, watershed councils, and the Salem-Keizer Transit District. Stakeholder interviews identified additional information regarding current natural hazards mitigation activities, identified mitigation needs or gaps, potential action items, and additional resources.

Hazard specific research:

Historical data is presented on eight natural hazards: flood, landslide, severe winter storm, windstorm, wildfire, earthquake, drought and volcanic eruption.

Community Open House:

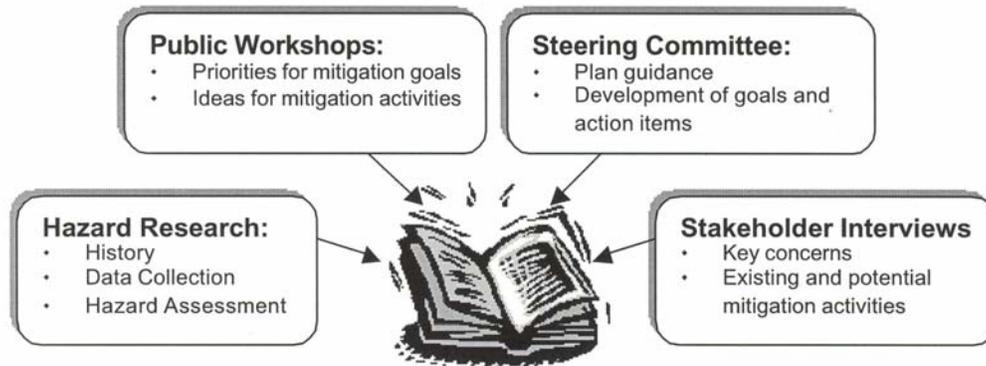
An open house was held on April 14, 2005, to inform the public about Marion County natural hazards. The purpose of the open house was to gather comments and ideas from the residents of Marion County about natural hazards mitigation planning, to inform the public about natural hazards that occur in Marion County, and identify community priorities, and potential strategies for achieving these priorities.

Meetings with the project steering committee, stakeholder interviews and the public open house all served as methods to obtain input and priorities in developing goals for reducing risk and preventing loss from natural hazards in Marion County.

How Do I Use the Plan?

The resources and information cited in the mitigation plan provide a strong local perspective and help identify strategies and activities to make Marion County more disaster resilient. **Figure 1.1** shows the mitigation planning process components and the key outcomes.

Figure 1.1. Hazard Mitigation Planning Process



Each section of the mitigation plan provides information and resources to assist people in understanding the county and the hazard-related issues facing citizens, businesses, and the environment. Combined, the sections of the plan work together to create a document that guides the mission to reduce risk and prevent loss from future natural hazard events.

The structure of the plan enables people to use a section of interest to them. It also allows county government to review and update sections when new data becomes available. The ability to update individual sections of the mitigation plan places less of a financial burden on the county. Decision-makers can allocate funding and staff resources to selected pieces in need of review, thereby avoiding a full update, which can be costly and time-consuming. New data can be easily incorporated, resulting in a natural hazards mitigation plan that remains current and relevant to Marion County.

Executive Summary: Five-Year Action Plan

Section 1: Introduction

The *Introduction* describes the background and purpose of developing the mitigation plan for Marion County.

Section 2: Community Profile

This section presents the history, geography, demographics, and socio-economics of Marion County. It serves as a tool to provide an historical perspective of natural hazards in the county.

Section 3: Risk Assessment

This section provides general information on hazard identification, vulnerability and risk associated with natural hazards in Marion County.

Section 4: Mitigation Plan Mission, Goals, and Action Items

This section provides information on the process used to develop goals and action items that cut across the eight natural hazards addressed in the

mitigation plan.

Section 5: Plan Implementation, Maintenance and Public Participation

This section provides information on plan implementation, monitoring and evaluation.

Volume II: Hazard-Specific Information

The *Marion County Natural Hazards Mitigation Plan* addresses six chronic hazards and two catastrophic hazards. Chronic hazards occur with some regularity and may be predicted through historic evidence and scientific methods. The chronic hazards addressed in the plan include:

- *Section 6: Flood*
- *Section 7: Landslide*
- *Section 8: Wildfire*
- *Section 9: Severe Winter Storm*
- *Section 10: Windstorm*
- *Section 11: Drought*

Catastrophic hazards do not occur with the frequency of chronic hazards, but can have devastating impacts on life, property, and the environment. The two catastrophic hazards presented in the plan are:

- *Section 12: Earthquake*
- *Section 13: Volcanic Eruption*

Each of the hazard-specific sections includes information on the history, hazard causes and characteristics, hazard assessment, goals and action items, and local, state, and national resources.

Volume III: Resources

The plan appendices are designed to provide users of the Marion County Natural Hazards Mitigation Plan with additional information to assist them in understanding the contents of the mitigation plan, and potential resources to assist them with implementation.

Appendix A: Plan Resource Directory

The resource directory includes county, regional, state, and national resources and programs that may be of technical and/or financial assistance to Marion County during plan implementation.

To be completed

Appendix B: Public Participation Process

This appendix includes specific information on the various public processes used during development of the plan.

To be completed

Appendix C: Approaches for Economic Analysis

This section describes FEMA's requirements for benefit-cost analysis in natural hazards mitigation, as well as various approaches for conducting economic analysis of proposed mitigation activities.

To be completed

Appendix D: List of Acronyms

This section provides a list of acronyms for county, regional, state, and federal agencies and organizations that may be referred to within the Marion County Natural Hazards Mitigation Plan.

To be completed

-
- ¹ Mid-Willamette Valley Council of Governments. 1996. *Flood Economic Recovery Coordination Project for Marion, Polk, and Yamhill, Counties, Oregon*. Salem, OR: MWVCOG.
- ² Agency descriptions (with the exception of the ODF description) are derived from: OR Department of Geology and Mineral Industries, Special Paper 31, *Mitigating Geologic Hazards in Oregon: A Technical Reference Manual*, 1999.
- ³ Oregon State Police, Office of Emergency Management. June 2000. *State Natural Hazards Mitigation Plan*.

Section 2: Community Profile

- Why Plan for Natural Hazards in Marion County? 2
- History of Natural Hazards in Marion County..... 2
- Geography and Environment 3
 - Rivers and Streams*..... 4
 - Climate*..... 5
 - Minerals and Soils*..... 6
 - Significant Geological Factors*..... 7
- Population and Demographics 7
- Land and Development 10
 - Development Regulations 11
- Housing and Community Development 12
- Employment and History 12
- Transportation and Commuting 13
- Historic and Cultural Resources 14
- Critical Facilities and Infrastructure 14

Why Plan for Natural Hazards in Marion County?

In 2000, the Federal Emergency Management Agency issued the Disaster Mitigation Act of 2000, commonly known as DMA 2000. Under DMA 2000, communities, states, and tribal governments must complete FEMA-approved natural hazard mitigation plans by December 31, 2004 to be eligible for certain federal assistance programs such as the Hazard Mitigation Grant Program (HMGP).¹

While Marion County is generally described as having a mild climate and a relatively flat terrain, with the exception of hills located toward the Cascade Mountains, natural hazards do present a threat to public and private property and to the health and safety of the County's residents. The next few chapters demonstrate how natural disasters have caused major concerns related to earthquakes, floods, volcanic activity, winter storm events, windstorms, and landslides in the Marion County region. The County's proximity to the banks of the Willamette River increases the threat of flood occurrences and damage. To minimize risk of harm to humans and personal property, it is vital to plan for the occurrence of potential natural hazards.

History of Natural Hazards in Marion County

Marion County is located in the largest agricultural income sector in Oregon. Agricultural industry is the major user of land resources for both historic and current food and fiber production within the county. Outside the Urban Growth Boundary, about 68 percent of the drainage area in Marion County is in agricultural production and nearly 8 percent is urbanized.² Historically, the region has experienced periodic fires, floods, windstorms, and landslides. For almost four thousand years, the Kalapuya Native Americans and early settlers regularly burned areas of the Willamette Valley to maintain "favorable plant community characteristics".³ Because the frequency and location of fires is not well documented, the impact on historical settlements cannot fully be assessed. Many large fires occurred in 1902 and 1910, however, which raised the public's awareness of deaths and loss of property related to fire hazards.⁴ Recent research indicates the potential for fire hazards in the forested area of the county from the lack of fire breaks surrounding rural residential properties, lack of water availability, and the absence of fire over the last 100 years.⁵

With many communities located along riverbanks and near local streams, Marion County has always been subject to winter flooding events. Such events often begin with heavy snow pack in the mountain regions followed by intense storm events that tend to increase the chance for local streams and rivers to flood. Almost a dozen historical flood events, half of which are recorded as "major floods", have been documented between 1861 and 1996.⁶ Flood severity in the county depends on the size of drainage areas, existing moisture levels, and obstacles located within flood prone areas. Smaller streams in the

county are subject to short duration, high intensity rainfall as opposed to larger basins.⁷ The most recent high water event in the Marion County area was the 1996 flood. On February 7, 1996, the Willamette River experienced a flood similar to the 1964 flood event, with the river cresting close to 35 feet and discharging 244,000 feet/sec of water.⁸

Marion County has also experienced severe windstorms over the years. Most of these storms resulted in building and property damage, utility failures, and in some cases injury or death. One of the strongest windstorms to hit Marion County occurred in 1962. The Columbus Day Storm of 1962 caused trees to blow down on the average of 80 acres per square mile.⁹

Other natural hazards that have affected the county include earthquakes, wildfires, volcanic eruption, and landslides. All have affected the County in the past.

Marion County's past experiences with natural hazards serve as important lessons about the potential impacts of future events. The potential threat from any one of these events points to the importance of planning for and reducing the risks posed by natural hazards.

Geography and Environment

As one of the original Oregon counties established in 1843, Marion County has an abundance of natural resources. The Willamette River and Interstate 5, border the county to the west. Highway 22 and the North Santiam River border the county to the south.

Marion County has an area of 1,200 square miles and extends from the Willamette River to the Cascade Mountains. Located in the heart of the Mid-Willamette Valley, Marion County has 20 incorporated and 37 unincorporated communities. All 20 cities are either surrounded by farmland or forest land.¹⁰ The Willamette River is the major river basin and is the county's western boundary. Other major river basins include the Little Pudding and North Santiam. Major waterbodies include Detroit Lake (Reservoir), and Lake Labish. Several smaller water bodies exist within the county and include Battle Creek and Croisan Creek located to the south, and Claggett Creek to the north.

The average elevation for Marion County is 154 feet. Elevations range between 100 feet near the Willamette River to 2400 feet in the foothills of the Cascade Mountains.¹¹ There is an elevated bench or terrace, marking the edge of the modern floodplain (100 to 500 year recurrence intervals) of the Willamette River in the north end of the county near the City of Keizer.¹²

Agriculture is the predominant land use in Marion County, which is home to some of the most productive farmland in Oregon.¹³ The County ranks first out of the 36 counties in 2004 gross farm and ranch sales (\$518 million).¹⁴ Forestlands cover the eastern 43 percent of the total county area and a majority of the water resources originate in this area.¹⁵ Other than the high-altitude forests to the east and sporadic foothills, the county is relatively flat.

Emergent Wetland and Bottomland/Wet Prairie lands were once pervasive throughout parts of Marion County and within the Willamette Valley region.¹⁶ These areas were once covered mostly by native prairie grasses and characterized by an oak savanna ecosystem. Early land surveying records indicate that these scenic oak savannas and native grass prairies were a direct result of fire ecology.¹⁷ Historical accounts of the river ecosystem indicate the primary tree species include cottonwood, alder, and other hardwoods.

Rivers and Streams

Willamette River

The Willamette River flows 187 miles from the Cascade Mountains in the east through northwestern Oregon to the Columbia River, which flows into the Pacific Ocean, and is known as the tenth largest river with respect to water volume in the continental United States.¹⁸ With approximately 70 percent of Oregon's population living within this basin, the Willamette River plays an integral role in the rural and urban landscapes through which it flows. The potential for natural hazards exists when the Willamette River experiences flood events within populated areas of the county. When the river rises, the extent of flooding on county roads depends on local stream flows. Marion County Emergency Management determines at least eight major county roads will experience roadway flooding if the Willamette River rises at Salem.¹⁹

North Santiam River

The North Santiam River is the southernmost border of Marion County and originates in the western slope of the Cascade Mountains at Mount Jefferson. Stretching west, toward the confluence of the Willamette River, the North Santiam is home to runs of steelhead, Chinook and silver (Coho) salmon, cutthroat and rainbow trout, whitefish, sculpin and squawfish.²⁰ In addition to providing a drinking water supply to Gates, Mill City, Lyons, Mehama, Stayton and Salem residents, the North Santiam River and its tributaries are used for irrigation, agriculture, and recreation purposes.²¹

Pudding River

The Pudding River is located in the northern end of Marion County and flows north directly into the confluence of the Molalla and Willamette Rivers.²² The Pudding joins the Willamette in Canby.²³ Tributaries to the Pudding River include Silver Creek, Abiqua Creek, Butte Creek and the Little Pudding River.

Little Pudding River

The Little Pudding River drains approximately 150 square miles in the center of Marion County and flows into the Pudding River near Parksville.²⁴ The level topography, urban development and loss of natural vegetation from agricultural activities are all factors related to flooding and drainage issues within the basin. The drainage basin experiences an average of 40 inches of precipitation occurring annually.²⁵

Lake Labish

This area can be better described as a long, narrow depression rather than a body of water. From a point on the Pudding River, about six miles east of Gervais, this extension flows in a southeasterly direction to the Willamette River.²⁶ Lake Labish ranges from a few hundred feet wide and close to ten feet deep at the northern end to approximately a quarter of a mile wide with depths appearing no greater than 30 feet deep.²⁷ While historical accounts claim it was a lake in an old channel of the Willamette River,²⁸ Lake Labish now drains west to Claggett Creek and east into the Little Pudding River. During extreme flood events, the Pudding River and Claggett Creek drainages are linked through Lake Labish and have flooded its headwaters when both systems were backed up.²⁹

Detroit Lake & Reservoir

Detroit Lake is about 50 miles east of Salem and located on the North Santiam River. The reservoir is approximately 5.6 square miles and releases close to 455 thousands of acre-feet, ranking as Oregon's 12th largest lake/reservoir in terms of volume.³⁰ The National Oceanic Atmospheric Administration (NOAA) tracks flooding potential of all reservoirs in the Willamette Basin, and continually monitors the river stage and elevation at the Detroit Reservoir.³¹

Mill Creek

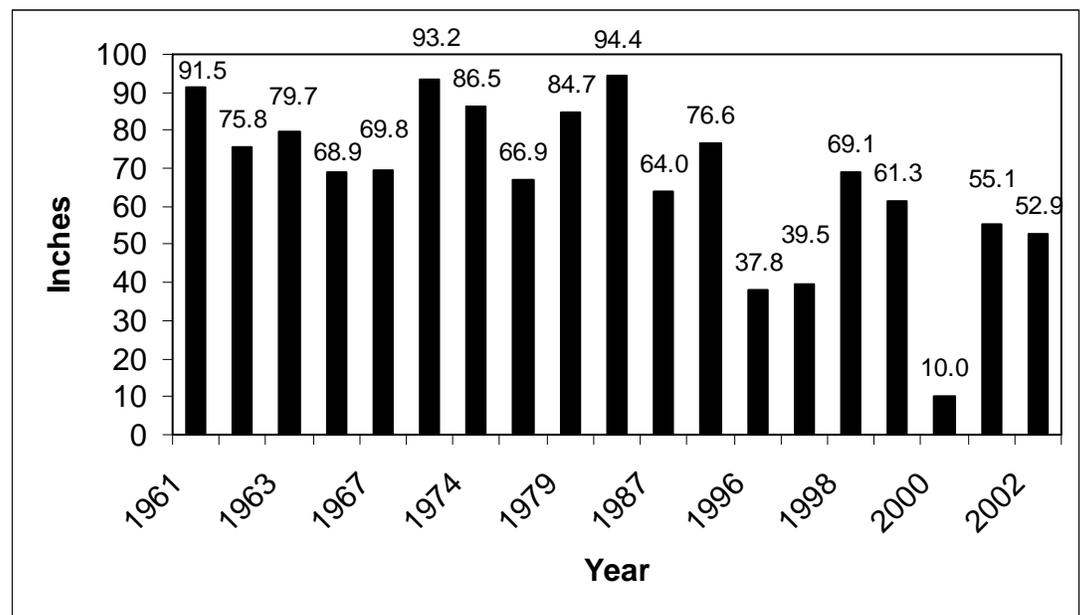
Mill Creek, originating in the Waldo Hills and western Cascades, enters Salem from the southeast and meanders through the downtown area before reaching the Willamette River.³² The Mill creek watershed covers approximately 110 square miles, and empties into the Willamette River north of the intersection of 'D' and Front Streets in Salem.³³ Several of its tributaries include Beaver Creek, McKinney Creek, and Battle Creek. West of the Oregon State Penitentiary property in Salem, Mill Creek subdivides into three branches including the human-constructed Mill Race and Shelton Ditch, toward the City of Salem.³⁴ Within urban areas of Salem, Mill Creek is a major drainage that passes through downtown. Along this stretch, Mill Creek is channelized in several locations with riprap placed along the banks to reduce the possibility of erosion.³⁵

Climate

Marion County has a modified marine climate where winters are cool and wet, while summers are moderately warm and dry.³⁶ Cool air flows

from the Pacific Ocean in the west and is tempered by the Cascade Mountains to the east. Marion County spans a wide range of physiographic regions; thus, there is considerable variation in precipitation, with elevations as the largest factor in precipitation totals. From 1961 to 1990, the average annual precipitation in Marion County was approximately 40 inches, with most precipitation received on the valley floor and gradually increasing eastward toward the low foothills near the Cascade Range.³⁷ In the Mid-Willamette Valley, 90 percent of the rainfall is experienced between October and the end of May.³⁸ Map 2 shows the range of annual precipitation levels within Marion County.

Figure 1. Annual Precipitation, Marion County, Oregon, 1961-2002.



Source: Oregon Climate Service
 * Data missing for the following incomplete years: 1969 – 1973, 1975-1977, 1980-1983, 1988-1994 – Silver Creek Falls station.

Minerals and Soils

Soil types in the Mid-Willamette Valley are valuable for land use practices that involve human, agricultural or forestry activities and urban development. Land capability classes consist of broad groupings of soils based on the risk of soil damage if mismanaged (e.g. loss of topsoil from erosion or sediment deposition) and whether soil limitations prevent the sustained cultivation of crops, pasture and rangeland vegetation.³⁹ In general, Class I through IV soils can be used for crop production with Class IV soil requiring conservation efforts such as erosion control terraces, grassed waterways, or tillage and residue management.⁴⁰ Class VI and VII are typically reserved for hay, pasture, and rangeland grazing activities.

According to the 2001 Atlas of Oregon, soils in Marion County primarily are Class III and range from Class II through VII.

Several common natural hazards are related to soil stability and water retention. These hazards include landslides, erosion, flooding, and liquefaction resulting from an earthquake. Mineral and soil compositions are important factors for determining whether Marion County is prone to hazards such as landslides.

Significant Geological Factors

Figure 2 shows how most of the Pacific Northwest lies within the Cascadia Subduction Zone, where the Juan de Fuca and North American plates meet. The convergence of these tectonic plates puts most areas of western Oregon and Washington at risk for a catastrophic earthquake with a magnitude of 8.0 or higher.

Marion County lies in this area of risk. Three geological zones are found in the downtown area of Salem, and consist of basalt rock, alluvial gravels and sediments.⁴¹

As an inland valley, the Willamette Valley was once a part of a broad continental shelf. The Eola Hills in West Salem and the Ankeny Hills to the south are examples of Columbia River Basalts or volcanic rocks uplifted along faults.⁴² In a feature unique to this area, the Willamette River flows not along wide stretches of flat floodplain, but rather converges between the bedrock hills of South Salem and Eola Hills.⁴⁴

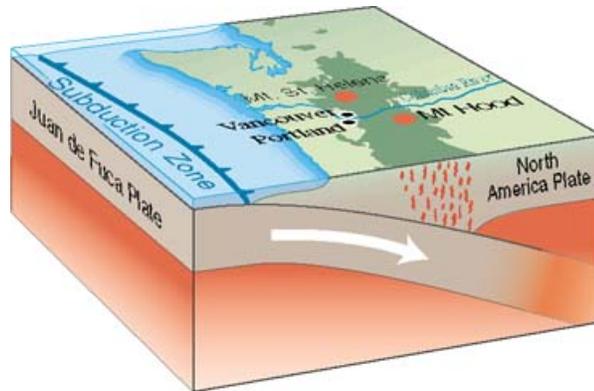


Figure 2 Cascadia Region Subduction Zone

Population and Demographics

In 2000, the population of Marion County was 284,834, representing an increase of 25 percent during the last ten years.⁴⁵ Table 1 shows growth for Marion County is slightly above that for the State of Oregon.

According to the Oregon Office of Economic Analysis, this rapid growth rate is projected to continue by approximately 15 percent at a rate of 1.9 percent per year over the next 20 years.

Table 1. Population Trends in Marion County and Oregon, 1990-2000

Area	1990 Population	2000 Population	%Change 1990-2000
Marion County	228,483	284,834	24.7
Oregon	2,842,321	3,421,399	20.4

Source: US Census

The percentage of Oregon's total population is 8.3 percent for Marion County, which ranks it as the state's fifth largest county.⁴⁶ Table 2 illustrates the populations living within incorporated and

unincorporated areas of Marion County. In 2000, the 20 incorporated cities within the county comprised about 80 percent of the county population, with the remaining 20 percent of the population in unincorporated areas.

Table 2. Incorporated and Unincorporated Communities in Marion County

Incorporated Cities	Population	Unincorporated	Communities
Aumsville	3,050	Breitenbush	Mehama
Aurora	660	Broadacres	Monitor
Detroit	260	Brooks	Niagara
Donald	608	Butteville	North Howell
Gates	471	Central Howell	North Santiam
Gervais	2,009	Clear Lake	Orville
Hubbard	2,483	Concomly	Pratum
Idanha	232	Crestwood	Roberts
Jefferson	2,487	Downs	Rockie Four
Keizer	32,203	Drakes Crossing	Corners
Mill City	1,537	Elkhorn	Rosedale
Mt. Angel	3,121	Fargo	St. Louis
St. Paul	354	Hazel Green	Shaw
Salem	136,924	Hopmere	Sydney
Scotts Mills	312	Labish Center	Skunkville
Silverton	7,414	Little Sweden	Sunnyside
Stayton	6,816	Lone Pine Corner	Talbot
Sublimity	2,148	Macleay	Waconda
Turner	1,199	Marion	West Stayton
Woodburn	20,100		

Source: U.S. Census 2000; and Marion County Web Site

From Table 2, the largest cities include Salem (the county's Metropolitan Service Area), Keizer, and Woodburn. Estimates using the 2000 Census data indicate approximate population by watershed: Pringle – 34,299; Claggett – 64,888; and Mill – 47,289. The majority of land is in private ownership and less than six percent of the land is considered public property.⁴⁷

According to the Region 3 Central/Southern Willamette Valley statewide hazard plan, Marion County has an incorporated population of 205,102, while the unincorporated population is 79,732. Table 3 demonstrates the percent change in Marion County’s incorporated cities from 1990 to 2000. Population in incorporated areas has increased 31.8 percent during this time frame, while population has increased by 9.3 percent in unincorporated areas.

Table 3. Marion County Population, Incorporated and Unincorporated Areas

Area	1990	2000	Percent Change 1990-2000
Incorporated Areas	155,564	205,102	+31.8%
Unincorporated Areas	72,919	79,732	+9.3%

Source: US Census and Oregon Office of Economic Analysis

This urban and rural growth pattern determines how agencies prepare to handle emergencies, as changes in population and development can increase risks associated with hazards.⁴⁸ For example, more people living on the urban fringe can increase their risk of fire. Wildfire has an increased chance of starting due to human activities in the urban/rural interface, and has the potential to injure more people and cause more property damage.⁴⁹

While natural hazards do not discriminate, the impacts in terms of risk of vulnerability and the ability to recover differ among the population.⁵⁰ According to a representative of the Federal Emergency Management Agency (FEMA), 80 percent of the disaster burden falls on the public, with a disproportionate burden placed upon special needs groups: women, children, minorities, and the poor.⁵¹

According to the 2000 census, approximately 17.1 percent of current residents in Marion County are Hispanics or Latinos. The 2000 US Census reports that 2.4 percent residents are Asian, and 2.6 percent are American Indian, Alaskan Native, or other ethnic descent. Such ethnic diversity suggests a need to address multi-cultural needs and services.

Close to 13.5 percent of individuals live in poverty in Marion County, of whom 7.4 percent are over 65. Approximately 9.6 percent are families and of that, 15.1 percent include children under 18 years old.⁵² Vulnerable populations, including children, women, seniors, disabled citizens, as well as people living in poverty, may be disproportionately impacted by natural hazards in Marion County. To increase access to services and programs, hazard mitigation policies must reflect such special needs populations. FEMA addresses such needs by encouraging agencies and organizations planning for natural disasters to identify special needs populations, make recovery centers more accessible, and review practices and procedures to resolve any discrimination in disaster relief or assistance.⁵³

A sense of inequity emerges when the financial responsibility of natural hazards recovery is placed on the general population, even though only a small proportion may benefit from governmental funds to rebuild private structures.⁵⁴ To ensure all members of the population are included in the decision-making process, a natural hazards dialogue in Marion County should include local citizen groups, insurance companies, and other public and private sector organizations.

Land and Development

Prior to early settlement of Marion County, the area was home to a scenic oak savanna, tall grassy prairies, colorful wildflowers, and tree-lined rushing rivers. During early settlement, the alluvial valley of the Willamette River was one of the first areas to use waterways as arterials for commerce and to be cleared for agriculture. Over time, an increase in awareness regarding the benefits of land use and development regulations is corresponding with an increase in awareness of the county's land and water resource limitations.

Today, Marion County is a community of residential, commercial, and agricultural land uses. As noted above, three drainage basins are found within Marion County. The Mill Creek watershed is the largest drainage basin in the county and includes the smaller communities of Turner, Aumsville, Sublimity and Stayton. Table 4 shows the percentage of agricultural to urbanized land estimated for the three watersheds located outside the urban growth boundary. It appears the Pringle and Claggett Creek Watersheds are highly urbanized while a large percentage of land in the Mill Creek Watershed remains in agricultural production.

Table 4. Percentage of Agricultural and Urbanized Land Outside the Urban Growth Boundary

Watershed	Agricultural Production	Urbanized
Mill Creek	68%	8%
Claggett Creek	45%	46%
Pringle Creek	27%	60%

Source: Pringle, Glenn-Gibson, Claggett, and Mill Creeks Watershed Assessment, January 2002

With increased development and population growth, Marion County has lost many of the ecosystems that existed prior to early European settlement. Such historical ecosystems not only were home to rare plant and animal species, they also served to control flooding, recharge groundwater, and stabilize riverbanks.⁵⁵ The problems associated with urbanization of rural land resources is especially important in Marion County with the importance of its natural resources to the local economy.⁵⁶

Table 5 shows the acres by various land use designations within Marion County. Land within incorporated city limits is designated as urban in

the table. More than 97 percent of the land within Marion County is zoned for agricultural or forest (timber) uses.

Table 5. Acres by Land Use Designation Marion County

Land Use Designation	Acres	Percent of Total Acres
Forest	353,714	64.6
Agriculture	178,447	32.6
Urban	7,444	1.4
Public	2,967	0.5
Residential	2,744	0.5
Industrial	1,447	0.3
Commercial	706	0.1
Total	547,469	100.0

Source: Marion County GIS, 2003

The 2002 Marion County Comprehensive Plan denotes rural development as the conversion of land outside all urban growth boundaries to a more intensive non-resource oriented use such as residential structures. Existing rural development in Marion County is predominately scattered single-family residences and a few rural communities with which include a mix of rural residential, commercial, industrial, and public uses.⁵⁷

To ensure that rural development occurs in a way that will help protect agricultural land and other natural lands from premature development, the Marion County Urban Growth Management Framework, was proposed as an amendment to the Urbanization Element of the 2002 Comprehensive Plan. This report addresses how to balance the projected growth and development with current quality of life and natural systems in Marion County. Specifically, the framework is designed to accommodate approximately 500,400 residents and 215,500 jobs within the 20 cities and unincorporated portions of Marion County by the year 2050.⁵⁸ This type of plan may enable the county to assess how and where future development has the potential to interfere with and be impacted by such natural processes as wildfires and floods.

Development Regulations

There are a number of current regulations regarding development in areas subject to natural hazards. The *Geologically Hazardous Areas Overlay Zones* included in the Marion County Comprehensive Plan have an urban and rural zoning ordinance component and include maps of areas with sensitive groundwater and excessive slopes as well as landslide susceptibility of the South Salem Hills.⁵⁹ Plan maps for the following communities are included in the overlay: Brooks/Hopmere, Butteville, Labish Village, Macleay, Marion, Mehama, Monitor, Quinaby, Shaw, Turner and one is pending for Fargo.

Housing and Community Development

Gaining an understanding of the county’s current housing stock, as well as trends in community development, is important when planning for natural hazards. To accommodate rapid growth, communities engaging in mitigation planning should evaluate the following: infrastructure and service needs, specific engineering standards and building codes.⁶⁰ Discontinuing or decreasing development in floodplains may potentially reduce an area’s vulnerability to hazards. While Oregon has land use goals that address mitigation planning in rural and urban areas, communities must make every effort to meet these goals when developing land for housing and industry.

According to the 2000 US Census, over 25,300 housing structures were built in Marion County over the last decade as shown in Table 6.

Table 6. Housing Age-Structure in Marion County

Year	Number	Percent
1999 - March 2000	2,618	2.4
1995 to 1998	12,355	11.4
1990 to 1994	10,327	9.5
1980 to 1989	12,444	11.5
1970 to 1979	28,371	26.2
1960 to 1969	13,855	12.8
1940 to 1959	17,655	16.3
1939 or earlier	10,549	9.8

Source: U.S. Census 2000

Between 1969 and 1979, roughly 39 percent of Marion County’s houses were built, followed by another 35 percent between 1980 and the year 2000.⁶¹ With all existing urban areas surrounded by forest or farmland and cities expected to expand, Marion County cannot provide for the bulk of housing needs of its population within rural areas.⁶²

The year-built date is important for mitigation because the older the home, the greater risk of damage from natural disaster. For example, structures built after the late 1960’s in the Northwest and California used earthquake resistant designs and construction techniques.⁶³ Likewise, FEMA began assisting communities with floodplain mapping during the 1970’s, and communities developed ordinances that required homes in the floodplain to be elevated at least one foot over Base Flood Elevation. See Section 6 of this plan.

Employment and History

According to the Oregon Department of Employment, the Central Willamette Region added approximately 68,400 jobs during the 1990s. Historically, the region relied on the lumber industry for jobs and income. According to the recently completed statewide hazard plan for the Central Willamette Valley, the sectors expected to grow in this region include, industrial, high tech, healthcare, administrative,

tourism and retail trade. Table 7 describes the county's employment by industry for the year 2000. It appears the highest percentage of workers in Marion County is employed in the educational/health/social services, manufacturing and retail trade sectors.

Table 7. Employment by Industry for Marion County

Industry	Number	Percent
Agriculture/Fishing/Forestry	6,015	4.7
Construction	9,358	7.4
Manufacturing	16,574	13.1
Wholesale Trade	5,150	4.1
Retail Trade	14,658	11.6
Transportation/Warehousing	4,635	3.7
Information	2,223	1.8
Finance/Insurance	7,741	6.1
Mgmt/Scientific/Waste	9,084	7.2
Educational/Health/Social Services	24,092	19
Arts/Entertainment/Recreation	8,840	7
Misc.	6,213	4.9
Public Administration	12,099	9.6

Source: U.S. Census, 2000

Median household income can be used as an indicator for the strength of the region's economic stability. It can also be used to compare economic areas as a whole, yet does not reflect how the income is divided among area residents. The 2000 Census indicates that the median household income for Marion County was \$40,314. This is slightly below the national average of \$41,433 and the state's average of \$40,916.

Mitigation plans and activities are essential at the business level to ensure the safety and welfare of workers and limit damage to industrial infrastructure. Employees are highly mobile, commuting from the surrounding areas to industrial and business centers within the county. The result is greater dependency on roads, communications, accessibility and emergency plans to reunite people with their families. Before a natural hazard event occurs, small and large businesses can develop strategies to prepare for and respond to natural hazards. Planning ahead in this manner can prevent the loss of life and property.

Transportation and Commuting

Rapid growth in an area contributes to local road traffic from worker commuting, trucks on the road, and an increase in general automobile traffic. A high percentage of commuters driving alone to work can cause traffic congestion and accidents.⁶⁴ The large increase in automobiles can place stress on roads, bridges, and infrastructure within the cities, and also in rural areas where you find fewer transit roads. During an emergency, local transit systems can be shut down, affecting evacuations. In addition, roads may become unusable from localized flooding and severe winter storms can potentially disrupt the daily driving routine of county residents.

According to the 2000 Census data, the average commute time for commuting workers in the Central Willamette Region is 22 minutes each way. In Marion County, approximately 73 percent of workers over the age of 16 commute to work alone by automobile and a little over two percent use public transportation.⁶⁵ Other modes of transportation in Marion County include carpooling (16 percent), working at home (4.5 percent), walking (3 percent), and using other means (1.6 percent).

Historic and Cultural Resources

As an important historical and cultural resource, the Willamette River offers natural beauty, abundant wildlife, and diverse recreational opportunities.⁶⁶ In addition to natural resources, Marion County also has nearly 100 structures on the National Register of Historic Places. In 2003, the county formed the Marion County Cultural Coalition Planning Committee,⁶⁷ which developed a plan for preserving, enhancing and supporting the arts, history, architecture, libraries, museums, festivals and other cultural assets, created a Web site, and initiated a database inventory of cultural assets available online. The committee dissolved after one year, launching as its successor the Marion Cultural Development Corporation, a private, non-profit entity, to build on the committee's initial work, accept donations and grants, and distribute grants to local projects intended to increase cultural assets and opportunities for the public in Marion County.⁶⁸

Critical Facilities and Infrastructure

Critical and essential facilities are those facilities vital to the continued delivery of key governmental services that may significantly impact the public's ability to recover from the emergency. These involve local police and fire stations, public works facilities, sewer and water facilities, hospitals, bridges, roads, and shelters. Map 3 and Table 8 shows critical facilities in Marion County. Map 4 shows essential facilities in Marion County.

Table 8. Critical Facilities in Marion County

Facility	Number
Hospitals	
Number of Hospitals	6*
Number of Beds	1,078+
Police Stations	20
Sheriff Stations	4
Fire and Rescue Stations	44
School Districts	10
Colleges/Universities	3
High Potential Loss Facilities	
Dams	
Number of Dams	56
Significant Hazard	10
Hazardous Material Sites	37 ²

Source: Oregon Department of Health, Local Sheriff Offices, Oregon Department of Education, Oregon Department of Energy, Oregon Water Resources Department.

* Albany General Hospital covers Jefferson; Legacy-Meridian Park Hospital covers Aurora, Donald, Hubbard, Woodburn; Providence Newberg Hospital covers St. Paul; Santiam Memorial Hospital covers Aumsville, Mill City, Scio, Lyons, Gates, Idanha, Stayton, Sublimity; Silverton Memorial Hospital covers Scotts Mills, Mt. Angel, Silverton, Woodburn; and Salem Memorial Hospital.

²Hazus-MH: Earthquake Event Report for Marion Crustal, Mt. Angel M6.9 Earthquake Scenario (March 14, 2005), page 4.

At any time, dam failures can occur and are recorded quite often. While most result in minor damage and pose little threat, some have the potential for severe damage where fatalities exist. The number for dams in Table 8 are those registered with the Oregon Water Resources Department (WRD), plus Detroit and Big Cliff Dams. According to Jon Falk, Dam Safety Coordinator for the WRD, only those dams that are ten feet or greater in height and that store more than 9.2 acre feet are required to be engineered and recorded in a dam safety database. Smaller structures are not recorded although all storage projects require a reservoir permit. Mr. Falk notes that a structure less than ten feet high could have a storage pond of 9.2 acre-feet or approximately three million gallons of water.

Jon Falk stated that within the WRD dam database, “significant hazard” is often confused with “risk.” Significant hazard does not speak to the condition of the dam. Significant hazard indicates a direct loss of human life if a dam were to suddenly fail.⁶⁹

Other critical and necessary facilities vital to the efficient delivery of key governmental services, or that may significantly impact the public’s ability to recover from emergencies, include correctional institutions, public services buildings, law enforcement centers, courthouses, and

juvenile service buildings. These and other public facilities should be detailed in local and regional mitigation plans.

-
- ¹ DMA 2000, State and Local Plan Criteria: Mitigation Planning Workshop for Local Governments,
http://www.fema.gov/fima/planning_toc4.shtm (Accessed 7/21/03)
- ² Pringle, Glenn-Gibson, Claggett, and Mill Creeks Watershed Assessment. January 2002.
- ³ Lower South Yamhill-Deer Creek Watershed Assessment. Yamhill Basin Council, September 2000.
- ⁴ Id.
- ⁵ Id.
- ⁶ Pringle, Glenn-Gibson, Claggett, and Mill Creeks Watershed Assessment. January 2002.
- ⁷ City of Salem. 1996. February Floods 1996, Post Flood Report prepared by Department of Public Works. Salem, OR.
- ⁸ City of Salem. 2001c. Salem Library History Project. "Our Heritage, Our Home." Salem, OR. <http://salemhistory.net/time_line/timeline.htm> and <http://salemhistory.net/natural_history/n02.htm> U.S. Geological Survey (USGS). 1998. Water Resources Data Oregon Water Year 1998. Water-Data Report OR-98-1. U.S. Department of the Interior. Washington D.C. <http://www.water.usgs.gov/or/nwis/> (Accessed 7/23/03)
- ⁹ Lower South Yamhill-Deer Creek Watershed Assessment. Yamhill Basin Council, September 2000.
- ¹⁰ Marion County Comprehensive Plan, 2002
- ¹¹ Pringle, Glenn-Gibson, Claggett, and Mill Creeks Watershed Assessment. January 2002.
- ¹² Salem-Keizer Area Local Wetland Inventory Marion and Polk Counties, Oregon. Martin Schott and Jay Lorenz, September, 1999.
- ¹³ Marion County webpage: < <http://www.co.marion.or.us/> > (Accessed 7/28/03)
- ¹⁴ "Agriculture is Important to All 36 Oregon Counties." Oregon Department of Agriculture Web site, accessed February 8, 2005 available from the World Wide Web <http://egov.oregon.gov/ODA/news/050202County.shtml>
- ¹⁵ Marion County Comprehensive Plan, 2002
<http://publicworks.co.marion.or.us/Planning/compplan.asp> (Accessed 7/28/03)
- ¹⁶ Marion County webpage: < <http://www.co.marion.or.us/> > (Accessed 7/28/03)
- ¹⁷ Indians, fire, and land in the Pacific Northwest. R. Boyd (ed). 1999. Oregon State University Press. Corvallis, OR.
- ¹⁸ American Heritage Rivers Progress Report. 2000. Federal EPA Interagency Task Force.
- ¹⁹ http://publicworks.co.marion.or.us/emergencymanagement/when_the_willamette_river_at_sal.asp (Accessed 7/28/03)
- ²⁰ North Santiam Watershed Council Website:
http://www.open.org/~nsantiam/about_the_NSW.htm (Accessed 7/31/03)
- ²¹ Id.
- ²² Atlas of Oregon, 2002. University of Oregon Press
- ²³ Salem-Keizer Area Local Wetland Inventory Marion and Polk Counties, Oregon. Martin Schott and Jay Lorenz, September, 1999.
- ²⁴ Id.
- ²⁵ Marion County Public Works Flood Model Scope website
http://publicworks.co.marion.or.us/administration/gis/mike11/proj_scope.asp (Accessed 7/31/03)
- ²⁶ Marion County Public Works website
<http://publicworks.co.marion.or.us/parks/labish/index.asp> (Accessed 7/31/03)
- ²⁷ Id.

-
- ²⁸ *Geology of Oregon*, 4th Rev. Kendall/Hunt Publishing, Dubuque, IA. E.L. Orr, W.N. Orr and Ewart M. Baldwin. 1992.
- ²⁹ Salem-Keizer Area Local Wetland Inventory Marion and Polk Counties, Oregon. Martin Schott and Jay Lorenz, September, 1999.
- ³⁰ *Atlas of Oregon*. 2002. Eugene, OR: University of Oregon Press
- ³¹ <http://www.nwrfc.noaa.gov/river/river.cgi> (Accessed 8/4/03)
- ³² Salem-Keizer Area Local Wetland Inventory Marion and Polk Counties, Oregon. Martin Schott and Jay Lorenz, September, 1999
- ³³ Pringle, Glenn-Gibson, Claggett, and Mill Creeks Watershed Assessment. January 2002.
- ³⁴ <http://www.nwrfc.noaa.gov/river/river.cgi> (Accessed 8/4/03)
- ³⁵ Id.
- ³⁶ Pringle, Glenn-Gibson, Claggett, and Mill Creeks Watershed Assessment. January 2002.
- ³⁷ *Atlas of Oregon*. 2002. University of Oregon Press
- ³⁸ Salem-Keizer Area Local Wetland Inventory Marion and Polk Counties, Oregon. Martin Schott and Jay Lorenz, September, 1999.
- ³⁹ *Atlas of Oregon*. 2002. University of Oregon Press
- ⁴⁰ Id.
- ⁴¹ Pringle, Glenn-Gibson, Claggett, and Mill Creeks Watershed Assessment. January 2002.
- ⁴² Salem-Keizer Area Local Wetland Inventory Marion and Polk Counties, Oregon. Martin Schott and Jay Lorenz, September, 1999.
- ⁴³ Pringle, Glenn-Gibson, Claggett, and Mill Creeks Watershed Assessment. January 2002.
- ⁴⁵ Region 3 Profile of Central/Southern Willamette Valley (2003)
- ⁴⁶ *Atlas of Oregon*. 2002. University of Oregon Press
- ⁴⁷ Pringle, Glenn-Gibson, Claggett, and Mill Creeks Watershed Assessment. January 2002.
- ⁴⁸ Region 3 Profile of Central/Southern Willamette Valley (2003)
- ⁴⁹ Clackamas County Mitigation Plan, September 2002
- ⁵⁰ Id.
- ⁵¹ <http://www.fema.gov/>(Accessed 8/4/03)
- ⁵² US Census. 2000.
- ⁵³ Hazards Workshop Session summary #16, Disasters, Diversity, and Equity. Annual Hazards Workshop (July 12, 2000) University of Colorado, Boulder
- ⁵⁴ Id.
- ⁵⁵ Marion County Public Works website
<http://publicworks.co.marion.or.us/parks/nhp/aboutnhp.asp> (Accessed 8/4/03)
- ⁵⁶ Marion County Comprehensive Plan, 2002
- ⁵⁷ Id.
- ⁵⁸ Marion County Public Works
http://publicworks.co.marion.or.us/Planning/Growth_Mgmt/compact%20framework_3_ls1.asp (Accessed 8/6/03)
- ⁵⁹ Marion County Public Works <http://publicworks.co.marion.or.us/Planning/maps.asp> (Accessed 8/6/03)
- ⁶⁰ Region 3 Profile of Central/Southern Willamette Valley (2003)
- ⁶¹ Id.
- ⁶² *Marion County Comprehensive Plan*. 2002
- ⁶³ *Clackamas County Mitigation Plan*. September 2002
- ⁶⁴ Id.

⁶⁵ US Census. 2000

⁶⁶ <http://www.willamette.edu/~broesler/riverweb/mainframeset.htm> (Accessed 8/12/03)

⁶⁷ <http://commissioners.co.marion.or.us/culturalcoalition/> (Accessed 8/12/03)

⁶⁸ Electronic mail communication from Sue McCracken, Board of Commissioners Office, March 21, 2005.

⁶⁹ Falk, John. Oregon Water Resources Department. Personal interview. September 24, 2004.

Section 3: Risk Assessment

What is a Risk Assessment?.....2
Federal Requirements for Risk Assessment.....4
Summary.....5

What is a Risk Assessment?

Conducting a risk assessment can provide information on the location of hazards, the value of existing land and property in hazard locations, and an analysis of risk to life, property, and the environment that may result from natural hazard events. Specifically, the three levels of a risk assessment are as follows:

- 1) ***Hazard Identification*** identifies the geographic extent and intensity of the hazard, the intensity of the hazard, and the probability of its occurrence. Maps are frequently used to display hazard identification data. Marion County identified eight major hazards that consistently affect this geographic area: floods, landslides, wildfires, earthquakes, severe winter storms, windstorms, drought and volcanoes. The geographic extent of each of the identified hazards has been identified by the Marion County GIS department using the best available data, and is illustrated by the maps listed in Table 3-1.
- 2) ***Profiling Hazard Events*** describes the causes and characteristics of each hazard, how it has affected Marion County in the past, and what part of Marion County's population, infrastructure, and environment has historically been vulnerable to each specific hazard. A profile of each hazard discussed in this plan is provided in each hazard section. For a full description of the history of hazard specific events, please see the appropriate hazard chapter.
- 3) ***Vulnerability Assessment/Inventorying Assets*** combines hazard identification with an inventory of the existing (or planned) property and population exposed to a hazard. Critical facilities are of particular concern because these entities provide essential products and services to the general public that are necessary to preserve the welfare and quality of life in the county and fulfill important public safety, emergency response, and/or disaster recovery functions. The critical facilities have been identified, mapped, and are illustrated in Map 3 in Section 2 of this plan. A description of the critical facilities in the county is also provided in Section 2. In addition, this plan includes a community issues summary in each hazard section to identify the most vulnerable and problematic areas in the county, including critical facilities, and other public and private property.
- 4) ***Risk Analysis/Estimating Potential Losses*** involves estimating the damage, injuries, and financial losses likely to be sustained in a geographic area over a given period of time. This level of analysis involves using mathematical models. The two measurable components of risk analysis are magnitude of the harm that may result and the likelihood of the harm occurring. Describing vulnerability in terms of dollar losses provides the community and the state with a common framework in which to measure the effects of hazards on assets. For each hazard where data was available, quantitative estimates for potential losses are included in the hazard assessment.

- 5) *Assessing Vulnerability/ Analyzing Development Trends* provides a general description of land uses and development trends within the community so that mitigation options can be considered in land use planning and future land use decisions. This plan provides comprehensive description of the character of Marion County in the Community Profile. This description includes the geography and environment, population and demographics, land use and development, housing and community development, employment and industry, and transportation and commuting patterns. Analyzing these components of Marion County can help in identifying potential problem areas, and can serve as a guide for incorporating the goals and ideas contained in this mitigation plan into other community development plans.

Table 3-1. List of Hazard Mitigation Plan Maps

Map #	Type of Map	Section of the Plan
1	Base Map of Marion County	Section 1: Introduction
2	Precipitation	Section 2: Community Profile
3	Critical Facilities	Section 2: Community Profile
4	Essential Facilities	Section 2: Community Profile
5	County 100-Year Flood plain	Section 6: Flood
6	River Subbasins Map	Section 6: Flood
7	Landslide Hazard	Section 7: Landslides
8	Debris Flow Hazard	Section 7: Landslides
9	Fire Districts	Section 8: Wildfire
10	Wildfire Hazard	Section 8: Wildfire
11	Earthquake Hazard	Section 11: Earthquake
12	Volcanic Hazard	Section 12: Volcanic Eruption

Hazard assessments are subject to the availability of hazard-specific data. Gathering data for a hazard assessment requires a commitment of resources on the part of participating organizations and agencies. Each hazard-specific section of the plan includes a section on hazard identification using data and information from county or state agency sources.

THREE PHASES OF HAZARD ASSESSMENT:
Hazard Identification → Vulnerability Assessment → Risk Analysis

Marion County conducted a vulnerability assessment for the flood hazard using Geographic Information Systems (GIS) to identify the geographic extent of the hazard and assess the land use and value at risk from the flood hazard. The vulnerability assessment for the earthquake hazard is addressed in part from FEMA’s HAZUS analysis model. Insufficient data exists to conduct vulnerability assessments and risk analyses for the other hazards addressed in the plan: landslides, severe winter storms, windstorms, wildfires, and volcanic eruptions.

Regardless of the data available for hazard assessments, there are numerous strategies the county can take to reduce risk. These strategies are described in the action items detailed in each hazard section of this Plan. Mitigation strategies can further reduce disruption to critical services, reduce the risk to human life, and alleviate damage to personal and public property and infrastructure. Action items throughout the hazard sections provide recommendations to collect further data to map hazard locations and conduct hazard assessments.

Federal Requirements for Risk Assessment

Recent federal regulations for hazard mitigation plans outlined in 44 CFR Part 201 include a requirement for risk assessment. This risk assessment requirement is intended to provide information that will help communities to identify and prioritize mitigation activities that will reduce losses from the identified hazards. There are seven hazards profiled in the mitigation plan, including floods, landslides, wildfires, earthquakes, winter storms, windstorms, and volcanic eruptions. The Federal criteria for risk assessment and information on how the Marion County Natural Hazard Mitigation Plan meets those criteria is outlined in Table 3-2 below.

Table 3-2. Federal Criteria for Risk Assessment

Section 322 Requirement	How is this addressed?
Identifying Hazards	Each hazard section includes an inventory of the best available data sources that identify hazard areas. To the extent GIS data are available, the county developed maps identifying the location of the hazard in the county. The Executive Summary and the Risk Assessment sections of the plan include a list of the hazard maps.
Profiling Hazard Events	Each hazard section includes documentation of the history, and causes and characteristics of the hazard in the county.
Assessing Vulnerability: Identifying Assets	Where data is available, the vulnerability assessment for each hazard addressed in the mitigation plan includes an inventory of all publicly owned land within hazardous areas. Each hazard section provides information on vulnerable areas in the county in the Community Issues section. Each hazard section also identifies potential mitigation strategies.
Assessing Vulnerability: Estimating Potential Losses	The Risk Assessment Section of this mitigation plan identifies key critical facilities and lifelines in the county and includes a map of these facilities. Vulnerability assessments have been completed for the hazards addressed in the plan, and quantitative estimates were made for each hazard where data was available.
Assessing Vulnerability: Analyzing Development Trends	The Marion County Community Profile Section of this plan provides a description of the development trends in the county, including the geography and environment, population and demographics, land use and development, housing and community development, employment and industry, and transportation and commuting patterns.

Summary

Natural hazard mitigation strategies can reduce the impacts concentrated at large employment and industrial centers, public infrastructure, and critical facilities. Natural hazard mitigation for industries and employers may include developing relationships with emergency management services and their employees before disaster strikes, and establishing mitigation strategies together. Collaboration among the public and private sector to create mitigation plans and actions can reduce the impacts of natural hazards.

Section 4:

Mitigation Plan Mission, Goals, and Action Items

Introduction	2
Mission.....	2
Mitigation Plan Goals	2
Natural Hazard Mitigation Plan Action Items	4
Coordinating Organization	4
Internal Partners.....	5
External Partners	5
Timeline.....	5
Ideas for Implementation.....	5
Plan Goals Addressed	6
Public Participation	6
Multi-Hazard Action Items (MH).....	6

Introduction

This section provides information on the process used to develop the mission, goals and action items addressed in the mitigation plan. It also describes the framework that focuses the plan on developing successful mitigation strategies. The framework is made up of three parts— Mission, Goals, and Action Items:

- *Mission*— The mission statement is a philosophical or value statement that answers the question, “Why develop a plan?” The mission statement provides the overarching direction for the natural hazards mitigation plan. In short, the mission states the purpose and defines the primary function of the Marion County Natural Hazards Mitigation Plan. The mission is an action-oriented statement of the purpose of the plan. It should be broad enough that it need not change unless the community environment changes.
- *Goals*—Goals are designed to drive actions and they are intended to represent the general end toward which the county effort is directed. Goals identify how stakeholders and the county plan to work toward mitigating risk from natural hazards. They should not specify how the community is to achieve a particular level of performance. The goals provide direction and a framework for the specific recommendations that are outlined in the action items.
- *Action Items*—The action items are detailed recommendations for activities that county and local agencies, residents, and others could engage in to reduce risks (See Section 5 for information on the plan’s action items).

Mission

The mission of the Marion County Natural Hazards Mitigation Plan is: *to promote sound public policy designed to protect people, critical and essential facilities, infrastructure, utilities, private property, and the environment from natural hazards. The plan fosters partnerships, coordinated implementation and funding, public awareness, and the development of multi-objective strategies for mitigation.*

Mitigation Plan Goals

Mitigation plan goals are broad statements of direction that Marion County citizens and public and private partners can take while working to reduce the county’s risk from natural hazards. These statements of direction form a bridge between the broad mission statement and particular action items.

Meetings with the project steering committee, stakeholder interviews, and an open house all served as methods to obtain input and priorities in developing goals for reducing risk and preventing loss from natural hazards in Marion County.

The plan goals addressed by each action item are a means for monitoring and evaluating how well the mitigation plan is achieving its goals following implementation.

The plan goals help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Goal #1: PUBLIC AWARENESS

Goal Statement: Increase public awareness of natural hazard risks, emergency notification and response, and resources for citizen preparedness.

Goal #2: EDUCATION

Goal Statement: Educate the public on how to successfully prepare for a natural disaster with minimal property damage and no loss of life.

Goal #3: PREVENTATIVE

Goal Statement: Minimize risks to life, property, the environment, and the economy from natural hazards.

Goal #4: FUNDING AND IMPLEMENTATION

Goal Statement: Identify potential funding sources and implement potential mitigation projects.

Goal #5: PARTNERSHIPS AND COORDINATION

Goal Statements:

- Create, maintain and enhance partnerships with other stakeholders involved with natural hazard management.
- Coordinate natural hazard mitigation efforts with adjacent jurisdictions and public/private agencies' risk management activities.

Goal #6: NATURAL RESOURCES UTILIZATION

Goal Statement: Promote the use of natural systems and features, watershed planning, and land use planning for natural hazard mitigation whenever possible to reduce long-term costs to the county and maximize effectiveness.

Goal #7: EMERGENCY SERVICES

Goal Statement: Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Natural Hazard Mitigation Plan Action Items

Action items are detailed recommendations for mitigating the impacts of natural hazard events in Marion County. Action items are measurable steps towards achieving the plan's mission. The action items are both hazard specific e.g., strategies for floods, wildfires, landslides, etc.) and multi-hazard (i.e., cuts across all specified hazards).

Steering committee meetings identified and refined natural hazards mitigation plan action items. Information from stakeholder interviews also identified and refined action items. The action items outline both short- and long-term strategies to reduce the risk to Marion County from natural hazards. Each action item includes information regarding the timeframe during which the action should occur, the responsible parties that should be involved, and what resources are needed to implement the activity.

It is important to note that it is not a requirement to perform cost-benefit analyses on the action items defined in the plan. The "ideas for implementation" found below each action item primarily emphasize incorporating the actions of the mitigation plan into existing programs and other planning mechanisms such as land use and capital improvement plans where appropriate.

Mitigation plan activities or action items may be considered for funding through federal and state grant programs, including the Federal Emergency Management Agency's Hazard Mitigation Grant Program and Pre-Disaster Mitigation Competitive Grant Program, as funds are made available. Each action item addresses the following five elements to help ensure implementation of the activities:

1. Coordinating organization(s).
2. Partner organizations (Internal and External).
3. Timeline.
4. Notes and implementation ideas.
5. Plan goals addressed.

The sections of this plan that address the five chronic hazards and the three catastrophic hazards include the action items pertaining to each specific natural hazard.

Coordinating Organization:

The coordinating organization is the public agency with regulatory responsibility to address natural hazards or one willing and able to organize resources, find appropriate funding, or oversee activity implementation, monitoring, and evaluation. Coordinating organizations may include local, county or regional groups that are in relative proximity to the county to facilitate implementation of activities and programs.

Partner Organizations:

Partner organizations are agencies, or public/private sector organizations that will assist the coordinating organizations in implementing action items by providing relevant resources. Partner organizations may include regional, state and federal agencies, as well as local and county public and private sector organizations. Partner organizations are potential partners recommended by the project steering committee, but were not necessarily contacted during plan development. Partner organizations should be contacted by the coordinating organization to establish commitment of time and resources to activities

Internal Partners:

Internal partner organizations are departments within the county that may be able to assist in the implementation of action items by providing relevant resources to the coordinating organization.

External Partners:

External partner organizations can assist the coordinating organization in implementing the action items in various functions and may include local, regional, state, or federal agencies, as well as local and regional public and private sector organizations. The internal and external partner organizations listed in the Mitigation Plan are potential partners recommended by the project steering committee, but were not necessarily contacted during the development of the plan. The coordinating organization should contact the identified partner organizations to see if they are capable of and interested in participation. This initial contact is also to gain a commitment of time and/or resources towards completion of the action items.

Timeline:

Action items include both short and long-term activities. Each action item includes an estimate of the timeline for implementation. *Short-term action items* (ST) are activities that may be implemented with existing resources and authority within one to two years. *Long-term action items* (LT) may require new or additional resources and/or authorities, and may take between three to five years to implement.

Ideas for Implementation:

Almost all action items include ideas for implementation and potential resources. This information offers a transition from theory to practice. The ideas for implementation serve as a starting point for this plan. This component of the action items is dynamic as some ideas may not be feasible and new ideas can be added during the plan maintenance process. (For more information on how this plan will be implemented and evaluated, see Section 5).

The action items are recommendations for ways to implement the plan goals only. Some of these items may prove to be unrealistic and other, more refined ideas may be identified and added to the plan. Ideas for

implementation include things such as collaboration with relevant organizations, grant programs, human resources, education and outreach, research, and physical modifications to buildings and infrastructure. A list of potential resources outlines what organization or agency will be most qualified and capable of performing the implementation strategy. Potential resources often include utility companies, non-profits, schools, and other community organizations. The multi-hazard and individual hazard action items detail this information.

Plan Goals Addressed

Each action item includes a list of the plan goals that the activity addresses. Action items should be fact based and tied directly to issues or needs identified throughout the planning process. Action items can be developed from a number of sources including participants in the planning process, noted deficiencies in local planning and response processes, or issues identified through risk assessment.

Public Participation

In addition to the Steering Committee meetings, an open house was held on April 14, 2005, to inform the public about Marion County natural hazards. The purpose of the open house was to gather comments and ideas from the residents of Marion County about natural hazards mitigation planning, to inform the public about natural hazards that occur in Marion County, identify community priorities, and identify potential strategies for achieving these priorities.

A complete listing of input methods and public comment is located in *Appendix B: Public Participation Process*.

Meetings with the project steering committee, stakeholder interviews and the public open house all served as methods to obtain input and priorities in developing goals for reducing risk and preventing loss from natural hazards in Marion County.

Multi-Hazard Action Items (MH)

Multi-hazard action items are those activities that may pertain to all eight hazards in the mitigation plan: flood, landslide, wildfire, severe winter storm, windstorm, drought, earthquake, and volcanic eruption.

Multi-Hazard Action Item 1: Sustain an education and outreach program for local jurisdictions and assist them in developing emergency operations, public information, and hazard mitigation plans.

NOTE: County Emergency Management is responsible for helping local jurisdictions develop plans that are compatible and well coordinated with other agency plans.

Ideas for Implementation:

- Develop workshops and outreach materials with Oregon Natural Hazards Workgroup (ONHW), MWVCOG, Marion

County Emergency Management, and Marion County Planning to assist in developing Natural Hazard Mitigation Plans for incorporated communities in Marion County.

- Incorporate completed, approved mitigation plans with the Marion County Natural Hazard Mitigation Plan as addenda.
- Train local jurisdictions on regional emergency management policies and procedures.
- Help coordinate countywide emergency management training and exercises.
- Help local jurisdictions develop resources and establish emergency facilities.
- Inform local jurisdictions about available resources; grant opportunities, and other assistance.
- Disseminate information from Oregon Emergency Management and the Federal Emergency Management Agency.

Coordinating Organization: Emergency Management
Internal Partner: Planning Division
External Partners: Incorporated communities in Marion County, city emergency management agencies, Red Cross, emergency response agencies, MWVCOG, OEM, FEMA
Timeline: 1 to 2 years, On-going
Plan Goals Addressed: Education, Preventive, Funding & Implementation, Partnerships & Coordination; Emergency Services

Multi-Hazard Action Item 2: Review and update the Marion County Emergency Operations Plan and the Natural Hazards Mitigation Plan on an annual basis. Conduct a complete review and update of the plans and have them officially promulgated by the Marion County Board of Commissioners (BOC) every five years.

Idea for Implementation:

- Marion County Emergency Management will coordinate plan updates annually and complete reviews at least every five years. During the complete reviews, the plans will be evaluated with respect to the county's Zoning Ordinance and Comprehensive Land Use Plan.
- Consider the goals and action items from the Marion County Natural Hazard Mitigation Plan for implementation in other county documents and programs, where appropriate.
- Review the Natural Hazards Mitigation Plan for opportunities to update the county's Comprehensive Land Use Plan and supporting plans and documents. Statewide Planning Goal 7 is

designed to protect life and property from natural disasters and hazards through planning strategies.

- Consider how components of the county's Natural Hazards Mitigation Plan might be used in updating current and future capital improvement plans.
- Integrate goals and action items into the county's stormwater management program.

Coordinating Organizations: Emergency Management and Planning Division
Internal Partners: County departments, Steering Committee
External Partners: City emergency management agencies, Red Cross, Marion Fire Defense Board, NWS, utility companies, ODF, ODOT, ARES
Timeline: On-going
Plan Goals Addressed: Public Awareness; Preventive; Funding & Implementation; Partnerships & Coordination; Natural Resources Utilization; Emergency Services

Multi-Hazard Action Item 3: Evaluate the effectiveness of existing programs and identify natural hazards mitigation needs. Balance the objectives of existing programs' goals with natural hazards mitigation.

Coordinating Organization: Emergency Management
Internal Partners: Public Works and Planning Division
Timeline: On-going
Plan Goals Addressed: Preventive

Multi-Hazard Action Item 4: Identify coordination opportunities to maximize or leverage funding opportunities that address multi-jurisdictional projects.

Ideas for Implementation:

- Develop incentives that encourage local governments, special districts, residents, and businesses to consider hazard mitigation projects.
- Consider identifying funding sources that assist in completing mitigation projects when possible.
- Develop partnerships among organizations and agencies in Marion County to identify grant programs and foundations that support mitigation activities.

Coordinating Organization: Steering Committee
Internal Partner: Planning Division
Timeline: 1 to 2 years
Plan Goals Addressed: Preventive; Education; Funding & Implementation; Partnerships & Coordination; Emergency Services

Multi-Hazard Action Item 5: Develop a process for the Marion County Natural Hazards Mitigation Plan Steering Committee to assist in implementing, monitoring, and evaluating county-wide mitigation activities.

Ideas for Implementation:

- Oversee implementation of the mitigation plan;
- Provide a mechanism to update and revise the mitigation plan;
- Monitor hazard mitigation implementation;
- Present an annual progress report to Board of Commissioners on mitigation action items to see which have been completed, which need to be added, deleted, postponed, etc.
- Conduct a review of the Natural Hazard Mitigation Plan at least every 5 years, evaluating mitigation successes and areas that were not addressed.

Coordinating Organization: Steering Committee
Timeline: One year
Plan Goals Addressed: Preventive; Funding & Implementation; Partnerships & Coordination

Multi-Hazard Action Item 6: Determine the impact that each natural hazard could have on the county's priority transportation routes to and from emergency facilities and first responder sites.

Ideas for Implementation:

- Establish action measures to ensure that priority routes are given priority in resource utilization to ensure open access during hazard events.

Coordinating Organization: Emergency Management
Internal Partner: Sheriff's Office
External Partners: Fire and police departments, and other first responders
Timeline: On-going (every 5 years)
Plan Goals Addressed: Preventive; Partnerships & Coordination; Emergency Services

Multi-Hazard Action Item 7: Identify collaborative programs that recognize ways to decrease the risks of natural hazards.

Ideas for Implementation:

- Distribute information about flood, fire, earthquake, and other forms of natural hazards to property owners in areas identified as high risk through hazard mapping.
- Educate individuals and businesses on the benefits of mitigation activities to reduce risk from hazards.
- Encourage communication and dissemination of natural hazards mitigation information utilizing available technology and resources.

Coordinating Organization: Emergency Management
Internal Partner: Planning Division
External Partner: Chambers of Commerce
Timeline: 1 to 2 years
Plan Goals Addressed: Public Awareness, Preventive, Funding & Implementation, Partnerships & Coordination; Natural Resources Utilization; Emergency Services

Multi-Hazard Action Item 8: Develop public and private partnerships to foster natural hazards mitigation program coordination and collaboration in Marion County.

Ideas for Implementation:

- Identify all organizations within Marion County that have programs or interests in natural hazards mitigation planning.
- Involve private businesses throughout the county in mitigation planning activities and education/outreach; as well as applicable emergency response and recovery.

Coordinating Organization: Emergency Management
Internal Partner: Planning Division
Timeline: On-going
Plan Goals Addressed: Public Awareness; Preventive;
Education; Funding &
Implementation; Partnerships &
Coordination

Multi-Hazard Action Item 9: Develop GIS inventories of essential facilities, at-risk buildings, and infrastructure.

Ideas for Implementation:

- Prioritize mitigation projects.
- Identify critical facilities at risk from natural hazards events.
- Develop strategies to mitigate risks to these facilities or to utilize alternative facilities should natural hazard events cause damage to the facilities in question.
- Identify bridges at risk from flood or earthquakes.
- Enhance evacuation route system capacities and identify alternative measures.

Coordinating Organization: Emergency Management
Internal Partner: Public Works and Planning Division, GIS
External Partner: ODOT, city planning and public works departments, utility companies, emergency response agencies, MWVCOG, ODF, BLM, USFS
Timeline: 1 to 2 years; On-going
Plan Goals Addressed: Preventive; Education; Funding &
Implementation; Partnerships &
Coordination

Multi-Hazard Action Item 10: Strengthen emergency services preparedness and response by linking emergency services with natural hazard mitigation programs and enhance public education on a regional scale.

Ideas for Implementation:

- Educate private property owners on limitations of infrastructure in an emergency (e.g., the county cannot plow private driveways).
- Encourage private property owners to upgrade private roadways to accommodate emergency vehicles.
- Encourage individual and family preparedness through public and private education projects.

- Encourage coordination of emergency transportation routes between the Marion County Sheriff's Office, Marion County Public Works, city jurisdictions, and ODOT.
- Utilize communication technology and equipment to provide the public with emergency/natural hazards information during events.
- Identify partnership opportunities amongst citizens, residents, private contractors, and other jurisdictions, which increase availability of equipment and staffing for response efforts.
- Continue coordination with public officials on requirements for disaster assistance.

Coordinating Organization: Emergency Management
 Internal Partner: Public Works, Planning Division
 External Partners: Cities, ODOT
 Timeline: 3 to 5 years
 Plan Goals Addressed: Public Awareness, Preventive; Education; Emergency Services

Multi-Hazard Action Item 11: Develop, enhance, and implement education programs aimed at mitigating natural hazards and reducing the risk to residents, public agencies, private property owners, businesses, and schools.

Ideas for Implementation:

- Develop outreach programs to Marion County business organizations emphasizing the need to prepare for natural hazard events.
- Develop adult and child public service announcements (PSA) or press releases adapted for communities to be used by local radio and cable stations.
- Utilize recognized "National Weeks" for fire prevention, public works, and other such events.
- Utilize county events such as the county fair and other county-sponsored events to disseminate and provide natural hazards information.
- Utilize county Web site and programs during annual outreach programs by various county divisions and agencies.
- Coordinate with school programs and adult education on reducing risk and preventing loss from natural hazards through education.
- Utilize community resources such as libraries, phone books, etc.
- Conduct natural hazards awareness program outreach in schools and community centers.

- Conduct workshops for public and private sector organizations to raise awareness of mitigation activities and programs.
- Develop outreach materials for mitigation, preparedness, response and recovery.

Coordinating Organization: School districts, facility safety personnel, education service districts

Internal Partner: Emergency Management, Planning and Building Divisions, Health Department

External Partners: CERT, emergency response providers, Red Cross, MWVCOG, OEM, FEMA, media

Timeline: On-going

Plan Goals Addressed: Public Awareness, Preventive, Education, Natural Resources Utilization

Multi-Hazard Action Item 12: Sustain a public awareness campaign about natural hazards.

Ideas for Implementation:

- Survey the public to determine level of preparedness and find out what deters people from taking preventive actions
- Inform and educate the public about potential natural hazards in Marion County, personal preparedness, mitigation activities and opportunities, and options available when natural hazards events occur. The public awareness campaign could include some of the following activities:
 - Present hazard-specific information at public workshops.
 - Distribute preparedness and mitigation information at community fairs and events.
 - Maintain a natural hazards display on historical hazard events at the Marion County Historical Society's museum.
 - Use public service announcements (PSA) to educate people about emergency procedures.
 - Develop a hazards information Web site that contains or links to scientific facts about natural hazards, information on building codes, lists of companies that provide insurance for specific hazards, and educational information on damage prevention.

Coordinating Organization: Emergency Management

Internal Partner: Public Works and Planning Division

External Partners: Red Cross, CERT, MWVCOG, school districts, emergency response

agencies, utility companies, media,
FEMA, OEM
Timeline: On-going
Plan Goals Addressed: Public Awareness, Preventive,
Education, Partnerships &
Coordination

Multi-Hazard Action Item 13: Make the Marion County Emergency Operations Plan, the Natural Hazards Mitigation Plan, and other resources on hazards planning and mitigation available to the public electronically.

Note: Publishing the Emergency Operations Plan and the Natural Hazards Mitigation Plan electronically can foster dissemination of hazards-related information and raise public awareness of natural hazards.

Coordinating Organization: Emergency Management
Internal Partner: County Webmaster
Timeline: 1 to 2 years
Plan Goals Addressed: Public Awareness, Education

Multi-Hazard Action Item 14: Promote hazard-resistant utility construction and maintenance methods (Best Management Practices – BMP).

Ideas for Implementation:

- Support/encourage utility and telecommunications companies to use construction and maintenance methods that reduce service and power outages from various natural hazards.

Coordinating Organizations: MWVCOG, Emergency Management
External Partners: City emergency management
Agencies
Timeline: 3 to 5 years
Plan Goals Addressed: Public Awareness, Preventive,
Education, Natural Resources
Utilization

Multi-Hazard Action Item 15: Develop a system for data collection for undeclared natural hazard events.

NOTE: All disasters are local, and cause cumulative effects for the community. If a natural hazard event is not declared by the state, but the event impacts the county, costs to deal with the event are borne by the county.

Ideas for Implementation:

- Establish a data collection system that collects and stores damage information, and link the information to a GIS database that can provide mapping of the impacted areas of the county.
- Include countywide damage totals and distribution for each event. Over time, this data will show the geographic patterns of occurrence and vulnerability.
- Utilize this data in hazards mitigation planning and prioritizing mitigation projects.

Coordinating Organization: Emergency Management
Internal Partners: Building Division, GIS
External Partners: City emergency management agencies, IISOI, farm services, insurance companies
Timeline: 3 to 5 years
Plan Goals Addressed: Public Awareness, Education, Partnerships & Coordination, Emergency Services

Multi-Hazard Action Item 16: Improve coordination of and evaluate technical and engineering gaps in response services (e.g., communication equipment/systems) for natural hazards event response. Develop ways to improve systems and services e.g., capacity/efficiency), and develop a long-term recovery plan for Marion County from the effects of natural hazards events.

Ideas for Implementation:

- Coordinate with other entities after a seismic event, and identify what limitations exist that inhibit a coordinated response.
- Where possible, develop mutual aid agreements for assistance after catastrophic natural events.
- Develop a long-term recovery plan that identifies how and where Marion County's unincorporated rural communities would rebuild after a catastrophic event.
- Identify likely scenarios for rebuilding structures, transportation routes, and infrastructure conduits.

Coordinating Organization: Emergency Management

External Partner: USGS, DOGAMI, adjacent counties’
emergency management, Red Cross,
hospitals, Army National Guard
Timeline: 1 to 5 years
Plan Goals Addressed: Partnerships & Coordination,
Emergency Services

Natural systems are in a constant state of flux, which creates unpredictability where unforeseen and unplanned natural hazard events happen. The Marion County Natural Hazards Mitigation Plan, through the use of the above multi-hazard action items, can address natural hazards outside of the eight hazards identified by the county. Such additional natural hazard events would be considered a *force majeure* (“Act of a Higher Power”).

All of the action items contained in this document, both hazard specific and multi-hazard, complement each other and prepare our communities to better cope with natural hazards.

Section 5: Plan Implementation, Maintenance and Public Participation

Overview	2
Implementing the Plan	2
<i>Coordinating Body</i>	3
<i>Convener</i>	3
<i>Implementation Through Existing Programs</i>	3
<i>Project Prioritization Process</i>	4
<i>Methodology for Prioritizing Plan Action Items</i>	6
Plan Maintenance: Evaluating and Updating the Plan	9
<i>Semi-Annual Meeting</i>	9
<i>Annual Review Meeting</i>	10
<i>Five-Year Review of Plan</i>	10
<i>Formal Review Process</i>	11
Continued Public Involvement	11



Overview

The plan implementation and maintenance section of this document details the formal process to ensure that the Marion County Natural Hazards Mitigation Plan (NHMP) remains an active and relevant document. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every five years. This section also describes how Marion County will integrate public participation throughout the plan maintenance and implementation process. Finally, this section includes an explanation of how the county intends to incorporate the mitigation strategies outlined in this plan into existing planning mechanisms and programs such as the county's comprehensive land use planning process, capital improvements planning process, and building codes enforcement and implementation.

The plan's format allows Marion County to review and update sections as new data becomes available. New data can be easily incorporated, resulting in a natural hazards mitigation plan that remains current and relevant to Marion County. The benefits of a current and relevant natural hazards mitigation plan include:

- Keeping the public informed of and involved in the county's natural hazards mitigation efforts;
- Building community partnerships and collaboration between local/state/federal governments, local businesses, and private landowners;
- Opening a variety of funding sources and opportunities to the county; and
- Protecting lives, property, and critical resources from natural hazards.

Implementing the Plan

The Marion County Natural Hazards Mitigation Plan was developed and will be implemented through a collaborative process. After the Marion County Board of Commissioners adopts the plan via order, Marion County Emergency Management will be responsible for submitting it to the State Hazard Mitigation Officer at Oregon Emergency Management (OEM). Oregon Emergency Management will then submit the plan to the Federal Emergency Management Agency (FEMA Region X) for review. This review will address the federal criteria outlined in FEMA Interim Final Rule 44 CFR Part 201. Upon acceptance by FEMA, the county will gain eligibility for the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program and Flood Mitigation Assistance program funds.

The Marion County Natural Hazards Mitigation Plan Steering Committee will meet periodically to focus efforts on implementing and maintaining the plan. The steering committee, however, will be condensed to a core team that will be directed to assist with

implementation and monitor the progress of the plan. This coordinating group's role is described in detail later in this document. Marion County Emergency Management will serve as the convener of the condensed steering committee.

The effectiveness of the county's non-regulatory Natural Hazards Mitigation Plan will be contingent on the implementation of the plan and incorporation of the outlined action items into existing county plans, policies, and programs. The Marion County Natural Hazards Mitigation Plan includes a range of action items that, if implemented, would reduce loss from hazard events in the Marion County. The action items in the Marion County Natural Hazards Mitigation Plan provide the framework for activities that county departments and divisions within the county's Public Works Department can choose to implement over the next five years. The Marion County Natural Hazards Mitigation Plan Steering Committee prioritized the plan's goals and identified actions, which will be implemented, as resources permit, through existing plans, policies and programs.

Coordinating Body

The Marion County Emergency Management Division of the Public Works Department will be the coordinating body for the mitigation plan.

To make coordination and review of the Marion County Natural Hazards Mitigation Plan as broad and useful as possible, Marion County Emergency Management will engage additional stakeholders and other relevant hazard mitigation organizations and agencies to implement the identified action items.

Convener

Following a disaster event, Marion County Emergency Management briefs the Board of Commissioners.

The county has designated Marion County Emergency Management as the responsible agency for the implementation and maintenance of the plan. Emergency Management's joint convener shall be the Planning Division of the Public Works Department.

Implementation Through Existing Programs

The Natural Hazards Mitigation Plan includes a range of action items that, when implemented, will reduce loss from severe natural events in Marion County. Within the framework of the plan, FEMA requires the identification of existing programs that might be used to implement these action items.

Marion County currently addresses statewide planning goals and legislative requirements through its comprehensive land use plan, a capital improvement program, transportation systems plan, stormwater management plan, mandated standards and building codes. To the extent possible, Marion County will work to incorporate the recommended mitigation action items into existing plans, programs and

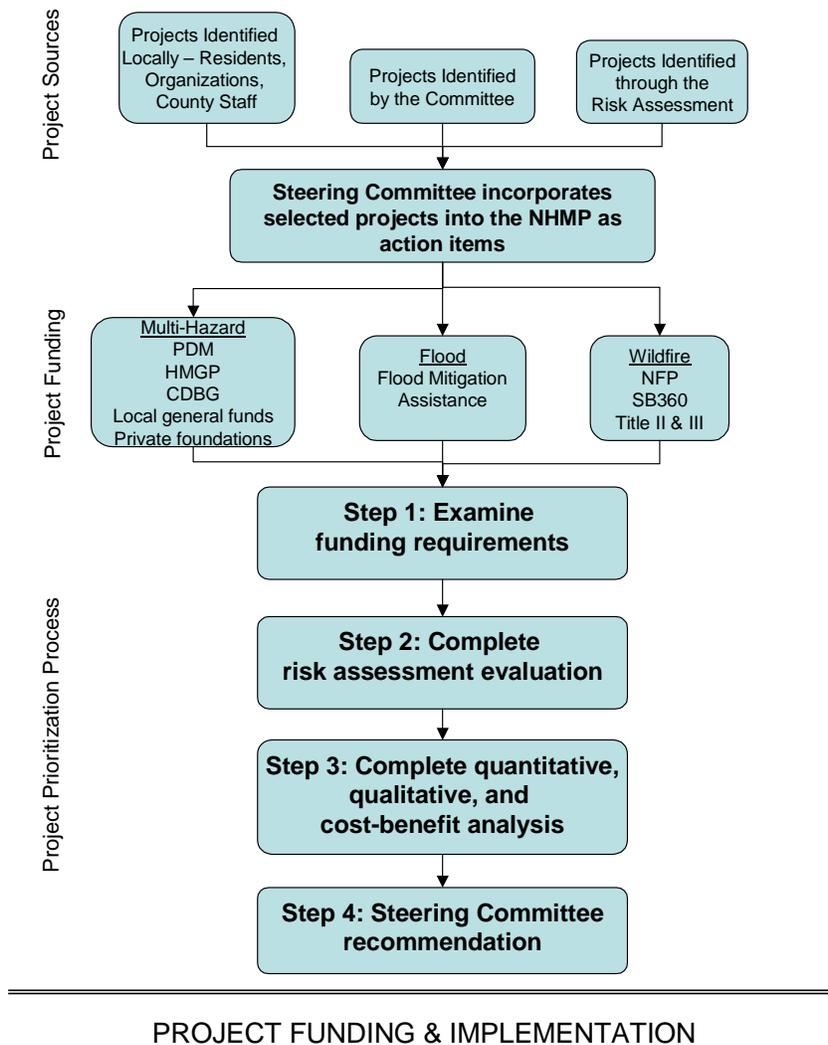
policies. Marion County periodically updates its land use, comprehensive and strategic plans and policies. Implementing the Natural Hazards Mitigation Plan's actions items through existing plans, programs and policies increases the likelihood of action items being supported and increases the likelihood that the plan gets updated to remain current and efficiently utilize the county's existing resources.

Project Prioritization Process

The requirements of the federal Disaster Mitigation Act of 2000 through FEMA's Pre-Disaster Mitigation Program state that the natural hazards mitigation plan must identify a process for prioritizing potential actions. Potential mitigation activities often come from a variety of sources. Therefore, the project prioritization process requires flexibility. Examples of methods in which projects may be identified include: Natural Hazards Mitigation Plan Steering Committee members, local government staff, other planning documents, or the plan's Risk Assessment.

The Steering Committee will consider all proposed projects and select projects that align with the plan's goals. Such projects may then be incorporated into the plan as formal action items. Funding can then be considered for projects that have been formally incorporated into the plan. Depending on the potential project's intent and implementation methods, several funding sources may be appropriate. Examples of mitigation funding sources include but are not limited to: FEMA's Pre-Disaster Mitigation competitive grant program (PDM), Flood Mitigation Assistance (FMA) program, National Fire Plan (NFP), Title II and Title III funds, Community Development Block Grants (CDBG), local general funds, and private foundations, among others. The prioritization process utilizes a four-step process to prioritize activities to help ensure that mitigation dollars are used in a cost effective manner. Figure 5.1 illustrates the project prioritization process.

Figure 5.1: Project Prioritization Process Overview



Source: Community Service Center's Oregon Natural Hazards Workgroup at the University of Oregon, 2005

Economic Analysis of Mitigation Projects

The Federal Emergency Management Agency's methods of identifying the costs and benefits associated with natural hazard mitigation strategies, measures and projects fall into two general categories: benefit/cost analysis and cost-effectiveness analysis. Conducting benefit/cost analysis for a mitigation activity can assist communities in determining whether a project is worth undertaking now, in order to avoid disaster-related damages later. Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. Determining the economic feasibility of mitigating natural hazards provides decision-makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects.

Marion County Emergency Management, the condensed Steering Committee, and the county's Planning Division will use FEMA-approved cost/benefit methodology as a tool for identifying and prioritizing mitigation action items when applying for federal mitigation funding. For other projects and funding sources, Emergency Management and Planning will use other approaches to understand the costs and benefits of each action item and develop a prioritized list. For more information regarding economic analysis of mitigation action items, please see Appendix C.

Methodology for Prioritizing Plan Action Items

To initially prioritize the plan's action items, Marion County utilized a multi-tiered approach. First, the plan goals were prioritized. Second, the Natural Hazards Mitigation Plan Steering Committee prioritized the community hazards.

Using the outcome of these two activities, each action item was tallied according to a point system in a third step in order to determine its relative priority within the plan. The prioritized list of action items serves simply as a starting point for the implementation of mitigation activities; it does not dictate the order of implementation.

The Natural Hazards Mitigation Plan Steering Committee and the Marion County Board of Commissioners have the option to implement any of the action items at any time, regardless of the prioritized order. This allows the committee to consider mitigation strategies as new opportunities arise, such as funding for action items that may not be of highest priority. This methodology used by the Natural Hazards Mitigation Plan Steering Committee to initially prioritize the plan's goals and action items will also be used by the Emergency Management Division of Marion County Public Works to maintain the list.

Marion County Emergency Management will convene a condensed Natural Hazards Mitigation Plan Steering Committee to review the issues surrounding grant applications and shared knowledge and/or resources. This process will afford greater coordination and less competition for limited funds.

Step 1: Prioritizing Plan Goals

To accomplish this task, the Natural Hazards Mitigation Plan Steering Committee examined and voted on the importance of each of the plan's seven goals. The steering committee was led through a prioritization activity to determine the relative priority of each goal. Steering committee members were instructed to prioritize the goals from highest to lowest, thereby ranking the importance of each goal in making Marion County more disaster resilient.

The steering committee was reminded that goals are designed to drive actions and that they are intended to represent the general end toward which the county's efforts are directed. They do not specify how the county is to achieve the level of performance. They are the guiding principles for the specific recommendations that are outlined in the

action items. The steering committee was asked to rank the goals regardless of how each goal would be to accomplish. After the vote, their priorities were tallied and the results are as follows:

1. Increase public awareness of natural hazard risks, emergency notification and response, and resources for citizen preparedness.
2. Educate the public on how to prepare to successfully endure a natural disaster with minimal property damage and no loss of life.
3. Minimize risks to life, property, the environment, and the economy from natural hazards.
4. Identify potential funding sources and implement potential mitigation projects.
5. Create and enhance partnerships with other stakeholders involved with natural hazard management; and coordinate natural hazard mitigation efforts with adjacent jurisdictions and public/private agencies' risk management activities.
6. Promote the use of natural systems and features, watershed planning, and land use planning for natural hazard mitigation whenever possible to reduce long-term costs to the county and maximize effectiveness.
7. Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Each action item in the plan is associated with one or more of these goals.

Step 2: Prioritizing Community Hazards

The second step in prioritizing the plan's action items was to examine which hazards they are associated with and where these hazards rank in terms of community risk.

To rank the hazards, each steering committee member completed a "relative priority" matrix like the one shown in Table 5.1.

Table 5.1 Natural Hazard Prioritization – Relative Priority Matrix

Natural Hazard	Frequency +	Area of Impact x	Magnitude of Damages =	Total
Flood				
Landslide				
Wildfire				
Severe Winter Storm				
Windstorm				
Drought				
Earthquake				
Volcanic Eruption				

The steering committee scored frequency, area of impact, and magnitude of damages from 1 to 5, with 1 being a low score and 5 the highest. The Frequency and Area of Impact scores were then added together and the result multiplied by the Magnitude of Damages score to calculate the Total score.

The rank ordering of hazards by risk follows:

1. Flood
2. Severe Winter Storm
3. Windstorm
4. Earthquake
5. Wildfire (tie)
5. Drought (tie)
6. Landslide
7. Volcanic Eruption

Each of the action items in the plan addresses risk from one or more of these hazards.

Step 3: Prioritizing and Implementing Action Items

The Natural Hazards Mitigation Plan Steering Committee and Marion County Emergency Management will consider action items for implementation based on the following information:

1. The prioritized Natural Hazards Mitigation Plan goals. Does the action item address a highly prioritized goal? Does it address multiple goals?
2. The degree of risk from the hazard. Does the action item address a high-risk hazard? Does it address multiple hazards?

The Steering Committee will determine whether or not the plan’s Risk Assessment supports the implementation of the action item i.e., mitigation activity. This determination will be based on the location of

the potential activity and the proximity to known hazard areas, historic hazard occurrence, and the probability of future occurrence.

Marion County’s Emergency Management will review, guide and promote the implementation of action items. In examining the feasibility of the plan’s prioritized action items, benefit/cost analysis would be encouraged for all structural mitigation projects. For FEMA-funded, nonstructural projects or projects funded through entities other than FEMA, a qualitative assessment will be completed to determine the project’s cost effectiveness. See Appendix C for more information on the assessment processes.

Step 4: Steering Committee Recommendation

Based on the steps above, the Steering Committee will recommend whether or not the mitigation activity should move forward. If the Steering Committee decides to sanction the action, Emergency Management would contact the coordinating organization designated for the activity to proceed and to document success upon project completion.

Plan Maintenance: Evaluating and Updating the Plan

Plan maintenance is a critical component of the natural hazards mitigation plan. Proper maintenance of the plan will ensure that this plan will benefit Marion County’s efforts to reduce the risks posed by natural hazards. The University of Oregon’s Oregon Natural Hazards Workgroup developed the following ‘plan maintenance’ section, which presents a process to ensure that a regular review and update of the plan occurs. The condensed Natural Hazards Mitigation Plan Steering Committee and local staff will be responsible implementing this process in addition to maintaining and updating the plan through a series of meetings outlined in the plan review meeting schedule shown in Table 5.2. As of September 23, 2005, the Steering Committee approved this process.

Table 5.2: Plan Review Meeting Schedule

Semi-Annual Meeting	Annual Review Meeting	Five-Year Review
Review Current Actions	Update Risk Assessment data and findings based on new data	Review plan update questions
Identify New Issues and Needs	Discussion of methods of continued public involvement	Update plan sections as necessary
Prioritize Potential Projects	Documenting successes and lessons learned	

Semi-Annual Meeting

The condensed Steering Committee will meet on a semi-annual basis to:

- Review existing action items to determine appropriateness for funding;
- Identify issues that may not have been identified when the plan was developed; and
- Prioritize potential mitigation projects using the methodology described below.

The convener will be responsible for documenting the outcome of the semi-annual meetings. The process the Steering Committee will use to prioritize mitigation projects is detailed in the 'Project Prioritization Process' section, above.

Annual Review Meeting

The Steering Committee will meet annually to review updates of the Risk Assessment data and findings, discuss methods of continued public involvement, and document successes and lessons learned based on actions that were accomplished during the past year. The co-convener will be responsible for documenting the outcomes of the annual meeting.

Five-Year Review of Plan

This plan will be updated every five years in accordance with the update schedule outlined in the Disaster Mitigation Act of 2000. During the five-year plan update, the following questions should be asked to determine what actions are necessary to update the plan. The co-conveners will be responsible for convening the Steering Committee to address the questions outlined below.

- Are the plan goals still applicable?
- Do the plan's priorities align with state priorities?
- Are there new partners that should be brought to the table?
- Are there new local, regional, state, or federal policies influencing natural hazards that should be addressed?
- Has the community successfully implemented any mitigation activities since the plan was last updated?
- Have new issues or problems related to hazards been identified in the community?
- Do existing actions need to be reprioritized for implementation?
- Are the actions still appropriate given current resources?
- Have there been any changes in development patterns that could influence the effects of hazards?
- Have there been any significant changes in the community's demographics that could influence the effects of hazards?
- Are there new studies or data available that would enhance the risk assessment?

- Has the community been affected by any disasters? Did the plan accurately address the impacts of this event?

These questions will help the Steering Committee determine what components of the mitigation plan need updating. The Marion County Emergency Management staff will be responsible for updating any deficiencies found in the plan based on the questions above.

Formal Review Process

This section presented Marion County's method to ensure that regular review and updating of the Marion County Natural Hazards Mitigation Plan occurs. In summary, Marion County Emergency Management is responsible for monitoring and evaluating the progress of the mitigation strategy in the plan. Emergency Management, as convener, will also organize plan review meetings on a regular basis.

At the plan review meetings, the condensed Steering Committee will review the mission and goals to determine their relevance to changing situations in the community, as well as to changes in state or federal policy, and to ensure that they continue to address current and expected conditions. The plan review meetings would also include annual review of the risk assessment portion of the plan to determine whether this information should be updated or modified. This review process would be conveyed to other interested parties via newsletters, presentations, the county Website, and the media.

Emergency Management is the responsible party for incorporating the changes and updates to the plan. On an annual basis, Emergency Management will present to the county Board of Commissioners updated drafts of the updated plan ready for adoption or for amending the existing plan. Upon adoption by the Board of Commissioners, the updated plan would then be submitted to the Oregon State Police – Office of Emergency Management (OEM) and to FEMA.

Continued Public Involvement

Marion County is dedicated to directly involving the public in the continual reviewing and updating of the Natural Hazards Mitigation Plan. Although members of the Natural Hazards Mitigation Plan Steering Committee represent the general public to some extent, the public will also have the opportunity to provide feedback about the plan.

A copy of the plan will be made available to the public at the offices of Marion County Emergency Management. In addition, access to the plan and notices of all updates and changes will be maintained on the Marion County Public Works Department Website. The Website will also provide the public with an e-mail address and phone number so that they may submit comments and questions about the plan.

A public meeting will be held for each annual evaluation when deemed necessary by the Marion County Emergency Management Coordinator. The meetings will provide a public forum for expressing concerns,

opinions or ideas about the plan. The Emergency Management Division of the Marion County Public Works Department will be responsible for publicizing public meetings and maintaining public involvement.

Section 6: Flood

- Why are Floods a Threat to Marion County? 2**
 - History of Flooding in Marion County 2
 - Repetitive Flood Losses in Marion County..... 5
 - What Factors Create Flood Risk 6
 - Floodplain Terminology 8
 - Characteristics of Flooding in Marion County 10
 - What is the Effect of Development on Floods? 10
 - How Are Flood-Prone Areas Identified?..... 11
- Flood Hazard Assessment 12
 - Hazard Identification 12
 - Vulnerability Assessment 13
 - Risk Analysis 13
- Community Flood Issues 13
 - What is Susceptible to Damage During a Flood Event? 13
- Existing Mitigation Activities 16
- Wetlands 23
- Mitigation Plan Goals 26
- Flood Mitigation Action Items 27
- Short-term (ST) Flood Action Items 27
- Long-term (LT) Flood Action Items 29
 - Flood Mitigation Resources 33
 - County Resources 33
 - State Resources..... 34
 - Regional Resources..... 36
 - Federal Resources and Programs 36
 - Additional Resources 39

Why are Floods a Threat to Marion County?

Marion County has several large rivers and smaller tributaries that are susceptible to annual flooding events. Flooding poses a threat to life and safety, and can cause severe damage to public and private property.

The County's most devastating floods of recent history occurred in 1996. In February 1996, prolonged precipitation accompanied by an early snowmelt caused many rivers and creeks throughout the Willamette River watershed to rise to 100-year flood levels. The Willamette River and many of its tributaries were filled beyond capacity, causing flooding in both rural and urban areas.

The 1996 floods caused a statewide loss of \$400 million in damages, as 26 major rivers rose to flood stage. More than 100 Red Cross and Salvation Army shelters were opened, and 23,000 residents fled their homes. Seven casualties were reported, and 50 people were injured. An estimated 1,700 Oregonians lost their jobs due to flooding, and the Small Business Association (SBA) loaned Oregon businesses over \$40.5 million to assist with recovery efforts.¹

Although this flood was a large-scale disaster, it was not unprecedented. During the Christmas Flood of 1964, over \$157 million in damage was done, and 20 Oregonians lost their lives.²

Residents in Marion County share a statewide concern about flood issues. According to the National Flood Insurance Program (NFIP), Oregon has 256 flood-prone communities within the 36 counties of the state. Although all of the counties in the state are vulnerable to flooding events, the risk of loss is much more pronounced in some counties than others.

As of September 2002, Oregon had 26,273 NFIP policies with an annual premium total of \$11,999,383 – 21.422 for single-family dwellings, 1,023 for two to four-family structures; 1,820 for other residential; and 2,008 for nonresidential. The average premium for all building types was \$457. For residential, the average premium was \$408 and for nonresidential is \$1,051.

Based on data through 2003, Marion County's population in its unincorporated area is 83,242 persons, with 16,034 one to four-family structures and 30,013 other structures. In the flood hazard areas only, the county's population is 3,423 persons with 797 one to four-family structures and 2,634 other structures.³

History of Flooding in Marion County

The Willamette River basin has a long history of flooding. Many mid-Willamette Valley residents may be familiar with the legendary floods of the 19th Century. The largest flood on record on the Willamette River occurred in 1861. In 1861, town of Champoeg disappeared in the flood.⁴ Since then, however, the construction of flood control dams in the 1940s and 1950s has changed the pattern of flooding significantly. Marion County has seen two major floods and three lesser floods during the last 35 years. One of the most memorable floods during this time period, the "Christmas" flood

of 1964, was rated "approximately a 100-year flood" by FEMA and was probably the most damaging in Oregon's history ⁵

December-January 1964

The "Christmas" flood of 1964 was the largest flood to occur since the major dam construction on the upper Willamette. This flood occurred as a result of two storms, one on December 19, 1964 and the other on January 31, 1965. These storms brought record-breaking rainfall that exacerbated near record early season snow depths. The flooding caused ten deaths, \$5 million dollars of damage to State bridges and \$10 million dollars of damage in Marion County.⁶ There were hundreds of landslides, bridges and roads washed out, houses were damaged or destroyed, and thousands of people were forced to evacuate their homes. Governor Mark Hatfield declared the entire State an emergency disaster area, and called the flooding, "the worst disaster ever to hit the state."⁷

Marion County Commissioners also declared the County a disaster area as the Willamette River crested at 29.7 feet in Salem; nearly 10 feet above flood stage, and most other streams in Marion County overflowed their banks.⁸ The floodwaters rendered sewage treatment plants in Salem inoperable causing raw sewage to be channeled directly into the Willamette River.

A significant portion of Keizer was inundated and more than a thousand people were evacuated.⁹ One hundred and twenty one patients were evacuated from the Salem Memorial Hospital and fifteen families in the Turner/Salem area were evacuated from their homes. In Independence, thirty people were temporarily housed in City Hall to escape the floods. Further east, the entire Detroit-Idanha-Marion Forks area was isolated by massive washouts near Detroit Dam and Marion Forks. Seven homes were washed away in Idanha and a landslide destroyed one house.¹⁰

January 1974

Heavy snow and freezing rain and a series of mild storms caused snowmelt and rapid runoff. The storms resulted in two fatalities and thirteen injuries in Oregon.¹¹ Nine counties in Oregon were declared disaster areas, including Marion County.¹²

In Marion County, the Willamette River crested at 32 feet, four feet above flood level and two bridges were washed away on Mill Creek. Many residents experienced power outages and four Turner residents were evacuated from their homes and more than twenty roads were closed due to high water. In Salem and other communities, wastewater treatment plants exceeded capacity resulting in millions of gallons of raw sewage being discharged into the Willamette River. Total damages to Marion County were approximately \$1.75 million.¹³

February 1986

This flood, caused by a combination of heavy rains and snowmelt, caused the Willamette River to crest at just over 29 feet and within ten inches of flooding. The Pudding River crested at 24½, two-and-one-half feet above

flood levels. In Salem, Minto Island was closed because of high water on roads¹⁴.

February 1996

Residents of Marion County experienced more than one flood during 1996. In February of 1996, a combination of snow-pack, warm temperatures, and record-breaking rains caused streams to rise to all-time flood record levels.¹⁵ Statewide, there were five flood related deaths¹⁶ and 150 people were evacuated from their homes.¹⁷ During this 25 -year flood event, overflow from the Little Pudding River inundated secondary roads, homes, and farmlands.

Two State parks along the Willamette River in Marion County suffered loss during the flood. Champoeg State Heritage Area lost all its picnic tables, and had to rewire all their electrical systems.¹⁸ Willamette Mission State Park is located on what is known as 'Beaver Island,' and also suffered severe damage.¹⁹ All the park's facilities were flooded, there was no power to the restrooms, all picnic tables were washed away, and some were found in trees down river.²⁰ A large chunk of riverbank in the park disappeared with the floods.²¹

Dikes collapsed upstream from the City of Jefferson, and water came not from the South Santiam River, but from areas parallel to the river – water trying to get back into the river.²² There were serious erosion problems within the South Santiam drainage basin.²³

Claggett Creek also presented flooding problems during the February floods, and was described as a 100-year storm event for the creek.²⁴ Three houses with basements flooded in the Keizer area. These houses were removed from the floodplain with FEMA funding assistance.²⁵

Marion Soil & Water Conservation District acted as pass through for \$3.5 million from USDA Natural Resources Conservation Service (NRCS) to get financial assistance to farmers, who provided a 25 percent match.²⁶

Flood damages from this flood event were estimated at \$2.6 million for the entire Pudding/Little Pudding River Basin.²⁷ In Keizer, damages reached \$4.2 million.²⁸ Total damages within Marion County were approximately \$24 million.²⁹

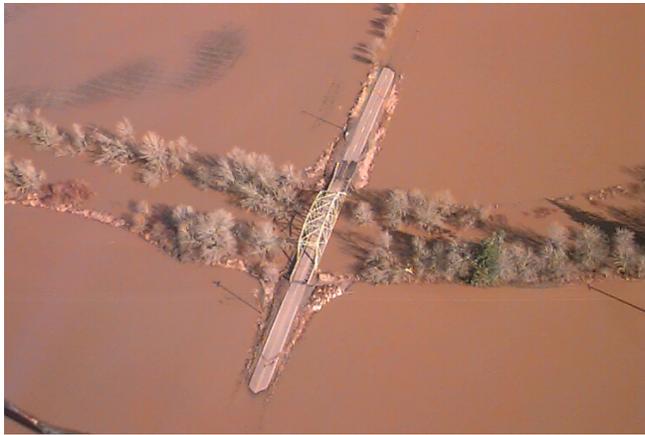
November 1996

Months after the flood of February 1996, Marion County experienced high water again. November 1996 brought with it more flooding to County residents and added damage from the year's previous flood. Like February's storm, the "pineapple express," a weather system that draws large amounts of moisture from an area near Hawaii and deposits it on the West Coast, caused the heavy rain.³⁰ Salem received about six inches of rain over a 48-hour period. The heavy rains swamped the Salem-Keizer sewer system, sent raw sewage into the Willamette River and caused smelly backups in some Salem residents' basements.³¹ Adding to the troubles of the Salem-Keizer area, eighteen inches of water flooded a Keizer subdivision damaging several homes.

Rural areas of the county were also hit hard by November's deluge. Five rural homes were evacuated and dozens of roads were closed. One such road was Parker Road near Independence. Floodwaters wiped out a 70-foot section of this road and left a fifteen-foot hole filled with rushing waters. Four motorists drove their vehicles into the gap, one was seriously injured and others' lives were put in jeopardy during rescue operations.³²

January 1997

This January storm was rooted in the last days of December 1996. Heavy rains once again caused flooding throughout the County. The Willamette River crested at 29 feet, one foot above flood level. Five thousand Mid-Willamette Valley residents lost power as high winds that accompanied the rain blew down power lines. Fallen trees and debris backed up sewer lines in Salem, and subdivisions in northeast Keizer were once again flooded, causing damages estimated at hundreds of thousands of dollars³³.



Marion County Flood Monitor-McKee Road and Bridge in February 1996

Repetitive Flood Losses in Marion County

The properties in and near the floodplains of Marion County are subject to flooding events almost annually. Since flooding is such a pervasive problem throughout the County, many residents have purchased flood insurance to help recover from losses incurred from flooding events. Flood insurance covers only the improved land, or the actual building structure. Although flood insurance assists in recovery, it can provide an inappropriate sense of protection from flooding. Many residents who have had flood damage rebuild in the same vulnerable areas, only to be flooded again. These properties are termed *repetitive loss* properties, and are very troublesome because they continue to expose lives and valuable property to the flooding hazard. Local governments as well as federal agencies such as FEMA recognize this pitfall in floodplain insurance, and attempt to remove the risk from repetitive loss of properties through projects such as acquiring land and relocating homes, or by elevating structures.

Continued repetitive loss claims from flood events lead to an increased amount of damage caused by floods, higher insurance rates, and contribute to the rising cost of taxpayer funded disaster relief for flood victims.³⁴

As of 2004, Marion County has three repetitive loss properties under the National Flood Insurance Program (NFIP) that involves properties with NFIP policies. A fourth repetitive loss property was removed in July 2002 when flood mitigation/protection was provided to the structure, elevating it above the base flood elevation.³⁵ Marion County residents have received approximately \$765,500 in repetitive loss payments through 2000.³⁶

What Factors Create Flood Risk

Flooding occurs when climate (or weather patterns), geology, and hydrology combine to create conditions where water flows outside of its usual course. In Marion County, geography and climate combine to create chronic seasonal flooding conditions.

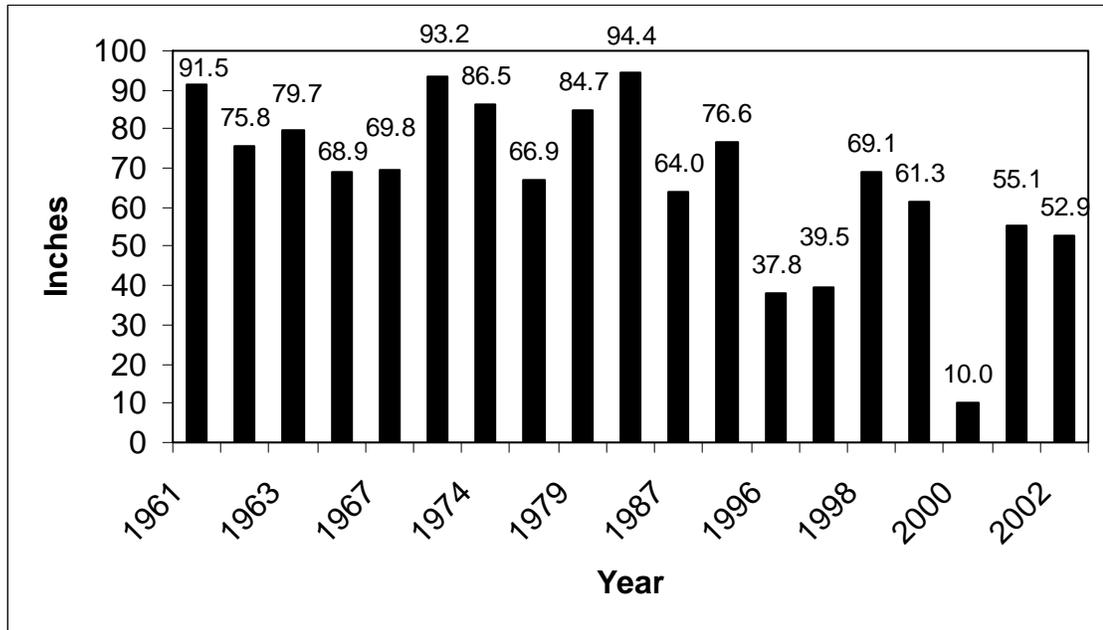
Precipitation

Because Marion County spans a wide range of climatic and geologic regions, there is considerable variation in precipitation, with elevation being the largest factor in precipitation totals. Elevation in Marion County ranges from about 5,000 feet in the Cascades to about 100 feet along the Willamette River. As is typical for the west side of the Cascades, precipitation is not spread evenly over the calendar year but falls during the winter and spring months in a water year that runs from October to May or June. Correspondingly, the average monthly precipitation ranges from approximately fourteen inches in the highest elevations to approximately five inches in lower elevation areas of the County.³⁷ Map 2 in Section 2 shows precipitation throughout Marion County.

The amount of precipitation is not the only factor that influences peak flows. They are also influenced by withdrawals for irrigation and drinking water, stream and wetland modifications, changes in land use and water-related technology, and the removal of vegetation.³⁸ These factors not only affect the amount of water present in streams, but also the rate of release of water into streams during a storm.

Flooding is most common from October through April, when storms from the Pacific Ocean, 60 miles away, bring intense rainfall to the area.³⁹ Marion County receives approximately 40.35 inches of rain on average each year⁴⁰ (see Figure 6.1 & 6.2). During winter months, rainfall totals average far higher than other months of the year. This results in high water, particularly in December and January. The larger floods are the result of heavy rains of two-day to five-day durations augmented by snowmelt at a time when the soil is near saturation from previous rains. Frozen topsoil also contributes to the frequency of floods.⁴¹

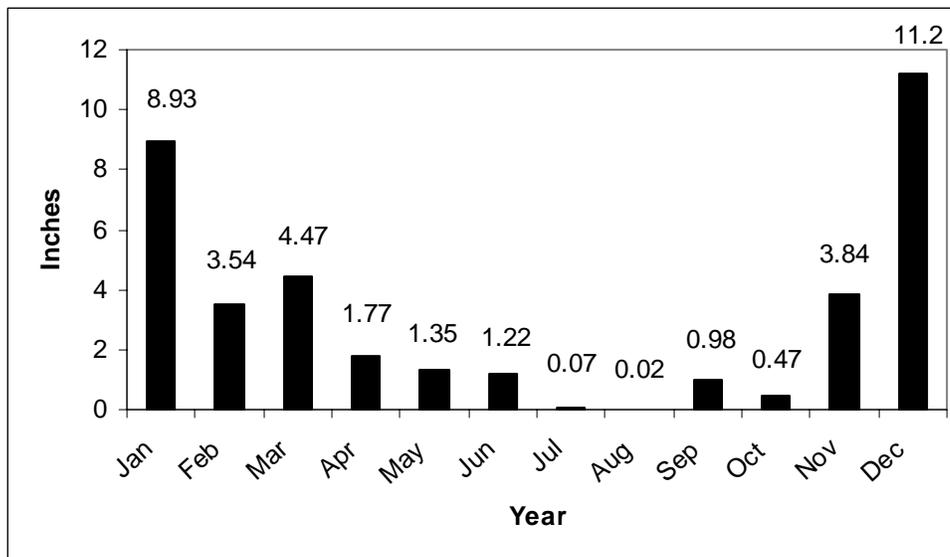
Figure 6.1 Annual Precipitation, Marion County, Oregon, 1961-2002



Source: Oregon Climate Service

Data missing for the following incomplete years: 1969 – 1973, 1975-1977, 1980-1983, 1988-1994 – Silver Creek Falls station.

Figure 6.2 Average Monthly Rainfall for Salem, Oregon 2002



Oregon Climate Service, Zone 2 Climate Data Archives. Webpage: <http://www.ocs.orst.edu/>

Geography

Marion County is located in the Mid-Willamette Valley, east of the Coast Range that runs the length of the entire state, and approximately 60 miles east of the Oregon Coast. Further inland from the coast are the Cascades whose slopes shoulder the County's eastern lands. Generally, weather

patterns move in a west-to-east direction. As such, most air masses that reach Marion County have moved for several days over the Pacific Ocean. When the air masses rise over the Coast Range they cool and become oversaturated. As a result, Marion County and the western slopes of the Cascades receive more precipitation than most parts of the United States.⁴² Both mountain ranges also protect counties in the Willamette Valley. The Coast Range provides a buffer from eastward moving coastal storms and the Cascades shield the Willamette Valley from great masses of continental air moving westward that cause extreme temperatures east of the Cascades.⁴³

Soils

There are eleven soil associations in Marion County ranging from excessively drained gravelly soils to poorly drained silt soils over clay loam. In areas near the Willamette River, soils are often formed in alluvial and lacustrine materials that are prone to flooding in many places.⁴⁴

Floodplain Terminology

Floodplain

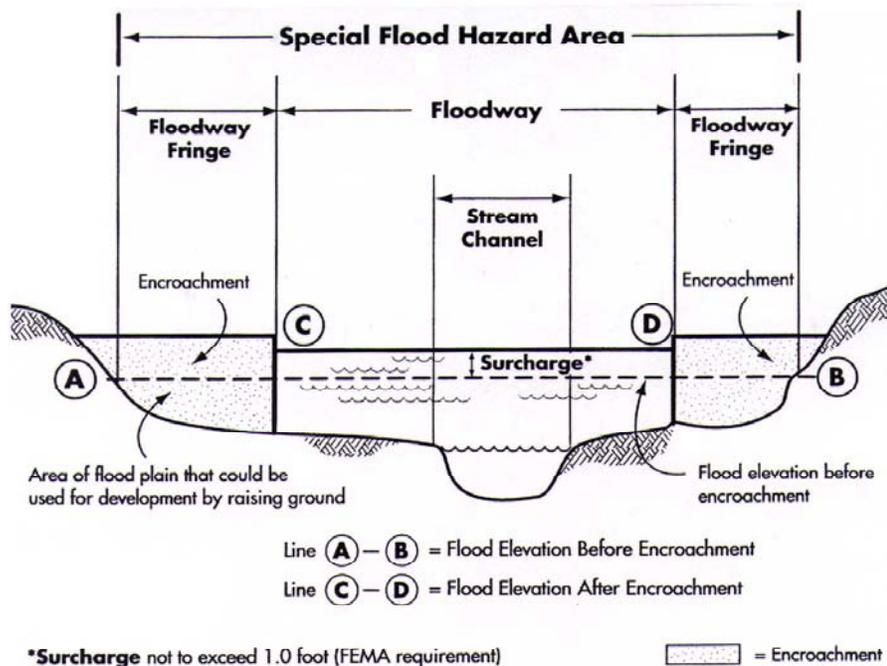
A floodplain is a land area adjacent to a river, stream, lake, estuary, or other water body that is subject to flooding (see Figure 6.3). This area, if left undisturbed, acts to store excess floodwater. The floodplain is made up of two sections: the floodway and the flood fringe.

Floodway

The floodway is one of two main sections that make up the floodplain. Unlike floodplains, floodways do not reflect a recognizable geologic feature and are defined for regulatory purposes by the National Flood Insurance Program (NFIP) as “the channel of a river or other watercourse and adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than one foot.”

The floodway carries the bulk of the floodwater downstream and is usually the area where water velocities and forces are the greatest. NFIP regulations require that the floodway be kept open and free from development or other structures that would obstruct or divert flood flows onto other properties. Floodways are not mapped for all rivers and streams but are generally mapped in developed areas.

Figure 6.3. Floodplain Schematic



Source: Floodplain Management in Missouri. (March 1999) Missouri Emergency Management Agency

Flood Fringe

The flood fringe refers to the outer portions of the floodplain, beginning at the edge of the floodway and continuing outward. The Marion County revised Flood Overlay Zoning Ordinance defines the flood fringe as “the area of the floodplain lying outside of the floodway as delineated on the Flood Boundary Floodway Map (FBFM) where encroachment by development will not increase the flood elevation more than one foot during the occurrence of the base flood discharge.” This is the area where development is most likely to occur, and where precautions to protect life and property need to be taken. The Marion County Flood Overlay Zoning Ordinance details acceptable uses within flood fringe and is codified in Chapter 19 of the County’s revised Urban Zoning Ordinance and Chapter 178 of the County’s revised Rural Zoning Ordinance.

Base Flood Elevation (BFE)

The term “Base Flood Elevation” refers to the height of the base flood, usually in feet, in relation to the National Geodetic Vertical Datum of 1929, the North American Vertical Datum of 1988, or other datum referenced in the Flood Insurance Study report, or average depth of the base flood, usually in feet, above the ground surface.⁴⁵ Base flood elevations can be set at levels other than the 100-year flood. Marion County defines its Base Flood Level as “the flood level having a one percent chance of being equaled or exceeded in any given year (100 year floodplain).”⁴⁶

Some communities choose to use higher frequency flood events as their base flood elevation for certain activities, while using lower frequency events for

others. For example, for the purpose of stormwater management, a 25-year flood event might serve as the base flood elevation, while the 500-year flood event may serve as the base flood elevation for the tie down of manufactured dwellings. The regulations of the NFIP focus on development in the 100-year floodplain.⁴⁷

Characteristics of Flooding in Marion County

Two types of flooding primarily affect Marion County: *urban* flooding and *riverine* flooding (see descriptions below). In addition, any low-lying area has the potential to flood. The flooding of developed areas may occur when the amount of water generated from rainfall and runoff exceeds a stormwater system's (ditch or sewer) capability to remove it.⁴⁸

Urban Flooding

As land is converted from fields or woodlands to roads and parking lots, it loses its ability to absorb rainfall. 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 violent force.

Most urban areas have a high concentration of impermeable surfaces that either collect water, or concentrate the flow of water in unnatural channels. 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.

Riverine Flooding

Riverine flooding is the over-bank flooding of rivers and streams. 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.⁴⁹

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 one to three feet. These areas are generally flooded by low velocity sheet flows of water.

What is the Effect of Development on Floods?

When structures or fill are placed in the floodway, water is displaced. Development raises the base flood elevation by forcing the river to compensate for the flow space obstructed by the inserted structures and/or fill. When structures or materials are added to the floodway, and no fill is removed to compensate, serious problems can arise. Floodwaters may expand beyond historic floodplain areas. As a result, other existing floodplain areas may experience floodwaters that rise above historic levels.

Local governments must manage development in floodplains and floodways to assure that any encroachments in the floodway or floodplain are

minimized. This can be by cut-and-fill balance and other methods to prevent the rise of pre-development flood levels. Displacement of only a few inches of water can mean the difference between no structural damage occurring in a given flood event, and the inundation of many homes, businesses, and other facilities. Careful attention must be paid to development that occurs within the floodway to ensure that structures are prepared to withstand base flood events without exacerbating flood levels.

How Are Flood-Prone Areas Identified?

Flood maps and Flood Insurance Studies are often used to identify flood-prone areas. The National Flood Insurance Program (NFIP) was established in 1968 as a means of providing low-cost flood insurance to the nation's flood-prone communities. The NFIP also reduces flood losses through regulations that focus on building codes and "sound floodplain management."⁵⁰ In Marion County, the NFIP and related building code regulations went into effect in 1974. NFIP regulations (44 Code of Federal Regulations (CFR) Chapter 1, Section 60.3) require that all new construction in floodplains must be elevated at or above base flood level. The Oregon Building Code requires new construction to be elevated one foot above the base flood elevation.

Communities participating in the NFIP may adopt regulations that are more stringent than those contained in 44 CFR 60.3, but not less stringent.⁵¹ In Marion County, all homes and other buildings legally constructed in the floodplain after January 1974 must be mitigated to NFIP standards with the first floor being elevated at least one foot above base flood level, or in the case of non-residential buildings, flood proofed to at least one foot above the base flood level.

FIRM Maps and Flood Insurance Studies

Floodplain maps are the basis for implementing floodplain regulations and for delineating flood insurance purchase requirements. A Flood Insurance Rate Map (FIRM) is the official map produced by the Federal Emergency Management Agency (FEMA), which delineates Special Flood Hazard Areas or floodplains where National Flood Insurance Program regulations apply. The maps are also used by insurance agents and mortgage lenders to determine if flood insurance is required and what insurance rates should apply.

Water surface elevations are combined with topographic data to develop FIRMs. These maps illustrate areas that would be inundated during a 100-year flood, floodway areas, and elevations marking the 100-year-flood level. In some cases, they also include base flood elevations (BFEs) and areas located within the 500-year floodplain.

Flood Insurance Studies and FIRMs produced for the NFIP provide assessments of the probability of flooding at a given location. FEMA conducted many Flood Insurance Studies in the late 1970s and early 1980s. FEMA flood maps, however, are not entirely accurate. These studies and maps represent flood risk at the point in time when FEMA completed the studies, and do not incorporate planning for floodplain changes in the future due to new development. Although FEMA is considering changing that

policy, it is optional for local communities. It should be noted that artificial and natural changes to the environment have changed the course of many of the rivers in Marion County, as well as their associated floodplain boundaries.⁵²

Flood Mapping Methods and Techniques

Although many communities rely exclusively on FIRMs to characterize the risk of flooding in their area, there are some flood-prone areas that are not mapped but remain susceptible to flooding. These areas include locations next to small creeks, local drainage areas, and areas susceptible to human-made flooding.

In order to address this lack of data, many jurisdictions have taken efforts to develop more localized flood hazard maps. One method that has been employed includes using high-water marks from flood events or aerial photos, in conjunction with the FEMA maps, to better reflect the true flood risk.

The use of GIS (Geographic Information System) is becoming an important tool for flood hazard mapping. FIRM maps can be imported directly into GIS, which allows for GIS analysis of flood hazard areas. Communities find it particularly useful to overlay flood hazard areas on tax assessment parcel maps. This allows a community to evaluate the flood hazard risk for a specific parcel during review of a development request. Coordination between FEMA and local planning jurisdictions is the key to making a strong connection with GIS technology for the purpose of flood hazard mapping.

FEMA and the Environmental Systems Research Institute (ESRI), a private company, have formed a partnership to provide multi-hazard maps and information to the public via the Internet. ESRI produces GIS software, including ArcView[®] and ArcInfo[®]. The ESRI Web site contains information on GIS technology and downloadable maps. The hazards maps provided on the ESRI Web site are intended to assist communities in evaluating geographic information about natural hazards. Flood information for most Oregon communities is available on the ESRI Web site. Visit <http://www.esri.com> for more information.

Flood Hazard Assessment

Hazard Identification

Hazard identification is the first phase of flood-hazard assessment. Identification is the process of estimating: (1) the geographic extent of the floodplain (i.e., the area at risk from flooding); (2) the intensity of the flooding that can be expected in specific areas of the floodplain; and (3) the probability of occurrence of flood events. This process usually results in the creation of a floodplain map. Floodplain maps provide detailed information that can assist jurisdictions in making policies and land-use decisions. Map 5 shows 100-year floodplains within Marion County. Map 6 shows the major river subbasins within the county.

Vulnerability Assessment

Vulnerability assessment is the second phase of flood hazard assessment. It combines the floodplain boundary, generated through hazard identification, with an inventory of the property within the floodplain. It identifies the number of properties at risk from flooding, and the dollar value of the property at risk. Floodplain data for Marion County can be used to conduct a preliminary vulnerability assessment for flood and drainage hazard areas.

Risk Analysis

Risk analysis is the third and most advanced phase of a hazard assessment. As such, it builds upon the hazard identification and vulnerability assessment.

A flood risk analysis for Marion County should include two components:

- (1) The amount of loss to both property and life that may result from a flood event (defined through the vulnerability assessment); and,
- (2) The number of flood events expected to occur over time. Within the broad components of a risk analysis, it is possible to predict the severity of damage from a range of events. For example, a risk analysis can be conducted for both 25-year (smaller storm) floodplains (Drainage Hazard Areas), and 100-year (larger storm) floodplains. Over time, the Drainage Hazard Areas will flood more often than areas within a 100-year floodplain, exposing properties in Drainage Hazard Areas to a greater risk of flood damage. Depending on the impacts resulting from a 25-year flood event versus a 100-year flood event and the amount of life and property exposed to the different hazard events, however, the level of risk may vary.

Flow velocity models can assist in predicting the amount of damage expected from different magnitudes of flood events. Hydrological analysis of landscape features forms the basis for data used to develop these models. Changes in the landscape, often associated with human development, can alter the flow velocity and the severity of damage that can be expected from a flood event. GIS technology and flow velocity models make it possible to map the damage that can be expected from both flood events over time. It is also possible to pinpoint the effects of certain flood events on individual properties.

Community Flood Issues

What is Susceptible to Damage During a Flood Event?

The largest impact on communities from flood events is the loss of life and property. During certain years, property losses resulting from flood damage are extensive. Development in the floodplains of Marion County will continue to be at risk from flooding because flood damage occurs on a regular basis throughout the county.

Property loss from floods strikes both private and public property. Public sector impacts (e.g., impacts to water and sewer systems, roads, etc.)

statewide resulted in approximately two-thirds of the damage from the 1996 flood events.⁵³

Property Loss Resulting from Flooding Events

The type of property damage caused by flood events depends on the depth and velocity of the floodwaters. Faster moving floodwaters can wash buildings off their foundations and sweep cars downstream. Pipelines, bridges, and other infrastructure can be damaged when high waters combine with flood debris. Extensive damage can be caused by basement flooding and landslide damage related to soil saturation from flood events. Seepage into basements or daylight basements is common during flood events, not only in or near floodplains, but also on hillsides and other areas that are far removed from floodplains.⁵⁴ Most flood damage is caused by water saturating materials susceptible to loss (e.g., wood, insulation, wallboard, fabric, furnishings, floor coverings, and appliances).

Manufactured Homes

Statewide, the 1996 floods destroyed 156 housing units. Of those units, 61 percent were manufactured homes and trailers.⁵⁵ Many older manufactured home parks are located in floodplain areas. Manufactured homes have a lower level of structural stability than “site-built” homes. A site-built home’s foundation and building frame are put together on site as opposed to manufactured homes which are pre-fabricated off site. Manufactured homes in floodplain zones must be anchored to provide additional structural stability during flood events. Because of confusion in the late 1980’s resulting from multiple changes in NFIP regulations, there are some communities that do not actively enforce anchoring requirements. Lack of enforcement of manufactured home construction standards in floodplains can contribute to severe damages from flood events.

Business/Industry

Flood events impact businesses by damaging property and by interrupting business. Flood events can cut off customer access to a business as well as close a business for repairs. A quick response to the needs of businesses affected by flood events can help a community maintain economic vitality in the face of flood damage. Responses to business damages can include funding to assist owners in elevating or relocating flood-prone business structures.

Public Infrastructure

Publicly owned facilities are a key component of daily life for all citizens of Marion County. Damage to public water and sewer systems, transportation networks, flood control facilities, emergency facilities, and offices can hinder the ability of the government to deliver services. Government can take action to reduce risk to public infrastructure from flood events, as well as adopt public policy that reduces risk to private property from flood events.

There are a variety of drinking water, surface water, and wastewater service providers throughout the county. During flooding events, the infrastructure that supports the water service providers in the county can be damaged and sometimes destroyed.

Power transmission can also be disrupted during a flood because when debris piles up around structures, the power poles sometimes collapse and cause power outages.⁵⁶

Buildings and Roads

In the wake of the 1996 flood events, damage to public buildings statewide represented 34 percent of total public losses.⁵⁷ Of particular importance during flood events are facilities located in flood hazard areas that are critical to government response and recovery activities.

During natural hazard events, or any type of emergency or disaster, dependable road connections are critical for providing emergency services. Roads systems in Marion County are maintained by multiple jurisdictions. Federal, state, county, and city governments all have a stake in protecting roads from flood damage. Road networks often traverse floodplain and floodway areas. Transportation agencies responsible for road maintenance are typically aware of roads at risk from flooding.

Bridges

There are 141 bridges maintained by Marion County.⁵⁸ A complete inventory of County bridges can be found in Appendix D of the Marion County Transportation System Plan.⁵⁹

Bridges in Marion County are key points of concern during flood events for two primary reasons:

- (1) They are often important links in road networks, crossing water courses or other significant natural features; and,
- (2) They can be obstructions in watercourses, inhibiting the flow of water during flood events.

Stormwater System

Local drainage problems are common throughout the region. Some communities have drainage master plans, and local public works staffs are often aware of local drainage threats. Marion County completed the *Stormwater Management Plan for the Urbanized Area around Salem and Keizer* in March 2004.⁶⁰

Local drainage problems are often present where open ditches enter culverts or go underground into storm sewers. In addition, high water tables in some areas can mean wet crawl spaces, yards, and basements after storms because the accumulated water does not drain quickly into a stream or storm sewer. Filled ditches and swales near buildings can inhibit or prevent the flow of water and compound these problems. Inadequate maintenance, especially following leaf accumulation in the fall, can also contribute to the flood hazard in urban areas.⁶¹

Floods and Natural Systems

Maintaining and restoring natural systems help mitigate the impact of flood events on the built environment. High water can be beneficial to the natural processes within a floodplain, and can benefit riparian areas.

Approximately 90 percent of the regulated floodplain areas in Marion County are maintained in open space or undeveloped land due to being public lands or resource lands where development is regulated or limited.

Riparian Areas

Riparian areas are important transitional areas, which link water and land ecosystems. Vegetation in riparian areas is dependent on stream processes, such as flooding, and often is composed of plants that require large amounts of water such as willow and cottonwood trees. Healthy vegetation in riparian buffers can reduce streamside erosion.⁶² During flood events, high water can cause significant erosion. Well-managed riparian areas can reduce the amount of erosion and help to protect water quality during flood events.

Wetlands

Many floodplain and stream-associated wetlands absorb and store stormwater flows, which reduces flood velocities and stream bank erosion. Preserving these wetlands reduces flood damage and the need for expensive flood control devices such as levees. When the storms are over, many wetlands augment summer stream flows by slowly releasing the stored water back to the stream system.⁶³ Wetlands are highly effective at removing nitrogen, phosphorous, heavy metals, and other pollutants from water. For this reason, artificial wetlands are often constructed for cleaning stormwater runoff and for tertiary treatment (polishing) of wastewater. Wetlands bordering streams and rivers and those that intercept runoff from fields and roads provide this valuable service free of charge.⁶⁴

Existing Mitigation Activities

County Programs

Flood mitigation activities listed here include current mitigation programs and activities that are being implemented by Marion County agencies or organizations.

The county provides the Salem Public Library with reference and resource materials on flood protection, and the county updates this material as new publications are presented by FEMA. The resource materials are catalogued and available to the public through the reference section of the library.

Marion County Flood Hazard Mitigation Plan (Resolution 98-38R)

On November 10, 1998, the Marion County Board of Commissioners adopted the *Marion County Flood Hazard Mitigation Plan* (Resolution 98-38R). The purpose of the plan is to identify strategies to reduce the effects of future floods in Marion County and incorporate those strategies with existing policies and procedures into a long-term approach toward implementing a “disaster-resistant” community design. The Mitigation Plan is consistent with the county’s Emergency Operations Plan and the county’s Comprehensive Plan, and serves as the county’s annex to the State of Oregon’s Natural Hazard Mitigation Plan. The plan has been made a

part of the *Marion County Natural Hazards Mitigation Plan*. See Appendix D.

In November 2001, the Board of Commissioners approved the updated *Flood Hazard Mitigation Plan* as an annex (Annex S) to the county's Emergency Operations Plan. The county's Emergency Operations Plan (EOP) contains a series of action plans by types of disasters that outline procedures for public warning of disaster management, flood emergency plans, and emergency response scenarios and operations in the event of a disaster.

The *Flood Hazard Mitigation Plan* analyzes potential hazards, reviews the results of flooding during February 1996, assesses on-going activities designed to mitigate flood hazards, establishes mitigation goals, evaluates mitigation measures, establishes priorities, and outlines a strategy for implementing mitigation projects.

The plan contains 21 action items. Five action items considered in 1998 were to:

- (1) Develop a flood-control wetlands area in the Lake Labish area,
- (2) Make structural modifications to Parkersville Dike,
- (3) Create a basin-wide drainage district for Mill Creek,
- (4) Improve data collection during flood events, and
- (5) Establish "rumor control" as a priority in the Emergency Operations Center during flood events.

In a July 1999 update to the Board of Commissioners, county staff recommended continuation of the following action items:

- (1) Establishment of a wetland in the Lake Labish area;
- (2) Work with Association of Oregon Counties (AOC) to encourage legislation to strengthen real estate disclosure laws;
- (3) Include in the county road maintenance program a requirement to perform annual inspections of bridges and cleaning of any stream debris build-up;
- (4) Include in the road maintenance program a requirement for annual inspection and cleaning of county-owned culverts and ditches; and
- (5) Develop a list of flood mitigation strategies and/or projects to prevent future damage to roadways in the floodplain that frequently experience flooding problems.

Public Works, Operations Division

The Public Works Department's Operations Division monitors water levels of rivers in the county that tend to flood over their banks, and may flood a county road. There are permanent high water gates installed along county roads that seasonally flood. Permanent 'Road Closed Ahead' Signs are posted that can be flipped up when not in use along certain county roads that flood.

Marion County Codes, Ordinances and Regulations

Declaratory Statements. Marion County requires the filing of declaratory statements with land use decisions and building permits that involve property within floodplain and identified geological hazard areas. The declaratory statements are recorded with the County Clerk against properties within identified hazard areas. The declaratory statements indicate that the owners acknowledge and covenant that the county has identified the property as being within a floodplain and that the county recommends that measures be taken to mitigate flood damage, flood hazards, and that the property owners maintain flood insurance on all improvements.

Nuisance and Enforcement Ordinances. Marion County adopted nuisance and enforcement ordinances that provide for county enforcement procedures to address zoning and drainage system/erosion control violations. The county also adopted an ordinance prohibiting stream dumping with the East Salem Service District.

Marion County uses building codes, zoning ordinances, and various planning strategies to address the Oregon Land Use Planning Goal 7, which aim at restricting development in areas of known hazards, and applying the appropriate safeguards.

Marion County's floodplain ordinance, Chapter 178 of the Marion County Rural Zoning Ordinance contains higher regulatory standards than NFIP regulations. For example, new site-built and manufactured dwellings, and replacement dwellings not being placed in the same location as the original dwelling are prohibited in the floodplain if there is an area on the subject property located outside of the floodplain where the dwelling can be placed.

Other provisions i.e., mitigation requirements in Chapter 178 include:

- Prior to obtaining a building permit, the property owner is required to sign and record in the Marion County Records Office a declaratory statement binding the landowner, and the landowner's successors in interest acknowledging that the property and the approved development are located in a floodplain.
- Prior to any mining, dredging, filling, grading, paving or excavation within the 500-year floodplain of the Mill Creek Basin Flood Hazard Areas as identified on Marion County zoning maps. Developers must complete a Floodplain Development Permit Application as outlined in Chapter 178 of the Rural Zoning Ordinance, and Chapter 19 of the Urban Zoning Ordinance.
- Dwellings shall have the top of the lowest floor, including basement, elevated on a permanent foundation to two (2) feet above base flood elevation and the bottom of the lowest floor constructed a minimum of one (1) foot above the base flood elevation. Developers must complete a Floodplain Development Permit Application as outlined in Chapter 178 of the Rural Zoning Ordinance, and Chapter 19 of the Urban Zoning Ordinance.

- Manufactured homes shall have the finished floor, including basement, elevated on a permanent foundation to two feet above base flood elevation. Where the base flood elevation is not available, the floor, including basement shall be elevated on a permanent foundation to two feet above the highest adjacent natural grade (within five feet) or the building site.
- New construction and substantial improvement of any commercial, industrial or other non-residential structures shall either have the lowest floor, including basement, elevated to two feet above the level of the base flood elevation . . . or together with attendant utility and sanitary facilities shall be flood proofed.
- New construction and substantial improvement of residential and nonresidential structures within AO zones shall have the lowest floor (including basement) elevated above the highest adjacent natural grade (within five feet) of the building site, to two feet above the depth number specified on the FIRM or three feet if no depth number is specified.

Floodplain Area Regulatory Functions

Marion County regulates floodplain areas i.e., 500-year floodplain areas and other areas identified in the floodplain ordinance such as the Mill Creek Basin Flood Hazard Areas and Pudding River Floodplain Areas in addition to the FEMA Special Flood Hazard Areas identified in the FIRMs. The county regulates 10,047 acres of floodplain in addition to the FIRM Flood Hazard Areas that total 64,479 acres. The additional floodplain areas are mapped on the county zone maps and subject to the county's floodplain ordinance. In addition, the county established a process for making amendments and revisions to the county regulated floodplain areas similar to the federal FIRM processes of "Letter of Map Amendment" and "Letter of Map Revision" that is initiated by owners of property within the regulated floodplain areas.

Floodplain Determination Project

Marion County Public Works' 100- and 500-year floodplain determination project identifies floodplain areas in addition to the Flood Insurance Rate Maps' (FIRM's) information. The 100- and 500-year floodplain maps created by Marion County Public Works include three sources of topographical data and two modeling schemes. The base terrain data was derived from elevation points taken from USGS 7.5 minute quadrangle maps with a contour interval of ten feet. This was translated into a triangulated irregular network to form a smooth surface of the terrain. From that point, a lattice was developed that represents a 25-foot grid cell size forming a digital elevation model.

To augment and calibrate this grid model, vertical data was acquired from RadarSAT satellite imagery received from NASA's Goddard Spaceflight Center in Greenbelt, Maryland, and from the Dartmouth Flood Observatory in Hanover, New Hampshire, both of which the county created a partnership for this project.

The telemetry and triangulation from this data proved that in some circumstances, the county improved its elevation value accuracy. The completed elevation model was used to determine continuity of FEMA's FIRM maps through areas that were not included in FEMA's previous reports. The county incorporated Marion County Public Works' detailed hydrologic layer to correct errors and remedy the absence of data in the FIRM's.

A 'broad stroke pass' was made to determine floodway limits of the rivers and channels in the county. The floodway limits were used to calculate the 100- and 500-year floodplains. The county based this on interpolating historical inundation limits (floods of 1865 and 1964), and extending them through the terrain model. The county calibrated the results by recent Global Positioning System (GPS) surveys conducted during the floods of February 1995 and January 1997.

Subsequent to this initial modeling endeavor, Public Works updated the current 100- and 500-year floodplain data, and added a 50-year event to the information. The county completed this by using the Danish Hydraulic Institute's MIKE 11 floodplain determination/river channel modeling/flood

water protection software package. Using this modeling program and the accurate elevation model, the county will develop a tool for determining an accurate floodway, add a 50-year floodplain inundation extent limit to the county flood management inventory, revise present 100- and 500-year floodplain maps (and by request from FEMA, update the FIRMs), and gain the ability to forecast flood behavior and high water limits during flooding events.

Elevation Certificate Maintenance

The county maintains its elevation certificates in computer format using the FEMA Elevation Certification software. Certificates are maintained in this computer format on all buildings built since county participation in the CRS program (October 1999). The county also maintains paper files of some pre-FIRM and post-FIRM buildings, listed by address. The certificates are available to the public for review.

Flood Data Maintenance

Marion County uses an ESRI Map Objects, desktop application to view data in the system. County staff uses its GIS and Map Objects on a daily basis when assisting the public, other county departments, and for individual staff projects. The system allows staff to display information and mapping contained in the data layers on computer monitors at county public service counters for viewing by the public regarding individual properties. The information can then be printed out for the public and maps can be generated and created utilizing the various data layers for use and distribution to the public for areas within the county. The system can also be used to conduct research on properties as the database contains building permit data, assessor records, deed information, survey records, land use case history, public works permits, and enforcement actions along with the geographic data. The county routinely updates its GIS. New system applications and programs that improve staff access to and use of data are made periodically. The county enters geographic and/or digital data as it becomes available, such as studies or inventories creating a new data layer.

Natural Systems – Mill Creek Culvert Project

Marion County received funding from the National Marine Fisheries Service to improve fish passage through county road culverts in the Mill Creek Watershed. The retrofitting of these culverts allows passage of Chinook salmon and steelhead, as well as cutthroat trout, opening up over 25 kilometers of habitat. Current barriers include inlets blocked by debris, excessive slope and outlet jumps, and shallow outlet pools. Unblocking the culverts also acts as flood mitigation. Marion County is working with ODFW to design "fish-friendly" culverts. The County expects completion of the retrofits in the summer of 2005.

Little Pudding River Floodplain Modeling Project

Marion County developed a hydrological model capable of predicting and illustrating river flow, flooding characteristics, and water pollution levels on the Little Pudding River and its associated watershed basin. The model serves as a useful tool in flood mitigation and management efforts within the Little Pudding River Watershed by providing information on flood water extent and road closure status for emergency officials and the public, and allow for wetland restoration planning.

FEMA Flood Map Modernization Program

Marion County and the cities within the county were selected in July 2003 as one of the first communities in FEMA Region X to receive Digital Flood Insurance Rate Maps (DFIRMs) in addition to the traditional paper format. The county converted its micro station maps, to the new GIS-based DFIRM standard in the latter part of 2003. Such conversion included a digital database that allows the county to incorporate FIRM information into a format compatible with standard GIS software.

Outreach

The county conducts an annual outreach (public service announcement) project to realtors, builders, mortgage brokers, insurance agents, and appraisers regarding available flood information and current flood management activities.

The county utilizes its Website, the community's official telephone directory, brochures and Capital Community Television (CCTV) as outreach tools to disseminate information pertaining to flooding and other hazards, flood protection tips, and links to other emergency preparedness activities. CCTV televises non-commercial television made by local residents about subjects important to the community.

Community Rating System (CRS) Program

The Federal Emergency Management Agency's National Flood Insurance Program (NFIP) established the Community Rating System (CRS) program. See "Federal Programs" described below for more information. Marion County participates in the voluntary CRS program. In 1999, there were 310 NFIP policies paying \$130,692 in premiums for \$42,400,900 in total value coverage. Since 1978, there had been 51 claims with payments totaling \$535,627.⁶⁵

As of December 2004, Marion County had 290 NFIP policies with insurance coverage of \$49,658,400 and premiums of \$123,811.⁶⁶

Stormwater

Marion County is one of several jurisdictions in Oregon that fall under the National Pollutant Discharge Elimination System (NPDES). The county developed a five-year stormwater plan that mostly addresses water quality in the U.S. Census-designated Urbanized Area around Keizer and Salem, Oregon. Components of that plan include better maintenance of the drainage system, low impact development ordinances and education, pollutant discharge detection, and erosion control.

In October 2000, the City of Salem, City of Keizer and Marion County entered into a Stormwater Management Agreement to address regional stormwater management issues of mutual concern within the Claggett Creek, Labish Ditch and Little Pudding River watersheds. The agreement provides a framework for communication and coordination with respect to stormwater management within the three watersheds.

Endangered Species Act

Marion County Public Works developed a set of best management practices (BMP) to comply with Section 4(d) Limit 10 of the Endangered Species Act in order to enhance salmon recovery in Marion County. These are primarily geared toward water quality, but also include replanting any trees removed near streams; avoiding dumping fill materials near wetlands, hydric soils, or streams; and erosion control. The county's BMP are accessible on the World Wide Web at <http://publicworks.co.marion.or.us/environment/salmon/Limit10/PDF/Oct2002/02index.asp>.

Wetlands

County transportation projects can impact wetlands and streams. When this is the case, the county replaces lost wetland functions via a mitigation process. This is primarily regulated through Section 404 of the Federal Clean Water Act. The county monitors these projects closely to ensure compliance with the relevant regulations. There are typically several projects each year.

Aumsville Wetlands Restoration. Many floodplain and stream-associated wetlands absorb and store stormwater flows, which reduces flood velocities and stream bank erosion. Preserving these wetlands reduces flood damage and the need for expensive flood control devices. Many wetland restoration projects have been initiated and completed by various organizations throughout the county.

The Aumsville Wetlands site is located 1.5 miles southeast of Aumsville at the intersection of Bates and Bishop Roads. The 77-acre site is composed of wetlands and upland buffer areas flows into Porter Creek, within the Mill Creek Watershed. Working with many community volunteers, the County intends to restore and preserve this site as part of the [Natural Heritage Parks Program](#). In addition to enhancing hydrologic functions, the Aumsville Wetlands Restoration will also expand educational and recreational opportunities for the community. Large-scale removal of blackberry and scotch broom has begun and the site is prepped for future restoration efforts.

Floodplain Parcel Acquisition

Acquisition of floodplain parcels to serve as parks and to reduce development in riparian areas e.g., Stayton Riverfront, Keizer Rapids, is one of Marion County's goals. Floodplain parcel acquisition, similar to the county's wetlands restoration projects, is aimed at ecological restoration in rural parks to enhance environmental benefits of parks and increase their capacity to absorb floodwater. Additional information about these projects

is available on the World Wide Web at
<http://publicworks.co.marion.or.us/parks/nhp/index.asp>.

Regional Programs

Marion SWCD is adding stream gauges and weather stations, and will have them accessible on a website, with a weather station at the headwaters of the Pudding River.

Wetland Restoration. Flood mitigation projects include wetland restoration. The Marion Soil & Water Conservation District (SWCD) has been working with the Claggett Creek Watershed Council to restore wetlands along Claggett Creek for flood mitigation. Along the North Santiam River, the Marion SWCD has been working with the Natural Resources Conservation Service (NRCS) and the North Santiam Watershed Council on returning areas along the North Santiam River to a riparian state. The Marion SWCD also is involved with a Conservation Reserve Enhance Program (CREP) activity along Abiqua Creek.

An offspring of the Conservation Reserve Program (CRP), CREP is a voluntary program for agricultural landowners. Unique state and federal partnerships allow participants to receive incentive payments for installing specific conservation practices. Through the CREP, farmers can receive annual rental payments and cost-share assistance to establish long-term, resource-conserving covers on eligible land.

Flood Management Projects. Flood management structures can assist in regulating flood levels by adjusting water flows upstream of flood-prone areas. There are a total of 58 dams in Marion County registered with the Oregon Water Resources Department holding billions of gallons of water in reservoirs. The largest reservoirs in the County, Detroit and Big Cliff Dam, are not included in that total because they are managed by the US Army Corps of Engineers. Releases of water from Detroit and Big Cliff Dams are designed to protect Marion County from high floodwaters. The largest reservoirs in Marion County include:

- Detroit (Lake) Dam – 321,000 acre feet usable storage (North Santiam River)
- Big Cliff Dam – 134,000 acre feet storage (North Santiam River)
- Silver Creek Reservoir – 1,300 acre feet storage (Silver Creek)
- Mission Creek Dam – 1,140 acre feet storage (Mission Creek)

State Programs

State of Oregon Floodplain and Floodway Removal/Fill Law

The Oregon Removal/Fill Law in ORS 196.795-990, which is administered by the Oregon Department of State Lands, requires a permit for activities that would remove or fill 50 cubic yards or more of material in waters of the state (e.g., streams, lakes, wetlands).

Oregon's Wetlands Protection Program

Oregon's Wetlands Program was created in 1989 to integrate federal and state rules concerning wetlands protection with the Oregon Land Use Planning Program. The Wetlands Program has a mandate to work closely with local governments and the Department of State Lands (DSL) to improve land use planning approaches to wetlands conservation. A Local Wetlands Inventory (LWI) is one component of that program. DSL also develops technical manuals, conducts wetlands workshops for planners, provides grant funds for wetlands planning, and works directly with local governments on wetlands planning tasks.

Oregon State Parks

Wetland restorations, natural resources projects with Marion SWCD, good stewardship of the land.⁶⁷

Oregon Wetlands Joint Venture

The Oregon Wetlands Joint Venture is a coalition of private conservation, waterfowl, fisheries, and agriculture organizations working with government agencies to protect and restore important wetland habitats.⁶⁸

Federal Programs

National Weather Service

The National Weather Service provides flood watches, warnings, and informational statements for rivers throughout Marion County. Visit the NWS website at <http://www.nws.noaa.gov>.

National Resources Conservation Service (NRCS), US Department of Agriculture

NRCS provides a suite of federal programs designed to assist state and local governments and landowners in mitigating the impacts of flood events. The Watershed Surveys and Planning Program and the Small Watershed Program provide technical and financial assistance to help participants solve natural resource and related economic problems on a watershed basis. The Wetlands Reserve Program and the Flood Risk Reduction Program provide financial incentives to landowners to put aside land that is either a wetland resource, or that experiences frequent flooding. The Emergency Watershed Protection Program (EWP) provides technical and financial assistance to clear debris from clogged waterways, restore vegetation, and stabilize riverbanks. The measures taken under EWP must be environmentally and economically sound and generally benefit more than one property.

Federal Emergency Management Agency (FEMA) Programs

The Federal Emergency Management Agency (FEMA) resulted from the consolidation of five federal agencies that were dealing with different types of emergencies. Since then, many states and local jurisdictions have accepted this approach and changed the names of their organizations to include the words "emergency management". FEMA provides maps of flood hazard areas, various publications related to flood mitigation, funding for

flood mitigation projects, and technical assistance. Visit FEMA's website at <http://www.fema.gov>.

National Flood Insurance Program (NFIP)

Flood insurance is available to citizens in communities that adopt and implement NFIP siting and building standards. The standards are applied to development that occurs within a delineated floodplain, a drainage hazard area, and areas subject to inundation during a base flood event, and properties within 250 feet of a floodplain boundary. These areas are depicted on federal Flood Insurance Rate Maps (FIRM) that are available through FEMA. Oregon's Department of Land Conservation and Development is the state's NFIP-coordinating agency.

The Community Rating System (CRS)

The Community Rating System (CRS) program, established by FEMA as part of the National Flood Insurance Program (NFIP), recognizes community floodplain management efforts that go beyond the minimum requirements of the NFIP. The CRS credits communities through a discount in flood insurance premiums to property owners.

Marion County participates in the voluntary Community Rating System (CRS) program. Marion County applied for the CRS in October 1999 and upon evaluation of its flood management program, received a Class 7 rating. Class 7 communities receive a fifteen percent premium reduction for properties purchasing flood insurance within the Special Flood Hazard Area (SFHA) and five percent reduction on premiums for properties outside the SFHA.

CRS communities in Oregon with Class 9 or better have 8,661 NFIP policies in force with premiums totaling \$3,781,687 and premium savings to property owners in CRS communities of \$428,771. Marion County has 336 NFIP policies paying an annual premium of \$125,525 with a reduction in premium costs to policyholders of \$11,914.⁶⁹

For further information on the CRS, visit FEMA's website at <http://www.fema.gov/nfip/crs.htm>.

Mitigation Plan Goals

The mitigation plan goals addressed by each action item are identified as a means for monitoring and evaluating how well the mitigation plan is achieving its goals following implementation.

The plan goals help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Goal #1: PUBLIC AWARENESS

Goal Statement: Increase public awareness of natural hazard risks, emergency notification and response, and resources for citizen preparedness.

Goal #2: EDUCATION

Goal Statement: Educate the public on how to prepare to successfully endure a natural disaster with minimal property damage and no loss of life.

Goal #3: PREVENTATIVE

Goal Statement: Minimize risks to life, property, the environment, and the economy from natural hazards.

Goal #4: FUNDING AND IMPLEMENTATION

Goal Statement: Identify potential funding sources and implement potential mitigation projects.

Goal #5: PARTNERSHIPS AND COORDINATION

Goal Statements:

- Create and enhance partnerships with other stakeholders involved with natural hazard management.
- Coordinate natural hazard mitigation efforts with adjacent jurisdictions and public/private agencies' risk management activities.

Goal #6: NATURAL RESOURCES UTILIZATION

Goal Statement: Promote the use of natural systems and features, watershed planning, and land use planning for natural hazard mitigation whenever possible to reduce long-term costs to the county and maximize effectiveness.

Goal #7: EMERGENCY SERVICES

Goal Statement: Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Flood Mitigation Action Items

The following mitigation action items were formulated through interviews with local stakeholders and researching regional mitigation plans and natural hazards planning literature. Refinement of the Plan's action items occurred through discussions with the mitigation plan steering committee and through an open house that presented the proposed items to the public.

The flood mitigation action items provide direction on specific activities that organizations and residents in Marion County can undertake to reduce risk and prevent loss from flood events. Each action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk from flood impacts in Marion County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Flood Action Items

Short-term flood action items include general mitigation activities that agencies are capable of implementing during the next two years, given their existing resources and authorities.

ST-FL #1: Develop better flood warning systems.

Ideas for Implementation

- Coordinate with appropriate organizations to evaluate the need for more stream gauges that are tied into National Weather Service flood forecasting activities; and;
- Distribute information regarding flooding to the general public efficiently through an automated community notification process e.g., “CityWatch®,” or a large-scale, community alerting, GIS/Web-based system.

Coordinating Organization: Emergency Management, Public Works
Internal Partner: Planning Division
External Partners: Watershed Councils, Cities, OSU Extension Service, USGS, WRD, DSL, OEM, BLM, USACE, private river gauges
Timeline: 1 to 2 years
Plan Goals Addressed: Preventative; Partnerships and Coordination, Emergency Services

ST-FL #2: Conduct workshops for target audiences on National Flood Insurance Programs, mitigation activities, and potential assistance from FEMA’s Flood Mitigation Assistance and Hazard Mitigation Grant Programs.

Ideas for Implementation

- Include information about the financial aspects of building (and rebuilding) in the floodplain;
- Include information on using low-impact development standards on private property;
- Present information on how other communities have addressed building in the floodplain; and
- Selected target audiences can include: realtors, lending institutions, surveyors, engineers, and government agencies.

Coordinating Organization: Emergency Management
Internal Partner: Planning
External Partners: Watershed Councils, DLCD, OEM, FEMA
Timeline: On-going

Plan Goals Addressed: Preventative; Partnerships and Coordination;
Education; Funding and Implementation

ST-FL #3: Maintain a map, information concerning, and a current copy of an inventory of all permitted dams built in the county.

Ideas for Implementation

- Update appropriate seismic criteria and procedures for evaluating performance of existing dams (varies with each permitted dam Emergency Action Plan);
 - Susceptibility to damage from flood events and/or earthquakes
 - Amount of water impounded
 - Type of construction
 - Year completed
 - Repair work performed
- Maintain information pertaining to types of properties downstream from the dam

Coordinating Organization: Emergency Management
Internal Partner: Public Works
External Partners: Watershed Councils, USACE, WRD, DEQ,
ODFW, NRCS
Timeline: 1 to 2 years
Plan Goals Addressed: Education; Public Awareness; Preventative

Long-term (LT) Flood Action Items

Long-term flood action items include general mitigation activities that are likely to take more than two years to implement and may require new or additional resources and/or authorities.

LT-FL #1: Update the Flood Insurance Rate Maps (FIRM) for Marion County as funding becomes available.

Ideas for Implementation

- Work with FEMA on specific areas to update as funding becomes available.

Coordinating Organization: Marion County
Internal Partners: Planning, GIS, Public Works
External Partners: DLCD, FEMA, Cities
Timeline: 3 to 5 years

Plan Goals Addressed: Preventative; Partnerships and Coordination;
Natural Resources Utilization

LT-FL #2: Enhance data and mapping for floodplain information within Marion County, and identify and map flood-prone areas outside of designated floodplains.

Ideas for Implementation

- Apply for FEMA's cooperative technical partnership using the two-foot contour interval floodplain mapping data acquired by Marion County GIS;
- Develop a program to maintain existing elevation reference marks and survey any new information concerning flooding reference marks;
- Identify and map areas where flood probability/frequency can be economically reduced or eliminated.
- Encourage the development of floodplain maps for all local streams not currently mapped on Flood Insurance Rate Maps or county maps, with special attention focused on mapping rural and unincorporated areas. The maps can be used for planning, risk analysis, and emergency management. The maps should show:
 1. The expected frequency of flooding,
 2. The level of flooding, and
 3. The areas subject to inundation.
- Maintain maps of covered streams and creeks;
- Identify mapped culverts that historically create flooding problems and target them for replacement;
- Prepare an inventory of rural drainage problems;
- Coordinate with local agencies and organizations to obtain flood data and mapping resources;
- Integrate the Capital Improvement Plan process with GIS;
- Include a map layer with arrow to indicate direction of stream/creek flow; and
- Add creek names that are missing and coordinate the naming of unnamed creeks.

Coordinating Organization: Outside UGB: County GIS, Public Works
Inside UGB: Cities
Internal Partners: Emergency Management, Planning Division
External Partners: NRCS, Marion SWCD, FEMA, Watershed Councils
Timeline: 3 to 5 years (as funding allows)
Plan Goals Addressed: Preventative

LT-FL #3: Identify surface water drainage obstructions for all parts of unincorporated Marion County.

Ideas for Implementation

- Integrate the county's three sets of culvert data (location/size/material) into one data base;
- Maintain capacity in existing drainage ways by restricting encroachment inside the East Salem Service District (ESSD) drainage easements.
- Prepare an inventory of culverts that historically create flooding problems and target them for replacement;
- Collaborate with gravel operations to assess and address downstream impacts from revetments; and
- Prepare an inventory of major drainage problems, and identify causes and potential mitigation actions for drainage problem areas.

Coordinating Organization: Public Works/Road Division
Internal Partners: Building, Planning, GIS
External Partners: Cities, NRCS, SWCD, Watershed Councils
Timeline: On-going
Plan Goals Addressed: Preventative

LT-FL #4: Preserve water quality by using stormwater best management practices (BMP).

Ideas for Implementation

- Support land design practices that improve upon existing infiltration systems and provide infiltration of water rather than creating stormwater runoff and increasing hydrologic impacts;
- Encourage practices that reduce sedimentation in drainage ways;
- Encourage the use of low-impact development standards on private property, including the use of pervious concrete;
- Continue maintenance on stormwater systems to increase capacity; and
- Consider stormwater detention/retention facilities where necessary

Coordinating Organization: Public Works
Internal Partner: Building, GIS
External Partners: NRCS, Marion SWCD, Watershed Councils
Timeline: 3 to 5 years
Plan Goals Addressed: Preventative

LT-FL #5: Collaborate with communities along the North Santiam River downstream from the Little North Santiam River to address flooding and erosion issues.

Ideas for Implementation

- Work with the City of Stayton to minimize flooding and erosion within Riverfront Park.

Coordinating Organization: Public Works
Internal Partner: Planning
External Partners: NRCS, North Santiam Watershed Council, People's Alliance for Livability in the Santiam Valley
Timeline: 3 to 5 years
Plan Goals Addressed: Preventative; Natural Resources Utilization

LT-FL #6: Collaborate with river communities along the Willamette River (City of Keizer, City of Salem) and the North Santiam River (Cities of Turner) to address flooding and erosion issues.

Ideas for Implementation

- Work with the City of Keizer to minimize problem flooding and erosion at Keizer Rapids Park;
- Work with City of Salem on hydrologic modeling for the East Salem drainage coordination; and

- Collaborate with the Cities of Keizer and Salem in completing Phase II of National Pollutant Discharge and Elimination System permitting requirements.

Coordinating Organization: Public Works
 Internal Partner: Planning
 External Partners: Cities of Keizer, Turner, and Salem; Watershed Councils; DEQ
 Timeline: 3 to 5 years
 Plan Goals Addressed: Preventative; Natural Resources Utilization

LT-FL #7: Mitigate repetitive flood loss properties.

Ideas for Implementation

- Elevate dwellings on repetitive flood-loss properties above the mean base flood elevation;
- Acquire the property when purchasing the property from the property owner is more feasible than repetitive reparations following flood loss;
- Relocate dwellings and other affected structures outside of the flood plain.

Coordinating Partners: Cities in Marion County, Marion County
 Internal Partner: County Tax Assessor
 External Partners: FEMA, OEM
 Timeline: On-going
 Plan Goals Addressed: Preventative; Partnerships and Coordination

Flood Mitigation Resources

The following resource directory lists the resources and programs that can assist county communities and organizations. The resource directory provides contact information for local, county, regional, state and federal programs that deal with natural hazards.

County Resources

Marion Soil & Water Conservation District

3867 Wolverine St NE, Building F, Suite 16
 Salem, Oregon 97305 (in the Salem USDA Service Center)

Phone: 503-391-9927

Fax: 503-399-5799

E-mail: marion.swcd@oacd.org

Watershed Councils

Claggett Creek Watershed (WS) Council

Contact: Bob Roth

Phone: 503-566-4034

Friends of Mill Creek

Contact: Bob Roth

Phone: 503-566-4053

North Santiam WS Council

Contact: Liz Redon (Coordinator)

Phone: 503-930-8202

Pringle Creek WS Council

Contact: Bob Roth

Phone: 503-566-4034

Pudding River WS Council

Contact: Scott Eden (Coordinator)

Phone: 503-566-5918

State Resources

Oregon's Wetlands Protection Program

Oregon's Wetlands Program was created in 1989 to integrate federal and state rules concerning wetlands protection with the Oregon Land Use Planning Program. The Wetlands Program has a mandate to work closely with local governments and the Department of State Lands (DSL) to improve the land use planning approaches to wetlands conservation. A Local Wetlands Inventory (LWI) is one component of that program. DSL also develops technical manuals and works directly with local governments on wetlands planning tasks.

Contact: Department of State Lands
Website: <http://statelands.dsl.state.or.us/>

Oregon Wetlands Joint Venture

The Oregon Wetlands Joint Venture is a coalition of private conservation, waterfowl, fisheries, and agriculture organizations working with government agencies to protect and restore important wetland habitats.

Contact: Oregon Wetlands Joint Venture
Website: <http://wetlands.dfw.state.or.us/>

Department of Land Conservation and Development (DLCD)

DLCD administers the state's Land Use Planning Program. The program is based on 19 Statewide Planning Goals, including Goal 7, Areas Subject to Natural Disasters and Hazards, with stream flooding as one of its major focus. DLCD serves as the federally designated agency to coordinate floodplain management in Oregon. DLCD also conducts various landslide related mitigation activities. In order to help local governments address natural hazards effectively, DLCD provides technical assistance such as conducting workshops, reviewing local land use plan amendments, and working interactively with other agencies.

Contact: Natural Hazards Program Manager, DLCD
Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540

Phone: 503-373-0050
Fax: 503-378-6033
Website: <http://www.lcd.state.or.us/hazards.html>
Oregon Floodplain Coordinator: 503-373-0050 ext. 255

Oregon State Police (OSP)-Office of Emergency Management (OEM)

OEM administers FEMA's Hazard Mitigation Grant Program, which provides post-disaster monies for acquisition, elevation, relocation, and demolition of structures located in the floodplain. OEM also administers FEMA's Flood Mitigation Assistance Program. This program provides assistance for NFIP insured structures only. OEM also helps local jurisdictions to develop hazard mitigation plans. OEM is heavily involved in flood damage assessment and works mainly with disaster recovery and hazard mitigation programs. OEM provides training for local governments through workshops on recovery and mitigation. OEM also helps implement and manage federal disaster recovery programs.

Contact: Office of Emergency Management
Location: 3225 State Street, P.O. Box 14370, Salem, OR 97309-5062
Phone: 503-378-2911
Fax: 503-373-7833
Website: <http://www.osp.state.or.us/oem/>
OEM Hazard Mitigation Officer: 503-378-2911 ext. 22247

Oregon Department of Fish and Wildlife (ODFW)

ODFW's mission is to protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations. ODFW regulates stream activity and engages in stream enhancement activities.

Contact: ODFW
Address: 3406 Cherry Avenue NE, Salem, OR 97303
Phone: 503-947-6000
Website: <http://www.dfw.state.or.us/>
Email: ODFW.Info@state.or.us

Oregon Department of State Lands (DSL)

DSL is a regulatory agency, responsible for administration of Oregon's Removal-Fill Law. This law is intended to protect, conserve, and make the best use of the state's water resources. It generally requires a permit from DSL to remove, fill, or alter more than 50 cubic yards of material within the bed or banks of waters of the state. Exceptions are in state scenic waterways and areas designated essential salmon habitat, where a permit is required for all in-stream activity, regardless of size. DSL and the US Army Corps of Engineers may issue these permits jointly.

Contact: Department of State Lands
Address: 775 Summer Street NE, Suite 100, Salem, OR 97301-1279
Phone: 503-378-3805
Fax: 503-378-4844
Website: <http://statelands.dsl.state.or.us/>
Assistant Director: 503-378-3805, ext. 279
Western Region Manager: 503-378-3805, ext. 244

Oregon Water Resources Department (WRD)

The WRD's mission is to serve the public by practicing and promoting wise long-term water management. The WRD provides services through 19 watermaster offices throughout the state. In addition, five regional offices provide services based on geographic regions. The Department's main administration is performed from the central office in Salem.

Contact: WRD
Address: 725 Summer St SE, Salem, OR 97301-1270
Phone: 503-986-0900
Website: <http://www.wrd.state.or.us/index.shtml>

OSU Watershed Extension Program

The OSU Watershed Extension Program's mission is to increase the capacity of Oregon watershed groups and communities for conserving, improving, protecting, and sustaining watershed functions and values. Increasing capacity is achieved through research-based education, skill-building projects, and new partnerships among residents, local organizations, businesses, agencies, and educational institutions.

Contact: Watershed Extension Program, Central Staff
Tara Nierenberg, Statewide Program Coordinator
Address: Oregon State University, Watershed Extension
307 Ballard Hall, Corvallis, OR 97331-3604
Phone: 541-737-8715
Email: Tara.Nierenberg@oregonstate.edu
Website: <http://seagrant.oregonstate.edu/wsep>

Regional Resources

Northwest Regional Floodplain Managers Association (NORFMA)

NORFMA is a nonprofit organization for regional networking and support on issues of environmental quality, economic sustainability, and scientific discovery on a watershed basis. The Association provides a channel for regional communication and cooperation in Oregon, Washington, Idaho, British Columbia and Alaska. NORFMA promotes educational programs on floodplain and watershed management topics, increases public awareness of the value and function of floodplains, and encourages government involvement in programs to reduce flood damages and to protect, manage, and restore floodplains.

The NORFMA website is a resource for floodplains, fisheries, and river engineering information for the Northwest. This site provides technical information, articles, and Internet links in the field of floodplain and fisheries management.

Contact: Christine Valentine, MFIP Coordinator – Oregon Regional Rep.
Address: Department of Land Conservation and Development (DLCD)
635 Capitol Street NE, Suite 150, Salem, OR 97301
Phone: (503) 373-0050 ext. 250
Fax: (503) 378-5518
Website: <http://www.norfma.org>

Federal Resources and Programs

Federal Emergency Management Agency (FEMA)

FEMA provides maps of flood hazard areas, various publications related to flood mitigation, funding for flood mitigation projects, and technical assistance. FEMA also operates the National Flood Insurance Program. FEMA's mission is "to reduce loss of life and property and protect the nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery." FEMA Region X serves the northwestern states of Alaska, Idaho, Oregon, and Washington.

Contact: FEMA, Federal Regional Center, Region 10
Address: 228th St. SW, Bothell, WA 98021-9796
Phone: 425-487-4678
Website: <http://www.fema.gov>

To obtain FEMA publications:

Phone: 800-480-2520

To obtain FEMA maps:

Contact: Map Service Center
Address: P.O. Box 1038, Jessup, Maryland 20794-1038
Phone: 800-358-9616
Fax: 800-358-9620

The National Flood Insurance Program

The National Flood Insurance Program (NFIP) Website is a subsection of the Federal Emergency Management Agency (FEMA) site (<http://www.fema.gov>). The NFIP information is intended for both the general public and the many organizations and agencies participating in the program. It includes information about the NFIP and other flood disaster assistance available from the Federal Government. It also provides access to the newly revised NFIP booklet: *Answers to Questions about the National Flood Insurance Program*.

Contact: The National Flood Insurance Program
Phone: 888-FLOOD29 or 800-427-5593
Website: <http://www.fema.gov/nfip>

United States Geological Survey (USGS)

The USGS website provides current stream flow conditions at USGS gauging stations in Oregon and throughout the Pacific Northwest. The Oregon USGS office is responsible for water-resources investigations for Oregon and part of southern Washington. Their office cooperates with more than 40 local, state, and federal agencies in Oregon. Cooperative activities include water-resources data collection and interpretive water-availability and water-quality studies.

Contact: USGS Oregon District Office
Address: 10615 S.E. Cherry Blossom Dr., Portland, OR 97216
Phone: 503-251-3200
Fax: 503-251-3470
Website: <http://oregon.usgs.gov>
Email: info-or@usgs.gov

USGS Water Resources

This web page offers current US water news; extensive current (including real-time) and historical water data; numerous fact sheets and other publications; various technical resources; descriptions of ongoing water survey programs; local water information; and connections to other sources of water information.

Contact: USGS Water Resources
Phone: 503-251-3200
Website: <http://water.usgs.gov> or <http://water.usgs.gov/public/realtime.html>
Email: info-or@usgs.gov

Bureau of Reclamation

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public. The closest dam to Marion County owned by the Bureau of Reclamation is Scoggins Dam in Washington County. The Bureau of Reclamation prepares emergency action plans for events at the dam.

Contact: Bureau of Reclamation, Pacific Northwest Region
Address: 1150 N. Curtis Road, Boise, ID 83706-1234
Phone: 208-378-5021
Website: <http://www.usbr.gov/pn>

Army Corps of Engineers

The Corps of Engineers administers a permit program to ensure that the nation's waterways are used in the public interest. Any person, firm, or agency planning to work in waters of the United States must first obtain a permit from the Army Corps of Engineers. In Oregon, joint permits may be issued with the Department of State Lands. The Corps is responsible for the protection and development of the nation's water resources, including navigation, flood control, energy production through hydropower management, water supply storage and recreation.

Contact: US Army Corps of Engineers-Portland District, Floodplain Information Branch
Address: P.O. Box 2946, Portland, OR 97208-2946 (mail); 333 SW First Avenue, Portland, OR
Phone: 503-808-5150
Fax: 503-808-4875
Website: <http://www.nwp.usace.army.mil/>

National Weather Service, Portland Bureau

The National Weather Service provides flood watches, warnings, and informational statements for rivers in Marion County. The NWS is the sole United States official voice for issuing warnings during life threatening weather situations. The majority of the county falls in the NWS "Central Willamette Valley" region. The eastern portions of the county, which includes areas east of Stayton, fall in the "North Oregon Cascades Range" region. The NWS Portland office provides river level information online and by phone.

Contact: National Weather Service, Portland Bureau
Address: 5241 NE 122nd Avenue, P.O. Box 2946, Portland, OR 97208-2946
Phone: 503-326-2340

Fax: 503-808-4875

Website: http://www.wrh.noaa.gov/Portland/public_hydro/

Office of Hydrology, National Weather Service

The National Weather Service's Office of Hydrology (OH) and its Hydrological Information Center offer information on floods and other aquatic disasters. This site offers current and historical data including an archive of past flood summaries, information on current hydrologic conditions, water supply outlooks, an Automated Local Flood Warning Systems Handbook, Natural Disaster Survey Reports, and other scientific publications on hydrology and flooding.

Contact: Office of Hydrology, National Weather Service

Website: <http://www.nws.noaa.gov/oh> or <http://www.nws.noaa.gov/oh/hic/>

National Resources Conservation Service (NRCS), US Department of Agriculture (USDA)

NRCS provides a suite of federal programs designed to assist state and local governments, and landowners in mitigating the impacts of flood events. The Watershed Surveys and Planning Program and the Small Watershed Program provide technical and financial assistance to help participants solve natural resource and related economic problems on a watershed basis. The Wetlands Reserve Program and the Flood Risk Reduction Program provide financial incentives to landowners to put aside land that is either a wetland resource or experiences frequent flooding. The Emergency Watershed Protection Program (EWP) provides technical and financial assistance for clearing debris from clogged waterways, restoring vegetation, and stabilizing riverbanks. The measures taken under the EWP must be environmentally and economically sound and generally benefit more than one property.

Contact: USDA-NRCS, Salem Service Center

Address: 3867 Wolverine Street NE, Salem, OR 97305-4266

Phone: 503-399-5741

Fax: 503-399-5799

Website: <http://www.or.nrcs.usda.gov>

Additional Resources

The Association of State Floodplain Managers

The Association of State Floodplain Managers (ASFPM) is an organization of professionals involved in floodplain management, flood hazard mitigation, the National Flood Insurance Program, and flood preparedness, warning, and recovery. ASFPM fosters communication among those responsible for flood hazard activities, provides technical advice to governments and other entities about proposed actions or policies that will affect flood hazards, and encourages flood hazard research, education, and training. The ASFPM Web site includes information on how to become a member, the organization's constitution and bylaws, directories of officers and committees, a publications list, information on upcoming conferences, a history of the association, and other useful information and Internet links.

Contact: The Association of State Floodplain Managers

Address: 2809 Fish Hatchery Road, Madison, WI 53713
Phone: 608-274-0123
Website: <http://www.floods.org>

The Floodplain Management Association

The Floodplain Management website was established by the Floodplain Management Association (FMA) to serve the entire floodplain management community. It includes full-text articles, a calendar of upcoming events, a list of positions available, an index of publications available free or at nominal cost, a list of associations, a list of firms and consultants in floodplain management, an index of newsletters dealing with flood issues (with hypertext links if available), a section on the basics of floodplain management, a list of frequently asked questions (FAQs) about the Website, and, of course, a copious catalog of Web links.

Contact: Floodplain Managers Association
Website: <http://www.floodplain.org>
Email: admin@floodplain.org

Insurance Services Offices, Inc. (ISO)

The Building Code Effectiveness Grading Schedule (BCEGS), developed and operated by the Insurance Services Offices, Inc. (ISO) assesses the building codes in effect in a community and how the community enforces them, with special emphasis on mitigation of losses from natural disasters. In BCEGS, each community is assigned a grade of 1 (best) to 10 (no recognized program), with two ratings for each jurisdiction, commercial and residential. Coordinating floodplain management with local building codes has advantages with regard to permits, inspections, other developments such as grading, post-flood inspections, application of floodplain management requirements, special certifications, construction quality and modifications to existing buildings. Marion County has a BCEGS classification of 3/3 and receives credit for this rating under FEMA's CRS program.

Contact: Insurance Services Offices, Inc. (ISO)
Government Relations Office
Address: 388 Market Street, Suite 750, San Francisco, CA 94111-5314
Phone: 415-434-4599 or 1-800-888-4476
Fax: 415-398-8064
Website: <http://www.iso.com/>
Email: <mailto:info.sanfrancisco@iso.com%20>

FEMA's List of Flood Related Websites

This site contains a long list of flood related Internet sites from "American Heritage Rivers" to "The Weather Channel," and is a good starting point for flood information on the Internet.

Contact: Federal Emergency Management Agency.
Phone: 800-480-2520
Website: <http://www.fema.gov/nfip/related.htm>

Publications

Morris, Marya. *Subdivision Design in Flood Hazard Areas*. PAS 473. Chicago, IL: APA. 1997.

This report explains planning techniques that minimize problems in a flood hazard area. Includes selected ordinances and policies.

Contact: American Planning Association, Planners Book Service
Address: 122 S. Michigan Ave., Suite 1600, Chicago, IL 60603
Phone: 312-786-6344
Fax: 312-431-9985
Website: www.planning.org

Planning for Natural Hazards: The Oregon Technical Resource Guide, Department of Land Conservation and Development (July 2000).

Produced by the Community Planning Workshop for the Department of Land Conservation and Development, this is a natural hazards planning and mitigation resource for Oregon cities and counties. It provides hazard-specific resources and plan evaluation tools. The document was written for local government employees and officials. The Technical Resource Guide includes a natural hazards comprehensive plan review, a hazard mitigation legal issues guide, and five hazard-specific technical resource guides, including: flooding, wildfires, landslides, coastal hazards, and earthquakes. This document is available online. You can also write, call, or fax to obtain this document:

Contact: Natural Hazards Program Manager, Department of Land Conservation and Development
Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540
Phone: 503-373-0050
Fax: 503-378-6033
Website: <http://www.lcd.state.or.us/hazards.html>

NFIP Community Rating System Coordinator's Manual. FEMA/NFIP. Indianapolis, IN.

This informative brochure explains how the Community Rating System works and what the benefits are to communities. It explains in detail the CRS point system, and what activities communities can pursue to earn points. These points then add up to the "rating" for the community, and flood insurance premium discounts are calculated based upon that "rating." The brochure also provides a table on the percent discount realized for each rating (1-10). Instructions on how to apply to be a CRS community are also included. Marion County's rating is 7 as of November 2004.

Contact: NFIP Community Rating System
Phone: 800-480-2520 or 317-848-2898
Website: <http://www.fema.gov/nfip/crs.htm>

Floodplain Management: A Local Floodplain Administrator's Guide to the NFIP. FEMA-Region 10. Bothell, WA.

This document discusses floodplain processes and terminology. It contains floodplain management and mitigation strategies, as well as information on the NFIP, CRS, Community Assistance Visits, and floodplain development standards.

Contact: National Flood Insurance Program
Phone: 800-480-2520
Website: <http://www.fema.gov/nfip/>

Flood Hazard Mitigation Planning: A Community Guide, (June 1997), Massachusetts Department of Environmental Management.

This guide offers a ten-step process for successful flood hazard mitigation. Steps include: map hazards, determine potential damage areas, take an inventory of facilities in the flood zone, determine what is or is not being done about flooding, identify gaps in protection, brainstorm alternatives and actions, determine feasible actions, coordinate with others, prioritize actions, develop strategies for implementation, and adopt and monitor the plan.

Contact: Massachusetts Flood Hazard Management Program
Phone: 617-626-1250
Website: <http://www.magnet.state.ma.us/dem/programs/mitigate>

Reducing Losses in High Risk Flood Hazard Areas: A Guidebook for Local Officials, (February 1987), FEMA-116.

This guidebook offers a table on actions that communities can take to reduce flood losses. It also offers a table with sources for floodplain mapping assistance for the various types of flooding hazards. There is information on various types of flood hazards with regard to existing mitigation efforts and options for action (policy and programs, mapping, regulatory, non-regulatory). Types of flooding that are covered include alluvial fan, areas behind levees, areas below unsafe dams, coastal flooding, flash floods, fluctuating lake level floods, ground failure triggered by earthquakes, ice jam flooding, and mudslides.

Contact: Federal Emergency Management Agency
Phone: 800-480-2520
Website: <http://www.fema.gov>

Oregon Model Flood Damage Prevention Ordinance, (January 1999), FEMA/DLCD.

This is an example of how to write an ordinance that complies with NFIP/FEMA standards. Communities can simply adopt this ordinance, word for word, filling in the blanks specific to their community or jurisdiction.

Contact: Department of Land Conservation and Development
Phone: 503-373-0050
Website: <http://www.lcd.state.or.us/hazards.html>

Flood Endnotes

-
- ¹ Interagency Hazard Mitigation Team, *State Hazard Mitigation Plan*. 2000. Oregon Emergency Management.
- ² Id.
- ³ Department of Homeland Security NFIP Biennial Report.
- ⁴ Dennis Wylie, Park Manager, Champoeg State Heritage Area. Telephone interview November 5, 2004.
- ⁵ Marion County Emergency Management. Available on the World Wide Web <http://publicworks.co.marion.or.us/emergencymanagement/>.
- ⁶ Oregon Statesman. December 25, 1964.
- ⁷ Kathleen Carlson. "Christmas Week Flood Brings Major Flooding, December 1964" Salem Online History Project available on the World Wide Web <http://www.salemhistory.net/home.htm>
- ⁸ Oregon Statesman. December 24, 1964. No. 272, page 1.
- ⁹ Marion County Emergency Management
- ¹⁰ Oregon Statesman. December 23, 1964, No. 271, page 1.
- ¹¹ Oregon Statesman. January 16, 1974. Page 1.
- ¹² George Taylor and Raymond Hatton. 1999. *Oregon Weather Book: A State of Extremes*. Corvallis, OR: Oregon State University Press.
- ¹³ Oregon Statesman. January 16, 1974.
- ¹⁴ The Statesman Journal. February 24, 1986.
- ¹⁵ George Taylor and Raymond Hatton. 1999. *Oregon Weather Book: A State of Extremes*. Corvallis, OR: Oregon State University Press.
- ¹⁶ Statesman Journal. February 5, 1996.
- ¹⁷ Statesman Journal. February 7, 1996. Page 1.
- ¹⁸ Dennis Wylie, Park Manager, Champoeg State Heritage Area. Telephone interview November 5, 2004.
- ¹⁹ Eric Timmons, Park Manager, Willamette Mission State Park Management Unit, Telephone Interview November 9, 2004.
- ²⁰ Id.
- ²¹ Id.
- ²² Matthew Crall, City of Jefferson, Oregon Development Coordinator. Telephone interview November 4, 2004.
- ²³ Id.
- ²⁴ Rob Kissler, Public Works Director, Keizer, OR. Telephone interview November 18, 2004.
- ²⁵ Id.
- ²⁶ Monte Graham, (former) District Manager, Marion SWCD. Telephone interview November 9, 2004.

-
- ²⁷ Marion County Website
http://publicworks.co.marion.or.us/administration/gis/mike11/proj_scope.as
- ²⁸ Statesman Journal. February 10, 1996.
- ²⁹ Mid-Willamette Valley Council of Governments. February 1996. *Flood Economic Recovery Coordination Project for Marion, Polk, and Yamhill Counties Oregon*. FEMA DR-1099-OR.
- ³⁰ “Pineapple Express Drenches Oregon Again.” Statesman Journal. November 20, 1996.
- ³¹ “Sewer System Backs Up Into Willamette.” Statesman Journal, November 20, 1996
- ³² Statesman Journal, February 20, 1996.
- ³³ Statesman Journal, January 2, 1997.
- ³⁴ National Flood Insurance Program. Available on the World Wide Web
<http://www.fema.gov/nfip>. Accessed April 2002.
- ³⁵ Sasaki, Les. Marion County Public Works Department, Planning Division, Senior Planner. Personal Interview. April 14, 2005.
- ³⁶ Oregon Office of Emergency Management.
- ³⁷ James E. Meacham and Erik B. Steiner. November 2002. *Atlas of Oregon*. Eugene, OR: University of Oregon Press.
- ³⁸ Yamhill Basin Council. June 2001. *Chehalem Watershed Assessment*. Yamhill & Polk Counties, OR.
- ³⁹ Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Oregon Emergency Management.
- ⁴⁰ Marion Soil and Water Conservation Web Page.
www.open.org/~mairswcd/marionSWCD2002.pdf
- ⁴¹ George H. Taylor and Chris Hannan. 1999. *The Climate of Oregon*. Corvallis, OR: Oregon State University Press.
- ⁴² Oregon Climate Service, Zone 2 Climate Data Archives. Available on the World Wide Web <http://www.ocs.orst.edu>
- ⁴³ Lynn H. Williams. September 1972. *Soil Survey of the Marion County Area*. USDA, Soil Conservation Service. Available on the World Wide Web
http://www.or.nrcs.usda.gov/pnw_soil/oregon/or643.html
- ⁴⁴ Id.
- ⁴⁵ Federal Emergency Management Agency. Available on the World Wide Web
http://www.fema.gov/fhm/fq_term.shtm#frequent4. Accessed June 2003.
- ⁴⁶ Marion County Urban Zoning Ordinance, Flood Plain Overlay Zone 19.01 B. Available on the World Wide Web
<http://publicworks.co.marion.or.us/Planning/uzo/chap19.html>.
- ⁴⁷ Oregon Department of Land Conservation and Development (DLCD). July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*. Ch. 4.
- ⁴⁸ G&E Engineering Systems. September 23, 1998. *All Hazard Mitigation Plan Clackamas County, Oregon*. Report 32.07.01, Revision 0.

-
- ⁴⁹ DLCD. *Planning for Natural Hazards: The Oregon Technical Resource Guide*. Ch. 4.
- ⁵⁰ FEMA, Region 10. *Floodplain Management: a Local Administrator's Guide to the National Flood Insurance Program*.
- ⁵¹ Id.
- ⁵² G&E Engineering Systems. September 23, 1998. *All Hazard Mitigation Plan Clackamas County, Oregon*. Report 32.07.01, Revision 0.
- ⁵³ The Interagency Hazards Mitigation Team. June 2000. *State Hazard Mitigation Plan*, Oregon State Police – Office of Emergency Management.
- ⁵⁴ Id.
- ⁵⁵ Id.
- ⁵⁶ Ernie Eichhorn, Bonneville Power Administration, Chemawa District. Telephone interview November 10, 2004.
- ⁵⁷ The Interagency Hazards Mitigation Team. June 2000. *State Hazard Mitigation Plan*. Oregon State Police – Office of Emergency Management.
- ⁵⁸ 2004 DRAFT Marion County Transportation System Plan. Available on the World Wide Web <http://publicworks.co.marion.or.us/engineering/transplan/update/>.
- ⁵⁹ Id.
- ⁶⁰ Marion County Department of Public Works, Environmental Services Division, Stormwater Management Program. March 2004. *Marion County Stormwater Management Plan for the Urbanized Area around Salem and Keizer*. Salem, OR. Available on the World Wide Web <http://publicworks.co.marion.or.us/es/stormwater/Index.asp>
- ⁶¹ Metro. June 1999. *Regional Hazard Mitigation Policy and Planning Guide*. Portland, OR.
- ⁶² Tualatin River Watershed Council. Available on the World Wide Web <http://www.trwc.org/>. Accessed February 2001.
- ⁶³ Oregon Department of State Lands. *Wetlands Functions and Assessment*. Available on the World Wide Web <http://statelands.dsl.state.or.us/fact5.pdf>. Accessed May 2001.
- ⁶⁴ Id.
- ⁶⁵ FEMA Region X NFIP Policy/Claims data.
- ⁶⁶ NFIP Policy Statistics, 2005.
- ⁶⁷ Eric Timmons, Park Manager, Willamette Mission State Park Management Unit, Telephone Interview November 9, 2004.
- ⁶⁸ Oregon Wetlands Joint Venture. Available on the World Wide Web <http://www.dfw.state.or.us/ODFwhtml/Wetlands/about.htm>. Accessed May 2001.
- ⁶⁹ State CRS Summary Report, March 2003.

Section 7: Landslide

- Why are Landslides a Threat to Marion County? 2**
 - History of Landslide Events..... 2
 - Landslide Characteristics 3
 - Landslide Conditions..... 5
 - Landslide Hazard Assessment 8
 - Hazard Identification 8
 - Vulnerability Assessment 8
 - Risk Analysis..... 8
 - Community Landslide Issues 9
 - Existing Activities 9
 - Existing Mitigation Activities 9
 - Mitigation Plan Goals 14
 - Landslide Mitigation Action Items 14
 - Short-term (ST) Landslide Action Items..... 15
 - Long-term (LT) Landslide Action Items..... 18
 - Landslide Resource Directory 20
 - County Resources..... 20
 - State Resources..... 20
 - Federal Resources and Programs 23
 - Additional Resources 23

Why are Landslides a Threat to Marion County?

Landslides are a serious geologic hazard in almost every state in America. Nationally, landslides cause 25 to 50 deaths each year.¹ The best estimates of the direct and indirect costs of landslide damage in the United States range between \$1 billion to \$2 billion annually.² 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.³ They can also pose a serious threat to human life.

A 1998 study completed by Oregon's Department of Geology and Mineral Industry (DOGAMI) states that although few landslides develop in the Willamette Valley as compared to more mountainous parts of the state, the marine sedimentary rock units near Salem and the edges of the valley are susceptible to large slides.⁴

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.

History of Landslide Events

Currently there is no comprehensive list of landslide events and/or dates for Marion County. A 1980 map of development limitations in Marion County, however, indicates that there are three major areas containing slide hazards.⁵ These areas include the western portion of the Salem Hills, the southeastern portion of the county (north of the Santiam River), and slopes located southeast of Scotts Mills.⁶

According to Dan Nevins, Bureau of Land Management (BLM) Road Engineer for the Cascades Resource Area, Little North Fork Road, which is a county road in the southeastern portion of the county, is always moving.⁷ Where Highway 22 narrows, on the north side and across the road from Giovanni's Pizza in Mill City, the hillside sloughs off three or four times a year.⁸ This section of Highway 22 is then closed for sometimes more than three hours, until the Oregon Department of Transportation (ODOT) can clear it of debris.⁹

The 1998 DOGAMI study of the Western Portion of the Salem Hills indicates that slopes nearest to the Willamette River contain the greatest risk of landslide. The study further states, "The rock types within the Salem Hills include weak and low-permeability marine sediments overlain by high-strength basalts with prominent and pervasive discontinuities. These rock types, along with clay-rich residual soils overlying the basalts, provide a setting that is susceptible to water-induced landsliding where slopes are relatively steep and within existing slide masses."¹⁰ As this area

is near the densest portion of the county, the greatest risk is imposed on life and property.

The geologic setting of the Salem Hills illustrates a historic pattern of landslides. Many prominent features that help identify the ancient landslide terrain are hummocky topography, disrupted drainage patterns, sag ponds, springs, back-tilted bedrock blocks, and subdued head scarps.¹¹

Landslide Characteristics

What is a Landslide?

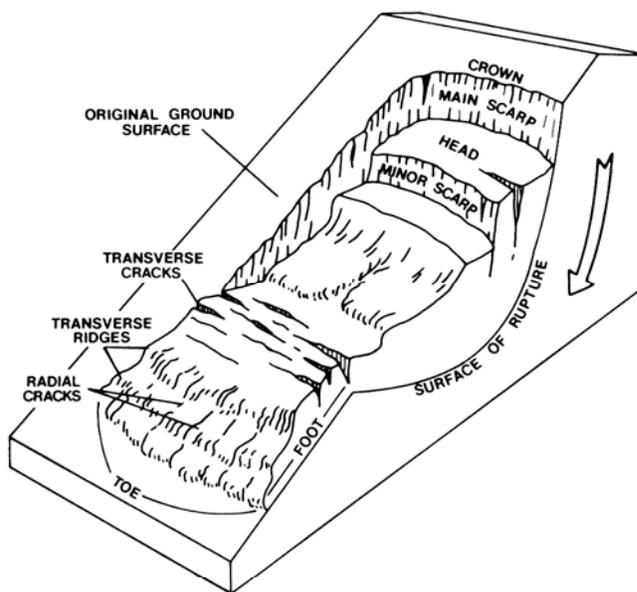
Landslides are downhill or lateral movements of rock, debris, or soil mass. The size of a landslide usually depends on the geology and the landslide triggering mechanism. Landslides initiated by rainfall tend to be smaller, while those initiated by earthquakes may be very large. Slides associated with volcanic eruptions can include as much as one cubic mile of material.

Landslides vary greatly in the volumes of rock and soil involved, the length, width, and depth of the area affected, frequency of occurrence, and speed of movement. Some characteristics that determine the type of landslide are slope of the hillside, moisture content, and the nature of the underlying materials. Landslides are given different names depending on the type of failure and their composition and characteristics. Types of landslides include slides, rock falls, and flows.

Slides move in contact with the underlying surface. These movements include rotational slides where sliding material moves along a curved surface, and translational slides where movement occurs along a flat surface. These slides are generally slow moving and can be deep. Slumps are small rotational slides that are generally shallow (See Figure 5.1). Slow-moving landslides can occur on relatively gentle slopes and can cause significant property damage, but are far less likely to result in serious injuries than rapidly moving landslides.¹²

Erosion occurs when ditches or culverts beneath hillside roads become blocked with debris. If the ditches are blocked, run-off from the slopes is inhibited during periods of precipitation. This causes the run-off water to collect in soil, and in some cases, cause a slide. Usually the slides are small (100 – 1,000 cubic yards), but they can be quite large.

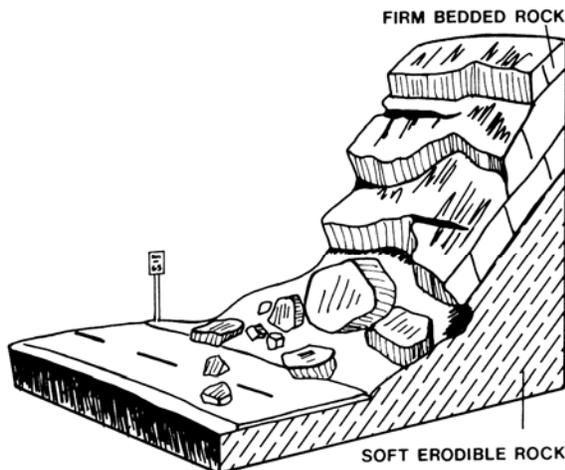
Figure 5.1. Rotational Slide



Source: *Planning for Natural Hazards: The Oregon Technical Resource Guide*, Oregon Department of Land Conservation and Development.

Rock falls (see Figure 5.2) occur when blocks of material come loose on steep slopes. Weathering, erosion, or excavations, such as those along highways, can cause falls where the road has been cut through bedrock. They are fast moving with the materials free falling or bouncing down the slope. In falls, material is detached from a steep slope or cliff. The volume of material involved is generally small, but large boulders or blocks of rock can cause significant damage. Rock falls have the potential to break off power poles located on hillsides. In Eugene area, this has been a problem.¹³

Figure 5.2. Rock Fall

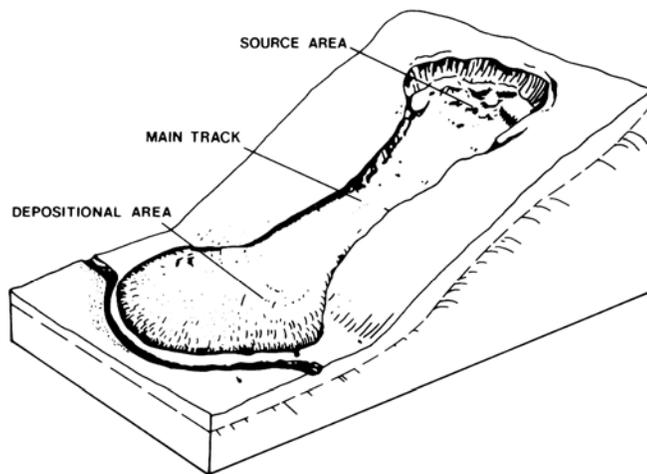


Source: *Planning for Natural Hazards: The Oregon Technical Resource Guide*, Oregon Department of Land Conservation and Development

Flows (see Figure 5.3) are plastic or liquid movements in which land mass (e.g. soil and rock) breaks up and flows during movement.

Earthquakes often trigger flows.¹⁴ Debris flows normally occur when a landslide moves downslope as a semi-fluid mass scouring, or partially scouring soils from the slope along its path. Flows are typically rapidly moving and also tend to increase in volume as they scour out the channel.¹⁵ Flows often occur during heavy rainfall, can occur on gentle slopes, and can move rapidly for large distances. One example of a flow in Oregon is the Dodson debris flow that occurred in 1996. This debris flow started high on the Columbia Gorge cliffs, and traveled far down steep canyons to form debris fans at Dodson.¹⁶

Figure 5.3. Earthflow



Source: *Planning for Natural Hazards: The Oregon Technical Resource Guide*, Oregon Department of Land Conservation and Development

Landslides are typically triggered by periods of heavy rainfall or rapid snowmelt. Earthquakes, volcanic activity, and excavations may also trigger landslides. Certain geologic formations are more susceptible to landslides than others. Human activities, including locating development near steep slopes, can increase susceptibility to landslide events. Landslides on steep slopes are more dangerous because movements can be rapid.

Although landslides are a natural geologic process, the incidence of landslides and their impacts on people can be exacerbated by human activities. Grading for road construction and development can increase slope steepness. Grading and construction can decrease the stability of a hillslope by adding weight to the top of the slope, removing support at the base of the slope, and increasing water content. Other human activities affecting landslides include: excavation, drainage and groundwater alterations, and changes in vegetation.¹⁷

Landslide Conditions

Natural Conditions

Natural processes can cause landslides or re-activate historical landslide sites. Incidental storm events result in debris flows, which increase

sediment loads to stream, and effect fish and wildlife habitat.¹⁸ Rainfall-initiated landslides tend to be smaller, while earthquake-induced landslides may be very large, but less frequent.

The removal of shoreline supporting material along bodies of water by currents and waves, or undercutting during construction at the base of a slope produces countless small slides each year. Seismic tremors can trigger landslides on slopes historically known to have landslide movement. Earthquakes can also cause additional failure (lateral spreading) that can occur on gentle slopes above steep streams and riverbanks. Landslides are particularly common along stream banks, reservoir shorelines, large lakes, and seacoasts. Steep, concave-shaped slopes with larger drainage areas appear to be more susceptible to landslides than other landforms. Landslides associated with volcanic eruptions can include volumes of over one cubic mile of material. All soil types can be affected by natural landslide triggering conditions.

Excavation and Grading

Slope excavation is common in the development of home sites or roads on sloping terrain. Grading these slopes can result in some slopes that are steeper than the pre-existing natural slopes. Since slope steepness is a major factor in landslides, these steeper slopes can be at an increased risk for landslides. The added weight of fill placed on slopes can also result in an increased landslide hazard. Small landslides can be fairly common along roads, in either the road cut or the road fill. Landslides occurring below

new construction sites are indicators of the potential impacts stemming from excavation.

What locations are at risk from landslides and debris flows?

Locations at risk from landslides or debris flows include areas with one or more of the following conditions:

- On or close to steep hills;
- Steep road-cuts or excavations into steep slopes;
- Existing landslides or places of known historic landslides (such sites often have tilted power lines, trees tilted in various directions, cracks in the ground, and irregular-surfaced ground);
- Steep areas where surface runoff is channeled, such as below culverts, V-shaped valleys, canyon bottoms, and steep stream channels;
- Fan-shaped areas of sediment and boulder accumulation at the outlets of canyons, large boulders (2 to 20 feet diameter) perched on soil near fans or adjacent to creeks; and
- Occurrences of logjams in streams.¹

Drainage and Groundwater Alterations

Water flowing through or over the ground is often the trigger for a landslide. Any activity that increases the amount of water flowing into landslide-prone slopes can increase landslide hazards. Broken or leaking water or sewer lines can be especially problematic, as can water retention facilities that direct water onto slopes. Even lawn irrigation and minor alterations to small streams in landslide prone locations can result in damaging landslides. Ineffective stormwater management and excess runoff

can also cause erosion and increase the risk of landslide hazards. Drainage can be affected naturally by the geology and topography of an area.

Development that results in an increase in impervious surface impairs the ability of the land to absorb water and may redirect water to other areas. As a result, more landslides could occur.

Channels, streams, ponding, and erosion on slopes all indicate potential slope problems. Road and driveway drains, gutters, downspouts, and other constructed drainage facilities can concentrate and accelerate flow. Ground saturation and concentrated velocity flow are major causes of slope problems and may trigger landslides.¹⁹

Changes in Vegetation

Removing vegetation from very steep slopes can increase landslide hazards. The *Storm Impacts Study* conducted by the Oregon Department of Forestry found that landslide hazards in three out of four steeply sloped areas were highest for a period of ten years after timber harvesting.²⁰ Areas that have experienced wildfire and land clearing for development may have long periods of increased landslide hazard. In addition, woody debris in stream channels (both natural and as a result of logging) may cause the impacts from debris flows to be more severe.²¹

Development

Development sites at the greatest risk from landslides are against the base of very steep slopes, in confined stream channels (small canyons), and on fans (rises) at the mouth of these confined channels. While home development sites do not cause landslides, they put residents and property at risk of landslide impacts. The simplest mitigation measure for this situation is to locate the home out of the impact area, or construct debris flow diversions for homes at risk. Three development-related actions that can put people at risk include:²²

1. **Creating Steeper Slopes.** Excavation practices, sometimes aggravated by drainage, can reduce the stability of otherwise stable slopes. These failures commonly affect only a small number of homes. Without these excavation practices, there is little risk of landslides in areas not prone to landslide movement.
2. **Development on or Adjacent to Existing Landslides.** Existing landslides are generally at risk of future movement regardless of excavation practices. Excavation and drainage practices can further increase risk of landslides. In many cases, there are no development practices that can completely assure stability. Homeowners and communities in these situations accept some risk of future landslide movement.
3. **Development on Gentle Slopes.** Development on gentle slopes can be subject to landslides that begin a long distance from the development.

Informing new residents, long-time homeowners, and developers about the risks associated with landslides is an important issue related to landslide location and occurrence. Developers that are uninformed about geological materials and processes may contribute to conditions that trigger landslide activity or increase susceptibility to landslide hazards.²³

Landslide Hazard Assessment

Hazard Identification

Hazard identification is the first phase of a hazard assessment, and is the process of estimating the geographic extent of the hazard, its intensity, and its probability of occurrence.²⁴ This process usually results in a hazard map. Hazard maps can provide detailed information in a clear format and can assist in making policy and land use decisions.

Debris flows generally occur during intense periods of rainfall on previously saturated soil. They generally start on steep slopes and accelerate to speeds as great as 35 miles per hour. These rapidly moving landslides have caused most of the recent landslide related injuries and deaths in Oregon.²⁵ The previous damage and deaths associated with rapidly moving landslides in Oregon have been the catalyst for agencies to map these types of landslides. Currently, two state agencies are involved in mapping debris flows: (1) the Oregon Department of Forestry (ODF); and (2) the Department of Geology and Mineral Industries (DOGAMI). Map 7 shows the debris flow hazard areas for Marion County from the ODF. Map 8 shows landslide hazard areas for Marion County.

Vulnerability Assessment

Vulnerability assessment is the second phase of a hazard assessment. It combines the information generated through debris flow identification with an inventory of the existing development exposed to landslide hazards. Vulnerability assessments assist in predicting how different types of property and population groups will be affected by a hazard.²⁶ The optimum method for doing this analysis at the county or jurisdiction level is to use parcel-specific assessment data on land use and structures.²⁷ Data that includes specific landslide-prone and debris flow locations in the county can be used to assess the population and total value of property at risk from future landslide occurrences.

While a quantitative vulnerability assessment (an assessment that describes number of lives or amount of property exposed to the hazard) has not yet been conducted for Marion County landslide events, there are many qualitative factors (issues relating to what is in danger within a community) that point to potential vulnerability. Landslides can impact major transportation arteries, blocking residents from essential services and businesses. While past landslide events have not caused major property damage or significantly impacted county residents, continuing to map county landslide and debris flow areas will help in preventing future loss.

Risk Analysis

Risk analysis is the third, and most advanced phase of a hazard assessment. It builds upon hazard identification and vulnerability assessments.

Factors included in assessing landslide risk include population and property distribution in the hazard area, the frequency of landslide or debris flow occurrences, slope steepness, soil characteristics, and precipitation intensity. This type of analysis could generate estimates of the damages to the county due to a landslide or debris flow event in a specific location. At the time of publication of this plan, data was insufficient to conduct a risk analysis and the software needed to conduct this type of analysis was not available.

The Oregon Department of Forestry and the Department of Geology and Mineral Industries are active in developing maps and collecting data on hazard risk. Developing partnerships with these agencies and other state and federal organizations can facilitate future strides in doing risk analysis for landslide hazards.

Community Landslide Issues

Landslides can affect utility services, transportation systems, and critical lifelines. Communities may suffer immediate damages and loss of service. Disruption of infrastructure, roads, and critical facilities may also have a long-term effect on the economy. Utilities, including potable water, wastewater, telecommunications, natural gas, and electric power are all essential to service community needs. Loss of electricity has the most widespread impact on other utilities and on the whole community. Natural gas pipes may also be at risk of breakage from landslide movements as small as an inch or two.²⁸

Lifelines and critical facilities should remain accessible if possible during a natural hazard event. The impact of closed transportation arteries may be increased if the closed road or bridge is a critical lifeline to hospitals or other emergency facilities. Therefore, inspection and repair of critical transportation facilities and routes is essential and should receive high priority. Losses of power and phone service are also potential consequences of landslide events. Due to heavy rains, soil erosion in hillside areas can be accelerated, resulting in loss of soil support beneath high voltage transmission towers in hillsides and remote areas.²⁹ Flood events can also cause landslides, which can have serious impacts on gas lines.

Existing Activities

Existing Mitigation Activities

County

Landslide Hazard Study

Through FEMA's Hazard Mitigation Grant Program, Marion County, City of Salem, and DOGAMI received \$250,000 and collaborated on a landslide hazard study project (1998-2000). This project was recognized and nominated for the 2003-2004 Partners for Disaster Resistance and Resilience, Oregon Showcase State Exemplary Natural Hazard Mitigation Project for its unique landslide/geohazard ordinances. The landslide hazard study and implementing landslide hazard ordinances demonstrate that

jurisdictions, by actively involving citizenry and using GIS, can collaborate to reduce the risk from geologic hazards on a local and regional scale.

The landslide hazard study scope of work identified the nature and causes of landslides, established hillside development regulations, and documented the activities and decision process. The process engaged geotechnical engineers, engineering geologists, neighborhood associations, community stakeholders such as builders/developers and watershed councils, the State Boards of Geologic and Engineering Examiners along with city/county staff as part of the project advisory group.

The city and county successfully established a planning process and method that reduces losses from future landslides through effective hazard mitigation strategies that incorporate five essential elements: input from a technical advisory committee; natural hazard inventories; screening mechanisms to determine when to regulate development; thorough site examination criteria; and provisions for dispersing responsibility and risk among stakeholders.

Marion County incorporated landslide data from the various sources utilized as inventory information for the geological hazards ordinance (see below), along with excessive slope information i.e., slopes in excess of 20 percent as data layers in the county's GIS. The point system to determine the level of geological review that is needed under the ordinance has been incorporated into the county zone maps making it easier for staff and property owners to determine the relative risk with regard to various hazard areas of a property. The information is available and viewable by the public and used as a tool in discussing development options for property owners whose parcels contain identified geological hazard areas.

Reference materials and reports completed as a result of the landslide hazard study project are listed in the Landslide Resource Directory, under State Resources (page 7-23).

County Zoning Ordinance

In 2002, Marion County began implementing the "Geologically Hazardous Areas Overlay Zone" chapter (Chapter 182) in its Zoning Ordinance. This chapter implements the Development Limitations goal and policies of the Rural Development Section of the Marion County Comprehensive Land Use Plan, and Statewide Land Use Planning Goal 7 – Areas Subject to Natural Disasters and Hazards. This chapter applies to the entire county. Chapter 182 implements the strategy for reviewing development applications for properties within identified slide hazard and excessive slope areas to address the risk that a proposed land use activity may adversely affect the stability and landslide susceptibility of an area.

The percentage of vacant land in landslide areas underscores the necessity of developing landslide hazard mitigation activities. The potential for future development necessitates strong regulations to reduce risk from potential landslide events. The provisions of Chapter 182 are intended to manage the risk of a landslide within identified slide hazard and excessive slope areas by requiring geological and/or geotechnical reports, but not act as a guarantee that the landslide hazard risk will be eliminated. Chapter

182 requires that an appropriate level of study occur before development occurs.

During the development of and prior to the adoption process for the county's geologically hazards areas ordinance, all properties within the identified hazard areas – whether low, medium or high risk areas – were notified of the possible ordinance. The county has noted a decrease in the number of developments requiring geological assessments and/or report with implementation of the ordinance, as property owners are location dwellings in areas of lower risk or outside the geological hazards areas, where activity is not subject to the ordinance.

The county ordinance contains a provision for county review of the ordinance following the county's processing of ten geological reports to gauge the effectiveness of the ordinance and to determine whether changes to the ordinance were warranted based on input from geologists/engineers, the county's report peer reviewer, and property owners/developers. The county's initial review determined that the ordinance was effective with only a couple of minor clarifications needed. A second county review of the ordinance will occur in 2006. Incorporation of the state's Senate Bill (SB) 12's "Further Review Areas of Rapidly Moving Landslide Areas" (see below) will not occur until the state completes its mapping specific to the legislation.

Relative Landslide Risk Maps

The county has developed maps that indicate the location of areas susceptible to landslides, areas of known landslide hazards, and excessive slope areas. These maps are based on the best available information and may be amended based upon receipt of corrected, updated or refined data, or upon the revision of studies upon which the maps were initially based.

State

Oregon State Senate Bill 12

The 1997 Legislature passed Senate Bill 12 to address problems caused by landslides and debris flows. Provisions include:

- Allowing the Oregon State Forester to prevent timber harvest or road construction in or below areas identified by the Department of Forestry as "high risk sites" and where homes or highways are in precarious locations.
- Allowing road officials to close roads that pose risk to human life because of landslides.
- Requiring State agencies to develop, and local officials to distribute, information about hazards of construction on sites that are vulnerable to landslides.
- Establishing a ten-member Task Force on Landslides and Public Safety to assess the problem and develop a solution. The task force includes

legislators and representatives from state natural resource agencies, boards of commissions, local government, and the public.

Debris Flow Mapping

Currently, the Oregon Department of Forestry and the Department of Geology and Mineral Industries (DOGAMI) are involved in mapping debris flows. Senate Bill 12 requires that the DOGAMI, with cooperation from local governments and the Department of Forestry, identify and map landslide-prone areas, or “further review areas.” Senate Bill 12 defines a further review area as “an area of land in which further site specific review should occur before land management or building activities begin.”³⁰

Oregon Department of Forestry (ODF)

The Oregon Department of Forestry has provided a preliminary indication of debris flow (rapidly moving landslides) in western Oregon. Their debris flow maps include the general locations subject to naturally occurring debris flows and include the initiation sites and locations along the paths of potential debris flows (confined stream channels and locations below steep slopes). These maps do not consider the effects of management-related slope alterations (drainage and excavation) that can increase the hazard, nor do they consider very large landslides that could possibly be triggered by volcanic or earthquake activity. Areas identified in these maps are not to be considered “further review areas” as defined by Senate Bill 12.³¹

Information used to develop the ODF Debris Flow maps include:

- Digital elevation models at 30-meter resolution, based on US Geological Survey data, were used to derive slope steepness and then to develop polygons for assigned hazards. Note that actual slopes are steeper than the digitally elevated models.
- Mapped locations of Tye soil formation and similar sedimentary geologic units.
- Oregon Department of Forestry *Storm Impacts and Landslides of 1996* study; debris flow initiation and path location data.
- Stream channel confinement near steep hill slopes based on US Geological Survey Digital Raster Graphics.
- Historical information on debris flow occurrence in western Oregon (from ODF, US Forest Service, DOGAMI, Bureau of Land Management, and the Oregon Department of Transportation).
- Fan-shaped land formations below long, steep slopes.

Areas of highest intensity precipitation do not appear to be correlated with known areas of high and extreme debris flow hazard, so precipitation intensity was *not* used to develop risk (hazard) ratings.³²

Prohibition of Certain Forest Operations

As part of the requirements of Senate Bill 12, the Oregon Department of Forestry is currently administering the deferral of certain forest operations on landslide-prone sites above homes and roads. The Department of Forestry’s policy is that timber harvesting or road construction operations

will be prohibited on land where landslides or debris flows pose a significant threat to human safety. Exceptions for salvage or other purposes are considered on an individual basis, but have been infrequent in keeping with the intent of preventing significant risks to human life.³³

Debris Flow Warning System

The debris flow warning system was initiated in 1997 and involves collaboration between ODF, DOGAMI, the Oregon Department of Transportation (ODOT), local law enforcement, National Oceanic and Atmospheric Administration (NOAA) Weather Radio, and local media.

Department of Forestry meteorologists are responsible for forecasting storms that may trigger debris flows. Information is broadcast over NOAA Weather Radio, and on the Law Enforcement Data System. DOGAMI provides additional information on debris flows through the media. ODOT provides warning signs to motorists in landslide-prone areas during high-risk periods.³⁴

Landslide Brochure

DOGAMI developed a landslide public outreach brochure in cooperation with several other state agencies. Forty thousand copies were printed in November 1997 and were distributed widely to building codes officials, county planners, local emergency managers, field offices of natural resource agencies, banks, real estate companies, insurance companies, and other outlets. Landslide brochures are available from DOGAMI, Office of Emergency Management (OEM), ODF, and the Department of Land Conservation and Development (DLCD).³⁵

Oregon State Building Code Standards

The Oregon Building Codes Division adopts statewide standards for building construction that are administered by state and local municipalities throughout Oregon. The One- and Two-Family Dwelling Code and the Structural Specialty Code contain provisions for lot grading and site preparation for the construction of building foundations.

Both codes contain requirements for cut, fill, and sloping of the lot in relationship to the location of the foundation. There are also building setback requirements from the top and bottom of slopes. The codes specify foundation design requirements to accommodate the type of soils, the soil bearing pressure, and the compaction and lateral loads from soil and groundwater on sloped lots. The building official has the authority to require a soils analysis for any project where it appears the site conditions do not meet the requirements of the code, or that special design considerations must be taken. Oregon Revised Statutes (ORS) 455.447 and the Structural Code require a seismic site hazard report for projects that include essential facilities such as hospitals, fire and police stations, emergency response facilities, and special occupancy structures, such as large schools and prisons.³⁶

Mitigation Plan Goals

The mitigation plan goals addressed by each action item are identified as a means for monitoring and evaluating how well the mitigation plan is achieving its goals following implementation.

The plan goals help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Goal #1: PUBLIC AWARENESS

Goal Statement: Increase public awareness of natural hazard risks, emergency notification and response, and resources for citizen preparedness.

Goal #2: EDUCATION

Goal Statement: Educate the public on how to prepare to successfully endure a natural disaster with minimal property damage and no loss of life.

Goal #3: PREVENTATIVE

Goal Statement: Minimize risks to life, property, the environment, and the economy from natural hazards.

Goal #4: FUNDING AND IMPLEMENTATION

Goal Statement: Identify potential funding sources and implement potential mitigation projects.

Goal #5: PARTNERSHIPS AND COORDINATION

Goal Statements:

- Create and enhance partnerships with other stakeholders involved with natural hazard management.
- Coordinate natural hazard mitigation efforts with adjacent jurisdictions and public/private agencies' risk management activities.

Goal #6: NATURAL RESOURCES UTILIZATION

Goal Statement: Promote the use of natural systems and features, watershed planning, and land use planning for natural hazard mitigation whenever possible to reduce long-term costs to the county and maximize effectiveness.

Goal #7: EMERGENCY SERVICES

Goal Statement: Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Landslide Mitigation Action Items

The mitigation action items were formulated through researching regional mitigation plans and natural hazards planning literature, and interviews with local stakeholders. Plan action items were refined through discussions

with the mitigation plan steering committee and through comments received at a public open house.

The landslide mitigation action items provide direction on specific activities that organizations and residents in Marion County can undertake to reduce risk and prevent loss from landslides. Each action item is followed by ideas for implementation, which can be used by local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk from landslides in Marion County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Landslide Action Items

Short-term landslide action items include general mitigation activities that agencies are capable of implementing during the next two years, given their existing resources and authorities.

ST-LS #1: Improve knowledge of landslide hazard areas and understanding of vulnerability and risk to life and property in hazard-prone areas.

Ideas for Implementation

- Incorporate the results of the DOGAMI mapping effort when available into the Marion County Natural Hazards Mitigation Plan Risk Assessment, and other county planning documents;
- 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;
- Analyze the risk of these areas to life, property, and infrastructures; and
- Develop public information to emphasize economic risk when building on potential or historical landslide areas.

Coordinating Organization:	GIS
Internal Partners:	Planning and Building Divisions, Emergency Management
External Partner:	DOGAMI, ODF, USFS, Cities
Timeline:	2 years and on-going
Plan Goals Addressed:	Public Awareness; Preventative; Partnerships and Coordination

ST-LS #2: Encourage construction, site location and design that can be applied to steep slopes to reduce the potential adverse impacts from development.

Ideas for Implementation

- Where appropriate, reduce the disruption of the natural contour and vegetation to the greatest extent possible;
- Where appropriate, reduce the number of building sites in landslide-prone areas to the greatest extent possible;
- Reduce driveway cuts into hillsides;
- 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 stormwater runoff during road and site construction;
- Reduce water input into slopes from building roof drains, storm drains, and surface runoff;
- Develop a 'how-to' development and construction guide for homeowners in potential landslide hazard areas;
- Develop public information to emphasize economic risk when building on potential or historical landslide areas; and
- Increase communication and coordination between the county Public Works-Environmental Services Division and the Building Division.

Coordinating Organization: Public Works – Environmental Services Division,
Building Division
Internal Partners: Planning Division
External Partners: DLCD, Cities, Institute for Business and Home
Safety (IBHS)
Timeline: 1 to 3 years
Plan Goals Addressed: Preventative; Funding and Implementation;
Partnerships and Coordination;

ST-LS #3: Identify safe evacuation and detour routes in high-risk debris flow and landslide areas.

Ideas for Implementation

- Identify potential debris removal and disposal resources;
- Maintain participation in regional committee planning for emergency transportation routes;

- Apply a regional approach to identifying detour routes in conjunction with adjacent counties affected by closure of Highway 22 through Santiam Canyon (Linn, Jefferson, Clackamas, Deschutes); and
- Identify and publicize information regarding emergency transportation routes.

Coordinating Organization: Public Works
 Internal Partner: Emergency Management
 External Partners: ODOT; Linn, Jefferson, Clackamas, and Deschutes Counties; DOGAMI
 Timeline: 2 years
 Plan Goals Addressed: Preventative; Partnerships and Coordination; Emergency Services

ST-LS #4: Compile Relative Landslide Risk maps for Marion County.

Note: DOGAMI will make the final determination of “further review areas” for rapidly moving landslides as required by Oregon Senate Bill 12 (1997).

Ideas for Implementation

- Once “further review areas” are established, overlay those areas with utility system maps and tax assessor information to identify potential risks.

Coordinating Organizations: DOGAMI, GIS
 Internal Partners: Emergency Management, Planning, Assessor
 External Partners: ODF, Utilities
 Timeline: Depending on DOGAMI funding in this biennium
 Plan Goals Addressed: Public Awareness; Education; Preventative; Partnerships and Coordination

ST-LS #5: Increase public education related to landslide hazards by distributing DOGAMI landslide informational brochure.

Ideas for Implementation:

- Distribute the DOGAMI landslide informational brochure.

Coordinating Organization: Emergency Management
 Internal Partners: Public Works, Planning and Building Divisions
 External Partners: City Emergency Managers, City Building and Planning Departments, DOGAMI, OEM, ODF, DLCD
 Timeline: 1 to 2 years
 Plan Goals Addressed: Public Awareness; Education; Partnerships and Coordination

Long-term (LT) Landslide Action Items

Long-term landslide action items include general mitigation activities that are likely to take more than two years to implement and may require new or additional resources and/or authorities.

LT-LS #1: Evaluate current landslide warning systems to ensure effectiveness and efficiency and increase coordination between local jurisdictions and ODF for landslide warning systems.

Ideas for Implementation

- Educate high-risk populations about climatic and soil conditions that are conducive to landslides; and`
- Partner with ODOT to place signboards stating landslide hazard and road detours in areas along highway that provide truck traffic sufficient areas to turnaround if necessary.

Coordinating Organization:	Emergency Management
Internal Partner:	Planning
External Partners:	City Planning Departments; Builders, Developers, Property Owners, ODF, ODOT
Timeline:	On-going
Plan Goals Addressed:	Public Awareness; Preventative; Partnerships and Coordination

LT-LS #2: Mitigate activities in identified potential and historical landslide areas through public outreach.

Ideas for Implementation

- Coordinate with property owners to reduce risk in landslide hazard areas;
- Provide information on hazard location to future residents;
- Distribute landslide educational materials to the public; and
- Identify and use existing mechanisms for public outreach (e.g., Marion SWCD, NRCS, watershed councils, etc.).

Coordinating Organization:	Planning, Emergency Management
Internal Partner:	Public Works, GIS
External Partners:	ODF, Cities, Mortgage Companies
Timeline:	On-going
Plan Goals Addressed:	Public Awareness; Preventative; Partnerships and Coordination

LT-LS #3: Increase coordination between local jurisdictions, emergency responders, homeowners and ODF for landslide warning systems.

Ideas for Implementation

- Educate at-risk home sites about climatic and soil conditions that are conducive to landslides; and
- Develop mitigation and evacuation information and procedures for at-risk home sites.

Coordinating Organization: Emergency Management
Internal Partners: Planning, Building
External Partners: City Planning Departments, ODF, BLM, USFS
Timeline: 3 to 5 years
Plan Goals Addressed: Public Awareness; Education; Preventative; Emergency Services.

LT-LS #4: Protect existing development in landslide-prone areas.

Ideas for Implementation

- Provide information to residents on landslide prevention. Publications such as FEMA's *Homeowners Landslide Guide for Hillside Flooding, Debris Flows, Erosion, and Landslide Control* and FEMA's *Hillside Drainage* flier 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;
- Construct debris-flow diversions to protect existing properties; and
- Publicize the Oregon Department of Forestry's debris-flow warning system.

Coordinating Organization: Emergency Management
Internal Partner: Planning
External Partner: ODF, DLCD, OEM, FEMA, Cities
Timeline: On-going
Plan Goals Addressed: Public Awareness; Preventative; Funding and Implementation; Partnerships and Coordination.

LT-LS #5: Maintain public and encourage maintenance of private drainage systems.

Ideas for Implementation

- Ensure that ditches, stormwater facilities, and culverts are inspected and cleared prior to the wet season each year.

Coordinating Organization:	Public Works
Internal Partner:	GIS, Planning
External Partners:	Cities, water and irrigation districts, watershed councils, DEQ
Timeline:	On-going
Plan Goals Addressed:	Public Awareness; Preventative; Funding and Implementation; Partnerships and Coordination.

Landslide Resource Directory

County Resources

Marion County Emergency Management

Marion County Emergency Management helps the community be better prepared for major emergencies and disasters. They work closely with cities, emergency responders, and volunteer agencies to find ways to reduce risks and minimize damages during hazard events. When a disaster occurs, they work with these partners in their Emergency Operations Center to coordinate resources and information. Once the event is over, they help bring assistance to those that have been harmed.

Contact: Marion County Emergency Management Coordinator
Address: 5155 Silverton Road, Salem, OR 97305-3899
Phone: 503-365-3133
Email: Emergency@fco.marion.or.us
Website: <http://PublicWorks.co.marion.or.us/EmergencyManagement>

State Resources

Department of Land Conservation and Development (DLCD)

Oregon's Department of Land Conservation and Development administers a natural hazards program to assist local governments in meeting statewide Planning Goal 7: Areas Subject to Natural Disasters and Hazards.

Activities relating to landslide mitigation include:

- Distribution of model ordinances through which hazards can be mitigated. DLCD advises local governments on which ordinance best meets their needs;
- Reviewing local land use plan amendments for consistency with state landslide programs and regulations and providing direct technical assistance;

- Providing a liaison between pertinent local, state, and federal agencies. DLCD representatives serve on a variety of commissions and ad hoc committees which deal with natural hazards;
- Adopting and amending statewide planning goals and administrative rules relating to natural hazards.

Contact: State Floodplain Manager, Natural Hazards Program Manager
Address: 635 Capitol Street NE, Suite 150
Phone: 503-373-0050
Fax: 503-378-6033
Website: <http://www.lcd.state.or.us/hazards.html>

Oregon Department of Forestry (ODF)

The mission of the Oregon Department of Forestry is to serve the people of Oregon through the protection, management, and promotion of a healthy forest environment, which will enhance Oregon's livability and economy for today and tomorrow. ODF regulates forest operations to reduce the risk of serious injury or death from rapidly moving landslides related to forest operations, and assists local governments in the siting review of permanent dwellings on and adjacent to forestlands in further review areas.

Contact: Oregon Department of Forestry, Salem Headquarters
Address: 2600 State Street, Salem, OR 97310
Phone: 503-945-7200
Website: <http://www.odf.state.or.us>

Oregon Department of Forestry Debris Flow Warning Page

The ODF debris-flow warning page provides communities with up-to-date access to information regarding potential debris flows. As the lead agency, ODF is responsible for forecasting and measuring rainfall from storms that may trigger debris flows. Advisories and warnings are issued as appropriate. Information is broadcast over NOAA weather radio and on the Law Enforcement Data System. DOGAMI provides additional information on debris flows to the media that convey the information to the public. ODOT also provides warnings to motorists during periods determined to be of highest risk for rapidly moving landslides along areas on state highways with a history of being most vulnerable. Information is available on the ODF website at www.odf.state.or.us.

Oregon Department of Geology and Mineral Industries (DOGAMI)

DOGAMI is an important agency for landslide mitigation activities in Oregon. Some key functions of DOGAMI are development of geologic data, producing maps, and acting as lead regulator for mining and drilling for geological resources. The agency also provides technical resources for communities and provides public education on geologic hazards. DOGAMI provides data and geologic information to local, state, and federal natural resource agencies, industry, and private groups.

Contact: Department of Geology and Mineral Industries (DOGAMI)
Address: 800 NE Oregon Street, Suite 965, Portland, Oregon 97232
Phone: 503-731-4100
Fax: 503-731-4066

Website: <http://sarvis.dogami.state.or.us>
Email: Info@naturenw.org

Nature of the Northwest

Oregon Department of Geology and Mineral Industries and the USDA Forest Service jointly operate the Nature of the Northwest Information Center. The Center offers a selection of maps and publications from state, federal, and private agencies.

Contact: The Nature of the Northwest Information Center
Address: 800 NE Oregon Street #5, Suite 177, Portland, Oregon 97232
Phone: 503-872- 2750
Fax: 503-731-4066
Website: <http://www.naturenw.org>
Email: Nature.of.Northwest@state.or.us

Oregon Department of Transportation (ODOT)

ODOT provides warnings to motorists during periods determined to be of highest risk of rapidly moving landslides along areas on state highways with a history of being most vulnerable to rapidly moving landslides. ODOT also monitors for landslide activity and responds to slide events on state highways.

Contact: ODOT Transportation Building
Address: 355 Capitol St. NE, Salem, OR 97310
Phone: 888-275-6368
Website: <http://www.odot.state.or.us>

Oregon State Police (OSP)-Office of Emergency Management (OEM)

OEM coordinates state resources for rapid and effective response to rapidly moving landslide and other landslide-related emergencies. The Oregon Emergency Response System (OERS) of OEM is a key player in the dissemination of debris flow advisories and warnings. OEM chairs a group that develops and measures landslide hazard mitigation strategies. OEM also administers the FEMA Hazard Mitigation Grant Program, which provides a source of funding for implementing hazard mitigation projects. OEM also works with other state agencies to develop information for local governments and the public on landslide hazards.

Contact: Oregon Emergency Management
Address: 3225 State Street, Salem, Oregon
Phone: 503-378-2911
Fax: 503-373-7833
Website: <http://www.osp.state.or.us/oem>

Portland State University, Department of Geology

Portland State University conducts research and prepares inventories and reports for communities throughout Oregon. Research and projects conducted through the Department of Geology at Portland State University include an inventory of landslides for the Portland metropolitan region after

the 1996 and 1997 floods and a subsequent susceptibility report and planning document for Metro in Portland.

Contact: Portland State University, Department of Geology
Address: 17 Cramer Hall; 1721 SW Broadway, Box 751, Portland, OR
Phone: 503-725-3022
Fax: 503-725-3025
Website: <http://www.geol.pdx.edu>
Email: geology@pdx.edu

Federal Resources and Programs

Federal Emergency Management Agency, landslide fact sheet

FEMA's website contains information on strategies to reduce risk and prevent loss from landslides and debris flows.

Contact: Federal Regional Center, Region 10
Address: 130-228th St. SW, Bothell, WA 98021-9796
Phone: 425-487-4600
Website: <http://www.fema.gov/library/landslif.htm>

Natural Resource Conservation Service (NRCS)

The NRCS produces soil surveys. These may be useful to local governments who are assessing areas with potential development limitations including steep slopes and soil types. They operate many programs dealing with the protection of natural resources.

Contact: NRCS, Oregon Branch
Address: 101 S.W. Main Street, Suite 1300, Portland, OR 97204
Phone: 503-414-3200
Fax: 503-414-3103
Website: <http://www.or.nrcs.usda.gov>

US Geological Survey, National Landslide Information Center (NLIC)

The NLIC website provides good information on the programs and resources regarding landslides. The page includes information on the National Landslide Hazards Program Information Center, a bibliography, publications, and current projects. USGS scientists are working to reduce long-term losses and casualties from landslide hazards through better understanding of the causes and mechanisms of ground failure both nationally and worldwide.

Contact: National Landslide Information Center
Phone: 800-654-4966
Website: <http://landslide.usgs.gov>

Additional Resources

American Planning Association (APA)

The APA's research department embarked on a program to bring together solutions from multiple disciplines into a single source. The APA landslides project will help serve local planning efforts in identifying landslide hazards during the planning process so as to minimize exposure to landslide risks. The APA's website highlights planning efforts to reduce risk and loss from landslides.

Contact: Principal Investigator, Landslides Project
Address: Research Department, American Planning Association
122 S. Michigan Ave., Suite 1600
Chicago, Illinois 60603-6107
Phone: 312-431-9100
Fax: 312-431-9985
Website: <http://www.planning.org/landslides>
Email: landslides@planning.org

Institute for Business & Home Safety (IBHS)

IBHS was created as an initiative of the insurance industry to reduce damage and losses caused by natural disasters. Their website provides educational resources and on-line publications for insurers, businesses, and homeowners who are interested in taking the initiative to minimize future damages and losses.

Contact: Institute for Business and Home Safety
Address: 1408 North Westshore Boulevard - Suite 208 - Tampa, FL 33607
Phone: 813-286-3400
Fax: 813-286-9960
E-mail: info@ibhs.org
Website: <http://www.ibhs.org/ibhs2>

State of Washington, Department of Ecology

The Washington State Department of Ecology manages a landslide website with tips for reducing risk, warning signs, and maps.

Contact: Department of Ecology
Address: PO Box 47600, Olympia, WA 98504-7600
Website: <http://www.ecy.wa.gov/programs/sea/landslides>
Email: hshi461@ecy.wa.gov

Publications

Planning for Natural Hazards: The Oregon Technical Resource Guide, Department of Land Conservation and Development (July 2000).

Produced by the Community Planning Workshop for the Department of Land Conservation and Development, this is a natural hazards planning and mitigation resource for Oregon cities and counties. The document provides hazard-specific resources and plan evaluation tools. The document was written for local government employees and officials. The Technical Resource Guide includes a natural hazards comprehensive plan review, a hazard mitigation legal issues guide, and five hazard-specific technical resource guides, including: flooding, wildfires, landslides, coastal hazards, and earthquakes. You can write, call, fax, or go on-line to obtain this document.

Contact: Natural Hazards Program Manager, DLCDD
Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540
Phone: 503-373-0050
Fax: 503-378-6033
Website: <http://www.lcd.state.or.us/hazards.html>

Mileti, Dennis, *Disasters by Design: A Reassessment of Natural Hazards in the United States (1999)* Joseph Henry Press.

This book offers a way to view, study, and manage hazards in the United States that will help foster disaster-resilient communities, higher environmental quality, inter- and intragenerational equity, economic sustainability, and an improved quality of life. The volume provides an overview of what is known about natural hazards, recovery, and mitigation; reveals how research findings have been translated into policies and programs; and advances a sustainable hazard mitigation research agenda.

Olshansky, Robert B., *Planning for Hillside Development (1996)* American Planning Association.

This document describes the history, purpose, and functions of hillside development and regulation and the role of planning, and provides excerpts from hillside plans, ordinances, and guidelines from communities throughout the US.

Olshansky, Robert B. & Rogers, J. David, *Unstable Ground: Landslide Policy in the United States (1987)* Ecology Law Quarterly.

This is about the history and policy of landslide mitigation in the US.

Public Assistance Debris Management Guide (July 2000) Federal Emergency Management Agency

The Debris Management Guide was developed to assist local officials in planning, mobilizing, organizing, and controlling large-scale debris clearance, removal, and disposal operations. Debris management is generally associated with post-disaster recovery. While it should be compliant with local and county emergency operations plans, developing strategies to ensure strong debris management is a way to integrate debris management within mitigation activities. The Guide is available in hard copy or on the FEMA website.

Contact: FEMA Distribution Center
Address: 130 228th Street, SW, Bothell, WA 98021-9796
Phone: 800-480-2520
Website: <http://www.fema.gov/r-n-r/pa/dmgtoc.htm>

USGS Landslide Program Brochure. National Landslide Information Center (NLIC), United States Geologic Survey

The brochure provides good, general information in simple terminology on the importance of landslide studies and a list of databases, outreach, and exhibits maintained by the NLIC. The brochure also includes information on the types and causes of landslides, rockfalls, and flows.

Contact: USGS- MS 966, Box 25046
Address: Denver, Federal Center, Denver, CO 80225
Phone: 800-654-4966
Web: <http://geohazards.cr.usgs.gov/>

Nuhfer, Edward B., Richard J. Proctor, and Paul H. Moser. 1993. *The Citizens' Guide to Geologic Hazard: A Guide to Understanding Geologic*

Hazards Including Asbestos, Radon, Swelling Soils, Earthquakes, Volcanoes. American Institute of Professional Geologists.

Written by professionals for lay readers, this book combines solid, practical content with easy readability. Contains specific sources for help in the appendices. Each chapter is followed by references and bibliographies of videotapes.

Contact: American Institute of Professional Geologists
Address: 1400 W. 122nd Avenue, Suite 250, Westminster, Colorado 80234.
Phone: 303-412-6205
Fax: 303- 253-9220
Web: <http://www.aipg.org/>

Marion County/City of Salem/DOGAMI Landslide Hazard Study

The landslide hazard study and ordinances adopted by the City of Salem and Marion County have been highlighted in various hazard planning documents and/or publications. The following is not a complete list:

- ♦ DLCD/OCPW Planning for Natural Hazards: Oregon Technical Resources Guide.
- ♦ Natural Hazard Mitigation Reference – A Guide for Local Governments, Rogue Valley Council of Governments. 2000.
- ♦ Oregon Planners’ Journal – “Landslide Planning-City/County Coordination.” 2004.
- ♦ Partnerships in Action published by Partners for Disaster Resistance & Resilience: Oregon Showcase State Program – “Mitigation on the Ground: Salem and Marion County’s Landslide Ordinances.” 2004.
- ♦ Practicing Planner (AICP’s quarterly magazine) – “Landslide Hazard Planning: Incorporating Scientific Analyses into Public Policy.” 2004.

The following products, reports and studies resulted from the Marion County, City of Salem and DOGAMI landslide hazard study project (1998-2000):

- IMS-5 Water-induced landslide hazards map and report, eastern portion of the Eola Hills, Polk County. 2000.
- IMS-6 Water-induced landslide hazards map and report, western portion of the Salem Hills, Marion County. 1998.
- DOGAMI Special Paper 31 – Mitigating Geologic Hazards in Oregon: A Technical Reference Manual. 1999.
- DOGAMI Special Paper 32 – Geological Hazards: Reducing Oregon’s Losses (A summary of Special Paper 31). 1999.
- Model ordinances developed by the City of Salem and Marion County to address development within geologically hazardous areas of each jurisdiction.

Other DOGAMI materials utilized as tools for identification of possible hazard areas in conjunction with Marion County's geological hazards ordinance:

- GMS-105 Relative Earthquake Hazard Maps of the Salem East and Salem West Quadrangles, Marion and Polk Counties. 1996.
- IMS-8 Relative Earthquake Hazard Maps for Selected Urban Areas in Western Oregon (Canby-Barlow-Aurora/Lebanon/Silverton-Mt. Angel/Stayton-Sublimity-Aumsville/Sweet Home/Woodburn-Hubbard). 1999.
- IMS-17 Earthquake-Induced Slope Instability: Relative Hazard Map Western Portion of the Salem Hills, Marion County; map and Special Paper 30. 2000.
- IMS-18 Earthquake-Induced Slope Instability: Relative Hazard Map Eastern Portion of the Eola Hills, Polk County. 2000.
- Open File Report 0-77-4 Geologic Restraints to Development in Selected Areas of Marion County. Herbert G. Schlicker. 1977.
- Open File Report 0-00-4 Guidelines for Engineering Geologic Reports and Site Specific Seismic Hazard Reports. Developed and adopted by the Oregon Board of Geologist Examiners.
- GMS-100 Earthquake Hazard Maps for Oregon. 1996.
- IMS-4 Map showing faults, bedrock geology, and sediment thickness of the western half of Oregon City 1:100,000 quadrangle (Washington, Multnomah, Clackamas and Marion Counties). 1997.
- Special Paper 34 – Slope Failures in Oregon, GIS Inventory for Three 1996/1997 Storm Events. 2000.
- IMS-22 Hazard Map of Potential Rapidly Moving Landslides in Western Oregon. 2002.

Landslides – Endnotes

¹ Mileti, Dennis. 1999. *Disasters by Design: A Reassessment of Natural Hazards in the United States*. Washington D.C.: Joseph Henry Press.

² Brabb, E.E., and B.L Harrod, eds. 1989. *Landslides: Extent and Economic Significance. Proceedings of the 28th International Geological Congress Symposium on Landslides*. Washington D.C., Rotterdam: Balkema.

³ *USGS Landslide Program Brochure*, National Landslide Information Center, United States Geologic Survey.

⁴ Harvey, Andrew F. and Gary L. Peterson. 1998. *Water-Induced Landslide Hazards, Western Portion of the Salem Hills*, Marion County, Oregon.

⁵ Marion County Planning Department. January 1980. *Development Limitations Map*.

⁶ Id.

-
- ⁷ Nevins, Dan. BLM Road Engineer, Cascades Resource Area. Personal Interview. 16 December 2004.
- ⁸ Ohrt, Leland. Fire Chief, Mill City. Personal Interview. 19 November 2004.
- ⁹ Id.
- ¹⁰ Harvey, Andrew F. and Gary L. Peterson. 1998. *Water-Induced Landslide Hazards, Western Portion of the Salem Hills*, Marion County, Oregon.
- ¹¹ Id.
- ¹² Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Oregon State Police – Office of Emergency Management.
- ¹³ Eichorn, Ernie. Field Representative, Chemawa District, Bonneville Power Authority. Personal Interview. 10 November 2004.
- ¹⁴ Robert Olson Associates. June 1999. *Metro Regional Hazard Mitigation Policy and Planning Guide*. Portland, OR: Metro.
- ¹⁵ Id.
- ¹⁶ *Planning for Natural Hazards: The Oregon Technical Resource Guide*. July 2000. Department of Land Conservation and Development. Chapter 5.
- ¹⁷ Id.
- ¹⁸ Halemeier, Dave. Ranger, USFS, Willamette National Forest - Detroit Ranger Station. Personal Interview. 16 November 2004.
- ¹⁹ *Homeowner's Guide for Landslide Control, Hillside Flooding, Debris Flows, Soil Erosion*. March 1997.
- ²⁰ Oregon Department of Forestry. 1999. *Storm Impacts and Landslides of 1996 Final Report*. Salem, OR.
- ²¹ Department of Land Conservation and Development. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*. Chapter 5.
- ²² Id.
- ²³ American Institute of Professional Geologists. *The Citizens' Guide to Geologic Hazard*. 1993. American Institute of Professional Geologists.
- ²⁴ Burby, R., ed. 1998. *Cooperating with Nature*. Washington D.C.: Joseph Henry Press.
- ²⁵ Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Oregon State Police – Office of Emergency Management.
- ²⁶ Burby, R., ed. 1998. *Cooperating with Nature*. Washington D.C.: Joseph Henry Press.
- ²⁷ Id.
- ²⁸ Goettel & Associates. February 1998. *Regional All Hazard Mitigation Master Plan for Clackamas County*.
- ²⁹ Id.
- ³⁰ Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Oregon State Police – Office of Emergency Management.
- ³¹ Department of Geology and Mineral Industries/Oregon Department of Forestry. 1999. *Western Oregon Debris Flow Hazard Maps: Methodology and Guidance for Map Use*.
- ³² Id.

³³ Id.

³⁴ Id.

³⁵ Id.

³⁶ Department of Land Conservation and Development. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*. Chapter 5.

Section 8: Wildfire

Why are Wildfires a threat to Marion County?	2
History of Oregon Wildfires	2
Wildfire Hazard Assessment.....	10
<i>Wildfire Hazard Identification</i>	<i>10</i>
<i>Vulnerability Assessment.....</i>	<i>12</i>
<i>Risk Analysis.....</i>	<i>12</i>
Community Wildfire Issues	12
Mitigation Plan Goals and Existing Activities	13
<i>Existing Mitigation Activities.....</i>	<i>14</i>
Wildfire Mitigation Action Items.....	21
Short-term (ST) Wildfire Action Items	21
Long-term (LT) Wildfire Action Items	28
Wildfire Resource Directory	32
<i>Regional Resources.....</i>	<i>32</i>
<i>State Resources.....</i>	<i>33</i>
<i>Federal Resources and Programs</i>	<i>35</i>
<i>Additional Resources</i>	<i>37</i>
<i>Publications.....</i>	<i>39</i>

Why are Wildfires a threat to Marion County?

Wildfires are a natural part of the ecosystem in Oregon and are widespread throughout the state. Oregon contains over 41 million acres (more than 64,000 square miles) of forest and rangeland that are susceptible to wildfire. In addition, significant agricultural areas of the Willamette Valley and north and central Oregon contain crops such as wheat, which are prone to wildfire damage. Communities are also at risk from wildfires, and substantial hazards exist for communities at the wildland/urban interface. According to the 2001 Federal Register, 367 Oregon communities are at risk of damage from wildfire. There are many wildland/urban interface communities in Marion County: Breitenbush, Detroit, Gates, Idanha, Jefferson, Lyons, Marion, Mehama, Salem, Scotts mills, Silverton and Stayton.¹

The majority of wildfires occur in the summer between June and October. Wildfires can occur at other times of the year, however, when weather and fuel conditions combine to allow ignition and spread. Seventy percent of Oregon's wildland fires result from human activity. The remaining thirty percent result from lightning, occurring most frequently in eastern and southern Oregon.

Residential development in forested areas will likely experience fires at some point. A lack of firebreaks surrounding buildings, limited water availability during the high-risk summer months, and fire suppression over the last 100 or more years contributes to a fire hazard in the forested hillsides of the watershed. Suppression of fire has contributed as much to the current vegetation pattern as historically intentional burning. Of course there are differences between the two land use patterns. The most obvious difference is that the region contains significantly more acres of Douglas fir and much less oak savanna and prairie since the end of intentional burning in the middle of the 19th century.²

History of Oregon Wildfires

Wildfires have been a feature of the Oregon landscape for thousands of years. These fires resulted from lightning and from the practices of Native Americans.

For at least the past four thousand years and possibly as long as ten thousand years prior to Euro-American settlement, humans have systematically burned large sections of the Willamette Valley, including the Chehalem Valley.

Fires in Southwest Yamhill County have resulted from both natural and human-induced causes. Natural fires were mostly the products of lightning strikes “but the frequency of thunderstorms in the Willamette Valley ranks among the lowest in North America.”³ Thus, the relative frequency of these natural fires is thought to be extremely low.

The indigenous Che-ahm-ill people of the “Yam Hills” area were a subgroup of the Kalapuyan culture. They occupied the valley at the time of

Euro-American contact.⁴ The Kalapuyans intentionally torched large portions of the landscape annually for a number of practical reasons including agriculture, hunting, communication, warfare, visibility, safety and sanitation.⁵ Many of these areas otherwise would have supported the Douglas fir forests which have grown up in these areas over the past 150 years. Native uses of fire, which included trail building, amusement, agriculture, camping and hunting, and logging slash,⁶ were replaced with those of Euro-American settlers.

Natural and human-caused wildfires continued to shape the landscape after Euro-American settlement, but in different ways. Between 1840 and 1900, wildland fires burned at least two million acres of forestland in western Oregon.⁷ In the 1850s, the Cost Range forests burned more than they had in previous decades while valley prairies and savannas began to experience less fire and were either turned into field and pasture or began growing into forests. Settlers and their descendents have viewed fire control as necessary to protect timber and property in the region, an approach that continues to this day.

There were many fires in 1902 and 1910.⁸ In 1933, the infamous Tillamook burn covered nearly a quarter of a million acres. The Tillamook fire is thought to have caused several localized burns in the Willamina watershed.⁹ Since the 1930s, fire suppression crews have become better trained and organized. In the 1950s, a public education campaign through area newspapers urged residents to prevent forest fires. Through the later decades of the 20th century and currently, large fires continue to burn most years in various parts of the West.

In the early 1970s, an increasing number of wildland fires affected or involved homes. Suburban growth continued through the 1980s, and by the early 1990s frequent and destructive wildland interface fires had become a major concern of the State Forester, the State Fire Marshal and the Legislature. In the 1990s, more than 100 structures burned in wildland fires, thousands more were threatened, and losses and suppression costs skyrocketed. In 1997, the Legislature passed Senate Bill 360, the Oregon Forestland-Urban Interface Fire Protection Act, “to provide a complete and coordinated fire protection system,” and recognized that “forestland-urban interface property owners have a basic responsibility to share in a complete and coordinated protection system.”

Fires in 2002 underscored the need for urgent action. Sparked by intense mid-summer dry lightning storms, wildfires burned hundreds of thousands of acres of Oregon forestland. There were ten, Governor-declared conflagrations, with as many as five events running concurrently. More than 50 structures burned and thousands more were threatened; at one point, the entire Illinois Valley in southwestern Oregon, the home of approximately 17,000 people, was under imminent evacuation alert due to the vast Florence/Biscuit Fire. Table 8-1 summarizes major fire events in Oregon between 1848 and 2003.

Table 8-1. Historic Fires in Oregon (1848-2003)

Year	Fire	Counties	Acres burned
1848	Nestucca	Tillamook/Yamhill	290,000
1849	Siletz	Lincoln/Polk	800,000
1853	Yaquina	Lincoln	482,000
1865	Silverton	Marion	988,000
1868	Coos Bay	Coos	296,000
1933	Tillamook	Tillamook/Yamhill	240,000
1936	Bandon	Coos	143,000
1939	Saddle Mountain	Tillamook/Yamhill	190,000
1945	Wilson River/Salmonberry	Tillamook	180,000
1951	North Fork/Elkhorn	Tillamook/Yamhill	33,000
1966	Oxbow	Lane	44,000
1987	Silver	Josephine	970,000
1992	Lone Pine	Klamath	31,000
1996	Skelton	Deschutes	17,000
2002	Biscuit	Josephine/Curry	500,000
2003	B&B Complex	Jefferson/Linn/Deschutes/Marion	80,000

Sources: (1) Atlas of Oregon, William G. Loy, et al, University of Oregon Books, 1976.

(2) Oregon Department of Forestry, Tillamook Burn to Tillamook State Forest, revised 1993.

(3) Oregon Emergency Management, State Hazard Risk Assessment, 2003.

(4) Department of Forestry,

http://www.odf.state.or.us/DIVISIONS/protection/fire_protection/stats/histfire.asp?id=3070105.

During the 2000 fire season, more than 7.5 million acres of public and private lands burned in the US, resulting in loss of property, damage to resources, and disruption of community services. Taxpayers spent more than \$1.6 billion to combat 90,000 fires nationwide.¹⁰ Many of these fires burned in wildland/urban interface areas and exceeded the fire suppression capabilities of those areas. The magnitude of wildfires is dependent on two primary factors: (1) severe drought, accompanied by a series of storms that produce thousands of lightning strikes and windy conditions; and (2) the effects of wildfire suppression over the past century that has led to buildup of brush and small diameter trees in the nation's forests and rangelands.¹¹ Table 8-2 illustrates the fire suppression costs for state, private, and federal lands protected by the Oregon Department of Forestry between 1985 and 2004.

Table 8-2. History of Fire Suppression Costs in Oregon 1985-2004

Year	Suppression Costs in \$*
1985	3,268,644
1986	5,847,018
1987	32,080,746
1988	13,192,596
1989	6,394,593
1990	8,279,974
1991	5,381,192
1992	17,000,000
1993	4,023,033
1994	21,100,000
1995	4,360,349
1996	5,066,227
1997	1,210,692
1998	2,056,343
1999	5,320,555
2000	5,750,862
2001	33,792,483
2002	65,255,154
2003	17,352,717
2004	10,493,951

Source: Oregon Department of Forestry

* Costs include District costs, extra costs, private costs and other costs.

2002 Wildfires

Apple (Umpqua National Forest)

This fire was 21 miles east of Glide, and encompassed 9,800 acres. Twenty residences were threatened.

Tiller Complex (Umpqua National Forest)

This 65,824-acre fire consisted of eight large and numerous small fires, on the Tiller Ranger District and in the Rogue-Umpqua Divide Wilderness Area, 25 miles east of Canyonville. Sixty-seven residences were threatened.

Biscuit Fire (Siskiyou National Forest)

This fire cost more than \$160 million to fight, and was located in southern Oregon and northern California. The fire began on July 13, 2002 and reached 500,023 acres in August 2002. Estimated to be one of Oregon's largest wildfire in recorded history, the Biscuit Fire encompassed most of the Kalmiopsis Wilderness. The boundary of the Biscuit Fire stretched from ten miles east of the coastal community of

Brookings, Oregon; south into northern California; east to the Illinois Valley; and north to within a few miles of the Rogue River. There were 274 structures threatened by this fire. Four residences and nine outbuildings were lost.¹²

2003 Wildfires

B&B Complex (Deschutes National Forest)

This fire, characterized by extreme plume-dominated behavior grew to 80,000 acres in September 2003 as the Booth and Bear Butte fires merged. The entire community of Camp Sherman, approximately 300 residents, was twice evacuated to avoid the fire's danger and Highway 20 was temporarily closed.¹³ A total of 2,205 personnel, 82 fire engines and 10 helicopters were employed to battle the fire. Governor Kulongoski invoked the Conflagration Act for the east side of the B&B Complex.¹⁴ The B & B Complex fire burned into a portion of Marion County.

Herman Creek Fire (USDA Forest Service & ODF lands)

The 370-acre Herman Creek Fire near Cascade Locks in the Columbia Gorge closed a 47-mile stretch between Hood River and Troutdale and caused traffic problems as far away as Portland. Union Pacific Railroad delayed its trains on the south side of the Columbia River as railroad ties caught fire. Sixty people were evacuated to temporary shelters in Stevens Point, WA as the fire burned within feet of dozens of homes. A bed and breakfast business and an abandoned house and barn burned to the ground.¹⁵

Wildfire Characteristics

The characteristics of fire are important to understand when trying to mitigate its negative effects on humans and structures. In order for fire to exist, the three components of the fire triangle must be present. The triangle consists of fuel, heat, and oxygen.¹⁶ Most naturally caused fires are initiated by lightning strikes. Human-caused fires, both accidental and deliberate, are produced in many ways, including campfires, chimneys, torches, matches, fireworks, cigarettes, vehicle fires, military ordnance, and smoldering slash piles.¹⁷ In either instance, natural or human-caused, the ignition is started because the fire triangle exists. Fire occurring in natural ecosystems begins as a point of ignition, burns outward into circles and spreads in the direction toward which the wind is blowing.¹⁸ Additionally, when burning occurs on uneven terrain, the fire spreads upslope to eventually form itself into broad ellipses.¹⁹

Effects of fire on ecosystem resources can represent damages, benefits, or some combination of both, depending largely on the characteristics of the fire site, the severity of the fire, the time period of valuation, and the values placed on the resources affected by the fire.²⁰ The ecosystems of most forests depend upon fire to maintain various functions. The use of fire for beneficial purposes is considered, where appropriate, in terms of reducing fuel loads, disposing of slash, preparing seedbeds, thinning overstocked stands, increasing forage plant production, improving wildlife habitats, changing hydrologic processes, and improving aesthetic environments.²¹ Despite its beneficial values to ecosystems, however, fire has been suppressed for years because of its perceived effects on timber harvest and threat to human life. In addition, new development continues to push its way into what is termed as the “wildland-urban interface.”

“With more Oregonians than ever living in forests that have grown thicker than ever through decades of strict fire suppression, even modest fires can quickly consume lives, homes, and the millions of dollars it costs to fight them.”

The Oregonian,
Feb. 26, 2001

The Interface

There are three categories of interface fire:²²

- The classic wildland-urban interface exists where well-defined urban and suburban development presses up against open expanses of wild land areas;
- The mixed wildland-urban interface is characterized by isolated homes, subdivisions, and small communities situated predominantly in wildland settings; and
- The occluded wildland-urban interface exists where islands of wildland vegetation occur inside a largely urbanized area.

Unlike most other natural hazards, the wildland-interface is not designated by geography alone. Certain conditions must be present for significant interface fires to occur. The most common are hot, dry, and windy weather; the inability of fire protection forces to contain or suppress the fire; the occurrence of multiple fires that overwhelm committed resources; and a large fuel load (dense vegetation).²³ Once a fire has started, several conditions influence its behavior, including fuel, topography, weather, drought, and development. These combined conditions are the key elements that add to increased wildfire risk. The severity of the wildfire is ultimately affected by the severity of these conditions. For example, if a steep slope (topography) is combined with extremely low humidity, high winds, and highly flammable vegetation, then a high-intensity wildfire may develop.

Since the 1970s, Oregon's growing population has expanded further and further into traditional resource lands such as forestland. The “interface” between urban and suburban areas and the resource lands created by this expansion has produced a significant increase in threats

to life and property from fires, and has pushed existing fire protection systems beyond original or current design or capability.²⁴ Property owners in the interface are often unaware of the problems and threats they face. Therefore, many owners have done very little to manage or offset fire hazards or risks on their own property. Furthermore, human activities increase the incidence of fire ignition and potential damage.

Fuel²⁵

Fuel is the material that feeds a fire, and is a key factor in wildfire behavior. Fuel is classified by volume and by type. Volume is described in terms of “fuel loading,” or the amount of available vegetative fuel. The type of fuel refers to the species of trees, shrubs, and grass that are present. Oregon, as a western state with prevalent conifer, brush, and rangeland fuel types, is subject to more frequent wildfires than other regions of the nation.

An important element in understanding the danger of wildfire is the availability of diverse fuels in the landscape, such as natural vegetation, manmade structures, and combustible materials. A house surrounded by brushy growth rather than cleared space allows for greater continuity of fuel and increases the fire’s ability to spread. After decades of fire suppression, “dog-hair” thickets have accumulated. These enable high intensity fires to flare and spread rapidly. Structures that are made of combustible material such as shake roofs and wood siding are especially susceptible to fire. Untrimmed bushes near these structures often serve as “ladder fuels” – enabling a slow moving ground fire to climb onto rooftops and into the crowns of trees. A crown fire is significantly more difficult to suppress than a ground fire, and are much more threatening to structures in the interface. Wildfire at the upper end of the wildfire intensity spectrum is likely to spread into the tops of the tallest trees in violent and discontinuous surges.²⁶ Fire that occurs at this severe end of the spectrum responds to its own convective winds, spreading rapidly as sparks from exploding trees ignite other fires many meters away.²⁷

Because of the many different possible “fuels” found in the interface landscape, firefighters have a difficult time predicting how fires will react or spread.

Smoke can be just as hazardous as conventional fuels because a path of smoke can be conductive in hot, dry weather.²⁸ When firefighters are fighting fires near BPA’s power lines, BPA de-energizes conductors for safety purposes.²⁹

Topography³⁰

Topography influences the movement of air, thereby directing a fire’s course. For example, if the percentage of uphill slope doubles, the rate of spread in wildfire will likely double. Gulches and canyons can funnel air and act as chimneys, which intensify fire behavior and cause the fire to spread faster. Solar heating of dry, south-facing slopes produces upslope drafts that can complicate fire behavior. Unfortunately, hillsides with hazardous topographic characteristics are also desirable

residential areas in many communities. This underscores the need for wildfire hazard mitigation and increased education and outreach to homeowners living in interface areas.

Weather³¹

Weather patterns combined with certain geographic locations can create a favorable climate for wildfire activity. Areas where annual precipitation is less than 30 inches per year are extremely fire susceptible.³² High-risk areas in Oregon share a hot, dry season in late summer and early fall when high temperatures and low humidity favor fire activity. Predominant wind directions may guide a fire's path. In addition, many high intensity fires produce their own wind, which aids in the spread of fire.

Drought

Recent concerns about the effects of climate change, particularly drought, are contributing to concerns about wildfire vulnerability. The term *drought* is applied to a period in which an unusual scarcity of rain causes a serious hydrological imbalance. Unusually dry winters, or significantly less rainfall than normal, can lead to relatively drier conditions, and leave reservoirs and water tables lower. Drought leads to problems with irrigation, and may contribute to additional fires, or additional difficulties in fighting fires.

The last statewide drought emergency in Oregon was in September 1992.³³

Most fuel types (not including grasses), however, require two or three years of drought before the fuel becomes dangerously dry. Drought contributes to the frequency and intensity of fires. A February 2001 *Oregonian* article reported: "Favorable weather last year helped the Northwest emerge largely unscathed from a fire season that scorched other parts of the West. But the forests remain thick with timber and with homes. And this winter has brought the Northwest far less snow and rain than usual, which could give a greater foothold to the flames that are sure to come."³⁴

On average over the last several years, Marion County has received less precipitation i.e., snow and rain than what is considered normal. A March 2005 *Oregonian* article reported: "Weather experts see problems this summer with fires, power rates, recreation, farming and fish unless spring brings rain."³⁵ The article continues: "Barring a spring soaking, Oregon and Washington face a drought that could ravage forests, raise power rates and leave fish high and dry."³⁶

Due to the significant shortage of water in area reservoirs, during the spring of 2005, the Marion County Board of Commissioners has been considering declaring a drought declaration.³⁷

The following information is from Oregon Governor Ted Kulongoski's "2005 Oregon Drought and Fire Conditions" Website:

Water conditions in Oregon are close to those experienced in the 1977 drought. Snow conditions are approximately 44 percent of normal statewide, very close to that experienced before the 1977 drought and well below the levels seen in 2001 at this time of year. Precipitation records indicate Northwest Oregon is experiencing the second driest water year on record and accumulated stream flow conditions statewide range in the 35 to 75-percentile level. As of March 1, the Columbia system is projected at 66 percent of normal stream flow, down ten percent from a month earlier. Reservoirs used for irrigation throughout the state are well below normal, and many are not expected to fill. Even if we have a significantly wet March, conditions are not expected to approach normal for this time of year.³⁸

Development

Growth and development in forested areas is increasing the number of human-caused structures in the interface in Oregon. Wildfire has an effect on development, yet development can also influence wildfire. While wildfires have always been a historic part of the ecosystem in Oregon, homes in the interface often lead to human ignition of fire. The combined increase in human development and activity in the interface, with the high content of fuels from years of fire suppression, can create a lethal combination.

For example, for the last six years, BLM has closed and locked gates to the BLM road system off of Little North Fork Road in southeastern Marion County from October through January (large game hunting season) because of persons starting fires on BLM land.³⁹ BLM believes that the best way to prevent anymore man-created fires is to prohibit entrance into parts of the forest.

Homeowners often prefer lots that are private and have scenic views nestled in vegetation. A private setting may be far from public roads, or hidden behind a narrow, curving driveway. These conditions, however, make evacuation and firefighting difficult. The scenic views found along mountain ridges can also mean areas of dangerous topography. Natural vegetation contributes to scenic beauty, but it may also provide a ready trail of fuel leading a fire directly to the combustible fuels of the home itself.⁴⁰

Wildfire Hazard Assessment

Wildfire Hazard Identification

Hazard identification is the first phase of a hazard assessment, and is the process of estimating the geographic extent of the hazard, its intensity, and its probability of occurrence.⁴¹ This process usually results in a hazard map. Hazard maps can provide detailed information in a clear format that provides public information and can assist in making policy and land use decisions.

Wildfire hazard areas are commonly identified in regions of the wildland/urban interface. Ranges of the wildfire hazard are further

determined by the ease of fire ignition due to natural or human conditions and the difficulty of fire suppression. The wildfire hazard is also magnified by several factors related to fire suppression/control, such as the surrounding fuel load, weather, topography, and property characteristics. Generally, hazard identification rating systems are based on weighted factors of fuels, weather, and topography. Indicators of least dangerous to most dangerous, illustrate each category. For example:

Roads and Signage

Steep; narrow; poorly signed	3
One or two of the above	2
Meets all requirements	1

Water Supply

None, except domestic	3
Hydrant, tank, or pool over 500 feet away	2
Hydrant, tank, or pool within 500 feet	1

Location of the Structure

Top of steep slope with brush/grass below	3
Mid-slope with clearance	2
Level with lawn, or watered groundcover	1

In order to determine the “base hazard factor” of specific wildfire hazard sites and interface regions, several factors must be taken into account. Categories used to assess the base hazard factor include:

- Topographic location, characteristics, and fuels;
- Site/building construction and design;
- Site/region fuel profile (landscaping);
- Defensible space (the zone surrounding a building where the property owner manages vegetation in order to reduce the risk of a wildfire igniting the structure);
- Accessibility;
- Fire protection response; and
- Water availability.

The use of Geographic Information System (GIS) technology in recent years has been a great asset to fire hazard assessment, allowing further integration of fuels, weather, and topography data for such ends as fire behavior prediction, watershed evaluation, mitigation strategies, and hazard mapping. As stated in the wildfire characteristics section of this chapter, the interface is not geographic in nature, but is associated with certain characteristics such as slope and vegetation.

Map 9 shows the coverage area for fire districts within Marion County. Map 10 shows areas of wildfire hazard within the county.

Vulnerability Assessment

Vulnerability assessment is the second phase of a hazard assessment. It combines the information generated through hazard identification with an inventory of the existing development exposed to wildfire. Vulnerability assessments assist in predicting how different types of property and population groups will be affected by a hazard.⁴² Data that includes the location of interface areas in Marion County can be used to assess the population and total value of property at risk from wildfire.

Risk Analysis

Risk analysis is the third, and most advanced phase of a hazard assessment. It builds upon hazard identification and vulnerability assessments.

Key factors included in assessing wildfire risk include ignition sources, building materials and design, community design, structural density, slope, vegetative fuel, fire occurrence, and weather, as well as occurrences of drought. The National Wildland/Urban Fire Protection Program has developed a Wildland/Urban Fire Hazard Assessment Methodology tool for communities to assess their risk to wildfire. For more information on wildfire hazard assessment, refer to www.Firewise.org.

Community Wildfire Issues

Characteristics of Growth and Development in the Interface

Residents in rural areas and unincorporated communities in Marion County are part of the wildland/urban interface characterized by a diverse mixture of varying housing structures, development patterns, ornamental and natural vegetation, and natural fuels. In the event of a wildfire, vegetation, structures, and other flammables can merge into unwieldy and unpredictable events. Factors germane to the fighting of such fires include access, firebreaks, and proximity of water sources, distance from a fire station, and available firefighting personnel and equipment. Reviewing past wildland/urban interface fires shows that many structures are destroyed or damaged for one or more of the following reasons:⁴³

- Combustible roofing material;
- Wood construction;
- Structures with no defensible space;
- Fire department with poor access to structures;
- Subdivisions located in heavy natural fuel types;
- Structures located on steep slopes covered with flammable vegetation;
- Limited water supply; and
- Winds over 30 miles per hour.

Road Access

Of particular concern to firefighters are developments with narrow roadways and few routes of egress, or routes with very limited accessibility. Many new subdivisions are constructed with cul-de-sacs, which contribute to the problem of road access. Most cul-de-sacs do not allow rear access to homes, which can be a significant problem for firefighters and emergency services in defending the structure and ensuring the safety of its inhabitants.

Water Supply

Water supply is a critical factor in the ability to fight wild land fires. Developments lacking an adequate water supply and hydrant taps create extra challenges for firefighting personnel. Another water supply issue is that of small diameter pipe water systems, which are inadequate to provide sustained fire-fighting flows.

Mitigation Plan Goals and Existing Activities

Plan Goals Addressed

The plan goals addressed help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Goal #1: PUBLIC AWARENESS

Goal Statement: Increase public awareness of natural hazard risks, emergency notification and response, and resources for citizen preparedness.

Goal #2: EDUCATION

Goal Statement: Educate the public on how to prepare to successfully endure a natural disaster with minimal property damage and no loss of life.

Goal #3: PREVENTATIVE

Goal Statement: Minimize risks to life, property, the environment, and the economy from natural hazards.

Goal #4: FUNDING AND IMPLEMENTATION

Goal Statement: Identify potential funding sources and implement potential mitigation projects.

Goal #5: PARTNERSHIPS AND COORDINATION

Goal Statements:

- Create and enhance partnerships with other stakeholders involved with natural hazard management.
- Coordinate natural hazard mitigation efforts with adjacent jurisdictions and public/private agencies' risk management activities.

Goal #6: NATURAL RESOURCES UTILIZATION

Goal Statement: Promote the use of natural systems and features, watershed planning, and land use planning for natural hazard mitigation whenever possible to reduce long-term costs to the county and maximize effectiveness.

Goal #7: EMERGENCY SERVICES

Goal Statement: Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Existing Mitigation Activities

Local Programs

Marion County adopted the Criteria for Forestland Dwellings set forth in ORS 215.730 into the county Zoning Ordinance (Chapter 138, Timber Conservation (TC) Zone and Chapter 139, Farm/Timber Zone).

State Programs

Oregon Revised Statute 215.730:

ORS 215.730, Additional Criteria for Forestland Dwellings, provides criteria for approving dwellings located on lands zoned for forest and mixed agriculture/forest use. Under its provisions, county governments must require, as a condition of approval, that single-family dwellings on lands zoned as forestland meet the following requirements:

1. Dwelling has a fire retardant roof;
2. Dwelling will not be sited on a slope of greater than 40 percent;
3. Evidence is provided that the domestic water supply is from a source authorized by the Water Resources Department and not from a Class II stream as designated by the State Board of Forestry;
4. Dwelling is located upon a parcel within a fire protection district or is provided with residential fire protection by contract;
5. If dwelling is not within a fire protection district, the applicant provides evidence that the applicant has asked to be included in the nearest such district;
6. If dwelling has a chimney or chimneys, each chimney has a spark arrester; and

7. Dwelling owner provides and maintains a primary fuel-free break and secondary break areas on land surrounding the dwelling that is owned or controlled by the owner.

If a governing body determines that meeting the fourth requirement is impractical, local officials can approve an alternative means for protecting the dwelling from fire hazards.

Oregon Revised Statute 477.015-061

Provisions in ORS 477.015-061, Urban Interface Fire Protection, were

For more information on forestland zones consult the Oregon Department of Land Conservation and Development; Statewide Goal 4 – Forestlands and Oregon Administrative Rules 660-006.

established through efforts of the Oregon Department of Forestry, the Office of the State Fire Marshal, fire service agencies from across the state, and the Commissioners of Deschutes, Jefferson, and Jackson Counties. It is innovative legislation designed to address the expanding interface wildfire problem within Oregon Department of Forestry Fire Protection Districts. Full implementation of the statute will occur on or after January 1, 2002. The statute does the following:

1. Directs the State Forester to establish a system of classifying forestland-urban interface areas;
2. Defines forestland-urban interface areas;
3. Provides education to property owners about fire hazards in forestland-urban interface areas. Allows for a forestland-urban interface county committee to establish classification standards;
4. Requires maps identifying classified areas to be made public;
5. Requires public hearings and mailings to affected property owners on proposed classifications;
6. Allows property owners appeal rights;
7. Directs the Board of Forestry to promulgate rules that set minimum acceptable standards to minimize and mitigate fire hazards within forestland-urban interface areas; and
8. Creates a certification system for property owners meeting acceptable standards. Establishes a \$100,000 liability limit for cost of suppressing fires, if certification requirements are not met.

478.120 Inclusion of forestland in district.

The authority to include forestland within a rural fire protection district pursuant to ORS 478.010 (2)(c) applies to forestland within the exterior boundaries of an existing district and to forestland on which structures subject to damage by fire have been added after July 20, 1973.

478.140 Procedure for adding land to district by consent of owner.

Any owner consenting to add the forestland of the owner to the district under ORS 478.010 (2)(c) shall do so on forms supplied by the Department of Revenue. The owner shall file the original with the district. The district shall forward a copy to the assessor of each county in which the land is located, within 20 days of receipt.

478.910 Adoption of fire prevention code.

A district board may, in accordance with ORS 198.510 to 198.600, adopt a fire prevention code.

478.920 Scope of fire prevention code.

The fire prevention code may provide reasonable regulations relating to:

- (1) Prevention and suppression of fires.
- (2) Mobile fire apparatus means of approach to buildings and structures.
- (3) Providing fire-fighting water supplies and fire detection and suppression apparatus adequate for the protection of buildings and structures.
- (4) Storage and use of combustibles and explosives.
- (5) Construction, maintenance and regulation of fire escapes.
- (6) Means and adequacy of exit in case of fires and the regulation and maintenance of fire and life safety features in factories, asylums, hospitals, churches, schools, halls, theaters, amphitheaters, all buildings, except private residences, which are occupied for sleeping purposes, and all other places where large numbers of persons work, live, or congregate from time to time for any purpose.
- (7) Requiring the issuance of permits by the fire chief of the district before burning trash or waste materials.
- (8) Providing for the inspection of premises by officers designated by the board of directors, and requiring the removal of fire hazards found on premises at such inspections.

478.927 Building-permit review for fire prevention code.

A district adopting a fire prevention code shall provide plan review at the agency of the city or county responsible for the issuance of building permits for the orderly administration of that portion of the fire prevention code that requires approval prior to the issuance of building permits.

Senate Bill 360

Senate Bill 360, passed in 1997, is state legislation put in place to address the growing wildland/urban interface problem. The bill has three purposes:

1. To provide an interface fire protection system in Oregon to minimize cost and risk and maximize effectiveness and efficiency;
2. To promote and encourage property owners' efforts to minimize and mitigate fire hazards and risks; and
3. To promote and encourage involvement of all levels of government and the private sector in interface solutions.⁴⁴

The bill has a five-year implementation plan that includes public education and outreach, and the development of rules, standards, and guidelines that address landowner and agency responsibilities. The success of Senate Bill 360 depends upon cooperation among local and regional fire departments, fire prevention cooperatives, and the Oregon Department of Forestry, which means interagency collaboration is vital for successful implementation of the bill. This cooperation is important in all aspects of wild land firefighting. Resources and funding are often limited, and no single agency has enough resources to tackle a tough fire season alone.

The introductory language of Senate Bill 360 states: "The fire protection needs of the interface must be satisfied if we are to meet the basic policy of the protection of human life, natural resources, and personal property. This protection must be provided in an efficient and effective manner, and in a cooperative partnership approach between property owners, local citizens, government leaders, and fire protection agencies."

Office of the State Fire Marshal

State Fire Marshal is similar to OEM in that the office has no authority, but advocates and represents fire districts that have authority within communities. The State Fire Marshal is a structural advocate, and works in partnership with ODF.

The State Fire Marshal can provide information about requirements, but cannot force entities and persons to adhere to those requirements, although if entities and persons do not adhere to requirements, then it is less likely that such entities and persons would receive financial or other resource support from the State Fire Marshal. Like OEM, the Office of the State Fire Marshal provides resources, training, leadership and guidance.

Oregon Department of Forestry (ODF)

ODF provides training for local fire chiefs and local fire departments to provide training. Local firefighters can get a range of experience from exposure to wild land firefighting. Local firefighters can also obtain their red card (wildland fire training documentation), and attend extensive workshops combining elements of structural and wild land firefighting, defending homes, and operations experience.⁴⁵

ODF has been involved with emergency managers to provide support during non-fire events and for years, ODF has worked with industrial partners (big timber companies) to share equipment in the case of extremely large fires.⁴⁶

Federal Programs

The proposed role of the federal land managing agencies, such as the U.S. Forest Service and the Bureau of Land Management, in the wildland/urban interface is diverse. Their roles include: reducing fuel hazards on the lands they administer; cooperating in prevention and education programs; providing technical and financial assistance; and developing agreements, partnerships, and relationships with property owners, local protection agencies, states, and other stakeholders in wildland/urban interface areas. These relationships focus on activities before a fire occurs, which render structures and communities safer and better able to survive a fire occurrence.⁴⁷

Federal Emergency Management Agency Programs

The Federal Emergency Management Agency (FEMA) is directly responsible for providing fire suppression assistance grants and, in certain cases, major disaster assistance and hazard mitigation grants in response to fires. The role of FEMA in the wildland/urban interface is to encourage comprehensive disaster preparedness plans and programs, increase the capability of state and local governments, and provide for a greater understanding of FEMA's programs at the federal, state, and local levels.⁴⁸

Fire Suppression Assistance Grants

Fire Suppression Assistance Grants may be provided to a state with an approved hazard mitigation plan for the suppression of a forest or grassland fire that threatens to become a major disaster on public or private lands. These grants are provided to protect life and improved property, and encourage the development and implementation of viable multi-hazard mitigation measures, and provide training to clarify FEMA's programs. The grant may include funds for equipment, supplies, and personnel. A Fire Suppression Assistance Grant is the form of assistance most often provided by FEMA to a state for a fire. The grants are cost-shared with states. Once the federal grant money is provided to the State, it is then passed along to local jurisdictions. FEMA's US Fire Administration (USFA) provides public education materials addressing wildland/urban interface issues, and the USFA's National Fire Academy provides training programs.⁴⁹

States must have an approved hazard mitigation plan in place to receive either a Fire Suppression Assistance Grant or a Hazard Mitigation Grant.

Hazard Mitigation Grant Program

Following a major disaster declaration, the FEMA Hazard Mitigation Grant Program provides funding for long-term hazard mitigation projects and activities to reduce the possibility of damages from all future fire hazards and to reduce the costs to the nation for responding to and recovering from the disaster.

National Wildland/Urban Interface Fire Protection Program

Federal agencies can use the National Wildland/Urban Interface Fire Protection Program to focus on wildland/urban interface fire protection issues and actions. The Western Governors' Association (WGA) can act

as a catalyst to involve state agencies, as well as local and private stakeholders, with the objective of developing an implementation plan to achieve a uniform, integrated national approach to hazard and risk assessment and fire prevention and protection in the wildland/urban interface. The program helps states develop viable and comprehensive wildland fire mitigation plans and performance-based partnerships.

US Forest Service

The US Forest Service (USFS) is involved in a fuel-loading program implemented to assess fuels and reduce hazardous buildup on US forestlands. The USFS is a cooperating agency and, while it does not have jurisdiction within city limits, it still has an interest in preventing fires in the interface, as fires often burn up the hills and into the higher elevation US forestlands.⁵⁰ This will especially be an important issue as Marion County's cities consider any annexations of land in the wildland-urban interface in the future.

The USFS has historic fire maps that date vegetation on landscape, and gives the agency an idea of historical fires, and provides better basis for risk assessments.⁵¹

Other Mitigation Programs and Activities

Some areas of the country are facing wildland/urban issues collaboratively. These are model programs that include local solutions. One example of this is in Ashland, Oregon. Because of the highly flammable slopes above Ashland, homeowners in the wildland urban interface face a high risk of encountering a wildland fire. Ashland has partnered with local organizations to help coordinate mitigation

“New data from National Forest Service fire ecologists shows that for every dollar spent on prescribed burning, forest thinning and the training of fire-management personnel, seven dollars worth of savings are realized in the costs of having to extinguish big fires. When that ratio is placed in the context of an average \$1 billion spent annually over the past decade on fire suppression, the implications of foresighted fire management are profound.”

The Nature Conservancy Magazine –
May/June 2001

strategies with homeowners in high-risk areas. Currently, more than 40 acres have been treated in the interface above Ashland.⁵² Treatment has included thinning of tree stands, removing highly flammable noxious weeds (i.e., Scotch Broom), and the creation of fuel breaks along ridge tops most susceptible to wild land fire. Ashland has contributed approximately \$500,000 dollars towards cost shares with homeowners to help reduce fuels near their homes.⁵³ In California, the Los Angeles County Fire Department has retrofitted more than 100 fire engines with fire retardant foam capability, and Orange County is evaluating a pilot insurance grading and rating schedule specific to the wildland/urban interface. Both are examples of successful programs that demonstrate the value of pre-suppression and prevention efforts when combined with property owner support to

mitigate hazards within the wildland/urban interface.⁵⁴

Prescribed Burning

The health and condition of a forest will determine the magnitude of a wildfire. If fuels – slash, dry or dead vegetation, fallen limbs and branches – are allowed to accumulate over long periods of time without being methodically cleared, fire can move more quickly and destroy everything in its path. The results are more catastrophic than if the fuels are periodically eliminated. Prescribed burning is the most efficient method to get rid of these fuels. In 1998, 3,000 prescribed fires were used to burn approximately 163,000 acres statewide.⁵⁵

Firewise

Firewise is a program developed within the National Wildland/ Urban Interface Fire Protection Program, and it is the primary federal program addressing interface fire. It is administered through the National Wildfire Coordinating Group whose extensive list of participants includes a wide range of federal agencies. The program is intended to empower planners and decision makers at the local level. Through conferences and information dissemination, Firewise increases support for interface wildfire mitigation by educating professionals and the general public about hazard evaluation and policy implementation techniques. Firewise offers online wildfire protection information and checklists, as well as listings of other publications, videos, and conferences. The interactive home page allows users to ask fire protection experts questions, and to register for new information as it becomes available.

For more information on the Firewise program, contact:
The National Wildland/Urban Interface Fire Program
1 Batterymarch Park, Quincy, MA 02269 - <http://www.firewise.org>

FireFree Program

FireFree is a unique private/public program for interface wildfire mitigation involving partnerships between an insurance company and local government agencies. It is an example of an effective non-regulatory approach to hazard mitigation. Originating in Bend, the program was developed in response to the Skelton Fire of 1996, which burned over 17,000 acres and damaged or destroyed 30 homes and structures.⁵⁶ Bend sought to create a new kind of public education initiative that emphasized local involvement. SAFECO Insurance Corporation was a willing collaborator in this effort. Bend's pilot program included:

- A short video production featuring local citizens as actors, made available at local video stores, libraries, and fire stations;
- Two city-wide yard debris removal events;
- A 30-minute program on a model FireFree home, aired on a local cable television station; and

- Distribution of brochures, featuring a property owner’s evaluation checklist and a listing of fire-resistant indigenous plants.

The success of the program helped to secure \$300,000 in Federal Emergency Management Agency (FEMA) “Project Impact” matching funds. By fostering local community involvement, FireFree also has the potential for building support for sound interface wildfire policy.

For more information on FireFree program, contact:
 SAFECO Plaza T-8
 Seattle, WA 98185, Tel: 206-545-6188
<http://www.FireFree.org>

Wildfire Mitigation Action Items

The wildfire mitigation action items were formulated through researching regional mitigation plans and natural hazards planning literature, and interviews with local stakeholders. Plan action items were refined through discussions with the mitigation plan steering committee and through an open house at which the county received public comments.

The wildfire mitigation action items provide direction on specific activities that organizations and residents in Marion County can undertake to reduce risk and prevent loss from wildfires. Each action item is followed by ideas for implementation, which can be used by local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risks from wildfires in Marion County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Wildfire Action Items

Short-term wildfire action items include general mitigation activities that agencies are capable of implementing during the next two years, given their existing resources and authorities.

ST-WF #1: Work with the Marion Fire Defense Board in the review of plans and inspection of structures for fire code compliance.

Note: Currently, construction plans for commercial and industrial structures are reviewed, but not residential plans. Identification of areas lacking experienced fire staff to review plans may be necessary.

Coordinating Organization:	Building
Internal Partners:	Public Works, Planning, Emergency Management
External Partners:	Marion Fire Defense Board, State Fire Marshal

Timeline: On-going
Plan Goals Addressed: Preventative; Partnerships and Coordination

ST-WF #2: Advocate water storage facilities with fire-resistant electrical pump systems in developments that are not connected to a community water/hydrant system

Ideas for Implementation

- Encourage accessibility to storage facilities for standard firefighting equipment and adequate for the needs of the structure(s) built; and
- Encourage the use of fire-resistant electrical pump systems so water can be replenished during use.

Coordinating Organization: Marion Fire Defense Board
Internal Partners: Building, Planning
External Partners: State Fire Marshall, ODF
Timeline: On-going
Plan Goals Addressed: Preventative

ST-WF #3: Continue to promote public awareness campaigns for individual property owners living in interface areas.

Ideas for Implementation

- Focus on community-specific outreach through:
 - Working demonstrations of risk reduction awareness measures (e.g., survivable space around structures [at the State Fair]; driveway, road and bridge specifications; and landscaping);
 - Voluntary site visits i.e., surveys by the applicable fire district's fire crews to consult with landowners about specific ways to reduce risk to their property and to identify properties that would not be saved if a wildfire occurred;
 - Public service announcements in the media;
 - Educate the general public on the level of fire protection available and fire insurance rating for properties in Marion County; and
 - Noxious weed abatement.
- Encourage the use of hazard-specific information to identify wildfire hazard areas, and promote the use of mitigation strategies and opportunities to reduce risks; and
- Assess available fire suppression assistance and disseminate information about opportunities to the public.

Coordinating Organization: Emergency Management
Internal Partner: Planning, Code Enforcement

External Partners: City Emergency Management, Media, OEM, FEMA, DLCDC, State Fire Marshal, ODF, Insurance and Real Estate Industries, ODA, Oregon Garden, State Fair
Timeline: 1 to 2 years, On-going
Plan Goals Addressed: Public Awareness; Education; Preventative; Partnerships and Coordination; Natural Resources Utilization; Emergency Services

ST-WF #4: Seek funding and labor opportunities to staff fuel-reduction projects throughout wildfire hazard prone areas in Marion County

Ideas for Implementation

- Work on Wildfire Hazard mapping of Marion County to identify areas and homes that would most benefit from fuel reduction projects;
- Promote opportunities for landowners to utilize fuel reduction projects;
- Enable communities and agencies to quickly transform grant opportunities to on-the-ground projects; and
- Investigate potential funding opportunities for individual mitigation projects.

Coordinating Organization: Emergency Management
Internal Partners: Planning, GIS
External Partners: Marion Fire Defense Board, State Fire Marshal, ODF, BLM, USFS
Timeline: 2 years
Plan Goals Addressed: Public Awareness; Education; Preventative; Partnerships and Coordination

ST-WF #5: Create incentives and assist landowners in reducing fuel loads on private property.

Ideas for Implementation

- Investigate potential funding opportunities for individual mitigation projects and assist property owners in securing funding; and
- Develop, approve, and promote cost share and assistance programs for landowners seeking fire mitigation activities and suppression preparedness.

Coordinating Organization: Emergency Management
External Partner: State Fire Marshal, ODF, Marion Rural Fire Defense Board
Timeline: 1 to 2 years
Plan Goals Addressed: Public Awareness; Education; Preventative; Partnerships and Coordination

ST-WF #6: Increase communication, coordination, and collaboration between wildland/urban interface property owners, city and county planners, and fire prevention crews and officials to address inherent risks in wildland/urban interface areas, existing mitigation (prevention/protection) measures, and federal mitigation assistance programs.

Ideas for Implementation

- Encourage single-family residences in wildfire hazard areas to have fire plans and promote homeowner wildfire hazard mitigation e.g., practice evacuation routes;
- Encourage fire surveys in residential homes by fire districts to increase awareness among homeowners and potential fire responders;
- Encourage Planning and Building Divisions to work closely with landowners and/or developers who choose to build in the wildland/urban interface area to identify and mitigate conditions that aggravate wildland/urban interface wildfire hazards, including:
 1. Limited access for emergency equipment due to width and grade of roadways;
 2. Inadequate water supplies, and the spacing, consistency, and species of vegetation around structures;
 3. Inadequate water pressure for fire suppression;
 4. Inadequate fuel breaks, or lack of defensible space;
 5. Inappropriate i.e., highly flammable construction materials;
 6. Preexisting, older building lots and subdivisions that are not in compliance with state and local land use and fire protection regulations;
 7. Inadequate entry/escape routes.
- Encourage all new homes and major remodels involving roofs or additions located in the interface to have fire resistant roofs and residential sprinkler systems;
- Provide education and training to the public to assess whether their homes meet fire safety performance standards;
- Partner with the Oregon Garden on safe plants for around interface houses. Encourage the Oregon Garden to create a display on defensible space around interface houses.
- Review development and building codes to ensure adequate requirements for sprinkler systems, setbacks, etc., in identified wildland interface areas; and
- Encourage the public to evaluate access routes to rural homes for firefighting vehicles and to develop passable routes if they do not exist.

Coordinating Organization: Planning, Building
Internal Partners: Emergency Management, Public Works
(Driveway Permits)
External Partners: Marion Fire Defense Board, ODF, State Fire
Marshal; Oregon Garden, Cities
Timeline: 1 to 5 years, On-going
Plan Goals Addressed: Public Awareness; Preventative; Funding
and Implementation; Partnerships and
Coordination; Emergency Services

ST-WF #7: Seek improved information gathering and distribution and technology for enhancing fire identification, initial response and evacuation if necessary.

Ideas for Implementation

- Update wildland/urban interface hazard maps;
- Conduct risk analysis incorporating data and the created hazard maps using GIS technology to identify risk sites and further assist in prioritizing mitigation activities; and
- Encourage development and use of new data and systems to identify hazard areas and better inform firefighters, communities and landowners of wildfire status once a fire occurs.

Coordinating Organization: Emergency Management
Internal Partner: GIS, Planning
External Partner: State Fire Marshal, ODF, Marion Fire
Defense Board
Timeline: 1 to 3 years
Plan Goals Addressed: Public Awareness; Education; Preventative;
Partnerships and Coordination

ST-WF #8: Enhance emergency services to increase the efficiency of wildfire response and recovery activities.

Ideas for Implementation

- Install more fire reporting stations for better access and coverage;
- Develop a county call list that includes all at-risk urban/wildland interface residents in Marion County in order to contact them during evacuations; and
- Inventory bridges on evacuation routes, assess the bridges for their ability to support fire apparatus ingress, and encourage replacement of inadequate bridges.

Coordinating Organization: Marion Fire Defense Board
Internal Partners: Emergency Management, Public Works
External Partners: State Fire Marshal, ODF
Timeline: 2 years

Plan Goals Addressed: Partnerships and Coordination; Emergency Services

ST-WF #9: Educate agency personnel on federal cost-share and grant programs, fire protection agreements, and other related federal programs so the full array of assistance available to local agencies is understood.

Ideas for Implementation

- Investigate potential funding opportunities for individual mitigation projects; and
- Develop, approve, and promote (and update, if applicable) fire protection agreements and partnerships to clarify roles and responsibilities and to provide for fire mitigation activities and suppression preparedness.

Coordinating Organization: Marion Fire Defense Board, Emergency Management
External Partner: State Fire Marshal, ODF, FEMA
Timeline: 1 to 2 years
Plan Goals Addressed: Public Awareness; Funding and Implementation; Partnerships and Coordination

ST-WF #10: Identify funding for and develop an inventory of alternative firefighting water sources and encourage the development of additional sources.

Ideas for Implementation

- Develop a protocol for fire jurisdictions and water districts to communicate all hydrant outages and water shortage information; and
- Encourage owners to maintain access roads and ramps to artificial and natural water sources.

Coordinating Organization: Marion Fire Defense Board
Internal Partners: Public Works, Emergency Management
External Partners: State Fire Marshal, Oregon Association of Water Utilities (OAWU), Irrigation Districts, Marion SWCD, NRCS, Watershed Councils, Cities
Timeline: 1 to 2 years
Plan Goals Addressed: Preventative; Partnerships and Coordination; Natural Resources Utilization; Emergency Services

ST-WF #11: Draft a wildfire plan that applies to both public and private lands. Plan must be seen as a policy guide that cuts across all local government operations.

Ideas for Implementation

- Include a risk analysis that discloses the vulnerabilities of the identified fire-hazard areas. Heavy fuels, long response times, limited water supply, smaller residential roads that do not meet contemporary access standards, and historic fire weather patterns are all factors that relate to high risk;
- Modify defensible space requirements to include both existing and new structures, and modify defensible space based on slope;
- Revise the vegetation management plan(s) for county-owned property to reduce the amount of flammable vegetation on these lands; and propose similar actions on private property, in cooperation with private property owners; and
- Develop an interagency evacuation plan, which deals with operational issues. Separate high-hazard areas into several evacuation areas determined by major canyons and road systems, and show evacuation routes and fire response routes for use by fire personnel.

Coordinating Organization: Emergency Management
Internal Partner: Public Works
External Partners: Marion Fire Defense Board, State Fire Marshal, Cities
Timeline: 1 to 2 years
Plan Goals Addressed: Preventative; Partnerships and Coordination; Natural Resources Utilization; Emergency Services

ST-WF #12: Create wildfire mitigation team(s) to oversee hazard reduction on nonpublic lands.

Ideas for Implementation

- Notify property owners through property tax enclosures and public notices of the county's intent to implement wildfire hazard reduction on private property.

Coordinating Organization: Emergency Management
Internal Partners: Public Works, Assessor
External Partners: Marion Fire Defense Board, State Fire Marshal, ODF (Santiam Unit, North Cascades District), Cities
Timeline: 1 to 2 years
Plan Goals Addressed: Preventative; Partnerships and Coordination; Emergency Services

Long-term (LT) Wildfire Action Items

Long-term wildfire action items include general mitigation activities that are likely to take more than two years to implement and may require new or additional resources and/or authorities.

LT-WF #1: Look for solutions to protect structures located outside of fire districts through partnerships, grant funding or expansion of fire district services.

Ideas for Implementation

- Form community partnerships that are equipped and trained by fire district personnel to combat fires in those areas; and
- Promote the expansion of rural fire districts to cover areas not now in a district.

Coordinating Organization:	Emergency Management
Internal Partner:	Assessor
External Partners:	State Fire Marshal, Marion Fire Defense Board, ODF
Timeline:	On-going
Plan Goals Addressed:	Public Awareness; Preventative; Partnerships and Coordination; Emergency Services

LT-WF #2: Reduce wildfire fuels.

Ideas for Implementation

- Identify methods of disposal or utilization of fire fuels removed from individual properties (e.g., prescribed burns, fuel reduction through grass/timber/brush removal, small diameter forest product-based industries, chipping, etc.);
- Every year at fire season, monitor use of fire pits and adhere to USFS regulations; and
- Adapt a program similar to the Firefree spring-cleaning program in Bend.

Coordinating Organization:	Emergency Management
Internal Partner:	Planning
External Partners:	Marion Fire Defense Board, ODF, State Fire Marshal, BLM, USFS
Timeline:	3 to 5 years
Plan Goals Addressed:	Public Awareness; Education; Preventative

LT-WF #3: Promote and continue support of agricultural uses that reduce fuel loads in interface areas.

Ideas for Implementation

- Educate the public on how agriculture can help to reduce fuel loads in interface areas; and
- Investigate and seek funding for conventional, chemical and biological fuel reduction and weed control programs.

Coordinating Organization: Marion SWCD
Internal Partner: Planning
External Partners: NRCS, Watershed Councils, ODF
Timeline: On-going
Plan Goals Addressed: Public Awareness; Education; Partnerships and Coordination

LT-WF #4: Maintain and further develop interagency and private industry relationships for continuing strong fire response in Marion County.

Ideas for Implementation

- Maintain and enhance protocol for fire jurisdictions, private industry cooperators and landowners to avoid problems during wildfire disruptions; and
- Promote and advocate streamlining to enable faster private industry assistance (use of vehicles, manpower, etc.) in a wildfire situation.

Coordinating Organization:	Emergency Management
Internal Partner:	Public Works
External Partners:	Marion Fire Defense Board, State Fire Marshal, USFS, BLM, timber industry, jobs in the woods programs
Timeline:	On-going
Plan Goals Addressed:	Public Awareness; Education; Preventative; Partnerships and Coordination

LT-WF #5: Develop and implement or enhance existing outreach and education programs aimed at mitigating wildfire hazards and reducing or preventing the exposure of residents, public agencies, private property owners, and businesses to natural hazards.

Ideas for Implementation:

Outreach

- Encourage the hiring of fire prevention and education personnel to oversee education programs;
- Visit urban interface neighborhoods and rural areas and conduct education and outreach activities;
- Assist fire districts to conduct specific community-based demonstration projects for fire prevention and mitigation in the urban interface;
- Assist fire districts to establish neighborhood “drive-through” activities that pinpoint site-specific mitigation activities. Fire crews can give property owners personal suggestions and assistance; and
- Assist fire districts to perform public outreach and information activities at 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 that will be implemented; and

- Develop a “preventive 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.

Coordinating Organization: Marion Fire Defense Board
 Internal Partner: Planning
 External Partners: School Districts, OEM, ODF
 Timeline: On-going
 Plan Goals Addressed: Public Awareness; Education; Preventative; Partnerships and Coordination; Natural Resources Utilization

LT-WF #6: Encourage development and dissemination of maps relating to fire hazard to help educate and assist builders and homeowners engaged in wildfire mitigation activities, and to help guide emergency services during response.

Ideas for Implementation:

- Using collected data and research, assess the nature and scope of the wildland/urban interface fire problem in Marion County;
- Conduct risk analysis incorporating data and the created hazard maps using GIS technology to identify risk sites and further assist in prioritizing mitigation activities; and
- Encourage coordination between fire jurisdictions and sanitary districts to make sure that the most accurate elevation maps are being used.

Coordinating Organization: Emergency Management
 Internal Partner: GIS, Planning
 External Partner: State Fire Marshal, Marion Fire Defense Board, ODF, DLCDC
 Timeline: 1 to 3 years
 Plan Goals Addressed: Preventative; Partnerships and Coordination; Funding and Implementation

LT-WF #7: Encourage implementation of wildfire mitigation activities in a manner consistent with the goals of promoting sustainable ecological management and community safety and economic stability.

NOTE: The whole ecology of fire needs to be understood – mechanical fuel reductions is not enough, because how does that work for future generations?

Ideas for Implementation:

- Employ mechanical thinning and prescribed burning to abate the risk of catastrophic fire and restore the more natural regime of high frequency, low-intensity burns. Prescribed burning can provide benefit to

ecosystems by thinning hazardous vegetation and restoring ecological diversity to areas homogenized by invasive plants;

- Encourage forest management practices that enhance species and stand age diversity, thereby making stands less prone to disease and fire;
- Use a variety of appropriate tools (prescribed fire application, fuel reduction through grass/timber/brush removal, small diameter forest product-based industries, etc.) to address the complex issue of mitigating wildfire hazards in urban/interface areas; and
- Clear trimmings, trees, brush, and other debris completely from sites when performing routine maintenance and landscaping to reduce fire risk.

Coordinating Organization: Oregon Department of Forestry (ODF)
Internal Partner: Public Works (Park Maintenance Crews)
External Partners: Marion Fire Defense Board, Watershed Councils, Utilities, BLM
Timeline: 1 to 5 years, on-going
Plan Goals Addressed: Public Awareness; Preventative; Funding and Implementation; Partnerships and Coordination; Natural Resources Utilization

Wildfire Resource Directory

County Resources

Marion County Emergency Management

Marion County Emergency Management helps the community be better prepared for major emergencies and disasters. They work closely with cities, emergency responders, and volunteer agencies to find ways to reduce risks and minimize damages during hazard events. When a disaster occurs, they work with these partners in their Emergency Operations Center to coordinate resources and information. Once the event is over, they help bring assistance to those that have been harmed.

Contact: Marion County Emergency Management Coordinator
Address: 5155 Silverton Road, Salem, OR 97305-3899
Phone: 503-365-3133
Email: Emergency@fco.marion.or.us
Website: <http://PublicWorks.co.marion.or.us/EmergencyManagement>

Regional Resources

Northwest Interagency Coordination Center (NWCC)

The Northwest Interagency Coordination Center serves as the northwest area geographic focal point to provide logistical support and intelligence relative to anticipated and ongoing wildfire activity for all federal and cooperating state wildland fire suppression agencies. The Center facilitates movement of resources between agencies' units and,

concurrently, ensures fire suppression capabilities to support large fire potential by monitoring weather and prescribed burning activity within the area. The Center also responds to requests for support to other geographic areas from the [National Interagency Coordination Center](#) at Boise, ID.

Contact: Northwest Coordination Center
Address: 5420 NE Marine Drive, Portland, OR 97218-1007
Phone: 503-808-2720
Fax: 503-808-2789
Email: ornwc@dms.nwcc.gov
Website: <http://www.or.blm.gov/nwcc/>

State Resources

Department of Land Conservation and Development (DLCD)

DLCD administers the state's Land Use Planning Program. The program is based on 19 Statewide Planning Goals, including Goal 7, related to natural hazards, with flood as its major focus. In order to help local governments address natural hazards effectively, DLCD provides technical assistance such as conducting workshops, reviewing local land use plan amendments, and working interactively with other agencies.

Contact: Natural Hazards Program Manager, DLCD
Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540
Phone: 503-373-0050
Fax: 503-378-6033
Website: <http://www.lcd.state.or.us/hazards.html>

Oregon Department of Consumer and Business Services

The Building Codes Division of Oregon's Department of Consumer and Business Services is responsible for administering statewide building codes. Its responsibilities include adoption of statewide construction standards that help create disaster-resistant buildings, particularly for flood, wildfire, wind, foundation stability, and seismic hazards. Information about wildfire-related building codes is found through this department.

Contact: Building Codes Division
Address: 1535 Edgewater St. NW, P.O. Box 14470, Salem, OR 97309
Phone: 503-373-4133
Fax: 503-378-2322
Website: <http://www.cbs.state.or.us/external/bcd>

Oregon Department of Forestry (ODF)

ODF's Fire Prevention Unit is involved in interface wildfire mitigation and provides information about Oregon's Wildfire Hazard Zones. The Protection From Fire section of the ODF website includes Oregon-specific fire protection resources. Wildfire condition reports can be accessed on the Website as well. ODF's Protection from Fire Program works to do the following:

- Clarify roles of ODF, landowners, and other agencies in relation to wildland fire protection in Oregon;
- Strengthen the role of forest landowners and the forest industry in the protection system;
- Understand and respond to needs for improving forest health conditions and the role/use of prescribed fire in relation to mixed ownerships, forest fuels and insects and disease; and
- Understand and respond to needs for improving the wildland/urban interface situation.

Contact: Oregon Department of Forestry, Fire Prevention Unit
Address: 2600 State Street, Salem, Oregon 97310
Phone: 503-945-7440
Website: <http://www.odf.state.or.us/fireprot.htm>

Oregon Forest Resources Institute (OFRI)

The Oregon Legislature created the Oregon Forest Resources Institute (OFRI) in 1991 to improve public understanding of the state's forest resources. OFRI provides information on Oregon's forest practices and encourages sound forest management. The Institute is funded by a tax on forest products producers.

Contact: Oregon Forest Resources Institute
Address: 317 SW Sixth Avenue, #400, Portland, OR 97204
Phone: 503-229-6718
Fax: 503-229-5823
Email: info@ofri.com
Website: <http://www.forestresourceinstitute.com/>

Oregon State Police (OSP)-Office of Emergency Management (OEM)

The purpose of OEM is to execute the Governor's responsibilities to maintain an emergency services system as prescribed in Oregon Revised Statutes Chapter 401 by planning, preparing, and providing for the prevention, mitigation, and management of emergencies or disasters that present a threat to the lives and property of citizens of and visitors to the state of Oregon.

Contact: Office of Emergency Management
Address: 3225 State Street, Salem, OR 97301
Phone: 503-378-2911
Fax: 503-373-7833
Website: <http://www.osp.state.or.us/oem/>

Office of the State Fire Marshal (OSFM)

The Prevention Unit of Oregon's Office of the State Fire Marshal contains 19 Deputy State Fire Marshals located in various regions. The responsibilities of these deputies include public education for local fire districts and inspection of businesses, public assemblies, schools, daycare centers, and adult foster homes. The State Fire Marshal's Community Education Services unit works to keep Oregonians safe from fires and injury by providing them with the knowledge to protect themselves and their property.

Contact: Oregon State Fire Marshal
Address: 4760 Portland Road NE, Salem, Oregon 97305-1760
Phone: 503-378-3473
Fax: 503-373-1825
Website: <http://159.121.82.250/>
Oregon Laws Relating to Fire Protection:
http://159.121.82.250/SFM_Admin/firelaws.htm
Email: Oregon.sfm@state.or.us

Office of the State Fire Marshal (OSFM) – Emergency Mobilization

The Office of State Fire Marshal assists and supports the Oregon fire services during major emergency operations through the Conflagration Act (ORS 476.510). The Conflagration Act was developed in 1940 as a civil defense measure and can be invoked only by the Governor. The act allows the State Fire Marshal to mobilize firefighters and equipment from around the state and provides for the funding of resources through state funds. The Conflagration Act is **only** used for fires that involve or **threaten life and structures**.

Website: http://www.sfm.state.or.us/Em%20Mob_Conflag%20Act/Emergency_Mobilization%20HOME.htm

Federal Resources and Programs

Federal Emergency Management Agency (FEMA)

FEMA's mission is “to reduce loss of life and property and protect our nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery.” FEMA Region X serves the northwestern states of Alaska, Idaho, Oregon, and Washington.

Contact: FEMA, Federal Regional Center, Region 10
Address: 130-228th St. SW, Bothell, WA 98021-9796
Phone: 425-487-4678
Website: <http://www.fema.gov/Reg-X/index.htm>

Federal Wildland Fire Policy, Wildland/Urban Interface Protection

This is a report describing federal policy and interface fire. Areas of needed improvement are identified and addressed through recommended goals and actions.

Website: <http://www.fs.fed.us/land/wdfire7c.thm>

National Fire Protection Association (NFPA)

This is the principal federal agency involved in the National Wildland/Urban Interface Fire Protection Initiative. NFPA has information on the Initiative's programs and documents. Other members of the initiative include: the National Association of State Foresters, the US Department of Agriculture Forest Service, the US Department of the Interior, and the United States Fire Administration.

Contact: Public Fire Protection Division

Address: 1 Battery March Park, P.O. Box 9101, Quincy, MA 02269-9101
Phone: 617-770-3000
Website: <http://www.nfpa.org>

National Interagency Fire Center (NIFC)

The NIFC in Boise, Idaho is the nation's support center for wild land firefighting. Seven federal agencies work together to coordinate and support wild land fire and disaster operations. These agencies include the Bureau of Indian Affairs, Bureau of Land Management, Forest Service, Fish and Wildlife Service, National Park Service, National Weather Service, and Office of Aircraft Services.

Contact: National Interagency Fire Center
Address: 3833 S. Development Avenue, Boise, Idaho 83705-5354
Phone: 208-387-5512
Website: <http://www.nifc.gov/>

United States Fire Administration (USFA) of the Federal Emergency Management Agency (FEMA)

As an entity of FEMA, the mission of the USFA is to reduce life and economic losses due to fire and related emergencies through leadership, advocacy, coordination, and support.

Contact: USFA, Planning Branch, Mitigation Directorate
Address: 16825 S. Seton Ave., Emmitsburg, MD 21727
Phone: 301-447-1000
Website: <http://www.fema.gov/mit/wfmit.htm> - Wildfire Mitigation Planning
<http://www.usfa.fema.gov/index.htm> - USFA Homepage
<http://www.usfa.fema.gov/wildfire/> - USFA Resources on Wildfire

United States Forest Service (USFS)

The USFS is a federal land management organization established to manage the nation's federally owned forests. As part of the Department of Agriculture, it provides timber for people, forage for cattle and wildlife, habitat for fish, plants, and animals, and recreation lands throughout the country. Following wildfires on federal lands, the USFS completes a Wildland Fire Analysis (WLFA).⁵⁷

Under the National Fire Plan, the USFS is more proactive than other agencies concerning wildfires. The USFS offers a possible link from local jurisdictions to federal grant programs, and provides special funding to decrease urban interface fuels.

Contact: USDA Forest Service - Pacific Northwest Region
Address: 333 SW First Avenue, Portland, Oregon 97204-3440;
P.O. Box 3623, Portland, OR 97208-3623
Phone: 503-808-2468
Website: <http://www.fs.fed.us/r6/welcome.htm>

Bureau of Land Management (BLM)

The BLM's National Office of Fire and Aviation is headquartered at the National Interagency Fire Center, in Boise, Idaho, where the fire experts develop policy, conduct wildland fire research, and coordinate with fire managers from other firefighting organizations.

Contact: National Office of Fire and Aviation
Address: 3833 S. Development Avenue, Boise, Idaho 83705
Phone: 208-387-5457, 208-455-6556 (TDY)
Website: <http://www.fire.blm.gov/>

Additional Resources

American Red Cross

The American Red Cross is a humanitarian organization, led by volunteers, that provides relief to victims of disasters and helps people prevent, prepare for, and respond to emergencies. The Willamette Chapter was chartered as a Red Cross unit in 1917. The chapter serves the residents of Marion and Polk counties. The Willamette Chapter provides a variety of community services which are consistent with the Red Cross mission and meet the specific needs of this area, including disaster planning, preparedness, and education.

Contact: American Red Cross, Willamette Chapter
Address: 675 Orchard Heights Rd NW, Suite 200 Salem, OR 97304
Phone: 503-585-5414
Fax: 503-362-3904
Email: rc@redcross-salem.org
Website: <http://www.redcross-salem.org/>

Institute for Business & Home Safety (IBHS)

IBHS was created as an initiative of the insurance industry to reduce damage and losses caused by natural disasters. This website provides educational resources and on-line publications for insurers, businesses, and homeowners who are interested in taking the initiative to minimize future damages and losses.

Contact: Institute for Business and Home Safety
Address: 1408 North Westshore Boulevard - Suite 208 - Tampa, FL 33607
Phone: 813-286-3400
Fax: 813-286-9960
E-mail: info@ibhs.org
Website: <http://www.ibhs.org/ibhs2>

FireFree Program to Promote Home Safety

In a pioneering effort to address wildfire danger in Bend, Oregon, four local agencies and a Fortune 500 corporation joined together to create "FireFree! Get In The Zone," a public education campaign designed to increase resident participation in wildfire safety and mitigate losses. Spearheaded by SAFECO Corporation, the partnership includes the Bend Fire Department, Deschutes County Rural Fire Protection District #2, Bend City Planning, and the Deschutes National Forest.

The Oregon Department of Forestry and a number of local government agencies and businesses have joined the program.

Contact: FireFree
Address: 1212 SW Simpson, Bend, OR 97701
Phone: 541-322-6309
E-mail: firewise@firefree.com
Website: <http://www.firefree.org>

Deschutes Project Wildfire

Community leaders in Deschutes County formed Project Wildfire in 2002. The mission of Project Wildfire is to reduce deaths, injuries, property, and environmental damage resulting from wildfires in Deschutes County. They seek to involve all communities while creating public-private partnerships that develop and implement pre-disaster strategies and activities. Project Wildfire incorporates a variety of funding sources to add to existing programs and/or build new needed programs. A governing committee sanctioned by the Deschutes County Commission oversees the business, policy and public awareness of Project Wildfire. The OSU Extension Service serves as coordination staff to manage grants and provide accountability to funding entities.

Contact: Teresa Hogue, Project Wildfire Coordinator
Address: OSU Extension, 3893 Airport Way, Redmond, OR 97756
Phone: 541-548-6088
Fax: 541-548-8919
E-mail: teresa.hogue@oregonstate.edu
Website: <http://impact.deschutes.org/>

Firewise – The National Wildland/Urban Interface Fire program

Firewise maintains a Website designed for people who live in wildfire-prone areas, but it also can be of use to local planners and decision makers. The site offers online wildfire protection information and checklists, as well as listings of other publications, videos, and conferences.

Contact: Firewise
Address: 1 Batterymarch Park, Quincy, MA 02269
Phone: 617-984-7056
E-mail: firewise@firewise.org
Website: <http://www.firewise.org/>

Society of American Foresters (SAF)

The Society of American Foresters (SAF) is the national scientific and educational organization representing the forestry profession in the United States. The mission of the SAF is to, in part, advance the science, education, technology, and practice of forestry; and to use the knowledge, skills, and conservation ethic of the profession to ensure the continued health and use of forest ecosystems and the present and future availability of forest resources to benefit society. The Oregon SAF is the largest state affiliate of the national Society. The Capital Chapter serves Yamhill, Polk and Marion Counties.

Contact: Society of American Foresters

Address: 5400 Grosvenor Lane, Bethesda, MD 20814-2198
Phone: 301-897-8720
Fax: 301-897-3690
E-mail: safweb@safnet.org
Website: <http://www.safnet.org>

Contact: Oregon Society of American Foresters
Address: 4033 SW Canyon Road, Portland, OR 97221
Phone: 503-224-8046
Fax: 503-226-2515
E-mail: rasor@safnwo.org
Website: <http://www.forestry.org>

Publications

Schwab, Jim, and Stuart Meck. *Planning for Wildfires*. PAS 429/530. Chicago, IL: American Planning Association. 2005.

This report outlines how knowledge of wildfire risks can be incorporated into comprehensive planning and identifies best practices for development in at-risk areas.

Contact: American Planning Association, Planners Book Service
Phone: 312-786-6344
Fax: 312-431-9985
Website: www.planning.org

National Fire Protection Association Standard 299: Protection of Life and Property from Wildfire. National Wildland/Urban Interface Fire Protection Program, (1991). National Fire Protection Association, Washington, D.C.

This document, developed by the NFPA Forest and Rural Fire Protection Committee, provides criteria for fire agencies, land use planners, architects, developers, and local governments to use in the development of areas that may be threatened by wildfire. To obtain this resource:

Contact: National Fire Protection Association Publications
Phone: 800-344-3555
Website: <http://www.nfpa.org> or <http://www.firewise.org>

An International Collection of Wildland-Urban Interface Resource Materials (Information Report NOR-X-344). Hirsch, K., Pinedo, M., & Greenlee, J. (1996). Edmonton, Alberta: Canadian Forest Service.

This is a comprehensive bibliography of interface wildfire materials. Over 2,000 resources are included, grouped under the categories of general and technical reports, newspaper articles, and public education materials. The citation format allows the reader to obtain most items through a library or directly from the publisher. The bibliography is available in hard copy or diskette at no cost. It is also available in downloadable PDF form. To obtain this resource:

Contact: Canadian Forest Service, Northern Forestry Centre, I-Zone Series
Phone: 780-435-7210
Website: <http://bookstore.pfc.cfs.nrcan.gc.ca>

Wildland/Urban Interface Fire Hazard Assessment Methodology. National Wildland/Urban Interface Fire Protection Program, (1998), NFPA, Washington, D.C. To obtain this resource:

Contact: Firewise (NFPA Public Fire Protection Division)
Phone: 617-984-7486
Website: <http://www.firewise.org>

Fire Protection in the Wildland/Urban Interface: Everyone's Responsibility. National Wildland/Urban Interface Fire Protection Program. 1998. Washington, D.C. To obtain this resource:

Contact: Firewise (NFPA Public Fire Protection Division)
Phone: 617-984-7486
Website: <http://www.firewise.org>

Planning for Natural Hazards: The Oregon Technical Resource Guide, Department of Land Conservation and Development (July 2000).

Produced by the Community Planning Workshop for the Department of Land Conservation and Development, this is a natural hazards planning and mitigation resource for Oregon cities and counties. It provides hazard-specific resources and plan evaluation tools. The document was written for local staffs and officials. The Technical Resource Guide includes a natural hazards comprehensive plan review, a hazard mitigation legal issues guide, and five hazard-specific technical resource guides, including: flooding, wildfires, landslides, coastal hazards, and earthquakes. This document is available online. You can also write, call, or fax to obtain this document:

Contact: Natural Hazards Program Manager
Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540
Phone: 503-373-0050
Fax: 503-378-6033
Website: <http://www.lcd.state.or.us/hazards.html>

Burning Questions. A Social Science Research Plan for Federal Wildland Fire Management, Machlis, G., Kaplan, A., Tuler, S., Bagby, K., and McKendry, J. (2002) National Wildfire Coordinating Group.

The plan covers a wide range of topics and questions related to the human dimensions of federal wildland fire management. Both the beneficial and harmful affects of wild land fire are considered. The plan includes research in the social sciences or anthropology, economics, geography, psychology, political science, and sociology, as well as interdisciplinary fields of research. The plan is national in scale but recognizes the importance of regional variation in wild land fire issues.

Contact: Sheila Williams, National Interagency Fire Center
Phone: 503-387-5203
E-mail: Sheila.Williams@nps.gov

Website: <http://www.lcd.state.or.us/hazards.html>

Forest Fire Risk and Restoration (2004) Oregon Forest Resources Institute
This 20-page report full of color photographs, illustrations and charts investigates what can be done to enhance the recovery of forest ecosystems that have been damaged by fire. It examines options for reducing the risk of large-scale fires recurring where uncharacteristically intense fires have occurred, and it looks at the short- and long-term consequences of each restoration option versus taking no action at all.

Contact: Oregon Forest Resources Institute
Address: 317 SW 6th Avenue, Suite 400, Portland, OR 97204
Fax: 503-229-5823
Website: <http://www.forestresourceinstitute.com/>

The Western Forester (periodical). Society of American Foresters' publication.

The *Western Forester* is an official publication of the Society of American Foresters. It is issued bi-monthly by the Oregon and Washington State Societies of American Foresters and is produced by the SAF Northwest Office. The publication promotes a timely exchange of quality resource management information among foresters, resource managers and those in related disciplines. Each issue focuses on a specific theme in addition to including other articles of interest to foresters.

Contact: Aimee Sanders, Assistant Editor
Phone: 503-224-8046
Email: aimee@safnwo.org
Website: <http://www.forestry.org>

¹ Urban Wildland Communities within the Vicinity of Federal Lands that are at High Risk from Wildfire. Federal Register, V. 66, N. 160. List 43383-43435 [01-20592]. August 17, 2001.

² Chehalem Watershed Assessment. June 2001. Yamhill Basin Council, Yamhill and Polk Counties, Oregon.

³ Zybach, Bob. 1993. *The Great Fires: Indian Burning and Catastrophic Forest Fire Patterns of the Oregon Coast Range, 1491-1951*. Corvallis, OR: Oregon State University Press.

⁴ Chehalem Watershed Assessment. June 2001.

⁵ Zybach, Bob. 1993. *The Great Fires: Indian Burning and Catastrophic Forest Fire Patterns of the Oregon Coast Range, 1491-1951*. Corvallis, OR: Oregon State University Press.

⁶ Id.

⁷ Chehalem Watershed Assessment. June 2001.

⁸ Id.

⁹ Willamina Watershed Assessment. August 2, 1999. Yamhill Basin Council. Yamhill and Polk Counties, Oregon.

¹⁰ Wilkinson, Todd. "Prometheus Unbound." *Nature Conservancy*. May/June 2001.

¹¹ National Interagency Fire Center, National Register of Urban Wildland Interface Communities Within the Vicinity of Federal Lands that are at High Risk from Wildfire. May 2001. <http://www.nifc.gov/fireplan/fedreg.html>.

¹² <http://www.biscuitfire.com/>

¹³ "Governor Declares State of Emergency", Ley Garnet, Oregon Public Broadcasting webpage, Portland Oregon: August 22, 2003.

http://www.publicbroadcasting.net/opb/news.newsmain?action=article&ARTICLE_ID=537432

¹⁴ Oregon Department of Forestry, Webpage (September 2003):

http://www.odf.state.or.us/DIVISIONS/resource_policy/public_affairs/News_Releases/daily/Default.asp

¹⁵ The Olympian webpage,

<http://www.theolympian.com/home/news/20030903/northwest/91088.shtml>, Accessed September 03, 2003.

¹⁶ DeBano, Leonard, Daniel Neary, and Peter Folliott. *Fire's Effects on Ecosystems*. 1998. Page 21

¹⁷ Id at 22

¹⁸ Id at 22

¹⁹ Id at 49

²⁰ Id at 304

²¹ Id

²² Department of Land Conservation and Development. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*. Chapter 7.

²³ Robert Olson Associates. June 1999. *Metro Regional Hazard Mitigation Policy and Planning Guide*. Portland, OR: Metro.

²⁴ Introductory language in Senate Bill 360, (July 2001), ODF website, <http://www.odf.state.or.us/fireprot/sb360.html>.

²⁵ Department of Land Conservation and Development. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*. Chapter 7.

²⁶ DeBano, Leonard, Daniel Neary, and Peter Folliott. *Fire's Effects on Ecosystems*. 1998. Page 59.

²⁷ Id

²⁸ Eichorn, Ernie. Field Representative, Chemawa District, Bonneville Power Administration. Personal Interview. November 10, 2004.

²⁹ Id.

³⁰ Department of Land Conservation and Development. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*. Chapter 7.

Id

³² Id

³³ Tomlinson, Stuart. "Dry, With a Dismal Outlook." *The Oregonian*. March 11, 2005. http://www.oregonlive.com/news/oregonian/index.ssf?/base/front_page/111053925353810.xml

³⁴ *The Oregonian*, Feb. 25, 2001.

³⁵ Tomlinson, Stuart. "Dry, With a Dismal Outlook." *The Oregonian*. March 11, 2005. http://www.oregonlive.com/news/oregonian/index.ssf?/base/front_page/111053925353810.xml

³⁶ Id.

³⁷ Board of Commissioners meeting, March 23, 2005.

³⁸ Oregon Governor Ted Kulongoski's "2005 Oregon Drought and Fire Conditions" Website http://governor.oregon.gov/Gov/fd/main_drought_fire.shtml. Accessed 23 March 2005.

³⁹ Bevin, Dan. Road Engineer, Cascade Resource Area, BLM. Personal Interview. December 16, 2004.

⁴⁰ Department of Land Conservation and Development. July 2000. *Planning for Natural Hazards: The Oregon Technical Resource Guide*. Chapter 7.

⁴¹ Burby, R., ed. 1998. *Cooperating with Nature: Confronting Natural Hazards with Land Use Planning for Sustainable Communities*. Washington D.C.: Joseph Henry Press.

⁴² Id.

⁴³ Colorado State Forest Service. July 2001. <http://205.169.13.227>.

⁴⁴ Oregon Department of Forestry, (1999) Oregon Forests Report.

⁴⁵ Wolf, J., Oregon Department of Forestry, personal communication, February 28, 2001.

⁴⁶ Id.

⁴⁷ Federal Wildland Fire Policy. July 2001. <http://www.fs.fed.us/land/wdfire7c.htm>.

⁴⁸ Id.

⁴⁹ Id.

⁵⁰ Harvey, M.J., United States Forest Service, personal communication, March 1, 2001.

⁵¹ Halemeier, David. Ranger, USFS, Willamette National Forest, Detroit Ranger Station. Personal Interview. November 16, 2004.

⁵² Fleeger, B., Regional Ecosystem Applied Learning (REAL) Corps, personal communication, June 30, 2003.

⁵³ Id.

⁵⁴ Harvey, M.J., United States Forest Service, personal communication, March 1, 2001

⁵⁵ Id.

⁵⁶ <http://www.firefree.org/ffreenew/index2a.htm> (Accessed 6/26/03)

⁵⁷ Halemeier, David. Ranger, USFS, Willamette National Forest, Detroit Ranger Station. Personal Interview. November 16, 2004.

Section 9:

Severe Winter Storm

Severe Winter Storm	1
Why are Severe Winter Storms a Threat to Marion County?	2
Historical Severe Winter Storm Events	2
<i>Characteristics of Severe Winter Storms in Marion County</i>	6
Severe Winter Storm Hazard Assessment	8
<i>Hazard Identification</i>	8
<i>Vulnerability Assessment</i>	8
<i>Risk Analysis</i>	8
Severe Winter Storm Community Issues	9
Mitigation Plan Goals and Existing Activities	9
<i>Existing Mitigation Activities</i>	11
<i>County Programs</i>	11
<i>State Programs</i>	11
Oregon Department of Transportation (ODOT) Winter Maintenance Practices	11
<i>Federal Programs</i>	11
Severe Winter Storm Mitigation Action Items	12
Short-term (ST) Severe Winter Storm Action Items	12
Long-term (LT) Severe Winter Storms Action Items	14
Severe Winter Storm Resource Directory	19
<i>State Resources</i>	19
<i>Federal Resources</i>	20
<i>Additional Resources</i>	21

Why are Severe Winter Storms a Threat to Marion County?

Severe winter storms pose a significant risk to life and property in Marion County by creating conditions that disrupt essential regional systems such as public utilities, telecommunications, and transportation routes. Severe winter storms can produce rain, freezing rain, ice, snow, cold temperatures, and wind. Ice storms accompanied by high winds can have destructive impacts, especially to trees, power lines, and utility services. Severe ice storms occur more frequently in areas exposed to east winds such as those blowing out of the Columbia River Gorge. Less common are severe freezes, where temperatures remain below freezing for five or more days, and severe or prolonged snow events. Both can produce widespread impacts on people and property throughout Marion County.

Historical Severe Winter Storm Events

Northwestern Oregon Region

Destructive storms, producing heavy snow and ice, have occurred throughout northwestern Oregon's history, most notably in 1937 and 1950. Over a five-day period between January 31 and February 4, 1937, snowstorms blew across most of Oregon. The heaviest snowfall occurred in the Cascade Mountains and Willamette Valley where Salem and Dallas recorded 26 inches of snow.¹ The storms were directly related to five Oregon deaths and caused over \$50,000 (in 1937 dollars) in damage to Salem.²

January 1950 was a very cold month statewide and was marked by three successive snowstorms that brought the heaviest snowfalls for the state as a whole since records were first kept in 1890. Over the course of the month Salem accumulated 39 inches of snow and Detroit Dam accumulated 122 inches. The snow and ice storms closed highways, stranded motorists, created power outages and resulted in hundreds of thousands of dollars of damage across the state.³

Snow Storms

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.⁴

January 1909

A six-day storm in January brought many locations more snow than what usually accumulates in one year.⁵

January 11 to 15, 1916

This storm affected the entire state. A few days earlier, on January 6 through January 10, heavy snow fell in mountainous areas. During the second storm of January 11 through 15, every reporting station in

western Oregon, except for the southwestern interior and the coastal areas, recorded storm totals of at least five inches and most locations had eight inches or more. McMinnville had the most snow in one day, with eleven (11) inches falling on January 12. Higher elevations in the Cascades received very heavy snowfall.⁶

December 1919

The December 1919 snowstorm was recorded as the third heaviest snowfall-producing storm in Oregon. 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.⁷

January 1937

The storms that hit Marion County in January 1937 broke an eighteen-year record for snowfall in Salem with 27 inches and caused \$50,000 in property damage. Much of the damage occurred as structures collapsed from the weight of the snow. For example, in Salem, four storefront marques collapsed, a shed fell on five vehicles in a lumberyard, the Salem Ferry Street Tabernacle collapsed and six structures at the Marion County Fairgrounds were damaged.⁸ In addition to property damage, many major roads were closed and residents of Detroit logging communities near Mill City were stranded for five days as heavy snow and an earth slide blocked a connecting highway.⁹

January 1950

The entire month of January 1950 was cold and frequent snowstorms occurred statewide. Snowfall and precipitation including freezing rain was heaviest from January 9th through the 18th.¹⁰ During this time, Marion County experienced wind gusts up to 80 mph and sustained winds up to 25 mph.^{11,12} Thirty-nine inches of snow fell on Salem over the course of the month, 54 inches fell in Detroit and 122 inches blanketed Detroit Dam.^{13,14} In Salem, Mill Creek flooded onto airport roads and in Detroit, a rod-and-gun club's roof collapsed under the weight of 20 inches of snow. The severe weather caused power outages in Mt. Angel and cut telephone service in Silverton. Schools throughout the county were sporadically closed and at least two weather-related traffic fatalities occurred in Oregon, one in Lyons.

March 1960

The first week of March 1960 was marked by a winter storm that brought more snow to Marion County than any time since 1950. Salem received 8.5 inches of snow and higher elevations received as much as 11 inches.¹⁵ This storm was responsible for two fatalities in Oregon, and 100 storm-related accidents in Marion County. In addition, most schools throughout the county were closed for several days.¹⁶

February 1989

The February 1989 storm dropped seven inches of snow on Marion County and saw temperatures as low as zero degrees Fahrenheit with a wind-chill factor dipping to 75 degrees *below* zero. The storm led to five

accidents on Interstate 5 that closed the highway between Salem and Albany. Near Woodburn, an overturned truck spilled 1,000 gallons of oil. There was also a storm related, four-vehicle accident on Highway 22 near Silverton. Hospitals in Salem reported 25 snow related injuries. The Oregon Department of Transportation estimated \$25,000 in additional costs were necessary for wages and supplies to deal with the storm's effects.^{17,18,19} In Salem, the adverse weather cost \$40,000 to keep streets open, \$10,000 more than the city budgeted for the storm.²⁰

February 1993

This storm event dropped nearly twelve inches of snow in Salem between February 18th and 19th; the greatest amount of snowfall ever recorded in a 24-hour period in Salem. As a result of the storm 2,100 Silverton area residents and 1,500 residents on Highway 99E north of Salem lost power. There were also several minor, storm-related injuries reported by Salem hospitals.²¹

December 26, 2003 – January 14, 2004

The winter snowstorm that blew through northwest Oregon at the end of December turned into an ice storm in January.²² According to state climatologist George Taylor, snowstorms that swept through the region beginning December 26, 2003, resulted in the snowiest, coldest winter since 1992-3. The storm resulted from the collision of a mass of moisture from the Pacific with an arctic cold front. Climatologists considered this the worst storm to pelt the west side of Oregon's Cascade Range since 1992 – even worse than a big ice storm that hit in 1998. According to the National Weather Service, Salem received three inches of snow on January 6th.

The storm's impact at Portland International Airport had thousands of passengers stranded for several days after the freezing rain cancelled flights. The runway conditions were among the worst in recorded history.²³ More than 330 flights were canceled on January 6, 2004, as airplanes sat on the runway encased in ice.²⁴ Another 140 flights were cancelled for the morning of January 7th alone.²⁵

58,000 Portland General Electric (PGE) customers were without power on January 6, 2004.²⁶ The hardest hit areas are the eastern and southern sections of the service territory, including east Multnomah County, Oregon City, Estacada, Molalla and Mulino, and the Salem area.²⁷

Champoeg State Heritage Area lost historic trees i.e., oaks estimated to be around 200 years old. During the winter storm, campers at the Heritage Area were trapped for a day because trees fell across the road, and park staff could not get to the park.²⁸ The Heritage Area qualified for FEMA funding, and it took four to five months to make repairs.²⁹ Fir and filbert trees were decimated at Willamette Mission State Park, but walnut trees withstood the storm.³⁰ Willamette Mission State Park suffered over \$30,000 in damage.³¹

For the Cascades, this storm was a typical storm (versus on the Valley floor where it was severe), although residents in the Santiam Canyon experienced problems with services (e.g., gas stations and stores closed) and power (e.g., disruption in electricity service). In the Cascades, a severe winter storm means that typically four to five feet of snow falls in a short period of time.³² In the 1970's, the Detroit-Idanha area experienced a record eight feet of snow.

Ice Storms

January 30-31, 1963

Cold temperatures and snow showers created hazardous driving conditions in Marion County during the last days of January 1963. Four inches of snow were recorded at McNary Field in Salem, Detroit recorded thirteen inches and Stayton reported that slush had frozen on area roadways.³³

January, 1978

During the early days of January 1978, a layer of cold air was driven into the Willamette Valley from Eastern Oregon via the Columbia Gorge. Rain from a higher warm air mass fell through the cold air below causing it to freeze. The cold temperatures and freezing rain iced roads throughout Marion County and the Willamette Valley causing eight traffic fatalities and dozens of traffic accidents.³⁴

February 2-4, 1996

Similar to the 1978 event, this storm began with a mass of cold air trapped in western Oregon followed by a warmer front that blew over the top of the cold air mass. Once the two fronts collided, they created a severe ice storm. Traffic accidents and power outages plagued the Willamette Valley. Freezing rain fell for two days, causing a 100-car pileup between Clackamas County and Salem, and a 22-car pile up on Highway 22 near Eola. One fatality occurred in a different traffic accident.^{35,36}

Extreme Cold Weather Events

December 15-26, 1924

In December 1924, temperatures stayed near or below the freezing mark for eleven straight days. At the time, this event in 1924 was recorded as the coldest December ever in Oregon. The cold period was long and severe. Most streams and rivers were frozen and blocked with ice. People drove their automobiles across the Willamette River.³⁷

In addition to the cold weather, four inches of snow fell over much of the Willamette Valley. The weight of the snow downed 400 telephone lines in Salem, and this weather event caused 21 car accidents in Salem.^{38,39} The freezing temperatures formed ice in the Willamette River that crushed a steamboat and caused several thousand dollars of damage to the Dennison Bath House.⁴⁰

January 24-31, 1957

The cold weather in January 1957 was the result of an arctic air mass that moved into Eastern Oregon and spread west toward the coast. The cold temperatures brought four inches of snow to Lyons and eleven inches to Detroit, as well as icy roads throughout Marion County.⁴¹

Temperatures in Marion County during this seven-day period were in the mid-teens, not considering the wind-chill created by 21 mph wind gusts. The cold snap cut electricity for 100 Salem residents and froze water pipes in many homes.⁴² Dozens of fires were reported in Salem from overheated chimneys and stoves, or from blowtorches used to thaw pipes. The cold temperatures also caused the Bonneville Power Authority to cut interruptible power to the regions' industrial customers because ice behind the dam slowed water flow and limited the ability to generate power.⁴³

February 1-8, 1989

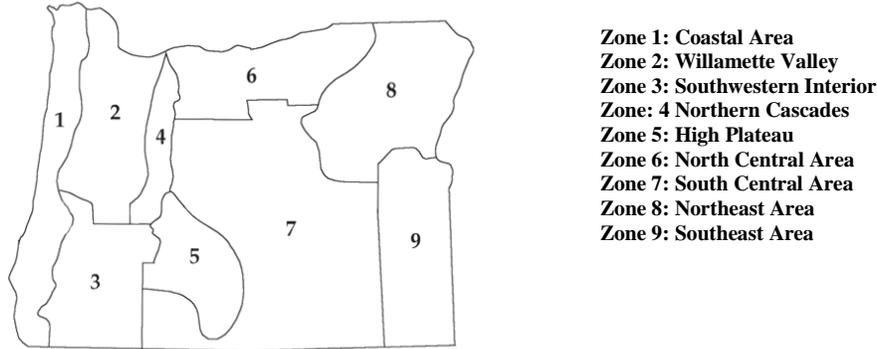
In early February 1989, Marion County experienced zero-degree temperatures and wind gusts up to 40 mph that created a wind-chill factor of negative 65-75 degrees Fahrenheit. The extreme cold damaged 20 to 40 percent of the county's cranberry crop, forced mills to send home thousands of employees, and froze or burst 200 Salem residents' water pipes.^{44,45,46}

Characteristics of Severe Winter Storms in Marion County

Weather patterns

Severe winter storms affecting Marion County typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from October through March.⁴⁷ Marion County's average precipitation is 40.35 inches. The National Climatic Data Center has established climate zones in the United States for areas that have similar temperature and precipitation characteristics. Oregon's latitude, topography, and proximity to the Pacific Ocean give the state diversified climates. Marion County is in Zone 2 as seen in Figure 8-1. The climate in Zone 2 generally consists of wet winters and dry summers.⁴⁸

Figure 8-1
Oregon Climate Zones



Source: Taylor, George H. and Hannan, Chris, *The Oregon Weather Book*, OSU Press (1999)

Snow

While snow is relatively rare in western Oregon, the break in the natural Cascades barrier at the Columbia Gorge provides a low-level passage through the mountains. Cold air, which lies east of the Cascades, often moves westward through the Gorge, and funnels cold air into the Portland Area, and may eventually sink southward into the Willamette Valley. If a wet Pacific storm happens to reach the area at the same time that the cold air is present, larger than average snow events may result.⁴⁹

An example of this type of snowstorm event occurred in January 1980, when strong storms, accompanied by snow, ice, wind, and freezing rain hit Oregon statewide. Impacts in the Portland area alone included one fatality; 200,000 customers left without power or phone service for several days; and 125 boats, with a combined value of over \$3 million dollars, sank in the Columbia Gorge.⁵⁰

Ice

Ice storms occasionally occur in northern areas of Oregon, resulting from cold air flowing westward through the Columbia Gorge.⁵¹ Like snow, ice storms are comprised of cold temperatures and moisture, but subtle changes can result in varying types of ice formation, including freezing rain, sleet, and hail.⁵²

Freezing rain can be the most damaging of ice formations. While sleet and hail can create hazards for motorists when it accumulates, freezing rain can cause the most dangerous conditions within a community. Ice buildup can bring down trees, communication towers, and wires creating hazards for property owners, motorists, and pedestrians alike. The most common freezing rain problems occur near the Columbia Gorge, but also pose a hazard to Marion County. As noted above, the Gorge is the most significant east-west air passage through the Cascades. Rain originating from the west can fall on frozen streets, cars, and other sub-freezing surfaces, creating dangerous conditions.⁵³

Severe Winter Storm Hazard Assessment

Hazard Identification

A severe winter storm is generally a prolonged event involving snow or ice. The characteristics of severe winter storms are determined by a number of meteorological factors including the amount and extent of snow or ice, air temperature, wind speed, and event duration.

Precipitation, an additional element of severe winter storms, is measured by gauging stations. The National Weather Service, Portland Bureau, monitors the stations and provides public warnings on storm, snow, and ice events as appropriate.

Vulnerability Assessment

Vulnerability assessment is the second phase of a hazard assessment. It combines the information generated through severe winter storm identification with an inventory of the existing development exposed to this hazard assisting in the prediction of how different types of property and population groups will be affected by a hazard.⁵⁴ Data that includes the areas exposed to winter storms in Marion County can be used to assess the population and total value of property at risk from severe storms.

While a quantitative vulnerability assessment (an assessment that describes number of lives or amount of property exposed to the hazard) has not yet been conducted for Marion County severe winter storm events, there are many qualitative factors (issues relating to what is in danger within a community) that point to potential vulnerability. Severe winter storms can cause power outages and transportation and economic disruptions, and pose a high risk for injuries and loss of life. The events can also be typified by a need to shelter and care for adversely impacted individuals. Marion County has suffered severe winter storms in the past that brought economic hardship and affected the life and safety of residents. Future severe winter storms may cause similar impacts countywide.

Risk Analysis

Risk analysis is the third, and most advanced phase of a hazard assessment. It is conducted by use of mathematical models and relies on information compiled during hazard identification and vulnerability assessments. Factors included in assessing severe winter storm risk include population and property distribution in the hazard area, the frequency of severe winter storm events, and information on trees, utilities, and infrastructure that may be impacted by severe winter storms. When sufficient data is collected for hazard identification and vulnerability assessment, a risk analysis can be completed. Insufficient data currently exists to complete a risk analysis.

Severe Winter Storm Community Issues

Life and Property

Winter storms are deceptive killers. Many winter storm deaths occur as a result of traffic accidents on icy roads, heart attacks while shoveling snow, and hypothermia from prolonged exposure to the cold.

Property is at risk due to flooding (see Section 6) and landslides (see Section 10) resulting from heavy snowmelt. Ice, wind, and snow can affect the stability of trees, power lines, telephone lines, and television and radio antennas. Falling trees and limbs affected by these events and saturated soils can become hazards for houses, cars, utilities and other property. Similarly, icy streets are difficult for emergency personnel to travel and may pose a secondary threat to life if police, fire, and medical personnel cannot respond to calls.⁵⁵

Roads and Bridges

Inclement winter weather can cause prolonged and extreme traffic disruptions. Snow and ice events resulting in icy road conditions can lead to major traffic accidents. Roads blocked by fallen trees during a windstorm may have tragic consequences for people who need access to emergency services. The ability to travel after a natural hazard event is a priority issue for county residents, organizations, and providers of essential services such as hospitals and utilities.

Power Lines

Historically, falling trees have been the major cause of power outages resulting in interruption of services and damaged property. In addition, falling trees can bring electric power lines down, creating the possibility of lethal electric shock. Snow and ice can also damage utility lines and cause prolonged power outages. Rising population growth and new infrastructure in the county creates a higher probability for damage to occur from severe winter storms as more life and property are exposed to risk.

Water Lines

The most frequent water system problem related to cold weather is a break in cast iron mainlines. Breaks frequently occur during severe freeze events, as well as during extreme cooling periods during the months of October, November, and December. Another common problem during severe freeze events is the failure of commercial and residential water lines. Inadequately insulated potable water and fire sprinkler pipes can rupture and cause extensive damage to property.

Mitigation Plan Goals and Existing Activities

Plan Goals Addressed

The plan goals addressed help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Goal #1: PUBLIC AWARENESS

Goal Statement: Increase public awareness of natural hazard risks, emergency notification and response, and resources for citizen preparedness.

Goal #2: EDUCATION

Goal Statement: Educate the public on how to prepare to successfully endure a natural disaster with minimal property damage and no loss of life.

Goal #3: PREVENTATIVE

Goal Statement: Minimize risks to life, property, the environment, and the economy from natural hazards.

Goal #4: FUNDING AND IMPLEMENTATION

Goal Statement: Identify potential funding sources and implement potential mitigation projects.

Goal #5: PARTNERSHIPS AND COORDINATION

Goal Statements:

- Create and enhance partnerships with other stakeholders involved with natural hazard management.
- Coordinate natural hazard mitigation efforts with adjacent jurisdictions and public/private agencies' risk management activities.

Goal #6: NATURAL RESOURCES UTILIZATION

Goal Statement: Promote the use of natural systems and features, watershed planning, and land use planning for natural hazard mitigation whenever possible to reduce long-term costs to the county and maximize effectiveness.

Goal #7: EMERGENCY SERVICES

Goal Statement: Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Existing Mitigation Activities

County Programs

Yamhill County Public Works' Road Department

The Road Department applies anti-icing agents as a precautionary measure. When a storm occurs and at times when an ice storm is anticipated, the Road Department sands the county's paved roads.

State Programs

Oregon Department of Transportation (ODOT) Winter Maintenance Practices

ODOT spends about \$16 million per year on snow and ice removal from the state highway system. ODOT's goal for winter maintenance is to improve the driving surfaces during winter conditions. ODOT uses three main approaches to mitigation of snow hazards on state highways:

- Snow plowing – moving snow out of the road;
- Sanding roadways for ice to make roads less slick; and
- Using anti-icing chemicals to stop ice from forming on roads.

ODOT highway maintenance crews prepare for severe winter conditions by November 1st each year. Crews make sure all equipment, including radios, and signs, are ready for the first frost or snowstorm. Equipment operators learn or refresh their ability to maintain and use snow and ice equipment.

Oregon State Parks close parks during natural disasters, and evacuate people from parkland when necessary.

Federal Programs

National Weather Service

The Portland Office of the National Weather Service issues severe winter storm watches and warnings when appropriate to alert government agencies and the public of possible or impending weather events. The watches and warnings are broadcast over NOAA weather radio and are forwarded to the local media for retransmission using the Emergency Alert System.

Severe Winter Storm Mitigation Action Items

The mitigation action items were formulated through researching regional and national mitigation plans and natural hazards planning literature, and interviews with local stakeholders. Plan action items were refined through discussions with the mitigation plan steering committee and through public workshops.

The severe winter storms mitigation action items provide direction on specific activities that organizations and residents in Marion County can undertake to reduce risk and prevent loss from severe winter storm and windstorm events. Each action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk from severe winter storms' impacts in Marion County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Severe Winter Storm Action Items

Short-term severe winter storm action items include general mitigation activities that agencies are capable of implementing during the next two years, given their existing resources and authorities.

ST-SWS #1: Enhance strategies for management of debris from severe winter storms.

Ideas for Implementation

- Maintain the coordinated management strategies for de-icing roads, plowing snow, clearing roads of fallen trees and debris from public and private property; and
- Secure funding for snow removal equipment, and be able to put it in place in advance of severe winter storms.

Coordinating Organization:	Public Works (Operations)
Internal Partners:	GIS, Planning, Parks, CAO, Juvenile Department
External Partners:	ODOT, USFS, State Parks
Timeline:	2 years
Plan Goals Addressed:	Preventative; Funding and Implementation; Partnerships and Coordination; Natural Resources Utilization; Emergency Services

ST-SWS #2: Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public infrastructure from severe winter storms.

Ideas for Implementation

- Partner with responsible agencies and organizations to design and implement programs that reduce risk to life, property, and utility systems; and
- Develop partnerships between utility providers and county and local public works agencies to document known hazard areas.

Coordinating Organization: Emergency Management
Internal Partners: Planning, Parks, Operations
External Partners: Cities, Utilities, USFS, ODF, State Parks
Timeline: 2 years
Plan Goals Addressed: Funding and Implementation; Partnerships and Coordination; Emergency Services

ST-SWS #3: Develop partnerships between utility providers and Marion County Public Works Divisions to document known hazard areas.

Ideas for Implementation

- Coordinate with the applicable divisions of the Public Works Department concerning preparedness.

Coordinating Organization: Emergency Management
Internal Partners: Planning, Parks, Operations
External Partners: Utilities, USFS, ODF
Timeline: 2 years
Plan Goals Addressed: Funding and Implementation; Partnerships and Coordination; Emergency Services

ST-SWS #4: Seek funding to reposition emergency power transfer connectors in areas documented as losing power as a result of severe winter storms, particularly in the Detroit/Idanha area

Note: This would reduce the impact to people in the community.

Ideas for Implementation:

- Encourage identified critical facilities to secure emergency (back-up) power; and
 - Work regionally with adjacent counties (Jefferson, Linn, Deschutes, Clackamas) to establish emergency power for critical facilities; and
 - Establish a maintenance program for emergency power generators i.e., once a month, make sure there is a sufficient fuel supply for the generators, and make sure the generators are able to pick up the load required for its purpose.
-

Coordinating Organization:	Emergency Management
Internal Partner:	Operations
External Partner:	Cities, Utilities, USFS
Timeline:	2 years
Plan Goals Addressed:	Preventative; Partnerships and Implementation; Emergency Services

Long-term (LT) Severe Winter Storms Action Items

Long-term severe winter storms action items include general mitigation activities that are likely to take more than two years to implement and may require new or additional resources and/or authorities.

LT-SWS #1: Increase and maintain public awareness of severe winter storms and the benefits of mitigation activities through education aimed at households, schools and businesses and increase targeting of special needs populations.

Ideas for Implementation

- Collect additional information and add to existing informational sources on public education materials for protecting life, property, and the environment from severe winter storm events. Such information would include, but not be limited to:
 1. Making available a map showing which power companies' territory a property belongs in;
 2. Creating a brochure that would explain how to safely hang holiday lights and the conductivity a tree's touching downed lines may contain, even though there is no 'arcing and sparking.'
- Distribute educational materials to county residents and public and private sector organizations regarding detour routes during road closures;
- Coordinate with utility companies and seek funding to develop an insert for inclusion with customers' utility bills to prepare for severe winter storms;
- Update county's Web site information and distribute information in bullet-point form (creep sheet) to the media;
- Distribute audience-specific educational materials to schools, churches, and other public and private sector organizations;
- Develop methods of improving emergency warning system;
- Seek funding to enhance warning systems in coordination with ODOT to place portable electronic sign board(s), like the one located west of

Highway 22's Gaffin Road Exit, just east of Mehama to warn motorists entering Highway 22 from Cascade Highway and Highway 226;

- Identify and contact at-risk populations such as the elderly or disabled not living in group homes/assisted care facilities; and
- Create inventory of supplies available for at-risk populations in severe winter storm situations.

Coordinating Organization: Emergency Management
Internal Partner: Planning
External Partners: Utilities, Cities, American Red Cross, St. Vincent DePaul, Churches, Oregon Voluntary Organizations Active in Disaster, Marion Fire Defense Board, Amateur Radio (Ham) Operators, residential facilities
Timeline: 1 to 2 years, and On-going
Plan Goals Addressed: Public Awareness; Preventative; Partnerships and Coordination

LT-SWS #2: Enhance weather monitoring to attain earlier severe winter storm warnings.

Ideas for Implementation

- Coordinate with appropriate organizations to evaluate the need for more weather stations and/or weather instrumentation.

Coordinating Organization: Emergency Management
External Partners: National Weather Service, Oregon Climate Service, USFS (Willamette National Forest, Detroit Ranger Station)
Timeline: On-going
Plan Goals Addressed: Education; Preventative; Funding and Implementation

LT-SWS #3: Develop and implement programs to keep trees from threatening lives, property, and public infrastructure in severe weather events.

Ideas for Implementation

- Develop partnerships between utility providers, county and city agencies to document known hazard areas and minimize risks;
- Coordinate with overhead utilities in developing GIS layers for power lines and at-risk trees;
- Consider reducing risk-prone species (e.g., alder, cottonwood) in right-of-way and replacing them with sturdier species; and
- Collaborate with overhead utilities on “Right Tree – Right Place Program.”

Coordinating Organization:	Marion County
Internal Partners:	GIS, Operations, Planning, Parks
External Partners:	Overhead Utilities, Cities, ODOT
Timeline:	On-going
Plan Goals Addressed:	Preventative; Partnerships and Coordination

LT-SWS #4: Develop and maintain comprehensive impact database and, when possible, map and publicize historical severe weather events in Marion County.

NOTE: Hazardous areas can be identified for the public so precautions can be taken at appropriate times. Information about county road icing and county road closures due to snow or other severe winter storm events is available on the county’s Emergency Management Web site, and could be mapped and disseminated countywide to make residents knowledgeable about severe winter (and windstorm) events.

Ideas for Implementation

- Research and analyze historic severe weather event damage in Marion County;
- Identify and map recurring patterns;
- 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 Marion County.
 2. Maps of the locations within Marion County most vulnerable to snow and ice, including roads, bridges, and utilities.
 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;
- Document future events including impacts and losses;
- Identify public infrastructure and facilities subject to closures due to snowfall and ice hazards during winter storms; and
- Develop partnerships between utility providers and county and city public works agencies to document known hazard areas and minimize risks.

Coordinating Organization: Marion County
 Internal Partners: Planning, GIS
 External Partners: Cities, National Weather Service, National Oceanic and Atmospheric Administration (NOAA), ODOT, Oregon Climate Service, Overhead Utilities
 Timeline: On-going
 Plan Goals Addressed: Education; Preventative; Partnerships and Coordination

LT-SWS #5: Support/encourage electrical utilities to use underground construction methods where possible to reduce power outages from severe winter storms through public incentives and partnerships.

Ideas for Implementation

- Continue support of utility under-grounding program in newly developed areas to minimize future conflicts with utilities;
- Encourage where appropriate the use of underground utilities where possible in redevelopment areas;
- Coordinate with local utility companies and contractors to install underground utilities;
- Partner with utilities to investigate under-grounding utilities in sections of Marion County that are prone to hazards related to overhead utilities; and
- Identify underground utilities projects as a part of future Capital Improvement Projects (CIP).

Coordinating Organization: Marion County, Emergency Management
 Internal Partners: Planning, GIS
 External Partners: Cities, Overhead Utilities
 Timeline: On-going

Plan Goals Addressed: Partnerships and Coordination

LT-SWS #6: Promote the benefits of tree-trimming and tree replacement programs and help to coordinate local efforts by public and private agencies.

NOTE: Utilities' tree-trimming and tree replacement programs provide tree maintenance benefits to local communities. Pacific Power could benefit in turn from cooperation with U.S. Forest Service, ODF and BLM foresters in harvest plans that are adjacent to roads and/or power line easements.

Coordinating Organization: Public Works (Operations)
Internal Partners: GIS, Emergency Management
External Partners: Utility and Telecommunications Companies, ODOT, City Public Works, USFS, BLM, ODF
Timeline: 3 to 5 years
Plan Goals Addressed: Education; Partnerships and Coordination

LT-SWS #7: Reduce hazards from trees along utility and road corridors, to prevent potential winter storm damage.

Ideas for Implementation

- Encourage the harvesting of trees along utility corridors and roads, which will prevent winter storm damage; and
- Encourage federal, state, local agencies and utility operators to harvest trees in the roadway corridors which will prevent winter storm damage, mitigate fire hazards, and could be used in fish enhancement projects to mitigate in riparian areas.

Coordinating Organization: Public Works
Internal Partners: Planning, Emergency Management
External Partners: Cities, Utilities, USFS, ODFW, DSL, BLM, ODOT, ODF
Timeline: On-going
Plan Goals Addressed: Preventative; Partnerships and Coordination; Natural Resources Utilization

LT-SWS #8: Encourage right-of-way coordination, education and management between property owners, utility operators, and government agencies.

Ideas for Implementation

- Encourage cooperation and education for managing right-of-way corridors with property owners.

Coordinating Organization: Emergency Management
Internal Partners: GIS, Building, Planning
External Partners: ODOT, USFS, BLM, DSL, ODOT, ODF,
Utilities, County Residents
Timeline: On-going
Plan Goals Addressed: Preventative; Funding and Implementation;
Partnerships and Coordination; Natural
Resources Utilization

LT-SWS #9: Encourage harvesting of trees blown down during a winter storm.

Ideas for Implementation

- Encourage the harvesting of trees blown down in winter storms; and
- Encourage federal, state and local agencies to harvest trees that have fallen during winter storms, which will mitigate fire hazards, and could be used in fish enhancement projects.

Coordinating Organization: Public Works
Internal Partners: Planning
External Partners: Cities, Utilities, FEMA, USFS, ODFW, DSL,
BLM, ODOT, ODF
Timeline: On-going
Plan Goals Addressed: Preventative; Partnerships and Coordination

Severe Winter Storm Resource Directory

State Resources

Department of Land Conservation and Development (DLCD)

DLCD administers the state's Land Use Planning Program. The program is based on 19 statewide planning goals, including Goal 7. In order to help local governments address natural hazards effectively, DLCD provides technical assistance such as conducting workshops, reviewing local land use plan amendments, and working interactively with other agencies.

Contact: Natural Hazards Program Manager, DLCD
Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540
Phone: 503-373-0050

Fax: 503-378-6033
Website: <http://www.lcd.state.or.us/hazards.html>

Oregon Climate Service (OCS)

The Oregon Climate Service collects, manages, and maintains Oregon weather and climate data. OCS provides weather and climate information to those within and outside the state of Oregon and educates the citizens of Oregon on current and emerging climate issues. OCS also performs independent research related to weather and climate issues.

Contact: Oregon Climate Service
Address: Oregon State University
Strand Ag Hall Room 326, Corvallis, OR 97331-2209
Phone: 541-737-5705
Fax: 541-737-5710
Website: <http://www.ocs.orst.edu>
Email: oregon@coas.oregonstate.edu

Oregon State Police (OSP)-Office of Emergency Management (OEM)

The purpose of OEM is to execute the Governor's responsibilities to maintain an emergency services system as prescribed in Oregon Revised Statutes Chapter 401 by planning, preparing, and providing for the prevention, mitigation, and management of emergencies or disasters that present a threat to the lives and property of citizens of and visitors to the state of Oregon.

Contact: Office of Emergency Management
Address: 3225 State Street, PO Box 14370, Salem, OR 97309-5022
Phone: 503-378-2911
Fax: 503-373-7833
Website: <http://www.osp.state.or.us/oem>

Federal Resources

Federal Emergency Management Agency (FEMA)

FEMA's mission is "to reduce loss of life and property and protect our nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery." FEMA Region X serves the northwestern states of Alaska, Idaho, Oregon, and Washington.

Contact: FEMA, Federal Regional Center, Region 10
Address: 130-228th St. SW, Bothell, WA 98021-9796
Phone: 425-487-4600
Fax: 425-487-4622
Website: <http://www.fema.gov/Regions/x/regx.shtm>

National Oceanic and Atmospheric Administration (NOAA)

NOAA's historical role has been to predict environmental changes, protect life and property, provide decision makers with reliable scientific information, and foster global environmental stewardship.

Contact: National Oceanic and Atmospheric Administration
Address: 14th Street & Constitution Avenue, NW, Room 6217, Washington, DC 20230
Phone: 202-482-6090
Fax: 202-482-3154
Website: <http://www.noaa.gov>
Email: answers@noaa.gov

National Weather Service, Portland Bureau

The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure, which can be used by other governmental agencies, the private sector, the public, and the global community.

Contact: National Weather Service
Address: 5241 NE 122nd Ave, Portland, Oregon 97230-1089
Phone: 503-326-2340
Website: <http://nimbo.wrh.noaa.gov/Portland>

Additional Resources

American Red Cross

The American Red Cross is a humanitarian organization, led by volunteers, that provides relief to victims of disasters and helps people prevent, prepare for, and respond to emergencies. The Willamette Chapter was chartered as a Red Cross unit in 1917. The chapter serves the residents of Marion and Polk counties. The Willamette Chapter provides a variety of community services which are consistent with the Red Cross mission and meet the specific needs of this area, including disaster planning, preparedness, and education.

Contact: American Red Cross, Willamette Chapter
Address: 675 Orchard Heights Rd NW, Suite 200 Salem, OR
Phone: 503-585-5414
Fax: 503-362-3904
Website: <http://www.redcross-salem.org/>
Email: rc@redcross-salem.org

Institute for Business & Home Safety (IBHS)

IBHS was created as an initiative of the insurance industry to reduce damage and losses caused by natural disasters. Their Website provides educational resources and on-line publications for insurers, businesses, and homeowners who are interested in taking the initiative to minimize future damages and losses.

Contact: Institute for Business and Home Safety
Address: 1408 North Westshore Boulevard - Suite 208 - Tampa, FL 33607
Phone: 813-286-3400
Fax: 813-286-9960
E-mail: info@ibhs.org
Website: <http://www.ibhs.org/ibhs2>

Publications

Public Assistance Debris Management Guide, Federal Emergency Management Agency (July 2000).

Debris Management Guide was developed to assist local officials in planning, mobilizing, organizing, and controlling large-scale debris clearance, removal, and disposal operations. Debris management is generally associated with post-disaster recovery. While it should be compliant with local and county emergency operations plans, developing strategies to ensure strong debris management is a way to integrate debris management within mitigation activities. The *Public Assistance Debris Management Guide* is available in hard copy or on the FEMA website.

Contact: FEMA Distribution Center
Address: 130 228th Street, SW, Bothell, WA 98021-9796
Phone: 800-480-2520
Fax: 425-487-4622
Website: <http://www.fema.gov/r-n-r/pa/dmgtoc.htm>

¹ National Weather Service, Portland Office.
www.wrh.noaa.gov/Portland/snowstorm.html. Accessed March 20, 2003.

² Oregon Statesman. February 2, 1937, no. 268. Page 1.

³ National Weather Service, Portland Office.
www.wrh.noaa.gov/Portland/snowstorm.html. Accessed March 20, 2003.

⁴ Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press.

⁵ Id.

⁶ *State of Oregon Natural Hazards Mitigation Plan*. August 2004. Available on the World Wide Web
http://csc.oregon.edu/pdr_website/projects/state/snhmp_web/index.htm

⁷ Id.

⁸ *Oregon Statesman*. February 2, 1937. No. 268, page 1.

⁹ *Oregon Statesman*. February 4, 1937. No. 270, page 1.

¹⁰ National Weather Service, Portland Office.
www.wrh.noaa.gov/Portland/snowstorm.html. Accessed March 20, 2003.

¹¹ *Oregon Statesman*. January 10, 1950: No. 308, page 1.

¹² *Oregon Statesman*. January 14, 1950: No.316, page 1.

-
- ¹³ National Weather Service, Portland Office.
www.wrh.noaa.gov/Portland/snowstorm.html. Accessed March 20, 2003.
- ¹⁴ *Oregon Statesman*. January 27, 1950: No.307, page 1.
- ¹⁵ *Oregon Statesman*. March 4, 1960: No. 342, page 1.
- ¹⁶ Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press.
- ¹⁷ *Statesman Journal*. February 2, 1989: page 1.
- ¹⁸ *Statesman Journal*. February, 3, 1989: page 2.
- ¹⁹ *Statesman Journal*. February 4, 1989: page 2.
- ²⁰ *Statesman Journal*. February 9, 1989: page 2.
- ²¹ *Statesman Journal*. February 20, 1993: page 1.
- ²² "Storm Leaves Northwest in a Standstill." January 7, 2004. KATU News. Available on the World Wide Web
<http://www.katu.com/news/story.asp?ID=63527>. Accessed August 23, 2004.
- ²³ "Some Areas Thawing, While Others Remain Icy." *KATU News*. January 8, 2004. Available on the World Wide Web
<http://www.katu.com/news/story.asp?ID=63532>. Accessed August 23, 2004.
- ²⁴ "Storm Leaves Northwest in a Standstill." KATU News. January 7, 2004. Available on the World Wide Web
<http://www.katu.com/news/story.asp?ID=63527>. Accessed August 23, 2004.
- ²⁵ "Ice Turns Roadways into Rinks." *News-Register*. January 8, 2004. Available on the World Wide Web
http://www.newsregister.com/news/results.cfm?story_no=175070. Accessed August 23, 2004.
- ²⁶ "Power Knocked Out to Thousands Across Northwest." KATU News. January 7, 2004. Available on the World Wide Web
<http://www.katu.com/news/story.asp?ID=63529>. Accessed August 23, 2004.
- ²⁷ Id.
- ²⁸ Wylie, Dennis. Park Manager, Champoeg State Heritage Area. Personal Interview. November 5, 2004.
- ²⁹ Id.
- ³⁰ Timmons, Eric. Park Manager, Willamette State Park Management Unit. Personal Interview. November 9, 2004.
- ³¹ Id.
- ³² Halemeier, David. Ranger, USFS Willamette National Forest, Detroit Ranger Station. Personal Interview. November 16, 2004.
- ³³ *The Oregon Statesman*. January 29, 1963: No. 308, page 1.
- ³⁴ *The Oregon Statesman*. January 3, 1978: Vol. 127, No. 195, page 1.

-
- ³⁵ Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press.
- ³⁶ *The Oregon Statesman*. February 4, 1996: page 1.
- ³⁷ Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press.
- ³⁸ *The Oregon Statesman*. December 16, 1924: page 1.
- ³⁹ *The Oregon Statesman*, December 17, 1924: page 3.
- ⁴⁰ *The Oregon Statesman*. December 25, 1924: page 1.
- ⁴¹ *The Oregon Statesman*. January 25, 1957: page 1.
- ⁴² *Oregon Statesman*. January 27, 1957: page 1.
- ⁴³ *Oregon Statesman*. January 28, 1957: No. 307, page 1.
- ⁴⁴ *Statesman Journal*. February 4, 1989: page 1, 4.
- ⁴⁵ *Statesman Journal*. February 8, 1989: page 2c.
- ⁴⁶ *Statesman Journal*. February 9, 1989: page 1, 2.
- ⁴⁷ Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Salem, OR: Oregon State Police – Office of Emergency Management:
- ⁴⁸ National Weather Service, Portland Bureau. March 2001.
<http://www.wrh.noaa.gov/Portland/snowstorm.html>.
- ⁴⁹ National Weather Service, Portland Office.
www.wrh.noaa.gov/Portland/snowstorm.html.
- ⁵⁰ Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press.
- ⁵¹ Id.
- ⁵² Id.
- ⁵³ Id.
- ⁵⁴ Burby, R., ed. 1998. *Cooperating with Nature: Confronting Natural Hazards with Land Use Planning for Sustainable Communities*. Washington D.C.: Joseph Henry Press.
- ⁵⁵ Robert Olson Associates. June 1999. *Metro Regional Hazard Mitigation Policy and Planning Guide*. Portland, OR: Metro.

Section 10: Windstorm

Why are Windstorms a threat to Marion County?	2
Historical Windstorm Events	2
<i>Regional</i>	<i>2</i>
<i>Marion County</i>	<i>3</i>
Characteristics of Windstorms in Marion County	5
Windstorm Hazard Assessment.....	7
<i>Hazard Identification</i>	<i>7</i>
<i>Vulnerability & Risk Assessment</i>	<i>7</i>
Windstorm Community Issues	7
Mitigation Plan Goals	11
Windstorm Mitigation Action Items.....	12
Short-term (ST) Windstorm Action Items	12
Long-term (LT) Windstorm Action Items.....	14
Windstorm Resource Directory	18
<i>State Resources</i>	<i>18</i>
<i>Federal Resources</i>	<i>19</i>
<i>Additional Resources</i>	<i>20</i>
<i>Publications</i>	<i>20</i>

Why are Windstorms a threat to Marion County?

When a strong windstorm strikes a community, it leaves behind a distinctive trail. Trees toppled over on buildings and cars, downed power lines crisscrossing the roads, and widespread power outages are a few of the signs that a windstorm has struck. After such an event, it can take communities days, weeks, or even longer to return to normal activities. In addition to costly structural damages, windstorms can cause injury or even death.

The December 12, 1995, windstorm damaged numerous homes, businesses, and public facilities, battered more than ten counties in Western Oregon, causing extensive damage to the electric utility infrastructure in the area. The windstorm generated tons of disaster-related debris, and cost local governments several million dollars to deal with the storm's impact throughout Oregon. Much of the damage to utility poles and power lines was a result of falling vegetation. Oregon received \$2.8 million through the Federal Emergency Management Agency's (FEMA) Public Assistance program to repair and restore damaged infrastructure. Approximately \$420,000 was allocated toward mitigation activities through FEMA's Hazard Mitigation Grant Program. While Marion County did not receive a Presidential Disaster Declaration for this storm, many nearby counties did. The hazard mitigation grant mitigated future losses to utility infrastructure. The grant assisted utilities in developing tree-trimming practices, right-of-way clearing policies, and in sharing techniques that reduce power line breakage by improved and alternate attachments to poles. A consumer-oriented program was also initiated to assist property owners in selecting trees that are power line friendly.

Similarly, a storm on February 7 and 8, 2002, resulted in a Presidential Disaster Declaration for five Oregon Counties.¹ Nine other counties, including Marion County, were declared contiguous counties affected by the storm. Such a declaration allowed family farmers to apply for loans to assist with storm-related damage.

Historical Windstorm Events

Regional

The Mid/Southern Willamette Valley, including Marion County, has experienced several powerful windstorms over the past several decades. Most of these storms resulted in building and property damage, utility failures, and in some cases injury or death. Table 10-1 outlines the most severe windstorms recorded in the region.

Table 10-1: Significant Wind Storms Affecting The Mid / Southern Willamette Valley, 1931-2002

Date	Affected Area	Characteristics
April 1931	Western Oregon	Unofficial wind speeds reported at 78 mph. Damage to fruit orchards and timber.
Nov. 10-11, 1951	Statewide	Widespread damage; transmission and utility lines; wind speed 40-60 mph; gusts 75-80 mph
Dec. 1951	Statewide	Wind speed 60 mph in Willamette Valley. 75 mph gusts. Damage to buildings and utility lines.
Dec. 1955	Statewide	Wind speeds 55-65 mph with 69 mph gusts. Considerable damage to buildings and utility lines
Nov. 1958	Statewide	Wind speeds at 51 mph with 71 mph gusts. Every major highway blocked by fallen trees
Oct. 1962	Statewide	Columbus Day Storm; Oregon's most destructive storm to date. 116 mph winds in Willamette Valley. Estimated 84 houses destroyed, with 5,000 severely damaged. Total damage estimated at \$170 million
March 1971	Most of Oregon	Greatest damage in Willamette Valley. Homes and power lines destroyed by falling trees. Destruction to timber in Lane Co.
Nov. 1981	Most of Oregon	Highest winds since October 1962. Wind speed 71 mph in Salem. Marinas, airports and bridges severely damaged.
Jan. 1990	Statewide	Heavy rain with winds exceeding 75-mph. Significant damage. One fatality.
Dec. 1995	Statewide	Followed path of Columbus Day Storm. Wind speeds 62 mph in Willamette Valley. Damage to trees (saturated soil a factor) and homes. (FEMA-1107-DR-OR)
Nov. 1997	Western Oregon	Wind speed 52 mph in Willamette Valley. Trees uprooted. Considerable damage to small airports.
Feb. 2002	Western Oregon	Strongest storm to strike western Oregon in several years. Many downed power lines (trees); damage to buildings; water supply problems (lack of power). Estimated damage costs: \$6.14 million. (FEMA-1405-DR-OR)

Source: George H. Taylor and Ray Hatton. 1999. *The Oregon Weather Book*, pp.151-157. Hazard Mitigation Team Survey Report, *Severe Windstorm in Western Oregon*, February 7, 2002 (FEMA-1405-DR-OR)

Marion County

Windstorms have historically been a threat to Marion County and most of the storms described in Table 10-1 also impacted Marion County. The following storms, though not exclusive to Marion County, caused particularly severe damage to the county.

April 1931 Windstorm

This storm, with winds up to 40 mph and gales up to 75 mph, blew moving vehicles off roadways in Salem and Woodburn.² The storm consisted of northeastern winds that blew tons of dust from Eastern Oregon down the Columbia Gorge where it then settled over much of the Willamette Valley. The dust reduced visibility to distances less than one mile. The sediment-filled winds also felled hundreds of trees causing road closures between Mill City and Detroit. The winds also caused several devastating fires. In Mehama, several buildings burned completely; including homes, a large store and the Stayton Bank. There were 22 home fires in the Salem area and throughout the Willamette Valley forest fires, as large as 3,000 acres in Linn County, were whipped up by the winds.³

December 1951 Windstorm

This mid-century storm with winds recorded at 57 mph and gusts up to 76 mph resulted in four Oregon deaths. Power outages for up to a day were recorded at Union Hill, Waldo Hill, Victor Point, Scotts Mills, Silverton Hills and Marquam. The North and South Santiam highways and the Siuslaw highway were closed due to fallen trees.⁴

October 12, 1962 (The Columbus Day Storm)

The Columbus Day storm in 1962 produced sustained winds in Salem of 58 mph and gusts as high as 90 mph⁵. It was the most destructive windstorm ever recorded in Oregon, both in terms of loss of life and property damage. Damage was most severe in the Willamette Valley where the storm killed 38 people and was responsible for two deaths in Salem and four injuries in Silverton.⁶ The storm caused upwards of \$200 million in damage (over \$800 million in today's dollars) statewide.⁷ Approximately \$4 million (in 1962 dollars) in damage occurred in Salem, while that number doubled to \$8 million worth of damage in Marion County as a whole.⁸

Hundreds of thousands of homes were without power for short periods of time, while others were without power for two to three weeks. More than 50,000 homes were seriously damaged, and nearly 100 were completely destroyed. In Salem, 40 schools were closed and 7,000 residents lost phone service.⁹ The storm destroyed fruit and nut orchards and killed scores of livestock.

March 25-26, 1971

This March windstorm produced winds up to 50 mph and hit the Hubbard and Scotts Mills area particularly hard while also causing power outages for approximately 60 homes in the Salem area¹⁰.

November 13-15, 1981

November 1981 saw two successive windstorms on the 13th and 14th. Sustained winds in Salem reached 52 mph and gusts were recorded at 71 mph.¹¹ Eleven people were killed and \$50 million in damage was reported as a result of the two storms. Numerous injuries resulted from wind-blown debris in western Washington and Oregon.¹²

Across the Pacific Northwest, hundreds of downed trees and power lines caused massive power outages and roof damage. The storm caused 500,000 Oregon residents to lose power,¹³ 20,000 in the Salem area alone. The storm toppled 23 power poles on the Silverton Road and power outages in Salem resulted in seven school closures.^{14,15}

December 12, 1995

This windstorm caused such widespread damage from downed trees and power and communication outages that Governor Kitzhaber declared a state of emergency for all of western Oregon and called 150 National Guard Troops to assist residents and public utility crews.^{16,17}

The storm caused three deaths, one in Marion County. The windstorm resulted in \$800,000 of damage to Marion County, \$500,000 of which occurred in Woodburn alone.¹⁸ Some of this damage included environmental damage as “millions of gallons of raw sewage” flowed into Salem area creeks and the Willamette River.¹⁹

In Salem, the National Weather Service reported average winds of 40 mph with gusts up to 59 mph. In the region between Salem and Corvallis, 7,500 people lost phone service. In the Salem area, including Silverton and Woodburn, 20,000 people lost power; in the Stayton and Mill City area, that number was 10,000. In addition to power and phone outages, Interstate 5 was shut down to truck traffic for several hours and Highway 22 at Valley Junction was closed.²⁰

February 7, 2002

The most recent of large windstorm events arrived in the Willamette Valley with wind gusts up to 70 mph causing 27,000 power outages statewide.²¹ The severity of this storm prompted President Bush to issue Major Disaster Declarations for five Oregon Counties. Nine other Oregon Counties, including Marion County, were named contiguous Counties, allowing family farmers to receive loans to address storm-related damage.²²

Eastern Marion County was one of the areas hardest hit by this storm. In Gates, the wind blew off the Post Office roof and Highway 22 east of Mehama was closed after trees blocked the roadway. A downed tree blocked Highway 99 near Jefferson and the Interstate 5 corridor between Salem and the Highway 34 exit experienced storm-related congestion.²³

Characteristics of Windstorms in Marion County

The most frequent surface winds in Oregon are from the southwest. These widespread winds are associated with storms moving onto the coast from the Pacific Ocean. Winds coming from the south are the most destructive. The Columbus Day Storm of 1962 was an example of this type of windstorm. Chinook winds are strong easterly winds coming out of the Columbia Gorge. Chinook is a native Indian word meaning “snow eater.” The Chinook wind is a warm dry wind that

often leads to the rapid disappearance of snow, and can gust up to 100 miles per hour. The gusts are caused by rapid atmospheric pressure changes. Studies have shown that these changes can result in physiological and psychological reactions in humans such as headaches and increased irritability. West winds generate from the Pacific Ocean and are strong along the coast, but slow down inland due to the obstruction of the Coastal and Cascade mountain ranges.²⁴ Prevailing winds in Oregon vary with the seasons. In summer, the most common wind directions are from the west or northwest; in winter, they are from the south and east. Local topography, however, plays a major role in affecting wind direction. For example, the north-south orientation of the Willamette Valley channels the wind most of the time, causing predominately north and south winds.²⁵

Tornadoes

Tornadoes are the most concentrated and violent storms produced by the earth's atmosphere. They are created by a vortex of rotating winds and strong vertical motion, which possess remarkable strength and cause widespread damage. Wind speeds in excess of 300 mph have been observed within tornadoes, and it is suspected that some tornado winds exceed 400 mph. The low pressure at the center of a tornado can destroy buildings and other structures it passes over. Tornadoes are most common in the Midwest, and are more infrequent and generally small west of the Rockies. Nonetheless, Oregon and other western states have experienced tornadoes on occasion, many of which have produced significant damage and occasionally injury or death.

Oregon's tornadoes can be formed in association with large Pacific storms arriving from the west. Most of them, however, are caused by intense local thunderstorms. These storms also produce lightning, hail, and heavy rain, and are more common during the warm season from April to October.²⁶ Since 1957, five reported tornados have struck Marion County.

Sandy – April 1957

A tornado 35-50 yards in diameter left a path three miles long and lifted large fir trees 40 feet in the air and damaged several homes.²⁷

Aumsville – March 8, 1960

A tornado hit and damaged several farms and uprooted trees.²⁸

Sandy – August 20, 1979

Sandy's second recorded tornado left a path two miles long, and damaged homes, toppled trees and caused power outages.²⁹

Aurora – August 26, 1984

A smaller tornado struck in Aurora, destroying a machine shop and scattering its pieces over a half-mile area.³⁰

Silverton – November 12, 1991

This tornado damaged a barn.³¹ Several timber units tumbled down in the Detroit Ranger District of the Willamette National Forest during

this windstorm, which was cyclonic in nature in the eastern portion of the Santiam Canyon.³²

Windstorm Hazard Assessment

Hazard Identification

A windstorm is generally a short duration event involving straight-line winds and/or gusts in excess of 50 mph. Windstorms affect areas of the county with significant tree stands, as well as areas with exposed property, major infrastructure, and aboveground utility lines. The lower wind speeds typical in the lower valleys are still high enough to knock down trees and power lines, and cause other property damage. Mountainous sections of the county experience much higher winds under more varied conditions. Because of the local nature of wind hazards in the mountains, a high-resolution wind speed map would be required to accurately identify the degree of wind hazard throughout Marion County. Such a map could identify wind hazards other than tree-falls, such as winds high enough to cause various degrees of structural damage. Unfortunately, high-resolution wind maps were not available at the time of this publication, so a precise wind hazard analysis could not be performed.

Vulnerability & Risk Assessment

A vulnerability assessment that describes the number of lives and amount of property exposed to the wind hazard has not yet been conducted for Marion County windstorms. There are many issues related, however, to what may present a danger within communities experiencing windstorms. Windstorms can cause power outages, transportation, and economic disruptions, and significant property damage, and pose a high risk for injuries and loss of life. Major utilities cite windstorms as one of the two biggest natural hazards that affect their infrastructure – ice storms is the second.³³ They can also be typified by a need to shelter and care for individuals impacted by the events. Several destructive windstorms, most notably the 1962 Columbus Day storm and the December 12, 1995 windstorm brought economic hardship and affected the life and safety of county residents. Future windstorms may cause similar impacts countywide.

Factors that should be included in windstorm risk analyses include: population and property distribution in the hazard area; the frequency of windstorm events; and information on the types of trees and failure rates most susceptible to windstorm events. When sufficient data is collected for hazard identification and vulnerability assessment, a risk analysis can be completed. Currently, insufficient data currently exists to complete a risk analysis.

Windstorm Community Issues

Property and Life

Windstorms have the ability to cause damage over 100 miles from the center of storm activity. Isolated wind phenomena in the mountainous

regions have more localized effects. Winds impacting walls, doors, windows, and roofs, may cause structural components to fail. Wind pressure can create a direct and frontal assault on a structure, pushing walls, doors, and windows inward. Conversely, passing currents can create lift and suction forces that act to pull building components and surfaces outward. The effects of winds are magnified in the upper levels of multi-story structures. As positive and negative forces impact the building's protective envelope (doors, windows, and walls), the result can be roof or building component failures and considerable structural damage. The effects of wind speed are shown in Table 10-2.

Table 10-2. Effect of Wind Speed

Wind Speed (Mph)	Wind Effects
25-31	Large branches will be in motion.
32-38	Whole trees in motion; inconvenience felt walking against the wind.
39-54	Twigs and small branches may break off trees; wind generally impedes progress when walking; high profile vehicles such as trucks and motor homes may be difficult to control.
55-74	Potential damage to TV antennae; may push over shallow rooted trees, especially if the soil is saturated.
75-95	Potential for minimal structural damage, particularly to unanchored mobile homes; power lines, and signs; and tree branches may be blown down.
96-110	Moderate structural damage to walls, roofs and windows; large signs and tree branches blown down; moving vehicles pushed off roads.
111-130	Extensive structural damage to walls, roofs, and windows; trees blown down; mobile homes may be destroyed.
131-155	Extreme damage to structures and roofs; trees uprooted or snapped.
Greater than 155	Catastrophic damage; structures destroyed.

Source: Washington County Office of Consolidated Emergency Management

Debris carried along by extreme winds can directly contribute to loss of life and indirectly to the failure of protective building envelopes, siding, or walls of buildings. When severe windstorms strike a community, downed trees, power lines, and damaged property can be major hindrances to emergency response and disaster recovery.

Infrastructure

Storm winds can damage buildings, power lines, and other property and infrastructure due to falling trees and branches. During wet winters, saturated soils cause trees to become less stable and more vulnerable to uprooting from high winds.

Marion County is susceptible to direct impacts on infrastructure and property. Windstorms can result in collapsed or damaged buildings, damaged or blocked roads and bridges, damaged traffic signals, streetlights, and parks, among others. Roads blocked by fallen trees

during a windstorm may have severe consequences to people who need access to emergency services. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted.³⁴ Industry and commerce can suffer losses from interruptions in electric service and from extended road closures. They can also sustain direct losses to buildings, personnel, and other vital equipment. There are direct consequences to the local economy resulting from windstorms related to both physical damages and interrupted services.

Utilities

Historically, falling trees have been the major cause of power outages in Marion County. Windstorms can cause flying debris and downed utility lines. For example, tree limbs breaking in winds of only 45 mph can be thrown over 75 feet. Thus, overhead power lines can be damaged even in relatively minor windstorm events. Utility lines brought down by summer thunderstorms have also been known to cause fires, which start in dry roadside vegetation.³⁵ Falling trees can bring electric power lines down to the pavement, creating the possibility of lethal electric shock. Rising population growth and new infrastructure in the county creates a higher probability for damage to occur from windstorms as more life and property are exposed to risk.

Tree Failure and Resulting Power Line Outages

Tree failure is one of the leading causes of power outages during severe weather events. According to Portland General Electric (PGE), trees are the leading cause of storm-related power outages in PGE's service area.³⁶ Tables 10-3 and 10-4 are Tree Failure Profiles developed by PGE for two of the most common tree failures in the PGE service territory. The profiles are developed from the data collected and used by PGE foresters in targeting "at-risk" trees during routine vegetation maintenance cycles.

Table 10-3. Tree Failure Profile - Species: Douglas fir (*Pseudotsuga menziesii*)

Failed Part	Description of failure/ Tree characteristics	Associated defects/ Indicators	Environment	Management History
BRANCH Frequency: High	Sm. diameter branches from mature trees; can sail up to 75 feet and wrap lines. Overhanging branch failure from snow/ice loading.	Evidence of previous branch failures.	Exposure to winds/gusts greater than 40 mph. Line downwind.	Side trimmed trees.
TRUNK Frequency: Low	Failure of multiple tops.	Old topping cut, previous break, decay present.	Wind or ice storms.	Previous topping.
	Interior trees, 3-8" dia.	Intermediate/suppressed trees.	Wind, snow/ice loading, recent exposure.	Thinning of stand, exposure as edge tree.
	Dead tree of any size in close proximity to line.	Entire tree dead for some time.	Line downwind.	
ROOT Frequency: High	Trees of all ages.	Evidence of other root failures.	Slight to moderate wind.	Site disturbance; leave trees from logging or development.
	Small, interior trees.	Poor taper, low live-crown ratio, aggravating site characteristics.	Slight to moderate wind.	Thinning of stand; overstocked, unmanaged stands.

Source: Portland General Electric, Forester's Office. 2001.

Table 10-4. Tree Failure Profile - Species: Bigleaf Maple (*Acer macrophyllum*)

Failed Part	Description of failure/ Tree characteristics	Associated defects/ Indicators	Environment	Management History
BRANCH Frequency: High	Mature trees; scaffold branches; or during full leaf-out.	Decay present at multiple branch attachment. Co-dominant stems with included bark.	Heavy rains after leaf-out in spring; heavy fall rains. Exposure to winds/gusts greater than 30 mph. Line downwind, ivy covered.	Natural and previously pruned; history of side trimming.
TRUNK Frequency: Low	Trunk failure at base of tree up to 12 feet.	Decay present in trunk or at base.	On a slope, line downwind, or ivy covered.	In unmanaged or natural areas.

Source: Portland General Electric, Forester's Office. 2001.

Mitigation Plan Goals

Plan Goals Addressed

The plan goals addressed help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Goal #1: PUBLIC AWARENESS

Goal Statement: Increase public awareness of natural hazard risks, emergency notification and response, and resources for citizen preparedness.

Goal #2: EDUCATION

Goal Statement: Educate the public on how to prepare to successfully endure a natural disaster with minimal property damage and no loss of life.

Goal #3: PREVENTATIVE

Goal Statement: Minimize risks to life, property, the environment, and the economy from natural hazards.

Goal #4: FUNDING AND IMPLEMENTATION

Goal Statement: Identify potential funding sources and implement potential mitigation projects.

Goal #5: PARTNERSHIPS AND COORDINATION

Goal Statements:

- Create and enhance partnerships with other stakeholders involved with natural hazard management.
- Coordinate natural hazard mitigation efforts with adjacent jurisdictions and public/private agencies' risk management activities.

Goal #6: NATURAL RESOURCES UTILIZATION

Goal Statement: Promote the use of natural systems and features, watershed planning, and land use planning for natural hazard mitigation whenever possible to reduce long-term costs to the county and maximize effectiveness.

Goal #7: EMERGENCY SERVICES

Goal Statement: Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Windstorm Mitigation Action Items

The mitigation action items were formulated through researching regional and national mitigation plans and natural hazards planning literature, and interviews with local stakeholders. Plan action items were refined through discussions with the mitigation plan steering committee and through public workshops.

The severe winter storms and windstorms mitigation action items provide direction on specific activities that organizations and residents in Marion County can undertake to reduce risk and prevent loss from windstorm events. Each action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk of windstorm impacts in Marion County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Windstorm Action Items

Short-term windstorm action items include general mitigation activities that agencies are capable of implementing during the next two years, given their existing resources and authorities.

ST-WS #1: Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events.

Ideas for Implementation

- Partner with responsible agencies and organizations to design and disseminate education information to property owners to reduce risks to life, property, and utility systems from tree failure;
- Develop partnerships between utility providers and county and local public works agencies to document known hazard areas and minimize risks;
- Identify and find solutions to potentially hazardous trees in developed areas, near utility corridors, and near vital infrastructure; and
- Partner with responsible agencies and organizations to develop landscaping and tree programs that have less impact on aboveground utility lines and roads.

Coordinating Organization: Public Works
Internal Partners: GIS, Planning
External Partners: Cities, ODF, Utility providers
Timeline: 2 years
Plan Goals Addressed: Preventative; Funding and Implementation;
Partnerships and Coordination

ST-WS #2: Enhance strategies for debris management and/or removal after windstorm events.

Ideas for Implementation

- Coordinate with local agencies responsible for debris removal and provide residents locations for debris disposal;
- Notify area residents, business owners, and employees of alternative routes in case of road blockage; and
- Publicize the debris/fallen tree drop-off location for property owners after severe storm events.

Coordinating Organization: Public Works (Operations)
Internal Partner: Emergency Management, Juvenile
Department
External Partners: ODOT, Cities, Regional Recycling Facilities
Timeline: 2 years
Plan Goals Addressed: Preventative; Funding and Implementation;
Partnerships and Coordination; Emergency
Services

ST-WS #3: Maintain tree trimming for above-ground power lines.

Ideas for Implementation

- Coordinate with overhead utilities to evaluate tree trimming.

Coordinating Organization: Public Works (Operations)
Internal Partner: Emergency Management
External Partner: Overhead Utilities, Cities
Timeline: On-going
Plan Goals Addressed: Preventative; Funding and Implementation;
Partnerships and Coordination; Emergency
Operations

Long-term (LT) Windstorm Action Items

Long-term windstorm action items include general mitigation activities that are likely to take more than two years to implement and may require new or additional resources and/or authorities.

LT-WS #1: Map and publicize locations around Marion County that have the highest incidence of extreme windstorms.

Ideas for Implementation

- Identify a responsible agency for central collection and reporting of storm data. Data collected should include:
 1. Windstorm data (sustained speeds, gusts, storm durations) for localities throughout Marion County.
 2. Maps of the locations within Marion County most vulnerable to high winds.
 3. Injury and property damage estimates, including locations.
- Identify a responsible agency to collect and transfer data to the National Climate Data Center (NCDC), Oregon Climate Service (OCS), FEMA, or other agencies concerned with the incidence of storms, to help establish and maintain baseline and historic records of storm events; and
- Identify public infrastructure and facilities subject to damage or closure during windstorm events.

Coordinating Organization: Emergency Management
Internal Partners: Operations, Engineering
External Partners: FEMA, NCDC, OCS, NWS, USFS
Timeline: 5 years
Plan Goals Addressed: Preventative; Natural Resources Utilization

LT-WS #2 Support/encourage electrical utilities to use underground construction methods where possible to reduce power outages from windstorms.

Ideas for Implementation

- Explore incentives to increase the use of underground utilities where possible; and
- Encourage the use of underground utilities where possible

Coordinating Organization: Marion County
Internal Partners: GIS, Emergency Management
External Partner: Utility Companies, Cities
Timeline: Ongoing

Plan Goals Addressed: Preventative; Natural Resources Utilization

LT-WS #3: Increase public awareness of windstorm mitigation activities.

Ideas for Implementation

- Collect existing information on public education materials for protecting life, property, and the environment in windstorm events;
- Identify and collect additional information and develop programs as necessary;
- Identify critical facilities that have secured emergency (back-up) power; and
- Distribute educational materials to county residents and public and private sector organizations regarding preparedness for no-power situations.

Coordinating Organization: Marion County
Internal Partners: Planning, Emergency Management
External Partners: Utilities, Cities, FEMA
Timeline: Ongoing
Plan Goals Addressed: Education; Preventative; Natural Resources Utilization; Emergency Services

LT-WS #4: Support/encourage contractors, homeowners and electrical utilities to use windstorm resistant construction methods where possible to reduce damage and power outages from windstorms.

Ideas for Implementation

- Encourage the use of underground utilities where possible;
- Provide guidance and information on wind-resistant construction methods; and
- Evaluate current building codes for efficacy in protecting structures from wind damage.

Coordinating Organization: Marion County
Internal Partners: Building Inspection, Planning
External Partners: Cities, Utilities
Timeline: 5 years
Plan Goals Addressed: Education; Preventative

LT-WS #5: Develop and implement programs to keep trees from threatening lives, property, and public infrastructure during windstorm events.

Ideas for Implementation

- Partner with responsible agencies and organizations to design and implement tree programs that reduce risk to life, property, and utility systems; and
- Develop partnerships between utility providers and county and local public works agencies to document known hazard areas.

Coordinating Organization: Marion County
Internal Partners: Operations, Planning
External Partners: Utilities, Cities
Timeline: On-going
Plan Goals Addressed: Preventative; Partnerships and
Coordination; Natural Resources Utilization

LT-WS #6: Identify trees that are potentially susceptible to wind throw.

Ideas for Implementation

- Analyze current maps of trees along county roads from any available sources (e.g., satellite imaging);
- Develop educational material on tree species that are susceptible to wind throw; and
- Locate hazardous trees and add to map.

Coordinating Organization: Marion County
Internal Partner: GIS
External Partners: Cities, Overhead Utilities, Local Plant Nurseries, Oregon Garden
Timeline: On-going
Plan Goals Addressed: Preventative; Partnerships and
Coordination; Natural Resources Utilization

LT-WS #7: Encourage harvesting of trees along utility and road corridors, preventing potential windstorm damage.

Ideas for Implementation

- Encourage the harvesting of trees along utility corridors and roads, to prevent windstorm damage;
- Replace stands of hazard-prone trees species in the right-of-way with more appropriate species; and
- Encourage federal, state and local agencies to harvest trees likely to fall during a winter storm to mitigate fire hazards, and could be used in fish enhancement projects.

Coordinating Organization: Emergency Management
Internal Partner: Operations
External Partners: Cities, Utilities, FEMA, USFS, ODFW, DSL,
BLM, ODOT, ODF
Timeline: On-going
Plan Goals Addressed: Preventative; Natural Resources Utilization

LT-WS #8: Encourage critical facilities to secure emergency power.

Ideas for Implementation

- Seek funding and capital improvements for emergency power availability for critical facilities; and
- Identify critical facilities that need to secure emergency (back-up) power.

Coordinating Organization: Emergency Management
Internal Partner: Operations
External Partners: Cities, Neighboring Counties, Marion Fire
Defense Board, Police Stations
Timeline: On-going
Plan Goals Addressed: Partnerships and Coordination

LT-WS #9: Encourage harvesting of trees blown down during a windstorm.

Ideas for Implementation

- Provide disposal options for private and business land owners; and
- Encourage federal, state and local agencies to remove trees that have fallen during a windstorm to mitigate fire hazards, which could be used in fish enhancement projects.

Coordinating Organization: Emergency Management
Internal Partner: Operations, Juvenile Department
External Partners: Cities, Utilities, FEMA, USFS, ODFW, DSL,
BLM, ODOT, ODF
Timeline: On-going
Plan Goals Addressed: Preventative; Natural Resources Utilization

LT-WS #10: Increase and maintain public awareness of severe windstorms and the benefits of mitigation activities through education aimed at households and businesses and increase targeting of special needs populations.

Ideas for Implementation

- Collect additional information and add to existing informational sources on public education materials for protecting life, property, and the environment from windstorm events;

- Distribute educational materials to county residents and public and private sector organizations regarding evacuation routes during road closures;
- Distribute audience-specific educational materials to schools, churches, and other public and private sector organizations;
- Develop methods of improving emergency warning system;

Coordinating Organization: Emergency Management
 Internal Partners: Planning, Operations
 External Partners: Utilities, Cities, American Red Cross, St. Vincent DePaul, Churches, Oregon Voluntary Organizations Active in Disaster, Amateur Radio (Ham) Operators, Marion Fire Defense Board

Timeline: On-going

Plan Goals Addressed: Public Awareness; Preventative; Partnerships and Coordination

Windstorm Resource Directory

State Resources

Oregon Department of Consumer and Business Services

The Building Codes Division of Oregon's Department of Consumer and Business Services is responsible for administering statewide building codes. Its responsibilities include adoption of statewide construction standards that help create disaster-resistant buildings, particularly for flood, wildfire, wind, foundation stability, and seismic hazards.

Contact: Building Codes Division

Address: 1535 Edgewater St. NW, P.O. Box 14470, Salem, OR 97309

Phone: 503-373-4133

Fax: 503-378-2322

Website: <http://www.cbs.state.or.us/external/bcd>

Oregon Climate Service

The Oregon Climate Service collects, manages, and maintains Oregon weather and climate data. OCS provides weather and climate information to those within and outside the state of Oregon and educates the citizens of Oregon on current and emerging climate issues. OCS also performs independent research related to weather and climate issues.

Contact: Oregon Climate Service

Address: Oregon State University
 Strand Ag Hall Room 326, Corvallis, OR 97331-2209

Phone: 541-737-5705

Website: <http://www.ocs.orst.edu/>

Email: oregon@coas.oregonstate.edu

Oregon State Police (OSP)-Office of Emergency Management (OEM)

The purpose of OEM is to execute the Governor's responsibilities to maintain an emergency services system as prescribed in Oregon Revised Statutes Chapter 401 by planning, preparing, and providing for the prevention, mitigation, and management of emergencies or disasters that present a threat to the lives and property of citizens of and visitors to the state of Oregon.

Contact: Office of Emergency Management
Address: 3225 State Street, Salem, OR 97301
Phone: 503-378-2911
Fax: 503-373-7833
Website: <http://www.osp.state.or.us/oem>

Federal Resources

Federal Emergency Management Agency (FEMA)

FEMA's mission is "to reduce loss of life and property and protect our nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery." FEMA Region X serves the northwestern states of Alaska, Idaho, Oregon, and Washington.

Contact: FEMA, Federal Regional Center, Region 10
Address: 130-228 St. SW, Bothell, WA 98021-9796
Phone: 425-487-4678
Website: <http://www.fema.gov/regions/x/regx.shtm>

National Weather Service, Portland Bureau

The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters, and ocean areas for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure, which can be used by other governmental agencies, the private sector, the public, and the global community.

Contact: National Weather Service
Address: 5241 NE 122nd Ave, Portland, Oregon 97230
Phone: 503-326-2340
Website: <http://nimbo.wrh.noaa.gov/Portland>

National Oceanic and Atmospheric Administration (NOAA)

NOAA's historical role has been to predict environmental changes, protect life and property, provide decision makers with reliable scientific information, and foster global environmental stewardship.

Contact: National Oceanic and Atmospheric Administration

Address: 14th Street & Constitution Avenue, NW, Room 6217, Washington, DC 20230
Phone: 202-482-6090
Fax: 202-482-3154
Website: <http://www.noaa.gov>
Email: answers@noaa.gov

Additional Resources

American Red Cross

The American Red Cross is a humanitarian organization, led by volunteers, that provides relief to victims of disasters and helps people prevent, prepare for, and respond to emergencies. The Willamette chapter serves the residents of Marion and Polk counties. The Willamette Chapter provides a variety of community services which are consistent with the Red Cross mission and meet the specific needs of this area, including disaster planning, preparedness, and education.

Contact: American Red Cross, Willamette Chapter
Address: 675 Orchard Heights Rd NW, Suite 200 Salem, OR
Phone: 503-585-5414
Fax: 503-362-3904
Website: <http://www.redcross-salem.org/>
Email: rc@redcross-salem.org

Institute for Business & Home Safety (IBHS)

IBHS was created as an initiative of the insurance industry to reduce damage and losses caused by natural disasters. Their website provides educational resources and on-line publications for insurers, businesses, and homeowners who are interested in taking the initiative to minimize future damages and losses.

Contact: Institute for Business and Home Safety
Address: 1408 North Westshore Boulevard - Suite 208 - Tampa, FL 33607
Phone: 813-286-3400
Fax: 813-286-9960
E-mail: info@ibhs.org
Website: <http://www.ibhs.org/>

Publications

Public Assistance Debris Management Guide. Federal Emergency Management Agency. July 2000.

The *Debris Management Guide* was developed to assist local officials in planning, mobilizing, organizing, and controlling large-scale debris clearance, removal, and disposal operations. Debris management is generally associated with post-disaster recovery. While it should be compliant with local and county emergency operations plans, developing strategies to ensure strong debris management is a way to integrate debris management within mitigation activities. *Public*

Assistance Debris Management Guide is available in hard copy or on the FEMA website.

Contact: FEMA Distribution Center
Address: 130 - 228th Street, SW, Bothell, WA 98021-9796
Phone: 800-480-2520
Fax: 425-487-4622
Website: <http://www.fema.gov/rrr/pa/dmgtoc.shtm>

¹ United States. Office of the President. *Presidential Declaration of a Major Disaster for the State of Oregon* (FEMA-1405-DR), dated March 12, 2002, and related determinations. The counties declared: Coos, Curry, Douglas, Lane, and Linn.

² *Oregon Statesman*. April 22, 1931.

³ *Oregon Statesman*. April 23, 24 1931.

⁴ *Oregon Statesman*. December 5, 1951.

⁵ National Weather Service, Portland Bureau. Available on the World Wide Web <http://www.wrh.noaa.gov/Portland>. Accessed February 2002.

⁶ Id.

⁷ Id.

⁸ *Oregon Statesman*. October 14, 1962.

⁹ *Oregon Statesman*. October 15, 1962.

¹⁰ *Oregon Statesman*. March 27, 1971.

¹¹ *Statesman Journal*. November 15, 1981.

¹² Taylor, George H. and Raymond R. Hatton. 1996. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press. Page 153.

¹³ National Weather Service, Portland Bureau. Available on the World Wide Web <http://www.wrh.noaa.gov/Portland/windstorm.html>. Accessed March 2003.

¹⁴ *Oregon Statesman*. November 15, 1981.

¹⁵ *Oregon Statesman*. November 17, 1981.

¹⁶ *Statesman Journal*. December 12, 1995.

¹⁷ *Statesman Journal*. December 14, 1995.

¹⁸ *Statesman Journal*. December 14, 1995.

¹⁹ Davies, Janet. *The Statesman Journal*. December 13, 1995: page 1A, 2A.

²⁰ *Statesman Journal*. December 13, 1995.

²¹ *Statesman Journal*. February 9, 2002.

²² US Department of Agriculture. Available on the World Wide Web <http://www.fsa.usda.gov/or/Notice/Flp104.pdf>

²³ *Statesman Journal*. February 8, 2002.

-
- ²⁴ National Weather Service, Portland Bureau. Available on the World Wide Web <http://www.wrh.noaa.gov/Portland>. Accessed February 2002.
- ²⁵ Taylor, George H. and Chris Hannan. 1999. *The Climate of Oregon*. Corvallis, OR: Oregon State University Press.
- ²⁶ Taylor, George H., Holly Bohman, and Luke Foster. August 1996. *A History of Tornadoes in Oregon*. Oregon Climate Service. Corvallis, OR: Oregon State University. Available on the World Wide Web <http://www.ocs.orst.edu/pubftp/reports/book/tornado.html>
- ²⁷ Id.
- ²⁸ Id.
- ²⁹ Id.
- ³⁰ Id.
- ³¹ Id.
- ³² Halemeier, Dave. Hydrogeologist, US Forest Service, Willamette National Forest, Detroit Ranger District. Personal Interview. February 3, 2005.
- ³³ Ford, Dave. Public Information Officer, Portland General Electric. Personal Interview. February 3, 2005.
- ³⁴ Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Oregon State Police – Office of Emergency Management.
- ³⁵ Winfrey, Greg. Chief of the Rogue River Rural Fire Protection District. Personal Communication. March 2001.
- ³⁶ Portland General Electric. Information available on the World Wide Web http://www.portlandgeneral.com/safety_and_outage/tree_maint/trees_and_outages.asp. Accessed May 2003.

Section 11: Drought

Why is Drought a Threat to Marion County?	2
Historical Drought Events	2
2005	3
<i>Characteristics of Drought in Oregon</i>	3
Drought Hazard Assessment	4
<i>Hazard Identification</i>	4
<i>Vulnerability and Risk</i>	4
Community Drought Issues.....	5
Mitigation Plan Goals	5
Drought Mitigation Action Items	6
Short-term (ST) Drought Action Items	7
Long-term (LT) Drought Action Items	7
Drought Resource Directory	10
<i>County Resources</i>	10
<i>State Resources</i>	11
<i>Federal Resources</i>	13
<i>Additional Resources</i>	14

Why is Drought a Threat to Marion County?

A drought is a long period of abnormally low precipitation that persists long enough to produce a serious hydrologic imbalance.¹ Drought is a normal part of virtually every climate on the planet, even relatively wet climates. It is the most complex of all natural hazards, and it affects more people than any other hazard. Analysis shows that it can be as expensive as floods and hurricanes.²

The impacts of drought are greater than the impacts of any other natural hazard. They are estimated to be between \$6 billion and \$8 billion annually in the United States and occur primarily in agriculture, transportation, recreation and tourism, forestry, and energy sectors.³ With drought, there is an increase in wildfire potential, and trees are more susceptible to insects like the bark beetle.⁴ Social and environmental impacts are also significant, although it is difficult to quantify these impacts.

Historical Drought Events

Oregon

1928-1941

A significant drought affected all of Oregon from 1928 to 1941. The prolonged statewide drought created significant problems for the agriculture industry. The first of the three Tillamook Forest burns occurred during this drought in 1933.⁵

1985-1994

Although not as severe as the 1976-77 drought in any one year (see below), the cumulative effect of ten dry years caused problems statewide. The peak year was 1992, when the state declared a drought emergency. In the seven-year period from 1986-1992, Medford received only five years' worth of precipitation and other areas of southern Oregon were also significantly affected. Forests throughout Oregon suffered from a lack of moisture with fires common and insect pests flourishing.⁶

2000-2001

Severe drought conditions affected southern, central, and eastern Oregon in response to a larger drought that impacted the western United States. According to the US Department of Agriculture's SNOTEL network, the mid-March 2001 snow pack water equivalents generally ranged from 45 to 75 percent of normal in key watershed areas from the Cascades to the northern Rockies.⁷

In 2001, Governor Kitzhaber declared a drought emergency for 18 counties in southern, central, and eastern Oregon.

The period from October 2000 - February 2001 was the second-driest period during the 106-year period of record in Washington and Oregon.⁸ Washington, Oregon, and Idaho experienced their second-driest March-

February period on record, with a twelve-month precipitation total slightly less than two-thirds of the long-term average.⁹ Only March 1976 to February 1977 was drier in the Northwest.¹⁰

Northwestern Oregon Region

1976-1981

During this drought period in western Oregon, low stream flows prevailed. The period between 1976 and 1977 was the single driest year of the century. The Portland Airport received only 7.19 inches of rain between October 1976 and February 1977.¹¹

In the twelve-month period from September, 1976 through August, 1977, Corvallis received only 22.2 inches of precipitation, 52 percent of the "normal" of 42.7 inches.¹² During the winter of that year, airborne dry ice seeding was used in Polk County as a means of enhancing winter precipitation for agricultural use.

2005

February 2005 is the driest February on record since 1977, surpassing 2001's conditions.¹³ Governor Ted Kulongoski's Office posted a State of Oregon Drought and Fire Web page. This page features weekly updates, drought and fire information, and agency links.

With above normal temperatures, and knowing that water will be short this summer, some irrigators are already contacting watermaster offices requesting permission to start irrigation a month early. In the Tualatin Basin the Watermaster reports sections of the Tualatin River, Gales Creek and the East Fork of Dairy Creek were all regulated to protect water rights. This is the first time that regulation has occurred in the pre-irrigation season period prior to May 1. Regulation normally begins in June or early July. Flow in the Tualatin River at Farmington is the lowest for this time of year since the Watermaster started keeping record in 1989. Irrigators are being told that water use outside the conditions of their permits, including time limits or season of use, is not discretionary.

If the current conditions persist, many irrigators will not have sufficient supply for their needs. Public water providers - cities, water districts, and others - will experience some shortages. Low stream flows will also mean problems for fish and other aquatic life. Recreational water users - boaters, fishers, and others - and the state's recreation industry will be impacted by low reservoir levels and low streams and rivers.

Characteristics of Drought in Oregon

Weather Patterns

A drought is a period of drier than normal conditions that results in water-related problems.¹⁴ Drought occurs in virtually all climatic zones, but its characteristics vary significantly from one region to another.¹⁵ Drought is a temporary condition; it differs from aridity,

which is restricted to low rainfall regions and is a permanent feature of climate.¹⁶

In Oregon, drought is often associated with El Niño events. In strong El Niño situations, warmer than normal waters cover nearly all of the eastern and central tropical Pacific.¹⁷ The area of strong convection, which produces large rain clouds, usually shifts eastward as waters in those areas warm.¹⁸ In the western Pacific, easterly trade winds often reverse and blow from the west, reducing ocean temperatures.¹⁹

Warmer temperatures in the central and eastern Pacific cause much greater cloudiness in those regions, while cooler than average temperatures in the western Pacific cause that normally very active area to be less cloudy, with fewer storms and less rainfall.²⁰ Both the polar and subtropical jet streams are changed as well.²¹ The former often dips southward over the North Pacific, and then veers northward into Alaska.²² Although some storms still reach the Northwest, they tend to be less frequent than during average years.²³ This causes the Northwest to be generally drier than average during such an event.

Drought Hazard Assessment

Hazard Identification

The severity of the drought depends upon the degree of moisture deficiency, and the duration and size of the affected area. There are four different ways that drought can be defined:

- Meteorological – a measure of departure of precipitation from normal; due to climatic differences what is considered a drought in one location may not be a drought in another location;
- Agricultural – refers to a situation when the amount of moisture in the soil no longer meets the needs of a particular crop;
- Hydrological – occurs when surface and subsurface water supplies are below normal; and
- Socioeconomic – refers to the situation that occurs when physical water shortage begins to affect people.²⁴

Vulnerability and Risk

A vulnerability assessment that describes the number of lives or amount of property exposed to elements of drought has not yet been conducted for Marion County. Depending on the severity of the drought, however, it poses a risk for agricultural and timber losses, property damage, and disruption of water supplies and availability in urban and rural areas.

Factors included in assessing drought risk include agricultural practices, including crop types and varieties grown, soil types, topography, and water storage capacity. When sufficient data is collected for hazard identification and vulnerability assessment, a risk

analysis can be completed. Insufficient data currently exists to complete a risk analysis.

Community Drought Issues

Life and Property

Many drought-related economic impacts occur in agriculture and related sectors because of the reliance of these sectors on surface and subsurface water supplies. In addition to obvious losses in yields in both crop and livestock production, drought is also associated with increases in insect infestations, plant disease, and wind erosion. The incidence of forest and range fires increases substantially during extended droughts, which in turn places both human and wildlife populations at higher levels of risk.²⁵

Both urban and rural water users are impacted by drought. Based on the severity of the drought, water usage may be limited or curtailed for specific uses to ensure that sufficient water is available to maintain water pressure, firefighting supply, drinking, and sanitation requirements.

Environmental

Environmental losses are the result of damages to plant and animal species, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. Many species, however, will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity of the landscape.²⁶

Mitigation Plan Goals

Plan Goals Addressed

The plan goals addressed help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Goal #1: PUBLIC AWARENESS

Goal Statement: Increase public awareness of natural hazard risks, emergency notification and response, and resources for citizen preparedness.

Goal #2: EDUCATION

Goal Statement: Educate the public on how to prepare to successfully endure a natural disaster with minimal property damage and no loss of life.

Goal #3: PREVENTATIVE

Goal Statement: Minimize risks to life, property, the environment, and the economy from natural hazards.

Goal #4: FUNDING AND IMPLEMENTATION

Goal Statement: Identify potential funding sources and implement potential mitigation projects.

Goal #5: PARTNERSHIPS AND COORDINATION

Goal Statements:

- Create and enhance partnerships with other stakeholders involved with natural hazard management.
- Coordinate natural hazard mitigation efforts with adjacent jurisdictions and public/private agencies' risk management activities.

Goal #6: NATURAL RESOURCES UTILIZATION

Goal Statement: Promote the use of natural systems and features, watershed planning, and land use planning for natural hazard mitigation whenever possible to reduce long-term costs to the county and maximize effectiveness.

Goal #7: EMERGENCY SERVICES

Goal Statement: Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Drought Mitigation Action Items

The following mitigation action items were formulated through researching regional mitigation plans, and natural hazards planning literature, and interviews with local stakeholders. Plan action items were refined through discussions with the mitigation plan steering committee and through an open house that presented the proposed action items to the public.

The drought action items provide direction on specific activities that organizations and residents in Marion County can undertake to reduce risk and prevent loss from drought. Each action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk from drought impacts in Marion County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Drought Action Items

Short-term drought action items include general mitigation activities that agencies are capable of implementing during the next two years, given their existing resources and authorities.

ST-D #1: Support the technical services provided by county-based agencies on effective methods of water use curtailment.

Ideas for Implementation

- Support Marion Soil & Water Conservation District (SWCD), Natural Resources Conservation Service (NRCS) and area watershed councils when they provide technical services for local landowners on ways to reduce water use during drought emergencies, including voluntary and enforced methods, no outside use of water (residential), mandatory reductions of certain uses, etc.; and
- Consider adoption of building codes that specify water conservation measures e.g., low-flow appliances.

Coordinating Organizations: Marion SWCD, Watershed Councils, OSU Extension Service, NRCS
Internal Partners: Planning, CAO
External Partners: Oregon Association of Water Utilities (OAWU)
Timeline: 2 years; on-going
Plan Goals Addressed: Public Awareness; Partnerships and Coordination

Long-term (LT) Drought Action Items

Long-term drought action items include general mitigation activities that are likely to take more than two years to implement and may require new or additional resources and/or authorities.

LT-D #1: Support local agencies' training on water conservation measures for farmers and ranchers, including drought management practices for crops and livestock.

Ideas for Implementation

- In cooperation with OSU Extension Service and agricultural organizations prominent and respected within the farming and ranching community, build on existing outreach methods with the goal of providing water conservation/drought management training to farmers and ranchers.

Coordinating Organization: OSU Extension
Internal Partners: Planning Division, Emergency Management
External Partners: Marion SWCD, NRCS, Watershed Councils,
Farm Bureau, ODA, WRD, ODFW, OAWU
Timeline: On-going
Plan Goals Addressed: Public Awareness; Preventative;
Partnerships and Coordination; Natural
Resources Utilization

LT-D #2: Support the technical service and low-interest loans provided to farmers and ranchers so that they can develop livestock watering systems.

Note:

- Livestock watering systems provide additional options for farmers and ranchers to provide drinking water, and can sometimes also improve riparian habitat. Systems can be divided into three types:
 - controlled access (to a river or stream);
 - gravity flow; and
 - pressure systems run by pumps, which are sometimes powered by wind or solar electricity.

Coordinating Organization: Marion SWCD
Internal Partner: Planning Division
External Partners: ODA, WRD, OECDD, DEQ, ODFW, NRCS,
OSU Extension Service; Watershed Councils
Timeline: On-going
Plan Goals Addressed: Education; Preventative; Funding and
Implementation; Natural Resources
Utilization

LT-D #3: Encourage storage of water, especially off-stream storage.

Ideas for Implementation

- Encourage storage facilities where they are needed and where they are feasible to construct e.g., very high in drainage basins so that the impact to anadromous fish would be minimal;
- Support Marion SWCD, NRCS and area watershed councils when they provide technical services for local landowners on ways to reduce water use during drought emergencies, including voluntary and enforced methods, no outside use of water (residential), mandatory reductions of certain uses, etc.
- Support land management practices that slow down or prevent runoff i.e., retains water in the watershed such as creation of wetlands, catchment depressions, diversion dikes, or terraces.

Coordinating Organization:	Public Works
Internal Partners:	GIS, Planning Division
External Partners:	OSU Extension Service, Watershed Councils, NRCS, SWCD, ODA, WRD, DSL, ODFW, DEQ
Timeline:	On-going
Plan Goals Addressed:	Preventative; Partnerships and Coordination; Natural Resources Utilization

LT-D #4: Support agencies' determination of locations for additional aquifer studies that might lead to greater water supplies and help determine funding sources for the studies.

NOTE: Studying aquifers may reveal under-utilized water resources and other information useful to water managers.

Ideas for Implementation

- Assist in the determination of which aquifers in the county would benefit by detailed studies and also assist in the determination of how these studies can be funded.

Coordinating Organization:	Public Works
Internal Partners:	Planning, GIS
External Partners:	Marion SWCD, WRD, ODA, DEQ, ODFW, OECDD, DOGAMI, DLCDD, Watershed Councils
Timeline:	3 to 5 years
Plan Goals Addressed:	Preventative; Partnerships and Coordination

Drought Resource Directory

County Resources

Marion Soil and Water Conservation District (Marion SWCD)

The staff employed by the Marion SWCD provides technical assistance to landowners and operators regarding soil and water quality issues on their land. The staff also provides education and outreach on various natural resource issues and topics. The mission of the Marion SWCD is to provide for the conservation of the renewable natural resources of Marion County through control and prevention of soil erosion, degradation of water quality, and flooding; conservation and development of natural resources, water resources, natural beauty, and recreation; and the promotion of the health, safety, and general welfare of the people of Marion County, Oregon.

Contact: Marion Soil and Water Conservation District
Address: 3867 Wolverine Street NE, Suite 16, Salem, OR 97305
Phone: 503-399-5741 ext. 101
Fax: 503-399-5799

State Resources

Oregon Drought Council

Drought Council is responsible for assessing the impact of drought conditions and making recommendations to the Governor's senior advisors. Drought Council is chaired and facilitated by Oregon Emergency Management. The goal of the Drought Council is to "strive to reduce the effects of an impending drought through a coordinated federal, state, local, and voluntary effort, consisting of the development of drought plans, policies, and procedures, and through coordinated state response."

Contact: Oregon Drought Council - Oregon Emergency Management
Address: 3225 State Street, P.O. Box 14370, Salem, OR 97301
Phone: 503-378-2911

Water Availability Committee

The Water Availability Committee monitors conditions throughout the state and report these conditions monthly. The Committee advises the Drought Council, and is chaired by the Oregon Water Resource Department. Committee members include representatives from the National Weather Service, NW River Forecast Center, NRCS, US Geological Survey, State Climatologist, and Oregon Department of Forestry. The primary responsibility of the Water Availability Committee is to determine the appropriate Oregon Drought Severity Index for locations throughout the state.

Contact: Oregon Water Resources Department
Address: 725 Summer Street NE, Suite A, Salem, OR 97301
Phone: 503-986-0900
Fax: 503-986-0903

Oregon Department of Agriculture (ODA)

ODA has a three-fold mission: food safety and consumer protection; protecting the natural resource base; and marketing agricultural products. The Natural Resources Division's mission is to conserve, protect, and develop natural resources on public and private lands so agriculture will continue to be productive and economically viable in Oregon. Primary program areas include: water quality, confined animal feeding operations, smoke management, land use, soil & water conservation districts, and plant conservation biology.

Contact: Oregon Department of Agriculture
Address: 635 Capitol Street NE, Salem, OR 97301-2532
Phone: 503-986-4550
Fax: 503-986-4747
E-Mail: info@oda.state.or.us
Website: <http://www.oregon.gov/oda>

Oregon Water Resources (WRD)

The Water Resources Department's role during a drought is one of overseeing a managed, responsible use of Oregon's water according to the water rights in place. Water Resources has three primary mechanisms to help individuals and communities cope with drought: emergency water use permits, temporary transfers of water rights, and use of existing right Option/Agreement. In counties where the Governor has declared a drought, residents may apply for emergency use permits. This means that a person in the county may apply to the Department for a permit to use water that they otherwise would not have right to. The permitting process for these counties is expedited in order to provide the use as soon as possible, if there is water available. The permit, however, is only valid for the extent of the drought and no longer than one year. Once the Governor undeclares the drought in the county, the emergency permits immediately become invalid. Additionally, due to the expedited review of the permits, potential for unseen harm to other users may be found later. In cases such as that, the emergency use permit may be suspended or rescinded immediately.

Contact: Northwest Region Manager,
Oregon Water Resources Department
Address: 725 Summer St NE, Suite A, Salem, Oregon 97301-1271
Phone: 503-986-0900
Fax: 503-986-0903
Website: <http://oregon.gov/OWRD/offices.shtml>

Oregon Water Resources Department (WRD) – Watermasters

The Oregon Water Resources Department has 20 watermaster offices statewide. Marion County is District 16. A watermaster's job, during the summer months, is to regulate the use of water among all the users. Regulation is done according to the date of priority - or the date an irrigator originally was granted the authority to use water. Some priority dates go back into the middle 1800's and some dates are as recent as this year. Irrigators with the oldest priority dates get their water first, and if there is water left over the younger priority dates are allowed to have water. In 2005, in many locations, only irrigators with the earliest priority dates will have sufficient water to meet their needs.

Contact: Bill Ferber, District 15 Watermaster,
Oregon Water Resources Department
Address: 725 Summer St NE, Suite A, Salem, Oregon 97301-1271
Phone: 503-986-0892
Fax: 503-986-0903
Website: <http://oregon.gov/OWRD/offices.shtml>

Oregon Climate Service

The Oregon Climate Service (OCS) collects, manages, and maintains Oregon weather and climate data. OCS provides weather and climate information to those within and outside the state of Oregon and educates the citizens of Oregon on current and emerging climate issues.

OCS also performs independent research related to weather and climate issues.

Contact: Oregon Climate Service
Address: Oregon State University
Strand Ag Hall Room 326 Corvallis, OR 97331-2209
Phone: 541-737-5705
Fax: 541-737-5710
Website: <http://www.ocs.orst.edu>
Email: oregon@coas.oregonstate.edu

Federal Resources

National Oceanic and Atmospheric Administration (NOAA)

NOAA's historical role has been to predict environmental changes, protect life and property, provide decision makers with reliable scientific information, and foster global environmental stewardship.

Contact: National Oceanic and Atmospheric Administration
Address: 14th Street & Constitution Avenue, NW, Room 6217, Washington, DC 20230
Phone: 202-482-6090
Fax: 202-482-3154
Website: <http://www.drought.noaa.gov>
Email: answers@noaa.gov

National Drought Mitigation Center

The National Drought Mitigation Center (NDMC), part of a federally coordinated effort to monitor droughts, helps people and institutions develop and implement measures to reduce societal vulnerability to drought, stressing preparedness and risk management. Most of the NDMC's services are directed to state, federal, regional, and tribal governments that are involved in drought and water supply planning.

Contact: National Drought Mitigation Center
Address: University of Nebraska–Lincoln
239 L.W. Chase Hall
P.O. Box 830749
Lincoln, NE 68583–0749
Phone: 402-472–6707
Fax: 402-472–6614
Website: <http://www.drought.unl.edu/index.htm>
Email: ndmc@drought.unl.edu

National Weather Service, Portland Bureau

The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure, which can be used by other governmental agencies, the private sector, the public, and the global community.

Contact: National Weather Service
Address: 5241 NE 122nd Ave, Portland, Oregon 97230-1809
Phone: 503-326-2340
Website: <http://nimbo.wrh.noaa.gov/Portland>

Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) provides assistance to owners of America's private land with conserving their soil, water, and other natural resources. Local, state and federal agencies and policymakers also rely on their expertise. The NRCS delivers technical assistance based on sound science suited to a customer's specific needs. Cost shares and financial incentives are available in some cases. Most work is done with local partners. The NRCS creates a monthly Surface Water Supply Index map that represents an index of factors like snowpack, reservoir levels, and precipitation and streamflow rates. The information is reflected as an indexed number to represent the availability of surface water in areas defined by NRCS. This map is called the [Surface Water Supply Index \(SWSI\)](#) and provides a quick overview of the surface water availability across Oregon.

Contact: Salem Service Center – NRCS
Address: 3867 Wolverine Street NE, Suite 16, Salem, Oregon 97305-4267
Phone: 503-399-5741
Fax: 503-399-5799
Website: <http://www.or.nrcs.usda.gov/contact/marion.html>

Additional Resources

Washington State University Extension Drought Alert

Access WSU Extension publications and news releases about drought concerns and issues, a list of experts on related subjects, and a list of useful links from other organizations and agencies.

Contact: Washington State University Extension Drought Alert
Address: 534 East Trent, PO Box 1495, Washington State University
Spokane, WA, 99210-1495
Phone: 509-358-7960
Website: <http://drought.wsu.edu/>

¹ Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Oregon State Police – Office of Emergency Management. Salem, OR.

² National Drought Mitigation Center

³ Id.

⁴ Halemeier, David. Park Ranger, USFS Willamette National Forest, Detroit Ranger Station. Personal Interview. November 16, 2004.

-
- ⁵ Taylor, George H. and Chris Hannan. 1999. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press.
- ⁶ Id.
- ⁷ National Drought Mitigation Center.
- ⁸ Id.
- ⁹ Id.
- ¹⁰ Id.
- ¹¹ Id.
- ¹² Taylor, George. "Weather Matters." *Mid-Valley Sunday*. January 9, 2000.
- ¹³ "Willamette Valley Reservoirs Succumb to Dry Weather." US Army Corps of Engineers Press Release. March 9, 2005. KATU 2 News. Available on the World Wide Web <http://www.katu.com/printstory.asp?ID=7552>
- ¹⁴ Moreland, A. 1993. Open-File Report 93-642. USGS.
- ¹⁵ National Drought Mitigation Center.
- ¹⁶ Id.
- ¹⁷ George H. Taylor. March 1998. *Impacts of the El Southern/Southern Oscillation on the Pacific Northwest*.
- ¹⁸ Id.
- ¹⁹ Id.
- ²⁰ Id.
- ²¹ Id.
- ²² Id.
- ²³ Id.
- ²⁴ Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan*. Oregon State Police – Office of Emergency Management. Salem, OR.
- ²⁵ National Drought Mitigation Center
- ²⁶ Id.

Section 12: Earthquake

Why are Earthquakes a threat to Marion County?	2
<i>Historical Earthquake Events</i>	<i>3</i>
<i>Causes and Characteristics of Earthquake in Marion County</i>	<i>7</i>
<i>Earthquake Related Hazards</i>	<i>9</i>
Earthquake Hazard Assessment	10
<i>Hazard Identification</i>	<i>10</i>
<i>Vulnerability Assessment</i>	<i>11</i>
<i>Risk Analysis</i>	<i>11</i>
Community Earthquake Issues	13
Existing Mitigation Activities	15
Earthquake Mitigation Action Items	17
Earthquake Resource Directory	23
<i>County Resources</i>	<i>23</i>
<i>State Resources</i>	<i>23</i>
<i>Federal Resources</i>	<i>25</i>
<i>Additional Resources</i>	<i>28</i>

Why are Earthquakes a threat to Marion County?

Social and geological records show that Oregon has a history of seismic events. Oregon has experienced damaging earthquakes in the historic past, and geologic evidence indicates that because of our increasing population and development, we may expect earthquakes with even greater damage potential to occur in the future. The highest probabilities of experiencing an earthquake are in western Oregon, although the entire state is susceptible.

Recent research suggests that the Cascadia Subduction Zone is capable of producing magnitude 9 earthquakes. Also, Marion County has the Mount Angel Fault running through its borders, which adds to the potential of future earthquakes. The fault runs past Woodburn, Mount Angel and Silverton before vanishing into the Waldo Hills, on the Willamette Valley's eastern fringe.¹ It is possible that this same fault line that runs near the Little North Santiam River.²

Earthquakes pose a serious threat to many Oregon communities. Local governments, planners, and engineers must consider the threat as they seek to balance development and risk. Identifying locations susceptible to seismic activity generated by local faults or the Cascadia Subduction Zone, adopting strong policies and implementing measures, and using other mitigation techniques are essential to reducing risk from seismic hazards in Marion County.³

The most recent significant earthquake event affecting Marion County was the February 28, 2001 Nisqually earthquake. The epicenter of the 6.8-magnitude earthquake was near Anderson Island in Pierce County, Washington, and shook western Washington and areas of western Oregon. Residents in the surrounding area, including Marion County felt the tremor. While the impacts of this quake were not severe in Oregon, the economic losses in Washington are estimated at \$1 to \$2 billion. Oregon ranks third in the nation for projections of future earthquake damage estimates. Projected losses in the Cascadia region alone could exceed \$12 billion, with over 30,000 destroyed buildings, and 8,000 lives lost in the event of a magnitude 8.5 Cascadia Subduction Zone earthquake.⁴

Most of the earthquake mapping and mitigation efforts made in Oregon have been accomplished in the past two decades, and public awareness has risen remarkably during this time. Major federal, state, and local government agencies and private organizations support earthquake risk reduction, and have made significant contributions in reducing the adverse impacts of earthquakes. Despite the progress, the majority of Oregon communities remain unprepared because there is a general lack of understanding regarding earthquake hazards among Oregonians.⁵

To better understand the earthquake hazard, the scientific community has looked at historical records and accelerated research on crustal

faults, which are among the sources of the earthquakes occurring in the Marion County region. Historical earthquake records can generally be divided into records of the pre-instrumental period and the instrumental period. In the absence of instrumentation, the detection of earthquakes is based on observations and felt reports, and is dependent upon population density and distribution. Since Oregon was sparsely populated in the 1800s, the detection of pre-instrumental earthquakes is quite difficult. Populations in some regions in or near the Willamette Valley and along the Columbia River, however, began growing as early as the 1850s, including Portland (1840), Salem (1844), Hillsboro (1845), Forest Grove (1850), Eugene (1852), McMinnville (1853), and Tillamook (1866). Newspapers from these towns provide a good source of historical documentation of earthquakes of a magnitude five or greater since about 1850.⁶ The seismic risk is more severe today than in the past because population is increasing.

It is imperative that residents of Marion County prepare for earthquakes. It is almost certain that significant loss of life, injuries and property damage will occur during a strong earthquake. The bases for this conclusion are:

- A significant portion of the population, and a large portion of the state government infrastructure is located within an area of greatest hazard; and
- Many of the older buildings as well as utility facilities in the western portions of the state have not been designed to resist earthquake damage.

Historical Earthquake Events

Dating back to 1841, there have been more than 6,000 recorded earthquakes in Oregon, most with a magnitude below three. Marion County has experienced multiple earthquakes of an estimated magnitude of four and greater, with major earthquakes felt in 1941 (magnitude 7.1), 1962 (magnitude 5.2), and 2001 (magnitude 6.8). Figure 10-1 shows the location of selected Pacific Northwest earthquakes that have occurred since 1872.

Although seismograph stations were established as early as 1906 in Seattle and 1944 in Corvallis, improved seismograph coverage of the Marion County region did not begin until 1980, when the University of Washington expanded its regional network into northwestern Oregon.

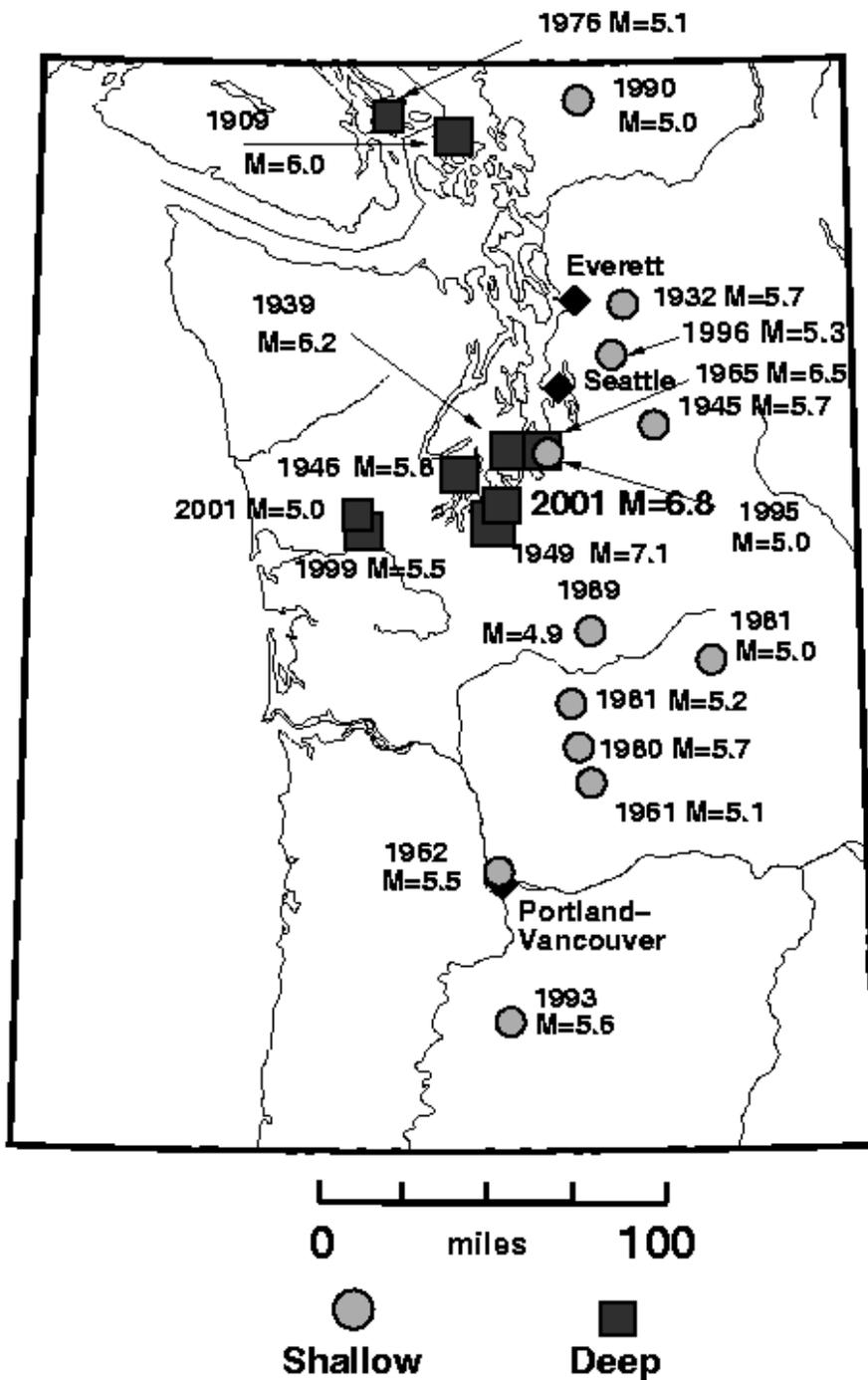
February 28, 2001, Nisqually Earthquake- Magnitude 6.8

The most recent earthquake to be felt in Marion County was the Nisqually earthquake, on February 28, 2001. The earthquake hit at 10:54 a.m. and was centered 35 miles southwest of Seattle.⁷ The quake registered 6.8 on the Richter Scale. In the Puget Sound area, this quake caused 400 injuries, one quake-related death, and about \$2 billion dollars in damage.⁸

While the quake caused little damage in Marion County, it did slow businesses and schools as potential damage was assessed. About 300 Salem City Hall employees went outside after the quake.⁹ About 1,000 employees evacuated the state Department of Human Services building after an employee pulled a fire alarm.¹⁰ Tremors were also felt in the upper floors of the Oregon State Capitol, and legislators and staff said they could feel the building swaying.¹¹ Schools in Marion County also felt the Nisqually Earthquake, although county school districts found little damage. The local schools that reported the strongest tremors were mostly in northern Marion County.¹² St. Paul and North Marion High Schools, both north of Woodburn, briefly evacuated students.¹³

Even though the quake amounted to billions of dollars in damage in Washington, the cost there could have been much higher if not for retrofitting. Officials said millions of dollars spent to remodel buildings and highways to protect against earthquakes had paid off.¹⁴

Figure 10-1. Selected Pacific Northwest Earthquakes since 1872



Source: Pacific Northwest Seismograph Network.
www.geophys.washington.edu/SEIS/PNSN/INFO_GENERAL/hist.html

March 25, 1993, Scotts Mills Earthquake- Magnitude 5.7

The Scotts Mills Earthquake (also known as the “Spring Break Quake”) was centered in Marion County, near the town of Woodburn and Scotts Mills. The quake originated about two miles south of Scotts Mills and twelve to thirteen miles underground. Because of its locality to Marion County, damage was more severe in the county than the Nisqually quake. In Salem, the rotunda of the state Capitol cracked, and the Golden Pioneer statue nearly rocked off its base.¹⁵ In the town of Mount Angel, authorities closed the historic St. Mary Catholic Church for fear its 200-foot bell tower could collapse.¹⁶ Chunks of plaster fell from the walls at the Queen of Angels Monastery.¹⁷

Woodburn felt the strongest effects of the quake. Officials shut down four century-old brick and mortar buildings that began to crumble.¹⁸ At the Wal-Mart store, fumes overcame several employees when pesticides, paints and car batteries mixed.¹⁹

March 7, 1963, Salem, Oregon – Magnitude 4.6

On March 7, 1963, a quake measuring 4.6 on the Richter scale shook Marion County. Despite the low magnitude of the quake, damage still occurred – especially to older masonry buildings. A porch was loosened from its house south of Salem, and three instances of cracked plaster were reported.²⁰ A tremor was felt on the third floor of the Marion County Courthouse.²¹ An employee at Boise Cascade noted, the “office building shook and rattled.”²²

November 5, 1962, Vancouver, Washington- Magnitude 5.2

Three and a half weeks after the devastating Columbus Day Storm, an earthquake that measured approximately 5.2 on the Richter scale shook the Portland area. It was the largest quake to be generated by a fault under Portland and Vancouver.²³ The *Oregon Statesman* reported little damage, although much of Marion County was shaken up. A resident in North Salem said it felt as if somebody was “shaking the house vigorously.”²⁴ Another resident said, “our table began shaking just like I was in a boat.”²⁵

The quake was felt over a wide area of Oregon and Washington. Reports of the earthquake came from Eugene, 110 miles south of Portland, and from Seattle, 135 miles to the north.²⁶ The heaviest damage report came from Tillamook on the Oregon coast where the quake, lasting only a few seconds, cracked open barn walls and broke out windows at a local ranch.²⁷

April 18, 1961, Albany, Oregon – Magnitude 4.5

A quake in April of 1961 caused little damage to the county, but startled many residents. The quake was centered just south of Salem, and registered 4.6 on the Richter scale. Described by most as a double shock, it shook houses, rattled dishes, woke the sleeping and startled the awake.²⁸ Damage was very limited – typical of an earthquake of lower magnitude. Albany reported some cracked plaster.²⁹

April 13, 1949, Olympia, Washington- Magnitude 7.1

On April 13, 1949, Marion County residents felt an earthquake that was centered near Olympia, Washington. In Washington, this quake caused eight deaths. While Marion County was shaken by the quake, damage was minimal, and no deaths occurred.

The quake rocked northwestern Oregon, extending as far south as Eugene, Coos Bay, and Reedsport, and as far east as Prineville and La Grande.³⁰ In downtown Salem and West Salem and in outlying areas buildings trembled, light-fixtures swayed, dishes rattle in cupboards. Most of those who were outside at the time reported no shock.³¹ Workers in the Marion County courthouse said that filing cabinets rocked back and forth.³²

Causes and Characteristics of Earthquake in Marion County

Most large earthquakes in the Pacific Northwest are shallow crustal, deep intraplate, or subduction zone earthquakes. These earthquakes can have great impact on Oregon communities. With its location in the Pacific Northwest, Marion County is susceptible to both intraplate and subduction zone earthquakes. In addition, the Mount Angel Fault, a crustal fault, is located within the county. This fault was attributed with the “Spring Break Quake,” and has the potential of producing more earthquakes.

Crustal Fault Earthquakes

Crustal fault earthquakes are the most common of earthquakes and occur at relatively shallow depths of six to twelve miles below the surface.³³ While most crustal fault earthquakes are smaller than magnitude 4.0 and generally create little or no damage, they can produce earthquakes of magnitudes 7.0 and higher and cause extensive damage. The Mount Angel Fault, a crustal fault located within the county, produced a 5.7 magnitude quake in 1993.

Deep Interplate Earthquakes

Occurring at depths from 25 to 40 miles below the earth’s surface in the subducting oceanic crust, deep intraplate earthquakes can reach magnitude 7.5.³⁴ The February 28, 2001 earthquake in Washington State was a deep intraplate earthquake. It produced a rolling motion that was felt from Vancouver, British Columbia to Coos Bay, Oregon and east to Salt Lake City, Utah. A 1965 magnitude 6.5-intraplate earthquake centered south of Seattle-Tacoma International Airport caused seven deaths.³⁵

Subduction Zone Earthquakes

The Pacific Northwest is located at a convergent plate boundary, where the Juan de Fuca and North American tectonic plates meet. The two plates are converging at a rate of about one to two inches per year. This boundary is called the Cascadia Subduction Zone (see Figure 10-2). It

extends from British Columbia to northern California. Subduction zone earthquakes are caused by the abrupt release of slowly accumulated stress. Subduction zones similar to the Cascadia Subduction Zone have produced earthquakes with magnitudes of 8.0 or larger. Historic subduction zone earthquakes include the 1960 Chile (magnitude 9.5) and the 1964 southern Alaska (magnitude 9.2) earthquakes. Geologic evidence shows that the Cascadia Subduction Zone has generated great earthquakes, most recently about 300 years ago. It is generally accepted to have been magnitude 9.0 or greater. The average recurrence interval of these great Cascadia earthquakes is approximately 500 years, with gaps between events as small as 200 years and as large as 1000 years. Such earthquakes may cause great damage to the coastal area of Oregon as well as inland areas in western Oregon including Marion County. It is estimated that shaking from a large subduction zone earthquake could last up to five minutes.³⁶

Figure 10-2. Cascadia Subduction Zone



Source: Department of Land Conservation and Development.
www.lcd.state.or.us/coast/hazards/juandefuaplates.htm

Earthquake Related Hazards

Ground Shaking

Ground shaking is the motion felt on the earth’s surface caused by seismic waves generated by the earthquake. It is the primary cause of earthquake damage. The strength of ground shaking depends on the magnitude of the earthquake, the type of fault, and distance from the epicenter (where the earthquake originates). Buildings on poorly consolidated and thick soils will typically see more damage than buildings on consolidated soils and bedrock.

Earthquake-Related Landslides

Earthquake-induced landslides are secondary earthquake hazards that occur from ground shaking. They can destroy roads, buildings, utilities, and other critical facilities necessary to respond to and recover from an earthquake. Many communities in Oregon, including those within Marion County, are likely to encounter such risks, especially in areas with steep slopes.

Liquefaction

Liquefaction occurs when ground shaking causes wet granular soils to change from a solid state to a liquid state. This results in the loss of soil strength and the soil's ability to support weight. Buildings and their occupants are at risk when the ground can no longer support these buildings and structures.³⁷ Areas of susceptibility to liquefaction include areas with groundwater tables and sandy soils.³⁸

Amplification

Soils and soft sedimentary rocks near the earth's surface can modify ground shaking caused by earthquakes. One of these modifications is amplification. Amplification increases the magnitude of the seismic waves generated by the earthquake. Amplification depends on the thickness of geologic materials and their physical properties. Buildings and structures built on soft and unconsolidated soils can face greater risk.³⁹ Amplification can also occur in areas with deep sediment filled basins.

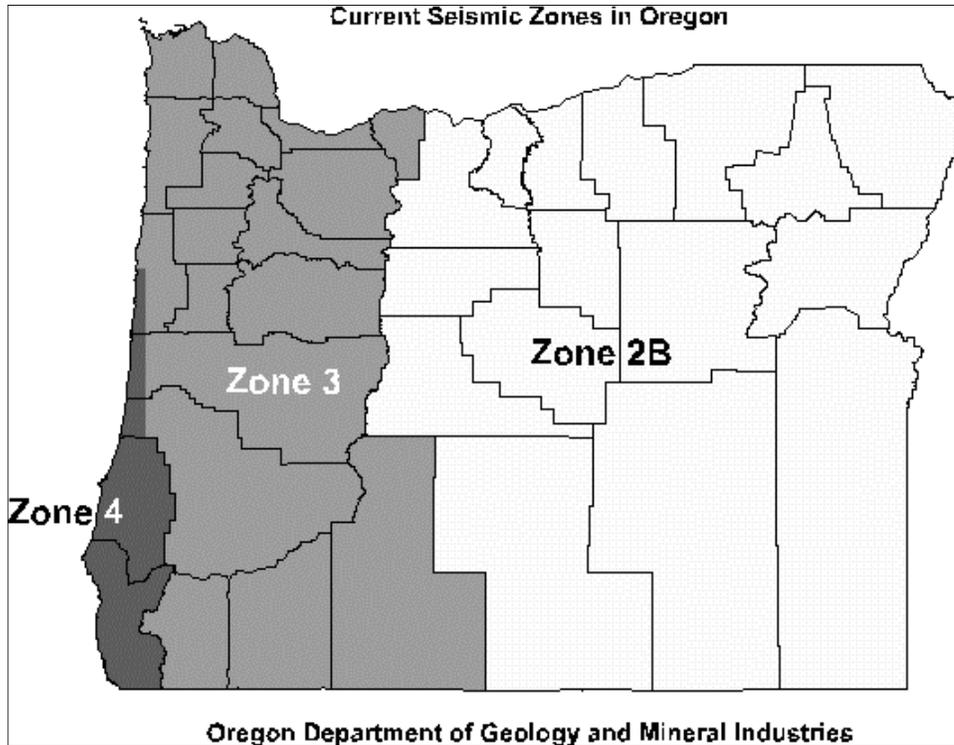
Earthquake Hazard Assessment

Hazard Identification

The Department of Geology and Mineral Industries (DOGAMI), in partnership with other state and federal agencies, has undertaken a rigorous program in Oregon to identify seismic hazards and risks, including active fault identification, bedrock shaking, tsunami inundation zones, ground motion amplification, liquefaction, and earthquake induced landslides. Seismic hazard maps have been published and are available for many communities in Oregon through DOGAMI.⁴⁰

The Oregon Building Codes Division revised and upgraded its construction standards for new buildings to make them resistant to seismic events. The change in State Building Codes reflects updated seismic zones (see Figure 10-3). An increase in zone number reflects increased risk of seismic activity. Many buildings in Marion County were built prior to the imposition of the new seismic zone code requirements, established in 1993.

Figure 10-3. Seismic Zones in Oregon



Vulnerability Assessment

The effects of earthquakes span a large area. The degree to which earthquakes are felt, however, and the damages associated with them may vary. At risk from earthquake damage are large old buildings and bridges, many “high tech” and hazardous material facilities, extensive sewer, water, and natural gas pipelines, petroleum pipelines, and other critical facilities and private property located within the county. The areas that are particularly vulnerable to potential earthquakes in the county have been identified as those areas near the crustal fault lines.

The relative or secondary earthquake hazards, which are liquefaction, ground shaking, amplification, and earthquake-induced landslides, can be just as devastating as the earthquake. DOGAMI is currently conducting research regarding the location and potential damage associated with secondary earthquake hazards.

Risk Analysis

Risk analysis is the third phase of a hazard assessment. Risk analysis involves estimating the damage and costs likely to be experienced in a geographic area over a period of time. Factors included in assessing earthquake risk include population and property distribution in the hazard area, the frequency of earthquake events, landslide susceptibility, buildings, infrastructure and disaster preparedness of

the region. This type of analysis can generate estimates of the damages to the county due to an earthquake event in a specific location. At the time of publication of this plan, data was insufficient to conduct a risk analysis and the software needed to conduct this type of analysis was not available. DOGAMI is leading state initiative in producing earthquake maps and conducting risk analyses of various regions in the state. Map 11 shows the relative earthquake hazard areas within Marion County.

Table 10-1 presents preliminary damage figures for Marion County for both an 8.5 Cascadia subduction zone event and a 500-year event. In this instance, both HAZUS97 and HAZUS99 were used, and compared. HAZUS is a regional earthquake loss estimation model that was developed by the Federal Emergency Management Agency and the National Institute of Building Sciences. The primary purpose of HAZUS is to provide a methodology and software application to develop earthquake losses at a regional scale. Primarily local, state and regional officials to plan and stimulate efforts to reduce risks from earthquakes and to prepare for emergency response and recovery would use these loss estimates.⁴¹ It should be noted that the figures have a high degree of uncertainty and should be used only for general planning purposes.⁴²

Table 10-1. Estimated Earthquake Damage Summary for Marion County

Marion County	8.5 Cascadia Subduction Zone event (HAZUS99 software)	8.5 Cascadia Subduction Zone event (HAZUS97 software)	500-year model (HAZUS99 software)	500-Year model (HAZUS97 software)
Injuries	N/A	499	7,085 (at 2pm)	1,951
Deaths	N/A	9	195	41
Displaced households	N/A	1,241	3814	3,356
Short term shelter needs	N/A	912	2840	2,484
Economic losses for buildings	N/A	776,000,000	2,500,574,000	2,300,000
<i>Operational the day after the quake:</i>				
Fire Stations	N/A	68%	33%	NA
Police stations	N/A	56%	24%	NA
Schools	N/A	64%	26%	NA
Bridges	N/A	81%	88%	NA
<i>Economic losses to:</i>				
Highways	N/A	59,000,000	2,485,000	59,000,000
Airports	N/A	5,000,000	22,840,000	23,000,000
<i>Communication systems:</i>				
Economic losses	N/A	2,000,000	2,713,000	8,000,000
Operating the day of the quake	N/A	62%	28%	NA
Debris generated (Thousands of tons)	N/A	664	1,994,000	1,855

HAZUS97 Source: Wang, Y., and J.L. Clark. "Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses." Special Paper 29, DOGAMI, 1999, page 47. HAZUS99 Source: Reesor, David, and Darienzo, Mark, OEM Office, September 3, 2003.

Community Earthquake Issues

Earthquake damage occurs because structures cannot withstand severe shaking. Buildings, airports, schools, and lifelines, including highways and phone, gas, and water lines suffer damage in earthquakes and can cause death or injury to humans.

The welfare of homes, major businesses, and public infrastructure is very important. Addressing the integrity of buildings, critical facilities, and infrastructure, and understanding the potential costs to government, businesses, and individuals as a result of an earthquake, are challenges faced by Marion County.

Buildings

The built environment is susceptible to damage from earthquakes. Buildings that collapse can trap and bury people, putting lives at risk and creating great costs to clean up the damages. Changes in the seismic zone for the Willamette Valley in 1990 and 1993 lead to increases in the construction standards for buildings in Marion County and the rest of the Willamette Valley. In 1993, the seismic zone for the Willamette Valley was upgraded from 2B to 3, requiring stricter construction standards.

In most Oregon communities, including those within Marion County, many buildings were built before 1993 when building codes were not as strict. Upgrading existing buildings to resist earthquake forces is more expensive than meeting code requirements for new construction. State code requires seismic upgrades only when there is significant structural alteration to the building or where there is a change in use that puts building occupants and the community at a greater risk. Therefore, the number of buildings at risk remains high. The lack of funding for such activity is a major issue. Although coordination among county and city building code officials is in progress, much work remains to be done to identify and plan for the risks to older structures.

Infrastructure and Communication

Residents in Marion County commute frequently by automobile and public transportation such as buses. 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 employees, customers, and suppliers.

Bridge Damage

Even modern bridges can sustain damage during earthquakes, leaving them unsafe for use. Some bridges have failed completely due to strong ground motion. Bridges are a vital transportation link – with even minor damages making some areas inaccessible. Because bridges vary in size, materials, siting, and design, any given earthquake will affect them differently. Bridges built before the mid-1970s have a

significantly higher risk of suffering structural damage during a moderate to large earthquake compared with those built after 1980, which contain structural improvements. It is appropriate to note here that much of the interstate highway system was built in the mid to late 1960's.

With the assistance of federal grants, the City of Keizer replaced the wooden-structure bridge over Chemawa. Once funds are acquired, the city plans to replace a similar bridge, near Dearborn.⁴³

Damage to Lifelines

Lifelines are the connections between communities and outside services. They include water and gas lines, transportation systems, electricity, and communication networks. Ground shaking and amplification can cause pipes to break, 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.

Disruption of Critical Services

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.

Businesses

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.

Individual Preparedness

A 1999 DOGAMI survey shows that about 39 percent of respondents think an earthquake will occur in Oregon within the next ten years. Only 28 percent of Oregon residents say they are prepared for an earthquake, and prior to the Spring Break Quake of 1993, only three percent of Oregon homeowners had earthquake insurance.⁴⁴ About 30 percent of homeowners now have earthquake coverage, according to Insurance Information Services of Oregon and Idaho (IISOI).⁴⁵

The DOGAMI survey also indicated that only 24 percent correctly identified what to do during an earthquake.⁴⁶ Because the potential for earthquake occurrences and earthquake-related property damage is relatively high, increasing individual preparedness is a significant need. Strapping down heavy furniture, water heaters, and expensive personal property as well as being insured for earthquake, are just a few steps individuals can take to prepare for an earthquake.

Death and Injury

Death and injury can occur both inside and outside of buildings due to falling equipment, furniture, debris, and structural materials. Downed power lines and broken water and gas lines can also endanger human life. Deaths can be prevented with proper building design and individual preparedness.

Fire

Downed power lines or broken gas mains can trigger fires. When fire stations suffer structural or lifeline damage, quick response to suppress fires is less likely. It is necessary for fire stations and critical facilities to be well protected from natural disasters.

Debris

Following damage to structures, much time is spent cleaning up brick, glass, wood, steel or concrete building elements, office and home contents, and other materials. Developing strong debris management strategies can assist in post-disaster recovery.

Existing Mitigation Activities

Mitigation through either regulatory or non-regulatory, voluntary strategies allow communities to gain cooperation, educate the public and provide solutions to ensure safety in the event of an earthquake.

Individual Preparedness

At an individual level, preparedness for an earthquake is minimal as perception and awareness of earthquake hazards are low. Strapping down heavy furniture, water heaters and expensive personal property as well as having earthquake insurance is a step towards earthquake mitigation.

Local Programs

Coordination Among Building Code Officials

Larger, incorporated areas in Marion County, such as Salem, Woodburn, Silverton, and Stayton, have a city Building Official, while smaller jurisdictions work directly with the Marion County Building Official. Together, city and county building officials enforce building codes and coordinate efficient inspection routines in the event of an earthquake. Geographic Information Systems (GIS) for Marion County has also mapped a majority of the critical facilities and major public buildings so that inspections of these places can be assigned quickly when an earthquake occurs.

State Programs

April is **Earthquake Awareness Month**. Oregon Emergency Management coordinates activities such as earthquake drills and encourages individuals to strap down computers, heavy furniture and bookshelves in homes and offices.

Schools conduct earthquake drills regularly throughout Oregon and teach students how to respond when an earthquake event occurs.

Insurance Information Service of Oregon and Idaho (IISOI) has a speaker's bureau that visits local communities to discuss loss prevention, insurance information, and effects from other natural hazard events.

Prioritization of Oregon Bridges for Seismic Retrofit

In January 1997, the Oregon Department of Transportation (ODOT), Oregon Local Agencies' Seismic Committee, and CH2Mhill consultants completed a four-year study of seismic vulnerability for Oregon's bridges. From this assessment, Marion County was able to prioritize bridges for seismic retrofit within the county. Bridges that are considered structurally unsafe will be retrofitted or rebuilt to withstand high water flows, landslides and other natural hazards in addition to seismic events. ODOT can be contacted for more information on the bridge inventory.

State Building Codes

The Oregon State Building Codes Division adopts statewide standards for building construction that are administered by the state, cities and counties throughout Oregon. The codes apply to new construction and to the alteration of, or addition to, existing structures. Within these standards are six levels of design and engineering specifications that are applied to areas according to the expected degree of ground motion and site conditions that a given area could experience during an earthquake. The Structural Code requires a site-specific seismic hazard report for projects including critical facilities such as hospitals, fire and police stations, emergency response facilities, and special occupancy structures, such as large schools and prisons.

The seismic hazard report required by the Structural Code for essential facilities and special occupancy structures considers factors such as the seismic zone, soil characteristics including amplification and liquefaction potential, any known faults, and potential landslides. The findings of the seismic hazard report must be considered in the design of the building. The Dwelling Code incorporates prescriptive requirements for foundation reinforcement and framing connections based on the applicable seismic zone for the area. The cost of these requirements is rarely more than a small percentage of the overall cost for a new building.

Requirements for existing buildings vary depending on the type and size of the alteration and whether there is a change in the use of the building that is considered more hazardous. Oregon State Building Codes recognize the difficulty of meeting new construction standards in existing buildings and allow some exception to the general seismic standards. Upgrading existing buildings to resist earthquake forces is more expensive than meeting code requirements for new construction. The state code only requires seismic upgrades when there is significant

structural alteration to the building or where there is a change in use that puts building occupants and the community at greater risk.

Local building officials are responsible for enforcing these codes. Although there is no statewide building code for substandard structures, local communities have the option of adopting a local building code to mitigate hazards in existing buildings. Oregon Revised Statutes allow municipalities to create local programs to require seismic retrofitting of existing buildings within their communities. The building codes do not regulate public utilities or facilities constructed in public right-of-way, such as bridges.

Earthquake Mitigation Action Items

The mitigation action items were formulated through researching regional mitigation plans, and natural hazards planning literature, and interviews with local stakeholders. Plan action items were refined through discussions with the mitigation plan steering committee and through comments received at a public open house.

The earthquake mitigation action items provide direction on specific activities that organizations and residents in Marion County can undertake to reduce risk and prevent loss from earthquakes. Each action item is followed by ideas for implementation, which can be used by the steering committee and local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk from earthquakes in Marion County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Earthquake Action Items

Short-term earthquake action items include general mitigation activities that agencies are capable of implementing during the next two years, given their existing resources and authorities.

ST-EQ #1: Integrate new earthquake hazard mapping data for Marion County as it becomes available and improve technical analysis of earthquake hazards.

Ideas for Implementation

- Map the best available information on the location of fault lines in Marion County, and incorporate into the Natural Hazards Plan;
- Update Marion County earthquake HAZUS data using more localized data; 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 assessing the adequacy of current land use requirements.

Coordinating Organization: GIS, DOGAMI
Internal Partners: Public Works, Planning, Emergency Management
External Partners: OSU, USGS, BLM, MWVCOG, OEM, FEMA
Timeline: 2 years
Plan Goals Addressed: Public Awareness; Education; Preventative; Partnerships and Coordination; Natural Resources Utilization

ST-EQ #2: Encourage reduction of nonstructural and structural earthquake hazards in homes, schools, medical and care facilities, businesses, and government offices.

Ideas for Implementation

- Provide information 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*;
- Encourage homeowners and renters to use *Is Your Home Protected from Earthquake Disaster? A Homeowner's Guide to Earthquake Retrofit* (Institute for Business & Home Safety - IBHS) for economic and efficient mitigation techniques;
- Work with local building supply outlets to feature checklists/retrofit kits for reducing nonstructural risk;
- Explore partnerships to provide retrofitting classes for homeowners, renters, building professionals, and contractors;

- Conduct periodic safety inspections of nonstructural seismic hazards;
- Use home shows to promote nonstructural strategies and mitigation information; and
- Target owners of developments located in potential fault zones or in unstable soils for intensive education and retrofitting resources.

Coordinating Organization: Emergency Management
 Internal Partners: Building, Community Development
 External Partners: City Building Officials, School Districts, Builders' Associations, Institute for Business and Home Safety (IBHS), Red Cross, DOGAMI, Insurance Information Service of Oregon and Idaho (IISOI), Oregon Seismic Safety Policy Advisory Commission (OSSPAC), Marion Fire Defense Board, FEMA, OEM, Residential Care Facilities, Places of Worship (churches, synagogues, etc.)

Timeline: 1 to 2 years, On-going
 Plan Goals Addressed: Preventative; Funding and Implementation; Partnerships and Coordination; Emergency Services

ST-EQ #3: Encourage purchase of earthquake hazard insurance by forming partnerships with the insurance and real estate industries.

Ideas for Implementation

- Provide earthquake insurance information to Marion County residents;
- Coordinate with insurance companies and organizations such as the Insurance Information Service of Oregon and Idaho (IISOI) to produce and distribute earthquake insurance information;
- Make contacts with insurance industry representatives to keep current with their requirements, rates, and plans; and
- Work with real estate industry representatives to educate them about what types of structures are resistant to earthquakes.

Coordinating Organization: Emergency Management
 Internal Partner: Building
 External Partners: IISOI through local Insurance Agencies, Mortgage Companies, Insurance and Real Estate Industries, DOGAMI

Timeline: On-going
 Plan Goals Addressed: Public Awareness; Education; Preventative; Partnerships and Coordination

ST-EQ #4: Maintain an inventory of all permitted dams in Marion County.

Ideas for Implementation

- Explore possibilities to conduct an analysis of the county's larger dams' vulnerability to seismic shakes, as well as an assessment of the possible liquefiable nature of alluvium remaining in dam foundations and the stability of nearby landslides; and
- Update appropriate seismic criteria and procedures for evaluating performance of existing dams (varies within each permitted dam Emergency Action Plan).
 - Susceptibility to damage from flood events
 - Amount of water impounded
 - Type of construction
 - Year completed
 - Repair work performed

Coordinating Organization: Emergency Management
Internal Partner: Public Works
External Partners: Water Masters, Watershed Councils, USACE, WRD
Timeline: 1 to 5 years
Plan Goals Addressed: Public Awareness; Education; Preventative

ST-EQ #5: Update the county's inventory of bridges.

Ideas for Implementation

- Maintain an inspection schedule;
- Indicate which bridges are structurally stable i.e., meet seismic standards; and
- Acquire funding to hire a consultant for seismic determination or to acquire software to enter the data about the bridges' structural integrity.

Coordinating Organization: Emergency Management
Internal Partner: Public Works
External Partners: DOGAMI, OEM, FEMA, ODOT
Timeline: 1 to 2 years
Plan Goals Addressed: Preventative; Emergency Services

Long-term (LT) Earthquake Action Items

Long-term earthquake action items include general mitigation activities that are likely to take more than two years to implement and may require new or additional resources and/or authorities.

LT-EQ #1: Promote and continue building code standards.

Ideas for Implementation

- Continue building code education, promotion, and utilization to ensure earthquake resistant new construction.

Coordinating Organization: Building
Internal Partner: Planning
External Partners: City Planning and Building Departments,
Builders, Developers, Property Owners
Timeline: On-going
Plan Goals Addressed: Public Awareness; Education; Preventative

LT-EQ #2: Encourage seismic strength evaluations of critical facilities in Marion County to identify vulnerabilities for mitigation of schools and universities, public infrastructure, and critical facilities to meet current seismic standards.

Ideas for Implementation

- Explore funding opportunities to develop an inventory of schools, universities, large employers' facilities, marketplaces and critical facilities that do not meet current seismic standards;
- Encourage retrofitting of critical facilities to bring them up to current earthquake standards;
- Encourage owners of non-retrofitted reservoirs to upgrade them to meet seismic standards; and
- Encourage all water providers to replace all old cast iron pipes with more ductile iron, and identify partnership opportunities with other agencies for pipe replacement.

Coordinating Organization: Emergency Management
Internal Partners: Planning Division, Building Division; Public Works
External Partners: City Planning Departments; Water service providers; Oregon Association of Water Utilities (OAWU); School Districts, Hospitals, ODOT, Colleges and Universities;

Timeline: Dam/reservoir owners/managers; Willamette ESD, Oregon Building Codes Division
Plan Goals Addressed: On-going
Public Awareness; Education; Preventative; Partnerships and Coordination; Emergency Services

LT-EQ #3: Encourage utility providers to improve the utilities' survivability in an earthquake.

Ideas for Implementation

- Coordinate utility improvements with companies, cities, and Marion County.

Coordinating Organization: Emergency Management
Internal Partners: Public Works, Building Division
External Partner: City Planning Departments, Utilities
Timeline: On-going
Plan Goals Addressed: Public Awareness; Education; Preventative

LT-EQ #4: Encourage earthquake safety promotion and drills by community groups.

Ideas for Implementation

- Assure that all county residents, regardless of income, disability, or ethnic group, receive information about earthquakes and have the opportunity to mitigate earthquake hazards in their home;
- Conduct safety seminars with community groups to describe earthquake dangers, and steps that can be taken to reduce their impact;
- Develop and distribute educational materials in appropriate languages including: Spanish, Russian, and Vietnamese; and
- Encourage County schools to promote earthquake safety education.

Coordinating Organization: Emergency Management
Internal Partner: Planning
External Partners: DOGAMI, City Planning Departments, School Districts, Willamette ESD, Community Organizations
Timeline: On-going
Plan Goals Addressed: Public Awareness; Education; Preventative; Partnerships and Coordination; Emergency Services

LT-EQ #5: Improve local capabilities to perform earthquake building safety evaluations.

Ideas for Implementation

- Offer training in procedures for earthquake building safety evaluations to CERT volunteers through acknowledged CERT teams throughout Marion County; and
- 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.

Coordinating Organization: Emergency Management
Internal Partners: Building, Marion Fire Defense Board
External Partners: FEMA, OEM, DOGAMI
Timeline: On-going
Plan Goals Addressed: Preventative; Funding and Implementation

Earthquake Resource Directory

County Resources

Marion County Emergency Management

Marion County Emergency Management helps the community be better prepared for major emergencies and disasters. They work closely with cities, emergency responders, and volunteer agencies to find ways to reduce risks and minimize damages during hazard events. When a disaster occurs, they work with these partners in their Emergency Operations Center to coordinate resources and information. Once the event is over, they help bring assistance to those that have been harmed.

Contact: Marion County Emergency Management Coordinator

Address: 5155 Silverton Road, Salem, OR 97305-3899

Phone: 503-365-3133

Email: Emergency@fco.marion.or.us

Website: <http://PublicWorks.co.marion.or.us/EmergencyManagement>

State Resources

Department of Land Conservation and Development (DLCD)

DLCD administers the state's Land Use Planning Program. The program is based on 19 Statewide Planning Goals, including Goal 7, related to natural hazards. In order to help local governments address natural hazards effectively, DLCD provides technical assistance such as conducting workshops, reviewing local land use plan amendments, and working interactively with other agencies.

Contact: Natural Hazards Program Manager
Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540
Phone: 503-373-0050
Fax: 503-378-6033
Website: <http://www.lcd.state.or.us/hazards.html>

Oregon Department of Geology and Mineral Industries (DOGAMI)

The mission of the Department of Geology and Mineral Industries is to serve a broad public by providing a cost-effective source of geologic information for Oregonians and to use that information in partnership to reduce the future loss of life and property due to potentially devastating earthquakes, tsunamis, landslides, floods, and other geologic hazards. The Department has mapped earthquake hazards in most of western Oregon.

Contacts: Deputy State Geologist, Seismic, Tsunami, and Coastal Hazards Team Leaders
Address: 800 NE Oregon St., Suite 965, Portland, Oregon 97232
Phone: 503-731-4100
Fax: 503-731-4066
Email: james.roddey@state.or.us
Website: <http://sarvis.dogami.state.or.us/homepage>

Oregon Department of Consumer & Business Services-Building Codes Division

The Building Codes Division (BCD) sets statewide standards for design, construction, and alteration of buildings that include resistance to seismic forces. BCD is active on several earthquake committees and funds construction related continuing education programs. BCD registers persons qualified to inspect buildings as safe or unsafe to occupy following an earthquake and works with OEM to assign inspection teams where they are needed.

Contact: Building Codes Division
Address: 1535 Edgewater St. NW, P.O. Box 14470, Salem, Oregon 97309-0404
Phone: 503-378-4133
Fax: 503-378-2322
Website: <http://www.cbs.state.or.us/external>

Oregon State Police (OSP)-Office of Emergency Management (OEM)

The purpose of OEM is to execute the Governor's responsibilities to maintain an emergency services system as prescribed in Oregon Revised Statutes Chapter 401 by planning, preparing, and providing for the prevention, mitigation and management of emergencies or disasters that present a threat to the lives and property of citizens of and visitors to the state of Oregon. OEM coordinates disaster support to local governments and works with BCD to deploy additional building inspectors when needed for damage assessment.

Contact: Earthquake and Tsunami Program Coordinator
Address: 3225 State Street, PO Box 14370, Salem, Oregon 97309-5062
Phone: 503-378-2911
Fax: 503-373-7833
Website: <http://www.osp.state.or.us/oem/>

The Nature of the Northwest Information Center

The Oregon Department of Geology and Mineral Industries and the USDA Forest Service operate the Nature of the Northwest Information Center jointly. It offers selections of maps and publications from state, federal, and private agencies. DOGAMI's earthquake hazard maps can be ordered from this site.

Address: Suite 177, 800 NE Oregon Street # 5, Portland, Oregon 97232
Phone: 503-872-2750
Fax: 503-731-4066
Email: Nature.of.NW@state.or.us
Website: <http://www.naturenw.org/geo-earthquakes.htm>

Northwest GeoData Clearinghouse Department of Geology – Portland State University

Portland State University conducts geologic research and prepares inventories and reports for communities throughout Oregon. The Geodata Clearinghouse provided geologic information on earthquakes in the Pacific Northwest. It is especially useful for finding earthquake-related maps or links to geospatial mapping sites around the nation.

Contact: Department of Geology
Address: Portland State University, P.O. Box 751, Portland, OR 97207-0751
Phone: 503-725-3022
Fax: 503-725-3025
Website: <http://www.metro.dst.or.us/metro/growth/gms.html>

Federal Resources

Federal Emergency Management Agency (FEMA)

FEMA is heavily involved with seismic risks in Oregon and has aided in several projects in Portland and Klamath Falls. The Federal Emergency Management Agency (FEMA) is an independent agency of the Federal Government, reporting to the President. FEMA's purpose is to reduce loss of life and property and protect the nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response, and recovery. FEMA coordinates the federal response and provides disaster relief funds following a natural hazard event and works most closely with Oregon Emergency Management (OEM).

Contact: Public Affairs Officer, FEMA, Federal Regional Center,
Address: 130 – 228th Street, St., Bothell, WA 98021-9796
Phone: 425-487-4610
Fax: 425-487-4690
Email: opa@fema.gov
Website: <http://www.fema.gov/library/quakef.htm>

FEMA – National Earthquake Hazards Reduction Program (NEHRP)

FEMA's earthquake program was established in 1977, under the authority of the Earthquake Hazards Reduction Act of 1977, enacted as Public Law 95-124. The purpose of the National Earthquake Hazards Reduction Program (NEHRP) is to reduce the risks of life and property from future earthquakes. FEMA serves as lead agency among the four primary NEHRP federal partners, responsible for planning and coordinating the Program.

Website: <http://www.fema.gov/hazards/earthquakes/nehrrp/>

U.S. Geological Survey (USGS) Earthquake Hazards Program

The Earthquake Hazard Program is part of the USGS effort to reduce earthquake hazard in the United States. The USGS is the only Federal agency with responsibility for recording and reporting earthquake activity nationwide. Citizens, emergency responders, and engineers rely on the USGS for accurate and timely information on where an earthquake occurred, how much the ground shook in different locations, and what the likelihood is of future significant ground shaking.

Contact: Earthquake Hazard Program, USGS
Address: University of Washington, Department of Earth and Space Sciences, Box 351310, Room 63, Seattle, WA 98195-1310
Website: <http://earthquake.usgs.gov/regional/pacnw>

USGS National Earthquake Information Center (NEIC)

The USGS is an active seismic research organization that also provides funding for research. (For an example of such research, see Recommended Seismic Publications below). The mission of the National Earthquake Information Center (NEIC) is to rapidly determine location and size of all destructive earthquakes worldwide and to immediately disseminate this information to concerned national and international agencies, scientists, and the general public. As [World Data Center for Seismology, Denver](#), the NEIC compiles and maintains an extensive, global seismic database on earthquake parameters and their effects that serves as a solid foundation for basic and applied earth science research.

Contact: USGS, National Earthquake Information Center
Address: Box 25046; DFC, MS 967; Denver, Colorado 80225-0046
Phone: 303-273-8500
Fax: 303-273-8450
Website: <http://neic.usgs.gov>

Building Seismic Safety Council (BSSC)

The Building Seismic Safety Council (BSSC), established by the National Institute of Building Sciences (NIBS), deals with complex regulatory, technical, social, and economic issues and develops and promotes building earthquake risk mitigation regulatory provisions for the nation.

Address: 1090 Vermont Avenue, NW, Suite 700, Washington, DC
20005-4905
Phone: 202-289-7800
Fax: 202-289-1092
Website: <http://www.bssconline.org/>

Western States Seismic Policy Council (WSSPC)

The WSSPC is a regional organization that includes representatives of the earthquake programs of thirteen states (Alaska, Arizona, California, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming), three U.S. territories (American Samoa, Commonwealth of the Northern Mariana Islands and Guam), one Canadian Province (British Columbia), and one Canadian Territory (Yukon). The primary aims of the organization have been: to improve public understanding of seismic risk; to improve earthquake preparedness; and, to provide a cooperative forum to enhance transfer of mitigation technologies at the local, state, interstate, and national levels.

The mission of the Council is to provide a forum to advance earthquake hazard reduction programs throughout the western region and to develop, recommend, and present seismic policies and programs through information exchange, research and education.

Contact: WSSPC
Address: 644 Emerson Street, Suite 22, Palo Alto, CA 94301
Phone: 650-330-1101
Fax: 650-330-1973
Email: wsspc@wsspc.com
Website: <http://www.wsspc.org/>

Cascadia Region Earthquake Workgroup (CREW)

CREW provides information on regional earthquake hazards, facts and mitigation strategies for the home and business office. CREW is a coalition of private and public representatives working together to improve the ability of Cascadia Region communities to reduce the effects of earthquake events. Members are from Oregon, Washington, California, and British Columbia. Goals are to:

- Promote efforts to reduce the loss of life and property.
- Conduct education efforts to motivate key decision makers to reduce risks associated with earthquakes.

- Foster productive linkages between scientists, critical infrastructure providers, businesses and governmental agencies in order to improve the viability of communities after an earthquake.

Contact: CREW, Executive Director
Address: 3110 Portage Bay Place E, Slip G, Seattle, WA 98102
Phone: 206-328-2533
Fax: 206-328-2533 (please call first)
Website: <http://www.crew.org/>
Email: bfreitag@mindspring.com

Additional Resources

American Red Cross

The American Red Cross is a humanitarian organization, led by volunteers, that provides relief to victims of disasters and helps people prevent, prepare for, and respond to emergencies. The Willamette chapter serves the residents of Marion and Polk counties. The Willamette Chapter provides a variety of community services which are consistent with the Red Cross mission and meet the specific needs of this area, including disaster planning, preparedness, and education.

Contact: American Red Cross, Willamette Chapter
Address: 675 Orchard Heights Rd NW, Suite 200 Salem, OR
Phone: 503-585-5414
Fax: 503-362-3904
Website: <http://www.redcross-salem.org/>
Email: rc@redcross-salem.org

Publications

Planning for Natural Hazards: The Oregon Technical Resource Guide, Department of Land Conservation and Development (July 2000).

Produced by the Community Planning Workshop for the Department of Land Conservation and Development, this is a natural hazards planning and mitigation resource for Oregon cities and counties. It provides hazard-specific resources and plan evaluation tools. The document was written for local government employees and officials. The Technical Resource Guide includes a natural hazards comprehensive plan review, a hazard mitigation legal issues guide, and five hazard-specific technical resource guides, including: flooding, wildfires, landslides, coastal hazards, and earthquakes. You can write, call, fax, or go on-line to obtain this document.

Contact: Natural Hazards Program Manager, DLCD
Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540
Phone: 503-373-0050
Fax: 503-378-6033
Website: <http://www.lcd.state.or.us/hazards.html>

Environmental, Groundwater and Engineering Geology: Applications for Oregon – Earthquake Risks and Mitigation in Oregon, Yumei Wang, (1998) Oregon Department of Geology and Mineral Industries, Star Publishing.

This paper deals with earthquake risks in Oregon, what is being done today, and what policies and programs are in action to help prevent loss and damage from seismic events. This article also gives a good list of organizations that are doing work in this field within the state. This article is somewhat technical but provides vital information to communities around the state.

Special Paper 29: Earthquake damage in Oregon: Preliminary estimates of future earthquake losses, Yumei Wang, Oregon Department Of Geology And Mineral Industries.

Wang, a geotechnical engineer, analyzed all faults with a ten percent chance of causing an earthquake in the next 50 years and projected potential damage. Wang stresses that these are preliminary figures. "There are two things we could not incorporate into this study that would significantly increase these figures. One is a tsunami. The other is an inventory of unreinforced brick or masonry buildings."

Contact: DOGAMI
Address: 800 NE Oregon St., Suite 965, Portland, Oregon 97232
Phone: 503-731-4100
Fax: 503-731-4066
Website: <http://sarvis.dogami.state.or.us/homepage>

Land Use Planning for Earthquake Hazard Mitigation: A Handbook for Planners, Wolfe, Myer R. et al., (1986) University of Colorado, Institute of Behavioral Science, National Science Foundation.

This handbook provides techniques that planners and others can utilize to help mitigate for seismic hazards. It provides information on the effects of earthquakes, sources on risk assessment, and effects of earthquakes on the built environment. The handbook also gives examples on application and implementation of planning techniques to be used by local communities.

Contact: Natural Hazards Research and Applications Information Center
Address: University of Colorado, 482 UCB, Boulder, CO 80309-0482
Phone: 303-492-6818
Fax: 303-492-2151
Email: hazctr@colorado.edu
Website: <http://www.colorado.edu/UCB/Research/IBS/hazards>

Spangle Associates. *Using Earthquake Hazard Maps: A Guide for Local Governments in the Portland Metropolitan Region: Evaluation of*

Earthquake Hazard Maps for the Portland Metropolitan Region. 1998/1999. Portola Valley, CA: Urban Planning and Research.

These two publications are useful for local governments concerned with land use in earthquake hazard areas. The proximity of Marion County to Portland and their interactive communities make these guides applicable to the county. The publications are written in clear and simplistic language and address issues such as how to apply earthquake hazard maps for land use decisions.

Contact: DOGAMI
Address: 800 NE Oregon St., Suite 965, Portland, Oregon 97232
Phone: 503-731-4100
Fax: 503-731-4066
Website: <http://sarvis.dogami.state.or.us/homepage>

Public Assistance Debris Management Guide. FEMA (July 2000).

The Debris Management Guide was developed to assist local officials in planning, mobilizing, organizing, and controlling large-scale debris clearance, removal, and disposal operations. Debris management is generally associated with post-disaster recovery. Developing strategies to ensure strong debris management is a way to integrate debris management within mitigation activities. The *Public Assistance Debris Management Guide* is available in hard copy or on the FEMA website.

Contact: FEMA Distribution Center
Address: 130 228th Street, SW, Bothell, WA 98021-9796
Phone: 800-480-2520
Fax: 425-487-4622
Website: <http://www.fema.gov/r-n-r/pa/dmgtoc.htm>

¹ *Statesman Journal.* March 26, 1993.

² Halemeier, David. Hydrologist, USDA, USFS, Willamette National Forest, Detroit/Sweet Home Ranger Districts. Personal Interview. November 16, 2004.

³ Interagency Hazard Mitigation Team. 2000. *State Hazard Mitigation Plan.* Oregon State Police – Office of Emergency Management.

⁴ Wang, Yumei and J.L. Clark. 1999. *Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses.* Oregon Department of Geology and Mineral Industries (DOGAMI). Special Paper 29. Portland, OR: DOGAMI.

⁵ “Preparing for Earthquakes in Oregon.” *Oregon Geology.* March/April 1997: Vol. 59. No. 2.

⁶ Bott, Jacqueline D.J. and Ivan G. Wong. “Historical Earthquakes In and Around Portland, Oregon.” *Oregon Geology.* September 1993: 55(5)-116.

-
- ⁷ *Statesman Journal*. March 1, 2001.
- ⁸ Hill, Richard. “Geo Watch Warning Quake Shook Portland 40 Years Ago.” *The Oregonian*. October 30, 2002.
- ⁹ *Statesman Journal*. March 1, 2001.
- ¹⁰ Id.
- ¹¹ Id.
- ¹² Id.
- ¹³ Id.
- ¹⁴ Id.
- ¹⁵ *Statesman Journal*. March 26, 1993.
- ¹⁶ Id.
- ¹⁷ Id.
- ¹⁸ Id.
- ¹⁹ Id.
- ²⁰ *Oregon Statesman*. March 8, 1963.
- ²¹ Id.
- ²² Id.
- ²³ Hill, Richard. “Geo Watch Warning Quake Shook Portland 40 Years Ago.” *The Oregonian*, October 30, 2002
- ²⁴ *Oregon Statesman*. November 6, 1962.
- ²⁵ Id.
- ²⁶ Id.
- ²⁷ Id.
- ²⁸ *Statesman Journal*. August 19, 1961.
- ²⁹ Id.
- ³⁰ *Statesman Journal*. April 13, 1949.
- ³¹ Id.
- ³² Id.
- ³³ Wong, Ivan G and Jacqueline D.J. Bott. November 1995. “A Look Back at Oregon’s Earthquake History, 1841- 1994.” *Oregon Geology* 57 (6): 125.
- ³⁴ Id.
- ³⁵ Hill, Richard. “Geo Watch Warning Quake Shook Portland 40 Years Ago.” *The Oregonian*. October 30, 2002.
- ³⁶ Community Planning Workshop. 2002.

³⁷ *Planning for Natural Hazards: The Oregon Technical Resource Guide*. July 2000. Department of Land Conservation and Development. Ch. 8, page 7.

³⁸ Burns, Scott. Personal Interview. Portland State University, Department of Geology. June 2003.

³⁹ Id.

⁴⁰ *Planning for Natural Hazards: The Oregon Technical Resource Guide*. July 2000. Department of Land Conservation and Development. Ch. 8, page 7.

⁴¹ Oregon Department of Geology & Mineral Industries. *HAZUS-MH: Earthquake Event Report (DRAFT)*. March 14, 2005.

⁴² Wang, Yumei and J.L. Clark. 1999. *Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses*. Oregon Department of Geology and Mineral Industries (DOGAMI). Special Paper 29, page 57. Portland, OR: DOGAMI.

⁴³ Kissler, Rob. City of Keizer Public Works Director. Personal Interview. November 18, 2004.

⁴⁴ Beggs, Charles E. March 21, 2000. "One in Three Homes Insured for Quakes Since Spring Break Shaker." *News-Register*. McMinnville, OR. Available on the World Wide Web http://www.newsregister.com/.../story_print.dfm?story_no=11361. Accessed August 26, 2004.

⁴⁵ Id.

⁴⁶ Id.

Section 13: Volcanic Eruption

Why are Volcanic Eruptions a threat to Marion County?	2
History of Volcanic Eruption Events in the Pacific Northwest	2
History of Volcanic Eruption Events Affecting Marion County	6
Hazards Related to Volcanic Eruptions	7
Volcanic Eruption Hazard Assessment	9
Hazard Identification	9
Vulnerability & Risk Assessment	10
Community Volcanic Eruption Issues.....	10
Existing Mitigation Activities	12
Volcanic Eruption Mitigation Action Items	13
Short-term (ST) Volcano Action Items	14
Long-term (LT) Volcano Action Items	17
Volcanic Eruption Resource Directory	18
County Resources	18
State Resources	19
Federal Resources	19
Additional Resources	21
Publications	22

Why are Volcanic Eruptions a threat to Marion County?

Marion County and the Pacific Northwest lie within 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 produce flying debris and ash clouds. The immediate danger area in a volcanic eruption generally lies within a 20-mile radius of the blast site. Mount Jefferson is located in the southeastern corner of Marion County, increasing the risk to county residents. There are also a number of active volcanoes within the 100-mile danger areas that pose a threat to county residents and property. The threat they pose is associated primarily with ash fall.

Volcanic eruptions affect the value of timber in timber sales. Ash impregnates the bark, and dulls saws.¹ Removing ash from roads is similar to snow removal, except for the need of a place to take the ash since it does not melt.² Tri cities area of Washington incorporated ash into their landfills.

Residents closest to Mount Jefferson, however, are at risk to lahars as well, also called volcanic mudflows or debris flows. Between 1843 and 1860, a series of 21 eruptions took place in the Cascades, and there is speculation that the Northwest may be entering another period of volcanic activity. The southeastern portion of Marion County has an annual probability of one in five thousand for the deposition of ten centimeters (four inches) or more of tephra from any of the major Cascade volcanoes.³

History of Volcanic Eruption Events in the Pacific Northwest

There are seven major volcanoes in the Cascade region that are in relative proximity and pose a potential threat to Marion County (see figure 11-2). They include Mount Jefferson, Mount St. Helens, Mount Hood, Mount Rainier, the Middle and South Sisters, and Broken Top. Of the seven, all are known or suspected to be active and most have geological records that indicate past histories of explosive eruptions with large ash releases. Mount Hood is the only volcano that has no

geological evidence of large explosive events, though it still poses a threat of ash releases.

Three Sisters and Broken Top

The Three Sisters are located about 40 miles southeast of Marion County. Recently, volcanic activity has been found on the South Sister. Recent satellite images have indicated upward movement of land near the volcano. The surface moved toward the satellite (mostly upward) by as much as ten centimeters (about four inches) sometime between August 1996 and October 2000.⁴ The most likely cause is magma accumulation in the Earth's crust, a process that has been observed with radar interferometry at several other volcanoes worldwide.⁵ There is no immediate danger of a volcanic eruption or other hazardous activity.⁶ The potential exists, however, that further activity could increase danger.

South Sister, Middle Sister, and Broken Top, major composite volcanoes clustered near the center of the region, have erupted repeatedly over tens of thousands of years and may erupt explosively in the future. In contrast, mafic volcanoes, which range from small cinder cones to large shield volcanoes like North Sister, are typically short-lived (weeks to centuries) and erupt less explosively than do composite volcanoes.⁷

Mount Hood

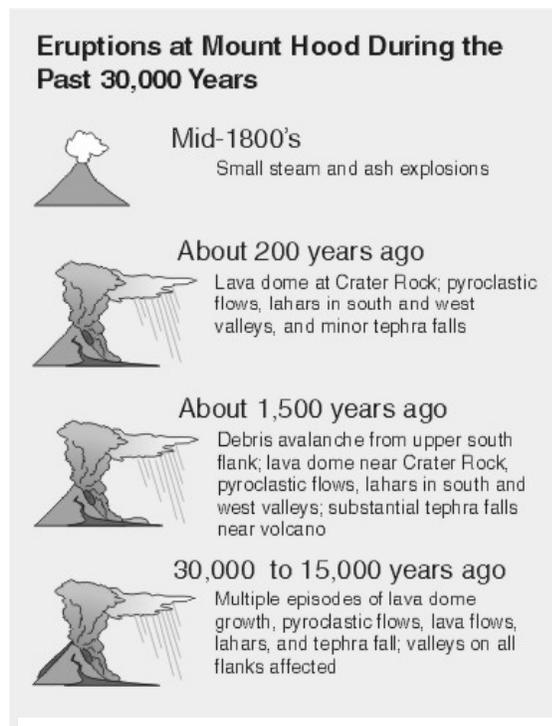
Mount Hood is located about 60 miles northeast of Marion County. It has been recurrently active over the past 50,000 years. It has had two significant eruptive periods in geologically recent times, one about 1,500 years ago and another about 200 years ago. Figure 11-1 shows the major geologic events in the Mount Hood Region during the past 30,000 years.

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 Jefferson

Mount Jefferson is the closest of all the volcanoes to Marion County. In fact, the northwestern edge of the mountain lies within the County.

Figure 11-1. Major Eruptions at Mt. Hood



Source: USGS Cascades Volcano Observatory

Mount Jefferson has erupted repeatedly for hundreds of thousands of years, with its last eruptive episode during the last major glaciation, which culminated about 15,000 years ago. Geologic evidence shows that Mount Jefferson is capable of large explosive eruptions. The largest such eruption occurred between 35,000 and 100,000 years ago, and caused ash to fall as far away as the present-day town of Arco in southeast Idaho. Although there has not been an eruption at Mount Jefferson for some time, experience at explosive volcanoes elsewhere suggests that Mount Jefferson cannot be regarded as extinct. If Mount Jefferson erupts again, areas close to the eruptive vent will be severely affected, and even areas tens of miles downstream along river valleys or hundreds miles downwind may be at risk.⁸

One specific concern to the county if Mount Jefferson is to erupt, is Detroit Lake and Dam. Detroit Lake is a reservoir and popular recreation site impounded behind Detroit Dam, a concrete structure, managed by the US Army Corps of Engineers for flood control. Water level in the lake varies greatly during the year, being highest (and close to capacity) from May through August. Lahars entering the lake have the potential to generate waves that could damage shore property and, in the case of large lahars entering the reservoir, waves that could overtop the dam.⁹

Communities in most danger of lahars and other volcanic hazards from an eruptive Mount Jefferson are Idanha and Detroit. Both lie adjacent to the Santiam River and near Detroit Dam.

Mount Rainier

Mount Rainier is located approximately 100 miles north of Marion County. Mount Rainier stands at 14,410 feet, and dominates the surrounding landscape as the tallest land feature. The primary hazard posed to Marion County is ash fallout from Mount Rainier.

Mount Rainier is an active volcano that first erupted about half a million years ago. Because of Rainier's great height and northerly location, glaciers have cut deeply into its lavas, making it appear deceptively older than it actually is. Mount Rainier is known to have erupted as recently as in the 1840s, and large eruptions took place as recently as about 1,000 and 2,300 years ago.¹⁰

Mount St. Helens

Mount St. Helens, located in southwestern Washington about 70 miles northeast of Marion County, is fifty thousand years old. Over the past 521 years, it has produced four major explosive eruptions and dozens of smaller eruptions. On May 18th, 1980, Mount St. Helens “exploded violently after two months of intense earthquake activity and intermittent, relatively weak eruptions, causing the worst volcanic disaster in the recorded history of the United States.”¹¹

Damage to the built environment within the immediate hazard vicinity in Washington 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.

The May 18, 1980 eruption was preceded by about two months of precursor activity, including dome building, minor earthquakes, and venting of gasses. The lateral blast, debris avalanche, and mudflow associated with the eruptions caused extensive loss of life and widespread destruction of property. The eruption triggered a 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 1980 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.

The May 18, 1980 eruption was followed by five smaller explosive eruptions over a period of five months.¹² A series of sixteen dome-building eruptions constructed the new, 880 foot high, lava dome in the crater formed by the May 18, 1980 eruption. An eruption occurring in 1480 A.D. was approximately five times larger than the May 18, 1980 event.¹³

On the night of March 8, 2005, a plume of ash and steam spewed nearly seven miles high into the air. Glowing tendrils of lava were spotted inside the mountain's crater following the explosion.¹⁴ The plume rose nearly twice as high as one produced by the last eruption in October 2004. Ten small earthquakes were measured in the area on Tuesday leading up to the eruption. The largest appeared to be a magnitude 2.5, according to the USGS.¹⁵

Figure 11-2. Potentially Active Volcanoes in the West



Source: USGS. <http://www.volcano.si.edu/reports/usgs/maps.cfm#usa>

History of Volcanic Eruption Events Affecting Marion County

The only historical incidence of a volcano directly affecting Marion County was the eruption of Mount St. Helens on May 18, 1980. The eruption resulted in massive mudflows, floods and other land-changing forces.¹⁶ A fine coating of volcanic ash covered the Willamette Valley after the eruption, and while it did not cause any major problems directly in Marion County, in Portland the speed limit was cut to 15 mph due to lack of visibility.¹⁷ Volcanic ash affected air filters on the Marion County RFPD No.1's equipment.¹⁸ No Oregon roads were closed, although fallout of volcanic ash restricted visibility and produced slippery roads and ash-clogged windshields.¹⁹

Indirectly, several people from Marion County perished in the eruption, when two members of a logging crew and a young man hiking the mountain were killed.²⁰ A Salem family traveling in Richmond,

Washington and a Woodburn National Guard Unit also experienced the eruption while in Washington. The family describes Richmond as being enveloped in ash clouds that left the city pitch black at 11:00 am, and the acid-sting of ash when it got in someone's eye.²¹ The National Guard unit was training just outside of Yakima, Washington and traveled back to Woodburn in the ash cloud. They described the experience of having to travel at ten miles per hour because of poor visibility, seeing electrical flashes in the clouds of ash, having to wear dust masks, smelling a strange sulfur odor, and observing ash so thick that they had to stop every few miles to clean out the air filters on the trucks.²²

Hazards Related to Volcanic Eruptions

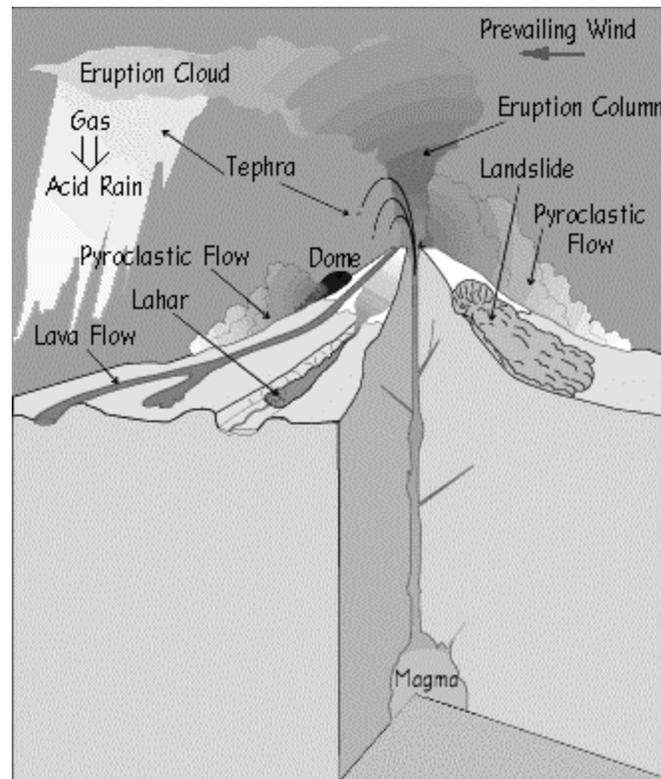
Volcanic hazards may be manifest in several ways – from lava flows and landslides to tephra (volcanic ash deposition). Figure 11-3 shows a cross-section of a volcano and the types of hazards that may be associated with volcanic events.

Tephra

Tephra consists of sand-sized or finer particles of volcanic rock and larger fragments. During explosive eruptions, tephra, together with a mixture of hot volcanic gases, is ejected rapidly into the air from volcanic vents. The suspended materials are carried high into the atmosphere and begin to move downwind. As the ash particles cool or become moisture laden, they start to fall under the influence of gravity. The larger fragments fall near the volcanic vent, while finer particles drift downwind as a large cloud and then fall to the ground to form a blanket-like deposit of ash.

Tephra introduces a number of hazards including the impact of falling fragments, the suspension of abrasive particles in the air and water, and the burial of structures, transportation routes, and vegetation. Tephra can also threaten public health, clog drainage systems, and create major debris management problems. The 1980 eruption of Mount St. Helens, for example, injected tephra to altitudes of twelve to twenty miles and deposited it over an area of 40,000 square miles or more. The direction and velocity of the wind, along with the magnitude and duration of the eruption, determine the location, size, and shape of the tephra fall. Wind forecasts from the National Weather Service and models of ash dispersal developed by volcanologists can provide short-term forecasts for areas that might be subject to ash fall.

Figure 11-3. Cross section of a volcano



Source: USGS. <http://volcanoes.usgs.gov/Hazards/What/hazards.html>

Lahars

Melting snow and ice caused by pyroclastic flows and surges can generate lahars, also called volcanic mudflows or debris flows. Lahars are rapidly flowing, water-saturated mixtures of mud and rock fragments. Lahars range in consistency from mixtures resembling freshly mixed concrete to very muddy water, and can carry materials as large as truck-size boulders. Past lahars at Mount Hood completely buried valley floors in the Sandy, Hood, and White River drainages.

Lava Flows

Magma under the Earth that reaches the surface is called lava. Lava flows downhill and is channeled into river valleys. A lava flow only affects terrain that is down-slope from its vent. While lava flows are destructive, they are not normally life threatening. The most likely instance of a lava flow in Marion County would occur near Mount Jefferson.

Earthquakes

Earthquakes can trigger volcanic eruptions or they can cause them. An earthquake produced by stress changes in solid rock from injection or withdrawal of magma (molten rock) is called a volcano-tectonic earthquake. The other categories of volcanic earthquakes, called long-period earthquakes, are produced by the injection of magma into

surrounding rock. Volcanic earthquakes tend to be mostly small and not a problem for areas tens of miles from the volcano. For specific hazards related to earthquakes, see Section 10 of this document.

Directed Blasts, Pyroclastic Flows and Volcanic Landslides

Directed blasts, also known as lateral blasts, are sideways-directed volcanic explosions that can shoot large pieces of rock at high speeds for several miles.²³ Pyroclastic flows are fluid mixtures of hot rock fragments, ash, and gases that sweep down the flanks of volcanoes. Landslides, or debris avalanches, are a rapid downhill movement of rocky material, snow, or ice.²⁴ These hazards could cause great impact to communities near an erupting volcano. Residents in the southeastern corner of Marion County have a potential risk if these events occur at Mount Jefferson.

A most sensational aspect of a volcanic eruption is the nuée ardente or pyroclastic flow. In this event, superhot, burning gas is suddenly pumped into the air to fall back to earth as a heavy cloud and move across the landscape at hundreds of miles per hour, immolating everything in its path. Even though geologists know pyroclastic flows, they were rarely witnessed and not filmed until the 1980s, when they were captured on videotape in Japan. In 1902, over 30,000 people in the village of St. Pierre on Martinique were incinerated by a pyroclastic flow, and more recently, the island of Monserrat experienced the same phenomenon, fortunately without loss of life. In Oregon, deposits from pyroclastic flows are a frequent part of the geologic record east of the Cascades.²⁵

Volcanic Eruption Hazard Assessment

Hazard Identification

The USGS/Cascades Volcano Observatory (CVO) produced volcanic hazard zonation reports for Mount Hood in 1997 and 2000. The reports include a description of potential hazards that may occur to immediate communities.

The hazard zones illustrated on Map 14 were determined based on the distance from the volcano, vent location, and type of hazardous events. Proximal Hazard Zones 1 and 2 are areas subject to rapidly moving debris avalanches, pyroclastic flows, and lahars that can reach the hazard boundary in less than 30 minutes, as well as slow-moving lava flows. Areas within proximal hazard zones should be evacuated before an eruption begins because there is little time to get people out of harm's way once an eruption starts. Most pyroclastic flows, lava flows, and debris avalanches will stop within the proximal hazard zone, but lahars can travel much farther.

Distal Hazards Zone 3 includes areas adjacent to rivers that are pathways for lahars. Estimated travel time for lahars to reach these zones is more than 30 minutes, which may allow individuals time to move to higher ground and greater safety if given notice. Lahars could

affect transportation corridors by damaging or destroying roads and other infrastructure.

Vulnerability & Risk Assessment

Vulnerability assessment is the second phase of a hazard assessment. It combines information generated through hazard identification with an inventory of the existing development exposed to volcanic eruptions. Vulnerability assessments assist in predicting how different types of property and population groups will be affected by a hazard.²⁶ Data that includes areas susceptible to ash fall in Marion County can be used to assess the population and total value of property at risk from volcanic eruptions events.

While a quantitative vulnerability assessment (an assessment that describes number of lives or amount of property exposed to the hazard) has not yet been conducted for Marion County volcanic eruption events, there are many qualitative factors (issues relating to what is in danger within a community) that point to potential vulnerability. The eastern portion of Marion County faces the greatest threat of volcanic eruption from Mount Jefferson. In addition, its proximity to a number of Cascade Range volcanoes places the county at risk from ash fallout originating from such an event.

Risk analysis is the third, and most advanced phase of a hazard assessment. It builds upon hazard identification and vulnerability assessments. Key factors included in assessing risk from volcanic eruptions and ash fall include population and property distribution in the hazard area, the frequency of events, and potential wind direction. At the time of publication of this plan, data was insufficient to conduct a risk analysis and the software needed to conduct this type of analysis was not available.

Community Volcanic Eruption Issues

Mount Jefferson poses the greatest threat of volcanic eruption to Marion County. Located on the eastern edge of the county, Mount Jefferson presents not only a threat of lahars and lava flows, but also a threat of ash fallout. In addition, the county is located within close proximity of other Cascade volcanoes, which present additional threats of ash fallout. The indirect effects of volcanoes within other counties must be considered as well.

Building and Infrastructure Damage

Ash fall of about 0.4 inch is capable of creating temporary disruptions of transportation operations and sewage disposal and water treatment systems. Highways and roads could be closed for hours, days, or weeks afterwards. The series of eruptions at Mount St. Helens in 1980 caused Interstate 90 from Seattle to Spokane to close for a week. US Highway 26 in Oregon faced similar problems. The impact of the ash fall caused the Portland International Airport to close for a few days. The airport faced a series of challenges in cleaning up the ash that accumulated on its runways.

The fine-grained, gritty ash can also cause substantial problems for internal-combustion engines and other mechanical and electrical equipment. The ash can contaminate oil systems, clog air filters, and scratch moving surfaces. Fine ash can also cause short circuits in electrical transformers, which in turn cause power blackouts.

During an eruption at Mount Hood, Bonneville Power Administration transmission lines may be severed. A number of high voltage lines are located in the immediate vicinity of Mount Hood. These lines provide a portion of the electrical power to Marion County, the Portland Metropolitan Area, and the rest of the Willamette Valley.

Pollution and Visibility

Ash fallout from an eruption column can blanket areas within a few miles of the vent with a thick layer of pumice. High-altitude winds may carry finer ash from tens to hundreds of miles from the volcano, posing a hazard to flying aircraft, particularly those with jet engines.²⁷ Fine ash in water supplies will cause brief muddiness and chemical contamination. Ash suspended in the atmosphere is especially a concern for airports, where aircraft machinery could be damaged or clogged.

Ash fall also decreases visibility and disrupts daily activities. For example, some individuals may experience eye irritation. When the ash fall produced by the Mount St. Helens' eruption started to blow towards Oregon in June 1980, some of the airlines at the Portland International Airport responded immediately by stopping their service.

Economy

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, cause rapid wear of machinery, clog air filters, block drains, creeks, and water intakes, and impact agriculture.²⁸ 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. Roads, railroads, and bridges can be damaged from lahars and mudflows. 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. The eruption did lead, however, to the creation of a thriving tourist industry for decades following event.

Transportation of goods may also be halted. Subsequent airport closures can disrupt airline schedules for travelers. In addition, the movement of goods via the Columbia River and other major waterways can also be halted due to debris in the river, and tephra in the air. The Mount St. Helens event in May 1980 cost the trade and commerce industry an estimated \$50 million in only two days, as ships were

unable to navigate the Columbia.²⁹ Clouds of ash often cause electrical storms that start fires and damp ash can short-circuit electrical systems and disrupt radio communication. Volcanic activity can also lead to the closure of nearby recreation areas as a safety precaution long before the activity ever culminates into an eruption.³⁰

Existing Mitigation Activities

Federal Programs

Monitoring Volcanic Activity at Mount Hood and Mount St. Helens

The USGS collaborated with scientists from the Geophysics Program at the University of Washington to monitor seismic activity at both Mount St. Helens and Mount Hood after the May 1980 eruption at Mount St. Helens. When unusual activity is observed, scientists immediately notify government officials and the public. The US Forest Service serves as the primary dissemination agency for emergency information. As the activity changes, USGS scientists provide updated advisories and meet with local, state, and federal officials to discuss the hazards and appropriate levels of emergency response. The experience since 1980 at Mount St. Helens and elsewhere indicates that monitoring is sufficient for scientists to detect the ascent of fresh magma that must take place before another large eruption. This information will enhance warnings and facilitate updated assessments of the hazard.

In addition, the USGS and the National Weather Service monitor lahar and flood hazards at Mount St. Helens. The latter agency has responsibility for providing warnings of floods, including lahars. These monitoring activities not only help nearby communities, but can also provide significant benefit to the Pacific Northwest, including Marion County.

Volcanic Event Notification Emergency Coordination

An emergency coordination center (ECC) was established at the US Forest Service (USFS) facility in Vancouver, Washington after the 1980 eruption of Mount St. Helens. A communications network and telephone call-down procedure was developed to facilitate rapid dissemination of information about the activity of the volcano. Information is also disseminated through public meetings, press conferences, and briefings with governmental agencies and private businesses. Currently, the system has the capability of issuing written predictions weeks in advance of most eruptions. This eliminates the need for 24-hour duty for both USFS/ECC and CVO staff except when eruptions are imminent. It can enter all predictions and updates into a computer "news" system for easy review by those on the call-down list; update volcanic activity reports when the volcano is quiet; and develop a seismic alarm to alert scientists to small events that occur without precursors.

Mitigation Plan Goals

Plan Goals Addressed

The plan goals addressed help to guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Goal #1: PUBLIC AWARENESS

Goal Statement: Increase public awareness of natural hazard risks, emergency notification and response, and resources for citizen preparedness.

Goal #2: EDUCATION

Goal Statement: Educate the public on how to prepare to successfully endure a natural disaster with minimal property damage and no loss of life.

Goal #3: PREVENTATIVE

Goal Statement: Minimize risks to life, property, the environment, and the economy from natural hazards.

Goal #4: FUNDING AND IMPLEMENTATION

Goal Statement: Identify potential funding sources and implement potential mitigation projects.

Goal #5: PARTNERSHIPS AND COORDINATION

Goal Statements:

- Create and enhance partnerships with other stakeholders involved with natural hazard management.
- Coordinate natural hazard mitigation efforts with adjacent jurisdictions and public/private agencies' risk management activities.

Goal #6: NATURAL RESOURCES UTILIZATION

Goal Statement: Promote the use of natural systems and features, watershed planning, and land use planning for natural hazard mitigation whenever possible to reduce long-term costs to the county and maximize effectiveness.

Goal #7: EMERGENCY SERVICES

Goal Statement: Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Volcanic Eruption Mitigation Action Items

The following mitigation action items were formulated through researching regional mitigation plans and natural hazards planning literature, and interviews with local stakeholders. Plan action items

were refined through discussions with the mitigation plan steering committee and through an open house at which the county received public comments.

The volcano action items provide direction on specific activities that organizations and residents in Marion County can undertake to reduce risk and prevent loss from volcanic eruptions. Each action item is followed by ideas for implementation, which can be used by local decision makers in pursuing strategies for implementation.

This section lists action items identified to reduce the risk from volcanic eruption impacts in Marion County. These action items are designed to meet the mitigation plan goals.

Short-term (ST) Volcano Action Items

Short-term volcano action items include general mitigation activities that agencies are capable of implementing during the next two years, given their existing resources and authorities.

ST-V #1: Collaborate with USGS-CVO and related agencies to develop ash fall models that are specific to Marion County.

Ideas for Implementation

- Strengthen chain-of-command communication with USGS-CVO and NOAA;
- Map and model ash fall to assist in interpreting potential scenarios that could impact Marion County;
- Create a virtual Web site depicting what would happen to a person during a volcanic eruption; and
- Determine critical activities that must be implemented for varying degrees of ash fall.

Coordinating Organization:	Emergency Management
Internal Partner:	GIS
External Partners:	USGS-CVO, DOGAMI
Timeline:	1 to 5 years
Plan Goals Addressed:	Preventative; Funding and Implementation; Partnerships and Coordination

ST-V #2: Increase awareness of volcanic eruptions and their potential impact to the county.

Education is an effective way to relate how an infrequent hazard event could affect the daily life of a county resident.

Ideas for Implementation

- Inform and educate the public about volcanic hazards in the Marion County region. The public awareness campaign may take many forms;
- Feature an interview with a representative of the Cascade Volcano Observatory (USGS), talking about how they determine the likelihood of a volcanic eruption;
- Play the USGS volcanic eruption videotape at schools, community centers, critical facilities, and major businesses; and play the videotape on the county’s local cable access channel;
- Place an informational kiosk in view of Mt. Hood, Mt. Jefferson, and/or Mt. St. Helen describing the area geology and potential volcanic hazards in the region; and
- Place informational kiosks in partnership with adjacent counties at ODOT rest areas along the I-5 corridor:
 - Partner with Linn County for placement at the Cascade Rest Area (~MP 240), south of Talbot Road.
 - Partner with Clackamas County for placement at the Aurora Rest Area (~MP 278).
- Develop a volcanic hazards guidebook, including how to identify possible volcanic eruption warning signals, air and water quality issues, techniques to minimize ash entering one’s home, and property clean-up procedures.

Coordinating Organization: Emergency Management, USGS-CVO
Internal Partner: Community Development
External Partners: Cities, Clackamas and Linn Counties, OSU, DOGAMI, USFS (Willamette National Forest, Detroit Ranger District), critical facilities and businesses.
Timeline: On-going
Plan Goals Addressed: Public Awareness; Education; Preventative; Partnerships and Coordination

ST-V #3: Identify critical facilities and industries that may be affected by ash fall and collaborate with them on ash fall emergency response.

The Intel Corporation has taken the initiative to consult scientists on the probability of problems associated with volcanic eruptions in the Cascade region.³¹

Ideas for Implementation

- 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.

Coordinating Organization: Emergency Management
 External Partners SEDCOR, Major Industries, Cities, DOGAMI, USFS, USGS-CVO
 Timeline: 1 to 2 years
 Plan Goals Addressed: Public Awareness; Education; Partnerships and Coordination

ST-V #4: Collaborate with USGS-CVO and related agencies to create ash fall warning messages that are more appropriate for Marion County.

Research has shown that warnings that are not specific in terms of areas affected or precautionary actions that should be prescribed or that lack a sense of urgency will result in low responses.³²

Ideas for Implementation

- Collaborate with USGS-CFO, 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; and
- Seek funding and develop a partnership to create a countywide call group that would be voluntary for cellular phone systems, similar to CityWatch® alert notification system.

Coordinating Organization: Emergency Management
 External Partners USGS-CVO, FAA, DOGAMI, OEM, National Weather Service, Law Enforcement Offices, Media
 Timeline: On-going
 Plan Goals Addressed: Public Awareness, Education, Partnerships and Coordination

ST-V #5: Create depositories for dust masks in strategic places in Marion County where ash fall would most likely hit.

Ideas for Implementation

- Partner with critical facilities in areas more prone to ash fall and wildfires to create storage areas for dust masks.

Coordinating Organization: Emergency Management
 External Partners USFS, Critical Facilities
 Timeline: 1 to 2 years

Long-term (LT) Volcano Action Items

Long-term volcano action items include general mitigation activities that are likely to take more than two years to implement and may require new or additional resources and/or authorities.

LT-V #1: Strengthen response and recovery programs, and develop and implement public education programs for volcanic eruption hazards.

Ideas for Implementation

- Determine critical activities that must be implemented for varying degrees of ash fall;
- Create a hazard-specific supplement in the Marion County Emergency Operations Plan that defines the special concerns created by ash fall (e.g., health, cleanup, impacts to high tech and other industries);
- Develop basic public education materials that describe volcanic eruption hazards (pyroclastic surges, pyroclastic flows, lahars, mudflows, landslides, ash fall), potential impacts, and appropriate response and mitigation activities;
- Create volcanic eruption hazard scenarios for Marion County to determine potential problems the county may face with varying amounts of ash fall, debris and mud flows; and
- Coordinate with the media for volcanic hazard education programs to reduce conveyance of misinformation.

Coordinating Organization:	Emergency Management
Internal Partner:	Community Development
External Partners:	OEM, USGS-CVO, DOGAMI, Cities, Media
Timeline:	On-going
Plan Goals Addressed:	Preventative; Funding and Implementation; Partnerships and Coordination; Emergency Services

LT-V #2: Create and map hypothetical eruption scenarios to display potential eruption hazards.

Note: Hypothetical eruption scenarios for area volcanoes, showing the different possible eruption hazards, can help the public understand the impacts of a volcanic eruption. Pierce County, Washington, uses hypothetical scenarios for Mount Rainier to show possible impacts.

Ideas for Implementation

- Potential scenarios can show such occurrences of lava flows, tephra, ash plumes, lahars (debris flows), and possible geographic extent of impact.
- The scenarios can also cover likely grain size, thickness, physical properties, and hazards associated with ash fall;
- Cascades Volcano Observatory could partner with OSU/PSU/OIT geologists to create potential eruption scenarios.

Coordinating Organization: Emergency Management
Internal Partner: GIS
External Partners: DOGAMI, OSU/PSU/OIT; USGS-CVO
Timeline: 3 to 5 years
Plan Goals Addressed: Public Awareness; Education

LT-V #3: Collaborate with county environmental health for immediate warning to communities about air quality following volcanic eruptions.

Note: Ash fall distribution is not predictable due to its dependence on wind speed and direction. The Marion County Environmental Health Division of the Health Department can alert communities when Mt. St. Helen, Mt. Hood, or other volcanoes produce ash, and distribute information quickly about air quality and visibility, and whether it is safe for residents to go outdoors or travel.

Coordinating Organization: County Environmental Health
Internal Partners: Emergency Management, GIS
External Partners: Media, DEQ
Timeline: 3 to 5 years
Plan Goals Addressed: Partnerships and Coordination, Emergency Services

Volcanic Eruption Resource Directory

County Resources

Marion County Emergency Management

Marion County Emergency Management helps the community be better prepared for major emergencies and disasters. They work closely with cities, emergency responders, and volunteer agencies to find ways to reduce risks and minimize damages during hazard events. When a disaster occurs, they work with these partners in their Emergency Operations Center to coordinate resources and information. Once the

event is over, they help bring assistance to those that have been harmed.

Contact: Marion County Emergency Management Coordinator
Address: 5155 Silverton Road, Salem, OR 97305-3899
Phone: 503-365-3133
Email: Emergency@fco.marion.or.us
Website: <http://PublicWorks.co.marion.or.us/EmergencyManagement>

State Resources

Department of Land Conservation and Development (DLCD)

DLCD administers the state's Land Use Planning Program. The program is based on 19 Statewide Planning Goals, including Goal 7, related to natural hazards. DLCD also conducts various landslide-related mitigation activities. In order to help local governments address natural hazards effectively, DLCD provides technical assistance such as conducting workshops, reviewing local land use plan amendments, and working interactively with other agencies.

Contact: Natural Hazards Program Manager
Address: 635 Capitol St. NE, Suite 200, Salem, OR 97301-2540
Phone: 503-373-0050
Fax: 503-378-6033
Website: <http://www.lcd.state.or.us/hazards.html>

Oregon State Police (OSP)-Office of Emergency Management (OEM)

The purpose of OEM is to execute the Governor's responsibilities to maintain an emergency services system as prescribed in Oregon Revised Statutes Chapter 401 by planning, preparing, and providing for the prevention, mitigation, and management of emergencies or disasters that present a threat to the lives and property of citizens of and visitors to the state of Oregon.

Contact: Office of Emergency Management
Address: 3225 State Street, Salem, OR 97301
Phone: 503-378-2911
Fax: 503-373-7833
Website: <http://www.osp.state.or.us/oem>

Federal Resources

USGS Video Programs

One good example of education and outreach is the USGS series of videos related to volcanic eruption. The USGS has produced a video program "At Risk: Volcano Hazards from Mount Hood, Oregon." The video describes and illustrates the types of volcanic hazards posed by Mount Hood, and shows areas near the volcano that could be affected by future activity. The video was produced to provide nearby residents, businesses, and public agencies basic information about future potential hazards from the volcano.

Decade Volcanoes

The Decade Volcanoes project began as part of the International Decade for Natural Disaster Reduction (IDNDR). The aim of the Decade Volcanoes project is to direct attention to a small number of selected, active volcanoes worldwide and to encourage the establishment of a range of research and public-awareness activities aimed at enhancing the understanding of volcanoes and the hazards posed by them. Mount Rainier in the Cascade Range has been designated one of the Decade Volcanoes.³³

USGS-David A. Johnston Cascades Volcano Observatory (CVO)

CVO provides accurate and timely information pertinent to assessment, warning, and mitigation of natural hazards. It provides warnings during volcanic crises by monitoring volcanoes and interpreting results in the context of current hazard assessments. It also provides information for use in land-use management emergency response plans, and public education.

Contact: CVO
Address: 1300 SE Cardinal Court, Building 10, Suite 100
Vancouver, WA 98683-9589
Phone: 360-993-8900
Fax: 360-993-8980
Website: http://vulcan.wr.usgs.gov/CVO_Info/framework.html

National Weather Service, Portland Bureau

The National Weather Service (NWS) provides weather, hydrologic, and climate forecasts and warnings for the United States, its territories, adjacent waters and ocean areas, for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure, which can be used by other governmental agencies, the private sector, the public, and the global community.

Contact: National Weather Service
Address: 5241 NE 122nd Ave, Portland, Oregon 97230-1089
Phone: 503-326-2340
Website: <http://nimbo.wrh.noaa.gov/Portland>

Federal Emergency Management Agency (FEMA)

The Federal Emergency Management Agency (FEMA) is an independent agency of the federal government, reporting to the President. FEMA's purpose is to reduce loss of life and property and protect the nation's critical infrastructure from all types of hazards through a comprehensive, risk-based, emergency management program of mitigation, preparedness, response and recovery. FEMA provides disaster relief funds following a natural hazard and works closely with the Oregon State Police - Office of Emergency Management.

Contact: Public Affairs Officer
Address: 130 228th Street, St., Bothell, WA 98021-9796

Phone: 425-487-4600
Fax: 425-487-4690
Website: <http://www.fema.gov/hazards/volcanoes/volcanof.shtm>
Email: FEMAOPA@dhs.gov

Additional Resources

Smithsonian Institution's Global Volcanism Program (GVP)

The Smithsonian Institution's Global Volcanism Program (GVP) is housed in the [Department of Mineral Sciences](#), part of the National Museum of Natural History, on the National Mall in Washington D.C. We are devoted to a better understanding of Earth's active volcanoes and their eruptions during the last 10,000 years. GVP activities can be divided into two main efforts that are closely linked: reporting of current eruptions around the world, and building databases and archival resources for Earth's active volcanoes and their eruptions. In doing so we provide a global context for our planet's active volcanism.

Contact: Global Volcanism Program, Department of Mineral Sciences
Address: Smithsonian National Museum of History, Washington, D.C. 20560-0119
Phone: 202-633-1860
Fax: 202-357-2476
Website: <http://www.volcano.si.edu/>
Email: gvp@si.edu

Institute for Business & Home Safety (IBHS)

IBHS was created as an initiative of the insurance industry to reduce damage and losses caused by natural disasters. Their website provides educational resources and on-line publications for insurers, businesses, and homeowners who are interested in taking the initiative to minimize future damages and losses.

Contact: Institute for Business and Home Safety
Address: 1408 North Westshore Boulevard - Suite 208, Tampa, FL 33607
Phone: 813-286-3400
Fax: 813-286-9960
E-mail: info@ibhs.org
Website: <http://www.ibhs.org/ibhs2>

Institute of Geological & Nuclear Sciences Limited (GNS)

GNS has an excellent website that describes volcanic hazards in New Zealand. It provides simple and informative descriptions of volcanic hazards that are useful for communities around the world. It discusses the types of volcanic hazards and emergency response and mitigation actions that could be implemented.

Contact: Institute of Geological & Nuclear Sciences

Address: 69 Gracefield Rd, PO Box 30-368, Lower Hutt, New Zealand
Phone: +64 4 570 1444
Fax: +64 4 570 4600
E-mail: webmaster@gns.cri.nz
Website: <http://www.gns.cri.nz/what/earthact/volcanoes/hazards/index.html>

Publications

Volcanic-Hazard Zonation for Mount St. Helens, Washington Open-File Report 95-497 (1995). Produced by the USGS-CVO in 1995, this report explains the various hazardous geologic processes of Mount St. Helens and the types of hazards and damages that have occurred at Mount St. Helens. It also includes valuable references and suggested reading.

Contact: USGS-CVO
Address: 1300 SE Cardinal Court, Building 10, Suite 100
Vancouver, WA 98683-9589
Phone: 360-993-8900
Fax: 360-993-8980
Website: <http://vulcan.wr.usgs.gov/Volcanoes/MSH/Hazards>

Volcano Hazards in the Mount Hood Region, Oregon Open-File Report 97-89 (1997) USGS-CVO

Produced by the USGS-CVO in 1997, this report documents past hazardous events that have occurred at Mount Hood and includes several volcano hazard maps. It also discusses hazard forecasts and warnings as well as ways to protect oneself from volcano hazards.

Contact: USGS-CVO
Address: 1300 SE Cardinal Court, Building 10, Suite 100
Vancouver, WA 98683-9589
Phone: 360-993-8900
Website: <http://vulcan.wr.usgs.gov/Volcanoes/MSH/Hazards>

Public Assistance Debris Management Guide, Federal Emergency Management Agency (July 2000).

Debris management is generally associated with post-disaster recovery. While debris management should be compliant with local and county emergency operations plans, developing management strategies to ensure strong debris management during and after a natural hazard event is a way to integrate debris management with mitigation. The *Public Assistance Debris Management Guide* is available in hard copy or on the FEMA website.

Contact: FEMA Distribution Center
Address: 130 - 228th Street, SW, Bothell, WA 98021-9796
Phone: 800-480-2520
Fax: 425-487-4622

Website: <http://www.fema.gov/r-n-r/pa/dmgtoc.htm>

¹ Halemeier, David. Hydrologist, USDA, USFS Willamette National Forest, Detroit/Sweet Home Ranger Districts. Personal Interview. November 16, 2004.

² Id.

¹United States Geological Service (USGS). Available on the World Wide Web, <http://geopubs.wr.usgs.gov/open-file/of99-437/of99-437map.pdf>. Accessed August 14, 2003.

⁴ USGS. Available on the World Wide Web, http://vulcan.wr.usgs.gov/Volcanoes/Sisters/WestUplift/ground_uplift_may2001.html. Accessed August 12, 2003.

⁵ Id.

⁶ Id.

⁷ <http://geopubs.wr.usgs.gov/open-file/of99-437/of99-437.pdf>. Accessed August 12, 2003.

⁸ <http://vulcan.wr.usgs.gov/Volcanoes/Cascades>. Accessed August 12, 2003 (entire paragraph).

⁹ http://vulcan.wr.usgs.gov/Volcanoes/Jefferson/Hazards/OFR99-24/OFR99-24_plate1_bw.pdf, Accessed August 20, 2003 (entire paragraph)

¹⁰ http://vulcan.wr.usgs.gov/Volcanoes/Rainier/summary_mount_rainier.html. Accessed August 20, 2003 (entire paragraph).

¹¹ Tilling, et al. 1990. <http://www.Vulcan.wr.usgs.gov/Volcanoes/MSH/Hazards>

¹² USGS. *Volcanic Hazard Zonation for Mount St. Helens, Washington*. 1995. Open-File-Report 95-497.

¹³ Community Planning Workshop. 2002.

¹⁴ "Scientists Seek Source of Mount St. Helens Blast." CNN.com Web site <<http://www.cnn.com/2005/TECH/science/03/09/saint.helens/>>. Posted March 9, 2005. Accessed March 28, 2005.

¹⁵ Id.

¹⁶ *The Valley Times*. May 21, 1980: Vol. 60 No. 37.

¹⁷ *Itemizer-Observer*. May 28, 1980.

¹⁸ Hari, Roy. Chief, Marion RFPD No. 1. Personal Interview. November 29, 2004.

¹⁹ "Salem Gets Dusted, But Misses Travel Tie Up." *Statesman Journal*. May 26, 1980: Page 1.

²⁰ *Silverton Appeal-Tribune*. June 5, 1980: No.23.

²¹ *Statesman Journal*. May 19, 1980.

²² *Woodburn Independent*, May 21, 1980: Vol.91, No.21.

²³ "Volcanoes." March 2001. FEMA Website, www.fema.gov/library/volcano.htm

-
- ²⁴ Wright and Pierson. 1973, 1992. "Living with Volcanoes." USGS Volcano Hazards Program Circular.
- ²⁵ DOGAMI. <http://sarvis.dogami.state.or.us/earthquakes/volcanoes.htm>. Accessed August 12, 2003. (Entire paragraph)
- ²⁶ Burby, R., ed. 1998. *Cooperating with Nature*. Washington D.C.: Joseph Henry Press.
- ²⁷ USGS. March 2001. *Volcano Hazards of the Lassen Volcanic National Park Area*.
- ²⁸ Id.
- ²⁹ *Clackamas County Courier*. October, 1986.
- ³⁰ Cashman, Kathy. University of Oregon Department of Volcanology. Personal Interview. March 14, 2001.
- ³¹ Community Planning Workshop. September 2001. Washington County Mitigation Action Plan: Volcanic Eruption.
- ³² Id.
- ³³ United States Geologic Survey – Cascades Volcano Observatory. http://volcano.und.nodak.edu/vwdocs/volc_images/decade/

MARION COUNTY NATURAL HAZARDS MITIGATION PLAN

Critical Facilities



Critical Facilities

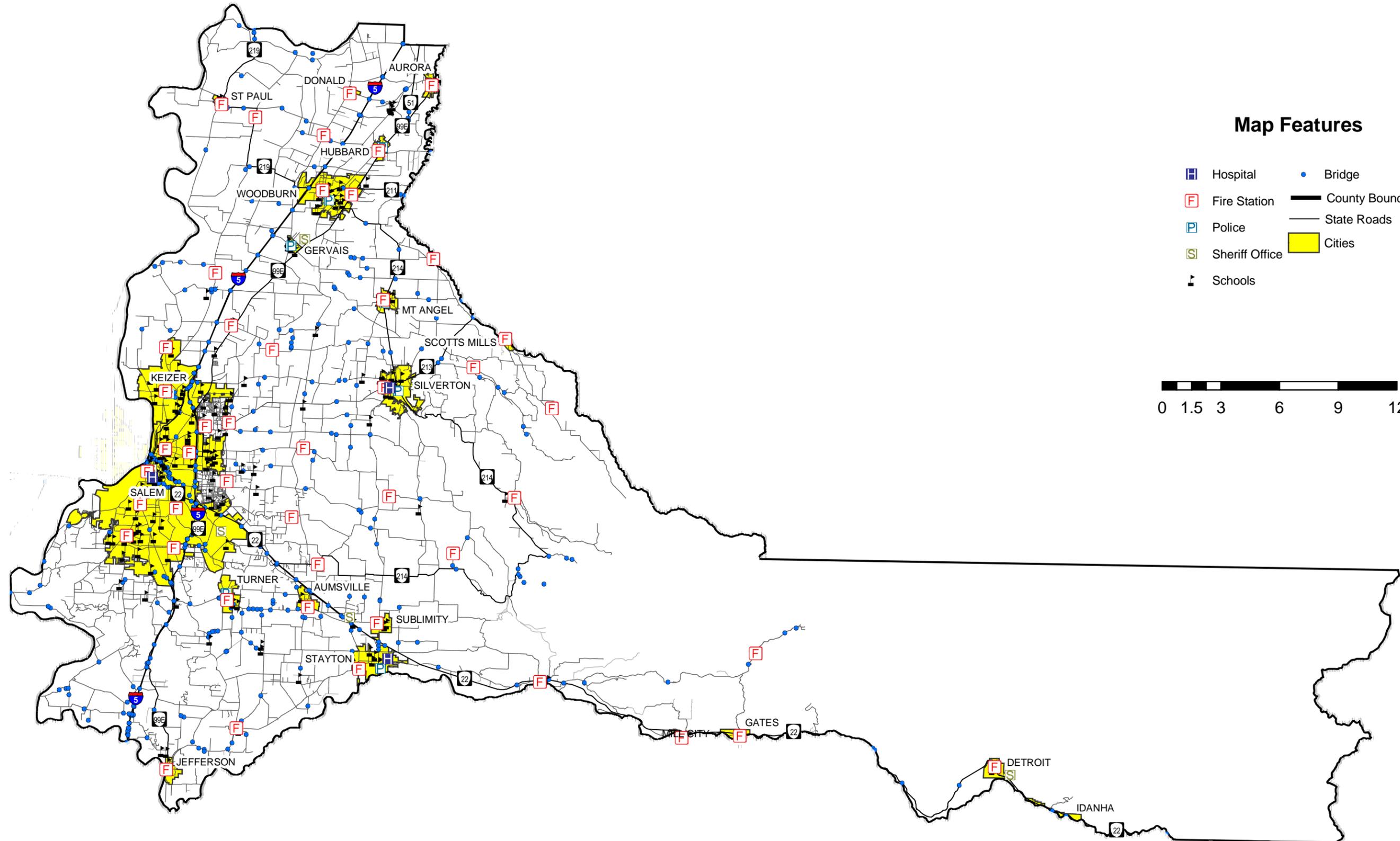
Map 3



Date:
05/23/05

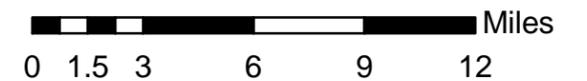
Project:
U:\GISProjects\Emergency\Hazard\CriticalFacilities.mxd

Prepared by:
Burnie



Map Features

- Hospital
- Fire Station
- Police
- Sheriff Office
- Schools
- Bridge
- County Boundary
- State Roads
- Cities



MARION COUNTY NATURAL HAZARDS MITIGATION PLAN

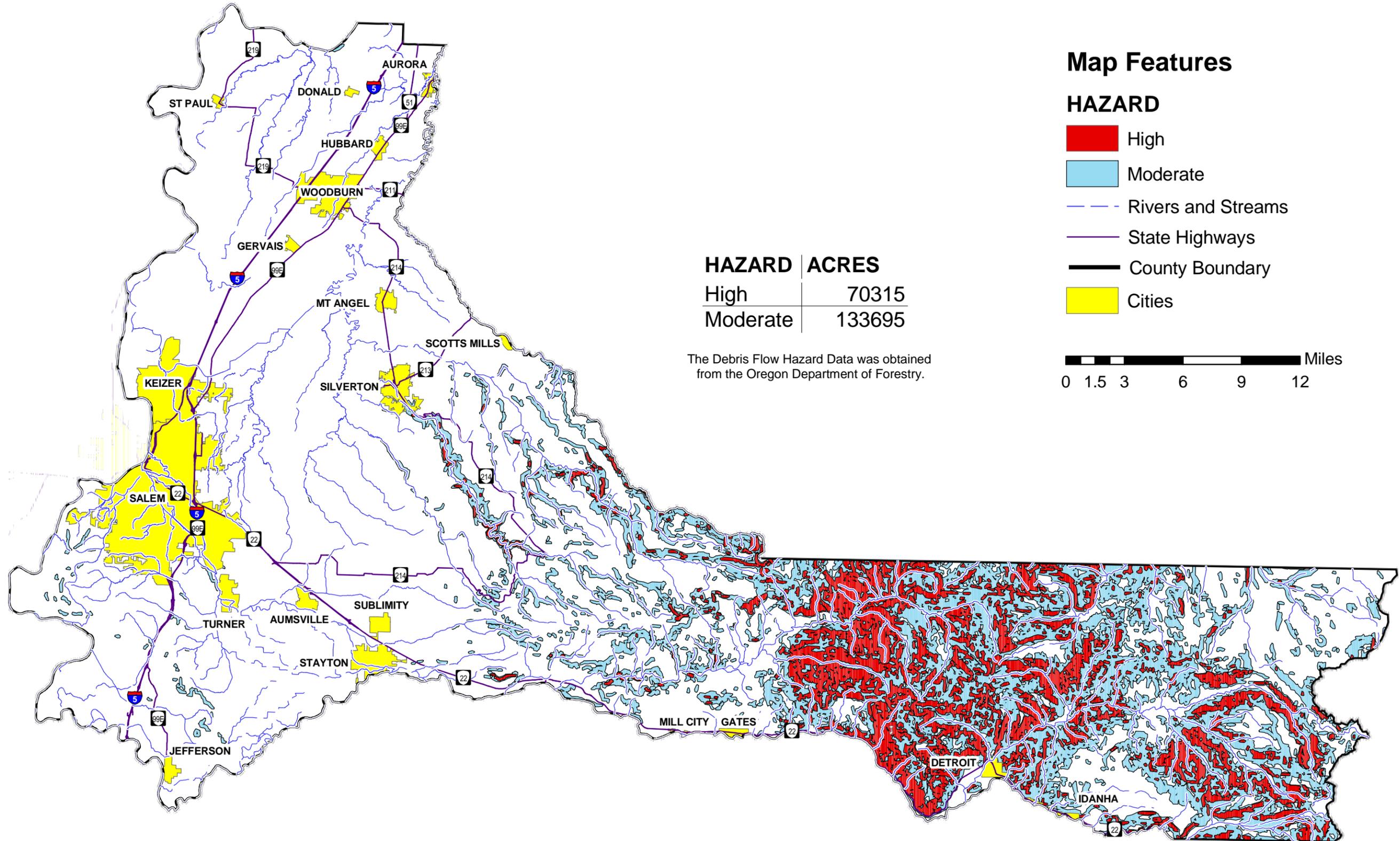
Debris Flow Hazard



Date:
05/25/05

Project:
U:\GISProjects\Emergency\Hazard\Debris.mxd

Prepared by:
Bumie



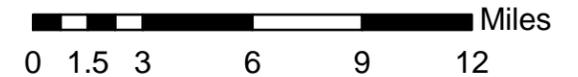
Map Features

HAZARD

- High
- Moderate
- Rivers and Streams
- State Highways
- County Boundary
- Cities

HAZARD	ACRES
High	70315
Moderate	133695

The Debris Flow Hazard Data was obtained from the Oregon Department of Forestry.



MARION COUNTY NATURAL HAZARDS MITIGATION PLAN

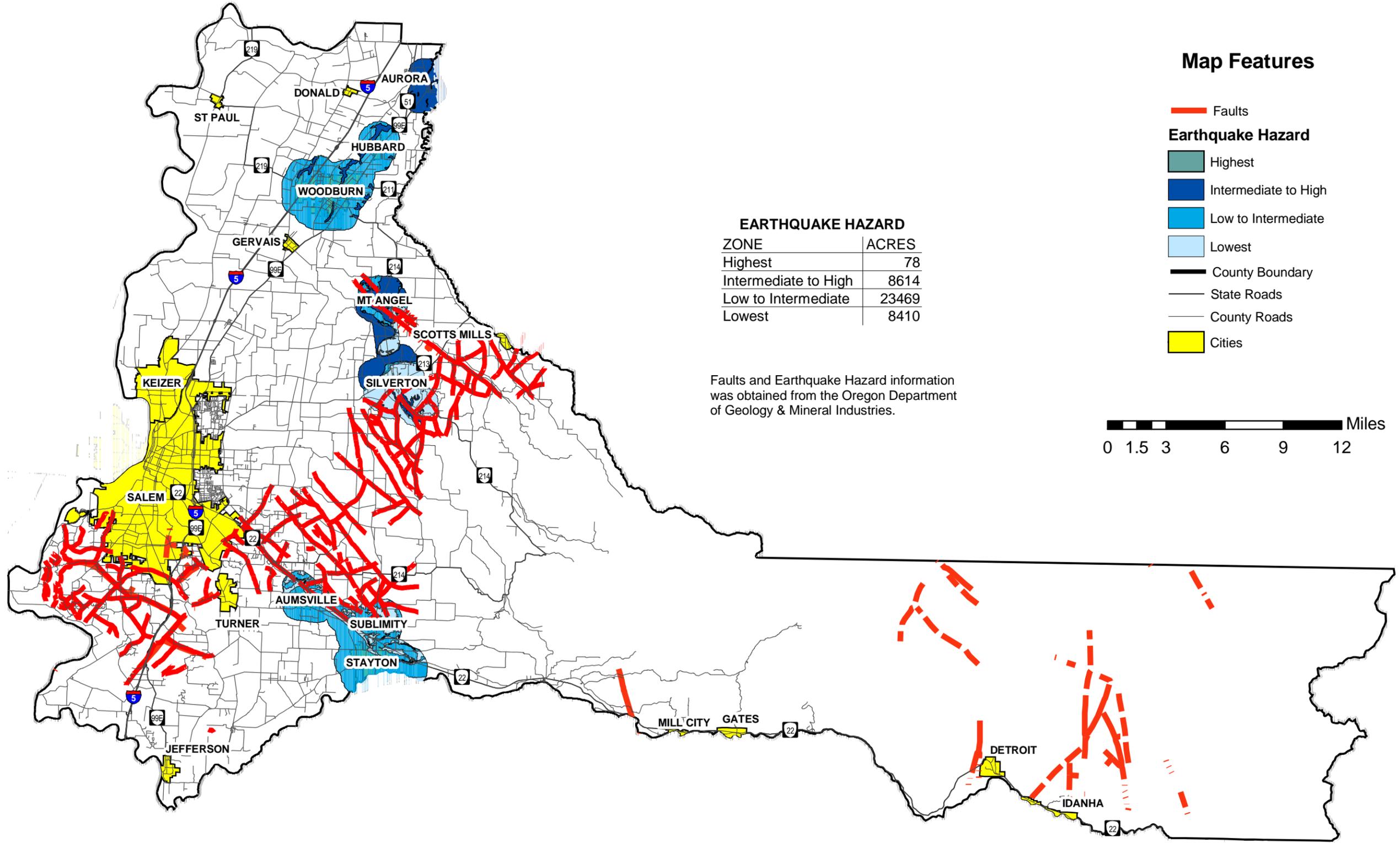
Earthquake Hazard



Date: 05/31/05

Project: U:\GISProjects\Emergency\Hazard\Earthquake1.mxd

Prepared by: Bumie



EARTHQUAKE HAZARD

ZONE	ACRES
Highest	78
Intermediate to High	8614
Low to Intermediate	23469
Lowest	8410

Faults and Earthquake Hazard information was obtained from the Oregon Department of Geology & Mineral Industries.

Map Features

- Faults
- Earthquake Hazard**
- Highest
- Intermediate to High
- Low to Intermediate
- Lowest
- County Boundary
- State Roads
- County Roads
- Cities



MARION COUNTY NATURAL HAZARDS MITIGATION PLAN

Essential Facilities



Essential Facilities

Map 4



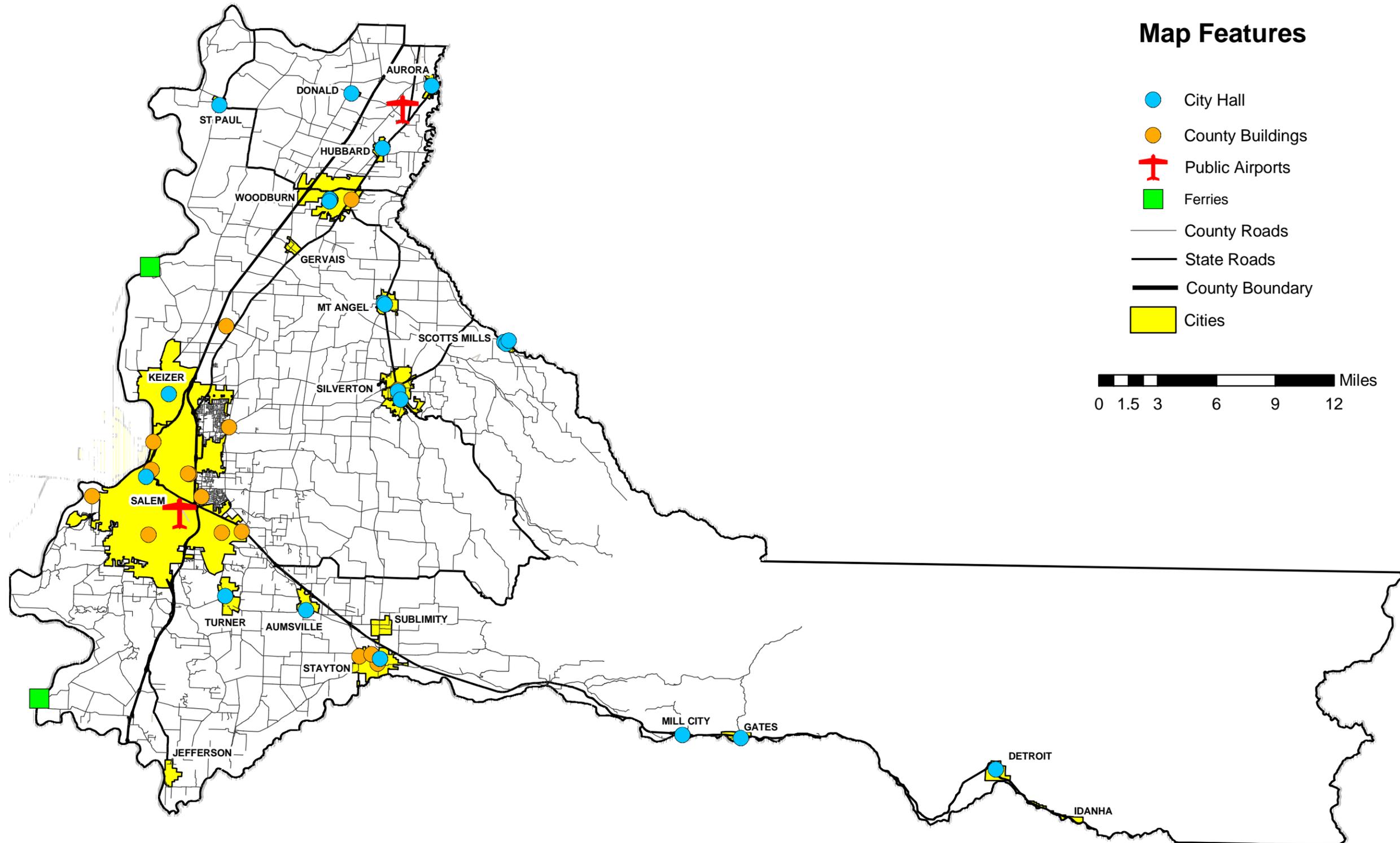
Date:
05/23/05

Project:
U:\GISProjects\Emergency\Hazard\EssentialFacilities.mxd

Prepared by:
Burnie

Map Features

- City Hall
- County Buildings
- Public Airports
- Ferries
- County Roads
- State Roads
- County Boundary
- Cities



MARION COUNTY NATURAL HAZARDS MITIGATION PLAN

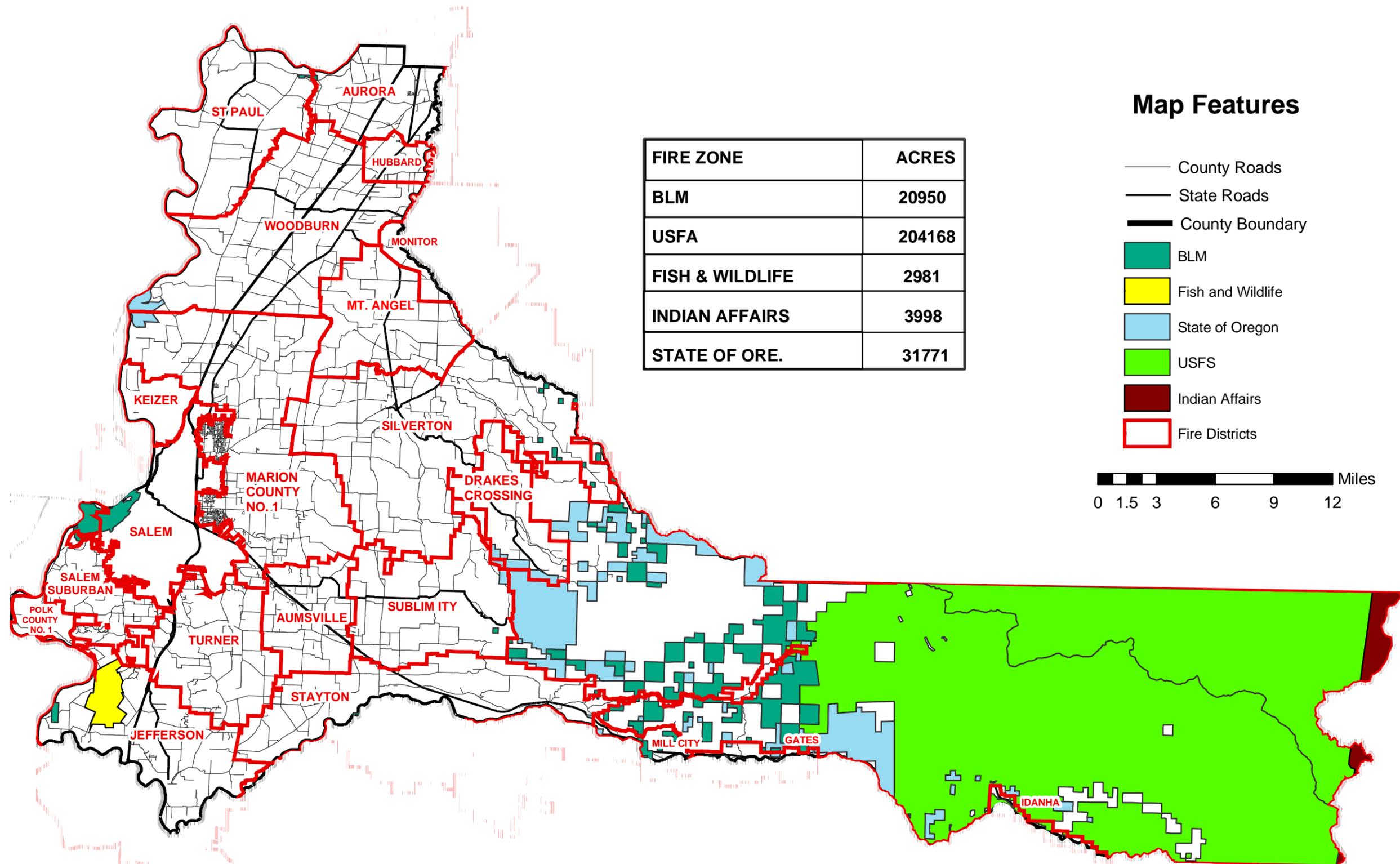
Fire Districts



Date:
05/23/05

Project:
U:\GISProjects\Emergency\Hazard\FireDistricts.mxd

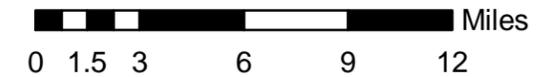
Prepared by:
Bumie



FIRE ZONE	ACRES
BLM	20950
USFA	204168
FISH & WILDLIFE	2981
INDIAN AFFAIRS	3998
STATE OF ORE.	31771

Map Features

- County Roads
- State Roads
- County Boundary
- BLM
- Fish and Wildlife
- State of Oregon
- USFS
- Indian Affairs
- Fire Districts



MARION COUNTY NATURAL HAZARDS MITIGATION PLAN

FEMA 100-Year Flood Plain



FEMA 100-Yr Flood Plain

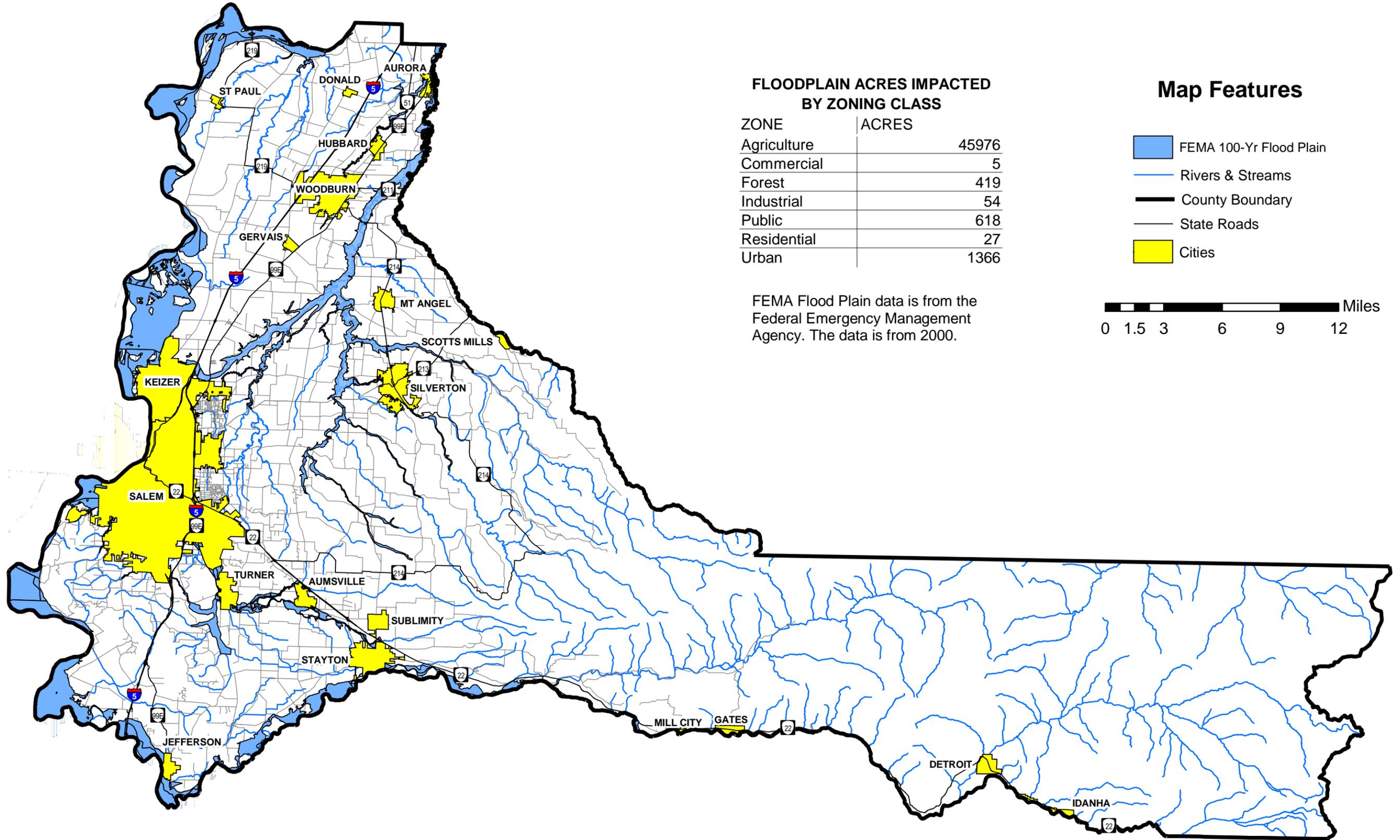
Map 5



Date:
05/31/05

Project:
U:\GISProjects\Emergency\Hazard\Flood.mxd

Prepared by:
Burnie



FLOODPLAIN ACRES IMPACTED BY ZONING CLASS

ZONE	ACRES
Agriculture	45976
Commercial	5
Forest	419
Industrial	54
Public	618
Residential	27
Urban	1366

FEMA Flood Plain data is from the Federal Emergency Management Agency. The data is from 2000.

Map Features

- FEMA 100-Yr Flood Plain
- Rivers & Streams
- County Boundary
- State Roads
- Cities



MARION COUNTY NATURAL HAZARDS MITIGATION PLAN

Landslide Hazard



Date:
05/31/05

Project:
U:\GISProjects\Emergency\Hazard\Landslides.mxd

Prepared by:
Burnie

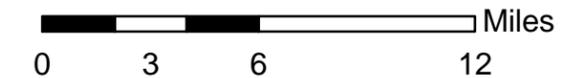
Map Features

Landslide Hazard

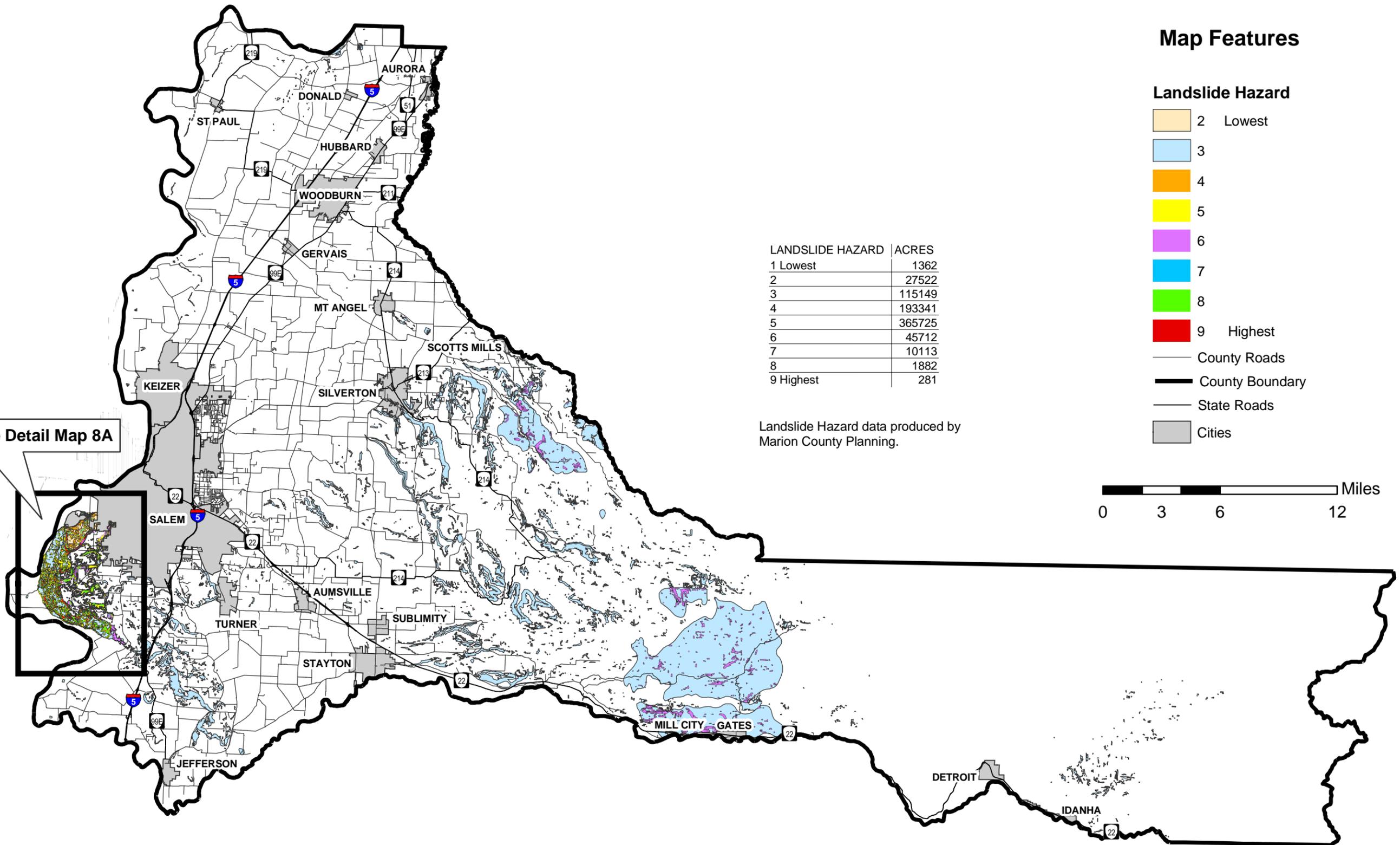
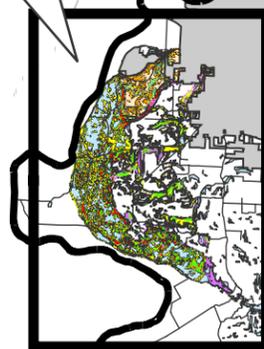


LANDSLIDE HAZARD	ACRES
1 Lowest	1362
2	27522
3	115149
4	193341
5	365725
6	45712
7	10113
8	1882
9 Highest	281

Landslide Hazard data produced by
Marion County Planning.



See Detail Map 8A



MARION COUNTY NATURAL HAZARDS MITIGATION PLAN

Base Map



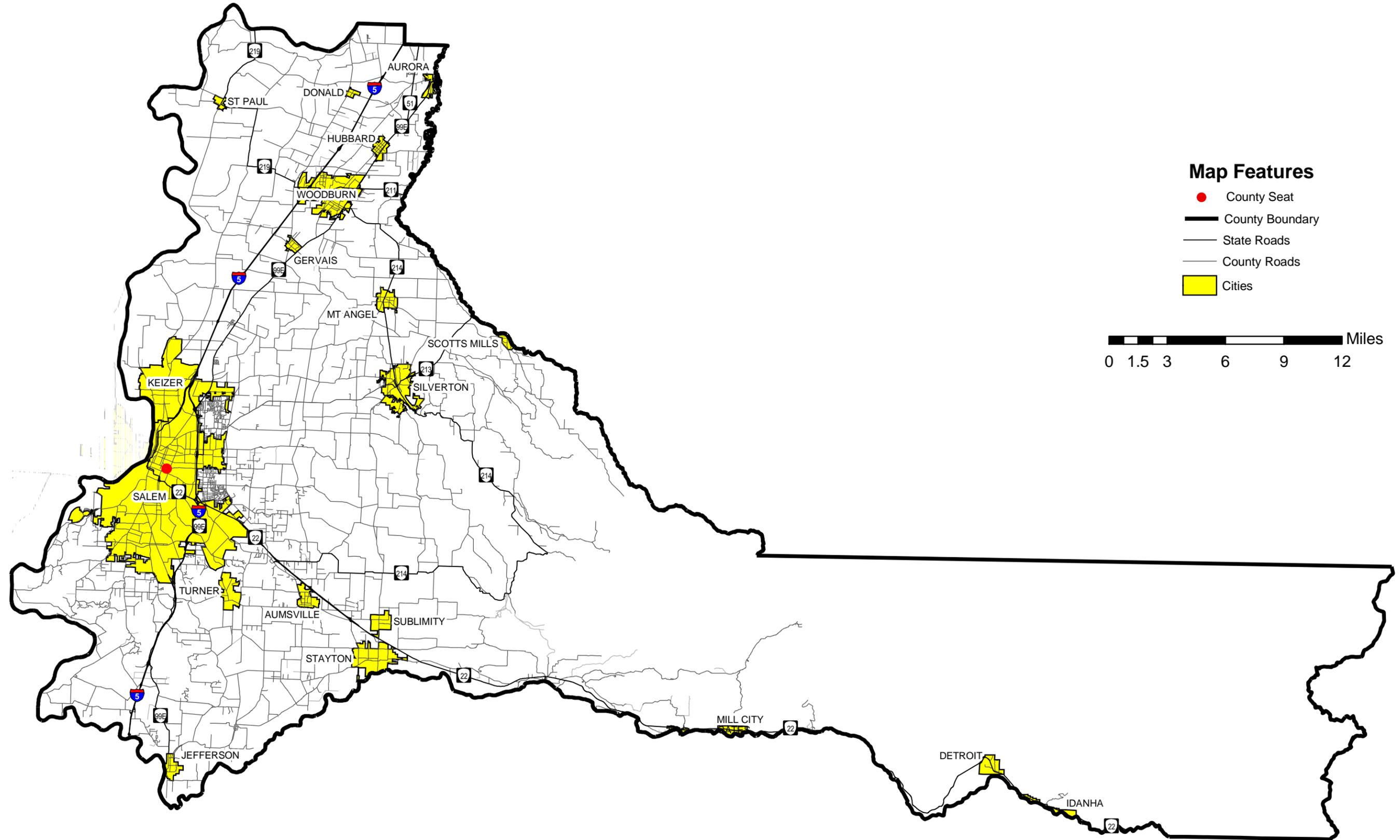
Base Map
Map 1



Date:
05/23/05

Project:
U:\GISProjects\Emergency\Hazard\Base.mxd

Prepared by:
Burnie



MARION COUNTY NATURAL HAZARDS MITIGATION PLAN

Precipitation



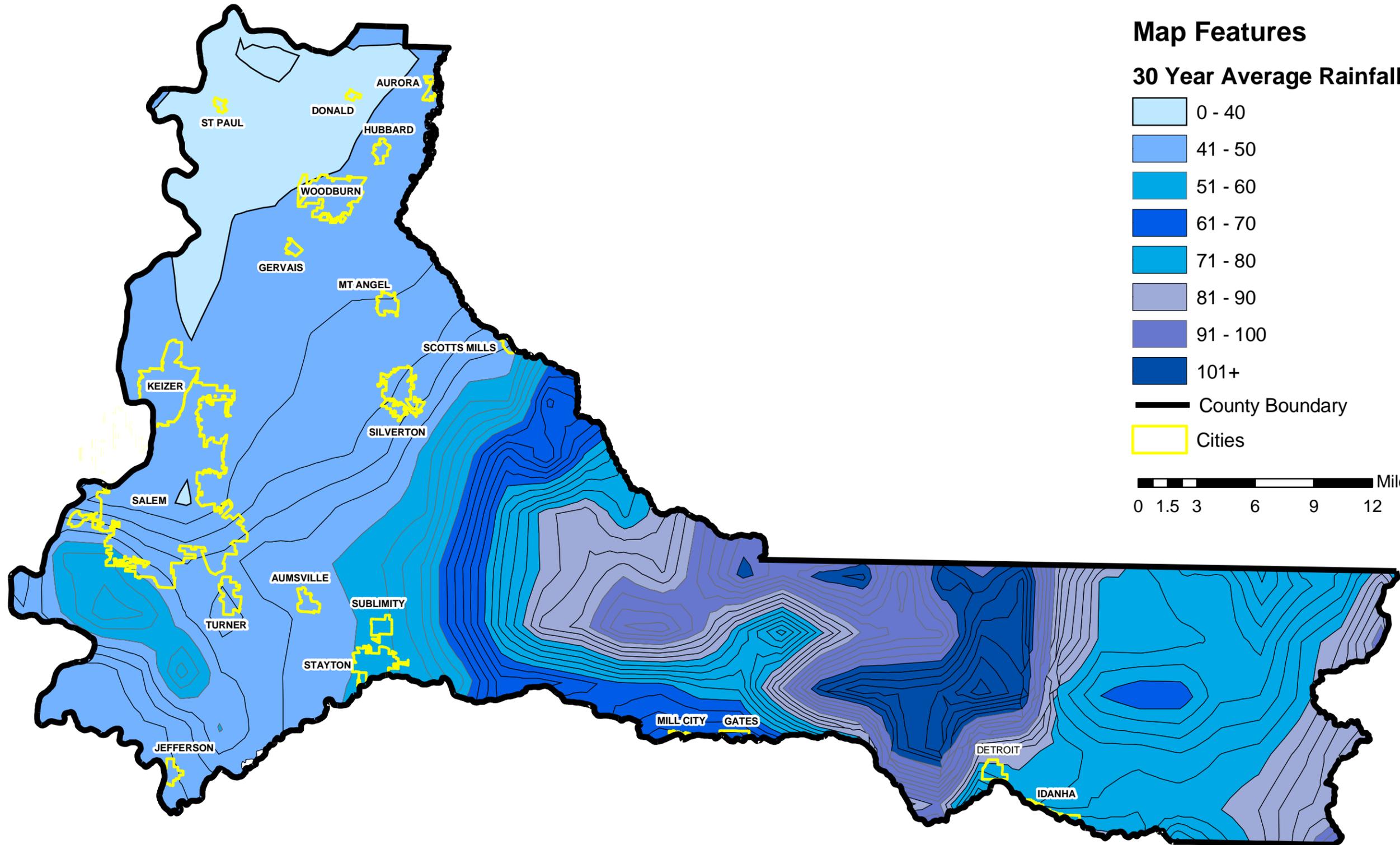
Precipitation Map 2



Date:
05/24/05

Project:
U:\GISProjects\Emergency\Hazard\Precipitation.mxd

Prepared by:
Bumie



MARION COUNTY NATURAL HAZARDS MITIGATION PLAN

River Subbasins



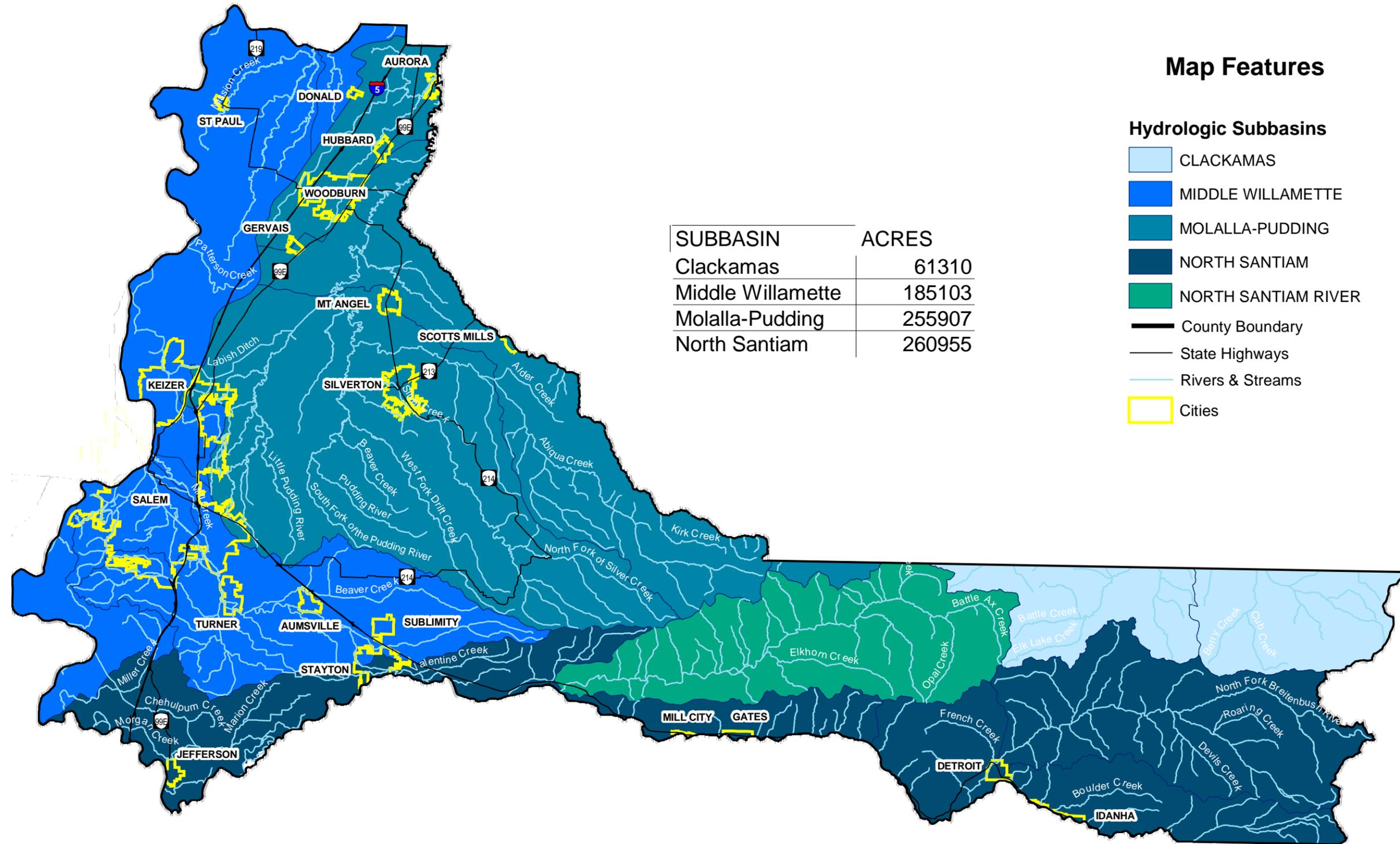
River Subbasins Map 6



Date:
05/25/05

Project:
U:\GISProjects\Emergency\Hazard\Subbasins.mxd

Prepared by:
Burnie



SUBBASIN	ACRES
Clackamas	61310
Middle Willamette	185103
Molalla-Pudding	255907
North Santiam	260955

Map Features

Hydrologic Subbasins

- CLACKAMAS
- MIDDLE WILLAMETTE
- MOLALLA-PUDDING
- NORTH SANTIAM
- NORTH SANTIAM RIVER
- County Boundary
- State Highways
- Rivers & Streams
- Cities

MARION COUNTY NATURAL HAZARDS MITIGATION PLAN

Volcanic Hazard



Volcanic Hazard

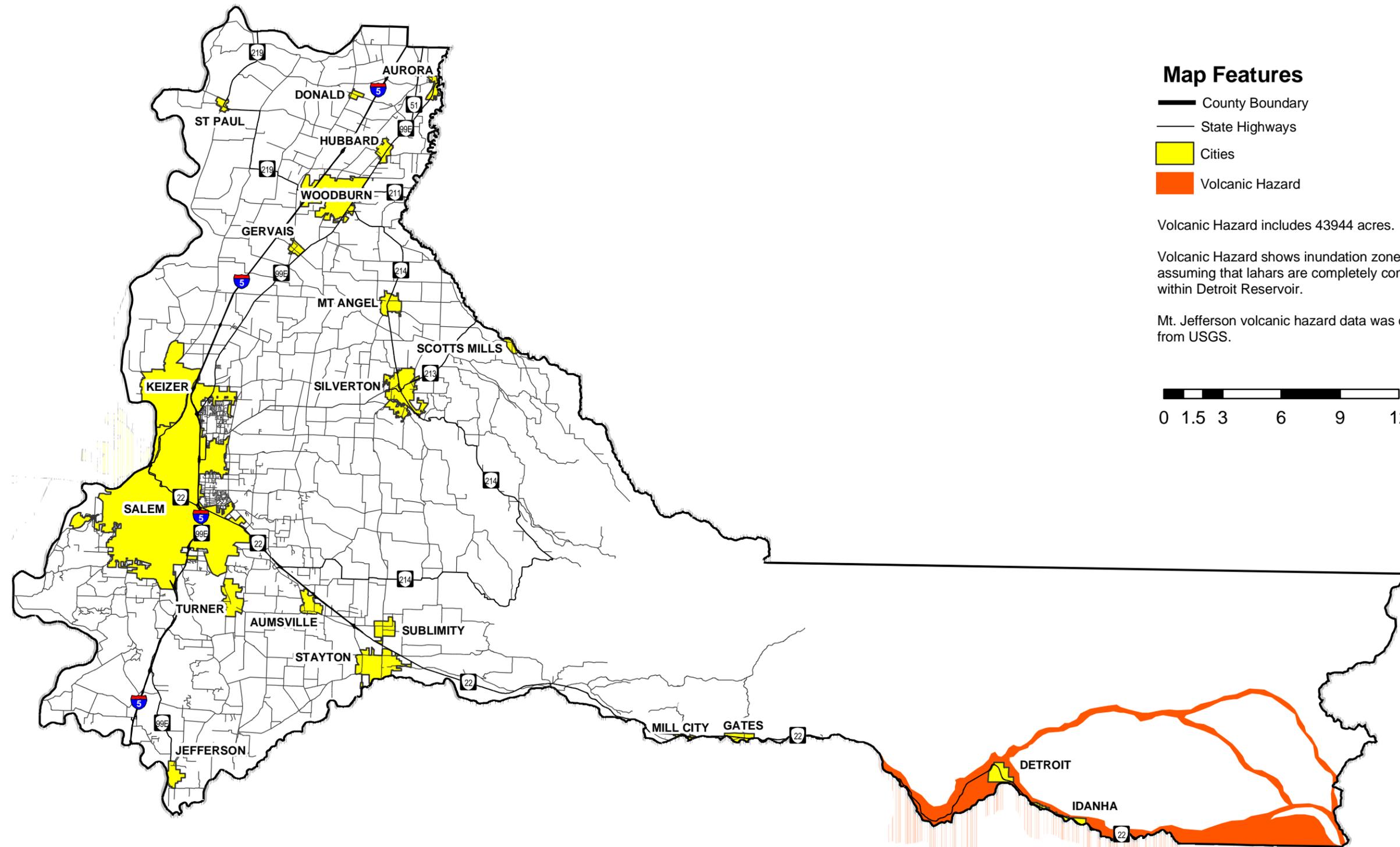
Map 12



Date:
05/25/05

Project:
U:\GISProjects\Emergency\Hazard\Volcanic.mxd

Prepared by:
Bumie



Map Features

- County Boundary
- State Highways
- Cities
- Volcanic Hazard

Volcanic Hazard includes 43944 acres.

Volcanic Hazard shows inundation zones assuming that lahars are completely contained within Detroit Reservoir.

Mt. Jefferson volcanic hazard data was obtained from USGS.



MARION COUNTY NATURAL HAZARDS MITIGATION PLAN

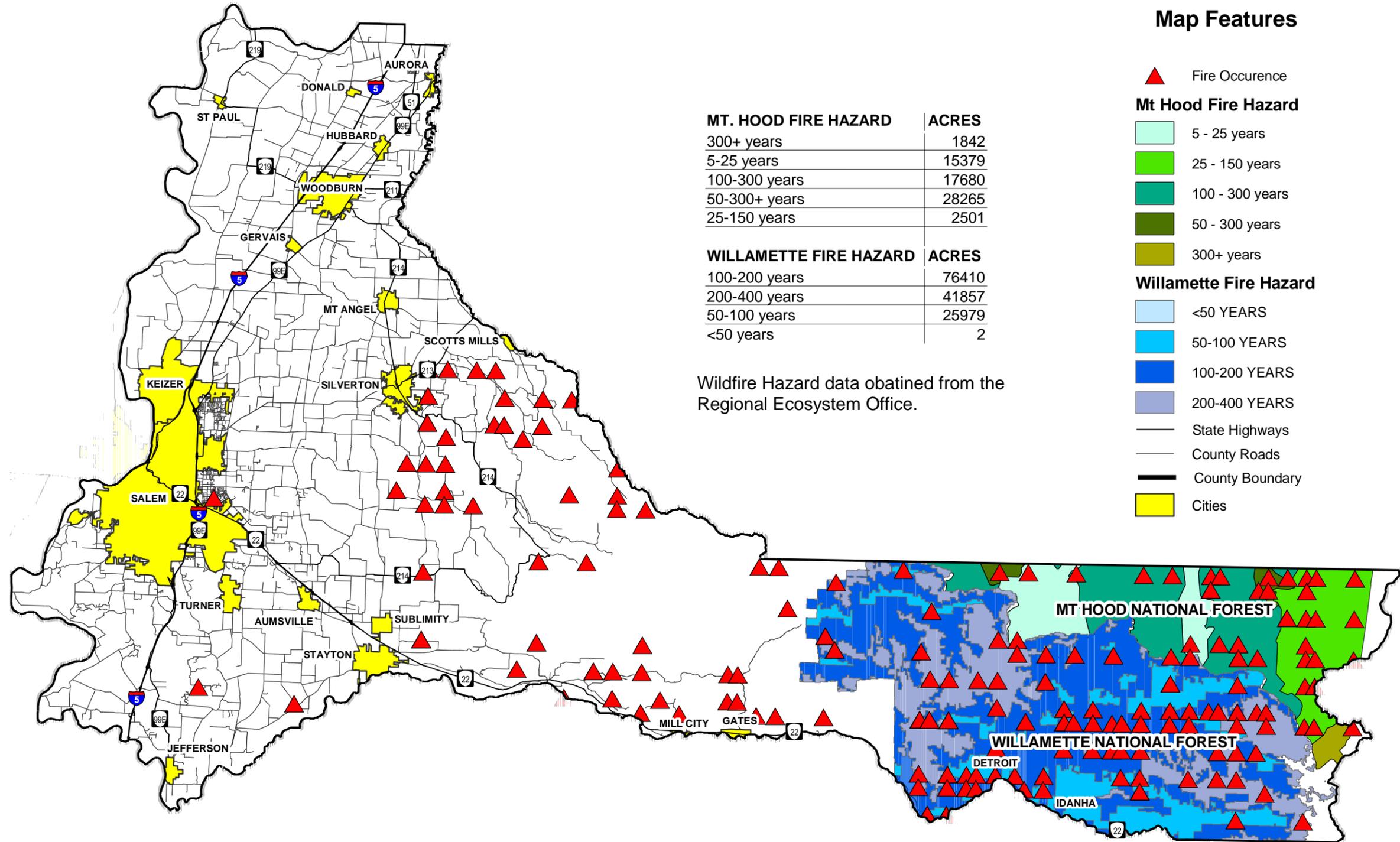
Wildfire Hazard



Date: 05/26/05

Project: U:\GISProjects\Emergency\Hazard\WildfireHazard.mxd

Prepared by: Burnie



Map Features

▲ Fire Occurrence

Mt Hood Fire Hazard

- 5 - 25 years
- 25 - 150 years
- 100 - 300 years
- 50 - 300 years
- 300+ years

Willamette Fire Hazard

- <50 YEARS
- 50-100 YEARS
- 100-200 YEARS
- 200-400 YEARS
- State Highways
- County Roads
- County Boundary
- Cities

MT. HOOD FIRE HAZARD	ACRES
300+ years	1842
5-25 years	15379
100-300 years	17680
50-300+ years	28265
25-150 years	2501

WILLAMETTE FIRE HAZARD	ACRES
100-200 years	76410
200-400 years	41857
50-100 years	25979
<50 years	2

Wildfire Hazard data obtained from the Regional Ecosystem Office.