Washington County
Natural Hazard Mitigation Plan

Washington County and the Cities of:
Tigard and Hillsboro

Volume I: Basic Plan

Prepared for:
Washington County Emergency Management

Prepared by:
University of Oregon
Community Service Center
Oregon Partnership for Disaster Resilience

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Gary Halvorson, Oregon State Archives

August 2016
This Natural Hazard Mitigation Plan was prepared by:

CSC
Community Service Center

With support from:

UNIVERSITY OF OREGON
PPPM
Department of Planning, Public Policy and Management
School of Architecture and Allied Arts

Planning grant funding provided by:

FEMA
Federal Emergency Management Agency (FEMA)
Pre-Disaster Mitigation Program
Grant: EMS-2014-PC-0011
Sub-grant Application Reference: PDMC-PL-10-OR-2015-002

Additional Support Provided by:

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Washington County developed this Multi-Jurisdictional Natural Hazards Mitigation Plan (NHMP or MNHMP) through a regional partnership funded by the Federal Emergency Management Agency’s (FEMA) Pre-Disaster Mitigation (PDM) Competitive Grant Program: EMS-2014-PC-0011, Sub-grant Application Reference: PDMC-PL-10-OR-2014-002. This updated Natural Hazard Mitigation Plan is a collaboration between Washington County and the cities of Tigard and Hillsboro. The county utilized a four-phased planning process, plan templates and plan development support provided by the Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon’s Community Service Center.

Special thanks to Chris Walsh, Washington County Emergency Management Coordinator; Tammy Bain, Hillsboro Emergency Manager; and Mike Lueck, City of Tigard Emergency Services Coordinator for their leadership in convening their respective steering committees.

Washington County NHMP Update Steering Committee

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- Tammy Bain, Hillsboro Emergency Management
- Rocky Brown, Washington County Department of Land Use and Transportation
- Richard Crucchiola, Washington County Department of Land Use and Transportation
- David Gassaway, Washington County Emergency Management
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- Neil Kennedy, Tualatin Valley Water District
- Mike Lueck, Tigard Emergency Management
- Chief Dustin Morrow, Tualatin Valley Fire and Rescue
- Jadene Stensland, Clean Water Services
- Duke Tran, Clean Water Services
- Bob Sanders, Public Works
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- Emily Tritsch, Planning
- Sarah Bruce, Planning

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- Tom Arnold, Public Works
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- Bob Sanders, Public Works
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• Kevin Hanway, Water
• Sophia Hobet, Water
• Greg Mont, Information Services
• Karen Muller, Library
• Greg Nelson, Fire
• Mark Prince, Fire
• Henry Reimann, Police
• Mary Loftin, Parks & Recreation
• Peter Brandon, City Manager’s Office
• Mark Clemons, Economic Development

City of Tigard

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• CPT Robert Rogers, Police
• Tom McGuire, Community Development
• John Goodrich, Water Utilities Manager
• Carin Grover, Citizen at Large

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Additional Thanks:

To Richard Crucchiola, Washington County GIS Analyst, for hazard mapping; to the Department of Geology and Mineral Industries for assistance with hazard data; to the Department of Land Conservation and Development staff for providing flood hazard data, and for mapping and process support; to the Oregon Military Department Office of Emergency Management for grant administration and process support.

About the Community Service Center

The Community Service Center (CSC), a research center affiliated with the Department of Planning, Public Policy, and Management at the University of Oregon, is an interdisciplinary organization that assists Oregon communities by providing planning and technical assistance to help solve local issues and improve the quality of life for Oregon residents. The role of the CSC is to link the skills, expertise, and innovation of higher education with the transportation, economic development, and environmental needs of communities and regions in the State of Oregon, thereby providing service to Oregon and learning opportunities to the students involved.
About the Oregon Partnership for Disaster Resilience

The Oregon Partnership for Disaster Resilience (OPDR) is a coalition of public, private, and professional organizations working collectively toward the mission of creating a disaster-resilient and sustainable state. Developed and coordinated by the Community Service Center at the University of Oregon, the OPDR employs a service-learning model to increase community capacity and enhance disaster safety and resilience statewide.

Plan Template Disclaimer

This Natural Hazards Mitigation Plan is based in part on a plan template developed by the Oregon Partnership for Disaster Resilience. The template is structured to address the requirements contained in 44 CFR 201.6; where language is applicable to communities throughout Oregon, OPDR encourages the use of standardized language. As part of this regional planning initiative, OPDR provided copies of the plan templates to communities for use in developing or updating their natural hazards mitigation plans. OPDR hereby authorizes the use of all content and language provided to Washington County in the plan template.
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Plan Summary

Washington County updated this Multi-Jurisdictional Natural Hazards Mitigation Plan (NHMP, MNHMP, or Plan) in an effort to prepare for the long-term effects resulting from natural hazards. This NHMP affects the unincorporated areas of the county and the incorporated cities of Hillsboro and Tigard. It is impossible to predict exactly when these hazards will occur or the extent to which they will affect the community. However, with careful planning and collaboration among public agencies, private sector organizations, and citizens within the community, it is possible to create a resilient community that will benefit from long-term recovery planning efforts.

The Federal Emergency Management Agency (FEMA) defines mitigation as “. . . the effort to reduce loss of life and property by lessening the impact of disasters . . . through risk analysis, which results in information that provides a foundation for mitigation activities that reduce risk.” Said another way, natural hazard mitigation is a method of permanently reducing or alleviating the losses of life, property, and injuries resulting from natural hazards through long and short-term strategies. Example strategies include policy changes, such as updated ordinances; projects, such as seismic retrofits to critical facilities; and education and outreach to targeted audiences, such as Spanish speaking residents or the elderly. Natural hazard mitigation is the responsibility of the “Whole Community” - individuals, private businesses and industries, state and local governments, and the federal government.

Why Develop this Mitigation Plan?

In addition to establishing a comprehensive community-level mitigation strategy, the Disaster Mitigation Act of 2000 (DMA2K) and the regulations contained in 44 CFR 201 require that jurisdictions maintain an approved Natural Hazard Mitigation Plan (NHMP) in order to receive federal funds for mitigation projects. Local and federal approval of this Plan ensures that the county and listed jurisdictions will remain eligible for pre- and post-disaster mitigation project grants.

What is Mitigation?

“Any sustained action taken to reduce or eliminate long-term risk to life and property from a hazard event.”

- U.S. Federal Emergency Management Agency
Who Participated in Developing the Plan?

The Washington County NHMP is the result of a collaborative effort between the county, cities, special districts, citizens, public agencies, non-profit organizations, the private sector and regional organizations. County and city steering committees guided the plan development process.

The county steering committee included representatives from the following jurisdictions and agencies:

- Washington County
- Clean Water Services
- Tualatin Valley Fire and Rescue
- Tualatin Valley Water District
- City of Hillsboro
- City of Tigard

Washington County Emergency Management and the emergency manager of Hillsboro and the emergency services coordinator for Tigard convened the planning process for their respective jurisdictions and will take the lead in implementing, maintaining and updating the plan. Washington County is dedicated to directly involving the public in the continual review and update of the natural hazards mitigation plan. Although members of the Steering Committee represent the public to some extent, the public will also have the opportunity to continue to provide feedback about the Plan throughout the implementation and maintenance period. Notably, the county invited additional participation in the planning process.

How Does this Mitigation Plan Reduce Risk?

The NHMP is intended to assist Washington County to reduce the risk from natural hazards by identifying resources, information, and strategies for risk reduction. It is also intended to guide and coordinate mitigation activities throughout the county. A risk assessment consists of three phases: hazard identification, vulnerability assessment, and risk analysis, as illustrated in the following graphic.
Figure PS-1 Understanding Risk

![Understanding Risk Diagram]

Source: USGS-Oregon Partnership for Disaster Resilience Research Collaboration, 2006

By identifying and understanding the relationship between natural hazards, vulnerable systems, and existing capacity, Washington County is better equipped to identify and implement actions aimed at reducing the overall risk to natural hazards.

What is Washington County’s Overall Risk to Hazards?

Washington County reviewed and updated their risk assessment to evaluate the probability of each hazard as well as the vulnerability of the community to that hazard. Scores are based on the Washington County Hazard Analysis submitted to the Oregon Office of Emergency Management (2012) and updated by the steering committee in 2015. Table PS-1 below summarizes hazard probability and vulnerability as determined by Washington County (for more information see Section 2, Risk Assessment and Appendix G).

Table PS-1 Risk Assessment Summary

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Probability</th>
<th>Vulnerability</th>
<th>Total Threat Score</th>
<th>Hazard Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought</td>
<td>Moderate</td>
<td>Moderate</td>
<td>155</td>
<td># 5</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Moderate</td>
<td>High</td>
<td>194</td>
<td># 3</td>
</tr>
<tr>
<td>Flood</td>
<td>High</td>
<td>Moderate</td>
<td>173</td>
<td># 4</td>
</tr>
<tr>
<td>Landslide</td>
<td>Low</td>
<td>Low</td>
<td>24</td>
<td># 9</td>
</tr>
<tr>
<td>Volcanic Ash</td>
<td>Low</td>
<td>High</td>
<td>129</td>
<td># 6</td>
</tr>
<tr>
<td>Wildland Fire</td>
<td>Moderate</td>
<td>Moderate</td>
<td>116</td>
<td># 7</td>
</tr>
<tr>
<td>Windstorm</td>
<td>High</td>
<td>High</td>
<td>206</td>
<td># 2</td>
</tr>
<tr>
<td>Tornado</td>
<td>Low</td>
<td>Low</td>
<td>34</td>
<td># 8</td>
</tr>
<tr>
<td>Winter Storm</td>
<td>High</td>
<td>High</td>
<td>240</td>
<td># 1</td>
</tr>
</tbody>
</table>

Source: Washington County NHMP Steering Committee (2015)
What is the Plan’s Mission?

The mission of the Washington County Natural Hazards Mitigation Plan is to:

Reduce risk, prevent loss, and protect life, property, and the environment from natural hazard events.

What are the Plan Goals?

The plan goals describe the overall direction that the participating jurisdiction’s agencies, organizations, and citizens can take toward mitigating risk from natural hazards. Below is a list of the plan goals (Note: although numbered the goals are not prioritized):

**Goal 1:** Minimize loss of life, public and private property damages and the disruption of essential infrastructure and services from natural hazards.

**Goal 2:** Minimize the impact of natural hazards while protecting and restoring the environment.

**Goal 3:** Provide documentation to support effective implementation and increased success in funding opportunities.

**Goal 4:** Engage and motivate the public to invest in natural hazard risk reduction policies and projects.

**Goal 5:** Support the adoption and application of development policies and standards that consider the potential impacts of natural hazards.

**Goal 6:** Increase cooperation and coordination among private entities, and local, state, and federal agencies to mitigate the risks posed by natural hazards.

**Goal 7:** Natural hazard information in local comprehensive plans is up to date and / or reflected through policy and implementing measures.

How are the Action Items Organized?

Priority action items are listed within tables included within Section 3, Mitigation Strategy (full descriptions are provided in Appendix A-1), A list of other actions to be considered is provided in an Action Item Pool (Appendix A-2).

Data collection, research and the public participation process resulted in the development of the action items. The action Items portray the overall plan mitigation strategy. Action items particular to each of the participating cities are included in Section 3, Mitigation Strategy, with each city’s addendum, and within Appendix A-1, and Appendix A-2.
Comprehensive Action Plan

The following tables summarize specific priority NHMP action items. Volume III, Appendix A-1 contains detailed information for all priority action items, including potential partners, implementation ideas, proposed timeline, and estimated budget.

**Table PS-2: Washington County Priority NHMP Actions**

<table>
<thead>
<tr>
<th>Priority Mitigation Actions</th>
<th>Washington County</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participate in the FEMA Risk MAP discovery, multi-hazard risk assessment, and resilience meeting processes.</td>
<td></td>
</tr>
<tr>
<td>Utilize the final multi-hazard risk report and assessment currently being developed by DOGAMI through FEMA's RiskMap program to update the Washington County Hazard Analysis.</td>
<td></td>
</tr>
<tr>
<td>Utilize the final multi-hazard risk report and assessment currently being developed by DOGAMI through FEMA's RiskMap program to inform an update to the Goal 7 Section of the Washington County Comprehensive Plan (Policy 8).</td>
<td></td>
</tr>
<tr>
<td>Update county risk assessment maps for relevant hazards using available LIDAR topographic data in collaboration with the Oregon Department of Geology and Mineral Industries.</td>
<td></td>
</tr>
<tr>
<td>Over the next five years, implement retrofit projects on at least two bridges identified as high-priority on Washington County's bridge assessment list.</td>
<td></td>
</tr>
<tr>
<td>Expand and complete a seismic safety inventory of public buildings (particularly critical and essential facilities) that may be vulnerable to natural hazards (particularly earthquake).</td>
<td></td>
</tr>
<tr>
<td>Continue to implement structural and non-structural retrofit projects of critical and essential facilities. Priority buildings include the Law Enforcement Center and the Walnut Street Center.</td>
<td></td>
</tr>
<tr>
<td>Ensure that the locations of Repetitive and Severe Repetitive Flood Loss Properties have been accurately registered with FEMA and work with affected property owners to remove, relocate, elevate or otherwise mitigate non-conforming structures in flood hazard areas.</td>
<td></td>
</tr>
<tr>
<td>Update the Washington County Community Wildfire Protection Plan (CWPP). Implement actions identified in the CWPP.</td>
<td></td>
</tr>
</tbody>
</table>

### Table PS-3: Hillsboro Priority NHMP Actions

<table>
<thead>
<tr>
<th>Priority Mitigation Actions</th>
<th>City of Hillsboro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop public and private partnerships to foster hazard mitigation activities.</td>
<td></td>
</tr>
<tr>
<td>Develop and/or enhance and implement education programs aimed at mitigating natural hazards and reducing the risk to citizens, private property owners, public agencies, businesses, and schools. Programs will focus on actionable items, such as creation of an emergency supply or home retrofitting.</td>
<td></td>
</tr>
<tr>
<td>Establish liaison with the Hillsboro 2035 Vision Implementation Committee to identify where we might have common interests and activities.</td>
<td></td>
</tr>
<tr>
<td>Identify and pursue funding opportunities to implement mitigation actions.</td>
<td></td>
</tr>
<tr>
<td>Integrate mitigation plan findings into planning and regulatory documents and programs, including the City of Hillsboro Comprehensive Plan.</td>
<td></td>
</tr>
</tbody>
</table>

Source: Hillsboro NHMP Steering Committees (2016)

### Table PS-4: Tigard Priority NHMP Actions

<table>
<thead>
<tr>
<th>Priority Mitigation Actions</th>
<th>City of Tigard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protect existing development in landslide prone areas.</td>
<td></td>
</tr>
<tr>
<td>Improve local capabilities to perform earthquake building safety evaluations and to record and manage building inventory data.</td>
<td></td>
</tr>
<tr>
<td>Integrate the goals and action items from the Tigard Natural Hazard Mitigation Plan Addendum into existing regulatory documents and programs, where appropriate.</td>
<td></td>
</tr>
<tr>
<td>Maintain public and private drainage systems.</td>
<td></td>
</tr>
<tr>
<td>Inventory and map alternative firefighting water sources and encourage the development of additional sources.</td>
<td></td>
</tr>
<tr>
<td>Adopt the Tualatin Valley Fire and Rescue Wildfire Hazard Map and implement the Wildfire Mitigation section of the Oregon Residential Specialty Code</td>
<td></td>
</tr>
<tr>
<td>Increase technical knowledge of natural hazards and mitigation strategies in Tigard and implement policies and programs on the basis of that knowledge.</td>
<td></td>
</tr>
<tr>
<td>Identify critical public infrastructure and facilities located in flood hazard areas and highlight those facilities as a focus for mitigation and preparedness measures.</td>
<td></td>
</tr>
</tbody>
</table>

Source: Tigard NHMP Steering Committees (2016)
How will the plan be implemented?

The plan maintenance section of this NHMP details the formal process that will ensure that the NHMP remains an active and relevant document. The NHMP will be implemented, maintained, and updated by a designated convener. The Washington County Emergency Management Supervisor is the designated convener (Plan Convener) and is responsible for overseeing the review and implementation processes (see city addenda for city conveners).

The NHMP maintenance process includes a schedule for monitoring and evaluating the NHMP semiannually and producing a plan revision every five years. This section also describes how the communities will integrate public participation throughout the plan maintenance process.

Plan Adoption

Once the NHMP is locally reviewed and deemed complete the Convener submits it to the State Hazard Mitigation Officer at the Oregon Military Department – Office of Emergency Management (OEM). OEM reviews the Plan and submits it 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 201.6. Once the NHMP is pre-approved by FEMA, the county and cities formally adopt the NHMP via resolution. The Convener will be responsible for ensuring local adoption of the NHMP and providing the support necessary to ensure plan implementation. Once the resolution is executed at the local level and documentation is provided to FEMA, the NHMP is formally acknowledged by FEMA and the county (and participating cities) will sustain eligibility for the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program funds, and the Flood Mitigation Assistance program funds.

The accomplishment of the NHMP goals and actions depends upon regular steering committee participation and adequate support from county and city leadership. Thorough familiarity with this NHMP will result in the efficient and effective implementation of appropriate mitigation activities and a reduction in the risk and the potential for losses from future natural hazard events.

The steering committees for the county and participating cities each met to review the NHMP update process and their governing bodies adopted the NHMP as shown below:

Washington County adopted the plan on [DATE], 2016
The City of Hillsboro adopted the plan on [DATE], 2016
The City of Tigard adopted the plan on [DATE], 2016
FEMA Region X approved the Washington County NHMP on [DATE], 2016. With approval of this Plan, the entities listed above are now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act’s hazard mitigation project grants through [DATE], 2021.
Washington County has suffered devastating losses from natural disasters. Severe weather events including wind, torrential rain, and ice and snow in 1996, 2007, 2008, and 2015 were declared federal disasters and FEMA provided Public and Individual Assistance to help the county recover. County residents are aware of the potential for economic loss, damaged infrastructure, and loss of life caused by floods, windstorms, and other natural hazards. This Natural Hazard Mitigation Plan (NHMP) seeks to mitigate those losses, or reduce the risk or impact of an event before it occurs.

Section I: Introduction provides a general introduction to natural hazard mitigation planning in Washington County. In addition, it addresses the planning process requirements contained in 44 CFR 201.6(b) thereby meeting the planning process documentation requirement contained in 44 CFR 201.6(c)(1). The section concludes with a general description of how the plan is organized.

What is Natural Hazard Mitigation?

The Federal Emergency Management Agency (FEMA) defines mitigation as “...the effort to reduce loss of life and property by lessening the impact of disasters.”¹ Said another way, natural hazard mitigation is a method of permanently reducing or alleviating the losses of life and damages to property resulting from natural hazards through long and short-term strategies. Example strategies include policy changes such as updated ordinances, projects such as seismic retrofits to critical facilities, and education and outreach to targeted audiences, such as Spanish speaking residents or the elderly. Natural hazard mitigation is the responsibility of the “Whole Community” - individuals, private businesses and industries, state and local governments, and the federal government.

Engaging in mitigation activities provides jurisdictions with a number of benefits, including reduced loss of life, property, essential services, critical facilities and economic hardship; reduced short-term and long-term recovery and reconstruction costs; increased cooperation and communication within the community through the planning process; and increased potential for state and federal funding for recovery and reconstruction projects.

Why Develop a Mitigation Plan?

Washington County developed this Natural Hazards Mitigation Plan (NHMP or Plan) in an effort to reduce future loss of life and damage to property resulting from natural hazards. Natural hazards can impact citizens, property, the environment, and the economy of any community. In Washington County, flooding, landslides, windstorms, severe winter storms, and wildfires have impacted residents, businesses and resources and exposed them to the financial and emotional costs of recovery. The risk associated with natural hazards increases

¹ FEMA, What is Mitigation? http://www.fema.gov/what-mitigation
as more people move to vulnerable areas. The inevitability of natural hazards, and the growing population and activity within the county, create an urgent need to develop strategies, coordinate resources, and increase public awareness to reduce risk and prevent loss from future natural hazard events.

Communities face a number of barriers to implementing natural hazard risk reduction measures. Mitigation plans assist communities reduce risk 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 Washington County; (2) identify and prioritize future mitigation projects; and (3) meet qualifications for federal assistance programs. The mitigation plan works in conjunction with other county plans, including the county comprehensive land use and emergency operations plans.

**Why are we updating the plan now?**

In addition to establishing a comprehensive community-level mitigation strategy, the Disaster Mitigation Act of 2000 (DMA2K) and the regulations contained in 44 CFR 201 require that jurisdictions maintain and periodically update an approved NHMP in order to receive federal funds for mitigation projects. FEMA requires plan updates on a five-year cycle. The Washington County NHMP was last updated in 2010. Local and federal approval of this plan ensures that the county and listed cities will remain eligible for pre- and post-disaster mitigation project grants.

**Who does the mitigation plan affect?**

The Washington County NHMP affects unincorporated urban areas, and the rural, unincorporated areas of the county. In addition, this plan includes the incorporated cities of Hillsboro and Tigard. For that reason, FEMA considers this a “multi-jurisdictional” plan. Notably, the city of Beaverton maintains a “stand-alone” plan. Other cities in Washington County are encouraged to develop local NHMPs or to participate in the county plan during future plan update cycles. The resources and background information in the plan is applicable countywide, and the goals and recommendations can lay the groundwork for local mitigation plans and partnerships.

**What Federal Requirements Does This Plan Address?**

DMA2K is the federal law that addresses mitigation planning. It reinforces the importance of mitigation planning and emphasizes planning for natural hazards before they occur. As such, this Act established the Pre-Disaster Mitigation (PDM) grant program and the post-disaster Hazard Mitigation Grant Program (HMGP). Section 322 of the Act specifically addresses mitigation planning at the state and local levels. State and local jurisdictions must have approved mitigation plans in place in order to qualify to receive PDM, HMGP, and Flood
Mitigation Assistance (FMA) grant funds. Some grant funds can be used to fund hazard mitigation planning projects. Mitigation plans must demonstrate that State and local jurisdictions’ proposed mitigation measures are based on a sound planning process that accounts for the risk to the individual and the capabilities of state and local jurisdictions.

Pursuant of Chapter 44 CFR, the NHMP planning processes shall include public comments on the plan during review, and the updated NHMP shall include documentation of the public planning process used to develop the plan.² The NHMP update must also contain a risk assessment, mitigation strategy, and a plan maintenance process that has been formally adopted by the governing body of the jurisdiction.³ Lastly, the NHMP must be submitted to the Oregon Military Department – Office of Emergency Management (OEM) for initial plan review and then to the Federal Emergency Management Agency (FEMA).⁴ Additionally, a recent change in the way OEM administers the Emergency Management Performance Grant (EMPG), which helps fund local emergency management programs, also requires a FEMA-approved NHMP.

What is the Policy Framework for Natural Hazards Planning 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 challenge faced by state and local governments is to keep this network of local plans coordinated in response to the changing conditions and needs of Oregon communities.

Statewide land use planning Goal 7: Areas Subject to Natural Hazards calls for local plans to include inventories, policies and ordinances to guide development in or away from hazard areas. Goal 7, along with other land use planning goals, has helped to reduce losses from natural hazards. Through risk identification and the recommendation of risk-reduction actions, this plan aligns with the goals of the comprehensive plans for the three jurisdictions and helps each jurisdiction meet the requirements of statewide land use planning Goal 7.

The primary responsibility for the development and implementation of risk reduction strategies and policies lies with local jurisdictions. However, additional resources exist at the state and federal levels. Some of the key agencies in this area include OEM, Oregon Building Codes Division (BCD), Oregon Department of Forestry (ODF), Oregon Department of Geology and Mineral Industries (DOGAMI), and the Department of Land Conservation and Development (DLCD).

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² ibid, subsection (b). 2015
³ ibid, subsection (c). 2015
⁴ ibid, subsection (d). 2015
How was the Plan Developed and Updated?

Washington County originally developed a DMA2K compliant NHMP in 2004. The county partnered with the Community Service Center at the University of Oregon to facilitate the planning process and complete the 2004 plan. In 2010, Washington County hired the consulting firm ECONorthwest to facilitate an update of the 2004 plan. The current plan update is again being completed in collaboration with the Community Service Center at the University of Oregon. The 2015/2016 update is partially funded through a FEMA PDM grant.

This version or the plan was developed by the Washington County NHMP Steering Committee and the steering committees for the cities of Tigard and Hillsboro. The Washington County Steering Committee formally convened on three occasions to discuss and revise the plan. Steering committee members contributed data and maps, and reviewed and updated the community profile, risk assessment, action items, and implementation and maintenance plan.

An open public involvement process is essential to the development of an effective NHMP. In order to develop a comprehensive approach to reducing the effects of natural disasters, the planning process included opportunities for the public, neighboring communities, local and regional agencies, and private and non-profit entities to comment on the NHMP during review. Washington County developed and administered a public survey to kick off the project and solicit input on hazards and risk reduction strategies (see Appendix F for survey results). The county also provided regular updates to emergency management partners through the Washington County Emergency Management Cooperative. Finally, Washington County provided a press release on their websites to encourage the public to offer feedback on the Plan update.

How is the Plan Organized?

Each volume of the Plan provides specific information and resources to assist readers in understanding the hazard-specific issues facing county and city residents, businesses, and the environment. Combined, the sections work in synergy to create a mitigation plan that furthers the community’s mission to reduce or eliminate long-term risk to people and their property from hazards and their effects. This plan structure enables stakeholders to use the section(s) of interest to them.

Volume I: Basic Plan

Plan Summary

The Plan Summary provides an overview of the FEMA requirements, planning process and highlights the key elements of the risk assessment, mitigation strategy, and implementation and maintenance strategy.

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$^5$ Code of Federal Regulations, Chapter 44. Section 201.6, subsection (b). 2015
Section 1: Introduction

The Introduction briefly describes the countywide mitigation planning efforts and the methodology used to develop the Plan.

Section 2: Risk Assessment

The Risk Assessment provides the factual basis for the mitigation strategies contained in Section 3. The Risk Assessment includes a brief description of community sensitivities and vulnerabilities, and characteristics that may be impacted by natural hazards.

A hazards summary is provided for each of the hazards addressed in the NHMP, which includes a hazard characteristic, history, probability assessment, and vulnerabilities. The following hazards are profiled in the Risk Assessment:

- Drought
- Earthquake
- Flood
- Landslide
- Volcano
- Wildland Fire
- Windstorm
- Winter Storm

Additionally, this section provides information on the jurisdictions’ participation in the National Flood Insurance Program (NFIP).

Section 3: Mitigation Strategy

The Mitigation Strategy documents the Plan vision, mission, goals, and mitigation actions and describes the components that guide implementation of the identified actions. Mitigation actions are based on community sensitivity and resilience factors and the Risk Assessment.

Section 4: Implementation and Maintenance

This section provides information on the implementation and maintenance of the NHMP. It describes the process for prioritizing projects and includes a suggested list of tasks for updating the NHMP to be completed at the semi-annual and five-year review meetings.

Volume II: City Addenda

Volume II of the plan includes the addenda for the cities of Hillsboro and Tigard. Previously the cities of Hillsboro and Tigard each had a stand-alone NHMP.

Volume III: Appendices

The resource appendices are designed to provide the users of the Washington County NHMP with additional information to assist them in understanding the contents of the mitigation plan, and provide them with potential resources to assist with plan implementation.
Appendix A: Action Items

This appendix contains the detailed action item forms for each of the mitigation strategies identified in this Plan. Appendix A-1 includes the priority actions for the county and cities, while Appendix A-2 provides a listing of the non-priority actions that the county and cities may opt to include as priority actions during their semi-annual maintenance. Appendix A-3 is a blank action item form to be used as new actions are identified.

Appendix B: Planning and Public Process

This appendix includes documentation of all the countywide public processes utilized to develop the Plan. It includes invitation lists, agendas, sign-in sheets, and summaries of Steering Committee meetings as well as any other public involvement methods.

Appendix C: Community Profile

The Community Profile describes the county and participating cities from a number of perspectives in order to help define and understand the region's sensitivity and resilience to natural hazards. The information in this section represents a snapshot in time of the current sensitivity and resilience factors in the region during this NHMP update.

Appendix D: Economic Analysis of Natural Hazard Mitigation Projects

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

Appendix E: Grant Programs and Resources

This appendix lists hazard-specific state and federal resources and programs.

Appendix F: Community Survey (2015)

This appendix includes the survey instrument and results from the hazards public opinions survey administered by Washington County.

Appendix G: Hazard Analysis

This appendix contains the Washington County Hazard Analysis which was obtained from OEM.
SECTION 2: RISK ASSESSMENT

The Risk Assessment applies to Washington County and the cities of Hillsboro and Tigard. City specific information is called out where relevant. In addition, this chapter can assist with addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. The Risk Assessment satisfies the NHMP plan requirement identified in 44 CFR 201.6(b)(2).

The information presented below, along with information presented in Appendix G: Hazard Analysis and Appendix C: Community Profile, are used to inform the risk reduction actions identified in Section 3: Mitigation Strategy. Understanding Risk is graphically depicted in Figure 2-1 below. Ultimately, the goal of hazard mitigation is to reduce the area where hazards and vulnerable systems overlap.

**Figure 2-1 Understanding Risk**

![Understanding Risk Diagram](source)

Source: Oregon Partnership for Disaster Resilience.

**What is a Risk Assessment?**

A risk assessment consists of three phases: hazard identification, vulnerability assessment, and risk analysis.

- **Phase 1**: Identify hazards that can impact the jurisdiction. This includes an evaluation of potential hazard impacts – type, location, extent, etc.
- **Phase 2**: Identify important community assets and system vulnerabilities. Example vulnerabilities include people, businesses, homes, roads, historic places and drinking water sources.
Phase 3: Evaluate the extent to which the identified hazards overlap with, or have an impact on, the important assets identified by the community.

The following figure illustrates the three-phase risk assessment process:

**Figure 2-2 Three Phases of a Risk Assessment**

The Three Levels of Hazard Assessment

- Community-Wide Hazard Identification
- Community-Wide Vulnerability Assessment
- Risk Analysis


This three-phase approach to developing a risk assessment should be conducted sequentially as each phase builds upon data from prior phases.

**Hazard Identification**

Washington County identifies nine natural hazards that could have an impact on each of the participating jurisdictions. Summary information for each hazard is presented below; additional information pertaining to the types and characteristics of each hazard is available in the Oregon Natural Hazard Mitigation Plan Region 3 Risk Assessment (Tornado is covered within the Windstorm section of the Oregon NHMP). Table 2-1 lists the hazards identified in the county in comparison to the hazards identified in the Oregon NHMP for the Northern Willamette Valley/Portland Metro (Region 2), which includes Washington County.

**Table 2-1 Washington County Hazard Identification**

<table>
<thead>
<tr>
<th>Washington County</th>
<th>State of Oregon NHMP Region 2: Northern Willamette Valley/Portland Metro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought</td>
<td>Drought</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Earthquake</td>
</tr>
<tr>
<td>Flood</td>
<td>Flood</td>
</tr>
<tr>
<td>Landslide</td>
<td>Landslide</td>
</tr>
<tr>
<td>Volcanic Ash</td>
<td>Volcano</td>
</tr>
<tr>
<td>Wildland Fire</td>
<td>Wildfire</td>
</tr>
<tr>
<td>Windstorm</td>
<td>Windstorm</td>
</tr>
<tr>
<td>Tornado</td>
<td>Winter Storm</td>
</tr>
</tbody>
</table>


The following subsections briefly describe relevant information for each hazard. For additional background on the hazards, vulnerabilities and general risk assessment information for hazards in the Northern Willamette Valley/Portland Metro (Region 2) refer to the [State of Oregon NHMP Risk Assessment (2015)](https://www.oregon.gov/OFRD/PRA/PRA mitigation/plan/Pages/region-three-risk-assessment.aspx).
Drought

Characteristics

A drought is a period of drier than normal conditions. Drought occurs in virtually every climatic zone but its characteristics vary significantly from one region to another. Drought is a temporary condition; it differs from aridity, which is restricted to low rainfall regions and is a permanent feature of climate. The extent of drought events depends upon the degree of moisture deficiency and the duration and size of the affected area. Typically, droughts occur as regional events and often affect more than one city and county.

Location and Extent

Drought may occur throughout Washington County and may have profound effects on the economy, particularly the agricultural sector. Drought is typically measured in terms of water availability in a defined geographical area. It is common to express drought with a numerical index that ranks severity. Most federal agencies use the Palmer Method which incorporates precipitation, runoff, evaporation, and soil moisture. However, the Palmer Method does not incorporate snowpack as a variable. Therefore, it is not believed to provide a very accurate indication of drought conditions in Oregon and the Pacific Northwest.

The Surface Water Supply Index (SWSI) from the Natural Resources Conservation Service is an index of current water conditions throughout the state. The index utilizes parameters derived from snow, precipitation, reservoir, and stream flow data. The data is gathered each month from key stations in each basin. The lowest SWSI value, -4.2, indicates extreme drought conditions (Low Surface Water Supply ranges from -1.6 to -4.2). The highest SWSI value, +4.2, indicates extreme wet conditions (High Surface Water Supply ranges from +1.6 to +4.2). The mid-point is 0.0, which indicates an average water supply (Average Water Supply ranges from +1.5 to -1.5).

Figure 2-3 below shows the monthly history of SWSI values from February 1982 to October 2015 for the Willamette Basin which includes Washington County. Research shows that the periods of drought have fluctuated; recent drought periods occurred in 1987, 1992, 1994, 2001, 2003, 2005, and 2015.
Figure 2-3 SWSI Values for the Willamette Basin (1982-2015)

Note: A portion of Washington County is within the North Coast Basin

History

Drought conditions are common in Washington County.

Since the drought profile section is new, all of the drought events have been added to the hazard history list:

- **1904-1905:** A statewide drought period of about 18 months
- **1917-1931:** A very dry period throughout Oregon, punctuated by brief wet spells in 1920-21 and 1927
- **1939-1941:** A three-year intense drought in Oregon
- **1976-1981:** Intense drought in western Oregon; 1976-1977
- **1986:** Drought conditions in Washington County open eligibility for USDA loans.
- **1987:** Drought conditions contributed to job losses in Pacific Northwest timber industry.
- **1990-1991:** Drought conditions lead to USDA payments to impacted farmers.
- **1992:** Formal Governor Declared Determination of State of Drought included Washington County.
- **1999:** Drought conditions open eligibility to non-farm businesses and agricultural cooperatives to receive low-interest loans to assist with financial obligations.
• 2000-2001: Klamath drought intensifies; low snowpack in mountains worsens conditions. Due to lack of water Bonneville Power Administration asked some consumers (industrial and residential) to limit power use. Hagg Lake fell to a record low of 9%, water conservation averted a water crisis.
• 2005: Due to water rationing some farmers cut back production of certain crops including wheat and hay.
• 2007: Farmers in Oregon allowed to use USDA Conservation Reserve Program to expand available land outside of drought stricken counties.
• August 2015: Federal Drought Declaration due low snow pack levels and low water conditions indirectly affected Washington County.

El Niño

El Niño Southern Oscillation (ENSO) weather patterns can increase the frequency and severity of drought. During El Niño periods, alterations in atmospheric pressure in equatorial regions yield an increase in the surface temperature off the west coast of North America. This gradual warming sets off a chain reaction affecting major air and water currents throughout the Pacific Ocean. In the North Pacific, the Jet Stream is pushed north, carrying moisture laden air up and away from its normal landfall along the Pacific Northwest coast. In Oregon, this shift results in reduced precipitation and warmer temperatures, normally experienced several months after the initial onset of the El Niño. These periods tend to last nine to twelve months, after which surface temperatures begin to trend back towards the long-term average. El Niño periods tend to develop between March and June, and peak from December to April. ENSO generally follows a two to seven-year cycle, with El Niño or La Niña periods occurring every three to five years. However, the cycle is highly irregular, and no set pattern exists. According to the National Weather Service, Climate Prediction Center, 21 El Niño episodes have occurred since 1950, with the two most recent strong El Niño episodes occurring in 1997-98 and 2015-16.¹

Future Climate Variability

The region west of the Cascades is experiencing more frequent and severe droughts. Many climate predictions see this trend continuing. Temperatures in the Pacific Northwest region increased in the 20th Century by about 1.5 degrees Fahrenheit and are projected to increasingly rise by an average of 0.2 degrees to 1.0 degrees Fahrenheit per decade. Average temperature change by 2040 is projected to be 3.2 degrees Fahrenheit, and by 2080, 5.3 degrees Fahrenheit. Temperature increases will occur throughout all seasons, with the greatest variation occurring during summer months.²

Probability Assessment

Oregon’s drought history reveals many short-term and a few long-term events. The average recurrence interval for severe droughts in Oregon is somewhere between eight and 12

² Climate Impacts Group, “Climate Change,” http://cses.washington.edu
years. Based on the available data and research for Washington County, the 2015 Hazard Analysis assessed the probability of experiencing a locally severe drought as “moderate,” meaning one incident is likely within the next 35 – 75-year period; this hazard was not profiled in the previous plan.

Vulnerability Assessment

The environmental and economic consequences can be significant, especially for the agricultural sector. Drought also increases the probability of wildfires. Drought can affect all segments of Washington County’s population, particularly those employed in water-dependent activities (e.g., agriculture, recreation, etc.). Also, domestic water-users may be subject to stringent conservation measures (e.g., rationing).

Potential impacts to community and farming water supplies are the greatest threats. Additionally, long-term drought periods of more than a year can impact forest conditions and set the stage for potentially destructive wildfires. The 2015 Hazard Analysis rated the county as having a “moderate” vulnerability to drought hazards, meaning between 1-10% of the region’s population or assets would be affected by a major drought emergency or disaster; this hazard was not profiled in the previous plan.

More information on this hazard can be found within the Hazard Analysis (2015) in Appendix F and in the Risk Assessment for Region 2, Northern Willamette Valley/Portland Metro, of the Oregon NHMP (2015).
**Earthquake**

**Significant Changes since Previous Plan:**

The content of the earthquake hazard section has been reformatted and edited to reference new data and history.

**Characteristics**

The Pacific Northwest in general is susceptible to earthquakes from four sources: 1) the offshore Cascadia Subduction Zone; 2) deep intraplate events within the subducting Juan de Fuca Plate; 3) shallow crustal events within the North American Plate, and 4) earthquakes associated with volcanic activity.

**Location and Extent**

There have been several significant earthquakes in the region; however, all significant events have been located outside of Washington County. Earthquakes historically affecting Washington County include crustal, intraplate, and Cascadia Subduction Zone earthquakes (CSZ). A CSZ earthquake poses the greatest threat to Washington County.

Figure 2-4 shows a generalized geologic map of Washington County and includes the Tualatin-Sherwood, Oatfield, Costco, Gales Creek, and the 30-Mile Portland Hills. These faults have been identified as having a potential to cause crustal fault earthquakes. The earthquakes shown in the figure below are relatively insignificant events below magnitude 4.0. The larger events may have been slightly felt but little to no structural or property damage resulted. Thus, the seismic hazard for the county arises predominantly from major earthquakes on the CSZ. Smaller, crustal earthquakes in or near the county could be locally damaging, but would not be expected to produce widespread or major damage.

The Oregon 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, including active fault identification, bedrock shaking, tsunami inundation zones, ground motion amplification, liquefaction, and earthquake induced landslides. DOGAMI has published a number of seismic hazard maps that are available for communities to use. The maps show liquefaction, ground motion amplification, landslide susceptibility, and relative earthquake hazards. Washington County used DOGAMI’s hazards data and Northern California Earthquake Data Center (NCEDC) data to create a visual map (Figure 2-4) of recent earthquake activity, active faults, and soft soils (liquefaction). The severity of an earthquake is dependent upon a number of factors including: 1) the distance from the earthquake’s source (or epicenter); 2) the ability of the soil and rock to conduct the earthquake’s seismic energy; 3) the degree (i.e., angle) of slope; 4) the composition of slope materials; 5) the magnitude of the earthquake; and 6) the type of earthquake.

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3 NCEDC (2014), Northern California Earthquake Data Center. UC Berkeley Seismological Laboratory. Dataset. doi:10.7932/NCEDC.
For more detailed mapping and analysis, see the following:


Interpretive Map Series: IMS-4, Map showing faults, bedrock, geology, and sediment thickness of western half of the Oregon City 1:100,000 quadrangle, Washington, Multnomah, Clackamas, and Marion Counties, Oregon (1997)

Interpretive Map Series: IMS-15, Earthquake Scenario map for Portland, Oregon metro area (2000)

Interpretive Map Series: IMS-16, Earthquake Scenario and probabilistic ground shaking maps for Portland, Oregon area (2000)

Interpretive Map Series: IMS-024 - Geologic hazards, earthquake and landslide hazard maps, and future earthquake damage estimates for six counties in the Mid/Southern Willamette Valley including Yamhill, Marion, Polk, Washington, Linn, and Lane Counties, and the City of Albany, Oregon, 2008


Open File Report: O-2013-12, 3D geology and shear-wave velocity models of the Portland, Oregon metropolitan area (2013)

Special Papers: SP-29, Earthquake damage in Oregon Preliminary estimates of future earthquake losses (1999)

Additional reports are available via DOGAMI’s Publications Search website: http://www.oregongeology.org/pubs/search.php

Other agency/consultant reports:

Oregon Seismic Safety Policy Advisory Commission Reports:

Oregon Resilience Plan (2013)

History

While Washington County has not experienced any significant earthquakes in the past few decades, earthquakes in Oregon and Washington that have affected the county are listed below\(^4\). There have been no major earthquake events since the previous plan, italicized events were not included in the previous plan:

- January 1700: Offshore, Cascadia Subduction Zone (CSZ)- Approximate 9.0 magnitude earthquake generated a tsunami that struck Oregon, Washington, and Japan; destroyed Native American villages along the coast (additional CSZ events occurred approximately in 1400 BCE, 1050 BCE, 600 BCE, 400, 750, and 900).
- 1877: 5.3 magnitude event in the Portland area.
- November 1962, Portland area, 5.5 magnitude, shaking lasted up to 30 seconds; chimneys cracked; windows broken; furniture moved.
- November 1962: Portland- A 5.2-5.5 magnitude earthquake caused damage to many homes (chimneys, windows, etc.). The earthquake was a crustal event.
- March 1993: Scotts Mills/“Spring Break Quake”- A 5.7 Richter Scale magnitude earthquake caused $27-$30 million in damages to homes, schools, businesses, state buildings (Salem); limited damage in Washington County. Crustal Event (FEMA-985-DR-OR).

Probability Assessment

Washington County is susceptible to deep intraplate events within the CSZ, where the Juan de Fuca Plate is diving beneath the North American Plate, ruptures of the CSZ, and shallow crustal events within the North American Plate.

According to the Oregon NHMP, the return period for the largest of the CSZ earthquakes (Magnitude 9.0+) is 530 years. The most recent CSZ event occurred 314 years ago in January of 1700. The probability of a 9.0+ CSZ event occurring in the next 50 years ranges from 7 - 12%. Notably, 10 - 20 Magnitude 8.3 - 8.5 earthquakes occurred over the past 10,000 years that primarily affected the southern half of Oregon and northern California. The average


The Pacific Northwest Seismic Network: Notable Pacific Northwest Earthquakes since 1993
return period for these events is roughly 240 years. The combined probability of any CSZ earthquake occurring in the next 50 years is 37 - 43%.

Establishing a probability for crustal earthquakes is difficult given the small number of historic events in the region. Earthquakes generated by volcanic activity in Oregon’s Cascade Range are possible, but likewise unpredictable.

Based on the available data and research for Washington County, the 2015 Hazard Analysis determined the probability of experiencing an earthquake is “moderate”, meaning one incident is likely within the next 50-year period; this rating has not changed since the previous plan.

Vulnerability Assessment

The local faults, the county’s proximity to the Cascadia Subduction Zone, potential slope instability, and the prevalence of certain soils subject to liquefaction and amplification combine to give the county a high-risk profile.

Earthquake-induced landslides are possible in areas with steep slopes. Landslide prone areas include the Tualatin Mountains on the northern and eastern county border, the Coast Range on the western border, and the Chehalem Mountains on the southern county border.

At this time, it is assumed that significant Infrastructure, residential, and commercial building damages are expected with a large crustal or CSZ earthquake event. The 2015 Hazard Analysis rated the county as having a “high” vulnerability to earthquake hazards, meaning more than 10% of the region’s population or assets would be affected by a major disaster; this rating has increased since the previous plan.

1999 Assessment (DOGAMI)

Factors included in an assessment of 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.

DOGAMI estimates that when the next CSZ earthquake occurs, “Oregon can expect an estimated 5,000 fatalities and over $30 billion in damages.”

The potential losses from an earthquake in Washington County extend beyond those to human life, homes, property and the landscape. A recent earthquake damage model has not been conducted for Washington County; however, based upon data from a 1999 DOGAMI report rough loss estimates are available. The economic base in Washington County is estimated at $16.552 billion (in 1999 dollars; $23.5 billion in 2015 dollars, ranking it 2 of 36 Oregon counties). It is expected that the county will incur total direct losses valuing $931 million (in 1999 dollars, $1.3 billion in 2015 dollars) for the Cascadia model and $3.8 billion

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5 Oregon NHMP, Region 2: Northern Willamette Valley/ Portland Metro (2015)

6 DOGAMI Winter Cascadia Newsletter (2010)
(in 1999 dollars, $5.4 billion in 2015 dollars) for the 500-year model. The CSZ event direct losses amount to a loss ratio of 3-percent, while the 500-year model event direct losses amount to a loss ratio of 12-percent. 7 Table 2-2 on the next page adjusts the economic loss estimates from DOGAMI’s 1999 report to account for inflation and reflect potential economic loss in 2015 dollars.

While the expected losses have increased due to increased development in the county, as well as inflation, the loss ratio and relative damage for the county is expected to be similar. See table on the following page for more information on expected losses. Local businesses are at substantial risk if an earthquake damages or otherwise necessitates the closure of any of the major transportation routes.

For more information, see: Special Papers: SP-29, Earthquake damage in Oregon Preliminary estimates of future earthquake losses (1999)

DOGAMI is currently conducting a multi-hazard risk assessment (Risk Report) for Washington County. The study is funded through the FEMA Risk MAP program and is expected to be complete in 2017. The Risk Report will provide a quantitative risk assessment that informs communities of their risks related to certain natural hazards (including earthquake). Once complete the county will consider incorporating the risk assessment to provide greater detail to sensitivity and exposure to the earthquake hazard. In addition, the Risk Report will include additional mitigation opportunities that the county may use to update their mitigation strategy (Action Items).

7 Ibid. The loss ratio is determined as a percentage of the expected losses to the county’s economic base.
Table 2-2 Washington County Earthquake Damage Summary

<table>
<thead>
<tr>
<th>Washington County</th>
<th>8.5 Cascadia Subduction Zone Event</th>
<th>500-year model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injuries</td>
<td>555</td>
<td>2,910</td>
</tr>
<tr>
<td>Death</td>
<td>10</td>
<td>62</td>
</tr>
<tr>
<td>Displaced households</td>
<td>2,062</td>
<td>7,666</td>
</tr>
<tr>
<td>Short-term shelter needs</td>
<td>1,284</td>
<td>4,660</td>
</tr>
<tr>
<td>Economic losses for buildings</td>
<td>$931 million/$1.3 billion*</td>
<td>$3.8 billion/$5.4 billion*</td>
</tr>
</tbody>
</table>

**Operational the day after the quake**

<table>
<thead>
<tr>
<th></th>
<th>66%</th>
<th>n/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fires Stations</td>
<td>66%</td>
<td>n/a</td>
</tr>
<tr>
<td>Police Stations</td>
<td>64%</td>
<td>n/a</td>
</tr>
<tr>
<td>Schools</td>
<td>64%</td>
<td>n/a</td>
</tr>
<tr>
<td>Bridges</td>
<td>79%</td>
<td>n/a</td>
</tr>
</tbody>
</table>

**Economic losses to**

<table>
<thead>
<tr>
<th></th>
<th>$15 million/$21.3 million*</th>
<th>$61 million/$86.6 million*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highways</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airports</td>
<td>$5 million/$7.1 million*</td>
<td>$23 million/$32.7 million*</td>
</tr>
</tbody>
</table>

**Communication Systems**

<table>
<thead>
<tr>
<th></th>
<th>$752,000/$1.1 million*</th>
<th>$4 million/$5.7 million*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic losses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating the day of the quake</td>
<td>60%</td>
<td>n/a</td>
</tr>
<tr>
<td>Debris generated (thousands of tons)</td>
<td>763</td>
<td>2,817</td>
</tr>
</tbody>
</table>


Note: * - 1999 dollars were adjusted for inflation to represent estimated economic loss in 2015 dollars (Source: State of Oregon Employment Department Inflation Calculator)

** - These figures have a high degree of uncertainty and should be used only for general planning purposes. Because of rounding, numbers may not add up to 100%. Because the 500 year model includes several earthquakes, the number of facilities operational the "day after" cannot be calculated.

**Rapid Visual Survey (DOGAMI)**

In 2007, DOGAMI completed a rapid visual screening (RVS) of educational and emergency facilities in communities across Oregon, as directed by the Oregon Legislature in Senate Bill 2 (2005). RVS is a technique used by FEMA to identify, inventory, and rank buildings that are potentially vulnerable to seismic events.8 DOGAMI ranked each building surveyed with a ‘low,’ ‘moderate,’ ‘high,’ or ‘very high’ potential for collapse in the event of an earthquake. It is important to note that these rankings represent a probability of collapse based on limited observed and analytical data and are therefore approximate rankings. To fully assess

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a building’s potential for collapse, a more detailed engineering study completed by a qualified professional is required.

DOGAMI surveyed 165 buildings in Washington County (including the incorporated cities). The RVS recommends further study on buildings that were ranked as either ‘high’ or ‘very high’ collapse potential. Facilities within unincorporated Washington County and the cities of Hillsboro and Tigard and with at least one building with a ‘very high’ or ‘high’ potential for collapse are listed below. Additional information can be found within the RVS study on DOGAMI’s website (www.oregongeology.org).

‘Very High’ Collapse Potential

- Peter Boscow Elementary (Hillsboro SD 1J, 452 NE 3rd Ave, Hillsboro)

‘High’ Collapse Potential

- County Emergency Operations Center (Confidential Location)
- Dilley Elementary (Forest Grove SD 15, 4115 SW Dilley Rd, Forest Grove). School is in unincorporated Washington County.
- Tuality Community Hospital (335 SW 8th Ave, Hillsboro). Mitigated per SRGP 2009-10, see Mitigation Successes below.
- Washington County Jail and Sherriff’s Office (215 SW Adams Ave, Hillsboro). Mitigated per SRGP 2013-14, see Mitigation Successes below.
- Brookwood Elementary (Hillsboro SD 1J, 3960 SW Cedar St, Hillsboro)
- David Hill Elementary (Hillsboro SD 1J, 440 SE Oak St, Hillsboro)
- Eastwood Elementary (Hillsboro SD 1J, 2100 NE Lincoln St, Hillsboro)
- J.W. Poynter Middle (Hillsboro SD 1J, 1535 NE Grant St, Hillsboro)
- Glencoe High (Hillsboro SD 1J, 2700 NW Glencoe Rd, Hillsboro)
- Tigard Police Department (13125 SW Hall Blvd, Tigard)
- Durham Elementary (Tigard-Tualatin SD 23J, 8048 SW Shaffer Ln, Tigard)
- James Templeton Elementary (Tigard-Tualatin SD 23J, 9500 SW Murdock St, Tigard)
- Mary Woodward Elementary (Tigard-Tualatin SD 23J, 12325 SW Katherine St, Tigard)
- Thomas R Fowler Middle (Tigard-Tualatin SD 23J, 10865 SW Walnut St, Tigard). Structural mitigation in process, see Mitigation Successes below.
- Twality Middle (Tigard-Tualatin SD 23J, 14650 SW 97th St, Tigard). Mitigated per SRGP 2010-11, see Mitigation Successes below.
- Tigard High (Tigard-Tualatin SD 23J, 9000 SW Durham Rd, Tigard)

A map of all facilities that were assessed is available on DOGAMI’s website.

Mitigation Successes

Seismic retrofit grant awards per the Seismic Rehabilitation Grant Program have been funded to retrofit Thomas R Fowler Middle School (Phase One of 2015-2017 grant award, 

9 The Seismic Rehabilitation Grant Program (SRGP) is a state of Oregon competitive grant program that provides funding for the seismic rehabilitation of critical public buildings, particularly public schools and emergency services facilities.
$1,299,126), and Gaston Elementary School (Phase One of 2015-2017 grant award, $1,493,000).

In addition, the following structures have also had some structural and/ or non-structural seismic retrofitting:

- **Mooberry Elementary School** (Hillsboro SD 1J, 1230 NE 10th Ave), retrofits per local construction bond ($510,000). Main building and kindergarten building. Wall anchorage, cross ties, transfer to shear walls.

- **Washington County Law Enforcement Center** (215 SW Adams St, Hillsboro), retrofits per a SRGP grant (2013-14, $1.5 million, total project cost $4.7 million). Law enforcement personnel wing retrofitted.

- **Charles D. Cameron Public Services Building** (155 N First Ave, Hillsboro), retrofits per local funds allocated by the Board of Commissioners ($17.6 million total cost, $13.75 million from Gain Share revenue). Retrofits are to protect life and safety and to ensure the “immediate occupancy” of the building. For more information visit the county’s website.

- **Tuality Community Hospital** (335 SW 8th Ave, Hillsboro), retrofits per a SRGP grant (2009-10, $1,380,480). Structural improvements made to Building A.

- **North Plains Elementary School** (Hillsboro SD 1J, 32030 NW North Ave, North Plains), retrofits per a SRGP grant (2010-2011, $593,623). Seismic retrofits to life safety standards.

- **Twality Middle School** (Tigard-Tualatin School District 23J, 14650 SW 97th St, Tigard), retrofits per a SRGP grant (2010-2011, $835,750). Modifications made to the both gymnasiums and most of the exterior of the building. Structural reinforcement to tie roof to walls. Re-occupied August 27, 2012.


The Washington County EOP includes a list of all facilities in the county with prioritization listed for post-event evaluation. See Appendix C, **Community Profile**, for a list of the critical facilities and the Washington County EOP for more information on the evaluation prioritization.

More information on this hazard can be found within the Hazard Analysis (2015) in Appendix F and in the Risk Assessment for [Region 2, Northern Willamette Valley/ Portland Metro](#), of the Oregon NHMP (2015).
Flood

**Significant Changes since Previous Plan:**

The Flood Hazard section includes updated national flood insurance program (NFIP) and hazard history information. It has also been reformatted and edited to reference new data.

Characteristics

Flooding results when rain and snowmelt creates water flow that exceeds the carrying capacity of rivers, streams, channels, ditches, and other watercourses. In Oregon, flooding is most common from October through April when storms from the Pacific Ocean bring intense rainfall. Most of Oregon’s destructive natural disasters have been floods. The principal types of flood that occur in Washington County are riverine floods and urban floods. Riverine flooding occurs when rivers and streams overwhelm their banks. Increased development accelerates the risk of urban flooding. Impervious surfaces such as concrete and asphalt collect water at a faster rate than an undeveloped landscape and the resulting runoff can collect in streets, ditches, and basements, impacting county residents on a regular basis.

Location and Extent

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. Flood studies often use historical records, such as streamflow gages, to determine the probability of occurrence for floods of different magnitudes. The probability of occurrence is expressed in percentages as the chance of a flood of a specific extent occurring in any given year.

The magnitude of flood used as the standard for floodplain management in the United States is a flood having a probability of occurrence of one-percent (1%) in any given year. This flood was commonly known as a “100 year flood,” but is now referred to as a Special Flood Hazard Area (SFHA). The most readily available source of information regarding SFHA is the system of Flood Insurance Rate Maps (FIRMs) prepared by FEMA. These maps are used to support the NFIP. The FIRMs show SFHA boundaries for identified flood hazards. These areas are the basis for flood insurance and floodplain management requirements.

Note: Washington County is undergoing a revision of their flood study/mapping. Preliminary maps were provided in 2015. The Letter of Final Determination was provided on May 4, 2016; the maps and the Flood Insurance Study (FIS) will become effective on November 4, 2016. To view the FIS and maps, contact Washington County or the Oregon Risk MAP program. You may also find the FIS at [http://msc.fema.gov/portal/advanceSearch](http://msc.fema.gov/portal/advanceSearch) under Washington County, Pending Products.

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Insert Figure 2-5 Special Flood and Drainage Hazard Area
History

Between the 1850’s and the present, human activity significantly changed the hydrology of the Willamette watershed, including changes to the Tualatin Basin. Flood control systems were constructed throughout the drainage basin. Private and public organizations engaged in the dewatering of wetlands, the draining of floodplains, and diking along some sections of the river. More recently, increasing urbanization has contributed to changes in basin hydrology. Prior to human alteration of the river system, rivers in the region flooded larger areas more often.

There has been one major flood event since the previous plan. *Italicized* events were not included in the previous plan:

- **Dec. 1861**: Willamette Basin and Coastal Rivers - Preceded by two weeks of heavy rain. Every town on the Willamette was flooded or washed away. 635,000 cfs at Portland.
- **Feb. 1890**: Willamette Basin and Coastal Rivers - Second largest known flood in the Willamette Basin. Almost every large bridge washed downstream.
- **Dec. 1933**: Tualatin River at West Linn.
- **Dec. 1937**: Western Oregon - Flooding followed heavy rains. Considerable highway flooding; landslides.
- **Jan. 1953**: Western Oregon - Widespread flooding in western Oregon accompanied by windstorm.
- **Dec. 1964-Jan. 1965**: Willamette Basin - Record flooding throughout Willamette Basin. Two intense storms. Near-record early season snow depths. Largest flood in Oregon since dam construction on upper Willamette (1940s-50s); peak discharge of 320,000 cubic feet per second (cfs) was regulated to a peak of 186,000 cfs. (FEMA-184-DR-OR).
- **Jan. 1972**: Western Oregon – Flooding(FEMA-319-DR-OR)
- **Jan. 1974**: Western Oregon - Flooding followed heavy wet snow and freezing rain. Nine counties received Disaster Declaration. (FEMA-413-DR-OR).
- **Dec. 1978**: Western Oregon - Intense heavy rain, snowmelt, saturated ground.
- **Feb. 1987**: Western Oregon - Willamette River and tributaries. Mudslides damaged highways and homes.
- **Nov. 1996**: Entire State - Record-breaking precipitation; local flooding / landslides. The four-day rainfall total in Hillsboro was 6.70 inches, surpassing the previous record of 5.91 inches set in 1974. Washington County suffered almost $10 million in damage from the event; statewide damages surpassed $280 million. National Flood Insurance Program claims from the event surpassed $2.3 million for the county alone. (FEMA-1107-DR-OR)
- **Dec. 2005 - Jan. 2006**: A very wet series of Pacific systems moved through northwest Oregon and southwest Washington dropping copious amounts of rainfall over the area. During the incident period of time, between 2 and 3 inches of precipitation fell over the Willamette Valley, and between 4 and 5 inches fell over parts of the Coast
and Cascade ranges. This period of heavy rainfall pushed many rivers above bank and most of those above flood stage. Many roads around the area were reported closed due to high water and road workers were busy battling several landslides. Low-lying areas and agricultural lands saw the most damage while multiple road closures were due to flooding over local roads. Oregon Governor Ted Kulongoski declared a state of emergency in 24 of Oregon’s 36 counties. (FEMA-1632-DR-OR, Washington County not included)

- Nov. - Dec. 2006: Similar storm system as the event at the beginning of the year. Washington County was not included in the presidential declaration but residents did experience disruption. (FEMA-1683-DR-OR, Washington County not included)
- Dec. 2007: Torrential rain to the region that caused flooding, landslides, and mudslides. Highway 26 and 6 were closed due to trees and debris blocking the roadway. The most severe impacts of this storm were felt by coastal counties, where hurricane force winds knocked out communications and power lines, and in Columbia County where the town of Vernonia was flooded when the Nehalem River breached its banks. In all, six counties in northwest Oregon, including Washington County, were eligible for federal disaster aid. (FEMA-1733-DR-OR)
- Dec. 2008: Severe winter storm, record or near record snow, landslides, and mudslides. (FEMA-1824-DR-OR)
- Dec. 2012: 25-year flood event caused some county road closures, some homes flooded from groundwater
- December, 2015: Severe Winter Storms, Straight-line Winds, Flooding, Landslides, and Mudslides; A series of subtropical weather systems produced torrential rains and flooding producing impacts in 13 Oregon counties. In Washington County, flood levels on the Tualatin River reached major flood stage on two occasions. Flooding caused many landslides, the inundation of dozens of homes and businesses, restricted or closed over 70 roads, damaged miles of roads and numerous culverts, and caused power outages for thousands of residents. (FEMA-4258-DR-OR)

Probability Assessment

SFHA are defined as the area that will be inundated by the flood event having a one-percent (1%) chance of being equaled or exceeded in any given year. The one-percent (1%) annual chance flood is also referred to as the base flood or 100-year flood. Moderate flood hazard areas are the areas between the limits of the base flood and the 0.2-percent-annual-chance (or 500-year) flood. The areas of minimal flood hazard are the areas outside the SFHA and higher than the elevation of the 0.2-percent-annual-chance flood.¹¹

Based on the available data and research for Washington County, the 2015 Hazard Analysis determined the probability of experiencing a flood is “high”, meaning one incident is likely within the next 10-year period; this rating has not changed since the previous plan.

Vulnerability Assessment

Flooding can occur every year depending on rainfall, snowmelt, or how runoff from development impacts streams and river. Surveys by the Department of Geology and Mineral Industries (DOGAMI), the county, and FEMA have established the SFHA and the county has designated some areas to 4.0-percent-annual-chance flood.

Changes to development patterns since 2010 have the potential to incur increased risk of flooding. However, Metro and county development regulations restrict new development in areas identified as floodplain. This reduces the impact of flooding on future buildings. As new land has been brought into the regional Urban Growth Boundary the applicable development codes have been written to prevent the siting of new structures in flood prone areas.

The floodplains in Washington County are generally located along the Tualatin River and its tributaries. GIS analysis of the tax lot information showing changes in the hazards areas between 2005 and 2009 determined that there were approximately 42,402 acres within the 0.1% SFHA (100-year floodplain) in the county jurisdiction and approximately 60,978 acres within the county Drainage Hazard Areas (as of 2009). DOGAMI is in the process of assessing the flood hazards based on new mapping. Once this is complete the Risk Assessment will be updated to include this information.

In 2007, the county revised the floodplain model to include potential development areas (including portions of the Urban and Rural reserves) and conducted new mapping that clarifies previous floodplain analysis. Due to the expanded flood model, the updated floodplain data reveals a significant increase in the amount of property — both land and buildings — in the floodplain (additional analysis by DOGAMI is expected in 2017 as noted below). As such, the 2015 Hazard Analysis rated the county as having a “moderate” vulnerability to flood hazards, meaning that between 1-10% of the region’s population or assets would be affected by a major disaster; this rating has not changed since the previous plan.

DOGAMI is currently conducting a multi-hazard risk assessment (Risk Report) for Washington County. The study is funded through the FEMA Risk MAP program and is expected to be complete in 2017. The Risk Report will provide a quantitative risk assessment that informs communities of their risks related to certain natural hazards (including flood). Once complete the county will consider incorporating the risk assessment to provide greater detail to sensitivity and exposure to the flood hazard. In addition, the Risk Report will include additional mitigation opportunities that the county may use to update their mitigation strategy (Action Items).

More information on this hazard can be found within the Hazard Analysis (2015) in Appendix F and in the Risk Assessment for Region 2, Northern Willamette Valley/Portland Metro, of the Oregon NHMP (2015).
Landslide

**Significant Changes since Previous Plan:**

The occurrence history for this hazard has been updated as well as the addition of new data. Minor changes to format and content were also made.

**Characteristics**

There are primarily three types of landslides: slides, rock falls, and flows. Some characteristics that determine the type of landslide are slope of the hillside, moisture content, and the nature of the underlying materials. 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. Slides caused by erosion are the most common type of landslide in Washington County. Many recent landslides in the county have primarily been slow moving and caused greatest impact to roads and culverts.

Landslides often occur together with other natural hazards, thereby exacerbating conditions, as described below:

- Shaking due to earthquakes can trigger events ranging from rockfalls and topples to massive slides.
- Intense or prolonged precipitation that causes flooding can also saturate slopes and cause failures leading to landslides.
- Landslides into a reservoir can indirectly compromise dam safety, and a landslide can even affect the dam itself.
- Wildfires can remove vegetation from hillsides, significantly increasing runoff and landslide potential.

**Location and Extent**

The characteristics of the minerals and soils present in Washington County indicate the potential types of hazards that may occur. Rock hardness and soil characteristics can determine whether or not an area will be prone to geologic hazards such as landslides. The four mineral and soil types in Washington County are valley fill and semi-consolidated sedimentary rocks, basaltic lavas, marine sedimentary rocks, and Eocene age volcanic and sedimentary rocks. The surface material includes unconsolidated, fine-grained deposits of Willamette silt, sand, and gravel, and recent floodplain deposits. Areas in the west hills of Portland, and along the western edge of Washington County are prone to landslides and debris flows (see Figure 2-6). The majority of areas that have the densest urban development are in the Tualatin River basin. However, in these areas even moderate slopes can become unstable and trigger a landslide if rain or runoff oversaturates the soil.
Insert Figure 2-6 Landslide Susceptibility Exposure
For Washington County, many high landslide potential areas are in hilly-forested areas. Landslides in these areas may damage or destroy some timber and impact logging roads. Many of the major highways in the county are at risk for landslides at one or more locations with a high potential for road closures and damage to utility lines. In the western portions of the county, with a limited redundancy of the road network, road closures may isolate some communities. In addition to direct landslide damages to roads and highways, affected communities are also subject to the economic impacts of road closures which may disrupt ingress to and egress from communities. Table 2-3 shows landslide susceptibility exposure for Washington County and cities.

Approximately 40% of the county land has High or Very High landslide susceptibility exposure, while the cities generally have less exposure (Tigard has about 40% of its land within the moderate susceptibility exposure category). Washington County cities have very low percentages of high and very high landslide exposure susceptibility.

### Table 2-3 Landslide Susceptibility Exposure

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Area, ft²</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
<th>Very High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washington County</td>
<td>20,258,824,921</td>
<td>31.4%</td>
<td>29.3%</td>
<td>35.3%</td>
<td>4.0%</td>
</tr>
<tr>
<td>Hillsboro</td>
<td>665,310,594</td>
<td>81.6%</td>
<td>16.3%</td>
<td>2.1%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Tigard</td>
<td>329,116,905</td>
<td>54.0%</td>
<td>40.1%</td>
<td>5.8%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>


DOGAMI is currently conducting a multi-hazard risk assessment (Risk Report) for Washington County. The study is funded through the FEMA Risk MAP program and is expected to be complete in 2017. The Risk Report will provide a quantitative risk assessment that informs communities of their risks related to certain natural hazards (including landslide). Once complete the county will consider incorporating the risk assessment to provide greater detail to sensitivity and exposure to the landslide hazard. In addition, the Risk Report will include additional mitigation opportunities that the county may use to update their mitigation strategy (Action Items).

For more information, refer to the following report and maps provided by DOGAMI:

- **Open File Report: O-08-09, Regional landslide hazard maps of the Southwest Quarter of the Beaverton quadrangle, West Bull Mountain planning area (2008)**
- **Interpretive Map Series: IMS-27, Landslide inventory map of the Southwest Quarter of the Beaverton quadrangle (2009)**
- **Interpretive Map Series: IMS-29, Landslide inventory maps of the Canby quadrangle (2009)**
- **Interpretive Map Series: IMS-32, Landslide inventory maps of the Lake Oswego quadrangle (2010)**
- **Interpretive Map Series: IMS-34, Landslide inventory maps of the Beaverton quadrangle (2011)**
- **Interpretive Map Series: IMS-35, Landslide inventory maps of the Linnton quadrangle (2011)**
• Interpretive Map Series: IMS-37, Landslide inventory maps of the Scholls quadrangle (2012)
• Interpretive Map Series: IMS-39, Landslide inventory maps of the Forest Grove quadrangle (2012)
• Interpretive Map Series: IMS-40, Landslide inventory maps of the Sauvie Island quadrangle (2012)
• Interpretive Map Series: IMS-41, Landslide inventory maps of the Mt. Tabor quadrangle (2012)
• Interpretive Map Series: IMS-44, Landslide inventory maps of the Dixie Mountain quadrangle (2012)
• Interpretive Map Series: IMS-45, Landslide inventory maps of the Vancouver quadrangle (2012)
• Interpretive Map Series: IMS-46, Landslide inventory maps of the Gales Creek quadrangle (2012)
• Interpretive Map Series: IMS-47, Landslide inventory maps of the Hillsboro quadrangle (2012)
• Interpretive Map Series: IMS-50, Landslide inventory maps of the Sherwood quadrangle (2012)
• Interpretive Map Series: IMS-53, Inventory of landslide deposits from light detection and ranging (lidar) imagery of the Portland metropolitan region (2012)

Additional reports are available via DOGAMI’s Publications Search website: http://www.oregongeology.org/pubs/search.php

History

Debris flows and landslides are a very common occurrence in hilly areas of the county. Many landslides occur in undeveloped areas and thus may go unnoticed or unreported. For example, DOGAMI conducted a statewide survey of landslides from four winter storms in 1996 and 1997 and found 9,582 documented landslides, with the actual number of landslides estimated to be many times the documented number. For the most part, landslides become a problem only when they impact developed areas and have the potential to damage buildings, roads, or utilities. Figure 2-6 shows the landslide susceptibility for the county. For additional information see the Statewide Landslide Information Database for Oregon.

Below are listed the most severe landslide events. One landslide event has been added since the previous plan (italicized):

• Dec. 3 1996: Washington County’s most recent severe major landslide event occurred when a large landslide prompted officials to close Dixie Mountain Road. This closure impacted local Christmas tree farms and forced area residents to take detours of up to 16 miles. No homes were directly in the path, although county analysis records 260 tax lots in the vicinity of the slide area and nearby hills.
• Dec. 2015: Severe Winter Storms, Straight-line Winds, Flooding, Landslides, and Mudslides; A landslide in the western portion of Washington County west of Hagg Lake caused significant damage to Scoggins Valley Rd. The closure of the road forced residents to take extremely long remote routes to commute to work and access local
communities while logging companies had to take long remote routes to haul timber to their facilities. (FEMA-4258-DR-OR)

Probability Assessment

The probability of rapidly moving landslides occurring depends on a number of factors including: steepness of slope, slope materials, local geology, vegetative cover, human activity, and water. There is a strong correlation between intensive winter rainstorms and the occurrence of rapidly moving landslides (debris flows). Many slower moving slides present in developed areas have been identified and mapped; however, the probability and timing of their movement is difficult to quantify. The installation of slope indicators or the use of more advanced measuring techniques could provide information on these slower moving slides.

Based on the available data and research for Washington County, the 2015 Hazard Analysis determined the probability of experiencing a landslide is “low”, meaning one incident is likely within the next 100-year period; this rating has not changed since the previous plan.

Vulnerabilities

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 local 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.

Roads and bridges are subject to closure during landslide events. Because many Washington County residents are dependent on roads and bridges for travel to work, delays and detours are likely to have an economic impact on county residents and businesses.

At the time of this update, sufficient data was not available to determine the landslide vulnerability of existing buildings, infrastructure, or critical infrastructure. However, locations vulnerable to landslides or debris flows include areas with one or more of the following conditions:

- On or close to steep hills including 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.
As such, the 2015 Hazard Analysis rated the county as having a “low” vulnerability to landslide hazards, meaning that less than 1% of the region’s population or assets would be affected by a major disaster; this rating has not changed since the previous plan.

More information on this hazard can be found within the Hazard Analysis (2015) in Appendix F and in the Risk Assessment for Region 2, Northern Willamette Valley/Portland Metro, of the Oregon NHMP (2015).
Volcano

**Significant Changes since Previous Plan:**
The Volcano Hazard has been reformatted and edited. There has been no new available data and no recent history.

**Characteristics**

The Pacific Northwest is 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.

The primary threat to lives and property from active volcanoes is from violent eruptions that unleash tremendous blast forces, generate mud and debris flows, or 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. In Washington County, ash fall from a nearby volcano represents a hazard to health and infrastructure.

**Location and Extent**

Due to Washington County’s proximity to nearby volcanoes, volcanic hazards such as lava flows, lahars, and debris flows do not pose a threat. However, volcanic ash from an eruption can contaminate water supplies, cause electrical storms, create health problems, and clog conveyance systems. Additionally, lahars (mudflows) from Mount Hood can cause the loss of potable water supply for the county from the Bull Run Watershed.

Washington County is located on the Pacific Rim. Tectonic movement within the earth's crust can renew nearby dormant volcanoes resulting in ash fallout. Volcanic activity is possible from Mount Hood and Mount Saint Helens, Three Sisters, Mount Bachelor, and the Newberry Crater areas. Because the distance to these potentially active volcanic areas is so great, the only adverse effect that would impact areas of Washington County is ash fallout, with perhaps some impact on water supplies. The area affected by ash fallout depends upon the height attained by the eruption column and the atmospheric conditions at the time of the eruption.

Geologic hazard maps have been created for most of the volcanoes in the Cascade Range by the USGS Volcano Program at the Cascade Volcano Observatory in Vancouver, WA and are available at [http://vulcan.wr.usgs.gov/Publications/hazards_reports.html](http://vulcan.wr.usgs.gov/Publications/hazards_reports.html).

Scientists use wind direction to predict areas that might be affected by volcanic ash; during an eruption that emits ash, the ash fall deposition is controlled by the prevailing wind direction. The predominant wind pattern over the Cascades originates from the west and previous eruptions seen in the geologic record have resulted in most ash fall drifting to the east of the volcanoes. Regional tephra fall shows the annual probability of ten centimeters or more of ash accumulation from Pacific Northwest volcanoes. Figure 2-7 depicts the potential and geographical extent of volcanic ash fall in excess of ten centimeters from a large eruption of Mt. St. Helens.
Figure 2-7 Regional Tephra-fall Maps

Annual probability of the deposition of 1 cm or more (left map) and 10 cm or more (right map) of tephra from any of the major Cascade volcanoes (black triangles).

Source: United States Geological Survey-Cascades Volcano Observatory (CVO), (Figure assembled by OPDR)

History

Mount Hood and Mount St. Helens are two active volcanoes in the vicinity of Washington County. Mount Hood is east of Washington County and has had two significant eruptive periods, one about 1,500 years ago and another about 200 years ago. Mount St. Helens is located in southern Washington State. In the past 200 years, seven of the Cascade volcanoes have erupted, including (from north to south): Mt. Baker, Glacier Peak, Mt. Rainier, Mt. Saint Helens, Mt. Hood, Mt. Shasta, and Mt. Lassen. There is no recent geologic history of volcanic impacts in Washington County and the probability of future events is very low.

There has been no recent volcanic activity in close proximity to the county. The 1980 explosion of Mt. Saint Helens is the latest on record and both Mt. Saint Helens and Mt. Hood remain listed as active volcanoes.

Probability Assessment

The United States Geological Survey-Cascades Volcano Observatory (CVO) produced volcanic hazard zonation reports for Mt. Saint Helens and Mt. Hood in 1995 and 1997. The reports include a description of potential hazards that may occur to immediate
communities. The CVO created an updated annual probability of tephra (ash) fall map for the Cascade region in 2001, which demonstrates the potential tephra hazard for Washington County (Figure 2-7). The map identifies the location and extent of the hazard.

The CVO Volcanic tephra fall map is based on the combined likelihood of tephra-producing eruptions occurring at Cascade volcanoes. Probability zones extend farther east of the range because winds blow from westerly directions most of the time. The map shows annual probabilities for a fall of one centimeter (about 0.4 inch). The patterns on the map show the dominating influence of Mt. Saint Helens as a tephra producer. Because small eruptions are more numerous than large eruptions, the probability of a thick tephra fall at a given locality is lower than that of a thin tephra fall. The annual probability of a fall of one centimeter or more of tephra is about 1 in 10,000 for Washington County. This is small when compared to other risks faced by the county. The USGS map on the previous page (Figure 2-7) illustrates potential tephra fall in the region.

Based on the available data and research for Washington County the 2015 Hazard Analysis determined the probability of experiencing a volcano is “low”, meaning one incident is likely within the next 100-year period; this rating has not changed since the previous plan.

Vulnerabilities

Though unlikely, the impacts of a significant ash fall are substantial. Persons with respiratory problems are endangered; transportation, communications, and other lifeline services are interrupted; drainage systems become overloaded/clogged; buildings can become structurally threatened; and economic disruptions are possible from short-term business closures. Any future eruption of a nearby volcano (e.g., Mt. Hood, Mt. Saint Helens, or Mt. Adams) occurring during a period of easterly winds would likely have adverse consequences for the county.

At the time of this update, sufficient data was not available to determine volcanic eruption vulnerability in terms of explicit types and numbers of existing buildings, infrastructure, or critical infrastructure.

As such, the 2015 Hazard Analysis rated the county as having a “high” vulnerability to volcano hazards, meaning that more than 10% of the region’s population or assets would be affected by a major disaster (volcanic ash); this rating has not changed since the previous plan.

More information on this hazard can be found within the Hazard Analysis (2015) in Appendix F and in the Risk Assessment for Region 2, Northern Willamette Valley/Portland Metro, of the Oregon NHMP (2015).
Wildland Fire

Significant Changes since Previous Plan:
The occurrence history for this hazard has been updated as well as the probability rating. The existing Community Wildfire Protection Plan (2007) is scheduled to be updated. When the CWPP is updated it should be incorporated into this plan. In addition, the format of the section and minor content changes have occurred.

Characteristics

A wildland fire is a type of wildfire that spreads through consumption of vegetation. Wildfires occur in areas with large amounts of flammable vegetation that require a suppression response due to uncontrolled burning. Fire is an essential part of Oregon’s ecosystem, but can also pose a serious threat to life and property particularly in the state’s growing rural communities. Wildfire can be divided into three categories: interface, wildland, and firestorms. The increase in residential development in interface areas has resulted in greater wildfire risk. Fire has historically been a natural wildland element and can sweep through vegetation that is adjacent to a combustible home. New residents in remote locations are often surprised to learn that in moving away from built-up urban areas, they have also left behind readily available fire services providing structural protection.

The following three factors contribute significantly to wildland fire behavior and can be used to identify wildland fire hazard areas.

Topography: As slope increases, the rate of wildland fire spread increases. South-facing slopes are also subject to more solar radiation, making them drier and thereby intensifying wildland fire behavior. However, ridgetops may mark the end of wildland fire spread, since fire spreads more slowly or may even be unable to spread downhill.

Fuel: The type and condition of vegetation plays a significant role in the occurrence and spread of wildland fires. Certain types of plants are more susceptible to burning or will burn with greater intensity. Dense or overgrown vegetation increases the amount of combustible material available to fuel the fire (referred to as the “fuel load”). The ratio of living to dead plant matter is also important. The risk of fire is increased significantly during periods of prolonged drought as the moisture content of both living and dead plant matter decreases. The fuel’s continuity, both horizontally and vertically, is also an important factor.

Weather: The most variable factor affecting wildland fire behavior is weather. Temperature, humidity, wind, and lightning can affect chances for ignition and spread of fire. Extreme weather, such as high temperatures and low humidity, can lead to extreme wildland fire activity. By contrast, cooling and higher humidity often signals reduced wildland fire occurrence and easier containment. The frequency and severity of wildland fires is also dependent upon other hazards, such as lightning, drought, equipment use, railroads, recreation use, arson, and infestations.
If not promptly controlled, wildland fires may grow into an emergency or disaster. Even small fires can threaten lives and resources and destroy improved properties. In addition to affecting people, wildland fires may severely affect livestock and pets. Such events may require emergency watering, feeding, evacuation, and shelter.

The indirect effects of wildland fires can be catastrophic. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways, and the land itself. Soil exposed to intense heat may lose its capability to absorb moisture and support life. Exposed soils erode quickly and enhance siltation of rivers and streams, thereby enhancing flood potential, harming aquatic life, and degrading water quality. Lands stripped of vegetation are also subject to increased debris flow hazards, as described above.

### Location and Extent

Wildfire hazard areas are commonly identified in regions of the Wildland-Urban Interface (WUI). The interface is the urban-rural fringe where homes and other structures are built into a densely forested or natural landscape. If left unchecked, it is likely that fires in these areas will threaten lives and property. One challenge Washington County faces is from the increasing number of houses being built in the urban/rural fringe as compared to twenty years ago. The “interface” between urban or suburban areas and the resource lands has significantly increased the threat to life and property from fires. Responding to fires in the expanding WUI area may tax existing fire protection systems beyond original design or current capability.

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 and control, such as the surrounding fuel load, weather, topography, and property characteristics.

Fire susceptibility throughout the county dramatically increases in late summer and early autumn as summer thunderstorms with lightning strikes increase and vegetation dries out, decreasing plant moisture content and increasing the ratio of dead fuel to living fuel. However, various other factors including humidity, wind speed and direction, fuel load and fuel type, and topography can contribute to the intensity and spread of wildland fire. In addition, common causes of wildland fires include arson and negligence from industrial and recreational activities.
Insert Figure 2-8 Wildland Fire Hazard Areas
History

Washington County has not directly experienced a significant wildfire event in the last 50 years; however, this does not mean that the county is at low risk. In fact, many of the fire professionals in Washington County believe the question is not “if” there will be a large fire in this area; it is “when.” Two wildfires occurred along the county’s western edge, however they were predominately in Tillamook County. Smaller wildfires occasionally occur in the county, including the Scoggins Creek Wildfire (see below).

One wildfire event have been added since the previous plan (italics):

- 1933: The Tillamook Burn covered 240,000 acres.
- 1945: The “3rd Tillamook Burn” covered 173,000 acres.
- Sep. 2014: Scoggins Creek Wildfire, six miles west of Forest Grove, 211 acres, included home evacuations.

Probability Assessment

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). Once a fire has started, several conditions influence its behavior, including fuel, topography, weather, drought, and development.

Based on the available data and research for Washington County the 2015 Hazard Analysis determined the probability of experiencing a wildland fire is “moderate”, meaning one incident is likely within the next 50-year period; this rating has not changed since the previous plan.

Vulnerability Assessment

The 2007 Washington County Community Wildfire Protection Plan profiles 33 communities, three (3) of which (Buxton, Cherry Grove, and Gales Creek) are included in Federal Register, Vol. 66, Number 160, Friday, August 17, 2001 as “Urban Wildland Interface communities within the vicinity of Federal Lands that are at high risk from wildfires”.

The CWPP development process included an analysis of Washington County’s fire hazard risk. Field visits and discussions with area residents and fire control specialists provided insights into forest health issues and treatment options. This information was mapped and evaluated to develop an assessment of wildland fire risk in the region. Table 2-4 and Figure 2-8 from the CWPP inventories the fire prone landscapes in the county to identify the location and extent of the wildfire hazard.

The risk category values developed in this analysis should be considered ordinal data, that is, while the values presented have a meaningful ranking, they neither have a true zero point nor scale between numbers. Rating in the “40” range is not necessarily twice as “risky” as rating in the “20” range. These category values also do not correspond to a rate of fire spread, a fuel loading indicator, or measurable potential fire intensity. Each of those scales is greatly influenced by weather, seasonal and daily variations in moisture (relative humidity), solar radiation, and other factors. The risk rating presented here serves to identify where
certain constant variables are present, aiding in identifying where fires typically spread into the largest fires across the landscape.

The CWPP provides an extensive Fire Hazard risk assessment see Washington County CWPP for more information.

**Table 2-4 Fire prone landscape acres in each category for Washington County**

<table>
<thead>
<tr>
<th>Color Code</th>
<th>Value</th>
<th>Total Acres</th>
<th>Percent of Total Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>14</td>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>10</td>
<td>9,351</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>73,892</td>
<td>16%</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>101,387</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>41,424</td>
<td>9%</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>95,224</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>114,316</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>27,441</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>1,813</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>29</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>-</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>


Washington County is in the planning stages of updating their CWPP. The update of the CWPP will include minor updates to the Risk Assessment, mitigation activities, and highest priority areas. When complete the updated CWPP shall be incorporated into this NHMP by reference. For more information on wildfire risk and fuels reduction projects see the Washington County CWPP.

DOGAMI is currently conducting a multi-hazard risk assessment (Risk Report) for Washington County. The study is funded through the FEMA Risk MAP program and is expected to be complete in 2017. The Risk Report will provide a quantitative risk assessment that informs communities of their risks related to certain natural hazards (including wildland fire). Once complete the county will consider incorporating the risk assessment to provide greater detail to sensitivity and exposure to the wildland fire hazard. In addition, the Risk Report will include additional mitigation opportunities that the county may use to update their mitigation strategy (Action Items).

As such, the 2015 Hazard Analysis rated the county as having a “moderate" vulnerability to wildland fire hazards, meaning that between 1-10% of the region’s population or assets would be affected by a major disaster; this rating has not changed since the previous plan.

More information on this hazard can be found within the Hazard Analysis (2015) in Appendix F and in the Risk Assessment for Region 2, Northern Willamette Valley/ Portland Metro, of the Oregon NHMP (2015).
Windstorm

**Significant Changes since Previous Plan:**

The Windstorm hazard has been reformatted and edited to reference new data and hazard history.

**Characteristics**

A windstorm is generally a short duration event involving straight-line winds or gusts in excess of 50 mph. The most persistent high winds take place along the Oregon Coast and in the Columbia River Gorge. The most impactful winds experienced in Washington County are the result of low pressure weather systems that form over the Pacific Ocean and make landfall on the Oregon Coast.

Though tornadoes are not common in Oregon, these events do occasionally occur and sometime produce significant property damage and even injury. They have been reported in most of the regions throughout the state since 1887. Most of them are caused by intense local thunderstorms common between April and October.

**Location and Extent**

The most common source for damaging winds in Washington County is from strong frontal boundaries associated with large-scale weather systems that develop in the eastern Pacific Ocean. In general, higher elevations experience stronger winds than areas in low lying valley floors. As a result, the following areas tend to experience the strongest winds: western portions of the county in the Coast Range, northern and eastern areas within the Tualatin Mountains, southern areas in the Chehalem Mountains, and Bull Mountain / Little Bull Mountain in the southeastern portion of the county.

Although windstorms can affect the entirety of the county, they are especially dangerous in developed areas with significant tree stands and major infrastructure, especially above ground utility lines. A windstorm will frequently knock down trees and power lines, damage homes, businesses, and public facilities, and create tons of storm related debris.

**History**

The Columbus Day windstorm in 1962 was the most destructive storm to ever occur in Oregon in recorded history, both in loss of life and property damage. The storm killed thirty-eight people and did upwards of $200 million in damage. 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. Entire fruit and nut orchards were destroyed and livestock killed as barns and trees blew over onto animals. Intense wind speeds were recorded in the metropolitan areas with gusts of 116 mph on the Portland Morrison Bridge and peak gusts in Hillsboro of 90mph.

November 1981 saw two successive windstorms on November 13 and 14. Wind gusts in Portland were recorded at 71 mph on the first day and 57 mph on the second day. Eleven
people were killed and $50 million in damages were reported as a result of the two storms. Estimates indicated that nearly 500,000 homes were without power for at least a short time during the weekend. Many airports across Oregon and Washington suffered damage.

The December 8, 1993 tornado near Newberg was the most powerful tornado in Oregon in many years. A dairy farm was damaged, roofs were blown off some small buildings, and many trees were broken. People reported that the funnel was sucking water from the Willamette River as it moved northeast and severely damaged a mobile home park.

On December 12, 1995 a large low pressure system hit Washington County. Gusts of over 100 mph occurred along the coast while gusts in the Willamette Valley exceeded 60 mph. Hundreds of thousands of people in the state lost power and there was widespread damage to homes, buildings, and boats. The damage resulted in a presidential disaster declaration. Four Oregonians lost their lives during the storm.

Five windstorm event were added to this hazard history section since the previous plan (Italics, including three events that occurred before 2010):

- Jan. 2006: Windstorm with winds up to 58 mph. Regional damage at $500,000.
- Feb. 2006: Windstorm causes regional damages over $500,000.
- July 2007: Windstorm affected the county, 58 mph winds.
- Sep. 2014: Windstorm caused approximately 2,600 power outages and blocked road due to fallen trees.

**Probability Assessment**

Windstorms in the county usually occur in the winter from October to March, and their extent is determined by their track, intensity (the air pressure gradient they generate), and local terrain. Summer thunderstorms may also bring high winds along with heavy rain and hail. The National Weather Service uses weather forecast models to predict oncoming windstorms while monitoring storms with weather stations in protected valley locations throughout Oregon.

The table below shows the wind speed probability intervals that structures 33 feet above the ground would expect to be exposed to within a 25, 50, and 100-year period. The table shows that structures in Region 2, which includes the county, can expect to be exposed to 65 mph winds in a 25-year recurrence interval (4% annual probability).

**Table 2-5 Probability of Severe Wind Events by NHMP Region**

<table>
<thead>
<tr>
<th>Region 2:</th>
<th>25-Year Event (4% annual probability)</th>
<th>50-Year Event (2% annual probability)</th>
<th>100-Year Event (1% annual probability)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Willamette Valley</td>
<td>65 mph</td>
<td>72 mph</td>
<td>80 mph</td>
</tr>
</tbody>
</table>

Source: Oregon State Natural Hazard Mitigation Plan, 2009

Based on the available data and research for Washington County, the 2015 Hazard Analysis determined the **probability of experiencing a windstorm is “high”**, meaning one incident is likely within the next 10-year period; **this rating has not changed since the previous plan.**
The Washington County 2015 Hazard Analysis determined the probability of experiencing a tornado (a specific type of windstorm) is “low”, meaning one incident is likely within the next 100-year period; this rating has not changed since the previous plan.

**Vulnerabilities**

Given current available data, no quantitative assessment of the risk of windstorm was possible at the time of this NHMP update. However, assessing the risk to the county from winter and windstorms should remain an ongoing process determined by community characteristics and physical vulnerabilities. Weather forecasting can give county resources (emergency vehicles, warming shelters) time to prepare for an impending storm but the changing character of the county population and resources will determine the impact of winter and wind storms on life and property in Washington County.

Old or poorly constructed structures are vulnerable to strong winds and can be heavily damaged. Well built and newly constructed structures are more resilient to strong wind events, although the entire built environment is vulnerable high winds and may experience varying degrees of damage.

When severe windstorms strike a community, downed trees, power lines, and damaged property can be major hindrances to emergency response and disaster recovery. Debris carried along by extreme winds can directly contribute to injuries or loss of life and indirectly to the failure of protective building envelopes, siding, or walls of buildings. Storm winds can damage buildings, power lines, and other property and infrastructure by means of falling trees and branches. During wet winters, saturated soils cause trees to become less stable and more vulnerable to uprooting from high winds.

The 2015 Hazard Analysis rated the county as having a “high” vulnerability to windstorm hazards, meaning that more than 10% of the region’s population or assets would be affected by a major disaster; this rating has not changed since the previous plan.

The 2015 Hazard Analysis rated the county as having a “low” vulnerability to tornado hazards (a specific type of windstorm), meaning that less than 1% of the region’s population or assets would be affected by a major disaster; this rating has decreased since the previous plan.

More information on this hazard can be found within the Hazard Analysis (2015) in Appendix F and in the Risk Assessment for Region 2, Northern Willamette Valley/Portland Metro, of the Oregon NHMP (2015).
**Winter Storm**

**Significant Changes since Previous Plan:**

The occurrence history for this hazard has been updated as well as the probability rating. In addition, the format of the section and minor content changes have occurred.

**Characteristics**

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, and can affect the county from the northwest and southeast and from the Columbia River Gorge. Severe winter storms affecting Washington County typically originate in the Gulf of Alaska and in the central Pacific Ocean and are most common from October through March.

Severe winter storms pose a significant risk to life and property in Washington 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 blowing out of the Columbia River Gorge. Severe freezes, where high temperatures remain below freezing for five or more days, occur every three to five years in Washington County. Severe or prolonged snow events occur less frequently, but have widespread impacts on people and property in the county.

**Location and Extent**

Ice storms occasionally occur in northern areas of Oregon, resulting from cold air flowing westward through the Columbia Gorge. 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. The Gorge is the most significant east-west air passage through the Cascades. Rain arriving from the west can fall on frozen streets, cars, and other sub-freezing surfaces, creating dangerous conditions.

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. Washington County is located within Zone 2: Willamette Valley. The climate in Zone 2...
generally consists of cool, wet winters and warm, dry summers.\textsuperscript{12} These wet winters result in potentially destructive winter storms that produce heavy snow, ice, rain and freezing rain, and high winds.

\textbf{Figure 2-9 Oregon Climate Divisions}

\begin{figure}
\centering
\includegraphics[width=\textwidth]{Oregon_Climate_Divisions.png}
\caption{Oregon’s Climate Divisions}
\end{figure}

The principal types of winter storms that occur include:

- **Snowstorms:** require three ingredients: cold air, moisture, and air disturbance. The result is snow, small ice particles that fall from the sky. In Oregon, the further inland and north one moves, the more snowfall can be expected. Blizzards are included in this category.

- **Ice storms:** are a type of winter storm that forms when a layer of warm air is sandwiched by two layers of cold air. Frozen precipitation melts when it hits the warm layer, and refreezes when hitting the cold layer below the inversion. Ice storms can include sleet (when the rain refreezes before hitting the ground) or freezing rain (when the rain freezes once hitting the ground).

- **Extreme Cold:** Dangerously low temperatures accompany many winter storms. This is particularly dangerous because snow and ice storms can cause power outages, leaving many people without adequate heating.

Unlike most other hazards, it is not simple to systematically map winter storm hazard zones. The entire county is susceptible to damaging winter storms. Winter storms that bring snow and ice can impact infrastructure, business, and individuals. Those resources that exist at higher elevations will experience more risk of snow and ice but the entire county can face damage from winter storms and, for example, the hail or dangerously cold temperatures that winter storms bring.

\textsuperscript{12} Oregon Climate Service, “Climate of Washington County,”
History

There were three severe winter storms in January 1950 with very little time separating them. Their net effect was a nearly continuous storm. The storm had severe effects on infrastructure, residents, and businesses across the state. Deep snow drifts closed all highways west of the Cascades and through the Columbia River Gorge. Sleet that turned to freezing rain caused unsafe conditions on highways and damaged trees and power lines. Freezing rain downed many trees and power lines, creating widespread power outages across northwestern Oregon. Hundreds of thousands of dollars in damage to public and private property occurred. Hillsboro reported 42.4 inches of snowfall during this event.

A severe winter storm hit Washington County and the region in December 2008 with record snowfall of 18.9 inches that paralyzed transportation and the economy for days. As the storms peaked, roughly 14,300 households and businesses lost power and shelters operated for 15 days throughout the county. Three state highways (US 26, OR 4, and OR 6) were closed at different times over the course of the storm despite the fact that transportation crews sanded and plowed county roads for nearly 15 days. Washington County and its neighbors were declared a presidential disaster and FEMA provided assistance for emergency protective measures for a period of 48 hours in addition to both Public Assistance and Individual Assistance.

Three winter storm events were added to this hazard history section since the previous plan (Italics, including one event prior to 2010):

- Feb. 2008: Snow event, Trimet train stopped
- Feb. 2014: Large snow event, freezing weather, water district stood up an EOC, some mainline breaks but mostly residential service interruptions, Trimet rail stranded and evacuated riders
- Dec. 2015: Severe Winter Storms, Straight-line Winds, Flooding, Landslides, and Mudslides. (FEMA-4258-DR-OR)

Probability Assessment

The recurrence interval for a severe winter storm is about every 13 years; however, there can be many localized storms between these periods. Severe winter storms occur in eastern Oregon regularly from November through February.

Based on the available data and research for Washington County the 2015 Hazard Analysis determined the probability of experiencing a winter storm is “high”, meaning one incident is likely within the next 10-year period; this rating has not changed since the previous plan.
Vulnerabilities

Given current available data, no quantitative assessment of the risk of winter storm was possible at the time of this NHMP update. However, assessing the risk to the county from winter storms should remain an ongoing process determined by community characteristics and physical vulnerabilities. Weather forecasting can give county resources (emergency vehicles, warming shelters) time to prepare for an impending storm but the changing character of the county population and resources will determine the impact of winter and wind storms on life and property in Washington County.

Washington County is susceptible to direct impacts on infrastructure and property, and indirect costs stemming from business closures and lost work time resulting from winter storms. Industry and commerce can suffer losses from power interruptions and 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 winter storms related to both physical damages and interrupted services.

Damage to infrastructure resulting from winter storms events include 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 or ice / snow event may have severe consequences to people who need access to emergency services. Historically, falling trees have been the major cause of power outages. Additionally, emergency response operations can be complicated when roads are blocked or when power supplies are interrupted.

Rising population growth and new infrastructure in the county creates a higher probability for damage to occur from winter storms as more life and property are exposed to risk. As both an industry best practice and hazard mitigation action, Washington County’s electric infrastructure is increasingly being built, or retrofitted, underground which lessens the risk from winter storms.

At the time of this update, sufficient data was not available to determine winter storm vulnerability in terms of explicit types and numbers of existing and future buildings, infrastructure, or critical infrastructure.

As such, the 2015 Hazard Analysis rated the county as having a “high” vulnerability to winter storm hazards, meaning that more than 10% of the region’s population or assets would be affected by a major disaster; this rating has not changed since the previous plan.

More information on this hazard can be found within the Hazard Analysis (2015) in Appendix F and in the Risk Assessment for Region 2, Northern Willamette Valley/ Portland Metro, of the Oregon NHMP (2015).
Vulnerability Assessment

Community vulnerabilities are an important component of the NHMP risk assessment. For more in-depth information regarding specific community vulnerabilities see Appendix C: Community Profile.

Vulnerability assesses the extent to which people are susceptible to injury or other impacts resulting from a hazard as well as the exposure of the built environment or other community assets (social, environmental, economic, etc.) to hazards. The exposure of community assets to hazards is critical in the assessment of the degree of risk a community has to each hazard. Identifying the populations, facilities, and infrastructure at risk from various hazards can assist the county in prioritizing resources for mitigation, and can assist in directing damage assessment efforts after a hazard event has occurred.

Population

The socio-demographic qualities of the community population such as language, race and ethnicity, age, income, and educational attainment are significant factors that can influence the community’s ability to cope, adapt to, and recover from natural disasters. Historically, 80 percent of the disaster burden falls on the public. Of this number, a disproportionate burden is placed upon special needs groups, particularly children, the elderly, the disabled, minorities, and low-income persons. Population vulnerabilities can be reduced or eliminated with proper outreach and community mitigation planning.

Population Vulnerabilities

- As of 2014, 11% of the county’s population is over the age of 64; that number is projected to rise to about 20% (or roughly 149,750 individuals) by 2035.16
- The county age dependency ratio17 is 47, which is lower than that of the state (48.6). For the participating cities the age dependency ratio is 45 for Hillsboro and 46 for Tigard. The age dependency figure for the county is expected to increase to 63 by the year 2035. The increase is due to the expected growth in population over age 64.
- Approximately 12% of the total county population lived at or below the poverty line in 2014, with 16% of children in poverty. For the participating cities, those percentages are: Hillsboro, 14% total population and 20% children; Tigard, 11% of total population and 14% children.
- Countywide about 90% of the population over 25 has graduated high school or higher, and 40% of the population has a bachelor’s degree or higher. Among participating cities Hillsboro has the highest percentage of non-high school graduates (13%).

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15 Hazards Workshop Session Summary #16, Disasters, Diversity, and Equity, University of Colorado, Boulder (2000).
17 Dependency Ratio: the ratio of population typically not in the work force (less than 15, greater than 64)
- Approximately 10% of the county population is estimated to have a disability; 9% in Hillsboro and 10% in Tigard. Of that, 15,594 individuals over 64 (33.1%) are disabled; 38% in Hillsboro and 33% in Tigard.
- Nearly 50% of county renters spend more than 35% of their income on housing. For the participating cities, those percentages are: 45% in Hillsboro and 50% in Tigard.\(^{18}\)

**Economy**

Economic diversification, employment, and industry are measures of economic capacity. However, economic resilience to natural disasters is far more complex than merely restoring employment or income in the local community. Building a resilient economy requires an understanding of how the component parts of employment sectors, workforce, resources, and infrastructure are interconnected in the existing economic picture. The current and anticipated financial conditions of a community are strong determinants of community resilience, as a strong and diverse economic base increases the ability of individuals, families, and the community to absorb disaster impacts for a quick recovery.

**Economic Vulnerabilities**

- According to the Oregon Employment Department countywide unemployment has decreased since 2010 and remains lower than the rate for Oregon.
- While the county has some basic industries, such as manufacturing, four out of its five largest industrial sectors are of the non-basic nature and thus they rely on local sales and services. Trending towards basic industries can lead to higher community resilience.\(^{19}\)
- The largest revenue sectors in Washington County are Manufacturing ($13.5 billion), Wholesale Trade ($8.7 billion), and Retail Trade ($8.4 billion).
- The Professional and Business Services sector is expected to have the most growth from 2014 to 2024 at 56%.\(^{20}\)

**Environment**

The capacity of the natural environment is essential in sustaining all forms of life including human life. Yet it often plays an underrepresented role in community resiliency to natural hazards. Critical elements of the natural environment in Washington County include land, air, water and other natural resources that support and provide space to live, work and recreate.\(^{21}\) Like human, built, and economic assets, environmental assets such as wetlands and forested hill slopes can be adversely impacted by natural hazard events. For example, wildfires can destroy forest cover leading to potential loss of timber revenue and increased

\(^{18}\) U.S. Census Bureau, 2010-2014 American Community Survey, Tables B25070 & B25091.


incidents of landslides and floods. Conversely, environmental assets can plan significant roles in protecting communities and the environment from natural hazards. For example, wetlands can provide important flood storage and filtration services that can mitigate flood impacts downstream. In short, it is important to consider vulnerabilities across environmental assets.

Environmental Vulnerabilities

- Forest ecosystems are vulnerable to drought, wildfire and severe storm impacts.
- Drinking water systems are vulnerable to drought, earthquake, and wildfire impacts.

Built Environment, Critical Facilities, and Infrastructure

Critical facilities (i.e. police, fire, and government facilities), housing supply and physical infrastructure are vital during a disaster and are essential for proper functioning and response. The lack or poor condition of infrastructure can negatively affect a community’s ability to cope, respond and recover from a natural disaster. Following a disaster, communities may experience isolation from surrounding cities and counties due to infrastructure failure. These conditions force communities to rely on local and immediately available resources.

Housing Vulnerabilities

- Mobile homes account for less than 3% of the housing countywide and 1% in Hillsboro and less than 1% in Tigard. These structures are particularly vulnerable to certain natural hazards, such as earthquake, tsunami, windstorms, and heavy flooding events.
- Based on U.S. Census data, more than 56% of the residential housing in the county was built before the current seismic building standards of 1990; 39% in Hillsboro and 64% in Tigard.
- Approximately 20% of residential structures were constructed prior to the local implementation of the flood elevation requirements of the 1970’s; 13% in Hillsboro and 18% in Tigard. County Flood Insurance Rate Maps –FIRMs- were not completed until the late 1970s and early 1980s.
- The housing vacancy rate in the county, Hillsboro, and Tigard was estimated at about 5% in 2014.

Critical Facilities and Infrastructure Vulnerabilities

- There are four county bridges and 19 state-owned bridges that have been identified as seismically vulnerable. Impacts to the transportation system can result in the isolation of vulnerable populations, limit access to critical facilities such as hospitals and adversely impact local commerce, employment and economic activity.

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22 U.S. Census Bureau, 2010-2014 American Community Survey, Table DP04.
23 Ibid.
24 Ibid.
- There are three “high threat potential” dams located in the county: Kay Lake, Trask River Reservoir, and Scoggins (Hagg Lake).

**Multi-Hazard Risk Summary**

This section provides a broad risk assessment overview.

**Federal Disaster and Emergency Declarations**

Reviewing past events can provide a general sense of the hazards that have caused significant damage in the county. Where trends emerge, disaster declarations can help inform hazard mitigation project priorities.

President Dwight D. Eisenhower approved the first federal disaster declaration in May 1953 following a tornado in Georgia. Since then, federally declared disasters have been approved within every state as a result of natural hazard related events. As of July 2016, FEMA has approved a total of 31 major disaster declarations, two emergency declarations, and 58 fire management assistance declarations in Oregon.25 When governors ask for presidential declarations of major disaster or emergency, they stipulate which counties in their state they want included in the declaration. Table 2-6 summarizes the major disasters declared in Oregon that affected Washington County, since 1955. The table shows that there have been eight (8) major disaster declarations for the county. All but one of which were related to severe weather resulting primarily in flooding, landslides, mudslides, and wind related damage; there was one earthquake related declaration in 1993.

An Emergency Declaration is more limited in scope and without the long-term federal recovery programs of a Major Disaster Declaration. Generally, federal assistance and funding are provided to meet a specific emergency need or to help prevent a major disaster from occurring. Washington County has only one recorded Emergency Declaration related to the 2005 Hurricane Katrina evacuation.

Fire Management Assistance may be provided after a state submits a request for assistance to the FEMA Regional Director at the time a "threat of major disaster" exists. There are no fire management assistance declarations on record for the county.

Table 2-6 FEMA Major Disaster (DR), Emergency (EM), and Fire Management Assistance (FMA) Declarations for Washington County

<table>
<thead>
<tr>
<th>Declaration Number</th>
<th>Declaration Date</th>
<th>Incident Period From</th>
<th>Incident</th>
<th>Individual Assistance</th>
<th>Public Assistance Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR-184</td>
<td>12/24/1964</td>
<td>12/24/1964</td>
<td>Heavy rains and flooding</td>
<td>Yes</td>
<td>A, B, C, D, E, F, G</td>
</tr>
<tr>
<td>DR-319</td>
<td>1/21/1972</td>
<td>1/21/1972</td>
<td>Severe Storms, Flooding</td>
<td>Yes</td>
<td>A, B, C, D, E, F, G</td>
</tr>
<tr>
<td>DR-1107</td>
<td>3/19/1997</td>
<td>12/10/1996</td>
<td>Severe Storms/High Winds</td>
<td>None</td>
<td>A, B, C, D, E, F, G</td>
</tr>
<tr>
<td>DR-1824</td>
<td>3/2/2009</td>
<td>12/13/2008</td>
<td>Near Record Snow, Landslides, and Mudslides</td>
<td>None</td>
<td>A, B, C, D, E, F, G</td>
</tr>
<tr>
<td>DR-4258</td>
<td>2/17/2016</td>
<td>12/6/2015</td>
<td>Oregon Severe Winter Storms, Straight-line Winds, Flooding, Landslides, and Mudslides</td>
<td>None</td>
<td>A, B, C, D, E, F, G</td>
</tr>
<tr>
<td>EM-3228</td>
<td>9/7/2005</td>
<td>8/29/2005</td>
<td>Hurricane Katrina Evacuation</td>
<td>None</td>
<td>B</td>
</tr>
</tbody>
</table>

Source: FEMA, Oregon Disaster History. Major Disaster Declarations.

National Flood Insurance Program (NFIP) Vulnerability

FEMA updated the Flood Insurance Study (FIS) and Flood Insurance Rate Maps (FIRMs) in 2016 (effective November 4, 2016). The table below shows that as of July 2016, Washington County (including NFIP participating incorporated cities) has 1,835 National Flood Insurance Program (NFIP) policies in force (951 within the unincorporated portion of the county). Of those, 1,024 were developed before the initial FIRM (640 within the unincorporated portion of the county). The last Community Assistance Visit (CAV) for Washington County was on May 21, 2002 (the most recent CAV was in Tigard (July 11, 2014). Neither the county nor the participating cities are members of the Community Rating System (CRS). The table shows that the majority of flood insurance policies are for residential structures, primarily single-family homes.
Table 2-7 Flood Insurance Detail

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Current FIRM Date</th>
<th>Initial FIRM Date</th>
<th>Total Policies</th>
<th>Pre-FIRM Policies</th>
<th>Single Family</th>
<th>2 to 4 Family</th>
<th>Other Residential</th>
<th>Non-Residential</th>
<th>Minus Rated A Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washington County</td>
<td>-</td>
<td>-</td>
<td>1,835</td>
<td>1,024</td>
<td>1,163</td>
<td>90</td>
<td>331</td>
<td>250</td>
<td>45</td>
</tr>
<tr>
<td>Unincorporated</td>
<td>2/18/2005</td>
<td>9/30/1982</td>
<td>951</td>
<td>640</td>
<td>732</td>
<td>20</td>
<td>145</td>
<td>54</td>
<td>20</td>
</tr>
<tr>
<td>Hillsboro</td>
<td>5/17/1982</td>
<td>5/17/1982</td>
<td>85</td>
<td>41</td>
<td>61</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Tigard</td>
<td>2/18/2005</td>
<td>3/1/1982</td>
<td>127</td>
<td>82</td>
<td>77</td>
<td>5</td>
<td>16</td>
<td>29</td>
<td>1</td>
</tr>
<tr>
<td>Other Incorporated*</td>
<td>-</td>
<td>-</td>
<td>672</td>
<td>261</td>
<td>273</td>
<td>64</td>
<td>170</td>
<td>164</td>
<td>19</td>
</tr>
</tbody>
</table>

Note 1: “Other Incorporated” includes all other cities located within Washington County except for the parts of Lake Oswego, Portland, Rivergrove, and Wilsonville that are within the county.
Note 2: An updated Flood Insurance Study and Flood Insurance Rate Maps will become effective November 4, 2016.

There have been 302 paid claims in the county totaling just over $5.2 million (198 within the unincorporated portion of the county totaling $2.9 million). In addition, there are a total of 39 Repetitive Loss Properties26 (29 in unincorporated Washington County) and eight (8) Severe Repetitive Loss Properties (seven (7) in unincorporated Washington County)27. There is one repetitive loss property within Tigard and no severe repetitive loss properties in Hillsboro or Tigard. There are an additional nine (9) repetitive loss properties and one (1) severe repetitive loss property in the “other incorporated” communities that are not participating in this NHMP. See Figure 2-10 for locations of NFIP policies and repetitive and severe repetitive loss properties.

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26 A Repetitive Loss (RL) property is any insurable building for which two or more claims of more than $1,000 were paid by the National Flood Insurance Program (NFIP) within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

27 A Severe Repetitive Loss (SRL) property is a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which 4 or more separate claims payments have been paid under flood insurance coverage, with the amount of each claim payment exceeding $5,000 and with cumulative amount of such claims payments exceeding $20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property.
Figure 2-10 Repetitive Loss and Severe Repetitive Loss Properties

Risk Assessment

Multi-jurisdictional Risk Assessment - §201.6(c) (2) (iii): For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

Hillsboro and Tigard participated in county Steering Committee meetings and/or worked with OPDR to complete a jurisdiction-specific hazard analysis; for more information on the process see Appendix B. City specific information is presented in Volume II, City Addenda.

Hazard Analysis Methodology

This NHMP includes a summary of the updated Washington County Hazards Analysis (2015). The hazard analysis methodology by counties in Oregon (primarily to inform Emergency Operations Planning) was first developed by FEMA circa 1983 and gradually refined by the Oregon Military Department’s Office of Emergency Management over the years.

The methodology produces scores that range from 24 (lowest possible) to 240 (highest possible). Vulnerability and probability are the two key components of the methodology. Vulnerability examines both typical and maximum credible events and probability and endeavors to reflect how physical changes in the jurisdiction and scientific research modify the historical record for each hazard. Vulnerability accounts for approximately 60% of the total score and probability approximately 40%. We include the hazard analysis summary here to ensure consistency between the EOP and NHMP.

The Oregon method provides the jurisdiction with a sense of hazard priorities, or relative risk. It doesn't predict the occurrence of a particular hazard but it does "quantify" the risk of one hazard compared with another. By doing this analysis, planning can first be focused where the risk is greatest.

In this analysis, severity ratings and weight factors, are applied to the four categories of history, vulnerability, maximum threat (worst-case scenario), and probability as demonstrated below.

History (Weight Factor = 2)

History is the record of previous occurrences. Events to include in assessing history of a hazard in your jurisdiction are events for which the following types of activities were required:

- The Emergency Operations Center (EOC) or alternate EOC was activated;
- Three or more Emergency Operations Planning (EOP) functions were implemented, e.g., alert & warning, evacuation, shelter, etc.;
- An extraordinary multi-jurisdictional response was required; and/or
- A "Local Emergency" was declared.

LOW = 0 to 1 event in the past 100 years, scores between 1 and 3 points
MODERATE = 2 to 3 event in the past 100 years, scores between 4 and 7 points
HIGH = 4+ events in the past 100 years, scores between 8 and 10 points

Probability (Weight Factor = 7)
Probability is the likelihood of future occurrence within a specified period of time.

**LOW** = one incident likely within 75 to 100 years, scores between 1 and 3 points

**MODERATE** = one incident likely within 35 to 75 years, scores between 4 and 7 points

**HIGH** = one incident likely within 10 to 35 years, scores between 8 and 10 points

**Vulnerability (Weight Factor = 5)**

Vulnerability is the percentage of population and property likely to be affected under an “average” occurrence of the hazard.

**LOW** = < 1% affected, scores between 1 and 3 points

**MODERATE** = 1 - 10% affected, scores between 4 and 7 points

**HIGH** = > 10% affected, scores between 8 and 10 points

**Maximum Threat (Weight Factor =10)**

Maximum threat is the highest percentage of population and property that could be impacted under a worst-case scenario.

**LOW** = < 5% affected, scores between 1 and 3 points

**MODERATE** = 5 - 25% affected, scores between 4 and 7 points

**HIGH** = > 25% affected, scores between 8 and 10 points

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. The table below presents the natural hazards (except pandemic) that are included in the Hazard Vulnerability Analysis (2015) for Washington County. The hazards are listed in rank order from high to low. The table shows that hazard scores are influenced by each of the four categories combined. Considering past historical events, the probability or likelihood of a particular hazard event occurring, the vulnerability to the community, and the maximum threat or worst-case scenario, winter storm, windstorm, and earthquake events rank as the top hazard threats to the county (top tier). Flood, droughts, and volcanic ash events rank in the middle (middle tier). Wildland fire and landslide comprise the lowest ranked hazards in the county (bottom tier).

### Table 2-8 Hazard Analysis Matrix – Washington County

<table>
<thead>
<tr>
<th>Hazard</th>
<th>History</th>
<th>Probability</th>
<th>Vulnerability</th>
<th>Maximum Threat</th>
<th>Total Threat Score</th>
<th>Hazard Rank</th>
<th>Hazard Tiers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter Storm</td>
<td>20</td>
<td>70</td>
<td>50</td>
<td>100</td>
<td>240</td>
<td># 1</td>
<td>Top Tier</td>
</tr>
<tr>
<td>Windstorm</td>
<td>20</td>
<td>56</td>
<td>50</td>
<td>80</td>
<td>206</td>
<td># 2</td>
<td>Middle Tier</td>
</tr>
<tr>
<td>Earthquake</td>
<td>2</td>
<td>42</td>
<td>50</td>
<td>100</td>
<td>194</td>
<td># 3</td>
<td>Top Tier</td>
</tr>
<tr>
<td>Flood</td>
<td>20</td>
<td>63</td>
<td>30</td>
<td>60</td>
<td>173</td>
<td># 4</td>
<td>Top Tier</td>
</tr>
<tr>
<td>Drought</td>
<td>2</td>
<td>28</td>
<td>25</td>
<td>100</td>
<td>155</td>
<td># 5</td>
<td>Middle Tier</td>
</tr>
<tr>
<td>Volcanic Ash</td>
<td>2</td>
<td>7</td>
<td>40</td>
<td>80</td>
<td>129</td>
<td># 6</td>
<td>Middle Tier</td>
</tr>
<tr>
<td>Wildland Fire</td>
<td>2</td>
<td>35</td>
<td>25</td>
<td>50</td>
<td>116</td>
<td># 7</td>
<td>Bottom Tier</td>
</tr>
<tr>
<td>Tornado</td>
<td>2</td>
<td>7</td>
<td>15</td>
<td>10</td>
<td>34</td>
<td># 8</td>
<td>Bottom Tier</td>
</tr>
<tr>
<td>Landslide</td>
<td>2</td>
<td>7</td>
<td>5</td>
<td>10</td>
<td>24</td>
<td># 9</td>
<td>Bottom Tier</td>
</tr>
</tbody>
</table>

Source: Washington County Hazard Analysis (2015), see Appendix G

Note: Pandemic and technological hazards included in the HVA are not included within this table.
For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery. The method provides the jurisdiction with a sense of hazard priorities but does not predict the occurrence of a particular hazard.

**City Specific Risk Assessment**

*Multi-jurisdictional Risk Assessment - §201.6(c) (2) (iii):* For multi-jurisdictional plans, the risk assessment must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.

The two participating cities in Washington County: Hillsboro and Tigard held local Steering Committee meetings and completed a jurisdiction specific hazard analysis. The multi-jurisdictional risk assessment information is located within the Risk Assessment section of each city’s addendum, which is located in Volume III of this NHMP.
Section 3 outlines Washington County’s strategy to reduce or avoid long-term vulnerabilities to the identified hazards. Specifically, this section presents a mission, specific goals, and actions thereby addressing the mitigation strategy requirements contained in 44 CFR 201.6(c). The NHMP Steering Committee reviewed and updated the mission, goals, and action items documented in this plan. Additional planning process documentation is in Appendix B.

The 2010 Washington County Natural Hazard Mitigation Plan included 26 mitigation actions to reduce the risk to life, property, and community systems. As part of the 2015/16 update process, the Steering Committee reviewed the plan mission and goals, including a comparison with current state mitigation goals. In addition, the committee reviewed the actions, activities and projects that took place between 2010 and 2015.

Mitigation Plan Mission

The purpose of the Washington County NHMP is to foster coordinated partnerships and the development of multi-objective strategies for mitigation. The Plan mission is intended to provide overall direction for the Washington County’s hazard mitigation program.

The mission of the Washington County NHMP is:

*Reduce risk, prevent loss, and protect life, property, and the environment from natural hazard events.*

The 2015/16 NHMP Steering Committee reviewed the previous plans mission statement and agreed that it still applies as written.

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that Washington County citizens, and public and private partners can take 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. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

Stakeholder participation was a key aspect in developing the Plan goals. Meetings with the project Steering Committee and stakeholder interviews all served as methods to obtain input and priorities in developing goals for reducing risk and preventing loss for natural hazards in Washington County.

The 2015/16 Washington County NHMP Steering Committee reviewed the 2010 plan goals in comparison to the State Natural Hazard Mitigation Plan (2015) goals and
determined they would modify several goals to better align with the State Natural Hazard Mitigation Plan goals, as well as current conditions in the County.

All the Plan goals are important and are listed below in no particular order of priority.

Below is a list of the plan goals:

**Goal 1:** Minimize loss of life, public and private property damages and the disruption of essential infrastructure and services from natural hazards.

**Goal 2:** Minimize the impact of natural hazards while protecting and restoring the environment.

**Goal 3:** Provide documentation to support effective implementation and increased success in funding opportunities.

**Goal 4:** Engage and motivate the public to invest in natural hazard risk reduction policies and projects.

**Goal 5:** Support the adoption and application of development policies and standards that consider the potential impacts of natural hazards.

**Goal 6:** Increase cooperation and coordination among private entities, and local, state, and federal agencies to mitigate the risks posed by natural hazards.

**Goal 7:** Natural hazard information in local comprehensive plans is up to date and / or reflected through policy and implementing measures.

### Action Item Development Process

Development of action items was a multi-step, iterative process that involved brainstorming, discussion, review, and revisions. Action items can be developed through a number of sources. The figure below illustrates some of these sources.

The majority of the action items were first created during the previous NHMP planning processes. During these processes, steering committees developed maps of local vulnerable populations, facilities, and infrastructure in respect to each identified hazard. Review of these maps generated discussion around potential actions to mitigate impacts to the vulnerable areas. The Oregon Partnership for Disaster Resilience (OPDR) provided guidance in the development of action items by presenting and discussing actions that were used in other communities. OPDR also took note of ideas that came up in steering committee meetings and drafted specific actions that met the intent of the steering committee. All actions were then reviewed by the steering committee, discussed at length, and revised as necessary before becoming a part of this document.
Figure 3-1 Development of Action Items

Priority Actions

Action items identified through the planning process are an important part of the mitigation plan. Action items are detailed recommendations for activities that local departments, citizens, and others could engage in to reduce risk. Due to resource constraints, Washington County and participating cities are listing a set of high priority actions (Table 3-1, Appendix A-1) in an effort to focus attention on an achievable set of activities over the next five years. Detailed implementation information for each priority action is listed in Appendix A-1. This plan identifies priority actions based on an evaluation of high impact hazards, resource availability, and FEMA identified best practices.

Action Item Matrix

The action item matrix (Appendix A-2) presents a pool of mitigation actions. The majority of these actions carry forward from prior versions of this plan. This expanded list of actions is available for local consideration as resources, capacity, technical expertise and/or political will become available. Appendix A-1, Priority Action Items, and Appendix A-2, Action Item Pool, provide detailed information about each of the priority action items (and some of the other actions). A blank action item form is included for use by the NHMP committee as additional action items are considered for implementation.

Note 1: Jurisdictional review and identification of additional priority action items will take place during the meeting immediately following finalization of the DOGAMI Multi-Hazard Risk Report (currently being funded through FEMA’s Risk Map program).
### Table 3-1 Washington County Priority Actions

<table>
<thead>
<tr>
<th>Priority #</th>
<th>Hazard</th>
<th>Action Title</th>
<th>Coordinating Organization</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Multi-Hazard</td>
<td>Participate in the FEMA Risk MAP discovery, multi-hazard risk assessment, and resilience meeting processes.</td>
<td>Washington County Planning</td>
<td>Short-Term</td>
</tr>
<tr>
<td>#2</td>
<td>Multi-Hazard</td>
<td>Utilize the final multi-hazard risk report and assessment currently being developed by DOGAMI through FEMA's RiskMap program to update the Washington County Hazard Analysis.</td>
<td>Washington County Emergency Management</td>
<td>Mid-Term</td>
</tr>
<tr>
<td>#3</td>
<td>Multi-Hazard</td>
<td>Utilize the final multi-hazard risk report and assessment currently being developed by DOGAMI through FEMA's RiskMap program to inform an update to the Goal 7 Section of the Washington County Comprehensive Plan (Policy B).</td>
<td>Washington County Planning and Development Services</td>
<td>Mid-Term</td>
</tr>
<tr>
<td>#4</td>
<td>Multi-Hazard</td>
<td>Update county risk assessment maps for relevant hazards using available LIDAR topographic data in collaboration with the Oregon Department of Geology and Mineral Industries.</td>
<td>Washington County GIS</td>
<td>Mid-Term</td>
</tr>
<tr>
<td>#5</td>
<td>Earthquake</td>
<td>Over the next five years, implement retrofit projects on at least two bridges identified as high-priority on Washington County's bridge assessment list.</td>
<td>Washington County Land Use and Transportation</td>
<td>Ongoing</td>
</tr>
<tr>
<td>#6</td>
<td>Earthquake</td>
<td>Expand and complete a seismic safety inventory of public buildings (particularly critical and essential facilities) that may be vulnerable to natural hazards (particularly earthquake).</td>
<td>Washington County Emergency Management</td>
<td>Mid-Term</td>
</tr>
<tr>
<td>#7</td>
<td>Earthquake</td>
<td>Continue to implement structural and non-structural retrofit projects of critical and essential facilities. Priority buildings include the Law Enforcement Center and the Walnut Street Center.</td>
<td>Washington County Emergency Management</td>
<td>Ongoing</td>
</tr>
<tr>
<td>#8</td>
<td>Flood</td>
<td>Ensure that the locations of Repetitive and Severe Repetitive Flood Loss Properties have been accurately registered with FEMA and work with affected property owners to remove, relocate, elevate or otherwise mitigate non-conforming structures in flood hazard areas.</td>
<td>Washington County Emergency Management</td>
<td>Ongoing</td>
</tr>
<tr>
<td>#9</td>
<td>Wildfire</td>
<td>Update the Washington County Community Wildfire Protection Plan (CWPP). Implement actions identified in the CWPP.</td>
<td>Washington County Emergency Management</td>
<td>Ongoing/Short Term</td>
</tr>
</tbody>
</table>

Source: Washington County NHMP Steering Committee
Short-Term = 0-2 years, Mid-Term = 2-5 years, Long-Term = 5+ years
Action Item Forms

Each priority action item has a corresponding action item form describing the activity, identifying the rationale for the project, identifying potential ideas for implementation, and assigning coordinating and partner organizations. The action item forms can assist the community in pre-packaging potential projects for grant funding. The form components are described below and the priority action item forms are located in Appendix A-1, Priority Action Items and Appendix A-2, Action Item Pool (not all actions in the pool have a form).

Action Item

Each action item includes a brief description of the proposed action.

Alignment with Plan Goals

The 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.

Priority

High priority action items are designated in order to clarify the importance of these mitigation actions for the affected jurisdictions; jurisdictions that have designated an action as a priority are responsible to show progress towards these actions (mitigation efforts) during the next update cycle. If an action is prioritized at one of the semi-annual meetings the participating jurisdiction will also show progress towards newly prioritized actions.

Participating Jurisdiction

The list of actions provided in the plan is comprehensive. However, not every jurisdiction is participating in each action. Each city identified as a “participating jurisdiction” will contribute to accomplishing the specified action at a local level. The matrices above (Table 3-1) and the action item forms and matrices in Appendix A-1 and A-2 provide more detailed information.

Alignment with Existing Plans / Policies

This section identifies any existing community plans and policies where the action item can be incorporated. Incorporating the mitigation action into existing plans and policies, such as comprehensive plans, will increase the likelihood that it will be implemented.

Rationale for Proposed Action Item

Action items should be fact-based and tied directly to issues or needs identified throughout the planning process. Action items can be developed at any time during the planning process and can come from a number of sources, including participants in the planning process, noted deficiencies in local capability, or issues identified through the
risk assessment. The rationale for proposed action items is based on the information documented in Section II and elsewhere in this plan.

**Ideas for Implementation**

For each action item, the form is designed to solicit ideas for implementation, which serve as the starting point for taking action. Ideas for implementation could include: (1) collaboration with relevant organizations, (2) alignment with the community priority areas, and (3) applications to new grant programs.

The ideas for implementation offer a transition from theory to practice and serve as a starting point for this Plan. This component of the action item is dynamic, since some ideas may prove to not be feasible, and new ideas may be added during the Plan maintenance process. Ideas for implementation include such things as: collaboration, grant programs, tax incentives, human resources, education and outreach, research, and physical manipulation of buildings and infrastructure. When an action is implemented, more work will probably be needed to determine the exact course of action.

The Washington County NHMP includes a range of action items that, when implemented, will reduce loss from hazard events in the County. Within the plan, FEMA requires the identification of existing programs that might be used to implement these action items. Washington County and the participating cities currently address statewide planning goals and legislative requirements through their comprehensive land use plans, capital improvement plans, mandated standards, and building codes. To the extent possible, the jurisdictions will work to incorporate the mitigation action items into existing programs and procedures.

Many of the recommendations contained in the Washington County NHMP are consistent with the goals and objectives of existing plans and policies. Where possible, Washington County and the participating cities will implement the recommendations and actions contained in the NHMP through existing plans and policies. Plans and policies already in existence have support from local residents, businesses, and policy makers. Many land-use, comprehensive, and strategic plans get updated regularly, and can adapt easily to changing conditions and needs. Implementing the action items contained in the NHMP through such plans and policies increases their likelihood of being supported and implemented.

**Coordinating Organization:**

The coordinating organization is the public agency with the regulatory responsibility to address natural hazards or that is willing and able to organize resources, find appropriate funding, or oversee activity implementation, monitoring and evaluation.

\[\text{Ibid}\]
Internal and External Partners:

The internal and external partner organizations listed in the Action Item Worksheets are potential partners recommended by the project steering committee but 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 toward completion of the action items.

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

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.

Potential Funding Sources

The steering committee has identified potential funding sources for each priority action item (listed on Action Item Form within Appendix A). Example funding sources can include: the federal Pre-Disaster Mitigation and Flood Mitigation Assistance Programs; state funding sources such as the Oregon Seismic Rehabilitation Grant Program; or local funding sources such as capital improvement or general funds. An action item may also have multiple funding sources.

Estimated Cost

Where possible, an estimate of the cost for implementing the action item is included.

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 authorities within two years. Mid-term action items (MT) may require new or additional resources and/or authorities, and may take from two to five years to implement. Long-term action items (LT) will require new or additional resources and/or authorities and likely will occur after the next update cycle five or more years to implement. Ongoing action items signify that work has begun and will either exist over an indefinite timeline, or an extended timeline.

Action Item Status

As action items are implemented or new ones are created during the plan maintenance process, it is important to indicate the status of the action item—whether it is new, ongoing, deferred, or complete. Documenting the status of the action will make reviewing and updating the mitigation plan easier during the plan’s five-year update, and can be used as a benchmark for progress. Deferred action items have yet to see any significant work begin on the particular action.
SECTION 4:
PLAN IMPLEMENTATION AND MAINTENANCE

Mitigation planning is a process and as such, it must constantly evaluate and respond to new data, new policies, and new development to reduce the county’s risk from natural hazards. The Plan Implementation and Maintenance section details the formal process that will ensure that Washington County Natural Hazard Mitigation Plan (NHMP) remains an active and relevant document. The plan implementation and maintenance process includes a schedule for monitoring and evaluating the plan bi-annually, as well as producing an updated plan every five years. Finally, this section describes how the county will integrate public participation throughout the Plan maintenance and implementation process.

Plan Maintenance Strategy

The success of the Washington County NHMP depends on how well the plan is maintained and how well the identified action items are implemented. In an effort to ensure that the activities identified are implemented, Washington County will take the following steps: (1) formal Plan adoption, (2) re-designation of the plan convener, (3) re-convening of the NHMP Steering Committee (4) ongoing prioritization and evaluation of actions, and (5) implementation through existing plans, programs, and policies where applicable. Each of these steps is described in further detail below.

Plan Adoption

Washington County updated the NHMP through a collaborative and iterative process. Plan maintenance will continue that collaborative process. Once the Plan is locally reviewed and deemed complete, the Washington County Emergency Manager submits it to the State Hazard Mitigation Officer (SHMO) at the Oregon Military Department – Office of Emergency Management (OEM) for state review. OEM then submits the plan to FEMA- Region X for review. This review addresses the federal criteria outlined in the FEMA Interim Final Rule 44 CFR Part 201. Upon pre-approval by FEMA, the county will adopt the plan via resolution. At that point, the county will retain its eligibility for the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program, and the Flood Mitigation Assistance program.

Following adoption by the county, the participating jurisdictions will convene local decision makers and adopt the Washington County Multijurisdictional NHMP.

Convener

Washington County Emergency Management will continue as convener of the Washington County NHMP. The convener is responsible for:

- Ongoing plan maintenance, including local plan adoption;
- Convening the NHMP Steering Committee;
- Setting Steering Committee agendas and facilitating bi-annual meetings;
- Assigning plan maintenance, reporting, and data acquisition tasks;
- Action item prioritization;
- Serving as a liaison to the Washington County Emergency Management Cooperative; and
- Ensuring ongoing public engagement and involvement in hazard mitigation.

Steering Committee

The Washington County Convener will re-convene the NHMP Steering Committee upon formal re-adoption and approval of the plan by FEMA. The steering committee is comprised of representatives from County DLUT, County Emergency Management, Clean Water Services, Tualatin Valley Water District, Tualatin Valley Fire and Rescue, and the Hillsboro Emergency Manager and the Tigard Emergency Services Coordinator. Notably, many of the members of the NHMP Steering Committee also participate in the Washington County Emergency Management Cooperative. The Steering Committee is responsible for:

- Attending future plan maintenance and plan update meetings;
- Serving as the local evaluation committee for funding programs such as the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program funds, and Flood Mitigation Assistance program funds;
- Prioritizing and recommending funding for natural hazard risk reduction projects;
- Evaluating and updating the NHMP in accordance with the prescribed maintenance schedule;
- Developing and coordinating ad hoc and/or standing subcommittees as needed; and,
- Assisting with public involvement activities.

Meetings

Following review of the 2010-2015 plan maintenance process and meeting schedule, the Steering Committee agreed to meet on at least a semiannual basis between 2016 and 2021. Additional meetings will be called on an as needed basis (for example, following a natural hazard event or disaster declaration). The committee will meet once in the fall prior to the county’s budget season and once in the spring following the winter storm season.

During the fall Steering Committee meeting, the group will, at minimum:

- Review existing action items to determine appropriateness for local funding;
- Discuss methods for continued public involvement and education before the summer months begin;
- Update decision makers on progress of the plan; and
- Document successes and lessons learned during the year.

During the spring Steering Committee meeting, the group will, at minimum:

- Update hazard histories after the winter storm season;

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1 The Emergency Management Cooperative for Washington County is committed to the development and maintenance of a countywide, integrated system to prepare for, respond to, recover from, and mitigate against disasters. The EMC is comprised of Beaverton, Cornelius, Forest Grove, Sherwood, Tigard, Clean Water Services and Tualatin Valley Fire and Rescue.
• Review new hazard data and update the county risk assessment as needed;
• Review existing action items to determine appropriateness for funding; and
• Prioritize potential mitigation projects

These meetings are also an opportunity for participating cities to report back to the county on progress that has been made towards their components of the NHMP. Any ad hoc committee that may form may revise the schedule as resources and events shift.

The Convener will be responsible for documenting the outcome of the bi-annual meetings. The format of the plan allows the county and participating jurisdictions to review and update sections when new data becomes available. New data can be easily incorporated, resulting in a NHMP that remains current and relevant to the participating jurisdictions.

To make the coordination and review of the Washington County NHMP as broad and as useful as possible, the Steering Committee will engage additional stakeholders and other relevant hazard mitigation organizations and agencies to implement the identified action items. Specific organizations have been identified as either internal or external partners on the individual action item forms found in Appendix A.

The State of Oregon as a partner

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:

• Oregon Military Department, Office of Emergency Management (OEM) is responsible for disaster mitigation, preparedness, response, recovery, and the administration of federal funds after a major disaster declaration;
• Oregon Building Codes Division (BCD), 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 and state lands. Additionally, in Western Oregon, ODF is responsible for Bureau of Land Management forestlands and administers forest practices regulations, including landslide mitigation, on non-federal lands;
• 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. In addition, DLCD manages the state Floodplain Management and FEMA Risk MAP programs. Statewide land use planning Goal 7: Planning for Natural 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. The county can use review of this NHMP as an avenue to update the Goal 7: Natural Hazards element of its comprehensive plan and to integrate mitigation into zoning and planning documents.

Other partners

Further, mitigation actions can be implemented through the ongoing efforts of county partners. The county will actively seek out opportunities for such partnerships to further NHMP objectives. For example:

- **Utilities and Special Districts**: As a water resources management utility with nearly 500,000 customers, Clean Water Services is already invested in protecting the health of county residents as well as the quality of natural resources in Washington County. Many of their programs can already be said to be effective mitigation action. For example, they encourage residents to do natural landscaping which incorporates better water management. This can reduce neighborhood flood issues. In response to drought conditions in 2015, Clean Water Services contracted with Tualatin Valley Irrigation District to tap into its Henry Hagg Lake water right. The purpose of the water purchase was to maintain adequate stream flows in the Tualatin River. Clean Water Services can continue to be a partner in outreach and mitigation actions.
- **West Oregon Electric Cooperative and Portland General Electric** are the electrical utility providers that cover Washington County. They provide an essential resource that county services, private industry, and citizens depend on. Continued collaboration to reduce vulnerabilities and increase the resilience of the power grid is a primary focus of this partnership.
- **County Departments**: Capital improvement planning that occurs in the future will also contribute to the goals in the NHMP. Many county departments develop Capital Improvement Plans (CIPs) and review them on an annual basis. At the time of annual review, the Hazard Mitigation Steering Committee may work with the departments to integrate the Washington County NHMP into appropriate sections of the CIPs.
- **Washington County Emergency Management Cooperative**: The Emergency Management Cooperative for Washington County is committed to the development and maintenance of a countywide, integrated system to prepare for, respond to, recover from, and mitigate against disasters. The EMC is comprised of Beaverton, Cornelius, Forest Grove, Sherwood, Tigard, Clean Water Services and Tualatin Valley Fire and Rescue. In addition to local governments and special service districts, the EMC provides assistance to local businesses, schools, social service agencies, church groups, neighborhood groups, civic organizations, and youth groups. The EMC takes a proactive approach to enhancing government preparedness and educating the public. Since government’s ability to respond may be limited during disasters, citizens need to be prepared to manage on their own for a minimum of three days.
- **Citizens**: There are numerous ways in which citizens and residents of Washington County may become involved in mitigation actions. For example, groups such as Citizen Participation Organizations (CPO’s) Homeowners Owners Associations, and
Neighborhood Association Committees may be invited to participate in the plan development, implementation, and maintenance processes.

- Volunteer Organizations: Community Emergency Response Teams (CERTs), Neighborhood Watch groups, and the Medical Reserve Corps in mitigation activities will not only facilitate implementation but also increase public awareness.

- Cities: The cities within the county can continue to be critical partners for identifying vulnerabilities, identifying risks, and implementing mitigation. Coordination and collaboration of mitigation plans between cities and the county will ensure both levels of government achieve their mitigation goals.

- Public Health and Social Service Providers: As organizations that interface with the public on a daily basis, public health and social service providers can be a conduit to get information directly to county residents. They can also provide emergency managers with critical information about vulnerabilities that exist in the population. These organizations are natural partners in hazard mitigation.

- Connections with the activities of other partners are part of the county’s strategy for ongoing public involvement. It allows the county to present mitigation actions and ideas more holistically, within the context of existing groups.

**Implementation through Existing Programs**

The NHMP includes a range of actions that, when implemented, will reduce loss from hazard events in the county. Within the plan, FEMA requires the identification of existing programs that might be used to implement these actions and, where applicable, the updated actions call out potential connections to existing plans. The county currently addresses statewide planning goals and legislative requirements through various other planning processes.

Where possible, the county should implement the recommended actions through existing plans and policies. Plans and policies already in existence have support from local residents, businesses, and policy makers. Many land use, comprehensive, and strategic plans get updated regularly, and can adapt easily to changing conditions and needs. Existing plans that can incorporate mitigation actions include:

- Washington County Capital Improvement Plan
- Washington County City and County Budgets
- Washington County Economic Development Action Plan
- Washington County Community Wildfire Protection Plans
- Washington County Comprehensive Land Use Plan
- Washington County Community Development Code

The State of Oregon and others are important planning partners that can contribute to mitigation planning efforts; their roles are called out in more detail below.

**Project Prioritization Process**

Each of the participating jurisdictions has included a short list of prioritized actions. Because DOGAMI is in the process of completing updated multi-hazard risk assessment products, future mitigation plan maintenance meetings will revisit the prioritization process.
The Disaster Mitigation Act of 2000 requires that jurisdictions identify a process for prioritizing potential actions. The previous version of the Washington County NHMP included a rigorous action prioritization method. At the February 3, 2016 plan update meeting, the Steering Committee recommended implementing a more flexible and user friendly approach to prioritize mitigation actions. The Oregon Partnership for Disaster Resilience recommended the following approach that is successfully being utilized by many other jurisdictions in Oregon.

Potential mitigation activities often come from a variety of sources; therefore, the project prioritization process needs to be flexible. Committee members, local government staff, other planning documents, or the risk assessment may be the source to identify projects. Figure 4-1 illustrates the project development and prioritization process.

**Figure 4-1 Action Item and Project Review Process**

![Project Selection Process Diagram](source: Oregon Partnership for Disaster Resilience)

**Step 1: Examine funding requirements**

The first step in prioritizing the Plan’s action items is to determine which funding sources are open for application. Several funding sources may be appropriate for the county’s proposed mitigation projects. 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, Hazard Mitigation Grant Program (HMGP), National Fire Plan (NFP), Community Development Block Grants (CDBG), DLCD Technical Assistance Grants, local general funds, and private foundations, among others. Please see Appendix E, *Grant Programs and Resources* for a more comprehensive list of potential grant programs.
Because grant programs open and close on differing schedules, the Steering Committee will examine upcoming funding streams’ requirements to determine which mitigation activities would be eligible. The Steering Committee may consult with the funding entity, Oregon Military Department – Office of Emergency Management (OEM), or other appropriate state or regional organizations about eligibility requirements. This examination of funding sources and requirements will happen during the Steering Committee’s semi-annual plan maintenance meetings.

Step 2: Complete risk assessment evaluation

The second step in prioritizing the plan’s action items is to examine which hazards the selected actions are associated with and where these hazards rank in terms of community risk. The Steering Committee will determine whether or not the plan’s risk assessment supports the implementation of eligible mitigation activities. This determination will be based on the location of the potential activities, their proximity to known hazard areas, and whether community assets are at risk. The Steering Committee will additionally consider whether the selected actions mitigate hazards that are likely to occur in the future or are likely to result in severe/catastrophic damages.

Step 3: Steering Committee Recommendation

Based on the steps above, the Steering Committee will recommend which mitigation activities should be moved forward. If the Steering Committee decides to move forward with an action, the coordinating organization designated on the action item form will be responsible for taking further action and, if applicable, documenting success upon project completion. The Steering Committee will convene a meeting to review the issues surrounding grant applications and to share knowledge and/or resources. This process will afford greater coordination and less competition for limited funds.

Step 4: Complete quantitative and qualitative assessment, and economic analysis

The fourth step is to identify the costs and benefits associated with the selected natural hazard mitigation strategies, measures, or projects. Two categories of analysis that are used in this step are: (1) benefit/cost analysis, and (2) cost-effectiveness analysis. Conducting benefit/cost analysis for a mitigation activity assists 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. Figure 4-2 shows decision criteria for selecting the appropriate method of analysis.
If the activity requires federal funding for a structural project, the Steering Committee will use a FEMA-approved cost-benefit analysis tool to evaluate the appropriateness of the activity. A project must have a benefit/cost ratio of greater than one in order to be eligible for FEMA grant funding.

For non-federally funded or nonstructural projects, a qualitative assessment will be completed to determine the project’s cost effectiveness. The Steering Committee will use a multivariable assessment technique called STAPLE/E to prioritize these actions. STAPLE/E stands for Social, Technical, Administrative, Political, Legal, Economic, and Environmental. Assessing projects based upon these seven variables can help define a project’s qualitative cost effectiveness. OPDR at the University of Oregon’s Community Service Center has tailored STAPLE/E technique for use in natural hazard action item prioritization.

**Continued Public Involvement and Participation**

Washington County is committed to involving the public directly in the maintenance and update of the NHMP. Although the Hazard Mitigation Steering Committee members are responsible for annual review and update of the NHMAP and represent the public to some extent, the public will still have an opportunity to provide direct feedback about the NHMAP.

The plan includes the address and the phone number of Washington County Emergency Management, which is responsible for tracking public comments about the NHMAP. The county will support public involvement through existing community organizations, the county website, and “Updates,” a Washington County Land Use and Transportation
quarterly newsletter. Specifically, the county will continue to partner with the Washington County Emergency Management Cooperative to distribute and disseminate information related to disaster preparedness, response, mitigation, and recovery. The WCEMC’s Take 5 to Survive educational campaign, for example, will serve as an important vehicle for information dissemination.

Copies of the NHMP and annual revisions will be posted on the county’s Emergency Management website, participating city websites, and the WCEMC website. In addition, notification of updates will be sent to the Citizen Participation Organizations (CPOs). The County Emergency Manager will be responsible for using county and other resources to publicize an annual public meeting and maintain public involvement. Finally, the NHMAP will be archived and posted on the University of Oregon Libraries’ Scholar’s Bank Digital Archive.

**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. **The Washington County NHMP is due to be updated by [DATE XX], 2021.** The convener will be responsible for organizing the Steering Committee to address plan update needs. The Steering Committee will be responsible for updating any deficiencies found in the plan and for ultimately meeting the Disaster Mitigation Act of 2000’s plan update requirements.

The following ‘toolkit’ can assist the convener in determining which plan update activities can be discussed during regularly scheduled plan maintenance meetings, and which activities require additional meeting time and/or the formation of sub-committees.
<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
<th>Plan Update Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the planning process description still relevant?</td>
<td></td>
<td></td>
<td>Modify this section to include a description of the plan update process. Document how the planning team reviewed and analyzed each section of the plan, and whether each section was revised as part of the update process. (This toolkit will help you do that).</td>
</tr>
<tr>
<td>Do you have a public involvement strategy for the plan update process?</td>
<td></td>
<td></td>
<td>Decide how the public will be involved in the plan update process. Allow the public an opportunity to comment on the plan process and prior to plan approval.</td>
</tr>
<tr>
<td>Have public involvement activities taken place since the plan was adopted?</td>
<td></td>
<td></td>
<td>Document activities in the &quot;planning process&quot; section of the plan update.</td>
</tr>
<tr>
<td>Are there new hazards that should be addressed?</td>
<td></td>
<td></td>
<td>Add new hazards to the risk assessment section.</td>
</tr>
<tr>
<td>Have there been hazard events in the community since the plan was adopted?</td>
<td></td>
<td></td>
<td>Document hazard history in the risk assessment section.</td>
</tr>
<tr>
<td>Have new studies or previous events identified changes in any hazard’s location or extent?</td>
<td></td>
<td></td>
<td>Document changes in location and extent in the risk assessment section.</td>
</tr>
<tr>
<td>Has vulnerability to any hazard changed?</td>
<td></td>
<td></td>
<td>Document changes in vulnerability in the risk assessment section.</td>
</tr>
<tr>
<td>Have development patterns changed? Is there more development in hazard prone areas?</td>
<td></td>
<td></td>
<td>Document changes in vulnerability in the risk assessment section.</td>
</tr>
<tr>
<td>Do future annexations include hazard prone areas?</td>
<td></td>
<td></td>
<td>Document changes in vulnerability in the risk assessment section.</td>
</tr>
<tr>
<td>Are there new high risk populations?</td>
<td></td>
<td></td>
<td>Document changes in vulnerability in the risk assessment section.</td>
</tr>
<tr>
<td>Are there completed mitigation actions that have decreased overall vulnerability?</td>
<td></td>
<td></td>
<td>Document changes in vulnerability in the risk assessment section.</td>
</tr>
<tr>
<td>Did the plan document and/or address National Flood Insurance Program repetitive flood loss properties?</td>
<td></td>
<td></td>
<td>Document any changes to flood loss property status.</td>
</tr>
<tr>
<td>Did the plan identify the number and type of existing and future buildings, infrastructure, and critical facilities in hazards areas?</td>
<td></td>
<td></td>
<td>1) Update existing data in risk assessment section, or 2) determine whether adequate data exists. If so, add information to plan. If not, describe why this could not be done at the time of the plan update.</td>
</tr>
<tr>
<td>Did the plan identify data limitations?</td>
<td></td>
<td></td>
<td>If yes, the plan update must address them: either state how deficiencies were overcome or why they couldn't be addressed.</td>
</tr>
<tr>
<td>Did the plan identify potential dollar losses for vulnerable structures?</td>
<td></td>
<td></td>
<td>1) Update existing data in risk assessment section, or 2) determine whether adequate data exists. If so, add information to plan. If not, describe why this could not be done at the time of the plan update.</td>
</tr>
<tr>
<td>Are the plan goals still relevant?</td>
<td></td>
<td></td>
<td>Document any updates in the plan goal section.</td>
</tr>
<tr>
<td>What is the status of each mitigation action?</td>
<td></td>
<td></td>
<td>Document whether each action is completed or pending. For those that remain pending explain why. For completed actions, provide a 'success' story.</td>
</tr>
<tr>
<td>Are there new actions that should be added?</td>
<td></td>
<td></td>
<td>Add new actions to the plan. Make sure that the mitigation plan includes actions that reduce the effects of hazards on both new and existing buildings.</td>
</tr>
<tr>
<td>Is there an action dealing with continued compliance with the National Flood Insurance Program?</td>
<td></td>
<td></td>
<td>If not, add this action to meet minimum NFIP planning requirements.</td>
</tr>
<tr>
<td>Are changes to the action item prioritization, implementation, and/or administration processes needed?</td>
<td></td>
<td></td>
<td>Document these changes in the plan implementation and maintenance section.</td>
</tr>
<tr>
<td>Do you need to make any changes to the plan maintenance schedule?</td>
<td></td>
<td></td>
<td>Document these changes in the plan implementation and maintenance section.</td>
</tr>
<tr>
<td>Is mitigation being implemented through existing planning mechanisms (such as comprehensive plans, or capital improvement plans)?</td>
<td></td>
<td></td>
<td>If the community has not made progress on process of implementing mitigation into existing mechanisms, further refine the process and document in the plan.</td>
</tr>
</tbody>
</table>

Source: Oregon Partnership for Disaster Resilience.