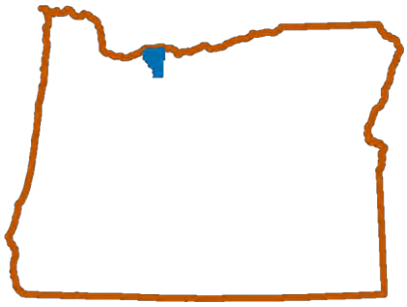
Hood River County

MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN



- Hood River County
- City of Cascade Locks
- City of Hood River
- Port of Cascade Locks
- Port of Hood River

FEMA

Effective November 9, 2018 through
November 8, 2023

Prepared for:

Hood River County Emergency Management Department

Prepared by:

University of Oregon's Institute for Policy Research and Engagement: the Oregon Partnership for Disaster Resilience and the Resource Assistance for Rural Environments

Oregon Department of Land Conservation and Development

The *2018 Hood River Multi-Jurisdictional Natural Hazards Mitigation Plan* is a living document that will be reviewed and updated periodically.

Comments, suggestions, corrections, and additions are enthusiastically encouraged to be submitted from all interested parties.

For further information and to provide comments, contact:

Barb Ayers, Emergency Manager
Hood River County
601 State Street
Hood River, Oregon 97031
Telephone: 541-386-1213
Email: Barbara.ayers@co.hood-river.or.us

GET READY GORGE
Hood River County Sheriff's Office
EMERGENCY MANAGEMENT

Oregon Department of Land Conservation and Development

RARE Resource Assistance for Rural Environments

UNIVERSITY OF OREGON

SPECIAL THANKS & ACKNOWLEDGEMENTS

Hood River County developed this Multi-Jurisdictional Natural Hazards Mitigation Plan through a regional partnership funded by the Federal Emergency Management Agency's Pre-Disaster Mitigation Grant Program. FEMA awarded the grant to support the update of natural hazards mitigation plans for eight counties in the region. The region's planning process utilized a four-phased planning process and plan development support provided by the University of Oregon's Institute for Policy Research and Engagement (IPRE) which includes the Resource Assistance for Rural Environments (RARE), and the Oregon Partnership for Disaster Resilience (OPDR). This project would not have been possible without technical and financial support provided by the Department of Land Conservation and Development (DLCD). In 2017, DLCD received two Pre-Disaster Mitigation grants (PDMC-PL-10-OR-2016-003 and PDMC-PL-OR-2016-005) from FEMA through the Oregon Emergency Management (OEM) to assist Hood River County and seven other counties with their NHMPs.

Regional partners include:

- Department of Land Conservation and Development
- Military Department, Office of Oregon Emergency Management
- FEMA Region X
- University of Oregon's Community Service Center
- Resource Assistance for Rural Environments at the University of Oregon's Community Service Center

Project Steering Committee:

John Roberts, Hood River County Community Development
Mikel Diwan, Hood River County Public Works
Mike Schrankel, Hood River County GIS Coordinator
Loretta Duke, US Forest Service
Theresa North, Columbia Area Transit
Mike McCafferty, Hood River Fire Defense Board
Mike Matthews, Public Health Manager, Hood River County Public Health
Catherine Dalbey, Director of Human Resources, Hood River County School District
Michael McElwee, Port of Hood River
Gordon Zimmerman, City of Cascade Locks
Paul Koch, Port of Cascade Locks
Dustin Nilsen, City of Hood River
Barbara Ayers, Hood River County Emergency Management

Project Managers:

Barbara Ayers, Director, Hood River County Emergency Management
Nicolia Mehrling, Resource Assistance for Rural Environments

Department of Land Conservation and Development Staff:

Tricia Sears, Natural Hazards Planner

Institute for Policy Research and Engagement Staff:

Megan Smith, Director, Resource Assistance for Rural Environments; Co-Director, Institute for Policy Research and Engagement
Michael Howard, Assistant Program Director, Oregon Partnership for Disaster Resilience
Titus Tomlinson, Program Coordinator, Resource Assistance for Rural Environments
Aniko Drlik-Muehleck, Project Coordinator
Julie Foster, Grants Administrator

Geographic Information Systems (GIS) Maps:

Mike Schrankel, Hood River County GIS
Oregon HazVu, Oregon Department of Geology and Mineral Industries

Plan Template Disclaimer

This Natural Hazards Mitigation Plan update is based in part on a plan template developed by the University of Oregon's Institute for Policy Research and Engagement (IPRE) - Oregon Partnership for Disaster Resilience (OPDR) and used in the 2012 Hood River NHMP. OPDR provided copies of the plan templates to communities for use in developing or updating their natural hazards mitigation plans at that time. OPDR hereby authorizes the use of all content and language provided to Hood River County in the plan template. 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. However, emphasis is placed on identifying and describing the unique attributes of the counties and cities for each plan. The basic format of the 2012 NHMP has been retained for this 2018 NHMP update.

About the Department of Land Conservation and Development

Oregon's statewide land use planning program — originated in 1973 under Senate Bill 100 — provides protection of farm and forest lands, conservation of natural resources, orderly and efficient development, coordination among local governments, and citizen involvement. The program affords all Oregonians predictability and sustainability to the development process by allocating land for industrial, commercial and housing development, as well as transportation and agriculture. The Department of Land Conservation and Development (DLCD) administers the program. A seven-member volunteer citizen board known as the Land Conservation and Development Commission (LCDC) guides DLCD. Under the program, all cities and counties have adopted comprehensive plans that meet mandatory state standards that address land use, development, housing, transportation, and conservation of natural resources. Periodic review of plans and technical assistance in the form of grants to local jurisdictions are key elements of the program.[1]

About the Institute for Policy Research and Engagement

The Institute for Policy Research and Engagement (IPRE), a research center affiliated with the School 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 IPRE 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 Institute for Policy Research and Engagement at the University of Oregon, the OPDR employs a service-learning model to increase community capacity and enhance disaster safety and resilience statewide.

About Resource Assistance for Rural Environments

RARE is an AmeriCorps program administered through the University of Oregon's Institute for Policy Research and Engagement. RARE is currently supported through grants from the Corporation for National & Community Service (AmeriCorps), The Ford Family Foundation, the University of Oregon, the Oregon Food Bank, the Federal Emergency Management Agency, the Oregon Department of Transportation, and other agencies. In addition, each participating community provides $19,000 of approximately $32,000 needed to place, train, and support a full-time RARE member.

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[1] http://www.oregon.gov/LCD/Pages/about_us.aspx

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HOOD RIVER COUNTY MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN

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U.S. Department of Homeland Security
FEMA Region 10
130 – 228th Street, SW
Bothell, Washington 98021-8627

FEMA

March 21, 2019

The Honorable Mike Oates
Chair, Hood River County Commissioners
601 State Street,
Hood River, Oregon 97031

Dear Chairman Oates:

On November 9, 2018, the U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region 10, approved the *Hood River Multi-Jurisdictional Hazard Mitigation Plan* as a multi-jurisdictional local plan as outlined in Code of Federal Regulations Title 44 Part 201. This approval provides the below jurisdictions eligibility to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's, Hazard Mitigation Assistance (HMA) grants through November 8, 2023, through your state.

Hood River County	City of Hood River	City of Cascade Locks
Port of Hood River	Port of Cascade Locks	

The updated list of approved jurisdictions includes Port of Hood River and the Port of Cascade Locks which recently adopted the *Hood River Multi-Jurisdictional Hazard Mitigation Plan*. To continue eligibility, jurisdictions must review, revise as appropriate, and resubmit the plan within five years of the original approval date.

If you have questions regarding your plan's approval or FEMA's mitigation grant programs, please contact Angie Lane, State Hazard Mitigation Officer with Oregon Emergency Management Division, at 503-378-4660, who coordinates and administers these efforts for local entities.

Sincerely,

John Graves for

Mark Carey, Director
Mitigation Division

Enclosure

JG

APPENDIX A:
LOCAL MITIGATION PLAN REVIEW TOOL

The *Local Mitigation Plan Review Tool* demonstrates how the Local Mitigation Plan meets the regulation in 44 CFR §201.6 and offers States and FEMA Mitigation Planners an opportunity to provide feedback to the community.

- The Regulation Checklist provides a summary of FEMA's evaluation of whether the Plan has addressed all requirements.
- The Plan Assessment identifies the plan's strengths as well as documents areas for future improvement.
- The Multi-jurisdiction Summary Sheet is an optional worksheet that can be used to document how each jurisdiction met the requirements of the each Element of the Plan (Planning Process; Hazard Identification and Risk Assessment; Mitigation Strategy; Plan Review, Evaluation, and Implementation; and Plan Adoption).

The FEMA Mitigation Planner must reference this *Local Mitigation Plan Review Guide* when completing the *Local Mitigation Plan Review Tool*.

Jurisdiction: Hood River County	**Title of Plan:** Hood River County Multi-Jurisdiction Natural Hazards Mitigation Plan	**Date of Plan:** June 2018
Local Point of Contact: Barbara Ayers		**Address:** 601 State Street, Hood River, Oregon 97031
Title: Director		
Agency: Hood River County Emergency Management		
Phone Number: (541) 386-1213		**E-Mail:** barbara.ayers@co.hood-river.or.us

State Reviewer: Joseph A. Murray	**Title:** Planner	**Date:** July 24, 2018 and January 9, 2019

FEMA Reviewer: Chelsea Kahn Kate Skaggs Kate.Skaggs@mbakerintl.com Jake Grabowsky	**Title:** CERC Planner Mitigation Champion Mitigation Planner	**Date:** August 17, 2018 August 20, 2018 January 25, 2019
Date Received in FEMA Region *(insert #)*	July 24, 2018	
Plan Not Approved	01/25/2019 (Ports Addendum)	
Plan Approvable Pending Adoption	August 21, 2018	
Plan Approved	November 9, 2018	

SECTION 1:
MULTI-JURISDICTION SUMMARY SHEET (OPTIONAL)

INSTRUCTIONS: For multi-jurisdictional plans, a Multi-jurisdiction Summary Spreadsheet may be completed by listing each participating jurisdiction, which required Elements for each jurisdiction were 'Met' or 'Not Met,' and when the adoption resolutions were received. This Summary Sheet does not imply that a mini-plan be developed for each jurisdiction; it should be used as an optional worksheet to ensure that each jurisdiction participating in the Plan has been documented and has met the requirements for those Elements (A through E).

MULTI-JURISDICTION SUMMARY SHEET (Add additional pages if necessary)											
#	Jurisdiction Name	Jurisdiction Type (city/borough/ district, etc.)	POC	Required Revisions / Comments	Requirements Met (Y/N)					
					A. Planning Process	B. Hazard Identification & Risk Assessment	C. Mitigation Strategy	D. Plan Review, Evaluation & Implementation	E. Plan Adoption	F. State Require-ments
1	Cascade Locks	City	Gordon Zimmerman gzimmerman@cascade-locks.or.us 541-374-8484		Y	Y	Y	NA	Y	NA
2	Hood River	City	Dustin Nilsen d.nilsen@ci.hood-river.or.us 541- 387-5210		Y	Y	Y	NA	Y	NA
3	Hood River	County	Barbara Ayers		Y	Y	Y	Y	Y	NA
4	Port of Cascade Locks	District	Paul Koch pkoch@portofcascadelocks.com 541-374-2401		Y	Y	Y	NA	N	NA
5	Port of Hood River	District	Michael S. McElwee mmcelwee@portofhoodriver.com 541-386-1138		Y	Y	Y	NA	Y	NA

SECTION 2:

REGULATION CHECKLIST

INSTRUCTIONS: The Regulation Checklist must be completed by FEMA. The purpose of the Checklist is to identify the location of relevant or applicable content in the Plan by Element/sub-element and to determine if each requirement has been 'Met' or 'Not Met.' The 'Required Revisions' summary at the bottom of each Element must be completed by FEMA to provide a clear explanation of the revisions that are required for plan approval. Required revisions must be explained for each plan sub-element that is 'Not Met.' Sub-elements should be referenced in each summary by using the appropriate numbers (A1, B3, etc.), where applicable. Requirements for each Element and sub-element are described in detail in this *Plan Review Guide* in Section 4, Regulation Checklist.

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	**Location in Plan (section and/or page number)**	**Met**	**Not Met**
ELEMENT A. PLANNING PROCESS			
A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? (Requirement §201.6(c)(1))	Volume 1: PDF 1, 9-10, 19-20; Appendix B, PDF 227-255 Addenda: PDF 135-136, 157-158, 183-184, 195-196; Appendix B, PDF 227-255	x	
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))	PDF 9-10, 20	X	
A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))	PDF 10, 19-20; Mitigation Strategy, PDF 47; Appendix B, PDF 246-253, 257-260; Appendix F, PDF 355-364.	X	
A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))	Section 4, PDF 62; Appendix C, PDF 338-339; Vol. II – Addenda PDF 139-140, 161-162, 186-187, 198-199	X	
A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))	Section 4, PDF 63-64, Addenda, PDF 140, 163, 187, 199	X	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))	Section 4, PDF 56-65; Addenda, PDF 141, 163-164, 186-187, 198-199.	X	
ELEMENT A: REQUIRED REVISIONS A3: It is not clear how the public was involved in either of the ports hazard mitigation plans. None of the public meetings described in this document appear to have been about the ports or addressed the ports in a meaningful way. To meet this requirement, clearly describe and provide documentation for how the public was given opportunity to comment on the draft plans and be involved in the planning process.			
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			
B1. Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s)? (Requirement §201.6(c)(2)(i))	Section 2, PDF 25-31; Hazard Annexes PDF 67-69. Addenda: PDF 143, 147-155, 166, 170-179, 190-191, 202-203	X	
B2. Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? (Requirement §201.6(c)(2)(i))	Section 2, throughout text, PDF 31-33 (and throughout); Hazard Annexes PDF 70-71, 78-79, 90-95, 106-107, 112-113, 117-120, 125-124, 130-133. Addenda: PDF 143, 147-155, 166, 170-179, 190-191, 202-203	X	
B3. Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? (Requirement §201.6(c)(2)(ii))	Risk Assessment pg. 2-8 to 2-17 (and throughout); Hazard Annexes, PDF 75-76, 83-88, 98-105, 110-111, 115-116, 124, 127-128, 135-136. Addenda: PDF 143, 147-155, 166, 170-179, 190-191, 202-203	X	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
B4. Does the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods? (Requirement §201.6(c)(2)(ii))	Section 2, PDF 43. Addenda: PDF 151, 175	X	
ELEMENT B: REQUIRED REVISIONS B4: The plan discusses repetitive loss properties in the cities and county but does not specifically address the ports. If there are repetitive loss properties in the port jurisdictions then list them, such as including the ports in the tables throughout the plan discussion repetitive loss properties. Or, explicitly state that if there are no NFIP-insured repetitive loss port properties			
ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs? (Requirement §201.6(c)(3))	Section 3, PDF 50-51; Section 4, PDF 57-59. Addenda: PDF 136-137, 158-159, 188, 200	X	
C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? (Requirement §201.6(c)(3)(ii))	Section 2, PDF 43-44. Addenda: PDF 151, 175	X	
C3. Does the Plan include goals to reduce/avoid long-term vulnerabilities to the identified hazards? (Requirement §201.6(c)(3)(i))	Page iv (PDF 12), Section 3, PDF 49-51	X	
C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? (Requirement §201.6(c)(3)(ii))	Section 3, PDF 52-55. Addenda: PDF 136-137, 158-159, 188, 200	X	
C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? (Requirement §201.6(c)(3)(iv)); (Requirement §201.6(c)(3)(iii))	Section 3, PDF 47-50; Section 5, PDF 60-63; Appendix A: Action Item Forms, PDF 188-199; Appendix D: Economic Analysis, PDF 324-331 Addenda: PDF 136-137, 158-159, 188, 200	X	

1. REGULATION CHECKLIST **Regulation** (44 CFR 201.6 Local Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))	Section 4, PDF 59; Community Profile, PDF 321-323; Addenda PDF 138-140, 161-162, 186-187, 198-199	X	
ELEMENT C: REQUIRED REVISIONS C2: Do the ports participate in the NFIP? To meet this requirement, state how their floodplain management program is maintained and in compliance with the NFIP. , Or, state that the ports do not participate.			
ELEMENT D. PLAN REVIEW, EVALUATION, AND IMPLEMENTATION (applicable to plan updates only)			
D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))	Section 2, PDF 36; Appendix C, PDF - 293-300	N/A	
D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))	Appendix B, PDF 203-220	N/A	
D3. Was the plan revised to reflect changes in priorities? (Requirement §201.6(d)(3))	Section 3, PDF 48-55	N/A	
ELEMENT D: REQUIRED REVISIONS			
ELEMENT E. PLAN ADOPTION			
E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? (Requirement §201.6(c)(5))	To be completed pending FEMA APA	X for port of hood river	
E2. For multi-jurisdictional plans, has each jurisdiction requesting approval of the plan documented formal plan adoption? (Requirement §201.6(c)(5))	To be completed pending FEMA APA		
ELEMENT E: REQUIRED REVISIONS			
ELEMENT F. ADDITIONAL STATE REQUIREMENTS (OPTIONAL FOR STATE REVIEWERS ONLY; NOT TO BE COMPLETED BY FEMA)			
ELEMENT F: REQUIRED REVISIONS			

SECTION 3:
PLAN ASSESSMENT

A. Plan Strengths and Opportunities for Improvement

This section provides a discussion of the strengths of the plan document and identifies areas where these could be improved beyond minimum requirements.

Element A: Planning Process

Plan Strengths

- Good engagement of planning partners including RARE, IPRE, and OPDR.
- Good inclusion of diverse organizations for the Steering Committee
- Supportive public outreach survey to gauge public opinion of problem statements.
- Helpful evaluation of community vulnerability through diverse populations.

Opportunities for Improvements

- Plan is easy to read, but consider consolidating sections and better linking information from Annexes to Sections 1-4.
- Consider moving *"How is the Plan Organized?"* to the beginning of Section 1 to better introduce organization of the document.
- Ensure all dates are updated and consistent throughout the document, for example the "x" placeholders on page i. and ii. should be updated. Similar text issues can be found throughout the document, such as on Page HA-3 (text cuts off in grey box). Ensure these are corrected in future revisions.
- Considering capturing notes and sign in sheets for all meeting for both the County and the Cities involved. This information can help inform the next planning process.
- Consider expanding on how the results of the outreach survey were used to develop mitigation actions.

Element B: Hazard Identification and Risk Assessment

Plan Strengths

- Clear summary of hazard analyses for the County and Cities throughout the plan and city addenda.
- Good linkage to Risk MAP data and Risk Report to improve floodplain information and other hazards.
- Helpful Risk Assessment Summary table (Table i-1).

Opportunities for Improvements

- Incorporate data and information from OCCRI report when available to capture the impact climate change will have on each identified hazard.
- Ensure all hazards meet the specific requirements of the plan; incorporate history or previous events for droughts for the Cities of Cascade Locks and Hood River.

Element C: Mitigation Strategy

Plan Strengths

- Unique and good use of Action Item Worksheets to determine and prioritize mitigation actions. Great way to collect information about funding sources and project partners.
- Clear organization of actions sorted by priority.
- Clear description of co-conveners, describing responsibilities and specific contacts.

Opportunities for Improvements

- Consider streamlining information about 2012 mitigation actions and new 2018 mitigation action; clearly documenting which actions were removed, completed and updated for inclusion in the 2018 plan.
- Consider including stronger information on updates to how hazard mitigation data was integrated into planning processes, capital improvements plans, or other planning mechanisms; this information would complement the extensive list of plans update. The intent of C6 is to gauge how acknowledging, and utilizing, hazard mitigation data has been institutionalized in planning processes to reduce risk.

Element D: Plan Update, Evaluation, and Implementation (*Plan Updates Only*)

Plan Strengths

- Clear description of goal review and re-prioritization process.
- Interesting prioritization method for identified goals.

Opportunities for Improvements

- While this plan update for the county mentions its rural nature and a 1.2-1.8% population growth per year, consider how hazard events such as the Eagle Creek wildfire, may have also changed the vulnerability of participating communities. The intent of the D1 requirement is to evaluate if development is occurring in hazardous areas and supporting mitigation actions to continue reducing this risk, in addition to addressing Goal 7.

B. Resources for Implementing Your Approved Plan

The **Region 10 Integrating Natural Hazard Mitigation into Comprehensive Planning** is a resource specific to Region 10 states and provides examples of how communities are integrating natural hazard mitigation strategies into comprehensive planning. You can find it in the FEMA Library at http://www.fema.gov/media-library/assets/documents/89725.

The Local Mitigation Plan Review Guide and Tool resource is available through FEMA's Library and should be referred to for the next plan update. http://www.fema.gov/library/viewRecord.do?id=4859
The Local Mitigation Planning Handbook is available. While the requirements under §201.6 have not changed, the Handbook provides guidance to local governments on developing or updating hazard mitigation plans to meet the requirements is available through the FEMA Library website. http://www.fema.gov/library/viewRecord.do?id=7209
The **Mitigation Ideas**: **A Resource for Reducing Risk from Natural Hazards** resource presents ideas for how to mitigate the impacts of different natural hazards, from drought and sea level rise, to severe winter weather and wildfire. The document also includes ideas for actions that communities can take to reduce risk to multiple hazards, such as incorporating a hazard risk assessment into the local development review process. http://www.fema.gov/library/viewRecord.do?id=6938
FEMA Hazard Mitigation Assistance: Currently, FEMA administers three programs that provide funding for eligible mitigation projects that reduces disaster losses and protect life and property from future disaster damages. The three programs are the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance (FMA) Program, and the Pre-Disaster Mitigation (PDM) Program.

- HMGP assists in implementing long-term hazard mitigation measures following a Presidential major disaster declaration
- PDM provides funds for hazard mitigation planning and projects on an annual basis
- FMA provides funds for projects to reduce or eliminate risk of flood damage to buildings that are insured under the National Flood Insurance Program (NFIP) on an annual basis

The mitigation strategy may include eligible projects to be funded through FEMA's hazard mitigation grant programs (Pre-Disaster Mitigation, Hazard Mitigation Grant Program, Flood Mitigation Assistance). Contact your State Hazard Mitigation Officer, Angie Lane at angie.lane@mil.state.or.us, for more information or visit: http://www.fema.gov/hazard-mitigation-assistance. The FEMA Region X Risk Mapping, Analysis, and Planning program (Risk MAP) releases a monthly newsletter that includes information about upcoming events and training opportunities, as well as hazard and risk related news from around the Region. Past newsletters can be viewed at: http://www.starrteam.com/starr/RegionalWorkspaces/RegionX/Pages/default.aspx. If you would like to receive future newsletters, email rxnewsletter@starr-team.com

Hood River County Board of Commissioners
Hood River County, Oregon

A Resolution Adopting the County of Hood River Representation in the Updates to the Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan	)))))	**RESOLUTION NO.** 2252

Whereas, the County of Hood River recognizes the threat that natural hazards pose to people, property and infrastructure within our community; and

Whereas, undertaking hazard mitigation actions will reduce the potential for harm to people, property and infrastructure from future hazard occurrences; and

Whereas, an adopted Natural Hazards Mitigation Plan is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

Whereas, the County of Hood River has fully participated in the FEMA prescribed mitigation planning process to prepare the *Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan*, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and

Whereas, the County of Hood River has identified natural hazard risks and prioritized several proposed actions and programs needed to mitigate the vulnerabilities of the County of Hood River to the impacts of future disasters within the *Hood River County Multi-Jurisdictional Natural Hazard Mitigation Plan*; and

Whereas, these proposed projects and programs have been incorporated into the *Hood River County, Multi-Jurisdictional Natural Hazards Mitigation Plan* that has been prepared and promulgated for consideration and implementation by the cities of Hood River County; and

Whereas, the Oregon Military Department's Office of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the *Hood River County, Multi-Jurisdictional Natural Hazards Mitigation Plan* and pre-approved it (dated, August 21, 2018) contingent upon this official adoption of the participating governments and entities;

Whereas, the NHMP is comprised of four volumes: Volume I -Basic Mitigation Plan, Volume II – Hazard Annexes. Volume III - Jurisdictional Addenda, and Volume IV – Mitigation Resources, collectively referred to herein as the NHMP; and

Whereas, the NHMP is in an on-going cycle of development and revision to improve it's effectiveness; and

Whereas, County of Hood River adopts the NHMP and directs County staff to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.

Now, therefore, be it resolved, that the County of Hood River adopts *the Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan* as an official plan; and

Be it further resolved, that the County of Hood River will submit this Adoption Resolution to the Oregon Military Department's Office of Emergency Management and Federal Emergency Management Agency, Region X officials to enable final approval of the *Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan.*

ADOPTED THIS 17th DAY OF SEPTEMBER 2018

HOOD RIVER COUNTY
BOARD OF COMMISSIONERS

Ron Rivers, Chair

Karen Joplin, Commissioner

Rich McBride, Commissioner

Robert Benton, Commissioner

Les Perkins, Commissioner

RESOLUTION NO. 1405

A RESOLUTION ADOPTING THE CITY OF CASCADE LOCKS REPRESENTATION IN THE UPDATES TO THE HOOD RIVER COUNTY MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN

Whereas, the City of Cascade Locks recognizes the threat that natural hazards pose to people, property and infrastructure within our community; and

Whereas, undertaking hazard mitigation actions will reduce the potential for harm to people, property and infrastructure from future hazard occurrences; and

Whereas, an adopted Natural Hazards Mitigation Plan is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

Whereas, the City of Cascade Locks has fully participated in the FEMA prescribed mitigation planning process to prepare the *Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan*, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and

Whereas, the City of Cascade Locks has identified natural hazard risks and prioritized several proposed actions and programs needed to mitigate the vulnerabilities of the City of Cascade Locks to the impacts of future disasters within the *Hood River County Multi-Jurisdictional Natural Hazard Mitigation Plan*; and

Whereas, these proposed projects and programs have been incorporated into the *Hood River County, Multi-Jurisdictional Natural Hazards Mitigation Plan* that has been prepared and promulgated for consideration and implementation by the cities of Hood River County; and

Whereas, the Oregon Military Department's Office of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the *Hood River County, Multi-Jurisdictional Natural Hazards Mitigation Plan* and pre-approved it (dated, August 21, 2018) contingent upon this official adoption of the participating governments and entities;

Whereas, the NHMP is comprised of four volumes: Volume I -Basic Mitigation Plan, Volume II – Hazard Annexes. Volume III - Jurisdictional Addenda, and Volume IV – Mitigation Resources, collectively referred to herein as the NHMP; and

Whereas, the NHMP is in an on-going cycle of development and revision to improve its effectiveness; and

Whereas, City of Cascade Locks adopts the NHMP and directs the City Administrator to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.

NOW, THEREFORE, THE COMMON COUNCIL FOR THE CITY OF CASCADE LOCKS, HOOD RIVER COUNTY, OREGON, RESOLVES AS FOLLOWS:

SECTION 1. The City of Cascade Locks adopts *the Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan* as an official plan.

SECTION 2. The City of Cascade Locks will submit this Adoption Resolution to the Oregon Military Department's Office of Emergency Management and Federal Emergency Management Agency, Region X officials to enable final approval of the *Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan*.

SECTION 3. This resolution shall become effective upon adoption by the City Council and approval by the Mayor.

ADOPTED by the City Council this 24th day of September, 2018.

APPROVED by the Mayor this 24th day of September, 2018.

Tom Cramblett

Tom Cramblett, Mayor

ATTEST:

Kathy Woosley, City Recorder

Resolution No. 2018-18

A Resolution Adopting the City of Hood River Representation in the Updates to the Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan

Whereas, the City of Hood River recognizes the threat that natural hazards pose to people, property and infrastructure within our community; and

Whereas, undertaking hazard mitigation actions will reduce the potential for harm to people, property and infrastructure from future hazard occurrences; and

Whereas, an adopted Natural Hazards Mitigation Plan is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

Whereas, the City of Hood River has fully participated in the FEMA prescribed mitigation planning process to prepare the *Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan*, which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and

Whereas, the City of Hood River has identified natural hazard risks and prioritized several proposed actions and programs needed to mitigate the vulnerabilities of the City of Hood River to the impacts of future disasters within the *Hood River County Multi-Jurisdictional Natural Hazard Mitigation Plan*; and

Whereas, these proposed projects and programs have been incorporated into the *Hood River County, Multi-Jurisdictional Natural Hazards Mitigation Plan* that has been prepared and promulgated for consideration and implementation by the cities of Hood River County; and

Whereas, the Oregon Military Department's Office of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the *Hood River County, Multi-Jurisdictional Natural Hazards Mitigation Plan* and pre-approved it (dated, August 21, 2018) contingent upon this official adoption of the participating governments and entities;

Whereas, the NHMP is comprised of four volumes: Volume I -Basic Mitigation Plan, Volume II – Hazard Annexes. Volume III - Jurisdictional Addenda, and Volume IV – Mitigation Resources, collectively referred to herein as the NHMP; and

Whereas, the NHMP is in an on-going cycle of development and revision to improve it's effectiveness; and

Whereas, City of Hood River adopts the NHMP and directs the City Manager to develop, approve, and implement the mitigation strategies and any administrative changes to the NHMP.

Now, therefore, be it resolved, that the City of Hood River adopts *the Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan* as an official plan; and

Be it further resolved, that the City of Hood River will submit this Adoption Resolution to the Oregon Military Department's Office of Emergency Management and Federal Emergency Management Agency, Region X officials to enable final approval of the *Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan.*

Adopted this 9th day of October, 2018

Paul Blackburn, Mayor

Attest:

Jennifer Gray, City Recorder

THE PORT OF CASCADE LOCKS

BOARD OF PORT COMMISSIONERS

CASCADE LOCKS, OREGON

A RESOLUTION OF THE PORT OF CASCADE LOCKS COMMISSION ADOPTING THE FORMAL ADDENDUM TO THE HOOD RIVER COUNTY NHMP.

RESOLUTION 2019-1

This resolution represents formal adoption by the Port Commission of the addendum to the Hood River County NHMP.

WHEREAS, it is required that the Port of Cascade Locks adopt the Resolution No. 2019-1 approving the Addendum to the County NHMP

WHEREAS, the Port desires to qualify for possible reimbursement of natural hazard costs

WHEREAS, this addendum will be effective through November 8, 2023

NOW, THEREFORE, BE IT RESOLVED, that the Port of Cascade Locks does approve the addendum attached as Exhibit A.

Adopted by the Port Board of Commissioners this 21st day of February 2019 and effective immediately.

Jess Groves, Commission President

Joeinne Caldwell, Commission Secretary-Treasurer

PORT OF HOOD RIVER
Resolution No. 2018-19-1

Resolution Approving and Adopting Updates to the Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan

Whereas, the Port of Hood River ("Port") recognizes the threat that natural hazards pose to people, property and infrastructure within our community; and

Whereas, undertaking hazard mitigation actions will reduce the potential for harm to people, property and infrastructure from future hazard occurrences; and

Whereas, an adopted Natural Hazards Mitigation Plan is required as a condition of future funding for mitigation projects under multiple FEMA pre- and post-disaster mitigation grant programs; and

Whereas, the Port has participated in the FEMA prescribed mitigation planning process to prepare the *Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan*, ("NHMP") which has established a comprehensive, coordinated planning process to eliminate or minimize these vulnerabilities; and

Whereas, the Port has identified natural hazard risks and supports several proposed actions and programs needed to mitigate the vulnerabilities to the Port of the impacts of future disasters within the *NHMP area*; and

Whereas, these proposed projects and programs have been incorporated into the *NHMP* that has been prepared and promulgated for consideration and implementation by the public agencies with Hood River Country; and

Whereas, the Oregon Military Department's Office of Emergency Management and Federal Emergency Management Agency, Region X officials have reviewed the *NHMP* and approved it on August 21, 2018 contingent upon adoption of the participating governments and entities;

Whereas, the NHMP is comprised of four volumes: Volume I -Basic Mitigation Plan, Volume II – Hazard Annexes. Volume III - Jurisdictional Addenda, and Volume IV – Mitigation Resources, collectively referred to herein as the NHMP; and

Whereas, the NHMP is in an on-going cycle of development and revision to improve its effectiveness.

Now, therefore, be it resolved, that the Port of Hood River approves and adopts *the Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan* as an official plan.

ADOPTED BY THE BOARD OF COMMISSIONERS this 2nd day of October 2018.

Hoby Streich

Brian Shortt

John Everitt

Ben Sheppard

David Meriwether

Volume I:
Basic Mitigation Plan

Photo Source: Hood River County

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EXECUTIVE SUMMARY

Hood River County developed this Natural Hazards Mitigation Plan in an effort to prepare for the long term effects resulting from natural hazards in Hood River County. 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 people within the community, it is possible to create a stronger, more resilient community that will benefit from long-term natural hazards planning efforts.

44 CFR 201.6 – The local mitigation plan is the representation of the jurisdiction's commitment to reduce risks from natural hazards, serving as a guide for decision makers as they commit resources to reducing the effects of natural hazards. . . .

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 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" –as defined by FEMA this includes individuals, families, businesses and industries, faith and community based organizations, non-profits, media outlets, schools and academia, and state, local and federal governments (https://www.fema.gov/whole-community).

Why Develop this Mitigation Plan?

44 CFR 201.6(a)(1) – A local government must have a mitigation plan approved pursuant to this section in order to receive HMGP project grants . . .

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 NHMP in order to receive federal funds for mitigation projects. Local and federal approval of this plan ensures that the county and listed cities will remain eligible for pre- and post-disaster mitigation grant funds.

Who Participated in Developing the Plan?

The *Hood River County Multi-Jurisdiction Natural Hazards Mitigation Plan* 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. A project Steering Committee guided the plan development process. Steering Committee meetings were held

on March 29, 2018 and April 19, 2018. The project Steering Committee included representatives from the following organizations:

44 CFR 201.6(c)(1) – Documentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

- Hood River County Community Development
- Hood River Soil and Water Conservation District
- Hood River County School District
- Hood River County Environmental Health Services
- Hood River Fire Department and Emergency Medical Service
- Hood River County Public Works
- City of Cascade Locks Administration
- City of Hood River Planning
- Hood River County Emergency Management
- Oregon Department of Transportation
- Bonneville Power Administration
- United States Forest Service

Other organizations that were involved in this 2018 NHMP update include: the Oregon Department of Land Conservation and Development and the University of Oregon's Institute for Policy Research and Engagement, which involved both the Oregon Partnership for Disaster Resilience and the Resource Assistance for Rural Environments.

Hood River County Emergency Management convened the planning process and will take the lead in implementing, maintaining and updating the plan. Public participation played a key role in the development of goals and action items. At various stages during the plan update's development, county officials and the public were invited to learn of its progress and to comment on completed sections. This took place primarily during a presentation before the county board of commissioners on June 18, 2018 and before the Hood River City Council on June 25, 2018. City officials from Hood River and Cascade Locks were also given a chance to comment on the plan development during scheduled meetings throughout the update process. Meetings with the cities occurred on these dates: Hood River on May 15, 2018 and Cascade Locks on May 10, 2018.

The public was also given a chance for further involvement in the plan update an online survey included in the public notice of the plan update; the survey was also distributed at outreach events, described in Appendices B and F. The survey was meant to gauge the priorities of the public in terms of government efforts to address natural hazards, but also contained questions that gauged the public's knowledge and awareness of the county's current NHMP, and thus served an additional purpose as an informational outreach tool. Outreach efforts were also made through presentations at food preparedness organizations, the Hood River County Rotary, the Cascade Locks Join Economic Development Work Group, and the Hood River County Fire Defense Board. The NHMP process outreach efforts included information on Radio Tierra, with public announcements on air and on Facebook. Finally, when a working draft of the updated plan was completed it was posted online on May 21, 2018 for public comment. Members of the general public were invited to view, critique, and otherwise express any concerns they may have had with the plan update, and

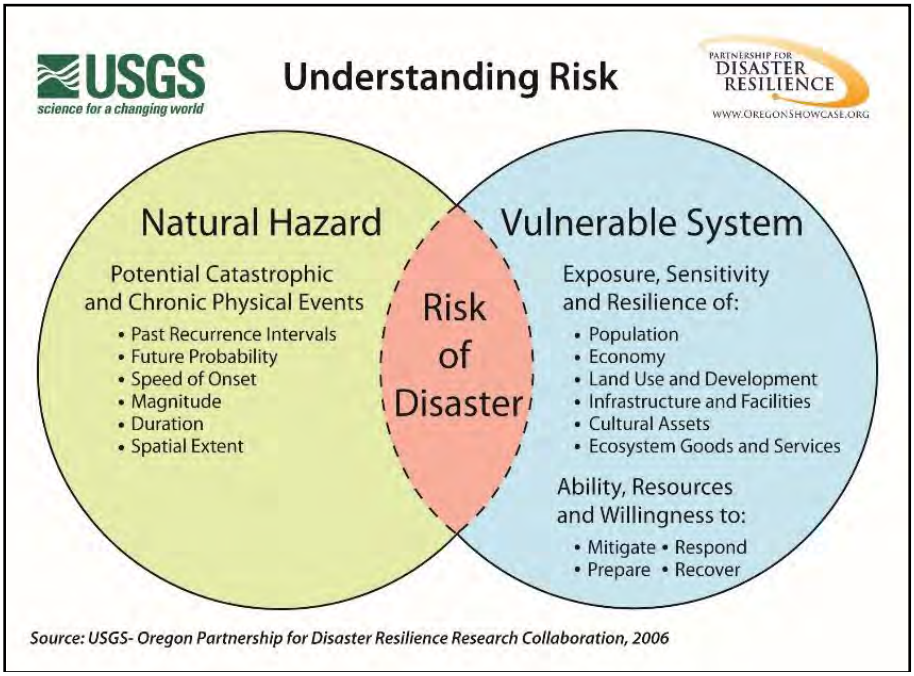
these comments were addressed during the final plan editing process. See Section B, Plan Implementation and Process for details on the outreach efforts made during this 2018 NHMP update.

How Does this Mitigation Plan Reduce Risk?

44 CFR 201.6(c)(2) – A Risk Assessment that provides the factual basis for activities proposed in the strategy . . .

This Natural Hazards Mitigation Plan is intended to assist Hood River County 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 i.1 Understanding Risk



Source: Oregon Partnership for Disaster Resilience

By identifying and understanding the relationship between natural hazards, vulnerable systems, and existing capacity, communities in Hood River County are better equipped to identify and implement actions aimed at reducing the overall risk to natural hazards.

What is the County's Overall Risk to Hazards?

Hood River County conducted a risk assessment to evaluate the probability of each hazard as well as the vulnerability of the community to that hazard. Table i.1 below presents the overall risk assessment for Hood River County including both the county's hazard analysis and relative risk. The hazards are listed in rank order from high to low, taking consideration of past historical events, vulnerability to populations, the maximum threat, and the probability, or likelihood of a hazard event occurring.

Table i.1: Risk Assessment Summary

Hazard	History	Probability	Vulnerability	Maximum Threat	Total	Rank	Risk Level
Winter Storm	9	10	9	10	**233**	**1**	**High**
Wildfire	9	9	6	9	**201**	**2**	**High**
CSZ Event	2	6	6	8	**156**	**3**	**Moderate**
Landslide	5	7	5	7	**154**	**4**	**Moderate**
Drought	4	7	7	6	**152**	**5**	**Moderate**
Flood	3	6	3	8	**143**	**6**	**Moderate**
Crustal Earthquake	2	4	5	8	**137**	**7**	**Moderate**
Windstorm	2	4	4	8	**132**	**8**	**Moderate**
Volcano	2	2	5	7	**113**	**9**	**Low**

Source: Hood River County Risk Assessment Steering Committee Meeting, March 29, 2018

What is the Plan's Mission?

The mission of the Hood River County Natural Hazards Mitigation Plan is to, "Protect life, property and the environment through coordination and cooperation among public and private partners, which will reduce risk and loss, and enhance the quality of life for the people of Hood River County."

44 CFR 201.6(c)(3)(i) – A description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

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. Hood River County's plan goals include:

- Protection of Life, Property, and Natural Resources
- Disaster Resilient Economy
- Education and Outreach
- Facilitate Partnerships and Coordination
- Acknowledge Responsibility
- Emergency Services Enhancement

How are the Action Items Organized?

44 CFR 201.6(c)(3)(ii) – A section that identifies and analyzes a comprehensive range of specific mitigation actions . . .

The action items are organized within an action item matrix (located in Section 3 of the plan), which lists all of the multi-hazard and hazard-specific action items included in the NHMP. Data collection, research and the public participation process resulted in the development of the action items. The Mitigation Action Tables included as Tables 3.2, 3.3, and 3.4, portray the overall plan framework and identifies linkages between the plan goals and actions. The tables document the title of each action along with the coordinating organization, timeline, and the plan goals addressed. Mitigation actions are further detailed in individual action item forms located in Appendix A of the plan.

How will the plan be implemented?

44 CFR 201.6(c)(3)(iii) – An action plan describing how the actions . . . will be prioritized, implemented and administered . . .

44 CFR 201.6(c)(4) – A plan maintenance process . . .

Section 4, Plan Implementation and Maintenance details the formal process that will ensure that the Hood River County Natural Hazards Mitigation Plan remains an active and relevant document. The plan will be implemented, maintained and updated by a designated convener. The convener is responsible for overseeing annual review processes. Cities and special districts developing addendums to the County plan will also designate a convener and will work closely with the County convener to keep the plans coordinated. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing a plan revision every five years. This section describes how the communities will integrate public participation throughout the plan maintenance process.

Plan Adoption

44 CFR 201.6(c)(5) – Documentation that the plan has been formally adopted by the governing body of the jurisdiction . . .

44 CFR 201.6(d) – Plan review [process] . . .

After the plan is locally reviewed, the Director of Hood River County Emergency Management submits it to the State Hazard Mitigation Officer (SHMO) at the Oregon Military Department, Office of Emergency Management (OEM). On behalf of the SHMO, a planner at OEM reviews the plan and submits it to the Federal Emergency Management Agency (FEMA – Region X) for review. The FEMA review will address the criteria outlined in FEMA Interim Final Rule 44 CFR Part 201.6. Once the plan is pre-approved by FEMA, indicated by a letter provided from FEMA to the county called the "Approval Pending Adoption" the county will then formally adopt the plan via resolution. The participating individual jurisdiction's conveners will be responsible for obtaining local adoption of the Hood River County Natural Hazards Mitigation Plan and providing the support necessary to ensure plan implementation. In this

plan that would be the Cities of Hood River and Cascade Locks. Once the resolution is executed at the local level and documentation is provided to FEMA, the plan is formally acknowledged by FEMA with an approval letter. With this, the county maintains eligibility for the Hazard Mitigation Assistance grant funds called the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Programs, and the Flood Mitigation Assistance program.

The accomplishment of the Natural Hazards Mitigation Plan goals and actions depends upon the maintenance of a competent Steering Committee, and adequate support from the County and City departments reflected in the plan in incorporating the mitigation actions into existing County plans and procedures. Thorough familiarity with this Plan will result in the efficient and effective implementation of appropriate mitigation activities and a reduction in the risk and the potential for loss from future natural hazard events.

SECTION I: INTRODUCTION

This section provides a general introduction to natural hazard mitigation planning in Hood River County. In addition, Section I: Introduction 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 . . . 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" –as defined by FEMA this includes individuals, families, businesses and industries, faith and community based organizations, non-profits, media outlets, schools and academia, and state, local and federal governments (https://www.fema.gov/whole-community).

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?

Hood River County updated this Natural Hazards Mitigation Plan in an effort to reduce future loss of life and damage to property resulting from natural hazards. This plan applies to both the cities and unincorporated regions of Hood River County. It is impossible to predict exactly when natural hazard events will occur, or the extent to which they will affect community assets. However, careful planning and collaboration among public agencies, private sector organizations, and citizens within the community, can minimize the losses that can result from natural hazards.

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 NHMP in order to receive federal funds for mitigation projects. 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.

What Federal Requirements Does This Plan Address?

The Disaster Mitigation Act of 2000 (DMA2K) is the latest federal legislation addressing mitigation planning. It emphasizes planning for natural hazards before they occur. As such, this Act established the Pre-Disaster Mitigation (PDM) grant program and new requirements for the national 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 post-disaster HMGP funds. Mitigation plans must demonstrate that their proposed mitigation measures are based on a sound planning process that accounts for the risk to the individual and State and local jurisdictional capabilities.

Chapter 44 Code of Federal Regulations (CFR), section 201.6, also requires a local government to have an approved mitigation plan in order to receive HMGP project grants.[1] Pursuant of Chapter 44 CFR, the Natural Hazard Mitigation Plan planning processes shall include opportunity for the public to comment on the plan during review, and the updated Natural Hazard Mitigation Plan shall include documentation of the public planning process used to develop the plan.[2] The Natural Hazard Mitigation Plan 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 Natural Hazard Mitigation Plan must be submitted to Oregon Military Department – Office of Emergency Management (OEM) for initial plan review, and then federal approval.[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.

These four subsections address plan requirements, the planning process, plan content, and plan review. Subsection (a) provides an outline of the overall plan requirements, including an overview of general plan components, exceptions to requirements, and multi-jurisdictional participation. Subsection (b) outlines the requirements of the planning process, with particular focus on public involvement in the update process, as well as the role of local agencies, organizations and other relevant entities in the development process, as well as standards for adequate levels of review and incorporation of existing plans and policies. Subsection (c) outlines requirements concerning the plan update's content, including an overview of necessary components for the update's planning process, risk assessment, mitigation strategy, plan maintenance, and overall process documentation. Subsection (d) outlines the steps and agencies required for proper review of the plan before finished plans are adopted by their respective communities.

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

[1] Code of Federal Regulations, Chapter 44. Section 201.6, subsection (a), 2015
[2] ibid, subsection (b). 2015
[3] ibid, subsection (c). 2015
[4] ibid, subsection (d). 2015

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 jurisdiction's Comprehensive Plan, 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, resources exist at the state and federal levels. Some of the key agencies in this area include Oregon Military Department, Office of Emergency Management (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).

How was the Plan Developed?

The plan was developed by the Hood River County Natural Hazard Mitigation Plan Steering Committee and the Steering Committees for the cities of Cascade Locks and Hood River. The Hood River County Steering Committee formally convened on four occasions to discuss and revise the plan. Each of the participating city Steering Committees met once formally. Steering Committee members contributed data and maps, and reviewed and updated the community profile, risk assessment, action items, and implementation and maintenance plan.

The following schedule was developed to provide a timeline for completion of the plan update sections, though altered accordingly throughout the year to reflect then-current levels of progress.

Figure 1.1: NHMP Update Timeline

Source: Oregon Partnership for Disaster Resilience, 2012

The first four stages of the update process had corresponding steering committee meetings, during which previous work could be reviewed and new content developed for each session. The first and second, and third and fourth stages were combined into long format steering committee meetings. A final draft of the plan was completed at the end of May and circulated among county officials and interested public for review before submission to FEMA for plan pre-approval.

At various stages during the plan update's development, county officials and the public were invited to review progress and comment on completed sections. The public was given a chance for further involvement in the plan update process when notice was posted to city and county web platforms. Announcement of the plan update was also made to the board of county commissioners, city councils, the county rotary group, and various social service organizations. A survey was available for residents to submit, and over 30 people responded.

Multiple opportunities were also provided for neighboring communities, local and regional agencies involved in hazard mitigation activities to be involved in the planning process, particularly during Hood River County NHMP Update Steering Committee meetings. Representatives from potential partner organizations and agencies were invited to join the Steering Committee responsible for reviewing and updating the county's plan early in the planning process.

During early stages of the planning process, pre-existing plans, studies, reports and other technical information from Hood River County were identified and reviewed for inclusion in the updated plan. Information and policy cultivated from this review was used to inform updates of the county's community profile, risk assessment and mitigation strategy sections, and listed where appropriate for general reference.

How is the Plan Organized?

Each volume of the mitigation plan provides specific information and resources to assist readers in understanding the hazard-specific issues facing Hood River County citizens, businesses, and the environment. Combined, the sections work in synergy to create a mitigation plan that furthers the Hood River County Emergency Management department's mission to prepare the region for large scale emergencies and disasters. This plan structure enables stakeholders to use the section(s) of interest to them.

Volume I: Basic Mitigation Plan

Executive 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.

Section 1: Introduction

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

Section 2: Risk Assessment

Section 2 provides the factual basis for the mitigation strategies contained in Section 3. Additional information is included in Appendix C, the Community Profile.

The section includes an overview of existing plans, policies, and programs, community organizations, existing mitigation actions, and the hazards impacting Hood River County. This section allows readers to gain an understanding of each jurisdictions sensitivities, vulnerabilities, and resilience – the ability to manage risk and adapt to hazard event impacts.

A brief hazard summary is provided for each of the hazards addressed in the plan. The summary overviews hazard history, location, extent, vulnerability, impacts, and probability. The majority of hazard information is in Volume II, the Hazard Annexes.

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

Section 3: Mitigation Strategy

This section documents the plan vision, mission, goals, and actions and also describes the components that guide implementation of the identified mitigation strategies. Actions are based on community sensitivity and resilience factors and the risk assessments in Section 2 and the Hazard Annexes.

Section 4: Plan Implementation and Maintenance

This section provides information on the implementation and maintenance of the plan. It describes the process for prioritizing projects and includes a suggested list of tasks for updating the plan to be completed at the semi-annual and 5-year review meetings.

Volume II: Hazard Annexes

The hazard annexes summarize the best available local hazard data. The summary includes hazard history, location, extent, vulnerability, impacts, and probability. The hazard specific annexes included with this plan are the following:

- Winter Storm
- Wildfire
- Earthquake
- Landslide
- Drought
- Flood
- Windstorm
- Volcanoes

Volume III: Jurisdictional Addenda

Volume III of the plan is reserved for any city or special district addenda developed through this multi-jurisdictional planning process. Both cities and port districts within the county

participated in the NHMP process and created addenda. As such, the five-year update cycle will be the same for the county, cities, and port districts.

Volume IV: Mitigation Resources

The resource appendices are designed to provide the users of the Hood River County Natural Hazards Mitigation Plan 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 Item Forms

This appendix contains the detailed action item forms for the high priority mitigation strategies identified in this plan.

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

This profile can be utilized to identify specific issues locally and to develop potential action items. The data in the updated profile are based on best available local, state, and federal data. The profile includes a *Natural Environmental Capacity* section that details the physical geography of the county; a *Socio Demographic Capacity* section that discusses the population in the county; a *Regional Economic Capacity* section that discusses local industry, regional affordability, economic diversity, employment and wages, and an overview of labor and commute sheds; a *Built Capacity* section that addresses the county's housing building stock, physical infrastructure, critical facilities, utilities (including transportation and power transmission systems), dependent facilities, and correctional facilities; a *Community Connectivity Capacity* section that discusses the county's social organizations, cultural resources, and community stability; and lastly a *Political Capital* section that provides an overview of the county's government structure, and existing plans and policies. In addition to describing characteristics and trends, each profile section identifies the traits that indicate sensitivity to natural hazards.

Appendix D: Economic Analysis

This appendix describes the Federal Emergency Management Agency's (FEMA) requirements for benefit cost analysis in natural hazards mitigation, as well as various approaches for conducting economic analysis of proposed mitigation activities. This appendix was developed by OPDR. It has been reviewed and accepted by the Federal Emergency Management Agency as a means of documenting how the prioritization of actions shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

Appendix E: Grant Programs and Resources

This appendix lists state and federal resources and programs by hazard.

Appendix F: Public Outreach Survey

This appendix includes the online and in person public outreach surveys used in this plan update process, as well as the results collected and a description of how results were incorporated into the final plan.

Appendix G: Climate Change influence on Natural Hazards: Overview and Hood River County Projections

This appendix includes two climate change reports produced by the Oregon Climate Change Research Institute (OCCRI). OCCRI's *Future Climate Projections: Hood River County* and the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports*, provide important information regarding the influence and impacts of climate change on existing natural hazards events such as heavy rains, river flooding, drought, heat waves, cold waves, wildfire, and air quality. The overview discusses all eight of the counties while the respective individual county reports are specific to each county. OCCRI's research and analysis focuses on how climate change is expected to influence natural hazards.

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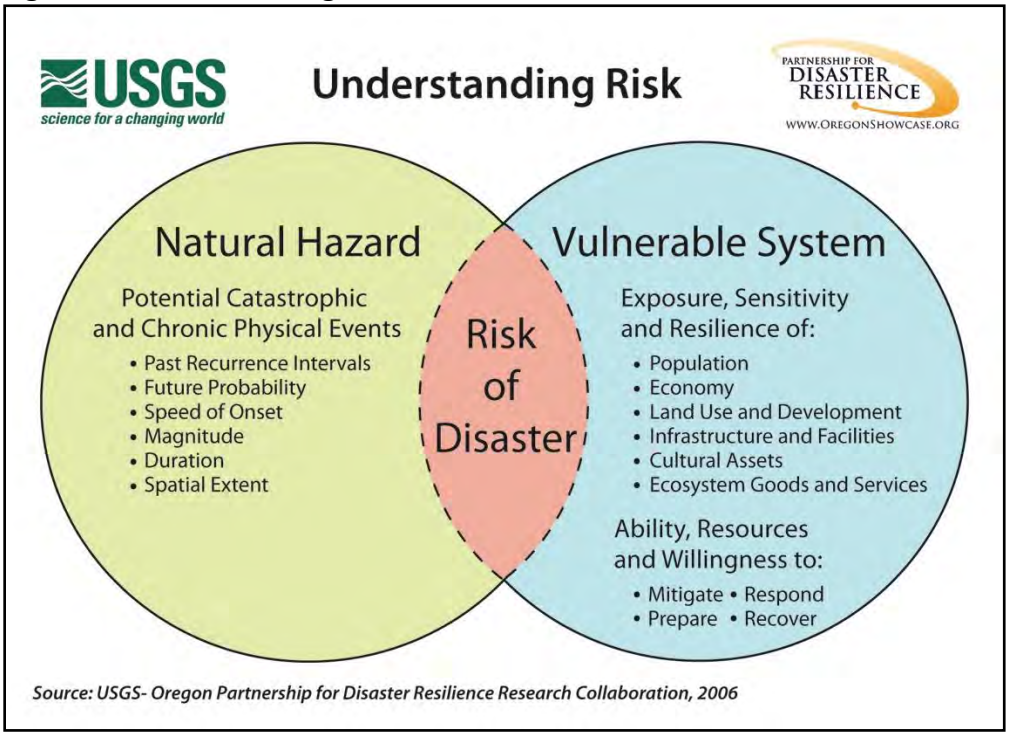
SECTION 2:
RISK ASSESSMENT

This section of the NHMP addresses 44 CFR 201.6(b)(2) - Risk Assessment and serves as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. This section first assesses risk by identifying hazards that can impact the jurisdiction. Potential impacts of each hazard are evaluated according to type, location, and extent. Then, important community assets and system vulnerabilities are identified. Finally, the plan evaluates the extent to which local hazards overlap with, or have an impact on, important assets.

The risk assessment process is graphically depicted in Figure 2.1 below. **The ultimate goal of hazard mitigation is to reduce the potential for hazards and vulnerable systems to overlap into the risk of disaster area.** The information presented in this section, along with more comprehensive data located in the Hazard Annexes and the Community Profile Appendix, informs the risk reduction actions identified in Section 3 – Mitigation Strategy.

Figure 2.1 Understanding Risk



Source: USGS and Oregon Partnership for Disaster Resilience Research Collaboration, year

Hazard Identification

Hood River County is regularly impacted by six natural hazards: wildfires, winter storms, windstorms, droughts, landslides, and floods. The County is also susceptible to risk from two additional hazards: earthquake events and volcanic eruptions. Wildfires and winter storms

are considered high risk and thus are priority hazards because the County is highly vulnerable to their impacts. Windstorms, droughts, landslides, and floods exist primarily as complicating or compounding factors; these hazards may increase the probability of wildfires or winter storms or occur as secondary impacts of wildfires or winter storms. A general overview of these hazards and their vulnerability level to Hood River County is listed below in Table 2.1. For the risk levels summary of these natural hazards, see Table 2-11. The Vulnerability Level in Table 2.1 is derived from the hazard analysis methodology described on page 2-19 of this Risk Assessment.

Table 2.1: Hood River County Hazard Overview

Hazard	General location and extent	Vulnerability Level
Winter Storm	Countywide; severe winter storms occur annually and create dangerous driving conditions, residential isolation, and power outages.	High
Wildfire	The entire county is vulnerable to the effects of wildfire; however steep slopes, unmanaged forests, and wind conditions intensify risk. Transportation and economic activity is disrupted by wildfire.	Moderate
Earthquake (CSZ and Crustal)	A subduction zone earthquake would collapse buildings and damage infrastructure countywide. Crustal quake events stemming from local faults could be catastrophic to County infrastructure.	Moderate
Landslide	Hood River County has many areas adjacent to the Columbia River Gorge where landslides have taken place; steep slopes and high precipitation increase landslide risk. Severe landslides can damage infrastructure and transportation.	Moderate
Drought	Countywide; frequent to regular moderate draughts; effect agricultural and recreational sectors.	Moderate
Flood	Rivers in Hood River County historically flood every few years. These include the Hood River, Indian Creek, Phelps Creek and the Columbia River. Flood hazard areas are along the East, Middle and West forks of the Hood River, and along Emil, Odell, Baldwin and Neal Creeks.	Low
Windstorm	Windstorms are frequent throughout the County, but rarely create catastrophic damage.	Moderate
Volcano	Hood River County may be impacted by a volcanic eruption from Mt. Hood at any time, which would impact White River, Sandy, and Hood River channels.	Moderate

Source: Hood River County Steering Committee, March 2018

The following subsections briefly describe relevant information for each hazard. For detailed information on Hood River County's natural hazards, refer to Volume II: Hazard Annexes. For additional background on the hazards, vulnerabilities and general risk assessment information for hazards in the Mid-Columbia region refer to the State of Oregon 2015

Natural Hazards Mitigation Plan (NHMP), Region 5: Mid-Columbia Regional Risk Assessment. In addition, the DOGAMI Risk Report for Hood River County (draft dated 6/8/18 and all subsequent versions) and included as Appendix G, contains hazards information that will be referenced in this Hood River County NHMP. The DOGAMI Risk Report focuses on the natural hazards of wildfire, earthquake, landslide, flood, volcano (lahar), and channel migration.

Winter Storms[1]

Hood River County is vulnerable to a variety of severe storm hazards including ice, snow, and freezing rain, which all have the ability to severely impact the county. Severe local storms seldom cause death and serious property damage but they can cause major utility and transportation disruptions. When major transportation corridors are blocked or electricity lines are damaged, residents may go without food and fuel resupply for multiple days. Winter storms occur regularly throughout the County.

Ice storms occur when rain falls from warm moist upper layers of the atmosphere into a cold, dry layer near the ground. The rain freezes on contact with the cold ground and accumulates on exposed surfaces, including tree branches and power lines. This can cause power outages and can obstruct transportation routes. A snow and ice storm occurred in 2012 that caused extensive damage to regional utilities and left two inches of ice in parts of the county for several days. Winter storms in 2017 closed I-84, a transportation lifeline, for almost a week.

Hood River County has had snowfall accumulations that vary depending on geographic location. Accumulations in excess of 150 inches may occur around the higher elevations of Mt. Hood, whereas in the area of the Hood River Experimental Station, average snowfall may accumulate to approximately 12 inches, depending on the year. Accumulations of snow usually increase with distance and elevation as the terrain rises to the south of the Columbia River. January is usually the month with the greatest snowfall.

Wildfire[2]

Historically, the instance of wildfire is increasing throughout the Columbia Gorge region. Though small in size, Hood River County contains a diverse set of wildfire hazard and risk situations. There are several climatic and topographic conditions found in Hood River County that are conducive for large wildfires: hot and dry conditions during the fire season throughout the county; frequent high winds along the Columbia River Gorge which can contribute to fast moving fires that are difficult to control; and moderate to steep slopes in places which add to the rate of wildfire spread and suppression difficulty. Hood River County's fire season usually runs from mid-May through October. However, any prolonged period of lack of precipitation presents a potentially dangerous problem.

Any instance of uncontrolled burning within a forested area is a forest fire, whereas uncontrolled burning in grassland, brush, or woodlands is classified as a wildfire. Hood River County's fire season usually runs from mid-May through October. The probability of a fire in

[1] Hood River County Natural Hazards Mitigation Plan, 2012
[2] Ibid

any one locality on a particular day depends on fuel conditions, topography, time of year, past and present weather conditions, and activities (debris burning, land clearing, camping, etc.) which are or will be taking place.

The effects of wildfires vary with intensity, area, and time of year. Factors affecting the degree of risk of fires include extent of rainfall, humidity, wind speed, type of vegetation, and proximity to firefighting agencies. The greatest short-term loss is the complete destruction of valuable resources, such as timber, wildlife habitat, scenic vistas, and watersheds. Vulnerability to flooding increases immediately after fires due to the complete or partial destruction of affected watersheds. Long-term effects include reduced timber stands for commercial purposes and reduction of travel and recreational activities. Over the past ten years, the major fires in Hood River County for which data is available occurred in 2017 (Eagle Creek Fire – Columbia Gorge National Scenic Area, 48,831 acres), 2008 (Gnarl Ridge, 3,280 acres), 2009 (Microwave, 1,224 acres), and 2011 (Dollar Lake, 6,304 acres).[3]

Home building in and near forests, referred to as wildland urban interface (WUI) areas, increase the risks from forest fires. Historically, it appears that the instance of wildfires is increasing in Hood River County and the region more generally. The existence of open range lands and large forested areas, increasing population and recreational activities, and the uncertain impact of a changing climate combine to increase the probability of a hazard event. The destruction of large tracts of forest land during wildfires have immediate economic impacts to the community through lost jobs and reduced taxes, while collateral economic and social effect can impact the county for years.

Earthquake[4]

An earthquake is the shaking of the ground caused by an abrupt shift of rock along a fracture in the earth, called a fault. Earthquakes in Hood River County are most likely to originate from two sources: 1) the Cascadia Subduction Zone (CSZ) and 2) crustal faults near the eastern end of the Columbia River Gorge.[5] These two earthquake sources have been distinguished in the Risk Assessment and Hazard Annexes of this NHMP due to their differing probabilities and impacts.

A CSZ event would result in strong to very strong shaking throughout the County, and soil liquefaction in the populated areas of Hood River and Cascade Locks Cities. It is likely that the County would become isolated from fuel and food supplies in such an event, and should be prepared to receive refugees from Western Oregon. A CSZ event is predicted to occur with 37-43% probability within the next 50 years.[6] Crustal faults are likely to produce small earthquakes; a significant event would range from 5 to 7 in magnitude. Table 2.2 lists the class A and B crustal faults that are located in or near the County.

[3] Inciweb – Incident Information System; https://inciweb.nwcg.gov/
[4] Hood River County Natural Hazards Mitigation Plan, 2012
[5] 2015 Oregon Natural Hazards Mitigation Plan, Mid-Columbia Region 5 Risk Assessment
[6] Oregon Resilience Plan: http://www.oregon.gov/oem/Documents/Oregon_Resilience_Plan_Final.pdf

Table 2.2: Class A and B Faults Located in or near Hood River County

Name	Class	Fault ID	Primary County	Length (km)	Time of most recent deformation	Slip-rate category
Faults near The Dalles	A	580	Hood River County, Oregon	69 km	Quaternary (<1.6 Ma)	Less than 0.2 mm/yr
Unnamed faults northwest of Condon	B	814	Gilliam County, Oregon	22 km	Quaternary (<1.6 Ma)	Less than 0.2 mm/yr
Faults along highway 35, passing through Parkdale	A	866	Hood River County, Oregon	44 km	Quaternary (<1.6 Ma)	Less than 0.2 mm/yr
Blue Ridge Fault	n/a	n/a	Hood River County, Oregon	12 km	Between ~13,540 and 9,835 years before present	Less than 0.2 mm/yr

Source: U.S. Geological Survey (USGS), Quaternary Fault and Fold Database, The Dalles 1° X 2° Sheet 6 and "Field-Trip Guide to Mount Hood, Oregon, Highlighting Eruptive History and Hazards (https://pubs.usgs.gov/sir/2017/5022/g/sir20175022g.pdf)

The entire County population, property, commerce, infrastructure and services may be vulnerable to an earthquake. Earthquake magnitude and level of preparedness in combination determine the potential scope of damage, which could range from minimal to moderate loss of life and destruction of property. Local geology demonstrates that the county has been impacted by significant earthquake events in the last 500 years.

Landslide/Debris Flow[7]

Hood River County has a history of landslides that tend to occur in isolated, sparsely developed areas. These landslides threaten individual structures and remote sections of the transportation, energy and communications infrastructure. In contrast, the landslide prone area along parts of Interstate Highway 84 from the border of Multnomah County to the City of Hood River has the potential to cause traffic accidents and damage to the region's transportation system. Landslides typically occur in Hood River County during or after periods of heavy rain and flooding.

The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Slides in Hood River County generally range in size from thin masses of soil of a few yards wide to deep-seated bedrock slides. Slide velocity ranges from a few inches per month to many feet per second, depending largely on slope, material, and water content. Dormant slide masses can be reactivated by earthquakes or unusually wet winters. Because ancient slide masses consist of broken

[7] Hood River County Natural Hazards Mitigation Plan, 2012

materials and disrupted ground water, they are more susceptible to construction-triggered sliding than adjacent undisturbed material.

It is most common for landslides to occur on water saturated slopes when the base of the slope can no longer support the weight of the soil above it. Landslides are commonly associated with heavy rain and flooding conditions, but they may also be associated with earthquakes and with volcanic activity. The period from December 1996 to February 1997, which saw intense winter storms, included a number of landslides in Hood River County. More recently, landslides have impacted transportation and infrastructure in the County, including water systems in the Middle Form Irrigation District and both minor and major roads.

Drought[8]

A history of drought within the region has periodically threatened the County's populations and natural resources, and during dry years, the entire population of the County is vulnerable. Of particular concern with regard to drought potential are the non-irrigated areas around the County, especially farms. Drought is defined by climatic dryness severe enough to reduce soil moisture and water below the minimum amount necessary for sustaining plant, animal, and human life systems. Hood River County has suffered from extended drought conditions regularly, and nearly all areas of Hood River County may be vulnerable to drought, with the exception of Cascade Locks. Significant droughts occurred in 2005 and 2015, and droughts impacted neighboring counties in 2008, 2013, and 2014 as well. [9]

Water shortages impact the agricultural industry, especially farmer owners. Droughts also lead to increased danger of wildfires, which has consumed millions of board feet of timber in past years. In many cases, subsequent erosion has caused heavy silting of streams, reservoirs, and rivers. Low stream flows have also damaged fish resources by creating high temperatures, oxygen depletion, and disease.

Due to these effects, droughts create economic and revenue losses for business, cities and the County as a whole. The entire population of the County is vulnerable to the effects of drought, though transportation and communications infrastructure would be minimally impacted, if at all. As growth places more pressure on limited local resources, future impacts may be greater.[10] Water management programs have been most effective in minimizing the impacts of droughts.

Flood[11]

Historically, flooding has occurred along one or more of the County's waterways every few years. These include the Hood River, Indian Creek, Phelps Creek and the Columbia River. Flood hazard areas are along the East, Middle and West forks of the Hood River, and along

[8] Hood River County Natural Hazards Mitigation Plan, 2012
[9] Hood River County NHMP, August 2012; DLCD Oregon NHMP, 2015; FEMA, Disaster Declarations for Oregon, retrieved 2017.
[10] Hood River County Strategic Preparedness Planning, Hazard Identification and Vulnerability Analysis, Updated November, 2011
[11] Hood River County Natural Hazards Mitigation Plan, 2012

Emil, Odell, Baldwin and Neal Creeks. Flooding on the Columbia River typically occurs during May, June, and July due to melting snowpack, whereas flooding of the other rivers and creeks in Hood River County usually occurs between October and March. Long periods of heavy rainfall and mild temperatures coupled with snowmelt contribute to flooding conditions.[12]

The main cause of Northwest floods is the moist air masses that regularly move over the region in the winter. In Hood River County, the weather that produces the most serious flooding events are extensive wet conditions that follow a period of mid and high elevation ice and snow pack development. The County is susceptible to both riverine and flash floods.

Windstorm[13]

Strong winds that impact Hood River County comes from two sources. Frequent and widespread strong winds come from the west and are associated with storms moving onto the coast from the Pacific Ocean. Strong west winds may also arise from a pressure differential when high atmospheric pressure occurs above the upper Columbia River Basin and low pressure above the Pacific Ocean. The Columbia River Gorge acts as a funnel, concentrating the intensity of the winds as they flow from the West. This generates frequent strong winds throughout the Gorge and at its outlet. No recorded instance of a tornado causing damage in Hood River County is available, but the conditions to produce a tornado do occur.

Volcanic Event[14]

A volcano is a vent in the earth's crust through which molten rock, rock fragments, gases or ashes are ejected from the earth's interior. There are a wide variety of hazards related to volcanoes and volcano eruption. Mount Hood is a potentially active volcano close to rapidly growing communities and recreation areas. The most likely widespread and hazardous consequence of a future eruption will be for lahars (rapidly moving mudflows) to sweep down the entire length of the Sandy (including the Zigzag) and White River valleys. Lahars can be generated by hot volcanic flows that melt snow and ice or by landslides from the steep upper flanks of the volcano. Structures close to river channels are at greatest risk of being destroyed. The degree of hazard decreases as height above a channel increases, but large lahars can affect areas more than 30 vertical meters (100 vertical feet) above river beds. See Appendix G: Risk Report for additional details on lahars. DOGAMI's analysis shows that in two of the three scenarios they used, unincorporated Hood River County and Parkdale will be especially impacted by lahars.

Cascade Range volcanoes in the U.S. have erupted more than 200 times during the past 12,000 years for an average of nearly two eruptions per century. At least five eruptions have occurred during the past 150 years. The most recent eruptions in the Cascade Range are the well-documented 1980-1986 eruptions of Mt. St. Helens, which claimed 57 lives and caused nearly a billion dollars in damage and response costs.

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[12] Hood River County Natural Hazards Mitigation Plan, 2012
[13] Hood River County Natural Hazards Mitigation Plan, 2012

[14] Ibid

FEMA Declarations

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 of March 2018, FEMA has approved a total of 33 federal disaster declarations, two emergency declarations and 69 fire management assistance declarations in Oregon.[15] When requesting a presidential declaration for a major disaster or emergency, governors provide detailed information about the amount of value of public and private property damage resulting from the event. FEMA uses these damage assessments to determine if the event meets the disaster declaration threshold, the amount of federal public and private assistance made available, as well as the specific counties to be included in the declaration.

Disaster declarations inform hazard mitigation project priorities by demonstrating and documenting which hazards have historically caused the most significant damage to the county. Table 2.3 summarizes the twelve major disasters declared for Hood River County by FEMA since 1953. The table shows that all of the major disaster declarations in Hood River County have been related to severe or winter storms, flooding, landslides or wildfires.

Table 2.3: FEMA Major Disaster Declarations for Oregon – Hood River County

Declaration Number:	Declaration Date:	Incident(s):	Incident(s) Period:	Individual Assistance:	Public Assistance Categories:
DR-4328	7-Jan-17	Severe Storms, Flooding, Landslides, and Mudslides	07-Jan-17 to 10-Jan-17	None	A, B, C, D, E, F, G
DR-4055	2-Mar-12	Severe Winter Storm, Flooding, Landslides, and Mudslides	17-Jan-12 to 21-Jan-12	None	A, B, C, D, E, F, G
DR-1824	02-Mar-09	Sever Winter Storm, Record and Near Record Snow, landslides, and Mudslides	13-Dec-08 to 26-Dec-08	None	A, B, C, D, E, F, G
DR-1672	29-Dec-06	Severe Storms, Flooding, Landslides, and Mudslides	5-Nov-06 to 8-Nov-06	None	A, B, C, D, E, F, G
DR-1510	19-Feb-04	Severe Winter Storms	26-Dec-03 to 14-Jan-04	None	A, B, C, D, E, F, G
DR-1099	9-Feb-96	Severe Storms, Flooding	4-Feb-96 to 21-Feb-96	Yes	A, B, C, D, E, F, G
DR-413	25-Jan-74	Severe Storms, Snowmelt, Flooding	25-Jan-74	Yes	A, B, C, D, E, F, G

[15] FEMA. Declared Disasters by Year or State. http://www.fema.gov/news/disaster_totals_annual.fema#markS. Accessed March 8, 2018

DR-184	24-Dec-64	Heavy Rain, Flooding	24-Dec-64	Yes	A, B, C, D, E, F, G

Source: FEMA, Oregon Disaster History, Major Disaster Declarations; Data Visualization: Disaster Declarations fro States and Counties

Table 2.4: FEMA Fire Management Assistance Declarations for Oregon – Hood River County

Declaration Number:	Declaration Date:	Incident:	Incident Period:
FM-5203	03-Sept-17	Eagle Creek Fire	02-Sept-17 to 20-Sept-17
FM-5046	18-Aug-13	Government Flats Fire Complex	17-Aug-13 to 26-Aug-13
FM-2829	28-Aug-09	Microwave Fire	28-Aug-09 to 01-Sept-09
FM-2495	02-Sept-03	Herman Creek Fire	02-Sept-03 to 08-Sept-03

Source: FEMA, Data Visualization: Disaster Declarations fro States and Counties, accessed on May 22, 2018

Community Vulnerability

Natural disasters occur as a predictable interaction among three broad systems: natural environment (e.g., climate, rivers systems, geology, forest ecosystems, etc.), the built environment (e.g., cities, buildings, roads, utilities, etc.), and societal systems (e.g., cultural institutions, community organization, business climate, service provision, etc.). A natural disaster occurs when a hazard impacts the built environment or societal systems and creates adverse conditions within a community. Communities can minimize losses from disaster events by identifying distinct vulnerabilities and addressing them with deliberate planning and mitigation.[16]

Populations[17]

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.[18] 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.

[16]State of Oregon Natural Hazards Mitigation Plan, Region 5: Mid-Columbia, February 2015
[17] Hazard Vulnerability Analysis, Updated March, 2018
[18] Hazards Workshop Session Summary #16, *Disasters, Diversity, and Equity*, University of Colorado, Boulder (2000).

Population Vulnerabilities

- A significant portion of the Hood River County population (28%) speaks a language other than English at home; half of this group, 15% of the total population, does not speak English well.[19] The vast majority of this group speaks Spanish.
- According to 2016 census estimates, persons 65 and older made up 13.7% of the total Hood River County population. An increase is expected; this group is predicted to make up 22.1% of the county's population by 2020.[20]
- Children constitute over a quarter of the population in Hood River County; children are more vulnerable and require assistance in emergency situations.
- Hood River County contains high numbers of mobile homes (10.8%) and vacant housing (13.8%) which are less likely to be prepared for disaster situations. [21]
- While incomes are rising, 13.3% of the Hood River County adult population and 20.1% of residents under 16 years-old live below the poverty level. The growing employment industries (manufacturing, leisure/hospitality/recreation, and education/health services) provide some of the lowest wages in the county. [22]

Non-English speaking and special cultural characteristics

A lack of ability to speak or read English presents a challenge to emergency managers, since instructions for self-protective action and general disaster information is often exclusively in English. The non-English speaking population relies on assistance from friends or service providers to translate instructions and information. In certain areas of Hood River County, it may be advisable for emergency managers and emergency response agencies to arrange for translation of disaster related information.

Transient/Tourist Population

The transient population is defined as those who do not have a permanent residence in Hood River County, yet are likely to be present during a hazard situation. Due to its proximity to the Columbia River and Mt. Hood, Hood River County is considered a major Northwest visitor destination, and the transient population peaks during weekends and summer months. United States Geological Survey (USGS) estimates two to five million tourists annually visit the Columbia Gorge and Mt. Hood, respectively.[23]

Travelers and visitors are particularly vulnerable to disasters because they are often unfamiliar with the hazards in the region and do not have the knowledge or the materials needed to care for themselves in a disaster. For example, a typical visitor may be unfamiliar with evacuation routes or shelter locations. Light traveling visitors may not have access to supplies of food, water, flashlights, radios, and other items that locals prepare for disaster situations. Furthermore, visitors usually do not have a local support structure of family, friends, and neighbors to rely on.

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[19] U.S. Census Bureau, 2012-2016 American Community Survey 5-year Estimates; American Fact Finder
[20] Source: Social Explorer Table T7; ACS 2016 (5-Year Estimates); U.S. Census Bureau
[21] U.S. Census Bureau, American Community Survey, 5 year Estimates, 2012-2016, American Fact Finder
[22] U.S. Census Bureau, Small Area Estimates Branch, 2005 Estimates, 2010 Estimates and ACS 2016 (5-Year Estimates) (SE), ACS 2016 (5-Year Estimates), Social Explorer Tables T114, T115, and T116; U.S. Census Bureau
[23] State of Oregon Natural Hazards Mitigation Plan, Region 5: Mid-Columbia, February 2015

Low Income

Insufficient financial resources during and after disasters prevent lower-income populations from coping with and recovering from disasters. This vulnerable population is also more likely to live in homes that are more susceptible to damage from flooding, windstorms, and severe weather.

Table 2.5: Hood River County Population Vulnerabilities

Hood River County Population Vulnerabilities	Drought	Winter Storm	Wind Storm	Earthquake	Landslide	Volcano	Flood	Wildfire
High density/assisted living centers – HR care center, Ashley Manor, Brookside Assisted Living, Parkhurst, Down Manor, Hawks Ridge, Dethman Manor, Taylor St. special needs home		X		X				
Hood River Hospital, Dialysis Unit				X				
Schools		X		X				
Special needs populations i.e. wheelchair, bed ridden, etc		X		X				
Hospice, Home health		X		X				
Hotels/motels located in Columbia River Floodplain							X	
Downtown cores (Cities of Hood River and Cascade Locks)				X	X		X	X
Parkdale and other County sub-divisions		X		X	X		X	X
Summer home populations (unidentifiable)		X		X	X		X	X
Unregistered assisted living homes		X		X			X	
Migrant worker housing				X			X	X
Public staff: limited and variable commutes		X		X	X		X	X

Source: Hood River County Risk Assessment Steering Committee Meeting, March 29, 2018

Economy

Hood River County is susceptible to economic disturbance from natural hazards, as a majority of funding for County services and a substantial amount of the region's income come from timber sales and agriculture, which can be severely disrupted by drought, flood, fire and winter storms, hazards with a high likelihood of probability across the entire county. Another primary economic driver in the County is tourism and recreation, which can be disrupted during winter storms and wildfires. Furthermore, disruption to I-84 or the Union Pacific railroad impact the local, regional, and statewide economy. Specific issues concerning the County's economy that were identified in the County's Risk Assessment Steering Committee Meeting are outlined in Table 2.6 below, along with the hazards that are most likely to impact them.

The unemployment rate in Hood River County is low, and major economic drivers are gradually diversifying; however a significant amount of jobs are in lower wage industries.

Many essential government staff commute to work, and a hazard event could easily disrupt the staffing capacity of emergency and government services. 39.6% of people who work in Hood River County work elsewhere; blocked transportation routes would interfere with normal economic activity.[24]

Table 2.6: Hood River County Economic Issues

Hood River County Economic Issues	Drought	Winter Storm	Wind Storm	Earthquake	Landslide	Volcano	Flood	Wildfire
Unregistered businesses							X	
Agriculture	X						X	X
Ski Lodges and Lifts		X			X			X
Inter-state bridges		X		X	X			
Port and buildings along river				X			X	
BPA Power lines		X	X					
Airport								
County forest land (primary revenue source)	X					X		X
Small business community								
Tourism infrastructure		X						X
Trail infrastructure		X				X	X	X

Source: Hood River County Risk Assessment Steering Committee Meeting, March 29, 2018

Land-use and Development

To accommodate growth and development, communities engaged in mitigation planning should address infrastructure, service needs, specific engineering standards and building codes. Eliminating or limiting development in hazard prone areas, such as floodplains, can reduce vulnerability to hazards, and the potential loss of life, injury, and property damage. Communities in the process of developing land for housing and industry need to ensure that land-use and protection goals are being met to prevent future risks.[25]

Overall, strong policies and plans in place to guide land use and development within the County. Specific issues concerning the County's land use and development that were identified in the County's Risk Assessment Steering Committee Meeting are outlined in Table 2.7 below, along with a list of hazards that are most likely to impact them. The County is experiencing annualized population growth of 1.2 – 1.8% per year. Hood River County remains rural; however land use within the designated urban growth boundaries continues to intensify.[26]

[24] Source: U.S. Census Bureau, OnTheMap, All Jobs Area Profile Analysis, 2015

[25] State of Oregon Natural Hazards Mitigation Plan, Region 5: Mid-Columbia Regional Profile, February 2015

[26] John Roberts, Hood River County Community Development, personal communication, 6/1/2018

Table 2.7: Hood River County Land Use and Development Issues

Hood River County Land Use Assets	Drought	Winter Storm	Wind Storm	Earthquake	Landslide	Volcano	Flood	Wildfire
Development in wildfire susceptible areas								X
Building codes					X		X	X
Floodplain ordinances (migrating channels not addressed)							X	
Development in port areas (liquefaction risk)				X	X		X	

Source: Hood River County Risk Assessment Steering Committee Meeting, March 29, 2018

Environment

With four distinct mild seasons, a diverse terrain and its proximity to the Columbia Gorge, Hood River County has historically dealt with habitual drought, flooding, wildfires and the occasional landslide. By identifying potential hazards, temperature and precipitation patterns, along with natural capitals such as key river systems, Hood River County can focus on key areas to better prepare, mitigate, and increase the resiliency of local communities.[27] Specific and general county-wide environmental concerns along with the hazards that are most likely to impact them are listed in Table 2.8 below.

Table 2.8: Hood River County Environmental Issues

Hood River County Environmental Issues	Drought	Winter Storm	Wind Storm	Earthquake	Landslide	Volcano	Flood	Wildfire
Two golf courses – one on Indian Creek	X						X	
Drinking water resources	X							X
Odell Creek chemical storage facility on Odell Highway				X			X	
Waste water facilities near Odell and Columbia River		X		X			X	
Tucker park and Toll Bridge park	X	X					X	X
State and National Parks	X					X	X	X
Forested areas	X				X	X		X
Hood River (irrigation and fish resources)	X				X		X	

Source: Hood River County Risk Assessment Steering Committee Meeting, March 29, 2018

[27] Hood River County NHMP Community Profile, 2018

Critical Facilities and Infrastructure

Transportation networks, systems for power transmission, and critical facilities such as hospitals and police stations are all vital to the functioning of a county. Due to the fundamental role that infrastructure plays both pre- and post-disaster, it deserves special attention in the context of creating more resilient communities.[28] Specific and general county-wide critical infrastructure and services concerns along with the hazards that are most likely to impact them are listed in Table 2.9 below.

A few transportation corridors are integral to food and fuel access, economic recovery, and staff mobility, including the Interstate 84 and two interstate bridges in Hood River and Cascade Locks. Most of the people and infrastructure are along the I-84 corridor, which runs along the northern portion of the region. This multimodal transportation corridor includes a major interstate highway (I-84); two transcontinental rail lines, Union Pacific and Burlington Northern Santa Fe; the Columbia River inland water navigation; major electric power and gas lines; and communication conduits.

These lifelines are susceptible to disruption by natural hazards, especially winter storms, wildfires, and earthquake events. Power-generating facilities and water systems in the County are diverse and numerous, increasing resiliency in face of a hazard event. However, disruption to one critical facility often affects other critical infrastructure, creating cascading damage. Local drinking water is supplied by wells, springs, and surface water, and as such is susceptible to erosion, pollution and sediment in a disaster.

Table 2.9: Hood River County Critical Infrastructure and Services Issues[29]

Structure	Address	City	Type	Comments
Hood River County				
Gorge Radio-Bicoastal Media Columbia River	1190 22nd Street	Hood River	Communications	n/a
Hood River County 911	601 State Street, 3rd floor	Hood River	Communications	Essential services - County
CenturyLink (phone and internet - hub-County bldg)	601 State Street, 2nd floor	Hood River	Communications	Essential services - County - 911 and EOC

[28] State of Oregon Natural Hazards Mitigation Plan, Region 5: Mid-Columbia Regional Profile, February 2015

[29] Critical Facilities: Structures and institutions necessary for response to and recovery from emergencies. Critical facilities provide services and functions essential to a community, especially during and after disaster.
Lifelines: Lifelines include utility systems (potable water, wastewater, oil, natural gas, electric power facilities and communication systems) and transportation systems (airways, bridges, roads, tunnels and waterways). Communication facilities are also important lifelines." (Portland Local Energy Assurance Plan, 2012).
Essential Services: Infrastructure and institutions necessary for social, economic, or political recovery. Services are essential to certain community populations and sectors. Harm arises when significant facilities are not operating for multiple days or weeks.

Structure	Address	City	Type	Comments
				dependency
BPA Powerlines and Towers	Just west of Hood River County line	Multnomah County	Electric	Lifeline to County and region
BPA dam and hydroelectric plant	Just west of Hood River County line	Mt. Hood	Dam and electric	Critical to power grid and vulnerable in earthquake
Pacific Power	Substations 12th and 13th Street	Hood River	Electric	n/a
Hood River Electric Cooperative	3521 Davis Street	Hood River, Odell, Parkdale	Electric	Lifeline to Odell
Fish Food Bank	Tucker Rd; Odell	County	Food	n/a
Northwest Natural Gas	Various gas lines and meters across community	County, Hood River, Cascade Locks	Fuel	volatile gas lines in emergencies
Ace Hardware, Hood River Supply	3831 Eagle Loop	County (Odell)	Supplies	n/a
Chrevron Odell Gas Station	3387 Odell Highway	County (Odell)	Fuel	n/a
Pine Grove Pit Stop	2385 OR-35	County (Pine Grove)	Fuel	n/a
Hood River County Public Works (City/County fuel supply)	918 18th Street	Hood River	Fuel - emergency services	essential service
76 gas station	616 Industrial St # 401	Hood River	Fuel	n/a
Valero gas station	101 N 1st St	Hood River	Fuel	n/a
Chevron downtown	2555 Cascade Ave	Hood River	Fuel	n/a
Astro fuel	214 Front Street	Hood River	Fuel	n/a
Carson Oil	2660 Dock Road	Hood River	Fuel	n/a
Harvey's Texaco	3450 Cascade Ave	Hood River	Fuel	n/a
Chevron waterfront	949 E Marina Dr	Hood River	Fuel	n/a
Nobi's Gas	1380 Tucker Road	Hood River	Fuel	n/a

Structure	Address	City	Type	Comments
Station				
County Administration, Board of Commissioners, EOC	601 State Street	Hood River	Government	essential services
Wy'East Fire District (2 stations: Odell,- Pine Grove)	2995 Van Horn Drive, 3431 Odell Hwy	Unincorporated	Government	n/a
Hood River County Sherriffs Office, Courthouse, parole and probation, juvenile, D.A.	309 State Street	Hood River	Government	essential services
Parkdale Fire District (3 fire stations - 2 in Mt. Hood, 1 in Dee)	4895 Baseline Drive	Mt. Hood	Government	essential service
Back-Up EOC: Intertribal Fisheries Enforcement	4270 WestCliff Drive	Hood River	Government	essential service
County Public Works	918 18th Street	Hood River	Government	n/a
Westside RFPD -1	4250 Barrett Drive	Hood River	Government	n/a
Westside RFPD -2	1185 Tucker Road	Hood River	Government	n/a
Wy'East Middle School	3000 Wyeast Road	County (Odell)	School	Possible shelter site
Hood River Airport	n/a	County	Transportation	n/a
Bonneville Dam	n/a	Cascade Locks	Infrastructure	n/a
The Dalles Dam	n/a	The Dalles	Infrastructure	n/a
Union Pacific Railway	waterfront adjacent to I-84 Countywide	County	Transportation	Extreme danger if combusted or derailed
Hood River-White Salmon Interstate Bridge	1000 E Port Marina Drive	Hood River	Transportation	Gas line on bridge

Structure	Address	City	Type	Comments
Bridge of the Gods	Cascade Locks	Cascade Locks	Transportation	n/a
I-84	Managed by ODOT	County	Transportation	Lifeline
Highway 35	Managed by ODOT	County	Transportation	Lifeline
Crystal Springs Water	3006 Chevron Drive	Odell	Water	n/a
Ice Fountain Water	1185 Tucket Road	Hood River	Water	n/a
Odell Water	3641 Davis Drive	Odell	Water	n/a
Parkdale Water	n/a	Parkdale	Water	n/a
Dee Bridge	Lost Lake Road	County	Water	City of HR main water line attached to bridge
WA Highway 14 (Managed by WSDOT)	SR 14 Klickitat County, WA	Washington	Transportation	Lifeline. Critical transportation corridor if I-84 closes
City of Cascade Locks				
City of Cascade Locks Power Utility (2 substations)	140 SW Wanapa Street	Cascade Locks	Electric	essential service
Bridge of the Gods (Port of Cascade Locks)	Cascade Locks	Cascade Locks	Transportation	lifeline
Bonneville Power Administration	n/a	County	Electric	essential service
Columbia Market	450 Wa Na Pa Street	Cascade Locks	Food	n/a
Thunder Island Brewery	515 SW Portage Rd	Cascade Locks	Food	n/a
Chevron Gas Station	437 Wa Na Pa Street	Cascade Locks	Fuel	n/a
Shell Gas Station	425 Wa Na Pa Street	Cascade Locks	Fuel	n/a
Cascade Locks Fire District	25 Wa Na Pa Street	Cascade Locks	Government	essential service
City Hall, Public Works	140 SW Wanapa Street	Cascade Locks	Government	essential service
Port Facilities	427 SW Portage Road	Cascade Locks	Government	essential service

Structure	Address	City	Type	Comments
City Water and Sewer	140 SW Wanapa Street	Cascade Locks	Sanitary	essential service
Marine Park	427 SW Portage Road	Cascade Locks	Government	n/a
Historical Houses	427 SW Portage Road	Cascade Locks	Cultural	n/a
ODOT Cascade Locks station	60 NW Forest Ln	Cascade Locks	Transportation	essential service
City of Hood River				
Hood River Distillery	660 Riverside Drive	Hood River	Business	Extreme danger if combusted
Ace Hardware, Hood River Supply	1945 12th St	Hood River	Fuel, hardware	Lifeline fuel and supplies
Astro Gas Station	214 Front Street	Hood River	Fuel	n/a
Valero Gas Station	101 N 1st Street	Hood River	Fuel	n/a
Shell Gas Station	1691 12th Street	Hood River	Fuel	n/a
Shell Gas Station	1108 E Marina Drive	Hood River	Fuel	n/a
Height's Fuel Stop	1413 12th Street	Hood River	Fuel	n/a
Chevron Gas Station 1	949 E Marina Drive	Hood River	Fuel	n/a
Chevron Gas Station 2	2555 Cascade Avenue	Hood River	Fuel	n/a
Hood River-White Salmon Interstate Bridge	1000 E Port Marina Drive	Hood River	Transportation	Lifeline. Gas line on bridge; can strand commuters and motorists if closed
Hood River County Public Works (City/County fuel supply)	918 18th Street	Hood River	Government	essential service
Havey's Texaco Gas Station	3450 Cascade Ave	Hood River	Fuel	n/a
Union 76 Gas Station	1650 Tucker Road	Hood River	Fuel	n/a
76 gas station	616 Industrial St # 401	Hood River	Fuel	n/a

Structure	Address	City	Type	Comments
Valero gas station	101 N 1st St	Hood River	Fuel	n/a
Chevron downtown	2555 Cascade Ave	Hood River	Fuel	n/a
Astro fuel	214 Front Street	Hood River	Fuel	n/a
Carson Oil	2660 Dock Road	Hood River	Fuel	n/a
Harvey's Texaco	3450 Cascade Ave	Hood River	Fuel	n/a
Chevron waterfront	949 E Marina Dr	Hood River	Fuel	n/a
Hood River Police, Hood River City Council and Administration	211 2nd Street	Hood River	Government	Essential services
Port Facilities - Administration, Marina	1000 E Port Marina Drive	Hood River	Government	Liquefaction area.
City of Hood River Fire	1785 Meyer Parkway	Hood River	Government	Essential services
Hood River City Hall	211 2nd Street	Hood River	Government	Essential services
City Public Works, Building water and sewer	1200 18th Street	Hood River	Government	Essential services
Columbia Gorge Community College - Hood River	1730 College Way	Hood River	Government	Possible shelter site
Providence Hood River Memorial Hospital	810 12th Street	Hood River	Health	Essential services
One Community Health and Radio Tierra	849 Pacific Ave	Hood River	Health, Communications	Bilingual outreach and community hub
Hood River Garbage and Recycling	3440 Guignard Drive	Hood River	Sanitary	n/a
Hood River Middle School	1602 May Street	Hood River	School	Possible shelter site
Hood River Waste Water	818 Riverside Drive	Hood River	Sewage	Liquefaction area; essential

Structure	Address	City	Type	Comments
Plant				services
City of Hood River Water District (Public Works)	1200 18th Street	Hood River	Water	Essential services
Safeway	2249 Cascade Avenue	Hood River	Food	Lifeline
Rosauer's Supermarket	1867 12th Street	Hood River	Food	Lifeline
Walmart	2700 Wasco Street	Hood River	Food	Lifeline in emergencies
Juanita's Market	1401 13th Street	Hood River	Food	n/a

Source: Hood River County Risk Assessment Steering Committee Meeting, March 29, 2018

National Flood Insurance Program (NFIP)

Hood River County's Flood Insurance Rate Maps are current as of September, 1984. Table 2.10 shows that as of February 2018, there were a total of 32 National Flood Insurance Program (NFIP) policies in force with a total coverage value of $9.8 million. Between 1978 and February, 2018, there were three NFIP claims including one in Cascade Locks, and two others in unincorporated areas across Hood River County.

Table 2.10: NFIP Summary Table

Jurisdiction	FIRM Status	FIRM Date	NFIP Status^	# NFIP Policies	Total Coverage	# NFIP Claims	Total Paid
Hood River County	ALL ZONE A,C,X- NO ELEVATION DETERMINED	Sep-84	P	32	$9,822,900	3	$29,616
Unincorporated	ALL ZONE A,C,X- NO ELEVATION DETERMINED	Sep-84	P	26	$8,024,900	2	$26,139
Hood River	ALL ZONE A,C,X- NO ELEVATION DETERMINED	Sep-84	P	3	$980,000	0	0
Cascade Locks	ALL ZONE A,C,X- NO ELEVATION DETERMINED	Sep-84	P	3	$818,000	1	$3,477

Source: Oregon Department of Land Conservation and Development, Planning Services Division. Received from Oregon Risk MAP Coordinator, Dave Lentzner, March 2018; ^ P = Participating, NP = Not Participating
Note: The Ports are not recognized communities that have authority to adopt and enforce floodplain management regulations for the areas within their jurisdiction and abide by the regulations of the cities they are located within.

Table 2.11 illustrates that as of February 2018, Hood River County and its incorporated cities have zero repetitive flood loss properties. There have been no Community Assistance Visits in Hood River County. Neither Hood River County nor its incorporated cities are members of

the Community Rating System (CRS). "The National Flood Insurance Program's (NFIP) Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements."[30] Participation in the program typically results in discounted flood insurance premium rates that reflect the reduced flood risk from community actions to meet CRS goals.

Table 2.11: NFIP Repetitive Loss and Severe Repetitive Loss Summary

Jurisdiction	# SRL Properties-Validated	# SRL Properties-Pending	# RL Properties
Hood River County	0	0	0
Cascade Locks	0	0	0
Hood River	0	0	0
TOTALS	**0**	**0**	**0**

Source: Oregon Department of Land Conservation and Development, Planning Services Division. State NFIP Coordinator, Dave Lentzner, March 2018
Note: The Ports are not recognized communities that have authority to adopt and enforce floodplain management regulations for the areas within their jurisdiction and abide by the regulations of the cities they are located within.

Risk Assessment

To develop a more comprehensive understanding of the risks facing Hood River County from natural hazards, a ranking system was used by members of the Hood River County NHMP Steering Committee. The ranking system resulted from the Hazard Analysis, described below, which uses OEM Methodology. A vulnerability score was combined with a probability score plus two other variables - event history and maximum threat- to develop a total risk score for each hazard. The risk scores were then ranked from highest to lowest. Then put into risk levels of high, moderate, and low. The scores were used for strategic preparedness planning and to justify the prioritization of individual natural hazards in the mitigation action item section, Section 3: Mitigation Strategy, of Hood River County's Natural Hazards Mitigation Plan.

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.[31] Cascade Locks and the City of Hood River participated in County Steering Committee meetings and also completed a separate jurisdiction specific hazard analysis for each incorporated city; for more information on the process see Appendix B. Jurisdiction specific information is presented in Volume III, Jurisdictional Addenda.

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.

30 Federal Emergency Management Agency, National Flood Insurance Program, Community Rating System, http://www.fema.gov/business/nfip/crs.shtm Accessed: May 30, 2012
31 University of Oregon Institute for Policy Research and Engagement, OPDR NHMP Update Manual

Hazard Analysis Methodology

The hazard analysis methodology 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 (OEM) 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 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 Hood River County EOP and NHMP.

The Oregon or OEM 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 different jurisdictions 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

Table 2.12 presents the overall risk assessment for Hood River County including both the County's hazard analysis and relative risk. The hazards are listed in rank order from high to low, taking consideration of past historical events, vulnerability to populations, the maximum threat, and the probability, or likelihood of a particular hazard event occurring. The data show that winter storm is the highest ranked hazard in the county, followed somewhat closely by wildfire. A Cascadia Subduction Zone event, landslide, and drought are similarly ranked as moderate risk. Flood and crustal earthquake events come in as slightly lower risk, followed by windstorm, but still at a moderate risk level. Volcano is the lowest ranked hazard in the County overall in terms of relative risk.

Table 2.12: Risk Assessment Summary – Hood River County

Hazard	History	Probability	Vulnerability	Maximum Threat	Total	Rank	Risk Level
Winter Storm	9	10	9	10	**233**	**1**	**High**
Wildfire	9	9	6	9	**201**	**2**	**High**
CSZ Event	2	6	6	8	**156**	**3**	**Moderate**
Landslide	5	7	5	7	**154**	**4**	**Moderate**
Drought	4	7	7	6	**152**	**5**	**Moderate**
Flood	3	6	3	8	**143**	**6**	**Moderate**
Crustal Earthquake	2	4	5	8	**137**	**7**	**Moderate**
Windstorm	2	4	4	8	**132**	**8**	**Moderate**
Volcano	2	2	5	7	**113**	**9**	**Low**

Source: Hood River County Risk Assessment Steering Committee Meeting, March 29, 2018

Jurisdiction 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.[32]

The two incorporated cities in Hood River County, Cascade Locks and Hood River and the two Port Districts (Port of Cascade Locks and Port of Hood River), completed jurisdiction specific hazard analysis. The multi-jurisdictional risk assessment information is located within the Risk Assessment section of each jurisdiction's addendum, which are located in Volume II of this NHMP.

[32] University of Oregon Institute for Policy Research and Engagement, OPDR NHMP Update Manual

SECTION 3: MITIGATION STRATEGY

This section of the NHMP addresses 44 CFR 201.6(c)(3) – Mitigation Strategy. The information provided in Section 2 and the Hazard Annexes provide the basis and justification for the mitigation actions identified in this plan. Section 3 provides information on the process used to develop a mission, goals and action items. The Mitigation Strategy also includes an explanation of how the County intends to incorporate the mitigation strategies outlined in the plan into existing planning mechanisms and programs such as the County comprehensive land use planning process, capital improvement planning process, emergency management process, and building codes enforcement and implementation.

Mitigation Plan Mission

Hood River County's overall vision and mission is, "Providing quality of life for all." The 2006 NHMP used this as the guiding principle when developing the NHMP mission. For this update, the plan's Hood River County NHMP Steering Committee reviewed and reaffirmed the NHMP mission at its Mitigation Strategy Meeting on March 29, 2018.

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

> *Protect life, property and the environment through coordination and cooperation among public and private partners, which will reduce risk and loss, and enhance the quality of life for the people of Hood River County.*

Mitigation Plan Goals

The plan goals help guide the direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here, in Table 3.1, serve as checkpoints as agencies and organizations begin implementing mitigation action items. Each goal has a series of statements which further reflect and more clearly define the goals.

Background

Soliciting community input during stakeholder interviews was a critical aspect of initial goal development in the 2006-2007 NHMP. Armed with stakeholder interview input, the mitigation plan goals and goal statements were drafted by the NHMP Coordinator using assistance from OPDR during the creation of the Hood River County NHMP in 2006. The draft goals were brought before the 2006 Hood River County Steering Committee for review and approval. The goals were revised with Steering Committee input before adoption by the Committee.

In an effort to prioritize goals, each member of the Steering Committee was asked to (i) identify three statements that were most important to them and (ii) speak to why they chose those statements. Their statement choices were tallied and goals prioritized by the number of statements selected; goals with the most statements selected are ranked in priority from I-II. This exercise was not meant to exclude the importance of the other goals,

but rather assist in the implementation of this plan by identifying which of the high priority risk reducing action items to pursue funding for first.

Goal Update Process

The 2018 Hood River County NHMP Steering Committee reviewed the plan goals during its Risk Assessment Meeting on March 29, 2018. The committee revised the language of some of the statements in all of the plan goals, and removed one goal, "Natural Resources Protection," because it was seen to be included in "Protection of Life and Property." Revisions continued to be collected and incorporated between meetings. The goals were then reaffirmed and re-prioritized during the NHMP Steering Committee Mitigation Strategy Meeting on April 24, 2018 by vote. The committee decided that the goals should continue to be listed in order of their new level of priority.

The outcome of the goal review and re-prioritization process is represented in Table 3.1 below. The "PRIORITY" column identifies the principal goals to serve as a starting point in the implementation of mitigation activities for Hood River County. This priority is based on the accumulation of votes for each goal by Steering Committee members.

The primary goals identified are the Protection of Life & Property, Facilitate Partnerships & Coordination, and Emergency Services Enhancement. These goals are listed in priority order of 1, 2, and 3. The secondary goals are Education and Outreach efforts and Disaster Resilient Economy. The secondary goals do not have a priority ranking.

Table 3.1: Hood River County NHMP Goals

Goal	Statement	Priority	Primary or Secondary
Protection of Life, Property, and Natural Resources	Prioritize increasing the resilience of County infrastructure, roads, and railways through mitigation activities	I	**Primary**
	Evaluate county guideline/codes and permitting processes in addressing hazard mitigation		
	Develop and implement activities to protect human life, commerce, property and natural resource systems		
	Link forest, agriculture, and watershed planning, natural resource management, and land use planning with natural hazard mitigation activities		
Facilitate Partnerships & Coordination	Strengthen communication and coordination of public/private partnerships and emergency services among local, county and regional governments, volunteers, and the private sector	II	**Primary**
	Create clear roles and expectations within partnerships		
Emergency Services Enhancement	Enhance resilience of emergency response services, critical facilities and core infrastructure to natural hazards	III	**Primary**

	Minimize life safety issues		
Education & Outreach	Develop and implement education programs to increase awareness, partnership, and action among citizens, local, county, and regional agencies, non-profit organizations, businesses, and industry		Secondary
	Develop and conduct outreach programs to increase hazard preparedness, planning, and mitigation in high risk and/or vulnerable areas, as well as in primary industries (agriculture and tourism)		
Disaster Resilient Economy	Leverage cross-sector partnerships to support small business environment through all stages of emergency management		Secondary
	Address high volume seasonal tourism and I-84 transportation corridor risks in hazard planning and protect recreation and tourism industries by raising awareness of potential hazard impacts		
Acknowledge Local Responsibility	Coordinate programs to increase natural hazard knowledge base		Secondary
	Research policies impacting local vulnerability and resilience and advocate for statewide policy change when appropriate		
	Acknowledge financial costs of mitigation actions and pursue funding sources		
	Educate county leadership and incorporate hazard mitigation as part of the county's routine decision making process		

Source: Hood River County NHMP Steering Committee, 2018

Mitigation Plan Action Items

Short and long-term 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. They address both multi-hazard (MH) and hazard-specific issues. Action items can be developed through a number of sources. The majority of the action items in the Hood River County NHMP were first created during the initial NHMP planning process in 2006-2007. These actions were sourced from steering committee meetings, stakeholder interviews, public outreach, and expert recommendations. All actions were reviewed by the Steering Committee, discussed at length, and revised as necessary before becoming a part of this 2018 NHMP. Several additional action items were identified and included during the 2018 update, as described in Appendix B, Planning and Public Process.

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 in 2018, Hood River County and participating cities list a set of high priority actions in an effort to focus attention on an achievable set of high leverage activities over the next five-years. This plan identifies priority actions based on an evaluation of high impact hazards, resource availability, and FEMA identified best practices. See Table 3.2 for high priority mitigation actions, Table 3.3 for medium priority actions and Table 3.4 for low priority actions.

Note 1: See Volume III, Jurisdictional Addenda, for the Priority Actions for each participating city and special district.

Action Item Worksheets

Each high and medium priority action item for Hood River County has a corresponding action item worksheet describing the activity, identifying the rationale for the project, identifying potential ideas for implementation, and assigning coordinating and partner organizations. The action item worksheets can assist the community in pre-packaging potential projects for grant funding. The worksheet components are described below. These action item worksheets are located in Appendix A. Low priority action items were not elaborated on in Appendix A.

Background

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 2 and the Hazard Annexes.

Ideas for Implementation

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 with relevant organizations, grant programs, tax incentives, human resources, education and outreach, research, and physical manipulation of buildings and infrastructure.

Implementation through Existing Programs

Many of the recommendations in the Hood River County Natural Hazards Mitigation Plan are consistent with the goals and objectives of the county's existing plans and policies. Where possible, Hood River County will implement the Natural Hazards Mitigation Plan's recommended actions through existing plans and policies. Plans and policies already in existence often 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.[1] Implementing the Natural Hazards Mitigation Plan's action items 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.

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.

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.

Plan Goals Addressed:

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.

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 in the next zero to two years. *Long-term action items* (LT) may require new or additional resources and/or authorities, and may take from three to five years to implement. *Ongoing* refers to actions that are currently in progress and take additional steps to complete, or refers to actions that reoccur on a regular basis. When possible, this rate of recurrence is indicated (i.e. annually, monthly, etc.).

[1] Burby, Raymond J., ed. 1998. Cooperating with Nature: Confronting Natural Hazards with Land-Use Planning for Sustainable Communities.

Action Item Development:

The 2006 NHMP Coordinator led the effort to collect and document action item ideas, disperse action worksheets to government agencies and community stakeholders, and ultimately draft action item worksheets to present to the Steering Committee. Action item input was gathered through the NHMP Community Stakeholder Forum, stakeholder interviews, and Steering Committee meetings. The Steering Committee was charged with the selection of draft action items to document in the plan and prioritization (high or low) of action items to help guide implementation. Selection and prioritization of action items was accomplished during a four stage review process of selection, prioritization, providing detail, and identifying critical actions.

Action Item Review and Update of the 2012 NHMP

The 2006-2007 mitigation action items were reviewed and revised by the 2011-2012 Hood River County NHMP Steering Committee, and again by the 2018 Hood River County NHMP Steering Committee during the Mitigation Strategy Meeting on March 29, 2018. Steering Committee Members analyzed each of the action items developed by the previous Steering Committee, and documented the progress made for each action item over the past five years since the plan's creation. See Appendix B: Planning and Public Process, Table B-2.

Existing 2012 NHMP mitigation actions were reviewed and organized as follows:

- Completed action items were described and removed, or deferred if the nature of the action item made its progress ongoing.
- Action items that had not been completed were either deleted or deferred.
- Action items that had become institutionalized to the point of becoming routine maintenance were described and removed from the action item list, though retained to demonstrate normalized mitigation activity.
- Action items that were identified as outside of the County's authority were removed.
- Most deferred action items were modified in some way, either in terms of the action itself, partner organizations, or the timeline for completion.

The actions taken by the 2018 Hood River County NHMP Steering Committee during their review of the plan's action items, along with justifications for these decisions, can be found in Appendix B: Planning and Public Process in Table B.2.

Action Items for the 2018 NHMP

The action item tables below are the result of the 2018 update process and are organized in tables for high, medium, and low priority mitigation actions. There are 14 total mitigation actions: two high, five medium, and seven low mitigation actions. These actions portray the overall action plan framework. They identify linkages between the actions and potential funding sources, partnerships (coordination and partner organizations), and timelines. The tables document a description of the action, Steering Committee identified priority, the coordinating organization, partner organizations, timeline, and the plan goals addressed. Further details on implementation, costs, and benefits for the high and medium priority actions can be found in Appendix A: Action Item Forms.

Table 3.2 High Priority Mitigation Actions

Action Item	Action Title	Coordinating Organization	Partner Organizations	Timeline	Potential Funding Source
Multi-Hazard #7	Develop Emergency Evacuation and Public Notification Plan	Emergency Management	Fire Defense Board, Sheriff's Office, 911; School district; community PIOs and partners; granting agencies	LT	PDM; HMGP
Earthquake Hazard #1	Address Structural Issues in Identified Vulnerable and Critical Facilities	Board of County Commissioners (BOCC)	Emergency Management, School Board, Port Commission, City Councils, Planning, GIS, Public Works, DOGAMI, OEM, DLCD	LT	Seismic Rehabilitation Grant Program; HMGP

Source: Hood River County Steering Committee, May 2018

Table 3.3 Medium Priority Mitigation Actions

Action Item	Action Title	Coordinating Organization	Partner Organizations	Timeline	Potential Funding Source
Multi - Hazard #1	Creation of a Part-time Position to Coordinate Volunteer Efforts and Pursue Mitigation Funding	Emergency Management	County Departments, SWCD, Cities, State Agencies, Nongovernment/Quasi-governmental Organizations, Public, CWPP	ST (ongoing)	FEMA grants
Multi - Hazard #2	Enhance Public Outreach and Educational Programs for All Hazards	Emergency Management	County Agencies (Planning, SWCD, Building specifically), Cities, State Agencies, Nongovernment/Quasi-governmental Organizations, Public, Media, Schools, Forest Service	ST (ongoing)	Existing Sources
Multi-Hazard #5	Develop Shelter Plan and Prepare Facilities to Provide Shelter-in-Place Services	Emergency Management	Gorge Grown, Granges and Town Halls; Rotary; Soroptomists; Lions Club; Community Development, RARE program at University of Oregon; AmeriCorps; OEM; City Councils, Planning, Fire Stations, GIS, FEMA	ST	EDA, PDM, HMGP
Wildfire Hazard #1	Enhance Interagency Cooperation Regarding Response and Fuel Reduction	Fire Districts	ODF, USFS, Emergency Management, Planning	ST (ongoing)	Existing Sources
Wildfire Hazard #3	Ensure Proper Road Continuity, Numbering and Naming	Planning	Fire Districts, Public Works	ST (ongoing)	Existing Sources

Source: Hood River County Steering Committee, May 2018

Table 3.4 Low Priority Mitigation Actions

Action Item	Action Title	Coordinating Organization	Partner Organizations	Timeline	Potential Funding Source
Multi - Hazard #3	Partner with Oregon Health Authority, health care sector, and Hood River County Public Health to Utilize Vulnerable Populations Database	Emergency Management	Health Department, Planning, Red Cross, Hospitals, 911, CCFL	ST	Existing Sources
Wildfire Hazard #2	Conduct County Policy Review to Reduce Wildfire Risk and Enhance Response Capabilities	Planning	Fire Districts, ODF, USFS	ST	Existing Sources
Multi - Hazard #4	Update County Land Use Plan and Zoning Ordinances to Mitigate Natural Hazard Risk from Wildfire and Landslide	Planning	BOC, DLCD	LT	Existing Sources
Drought Hazard #1	Ensure Long-range Water Resources Conservation	Hood River Watershed Group	SWCD, County Agencies, Irrigation Districts, OSU Extension, Fruit Growers, OWRD	LT	
Earthquake Hazard #2	Improve Knowledge of Earthquake Impacts (Blue Ridge Fault and CSZ)	Emergency Management	GIS, Public Works, DOGAMI, OEM, DLCD	LT	
Landslide Hazard #1	Improve Understanding of Landslide Risk in Eagle Creek Burn Scar	Planning	Emergency Management, DOGAMI, ODF, DLCD, GIS, USGS	LT	
Winter Storm Hazard #1	Continue Partnership Programs to Reduce Vulnerability of Public Infrastructure from Severe Winter Storms	Emergency Management	Planning, Public Works, Cities, Utilities, ODOT, OSP	LT (ongoing)	

Source: Hood River County Steering Committee, May 2018

Table 3.5 Institutionalized Mitigation Activities

2012 Action Title	Activity Description	Responsible Organization
Annual Review and Update of the County Community Wildfire Protection Plan, and Natural Hazards Mitigation Plan; Re-Adoption by County Court Every 5-Years; Review and Update of the County Emergency Operations Plan Every 2-Years	Hood River County Emergency Management coordinates NHMP review and update meetings twice annually, and ensures re-adoption by the County Court every 5 years. Emergency Management reviews and updates the County Emergency Operations Plan every 2 years.	Emergency Management
Maintain Comprehensive Impact Database	Hood River County Planning Department developed this database and now maintains it sufficiently	GIS Coordinator
County Forest Road Maintenance	All Timber Sales fund road condition maintenance, reconstruction, and improvement, including drainage and surfacing as needed. Priority typically given to fish bearing waters, then to areas that will be prone to impact waters of the state. Legacy road slope failures are stabilized as needed.	Hood River County Forestry Department
Extend Streamside Vegetation Protection to All Land Uses	The Hood River Soil and Water Conservation District and Hood River Watershed Group (HRWG) continue to work to expand streamside vegetation. HRWG tends to work on non-ag lands, and the SWCD tends to work on ag lands. SWCD reviews all relevant county development permit applications and provide comments/recommendations where needed.	Hood River County Soil and Water Conservation District
Support Local Agencies Training on Water Conservation Measures and Drought Management Practices	Outreach and education was key in 2015 drought event. The SWCD takes a lead role in educating the public and assisting in the coordination of efforts among entities.	Hood River County Soil and Water Conservation District
Culvert Barrier Remediation for Fish Passage and Flood Mitigation	Culvert repair and replacement occurs regularly, as needed, with a focus on improving fish passage and drainage.	Hood River County Public Works
Reduce Trees in Public Utility Right of Ways - Avoiding Damage to Power Lines	Utility companies are responsible for ongoing maintenance. Public Works also clears trees as necessary.	Hood River County Public Works
Residential Fuel Reduction Capacity	SB 360 is in place and enforced. USFS and ODF have active programs improving residential fuel reduction and local districts partner and implement routinely	USFS, ODF, Fire Districts

Source: Hood River County Steering Committee, May 2018

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SECTION 4:
PLAN IMPLEMENTATION AND MAINTENANCE

This section of the NHMP addresses 44 CFR 201.6(c)(4) – Plan Maintenance. Specifically, the section details the formal process that will ensure that the *Hood River County Multi-Jurisdiction Natural Hazards Mitigation Plan* remains an active and relevant document. The plan implementation and maintenance process includes a schedule for monitoring and evaluating the plan annually, as well as producing an updated plan every five years. Finally, this section describes how the county and participating jurisdictions will integrate public participation throughout the plan maintenance and implementation process.

Implementing the Plan

After the Plan is locally reviewed and deemed complete, Hood River County Emergency Management submits it to the State Hazard Mitigation Officer at the Oregon Military Department, Office of Emergency Management, which conducts a pre-adoption review of the Plan, and then submits it to the Federal Emergency Management Agency (FEMA--Region X) for review. This review addresses the federal criteria outlined in the FEMA Interim Final Rule 44 CFR Part 201. Upon acceptance by FEMA, the county will adopt the plan via resolution. At that point the county will maintain eligibility for the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program, and Flood Mitigation Assistance.

Co-conveners

Hood River County Emergency Management and Hood River County Community Development Department shall serve as co-conveners of this plan. The agencies shall split responsibilities with (1) Emergency Management coordinating emergency service related aspects of the plan and its projects; and (2) Community Development Department coordinating GIS and land use related aspects.

Emergency Services Convener: Hood River County Emergency Management

The County's Emergency Management system strives to coordinate activities to mitigate, prepare for, respond to and recover from major emergencies or disasters. As the agency responsible for the implementation and maintenance of the mitigation plan, Hood River County Emergency Management shall:

- Serve as a communication conduit between the Steering Committee and key plan stakeholders;
- Coordinate Steering Committee meeting dates, times, locations, agendas, and outcomes;

- Utilize the Risk Assessment as a tool for prioritizing proposed natural hazards risk reduction projects;
- Identify emergency management-related funding sources for natural hazard mitigation projects;
- Prioritize and recommend funding sources for natural hazard risk reduction projects;
- Document successes and lessons learned;
- Develop and coordinate ad hoc and/or standing subcommittees as needed.

Contact: Barbara Ayers, Emergency Program Manager
Hood River County Emergency Management
601 State Street
Hood River, OR 97031
V: (541) 386-1213
E: barbara.ayers@co.hood-river.or.us

Land Use Convener: Hood River County Community Development

The agency administers and enforces land use planning regulations for the county. Hood River County Community Development strives to protect life, property, the environment, and economic health of the county by (1) coordinating private development with the provision of public services and infrastructure and (2) determining how and where development occurs in a way that preserves for future generations. As the agency responsible for the implementation and maintenance of the mitigation plan, the Hood River County Community Development Department shall:

- Incorporate, maintain, and update Hood River County's natural hazards risk and community development GIS data elements; and
- Incorporate, maintain, and update Hood River County's land use plans and codes to help mitigate hazards and risk elements; and
- Utilize the Risk Assessment as a tool for prioritizing land use plans and code updates.

Contact: John Roberts, Director
Hood River County Community Development Department
601 State Street
Hood River, OR 97031
V: (541) 387-6868
E: john.roberts@co.hood-river.or.us

Coordinating Body

Key stakeholders that are part of the NHMP Steering Committee or that serve in regular County Emergency Management / Emergency Operations Center activations, meetings and drills review the mitigation plan semi-annually. The responsibilities of the coordinating body include:

- Review and evaluate opportunities to develop funding programs such as the Pre-Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program funds, and Flood Mitigation Assistance program funds; Homeland Security grants and other public or private funding and grants to enhance implementation of mitigation projects;
- Prioritize and recommend natural hazard risk reduction projects;
- Coordinating body agencies will continue to pursue opportunities to develop these mitigation projects to enhance fulfillment of this plan leveraging regional collaboration;
- Evaluate the Natural Hazards Mitigation Plan following a disaster and update as needed; and
- Serve as key stakeholders to promote, facilitate and enhance hazard mitigation projects.

Members

The following organizations were represented and served on the Steering Committee during the development of the *Hood River County Multi-Jurisdiction Natural Hazards Mitigation Plan*:

Table 4.1: Hood River County NHMP Update Steering Committee

Name	Title	Organization
John Roberts	Planning Director	Hood River County Community Development
Dustin Nielson	Planning Director	Hood River City
Barbara Ayers	Emergency Manager	Hood River County Sherriff's Office
Michael McElwee	Executive Director	Port of Hood River
Paul Koch	General Manager	Port of Cascade Locks
Theresa North	Board Chair	Columbia Area Transit
Mike McCafferty	Fire Chief, Parkdale Fire; Hood River County Fire Defense Board Chief	Parkdale Fire
Mikel Diwan	Public Works Director	Hood River County Public Works
Mike Matthews	Public Health Manager	Hood River County Public Health
Catherine Dalbey	Director of Human Resources	Hood River County School District
Gordon Zimmerman	City Administrator	City of Cascade Locks
Loretta Duke	Asst. Fire Mgmt Officer	US Forest Service
Mike Schrankel	GIS coordinator	Hood River County Community Development

To make the coordination and review of Hood River County Natural Hazards Mitigation Plan as broad and useful as possible, the coordinating body 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.

Implementation through Existing Programs

The Natural Hazards Mitigation Plan includes a range of action items that, when implemented, help 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. Hood River County currently addresses statewide planning goals and legislative requirements through its comprehensive land use plan, capital improvement plans, mandated standards and building codes. To the extent possible, Hood River County will work to incorporate the recommended mitigation action items into existing programs and procedures.

Many of the Natural Hazards Mitigation Plan's recommendations are consistent with the goals and objectives of the county's existing plans and policies. Where possible, Hood River County should implement the Natural Hazards Mitigation Plan's recommended actions through existing plans and policies. Plans and policies already in existence often 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 Natural Hazards Mitigation Plan's action items through such plans and policies increases their likelihood of being supported and implemented.

Examples of plans, programs or agencies that may be used to implement mitigation activities include:

- Community Wildfire Protection Plan
- Hood River County Budget, ordinances and work plans
- Hood River Fire Defense Board budget, plans and projects
- Hood River County Emergency Management/Emergency Operations Center budget, plans and projects
- Hood River County Economic Development Action Plan
- Hood River County Comprehensive Plan
- Hood River County building codes
- Hood River County Community Development work plans
- Soil and Water Conservation District plans
- Hood River County Energy Plan

For additional examples of plans, programs or agencies that may be used to implement mitigation activities refer to Section 3: Mitigation Strategy.

Plan Maintenance

Plan maintenance is a critical component of the natural hazard mitigation plan. Proper maintenance of the plan ensures that this plan will maximize the county's efforts to reduce the risks posed by natural hazards. This section was developed by the University of Oregon's Partnership for Disaster Resilience and

includes a process to ensure that a regular review and update of the plan occurs. Co-conveners, Steering Committee and local staff are responsible for implementing this process, maintaining and updating the plan as outlined in the maintenance schedule below.

Semi-Annual Meetings

The committee will meet on a semi-annual basis to complete the following tasks. During the first meeting the Committee will:

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

During the second meeting of the year the Committee will:

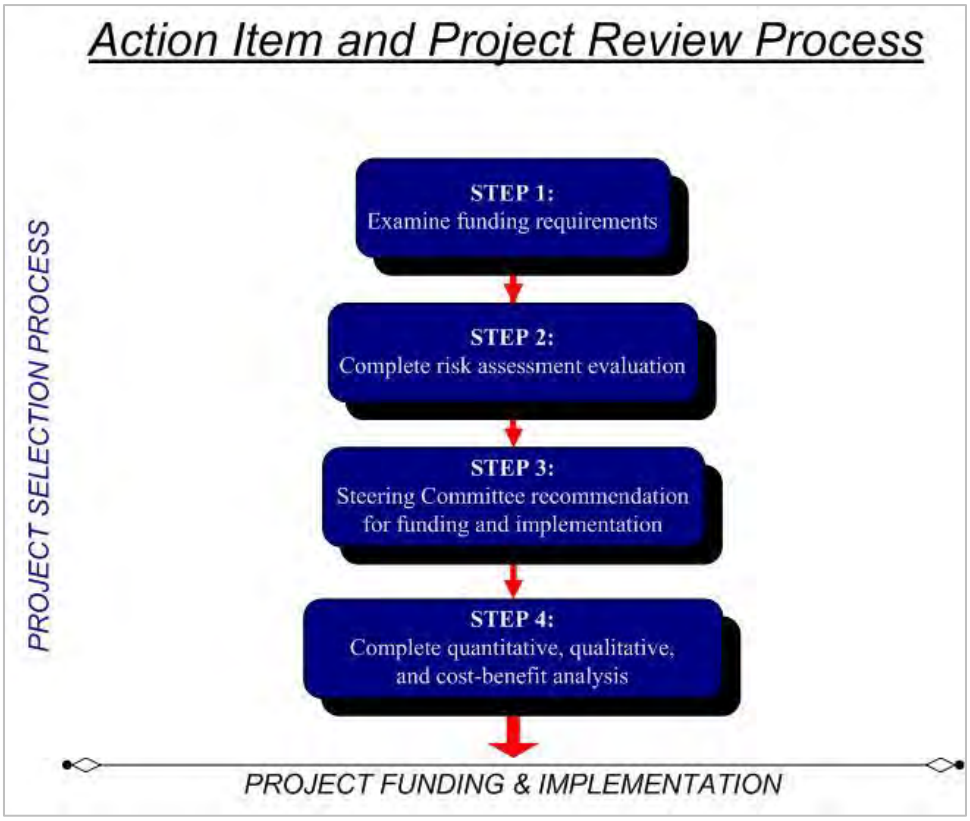
- Review existing and new risk assessment data;
- Discuss methods for continued public involvement; and
- Document successes and lessons learned during the year.

The Hood River County Emergency Manager will be responsible for documenting the outcome of the semi-annual meetings in Appendix B. The process the coordinating body will use to prioritize mitigation projects is detailed in the section below. The plan's format 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 natural hazards mitigation plan that remains current and relevant to the participating jurisdictions.

Project Prioritization Process

The Disaster Mitigation Act of 2000 requires that jurisdictions identify a process for prioritizing potential actions. Potential mitigation activities often come from a variety of sources; therefore the project prioritization process needs to be flexible. Projects may be identified by committee members, local government staff, other planning documents, or the risk assessment. Figure 4.1 illustrates the project development and prioritization process.

Figure 4.1: Project Prioritization Process



Source: Community Service Center's Partnership for Disaster Resilience at the University of Oregon, 2008.

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), Homeland Security grants, local general funds, and private foundations, among others. Please see Appendix F: Grant Programs for a more comprehensive list of potential grant programs.

Because grant programs open and close on differing schedules, the coordinating body will examine upcoming funding streams' requirements to determine which mitigation activities would be eligible. The coordinating body may consult with the funding entity, Oregon Emergency Management, or other appropriate state or regional organizations about project eligibility requirements. This examination of funding sources and requirements will happen during the coordinating body'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 co-conveners, working with the coordinating body 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 coordinating body 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.

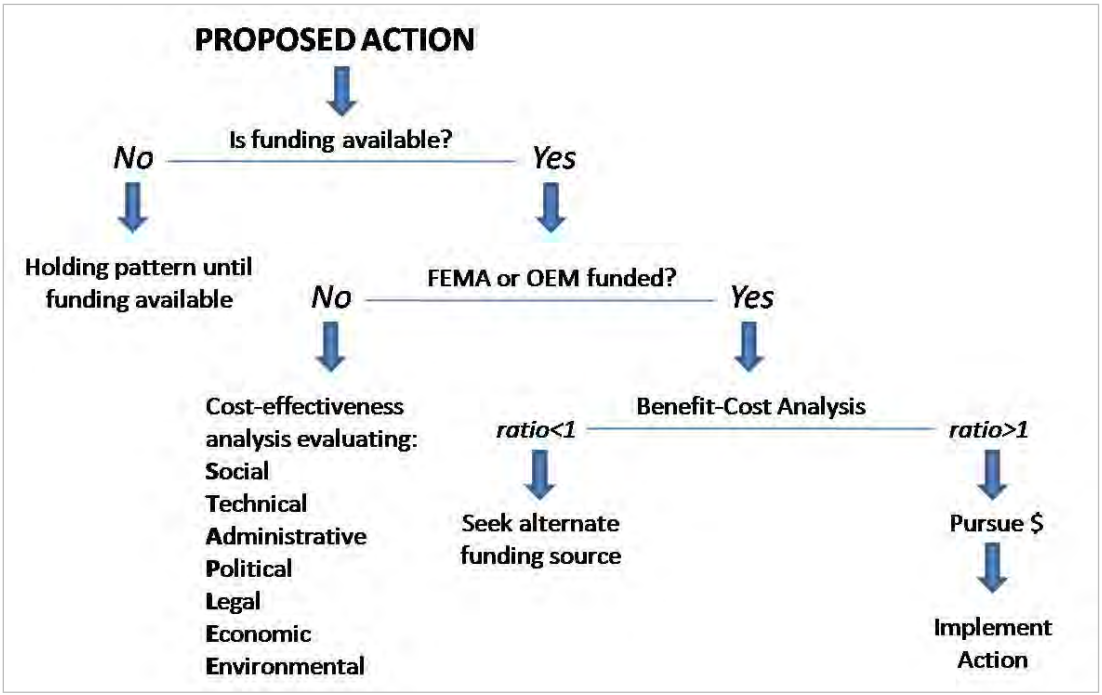
Step 3: Committee Recommendation

Based on the steps above, the co-conveners will recommend which mitigation activities should be moved forward. If the coordinating body 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. Co-conveners will hold a meeting to review the issues surrounding grant applications and to share knowledge and/or resources as needed. 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.

Figure 4.2: Benefit Cost Decision Criteria



Source: Community Service Center's Partnership for Disaster Resilience at the University of Oregon, 2010.

If the activity requires federal funding for a structural project, the Committee will use a Federal Emergency Management Agency-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 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. The STAPLE/E technique has been tailored for use in natural hazard action item prioritization by the Partnership for Disaster Resilience at the University of Oregon's Community Service Center. See Appendix D for a description of the STAPLE/E evaluation methodology.

Continued Public Involvement & Participation

The participating departments, agencies and organizations are dedicated to involving the public directly in the continual reshaping and updating of the Hood River County 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.

To ensure continued public engagement and support of this plan, Hood River County shall invite the public to participate in future plan developments in the following ways:

- Post plan on Hood River County, Hood River County Emergency Management and Hood River Community Development Department Websites for comment
- Post notices to invite stakeholders to participate in one of the semi-annual Steering Committee meetings
- Hold community hazard workshops
- Implement significant outreach activities documented in this plan (See Section 3:Mitigation Strategy)

In addition to the involvement activities listed above, the county's Natural Hazards Mitigation Plan has been archived and posted on the Partnership website via the University of Oregon Libraries' Scholar's Bank Digital Archive.

Five-Year Review of Plan

This plan will be updated every five years or as the County deems necessary. The Hood River County Natural Hazards Mitigation Plan is due to be updated in the fall of 2023. County convener/s will be responsible for updating any deficiencies found in the plan, with the help of the steering committee.

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 4.2 Natural Hazards Mitigation Plan Update Toolkit

Question	Yes	No	Plan Update Action
Is the planning process description still relevant?			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).
Do you have a public involvement strategy for the plan update process?			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.
Have public involvement activities taken place since the plan was adopted?			Document activities in the "planning process" section of the plan update
Are there new hazards that should be addressed?			Add new hazards to the risk assessment section
Have there been hazard events in the community since the plan was adopted?			Document hazard history in the risk assessment section
Have new studies or previous events identified changes in any hazard's location or extent?			Document changes in location and extent in the risk assessment section
Has vulnerability to any hazard changed?			Document changes in vulnerability in the risk assessment section
Have development patterns changed? Is there more development in hazard prone areas?			Document changes in vulnerability in the risk assessment section
Do future annexations include hazard prone areas?			Document changes in vulnerability in the risk assessment section
Are there new high risk populations?			Document changes in vulnerability in the risk assessment section
Are there completed mitigation actions that have decreased overall vulnerability?			Document changes in vulnerability in the risk assessment section
Did the plan document and/or address National Flood Insurance Program repetitive flood loss properties?			Document any changes to flood loss property status
Did the plan identify the number and type of existing and future buildings, infrastructure, and critical facilities in hazards areas?			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
Did the plan identify data limitations?			If yes, the plan update must address them: either state how deficiencies were overcome or why they couldn't be addressed
Did the plan identify potential dollar losses for vulnerable structures?			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
Are the plan goals still relevant?			Document any updates in the plan goal section
What is the status of each mitigation action?			Document whether each action is completed or pending. For those that remain pending explain why. For completed actions, provide a 'success' story.
Are there new actions that should be added?			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.
Is there an action dealing with continued compliance with the National Flood Insurance Program?			If not, add this action to meet minimum NFIP planning requirements
Are changes to the action item prioritization, implementation, and/or administration processes needed?			Document these changes in the plan implementation and maintenance section
Do you need to make any changes to the plan maintenance schedule?			Document these changes in the plan implementation and maintenance section
Is mitigation being implemented through existing planning mechanisms (such as comprehensive plans, or capital improvement plans)?			If the community has not made progress on process of implementing mitigation into existing mechanisms, further refine the process and document in the plan.

Source: Oregon Partnership for Disaster Resilience, 2010

Volume II:
Hazard Annex

Photo Source: Hood River County

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Introduction

Hood River County is regularly impacted by six natural hazards: wildfires, winter storms, windstorms, droughts, landslides, and floods. The County is also susceptible to risk from two additional hazards: earthquake events and volcanic eruptions. Wildfires and winter storms are considered high risk and thus are priority hazards because the County is highly vulnerable to their impacts. Windstorms, droughts, landslides, and floods exist primarily as complicating or compounding factors; these hazards may increase the probability of wildfires or winter storms or occur as secondary impacts of wildfires or winter storms. In general, hazard vulnerability is increasing in Hood River County and the Cities of Cascade Locks and Hood River due to increasing populations.

A general overview of these natural hazards and their threat to Hood River County is listed below in Table HA- 1. For additional information beyond this Hazards Annexes section, see Volume I, Section 2, Risk Assessment.

Table HA- 1: Hood River County Hazard Overview

Hazard	General location and extent	Risk Level
Winter Storm	Countywide; severe winter storms occur annually and create dangerous driving conditions, residential isolation, and power outages.	High
Wildfire	The entire county is vulnerable to the effects of wildfire; however steep slopes, unmanaged forests, and wind conditions intensify risk. Transportation and economic activity is disrupted by wildfire.	High
Earthquake (CSZ and Crustal)	A subduction zone earthquake would collapse buildings and damage infrastructure countywide. Crustal quake events stemming from local faults could be catastrophic to County infrastructure.	Moderate
Landslide	Hood River County has many areas adjacent to the Columbia River Gorge where landslides have taken place; steep slopes and high precipitation increase landslide risk. Severe landslides can damage infrastructure and transportation. Heightened risk in recent wildfire burn zone.	Moderate
Drought	Countywide; frequent to regular moderate droughts; affect agricultural and recreational sectors.	Moderate
Flood	Rivers in Hood River County historically flood every few years. These include the Hood River, Indian Creek, Phelps Creek and the Columbia River. Flood hazard areas are along the East, Middle and West forks of the Hood River, and along Emil, Odell, Baldwin and Neal Creeks.	Low
Windstorm	Windstorms are frequent throughout the County, but rarely create catastrophic damage.	Moderate
Volcano	Hood River County may be impacted by a volcanic eruption from Mt. Hood at any time, which would impact White River, Sandy, and Hood River channels.	Low

Source: Hood River County

In addition, the Oregon Department of Geology and Mineral Industries (DOGAMI) conducted a multi-hazard risk assessment for Hood River County. The study was funded through the FEMA Risk MAP program and is expected to be completed in 2018. A preliminary draft was available at the time of this NHMP update. The Natural Hazard Risk Report for Hood River County, Oregon: Including the Cities of Cascade Locks, Hood River, and Unincorporated Communities of Odell, Parkdale, and Rockford (Risk Report) provides a quantitative risk assessment that informs communities of their risks related to the following natural hazards: earthquake, flood, lahar (volcanic event), landslide, and wildfire. The County hereby incorporates the preliminary Risk Report into this NHMP by reference to provide greater detail to hazard sensitivity and exposure. The full report can be accessed on the DOGAMI Interpretive Map Series webpage: http://www.oregongeology.org/pubs/ims/p-ims.htm.

This Hazard Annex describes the characteristics, location, extent, history, and probability for each hazard addressed in the Hood River County NHMP. The hazards are discussed in order of their Total Risk Level (which is based on the risk score), as determined by the Hood River County Steering Committee. Probability is described and uses the OEM Methodology; see the full description of the OEM Methodology in Volume I, Section 2, Risk Assessment. Locally specific vulnerabilities are also described. These subsections comprise and provide a risk analysis for the natural hazards identified by Hood River County. Additional information pertaining to the types and characteristics of each hazard is available in the State of Oregon Natural Hazards Mitigation Plan Region 5 (Mid-Columbia), Risk Assessment.[1] Notable changes to this section include:

- The Hazard Annexes were significantly altered for clarity. Hazard identification, characteristics, history, probability, vulnerability, and hazard specific mitigation activities were updated. Extraneous information was removed and links to technical reports were added as a replacement. Links to specific hazard studies and data are embedded directly into the plan where relevant and available. The section was reorganized according to priority.
- All hazard subsections have been reformatted to emphasize characteristics, location and extent, history, probability, and vulnerability
- The addition of hazard history events in all hazard types except volcano
- New earthquake probability and vulnerability information added
- Wildfire location specific risk information added
- The Severe Storm hazard was divided into Winter Storm and Windstorm, in order to align with the State Natural Hazards categorization and to account for the distinct impacts of those each storm type.
- Maps depicting hazard location and local vulnerability were added whenever available
- Previously included statistics and information was updated with most current data

Changes to each hazard sub-section are noted at the beginning of each sub-section.

[1] State of Oregon Natural Hazards Mitigation Plan Region 5 (Mid Columbia), Risk Assessment

Predicted Climate Variability

Temperatures increased across the Pacific Northwest by 1.3 ˚F in the period 1895–2011 (the observed record). In that same timeframe, Cascade Mountain snowpacks have declined, and higher temperatures are causing earlier spring snowmelt and spring peak streamflows. In Oregon's forested areas, large areas have been impacted by disturbances that include wildfire in recent years, and climate change is probably one major factor. [2]

The state climate change information, described in detail in the 2015 Oregon NHMP, indicates that hazards projected to be impacted by climate change in Region 5 include drought and wildfire. Climate models project warmer drier summers and a decline in mean summer precipitation for Oregon. While winter storms and windstorms affect Region 5, there is little research on how climate change influences these hazards in the Pacific Northwest. When climate variability information is available, its expected impact is noted in each hazard section.[3]

As part of the PDM-16 planning grant the Department of Land Conservation and Development (DLCD) contracted with the Oregon Climate Change Research Initiative (OCCRI) to provide an analysis of climate change influences on natural hazards (Appendix G). OCCRI's *Future Climate Projections: Hood River County* and the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports*, provide important information regarding the influence and impacts of climate change on existing natural hazards events such as heavy rains, river flooding, drought, heat waves, cold waves, wildfire, and air quality (Appendix G).

The basis of the research prepared by OCCRI uses future climate projections that are derived from 10–20 global climate models and have been "downscaled"—made locally relevant. Several climate metrics that relate to natural hazards are being calculated for historical and mid-21st century periods under two future emissions scenarios that result in varying future temperature increases for the State of Oregon.

Each county report describes county-specific projected changes in climate metrics related to the selected natural hazards. The reports present future climate projections for the 2020s (2010-2039 average) and the 2050s (2040-2069 average) compared to the 1971-2000 average historical baseline. Each hazard in the report has a box highlighting "key messages" that call out the main points of the research and analysis for that hazard.

Table HA-2 provides an overview of expected climate change impacts for Hood River County. The table shows the direction of change (increasing, decreasing, unchanging) and indicates the level of confidence in direction of change (high, medium, low). According to the OCCRI reports there is high confidence that heat waves and droughts will increase and that cold waves will decrease. The table also shows that there is medium confidence that heavy rains, river flooding, wildfire, prevalence of invasive species, and loss of wetland ecosystems will increase. The overview describes results for the natural hazards using climate metrics in summary and as a comparison. For more information see the OCCRI reports in Appendix G.

[2] Ibid.
[3] Ibid.

Table HA-2 Overview of Expected Climate Change Impacts for Hood River County

Heat Waves	↑↑	Heavy Rains	↑↑	Poor Air Quality	↑↑
Cold Waves	↓↓	River Flooding	↑↑	Windstorms	=
Drought	↑↑	Wildfire	↑↑	Dust Storms	↓↓
		Increased Invasive Species	↑↑		
		Loss of Wetland Ecosystems	↑↑		

Level of Confidence in Direction of Change		Expected Direction of Change	
	High Confidence	Risk Increasing	↑↑
	Medium Confidence	Risk Decreasing	↓↓
	Low Confidence	Risk Unchanging	=

Source: OCCRI, Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports

Winter Storm

Significant Changes since the Previous Plan:

Severe Storm hazard category was divided into Winter Storms and Windstorms, in alignment with the state Natural Hazards Mitigation Plan. While many winter storms are complicated by high wind speeds, snow, ice, freezing rain, and cold temperatures generate their distinct impacts, specifically road closures and community isolation. Winter Storms remain the first priority hazard for Hood River County. Three recent local hazard events were added to the hazard history section and several regional hazards events were added.

Hazard Characteristics

Severe winter weather in the region can be characterized by extreme cold, snow, ice, and sleet, caused by frigid air moving westward out of the Wallowa Mountains through the Columbia River Gorge. Winter storm events are an annual occurrence regionally. Severe weather conditions usually do not last long; consequently, winter-preparedness is a moderate priority. This is advantageous in at least one respect: in general, the region is

prepared, and those visiting the region during the winter usually come prepared. However, there are occasions when preparation cannot meet the challenge.[4] Severe local storms seldom cause death and serious property damage but can cause major utility and transportation disruptions. Although major winter storms are often accompanied by wind, tornadoes and windstorms are described in a separate section because they have distinct causes and impacts.

The principal types of winter storms that occur include:

Snowstorms: Snowstorms require three variables: cold air, moisture, and air disturbance. Blizzards are included in this category.

Ice storms: Ice storms are a type of winter storm that forms when a layer of warm air is trapped between two layers of cold air. Frozen precipitation melts when it hits the warm air layer, and refreezes when hitting the cold air layer below the inversion. Ice storms can include sleet (when the rain freezes before hitting the ground) or freezing rain (when the rain freezes once hitting the ground). Sleet and hail can create hazards for motorists when it accumulates, but 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.

Extreme Cold: Low temperatures often accompany winter storms. Low temperatures can become dangerous because snow and ice storms can cause power outages, leaving many people without adequate heating.

Rain arriving from the west can fall on frozen streets, cars, and other sub-freezing surfaces, creating dangerous conditions. Rain on snow events happen periodically in the Pacific Northwest and tend to be very impactful.

Location and Extent

The entire County is susceptible to damaging severe weather. The impacts of winter storms are variable and compounding throughout Hood River County. Mid-latitude storms approaching from the West are forced to rise as they encounter the Cascades, releasing large amounts of precipitation on the western slopes. Areas of the County at higher elevations have an increased risk of snow and ice, however, the entire County is susceptible to dangerous winter storm impacts. Prolonged heavy rains cause the ground to become saturated, rivers and streams to rise, and often results in local flooding and landslides.

Hood River County snow accumulations vary depending on location. For example, the Mt. Hood National Forest experiences accumulations in excess of 150 inches around the higher elevations Mt. Hood. In the area of the Hood River Experimental Station, average snowfall may accumulate to approximately 12 inches, depending on the year. Accumulations of snow usually increase as the terrain rises to the south of the Columbia River. The greatest snowfall usually occurs in January.

[4] State of Oregon Natural Hazards Mitigation Plan Region 5 (Mid Columbia), Risk Assessment

History

The winter storm hazard history for Hood River County is show in Table HA-3.

Table HA- 3: Hood River County Winter Storm Hazard History Events

Date	Location	Type of Weather	Description
1862	Hood River, Columbia Gorge	Snow and ice	Columbia River frozen until mid-March. Accumulated snowfall at the river was over 13 feet.
Dec. 1884	Columbia Basin	Snow	Heavy snowfall. The Dalles had 29.5 inches in one day. On Dec. 13th gale force east winds hit the Gorge and it snowed for 3 weeks. Snow depth in downtown Hood River was over 9 feet. A west bound train was buried by an avalanche east of Wyeth at a place now called Starvation Creek because of the effort it took to get food to the stranded passengers and crew.
Dec. 1885	Wasco County	Snow	The most snow recorded (6-10 feet). Trains had difficulty reaching Portland.
Dec. 1892	Northern counties in Oregon	Snow	The record snowfall in the region occurred December 20-23, 1892. In Southwest Washington and Northwest Oregon, 15 to 30 inches of snow fell, while Portland had 27.5 inches.
Jan. 1919	Hood River and Gorge	Ice; river frozen	Columbia River froze solid, temperatures down to 27 degrees below zero were recorded and most of the apple trees did not survive. This was the beginning of the ascendency of pears in the Hood River Valley.
Nov. 1921	Hood River	Heavy snow	Thirty to forty foot drifts covered the road and railroad tracks at Viento
Jan. and Feb. 1937	Statewide; Hood River and Gorge	Snow and ice	Deep snow drifts. Twelve below zero and the Columbia River froze bank-to-bank.
Winter 1930	Hood River	Snow and ice	Thirty below zero temperatures and 11 feet of snow at Red Hill
Jan. 1950	Statewide and Hood River	Snow	Friday the 13th Storm. Heaviest snowfall since 1890. Freezing rain. Deep snowdrifts closed all highways west of the Cascades and through the Columbia Gorge. Roads and schools closed. Downed power lines. Severed communication. Hundreds of thousands of dollars in property damage. Snowstorm during the second week of January dumped 64.4” of snow on Hood River and 8 to 10 feet fell in Parkdale over the month.

Date	Location	Type of Weather	Description
Dec. 1964	Statewide	Heavy rains and flooding	DR-184. The statewide event occurred in December 1964. On Dec. 22, 1964 in Hood River, 30" of snow fell followed by warm rain. At Tucker Bridge: 20.60' stage, 33,000 c.f.s. This is the number one historical flood crest of the Hood River.
Jan. 1969	Statewide	Snow	Record-breaking snowfalls. $3 to $4 million in property damage.
Jan. 1970	Hood River	Ice storm and thaw	"Silver Thaw" in Dee turns orchards to "icy garbage piles." Gov. McCall declares Hood River County a state disaster area.
Jan. 1972	W. Oregon	Storms and flooding	DR-319. Storm and flooding events on January 21, 1972.
Jan. 1974	W. Oregon, Hood River	Rain on snow, flooding	DR-413. Flooding resulted from rain on snow events. Willamette River at Portland crested at 25.7 feet. Nine counties declared disasters. Jan. 16, 1974 – the 6th highest flood of record on the Hood River. Crest at 14.48' at Tucker Bridge.
Jan. 1980	Statewide	Winter storm	Series of storms bringing snow, ice, wind, and freezing rain. Injuries, power outages, six fatalities.
Feb. 1990	Statewide	Snow	On February 14-16, 1990 a storm brought 24 to 35 inches of snow to the Columbia Gorge cities of Cascade Locks and Hood River, 16 inches at Timberline Lodge. On the 16th, 20 to 35 inches fell in the North Cascades. The Columbia Gorge had up to 6 inches of snow while the Willamette Valley had 2 to 5 inches more.
Feb. 1993	W. Oregon	Snow	Record snowfalls.
Nov. 1993	Cascade Mountains, OR	Snow	Heavy snow throughout the region.
Mar. 1994	Cascade Mountains, OR	Snow	Heavy snow throughout the region.
Feb. 1996	Statewide	Storms, flooding, rain on snow	DR-1099 Winter storms with rain, snow, ice, floods, and landslides. Power outages, road closures and property damage. Warm temperatures, record breaking rains; extensive flooding in Multnomah County; widespread closures of major highways and secondary roads; 8 fatalities. 27 counties covered by the disaster declaration.
Dec. 1996	Statewide	Winter storm	DR-1160. Severe snow and ice. Up to 4 to 5 inches of ice in the Columbia Gorge. Interstate 84 closed for 4 days. Hundreds of downed trees and power lines.

Date	Location	Type of Weather	Description
Feb. 2002	W. Oregon	Winter storm	Damages $6.14 million. Downed power lines and trees. Buildings damaged. Power outages caused some water supply problems.
Dec. 2003-Jan. 2004	Statewide	Snow and ice	DR-1510. Much of Portland area shut down. Twenty-six counties receive FEMA assistance.
Nov. 2006	W. Oregon, Hood River County	Winter storm, flooding, landslides	DR-1962. The events occurred November 6-8, 2006. Heavy freezing rain along I-84, closed highway near Hood River. Debris Flow from the Elliot Glacier and the Newton Clark Glacier caused multimillions of dollars of damage and took out sections of Highway #35 in three places; several key structures of the Middle Fork Irrigation District shut down hydroelectric plants, wiped out the Red Hill Road Bridge, damaged Toll Bridge Road, invaded and undercut the spring box of the Ice Fountain Water District, suspended 300 yards of track of the Mount Hood Railroad in mid-air, ripped away critical infrastructure of the Farmers Irrigation District and shut down their hydroelectric plants, and created a huge new river delta in the Columbia River, now known as the sandbar.
Dec. 2006	Hood River County	Freezing rain	Freezing rain and sleet caused ice conditions from Cascade Locks to Hood River; black ice on I-84
Dec. 2007-Jan. 2008	W. Oregon	Winter storm	DR-1824. Severe winter storm, record and near record snow, landslides and mudslides. Heavy freezing rain along I-84 caused accidents, one fatality.
Dec. 2008	Statewide	Winter storms, heavy rain, flooding	DR-1824. Severe winter storm, flooding, winds, record and near record snow, landslides and mudslides. Gresham received, 26” of snow. Many roads closed. Significant damages to public infrastructure, homes and businesses. Event occurred Dec. 20-26. On December 22, 2008, over 22 inches of snow fell on Hood River in 22 hours at river level.
Dec. 2009	Statewide	Winter storm	Snow and freezing rain in Salem, and Portland to Hood River. I-84 closed for 22 hours.
Nov. 2010	Statewide	Winter storm	Snow, freezing rain, and ice in Portland to Hood River.
Jan. 2011	Statewide	Winter storm	DR-1956. Severe winter storm, flooding, mudslides, landslides, and debris flows.
Jan. 2012	W. Oregon	Winter storm	DR-4055. The incident period was January 12-21, 2012. Severe winter storm with flooding, landslides,

Date	Location	Type of Weather	Description
			and mudslides. Declaration involves 12 counties including Hood River County. FEMA public assistance was offered to Hood River and other counties for damages.
Dec. 2015	Western Oregon	Winter storm	DR-4258. Severe winter storms, straight-line winds, flooding, landslides, and mudslides.
Jan. 2017	Statewide and Hood River	Severe winter storms, flooding, landslides, mudslides	DR-4238. The event occurred January 7-20, 2017. Counties that were part of the disaster declaration: Hood River (OERS# 2017-0052) Columbia, Josephine, and Deschutes. Other counties were also greatly impacted by this and other storms that occurred. SBA disaster loans were offered by the federal government to aid in recovery and FEMA public assistance was offered to the County.

Source: Hood River County NHMP, August 2012; Oregon NHMP, 2015; FEMA, Disaster Declarations for Oregon, retrieved 2017. Taylor and Hatton, 1999.

Probability

The probability that Hood River County will experience winter storms is **high**, meaning one event is likely in the next 35 years. In fact, history demonstrates that winter storms are likely to occur annually, and severe storms occur about every 4 years.

Winter storms and heavy rains are not addressed by the DOGAMI Risk Report. The OCCRI report identifies that the risk of heavy rains is increasing and that the risk of cold waves is decreasing for Hood River County.

Vulnerability

Both the probability and vulnerability rankings were **high** in the 2012 NHMP update, and remain **high** in the 2018 update.

Given current available data, no quantitative assessment of the risk of winter storm was possible at the time of this NHMP update. 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; the changing character of the county population and resources will determine the impact of winter storms on life and property in Hood River County.

Historical damage and cumulative costs of destructive storms suggest **high vulnerability,** meaning more than 10% of the region's population or assets would be affected by a major winter storm disaster. The effects vary with storm intensity, the level of preparation by local jurisdictions and residents, and equipment and staff available. Deaths related to winter storms can occur as a result of traffic accidents on icy roads, and hypothermia from prolonged exposure to the cold. Low temperatures and temporary loss of home heating can

be particularly hard on the elderly, young children and other vulnerable individuals. In the last five years, I-84 has closed every year due to winter storm impacts. As of this update, Hood River County has no comprehensive backup/generator system, leaving many residents without heat, food, and fuel in the event of isolation. [5]

Hood River County contains the commodity flow route to Eastern Oregon and beyond. With long road closures, the communities suffer from the loss of traffic and revenue. Drifting, blowing snow has brought highway traffic to a standstill. Also, windy and icy conditions have closed Oregon's principal east-west transportation route, I-84, for hours. For local residents, heating, food, fuel and the care of livestock and farm animals are everyday concerns.[6]

Severe storms cause massive power and telephone outages. Even moderate storms can bring down power lines and/or tree limbs, obstruct roadways and damage structures. Severe storms in Hood River County have left thousands without power. In certain areas, several days may pass before power is restored, creating life-threatening problems for people with life support equipment such as dialysis machines, respirators, and oxygen generators. Days without a heated home can also be life-threatening for any person during cold winter temperatures. Severe storms also create hazardous driving conditions that can slow down or inhibit traffic, which in turn hinders police, fire, and medical responses to urgent calls. Law enforcement resources are often occupied with welfare inquiries and traffic control, while fire departments focus on electrical hazards and debris removal, a short and long term challenge. Following severe storms, hundreds of tons of debris can pile up in residential and commercial areas.

Combinations of storm types or accompaniment by freezing temperatures can exacerbate a storm's impact. Isolated residents without power are more likely to use wood fires to stay warm or to cook, increasing the risk of structural fires. Residents without food or water may attempt to use impassable roads and thereby increase the number of rescues.

Ensuring that people stay off roads and remain in safe places until a storm passes is the best strategy for mitigating harm. Effective employee and student dismissal plans and event cancellation supports safety. It is also important to promptly notify the public of severe weather watches and warnings. In responding to severe storms, phone and power restoration services must be prioritized.

Once the public has weathered a severe storm and power and phone service is restored, the highest priority is to quickly and efficiently remove the debris on property and on roads.

[5] Hood River Emergency Manager, Barbara Ayerys, personal communication 5/10/2017

[6] State of Oregon Natural Hazards Mitigation Plan Region 5 (Mid Columbia), Risk Assessment

Wildfire

Significant Changes since Previous Plan:

Six wildfire incidents have occurred in Hood River County since the 2012 NHMP. One of these, the Eagle Creek Fire, was the number one federal priority fire for several weeks, and burned 48,861 acres. Wildfire hazard events have risen from 3rd priority to 2nd priority.
The plan has also been updated to include content from the Hood River County Wildfire Protection Plan concerning location and extent of hazard risk.

Hazard Characteristics

Wildland fires occur in areas with large amounts of flammable vegetation that require a suppression response due to uncontrolled burning. An uncontrolled burning within a forested area is a forest fire, whereas uncontrolled burning in grassland, brush, or woodlands is classified as a wildfire. Wildfires burn primarily in vegetative fuels outside the urban areas, and can generally be categorized as agricultural, forest, range, or wildland-urban interface fires. Fire is an essential part of Oregon's ecosystem, but can also pose a serious threat to life and property, particularly in growing rural communities.[7]

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

Topography: As slope increases, the rate of Wildfire spread increases. South-facing slopes are also subject to more solar radiation, making them drier and thereby intensifying Wildfire behavior. However, ridgetops may mark the end of Wildfire 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 Wildfires. 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 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, also contributes to the wildfire's rate of spread.

Weather: The most variable factor affecting Wildfire behavior is weather. Temperature, humidity, wind, and lightning can affect chances on ignition and spread of fire. Extreme weather, such as high temperatures, low humidity, and high wind speeds, can lead to extreme Wildfire activity. By contrast, cooling, higher humidity, and little to no wind often signals reduced occurrence and easier containment. [8]

The frequency and severity of Wildfires is also dependent on other factors such as lightning, equipment use, railroads, recreation use, arson, and infestations. If not promptly controlled,

7 State of Oregon Natural Hazards Mitigation Plan Region 5 (Mid Columbia), Risk Assessment
8 Hood River County Wildfire Protection Plan, 2013

Wildfires may grow into an emergency or disaster. Even small fires can threaten lives and resources, and destroy improved properties. In addition to affecting people, Wildfires may severely affect livestock and pets. Such events may require emergency watering/feeding, evacuation, and shelter.

The indirect effects of Wildfires 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, and can burn seed sources within the topsoil layer. Exposed soils erode quickly and increase 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 in the Landslides section of this plan.[9]

The Hood River County Wildfire Protection Plan provides comprehensive information on the local vulnerabilities, characteristics, and risk locations for Wildfires.

Location and Extent

Hood River County's fire season usually runs from mid-May through October. Fire susceptibility throughout the County dramatically increases in late summer and early autumn as summer thunderstorms with lightning strikes increases and vegetation dries out. The probability of a fire in any specific time or place depends on fuel conditions, topography, the time of year, the past and present weather conditions, and the human activities (debris burning, land clearing, camping, etc.) taking place.

Hood River County and the surrounding region have unique geographic features, weather characteristics, a history of unmanaged fuels, and an expanding urban interface that make the area susceptible to Wildfire. Douglas fir, grand fir, and western hemlock (fire interval 150– 400 years) dominate in the wetter forests of the western Columbia River Gorge, while ponderosa pine, Oregon white oak brush, and grass are more characteristic toward the east (15 year fire intervals). North and east facing slopes are typically forested while south and westerly aspects are generally open and grass covered. [14]

National Forest covers roughly half of Hood River County's 533 square miles. Private and county forestland covers another roughly 20% of land within the county. Where the damp forests of the west Cascades tend to see fewer fires, fires tend to be large and cause high rates of tree mortality; the east Cascades sees increased fire frequency, however fires tend to be less intense.

Many of the larger fires in the west Cascades and Columbia River Gorge burned in steep, forested terrain—a geography where few human settlements exist and the main hazards are to infrastructure such as water supplies and high-voltage power lines. The west end of the heavily wooded region is pinched between the Columbia River and the near vertical sides of the river gorge. As the percentage of slope increases more preheating of fuels preceding the fire front will occur. The fire front will proceed up the hill at a faster rate and

[9] Hood River County Wildfire Protection Plan, 2013

the fire will burn more intensely. Coupled with high winds and low humidity, this region has the potential for a severe wildfire.

Fires have the potential to spread from Washington State across the river into Oregon via long-range spotting. This region is subject to weather patterns that can contribute significantly to extreme fire behavior. Winds can attain speeds of 80 mph, halt truck traffic, and damage a variety of structures and facilities. Areas along the Gorge experience 20–30 mph winds daily and, at times, winds exceed 40 mph. The average wind speed at Hood River is 13 mph. Significant drying occurs as sustained winds, coupled with high daytime temperatures and drier air from the desert.

Sources of human-caused ignition include discarded cigarettes, motor cars and trucks, railroads, mowing, acts of nature, and fire emanating from adjoining land. Most fires adjacent to the freeway start in fine grasses and can rapidly progress into conifers that line the safety zone for almost the entire breadth of the region's west end.

The Wildfire Risk Explorer web map (currently in development) is an interactive tool for planners, property owners, and others which demonstrate location and extent of risk factors for Oregon counties.

For more information on forest compositions, fuel loads, and slope grades in Hood River County, see the 2013 Hood River County Wildfire Protection Plan. The CWPP explains how fire ecology varies across the County landscape and how best to manage fires in the human impacted environment.

History

Table HA-4 shows the history of wildfire in Hood River County. Between 1991 and 2016 Oregon Department of Forestry reported over 300 wildfires in Hood River County.[10] While the majority of these fires remained small, they still posed considerable threat. The Herman Creek fire (2003) was suppressed at 375 acres, however it was not before the fire jumped Interstate 84 five times, destroyed three structures, and cost local, state, and federal agencies over $600,000.[11] It was caused by downed power lines during an east wind event characteristic to the area during late summer. The 2017 Eagle Creek Fire reached 48,831 acres, burned for several weeks, and led to the evacuation of the City of Cascade Locks. The region continues to experience economic impacts for the Eagle Creek Fire.

For more detailed descriptions of local fires, see the Community Wildfire Protection Plan.

Table HA- 4: Hood River County and Regional Wildfire Hazard History Events

Date	Name	Location	Description
1902	Yacolt Burn	Columbia Gorge	The largest fire in Washington State history. 240,000 acres burned in only 2 days, spreading 20 miles in 12 hours and killing 38 people.

[10] Fires Statistics Charts, Oregon Department of Forestry, http://www.odf.state.or.us/DIVISIONS/protection/fire_protection/fires/FireCharts.asp, 3/12/18
[11] Hood River News, 2005

Date	Name	Location	Description
1927	Rock Creek Fire	Gifford Pinchot National Forest	50,000 acres burned, believed to be caused by lightning.
1929	Dole Valley Burn	Gifford Pinchot National Forest	227,500 acres burned, largest of the 26 reburns after Yacolt Burn.
Sept. 1971	Skyhook Fire	12 miles SW of Hood River (Mt. Hood National Forest)	5,000 acres burned, believed to be caused by a discarded cigarette.
1991	Falls Fire	Columbia Gorge	1,100 acres burned between Multnomah Falls and Bridal Veil. 228,000 gallons of retardant dropped, 75 residents evacuated, 1,400 firefighters deployed.
1998	Cleveland Fire	Klickitat County	Burned 15 homes, killed 143 cattle. Growth blamed on lack of effective radio equipment amongst fire personnel.
2003	Herman Creek Fire	Columbia Gorge	300 acres burned
Aug. 2006	Mt. Hood Complex	Mt. Hood National Forest	Consisted of the Gumjuwac Fire on the east side of Highway 35 and the Bluegrass Ridge Fire on the west side of 35, the latter of which grew to 1,850 acres and cost over $10 million to extinguish.
2006	Frankton Road Fire	Columbia Gorge	37 acres burned
July 2008	Cold Springs Fire	Mt. Adams	8,000 acres burned, $5 million dollars to suppress, recreationalists evacuated.
Aug. 2008	Gnarl Ridge Fire	Mt. Hood Wildnerness	Burned 3,280 acres. Started by lightning on August 7 and burned into October.
2009	Microwave Fire	Mark O'Hatfield State Park	FM-2829. Burned 1,264 acres. Occurred August 28-September 1, 2009; located between the City of Mosier and the City of Hood River.
Aug. 2011	Dollar Lake Fire	Mt. Hood National Forest	6,304 acres burned. Cost $15 million to contain. Threatened historic structures, homes, power lines, and the Run Watershed.
Sept. 2012	Cascade Creek Fire	Mt. Adams	20,500 acres burned. Fuels included standing and bug-killed timber.
Aug. 2013	Government Flats Fire	The Dalles Watershed	FM-5046. Occurred August 17-23, 2013. Burned 11,434 acres, 13 structures were destroyed, suppression costs exceeded $12 million.
Aug. 2014	Rowena Fire	6 miles west of The Dalles	FM-5073. Occurred August 5-11, 2014. Burned 3,680 acres.

Date	Name	Location	Description
Sep. 2014	Pit Fire	Mt. Hood National Forest	FM-5080. September 15-26, 2014. Located mainly within the Mt. Hood National Forest along the stretch of the Clackamas River roughly between the South Fork of the Clackamas River at the northwest and Carter Bridge Campground at the southeast.
July 2017	Indian Creek Fire; 00176	Mt. Hood National Forest, Hood River County. 6.5 miles south of Cascade Locks.	Fire number 00176. Burned July 4 – September 5. Burned 850 acres. Located approximately 2-3 miles west of Chinidare Mountain, where the East Fork of Eagle Creek diverges from Eagle Creek; later conjoined with Eagle Creek Fire.
Sept. 2017	Rim Fire	Mt. Hood National Forest, Wasco County. 37.2 miles south of Hood River.	Burned 237 acres.
Sep. – Nov. 2017	Eagle Creek Fire	Columbia Gorge National Scenic area, Hood River County. 1 mile south of Cascade Locks	FM-5203. Reported September 2 at approximately 4 pm in the Columbia River Gorge National Scenic Area near the town of Cascade Locks, Oregon. The fire grew to 3,000 acres that first night. During the night of September 4th and 5th, east winds, combined with excessive heat caused the fire rapidly increase in size pushing westward. Total acres burned is 48,831. (100% contained on 11/30/17)

Sources: Hood River County NHMP, 2012; DLCD Oregon NHMP, 2015; FEMA, Disaster Declarations for Oregon, retrieved August 2017; InciWeb, retrieved November 2017

Probability

Instances of wildfire are high, and increasing, throughout the region due to the existence of open lands and large forested areas, increasing population and recreational activities, more frequent droughts and the uncertain impact of a changing climate. Accordingly, a **high probability of occurrence** is assigned**,** meaning one incident is likely within the next 35-year period. In fact, wildfires occur annually, and when certain conditions occur, they become hazards.

The DOGAMI Risk Report describes wildfire risk for Hood River County. The OCCRI report identifies that the risk of wildfires is increasing.

Certain conditions must be present for significant wildland urban interface (WUI) 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.

Human use of the wildland urban interface increases the probability of loss to fire and fire ignition. Hood River County has become famous for its plentiful recreation opportunities across the nation. As a result, the County has experienced more tourism from outdoor enthusiasts in the form of mountain biking, hiking, camping, wind surfing, kite boarding, and fishing. The peak month for these activities is August, when fire season is at or near its peak. Tourism increases the risk of a fire ignition and wildfires endanger tourists in the area.[12]

While the largest fires have been caused by lightning, human induced fires present a significant risk to Hood River County. The recent Eagle Creek Fire was ignited by the release of an illegal firework on a public trail. Industrial ignitions from power lines (Microwave, 2009) and railroad (MP 66, 2012) are likely to remain constant in the valley and their risk is mitigated through the clearing of ladder fuels in the right of way. Fires caused by vehicles are also likely to remain a constant risk for fires due to high traffic volumes. In 2012, Interstate 84 had an annual average daily traffic volume (AADT) of 20,800 vehicles, while Oregon Highway 35 has an AADT of 1,200.[13]

Looking at the largest fires in Hood River only paints part of the picture of fire risk—over the past two decades ODF reports that 310 fire ignitions burned 204 acres, with the mean fire size just over 0.6 acres. While these fires are small, every ignition is a risk of becoming a fully involved wildfire. Looking at the historical sources of fire ignition, Hood River fire prevention should focus on landowner education to reduce fire starts caused by debris burning and equipment use. Further preventative education should focus on the education of recreationalists.

Land ownership, and resultant management and suppression capabilities and protocols, also affect the potential for wildfires. In Hood River County, the most significant land ownership falls to federal agencies, and includes forested and wilderness areas. Federal lands in this area are characterized by dense stands, heavy underbrush, and ladder fuels, increasing the potential for wildfires. County, state, and private lands contribute to the remainder. These lands have a variety of management practices resulting in a mix of stand conditions and resultant fire potential.[14] Senate Bill 360 (Oregon Forestland-Urban Interface Protection Act) has been implemented in Hood River, Wasco and Umatilla Counties.

Vulnerability

The Hood River County Steering Committee determined a **high** probability ranking for wildfire in 2012 and 2018. The vulnerability ranking for wildfire dropped from **high** to **moderate** in the 2018 NHMP update.

Large lightning induced fires will continue to pose a significant risk to Hood River County and the surrounding area, especially as a warming climate is predicted to contribute to a longer growing season and increased lightning frequency.[14] The destruction of large tracts of forest

[12] Hood River County Wildfire Protection Plan, 2013
13 Oregon Department of Transportation
14 Bachelet 2007

land would have immediate economic impact to the community through lost jobs, reduced taxes, and increased public support while collateral economic and social effects could impact the County for years, suggesting **moderate vulnerability**. Cost of suppression of remote fires is up to five times the national average of $979 per acre.[15] Steep terrain and roadside fuels along I-84 can make fire protection and suppression difficult. Nearly 70% of Hood River County land is owned and managed by US Forest Service; other forests are managed by the county or my Oregon Department of Forestry. Prevailing strong west winds in eastern Hood River County, paired with fuel load to the west, results in extreme forest fire risk. The near constant presence of hazardous materials, prevalent in the rural farming communities, and in transportation corridors on Union Pacific railway and I-84, creates a secondary hazard of explosion.[16]

The economic stability of Hood River County and the surrounding region is dependent on a major interstate highway (I-84). Closures can be expected in the face of low or no visibility resulting from wildfires or inclement winter weather. Additional economic sectors that could be affected by wildfire are agriculture, forest products, tourism, manufacturing, recreation, and power generation. Community and natural resources at risk of wildfire include agriculture and livestock, wildlife and salmonids, and historic buildings. The greatest short-term loss from fires is the destruction of valuable resources, such as timber, wildlife habitat, scenic vistas, and watersheds. An immediate increase in vulnerability to flooding follows wildfires due to the destruction of all or part of the watershed. Landslide risks increase as well due to ground cover loss.

Vulnerability is a direct result of early detection and emergency personally response time. For Hood River, it is critical to suppress a fire before it grows larger than one tenth of an acre. A response time of ten to twelve minutes is the commonly accepted threshold. Four of the five fire districts in Hood River County depend predominantly on volunteer response, hence a ten to twelve minute response time must additionally include transport time to the fire station to retrieve necessary apparatus.[17]

Disruption to the municipal water supply and irrigation water supply from wildfires would negatively impact all of the residents and agricultural operators that depend on this resource by reducing water quality and availability. Roads, bridges, and evacuation routes could be compromised, limiting the ability of firefighters to reach the fire as well as inhibiting evacuation procedures. Utilities including Bonneville Power Administration power lines, Portland General Electric and Northwest Natural Gas electrical and gas distribution lines and communication infrastructure are also at risk.[18] Any significant amount of time that I-84 is closed will impact County fuel and food supply and distribution.

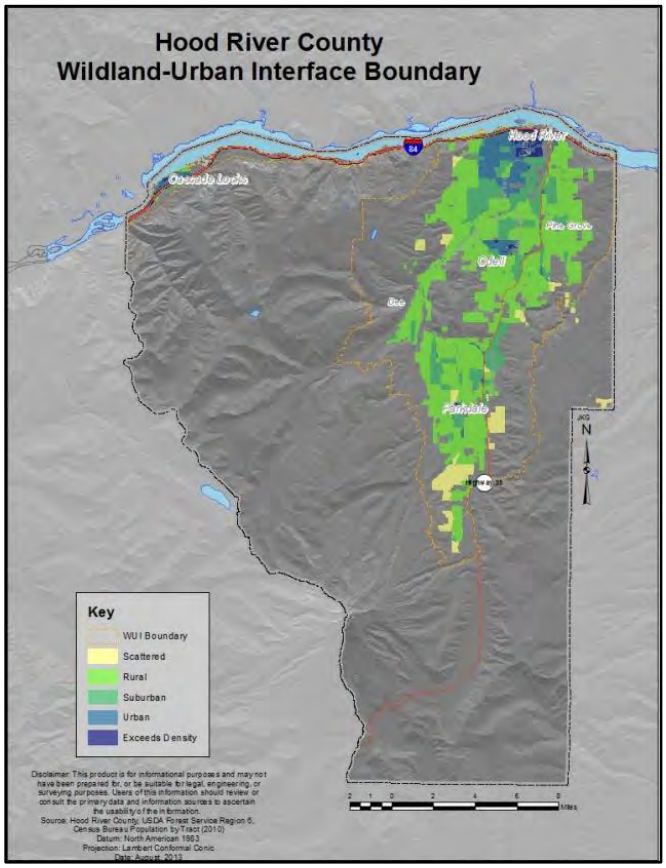
Wildland Urban Interface

Any fire within the Wildland Urban Interface (WUI) poses a grave threat to life and property. The WUI is defined where there is at least 1 home per 40 acres within 1.5 miles of a vegetated area.[19] This default definition includes both houses that directly intermingle with

15 Gebert 2007
16 Hood River Emergency Manager, Barbara Ayerys, personal communication 5/10/2017
17 Hood River County Wildfire Protection Plan, 2013
18 State of Oregon Natural Hazards Mitigation Plan Region 5 (Mid Columbia), Risk Assessment
19 Silvis Forest Lab, 2013

continuous vegetation and houses that are in the vicinity of highly vegetated areas. This definition indicates that even those homes that are in relative proximity to forest can be in danger. The WUI boundary in Hood River County can be seen in Figure HA- 1: Hood River County Wildland-Urban Interface Boundary. Often structures in interface areas have been built and maintained with minimal awareness of fire mitigation, including both protecting property from exterior fire sources and preventing interior fires from spreading to forested lands.

Figure HA- 1: Hood River County Wildland-Urban Interface Boundary



Source: Hood River County Community Wildfire Protection Plan, 2013

Strict planning and development laws at both the state and county level have limited housing growth on the edges of the wildland/urban interface. Furthermore, the geographic and political considerations that helped to identify the WUI have remained unchanged. These include power line ROWs, major transportation routes, waterbodies, ridges, clearcuts, and private timber, County, State, and Federal lands.

Figure HA- 1 also depicts Communities at Risk. In Hood River County, eight communities were identified as Communities at Risk, all corresponding with the local fire jurisdictions at the time. A Community at Risk (CAR) is a geographic region with a minimum housing density of 1 house per 40 acres. These include: the City of Cascade Locks, Dee RFPD, the City of Hood River, Odell RFPD, Pine Grove RFPD, West Side RFPD, Parkdale RFPD, and Hood River County as a whole. All eight communities received a state rating of “high overall risk.” According to 2010 U.S. Census Data, about 16,000 residents—or 70 percent of the total

population—live within a community at risk. The Hood River County Community Wildfire Protection Plan goes into detail on specific local risk factors and locations.

The total property value of state owned/leased critical/essential facilities in wildfire hazard areas is $8,027,110 and includes 6 state owned/leased critical/essential facilities, 38 non state owned/leased critical essential facilities, and 29 state owned/leased non critical/essential facilities.[20]

Hazardous Areas

Specific hazard risk maps for the Wy'East Fire District, Parkdale Fire District, West Side Fire District, and Hood River Fire Department, and City of Cascade Locks, as well as descriptions of the risks, hazards, protection capability and recommended projects for each Community at Risk can be found in the Hood River County Community Wildfire Protection Plan. Figure HA-displays overall County hazard risk based on fuels, terrain, and elevation throughout the region.

Mitigation Efforts

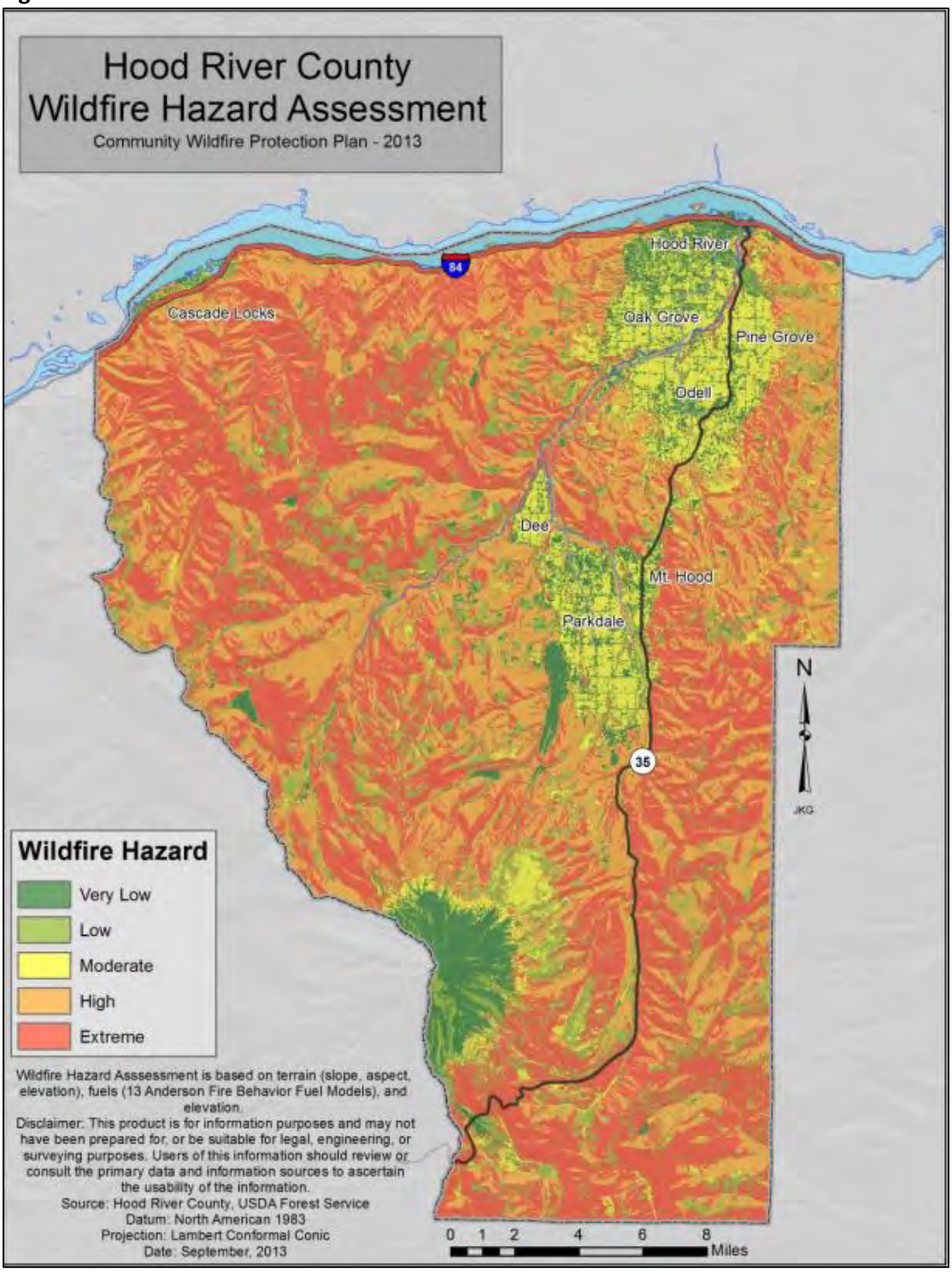
Completed and ongoing mitigation projects to reduce wildfire risk in Hood River County include the following:

- Establish County-wide Wildfire Protection Group—Complete—The Hood River Fire Chief's Association serves as the coordinated wildfire protection group, meeting monthly to discuss county conditions and action items.
- Establish Demonstration Sites—Ongoing—Sites around the county have benefited from hazardous fuels reduction projects.
- Improve Residential Fire Protection Capability—Ongoing—Residential fire protection capacity has been improved through county land-use process for homes within the WUI.
- Hazardous Fuel Reduction—Ongoing—Hazardous fuels reduction projects have continued throughout Hood River County.
- GIS Infrastructure—Ongoing—Hood River County Fire services will continue to update GIS infrastructure through Title III Funding.
- Uniform Application of SB 360—Complete/Ongoing—Hood River County has adopted SB 360 county-wide with the help of Oregon Department of Forestry.
- Development and deployment of Emergency Management Volunteer Program – Complete/Ongoing – Hood River County Emergency Management equipped to open/operate Hood River County Emergency Operations Center to supplement response efforts when local emergency services are overwhelmed.

Additional mitigation actions currently underway are described in Section 3: Mitigation Strategy and Appendix B: Planning and Public Process. For more information and local maps on wildfire hazards, see Oregon Explorer.

[20] State of Oregon Natural Hazards Mitigation Plan Region 5 (Mid Columbia), Risk Assessment

Figure HA- 2: Wildfire Hazard Assessment



Source: Hood River County Community Wildfire Protection Plan, 2013

Earthquake

Significant Changes since Previous Plan:

The Earthquake Hazard section was reformatted since the 2012 Plan. There has not been any new history. However, the Oregon Resilience Plan (2013) and Oregon Natural Hazards Mitigation Plan (2015) have been cited and incorporated where applicable. Both Oregon Emergency Management (OEM) and Federal Emergenancy Management Agency (FEMA) have called for Oregon to better prepare for a Cascadia Subduction Zone event, which is likely to occur, and for which the State is ill-prepared.

The probability and vulnerability ratings were updated to distinguish between a Cascadia Subduction Zone (CSZ) event and a crustal event. The impact of a CSZ event has been expanded on, and new data models for crustal events have been incorporated. The Blue Ridge Fault, located in the Mt. Hood Fault Zone, was recently identified, and is now included in this plan.

In the 2012 Hood River County Natural Hazards Mitigation Plan, the combined earthquake hazard was ranked as 5th priority. In this update, a CSZ event is ranked as 3rd priority while a crustal event is ranked 7th priority.

Hazard 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. All types of earthquakes in the region are related to the subducting, or diving, of the dense, oceanic Juan de Fuca Plate under the lighter continental North American Plate.

The greatest earthquake hazard to Oregon is posed by infrequent megathrust earthquakes in the Cascadia Subduction Zone (CSZ). The second major hazard comes from smaller crustal earthquakes on faults in or near populated areas, which include all of Oregon's damaging historic earthquakes. Intraplate earthquakes, which have been historically damaging in the Puget Sound area, are possible in Oregon but no damaging prehistoric or historic events are known.[21]

Cascadia Subduction Zone - A CSZ quake occurs when two converging plates become stuck along their interface, build up energy across the locked surface, and then abruptly slip, releasing the strain. The zone is where the oceanic Juan de Fuca plate slides beneath the continental North American plate at a rate of 1.5 inches per year. The fault is usually locked, so that rather than sliding slowly and continuously, the 1.5 inches per year of subduction motion builds tremendous stress along the fault. This stress is periodically released in a

[21] State of Oregon Natural Hazards Mitigation Plan Region 5 (Mid Columbia), Risk Assessment

megathrust earthquake, which can have a magnitude anywhere from 8.3 to 9.3.[22] A CSZ earthquake, and the ground shaking, subsidence, land sliding, liquefaction, and tsunamis that would accompany one are catastrophic hazards.[23]

A northwest CSZ earthquake has not occurred locally since the 1700's. The CSZ closely mirrors the subduction zone in northern Japan that produced the 2011 Tohoku magnitude 9 earthquake and associated tsunami. Geologic evidence indicates that the Cascadia Subduction Zone has generated great earthquakes at roughly 500 year intervals, most recently about 300 years ago. The calculated odds that a Cascadia earthquake will occur in the next 50 years range from 7-15 percent for a great earthquake (M9+) affecting the entire Pacific Northwest to 37-43 percent for a very large earthquake(M8+) affecting southern Oregon and northern California.[24]

For more information of CSZ characteristics and impacts, see the Oregon Resilience Plan.

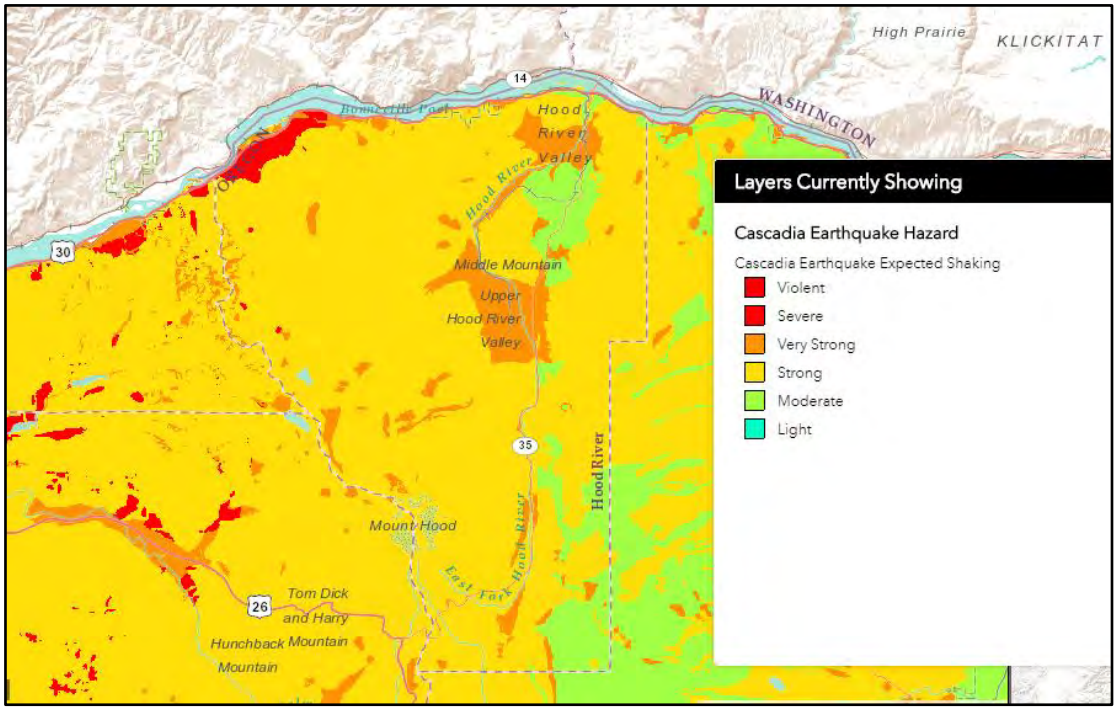
Crustal or Shallow Faults - Shallow or crustal quakes, 5 to 10 miles beneath the earth's surface, occur regularly, with minimal to moderate severity, in Hood River County. Crustal earthquakes occur due to much smaller faults located in the North American plate. These are the more familiar "California-style" earthquakes with magnitudes in the 5 to 7 range. Although smaller than the megathrust earthquakes, crustal earthquakes may occur closer to population centers, and are capable of producing severe shaking and damage in localized areas. For many parts of eastern Oregon, crustal faults dominate the hazard, and they may also have a significant impact in the Portland region and Willamette Valley. Because only certain faults have been studied in detail and determined to be active, there may be many more crustal faults in the region capable of producing earthquakes which have not yet been identified.

Location and Extent

Cascadia Subduction Zone - Hood River County is located within the geographical area bordering the Cascadia Subduction Zone, which is located 50 miles off the Oregon shoreline. This zone is comprised of an 800-mile sloping fault and several smaller inland and offshore faults extending from Vancouver Island in British Columbia to Cape Mendocino in Northern California. The fault system separates the Juan de Fuca and North American plates. The Cascadia Subduction Zone earthquake would impact the entire state, including Hood River County. Hood River County borders the eastern and valley zones of Oregon; shaking will be mild to strong, landslides and liquefaction sporadic, and damage moderate. Figure HA- 3 shows that the county may experience "moderate" to "severe shaking" lasting two to four minutes.

[22] Magnitude is the measure of the strength of an earthquake, or the strain energy released by it, as determined by seismographic observations. The Richter Scale is the best known of several measurement methods, and measures magnitude in whole numbers and decimal fractions. Due to its logarithmic base, each whole number increase in magnitude represents a tenfold increase in energetic amplitude. Each whole number increase in the magnitude scale corresponds to the release of approximately 31 times more energy.
[23] Oregon Resilience Plan: http://www.oregon.gov/oem/Documents/Oregon_Resilience_Plan_Final.pdf
[24] Oregon Resilience Plan: http://www.oregon.gov/oem/Documents/Oregon_Resilience_Plan_Final.pdf

Figure HA-3: Expected Shaking from Cascadia Subduction Zone Earthquake



Source: Oregon HazVu, Statewide Geohazards Viewer, Department of Geology and Mineral Industries. http://www.oregongeology.org/sub/hazvu/index.htm. Retrieved, February, 2018.

Crustal Faults - Because frequent large earthquakes have not occurred locally, potential earthquake sources are not well known. Studies of many small earthquakes, investigations of known faults, and geological surveys generate the following earthquake source estimations. The USGS Quaternary Fault and Fold Database describes several known faults in Hood River County, listed in the Table HA- and depicted in Figure HA-4.[25]

Table HA- 5: Class A and B Faults Located in or near Hood River County

Name	Class	Fault ID	Primary County	Length (km)	Time of most recent deformation	Slip-rate category
Faults near The Dalles	A	580	Hood River County, Oregon	69 km	Quaternary (<1.6 Ma)	Less than 0.2 mm/yr
Unnamed faults northwest of Condon	B	814	Gilliam County, Oregon	22 km	Quaternary (<1.6 Ma)	Less than 0.2 mm/yr

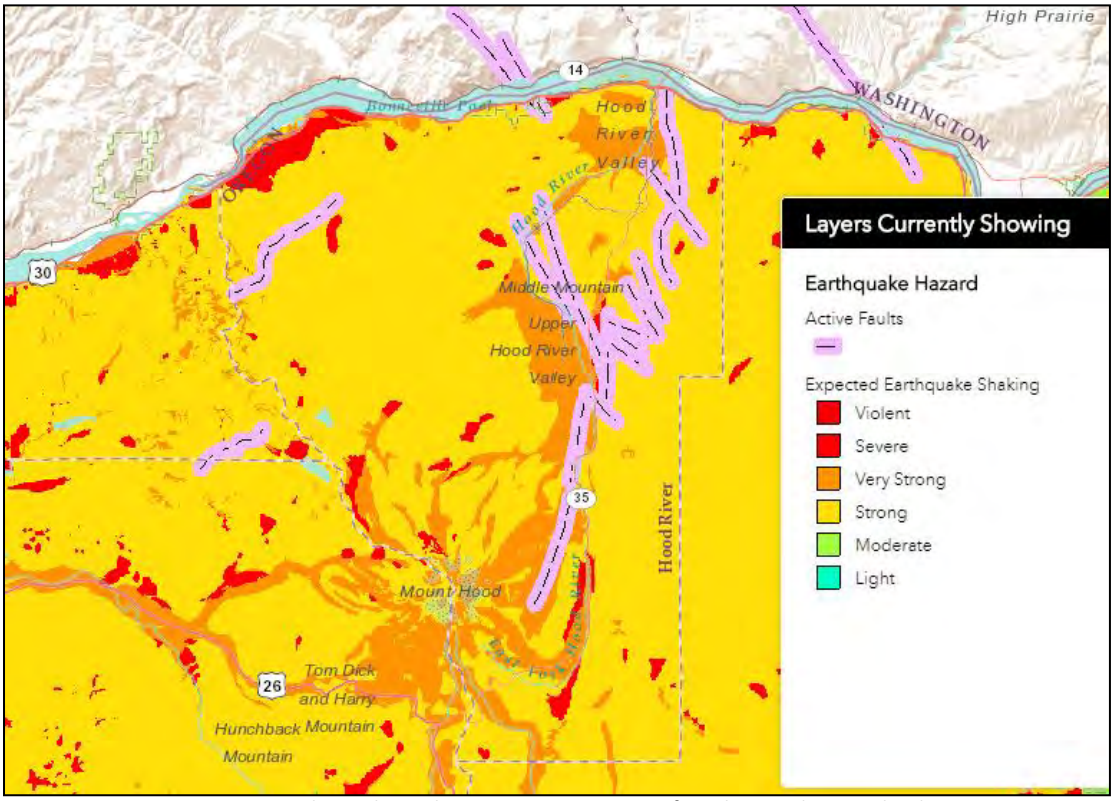
[25] U.S. Geological Survey, 2006, Quaternary fault and fold database for the United States, accessed 2/12/2018 from USGS web site: http//earthquake.usgs.gov/hazards/qfaults/

Name	Class	Fault ID	Primary County	Length (km)	Time of most recent deformation	Slip-rate category
Faults along highway 35, passing through Parkdale	A	866	Hood River County, Oregon	44 km	Quaternary (<1.6 Ma)	Less than 0.2 mm/yr
Blue Ridge Fault	n/a	n/a	Hood River County, Oregon	12 km	Between ~13,540 and 9,835 years before present	Less than 0.2 mm/yr

Source: U.S. Geological Survey (USGS), Quaternary Fault and Fold Database, The Dalles 1° X 2° Sheet 6 and "Field-Trip Guide to Mount Hood, Oregon, Highlighting Eruptive History and Hazards (https://pubs.usgs.gov/sir/2017/5022/g/sir20175022g.pdf)

Hazard Shake Maps produced by the United States Geological Survey (USGS) show the ground motion level that has 1 in 475 chance of being exceeded each year, equal to a 10 percent probability of being exceeded in 50 years (Figure HA-4).

Figure HA- 4: Active Faults and Expected Earthquake Shaking from Crustal Faults

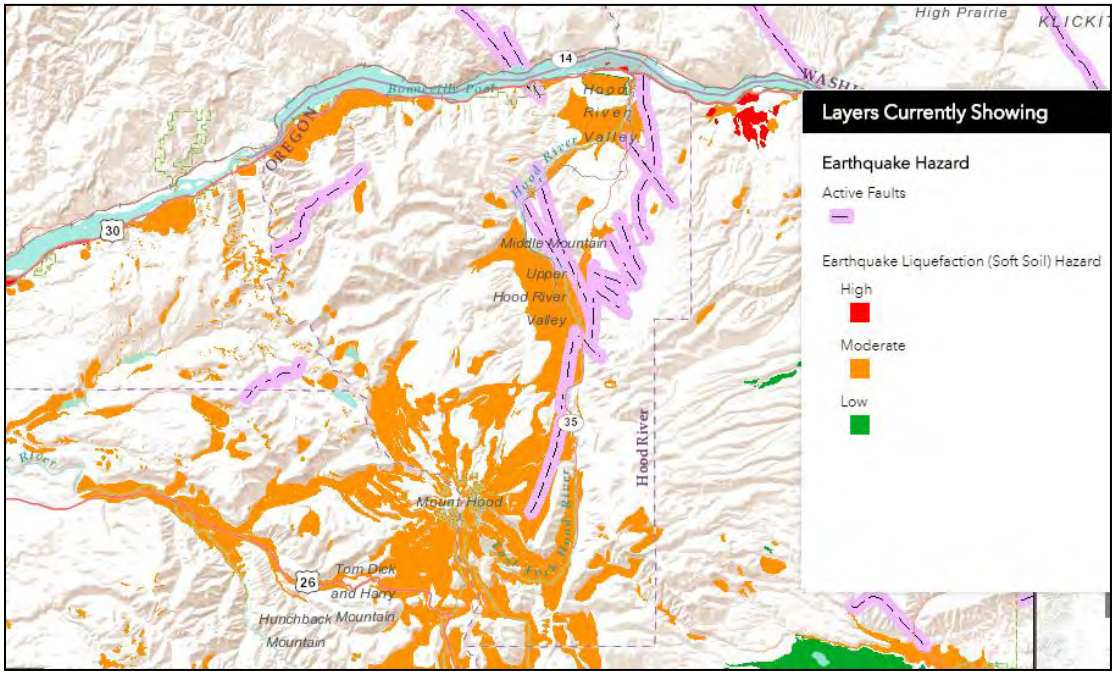


Source: Oregon HazVu, Statewide Geohazards Viewer, Department of Geology and Mineral Industries. http://www.oregongeology.org/sub/hazvu/index.htm. Accessed February, 2018. [7]

Most of Hood River County falls within the "strong" shaking range, and the area directly around Mt. Hood falls within the "very strong" range due to a possible epicenter on Mt. Hood. 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 materials; 4) the composition of slope materials; 5) the magnitude of the earthquake; and 6) the type of earthquake.

Figure HA- shows liquefaction potential based on soft soil locations. Much of the population lives in the cities of Hood River and Cascade Locks, where liquefaction during an earthquake event is likely.

Figure HA- 5: Liquefaction Hazard in Hood River County



Source: Oregon HazVu, Statewide Geohazards Viewer, Department of Geology and Mineral Industries. http://www.oregongeology.org/sub/hazvu/index.htm. Accessed February, 2018.

A new fault, the Blue Ridge Fault, was discovered with LIDAR imaging in 2011, and is not captured in the Figure HA-5. The Blue Ridge Fault is 8 miles long and 10-15 miles deep. It is located 10 miles west of Parkdale, near Mt. Hood, with its north end terminating 20 miles from Cascade Locks and the Bonneville Dam. At some point in history, year unknown, it created a 6 to 7 magnitude earthquake which jolted the earth 6 feet.[26]

The Blue Ridge Fault is part of the Mt. Hood Fault Zone, a 55 km area bordered by four fault segments. Geological evidence points to a single earthquake event between 13,540 and 9,835 years ago. The previous quake from this fault is estimated to have been 6.8 to 6.9 in magnitude. A future quake might be M6.5 or greater. The entire fault zone could cause a M7.9 quake. All populated areas within Hood River County would be threatened, as well as

[26] Hood River News

the highway and rail transportation corridors, Portland General Electric storage reservoirs, and the power generation facilities at the Bonneville Dam. [27]

When all earthquake sources are added together, general earthquake hazard as a whole is relatively moderate to high. 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. More information can be found at the following links:

Multi-hazard and risk study for the Mount Hood region, Multnomah, Clackamas, and Hood River Counties, Oregon, 2011

DOGAMI Publications Search

Relative earthquake hazard maps for selected urban areas in western Oregon, 1999

Geologic hazards of parts of northern Hood River, Wasco, and Sherman Counties, 1977

History

Each year, since 1980, the Pacific Northwest Seismograph Network has recorded an average of more than two thousand earthquakes in Washington and Oregon (Table HA-6). The vast majority are shallow earthquakes and 99% have a magnitude less than 3.0.

The shallow 1872 earthquake in North Cascades of Washington was the largest in the history of Washington and Oregon, with an estimated magnitude of 7.4 and many aftershocks. In 1993, a magnitude 5.6 earthquake in the Willamette Valley of Oregon caused $28 million in damages, including damage to the Oregon State Capital in Salem. A pair of earthquakes near Klamath Falls, Oregon with magnitudes of 5.9 and 6.0 caused two fatalities and $7 million in damage. Large shallow quakes occur in the Pacific Northwest about once every 50 years.

While this history table recounts medium to large events, numerous smaller earthquakes are listed by the USGS Latest Earthquakes Program. 393 small (less than 2.5M) earthquakes have occurred in the region since 2001. More information can be found at the USGS Earthquake Catalog.

[27] https://pubs.usgs.gov/sir/2017/5022/g/sir20175022g.pdf

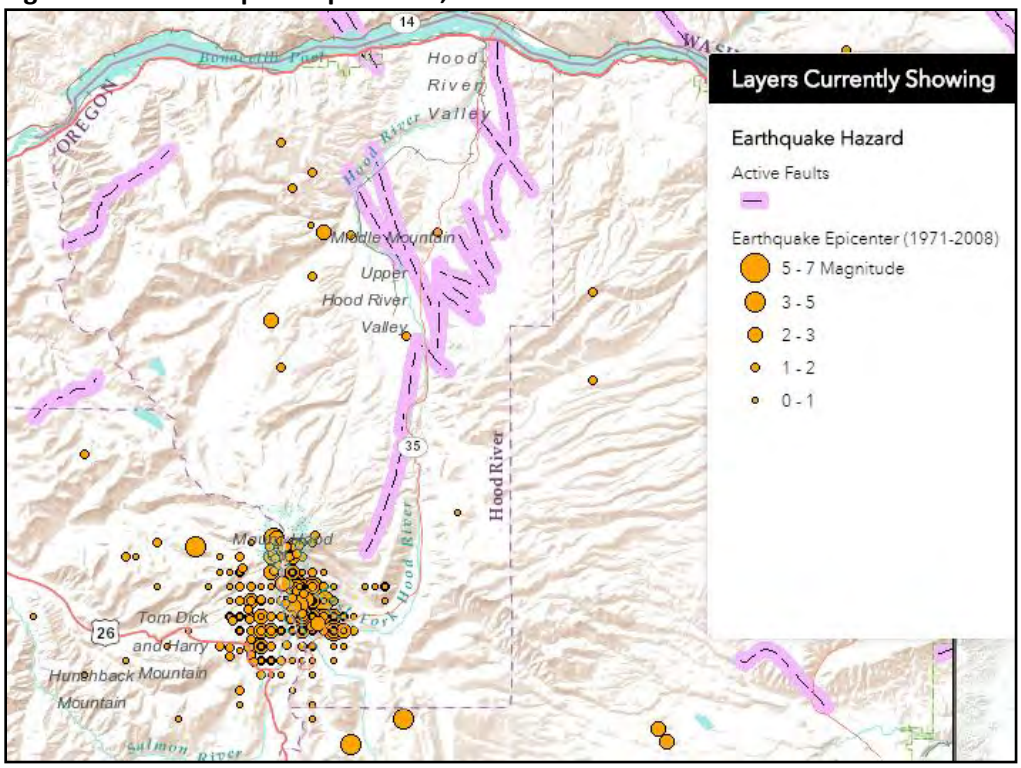
Table HA- 6: Hood River County Earthquake Hazard History Events

Date	Location	Size (M)	Description
Approximate years: 1400 BCE, 1050 BCE, 600 BCE, 400. 750, 900	Cascadia Subduction Zone (CSZ)	Probably 8.0-9.0	Based on studies of earthquake and tsunami at Willapa Bay, Washington. These are the mid-points of the age ranges for these six events.
Jan. 1700	CSZ	About 9.0	On January 26, 1700, an approximately 9.0 earthquake generated a tsunami that struck Oregon, Washington, and Japan. Destroyed Native American villages along the coast.
Nov. 1873	Brookings, OR	7.3	Impacts: chimneys fell in Port Orford, Grants Pass, and Jacksonville; no aftershocks; origin probably in the Gorda block of the Juan de Fuca plate; intraplate event.
Oct. 1897	Gresham, OR	6.7	Occurred on October 12, 1897.
Feb, 1892	Portland, OR	5.6	Occurred on February 4, 1892.
Mar. 1893	Umatilla, OR	5.7	Occurred on March 7, 1893.
Dec. 1953	Portland, OR	5.6	Occurred on December 16, 1953.
Nov. 1962	Vancouver, WA	5.5	Occurred on November 5, 1962. Shaking lasted 30 seconds. Chimneys cracked, furniture moved, windows broke.
Oct. 1964	Portland, OR	5.3	Occurred on October 1, 1964. Earthquake on Sauvie Island in the Columbia River
Apr. 1976	Near Maupin, OR	4.8	Sounds described as distant thunder, sonic booms, and strong wind.
Feb. 1981	Mt. St. Helens, WA	5.5	Occurred on February 13, 1981. Centered near Mt. St. Helens and shook the Portland area.
Apr. 1992	Cape Mendocino, CA; CSZ	7.0	Subduction earthquake at the triple junction of the Cascadia Subduction Zone, San Andreas, and Mendocino faults.
Mar. 1993	Scotts Mills, OR	5.6	DR-985. On Mt. Angel-Gales Creek fault. $30 million damage (including Oregon Capitol Building in Salem). Magnitude 5.6 centered near Woodburn occurred on March 23, 1993.
Sep. 1993	Klamath Falls, OR	6.0	DR-1004. Two earthquakes in Klamath Falls, 2 people killed. Occurred on September 20, 1993. Magnitude 6.0 centered 10 mi NW of Klamath Falls and caused damaged to the courthouse and county offices. Magnitude 5.9 centered 15 mi NW of Klamath Falls closed highways and bridges.
Feb. 2001	Nisqually, WA	6.8	Felt in the region. No damage reported.

Sources: Wong and Bolt, 1995; University of Oregon, Hood River County NHMP, August 2012; DLCD Oregon NHMP, 2015; FEMA, Disaster Declarations for Oregon, retrieved 2017.

Figure HA- 6 below depicts earthquake events that took place in the area between 1971 and 2008. Most of the earthquakes shown in the figure below are relatively insignificant events below M 2.0. The larger events may have been felt slightly, but little to no structural/property damage resulted.

Figure HA- 6: Earthquake Epicenters, 1971-2008



Source: Oregon HazVu, Statewide Geohazards Viewer, Department of Geology and Mineral Industries. http://www.oregongeology.org/sub/hazvu/index.htm. Accessed February, 2018.

Probability

Cascadia Subduction Zone - According to the State NHMP, the return period for the largest of the CSZ earthquakes (Magnitude 9.0+) is 530 years with the last CSZ event occurring 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 "smaller" 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 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%.[28]

Crustal Earthquakes - The probabilistic earthquake hazard is defined as the maximum level of earthquake shaking and damage expected with a 2% change of occurrence in the next 50 years. In Hood River County, it ranges from moderate to high, which indicates a quake will be felt by all, weak buildings will be cracked to collapsed, with severe damage to weak buildings and to wood frame structures. Because we do not have a complete history of

[28] State of Oregon Natural Hazards Mitigation Plan Region 5 (Mid Columbia), Risk Assessment

Oregon earthquakes, we cannot fully assess the future risk. High rainfall promotes high erosion rates and dense ground cover, both of which hide faults.

Earthquake hazard probability, as assigned by the Hood River County NHMP Steering Committee, is **moderate** for both a Crustal and a Cascadia Subduction Zone event, however, using the OEM methodology, a CSZ event was assessed at a "6" and a Crustal event at a "4." This indicates that a CSZ event is expected within the next 35-50 years while a Crustal event is expected in the next 60-75 years (see Section 2 – Risk Assessment for more information).

The DOGAMI Risk Report describes earthquake risk for Hood River County. The OCCRI report does not.

Vulnerability

In the previous NHMP, earthquake probability and vulnerability were rated as moderate. In the 2018 update, probability and vulnerability for both a CSZ and a crustal event were rated as moderate; however the ratings were relatively higher for CSZ event than a crustal event.

The Mid-Columbia Region is considered moderately vulnerable to earthquake hazards from earthquake induced landslides in the Cascades, ground shaking, and liquefaction. The NHMP Steering Committee rated the county as having a **high vulnerability** for both a CSZ event and crustal earthquakes, meaning that more than 10% of the region's population or assets would be affected by a major crustal earthquake emergency or disaster. The secondary impacts of an earthquake, include power outages, gas leaks, and disrupted economy, could be devastating. It is likely that the region would experience the equivalent of a magnitude 5 quake for 30 seconds, and also likely that relief from elsewhere in the state would be delayed for days or weeks.[29] The number of people in Hood River County fluctuates dramatically based on season and time of day, so the number of people impacted in a hazard event is unpredictable. Secondary impacts to electricity, natural gas, and fuel supply are of concern as well.

Most injury, death, and property damage in an earthquake result from seismic impacts on structural and non-structural materials. Most injuries in earthquakes result from non-structural materials such as light fixtures, equipment, and furniture, falling on people and causing injury. Shaking could topple high-voltage transmission towers, especially near the river where water-saturated ground is likely to sink, tilt and collapse foundations.

Earthquakes are unique in their impact to structures. The entire county population, property, commerce, infrastructure and services (including hospitals, emergency services, and transportation lifelines) are susceptible to earthquake damage. Water, wastewater, electric and natural gas utilities and dams may also be damaged. The scope of damage results from earthquake magnitude and level of preparedness, and could range from minimal to moderate. The populated areas proximal to the Columbia River are most susceptible due to soft soils. Homes built before 1994 are more vulnerable than homes built in or after 1994 due to the more rigorous building code standards passed in 1993. The Hood River County historic buildings, and the majority of schools and emergency response

[29] Hood River County Emergency Management, Barbara Ayers, 5/10/2017

buildings, are constructed from unreinforced masonry. This is especially true in Hood River City downtown area, which is also subject to liquefaction.

Strong shaking from a CSZ event may be extremely damaging to lifeline transportation routes including Highway 84 and Highway 35. A CSZ event will likely impact the interstate bridges at Cascade Locks and Hood River and disrupt Columbia River navigation. The highway-related losses include disconnection from supplies and replacement inventory, and the loss of tourists and other customers who must travel to do business with affected businesses. Additionally, highway closures strand employees, commuters, and freight traffic; preventing economic and emergency response activity and creating significant congestion. Highway 84 was identified as part of Oregon's backbone transportation system in a CSV event and is included in the Oregon Resilience Plan. The effects on the regional power grid and liquid fuel supply will be devastating throughout the coastal and valley regions of Oregon. It is also likely that displaced people from the valley and coastal regions will come to Eastern Oregon or on eastern counties for resources.

Seismic activity can cause great loss to businesses, either a large-scale corporation or a small retail shop. Losses not only result in rebuilding cost, but fragile inventory and equipment can be destroyed. When a company is forced to stop production for just a day, business loss can be tremendous. Residents, workers, businesses, and industry all suffer temporary loss of income when their source of finances is damaged or disrupted. Damage to shipping channels and shore facilities, and failure of Columbia River bridges west of Hood River County may have long-term impacts on freight shipments into and out the mid-Columbia region. [30]

Structures in wetland, alluvial, and other saturated areas may be subject to liquefaction damage, particularly in areas associated with the Columbia River. Water-saturated loose sand and silt loses its ability to support structures in an earthquake. Areas in Hood River County that are near floodplains or areas with silt deposits are at the greatest risk during an earthquake.

Economic Losses

The preliminary Risk Report (DOGAMI, 2018) includes an earthquake damage model. The preliminary results show the following building loss estimates from a Cascadia Subduction Zone (CSZ) event (Hood River Countywide 500-year probabilistic M9.0 earthquake results):

- Number of red-tagged buildings: 596
- Number of yellow-tagged buildings: 81
- Loss estimate: $247,045,000
- Loss ratio: 6.4%
- Non-functioning critical facilities: 5
- Potentially displaced population: 931

In 2007, DOGAMI developed two earthquake loss models for Oregon based on the two most likely sources of seismic events: (a) a M6.5 Arbitrary Crustal event and (b) a 2,500 year mean return period probabilistic earthquake scenario (2,500-year Model). Both models are based

[30] State of Oregon Natural Hazards Mitigation Plan Region 5 (Mid Columbia), Risk Assessment

on Hazus-MH, a computer program currently used by the Federal Emergency Management Agency (FEMA) as a means of determining potential losses from earthquakes. The arbitrary crustal event is based on a potential M6.5 earthquake generated from an arbitrarily chosen fault using the Hazus software, and assuming a worst-case scenario. The 2,500-year crustal model does not look at a single earthquake (as in the CSZ model); it encompasses many faults, each with a 2% chance of producing an earthquake in the next 50 years. The model assumes that each fault will produce a single "average" earthquake during this time. DOGAMI Seismic Needs Assessment evaluates damage to buildings in an earthquake event. Potential losses are described in Table HA-7 and HA-8 (a-c). 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 crustal models include several earthquakes, the number of facilities operational the "day after" cannot be calculated.

Table HA- 7: Economic Loss Estimates for Hood River County

Hood River County	**Arbitrary M6.5 Crustal Event (2007 Assessment)**	**2,500-Year Probable M6.5 Driving Scenario (2007 Assessment)**
Injuries	120	111
Death	6	6
Displaced households	419	303
Short-term shelter needs	n/a	n/a
Economic losses for buildings	$189.96 million ($226 million*)	$153.5 million ($183.5 million*)
Operational the day after the quake		
Fires Stations	60%	20%
Police Stations	0%	100%
Schools	21%	14%
Bridges	100%	82%
Economic losses to		
Highways	$37.2 million ($44.5 million*)	$71.9 million ($86 million*)
Airports	$7.3 million ($8.7 million*)	$7.6 million ($9.1 million*)
Communication Systems		
Economic losses	$800,000 ($956,000*)	$500,000 ($598,000)
Operating the day of the quake	n/a	n/a
Debris generated (thousands of tons)	0	0

Source: W. J. Burns, 2007, DOGAMI unpublished report: Geologic hazards, earthquake and landslide hazard maps, and future earthquake damage and loss estimates for seven counties in the Mid-Columbia River Gorge Region including Hood River, Wasco, Sherman, Gilliam, Morrow, Umatilla, Jefferson, and Wheeler

The estimates in Table HA-7, from 2007, can provide a rough estimate for losses from a crustal event. Local estimates of losses are significantly higher. However, these reports are the most recent estimates upon this plan update. Estimates are likely too low.

Building Collapse Potential

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 the Federal Emergency Management Agency (FEMA), known as FEMA 154, to identify, inventory, and rank buildings that are potentially vulnerable to seismic events. 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 a building's potential for collapse, a more detailed engineering study completed by a qualified professional is required, but the RVS study can help to prioritize which buildings to survey.

DOGAMI surveyed 23 buildings in Hood River County. The collapse potentials of Hood River County schools and public safety facilities are listed in Table HA-8 (a-c). Additional information can be found within the Hood River County Seismic Needs Assessment on DOGAMI's website.[31] The map of facility locations can be found there as well.[32]

Local sources identify the top floor of the County building as extremely high risk; this floor includes County 911, Emergency Management and Emergency Operations Center, and County Finance, Budget, and Administration.

Table HA- 8(a): Collapse Potential of Hood River County Critical Facilities

Facility	Site ID*	Level of Collapse Potential			
		Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Public Safety					
Parkdale RFPD	Hood_fir09		X		
Parkdale RFPD (Mount Hood)	Hood_fir01				X
Schools					
Parkdale Elementary School	Hood_sch01	X	X		X
Mid Valley Elementary School (Odell)	Hood_sch07	X		X	X

Source: DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment. "*" – Site ID is referenced on the RVS Hood River County Map

[31] RVS study. DOGAMI Statewide Seismic Needs Assessment Using Rapid Visual Screening (RVS)
[32] http://www.oregongeology.org/rvs/maps/Maps_Hood_River_County.pdf

Table HA- 8(b): Collapse Potential of Cascade Locks Critical Facilities

Facility	Site ID*	Level of Collapse Potential			
		Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Public Safety					
Cascade Locks FD	Hood_fir06		X		
Cascade Locks School	Hood_sch08		X,X		X

Source: DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment. "*" – Site ID is referenced on the RVS Hood River County Map

Table HA- 8(c): Collapse Potential of City of Hood River Critical Facilities

Facility	Site ID*	Level of Collapse Potential			
		Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools					
Hood River Middle School*	Hood_sch05		X		X,X
Hood River Valley High School	Hood_sch04	X,X,X,X,X			
May Street Elementary School*	Hood_sch06	X			X,X
Pine Grove Elementary School	Hood_sch09	X	X		
Westside Elementary School	Hood_sch02	X,X,X		X	
Wy'East Middle School*	Hood_sch03	X,X	X		X,X
Universities/ Colleges					
Community College - Bldg 1	Hood_coc01		X		
Public Safety					
Hood River Police	Hood_pol03		X		
Dee/Parkdale fire station (Dee RFPD)	Hood_fir08		X		
Odell RFPD	Hood_fir02	X		X	
Pine Grove VFD	Hood_fir03	X	X	X	
Westside RFPD	Hood_fir04			X	
Westside RFPD	Hood_fir07	X		X	

Facility	Site ID*	Level of Collapse Potential			
		Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Hood River FD*	Hood_fir05				X
Hood River County Sherriff	Hood_pol01		X,X		
Hood River EOC/911	Hood_eoc01		X,X		
Hospitals					
Providence Hood River Memorial Hospital	Hood_hos01				X

*Rehabilitation or replacement implemented since 2007 RVS
Source: DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment. "*" – Site ID is referenced on the RVS Hood River County Map

Several buildings within Hood River County have been retrofit, or retrofits/replacements are planned or in process.

- Hood River Fire Department: retrofitted in 2010 by the Seismic Rehabilitation Grant Program ($291,225 project)
- Wy'east Middle School and Hood River Middle School: retrofits in progress as of the 2018 NHMP update. Gymnasium retrofits is funded by state seismic grants. Other remodeling is funded by a local school bond measure. The retrofits are to ensure safe evacuation.
- May Street Elementary: Building additional, seismically sound gymnasium in 2018
- Westside Fire District: Both buildings were approved for seismic retrofits in May 2018; $2.8 million dollar project funded by
- Parkdale Fire Department will be applying for a retrofit grant in 2019

More information on the Seismic Rehabilitation Grant Program and recent projects can be found at the following Oregon Department of Geology and Mineral Industries (DOGAMI) resources:

Infrastructure Finance Authority Seismic Rehabilitation Grant Program:

http://www.orinfrastructure.org/Infrastructure-Programs/Seismic-Rehab/

DOGAMI Seismic Status Reports:

http://www.oregongeology.org/rvs/activity-updates/status.html

Landslide

Significant Changes since Previous Plan:

New landslide susceptibility information based on updated Lidar data has been included. Three landslide events were added to the hazard history section. As a result of increased susceptibility due to the recent Eagle Creek Wildfire, landslide hazard events have risen from 6th priority to 4th priority.

Hazard Characteristics

A landslide is any detached mass of soil, rock, or debris that falls, slides or flows down a slope or a stream channel. Landslides are classified according to the type and rate of movement and the type of materials that are transported. Hood River County landslides or debris flows (mudslides) may affect buildings, roads, and utilities.[33]

Additionally, 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; this is common in Hood River County
- 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
- The heat and debris associated with volcanic eruptions trigger extensive landslides

For more information, see the Landslide Hazards in Oregon Fact Sheet

Location and Extent

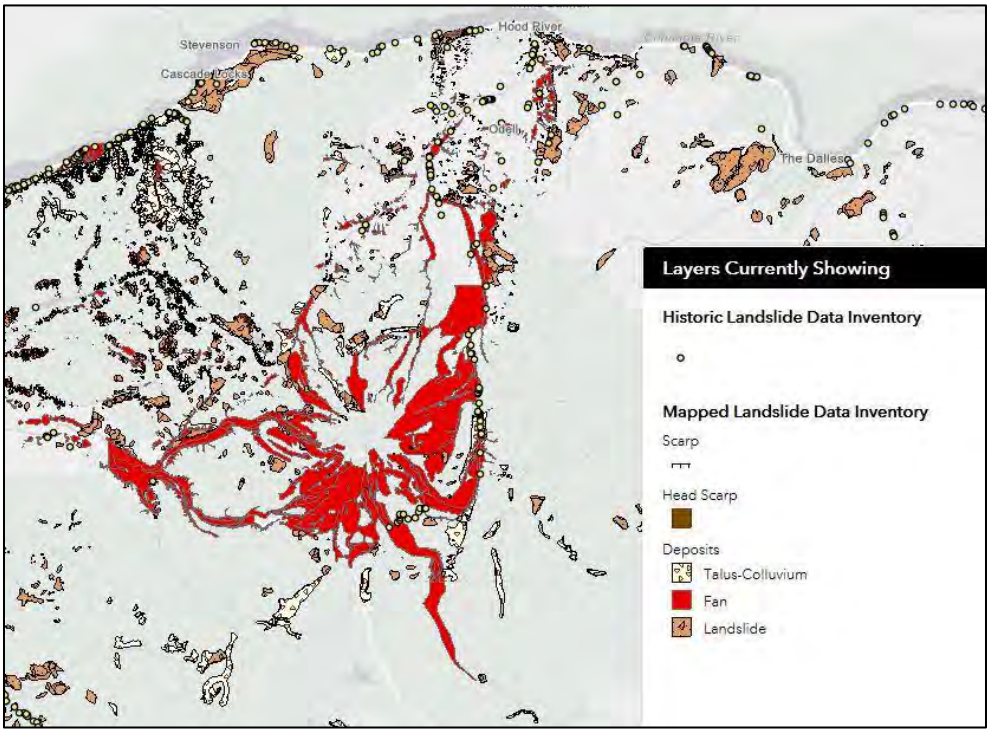
Landslides in Hood River County generally range in size from thin masses of soil of a few yards wide to much larger, deep-seated bedrock slides. Travel rate may range from a few inches per month to many feet per second, depending largely on slope grade, material, and water content. Ancient, dormant slide masses can be reactivated by earthquakes or unusually wet winters. Dormant slides consisting of broken materials and disrupted ground water are more susceptible to construction-triggered sliding than adjacent undisturbed material.

Landslides occur throughout this region, but areas with steeper slopes, weaker geology, and higher annual precipitation tend to have more landslides. Occasionally, major landslides sever major transportation routes, including highways and rail lines, causing temporary but significant economic damage. In February 2014, a large rock slide in Hood River closed I-84

[33] Hood River County Natural Hazards Mitigation Plan, 2012

for almost a week. Figure HA-7 depicts the location of historic slides and landslide susceptibility for Hood River County.[34]

Figure HA- 7: Historic Landslides, Scarps, and Deposits



Source: Oregon HazVu, Statewide Geohazards Viewer, Department of Geology and Mineral Industries. http://www.oregongeology.org/sub/hazvu/index.htm. Retrieved, February, 2018.

History

Landslides occur in Hood River County during or after periods of heavy rain and flooding. The period from December 1996 to February 1997, marked by severe winter storms, saw 49 landslides in Hood River County.[35] Many slides take place in undeveloped areas and are unreported or even unnoticed. Landslides potentially threaten water, electricity, and communications infrastructure. Table HA-9 lists historic landslides.

Table HA-9: Hood River County Landslide Hazard History Events

Date	Location	Description
Dec. 1964	Statewide	DR-184. Heavy rains and flooding, with landslides, on December 24, 1964.
Feb. 1996	Statewide	DR-1099. Heavy rains and rapidly melting snow contributed to hundreds of landslides / debris flows across the state; many occurred on clear cuts that damaged logging roads. Log jams

[34] DOGAMI Hazards Viewer https://gis.dogami.oregon.gov/hazvu/
[35] Special Paper 34: Slope failures in Oregon: GIS inventory for three 1996/97 storm events, 2000

Date	Location	Description
		and dirt from Mt. Hood traveled down Hood River and created a sandbar expansion on the Columbia River
Dec. 1980	Polallie Creek in Hood River County	Debris flow from Mt. Hood. Debris dam formed a small lake that was later breached. Damage to highways and utilities.
Dec. 2003-Jan. 2004	Statewide	DR-1510. Winter storms with landslides.
May 2006	Statewide	DR-1632. Statewide impacts from storms, floods, landslides, and mudslides.
Nov. 2006	Hood River, Clatsop, Tillamook, Lincoln Counties.	DR-1672. Severe storms, flooding, landslides, and mudslides November 6-8, 2006. DR-1962. Heavy freezing rain along I-84, closed the only N/W highway to Hood River County. Debris Flow from the Elliot Glacier and the Newton Clark Glacier caused multimillions of dollars of damage and took out sections of Highway #35 in three places; several key structures of the Middle Fork Irrigation District shut down hydroelectric plants, wiped out the Red Hill Road Bridge, damaged Toll Bridge Road, invaded and undercut the spring box of the Ice Fountain Water District, suspended 300 yards of track of the Mount Hood Railroad in mid-air, ripped away critical infrastructure of the Farmers Irrigation District and shut down their hydroelectric plants, and created a huge new river delta in the Columbia River, now known as the sandbar.
Dec. 2008	Statewide and Hood River	DR-1824. Severe winter storm, flooding, winds, record and near record snow, landslides and mudslides. Gresham received, 26" of snow. Many roads closed. Significant damages to public infrastructure, homes and businesses. Event occurred Dec. 20-26. Hood River significantly impacted.
2009	Hood River County	Property damage; cost $78,571.
Jan. 2012	W. Oregon	DR-4055. The incident period was January 12-21, 2012. Severe winter storm with flooding, landslides, and mudslides. Declaration involves 12 counties including Hood River County.
2014	Hood River county	Rock slide on I-84; interstate closed for several days.
Jan. 2017	Clackamas, Hood River, Columbia, Deschutes, Josephine Counties	DR-4238. Severe winter storms, flooding, landslides, mudslides. The events occurred January 7-20, 2017.

Date	Location	Description
Dec 2017 - 2019	Hood River and Multnomah counties along I-84 near Cascade Locks, Dodson and Warrendale	Landslide threat in the Gorge is significantly elevated after wildfire. "The Columbia Gorge already earned the distinction of being the state's highest landslide risk…now the Eagle Creek fire heightened that threat in some of the most popular Gorge areas… which are located firmly in the landslide zone" – DOGAMI, fall 2017.

Source: University of Oregon, Hood River County NHMP, August 2012; DLCD Oregon NHMP, 2015; FEMA, Disaster Declarations for Oregon, retrieved 2017; Hazards and Vulnerability Research Institute (2007); the Spatial Hazard Events and Losses Database for the United States, Version 5.1 (online database), Columbia, S.C: University of South Carolina, available from http://www.shieldus.org/.

Probability

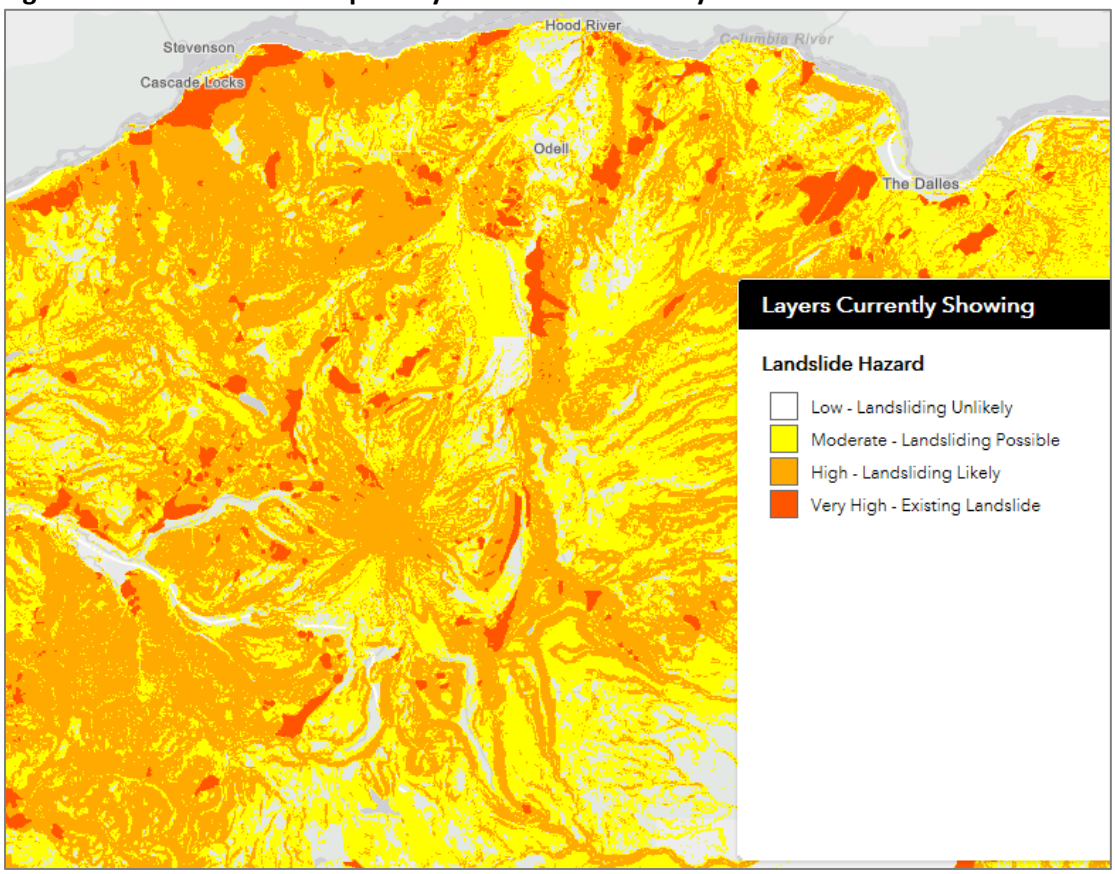
The probability of rapidly moving landslides occurring depends on a number of factors: steepness of slope, slope materials, local geology, vegetative cover, human activity, and both surface and ground water. Rapidly moving landslides (debris flows) are strongly correlated with intensive winter rainstorms. There is a 100% probability of landslides occurring in this region in the future. Although we do not know exactly where and when they will occur, they are more likely to happen in the general areas where landslides have occurred in the past. Also, they will likely occur during heavy rainfall events or a future earthquake.[36] Based on the available data and research for Hood River County the NHMP Steering Committee determined the probability of experiencing a landslide is **moderate,** meaning at least one incident is likely within the next 35-year period. For more detailed landslide hazard mapping, see the DOGAMI Hazards Viewer.

Within Hood River County, 6.6% of land has "very high" susceptibility to landslides, 50.9% has "high," and 32.5% has moderate susceptibility.[37] Figure HA-8 illustrates where landslides are most likely to occur in the County. In a December 2017 presentation, DOGAMI representatives stated that, "the Columbia Gorge already earned the distinction of the state highest landslide risk…Eagle Creek Fire heightened that threat in some of the most popular Gorge areas…firmly in the landslide zone."[38] High risk areas do not indicated that landslides will occur, but that they are susceptible.

The DOGAMI Risk Report describes landslide risk for Hood River County. The OCCRI report does not.

[36] State of Oregon Natural Hazards Mitigation Plan Region 5 (Mid Columbia), Risk Assessment
[37] Open-File Report 0-16-02, Landslide susceptibility overview map of Oregon, DOGAMI
[38] Hood River County Emergency Manager, Barbara Ayers, personal communication, 5/10/2017; references Outreach 12/2017

Figure HA-8: Landslide Susceptibility in Hood River County



Source: Oregon HazVu, Statewide Geohazards Viewer, Department of Geology and Mineral Industries. http://www.oregongeology.org/sub/hazvu/index.htm. Accessed February, 2018.

Vulnerability

The Steering Committee determined probability for Landslide risk in Hood River County rose from **moderate** to **high** in the 2018 NHMP Update. The vulnerability ranking remained **moderate** in both 2012 and 2018.

Landslides tend to occur in sparsely developed areas and threaten individual structures and remote sections of the transportation, energy and communications infrastructure, suggesting **moderate vulnerability**. Landslides can affect structures (residential, commercial, industrial), utility services, transportation systems, and critical lifelines among others. Communities may suffer immediate damages and loss of service. Disruption of infrastructure, roads, and critical facilities may also have a long-term effect on the economy. 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 slight landslide movements as small as an inch or two. Landslide damage tends to be underreported: claims are rarely made to insurance companies, the press rarely covers slides unless they are severe, and transportation network slides may be listed in records simply as “maintenance.”

Due to heavy rains, soil erosion in hillside areas can be accelerated, resulting in loss of soil support beneath high voltage transmission towers in hillsides and remote areas. Flood events can also cause landslides which impact gas lines and other infrastructure. Water and waste-water utilities may need treatment to quickly improve water quality by reducing excessive water turbidity and reestablishing wastewater disposal capability.

Because many Hood River 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. I-84, a major County lifeline, is at risk for landslides with a high potential for road closures and damage to utility lines.

The preliminary Risk Report (DOGAMI, 2018) includes a comprehensive landslide risk assessment. Most of the area that is susceptible to landslides is remote and does not include significant development. As such, the NHMP Steering Committee rated the County as having a **moderate** vulnerability to landslide hazards, meaning that less than 1-10% of the region's population or assets would be affected by a major disaster.

Mitigation efforts have been taken to prevent developments on top of or below slopes subject to sliding without geotechnical investigations and preventative improvements, and to create barriers between major roadways and landslide hazard areas. Current efforts are in progress to understand and mitigate the landslide risk in the Eagle Creek Fire burn scar.

Drought

Significant Changes since Previous Plan:

One significant drought event occurred since the previous plan, in 2015. New content was added, including a Surface Water Supply Index. Drought is considered a lower priority that in the previous NHMP; it shifted from 2nd to 5th priority due to lower impacts on residents and businesses despite high probability.

Hazard Characteristics

A drought is a period of drier than normal conditions, which can reduce soil moisture and available water below the minimum necessary for sustaining plant, animal, and human life systems. 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.[39]

Location and Extent

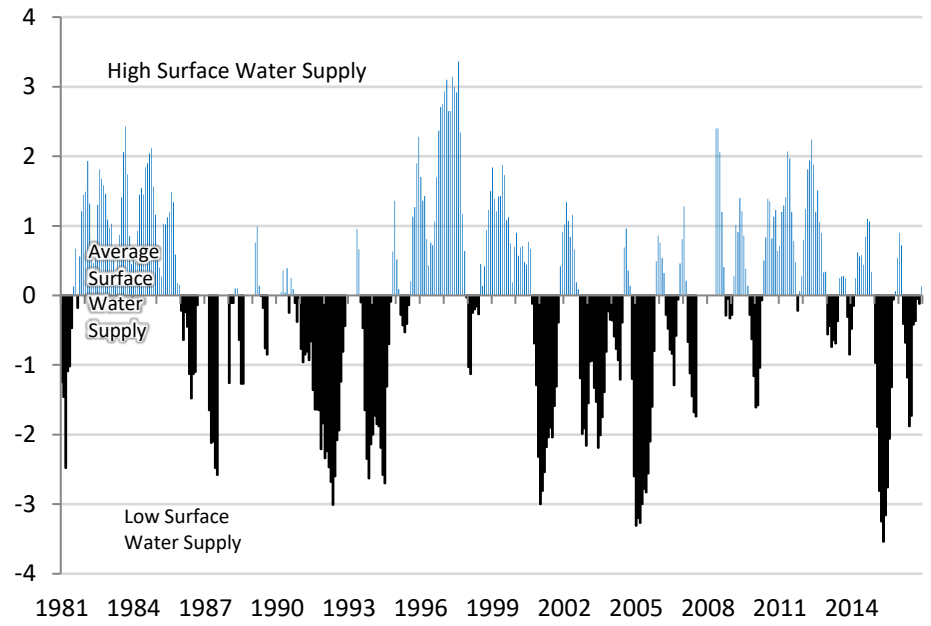
Droughts occur throughout Hood River County and may have profound effects on the economy, particularly the agricultural and recreation sectors. Drought is typically measured

[39] Hood River County Natural Hazards Mitigation Plan, 2012

in terms of water availability in a defined geographical area and expressed 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 and is therefore not believed to provide an 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 gathered monthly from key stations. The lowest SWSI value, -4.2, indicates extreme drought conditions. The highest SWSI value, +4.2, indicates extreme wet conditions. An average water supply ranges from +1.5 to -1.5. Figure HA-9 below shows the monthly history of SWSI values from April 1981 to March 2017 for the Lower Deschutes Basin, which includes Hood River County. [40]

Figure HA-9: Surface Water Supply Index for the Lower Deschutes Basin



Source: Department of Agriculture-Natural Resources Conservation Service, "Surface Water Supply Index, Lower Deschutes Basin" www.or.nrcs.usda.gov. Accessed February 2018.

History

Local drought history is characterized by several extreme droughts and periods of frequent moderate droughts. One major drought occurred in Hood River County since the previous plan, and two moderate droughts impacted neighboring counties. Table HA-10 lists significant drought events for Hood River County and the surrounding region.

[40] Department of Agriculture-Natural Resources Conservation Service, "Surface Water Supply Index, Lower Deschutes Basin" www.or.nrcs.usda.gov. Accessed February 2018.

Table HA-10: Hood River County Drought Hazard History Events

Date	Location	Description
1904-05	Statewide	Drought period of about 18 months.
1939-41	Statewide	Three-year intense drought, extreme in Hood River County 1939-1940
1965-68	Statewide	Three-year drought following the big regional floods of 1964-65.
1976-77	Statewide	EM 3039. Oregon Drought. Declared April 29, 1977. Brief very intense statewide drought with significant impacts to agriculture.
1992	Statewide, including Hood River County	Governor declared drought (Executive Order 92-21) in many counties for the period of September through October.
1985-94	Statewide	Generally dry period, capped by statewide droughts in 1992 and 1994. In 1994, the Governor declared drought in 11 counties within regions 4, 5, 6, 7, and 8.
2001-2003	Region 1 and 4-8	Governor declared drought (Executive Order 01-05) from May 2001 through June 2003 in 18 counties including: Hood River, Wasco, Sherman, and Gilliam.
2005	Region 5 - 7	Governor declared drought (Executive Order 05-05) from April through December for Hood River County and others (via other Executive Orders) in 2005.
2014	Regions 4, 6-8 (Hood River County is in Region 5)	Governor declared drought in 10 counties (via several Executive Orders). This was the third driest Nov.-Jan. period since 1895. State drought declarations: Baker, Crook, Grant, Harney, Jackson, Josephine, Klamath, Lake, Malheur and Wheeler counties. USDA drought disaster declarations: Baker, Benton, Coos, Crook, Curry, Deschutes, Douglas, Grant, Harney, Jackson, Jefferson, Josephine, Klamath, Lake, Lane, Lincoln, Linn, Malheur, Morrow, Umatilla, Union, Wallowa and Wheeler counties.
2015	Statewide	Governor declared drought (Executive Order 15-08) for Hood River County and others (via other Executive Orders) in 2015. Declaration maintained from July through December. FEMA declared drought in June.

Sources: Hood River County NHMP, August 2012; DLCD Oregon NHMP, 2015; FEMA, Disaster Declarations for Oregon, retrieved 2017. The Oregonian, http://www.oregonlive.com/weather/index.ssf/2014/09/oregon_drought_not_much_relief.html; Oregon Water Resources Department Public Declaration Report http://apps.wrd.state.or.us/apps/wr/wr_drought/declaration_status_report.aspx, Haberman, Margaret (September 15, 2014). The Oregonian. http://www.oregonlive.com/weather/index.ssf/2014/09/oregon_drought_not_much_relief.html; Taylor and Hatton, 1999.

Probability

Increased droughts may occur in the Mid-Columbia region because of various factors, including reduced snowpack, rising temperatures, and likely reductions in summer precipitation. Climate models for Oregon suggest increases in temperature around 0.2-1°F per decade in the 21st Century, with mean projected seasonal increases in summer temperatures of 2.6 to 3.6 ˚C by mid-century. Climate models suggest that as the region warms, winter snow precipitation will likely shift to higher elevations and snowpack will be diminished. As more precipitation falls as rain, surface flows will be altered.[41] Virtually all climate models project warmer, drier summers for Oregon, and a decline in mean summer precipitation amounts of 5.6 to 7.5% by mid-century. Models project a mean increase in winter temperatures of 2.5 to 3.2 ˚C by midcentury. This combination of factors exacerbates the likelihood of drought, which in turn leads to an increase in the likelihood of wildfires and dust storms.

History and climate models suggest a high probability of occurrence. The Hood River County NHMP Steering Committee assigned **moderate** probability, indicating one significant event is likely in the next 35 to 75 years.

The DOGAMI Risk Report does not describe drought for Hood River County. The OCCRI report states that the risk of drought is increasing in Hood River County.

Vulnerability

The 2012 NHMP Steering Committee rated drought with **high** probability and **high** vulnerability, while the 2018 NHMP Steering Committee rated drought with **moderate** probability and **moderate** vulnerability. This difference is primarily attributed to recent experiences to low-impact droughts and improvements the County has made to long term water storage and water conservation.

All parts of Hood River County are susceptible to drought; however, the following areas and issues are of particular concern:

- Agriculture
- Drinking water system
- Power and water enterprises
- Residential and community wells in rural areas
- Fire response capabilities
- Fish and wildlife

Potential impacts from drought include community water shortages, limited recreation appeal, and crop loss. Longer and drier growing seasons will result in increased demand on ground water resources and increased consumption of water for irrigation, which will have potential consequences for natural systems as well as increase irrigation costs. Direct environmental effects also include livestock death or decreased production, wildland fire,

[41] Oregon Climate Change Research Institute (OCCRI), Oregon Climate Assessment Report (2017) and Northwest Climate Assessment Report (2013). http://occri.net/reports

impaired productivity of forest land, damage to fish habitat, loss of wetlands, and decreased air quality. Drought is also associated with insect infestation, disease, and wind erosion. Indirect effects to society include the economic and physical hardships brought on by drought and by the increased stress on residents of a drought-stricken area. Long-term drought periods of more than a year can impact forest conditions and set the stage for potentially destructive wildfires.[42]

All of the above effects result in economic and revenue losses for business, cities and the County. In Hood River County, economic losses in the recreation and agricultural sectors would be most significant. As growth places more pressure on limited local resources, future impacts may be greater. As a result, a **moderate** vulnerability rating is assigned, indicating that 1- 10% of the populations and property could be impacted by an average drought event. This is a decrease from the 2012 vulnerability rating. Because steps have been taken to alleviate the impacts…

More information on this hazard can be found in the Risk Assessment for Region 5, Mid-Columbia, of the Oregon NHMP (2015).

Flood

Significant Changes Since Previous Plan:

One average flood event occurred in Hood River County since the previous plan. New content has been added to this section. Flood hazard has shifted from 4th priority to 6th priority for the County.

Hazard Characteristics

Flooding results when rain and snowmelt creates water flow that exceed the carrying capacity of rivers, streams, channels, ditches, and other watercourses. In Hood River County, serious flooding events result from wet conditions following a period of mid to high elevation snow pack development. The main cause of Northwest floods is moist air masses that regularly move over the region in the winter. Unseasonably warm weather during the winter months, which can quickly melt snow, often contributes to floods. [12]

The principal types of flood that occur in Hood River County include: riverine floods, flash floods and urban floods.

Riverine floods are the most common types of flooding and refer to instances when river flow exceeds the river channel capacity. Severe and prolonged storms can raise rivers and streams to their flood stages for three to four days or longer. Riverine flooding is most common from October through April.

Flash floods are almost always a summer phenomenon associated with intense local thunderstorms. Flash flooding is likely in steeply sloping valleys and small waterways.

[42] State of Oregon Natural Hazards Mitigation Plan Region 5 (Mid Columbia), Risk Assessment

Urban flooding occurs in developed areas where the amount of water generated from rainfall and runoff exceeds the storm water systems' capacity. Poor drainage, elevated groundwater levels, and ponding can cause property damage. Rain flows over impervious surfaces such as concrete and asphalt and into nearby storm sewers and streams. This runoff can result in the rapid rise of floodwaters. During urban floods, streets can become inundated, and basements can fill with water.

Development in the floodplain can raise the base flood elevation and cause floodwaters to expand past their historic floodplains. Rapid development makes stormwater flooding a concern in Hood River County.[43] Lastly, a dam failure, though unlikely, could cause flooding throughout the county.

Location and Extent

Hood River, Indian Creek, Phelps Creek and the Columbia River historically flood every few years. Flood hazard areas are along the East, Middle and West forks of the Hood River, and along Emil, Odell, Baldwin and Neal Creeks.[44] The Columbia itself does not pose a significant risk because of upstream dams. A swollen Columbia River, however, can back up tributary streams to the point where they constitute a significant hazard.[45] Floods in Hood River County have occasionally had devastating impacts. The stream flow of the Hood River, including three significant dams/structures, can be seen in Figure HA-10.

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 stream-flow gauges, 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 one percent probability of occurrence in any given year. This flood is also known as the 100-year flood or base flood. The most readily available source of information regarding the 100-year flood is the system of Flood Insurance Rate Maps (FIRMs) prepared by FEMA. The FIRMs show 100-year floodplain boundaries for identified flood hazards. These areas are also referred to as Special Flood Hazard Areas (SFHAs) and are the basis for flood insurance and floodplain management requirements.

FEMA released the current Flood Insurance Rate Map for Hood River County in September, 1984. The maps do not include recent development, and are not in a fine enough scale to provide useful information for this hazard analysis. Preliminary updated FIRM maps are expected to be available in 2019 and the final maps in 2020.[46]

[43] State of Oregon Natural Hazards Mitigation Plan Region 5 (Mid Columbia), Risk Assessment
[44] Hood River County Natural Hazards Mitigation Plan, 2012
[45] State of Oregon Natural Hazards Mitigation Plan Region 5 (Mid Columbia), Risk Assessment
[46] Tricia Sears, Department of Land Conservation and Development, Personal Communication 6/20/18

Figure HA-10: Hood River Watershed Tributaries

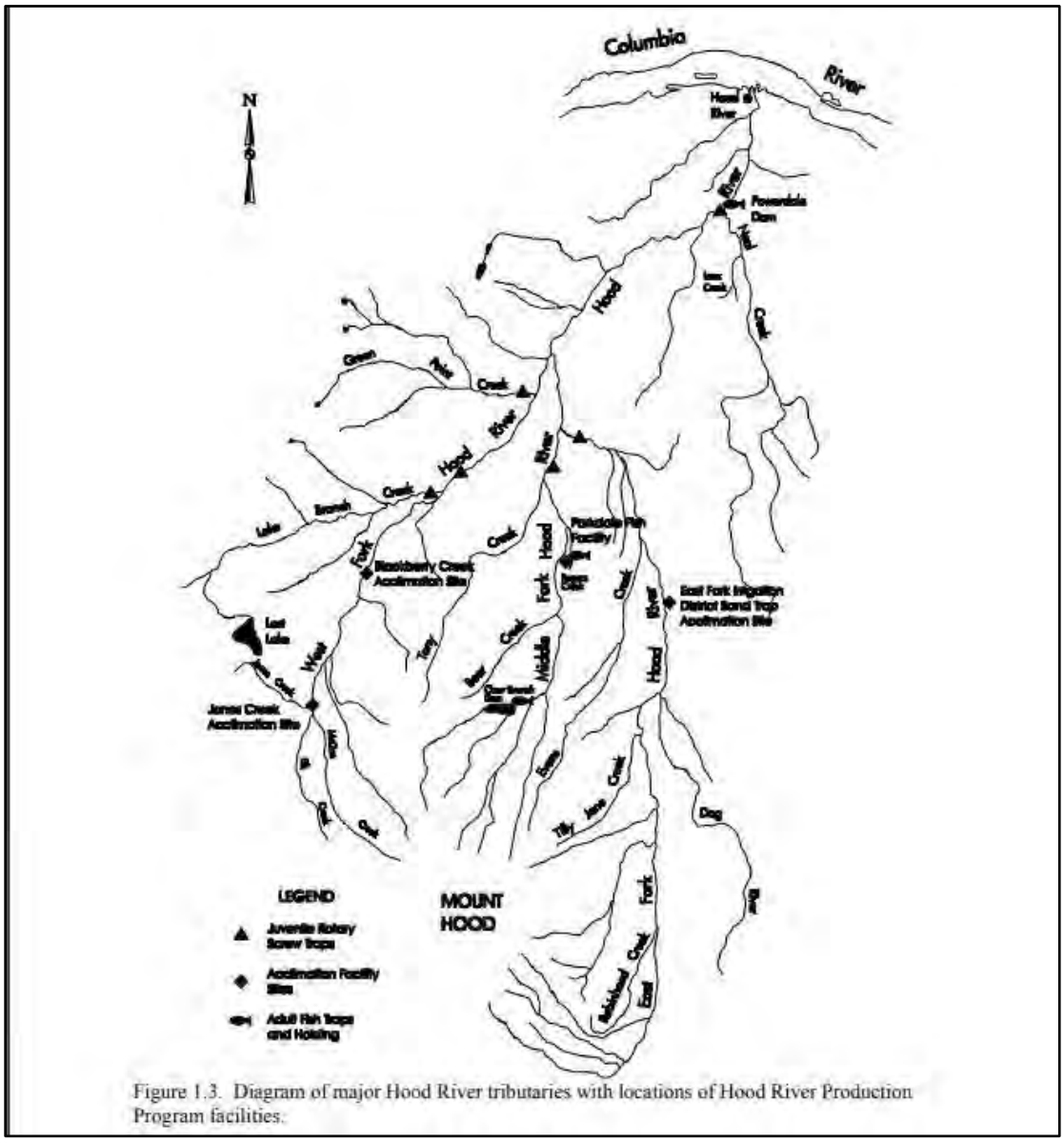
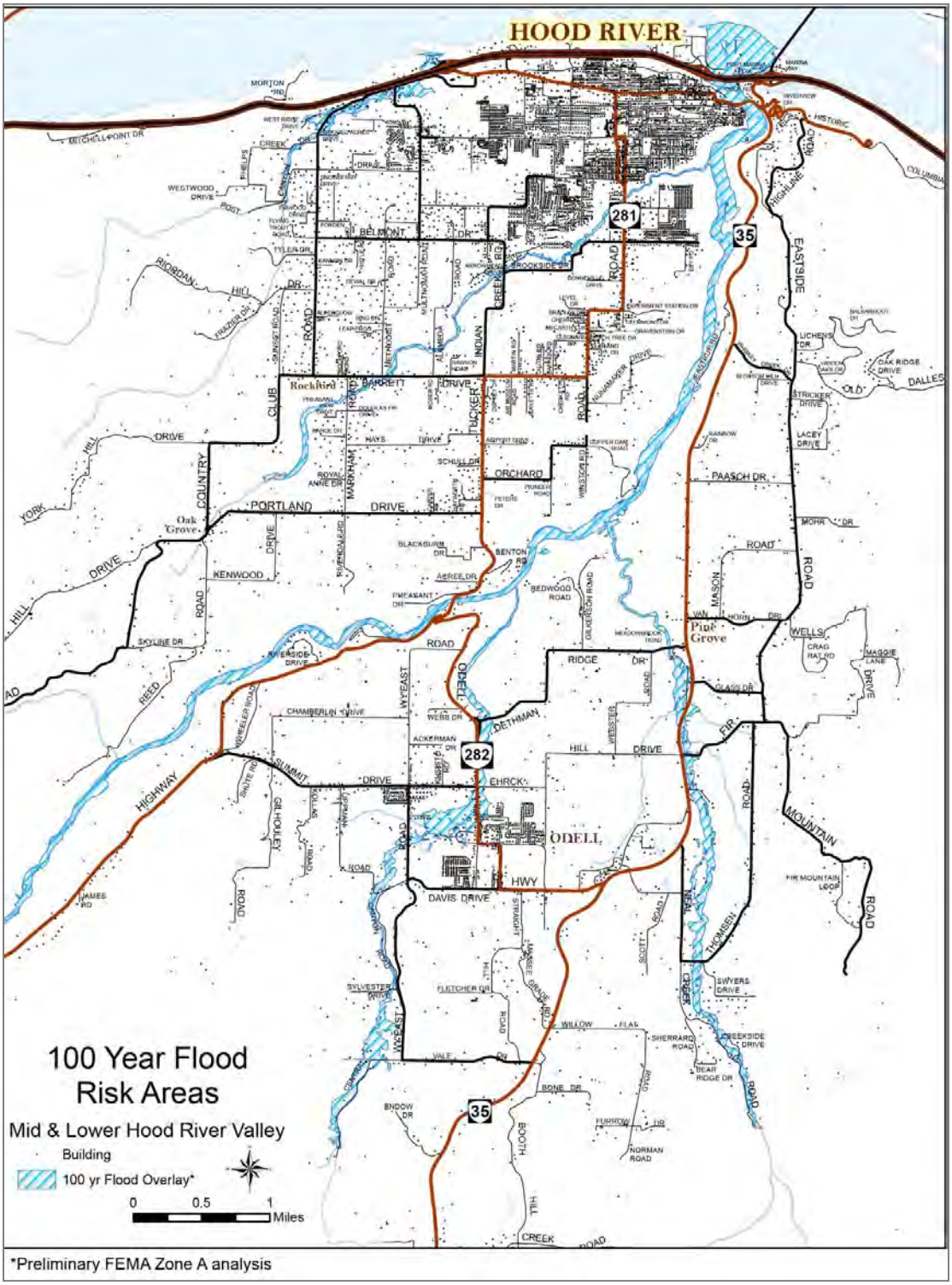


Figure 1.3. Diagram of major Hood River tributaries with locations of Hood River Production Program facilities.

Source: Hood River Watershed Assessment, 1999, Hood River Soil and Water Conservation District

Figure HA-11, developed locally, shows development in the floodplain for the mid and lower Hood River Valley, which is the most populated area in the county. More information on floodplain location can be found through DOGAMI HazVU or the Oregon Risk Map (still in development as of 2018).

Figure HA-11: 100 Year Flood Risk Areas, Mid and Lower Hood River Valley



Source: Hood River County Community Development Department, GIS Coordinator Mike Schrankel. Provided February 2018.

History

Moderate flood events have occurred every few years in Hood River County and the surrounding areas (Table HA-11).

Table HA-11: Hood River County Flood Hazard History Events

Date	Location	Type of Flood	Description
Jan. 1923	Area of the Hood River	Riverine	Record flood levels on the Hood River.
May 1928	Columbia River	Riverine	Columbia River flooding occurred.
May 1948	Columbia River	Riverine	Columbia River crested at 34.4 ft. Flood stage at that time was 15 ft. The flood destroyed the City of Vanport. Fifteen people died in the flood.
Dec. 1955	Statewide	Rain on snow	DR-49. Event occurred on December 29, 1955. Flooding and strong winds; 5 fatalities.
Jul. 1956	Statewide	Storms, flooding	DR-60. Event occurred on July 20, 1956. Storms and flooding.
Oct. 1962	Statewide	Storms	DR-136. Event occurred on October 12, 1962. Referred to as the Columbus Day Storm.
Dec. 1964	Statewide; Hood River	Heavy rains, flooding, rain on snow	DR-184. Event occurred on December 24, 1964. Statewide damage totaled $157 million and 17 deaths. On Dec. 22, Hood River had 30" of snowfall, followed by warm rain. At Tucker Bridge: 20.60' stage, 33,000 c.f.s. The number one historical flood crest of the Hood River.
Jan. 1974	Western Oregon and Hood River	Rain on snow, flooding	DR-413. Flooding resulted from rain on snow events. Willamette River at Portland crested at 25.7 feet. Nine counties declared disasters. The 6th highest flood of record on the Hood River. Crest at 14.48' at Tucker Bridge.
Dec. 1980	Polallie Creek in Hood River County	Debris flow caused by rain	Debris flow from vicinity of Mt. Hood. The debris dam formed a small lake that was later breached. Damage to highways and utilities. Christmas Day Flood was the 5th highest flood of record with a crest of 14.74' at Tucker Bridge. Rainfall heavy and the temperature reached 60 degrees. About 9PM in the evening a sudden flood on Pollalie Creek created a debris flow that swept a camper at the Pollalie Creek Campground to his death, dammed the East Fork for a short period of time, blew out, and tore downstream. Four bridges were torn out, over 5 miles of Highway #35 was damaged or wiped out, and 600' of the main line of Crystal Springs Water District ripped out.

Date	Location	Type of Flood	Description
Feb. 1986	Statewide	Snow melt, flooding	Intense rain, a melting snow, and flooding. Some homes evacuated.
1990	Western Oregon	Rain on snow, flooding	Ten rivers in eight counties were flooding in a rain-on-snow weather event. Many bridges were washed away.
Feb. 1996	Statewide	Storms, flooding, rain on snow	DR-1099. Winter storms with rain, snow, ice, floods, and landslides. Power outages, road closures and property damage. Warm temperatures, record breaking rains; extensive flooding. Once-in-a-generation flood in Hood River County - 5.5" of rain fell over two days creating mud flows which closed I-84 in several places as well as Highway 35. The number two historical crest of the Hood River was Feb. 7 at 17.11' and the number three historical crest was 16.03' on Feb. 8th. The 4" main of Crystal Springs at Neal Creek was washed out and the spring box was contaminated thus initiating chlorination. The East Fork Irrigation District sustained significant infrastructure damage. Statewide: widespread closures of major highways and secondary roads; 8 fatalities; 27 counties covered by the disaster declaration.
Dec. 1996-Jan. 1997	Statewide	Winter storm, flooding	DR-1160. Severe snow and ice. Up to 4 to 5 inches of ice in the Columbia Gorge. Interstate 84 closed for 4 days. Hundreds of downed trees and power lines.
Jan.-Feb. 1999	NW Oregon	Rain, flooding, landslides, mudslides	Widespread flooding on smaller rivers and streams; numerous landslides and mudslides.
Nov. 2006	Statewide	Severe storms, flooding, landslides, mudslides	DR-1962. The events occurred November 6-8, 2006. Total rainfall for November was 14.67 inches in Hood River County; the previous record was 11.09 in 1973. Total estimated damages: $27 million.
Sept. 2000	Hood River County	Flood, mud slide, road damage	On September 30, 3-4" of warm rain fell and melted portions of the White and Newton Clark glaciers. Water and hundreds of cubic yards of rock and mud descended down the White River and Newton Creek. A group of 10 hunters at the Robinhood Campground barely escaped. The campground was destroyed and has never reopened. Twenty miles of Highway #35 was closed.

Date	Location	Type of Flood	Description
Dec. 2008	Statewide	Winter storms, heavy rain, flooding	DR-1824. Severe winter storm, flooding, winds, record and near record snow, landslides and mudslides. Gresham received, 26" of snow. Many roads closed. Significant damages to public infrastructure, homes and businesses. Event occurred Dec. 20-26.
Jan. 2011	Statewide	Winter storm	DR-1956. Severe winter storm, flooding, mudslides, landslides, and debris flows.
Jan. 2012	W. Oregon	Severe winter storms, flooding, landslides, mudslides	DR-4055. The incident period was January 12-21, 2012. Severe winter storm with flooding, landslides, and mudslides. Declaration involves 12 counties including Hood River County (1/17 -1/24/12.) Hood River County qualified for FEMA Public Assistance relief for severity of community storm impacts.
Dec. 2015	Western Oregon	Winter storm, heavy rain	DR-4258. Severe winter storms, straight-line winds, flooding, landslides, and mudslides.
Jan. 2017	Hood River, Columbia, Deschutes, Josephine Counties	Severe winter storms, flooding, landslides, mudslides	DR-4238. The event occurred January 7-20, 2017. Hood River County emergency declaration 1/16-1/20/17 – EOC on full activation OERS# 2017-0205. Hood River qualified for SBA (Small Business Admin) emergency relief loans for severity of storm impacts on the local economy.

Sources: Hood River County NHMP, August 2012; DLCD Oregon NHMP, 2015; FEMA, Disaster Declarations for Oregon, retrieved 2017; Taylor and Hatton, 1999.

Probability

Flooding occurs along one or more of the County's waterways every few years, with a significant flood every 5-7 years. A **moderate probability of occurrence** is assigned; meaning one incident in the next 35 to 75 years is likely.

The DOGAMI Risk Report describes flood information for Hood River County. The OCCRI report describes that the risk for flooding in Hood River County is increasing.

Hood River County participates in the National Flood Insurance Program and has developed local ordinances to better regulate development in floodplain areas. These local ordinances direct planning, construction, operation, maintenance and improvements of any structures in order to protect life, health, and property against flood damage and/or avoid adversely influencing bodies of water.

With some uninsured structures located in flood plains, Hood River County home and business owners are vulnerable to flood damage. New growth increases pressure to develop more marginal land and increases the number of households living in floodplains. Furthermore, as the density of development increases and permeable natural surfaces are replaced with homes and roads, the volume and expanse of storm water runoff increase. As

a result, homes once outside mapped floodplains face an increased threat of flooding, which they were not built to withstand.

Vulnerability

Significant Changes Since Previous Plan:

Since the 2012 NHMP update to the 2018 NHMP update, the flood probability ranking dropped from **high** to **moderate** and the flood vulnerability ranking dropped from **moderate** to **low**. These ratings dropped because the Steering Committee determined flood hazard to be lower risk than other local hazards, and adjusted rankings to reflect that. Because development is primarily outside of the floodplain, the County is exposed to **low vulnerability,** meaning that less than 1% of the region's population or assets would be affected by a major flood event.

Flooding can occur every year depending on rainfall, snowmelt, and runoff from development. Surveys by the Department of Geology & Mineral Industries (DOGAMI), the county, and FEMA have established the 100-year floodplain. Changes to development patterns since 2009 have the potential to incur increased risk of flooding. However, County development regulations restrict, but do not prohibit, new development in areas identified as floodplain. This reduces the impact of flooding on future buildings.

The preliminary Risk Report (DOGAMI, 2018) includes a comprehensive flood risk assessment using HAZUS. FEMA recommends that communities use HAZUS software (HAZUS = Hazards United States; a geographic information system-based natural hazard loss estimation software package) to produce loss estimates that accurately reflect local conditions. The HAZUS-MH Flood Model allows planners and other practitioners to carry out a wide range of flood hazard analyses, including:

- Studies of specific return intervals of floods (e.g., 100-year return interval)
- Studies of discharge frequencies, including analysis of discharges from specific streams and the exposure to buildings and population from the resultant flooding.
- Studies of annualized losses from flooding.
- 'Quick look' assessments, which allow the user to quickly evaluate potential flooding from specific flood depths at specific locations.
- 'What if' scenarios, which allow users to evaluate the consequences of specific actions, such as the introduction of flow regulation devices, acquisition of flood-prone properties, and other mitigation measures.

Hood River County has a total of 32 NFIP policies as of 2018. Three claims have been submitted and paid under the National Flood Insurance Program; all three were submitted prior to FIRM adoption in 1984. The County has no repetitive loss properties. Hood River County would benefit from updated floodplain information to inform development. Detailed information on FIRM policies and claims is included in Volume I, Section II Risk Assessment.

Windstorm

Significant Changes since Previous Plan:

The information in this section was previously incorporated with winter storms into a "Severe Weather" section. It also includes information from the previous section on Tornado hazards. The Tornado hazard section was eliminated due to the extremely low history and probability of tornadoes in the area. Both the Tornado hazard in the 2012 NHMP and the Windstorm hazard in 2018 NHMP are ranked as 8th priority for the County. High winds are a concern when in conjunction with winter storms or wildfire.

Hazard Characteristics

A windstorm is generally a short duration event involving straight-line winds and/or gusts in excess of 50 mph. Two sources generate the strong winds that impact Hood River County. Frequent and widespread strong winds from the west are associated with storms inland from the Pacific Ocean and/or a pressure differential between the upper Columbia River Basin (high atmospheric pressure) and the Pacific Ocean (low atmospheric pressure). Furthermore, the Columbia River Gorge is the most significant east-west gap in the Cascade Mountains between California and Canada, and acts as a funnel, concentrating the intensity of winds as they flow. High winds can cause widespread damage to trees and power lines and interrupt transportation, communications, and power distribution.

Tornadoes are not common inHood River County, but they have been observed in the surrounding region, sometimes producing significant property damage and even injury. Tornadoes are the most concentrated and violent storms produced by earth's atmosphere, and can produce winds in excess of 300 mph. Most Oregon tornadoes are caused by intense local thunderstorms, common between April and October. Tornadoes can affect an area of ¼ to ¾ of a mile and seldom more than 16 miles long. They form when a strong crosswind intersects with strong warm updrafts causing a slowly spinning vortex to form within a cloud. Eventually, this vortex may develop intensity and descend to form a funnel cloud. When this funnel cloud gets close enough to the ground to affect the surface it becomes a tornado.

Location and Extent

Although windstorms can affect the entire 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, public facilities, and create a significant amount of storm related debris. Severe windstorms usually cause the greatest damage to ridgelines that face into the winds. There is an additional hazard in newly developed areas that have been thinned of trees to make way for new structures; unprotected trees in these areas are more likely to fall. Widespread power outages from downed power lines are the most significant impact of windstorms in Hood River County.

High winds in the Columbia Gorge are well documented, leading to special building code standards. Peak local wind gust speeds have been 100 miles per hour. The average wind speed at Hood River is 13 mph. All manufactured homes in the County that are within 30 miles of the Columbia River must meet special anchoring standards.

Tornadoes are not a normal occurrence in the Northwest because the climate does not normally generate the temperature variations conducive to tornado formation. With the exception of the April 1972 disaster occurring in Clark County, Washington, tornadoes in Washington and Oregon tend to be light or moderate, with winds ranging from 40 to 112 mph. Two notable tornadoes in recent Oregon history: the Manzanita tornado on October 14, 2016 and the Aumsville tornado on December 15, 2010.

History

No recorded instance of a tornado causing damage in Hood River County is available. Table HA-12 lists windstorm events.

Table HA- 12: Hood River County Windstorm Hazard History Events

Date	Location	Description
Apr. 1931	W. Oregon	Unofficial wind speeds reported at 78 mph. Damaged fruit orchards and timber.
Dec. 1935	W. Columbia Gorge	Wind gusts were up to 120 mph. Damage to cars.
Nov. 1951	W. Oregon	Widespread damage. Transmission and utility lines damaged. Wind speeds were 40-60 mph and gusts 75-80 mph.
Dec. 1955	W. Oregon	Wind speeds 55-65 with 69 mph gust. Considerable damage to buildings and utility lines.
Nov. 1958	Statewide	Wind speeds at 51 mph with 71 mph gusts. Every major highway blocked by fallen trees.
Oct. 1962	W. Oregon	DR-136. 1962 Columbus Day Storm. Most severe windstorm for Western Oregon due to sustained wind speeds and damage levels. Winds in the Willamette Valley up to 116 mph. 84 homes destroyed, 5,000 severely damaged. Killed 38 people and created $170-200 million in damages in the state.
Jan. 1993	Northern OR	Severe windstorm. Damage to utilities.
Dec. 1995	Statewide	Widespread damage.
Nov. 1997	W. Oregon	Uprooted trees. Considerable damage to small airports. Winds up to 52 mph.
Apr. 2004	Hood River and Wasco Counties	$25,000 in property damage in Hood River County and $1,000 in Wasco County.
Dec. 2015	Western Oregon	DR-4258. Severe winter storms, straight-line winds, flooding, landslides, and mudslides.

Source: Hood River County NHMP, August 2012; DLCD Oregon NHMP, 2015; FEMA, Disaster Declarations for Oregon, retrieved 2017. Taylor and Hatton, 1999.

Probability

High winds occur yearly in the Columbia River Gorge. History and geography suggest a high probability of occurrence; however, most of these events do not cause significant damage. The probability of a major windstorm is **moderate**. The 100-year event in this region consists of 1-minute average winds of 90 mph. A 50 year event has average winds of 80 mph. A 25-year event has average winds of 75 mph.

The DOGAMI Risk Report does not address windstorms. The OCCRI report describes that the risk of windstorms is increasing for Hood River County.

Vulnerability

Windstorm was incorporated into Severe Weather in the 2012 NHMP Update, and thus did not have a distinct ranking. However, tornado hazard (now included in windstorm) was ranked with a **low** probability and **low** vulnerability. The 2018 NHMP update ranks windstorm probability and vulnerability as **moderate**.

Many buildings, utilities, and transportation systems are vulnerable to wind damage. This is especially true in open areas, such as natural grasslands or farmlands. It also is true in forested areas, along tree-lined roads and electrical transmission lines, and on residential parcels where trees have been planted or left for aesthetic purposes. Structures most vulnerable to high winds include insufficiently anchored manufactured homes and older buildings in need of roof repair.

Fallen trees can block roads and rails for long periods, which can affect emergency operations. In addition, uprooted or shattered trees can down power and/or utility lines and effectively halt local economic activity and other essential services. Uprooted trees growing next to a house have destroyed roofs when they fall as a result of windstorms. In some situations, strategic pruning is useful.

Due to the nature of the hazard, it is impossible to predict the location or extent of future events with any probability, although it can be assumed that all residential and critical facilities and infrastructure within the County are at risk.

Because there are no recorded events, there is no demonstrated likelihood of tornadoes impacting Hood River County. It is extremely rare for tornado warnings to be issued in the Pacific Northwest. However, there is limited awareness of tornado threat in Oregon and local forecasting and warning systems are under-developed. There is little public awareness of the warning systems and self-protection measures common to the tornado prone states.

The NHMP Steering Committee determined a **moderate** vulnerability ranking, meaning 1-10% of the population and property would be affected. The Committee determined that proper protections have been taken to reduce the impacts of a windstorm event, decreasing vulnerability. A major event could still cause significant disruption.

Volcano

Significant Changes Since Previous Plan:

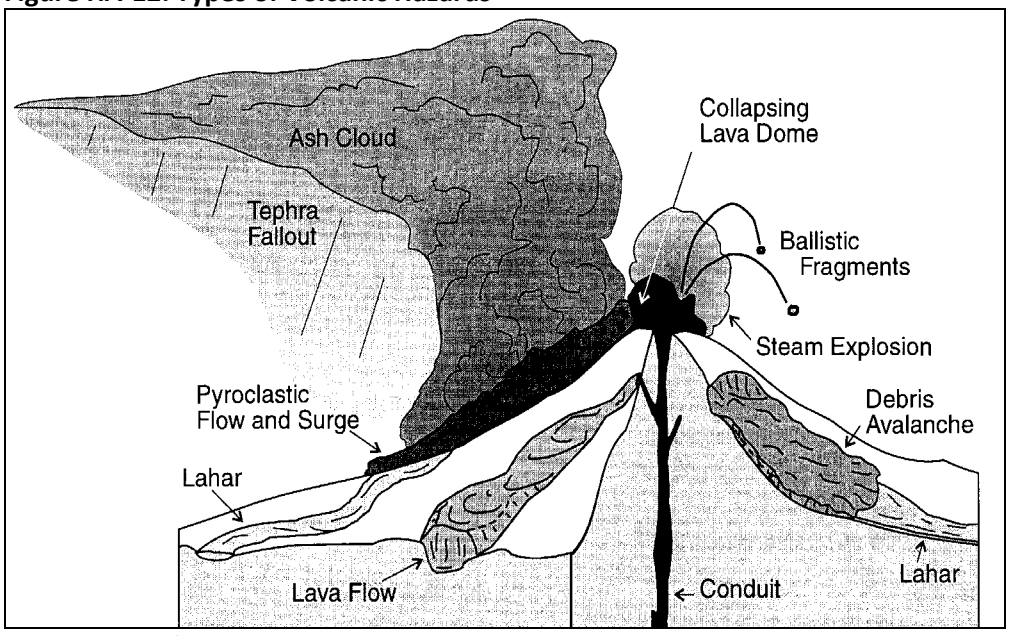
No new history has been added to this section so the text of the 2012 NHMP has been retained. Note that the preliminary Risk Report (DOGAMI, 2018) provides important volcano, including lahar, information. Hood River Valley is at relatively low risk compared to the Sandy and White River Valleys. Volcano hazard events were lowered in priority from 7th to 9th priority.

Hazard Characteristics

The Cascade Range is a series of mountains derived from volcanic activity which includes several active and potentially active volcanoes. Mount Hood, Mount Jefferson, and Mount Adams are all potentially active volcanoes close to Hood River County that can impact these communities.

A volcano is a vent in the earth's crust through which molten rock, rock fragments, gases or ashes are ejected from the earth's interior. Volcanic activity can produce many types of hazardous events (Figure HA-12) including landslides, ashfall, lahars, pyroclastic flows, and lava flows.

Figure HA-12: Types of Volcanic Hazards



Source: Scott et al., 1997

Pyroclastic flows are fluid mixtures of hot rock fragments, ash, and gases that can move down the flanks of volcanoes at speeds of 50 to more than 150 kilometers per hour (30 to

90 miles per hour).[47] Lahars or volcanic debris flows are water-saturated mixtures of soil and rock fragments that can travel very long distances (over 100 km) as fast as 80 kilometers per hour (50 miles per hour) in steep channels close to a volcano.[48] Lahars can be very localized (only meters across) or can affect areas hundreds of kilometers away. Lahars can be generated by hot volcanic flows that melt snow and ice or by landslides from the steep upper flanks of the volcano. Structures close to river channels are at greatest risk of being destroyed. Large lahars can affect areas more than 30 vertical meters (100 vertical feet) above riverbeds.

Mount Hood's eruptive history can be traced to late Pleistocene times (15,000–30,000 years ago) and will no doubt continue. The most recent series of events (1760–1810) consisted of small lahars and debris avalanches; steam explosions and minor tephra falls occurred between 1859 and 1865. Mount Hood's recent history also includes ashfalls, dome building, lahars, pyroclastic flows, and steam explosions.

Location and Extent

Mount Hood is an active volcano close to rapidly growing communities, recreation areas, and major transportation routes and therefore imposes heightened risk. Potential hazards include collapse of growing lava domes and generation of pyroclastic flows, which in turn melt snow and ice to form lahars that flow far down valleys; the long-term adjustment of river channels to the large quantities of volcano generated sediment dumped into valleys that head on the volcano; and landslides of hydrothermally altered material from steep upper slopes of the volcano that spawn debris avalanches and related lahars. The most likely widespread and hazardous consequence of a future eruption would be for lahars to sweep down the entire length of the Sandy and White River valleys. Modest production of tephra would also pose chiefly non-life-threatening hazards to nearby communities.

The preliminary Risk Report (DOGAMI, 2018) includes a comprehensive volcano (lahar) risk assessment. Areas particularly vulnerable to volcanic activity include the Cities of Parkdale and Hood River near Mount Hood. Former Mount Hood lahars (water saturated debris slides) completely buried valley floors in the Sandy and Hood River drainages to the Columbia River and in the White River drainage all the way to the Deschutes River, disrupting stream flow and channel transport.

Though most volcanic activity is considered local, lahars and ashfall can travel many miles, impacting small mountain communities, dams, reservoirs, energy generating facilities, and highways. These hazards could impact the entire County. On the basis of the type and magnitude of tephra (ashfall) production expected from Mount Hood, only nearby communities such as Government Camp, Rhododendron, and Parkdale, would likely receive a tephra thickness approaching 1.5 centimeters, the perceived disaster amount, in any one event.

The general location of different volcanic hazards from Mt. Hood is shown in Figure HA-13.

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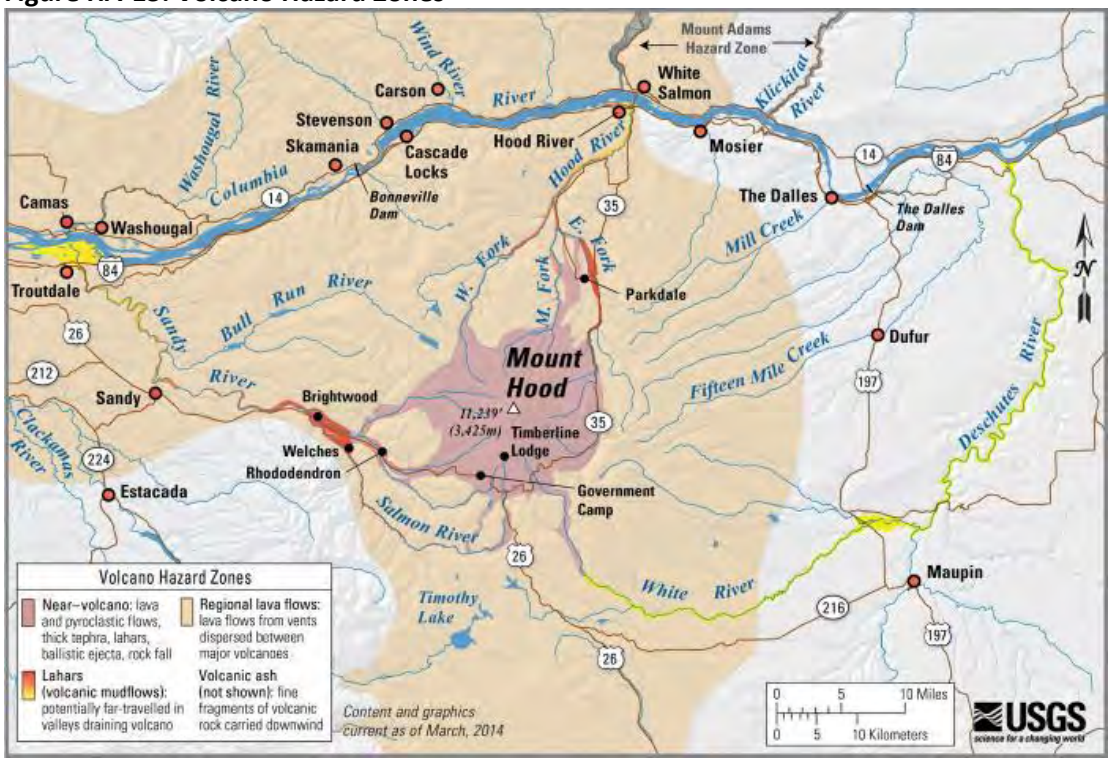
[47] W.E. Scott, T.C. Pierson, S.P. Schilling, J.E. Costa, C.A. Gardner, J.W. Vallance, and J.J. Major, 1997, Volcano Hazards in the Mount Hood Region, Oregon: USGS Open-File Report 97-89

[48] Ibid.

Figure HA-13: Volcano Hazard Zones



Source: Mount Hood, U.S. Geological Survey, https://volcanoes.usgs.gov/volcanoes/mount_hood/; Accessed March, 2018

Proximal Hazard Zones

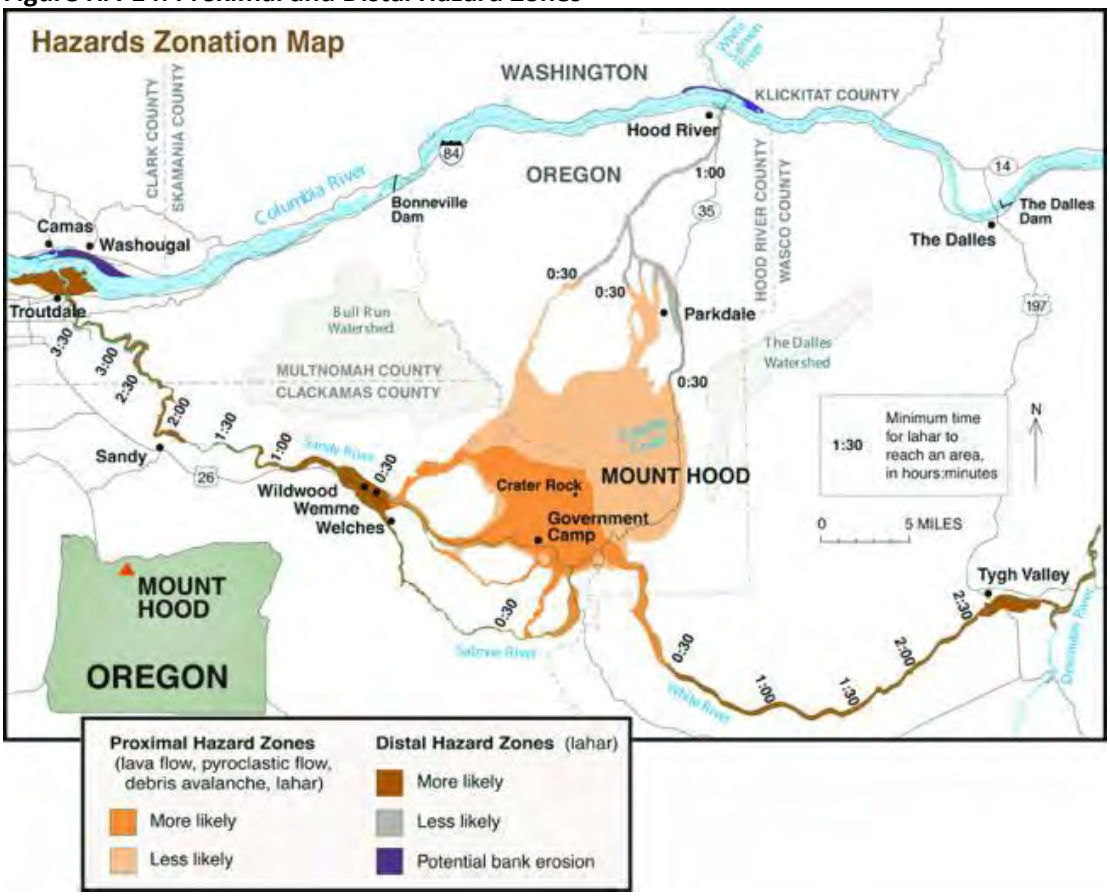
During the past 1,500 years, lava-dome growth has been localized in the area around Crater Rock, which lies in a steeply sloping crater south of the summit ridge. This is the most likely vent location during the next eruption as well. Several major valleys within the proximal hazard zones are more likely to be affected during early stages of lava dome growth. These valleys, along with Polallie Creek valley, are also subject to frequent small lahars, floods, and debris avalanches triggered by storms or other noneruptive causes. If a lava dome grows near Crater Rock, the White and Zigzag River valleys, the valley of Zigzag Glacier and its melt water stream, an unnamed tributary of the upper Sandy, are the most likely pyroclastic-flow and lahar paths. If an eruptive episode continues long enough that debris fills the heads of these drainages, pyroclastic flows and lahars will sweep over a broader area, which could include the Little Zigzag River, Still Creek (including the area around Government Camp), and Salmon River valleys. The proximal hazard zone area between these valleys that is drained by Polallie and several other creeks probably would not be initially affected.

Proximal hazard zones include areas from the summit out 24 km (15 miles) along major valleys and 12 kilometers (7 miles) between major valleys. Pyroclastic flows and surges will travel out to a maximum distance of about 12 kilometers in less than 10 minutes, whereas lahars and debris avalanches can travel out to the 24 km hazard boundary in as little as 30 minutes. Areas up to 5 kilometers (3 miles) from a vent could also be subject to showers of large ballistic fragments within a few minutes of an explosion. Owing to such high speeds, escape or survival is unlikely in proximal hazard zones. Therefore, evacuation of proximal

hazard zones prior to onset of an event is realistically the only way to protect lives. Lava flows issuing from vents on the upper flanks of Mount Hood would be largely restricted to proximal hazard zones, but would move much more slowly. Figure HA-14 depicts the approximate locations of proximal and distal hazard zones.

The earthquakes and deformation associated with future intrusion of magma into Mount Hood can trigger landslides of fractured and weakened rock from the steep upper slopes. Landslides anywhere on the mountain can generate debris avalanches and related lahars in valleys not otherwise affected by dome growth. Explosions can hurl large ballistic fragments outward up to 3 miles. Such events are less constrained by topographic features than pyroclastic flows from dome collapse, so explosions at a vent in one proximal zone could impact other areas.

Figure HA-14: Proximal and Distal Hazard Zones



Source: Mount Hood, U.S. Geological Survey, https://volcanoes.usgs.gov/volcanoes/mount_hood/; Accessed March, 2018

Distal Hazard Zones

Recent eruptions only indirectly affected upper parts of the Hood River basin, producing modest debris avalanches and related lahars. Due to the lack of evidence of recent events in the Hood River Valley, the probability of lahars or debris avalanches inundating areas along Hood River have a 30-year probability of 1 in 300. Several masses of partly altered and highly fractured rock on the steep upper east and north flanks could generate a debris

avalanche and related lahar with a volume of about 50 million cubic meters (65 million cubic yards). Dome growth on the upper east or north flank could generate lahars similar to those produced by dome growth and collapse near Crater Rock during the past 1,500 years, but this is unlikely.

For more information, see the USGS Volcano Hazards Program and the preliminary Risk Report (DOGAMI, 2018).

Mount St. Helens is an active volcano outside of Hood River County; it is located across the Columbia River in Washington State. However Mt. St. Helens erupted twice in recent decades and dispersed significant ash fall across the Columbia Gorge. Depending on wind direction, ashfall from a future Mt. St. Helens eruptions could impact Hood River County. Mt. St. Helens is the most active volcano in the Cascade Range and the most likely to erupt in the next generation. While some volcanic mudflows (lahars) would reach the Columbia River from the northern side, they are unlikely to directly affect Hood River County. USGS maintains a robust monitoring system at Mt. St. Helens, so future activity will be preceded by a warning.[49]

History

Cascade Range volcanoes in the U.S. have erupted more than 200 times during the past 12,000 years for an average of nearly two eruptions per century (Table HA-13). At least five eruptions have occurred during the past 150 years. The most recent eruptions in the Cascade Range are the well-documented 1980-1986 eruptions of Mt. St. Helens, which claimed 57 lives and caused nearly a billion dollars in damage and response costs. The effects were felt throughout the northwest.

Mt. Hood has erupted episodically for about 500,000 years and hosted two major eruptive periods during the past 1,500 years. During both recent eruptive periods, growing lava domes high on the southwest flank collapsed repeatedly to form pyroclastic flows and lahars that were distributed primarily to the south and west along the Sandy River and its tributaries. The last eruptive period began in AD 1781 and affected the White River as well as Sandy River valleys. The Lewis and Clark Expedition explored the mouth of the Sandy River in 1805 and 1806 and described a river much different from today's Sandy. At that time the river was choked with sediment generated by erosion of the deposits from the eruption, which had stopped about a decade before their visit. In the mid-1800's, local residents reported minor explosive activity, but since that time the volcano has been quiet.[50]

[49] US Geological Surveys; Volcanic Hazards at Mount St. Helens; https://volcanoes.usgs.gov/volcanoes/st_helens/
[50] US Geological Surveys

Table HA-13: Hood River County Volcano Hazard History Events

Date	Location	Description
About 20,000 to 13,000 YPB	Polallie eruptive episode, Mount Hood	Lava dome, pyroclastic flows, lahars, and tephra.
About 7,780 to 15,000 YBP	Cinnamon Butte, Southern Cascades	Balsatic scaria cone and lava flows.
About 7,700 YBP	Crater Lake Caldera	Formation of Crater Lake caldera, pyroclastic flows, and widespread ashfall.
About 7,700 YBP	Parkdale, north central Oregon	Eruption of Parkdale lava flow.
About <7,700 YBP; 5,300 to 5,600 YBP	Davis Lake, southern Cascades	Lava flows and scoria cones in Davis Lake field.
About 1,500 YBP	Timberline eruptive period, Mount Hood	Lava dome, pyroclastic flows, lahars, and tephra.
1760–1810	Crater Rock/Old Maid Flat on Mount Hood	Pyroclastic flows in upper White River; lahars in Old Maid Flat; dome building at Crater Rock.
1859-1865	Crater Rock on Mount Hood	Steam explosions and tephra falls.
1907 (?)	Crater Rock on Mount Hood	Steam explosions.
1980	Mount St. Helens (Washington)	Mt. St. Helens erupts: Debris avalanche, ashfall, and flooding on Columbia River. 57 people died.
1981-1986	Mount St. Helens (Washington)	Lava dome growth, steam, and lahars.
1989-2001	Mount St. Helens (Washington)	Hydrothermal explosions.
2004-2008	Mount St. Helens (Washington)	Lava dome growth, steam, and ash.

Sources: USGS, n.d.; Wolfe and Pierson, 1995; Scott et al, 1997; University of Oregon, Hood River County NHMP, August 2012; DLCD Oregon NHMP, 2015; FEMA, Disaster Declarations for Oregon, retrieved 2017.

Probability

Based on the history of eruptions, the NHMP Steering Committee determined **a low probability** of occurrence.

The DOGAMI Risk Report describes volcano and lahar risk for Hood River County. The OCCRI report does not.

The most likely widespread and hazardous consequence of a future eruption from Mt. Hood will be for lahars (rapidly moving mudflows) to sweep down the entire length of the Sandy (including the Zigzag) and White River valleys, neither of which are located within Hood River County. The probability of eruption-generated lahars affecting the Sandy and White River valleys are 1-in-15 to 1-in-30 during the next 30 years, whereas the probability of extensive areas in the Hood River Valley being affected by lahars is about ten times less.

Mount St. Helens remains a probable source of ashfall. It has repeatedly produced voluminous amounts of this material and has erupted much more frequently in recent historical time than any other Cascade volcano. It blanketed Yakima and Spokane, Washington during the 1980 eruption and continues to be of concern. The location, size, and shape of the area affected by ashfall are determined by the vigor and duration of the eruption and the wind direction. Because wind direction and velocity vary with both time and altitude, it is impossible to predict the direction and speed of ash transport more than a few hours in advance.

Geoscientists have provided some estimates of future activity in the vicinity of Crater Rock, a well-known feature on Mount Hood. They estimate a 1 in 300 chance that some dome activity will take place in a 30-year period (1996–2026). For comparison, the 30-year probability of a house being damaged by fire in the United States is about 1 in 90. The probability of 1 cm or more of ashfall from eruptions anywhere in the Cascade Range effecting Hood River County is between 1 in 500 and 1 in 1,000.[51]

Vulnerability

The probability ranking remained **low** in the both the 2012 and the 2018 NHMP updates. The vulnerability ranking for volcano hazard rose from **low** to **moderate** vulnerability.

Unexpected volcanic activity may occur anytime and significantly impact Hood River County. However, Hood River County's vulnerability is limited by the modern capability to accurately detect eruptive activity well before eruption. The USGS constantly monitors seismic activity directly underneath Cascade volcanoes. Clusters or 'swarms' of small earthquakes underneath a volcano have proven to be a precursor to renewed volcanic activity. Emergency managers and other responsible agencies must ensure an aggressive response to these warnings. Because an eruption can occur within days to months of the first precursory activity and because some hazardous events can occur without warning, suitable emergency

[51] USGS Volcano Hazards Program

plans should be made beforehand. Public officials need to consider issues such as public education, communications, and evacuations. Emergency plans already developed for floods may apply, with modifications, to lahar hazards.

Mount Hood has a settlement (Government Camp), major highways (US 26 and OR 35), and popular tourist and recreation areas (Timberline Lodge and Mount Hood Meadows Ski Area) on its flanks. Furthermore, several thousand people live within 35 kilometers (22 miles) of Mount Hood along the channels and flood plains of rivers that drain the volcano. Such areas could be inundated within one hour of event onset.

Tephra fallout produced by future eruptions of Mount Hood can create darkness lasting tens of minutes or more and reduce visibility on highways. Tephra ingested by vehicle engines can clog filters and increase wear. Deposits of tephra can short-circuit electric transformers and power lines, especially if the tephra is wet and thereby highly conductive, sticky, and heavy. This effect could seriously disrupt hydroelectric power generation and transmission along the Columbia River and power line corridors north and east of the volcano. Tephra clouds often spawn lightning, which can interfere with electrical and communication systems and start fires. Even small, dilute tephra clouds damage and reduce visibility for jet aircraft.

Future eruptions of Mount Hood could seriously disrupt transportation and hydroelectric power generation and transmission in northwest Oregon and southwest Washington. In addition, some municipal water supplies are vulnerable to increased turbidity from falling tephra. U.S. Highway 26, a major cross-Cascades route, and Oregon Highway 35, an important recreational road, could be severed by lahars and other hazards and would probably be closed during volcanic unrest and eruption. Depending on the character and impact of a future eruption, the highways could be lost for years or decades. Large loads of sediment delivered to the Columbia River by lahars or by the Sandy and other rivers transporting sediment from eruption-impacted watersheds would have a serious effect on the Columbia River shipping channel, which could last long after an eruptive period ends. A future Mount St. Helens eruption could result in laborious cleanup of ash fall throughout the County, depending on wind direction. Because of potential impact to the Hood River Valley from a lahar flow from the Hood River, the 2018 NHMP Steering Committee assigned a **moderate** vulnerability. They agreed the vulnerability should be higher than what the 2012 NHMP had identified.

Volume III:
Jurisdictional Addenda

Photo Source: Hood River County

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CITY OF CASCADE LOCKS ADDENDUM

Purpose

This document serves as the City of Cascade Locks' Addendum to the Hood River County Multi-Jurisdiction Natural Hazards Mitigation Plan (MNHMP, NHMP). This addendum supplements information contained in Volume I (Basic Mitigation Plan) of this NHMP, which serves as the foundation for this jurisdiction's addendum, and Volume IV (Mitigation Resources), which provides additional information (particularly regarding participation and mitigation strategy). This addendum meets the following requirements:

- Multi-jurisdictional **Plan Adoption** §201.6(c)(5),
- Multi-jurisdictional **Participation** §201.6(a)(3),
- Multi-jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv), and
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii).

Plan Process, Participation, and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), *Plan Adoption*, and 44 CFR 201.6(a)(3), *Participation.*

In January, 2018, the Department of Land Conservation and Development (DLCD) partnered with the University of Oregon's Institute for Policy Research and Engagement (IPRE) with the Oregon Partnership for Disaster Resilience (OPDR) and the Resource Assistance for Rural Environments (RARE) program, and Hood River County and cities, including Cascade Locks, to update their NHMP, which expired December 16, 2017. After funding was awarded in July 2017 to DLCD for two PDM 16 grants (PDMC-PL-10-2016-003 and PDMC-PL-10-2016-005), a regional kickoff meeting for all eight counties involved in the PDM 16 grants was held on July 18, 2017.

To be able to receive certain pre- and post- disaster natural hazard mitigation funds from FEMA, local governments must have a current, FEMA approved NHMP. NHMPs must be updated and approved every five years. By developing this addendum to the Hood River County NHMP, locally adopting it, and having it approved by FEMA, Cascade Locks will regain eligibility for FEMA Hazard Mitigation, Pre-Disaster Mitigation, and Flood Mitigation Assistance grant program funds.

The Hood River County NHMP, and Cascade Locks addendum, are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private sector, and regional organizations. A project Steering Committee guided the process of developing the plan. For more information on the composition of the Steering Committee see *Planning and Public Process* (Volume IV, Appendix B).

The City Administrator of Cascade Locks is the designated local convener and will take the lead in implementing, maintaining, and updating the addendum to the NHMP in

collaboration with the designated convener of the Hood River County NHMP (County Emergency Management).

Representatives from the City of Cascade Locks Steering Committee convened on the following occasions (see Appendix B for more information):

- March 29, 2018 - Hood River County NHMP Project Initiation Meeting
- April 19, 2018 – Hood River County NHMP Second Meeting
- May 10, 2018 – Cascade Locks Steering Committee Meeting #1

The City's addendum reflects decisions decided upon at the plan update meeting and during subsequent work and communication with NHMP Update Coordinator.

The Cascade Locks Steering Committee was comprised of the following representatives:

- Convener, Gordon Zimmerman, City of Cascade Locks Administrator/Manager
- Paul Koch, General Manager, Port of Cascade Locks
- Barbara Ayers, Hood River County Emergency Manager
- Brittany Berge, Special Project Coordinator, Port of Cascade Locks
- Nicolia Mehrling, Natural Hazards Planning Coordinator, County Hood River

Public participation was achieved with the establishment of the Steering Committee, which was comprised of city officials representing different organizations and sectors. The Steering Committee was closely involved throughout the development of the plan and served as the local oversight body for the plan's development. In addition, community members outside of the Steering Committee were provided an opportunity for comment via the plan review process (see Appendix A for more information).

The Hood River County NHMP was approved by FEMA on November 9, 2018 and the Cascade Locks addendum was adopted via resolution on September 24, 2018. This NHMP is effective through November 8, 2023.

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3(iv), *Mitigation Strategy*.

During the 2017/2018 Hood River County NHMP update process the County and City Steering Committees re-evaluated the mitigation actions. Following the review actions were updated, noting what accomplishments had been made, and whether the actions were still relevant and if existing language needed to change; any new action items were identified at this time (see Appendix A for more information). Each jurisdiction developed a list of priority actions. The City's priority actions are listed below in Table CLA-1 Cascade Locks Priority Mitigation Action Items. Because this is the first formal addendum for the City of Cascade Locks, all of the 2018 mitigation actions were created during this update.

Ongoing mitigation activities regarding winter storms and wildfires occur at both the City and County level, and are described in the County NHMP in Volume II, the Hazard Annexes, and Appendix B, Planning and Public Process. Routine activities include public outreach, underground utility construction, equipment improvements, volunteer recruitment, and the creation of defensible space. These institutionalized actions are considered a success of the previous NHMP collaborations. Because these activities are ongoing, the Steering

Committee decided not to list them as mitigation actions. As a result, the prioritized mitigation activities do not directly address winter storms or wildfires. However, the multi-hazard actions listed in Table CLA -1 will mitigate these frequent hazards as well.

Table CLA-1 Cascade Locks Priority Mitigation Action Items

Action Item	Action Title	Managing Department/Agency	Timeline	Potential Funding Source
MH #1	Locate temporary offsite location for City Administration; conduct seismic assessment of City Hall to determine risk	City of Cascade Locks - Administration	Long Term (4-5 years)	Local revenue stream
MH #2	Research and develop teleconferencing solution for emergency communications during hazard event; possible join with retrofitting House 3 (Port property)	Port of Cascade Locks	Short Term (2-3 years)	General Fund
WF #1	Update the City Community Wildfire Protection Plan, incorporating changes and lessons learned post Eagle Creek Fire	City of Cascade Locks; Fire Department	Short Term	Grants
EQ #1	Seismically upgrade Bridge of the Gods to withstand strong shaking; implement improvement maintenance schedule	Port of Cascade Locks	Short Term (welding); Long Term (additions)	Federal and state funds, toll revenue

Source: City of Cascade Locks NHMP Steering Committee, 2018.
MH=Multi-Hazard, EQ=Earthquake, WF=Wildfire

Plan Implementation and Maintenance

The City Council will be responsible for adopting the City of Cascade Locks addendum to the Hood River County NHMP. This addendum designates a coordinating body and a convener to oversee the development and implementation of action items. Because the city addendum is part of the county's multi-jurisdictional NHMP, the City will look for opportunities to partner with the county. The City's Steering Committee will convene after re-adoption of the City of Cascade Locks addendum on an annual schedule; the county is meeting on a semi-annual basis and will provide opportunities for the cities to report on NHMP implementation and maintenance during their meetings. The City Administrator will serve as the convener and will be responsible for assembling the Steering Committee (coordinating body). The Steering Committee will be responsible for:

- identifying new risk assessment data,
- reviewing status of mitigation actions,
- identifying new actions, and
- seeking funding to implement the City's mitigation strategy (actions).

The convener will also remain active in the county's implementation and maintenance process (see Volume I, Section 4 for more information).

The City will utilize the same prioritization process as the county (See Volume I, Section 4: Plan Implementation and Maintenance and Volume IV, Appendix D: Economic Analysis for more information).

Implementation through Existing Programs

Many of the recommendations in the Natural Hazards Mitigation Plan are consistent with the goals and objectives of the City's existing plans and policies. Where possible, the City of Cascade Locks will implement the NHMP's 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, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented.

Cascade Locks' acknowledged comprehensive plan is the Cascade Locks Comprehensive Plan. The Oregon Land Conservation and Development Commission first acknowledged the plan in 2001. The City implements the plan through the Cascade Locks Community Development Code and City Zoning Ordinances, which are being updated as of this plan update (2018).

Cascade Locks currently has the following plans, programs, and policies that relate to natural hazard mitigation. For a complete list visit the City website:

Table CLA-2 Legal and Regulatory Resources Available for Hazard Mitigation

Regulatory Tool	Name	Effects on Hazard Mitigation
Plans	Emergency Operations Plan (2015)	Identifies emergency planning, policies, procedures, and response to extraordinary emergency situations associated with natural disasters, technological incidents, and national security emergencies.
	Comprehensive Plan (2001)	The Comprehensive Plan guides development via zoning ordinances and building codes to adhere to safety guidelines.
	Transportation System Plan (2001)	The TSP describes current transportation systems in Cascade Locks and plans upgrades.
	Wastewater Plan (2017)	Provides a description and analysis of wastewater system and outlines planned improvements.
	Water System Plan (2014)	Provides a description and analysis of water system and outlines planned improvements, including hazard risks.
	Business Park and Marine Park Plan	Outlines current uses and future development of Port properties.
	Community Wildfire Protection Plan (2005)	Provides information regarding wildfire risk and makes mitigation recommendations.
Programs	National Flood Insurance Program (NFIP)	Makes affordable flood insurance available to homeowners, business owners, and renters in participating communities. In exchange, those communities must adopt and enforce minimum floodplain management regulations to reduce the risk of damage from future floods.
Policies (Municipal Codes)	Community Development Code	Guides the City of Cascade Locks's community development
	City Zoning Ordinances, including Subdivision Ordinance and Floodplain Ordinance (2018)	Currently updating; regulate land use.

Table CLA-3 Administrative and Technical Resources for Hazard Mitigation

Staff/Personnel Resources	Department/Division Position
Risk Management Committee	Department heads meet quarterly to address risks including hazard-related risks
Public Works; maintenance programs, storm water drainage.	Public works
Engineers with an understanding of manmade or natural hazards	Contracted with City for water, wastewater, and street engineering
Building Official, Emergency Manager, GIS Coordinator, 911 services provided by County	Hood River County
Finance (grant writers, purchasing)	City Administrator

Table CLA-4 Financial Resources for Hazard Mitigation

Financial Resources	Effect on Hazard Mitigation
Authority to levy taxes for specific purposes	City has this resource, but has not used it
Incur debt through private activity bonds	Provides infrastructure maintenance and improvement funding
Incur debt through special tax and revenue bonds or general obligation bonds	City has this resource, but has not used it
State grants (USDA and Business Oregon grants and loans)	Capital Improvement projects and retrofits funded
Fees for utlity services (water, sewer, electric)	Maintains City personnel operating funds
Impact fees for new development	Enhances City operations and services

Note: See Appendix E – Grant Programs for additional financial resources.

Continued Public Participation

Keeping the public informed of the City's efforts to reduce the City's risk to future natural hazards events is important for successful plan implementation and maintenance. The City is committed to involving the public in the plan review and updated process. See Volume I, Section 4, for more information.

Plan Maintenance

The Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan and city addendum will be updated every five years in accordance with the update schedule outlined in the Disaster Mitigation Act of 2000. During the county plan update process, the City will also review and update its addendum. The convener will be responsible for convening the Steering Committee to address the questions outlined below.

- Are there new partners that should be brought to the table?
- Are there new local, regional, state, or federal policies influencing natural hazards that should be addressed?
- Has the community successfully implemented any mitigation activities since the plan was last updated?
- Have new issues or problems related to hazards been identified in the community?
- Are the actions still appropriate given current resources?
- Have there been any changes in development patterns that could influence the effects of hazards?
- Have there been any significant changes in the community's demographics that could influence the effects of hazards?
- Are there new studies or data available that would enhance the risk assessment?
- Has the community been affected by any disasters? Did the plan accurately address the impacts of this event?

These questions will help the Steering Committee determine what components of the mitigation plan need updating. The Steering Committee will be responsible for updating any deficiencies found in the plan.

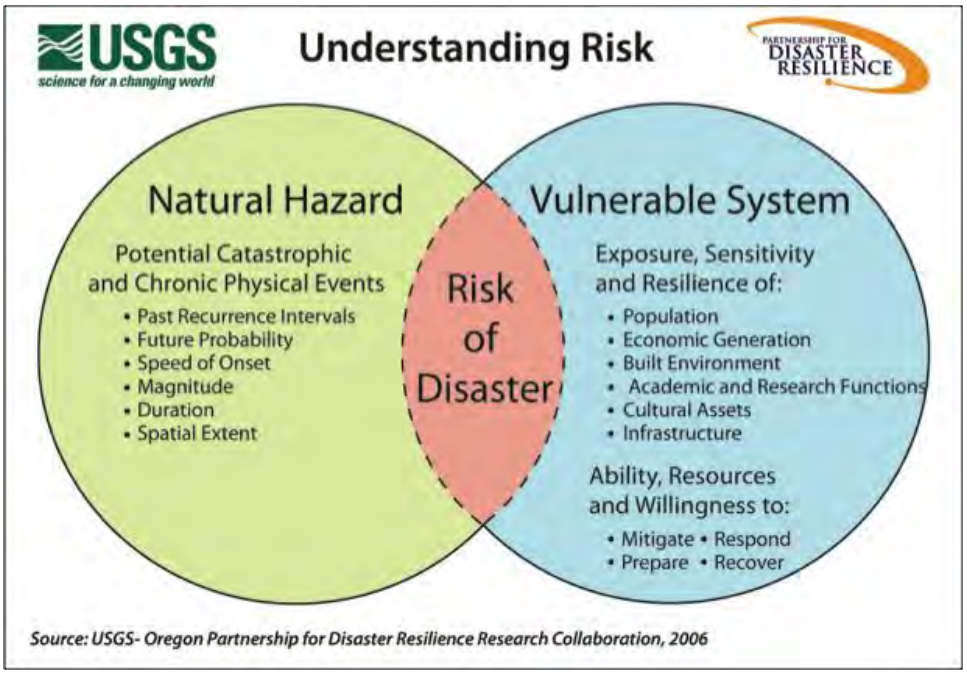
Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk has three phases:

- **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 local level rationale for the identified mitigation strategies (action items) is presented herein, and within Section 2, *Risk Assessment*, and Appendix C, *Community Profile*. The risk assessment process is graphically depicted in Figure CLA-1 below. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure CLA-1 Understanding Risk



Hazard Analysis Methodology

This NHMP utilizes a hazard analysis methodology that was first developed by FEMA circa 1983, and gradually refined by the Oregon Military Department's Office of Emergency Management (OEM) 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 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%.

This 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 shown in the table below. See Volume I, Section 2 (Risk Assessment) for more information.

Hazard Analysis

The Cascade Locks Steering Committee developed their hazard vulnerability assessment (HVA), using the county's HVA as a reference. Changes from the county's HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to Cascade Locks, which are discussed throughout this addendum.

Table CLA-5 shows the HVA matrix for Cascade Locks showing each hazard listed in order of rank from high to low. 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 sense of hazard priorities, but does not predict the occurrence of a particular hazard.

Three chronic hazards (winter storms, wildfires, and landslides) rank as the top hazard threats to the City. One catastrophic hazard (Cascadia Subduction Zone earthquake) also warranted a top ranking. The Crustal Earthquakes and Windstorm hazards comprise the next highest ranked hazards, while flood, volcano, and drought hazards comprise the lowest ranked hazards.

Table CLA-5 Hazard Analysis Matrix – Cascade Locks

Hazard	History	Probability	Vulnerability	Maximum Threat	Total	Rank	Risk Level
Winter Storm	9	10	9	10	**233**	**1**	**High**
Wildfire	9	9	7	9	**206**	**2**	**High**
Landslide	7	8	8	8	**190**	**3**	**High**
CSZ Event	2	6	8	9	**176**	**4**	**High**
Crustal Earthquake	2	4	5	6	**117**	**5**	**Moderate**
Windstorm	3	4	4	5	**104**	**6**	**Moderate**
Flood	3	4	3	5	**99**	**7**	**Low**
Volcano	2	2	3	4	**73**	**8**	**Low**
Drought	1	1	1	1	**24**	**9**	**Low**

Source: Cascade Locks NHMP Steering Committee, 2018.

Table CLA-6 categorizes the probability and vulnerability scores from the hazard analysis for the City and compares the results to the assessment completed by the Hood River County NHMP Steering Committee (areas of differences are noted with **bold** text within the City ratings). The City ranked their vulnerability to wildfires, landslides and a Cascadia Subduction Zone earthquake event as higher than the county, and their drought vulnerability as lower.

Table CLA-6 Probability and Vulnerability Comparison

	Cascade Locks		County	
Hazard	**Probability**	**Vulnerability**	**Probability**	**Vulnerability**
Winter Storm	High	High	High	High
Wildfire	High	**High**	High	Moderate
CSZ Event	Moderate	**High**	Moderate	Moderate
Landslide	**High**	**High**	Moderate	Moderate
Drought	**Low**	**Low**	Moderate	Moderate
Flood	Moderate	Low	Moderate	Low
Crustal Earthquake	Moderate	Moderate	Moderate	Moderate
Windstorm	Moderate	Moderate	Moderate	Moderate
Volcano	**Low**	Low	Low	Moderate

Source: Cascade Locks NHMP Steering Committee and Hood River County NHMP Steering Committee, 2018.

Community Asset Identification

This section provides information on City specific assets. For additional information on the characteristics of Cascade Locks, in terms of geography, environment, population, demographics, employment and economics, as well as housing and transportation see Volume IV, Appendix C, *Community Profile*. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the City specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

Community Characteristics

Cascade Locks is located in the westernmost area of the Columbia Gorge covering an area of about 3.04 square miles, 0.96 of which are water.[1] The climate of Cascade Locks is moderate; the average monthly temperatures range from 55 – 80 degrees in July and August, and 33-41 degrees in December and January. The City receives approximately 76 inches of rain and 33 inches of snow each year[2]. It receives more rainfall than the areas both east and west. Monthly precipitation is about 9-13 inches during the wetter months of November – March, and average about 1-6 inches during the drier months of June - September. The City's topography ranges from flat to steeply sloped, and includes riparian and forested lands. The City lies between the Columbia River to the north and the western slopes of the Cascade Range to the south. It is bounded by the Columbia Gorge National Scenic Area.

1 "US Gazetteer files 2010". United States Census Bureau.
2 Western Regional Climate Center, "Cascade Locks, OR (351407)". Retrieved May 1, 2018.

From 2015-2018, 90 new homes were added to Cascade Locks; the City previously included 450 housing units, making this 20% growth. New development has complied with the standards of the Oregon Building Code and the County's development code including their floodplain ordinance. Over the same time period 10 new businesses employing 60 employees total began operating in the City.[3] The City is experiencing growth and transition.

Current infrastructure projects include the replacement of 15,000 feet of water pipeline. A waste water improvement project, an electrical system improvement project, and a complete bridge replacement project are planned over the next 5, 3, and 50 years respectively. The City of Cascade Locks intends to incorporate seismic retrofitting in these capital improvement projects.[4]

The City of Cascade Locks has historically experienced high turnover in elected officials, and in recent years has not had a sufficient quorum of city council members on two extended occasions. The past few years have seen increased engagement and participation in city leadership.

Economy

The median household income in Cascade Locks is $32,443, significantly below that of Hood River County and the state.[5] Cascade Locks' primary industries are manufacturing, transportation and warehousing, and arts, recreation, entertainment, accommodation and food service.[6] Port property houses many manufacturing and warehousing operations. Other employment drivers include local government, federal forest agency, and the school district. Retail and recreation industries thrive during high-tourist summer months, when Cascade Locks is a top tourist destination.[7]

Population Characteristics

22% of the Cascade Locks population is over 65 years old, and 19% is under 18 years old. 80% of the workforce commutes to either Hood River City to the east or Portland and Gresham to the west. Additionally, all children in grades 6 through 12 bus daily to the City of Hood River for school.[8] If an incident were to occur during the day time, it is likely that families would be separated. Almost two thirds of the population (60%) lives below the federal poverty level, indicating that personal preparedness and resiliency levels are likely to be low.[9] It should be noted that Census data can be inaccurate at the small city level; local officials agree that the poverty level is above half of the population. The unemployment rate is 17%, significantly higher than the County overall.[10]

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3 Gordon Zimmerman, City Administrator, Personal Communication April 10, 2018
4 Ibid.
5 ACS 2016 (5-Year Estimates) (SE), ACS 2016 (5-Year Estimates), Social Explorer Table 57; U.S. Census Bureau
6 ACS 2016 (5-Year Estimates) (SE), ACS 2016 (5-Year Estimates), Social Explorer Table 49; U.S. Census Bureau
7 Gordon Zimmerman, personal communication. April 10, 2018
8 Gordon Zimmerman, Personal Communication, April 10, 2018
9 ACS 2016 (5-Year Estimates) (SE), ACS 2016 (5-Year Estimates), Social Explorer Tables 114, 115, 116; U.S. Census Bureau
10 Social Explorer Tables: ACS 2016 (5-Year Estimates) (SE), ACS 2016 (5-Year Estimates), Social Explorer Table T37; U.S. Census Bureau

Asset Inventory

Asset inventory is the first step of a vulnerability analysis. Assets that may be affected by hazard events include population, residential and nonresidential buildings, critical facilities, and infrastructure. Of note, Cascade Locks owns and manages its water and electric utilities.

The asset inventory delineates the City's existing building and infrastructure assets in detail in Table CLA-7.

Table CLA-7 Cascade Locks Critical Facilities and Infrastructure

Facility Type	Name	Address
Government	City Hall, Public Works	140 SW Wanapa Street
	Port Facilities	427 SW Portage Road
Emergency Response	Cascade Locks Fire District	25 Wa Na Pa Street
	CL Elementary School Bomb Shelter	300 SW Wanapa Street
	Ruckle Creek Floods Lift Station	
	Pavilion and House 3 (Shelter site)	
	Cascade Locks Airport (Emergency only)	Forest Lane
Community	Marine Park	427 SW Portage Road
	Historical Houses	427 SW Portage Road
	Thunder Island Brewery	515 SW Portage Rd
	Columbia Market	450 Wa Na Pa Street
State and Federal Highways	I-84	
Railroads	Union Pacific	
Bridges	Bridge of the Gods	
Transportation Facilities	Sternwheeler Boat/Dock (for evacuation)	Marina Park
Utilities	City of Cascade Locks Power Utility (2 substations)	140 SW Wanapa Street
	Bonneville Power Administration	
	City Water and Sewer	140 SW Wanapa Street
Fuel	Chevron Gas Station	437 Wa Na Pa Street
	Shell Gas Station	425 Wa Na Pa Street
Education	Cascade Locks Elementary School	300 SW Wanapa St

Source: Cascade Locks Steering Committee, May 2018

See hazard sections below and Section 2, *Risk Assessment*, for potential hazard vulnerabilities to these facilities.

Hazard Characteristics

Related to this NHMP update process, FEMA is providing an opportunity for the County and City to participate in a Risk Mapping, Assessment, and Planning (Risk MAP) process that generates additional data on risks and vulnerabilities of natural hazards. The Risk Report, prepared by the Oregon Department of Geology and Mineral Industries (DOGAMI) provides a quantitative risk assessment that informs communities of their risks related to certain natural hazards (including earthquake, flood, lahar (volcanic event), landslide, and wildfire). The City hereby incorporates the preliminary Risk Report into this NHMP by reference to provide greater detail to hazard sensitivity and exposure. The full report can be accessed on the DOGAMI Interpretive Map Series webpage: http://www.oregongeology.org/pubs/ims/p-ims.htm.

Drought

The Steering Committee determined that the City's probability for drought is **low** (which is lower than the County's rating) and that their vulnerability to drought is **low** (which is lower than the County's rating).

Volume I, Section 2, *Risk Assessment*, adequately describes the characteristics of drought hazards, as well as the location and extent of a potential event. Moderate droughts occur regularly in Hood River County, primarily impacting the agricultural industry. Cascade Locks aquifer releases 8-16 cubic feet/second of water, of which the City uses an insignificant portion. The lowest rainfall on record was in 1885, which precipitation was 50 inches.[11]

Cascade Locks' primary water supply comes from 2 wells sunk into the Herman Creek aquifer. The City has one old reservoir, is abandoning another reservoir, and building a new reservoir in 2018. Together the City will have approximately 900,000 gallons of storage capacity. The City does not have a water treatment plant, and instead adds chlorine to the well water to treat the water. In general, the City has 4.0 cubic feet per second (cfs) of water right from the Herman Creek Aquifer, but utilizes less than .25 cfs currently. The capacity of the aquifer has been measured between 8 and 15 cfs depending on the time of year. In general, water supply is available and sufficient.[12]

Earthquake

The Steering Committee determined that the City's probability for a Cascadia Subduction Zone (CSZ) Earthquake event is **moderate** (which is the same as the County's rating) and that their vulnerability to a Cascadia Earthquake event is **high** (which is higher than the County's rating). The Steering Committee determined that the City's probability for a Crustal Earthquake event is **moderate** (which is the same as the County's rating) and that their vulnerability to a Crustal Earthquake event is **moderate** (which is the same as the County's rating).

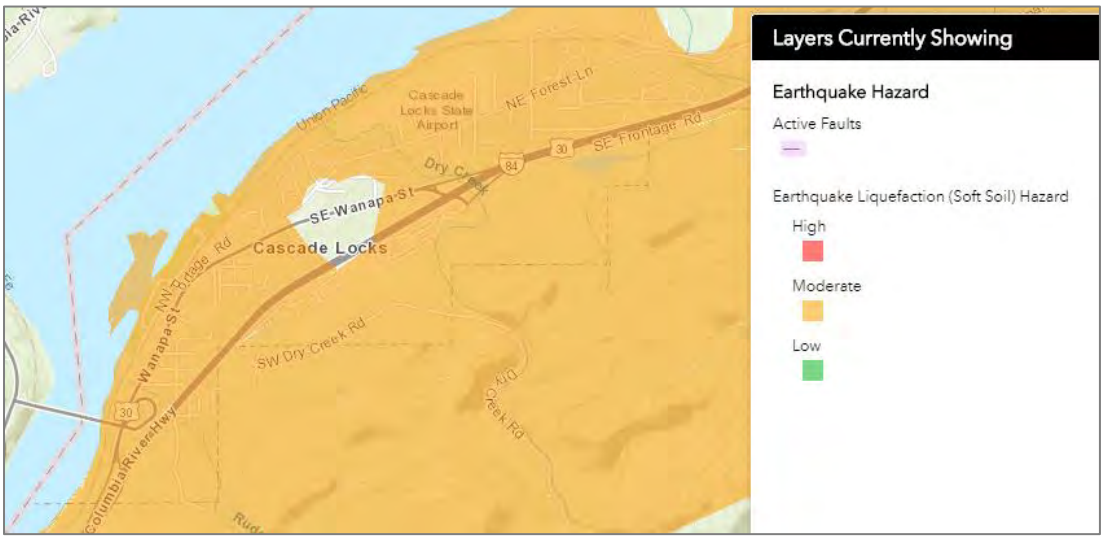
Volume I, Section 2, *Risk Assessment*, adequately describes the characteristics of earthquake hazards, history, as well as the location and extent of a potential event. Generally, an event

[11] City of Cascade Locks Steering Committee, May 10, 2018
[12] Gordon Zimmerman, City of Cascade Locks City Administrator, Personal Communication, 6/1/2018

that affects the County is likely to affect Cascade Locks more severely. The liquefaction potential is greater for Cascade Locks, and expected shaking is stronger as well. The causes and characteristics of an earthquake event are appropriately described within the County's NHMP, as well as the location and extent of potential hazards. Previous occurrences are well-documented within the County's plan. The community impacts described by the County would occur in Cascade Locks to a greater extent: weak buildings would collapse and stable buildings would suffer damages.

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building and soil characteristics. Presently, it is not possible to accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any particular site. In many major earthquakes, damages have primarily been caused by the behavior of the soil. Figure CLA-2 displays relative liquefaction hazards. As shown, the entire City is subject to moderate soil liquefaction.

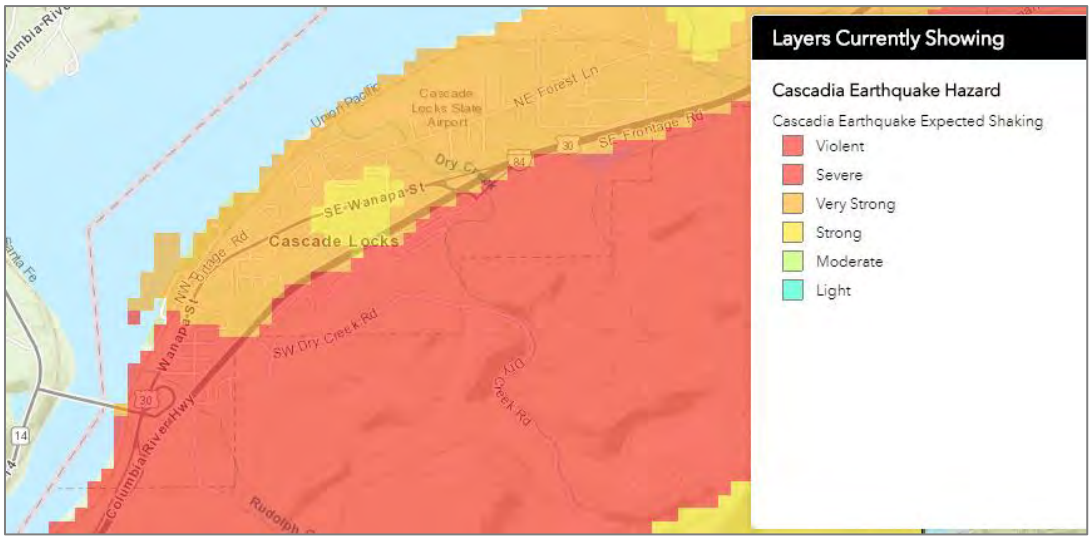
Figure CLA-2 Active Faults and Soft Soils



Source: [Oregon HazVu: Statewide Geohazards Viewer (DOGAMI), accessed on 5/2/2018]

Figure CLA-3 below shows the expected shaking/ damage potential for Cascade Locks because of a Cascadia Subduction Zone (CSZ) earthquake event. The figure shows that the City will experience "very strong" to "severe" shaking that will last two to four minutes. The shaking will be extremely damaging to lifeline transportation routes including Interstate 84, the interstate Bridge of the Gods, and the Union Pacific Railroad. For more information on expected losses due to a CSZ event see the Oregon Resilience Plan.

Figure CLA-3 Cascadia Subduction Zone Expected Shaking



Source: [Oregon HazVu: Statewide Geohazards Viewer (DOGAMI) accessed on 5/2/2018]

As noted in the Community Profile, Appendix C, approximately 79% of residential buildings were built prior to 1990, which increases the City's vulnerability to the earthquake hazard. Information on specific public buildings' (schools and public safety) estimated seismic resistance, determined by DOGAMI in 2007, is shown in Table CLA-8; each "X" represents one building within that ranking category. Of the facilities evaluated by DOGAMI using RVS, one (1) has a very high (100% chance) collapse potential, and three (3) have a moderate (1-10%) collapse potential.

In addition to building damages, utility (electric power, water, wastewater, and transportation systems (bridges, pipelines) are also likely to experience significant damage. The Bridge of the Gods is the first Columbia River crossing east of Portland, and is likely to experience damage. A 15 year improvement plan is underway that will include 80% of seismic enhancements recommended.[13]

Utility systems will be significantly damaged, including damaged buildings and damage to utility infrastructure, including water treatment plants and equipment at high voltage substations (especially 230 kV or higher which are more vulnerable than lower voltage substations). Buried pipe systems will suffer extensive damage with approximately one break per mile in soft soil areas. There would be much lower rate of pipe breaks in other areas. Restoration of utility services will require substantial mutual aid from utilities outside of the affected area.

[13] Port of Cascade Locks General Manager, Paul Koch, May 10 2018

Table CLA-8 Rapid Visual Survey Scores

Facility	Site ID*	Level of Collapse Potential: Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Cascade Locks FD	Hood_fir06		X		
Cascade Locks School	Hood_sch08		X,X		X

Source: DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment. "*" – Site ID is referenced on the RVS Hood River County Map

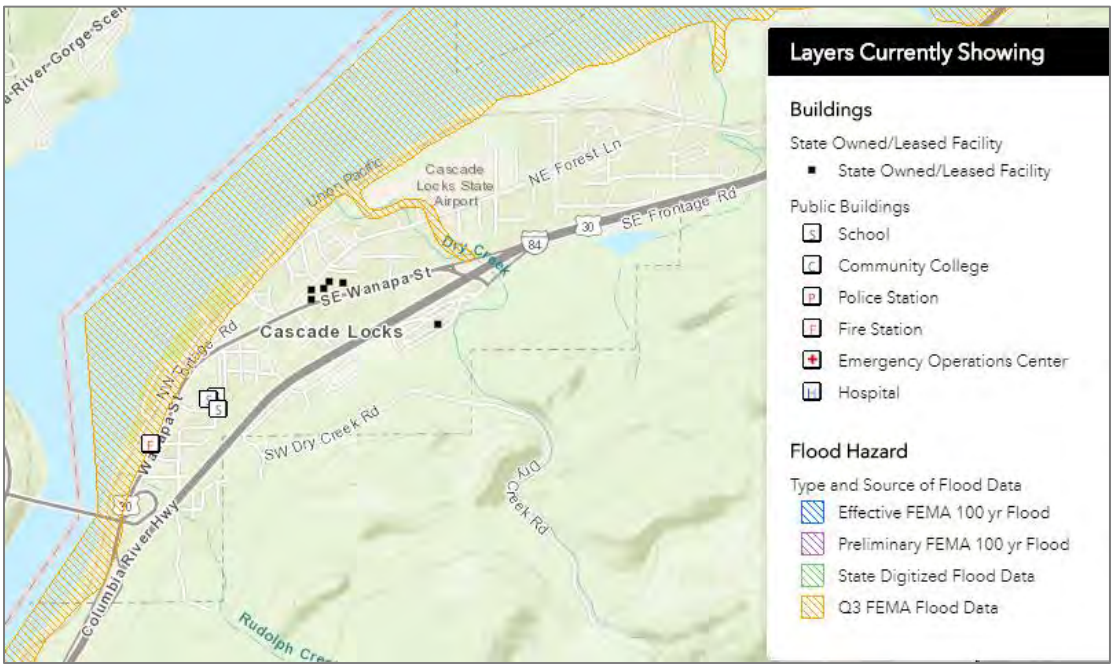
Please review the Risk Assessment (Volume I, Section 2) for additional information on this hazard.

Flood

The Steering Committee determined that the City's probability for flood is **moderate** (which is the same as the County's rating) and that their vulnerability to flood is **low** (which is the same as the County's rating).

Volume I, Section 2, *Risk Assessment*, adequately describes the causes and characteristics of flooding hazards within the region, as well as previous flooding occurrences. General flood-related community impacts are adequately described within the Flood Hazard Annex of Hood River County's Natural Hazards Mitigation Plan. Portions of Cascade Locks have areas of floodplains (special flood hazard areas). These include areas along Dry Creek and bordering the Columbia River (see Figure CLA-4). However, damage from floods has been insignificant historically.

Figure CLA-4 Special Flood Hazard Area



Source: Oregon HazVu: Statewide Geohazards Viewer (DOGAMI) accessed on 5/2/2018

National Flood Insurance Program (NFIP)

FEMA has not modernized the Cascade Locks Flood Insurance Rate Maps (FIRMs); the FIRMs are the originals from 1984. Table CLA-10 shows that as of February 2018, Cascade Locks has three National Flood Insurance Program (NFIP) policies in force. Of those, two are for properties that were constructed before the initial FIRM. Cascade Locks is not a member of the Community Rating System (CRS). There has been a total of one (1) paid claim for $3,477.

The Community Repetitive Loss record for Cascade Locks identifies no Repetitive Loss Properties[14] and no Severe Repetitive Loss Properties[15].

Table CLA-10 Flood Insurance Detail

Jurisdiction	FIRM Date	# NFIP Policies	Total Coverage	# NFIP Claim	Total Paid
Hood River County	9/24/1984	32	$9,822,900	3	$29,616
Cascade Locks	9/24/1984	3	$818,000	1	$3,477

Source: Information compiled by Department of Land Conservation and Development, February 2018.

Landslide

The Steering Committee determined that the City's probability for landslide is **high** (which is higher than the County's rating) and that their vulnerability to landslide is **high** (which is the higher than the County's rating).

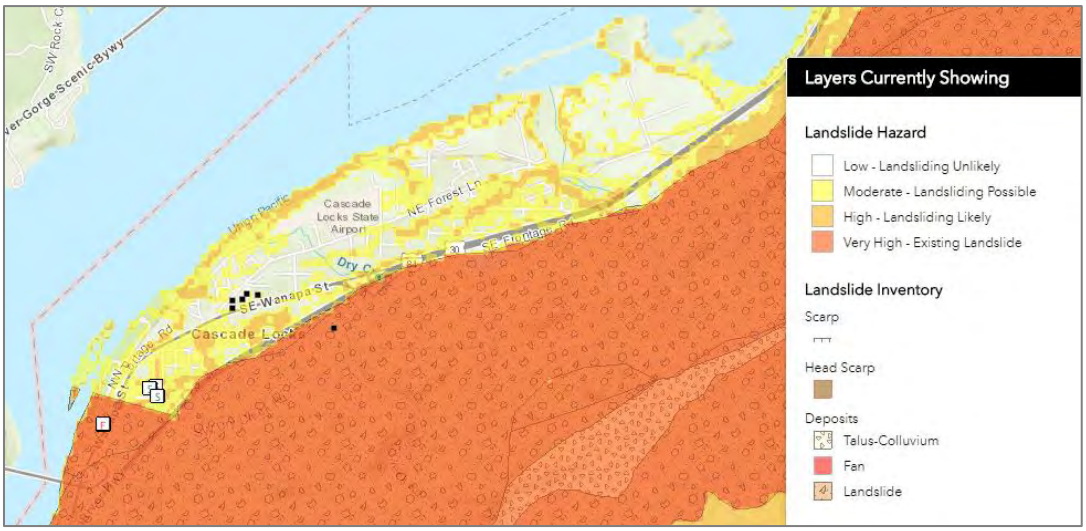
Volume I, Section 2, *Risk Assessment*, adequately describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. The potential for landslide in Cascade Locks is high, especially in the steeply sloped areas to the south of I-84. Landslide susceptibility exposure for Cascade Locks is shown in Figure CLA-5. Approximately 25.1% of Cascade Locks has Very High, 8.7% High, and approximately 14.6% Moderate, landslide susceptibility exposure[16] (nearly 50% of the City land has higher than "Low" landslide susceptibility). Landslide susceptibility does not guarantee a landslide will occur, but rather indicates higher and lower likelihood based on risk factors present. Some parts of the City are protected by ridges which would halt major debris flows from Mt. Hood. The communities south of I-84, including Warrandale and Dodson are most at risk, as is the highly vulnerable houseless population that resides within Cascade Locks.

[14] 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.

[15] 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.

[16] DOGAMI Open-File Report, O-16-02, Landslide Susceptibility Overview Map of Oregon (2016)

Figure CLA-5 Landslide Susceptibility Exposure



Source: [Oregon HazVu: Statewide Geohazards Viewer (DOGAMI) accessed on 5/2/2018]

Potential landslide-related impacts are described within the County's NHMP, and include infrastructural damages, economic impacts (due to isolation and/or arterial road closures), property damages, and obstruction to evacuation routes. Rain-induced landslides and debris flows can potentially occur during any winter in Hood River County, and highway and other major roads beyond City limits are susceptible to obstruction as well. Landslides have historically blocks major roads and cut off transportation about once every ten years.

Please review the Risk Assessment (Volume I, Section 2) for additional information on this hazard.

Volcano

The Steering Committee determined that the City's probability for volcanic event is **low** (which is the same as the County's rating) and that their vulnerability to volcanic event is **low** (which is lower than the County's rating).

Volume I, Section 2, *Risk Assessment*, adequately describes Cascade Locks' risk to volcanic events. Generally, an event that affects the County is likely to affect Cascade Locks as well, but less severely than the Hood River Valley to the east. The causes and characteristics of a volcanic event are appropriately described within the County's plan, as well as the location and extent of potential hazards. Previous occurrences are well-documented within the County's plan, and the community impacts described by the County would generally be the same for Cascade Locks as well. Cascade Locks is very unlikely to experience anything more than volcanic ash during a volcanic event. When Mt. Saint Helens erupted in 1980, the City of Hood River to the east received ash fall, but Cascade Locks did not have any impacts.

Due to the nature of the hazard, it is impossible to predict the location or extent of future events with any probability, although it can be assumed that all residential and critical facilities and infrastructure within the City of Cascade Locks are at risk.

Please review the Risk Assessment (Volume I, Section 2) for additional information on this hazard.

Wildfire

The Steering Committee determined that the City's probability for wildfire is **high** (which is the same as the County's rating) and that their vulnerability to wildfire is **high** (which is higher than the County's rating).

Volume I, Section 2, *Risk Assessment*, adequately describes the causes and characteristics of wildfires, as well as the County and City's history of wildfire events. Several significant wildfire events have occurred in Cascade Locks, the most recent being the Eagle Creek Fire (2017), a declared conflagration which was the top priority fire nationally for two weeks. The location and extent of wildfires vary depending on fuel, topography, and weather conditions. Adjacency to forest land and steep slopes create conditions conducive to wildfires. Cascade Locks experiences higher wind speeds than the rest of the County. Current vulnerability may be decreased by the recent fire consumed available fuel.

The potential community impacts and vulnerabilities described in the County's NHMP are generally accurate for the City as well. Hood River County developed a Community Wildfire Protection Plan (CWPP) in 2013, which mapped wildland urban interface areas and developed actions to mitigate wildfire risk). The City is a participant in the CWPP and will update the City's wildfire risk assessment if the CWPP presents better data during future updates. The City created a stand-alone Wildfire Fire Protection Plan in 2006 and plans to update it in the next five years.

History:

- September –November 2017, Eagle Creek Fire, Columbia Gorge National Scenic area, 1 mile south of Cascade Locks (FM-5203).
    - The fire grew to 3,000 acres the first night. During the night of September 4th and 5th, east winds, combined with excessive heat caused the fire rapidly increase in size pushing westward. Total acres burned is 48,831. (100% contained on 11/30/2017) Irrigated agricultural land surrounds much of Cascade Locks, thereby reducing the risk to wildfire to the City.

The Hood River County CWPP provides some risk and vulnerability information related to Cascade Locks that has been incorporated into this plan as applicable.[17]

Please review the Risk Assessment (Volume I, Section 2) for additional information on this hazard.

Windstorm

The Steering Committee determined that the City's probability for windstorm is **moderate** (which is the same as the county's rating) and that their vulnerability to windstorm is **moderate** (which is the same as the county's rating).

[17] Hood River County Wildfire Protection Plan, 2013. See pages 127 for Cascade Locks specific information.

Volume I, Section 2, *Risk Assessment*, adequately describes the causes and characteristics of windstorms, as well as the location and extent of windstorm hazards. The region's (and City's) history of events is adequately described within the county's plan as well. Because windstorms typically occur during winter months, they are sometimes accompanied by ice, freezing rain, flooding, and very rarely, snow. For the purposes of this plan, windstorms are considered an individual hazard, distinct from winter storms. Alone, they have much lower potential to affect the City. Winds are a frequent, almost constant occurrence in Cascade Locks, and Crown Point, an area at higher elevation than the City, saw 115-130 mph winds in 2016.[18] The neighborhoods located on high ridgelines to the south of the City are most susceptible to damage. North south winds, more rare, frequently down trees.

Hood River County's plan adequately describes the impacts caused by windstorms, including power outages, downed trees, and storm-related debris. Transportation and economic disruptions are secondary results. Cascade Locks experiences wind related power outages twice annually. The City clears its utility lines and BPA clears transmission lines as part of routine management. 40% of power lines are understand as of 2018, with efforts to continue transitioning lines underground.

Due to the nature of the hazard, it is impossible to predict the location or extent of future events with any probability, although it can be assumed that all residential and critical facilities and infrastructure within Cascade Locks are at risk.

Please review the Risk Assessment (Volume I, Section 2) for additional information on this hazard.

Winter Storm

The Steering Committee determined that the City's probability for winter storm is **high** (which is the same as the county's rating) and that their vulnerability to winter storm is **high** (which is the same than the county's rating).

Volume I, Section 2, *Risk Assessment*, adequately describes the causes and characteristics of winter storms, as well as the location and extent of winter storm hazards. In general, Cascade Locks experiences more rain and higher severity of winter storm impacts. The region's (and City's) history of events is adequately described within the county's plan. Severe winter storms can consist of rain, freezing rain, ice, snow, extreme cold, sleet, and wind. They originate from frigid air moving westward out of the Wallowa Mountains through the Columbia River. Mid-latitude storms approaching from the West are forced to rise as they encounter the Cascades, releasing large amounts of precipitation on the western slopes. Cascade Locks is located in the narrowest part of the Gorge, so wind speeds are higher. These storms are most common from November through March and are an annual occurrence. Prolonged heavy rains cause the ground to become saturated and often result in local flooding and landslides. The 2017 Eagle Creek Fire damage trees in the slopes above Cascade Locks; it is estimated that as their roots decay over the next 5 years, the trees will fall and winter storm associate debris flow will increase.

[18] City of Cascade Locks Steering Committee, May 10, 2018

Major winter storms can and have occurred in the Cascade Locks area, and while they typically do not cause significant damage, they are frequent and have the potential to impact economic activity. Road closures on major roads due to winter weather can interrupt commuter and large truck traffic, including food and fuel supply. Road closures occur annually.

Due to the nature of the hazard, it is impossible to predict the location or extent of future events with any probability, although it can be assumed that all residential and critical facilities and infrastructure within Cascade Locks are at risk.

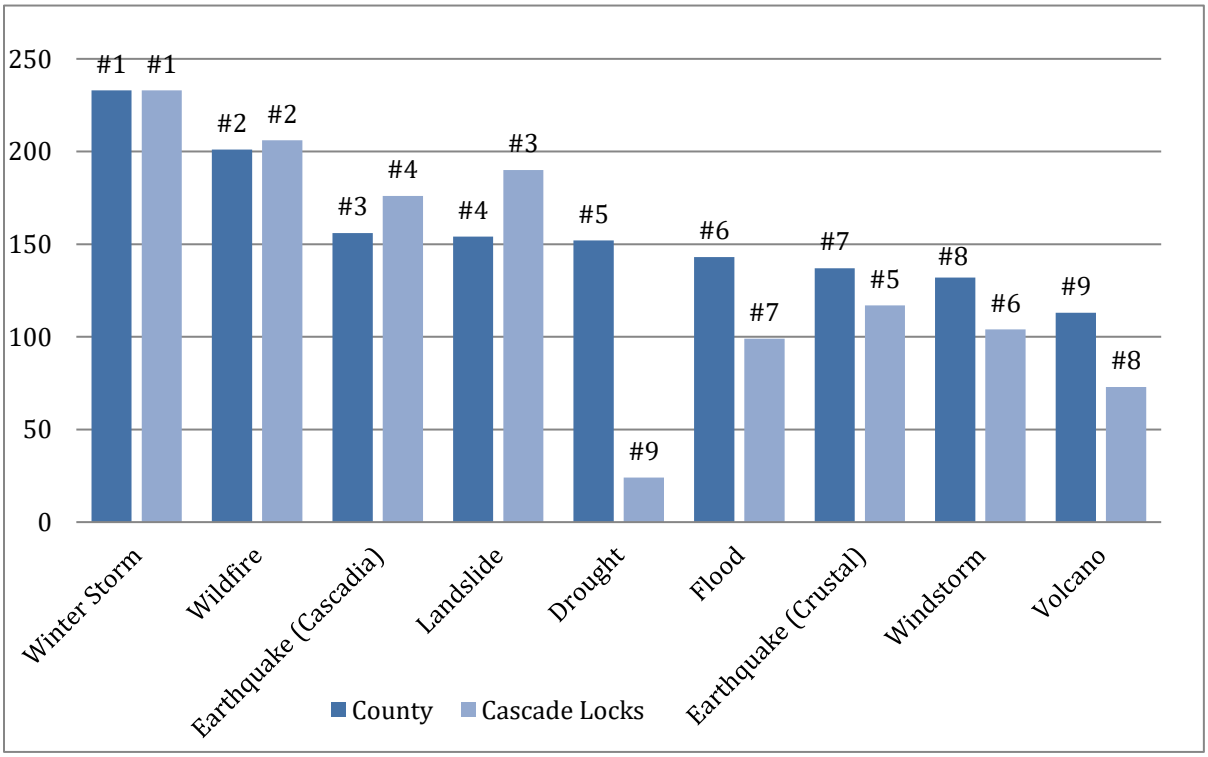
Please review the Risk Assessment (Volume I, Section 2) for additional information on this hazard.

Summary

Figure CLA-6 presents a summary of the hazard analysis for the City of Cascade Locks and compares the results to the assessment completed by Hood River County.

The City rated their threat from the Cascadia Subduction Zone earthquake, landslides, and floods higher than the county, and their threat from drought, flood, crustal earthquakes, and wind storms lower than the county.

Figure CLA-6 Overall Hazard Analysis Comparison–Hood River County/ Cascade Locks



Source: City of Cascade Locks NHMP Steering Committee and Hood River County NHMP Steering Committee

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CITY OF HOOD RIVER ADDENDUM

Purpose

This document serves as the City of Hood River's Addendum to the Hood River County Multi-Jurisdiction Natural Hazards Mitigation Plan (MNHMP, NHMP). This addendum supplements information contained in Volume I (Basic Mitigation Plan) of this NHMP, which serves as the foundation for this jurisdiction's addendum, and Volume IV (Mitigation Resources), which provides additional information (particularly regarding participation and mitigation strategy). This addendum meets the following requirements:

- Multi-jurisdictional **Plan Adoption** §201.6(c)(5),
- Multi-jurisdictional **Participation** §201.6(a)(3),
- Multi-jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv), and
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii).

Plan Process, Participation, and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(c)(5), *Plan Adoption*, and 44 CFR 201.6(a)(3), *Participation.*

In January 2018, the Department of Land Conservation and Development (DLCD) partnered with the University of Oregon's Institute for Policy Research and Engagement (IPRE): the Oregon Partnership for Disaster Resilience (OPDR) and the Resource Assistance for Rural Environments (RARE) program, and Hood River County and the Cities, including City of Hood River and Cascade Locks, to update their NHMP, which expired December 16, 2017. This project is funded through the Federal Emergency Management Agency's (FEMA) FY16 Pre-Disaster Mitigation Competitive Grant Program). After funding was awarded in July 2017 to DLCD for two PDM 16 grants (PDMC-PL-10-2016-003 and PDMC-PL-10-2016-005), a regional kickoff meeting for all eight counties involved in the PDM 16 grants was held on July 18, 2017.

To be eligible to receive certain pre- and post-disaster natural hazard mitigation funds from FEMA, local governments must have a current, FEMA-approved NHMP. NHMPs must be updated and re-approved every five years. By developing this addendum to the Hood River County NHMP, locally adopting it, and having it approved by FEMA, the City of Hood River will regain eligibility for FEMA Hazard Mitigation, Pre-Disaster Mitigation, and Flood Mitigation Assistance grant program funds.

The Hood River County NHMP, and Hood River City addendum, are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private sector, and regional organizations. A project Steering Committee guided the process of developing the plan. For more information on the composition of the Steering Committee see the *Planning and Public Process* (Volume IV, Appendix B).

The Planning Director of the City of Hood River is the designated local convener and will take the lead in implementing, maintaining, and updating the addendum to the NHMP in collaboration with the designated convener of the Hood River County NHMP (County Emergency Management).

Representatives from the City of Hood River Steering Committee convened on the following occasions (see Appendix B for more information):

- March 29, 2018 - Hood River County NHMP Project Initiation Meeting
- April 19, 2018 – Hood River County NHMP Second Meeting
- May 15, 2018 – Hood River City Steering Committee Meeting #1

The City's addendum reflects decisions decided upon at the plan update meeting and during subsequent work and communication with NHMP Update Coordinator.

The Hood River City Steering Committee was comprised of the following representatives:

- Convener, Dustin Nilsen, City of Hood River Planning Director
- Leonard Damian, Fire Chief, City of Hood River Fire Department
- Mark Lago, Director of Public Works, City of Hood River Public Works
- Don Cheli, Lieutenant, City of Hood River Police

Public participation was achieved with the establishment of the Steering Committee, which was comprised of city officials representing different organizations and sectors. The Steering Committee was closely involved throughout the development of the plan and served as the local oversight body for the plan's development. In addition, community members outside of the Steering Committee were provided an opportunity for comment via the plan review process (see Appendix A for more information).

The Hood River County NHMP was approved by FEMA on November 9, 2018 and the City of Hood River addendum was adopted via resolution on October 9, 2018. This NHMP is effective through November 8, 2023.

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3(iv), *Mitigation Strategy*.

During the 2018 Hood River County update process the County and local Steering Committees re-evaluated the Action Items. Following the review actions were updated, noting what accomplishments had been made, and whether the actions were still relevant; any new action items were identified at this time (see Appendix A for more information). Each jurisdiction developed a list of priority actions in an effort to focus attention on an achievable set of high leverage activities over the next five-years. The city's actions are listed below in Table HRA-1. Because this is the first formal addendum for the City of Hood River, all of the 2018 mitigation actions were created during this update.

Table HRA-1 City of Hood River Action Items

Action Item	Action Title	Managing Department/Agency	Timeline	Potential Funding Source(s)
MH #1	Identify and construct site for new police department	City of Hood River Police, City Hood River Administration	Long Term (3-5 years)	Debt/Bond
MH #2	Build GIS layers for public outreach map including evacuation routes, hazard education, risk areas	City of Hood River Public Works	Short Term (1-2 years)	Local sources
WH #1	Update Community Wildfire Protection Plan with Eagle Creek Fire lessons learned and after action plans	Hood River County Emergency Management	Short Term (2019)	Local sources
WH #2	Update building codes with more robust building features for houses in WUI	City of Hood River Building Department	Short Term (1-2 years); ongoing	Local sources
EH #1	Replace Hood River-White Salmon bridge to withstand strong shaking	Port of Hood River	Long Term (15 years)	General Fund; bridge tolls, private investment

Source: City of Hood River NHMP Steering Committee, 2018.
MH=Multi-Hazard, EH=Earthquake Hazard, WH=Wildfire Hazard

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Plan Implementation and Maintenance

The City Council will be responsible for adopting the City of Hood River addendum to the Hood River County NHMP. This addendum designates a coordinating body and a convener to oversee the development and implementation of action items. Because the city addendum is part of the county's multi-jurisdictional NHMP, the city will look for opportunities to partner with the county. The city's Steering Committee will convene after re-adoption of the City of Hood River addendum on an annual schedule; the county is meeting on a semi-annual basis and will provide opportunities for the cities to report on NHMP implementation and maintenance during their meetings. The City Planning Director will serve as the convener and will be responsible for assembling the Steering Committee (coordinating body). The Steering Committee will be responsible for:

- identifying new risk assessment data,
- reviewing status of mitigation actions,
- identifying new actions, and
- seeking funding to implement the city's mitigation strategy (actions).

The convener will also remain active in the county's implementation and maintenance process (see Volume I, Section 4 for more information).

The city will utilize the same prioritization process as the county (See Volume I, Section 4: Plan Implementation and Maintenance and Volume IV, Appendix D: Economic Analysis for more information).

Implementation through Existing Programs

Many of the Natural Hazards Mitigation Plan's recommendations are consistent with the goals and objectives of the city's existing plans and policies. Where possible, the City of Hood River will implement the NHMP's 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, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented.

Hood River's acknowledged comprehensive plan is the County of Hood River Comprehensive Plan. The City implements the plan through the City of Hood River Zoning and Development Code, which is in revision as of this plan update.

The City of Hood River currently has the following plans, programs, and policies that relate to natural hazard mitigation. For a complete list visit the city website:

Table HRA-2 Legal and Regulatory Resources Available for Hazard Mitigation

Regulatory Tool	Name	Effects on Hazard Mitigation
Plans	Emergency Operations Plan (2015)	Identifies emergency planning, policies, procedures, and response to extraordinary emergency situations associated with natural disasters, technological incidents, and national security emergencies.
	Comprehensive Plan (1983)	The City of Hood River Comprehensive Plan implements statewide planning goals, and specifically addresses environmental hazards and flood risk. It does not currently identify mitigation projects, but can be used to implement mitigation The Comp Plan has been updated several times since 1983.
	Transportation System Plan (2011)	The purpose of the TSP is to develop a plan that addresses the transportation issues and needs for all users of the City of Hood River's transportation network; currently being updated.
	Capital Improvements Plan (2015)	Addresses water, sewer, roads, and fleet.
	Stormwater Management Plan	In development; positioned for adoption in 2018/2019
Programs	National Flood Insurance Program (NFIP)	Makes affordable flood insurance available to homeowners, business owners, and renters in participating communities. In exchange, those communities must adopt and enforce minimum floodplain management regulations to reduce the risk of damage from future floods.
	Hood River Soil & Water Conservation District	Coordinates conversation and infrastructure development, including mitigation measures.
Policies (Municipal Codes)	Zoning Ordinances	Includes subdivision, floodplain ordinances, and natural hazard specific articles.
	Building Codes	Updated with state standards; current

Source: Dustin Nilsen, City of Hood River Planner, May 2018

Table HRA-3 Administrative and Technical Resources for Hazard Mitigation

Staff/Personnel Resources	Department/Division Position
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	Multiple full time staff positions; Public Works
Planner(s) or engineer(s) with an understanding of manmade or natural hazards	City of Hood River; 4 FTE
Floodplain administrator	One part-time administrator
Personnel skilled in GIS and/or HAZUS-MH	Public Works, full time staff
Director of Emergency Services	County staff emergency management

Source: Dustin Nilsen, City of Hood River Planner, May 2018

Table HRA-4 Financial Resources for Hazard Mitigation

Financial Resources	Effect on Hazard Mitigation
Authority to levy taxes for specific purposes	Can be used for mitigation projects
Incur debt through general obligation bonds	Primarily used for infrastructure and staffing
Fees for utility services	Provides funds for infrastructure and staffing
State funding programs	Provides funds for planning, transportation, and fire mitigation
Capital improvements project funding; impact fees for new development; incur debt through private activities	All available, not specifically used for mitigation

Source: Dustin Nilsen, City of Hood River Planner, May 2018
Note: See Appendix E – Grant Programs for additional financial resources

Continued Public Participation

Keeping the public informed of the city's efforts to reduce the city's risk to future natural hazards events is important for successful plan implementation and maintenance. The city is committed to involving the public in the plan review and updated process. See Volume I, Section 4, for more information.

Plan Maintenance

The Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan and city addendum will be updated every five years in accordance with the update schedule outlined

in the Disaster Mitigation Act of 2000. During the county plan update process, the city will also review and update its addendum. The convener will be responsible for convening the Steering Committee to address the questions outlined below.

- Are there new partners that should be brought to the table?
- Are there new local, regional, state, or federal policies influencing natural hazards that should be addressed?
- Has the community successfully implemented any mitigation activities since the plan was last updated?
- Have new issues or problems related to hazards been identified in the community?
- Are the actions still appropriate given current resources?
- Have there been any changes in development patterns that could influence the effects of hazards?
- Have there been any significant changes in the community's demographics that could influence the effects of hazards?
- Are there new studies or data available that would enhance the risk assessment?
- Has the community been affected by any disasters? Did the plan accurately address the impacts of this event?

These questions will help the Steering Committee determine what components of the mitigation plan need updating. The Steering Committee will be responsible for updating any deficiencies found in the plan.

Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(b)(2) - Risk Assessment. In addition, this chapter can serve as the factual basis for addressing Oregon Statewide Planning Goal 7 – Areas Subject to Natural Hazards. Assessing natural hazard risk has three phases:

- **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 local level rationale for the identified mitigation strategies (action items) is presented herein, and within Section 2, *Risk Assessment*, and Appendix C, *Community Profile*. The risk assessment process is graphically depicted in Figure HRA-1 below. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure HRA-1 Understanding Risk

Hazard Analysis Methodology

This NHMP utilizes a hazard analysis methodology that was first developed by FEMA circa 1983, and gradually refined by the Oregon Military Department's Office of Emergency Management (OEM) 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 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%.

This 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 shown in the table below. See Volume I, Section 2 (Risk Assessment) for more information.

Hazard Analysis

The City of Hood River Steering Committee developed their hazard vulnerability assessment (HVA), using the county's HVA as a reference. Changes from the county's HVA were made where appropriate to reflect distinctions in vulnerability and risk from natural hazards unique to City of Hood River, which are discussed throughout this addendum.

Table HRA-5 shows the HVA matrix for the City of Hood River showing each hazard listed in order of rank from high to low. 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 sense of hazard priorities, but does not predict the occurrence of a particular hazard.

Two chronic hazards (winter storm and wildfire) and one catastrophic hazard (Cascadia Subduction Zone earthquake) rank as the top hazard threats to the city. Crustal earthquake hazards, volcano, and drought comprise the next highest ranked hazards, while flood, landslide, and windstorm hazards comprise the lowest ranked hazards.

Table HRA-5 Hazard Analysis Matrix – City of Hood River

Hazard	History	Probability	Vulnerability	Maximum Threat	Total	Rank	Risk Level
Winter Storm	9	10	9	10	**233**	**1**	**High**
Wildfire	6	7	6	9	**181**	**2**	**High**
CSZ Event	2	6	8	9	**176**	**3**	**High**
Crustal Earthquake	2	4	5	8	**137**	**4**	**Moderate**
Volcano	2	2	5	7	**113**	**5**	**Moderate**
Drought	4	7	3	4	**112**	**6**	**Moderate**
Flood	3	6	3	4	**103**	**7**	**Low**
Landslide	3	3	1	5	**82**	**8**	**Low**
Windstorm	2	3	2	4	**75**	**9**	**Low**

Source: City of Hood River NHMP Steering Committee, 2018.

Table HRA-6 categorizes the probability and vulnerability scores from the hazard analysis for the city and compares the results to the assessment completed by the Hood River County NHMP Steering Committee (areas of differences are noted with **bold** text within the city ratings). The city ranked their vulnerability to Cascadia Subduction Zone earthquakes higher than the county, the probability and vulnerability of both landslides and windstorms as lower than the county, and the probability of drought as higher, but the vulnerability of drought as lower, than the county.

Table HRA-6 Probability and Vulnerability Comparison

	Hood River		County	
Hazard	**Probability**	**Vulnerability**	**Probability**	**Vulnerability**
Winter Storm	High	High	High	High
Wildfire	High	Moderate	High	Moderate
CSZ Event	Moderate	**High**	Moderate	Moderate
Landslide	**Low**	**Low**	Moderate	Moderate
Drought	**High**	**Low**	Moderate	Moderate
Flood	Moderate	Low	Moderate	Low
Crustal Earthquake	Moderate	Moderate	Moderate	Moderate
Windstorm	**Low**	**Low**	Moderate	Moderate
Volcano	Low	Moderate	Low	Moderate

Source: City of Hood River NHMP Steering Committee and Hood River County NHMP Steering Committee, 2018.

Community Asset Identification

This section provides information on city specific assets. For additional information on the characteristics of Hood River, in terms of geography, environment, population, demographics, employment and economics, as well as housing and transportation see Volume IV, Appendix C, *Community Profile*. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the city specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

Community Characteristics

The City of Hood River is located along the Columbia River, at the mouth of the Hood River. The city lies in the north eastern portion of Hood River County. Hood River City covers an area of about 3.35 square miles, 0.80 of which are water.[1] The climate of Hood River is moderate; the average monthly temperatures range from 53 – 81 degrees in July and August, and 28-41 degrees in December and January. The city receives approximately 30.6 inches of rain and 36 inches of snow each year.[2] Monthly precipitation is about 3-5 inches during the wetter months of November – March, and rarely occurs during dry summer months. The city includes densely populated residential areas and borders agricultural properties. The city lies between the Columbia River to the north and the western slopes of

1 ACS 2016 (5-Year Estimates) (SE), ACS 2016 (5-Year Estimates), Social Explorer Table 3; U.S. Census Bureau
2 Western Regional Climate Center, "City of Hood River, OR (351407)". https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?or4003; Retrieved May 1, 2018.

the Cascade Range to the south; the downtown business core and essential city services both reside in the flat land adjacent to the Columbia River.

Economy

The median household income in Hood River is $47,967, roughly 15% below that of Hood River County and the state.[3] Hood River' primary employment industries are Educational services/Health Care/Social Assistance, and Retail Trade, followed by Manufacturing and Artis/Entertainment/Recreation/Food Service.[4] Retail and recreation industries thrive during high-tourist summer months, when Hood River is a top tourist destination, but also prosper during winter due to snow sport related tourism. The Westside Plan is currently in development to address growth and will focus on planning, housing, and infrastructure in the residential western portion of the City. [5]

Population Characteristics

Of the Hood River City population, 13% is over 65 years old, and 25% is under 18 years old. Almost two thirds of the population (56%) lives below the federal poverty level, indicating that personal preparedness and resiliency levels are likely to be low.[6] Of those 1453 individuals, 657 (almost half) are children. The City population is growing older and more affluent as urban retirees move to the City.[7] The City of Hood River is the most densely populated area within Hood River County. The City of Hood River experiences high tourist populations in the summer and winter for outdoor recreation, as well as intense tourism during weekends.

Asset Inventory

Asset inventory is the first step of a vulnerability analysis. Assets that may be affected by hazard events include population, residential and nonresidential buildings, critical facilities, and infrastructure.

The asset inventory delineates the City's existing building and infrastructure assets in detail in Table HRA-7.

3 ACS 2016 (5-Year Estimates) (SE), ACS 2016 (5-Year Estimates), Social Explorer Table 57; U.S. Census Bureau
4 ACS 2016 (5-Year Estimates) (SE), ACS 2016 (5-Year Estimates), Social Explorer Table 49; U.S. Census Bureau
5 Hood River Westside Area Concept Plan; http://www.hrwestsideplan.com, 5/21/2018
6 ACS 2016 (5-Year Estimates) (SE), ACS 2016 (5-Year Estimates), Social Explorer Tables 114, 115, 116; U.S. Census Bureau
7 City of Hood River Steering Committee, May 2018

Table HRA-7 City of Hood River Critical Facilities and Infrastructure

Facility Type	Name / Number	Address
Government	Port Facilities	1000 E Port Marina Drive
	Hood River Fire and EMS	1785 Meyer Parkway
	City Hall	211 2nd Street
	City Public Works, Engineering Offices/PW	1200 18th Street
Educational	Hood River Middle School	1602 May Street
	May Street Elementary School	911 May Street
	Community College Buildings	1730 College Way
Care Facility	Providence Hood River Memorial Hospital	810 12th Street
	One Community Health	849 Pacific Ave
	Hood River Police	211 2nd Street
State and Federal Highways	I-84	
	Highway 35	
Railroads	Union Pacific Railroad	
Bridges	Hood River-White Salmon Bridge	
Utilities	Sewer; Indian Creek Lift Station, Port Marina Lift Station, West Cliff Lift Station, Country Club Lift Station	
	Wilson Street Reservoir and Coe Reservoir	Below Providence Hospital
	Hood River Waste Water Plant	818 Riverside Drive
	Lost Lake Chlorine Station	School bus turnaround
	City of Hood River Water District	1200 18th Street
	City of Hood River Sanitary	1200 18th Street

Facility Type	Name / Number	Address
Fuel	Astro Gas Station	214 Front Street
	Valero Gas Station	101 N 1st Street
	Shell Gas Station	1691 12th Street
	Shell Gas Station	1108 E Marina Drive
	Height's Fuel Stop	1413 12th Street
	Chevron Gas Station 1	949 E Marina Drive
	Chevron Gas Station 2	2555 Cascade Avenue
	Havey's Texaco Gas Station	3450 Cascade Ave
	76 Gas Station	3450 Cascade Ave
	Parkhurst Place	2450 May Street
Assisted Living	Providence Brookside Manor	1550 Brookside Drive
	Hood River Care Center	729 Henderson Road
	Hawks Ridge	1795 8th Street
	Providence Dethman House	1205 Montello Ave
	Hood River Senior Center	2010 Sterling Place

Source: Hood River City Steering Committee, April 2018

See hazard sections below and Section 2, *Risk Assessment*, for potential hazard vulnerabilities to these facilities.

Hazard Characteristics

A comprehensive risk and vulnerability assessment is not available. As of the publication of this NHMP FEMA is providing an opportunity for the County and City to participate in a Risk Mapping, Assessment, and Planning (Risk MAP) process that generates additional data on risks and vulnerabilities of natural hazards. The Risk Report, prepared by the Oregon Department of Geology and Mineral Industries (DOGAMI) provides a quantitative risk assessment that informs communities of their risks related to certain natural hazards (including earthquake, flood, lahar (volcanic event), landslide, and wildfire). The City hereby incorporates the preliminary Risk Report into this NHMP by reference to provide greater detail to hazard sensitivity and exposure. The full report can be accessed on the DOGAMI Interpretive Map Series webpage: http://www.oregongeology.org/pubs/ims/p-ims.htm.

Drought

The Steering Committee determined that the city's probability for drought is **high** (which is higher than the county's rating) and that their vulnerability to drought is **low** (which is lower than the county's rating).

Volume I, Section 2, *Risk Assessment*, describes the characteristics of drought hazards, as well as the location and extent of a potential event. Moderate droughts occur regularly in Hood River County, primarily impacting the agricultural industry.

City of Hood River' primary water supply comes from three springs located approximately 15 miles southwest of the City. It is estimated that the springs can continuously provide at least 10 million gallons of water per day. The city has a five million gallon reservoir and a 14-inch steel transmission main, which was constructed in 1929, and two additional storage reservoir(s) for a total of 6 million gallons of treated water storage capacity. The City operates a water chlorinating plan. In general, water supply is available and sufficient. So while the probability is higher for the City compared to the County, the vulnerability is therefore low for the City compared to the County. Additional, drought-related community impacts are described within the county's Drought Hazard Annex.

Earthquake

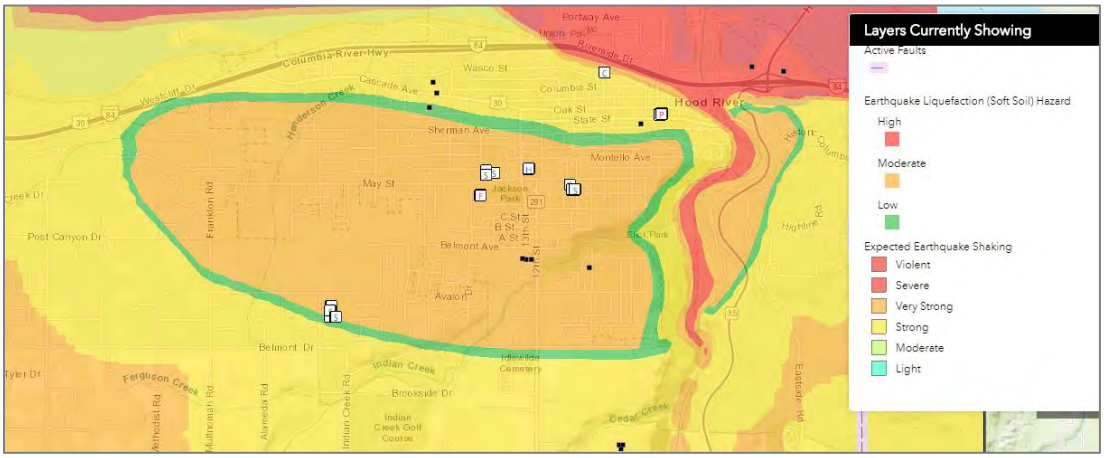
The Steering Committee determined that the city's probability for a Cascadia Subduction Zone (CSZ) Earthquake event is **moderate** (which is the same as the county's rating) and that their vulnerability to a Cascadia Earthquake event is **high** (which is higher than the county's rating). The Steering Committee determined that the city's probability for a Crustal Earthquake event is **moderate** (which is the same as the county's rating) and that their vulnerability to a Crustal Earthquake event is **moderate** (which is the same as the county's rating). This is further explained below.

Volume I, Section 2, *Risk Assessment*, describes the characteristics of earthquake hazards, history, as well as the location and extent of a potential event. Generally, an event that affects the county is likely to affect City of Hood River more severely. The liquefaction potential is greater for City of Hood River than the County generally, and the City includes a majority of the County's critical infrastructure. The causes and characteristics of an earthquake event are appropriately described within the county's plan, as well as the location and extent of potential hazards. Previous occurrences are well-documented within the county's plan. The community impacts described by the county would occur in City of Hood River to a greater extent: weak buildings would collapse and stable buildings would suffer damages, including critical and emergency facilities. The only hospital in the County is located in the City of Hood River, on a slope, and was found by DOGAMI RVS to have a very high collapse potential. It is possible that the City will experience an influx of refugees from the Portland metropolitan area, which would put a further strain on emergency response services.

Earthquake-induced damages are difficult to predict, and depend on the size, type, and location of the earthquake, as well as site-specific building and soil characteristics. Presently, it is not possible to accurately forecast the location or size of earthquakes, but it is possible to predict the behavior of soil at any particular site. In many major earthquakes, damages have primarily been caused by the behavior of the soil. Figure HRA-2 displays relative

liquefaction hazards. As shown in Figure HRA-2, portions of the downtown core are subject to moderate liquefaction, most of the Port properties are subject to high liquefaction, and all of the city will experience very strong shaking in a crustal event.

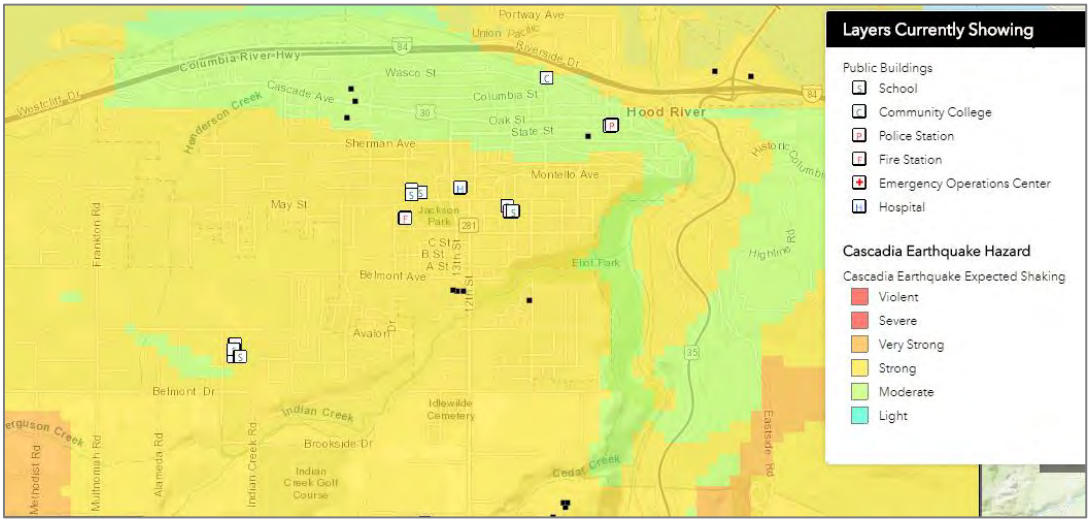
Figure HRA-2 Active Faults and Soft Soils (crustal event)



Source: [Oregon HazVu: Statewide Geohazards Viewer (DOGAMI)], retrieved 5/6/18

Figure HRA-3 below shows the expected shaking/ damage potential for City of Hood River because of a Cascadia Subduction Zone (CSZ) earthquake event. The figure shows that the city will experience "moderate" to "strong" shaking that will last two to four minutes. The shaking may damage lifeline transportation routes including Interstate 84, the Union Pacific Railroad, and the Hood River – White Salmon Interstate Bridge. For more information on expected losses due to a CSZ event see the Oregon Resilience Plan.

Figure HRA-3 Cascadia Subduction Zone Expected Shaking



Source: [Oregon HazVu: Statewide Geohazards Viewer (DOGAMI)], retrieved 5/6/18

As noted in the Community Profile, Appendix C, approximately 68% of residential buildings were built prior to 1990, which increases the city's vulnerability to the earthquake hazard. Information on specific public buildings' (schools and public safety) estimated seismic

resistance, determined by DOGAMI in 2007, is shown in Table HRA-9; each "X" represents one building within that ranking category. Of the facilities evaluated by DOGAMI using RVS, eight (8) have a very high (100% chance) collapse potential, five (5) have a high (>10%) and eleven (11) have a moderate (1-10%) collapse potential.

Table HRA-8 Rapid Visual Survey Scores

Facility	Site ID*	Level of Collapse Potential			
		Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools					
Hood River Middle School	Hood_sch05		X		X,X
Hood River Valley High School	Hood_sch04	X,X,X, X,X			
May Street Elementary School^	Hood_sch06	X			X,X
Pine Grove Elementary School	Hood_sch09	X	X		
Westside Elementary School	Hood_sch02	X,X,X		X	
Wy'East Middle School^	Hood_sch03	X,X	X		X,X
Universities/ Colleges					
Community College - Bldg 1	Hood_coc01		X		
Public Safety					
Hood River Police	Hood_pol03		X		
Dee RFPD	Hood_fir08		X		
Odell RFPD	Hood_fir02	X		X	
Pine Grove VFD	Hood_fir03	X	X	X	
Westside RFPD	Hood_fir04			X	
Westside RFPD	Hood_fir07	X		X	
Hood River FD^	Hood_fir05				X
Hood River County Sherriff	Hood_pol01		X,X		
Hood River EOC/911	Hood_eoc01		X,X		
Hospitals					
Providence Hood River Memorial Hospital	Hood_hos01				X

Source: DOGAMI 2007. Open File Report 0-07-02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment. "*" – Site ID is referenced on the RVS Hood River County Map
"^" – Building has been rebuilt or retrofit since 2007 RVS

The following buildings have received seismic enhancements since 2007:

- Hood River Fire Department: retrofitted in 2010 by the Seismic Rehabilitation Grant Program ($291,225 project) and rebuilt in 2012.
- Wy'east Middle School and Hood River Middle School: retrofits in progress as of the 2018 NHMP update. Gymnasium retrofits is funded by state seismic grants. Other remodeling is funded by a local school bond measure. The retrofits are to ensure safe evacuation.
- May Street Elementary: Building additional, seismically sound structure.

In addition to building damages, utility (electric power, water, wastewater, natural gas) and transportation systems (bridges, pipelines) are also likely to experience significant damage. Restoration of utility services will require substantial mutual aid from utilities outside of the affected area.

Please review the Risk Assessment (Volume I, Section 2) for additional information on this hazard.

Flood

The Steering Committee determined that the city's probability for flood is **moderate** (which is the same as the county's rating) and that their vulnerability to flood is **low** (which is the same as the county's rating). Volume I, Section 2, *Risk Assessment*, describes the causes and characteristics of flooding hazards within the region, as well as previous flooding occurrences. General flood-related community impacts are described within the Flood Hazard Annex of Hood River County's Natural Hazards Mitigation Plan. Portions of City of Hood River have areas of floodplains (Special Flood Hazard Areas). These include areas along the Hood River and Indian Creek, and bordering the Columbia River (see Figure HRA-4 and Attachment A, Map HRA-1).

Figure HRA-4 Special Flood Hazard Area

Source: Oregon HazVu: Statewide Geohazards Viewer (DOGAMI), retrieved 5/6/18

National Flood Insurance Program (NFIP)

FEMA has not modernized the City of Hood River Flood Insurance Rate Maps (FIRMs); the FIRMs are the originals from 1984. Table HRA-9 shows that as of February 2018, City of Hood River has three (3) National Flood Insurance Program (NFIP) policies in force. Of those, one is for property constructed before the initial FIRM. City of Hood River is not a member of the Community Rating System (CRS). There have been zero paid claims within the City boundaries. The County and City both used modern, improved flood hazard data for internal planning and zoning. The Community Repetitive Loss record for City of Hood River identifies no Repetitive Loss Properties[8] and no Severe Repetitive Loss Properties[9].

Table HRA-9 Flood Insurance Detail

Jurisdiction	FIRM Date	# NFIP Policies	Total Coverage	# NFIP Claims	Total Paid
Hood River County	9/24/1984	32	$9,822,900	3	$29,616
City of Hood River	9/24/1984	3	$980,000	0	$0

Source: Information compiled by Department of Land Conservation and Development, February 2018.

Landslide

The Steering Committee determined that the city's probability for landslide is **low** (which is lower than the county's rating) and that their vulnerability to landslide is **low** (which is lower than the county's rating). This difference is attributed to the relative distance between population and property within the City and landslide susceptible areas. Landslides are more likely to affect remote infrastructure than City residents.

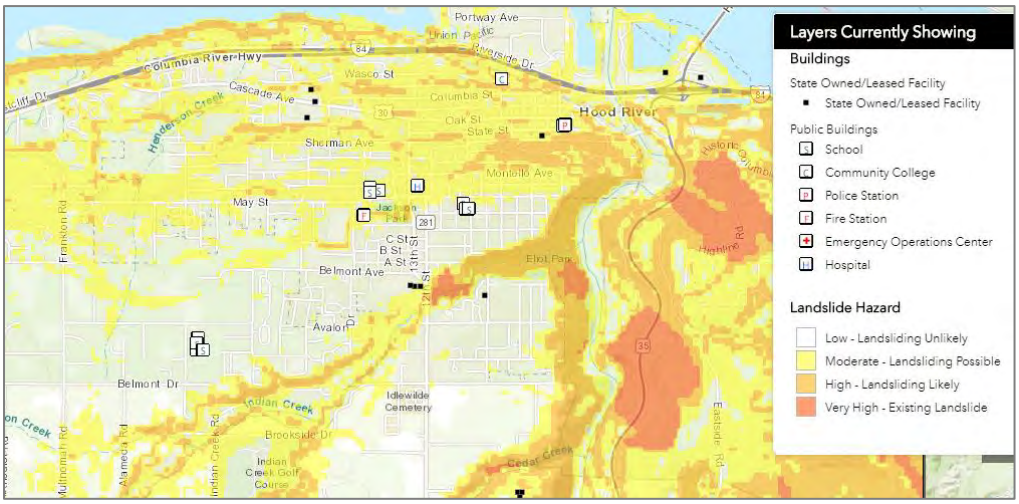
Volume I, Section 2, *Risk Assessment*, describes the characteristics of landslide hazards, history, as well as the location, extent, and probability of a potential event within the region. The potential for landslide in City of Hood River ranges from low to moderate, with high and very high susceptibility along the Hood River watershed. Highway 35 is particularly vulnerable to landslide hazard. Landslide susceptibility exposure for City of Hood River is shown in Figure HRA-5 and Map HRA-5 (Attachment A). Approximately 0.4% of City of Hood River has Very High, 10.7% High, and approximately 29.4% Moderate, landslide susceptibility exposure.[10] The majority of City land has "Low" landslide susceptibility (59.5%). Susceptibility is highest along Serpentine Street and Lovers Lane. Landslide susceptibility does not indicate that landslides will occur, rather, it indicates which areas are at higher risk.

[8] 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.

[9] 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.

[10] DOGAMI Open-File Report, O-16-02, Landslide Susceptibility Overview Map of Oregon (2016)

Figure HRA-5 Landslide Susceptibility Exposure



Source: [Oregon HazVu: Statewide Geohazards Viewer (DOGAMI)](), retrieved 5/6/18

Potential landslide-related impacts are adequately described within the county's plan, and include infrastructural damages, economic impacts (due to isolation and/or arterial road closures), property damages, and obstruction to evacuation routes. Rain-induced landslides and debris flows can potentially occur during any winter in Hood River County, and highways and other major roads beyond city limits are susceptible to obstruction as well.

Please review the Risk Assessment (Volume I, Section 2) for additional information on this hazard.

Volcano

The Steering Committee determined that the city's probability for volcanic event is **low** (which is the same as the county's rating) and that their vulnerability to volcanic event is **moderate** (which is the same as the county's rating).

Volume I, Section 2, *Risk Assessment*, describes City of Hood River' risk to volcanic events. Generally, an eruption from Mt. Hood may bring debris flows down the Hood River Valley and trigger landslides; however, lahars are more likely to flow down the east and south sides of the volcano. The causes and characteristics of a volcanic event are described within the county's plan, as well as the location and extent of potential hazards. Previous occurrences are well-documented within the county's plan, and the community impacts described by the county would generally be the same for City of Hood River as well. City of Hood River is unlikely to experience anything more than volcanic ash during a volcanic event. When Mt. Saint Helens erupted in 1980, the City of Hood River experienced significant ash fall, which was laborious to remove. Future ash fall would be dependent on wind direction.

Due to the nature of the hazard, it is impossible to predict the location or extent of future events with any probability, although it can be assumed that all residential and critical facilities and infrastructure within the City of Hood River are at risk.

Please review the Risk Assessment (Volume I, Section 2) for additional information on this hazard.

Wildfire

The Steering Committee determined that the city's probability for wildfire is **high** (which is the same as the county's rating) and that their vulnerability to wildfire is **moderate** (which is the same as the county's rating).

Volume I, Section 2, *Risk Assessment*, adequately describes the causes and characteristics of wildfires, as well as the county and city's history of wildfire events. The location and extent of wildfires vary depending on fuel, topography, and weather conditions. Adjacency to forest land and steep slopes create conditions conducive to wildfires.

The potential community impacts and vulnerabilities described in the county's plan are generally accurate for the city as well. As the most densely populated area within Hood River County, the City of Hood River is most at risk for house fires. Fires elsewhere in the County also have an emotional impact on residents, even if physical damage does not reach the City. Hood River County developed a Community Wildfire Protection Plan (CWPP) in 2013, which mapped wildland urban interface (WUI) areas and developed actions to mitigate wildfire risk (see Attachment A, Map HRA-6). The city is a participant in the CWPP and will update the city's wildfire risk assessment if the CWPP presents better data during future updates. In general, wildfire conditions are greatest in the Indian Creek riparian area and adjacent housing, as well as the Sieverkropp subdivision, located behind Rosauer's Supermarket, adjacent to Hood River. The City hosts a number of urban homeless residents who may use fires in the Indian Creek area, increasing risk. Indian Creek is not managed for fuels reduction.

History: September – November 2017, Eagle Creek Fire, Columbia Gorge National Scenic area, 30 miles south of City of Hood River (FM-5203). Significantly impacted air quality for city residents. Merged with Indian Creek Fire.

The Hood River County CWPP provides some risk and vulnerability information related to City of Hood River that has been incorporated into this plan as applicable.[11] See also the DOGAMI Risk Report.

The Hood River Fire & EMS provides countywide services through a variety of means. The department is funded through property taxes and a fee based ambulance service; the ISO rating is a class 3.[12] Hood River Fire Department has mutual aid agreements with three neighboring counties. One of which is Wasco County; they have critical infrastructure on the state watch list. Hood River County is their initial first response in a mutual aid situation. Hood River Fire/EMS also has mutual aid agreements with the Oregon Department of Forestry and the US Forest Service. During wildland fire season, units are constantly used to supplement forestry units. Annually resources are requested by the State of Oregon during enacted conflagration incidents.

Please review the Risk Assessment (Volume I, Section 2) for additional information on this hazard.

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[11] Hood River County Wildfire Protection Plan, 2013. See pages 123 for City of Hood River specific information.
[12] City of Hood River webpage; http://ci.hood-river.or.us/pageview.aspx?id=18246

Windstorm

The Steering Committee determined that the city's probability for windstorm is **low** (which is lower than the county's rating) and that their vulnerability to windstorm is **low** (which is lower than the county's rating). No high wind incidents that affected the City of Hood River can be recalled.

Volume I, Section 2, *Risk Assessment*, describes the causes and characteristics of windstorms, as well as the location and extent of windstorm hazards. The region's (and city's) history of events is described within the county's plan as well. Windstorms are sometimes accompanied by ice, freezing rain, flooding, and rarely, snow. For the purposes of this plan, windstorms are considered an individual hazard, distinct from winter storms. Alone, they have much lower potential to affect the City.

Hood River County's plan adequately describes the impacts caused by windstorms, including power outages, downed trees, building damages, and storm-related debris, which can in turn disrupt economic activity and transportation.

Due to the nature of the hazard, it is impossible to predict the location or extent of future events with any probability, although it can be assumed that all residential and critical facilities and infrastructure within City of Hood River are at risk.

Please review the Risk Assessment (Volume I, Section 2) for additional information on this hazard.

Winter Storm

The Steering Committee determined that the city's probability for winter storm is **high** (which is the same as the county's rating) and that their vulnerability to winter storm is **high** (which is the same as the county's rating).

Volume I, Section 2, *Risk Assessment*, describes the causes and characteristics of winter storms, as well as the location and extent of winter storm hazards. The region's (and city's) history of events is described within the county's plan as well. Severe winter storms can consist of rain, freezing rain, ice, snow, extreme cold, sleet, and wind. They originate from frigid air moving westward out of the Wallowa Mountains through the Columbia River. Mid-latitude storms approaching from the West are forced to rise as they encounter the Cascades, releasing large amounts of precipitation on the western slopes. These storms are most common from November through March and are an annual occurrence.

Major winter storms can and have occurred in the City of Hood River area, and while they typically do not cause significant damage, they are frequent and have the potential to impact economic activity. Road closures on major roads due to winter weather can interrupt commuter and large truck traffic, including food and fuel supply. I-84, the major highway supporting the City, closes every few years. The City of Hood River erects barricades on the steeply graded streets between 3rd and 13th annually to mitigate damage from winter storms. The City experiences more traffic than the rest of the County, intensifying storm related hazardous road conditions. Additionally, city residents may be less prepared for hazard impacts than unincorporated County residents and require more government support.

Due to the nature of the hazard, it is impossible to predict the location or extent of future events with any probability, although it can be assumed that all residential and critical facilities and infrastructure within City of Hood River are at risk.

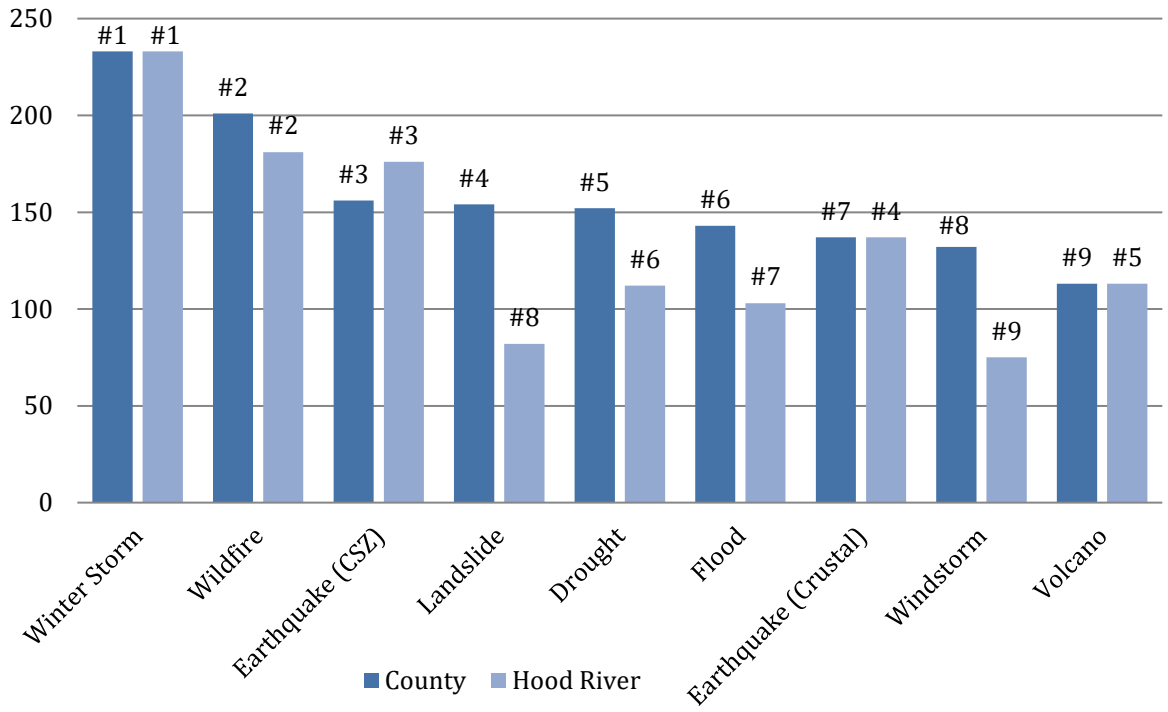
Please review the Risk Assessment (Volume I, Section 2) for additional information on this hazard.

Summary

Figure HRA-6 presents a summary of the hazard analysis for the City of Hood River and compares the results to the assessment completed by Hood River County.

The City rated their vulnerability to the Cascadia Subduction Zone earthquake, and their vulnerability to landslides, droughts, and windstorms as lower than the County. The top three hazards for the city are winter storm, wildfire, and a Cascadia Subduction Zone earthquake.

Figure HRA-6 Overall Hazard Analysis Comparison –Hood River County/ City of Hood River



Source: City of Hood River NHMP Steering Committee and Hood River County NHMP Steering Committee

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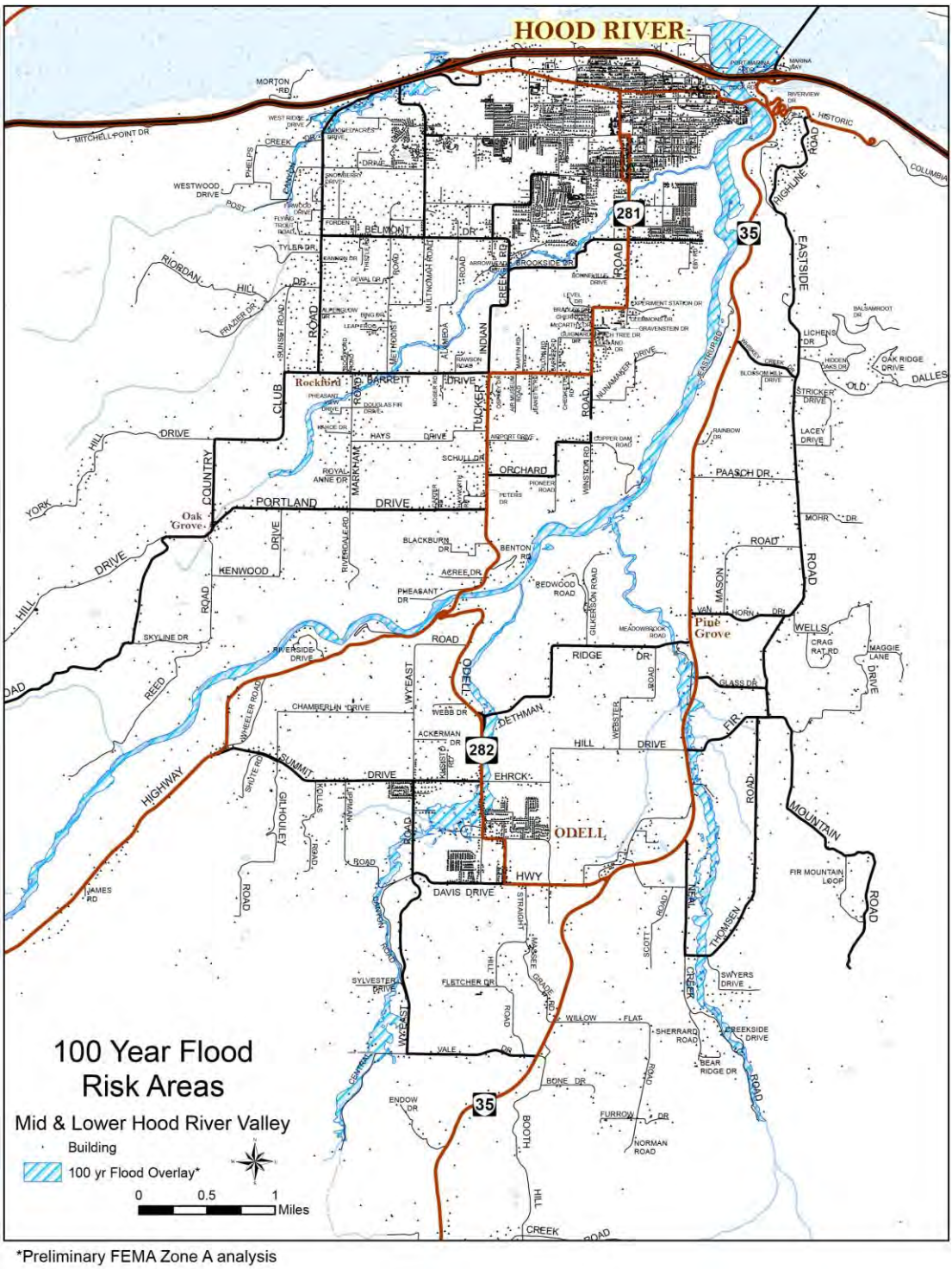
Map HRA-1 Flood Hazard Area - City of Hood River



Source: Hood River County Community Development Department

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PORT OF CASCADE LOCKS ADDENDUM

Purpose

This document serves as the Port of Cascade Locks' Addendum to the Hood River County Multi-Jurisdiction Natural Hazards Mitigation Plan (MNHMP, NHMP). This addendum describes how the Port of Cascade Locks' risks vary from the entire Hood River County planning area (in which the entirety of the Port's District is located), more specifically the City of Cascade Locks (in which all the Port's facilities are located). Information contained herein supplements information contained in Volume I (Basic Mitigation Plan) of this NHMP, which serves as the foundation for this jurisdiction's addendum, Volume II (Hazard Annexes), Volume III (City of Cascade Locks Addendum), and Volume IV (Mitigation Resources), which provides additional information (particularly regarding participation). This addendum meets all the requirements of Title 44 §201.6 including:

- Multi-jurisdictional **Plan Requirements** §201.6(a)(4),
- Multi-jurisdictional **Planning Process** §201.6(b)(1-3),
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii),
- Multi-jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv),
- Multi-jurisdictional **Plan Maintenance Process** §201.6(c)(4), and
- Multi-jurisdictional **Plan Adoption** §201.6(c)(5).

Plan Process, Participation, and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(a)(4), *Plan Requirements,* 44 CFR 201.6(b)(1-3), *Planning Process, and* 44 CFR 201.6(c)(5), *Plan Adoption.*

In January 2018 the Department of Land Conservation and Development (DLCD) partnered with the University of Oregon's Institute for Policy Research and Engagement (IPRE) with the Oregon Partnership for Disaster Resilience (OPDR) and the Resource Assistance for Rural Environments (RARE) program, and Hood River County and cities, including the Port of Cascade Locks, to update the County NHMP, which expired December 16, 2017. After funding was awarded in July 2017 to DLCD for two PDM 16 grants (PDMC-PL-10-2016-003 and PDMC-PL-10-2016-005), a regional kickoff meeting for all eight counties involved in the PDM 16 grants was held on July 18, 2017.

To be able to receive certain pre- and post- disaster natural hazard mitigation funds from FEMA, local governments must have a current, FEMA approved NHMP. NHMPs must be updated and approved every five years. By developing this addendum to the Hood River County NHMP, locally adopting it, and having it approved by FEMA, the Port of Cascade Locks will gain eligibility for FEMA Hazard Mitigation, Pre-Disaster Mitigation, and Flood Mitigation Assistance grant program funds.

The Hood River County NHMP, and Port of Cascade Locks addendum, are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private

sector, and regional organizations. The Port of Cascade Locks Steering Committee guided the process of developing this addendum. For more information on the composition of the Steering Committee see *Planning and Public Process* (Volume IV, Appendix B).

The General Manager (Paul Koch) of the Port of Cascade Locks is the designated local convener and will take the lead in implementing, maintaining, and updating the addendum to the NHMP in collaboration with the designated convener of the Hood River County NHMP (County Emergency Management).

Representatives from the Port of Cascade Locks Steering Committee met formally, and informally, to discuss develop this addendum (Volume IV, Appendix B). The Port's addendum reflects decisions decided upon at the plan development meetings and during subsequent work and communication with NHMP Update Coordinator.

Public participation was achieved with the establishment of the Steering Committee, which was comprised of Port officials. The Steering Committee was closely involved throughout the development of the plan and served as the local oversight body for the plan's development. In addition, community members outside of the Steering Committee were provided an opportunity for comment during the drafting stage and prior to plan approval (see Appendix B for more information).

Port Governance Structure

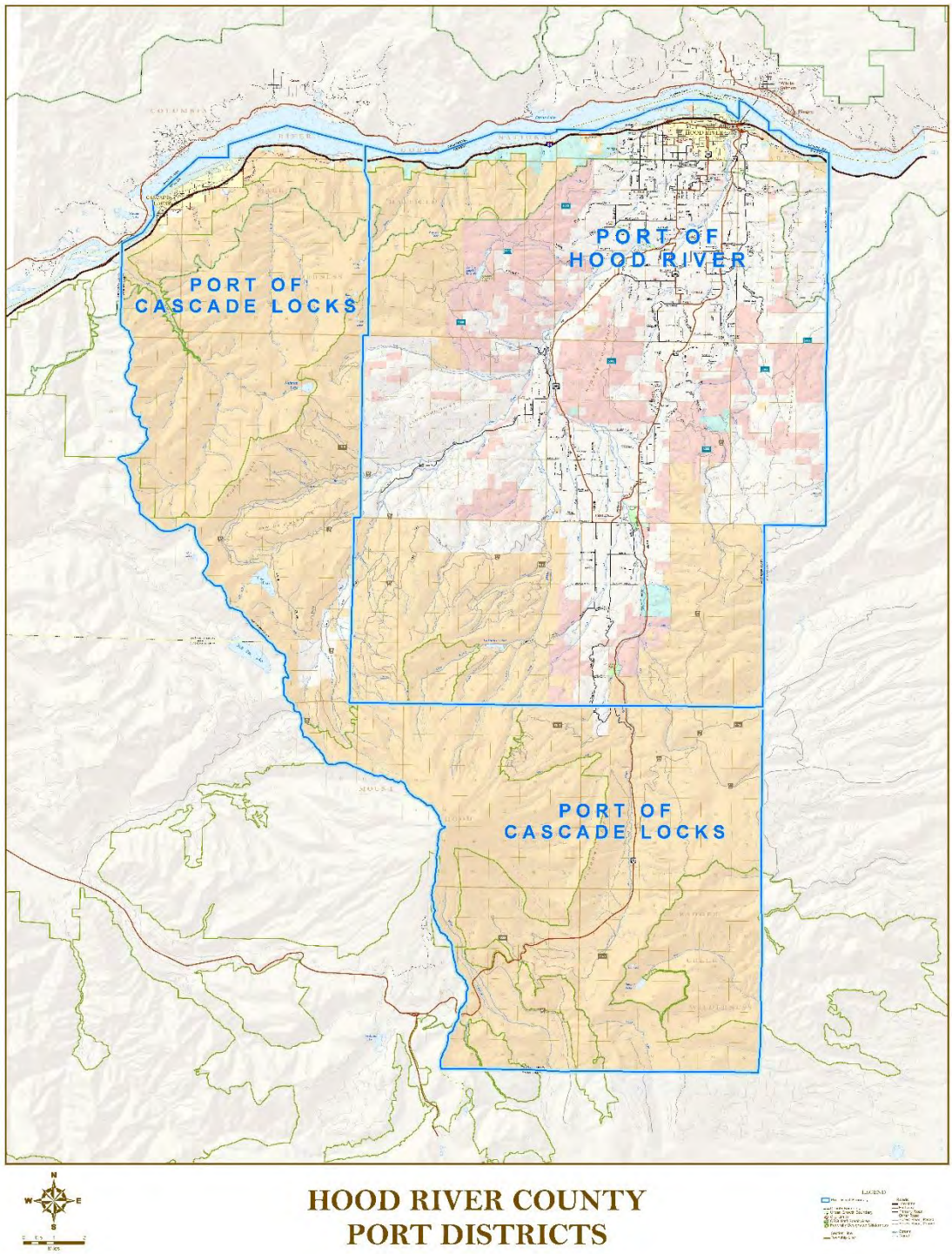
The Port of Cascade Locks is governed by a Port Commission (per ORS 777). The Commission consists of five members elected to four-year terms by voters within the Port's District (Figure PCL-1). The Commission is responsible for identifying problems and needs within the Port of Cascade Locks and then addressing those problems through policy. The Port also maintains a Budget Committee that is composed of all five Commission members and five additional citizen members appointed to the committee by the Commission.

The Port of Cascade Locks currently has the following staff which have a role in natural hazard mitigation: Port General Manager, Economic Development Manager, Manager of Bridge Operations, Maintenance and Construction Manager, and Accounting.

The Port Commission will be responsible for adopting the Port of Cascade Locks addendum to the Hood River County NHMP.

The Hood River County NHMP was approved by FEMA on November 9, 2018 and the Port of Cascade Locks addendum was adopted via resolution on February 21, 2019. FEMA added the Port to the approved jurisdictions on March 21, 2019. This NHMP addendum is effective through November 8, 2023.

Figure PCL-1 Port of Cascade Locks District Map



Source: Port of Cascade Locks, 2018.

Plan Implementation and Maintenance

This section of the NHMP addendum addresses 44 CFR 201.6(c)(4), *Plan Maintenance Process.*

This addendum designates a coordinating body and a convener to oversee the development and implementation of action items. Because the Port addendum is part of the county's multi-jurisdictional NHMP, the Port will look for opportunities to partner with the county. The Port's Steering Committee will convene after re-adoption of the Port of Cascade Locks addendum on an annual schedule; the county is meeting on a semi-annual basis and will provide opportunities for the cities to report on NHMP implementation and maintenance during their meetings. The Port's General Manager will serve as the convener and will be responsible for assembling the Steering Committee (coordinating body). The Steering Committee will be responsible for:

- identifying new risk assessment data,
- reviewing status of mitigation actions,
- identifying new actions, and
- seeking funding to implement the Port's mitigation strategy (actions).

The convener will also remain active in the county's implementation and maintenance process (see Volume I, Section 4 for more information).

The Port will utilize the same prioritization process as the county (See Volume I, Section 4: Plan Implementation and Maintenance and Volume IV, Appendix D: Economic Analysis for more information).

Implementation through Existing Programs

Many of the recommendations in the NHMP are consistent with the goals and objectives of the Port's existing plans and policies. Where possible, the Port of Cascade Locks will implement the NHMP's recommended actions through existing plans and policies. Plans and policies already in existence have support from the community, businesses, and policy makers. Many land-use, comprehensive, and strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented.

Cascade Locks currently has the following plans, programs, and policies that relate to natural hazard mitigation. For a complete list visit the Port website:

- Intergovernmental Agreement: Outlines Port and City responsibilities, particularly about provision of water, waste water treatment, and electric.
- Strategic Business Plan with Capital Improvements Plan: This plan provides a long-term, strategic business plan for the Port of Cascade Locks. 2016 Revision.
- Bridge of the Gods 15 Year Plan Spreadsheet
- Business Park Master Plan: Outlines current uses and future development of the Port's Business Park.
    - Business Park Master Plan Map
    - Business Park Development Guidelines

- Marine Park Master Plan: Outlines current uses and future development of the Port's Marine Park.
    - Marine Park Map
- Airport Feasibility Study: Evaluates options for future uses of the Cascade Locks Airport. *Note: The airport is owned by the State of Oregon through the Department of Aviation.*

Additionally, the Port is subject to the following City of Cascade Locks plans: Emergency Operations Plan, Comprehensive Plan and Development Code, Transportation System Plan, Wastewater Plan, Water System Plan, Community Wildfire Protection Plan.

Continued Public Participation

Keeping the public informed of the Port's efforts to reduce the Port's risk to future natural hazards events is important for successful plan implementation and maintenance. The Port is committed to involving the public in the plan review and updated process. See Volume I, Section 4, for more information.

Plan Maintenance

The Hood River County NHMP and Port addendum will be updated every five years in accordance with the update schedule outlined in the Disaster Mitigation Act of 2000. During the county plan update process, the Port will also review and update its addendum. The convener will be responsible for convening the Steering Committee to address the questions outlined below.

- Are there new partners that should be brought to the table?
- Are there new local, regional, state, or federal policies influencing natural hazards that should be addressed?
- Has the community successfully implemented any mitigation activities since the plan was last updated?
- Have new issues or problems related to hazards been identified in the community?
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- Have there been any significant changes in the community's demographics that could influence the effects of hazards?
- Are there new studies or data available that would enhance the risk assessment?
- Has the community been affected by any disasters? Did the plan accurately address the impacts of this event?

These questions will help the Steering Committee determine what components of the mitigation plan need updating. The Steering Committee will be responsible for updating any deficiencies found in the plan.

Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3(iv), *Mitigation Strategy*.

During the 2017/2018 Hood River County NHMP update process the County, City, and Port Steering Committees reviewed the County mitigation actions. Following the review actions were created specific to the Port of Cascade Locks. Each jurisdiction developed a list of priority actions. The Port has identified two priority actions listed in Table PCL-1.

Table PCL-1 Port of Cascade Locks Priority Mitigation Action Items

Action Item	Action Title	Managing Department/Agency	Timeline	Potential Funding Source
MH #1	Research and develop teleconferencing solution for emergency communications during hazard event; possible join with retrofitting House 3 (Port property)	Port of Cascade Locks	Short Term (2-3 years)	General Fund
EQ #1	Seismically upgrade Bridge of the Gods to withstand strong shaking; implement improvement maintenance schedule	Port of Cascade Locks	Short Term (welding); Long Term (additions)	Federal and state funds, toll revenue

Source: Port of Cascade Locks NHMP Steering Committee, 2018. EQ=Earthquake
Notes: MH #1 is a joint action with the City of Cascade Locks and appears as MH #2 in their addendum (the Port uses the boardroom in House 3 as the emergency communications center). EQ #1 is identified as Priority Project #1 in the Port of Cascade Locks Strategic Business Plan Revisions (2016); the Port is seeking federal funds to perform seismic work as identified in the Bridge of the Gods 15 year plan.

Ongoing mitigation activities regarding droughts, floods, landslides, wildfires, windstorms, and winter storms occur at the Port, City, and County level, and are described in the County NHMP in Volume I, the Hazard Annexes in Volume II, the City of Cascade Locks Addendum in Volume III, and the Mitigation Resources, specifically Appendices A and B in Volume IV. Routine activities include public outreach, underground utility construction, equipment improvements, volunteer recruitment, and the creation of defensible space. These institutionalized actions are considered a success of the previous NHMP collaborations. Because these activities are ongoing, and/or completed for the land within the Port District by the County or City, the Steering Committee decided not to list them as separate mitigation actions within this addendum. As a result, the prioritized mitigation action does not directly address these hazards. The Port will continue to partner with the County and City on the implementation of mitigation strategies related to these hazards that benefit both jurisdictions.

The Port of Cascade Locks does not believe that implementing volcano-related mitigation activities will be cost-effective at this time. As such, the Port has not identified volcano hazard mitigation action items.

Risk Assessment

This section of the NHMP addendum addresses 44 CFR 201.6(c)(2)(iii), *Risk Assessment*.

Assessing natural hazard risk has three phases:

- **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 local level rationale for the identified mitigation strategies (action items) is presented herein, and within Section 2, *Risk Assessment*, and Appendix C, *Community Profile*. The risk assessment process is graphically depicted in Figure PCL-2. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

Figure PCL-2 Understanding Risk

Hazard Analysis Methodology

This NHMP utilizes a hazard analysis methodology that was first developed by FEMA circa 1983, and gradually refined by the Oregon Military Department's Office of Emergency Management (OEM) 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 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%.

This method provides the jurisdiction with a sense of hazard priorities, or relative risk. It doesn't predict the occurrence of a 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 shown in the table below. See Volume I, Section 2 (Risk Assessment) for more information.

Hazard Analysis

The Port of Cascade Locks worked with the Cascade Locks Steering Committee to develop a hazard vulnerability assessment that covers the Port and the City. As such the ratings for the City of Cascade Locks are the same for the Port of Cascade Locks.

Table PCL-2 shows the HVA matrix for the Port of Cascade Locks showing each hazard listed in order of rank from high to low. For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery.

Three chronic hazards (winter storms, wildfires, and landslides) rank as the top hazard threats to the Port. One catastrophic hazard (Cascadia Subduction Zone earthquake) also warranted a top ranking. The Crustal Earthquakes and Windstorm hazards comprise the next highest ranked hazards, while flood, volcano, and drought hazards comprise the lowest ranked hazards.

Table PCL-2 Hazard Analysis Matrix – Port of Cascade Locks

Hazard	History (x2)	Probability (x7)	Vulnerability (x5)	Maximum Threat (x10)	Total	Rank	Risk Level
Winter Storm	9	10	9	10	**233**	**1**	**High**
Wildfire	9	9	7	9	**206**	**2**	**High**
Landslide	7	8	8	8	**190**	**3**	**High**
CSZ Event	2	6	8	9	**176**	**4**	**High**
Crustal Earthquake	2	4	5	6	**117**	**5**	**Moderate**
Windstorm	3	4	4	5	**104**	**6**	**Moderate**
Flood	3	4	3	5	**99**	**7**	**Low**
Volcano	2	2	3	4	**73**	**8**	**Low**
Drought	1	1	1	1	**24**	**9**	**Low**

Source: Port of Cascade Locks NHMP Steering Committee, 2018.

Table PCL-3 categorizes the probability and vulnerability scores from the hazard analysis (Table PCL-2) for the Port and compares the results to the assessment completed by the Hood River County (areas of differences are noted with **bold** text within the Port ratings).

Table PCL-3 Probability and Vulnerability Comparison

	Port of Cascade Locks*		County	
Hazard	**Probability**	**Vulnerability**	**Probability**	**Vulnerability**
Winter Storm	High	High	High	High
Wildfire	High	**High**	High	Moderate
CSZ Event	Moderate	**High**	Moderate	Moderate
Landslide	**High**	**High**	Moderate	Moderate
Drought	**Low**	**Low**	Moderate	Moderate
Flood	Moderate	Low	Moderate	Low
Crustal Earthquake	Moderate	Moderate	Moderate	Moderate
Windstorm	Moderate	Moderate	Moderate	Moderate
Volcano	**Low**	Low	Low	Moderate

Source: Port of Cascade Locks NHMP and Hood River County NHMP Steering Committees, 2018.
Note: * - the HVA ratings for the City and Port of Cascade Locks are identical.

Hazard Characteristics

Related to this NHMP update process, FEMA is providing an opportunity for the County, City, and Port to participate in a Risk Mapping, Assessment, and Planning (Risk MAP) process that generates additional data on risks and vulnerabilities of natural hazards. The Risk Report, prepared by the Oregon Department of Geology and Mineral Industries (DOGAMI) provides a quantitative risk assessment that informs communities of their risks related to certain natural hazards (including earthquake, flood, lahar (volcanic event), landslide, and wildfire). The Port hereby incorporates the preliminary Risk Report into this NHMP by reference to provide greater detail to hazard sensitivity and exposure. The full report can be accessed on the DOGAMI Interpretive Map Series webpage: http://www.oregongeology.org/pubs/ims/p-ims.htm.

The Port of Cascade Locks facilities are entirely contained within the City of Cascade Locks (except for the northern section of the Bridge of the Gods which is in Washington). The Port's Steering Committee was actively involved in the determination of risk and vulnerability along with the City of Cascade Locks. As such, the Port's risk assessment is identical to the City's regarding the type, location, and extent for the identified natural hazards. The Port is not a community which has authority to adopt and enforce floodplain management regulations for the areas within its jurisdiction. The City of Cascade Locks, and Hood River County participate in the National Flood Insurance Program (NFIP). There are no repetitive loss or severe repetitive loss properties in the Port, City, or County (see Volume I, Section 2, Table 2.11 for more information).

Please review the Risk Assessment (Volume I, Section 2 and Volume III, City of Cascade Locks Addendum) for additional information on hazard identification and vulnerability for the Port.

Port Asset Identification

This section provides information on Port specific assets. For additional information on the characteristics of the City of Cascade Locks, in terms of geography, environment, population, demographics, employment and economics, as well as housing and transportation see Volume III, *City of Cascade Locks Addendum,* and Volume IV, Appendix C, *Community Profile*. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the Port specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

Facilities and Property Assets Inventory

Asset inventory is the first step of a vulnerability analysis. Assets that may be affected by hazard events include population, residential and nonresidential buildings, critical facilities, and infrastructure. The following list includes port assets:

Bridge of the Gods: includes all three steel truss spans, toll house park property, bridge road, toll booth, garage building, and property at base of bridge on Washington side.

Industrial Park: parcel leased to Bear Mountain Forest Products, Easy Climb Trail System and improvements, The Locks Approach (disc golf course), Blackberry Beach and Jetty, Herman Creek Cove boat ramp, quarry, cell tower lease site, and various undeveloped properties and property below the high-water line at Government Rock.

Herman Creek Lane: Flex Building #1, Flex Building #2 pad and utilities, Flex Building #3 (renovated, old shop building, currently leased), and Flex Building #4.

Marine Park: land, street, lighting, signage, parking improvements, visitor center building, the pavilion, House 1 (Museum), House 2 (Port Office building), House 3 (Community Center), maintenance warehouse, restrooms at public boat ramp, Oregon Pony building, Sternwheeler dock, marina docks, open shelter at museum, campground and restrooms, east cook shack, west cook shack, Thunder Island, playground and equipment, restrooms at playground, Sternwheeler (*Columbia Gorge*), footbridge to Thunder Island, fish cleaning station, sailboat storage area improvements, historic locks, two bronze sculptures.

Moody Road: Mood Road property, portion of gravel right-of-way on Moody Road, USFS land exchange property.

Vulnerabilities to Port facilities are listed in Table PCL-4. The Bridge of the Gods is an identified vulnerability to the Port and City. The bridge is the first Columbia River crossing east of Portland and is likely to experience damage during a Cascadia Subduction Zone or crustal earthquake event. A 15-year improvement plan is underway that will include 80% of seismic enhancements recommended. For information on bridge projects see the 15-year Maintenance Preservation Plan-Bridge of the Gods and Approaches (January 18, 2018) and on expected losses due to a CSZ event see the Oregon Resilience Plan.

Table PCL-4 Port of Cascade Locks Facility and Infrastructure Hazard Vulnerability

Facility Type	Name	Drought	Earthquake	Flood	Landslide	Volcano	Wildfire	Windstorm	Winter Storm
Government	Port Office (House 2)		X				X	X	X
	Herman Creek Lane		X				X	X	X
	Industrial Park		X			X	X	X	X
	Marine Park		X	X	X	X	X	X	X
	Moody Road		X				X	X	X
	Thunder Island Brewery		X		X		X	X	X
Bridges	Bridge of the Gods		X				X		X
Transportation/ Emergency Facilities	Sternwheeler Boat/Dock (for evacuation)			X					X
	Cascade Locks Airport*					X			X

Source: Port of Cascade Locks Steering Committee, May 2018

Note: * - The airport is currently owned by the State of Oregon through the Department of Aviation.

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PORT OF HOOD RIVER ADDENDUM

Purpose

This document serves as the Port of Hood River's Addendum to the Hood River County Multi-Jurisdiction Natural Hazards Mitigation Plan (MNHMP, NHMP). This addendum describes how the Port of Hood River's risks vary from the entire Hood River County planning area (in which the entirety of the Port's District is located), more specifically the City of Hood River (in which all the Port's facilities are located). Information contained herein supplements information contained in Volume I (Basic Mitigation Plan) of this NHMP, which serves as the foundation for this jurisdiction's addendum, Volume II (Hazard Annexes), Volume III (City of Hood River Addendum), and Volume IV (Mitigation Resources), which provides additional information (particularly regarding participation). This addendum meets all the requirements of Title 44 §201.6 including:

- Multi-jurisdictional **Plan Requirements** §201.6(a)(4),
- Multi-jurisdictional **Planning Process** §201.6(b)(1-3),
- Multi-Jurisdictional **Risk Assessment** §201.6(c)(2)(iii),
- Multi-jurisdictional **Mitigation Strategy** §201.6(c)(3)(iv),
- Multi-jurisdictional **Plan Maintenance Process** §201.6(c)(4), and
- Multi-jurisdictional **Plan Adoption** §201.6(c)(5).

Plan Process, Participation, and Adoption

This section of the NHMP addendum addresses 44 CFR 201.6(a)(4), *Plan Requirements,* 44 CFR 201.6(b)(1-3), *Planning Process, and* 44 CFR 201.6(c)(5), *Plan Adoption.*

In January 2018 the Department of Land Conservation and Development (DLCD) partnered with the University of Oregon's Institute for Policy Research and Engagement (IPRE) with the Oregon Partnership for Disaster Resilience (OPDR) and the Resource Assistance for Rural Environments (RARE) program, and Hood River County and cities, including the Port of Hood River, to update the County NHMP, which expired December 16, 2017. After funding was awarded in July 2017 to DLCD for two PDM 16 grants (PDMC-PL-10-2016-003 and PDMC-PL-10-2016-005), a regional kickoff meeting for all eight counties involved in the PDM 16 grants was held on July 18, 2017.

To be able to receive certain pre- and post- disaster natural hazard mitigation funds from FEMA, local governments must have a current, FEMA approved NHMP. NHMPs must be updated and approved every five years. By developing this addendum to the Hood River County NHMP, locally adopting it, and having it approved by FEMA, the Port of Hood River will gain eligibility for FEMA Hazard Mitigation, Pre-Disaster Mitigation, and Flood Mitigation Assistance grant program funds.

The Hood River County NHMP, and Port of Hood River addendum, are the result of a collaborative effort between citizens, public agencies, non-profit organizations, the private

sector, and regional organizations. The Port of Hood River Steering Committee guided the process of developing this addendum. For more information on the composition of the Steering Committee see *Planning and Public Process* (Volume IV, Appendix B).

The Executive Director (Michael McElwee) of the Port of Hood River is the designated local convener and will take the lead in implementing, maintaining, and updating the addendum to the NHMP in collaboration with the designated convener of the Hood River County NHMP (County Emergency Management).

Representatives from the Port of Hood River Steering Committee met formally, and informally, to discuss develop this addendum (Volume IV, Appendix B). The Port's addendum reflects decisions decided upon at the plan development meetings and during subsequent work and communication with NHMP Update Coordinator.

Public participation was achieved with the establishment of the Steering Committee, which was comprised of Port officials. The Steering Committee was closely involved throughout the development of the plan and served as the local oversight body for the plan's development. In addition, community members outside of the Steering Committee were provided an opportunity for comment during the drafting stage and prior to plan approval (see Appendix B for more information).

Port Governance Structure

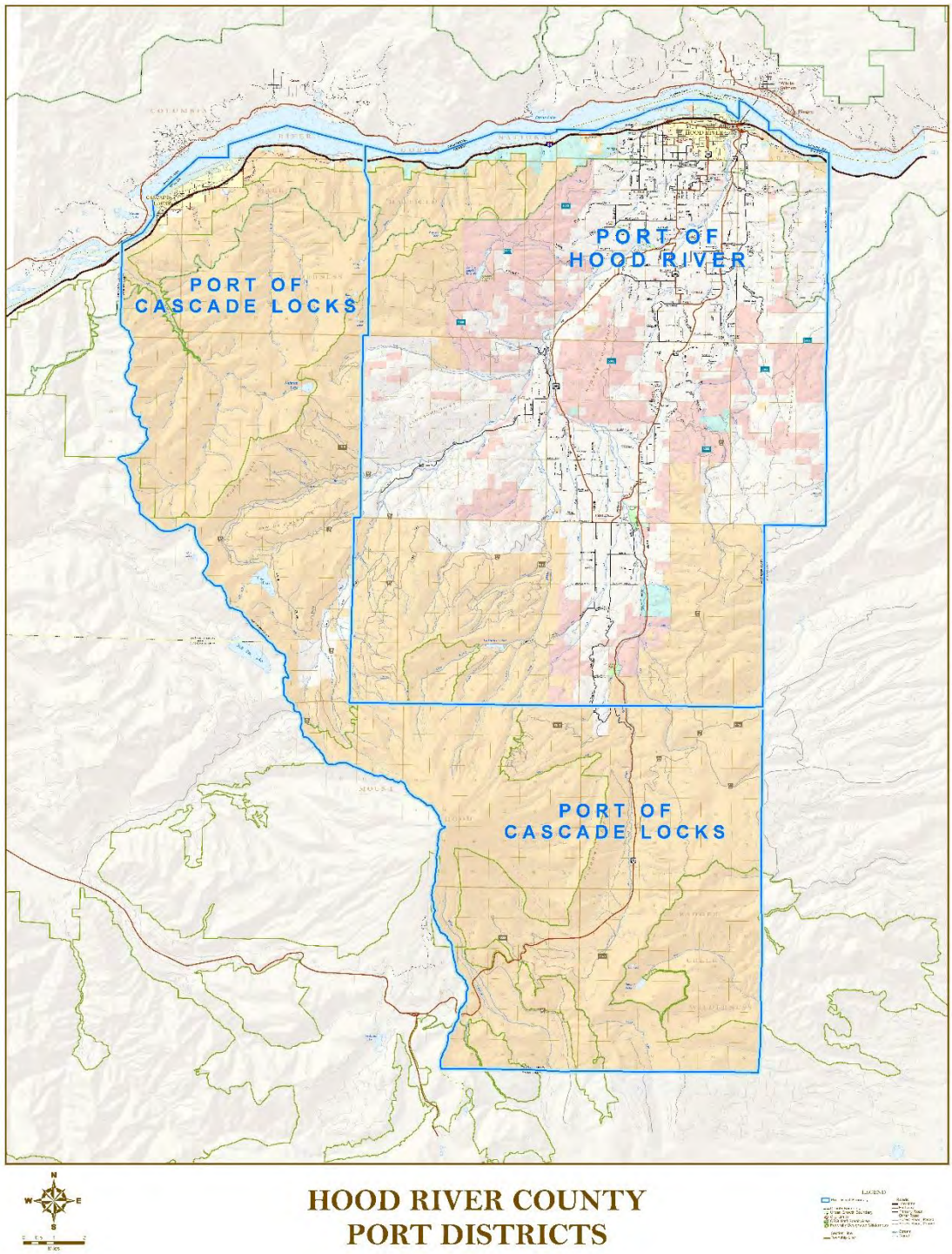
The Port of Hood River is governed by a Port Commission (per ORS 777). The Commission consists of five members elected to four-year terms by voters within the Port's District (Figure PHR-1). The Commission is responsible for identifying problems and needs within the Port of Hood River and then addressing those problems through policy. The Port also maintains Airport Advisory, Budget, Marina, and Waterfront Recreation Advisory committees. More information can be found in the Port's Governance Manual.

The Port of Hood River currently has the following staff which have a role in natural hazard mitigation: Port Executive Director, Chief Financial Officer, Bridge Replacement Project Director, Development and Property Manager, Waterfront and Marina Manager, and Facilities Manager.

The Port Commission will be responsible for adopting the Port of Hood River addendum to the Hood River County NHMP.

The Port of Hood River adopted via resolution on October 2, 2018, and the Hood River County NHMP was approved by FEMA on November 9, 2018. FEMA's approval was extended to the Port on March 21, 2019, after the Port reorganized its material into a formal addendum. This NHMP addendum is effective through November 8, 2023.

Figure PHR-1 Port of Hood River District Map



Source: Port of Cascade Locks, 2018.

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- identifying new risk assessment data,
- reviewing status of mitigation actions,
- identifying new actions, and
- seeking funding to implement the Port's mitigation strategy (actions).

The convener will also remain active in the county's implementation and maintenance process (see Volume I, Section 4 for more information).

The Port will utilize the same prioritization process as the county (See Volume I, Section 4: Plan Implementation and Maintenance and Volume IV, Appendix D: Economic Analysis for more information).

Implementation through Existing Programs

Many of the recommendations in the NHMP are consistent with the goals and objectives of the Port's existing plans and policies. Where possible, the Port of Hood River will implement the NHMP's recommended actions through existing plans and policies. Plans and policies already in existence have support from the community, businesses, and policy makers. Many land-use, comprehensive, and strategic plans get updated regularly, allowing them to adapt to changing conditions and needs. Implementing the NHMP's action items through such plans and policies increases their likelihood of being supported and implemented.

Hood River currently has the following plans, programs, and policies that relate to natural hazard mitigation. For a complete list visit the Port website:

- Strategic Business Plan: This plan provides a long-term, strategic business plan for the Port of Hood River.
- Airport Master Plan (2009) Outlines current uses and future development of the Ken Jernstedt Airfield.
- Hood River-White Salmon Bridge
    - Bridge Long-term Operations Plan Outlines current and future operation needs of the Hood River-White Salmon Bridge.
    - Bridge Replacement Project, Project Updates
    - Intergovernmental Agreement: Outlines Port and ODOT responsibilities regarding the terms and conditions of $5 million in state funding for

planning tasks to develop a plan to replace the Interstate Bridge (Hood River-White Salmon).
    - Additional studies and reports on the bridge.
- Waterfront Development Strategy. Provides a framework for future development of the basin and to guide system upgrades and infrastructure improvements.
    - Waterfront Access Zone Map.
    - Assessment of Waterfront Recreation Sites

Additionally, the Port is subject to the following City of Hood River plans: Emergency Operations Plan, Comprehensive Plan and Development Code, Transportation System Plan, Capital Improvements Plan, Stormwater Management Plan, Water System Plan, Community Wildfire Protection Plan.

Continued Public Participation

Keeping the public informed of the Port's efforts to reduce the Port's risk to future natural hazards events is important for successful plan implementation and maintenance. The Port is committed to involving the public in the plan review and updated process. See Volume I, Section 4, for more information.

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- Are there new partners that should be brought to the table?
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Mitigation Strategy

This section of the NHMP addendum addresses 44 CFR 201.6(c)(3(iv), *Mitigation Strategy*.

During the 2017/2018 Hood River County NHMP update process the County, City, and Port Steering Committees reviewed the County mitigation actions. Following the review actions were created specific to the Port of Hood River. Each jurisdiction developed a list of priority actions. The Port has identified one priority action listed in Table PHR-1.

Table PHR-1 Port of Hood River Priority Mitigation Action Items

Action Item	Action Title	Managing Department/Agency	Timeline	Potential Funding Source(s)
EH #1	Replace Hood River-White Salmon bridge to withstand strong shaking.	Port of Hood River	Long Term (15 years)	General Fund; bridge tolls, private investment

Source: Port of Hood River NHMP Steering Committee, 2018. EH=Earthquake
Note: The Hood River-White Salmon is considered particularly vulnerable to earthquake and the Port has taken steps to mitigate the bridge. See report and studies listed above for more information.

Ongoing mitigation activities regarding droughts, floods, landslides, wildfires, windstorms, and winter storms occur at the Port, City, and County level, and are described in the County NHMP in Volume I, the Hazard Annex in Volume II, the City of Hood River Addendum in Volume III, and the Mitigation Resources, specifically Appendices A and B in Volume IV. Routine activities include public outreach, underground utility construction, equipment improvements, volunteer recruitment, and the creation of defensible space. These institutionalized actions are considered a success of the previous NHMP collaborations. Because these activities are ongoing, and/or completed for the land within the Port District by the County or City, the Steering Committee decided not to list them as separate mitigation actions within this addendum. As a result, the prioritized mitigation action does not directly address these hazards. The Port will continue to partner with the County and City on the implementation of mitigation strategies related to these hazards that benefit both jurisdictions.

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The local level rationale for the identified mitigation strategies (action items) is presented herein, and within Section 2, *Risk Assessment*, and Appendix C, *Community Profile*. The risk assessment process is graphically depicted in Figure PHR-2. Ultimately, the goal of hazard mitigation is to reduce the area of risk, where hazards overlap vulnerable systems.

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This NHMP utilizes a hazard analysis methodology that was first developed by FEMA circa 1983, and gradually refined by the Oregon Military Department's Office of Emergency Management (OEM) 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 endeavors to reflect how physical changes in the jurisdiction and scientific research modify

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Hazard Analysis

The Port of Hood River worked with the Hood River Steering Committee to develop a hazard vulnerability assessment that covers the Port and the City. As such the ratings for the City of Hood River are the same for the Port of Hood River.

Table PHR-2 shows the HVA matrix for the Port of Hood River showing each hazard listed in order of rank from high to low. For local governments, conducting the hazard analysis is a useful step in planning for hazard mitigation, response, and recovery.

Two chronic hazards (winter storm and wildfire) and one catastrophic hazard (Cascadia Subduction Zone earthquake) rank as the top hazard threats to the Port. Crustal earthquake hazards, volcano, and drought comprise the next highest ranked hazards, while flood, landslide, and windstorm hazards comprise the lowest ranked hazards.

Table PHR-2 Hazard Analysis Matrix – Port of Hood River

Hazard	History (x2)	Probability (x7)	Vulnerability (x5)	Maximum Threat (x10)	Total	Rank	Risk Level
Winter Storm	9	10	9	10	**233**	**1**	**High**
Wildfire	6	7	6	9	**181**	**2**	**High**
CSZ Event	2	6	8	9	**176**	**3**	**High**
Crustal Earthquake	2	4	5	8	**137**	**4**	**Moderate**
Volcano	2	2	5	7	**113**	**5**	**Moderate**
Drought	4	7	3	4	**112**	**6**	**Moderate**
Flood	3	6	3	4	**103**	**7**	**Low**
Landslide	3	3	1	5	**82**	**8**	**Low**
Windstorm	2	3	2	4	**75**	**9**	**Low**

Source: Port of Hood River NHMP Steering Committee, 2018.

Table PHR-3 categorizes the probability and vulnerability scores from the hazard analysis (Table PHR-2) for the Port and compares the results to the assessment completed by Hood River County (areas of differences are noted with **bold** text within the Port ratings).

Table PHR-3 Probability and Vulnerability Comparison

	Port of Hood River		County	
Hazard	**Probability**	**Vulnerability**	**Probability**	**Vulnerability**
Winter Storm	High	High	High	High
Wildfire	High	Moderate	High	Moderate
CSZ Event	Moderate	**High**	Moderate	Moderate
Landslide	**Low**	**Low**	Moderate	Moderate
Drought	**High**	**Low**	Moderate	Moderate
Flood	Moderate	Low	Moderate	Low
Crustal Earthquake	Moderate	Moderate	Moderate	Moderate
Windstorm	**Low**	**Low**	Moderate	Moderate
Volcano	Low	Moderate	Low	Moderate

Source: Port of Hood River NHMP and Hood River County NHMP Steering Committees, 2018.
Note: * - the HVA ratings for the City and Port of Hood River are identical.

Hazard Characteristics

Related to this NHMP update process, FEMA is providing an opportunity for the County, City, and Port to participate in a Risk Mapping, Assessment, and Planning (Risk MAP) process that generates additional data on risks and vulnerabilities of natural hazards. The Risk Report, prepared by the Oregon Department of Geology and Mineral Industries (DOGAMI) provides a quantitative risk assessment that informs communities of their risks related to certain natural hazards (including earthquake, flood, lahar (volcanic event), landslide, and wildfire). The Port hereby incorporates the preliminary Risk Report into this NHMP by reference to provide greater detail to hazard sensitivity and exposure. The full report can be accessed on the DOGAMI Interpretive Map Series webpage: http://www.oregongeology.org/pubs/ims/p-ims.htm.

The Port of Hood River facilities are entirely contained within the City of Hood River (except for the northern section of the Hood River-White Salmon Bridge which is in Washington). The Port's Steering Committee was actively involved in the determination of risk and vulnerability along with the City of Hood River. As such, the Port's risk assessment is identical to the City's regarding the type, location, and extent for the identified natural hazards. The Port is not a community which has authority to adopt and enforce floodplain management regulations for the areas within its jurisdiction. The City of Hood River, and Hood River County participate in the National Flood Insurance Program (NFIP). There are no repetitive loss or severe repetitive loss properties in the Port, City, or County (see Volume I, Section 2, Table 2.11 for more information).

Please review the Risk Assessment (Volume I, Section 2 and Volume III, City of Hood River Addendum) for additional information on hazard identification and vulnerability for the Port.

Port Asset Identification

This section provides information on Port specific assets. For additional information on the characteristics of the City of Hood River, in terms of geography, environment, population, demographics, employment and economics, as well as housing and transportation see Volume III, *City of Hood River Addendum,* and Volume IV, Appendix C, *Community Profile*. Many of these community characteristics can affect how natural hazards impact communities and how communities choose to plan for natural hazard mitigation. Considering the Port specific assets during the planning process can assist in identifying appropriate measures for natural hazard mitigation.

Facilities and Property Assets Inventory

Asset inventory is the first step of a vulnerability analysis. Assets that may be affected by hazard events include population, residential and nonresidential buildings, critical facilities, and infrastructure. The following list includes port assets:

Hood River-White Salmon Interstate Bridge: includes all spans of the steel truss composite bridge.

Ken Jernstedt Airfield: A 120-acre visual approach Basic Utility, Stage II airport, serving single-engine and small twin-engine airplanes, with approximately 105 aircraft based at the facility and handling about 14,000 operations annually. Includes a 1,353 sq. ft. office, 4,3338 sq. ft. maintenance hangar and 36 T-hangar spaces.

Hood River Waterfront: Includes 105 acres of land (primarily owned by the Port), about 50 acres are developed with light industrial or commercial properties, 10 acres are vacant, 45 acres are dedicated to parks, recreation sites, trails, and other open space.

- Waterfront Industrial Property
  - Halyard Building: 21,148 s.f. flex-space light industrial building ca. 2010.
  - Jensen Building: 71,857 s.f. classic light industrial building acquired in 2010.
  - Maritime Building: 38,806 s.f. basic industrial building ca. 1975.
  - Expo Center: 26,031 s.f. commercial building ca. 1981.
- Waterfront Recreational Property: Includes The Spit, Event Site, and The Hook plus a trail system that support recreational pursuits including windsurfing, kiteboarding, stand-up paddle boarding, and kayaking.
- Marina Basin: Two major components (1) a gated, semi-private marina ca. 1970s with 154 slips, 11 boathouses, and 110 parking spaces for tenant use; and (2) a pubic boat launch ca. 1970s that includes a two-lane boat ramp, 150 ft of transient dock for visitor tie-up, 55 trailer and 28 vehicle parking spaces, and a public restroom.
- Port Marina Park: 22 acres of active and passive opens space and four commercial buildings:
  - *Marina Park Office Building No. 1*: 5,738 s.f. ca. 1973 (improvements in 2012) location of Hood River Chamber of Commerce and Visitors Center.
  - *Marina Park Office Building No*. 2: 2,406 s.f. location of State DMV.

    - *Port Office Building and Shop*: 4,934 s.f. office and 3,226 s.f. shop ca. 1970s (updated in 2008). Location of Port administration and facilities maintenance and a small business accelerator.
    - *Marina Park*: includes an 839 s.f. structure which houses the Hood River Yacht Club, lawn space, picnic shelter, beaches, restrooms, and a multi-use field.
- Other Assets:
    - *Wasco Business Building*: 14,650 s.f. building ca. 2004
    - *Big 7*: 38,854 s.f. office and industrial building ca. 1984 (updated in 1990s)
    - *Timber Incubator Building*: 10,000 s.f. timber incubator building located in the 29-acre John Weber Business Park ca. 1997.

Vulnerabilities to Port facilities are listed in Table PHR-4. The Hood River-White Salmon Bridge is an identified vulnerability to the Port and City. The bridge is a key transportation connector between residents north and south of the Columbia River crossing east of Portland and is likely to experience damage during a Cascadia Subduction Zone or crustal earthquake event. The Port has undergone numerous feasibility studies to evaluate the replacement of the bridge. More information can be found on the Port's website: https://portofhoodriver.com/bridge/bridge-replacement-project/. For information on expected losses due to a CSZ event see the Oregon Resilience Plan.

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Table PHR-4 Port of Hood River Facility and Infrastructure Hazard Vulnerability

Facility Type	Name	Drought	Earthquake	Flood	Landslide	Volcano	Wildfire	Windstorm	Winter Storm
Government	Port Office		X						X
Community	Waterfront Industrial Property		X			X	X	X	X
	Waterfront Recreational Property		X					X	X
	Marina Basin		X			X	X	X	X
	Port Marina Park		X			X	X	X	X
	Other Assets		X						
Bridges	Hood River-White Salmon		X						X
Utilities	Port Marina Lift Station	X		X					
Airport	Ken Jenstedt Airfield		X			X		X	X

Source: Hood River Steering Committee, April 2018

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Volume IV:
Mitigation Resources

Photo Source: Hood River County

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Appendix A:
Action Item Forms

There are 14 total mitigation actions determined by the Steering Committee during the 2018 NHMP update and they are categorized in high (2), medium (5), and low (7) priority categories. The County is operating with low funds and minimal staff, so chose to focus efforts only on actions deemed priority according to their feasibility. The high and medium priority actions are included below in the Action Item Forms, but the low priority actions are not.

High Priority Mitigation Actions

Action Item: Earthquake Hazard #1	
Mitigation Action/Project Title: Address Structural Issues and Seismic Collapse Risk of Vulnerable and Critical Facilities	
Background/ Issue:	County essential and emergency services are housed in two unreinforced masonry buildings – 309 State St. and 601 State St. The Hood River/White Salmon bridge, Hood River City Hall, Cascade Locks City Hall, Bridge of the Gods, schools and fire stations are not seismically retrofit to withstand a Cascadia Subduction Zone (CSZ) event or a significant crustal earthquake shaking Hood River County at a "strong" or "very strong" level for 2-4 minutes. Both County essential services buildings and most fire departments have not been retrofit. It is unlikely that emergency service could respond adequately in a CSZ event or that essential service buildings would be safe or able to reinstate services. With Emergency Management (EM) support, three schools have begun seismic retrofitting (Hood River Middle, Wy'East Middle and May St. Elementary) these are now/will be possible shelters. Two Fire Districts are pursuing State seismic retrofit grants - one was approved May 2018, $2.5 million for both Westside Fire Stations. County Emergency Management has also designated and developed a new alternate EOC, Mobile EOC, to reinstate services at any safe building when the County buildings have failed, a project that was successful in obtaining 2017 state and federal grant support. A second phase of grant funding was requested by EM in January 2018.
Implementation /Integration Steps:	• Develop list of vulnerable facilities and identify first, second, and third tier priorities. • Perform a Rapid Visual Survey and other needed studies of top priority facilities to determine needs and costs (using DOGAMI /ATC process). • Promote seismic retrofit grants to local public agencies. • Support agencies in making building upgrades, reinforcement or replacement plans.
Responsible Agency:	Emergency Management
Partners:	County Administration, Public Works and Commission, Port of Hood River Director and Commission; Hood River County School District Administration; Hood River City Manager, Public Works and Council; Westside, Parkdale and Wy'East Fire District Chiefs and Boards; GIS, Public Works, DOGAMI, Business Oregon, OEM
Potential Funding:	State Rehabilitation Grant Program, HMGP or PDM grant, local bonds/taxes
Cost Estimate:	Local staff time for developing list ($10,000) Engineering assessments ($30,000) Cost matching where applicable (grant match – TBD)

Benefits (losses avoided):	• Ensure continuity of government and emergency response • Ensure life safety for essential service personnel, children, fire fighters and Interstate commuters if structures fail • Avoid loss of life and property in event of emergency response failure • Avoid high costs of rebuilding emergency facilities post disaster
Timeline:	Develop list by December 2019 RVS by December 2020 Identify funding source by January 2022 Begin application process for grants 2022-2023
Priority:	**High Priority** because of the high probability of a seismic event and relative instability of critical structures.
Worksheet Completed by:	Emergency Manager

Action Item: Multi-Hazard #7	
Mitigation Action/Project Title: **Develop Emergency Evacuation and Public Notification**	
Background/ Issue:	In recent emergencies, gaps have become apparent in our emergency planning, notification and evacuations. Road closures clog evacuations and residents are not familiar with what evacuation zones they are in. New templates and pre-scripted Everbridge (reverse 911) tools need to be developed; news release and PIO (Public Information Officer) tool kits needs to be developed. Developing a call center, evacuation plans and road closure plans are critical to ensuring safe notification and evacuation. In addition, the County EAS system (radio emergency alert) is inoperative and 911 communications need continuing investments and enhancements we cannot afford.
Implementation/ Integration Steps:	• Research funding sources. • Apply for grants and enhanced funding. • Build a short term list of priorities • Complete a PIO evacuation tool kit • Complete a 911 Everbridge notification tool kit • Complete and promulgate the Evacuation Plan as appropriate • Public Outreach to build evacuation zone awareness and community resilience.
Responsible Agency:	Hood River County Emergency Management
Partners:	School district; community PIOs and partners; granting agencies; County 911; Hood River Sheriff's Office; School Task Force
Potential Funding:	Homeland Security Funding; Ford Foundation; AmeriCorps; private foundations for capacity building
Cost Estimate:	Local staff time for developing short term plans and MOUs ($10,000) Contractor or staff to write shelter plan and hold workshops to ensure wide participation ($28,000) Grant writer ($15,000) Staff time on grant project fulfillment ($15,000)
Benefits (losses avoided):	• Avoid loss of life and property in event of road closures, long term power outages, winter storms, evacuations • Leverage Red Cross expertise, local community centers with non-profit volunteers and boards; enhance our readiness after Red Cross downsizing in Hood River, reducing services.
Timeline:	Build a short term list of priorities by Dec 2019 Complete and promulgate the Evacuation plan by Dec 2019 Research funding sources and apply for grants and enhanced funding by Sept. 2020. Complete a PIO evacuation tool kit by June 2020 Complete a 911 Everbridge notification tool kit by Dec 2020 Public Outreach to build evacuation zone awareness and community resilience by Dec 2022

Priority:	**High Priority** because of recent evacuations and notifications and high probability of future evacuations and emergencies
Worksheet Completed by:	Emergency Manager

Medium Priority Actions

Action Item: Multi-Hazard #5	
Mitigation Action/Project Title: **Develop Shelter Plan and Prepare Facilities to Provide Shelter-in-Place Services**	
Background/ Issue:	In recent emergencies, gaps have become apparent in our shelter planning. Red Cross, located primarily in Portland and Vancouver with a satellite shelter in The Dalles, cannot arrive to Hood River in winter to open shelters and in any event, may not arrive for three days or more. In recent emergencies Red Cross faced challenges providing services from the Washington side of the Gorge. Also, people are often reluctant to relocate to Red Cross shelters due to stigma. Life safety in winter storms or evacuations is at risk, especially if winter temperatures remain low and there are long term power outages. In wildfires or earthquakes, I-84 may be closed, Highway 35 and 14 are maxed out with truck traffic and the community may be isolated. The county has experienced instances when needed supplies and fuel to sustain our population were not available. Our local stores and stations hold three days of supplies.
Implementation /Integration Steps:	• Research and obtain grant funding for grant writing and research funding sources. • Build a short-term list of local network of non-profit granges and Town Halls on an EOC resource list. (EM staff) • Develop short-term hybrid shelter management plans with Red Cross that leverages their expertise and local volunteer support and offer shelter classes. • Apply for funding to develop a long-term shelter plan. • With grant funding, develop a shelter plan that allows people to shelter in place and share resources at local community centers, which are run by local NGO's and supported by government agencies. Ensure there are staging areas in the event of a traffic jam in evacuations or road closures; ensure community centers and shelters are supported by community equipment caches; ensure a road closure a flow plan is created; ensure residents know which evacuation zone they are in, so they are more prepared for disasters. • Write and obtain grants for community disaster equipment caches.
Responsible Agency:	Hood River County Emergency Management
Partners:	Gorge Grown, Granges and Town Halls; Rotary; Soroptomists; Lions Club; Community Development, RARE program at University of Oregon; AmeriCorps; OEM; City Councils, Planning, Fire Stations, GIS, FEMA
Potential Funding:	Homeland Security Funding; Ford Foundation; AmeriCorps; private foundations for capacity building
Cost Estimate:	Local staff time for developing short term plans and MOUs ($10,000) Contractor or staff to write shelter plan and hold workshops to ensure wide participation ($28,000) Grant writer ($15,000) Staff time on grant project fulfillment ($15,000)

Benefits (losses avoided):	• Reduce and avoid loss of life and property in event of road closures, long term power outages, winter storms, evacuations • Leverage Red Cross expertise, local community centers with non-profit volunteers and boards; enhance our readiness after Red Cross downsizing in Hood River, reducing services.
Timeline:	Develop initial EOC shelter resource list by December 2019 Develop short-term hybrid shelter management plan by June 2020. Apply for funding for long term shelter plan by Dec 2021 Write grants for community disaster equipment caches by December 2023 With grant funding, develop a shelter plan by June 2023
Priority:	**Medium Priority** because of need for shelters and evacuations, complicated by long-term power outages and road closures, as experienced in recent emergencies.
Worksheet Completed by:	Emergency Manager

Action Item: Multi-Hazard #2	
Mitigation Action/Project Title: **Enhance Public Outreach and Educational Programs for All Hazards**	
Background/Issue:	In recent emergencies, residents needed a full call center to answer their questions; they seemed unfamiliar with READY, SET, GO evacuation levels. Residents are not familiar with what evacuation zones they live in and how ready they should be in disasters. Local businesses are vulnerable and need COOP and contingency plans. We have made progress in getting families to prepare for disasters but need targeted outreach. The vast majority are not familiar with defensible space, earthquake risks, evacuation routes, and landslide risks. We also need an intensive bilingual outreach strategy and a plan to reach vulnerable populations.
Implementation/ Integration Steps:	• Research funding sources. • Find and partner with other organizations. • Apply for grants and enhanced funding. • Build a short term list of priorities • Complete a public outreach strategy • Public Outreach to build community resilience.
Responsible Agency:	Hood River County Emergency Management; County 911; Hood River Sheriff's Office
Partners:	School district; community PIOs and partners; granting agencies; local network of PIO's (Public Information Officers)
Potential Funding:	Homeland Security Funding; Ford Foundation; AmeriCorps; private foundations for capacity building
Cost Estimate:	Local staff time for developing short term needs ($10,000) Grant funded PIO outreach ($35,000) Staff time on grant project fulfillment ($15,000)
Benefits (losses avoided):	• Reduce and avoid loss of life and property in event of all hazard emergencies
Timeline:	Research funding sources by Feb 2020. Apply for grants and enhanced funding by Dec 2020. Complete a short term public outreach strategy by Dec 2019 Grant funded public outreach by June 2021
Priority:	**Medium Priority** because of recent evacuations and emergencies
Worksheet Completed by:	Emergency Manager

Action item: Multi-Hazard #1	
Mitigation Action/Project Title: **Creation of a Part-time Position to Coordinate Volunteer Efforts and Pursue Mitigation Funding**	
Background/Issue:	Mitigation actions by and large are beyond the funding capacity of local government agencies and non-profit organizations. We need a staff person to follow up on all high and medium priority projects and ensure follow up and actions occur to achieve fulfillment of this NHMP.
Implementation/ Integration Steps:	• Research funding sources and partnerships. • Apply for grants and enhanced funding. • Hire a part time or full time temporary person to fulfill NHMP actions
Responsible Agency:	Hood River County Emergency Management; Community Development Dept.
Partners:	County Departments, SWCD, Cities, State Agencies, Nongovernment/Quasi-governmental Organizations, Public, CWPP, RARE, University of Oregon, OEM
Potential Funding:	Ford Foundation, AmeriCorps, Bill and Melinda Gates Foundation
Cost Estimate:	Local staff time or grant writer for writing requests ($10,000) Staff time on grant project fulfillment ($35,000)
Benefits (losses avoided):	• Reduce and avoid loss of life and property in event of all hazard emergencies while local agencies do not have the funding capacity to fulfill the projects in the NHMP
Timeline:	Research funding sources by July 2020. Apply for grants and enhanced funding by Dec 2021. Staff begins with grant funding by Dec 2023
Priority:	**Medium priority** because of County's inability to fund mitigation actions with county, city and local funding
Worksheet Completed by:	Emergency Manager

Action item: Wildfire Hazard #1	
Mitigation Action/Project Title: **Enhance Interagency Cooperation Regarding Response and Fuel Reduction**	
Background/Issue:	Forested lands in the County are managed by federal, state, county and private entities. The Mid-Columbia Fire Defense Board meets regularly to discuss critical issues and support collaboration. The Hood River County Fire Defense Boards collaborates with this entity as well. Proper fuel management and public outreach requires cooperation between managing organizations.
Implementation/Integration Steps:	• Update Community Wildfire Protection Plan high hazard areas. • Outreach to property owners in high hazard areas. Identify gaps in service between agencies.
Responsible Agency:	Hood River County Fire Defense Board
Partners:	ODF, USFS, Emergency Management, County Planning, County Forestry
Potential Funding:	Local sources and regular agency funding, ODF, USFS
Cost Estimate:	Local staff time
Benefits (losses avoided):	Reduce and void loss of life and property due to gaps in outreach and services. Avoid delayed response time due to communication disruptions.
Timeline:	Ongoing
Priority:	**Medium Priority** due to high wildfire risk and successful actions already occurring.
Worksheet Completed by:	NHMP Update Coordinator

Action Item: Wildfire Hazard #3	
Mitigation Action/Project Title: **Ensure Proper Road Continuity, Numbering, and Naming**	
Background/Issue:	Emergency response times are encumbered by inconsistencies in addressing, which include multiple dwellings at a single address, unaddressed roads and conflicting/repeating road names.
Implementation/ Integration Steps:	Fire districts will identify main roads containing inconsistencies. Fire districts will prioritize and map high need areas. County planning will apply corrective action via various technical fixes to address assignment.
Responsible Agency:	Hood River County Planning
Partners:	Hood River County Emergency Management, USPS, County Building Department, City of Hood River, City of Cascade Locks, Fire Districts, Fire Defense Board
Potential Funding:	Local sources and regular agency funding
Cost Estimate:	Local staff time
Benefits (losses avoided):	Improved agency coordination. Reduce and avoid loss of property and life through better response time.
Timeline:	ST (2-5 years)
Priority:	Issue only affects certain residential projects; other mitigation actions protect the entire County.
Worksheet Completed by:	NHMP Update Coordinator

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APPENDIX B: PLANNING AND PUBLIC PROCESS

This appendix describes the changes made to the 2012 Hood River County NHMP Natural Hazards Mitigation Plan (NHMP) during the 2018 plan update process.

Project Background

Hood River County collaborated with the Department of Land Conservation and Development (DLCD), and the University of Oregon's Institute for Policy Research and Engagement IPRE) through the Resource Assistance for Rural Environments (RARE) and the Oregon Partnership for Disaster Resilience (OPDR), to update the 2012 Hood River County NHMP. The Disaster Mitigation Act of 2000 requires communities to update their NHMPs every five years to remain eligible for Hazard Mitigation Assistance (HMA) funds through the Pre-Disaster Mitigation (PDM) program, Flood Mitigation Assistance (FMA) program, and the Hazard Grant Mitigation Program (HMGP). Steering Committee members from Hood River County and participating Cities met to update their NHMP. Participating Cities are the City of Hood River and the City of Cascade Locks. Major changes to the 2012 NHMP are documented and summarized in this appendix.

2018 Plan Update Changes

The sections below only discuss *major* changes made to the 2012 NHMP during the 2018 plan update process. Major changes include the replacement or deletion of large portions of text, changes to the plan's organization, updated hazard risk and vulnerability assessment, and new mitigation action items. If a section is not mentioned, then it can be assumed that no significant changes occurred.

Table B-1 lists the 2012 Hood River County NHMP plan section names and the corresponding 2018 section names, as updated This appendix will use the 2018 plan update section names to reference any changes, additions, or deletions within the plan. The changes are described sequentially in the text following Table B-1.

Table B-1 Changes to Plan Organization

2012 Hood River County NHMP	2018 Hood River County NHMP
Volume I: Basic Plan	**Volume I: Basic Mitigation Plan**
Executive Summary	Executive Summary
Introduction	Introduction
Risk Assessment	Risk Assessment
Mitigation Strategy	Mitigation Strategy
Implementation and Maintenance	Implementation and Maintenance
Volume II: Hazard Annex	**Volume II: Hazard Annex**
	Volume III: Jurisdictional Addenda
	City of Cascade Locks Addendum
	Port of Cascade Locks Addendum
	City of Hood River Addendum
	Port of Hood River Addendum
Volume III: Appendices	**Volume IV: Mitigation Resources**
Appendix A: Action Item Forms	Appendix A: Action Item Forms
Appendix B: Planning and Public Process	Appendix B: Planning and Public Process
Appendix C: Community Profile	Appendix C: Community Profile
Appendix D: Economic Analysis of Mitigation Actions	Appendix D: Economic Analysis
Appendix E: Grant Programs	Appendix E: Grant Programs and Resources
	Appendix F: Public Outreach Survey
	Appendix G: Climate Change Influence on Natural Hazards: Overview and Hood River County Projections

Front Pages

Acknowledgements have been updated to include the 2018 project partners and planning participants.

The FEMA approval letter, review tool, and city resolution of adoption are included.

Volume I: Basic Plan

Volume I provides the overall plan framework for the 2018 NHMP update, including the following sections:

Executive Summary

The 2018 NHMP includes an updated plan summary that provides information about the purpose of natural hazards mitigation planning, key points from the NHMP update process, and describes how the plan will be implemented.

Section 1: Introduction

Section 1 introduces the concept of natural hazards mitigation planning and answers the question, "Why develop a mitigation plan?" Additionally, Section 1 summarizes the 2018 plan update process, and provides an overview of how the plan is organized.

Section 2: Risk Assessment

Section 2, Risk Assessment, consists of three phases: hazard identification, vulnerability assessment, and risk analysis. Hazard identification involves the identification of hazard geographic extent, its intensity, and probability of occurrence. The second phase attempts to predict how different types of property and population groups will be affected by the hazard. The third phase involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time.

Changes to Section 2 include updates to:

- Hazard characteristics, probability, and vulnerability information.
- Population vulnerability trends and significant statistics.
- National Flood Insurance Program (NFIP) information.
- The Hazard Vulnerability Analysis tool.

Section 3: Mitigation Strategy

This section provides the basis and justification for the mission, goals, and mitigation actions identified in the NHMP. Major changes to Section 3 include the following:

Mission and Goals were reviewed and compared with the State NHMP Mission and Goals, changes were made and are described in the meeting notes, included in this section. "Natural Resource Protection" was included with "Protection of Life and Property" and detailed goal statements were updated to reflect current priorities.

The Hood River County Steering Committee met to review the previous NHMP action items. Steering Committee members provided updates and edits to the mitigation actions where applicable including, the revision and consolidation of existing actions, managing department/agency designations, timeframe, and potential funding sources. See the mitigation action tables below for changes for the County and Cities mitigation actions.

A list of prioritized actions for the County was included in tables Table 3.2, 3.2, 3.4. New action items are based upon current needs based upon the community risk assessment. They are designed to be feasibly accomplished within the next five years and can be found in Table 3-1.

The 2012 Mitigation Actions are listed below, including the progress achieved since the 2012 update, the 2018 status of the action item, and the rationale for that status. New Mitigation Actions developed during the 2018 update are listed after the 2012 actions.

Key:

- Action Item: Identifies Action Item according to 2012 item number. Hazards are indicated by the following abbreviations;
- MH = Multi-Hazard, DH = Drought Hazard, FL= Flood Hazard, EH = Earthquake Hazard, SH = Severe Storm Hazard, WH = Wildfire Hazard, VH = Volcano Hazard
- Action Title: Short descriptor of mitigation action
- Coordinating Organization: Agency responsible for managing action
- Status: Steering Committee determination on whether to defer, modify or eliminate 2012 actions in the 2018 plan.
- For the purposes of this plan "defer" indicates action was retained without changes; these actions remain priorities of the County and project partners, timelines, and implementation remains the same.
- "Modify" indicates that the action remains priority, and some element of the project has been updated (for instance, implementation focus, timeline, or project lead), and the action title remains consistent with the 2012 title.
- *Eliminate* indicates an action is not included in the 2018 update
- Status Comments: The rationale supporting the Steering Committee status determination
- Progress/Update: An overview of the progress made since 2012 for the listed mitigation action

Tables B-2: 2012 Mitigation Actions

Action Item:	**MH #1**
Action Title:	Identification and Pursuit of Implementation Funding for Mitigation Actions and Creation of Part-time Position to Coordinate Efforts (NHMP & CWPP)
Coordinating Organization:	Board of Commissioners
Status:	Defer/ Modify
Status Comments:	This is a necessary action to support other identified actions. A major component of this action will be defining specific projects, budgetary needs and grant opportunities. This action will incorporate MH #6 to continue the County's volunteer program.

Progress/Updates:	County Emergency Manager position increased from .75 FTE to 1.00 FTE to increase public outreach and grant writing July 1, 2015. Part time staff requested in Homeland Security grant Jan. 2018. Future part time staff or mitigation measures to be pursued as possible via new PDM or HMPG or other grants. County budget crisis forcing department reductions 2017-2020. County has a long-term structural budget deficit and is underfunded for current operations. Mitigation plan and significant follow up actions are only achievable with new revenue or grant funding.

Action Item:	**MH #2**
Action Title:	Develop Public Outreach / Educational Programs
Coordinating Organization:	Emergency Management
Status:	Defer/ Modify
Status Comments:	Strategies and opportunities for outreach and education overlap for each hazard. Emergency Management can leverage platforms to combine hazard specific outreach.
Progress/Updates:	Series of public service radio announcements on emergency procedures have aired over the last three years County Emergency Management, Sheriff and Public Health Departments have significantly increased outreach. We partnered with NW Natural and HR Electric COOP as well as Pacific Power on preparedness outreach 2015-2017.Two to five annual ads in Hood River News, Hoodrivernews.com and Hood River Community Education catalog (mailed twice a year to 50,000 Gorge households). Two annual The Big One outreach events- well attended by citizens; hands-on booths and preparedness presentations. Annual attendance by citizens in excess of 300. Annual preparedness booths at back to school nights and Families in the Park concert events attracting 5,000 or more to each event.

Action Item:	**MH#3**
Action Title:	Annual Review and Update of the County Community Wildfire Protection Plan, and Natural Hazards Mitigation Plan; Re-Adoption by County Commission Every 5-Years; Review and Update of the County Emergency Operations Plan Every 2-Years
Coordinating Organization:	Emergency Management, BOC
Status:	Eliminate
Status Comments:	Action institutionalized. Occurs twice annually.
Progress/Updates:	County Emergency Management held and continues to hold two or more annual NHMP review meetings every year since NHMP plan was adopted in 2012.

	County EM coordinates plan updates every five years as grant funding for NHMP coordinator allows. The PDM grant to update Hood River NHMP was delayed by FEMA and started in fall 2017, during which the Eagle Creek Fire occurred, a significant national emergency, further delaying update process until spring 2018.

Action Item:	MH#4
Action Title:	Develop & Maintain Comprehensive Impact Database
Coordinating Organization:	GIS
Status:	Eliminate
Status Comments:	Development completed. Maintenance occurs on an ongoing basis.
Progress/Updates:	State is developing similar database, to be shared with Counties. County's GIS mapping program was well utilized to build a database of hazards as part of our annual and NHMP planning process County GIS hazard mapping was used daily to track progress and hazards of the Eagle Creek Fire incident from Sep. 2 to 30, 2017.

Action Item:	MH#5
Action Title:	Create Systems to Support Special Needs Populations
Coordinating Organization:	Emergency Management
Status:	Defer/ Modify
Status Comments:	Database was created by Oregon Health Authority. Next step is to ensure database is used by agencies. Reverse 911 system also requires vulnerability specific registration.
Progress/Updates:	A special needs population database was created and tested during the Eagle Creek Fire. The protocol for future incidents is now in place. Information was used in evacuation plan implementation.

Action Item:	MH#6
Action Title:	Create County Position for Volunteer Coordination & Planning
Coordinating Organization:	BOC
Status:	Eliminate
Status Comments:	A successful volunteer program has been established. A County position solely for this purpose is not realistic in the current funding landscape. The part-time staff noted in MH #1 will be responsible for grant writing and volunteer coordination. This action is incorporated into MH #1.
Progress/Updates:	IEMC training – County awarded nationally competitive grant to bring FEMA training academy to Hood River for integrated emergency management. 98 community attendees across multiple sectors, NGO's, volunteers, businesses and citizens. County Emergency Management launched an EM/EOC (Emergency Operations Center) volunteer program in 2016, utilizing existing budget and FTE and recruited 22 volunteers to this program. This built new capacity among this pool of citizen volunteers, many who are leaders with access to large pools of additional volunteers. Needs further development and sustainment, leveraging volunteer fire agencies' needs, NGO facilities such as Granges, and other capacity building needs, etc. Volunteers attend monthly drills and staffed the County EOC for natural hazards incidents - Sept. 2017 Eagle Creek fire – EOC averaged 31 people per day for 18 days when county staffs were not available. This was a key step forward from 2016-18 as evidence by EOC response in Winter Storm emergency 2017; Oregon total Solar Eclipse August 2017; Eagle Creek Fire 2017; Long Term Power Outage tabletop; long term recovery tabletop; IEMC Dec 2016; Drought emergency planning 2015. As with all volunteer programs, we are experiencing attrition and do not know who can help in emergencies, given lack of road access or schedule conflicts, thus the need for continuing capacity building.

Action Item:	MH#7
Action Title:	Formation of All Hazard Overhead Team
Coordinating Organization:	Fire Districts
Status:	Eliminate
Status Comments:	An All Hazard Overhead Team forms during emergency situations via Incident Command Protocol. An ongoing team is not financially feasible.
Progress/Updates:	We have significantly increased our emergency response capacity since 2015 as previously described. We also brought in mutual aid for large-scale response in the Eagle Creek Fire. Due to small Countywide staff access, overhead teams are most likely readily available via the national IMT (Incident Management System) as were utilized in the Eagle Creek Fire to assist us with incident management.

Action Item:	MH#8
Action Title:	Develop Post-Disaster Short Term Recovery Plan
Coordinating Organization:	BOCC
Status:	Eliminate
Status Comments:	This is not a high priority action considering the current funding situation. Power, water, and road access recovery actions are implemented as standard procedure.
Progress/Updates:	HRC Emergency Management activated the federal Small Business Assistance loan program in 2017 for the winter ice storm and Eagle Creek Fire. Extensive recovery actions after the ECF with state and regional partners. No stand-alone plan has been developed.

Action Item:	MH#9
Action Title:	Develop Small Business Awareness & Continuity Planning Campaign
Coordinating Organization:	Hood River Chamber of Commerce
Status:	Eliminate
Status Comments:	All outreach related actions are incorporated and combined into MH #2: Develop Public Outreach and Educational Programs.
Progress/Updates:	A couple seminars with the Chamber of Commerce. Consumer Org of State came into Cascade Locks, resource came from state after Eagle Cree Fire.

Action Item:	MH#10
Action Title:	Update County Comprehensive Land Use Plan
Coordinating Organization:	Planning
Status:	Defer/ Modify
Status Comments:	This action will be expanded to include desirable updates to zoning ordinances and building codes. Hazard information has improved substantially and can be incorporated into County planning, ordinances, and codes.
Progress/Updates:	No update, near-future updates unlikely.

Action Item:	MH#11
Action Title:	Improve County Forest Road Maintenance
Coordinating Organization:	HRC Forestry Department
Status:	Eliminate
Status Comments:	This occurs on an ongoing basis as routine maintenance.
Progress/Updates:	The SWCD has provided assistance to USFS on a few culvert replacement/ upgrade projects to improve fish passage since 2012. HRWG has been involved in a culvert and fish passage project on Evan Creek at Hutson Rd. (Not a county forest road). All Timber Sales fund road condition maintenance, reconstruction, and improvement, including drainage and surfacing as needed. Priority typically given to fish bearing waters, then to areas that will be prone to impact waters of the state. Legacy road slope failures are stabilized as needed. Large projects included replacement of washed out culverts on the West Fork of Neal Ck. with bridges which improved fish passage. We have installed or replaced multiple culverts every year as part of timber sale contracts or as emergent needs.

Action Item:	MH#12
Action Title:	Extend Streamside Vegetation Protection to All Land Uses
Coordinating Organization:	Hood River Watershed Group
Status:	Eliminate
Status Comments:	This occurs on an ongoing basis.
Progress/Updates:	The Hood River SWCD and HRWG continue to work to expand streamside vegetation. HRWG tends to work on non-ag lands, and the SWCD tends to work on ag lands. However, the SWCD does review all relevant county development permit applications and provide comments/recommendations where needed.

Action Item:	MH#13
Action Title:	Identification / Analysis of Irrigation Water Systems & Elimination of Open Irrigation Water with Consideration of Impact on Storm water
Coordinating Organization:	SWCD
Status:	Defer/ Modify
Status Comments:	Modified to include both water resource development and irrigation systems improvement in order to mitigate drought and flood hazards. Long-range development includes irrigation systems, groundwater monitoring, and well construction. The implementation and coordination of DH #2 and MH #13 overlap in practice.
Progress/Updates:	Significant progress has been made on this front since 2012. However, more work is yet to be done. We consider this a high propriety for our continued efforts to adapt to climate change and droughts.

Action Item:	DH#1
Action Title:	Support Local Agencies Training on Water Conservation Measures and Drought Management Practices
Coordinating Organization:	SWCD
Status:	Eliminate
Status Comments:	This occurs on an ongoing basis.
Progress/Updates:	Outreach and education was key in 2015 drought event. The SWCD took a lead role in educating the public and assisting in the coordination of efforts among entities. We will continue to do so in future. This could also be considered on-going.

Action Item:	DH#2
Action Title:	Ensure Long-range Water Resources Development
Coordinating Organization:	Hood River County Water Planning Group
Status:	Eliminate
Status Comments:	High priority action is incorporated into MH #13, see MH #13 rationale.
Progress/Updates:	The SWCD is conducting groundwater monitoring and has done so for the last three years in partnership with OWRD and the County. HRWG and SWCD secured funding to conduct a feasibility study to develop a Water Bank for HR County. The study is underway. If feasible, a Water Bank could further mitigate irrigation impacts during drought years.

Action Item:	FH#1
Action Title:	Mitigate Flood Event Resulting from Naturally Induced Dam Failure
Coordinating Organization:	Middle Fork Irrigation District
Status:	Eliminate
Status Comments:	Completed.
Progress/Updates:	Completed. Upcoming dam breach drill in 2018. Dam failure emergency plan is reviewed and revised annually.

Action Item:	FH#2
Action Title:	Apply for NFIP Community Rating System
Coordinating Organization:	Planning
Status:	Eliminate
Status Comments:	Unnecessary for amount of flood damage experienced by County.
Progress/Updates:	No update; deemed unnecessary due to infrequent flooding.

Action Item:	FH#3
Action Title:	Update FIRM Maps
Coordinating Organization:	Planning
Status:	Eliminate
Status Comments:	Internal County floodplain information is updates and sufficient. FIRM maps are updated by the State; this action is not in County control. Incorporating internal floodplain information into County Zoning Ordinances will be included in a comprehensive County Planning mitigation action.
Progress/Updates:	This is a work in progress (tied to NFIP). Expected to be completed by 2020 or 2021

Action Item:	FH#4
Action Title:	Improve Methods of Barrier Prioritization and Culvert Barrier Remediation for Fish Passage & Flood Mitigation
Coordinating Organization:	Public Works
Status:	Eliminate
Status Comments:	This occurs on an ongoing basis as routine maintenance.
Progress/Updates:	Expecting to construct the Evans Creek Culvert Replacement Project this summer which is a fish-passage/restoration project. It will be an ongoing effort for some time. We typically improve small culvert capacity along roadsides when existing culverts become damaged and need to be replaced or in areas where we know there is a problem. Improving fish passage is hardly ever a bad thing but from our position it is usually associated with a much broader project; i.e., if we need to replace a culvert we might as well improve fish passage.

Action Item:	EH#1
Action Title:	Rehabilitate Identified Vulnerable Schools, Emergency Facilities, and Public Buildings/Lifelines
Coordinating Organization:	County Facilities
Status:	Defer/ Modify
Status Comments:	This continues to be a high priority for the County. Replacement or rehabilitation may be appropriate. The Coordinating organizations are BOCC, Port Commissioners, School Board, and City Councils. Rehabilitation or replacement may be appropriate.
Progress/Updates:	Hood River EM heavily promoted the seismic retrofit grant opportunities offered by the state since 2015 – and Hood River County School District and local fire stations have applied for retrofit grants. HR Schools retrofit HR Middle School and are currently retrofitting Wy'East Middle school. These also may serve as County emergency shelters in disasters. Parkdale Fire and Westside Fire Departments are also currently submitting/or have submitted retrofit grant requests to the state. Addition of new alternate EOC/911 Centers – HR Fire Dept., HR Public Works and Mobile EOC to offset risk of loss of essential services in a Cascadia scenario. County EM wrote two Homeland Security grants to add Mobile EOC response. Phase one grant was successfully implemented Dec 2017 and we now have part of a Mobile EOC; the phase two grant is pending OEM/FEMA approval in June 2018.

Action Item:	EH#2
Action Title:	Improve Knowledge of Earthquake Sources / Improve Earthquake Hazard Zone Maps
Coordinating Organization:	Emergency Management
Status:	Defer/ Modify
Status Comments:	Maps are not necessary for sufficient understanding. The County seeks information on the Cascadia Subduction Zone event and the local Blue Ridge Fault.
Progress/Updates:	We have added the latest DOGAMI lidar maps to our County EM (Sheriff's) website but we do not have good interpretation of what this means for local impacts. County supported DOGAMI's recent applications for new landslide hazards maps for Eagle Creek Fire Burn Scar Area.

Action Item:	EH#3
Action Title:	Educate Those at Risk
Coordinating Organization:	Emergency Management
Status:	Eliminate
Status Comments:	All outreach related actions are incorporated and combined into MH #2: Develop Public Outreach and Educational Programs.
Progress/Updates:	Preparedness information distributed. Held two "Big One" outreach presentations on CSZ risks and preparedness activities. Annually hosted outreach booth from 2015-2018 at County fair attended by 2000-4000. See MH #2 for more outreach details.

Action Item:	LH#1
Action Title:	Improve Understanding of Landslide Risk Inside Hazard Areas
Coordinating Organization:	Planning
Status:	Defer/ Modify
Status Comments:	Landslide risk has expanded beyond specifically demarcated hazard areas. County requires new data on recent risk from Eagle Creek Fire.
Progress/Updates:	DOGAMI received a PDM grant to examine landslide risk in the Eagle Creek Fire burn scar.

Action Item:	LH#2
Action Title:	Improve Landslide Hazard Area Maps
Coordinating Organization:	GIS
Status:	Eliminate
Status Comments:	Landslide Hazard maps were created at the state level and are used as needed in zoning and planning. Current staff cannot remember the intention of this action item.
Progress/Updates:	DOGAMI produced landslide data and County GIS incorporated it into detailed and relevant maps for landslide hazards. These maps are in use by the Hood River Planning and Emergency Management Departments.

Action Item:	LH#3
Action Title:	Provide Education/Awareness for Those at Risk
Coordinating Organization:	Planning
Status:	Eliminate
Status Comments:	All outreach related actions are incorporated and combined into MH #2: Develop Public Outreach and Educational Programs.
Progress/Updates:	Initial work completed after Eagle Creek Fire in west Hood River County. Would need additional staff to make progress.

Action Item:	LH#4
Action Title:	Update County Zoning Ordinance Regarding Landslide Hazards
Coordinating Organization:	Planning
Status:	Eliminate
Status Comments:	All zoning related actions will be incorporated into a comprehensive County Planning mitigation action.
Progress/Updates:	This has not happened but it remains an important mitigation action.

Action Item:	SH#1
Action Title:	Continue Partnership Programs to Reduce Vulnerability of Public Infrastructure from Severe Winter Storms
Coordinating Organization:	Emergency Management
Status:	Defer/ Modify
Status Comments:	Partnership programs are in place, active and effective. Public infrastructure remains vulnerable.
Progress/Updates:	Partnership programs in place. Partnership determined a need for generators, a shelter plan, and a shelter-in-place plan to mitigate severe winter storms/long-term power outage. There is no current funding for these efforts. Mobile EOC Grant was written. County faces significant life safety risks when I-84 closes (blocked supply trucks, sub-freezing temps, cut off community). Note: efforts toward this project directly aid CSZ and other hazard mitigation efforts as well.

Action Item:	SH#2
Action Title:	Support/Encourage Electrical Utilities to Use Underground Construction Methods
Coordinating Organization:	Planning
Status:	Eliminate
Status Comments:	Completed within City boundaries. Otherwise set by State policy, outside of County power to influence.
Progress/Updates:	Utilities are transitioning towards underground methods as lines are replaced.

Action Item:	SH#3
Action Title:	Increase and Maintain Public Awareness of Severe Storms.
Coordinating Organization:	Emergency Management
Status:	Eliminate
Status Comments:	All outreach related actions are incorporated and combined into MH #2: Develop Public Outreach and Educational Programs.
Progress/Updates:	Completed. Significant enhanced outreach with emergency email list serv, everbridge (reverse 911), and outreach during winter emergencies 2015-18. An 8-page resource guide was distributed to residents. See MH #2 for more outreach details.

Action Item:	SH#4
Action Title:	Reduce Trees in Public Utility Right-of-ways - Avoiding Damage to Power Lines
Coordinating Organization:	Public Works
Status:	Eliminate
Status Comments:	Completed and continued on an ongoing basis by both utility companies and Public Works.
Progress/Updates:	Trimming and removing trees and vegetation as necessary. Initiated a roadside spray program specifically under the direction of County Public Works. Continue to work with utility providers to address problem areas. Formally adopted a Tree Trimming and Removal Policy to better acknowledge responsibility and to clarify our jurisdiction.

Action Item:	WH#1
Action Title:	Establish County-wide Wildfire Protection Group
Coordinating Organization:	BOCC
Status:	Eliminate
Status Comments:	Hood River County Fire Defense Board includes all five local Fire Districts, ODF, State Fire Marshall's Office, and USFS; this group works cooperatively to assess and promote fire hazard risks. They are responsible for public outreach, defensible space priorities, and response planning.
Progress/Updates:	Hood River County Fire Defense Board includes all 5 local Fire Districts and works cooperatively to assess and promote fire hazard risks.

Action Item:	WH#2
Action Title:	Improve Residential Fire Protection Capacity
Coordinating Organization:	Fire Districts
Status:	Eliminate
Status Comments:	State agencies set regulations; local fire districts obtain highest standards possible and implement on a routine basis.
Progress/Updates:	Distributed outreach information to homeowners in WUI, collaborated with USFS and ODF.

Action Item:	WH#3
Action Title:	Hazard Fuel Reduction
Coordinating Organization:	Fire Districts / BOCC
Status:	Eliminate
Status Comments:	The majority of forested land is managed by ODF and USFS; both organizations have active hazard fuel reduction programs.
Progress/Updates:	Hood River Fire Defense Board and local fire agencies have worked on this with OR State Fire Marshall's Office in the last five years.

Action Item:	WH#4
Action Title:	Ensure Proper Road Continuity, Numbering and Naming
Coordinating Organization:	Planning
Status:	Defer
Status Comments:	Still a need. Multiple dwellings on property, farm labor housing. Multiple swellings. Partner with planners. More for response.
Progress/Updates:	This is done and will continue to be done.

Action Item:	WH#5
Action Title:	Update County Zoning Ordinance to Implement the WUI
Coordinating Organization:	Planning
Status:	Eliminate
Status Comments:	All zoning related actions will be incorporated into a comprehensive County Planning mitigation action.
Progress/Updates:	County indirectly implements WUI, but has concerns about putting it in the County's zoning ordinance. The County is planning to put WUI info online through GIS program.

Action Item:	WH#6
Action Title:	Perform Routine Forest Management on Zones of Contribution for County-wide Potable Water Systems
Coordinating Organization:	Hood River Wildfire Protection Group, CWPP Manager
Status:	Eliminate
Status Comments:	Steering Committee has no information about original intent of this action.
Progress/Updates:	Committee unclear on intended meaning of this action.

Action Item:	VH#1
Action Title:	Improve the Public's Knowledge Base of Volcanic Risk and Vulnerability
Coordinating Organization:	Planning
Status:	Eliminate
Status Comments:	All outreach related actions are incorporated and combined into MH #2: Develop Public Outreach and Educational Programs.
Progress/Updates:	USGS recently added a new volcanic sensor on Mt Hood that might help inform future needs.

Action Item:	VH#2
Action Title:	Evaluate Emergency Response Plan and Identify Areas of Public Notification and Evacuation Routes
Coordinating Organization:	Emergency Management
Status:	Defer/ Modify
Status Comments:	Emergency Response and Evacuation tested and evaluated during Eagle Creek Fire. Gaps identified. Comprehensive plan needed, and would address multiple hazards. Change to Multi-hazard action.
Progress/Updates:	Completed initial evacuation plan. Future gaps identified. County Emergency Management / Sheriff's Office created and adopted the Hood River County Evacuation Plan during the Eagle Creek Fire and successfully tested/implemented this plan. Determined significant gaps in a series of recent emergencies that crippled the Gorge's transportation corridor.

Institutionalized Mitigation Activities

Several mitigation actions named in the 2007 and 2012 NHMPs have become routine practices in Hood River County. These actions are now institutionalized as part of the normal activities of a Hood River County agency. As such, they need not be named and reviewed as part of the NHMP review process. The Steering Committee determined to name them in the NHMP as "institutionalized mitigation activities" to highlight their importance. These actions are listed in Table B-3.

Table B-3 Hood River County Institutionalized Mitigation Activities

Mitigation Action	Description	Responsible Organization
Annual Review and Update of the County Community Wildfire Protection Plan, and Natural Hazards Mitigation Plan; Re-Adoption by County Court Every 5-Years; Review and Update of the County Emergency Operations Plan Every 2-Years	Hood River County Emergency Management coordinates NHMP review and update meetings twice annually, and ensures re-adoption by the County Court every 5 years. Emergency Management reviews and updates the County Emergency Operations Plan every 2 years.	Emergency Management
Maintain Comprehensive Impact Database	Hood River County Planning Department developed this database and now maintains it sufficiently	GIS Coordinator
County Forest Road Maintenance	All Timber Sales fund road condition maintenance, reconstruction, and improvement, including drainage and surfacing as needed. Priority typically given to fish bearing waters, then to areas that will be prone to impact waters of the state. Legacy road slope failures are stabilized as needed.	Hood River County Forestry Department
Extend Streamside Vegetation Protection to All Land Uses	The Hood River Soil and Water Conservation District and Hood River Watershed Group continue to work to expand streamside vegetation. HRWG tends to work on non-ag lands, and the SWCD tends to work on ag lands. SWCD reviews all relevant county development permit applications and provide comments/recommendations where needed.	Hood River County Soil and Water Conservation District
Support Local Agencies Training on Water Conservation Measures and Drought Management Practices	Outreach and education was key in 2015 drought event. The SWCD takes a lead role in educating the public and assisting in the coordination of efforts among entities.	Hood River County Soil and Water Conservation District
Culvert Barrier Remediation for Fish Passage and Flood Mitigation	Culvert repair and replacement occurs regularly, as needed, with a focus on improving fish passage and drainage.	Hood River County Public Works
Reduce Trees in Public Utility Right of Ways - Avoiding Damage to Power Lines	Utility companies are responsible for ongoing maintenance. Public Works also clears trees as necessary.	Hood River County Public Works
Residential Fuel Reduction Capacity	SB 360 is in place and enforced. USFS and ODF have active programs improving residential fuel reduction and local districts partner and implement routinely	USFS, ODF, Fire Districts

Table B-4 Hood River County Completed Actions from 2012 NHMP

Action Item	Priority	Action Title	Coordinating Organization	Partner Organizations	Comments
MH#4	Highest	Develop & Maintain Comprehensive Impact Database	GIS	EM, Planning, Public Works, ODOT, BLM, ODF, USFS, Utilities, Telecommunications, DOGAMI	County's GIS mapping program was well utilized to build a database of hazards as part of our annual and NHMP planning process County GIS hazard mapping was used daily to track progress and hazards of the Eagle Creek Fire incident from Sep. 2 to 30, 2017.
MH#5	H	Create Systems to Support Special Needs Populations	Emergency Management	Health Department, Planning, Red Cross, Hospitals, 911, CCFL	A special needs population database was created and tested during the Eagle Creek Fire. The protocol for future incidents is now in place. Information was used in evacuation plan implementation.
FH#1	H	Mitigate Flood Event Resulting from Naturally Induced Dam Failure	Middle Fork Irrigation District	Public Works, GIS, Fire Dept., Army Corps of Engineers, BPA, DEQ, FERC	
LH#2	H	Improve Landslide Hazard Area Maps	GIS	Planning, Emergency Management, DOGAMI, ODF, DLCD, USGS	State hazard maps were incorporated into County planning practices. DOGAMI received a PDM grant to examine landslide risk in the Eagle Creek Fire burn scar.
WH#1	Highest	Establish County-wide Wildfire Protection Group	BOC	County Agencies, Fire Districts, Ports, SWCD, Cities, ODF, USFS	Hood River County Fire Defense Board includes all five local Fire Districts, ODF, State Fire Marshall's Office, and USFS; this group works cooperatively to assess and promote fire hazard risks. They are responsible for public outreach, defensible space priorities, and response planning.

Section 4: Plan Implementation and Maintenance

The Steering Committee informally met several times since the previous version of this NHMP. Progress towards action items is documented in Section 3 (above). The Steering Committee agreed to meet semi-annually and the Hood River County Emergency Management Department will be the convener of these meetings. Co-convening responsibilities are divided between Hood River County Emergency Management and Hood River County Community Development. The Steering Committee will discuss options to integrate the NHMP into other planning documents (including the comprehensive plan) and revisit funding options during their semi-annual meetings.

Volume II: Hazard Annex

The Hazard Annex was significantly altered for clarity. Hazard identification, characteristics, history, probability, vulnerability, and hazard specific mitigation activities were updated. Extraneous information was removed and links to technical reports were added as a replacement. Links to specific hazard studies and data are embedded directly into the plan where relevant and available. The section was reorganized according to priority. Specific changes included the following:

- All hazard subsections have been reformatted to emphasize characteristics, location and extent, history, probability, and vulnerability
- The addition of hazard history events in all hazard types except volcano
- New earthquake probability and vulnerability information added
- Wildfire location specific risk information added
- The Severe Storm hazard was divided into Winter Storm and Windstorm, in order to align with the State Natural Hazards categorization and to account for the distinct impacts of those each storm type.
- Maps depicting hazard location and local vulnerability were added whenever available
- Previously included statistics and information was updated with most current data

Volume III: Jurisdictional Addenda

The previous version of the NHMP did not include jurisdictional addenda. The cities of Cascade Locks and Hood River, and the ports of Cascade Locks and Hood River, participated and formed Steering Committees to inform the Jurisdictional Addenda.

Volume IIV: Mitigation Resources

Appendix A: Action Item Forms

This appendix details background, implementation steps, benefits, costs, and importance for the high and medium priority actions included in the 2018 NHMP. Entirely new action item forms were developed as part of this plan update.

Appendix B: Planning and Public Process

This planning and public process appendix reflects changes made to the Hood River County NHMP and documents the 2018 planning and public process.

Appendix C: Community Profile
The community profile has been updated to be more concise and locally relevant, and includes updated data. Several subsections (disability demographics, physiographic provinces, civic engagement and employment industry forecasts) were removed. Data depicting housing affordability and income diversity was added.

Appendix D: Economic Analysis
Updates are provided for the economic analysis of natural hazard mitigation projects.

Appendix E: Grant Programs and Resources
Some of the previously provided resources were deemed unnecessary since this material is covered within the Oregon NHMP. Updates were made to the remaining grant programs and resources.

Appendix F: Public Outreach Survey
An additional appendix was added to detail the public outreach survey used and responses collected during the 2018 NHMP update.

Appendix G: Climate Change Influence on Natural Hazards: Overview and Hood River County Projections
The Oregon Climate Change Research Institute (OCCRI) produced two climate change reports. OCCRI's *Future Climate Projections Hood River County* and the *Climate Change Influence on Natural Hazards in Eight Oregon Counties: Overview of County Reports*, provide important information regarding the influence and impacts of climate change on existing natural hazards events such as heavy rains, river flooding, drought, heat waves, cold waves, wildfire, and air quality. The overview discusses all eight of the counties while the respective individual county reports are specific to each county. OCCRI's research and analysis focuses on how climate change is expected to influence natural hazards.

These reports used funds provided by the two Pre-Disaster Mitigation (PDM) 16 grants that DLCD had been awarded by FEMA.

2018 NHMP Update

Hood River County is dedicated to directly involving the public in the review and update of the natural hazard mitigation plan. Although members of the Steering Committee represent the public to some extent, the residents of Hood River County were also given the opportunity to provide feedback about the Plan.

Hood River County made the draft NHMP available via the County Emergency Management's website for public comment from May 25, 2018 through the FEMA review period. After FEMA approval, the final NHMP will be posted on the County's Emergency Management website.

Public Involvement Summary

Hood River County announced the plan update on the County Planning and Emergency Management websites, and the Cities of Hood River and Cascade Locks websites. The purpose of the notice was to inform the public that an update to the NHMP was occurring and to provide an opportunity for the public to learn more about the update and comment. The notice was posted to the County websites on April 10, 2018, the City of Cascade Locks website on April 5, 2018, and the City of Hood River website on April 23, 2018. The notice remained posted on all the websites throughout the NHMP planning process. Note: The Port of Cascade Locks and the Port of Hood River combined efforts throughout the public outreach process. The Ports taxing districts encompass the entirety of each respective City. To reduce confusion notices did not separate the City and Port jurisdictions since they are municipal corporations whose primary purpose is to facilitate the economic development of each applicable City. The draft NHMP was added on May 25, 2018, and remained there until FEMA approval, at which point the final NHMP was posted. Screen shot images of the notices for each jurisdiction are included below in Figures B 1-5. The notices included a short online survey for residents to answer. The survey and responses can be found in Appendix F. The text included in the public notice is as follows:

> *We know disasters will come to Hood River County…the only question is when. How will we prepare for the inevitable?*
>
> *Hood River County is updating the Natural Hazards Mitigation Plan. Mitigation plans outline community risk to natural hazards and potential actions the County can take to reduce risks to people, property and the local economy BEFORE the next wildfire, winter storm, flood, earthquake, etc. strikes. The Cities of Cascade Locks and Hood River are creating locally specific action plans as well.*

Please help us out by completing this SHORT survey (less than 5 minutes!): https://www.surveymonkey.com/r/WG8CMFW.

If you are interested in learning more or providing input, contact Nicolia Mehrling at nicolia.mehrling@co.hood-river.or.us. You can see the former version of the plan, adopted in 2012, here, at the Hood River County Emergency Management web page. Drafts of the new plan will be posted as soon as they are available.

Three residents responded to the online survey; their answers are detailed in Appendix F. A second survey was handed out at several outreach events. Twenty-nine residents answered this survey. The questions and 32 responses are detailed in Appendix F. Members of the Steering Committee provided edits and updates to the NHMP.

The NHMP Coordinator and/or Hood River Emergency Manager also presented to the following community groups:

- Food systems preparedness organizations (food banks, assisted living centers, hospital staff), April 13, May 13, and May 30, 2018
- Hood River County Rotary May 17, 2018, Emergency Operations Center volunteers; May 23, 2018
- Cascade Locks Joint Economic Development Work Group, May 31, 2018
- Hood River County Fire Defense Board, June 7, 2018

The NHMP process was announced on Radio Tierra, the local Spanish language radio station and published on the station's Facebook page on April 17, 2018 (Figure B-6).

The NHMP Coordinator also held stakeholder interviews with the following organizations:

- Hood River County Community Development, March 22, 2018
- Port of Cascade Locks, April 3, 2018
- Hood River County Energy Plan Coordinator, April 6, 2018
- City of Cascade Locks Administration, April 10, 2018
- Columbia Gorge Commission, May 2, 2018

Finally, the NHMP Update Coordinator presented at the following public meetings for the County:

Hood River County Board of Commissioners Public Meeting: June 18, 2018
On June 18, 2018 Hood River County staff briefed the Hood River County Board of Commissioners on the updated Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan.

City of Hood River City Council Public Meeting: June 25, 2018
On June 25, 2018 the NHMP Update Coordinator briefed the Hood River City Council on the updated Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan.

City of Cascade Locks City Council Public Meeting: July 9, 2018

On July 9, 2018 the NHMP Update Coordinator briefed the Cascade Locks City Council on the updated Hood River County Multi-Jurisdictional Natural Hazards Mitigation Plan.

A press release announcing the posting of the updated draft NHMP to the Hood River County Emergency Management website was included in the Hood River News on June 21, 2018. The press release text is included as Figure B-7.

Figure B-1: City of Hood River Notice Dated April 23, 2018

Figure B-2: Hood River County Notice Dated April 10, 2018 (Community Development Website)

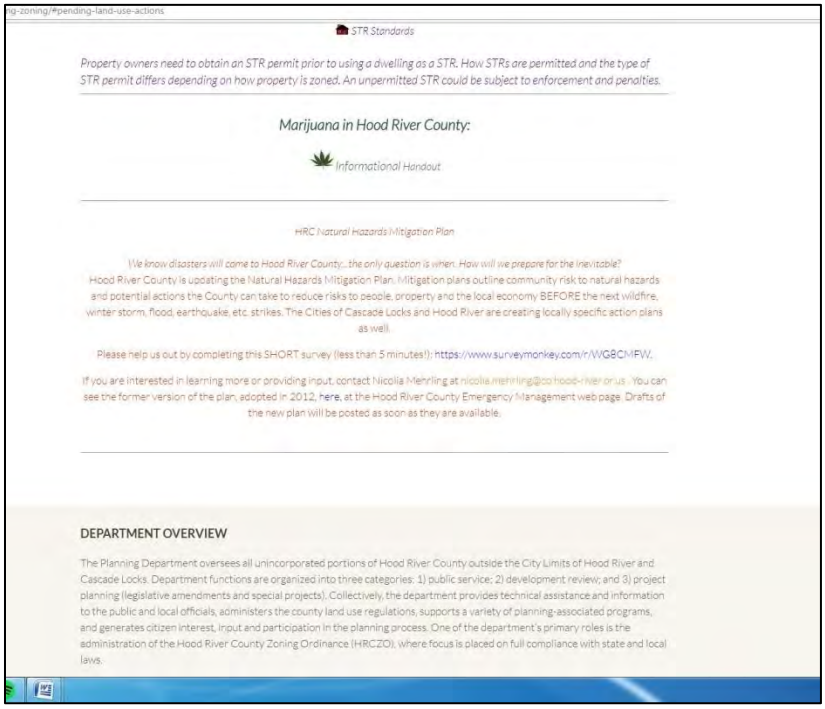


Figure B-3: Hood River County Notice Dated April 9, 2018 (Emergency Management Website)

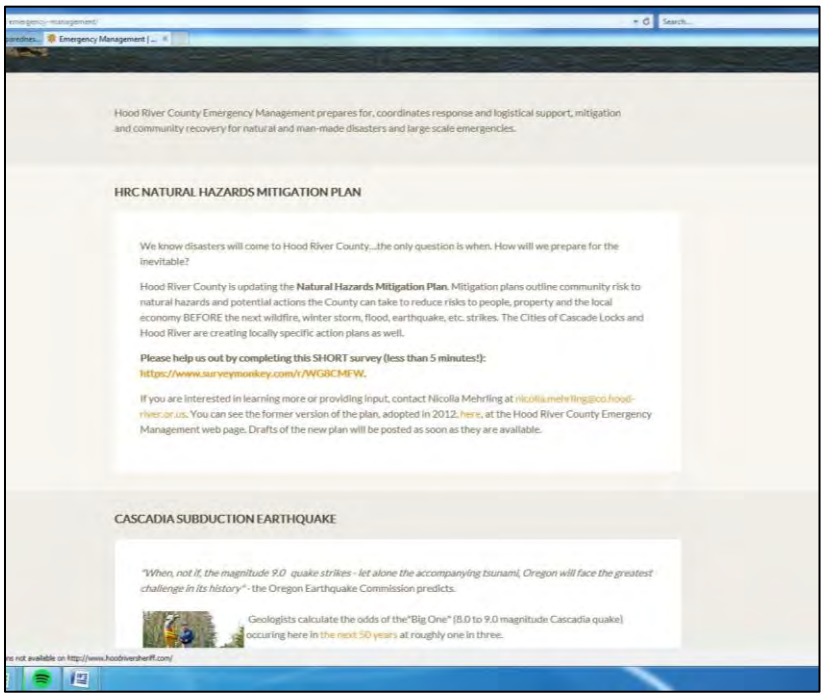


Figure B-4: City of Cascade Locks Notice Dated April 5, 2018 (Facebook Page)

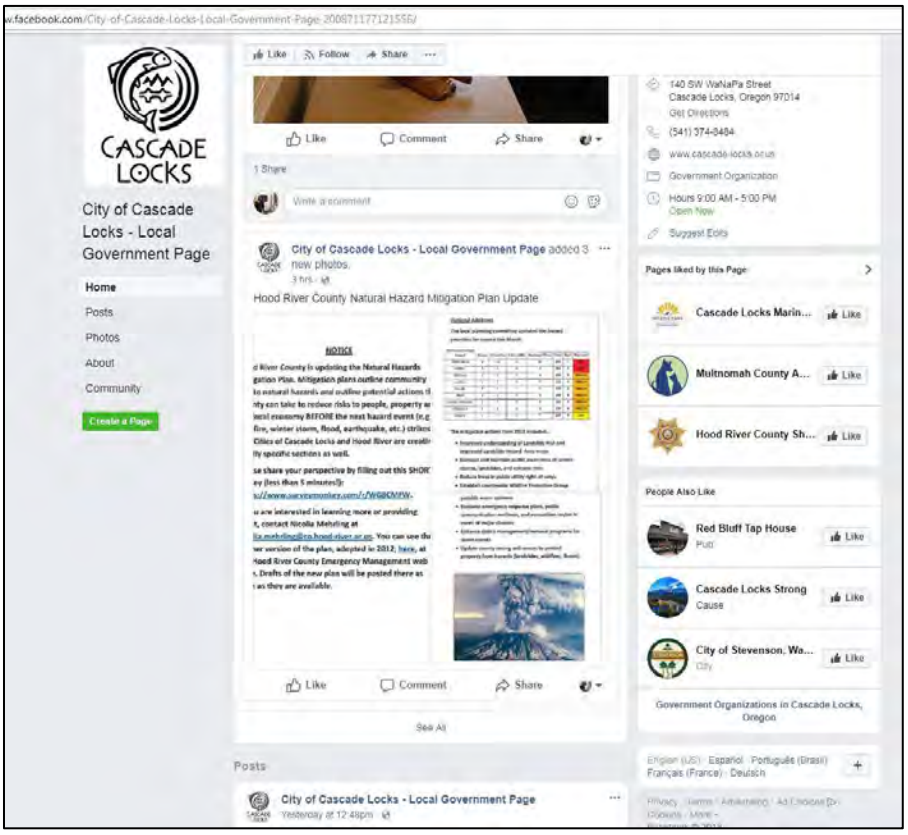
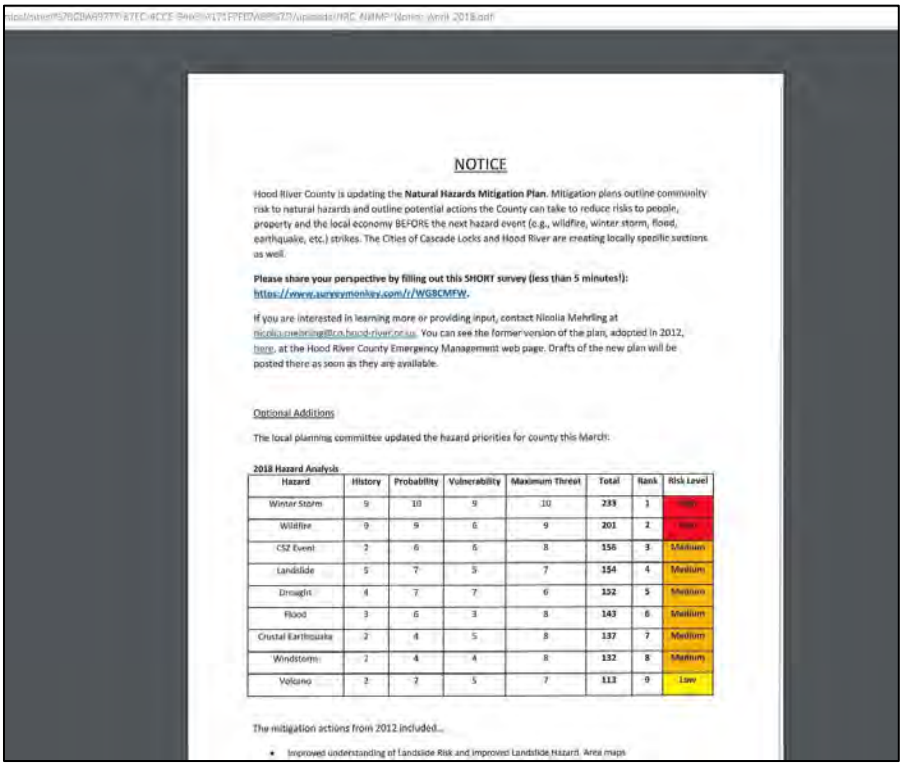


Figure B-5: City of Cascade Locks Notice Dated April 5, 2018 (City Website)



NOTICE

Hood River County is updating the **Natural Hazards Mitigation Plan**. Mitigation plans outline community risk to natural hazards and outline potential actions the County can take to reduce risks to people, property and the local economy BEFORE the next hazard event (e.g., wildfire, winter storm, flood, earthquake, etc.) strikes. The Cities of Cascade Locks and Hood River are creating locally specific sections as well.

Please share your perspective by filling out this SHORT survey (less than 5 minutes!):
https://www.surveymonkey.com/r/WG8CMFW.

If you are interested in learning more or providing input, contact Nicolia Mehrling at nicolia.mehrling@co.hood-river.or.us. You can see the former version of the plan, adopted in 2012, here, at the Hood River County Emergency Management web page. Drafts of the new plan will be posted there as soon as they are available.

Optional Additions

The local planning committee updated the hazard priorities for county this March:

2018 Hazard Analysis

Hazard	History	Probability	Vulnerability	Maximum Threat	Total	Rank	Risk Level
Winter Storm	9	10	9	10	233	1	
Wildfire	9	9	6	9	201	2	
CSZ Event	2	6	6	8	156	3	Medium
Landslide	5	7	5	7	154	4	Medium
Drought	4	7	7	6	152	5	Medium
Flood	3	6	3	8	143	6	Medium
Crustal Earthquake	2	4	5	8	137	7	Medium
Windstorm	2	4	4	8	132	8	Medium
Volcano	2	2	5	7	113	9	Low

The mitigation actions from 2012 included...

- Improved understanding of Landslide Risk and improved Landslide Hazard Area maps

Figure B-6: Radio Tierra Notice Dated April 17, 2018

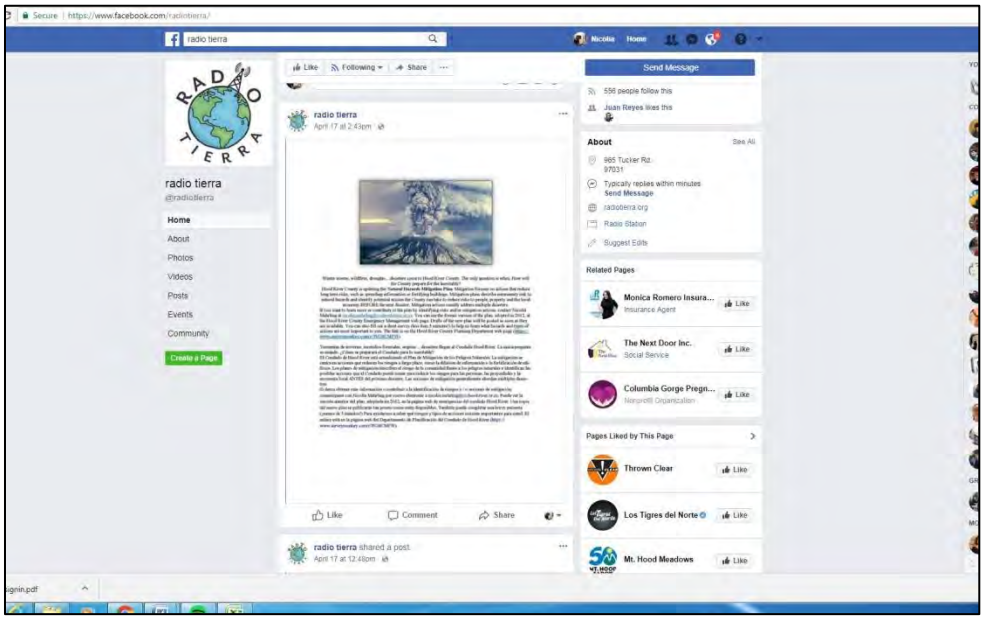


Figure B-7: Hood River News Press Release

Natural Hazards Mitigation Plan draft – for review and input

PRESS RELEASE

DATE: June 20, 2018
FROM: Hood River County Emergency Management
SUBJECT: Press Release for Hood River County Multi-Jurisdictional Natural Hazard Mitigation Plan Update – Notice and Opportunity for Public Comment

FOR MORE INFORMATION CONTACT:

Nicolia Mehrling, NHMP Update Coordinator, 541-387-2290, Nicolia.mehrling@co.hood-river.or.us or
Barbara Ayers, Emergency Manager, 541-386-1213,
Barbara.ayers@co.hood-river.or.us

Hood River County seeks additional public input on Natural Hazard Mitigation Plan update – draft for review now until July 30

Hood River County residents live in the magnificent Columbia Gorge National Scenic Area, known for its spectacular cliffs, waterfalls, rivers and mountainous scenery – and as a result, we also live in an area of greater risk for natural hazards. The County of Hood River County has declared emergencies three times in the last three years – all for natural hazards – drought - 2015, winter ice storm 2017 and Eagle Creek wildfire 2017. These incidents were so severe they were also were also declared state and national emergencies.

To increase our community's awareness about hazards, prepare for disasters and build our resilience, the County has been updating its Natural Hazard Mitigation Plan (NHMP.) The new draft Hood River County NHMP is available now for public review and comment before its final draft and adoption. This plan also covers the Cities of Cascade Locks and Hood River.

This Hood River NHMP work is being performed by a RARE (Resources Assistance for Rural Environments,) post graduate volunteer through an Americorps program at University of Oregon for Hood River County Sheriff's Office of Emergency Management. The plan update was made possible by a cooperative grant agreement between Hood River County, Department of Land Conservation and Development, the University of Oregon's Institute for Policy Research and Engagement - Oregon Partnership for Disaster Resilience and the Oregon Office of Emergency Management (OEM,) leveraging utilizing a FEMA (Federal Emergency Management Agency) pre- disaster mitigation grant.

An electronic version of the current draft Hood River County NHMP has been available for formal public comment since May 29. Recent updates have been made and the County is accepting comments until July 30 on this plan before adoption.

Link to PDF of the plan: http://www.hoodriversheriff.com/images/uploads/documents/NHMP_2018_6.14.pdf

Website with more information:
http://www.hoodriversheriff.com/what-we-do/emergency-management/

The public is invited to send input for consideration in this plan update by July 30, 2018 to:
Nicolia.mehrling@co.hood-river.or.us.

This NHMP update resulted from after an extensive local planning process including a wide range of representatives from City and County government, emergency management and fire personnel, planning, public health, public works staffs, Hood River County School District, Columbia Area Transit, The Cities and Ports of Hood River and Cascade Locks, ODF, USFS and ODOT. Outreach to gain input on the plan from members of the public has been underway via outreach events, web content, Facebook and an online survey.

After that, DLCD and University of Oregon's Partnership for Disaster Resilience reviewed the plan; the public has had access to the plan to reviews the versions as updated. Next steps before adoption are State OEM review then FEMA. Along the way, changes are made to ensure the plan is as comprehensive and inclusive as possible. According to state regulations, Hood River County must have an Emergency Management function that helps coordinate disaster response when emergency services are overwhelmed. The Emergency Manager activates the County's Emergency Operations Center, and countywide, state and outside resources come to help meet the community's need – as they did for the Winter Ice storm, January 2017 and Eagle Creek Fire, September 2017.

Counties must have an adopted NHMP for its jurisdictions to be eligible for certain government grants. With re-adoption of the plan, Hood River County jurisdictions maintain their eligibility to apply for federal funding towards natural hazard mitigation projects and the Emergency Management Performance Grant (EMPG.)

A natural hazard mitigation plan provides communities with a set of goals, action items, and resources designed to reduce risk from future natural disaster events. Mitigation activities helps reduce 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. A national study indicated that $1 of mitigation spending saves four to six dollars of response and recovery funding nationwide.

For questions regarding the Hood River County NHMP or the update process in general, please contact Nicolia Mehrling, NHMP Update Coordinator, Hood River County Emergency Management at 541-387-2290, or nicolia.mehrling@co.hood-river.or.us.

Emergency Management is one of the specialty services offered by Hood River County Sheriff's Office, including Search and Rescue, Marine Patrol, 911 dispatch, Animal Control, patrol division, civil division and management support for Norcor jail.

Hood River County Steering Committee

Steering Committee members possessed familiarity with the Hood River County community and how it's affected by natural hazard events. The Steering Committee guided the update process through several steps including goal confirmation and prioritization, mitigation action item review and development and information sharing to update the plan and to make the plan as comprehensive as possible. Members from the Cities of Hood River and Cascade Locks Steering Committees also participated in the County Steering Committee meeting that met on the following dates:

- **Meeting #1:** Kickoff, Risk Assessment, Hazard Analysis, March 29, 2018
- **Meeting #2:** Mitigation Strategies, Implementation and Maintenance, April 24, 2018

In addition, each city held Steering Committee meetings as indicated below:

- Cascade Locks Steering Committee Meeting #1; May 10, 2018
- Hood River Steering Committee Meeting #1; May 15, 2018

For a list of meeting attendees see the individual city and port addendum within Volume II.

The County's and Cities' NHMP reflects decisions decided upon at the plan update meetings, during subsequent work and communication internally between Steering Committee members and other staff, and externally with DLCD staff and the RARE coordinator.

The following pages provide copies of meeting agendas and sign-in sheets from County Steering Committee meetings,a swell as the meetings with the Cities of Hood River and Cascade Locks.

Meeting #1

Hood River County NHMP Update
Steering Committee Meeting #1

March 29, 2018
9 am – 11 am

Hood River County Commissioners Conference Room
County Building, 601 State Street
Hood River, OR 97301

AGENDA

I. Welcome & Introductions (5 minutes)

II. Natural Hazards Mitigation Planning (20 minutes)
   a. Hazard mitigation and the Natural Hazards Mitigation Plan (NHMP)
   b. NHMP Overview (NHMP Info Sheet)
   c. NHMP Funding/PDM Grant (Cost Share Form)
   d. NHMP Update Process
      i. Planning Process and Schedule (Project Schedule)
      ii. Steering Committee (Roster)
   e. Mission and Goals (*Page X*, NHMP)

III. OCCRI Report – Meghan Dalton @ 9:30 am (OCCRI Handout) (5-10 minutes)

IV. Hazard Vulnerability Analysis (HVA) (50 min)
   a. Hazard History Review (Hazard History Tables)
      i. Any changes since previous plan? Any of these events not relevant to Hood River County, or without significant impact?
   b. Work Session (HVA Worksheet)

V. Community Profile Update (15 minutes)
   a. Changes in development, plans, policy since previous plan?
   b. Critical Infrastructure, Critical Facilities, and Lifelines? (Critical Infrastructure List)
   c. Assets? (County Assets List)

VI. Public Outreach (10 min)

VII. Next Steps (5 min)

Materials
Hood River County 2012 NHMP: Introduction, Hazard Annexes, Risk Assessment
Meeting Agenda; NHMP Info Sheet; Cost Share Form; Project Schedule; SC Roster; OCRRI Handout; *Page X* Excerpted from 2012 NHMP; Hazard History Tables; HVA Worksheet; Critical Infrastructure List; County Assets List

Hood River County Natural Hazards Mitigation Plan
Steering Committee Meeting

County Building, 601 State Street,
Hood River, OR 97031

Thursday, March 29, 2018, from 9-11 am					
PLEASE SIGN IN (Sign your name or add to the list)					
Full Signature	**Name**	**Title**	**Representing**	**Phone**	**Email**
	Barbara Ayers	Emergency Manager	Hood River County Sherriff's Office		barbara.ayers@co.hood-river.or.us
	Bart Kicklighter	Fire Mgmt Officer	US Forest Service		bkicklighter@fs.fed.us
	Catherine Dalbey	Director of Human Resources	Hood River County School District		catherine.dalbey@hoodriver.k12.or.us
	Dustin Nielson	Planning Director	Hood River City		d.nilsen@ci.hood-river.or.us
	Gordon Zimmerman	City Administrator	City of Cascade Locks		roryjasper@yahoo.com
	John Roberts	Planning Director	Hood River County		john.roberts@co.hood-river.or.us
	Kristy Beachamp	Public Health Liason	Oregon Health Authority		kristy.a.beachamp@state.or.us
	Michael McElwee	Executive Director	Port of Hood River		mmcelwee@portofhoodriver.com
	Mike McCafferty	Fire Chief, Parkdale	Parkdale Fire (Fire Defense Board delegate)		mike@parkdalefire.com
	Mikel Diwan	Public Works (Director)	Hood River County		mikel.diwan@co-hood.river.or.us
	Nicolia Mehrling	NHMP Update Coordinator	Hood River County/RARE		nicolia.mehrling@co.hood-river.or.us
	Paul Koch	General Manager	Port of Cascade Locks		pkoch@portofcascadelocks.org
	Steve Wheeler	City Manager	City of Hood River		s.wheeler@ci.hood-river.or.us
	Theresa North	Board Chair	Columbia Area Transit		roryjasper@yahoo.com
	Liz Kinney	EOC staff	Hood River County		[illegible]
	MIKE MATTHEWS	ENV HEALTH	HOOD RIVER COUNTY		MIKE.MATTHEWS@CO.HOOD-RIVER.OR.US
	MIKEL DIWAN	PUBLIC WORKS DIRECTOR	HRC		mikel.diwan@co.hood-river.or.us
	MIKE SCHRANKEL	GIS	HR (Community Dev		Mike.schrankel@co.hood-river.or.us
	Loretta Duke	USFS AFMO	US Forest Service (For Bart Kicklighter)		lorettaduke@fs.fed.us

Hood River County NHMP Update

Steering Committee Meeting #1 Minutes

March 29, 2018 County Building, 601 State Street

9 am – 11 am Hood River, OR 97301

Materials used are in **bold**

Welcome and Introductions

In attendance:

Barbara Ayers, Emergency Manager, Hood River County Sherrif's Office

Catherine Dalbey, Director of Human Resources, Hood River County School District

Dustin Nilson, Planning Director, Hood River City

Gordon Zimmerman, City Administrator, City of Cascade Locks

Mike McCafferty, Fire Chief, Parkdale Fire

Mikel Diwan, Public Works Director, Hood River County Public Works

Paul Koch, General Manager, Port of Cascade Locks

Theresa North, Board Chair, Columbia Area Transit

Liz Kinney, EOC Staff, Former Forest Service Deputy, Hood River County

Mike Matthews, Environmental Health Director, Hood River County

Mike Schrankel, GIS Coordinator, Hood River County Community Development

Loretta Duke, Assistant Fire Management Officer, USFS

Mike Howard, Assistant Program Director, Oregon Partnership for Disaster Resilience (via phone)

Nicolia Mehrling, NHMP Update Coordinator, Hood River County

Absent:

John Roberts, Planning Director, Hood River County Community Development

Michael McElwee, Executive Director, Port of Hood River

Kristy Beachamp, Public Health Liason, Oregon Health Authority

As part of the introductions, each person noted their familiarity with Natural Hazards Mitigation Plans (NHMPs) and any previous participation in a NHMP update.

Natural Hazards Mitigation Plan Project (20 minutes)

Hazard mitigation and the Natural Hazards Mitigation Plan (NHMP)

NHMP Overview (NHMP Info Sheet)

NHMP Funding/PDM Grant (Cost Share Form)

NHMP Update Process

Planning Process and Schedule (Project Schedule)

Steering Committee (Roster)

Barbara presented an overview of recent hazards and disasters in Hood River County, including recent winter storms that interfered with transportation and the Eagle Creek fire which shut down I-84 and burned 48,000 acres. She highlighted the County's strengths, partnership and high engagement, and challenges, lack of funding and staff capacity, and frequent hazards.

Nicolia provided all in attendance with handouts related to this Steering Committee meeting. Nicolia is the RARE Americorps Volunteer responsible for the Hood River County NHMP Update.

The **NHMP Info Sheet** explains what is a NHMP, what the process involves, and identifies the eight counties funded by the Pre-Disaster Mitigation (PDM) 16 grant to update their NHMPs.

Nicolia explained the role mitigation in emergency preparedness. Mitigation is action focusing on preventing emergencies or reducing their effects. Mitigation increases the community's ability to adapt to changing conditions, and withstand and recover from hazard disruptions. Mitigation is more cost effective than response and recovery. It is a proactive way to REDUCE or ELIMINATE long-term risk to life and property. Mitigation example include infrastructure projects (retrofits, earthquake strapping), education and outreach, policy changes and code reviews, and many others.

Nicolia explained the three types of grants that are available for counties with a NHMP:

Pre-Disaster Mitigation (PDM) Program: Provides funding for hazard mitigation planning, and the implementation of mitigation projects *prior* to a disaster event. PDM 16 funds this project.

Hazard Mitigation Grant Program (HMGP): Provides funding to implement long-term hazard mitigation measures after a major disaster declaration (5 declarations in Oregon since previous plan).

Flood Mitigation Assistance (FMA) Program: Property owners who participate in the FMA program must have a flood insurance policy on the structure to be mitigated that is current at the time of application and maintained through award

***Emergency Management Performance Grant (EMPG):** OEM requires current NHMP as part of performance measure to receive funds

Nicolia provided a short overview of the collaboration supporting this update. The update is funded by FEMA, through OEM, administered by DLCD. Nicolia herself is a volunteer with RARE, a program of the University of Oregon. The county is responsible for an in-kind cost share for the PDM 16 grants that funds this update. The **Cost Share Form**s track hours dedicated to this update. All non-federally funded position hours spent on the grant can be included, as well as resource contributions like photocopying. Nicolia and Barb will be tracking hours using the sign-in sheets and request that participants track their hours outside of official meetings.

Nicolia provided an overview of the essential pieces of a NHMP:

Hazards Profile: Description of local hazards to help the SC make decisions about hazard priority

Community Profile: Overview of physical, natural, demographic, and social community characteristics, intended to highlight vulnerabilities.

Risk Assessment: Identification of priority risks based on hazard and community information.

Mitigation Strategy: Set of actions the community prioritizes to respond to risks.

Policy Crosswalk: Plan to integrate hazards into other county plans and policies.

Jurisdictional Addendums: Specific information and mitigation actions for the incorporated cities and ports.

Nicolia provided a **project schedule** demonstrating the expected project timeline and expected dates of completion. The schedule includes at least two Steering Committee

meetings, meetings with the Cities of Hood River and Cascade Locks, and public outreach events highlight the NHMP update. The expected completion of this project will be August 2018.

Nicolia described the expectations of Steering Committee members. They are expected to provide technical advice and policy direction. They will review drafts, provide information, and make high-level decisions regarding NHMP content. The group discussed who else should be invited to the Steering Committee and generated the following ideas:

- State Parks representative
- ODOT representative
- Brad DeHart
- Pat Cimmiyotti
- Provident Hospital representative
- Bonneville Power Administration representative
- Water District representative
- National Scenic Area representative
- Krystyna Wolniakowski
- Jessica Gist
- Columbia River Inter-tribal Fisheries Commission representative
- Inter-tribal Law Enforcement representative
- Hood River Watershed Group
- Utility providers
- Ice Fountain

Nicolia will invite those named to participate and will follow up with the Steering Committee about specific representatives. Nicolia invited Brad, Pat, Krystyna, and Jessica.

Nicolia discussed the OCCRI report being developed that provides locally specific information on how hazards will change based on future climate variability. Meghan Dalton of OCCRI provided a **handout** on the project that explains the types of data and graphics the report will include.

Mission and Goals (*Page X*, NHMP, State and County Goal Comparison, 2012 Goal Statements)

The **2012 Mission and Goals** were reviewed. This handout listed 2012 NHMP Goals, goal statements, and their priority rank. It also compared Hood River County goals to Oregon State goals. The Steering Committee chose to keep the same goals and add statements within several goals. A focus on prioritizing infrastructure and transportation mitigation actions will be added to “Protection of Life and Property.” Emphasis on financial responsibility and seeking funding sources will be added to “Acknowledge Responsibility.” Efforts to influence and coordinate with state agencies and organizations (i.e. Travel Oregon) and regional private entities will be added to “Facilitate Partnerships and Collaboration.”

As a result of this discussion, some specific mitigation actions were noted. They included working for policy change at the state level, advocating for tourist education from tourist agencies, and focusing on food and water availability in the case of I-84 closure. Paul requested information about a potential OSU plan to reduce wildfire risk in the federally managed forest areas.

Mitigation actions from past six years were also noted. They include landslide stabilization projects along I-84, retrofits to the Hood River Fire Department and three County schools, and extensive outreach about emergency preparedness. It was noted that the next Steering Committee meeting will focus on successful, ongoing, and desired mitigation actions.

Hazard Vulnerability Analysis (HVA) (50 min)

Hazard History Review (Hazard History Tables)

Work Session (HVA Worksheet)

The Steering Committee engaged in an in-depth discussion of the changes in local hazards. The group agreed that Winter Storms are the most severe hazard for the County, followed by wildfires. The results for the Hazard Analysis varied from the 2011 rankings:

2018 Hazard Analysis

Hazard	History	Probability	Vulnerability	Maximum Threat	Total	Rank	Risk Level
Winter Storm	9	10	9	10	233	1	High
Wildfire	9	9	6	9	201	2	High
CSZ Event	2	6	6	8	156	3	Medium
Landslide	5	7	5	7	154	4	Medium
Drought	4	7	7	6	152	5	Medium
Flood	3	6	3	8	143	6	Medium
Crustal Earthquake	2	4	5	8	137	7	Medium
Windstorm	2	4	4	8	132	8	Medium
Volcano	2	2	5	7	113	9	Low

For multiple hazards, average hazard events occur regularly and extreme events could be extremely damaging. Furthermore, the hazards interact with each other. The impact of power outages and interruptions to the transportation corridor (associated with multiple hazards) was emphasized as the County's highest risk.

Steering Committee members noted that floods are less frequent and less damaging than previously listed. It was noted that the dam is being raised to preserve more water and mitigate the effects of draught. The committee decided to divide "Severe Weather" into "Winter Storms" and "Wind Storms" to align with the Oregon State NHMP. The Tornado hazard category was eliminated because it does not occur in the County. No new hazards were added. Some additional history for Wind Storms in neighboring Multnomah County had impacted Cascade Locks, and was noted. Participants noted that wind storms, while frequent, are rarely severe, and are already well-mitigated by utility companies.

The Steering Committee has significant, diverse, expert knowledge of the history and impacts of Hood River County hazards. Discussions were wide-ranging and nuanced. Members agreed the most damaging impacts of natural hazards were disruption to transportation routes. Food, water, county staff, and emergency response is dependent on a few key roads, which can be disrupted by wildfires, winter storms, landslides, and earthquakes.

Community Profile Update (15 minutes)

Changes in development, plans, policy since previous plan?

Changes to Critical Infrastructure, Critical Facilities, and Lifelines? (**Critical Infrastructure List**)

Changes to County Assets? (**County Assets List**)

Nicolia explained the **Critical Infrastructure, Essential Infrastructure, and County Assets lists** and requested that Steering Committee members review and provide feedback via email or in person. Due to time limitations, a thorough discussion was not possible. Previous to this meeting, Barbara had added a significant number of facilities to the critical infrastructure list.

Public Outreach (10 min)

Outreach is a key requirement from FEMA in NHMPs. The Steering Committee agreed to post notices to the County and City websites, reach out to present to community groups (such as the EOC volunteer group and the Rotary Club), and request input from a wide stakeholder email list. Dustin noted that the City of Hood River Public Works email list would be a good opportunity for outreach. It was suggested to hold a work session with the Board of Commissioners at both County and City levels.

All the outreach efforts that SC members make will be documented in a timeline and included in the NHMP.

Next Steps (5 min)

Nicolia will provide the 3/29/18 meeting notes, the updated Hazard Vulnerability Analysis and Mission and Goals, and initial drafts of the Hazard Profile and Community Profile.

Steering Committee members will provide input on community development, planning development, and critical infrastructure to Nicolia.

Nicolia will follow up with the County and Cities regarding posting update notices to their websites, and with the Cities to schedule city specific meetings.

The next meeting is scheduled for April 19th, 9-12pm, and will focus on Mitigation Strategy and Implementation and Maintenance.

Meeting #2

Hood River County NHMP Update
Steering Committee Meeting #2

Thursday, April 19, 2018
9:00 AM – 12:00 PM

Hood River County EOC
601 State Street, 3rd Floor
Hood River, OR 97301

AGENDA

I. Welcome & Introductions (5 min)

II. Steering Committee (15 min)

- Sign Cost Share Forms (Cost Share Form)
- Updates from the group; committee expectations
- Identify public outreach activities and target dates (Project Schedule)

III. Changing Future Conditions @ 9:30 am (10 min)
- Meghan Dalton from Oregon Climate Change Research Institute (OCCRI) via phone (OCCRI Handout)

IV. Meeting #1 Review (20 min)
- Hazard Analysis Summary (Hazard Analysis Summary)
  - Review and discuss
- Mission and Goals (Mission and Goals Table)
  - Review and finalize
- Critical Infrastructure/Assets (Infrastructure and Assets Lists)
  - Review and finalize

V. Mitigation Actions (90 min)
- Review 2012 list of actions, update with status, and identify (modify, delete, add) actions for 2017-2018 NHMP (Mitigation Actions Tables)
- Definitions of Mitigation Actions Timelines (On back of Agenda)

VI Implementation and Maintenance (10 min)
- Review 2012 Maintenance plan, modify and approve (NHMP Sec. 4f)

VIII. Next Steps (10 min)
- Nicolia will send Meeting Notes and Follow up
- Drafts to review: Hazard Annexes, Community Profile, Risk Assessment, Mitigation Strategy
- City Addendum Meetings
- City and County Adoption

Materials
Meeting Agenda; Cost Share Form; Project Schedule; OCCRI Handout; Hazard Analysis Summary; Mission and Goals Table; Mitigation Actions Tables; and the Hood River County 2012 NHMP, Section 4 (Implementation and Maintenance)

Hood River County NHMP Update
Steering Committee Meeting #2

Thursday, April 19, 2018
9:00 AM – 12:00 PM

Hood River County EOC
601 State Street, 3rd Floor
Hood River, OR 97301

AGENDA

I. Welcome & Introductions (5 min)

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- Sign Cost Share Forms (Cost Share Form)
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- City and County Adoption

Materials
Meeting Agenda; Cost Share Form; Project Schedule; OCCRI Handout; Hazard Analysis Summary; Mission and Goals Table; Mitigation Actions Tables; and the Hood River County 2012 NHMP, Section 4 (Implementation and Maintenance)

Hood River County Natural Hazards Mitigation Plan
Steering Committee Meeting

County Building, 601 State Street,
Hood River, OR 97031

Thursday, April 19, 2018, 9am-12pm				
PLEASE SIGN IN (Sign your name or add to the list)				
Full Signature	**Name**	**Title**	**Representing**	**Email**
	~~Barbara Ayers~~	Emergency Manager	Hood River County Sherriff's Office	barbara.ayers@co.hood-river.or.us
	Bart Kicklighter	Fire Mgmt Officer	US Forest Service	bkicklighter@fs.fed.us
	Catherine Dalbey	Director of Human Resources	Hood River County School District	catherine.dalbey@hoodriver.k12.or.us
	Dustin Nielson	Planning Director	Hood River City	d.nilsen@ci.hood-river.or.us
	Gordon Zimmerman	City Administrator	City of Cascade Locks	roryjasper@yahoo.com
	John Roberts	Planning Director	Hood River County	john.roberts@co.hood-river.or.us
	Mike Matthews	Environmental Health Supervisor	Hood River County	mike.matthews@co.hood-river.or.us
	Michael McElwee	Executive Director	Port of Hood River	mmcelwee@portofhoodriver.com
	Mike McCafferty	Fire Chief, Parkdale	Parkdale Fire (Fire Defense Board delegate)	mike@parkdalefire.com
4/19/18	Mikel Diwan	Public Works (Director)	Hood River County	mikel.diwan@co.hood.river.or.us
	Nicolia Mehrling	NHMP Update Coordinator	Hood River County/RARE	nicolia.mehrling@co.hood-river.or.us
	Paul Koch	General Manager	Port of Cascade Locks	pkoch@portofcascadelocks.org
	Loretta Duke	AFMO	US Forest Service	lorettaduke@fs.fed.us
	Theresa North	Board Chair	Columbia Area Transit	roryjasper@yahoo.com
	Mike Schrankel	GIS Coordinator	Hood River County	Mike.schrankel@co.hood-river.or.us
	Kiel Nairns	AUF	Oregon Dept. of Forestry	kiel.nairns@oregon.gov
	Dave Koski	District Manager	BPA	gdKoski@BPA.gov
	Scott Williams	Line Foreman III	BPA	SMWilliams1@BPA.GOV
Jason Skaug	Josi Sz	TMM	ODOT	ODOT	John.Skirving@odot.state.OR.US

Hood River County NHMP Update

Steering Committee Meeting #2 Minutes

April 19, 2018 County Building, 601 State Street

9 am – 12 pm Hood River, OR 97301

Materials used are in **bold**

Welcome and Introductions

In attendance:

Barbara Ayers, Emergency Manager, Hood River County Sherrif's Office

Dustin Nilson, Planning Director, Hood River City

Gordon Zimmerman, City Administrator, City of Cascade Locks

Mikel Diwan, Public Works Director, Hood River County Public Works

Theresa North, Board Chair, Columbia Area Transit

Mike Matthews, Environmental Health Director, Hood River County

Mike Schrankel, GIS Coordinator, Hood River County Community Development

Loretta Duke, Assistant Fire Management Officer, USFS

John Roberts, Planning Director, Hood River County Community Development

Michael McElwee, Executive Director, Port of Hood River

Kiel Nairns, Assistant Unit Forester, Oregon Department of Forestry

Dave Koski, District Manager, BPA

Scott Williams, Line Foreman III, BPA

Jason Skirving, ODOT

Nicolia Mehrling, NHMP Update Coordinator, Hood River County

Absent:

Kristy Beachamp, Public Health Liason, Oregon Health Authority

Paul Koch, General Manager, Port of Cascade Locks

Mike McCafferty, Fire Chief, Parkdale (Fire Defense Board Delegate)

Catherine Dalbey, Director of Human Resources, Hood River County School District

As part of the introductions, each person noted any current or hoped for mitigation actions.

Steering Committee

Sign Cost Share Forms (Cost Share Form)

Updates from the group; committee expectations

Identify public outreach activities and target dates (Project Schedule)

Cost Share Forms were distributed and filled in by Steering Committee members. Nicolia presented current, past and future public outreach activities. She has posted notice and invitation to comment on both cities and the county websites. She has presented at one community group, with commitments to present at five others. Gordon suggested presenting to One Gorge advocacy group. Michael McElwee suggested presenting to the Port Commission.

The Steering Committee was appraised of expected contributions moving forward – to supply information, review upcoming drafts, and support formal adoption. Updates to the **Project Schedule** were noted. An initial draft of the NHMP is planned to be available mid-May.

Changing Future Conditions: Meghan Dalton from Oregon Climate Change Research Institute (OCCRI, via phone)

Meghan Dalton from OCCRI called into the meeting. She walked through the **OCCRI Handout** and noted how projections are calculated. Steering Committee members asked whether severe weather magnitude would be measured. That measurement is not part of the current scope of work. Members noted that Hood River County contains extreme ecological and geological diversity, and expressed concern that the extremes would cancel out and be poorly represented by averages. They requested a secondary set of data focusing on magnitude and diversity within the County.

Meeting #1 Review

Hazard Analysis Summary (Haz ard Analysis Summary)

Mission and Goals (Mission and Goals Table)

Critical Infrastructure/Assets (Infrastructure and Assets Lists)

The Steering Committee reviewed the final Hazard Vulnerability Analysis. They expressed some concern that Windstorm was ranked too low. They noted that the County is more vulnerable than expressed in the HVA. Wind is a dangerous complicating factor in wildfires and winter storms; however it is not a significant hazard by itself. This will be noted in the NHMP.

The updated 2018 goals were reviewed and prioritized. Some debate occurred over the inclusion of Natural Resource Protection as its own goal. A recommendation was made to include it in Protection of Life and Property, but some concern about it decreasing in relative significance was expressed. The committee decided to combine those two goals. There was a request to add "enhancing communication systems" to Emergency Services Enhancement goal, and to define roles/expectations for partnerships. All other updates were accepted.

Assets were reviewed and additions suggested. Overall, the Committee noted how the 2012 plan listed vulnerabilities rather than assets. They recommended adding the small business community, tourism infrastructure, trail infrastructure, and the Hood River City downtown core to the economic assets list. Farmers' irrigation systems, forest land and the Hood River were added to environmental assets. The airport was also noted as an economic asset.

Mitigation Actions

Review 2012 list of actions, update with status, and identify (modify, delete, add) actions for 2017-2018 NHMP (**Mitigation Actions Tables**)

Definitions of Mitigation Actions Timelines (On back of Agenda)

The Steering Committee began by noting the constraints the County is facing regarding funding and staff capacity. The importance of leveraging partnerships recurred throughout the conversation. Committee members noted that collaboration and partnership is the most successful strategy the County employs. Barb requested that the Committee narrow down the mitigation actions to only those that are feasible and actionable over the next five years.

With that in mind, the Committee reviewed each mitigation action from 2012, described the progress made, shared any updates, and made a recommendation for inclusion or elimination from the 2018 NHMP. The Steering Committee acknowledged that funding was necessary for any action, but noted that defining projects and identifying project needs was the first step towards pursing funding. Many actions from 2012 were identified as routinely occurring as a responsibility of the organizations or agencies present. It was decided that these actions will not be included in the 2018 plan, but noted as "institutionalized maintenance." Several actions were completed; these were also eliminated. Two actions

(public outreach and county planning/zoning) were consolidated from numerous actions with the same tactics for distinct hazards. They were combined into Multi-Hazard actions.

A discussion about how to address transportation blockages followed. The Steering Committee prioritized planning for refugees in a CSZ event and developing shelters for the community isolation that could result from several hazards, including winter storms, earthquakes, and wildfires. The Committee emphasized that rehabilitation and replacement of infrastructure is essential over the next decade.

Two new actions were identified: a plan for refugees and development of a shelter plan. Other ideas were discussed, including tourist education, policy reviews, and developing IGA agreements to address a situation in which government staff is isolated away from their workplace or equipment.

Some Steering Committee members expressed concern that there were too few mitigation actions for wildfires and winter storms, the County's most severe hazards. However, it was noted that mitigation actions are already occurring for both hazards, and that the mitigation actions are being conducted by responsible agencies outside of County jurisdiction. For example, ODF and USFS are actively managing and reducing fuels throughout the forests of Hood River County, and utility companies are removing trees from utility right-of-ways. It was decided that the County's most effective strategy would be to partner with, support, and inform these public-private collaborations. Overall, a focus on what was realistic given the current County resources was emphasized.

After the 2018 actions were identified, Steering Committee members voted to determine their priority.

VI Implementation and Maintenance

Review 2012 Maintenance plan, modify and approve (NHMP Sec. 4f)

Barb and John, the NHMP co-conveners reviewed the Implementation and Maintenance process from the 2012 plan and made recommendations. The coordination role will shift to Emergency Management, while Community Development will be responsible for incorporating mitigation into local planning and zoning policy. The Steering Committee is given the additional responsibility of pursuing their respective mitigation actions and collaborating regarding public outreach.

VIII. Next Steps

Nicolia will send out meeting notes and new mitigation actions for review. Nicolia will begin sending out drafts of the NHMP and requesting feedback. Steering Committee members are expected to provide feedback within one week of receiving drafts. City NHMP meetings will occur May 10th (Cascade Locks) and May 14th (Hood River). City and County adoption hearings will be schedule for the summer time.

Materials

Meeting Agenda; Cost Share Form; Project Schedule; OCCRI Handout; Hazard Analysis Summary; Mission and Goals Table; Mitigation Actions Tables; and the Hood River County 2012 NHMP, Section 4 (Implementation and Maintenance)

City of Cascade Locks Meeting[1]

Cascade Locks City Addendum
NHMP Update
Steering Committee Meeting

May 10, 2018
1 pm- 3 pm

City Hall
140 Wa Na Pa Street
Cascade Locks, OR

AGENDA

I. **Welcome and Introductions** (5 minutes)

II. **Hazard Identification** (20 minutes)
   a. Review County Hazard Identification
   b. Complete Jurisdiction Specific Hazard Inventories

III. **Review Existing Vulnerability Information** (30 minutes)
   a. Review County Identified Vulnerabilities
   b. Identify Jurisdiction Specific Assets and Vulnerabilities (Local Capabilities Worksheet)
      i. City specific plans, policies, programs
      ii. City specific physical, social, economic vulnerabilities
      iii. City Specific Critical Facilities and Infrastructure (Critical Facilities List)

IV. **Jurisdiction Specific Risk Assessment** (15 minutes)
   a. Review/ Revise City Specific Hazard Vulnerability Assessment (HVA)

V. **Jurisdiction Specific Mitigation Strategy** (30 minutes)
   a. Review Process and County Strategy
   b. Develop Jurisdiction Specific Actions (Mitigation Action Table)
   c. Prioritize Mitigation Actions

VI. **Overview of Implementation and Maintenance** (10 minutes)
   a. Name Convener and Coordinating Body Responsibilities (CL Draft Addendum)

VII. **Next Steps** (10 minutes)
   a. Prepare final draft of the NHMP for Review by City, County, DLCD, and the Public
   b. Submit to OMD-Office of Emergency Management; OEM submits to FEMA
   c. Formal adoption by City Council after FEMA approval

Materials
Hood River County NHMP Drafts: Hazard Annex, Community Profile, Risk Assessment, Mitigation Strategy; Meeting Agenda; Local Capabilities Worksheet; Critical Infrastructure List; Mitigation Action Table; HVA Worksheet; Cascade Locks City Addendum (Draft)

[1] The May 10, 2018 City of Cascade Locks Meeting included Gordon Zimmerman, Paul Koch, Brittany Berge, Barbara Ayers, and Nicolia Mehrling. A sign-in sheet was not circulated. All members of the City of Cascade Locks and Port of Cascade Locks Steering Committee attended and subsequently reviewed drafts of the City and Port Addenda, as described in Volume III.

City of Hood River Meeting

Hood River City Addendum
NHMP Update
Steering Committee Meeting

May 15, 2018
8:30 am – 10:30 am

Hood River City Hall
211 2nd Street
Hood River, OR

AGENDA

I. **Welcome and Introductions** (5 minutes)

II. **Hazard Identification** (20 minutes)
   a. Review County Hazard Identification
   b. Complete Jurisdiction Specific Hazard Inventories

III. **Review Existing Vulnerability Information** (30 minutes)
   a. Review County Identified Vulnerabilities
   b. Identify Jurisdiction Specific Assets and Vulnerabilities (Local Capabilities Worksheet)
      i. City specific plans, policies, programs
      ii. City specific physical, social, economic vulnerabilities
      iii. City Specific Critical Facilities and Infrastructure

IV. **Jurisdiction Specific Risk Assessment** (15 minutes)
   a. Review/ Revise City Specific Hazard Vulnerability Assessment (HVA)

V. **Jurisdiction Specific Mitigation Strategy** (30 minutes)
   a. Review Process and County Strategy
   b. Develop Jurisdiction Specific Actions
   c. Prioritize Actions

VI. **Overview of Implementation and Maintenance** (10 minutes)
   a. Name Convener and Coordinating Body Responsibilities

VII. **Next Steps** (10 minutes)
   a. Prepare final draft of the NHMP for County and City Review
   b. Provide the OMD-Office of Emergency Management a Review Opportunity
   c. Submit updated plan to FEMA for review

Materials
Hood River County NHMP Drafts: Hazard Annex, Community Profile, Risk Assessment, Mitigation Strategy; Meeting Agenda; HVA Worksheet; Critical Infrastructure List; Local Capabilities Worksheet; Hood River City Addendum (Draft)

Hood River County Natural Hazards Mitigation Plan
City of Hood River Steering Committee Meeting

City Hall, 211 2nd Street
Hood River, OR 97031

Tuesday, May 15, 2018, from 8:30-10:30 am

PLEASE SIGN IN (Sign your name or add to the list)

Full Signature	Name	Title	Representing	Phone	Email
	DUSTIN NILSEN	DIRECTOR OF P&A	CITY OF H.R.	541 387-5208	D.NILSEN@CITYOFHOODRIVER.COM
	LEONARD DAMIAN	FIRE CHIEF	CITY OF H.R.	541 386 9458	l.damian@hoodriverfire.com
	MARK LAGO	DIRECTOR OF PUBLIC WORKS	CITY OF H.R.	541 387 5265	MLAGO@CI.HOOD-RIVER.OR.US
Dan Ehell	Dan Ehell	Lieutenant	City of HR	541-387 5256	dan.ehell@ci.hood-river.or.us

2012 PLAN UPDATE PROCESS

Project Background

In August 2011, Hood River County partnered with the Oregon Partnership for Disaster Resilience (OPDR) to update the 2007 Hood River County Natural Hazards Mitigation Plan (NHMP). Members of OPDR and the plan coordinator met with members of the Hood River County Steering Committee in November (2011), February, May, and June (2012) to update all content within the County's NHMP. OPDR and the committee made several changes to the 2007 NHMP.

2012 Plan Update Changes

The sections below only discuss *major* changes made to the 2007 Hood River County NHMP during the 2012 plan update process. Major changes include replacement or deletion of large portions of text, changes to the plan's organization, and new additions to the plan. If a section is not addressed in this memo, then it can be assumed that no significant changes occurred.

Aside from substantial changes to plan section content, the most visible changes to the plan's organization from the update process are the reclassification of the community profile from a section to an appendix, the replacement of the plan's hazard annex with the natural hazard section of Hood River County's Hazard Identification and Vulnerability Analysis (HIVA) document, the addition of an appendix that provides grant program information, and the removal of Appendix G: Acronyms as well as Appendix B: Resource Directory.

Major changes to Section 1 include the following:

1. Most of Section 1 includes new information that replaces out of date text found in the 2007 NHMP. The new text defines mitigation, gives examples of mitigation strategies, and describes the federal mitigation funding programs for which Hood River County is eligible to apply (i.e., the Pre-Disaster Mitigation (PDM) Program, the Flood Mitigation Assistance (FMA) Program, and the Hazard Mitigation Grant Program (HMGP)).

2. Section 1 of the 2007 NHMP discussed the methodology for developing a plan and how the plan was organized. OPDR and the plan update coordinator replaced this information with text that summarized the development of the 2007 NHMP and added new text to describe the 2012 plan update process, including plan update meetings, public outreach efforts, and final plan review and adoption processes.

Major changes to Section 2 include the following:

1. Development of Relative Risk scores to more accurately define hazard risks in the county, and to supplement previously developed Total Threat Scores.

2. An overview of Hood River County hazards was developed that summarizes information from the plan's Hazard Annex.

3. Community Vulnerability has been added to the section, including a listing of community assets and issues that fall under Populations, Economies, Land Use and Development, Critical Infrastructure, and Environment categories.

4. Additional tables address NFIP participation information and general risk assessment scoring.

Major changes to Section 3 include the following:

1. Hood River County's Steering Committee reviewed the 2007 plan's goals and modified them with the goals currently identified in Section 3. One goal (Intergenerational Equity) was deleted from the plan entirely, and four others (Protection of Life and Property, Acknowledge Responsibility, Facilitate Partnerships and Coordination, and Emergency Services Enhancement) were modified slightly in terms of language. The 2007 NHMP goals previously read as follows:

2. The county's goals were also re-prioritized by members of the 2012 Steering Committee during a committee meeting activity, where they were re-prioritized to the way they currently appear in Section 3.

Table B.1: Changes to Plan Sections

2007 Hood River County NHMP	2012 Hood River County NHMP
Table of Contents	Table of Contents
Executive Summary	Executive Summary
Section I: Introduction	Section 1: Introduction
Section II: Community Profile	Section 2: Risk Assessment
Section III: Risk Assessment Summary	Section 3: Mission, Goals, and Action Items
Section IV: Goals & Action Items	Section 4: Plan Implementation and Maintenance
Section V: Plan Implementation & Maintenance	Hazard Annexes
Hazard Annex	Appendix A: Action Item Forms
Appendix A: Public Process	Appendix B: Planning and Public Process
Appendix B: Resource Directory	Appendix C: Community Profile
Appendix C: Household Natural Hazards Preparedness Survey	Appendix D: Economic Analysis
Appendix D: Economic Analysis	Appendix E: Mid-Columbia Region Natural Hazard Mitigation Public Opinion Survey
Appendix E: Existing Plans & Programs	Appendix F: Grant Programs
Appendix F: Mitigation Tools	
Appendix G: Acronyms	

2007 PLAN DEVELOPMENT PROCESS

To engage public support of this plan, and to involve the residents in the process, the University of Oregon RARE participant assigned to coordinate this projected reached out to the Hood River County community in three primary ways. First, a Steering Committee was formed to guide the NHMP Coordinator through the process of developing the plan. Secondly, The Coordinator sent out invitations to key stakeholders and an open invitation to the public for a NHMP Community Stakeholder Forum to raise awareness about natural hazard events and solicit input from community. Lastly, stakeholder interviews were conducted to retrieve local community knowledge of hazard events and how to best address the community's risk. Secondary methods of outreach were also conducted in posting the final draft of the mitigation plan for public comment on the County Planning & Development website and the printing and distribution of the International Business & Home Safety *Protect Your Home From Wildfire* brochure at the Hood River County Planning & Building services counter. Lastly, region-wide outreach and training efforts in the form of a regional household preparedness survey and IBHS *Open for Business* training were conducted by the Oregon Natural Hazards Workgroup.

Steering Committee

The Hood River County Steering Committee was comprised of individuals best suited to guide the county through the planning process and ensure that the mitigation plan is fully implemented once adopted.

Its mission is to ensure proper development and implementation of the county natural hazards mitigation plan by:

- setting goals;
- establishing subcommittee work groups to address specific needs;
- ensuring public, private and federal participation;
- distributing and presenting the plan;
- facilitating public discussion/involvement;
- developing implementation activities; and
- coordinating plan maintenance and implementation strategies.

Three Steering Committee sessions were held over the course of the 2006 calendar year:

1) Introduction & Overview: 18 January 2006

2) Hazard Risk Assessment: 3 March 2006

3) Goals & Action Items: 14 July 2006

The Steering Committee played an integral part in the development of the mitigation plan vision, mission, goals and action items. The Committee revised the drafted vision, mission and goals, and selected and prioritized the action items documented in this plan. The Steering Committee was formed by Michael Pasternak, NHMP Coordinator under the guidance of Mike Benedict, Hood River County Planning & Building Services.

Community Stakeholder Forum

The County-wide Stakeholder Forum held was designed to solicit input from individuals and community organizations with resources or property that may be severely impacted by natural disasters. The Forums was held on April 11th 2006 at the County Business & Administration Building in Hood River, OR. Roughly 50 people from the County were invited to attend the Forum. The invitees consisted of business leaders, utility providers, government workers (state and county), service providers, transportation & communication workers, health providers, and representatives of vulnerable populations (e.g. elderly, migrant workers).

The purpose of the Forum was three-fold:

1) To spread awareness of potential disasters impacting the County by soliciting a large cross-section of the active public to participate in the hazard mitigation process;

2) To provide a factual basis for potential hazard mitigation measures by public input into critical County infrastructure and resources, and known hazard zones, through the critical asset and hazard identification mapping exercise; and

3) To plant the seeds for potential mitigation measures by introduction and discussion of the action item concept and creating personal relationships (i.e. face-toface introduction) for stakeholder interview and action item follow-ups.

Stakeholder Interviews

Due to poor community participation in the Stakeholder Forum, the stakeholder interviews became a crucial component of the public process. Many of the Forum invitees were contacted and their input included in the plan. The individuals contacted ranged from city, state, and federal government employees to business owners and farmers. These individuals provided insight into how hazard events have impacted the community in the past, how growth and development could collide with future hazard events, and how the community can best work together to reduce collective risk. Many of the action items documented in this plan were spawned from ideas discussed during the stakeholder interview process.

Stakeholder interviews were conducted May through July 2006. The NHMP Coordinator telephoned stakeholders individually and asked a series of questions. The questions are as follows:

- What is the history of natural hazard events in Hood River County?
- How does growth and development in the community, both current and projected, contribute to natural hazard events?
- Does your organization/industry currently work in natural hazard mitigation? If so, how?
- How can your organization/industry contribute to strengthen regional coordination and cooperation in reducing risk from natural hazards?
- What activities will assist Hood River County in reducing risk and preventing loss from future natural hazard events? (e.g. If you had the money, how would you spend it?)
- How does your organization/industry view the County government's role in reducing risk from natural hazard events?
- What are the ways you would like to see agencies, organizations or individuals participating and coordinating to reduce risk from natural hazard events?
- How does hazard mitigation fit into Hood River County's land-use, environmental, social, and economic goals?
- What goals should the County set to reduce risk from natural hazard events, and how would we measure whether our mitigation efforts are successful?
- Can you think of anyone else that should be contacted as part of this process?

The information recorded from the stakeholder interviews was primarily incorporated into three sections of this plan: Community Profile, Risk Assessment, and Goals & Action items.

Secondary Outreach Methods

Additional methods of outreach involved in the public process included:

Public Comment of Hood River County NHMP Draft

The mitigation plan draft was sent to Steering Committee members for review, comment, and approval before the final draft was shipped off the OEM for State review. Additionally, the plan was posted on the Hood River County Planning & Development website for public review and comment.

IBHS Wildfire Brochure

While the final draft of the NHMP was under review by the Steering Committee and public, the NHMP Coordinator oversaw the printing and distribution of the International Business & Home Safety *Protect Your Home From Wildfire* brochure at the Hood River County Planning & Building service counter.

ONHW Region-wide Outreach

The Oregon Natural Hazards Workgroup conducted region-wide outreach activities which included:

Household Preparedness Survey

As part of the regional PDM grant, ONHW implemented a region wide household preparedness survey. The survey gauged household knowledge of mitigation tools and techniques and assessed household disaster preparedness. The survey results improve public/private coordination of mitigation and preparedness for natural hazards by obtaining more accurate information on household understanding and needs. The results of the survey are documented in the plan's *Appendix C: Regional Household Survey*.

IBHS Open for Business Training

ONHW, with commitment from the Institute for Business & Home Safety (IBHS), provided individuals in the Mid-Columbia region with access to, and use of, the IBHS interactive, web-based *Open for Business* property protection and disaster recovery planning tool. The access was provided in two classes, one located in Hermiston, Oregon on May 24th, 2006 and the second in The Dalles, Oregon on May 25th, 2006. The following agencies and organizations were invited to attend: agencies providing start-up and ongoing counseling services to micro and small businesses in low-income areas, such as the Statewide Small Business Development Center; agencies providing housing services to hundreds of low-income residents, such as County Housing Authorities, which also employs low-income people; and disaster assistance agencies serving at-risk populations, such as food banks and the American Red Cross. Any remaining spaces were made available to: micro- or small business start-up companies; and established micro- or small businesses.

The classes were organized as train-the-trainer classes, so that the agency personnel and the business people could: 1. Understand the importance of disaster planning; 2. Learn how to navigate the interactive, web-based *Open for Business* property protection and disaster recovery planning tool; 3. Start to develop their own plans during the training; 4. Learn how to communicate the importance of developing and utilizing plans for property protection and recovery from business interruption to their constituencies and/or colleagues, in order to institutionalize disaster safety into every day decision making.

Recruitment Process

The Oregon Natural Hazards Workgroup assembled a list of social service providers from basic internet searches and representative small businesses from Chamber of Commerce Membership databases for the seven counties in the region. E-mail and/or mailed invitations were sent to over 200 agencies, organizations and businesses in the region. Recruitment materials can be found on the following page.

The following agencies and organizations attended the workshop:

- Umatilla/Morrow County Housing Authority
- Irrigon Chamber of Commerce

- Pendleton Chamber of Commerce
- Small Business Development Center – Blue Mountain Community College
- Small Business Development Center – Columbia Gorge Community College

Appendix C:
Community Profile

The following section describes Hood River County from a number of perspectives to help define and understand its sensitivity and resilience to natural hazards. Sensitivity and resilience indicators are identified through the examination the natural environment, socio-demographic capacity, regional economy, physical infrastructure, community connectivity and political capital This section provides a useful framework for identifying the diverse resources and activities that are found in Hood River County.[1]

Sensitivity factors can be defined as community assets and characteristics that may be impacted by natural hazards. Community resilience factors can be defined as the community's ability to manage risk and adapt to hazard impacts by way of the governmental structure, agency missions and directives, as well as through plans, policies, and programs. This section describes both sensitivity and resilience factors to outline resources Hood River County might use to mitigate natural hazards.

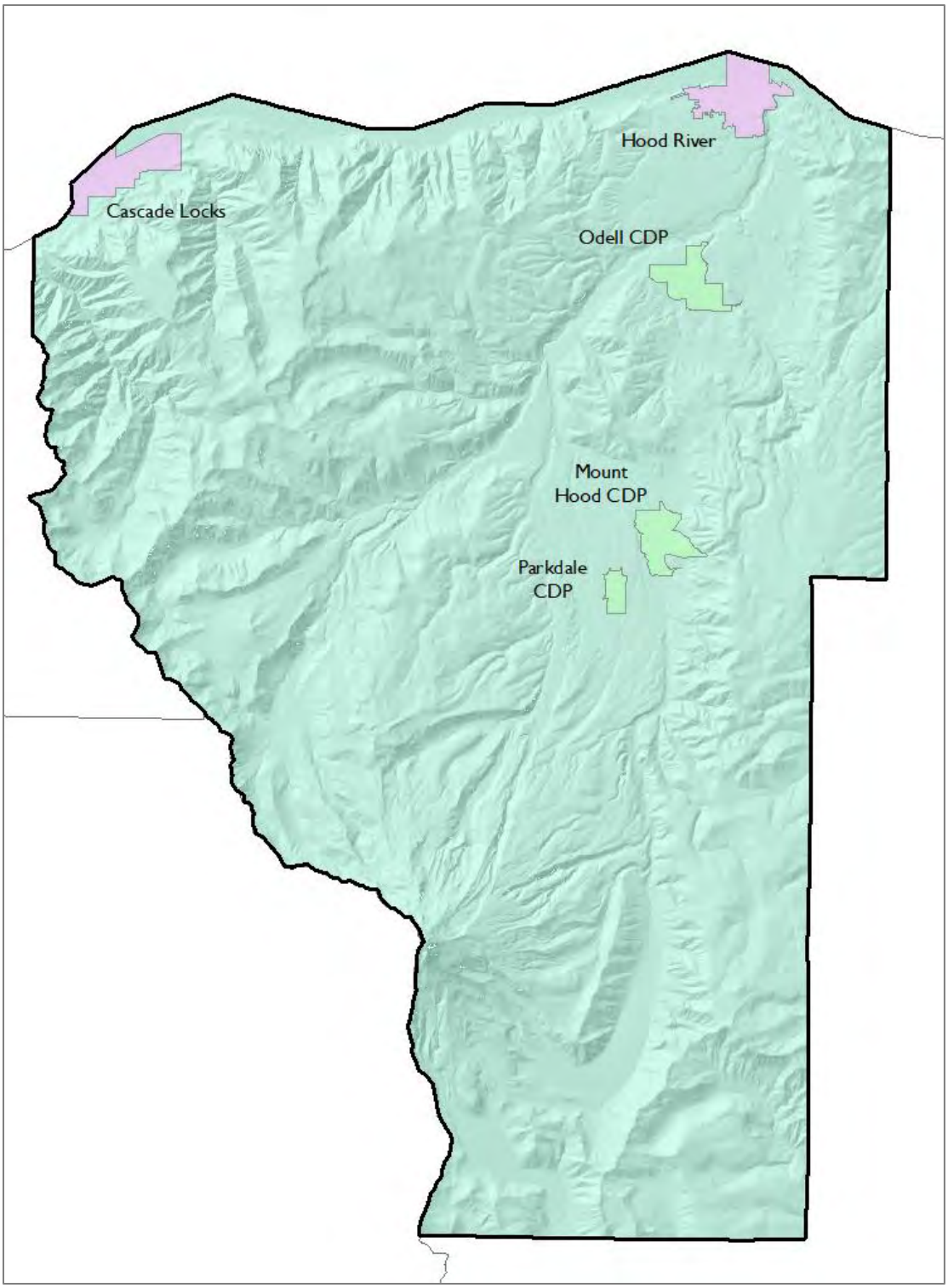
The information in this section represents a snapshot in time of the sensitivity and resilience factors in Hood River County during the plan's 2018 update. The information documented below, along with the hazard assessments located in *Section 2: Risk Assessment*, and the Hazard Annexes in Volume II, should be used as the local level rationale for the risk reduction or mitigation action items identified in *Appendix A*.

The U.S. Census delineates areas of settled population concentrations that are identifiable by name but are not legally incorporated as Census Designated Places (CDPs). There are three CDPs in Hood River County: Mount Hood, Odell, and Parkdale. There are two incorporated cities in Hood River County: Cascade Locks and the City of Hood River. See Figure C.1 for detail. Data applying to Census Designated Places may contain inaccuracies due to small sample size. They have been noted or adjusted when possible.

Contents

[1] Cornelia Flora, Jan Flora, Susan Fey and Mary Emery, "Community Capitals Framework," English Language Learners Symposium.

Figure C.1: Hood River County, Incorporated Cities, and Census Designated Places



Source: Institute for Policy Research and Engagement, University of Oregon

Natural Environment Capacity

Natural environment capacity is recognized as the geography, climate, and land cover of the area such as, urban, water and forested lands that maintain clean water, air and a stable climate.2 Natural resources such as wetlands and forested hill slopes play significant roles in protecting communities and the environment from weather-related hazards, such as flooding and landslides. However, natural systems are often impacted or depleted by human activities adversely affecting community resilience.

Geography

Hood River County, located in the north central section of Oregon in the Columbia Gorge, has a land area of 533 square miles, making it the second smallest county in the state in terms of geographic area. Its dimensions are a length of 32 miles from north to south, and a width varying from 23 miles, in the north, to 10.5 miles in the extreme south. It is situated on the eastern edge of Oregon's Cascade Range and west of the Umatilla Plateau, bounded by Mt Hood and the Mt Hood National Forest to the south, and the Columbia River to the north. The majestic snowcapped Mt. Hood in the southwest portion of the county, and the Columbia River Gorge to the north, provide the stunning backdrop that has made Hood River one of the most unique and beautiful places in the Northwest. The County is characterized by extreme weather, diverse terrain, and multiple recurring natural hazards. The northern boundary of the Columbia River also marks the boundary between Oregon and Washington.

Oregon, like most of the Western States, is largely owned by the federal government with a vast majority of federal lands administered by the Bureau of Land Management (BLM) and the United States Forest Service (USFS).[3] In Hood River County 27% of the land is privately owned (roughly 90,000 acres), whereas the remaining 73% is held publicly. The majority, 62% is owned by the US Forest Service (roughly 208,000 acres).[4] Land owned by the US Forest Service arcs from the west of Hood River County to the southeast, and is primarily designated as the Mt Hood National Forest. A majority of the private land in the county is either agricultural land or forest, and the entire county is classified as rural except for land within the City of Hood River.[5]

Table C.1: Hood River County Land Ownership

Ownership	Square Miles	Acreage	Percentage
Federal (Primarily USFS)	324.7	207,811	62%
County Owned	48.8	31,213	9%
State	6.7	4,274	1%
City	0.4	228	0.1%
Special Districts	1.0	666	0.2%

[2] Mayunga, J. 2007. Understanding and Applying the Concept of Community Disaster Resilience: A capital-based approach. Summer Academy for Social Vulnerability and Resilience Building.
[3] Allan, Stuart et al., Atlas of Oregon. Pg. 83.
[4] Allan, Stuart et. al., Atlas of Oregon. Pg. 84.
[5] U.S. Census Bureau, 2010 Census, Oregon's 68 Urban Areas

Ownership	Square Miles	Acreage	Percentage
(Ports, Irrigation, Parks			
Other non-assessed (Church, School, or Cemetery property)	1.0	625	0.2%
Total Non-Private	382.5	244,817.3	73.1%
Private	140.4	89,869.0	27%
Total	522.9	334,686.4	100%

Source: Hood River County Community Development, 2015

Hood River County is a relatively compact physiographic unit, primarily situated in the Middle Columbia Basin. The Hood River Valley, occupying the bottom of the Hood River drainage basin, is 20 miles long and four to eight miles wide. Local relief separates the valley into two distinct units known as the Lower and Upper Valleys. The Lower Valley, the larger unit, extends about six miles southward from the Columbia River to Middle Mountain, a traverse ridge about 2,000 feet in elevation. A low ridge encloses a small bench of a few thousand acres on the north flank of Middle Mountain known locally as Middle Valley. The Upper Valley, located south of Middle Mountain, is approximately seven miles long and four miles wide and rises southward in elevation from 1,500 to 3,000 feet. Depictions of the Hood River Watershed land-cover and water systems can be found in the Hood River Soil and Water Conservation District Action Plan and associated maps.[6]

The surface of the entire valley was modified by glacial action. A till sheet of varying thickness was laid down over the floor and subsequently reworked by glacial melt waters and forerunners of the present rivers. The soil pattern is directly related to the nature of the local till and the action of water. Variations range from silt loam laid down in the quiet waters of a lake in the bottom lands of the Lower Valley, to loams derived from weathering of glacial outwash materials and gravelly sandy loams derived from stream deposits. In portions of the Upper Valley, soils deriving from recent volcanic ash deposits cover many outwash terraces.

Rivers

Most of Hood River County is within the drainage basin of the Hood River. The Hood River system rises on the slopes of Mt. Hood and flows north to join the Columbia River at the City of Hood River, a river distance of 39 miles and a fall of 7,500 feet from source to mouth.

Columbia River Basin

The Columbia River Basin is North America's fourth largest, draining a 259,000 square mile basin that includes territory in seven states (Oregon, Washington, Idaho, Montana, Nevada, Wyoming and Utah) and one Canadian province (British Columbia). The river flows for more

[6]Hood River Watershed Action Plan, 2002; Hood River Watershed Group; file:///Z:/Natural%20Hazards%20Mitigation%20Plan/2018%20Hood%20River%20Update/ActionPlan%20Soil%20and%20water%20consevation%20district.pdf; file:///Z:/Natural%20Hazards%20Mitigation%20Plan/2018%20Hood%20River%20Update/Appendix_A_3%20Soil%20and%20water%20conservation%20district%20maps.pdf

than 1,200 miles, from the base of the Canadian Rockies in southeastern British Columbia to the Pacific Ocean at Astoria, Oregon, and Ilwaco, Washington. The Columbia is a snow-charged river that seasonally fluctuates in volume. Its annual average discharge is 160 million acre-feet of water with the highest volumes between April and September and the lowest from December to February. From its source at 2,650 feet above sea level, the river drops an average of more than two feet per mile, but in some sections it falls nearly five feet per mile.[7]

The Columbia River is a complex waterway which includes regular activity of barges, windsurfers, boaters, strong currents, and windy conditions as it passes by Hood River County. It flows directly alongside the major transportation corridor I-84 and a major east-west railway (Union Pacific). The Columbia River Basin is the most hydroelectrically developed river system in the world.[8] There are more than 250 reservoirs and around 150 hydroelectric projects in the basin, including 18 mainstream dams on the Columbia and its main tributary, the Snake River.

The US Army Corps of Engineers (COE) and the Bureau of Reclamation (USBR) are the owners and operators of the 31 federally owned hydro projects on the Columbia and Snake Rivers. Bonneville Power Administration markets and distributes the power generated from these federal dams and from Columbia Generating Station. BPA also owns and operates about 75% of the Northwest's transmission system. The dams and the electrical system are known as the Federal Columbia River Power System (FCRPS).

The Federal Columbia River Power System (FCRPS) is a unique collaboration among three U.S. government agencies – the Bonneville Power Administration (BPA), the U.S. Army Corps of Engineers (the Corps) and the Bureau of Reclamation (Reclamation). Collectively, these agencies generate power, protect fish and wildlife, control floods, provide irrigation and navigation, and sustain cultural resources.

HOOD RIVER

The Hood River drains 339 square miles (217,340 acres) of Hood River County and consists of three main forks (West, Middle, and East) that converge into the mainstem Hood River near River Mile 12.0 (along the Dee Highway, by Dead Point Creek Falls). The drainage contains approximately 400 miles of perennial stream channel of which an estimated 100 miles is accessible to anadromous fish. The Hood River Watershed has been fully evaluated and described in the Hood River Watershed Assessment.[9]

Five tributaries of the three forks are fed by glacial sources that drain approximately one third of the total glacial ice on Mt. Hood. During high flows, large amounts of bedload and sediment are transported in these tributaries and in the mainstem. Glacial melt increases water turbidity in the form of suspended silt and glacial flour during summer and early fall. Glacial sediment is more prevalent in the Middle and East Forks and Hood River mainstem,

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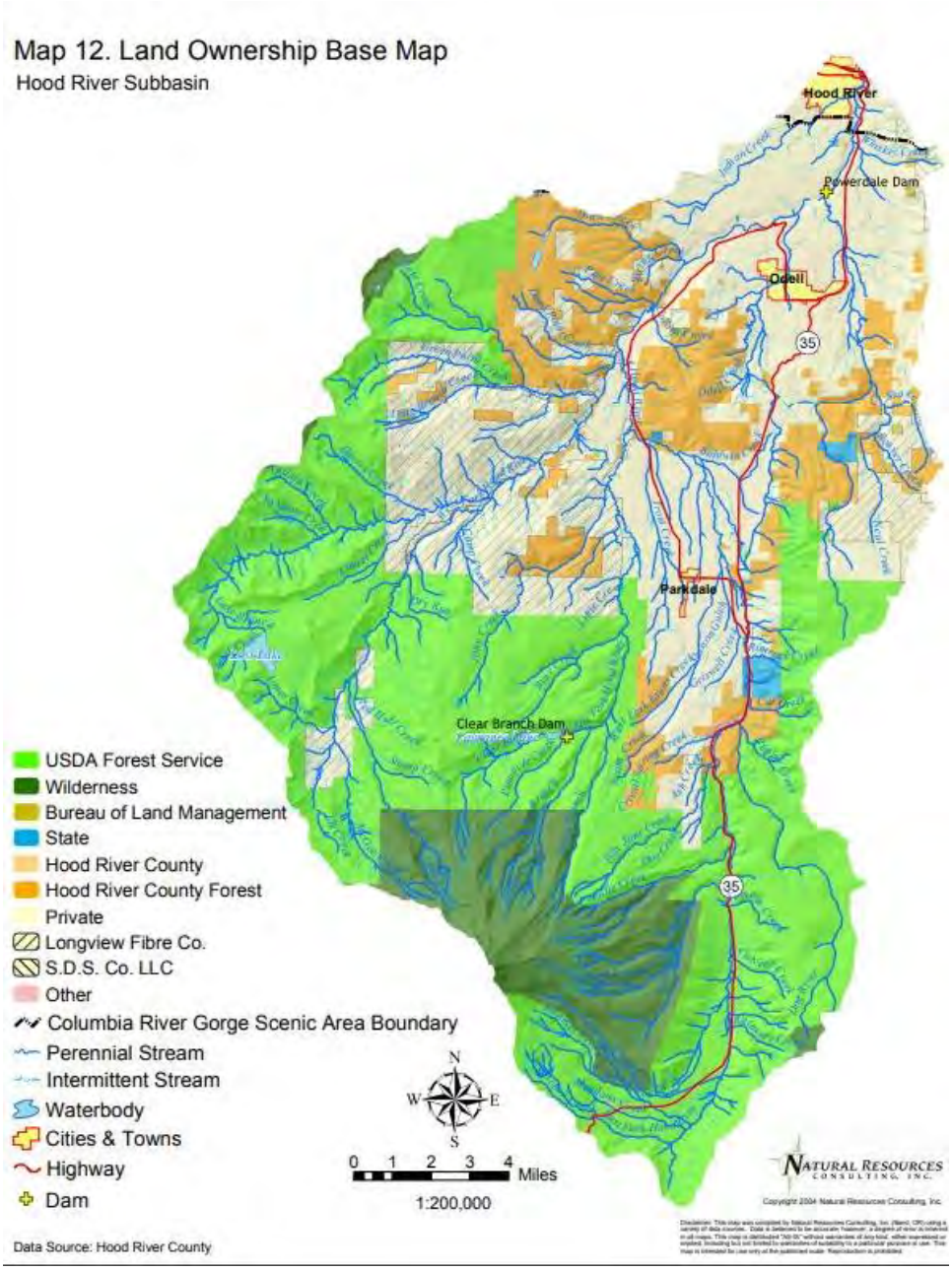
7 Center for Columbia River History. "Columbia River". Written by: Bill Lang Professor of History Portland State University, Former Director, Center for Columbia River History. http://www.ccrh.org/river/history.htm.
8 Ibid
9 Hood River Watershed Assessment, 1999, Hood River Soil and Water Conservation District; file:///Z:/Natural%20Hazards%20Mitigation%20Plan/2018%20Hood%20River%20Update/Watershed%20Councils_300_DOC_HoodR_WSassess_1999.pdf

while glacial sediment in the West Fork is contributed by a single small tributary, Ladd Creek. Natural disturbances that contribute significant amounts of sediment to stream channels include landslides and debris torrents that originate on glacial moraines and steep slopes of Mt Hood.

Figure C.2: Land Ownership in the Hood River Watershed



Source: Natural Resources Consulting, Inc, 2004. Provided by Hood River County.

Typical of many Cascade mountain streams, the hydrology of Hood River County is characterized by highly variable stream flow and rapid storm runoff. The mean annual flow for water year 2016 in the Hood River is 1,063 cubic feet per second (cfs) at Tucker Bridge (River Mile 6.1). Mean monthly flows in water year 2016 range from 274 cfs in August to a

high of 1,895 cfs in March. Snowmelt generally begins during April. Many tributaries have very low summer flows, while tributaries with glacial sources maintain higher flows. Natural disturbances occurring in the Hood River watershed include floods, fires, mudflows, landslides, and insect and botanical disease epidemics. Rain-on-snow floods are common disturbance events. Periodically, natural dams created by terminal moraines at receding glaciers on Mt. Hood break and cause floods and debris flows; many of these events are triggered by intense rainstorms. Landslides are common but not frequent events.

Climate

Temperature, Precipitation and Topography

The Hood River Valley lies in a transitional zone between the marine-influenced climates west of the Cascade Mountains and the dry-continental climate of the intermountain region. Local topography and elevation create marked differences in average temperature and precipitation between the Lower and Upper Valleys, and between the eastern and western portions of the County. The Columbia River Gorge is a near sea-level water gap through which marine, often relatively warm, air normally flows from the west.

The County's rolling topography creates local differences in wind patterns, and highly unstable climatic conditions are found in the Columbia River Gorge and nearby areas as a result. The contact between continental and maritime air masses produces strong wind patterns. Prevailing winds are north-westerly in summer and north-easterly in winter, but are highly variable throughout the Gorge. Winds are less dominant away from the Columbia Gorge, and southern parts of Hood River County are generally protected from winds by the Cascade Mountains. Reliable 20-30 mile per hour winds throughout summer, and occasional extreme gusts, draw many wind sport recreationalists.

Strong marine influences also reflect the occurrence of precipitation, more than half of which falls from November through February. The city has an average growing season of 183 days. The County is temperate in climate, with summer temperatures ranging from 52-81 degrees and winter temperate ranging from 27-41 degrees. In this period of record, the average annual precipitation equaled 30.6 inches per year; however precipitation varies significantly throughout the County. The City of Cascade Locks receives more than twice the rainfall than the City of Hood River. Snowfall amounts averaged 36.0 inches per year with the highest amounts occurring in December and January. Note that snowfall averages displayed in the table below are from over a hundred years of observation, and thus may not be representative of current climate trends.[10] Like rain, snowfall varies significantly throughout the County, from over a hundred inches at Mt. Hood to zero or near zero by the Columbia River.[11]

The current climate may be changing, and the impacts from those changes can be examined in relationship to natural hazards. For more information on the influence of climate change, or changing future conditions, on natural hazards see Appendix H, a report from the Oregon Climate Change Research Initiative (OCCRI) with county-specific data, graphics, and text.

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[10] National Centers for Environmental Information; 1981-2010 Normals; https://www.ncdc.noaa.gov/cdo-web/datatools/normals

[11] Western Regional Climate Center, Western US Climate Historical Summaries retrieved on 3/24/18 from https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?or4003

Synthesis

Natural capital is essential in sustaining all forms of life, including human life, and plays an often under represented role in natural hazard community resiliency planning. With four distinct mild seasons, a diverse terrain and its proximity to the Columbia Gorge, Hood River County has historically dealt with habitual severe storms and wildfires, drought, flooding, and recurring landslides. Managing natural capitals with hazards in mind can increase Hood River County resiliency.

Socio Demographic Capacity

Social/demographic capacity is a significant indicator of community hazard resilience. The characteristics and qualities of the community population such as language, race and ethnicity, age, income, educational attainment, and health are factors that influence the community's ability to cope with, adapt to and recover from natural disasters.

Population

According to the Portland State Population Research Center, the population of Hood River County was 24,735 on July 1, 2016 an increase from the 2010 population of 22,346.[12] The population in the State of Oregon increased by 9.4% from 2010 to 2016, while the population of Hood River County increased by 10.7%.[13] The county is primarily rural and currently the twenty-third most populated in the State of Oregon. The population of the county is slightly less than neighboring Wasco County which is to the east, and significantly less than the populations of neighboring Clackamas and Multnomah Counties, which are to the west. Table C.1 describes the population change in Hood River County and nearby communities.

Table C.1: Regional Change in County Populations

	2010 Census Population	2016 Population Estimate	Population Change 2010-16	Average Annual Change	Net Migration 2010-16
Hood River	22,346	24,735	2,389	1.6%	1,698
Clackamas	375,992	404,980	28,988	1.2%	23,745
Gilliam	1,871	1,980	109	0.9%	115
Multnomah	735,334	790,670	55,336	1.2%	30,902
Sherman	1,765	1,795	30	0.3%	31
Wasco	25,213	26,700	1,487	0.9%	1,537
Oregon	3,831,074	4,076,350	245,276	1.0%	171,874

Source: U.S. Census Bureau, 2010 Census; Oregon Annual Population Report 2016 prepared by PSU Population Research Center, dated April 2017

[12] Oregon Annual Population Report 2016; PSU Population Research Center; April 2017; https://www.pdx.edu/prc/population-reports-estimates)
[13] Ibid.

The largest populated area in Hood River County is the City of Hood River, where just under a third of county residents reside. Table C.2 describes the population change between 2010 and 2016 in the Cities of Hood River and Cascade Locks, along with the unincorporated areas of Hood River County, compared to the county as a whole. The unincorporated areas of Hood River County had the highest percent increase in population. These areas include the Census Designated Places (CDPs) of Odell, Parkdale, and Mt. Hood.

Note that many of the small jurisdictions and unincorporated areas have limited resources with respect to fire, police and emergency medical. In most cases, the residential populations are served by volunteer fire fighters and emergency medical technicians. In areas with a positive population growth, it will be important to continue to promote volunteer service that will be responsible as first responders in the event of a natural hazard. See Political Capital: Education and Outreach for a description of recent increases in volunteer programs.

Table C.2: Change in Hood River County Population

Jurisdiction	Population (2010)	Population (2016)	Population Change (2010 - 2016)	Percent Change (2010 - 2016)	Average Annual Growth Rate
Hood River	7,180	7,760	580	8.1%	1.3%
Cascade Locks	1,145	1,250	105	9.2%	1.5%
Unincorporated	14,060	15,725	1,665	11.8%	2.0%
Hood River County	22,385	24,735	2,350	10.5%	1.7%

Source: U.S. Census Bureau, 2010 Census, 2016 estimates from Oregon Annual Population Report 2016 prepared by PSU Population Research Center, dated April 2017

These population counts provide a snapshot of growth. Population tracking methodology also provides population projections to support planning and development. The Hood River County population is expected to continue to increase over the coming decades, especially in the City of Hood River.

Table C.3: Population Forecast for Hood River County

Area/Year	2030	2040	2050	% Growth (2016-2040)
Hood River County	29,014	32,045	34,939	30%
Cascade Locks UGB	1,408	1,515	1,605	21%
Hood River UGB	11,811	13,342	14,804	72%
Outside UGB Area	15,795	17,188	18,529	9.3%

Source: Population Research Center, Portland State University, June 30, 2016.

The Columbia Gorge area is the fastest-growing rural region in Oregon, with growth projected at 11 percent between 2014 and 2024. Growth will add about 3,300 job openings, while 7,300 replacement openings are projected. Leisure and hospitality expects the most replacement openings, swiftly followed by education and health services, and natural

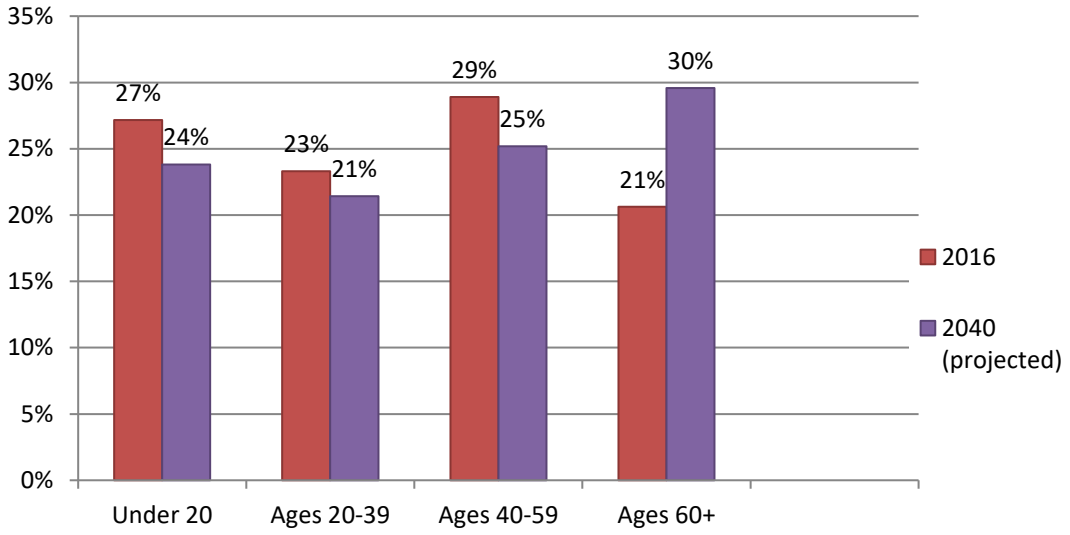
resources – each accounts for about 1,200 openings by 2024.[14] However, it is likely that many jobs will be low paying or part time, so incomes may not keep pace with rising living costs.

The location, composition and capacity of the population within the community determines vulnerability. Factors such as age, race, education, income, health and safety can impact a community's resilience to and ability to recover from, natural disasters. It is important to recognize that women tend to have more institutionalized obstacles than men during recovery due to sector-specific employment, lower wages, and family care responsibilities (Cutter et al., 2003).

Age

The age profile of an area impacts both what actions are prioritized for mitigation and how response to hazard incidents is carried out. Figure C.3 illustrates the current and projected percentage of population by age groups within the county.

Figure C.3: Hood River County Population by Age, 2016 and 2040



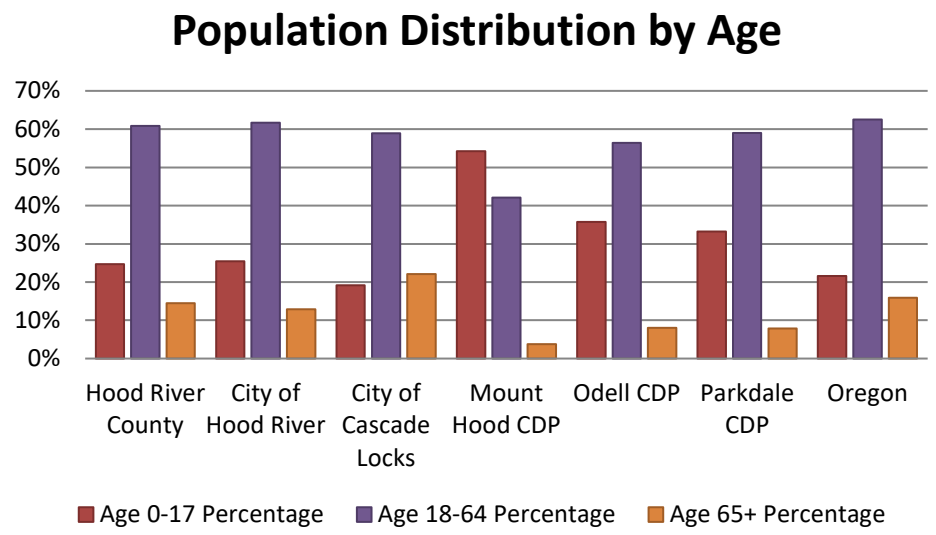
Source: Hood River County Final Forecast Tables; Population Research Center, Portland State University, June 30, 2016.

Figure C.4 illustrates the percentage of population by various age groups in the cities and incorporated areas compared with Hood River County as a whole. The CDPs have a much higher population of children than the County or State averages, while the City of Cascade Locks has a higher elderly population. Special consideration should be given to young children, schools, and parents during the natural hazard mitigation planning process. Young children are more vulnerable to heat and cold, have fewer transportation options, and require assistance to access medical facilities. Parents may lose time from work and money when their children's childcare facilities and schools are impacted by disasters (Cutter et al., 2003). Older populations may require assistance in an evacuation due to limited mobility or health issues. Additionally, older populations may require special medical equipment or

[14] Employment Landscape of Rural Oregon, Oregon Employment Department, May 2017

medications and can lack the social and economic resources needed for post-disaster recovery.[15]

Figure C.4: Hood River County Population Distribution by Age, 2016



Source: Social Explorer Table T7; ACS 2016 (5-Year Estimates); U.S. Census Bureau

Other high risk populations include the number of households where persons over the age of 65 live alone as well as single parent households with children under 18. Table C.4 describes the high risk populations in each jurisdiction within the County. Over 30% of the households in the county have individuals living in them who are 65 or older, and close to half of those (13%) are 65 or older householders that live alone. Additionally, 8% of the households in the county are occupied by single parents with children under the age of 18. These groups are more heavily impacted because they may lack the necessary resources, knowledge, skills, social support structures, or the mental and physical abilities necessary to take care of themselves. Historically, vulnerable populations present a special challenge to emergency managers and response agencies and they are more likely to be victims of a disaster and are less likely to recover. [16]

[15] Wood, Nathan. Variations in City Exposure and Sensitivity to Tsunami Hazards in Oregon. U.S. Geological Survey, Reston, VA, 2007.
[16] Source: Hood River County HIVA, July 2008

Table C.4: Hood River County High Risk Populations

High Risk Households	Hood River County	Percent	Cascade Locks	Percent	The City of Hood River	Percent
Total households	8,173		445		2,972	
Households with individuals under 18	2,934	29.3%	135	30.3%	1,004	33.8%
Single householder with own children under 18	653	8.0%	47	10.6%	286	9.6%
Households with individuals 65 years and over	2,003	30.8%	99	22.3%	703	23.7%
Householder 65 years and over living alone	806	12.5%	33	7.4%	409	13.8%

Source: Social Explorer Tables T165 and T17; ACS 2016 (5-Year Estimates); U.S. Census Bureau

Race

The impact following a disaster in terms of losses and the ability of the community to recover may also vary among minority population groups. Minorities are more likely to be isolated in their communities, are less likely to have the savings to rebuild after a disaster, and less likely to have access to transportation and medical care. 89% of Hood River County residents identify as "white," however, 40% of the population identifies as Hispanic (see next section). "Hispanic" is not a racial category in the U.S. Census; people identifying as Hispanic may identify as any race. The majority of residents who identify as some other race than white live in CDPs and unincorporated areas of the County. Table C.5 depicts where the Hood River County Hispanic population resides.

Table C.5: Hood River County Hispanic Ethnicity

	Hood River County	Cascade Locks City	Hood River City	Mount Hood CDP	Odell CDP	Parkdale CDP
Total Population	22,842	1,134	7,476	238	2,478	528
Not Hispanic or Latino	15,796 (69%)	1,110 (98%)	5,580 (75%)	84 (35%)	795 (32%)	267 (51%)
Hispanic or Latino	7,046 (40%)	24 (2%)	1,896 (25%)	154 (65%)	1,683 (68%)	261 (49%)

Source: Social Explorer Table T14; ACS 2016 (5-Year Estimates) (SE), ACS 2016 (5-Year Estimates), Social Explorer; U.S. Census Bureau

Just over 30% of the population is of Hispanic or Latino origin, primarily individuals who self-identify as Mexican. Culturally appropriate and effective outreach includes both methods and messaging targeted to this audience. For example, connecting to historically disenfranchised populations through trusted sources or providing preparedness handouts and presentations in the languages spoken by the population can increase community

resilience. This population includes undocumented residents and migrant farm workers as well, indicating more creative outreach might be necessary.

Language

According to the 2010 US Census, 28% of all County residents speak a language other than English; the vast majority of which (95%) speak Spanish. Just over half of bilingual residents (15% of the Hood River County population) reports speaking English less that "very well." Education and outreach efforts should take language needs into consideration when developing materials and tactics. [17]

Education

Education can influence the ability to access resources, while lack of resources may constrain the ability to understand warning information (Cutter et al., 2003). Therefore, levels of education within the region should be considered when designing hazard outreach materials to communities. Table C.8 describes educational attainment throughout the County and the state. Compared to the state, Hood River County has both a lower percentage of high school graduates and college graduates with a Bachelor's degree or higher.

Table C.6: Educational Attainment for Population 25 Years and Over

	Oregon	Hood River County	Cascade Locks City	Hood River City	Mount Hood CDP	Odell CDP	Parkdale CDP
Less than High School	10%	19.7%	13.7%	16.1%	0.0%	44.0%	35.9%
High School Graduate	59%	50%	69%	55%	82%	50%	59%
Bachelor's Degree or Higher	32%	30%	18%	39%	17%	6%	4%

Includes Equivalency, includes Some College
Source: Social Explorer Table T25; ACS 2016 (5-Year Estimates), Social Explorer; U.S. Census Bureau

Educational attainment often reflects higher income and therefore higher self-reliance. Widespread educational attainment is also beneficial for the regional economy and employment sectors as there are potential employees for professional, service and manual labor workforces. An oversaturation of either highly educated residents or low educational attainment can both have negative effects on the resiliency of the community. Hood River County includes both highly educated residents and those with little education; however they are segregated into different population centers, with the majority of residents with a bachelor's degree residing in Hood River City, and the majority of the unincorporated populations having high school or less equivalency.

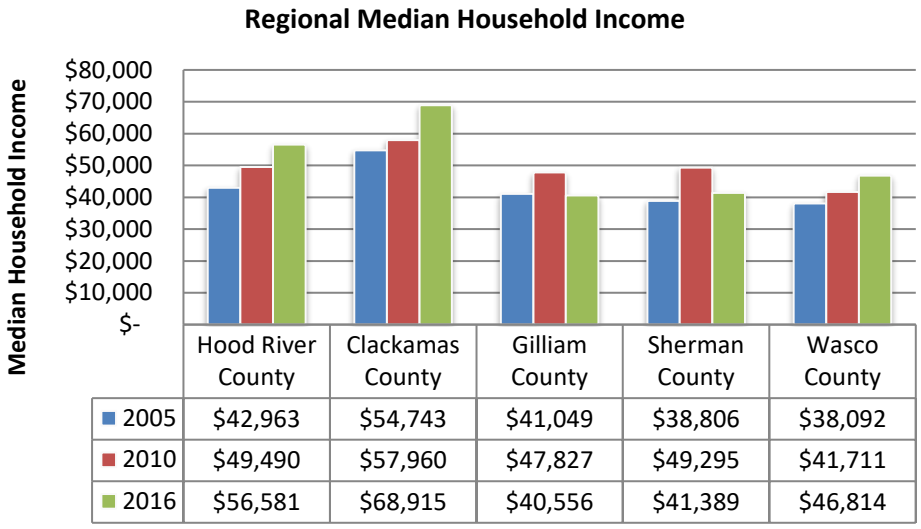
Income

Household income and poverty status levels are indicators of socio demographic capacity and the stability of the local economy. Household income can be used to compare

[17] U.S. Census Bureau, 2012-2016 American Community Survey 5-year Estimates; American Fact Finder

economic areas as a whole, but does not reflect how the income is divided among the residents in the area.[18] Figure C.5 illustrates changes in the median household income from 2005 to 2016 in Hood River and surrounding Counties. In 2010 the median household income across Hood River County equaled $49,490, roughly $3,000 higher than Oregon as a whole. Likewise, the county's 14.3% growth in median household income between 2010 and 2016 is higher than the 12.2% growth in the state as a whole over the same period of time. However, this may reflect increasing numbers of residents who own property in the County but reside elsewhere, living only in the area during summer months.

Figure C.5: Median Household Income, 2005-2016



	Hood River County	Clackamas County	Gilliam County	Sherman County	Wasco County
2005	$42,963	$54,743	$41,049	$38,806	$38,092
2010	$49,490	$57,960	$47,827	$49,295	$41,711
2016	$56,581	$68,915	$40,556	$41,389	$46,814

Source: U.S. Census Bureau, Small Area Estimates Branch, 2005-2010 and ACS 2016 (5-Year Estimates) (SE), ACS 2016 (5-Year Estimates), Social Explorer; U.S. Census Bureau

Historically, 80% of the disaster burden falls on the public. Of this number, a disproportionate burden is placed upon those living in poverty. Poverty limits the ability of households to engage in household level mitigation activities. People living in poverty are more likely to be isolated, are less likely to have the savings to rebuild after a disaster, and are less likely to have access to transportation and medical care. Table C.7 identifies both the number and the percentage of individuals living below the poverty level. In 2010, the national poverty guideline for a family of four equaled income levels at or below $22,050.[19] Notably, the poverty estimates as a percentage were consistently higher in Hood River County compared to state and national averages in 2005; however they are now below both the state and national averages. It should be noted that income is geographically variable throughout the County, with higher income residents clustered in the City of Hood River and lower income residents residing in the City of Cascade Locks and unincorporated areas of the County.

[18] 2015 Oregon Natural Hazards Mitigation Plan, Region 5 Mid-Columbia Region Profile

[19] U.S. Department of Health and Human Services. *Federal Register*, Vol. 75, No. 148, August 3, 2010, pp. 45628–45629

Table C.7: Individuals Living Below Poverty Level

	All ages			Under 18		
	2005 Poverty	2010 Poverty	2016 Poverty	2005 Poverty	2010 Poverty	2016 Poverty
Hood River County	3,105	2,888	3,038	1,220	1,196	1,100
Percent Poverty						
Hood River County	15%	13%	13%	23%	21%	20%
Oregon	14%	15%	15%	19%	22%	20%
United States	13%	15%	13%	19%	22%	18%

Source: U.S. Census Bureau, Small Area Estimates Branch, 2005 Estimates, 2010 Estimates and ACS 2016 (5-Year Estimates) (SE), ACS 2016 (5-Year Estimates), Social Explorer Tables T114, T115, and T116; U.S. Census Bureau

Low-income populations require special consideration when mitigating loss to a natural hazard. When a natural disaster interrupts work, the ability to provide housing, food, and basic necessities becomes increasingly difficult. In addition, low-income populations often rely on public transportation, public food assistance, public housing, and other public programs for day-to-day activities; these services are often impacted in the aftermath of the natural disaster. As shown in Table C.7, 20% of Hood River County residents live at or below the federal poverty line. Over half of school age students are eligible for free or reduced lunch. To reduce the compounded loss incurred by low-income populations post-disaster, mitigation actions need to be specially tailored to ensure safety nets are in place to provide further support to those with fewer personal resources (Cutter et al., 2003).

Table C.8: Hood River County Free or Reduced Price School Lunch Eligibility

	2006	2008	2010	2012	2014	2016
Percent of children eligible to receive free/reduced lunch during the school year	54.0%	54.9%	54.7%	57.0%	59.6%	56.3%

Source: Children First for Oregon, Status of Oregon's Children, 2005-2016

Oregon State University estimates that 8.8% of the Hood River County population was food insecure in 2015, indicating they did not have a reliable food source for their next meal. In a disaster situation, this creates extreme vulnerability.

Wealth can increase the ability to recover following a natural disaster (Cutter et al., 2003), and homeownership, versus renting, is often linked to having more wealth. Renters often do not have personal financial resources or insurance to help recover post-disaster. On the other hand, renters tend to be more mobile and have fewer assets at risk. In the most extreme cases, renters lack sufficient shelter options when lodging becomes uninhabitable or unaffordable due to natural disaster events. 64.6% of the housing units in Hood River County are renter-occupied. Of those, over half house a single occupant and 12% are mobile homes.

Table C.9 Housing Tenure, Hood River County

Hood River County		
	Population	Percent
Housing Units:	9,523	
Occupied	8,213	86.2%
Vacant	1,310	13.8%
Renter-Occupied	2,908	64.60%
Owner-Occupied	5,305	35.40%

Source: ACS 2016 (5-Year Estimates) (SE), ACS 2016 (5-Year Estimates), Social Explorer T95 and T207; U.S. Census Bureau

Housing prices are increasing in Hood River County. A 2015 study by ECONorthwest found that:

- The median housing value rose from 3.9 times the median household income in 2000 to 5.7 times the median household income by 2009-2013.
- Thirty-five percent of Hood River County's households were cost burdened in the 2009-2013 period, meaning they spent more than 30% of their gross income on housing costs. Forty-two percent of renters were cost burdened, compared with 32% of homeowners.[20]

Health and Safety

Individual and community health play an integral role in community resiliency. Those who lack health insurance have higher vulnerability to hazards and will likely require additional community support and resources. Table C.11 identifies health insurance coverage across Hood River County. The Census Bureau estimates in 2016 that the number of uninsured residents in Hood River County equaled 2,973, roughly 13.1%. The uninsured rate for persons under the age of 65 has been consistently higher in the County compared to the state over the past decade. Overall, the percent of uninsured residents in Hood River County has decreased dramatically, from 23.9% in 2009, and upwards of 25% before that, to current low rates. This is primarily due to expanded coverage through the Affordable Care Act, which may be subject to revisions at the federal level at any time.

Table C.10: Hood River County Health Insurance Coverage

		Percent Uninsured - Under Age 65	Percent Uninsured - Under Age 19
2010	Hood River County	23.8%	12.5%
	Oregon	19.3%	9.2%
2012	Hood River County	22.5%	9.6
	Oregon	17.0%	6.9%

[20] The Hood River County Short-Term Rentals and Second Homes; ECONorthwest; September 17, 2015

		Percent Uninsured - Under Age 65	Percent Uninsured - Under Age 19
2014	Hood River County	14.2%	7.9%
	Oregon	11.6%	5.1%
2016	Hood River County	10.6%	5.5%
	Oregon	7.4%	3.5%

Source: U.S. Census Bureau, Small Area Health Insurance Estimates, 2010-2016

The availability of law enforcement officials and professional medical care providers can lessen the impacts during and immediately following a major disaster. According to the Federal Bureau of Investigation, Hood River County has less than half of the state average of sworn police officers per 1000 people, but nearly four physicians in patient care per 1,000 people, over two thirds more than the state as a whole.

Vulnerable Populations

Several other vulnerability characteristics, including disability and homelessness can influence resiliency and recovery. Some disabilities are easily detected while others are invisible. In Hood River County, 2,217, or 10% of the population, are residents with disabilities. Of this number, 140 are youths with a disability (2.4%) and 874 are 65 years or older (31.9%).[21]

Table C.11: Homeless Point-In-Time Count

	Hood River County	Oregon
2009	18	17,309
2010	482	19,208
2011	284	17,254
2015	69	13,176

Source: Oregon Point in Time Homeless Count, Oregon Housing and Community Services; http://www.oregon.gov/ohcs/pages/ra_point_in_time_homeless_count.aspx

The homeless population in the County varies widely year to year, and fluctuates depending on the seasons and the economy. In Hood River County, the estimated homeless population grew from 18 in 2009 to 482 in 2010, and then fell to 284 in 2011.[22] The homeless count fell again to 69 in January 2015.[23] It is likely that homelessness varies seasonally. According to Oregon Housing and Community Services, 15% of the homeless population in Hood River County is Hispanic. The vast majority of homeless people are single adult males or families with children. The need for social services will increase following a disaster; homeless populations may be very vulnerable to heat, cold, and smoke. Natural hazard mitigation efforts with homeless populations can be difficult because of a lack of reliable

[21] U.S. Census Bureau, 2008-20012 American Community Survey 5-year Estimates; American Fact Finder
[22] Oregon Point in Time Homeless Count, Oregon Housing and Community Services; http://www.oregon.gov/ohcs/pages/ra_point_in_time_homeless_count.aspx
[23] Oregon Point-In-Time Homeless Counts; Oregon Housing and Community Services; http://www.oregon.gov/ohcs/Pages/research-point-in-time-homeless-count-in-oregon.aspx

communication pathways. Shelters and social services are necessary for these people in a disaster situation.[24]

Tourists

Tourists are not counted in population statistics and are therefore considered separately in this analysis. Tourists are specifically vulnerable due to the difficulty of locating or accounting for travelers within the region. Tourists are often at greater risk during a natural disaster because of unfamiliarity with evacuation routes, communication outlets, or even the type of hazard that may occur.

Tourism activities in Hood River County focus on outdoor activities (hiking/backpacking, water sports, snow sports, etc.), touring (traveling to experience scenic beauty, history and culture), and special events (such as fairs or festivals). (Longwoods Travel USA, 2011). Two thirds of trips to Region 5 occur between April and September; the average travel party contains four persons. Hood River County experiences high tourism in both the summer (for water sports) and winter (for snow sports). The average stay is over four nights. (Data for Morrow and Umatilla Counties are not included in this count.) Over the past 10 years, destination spending in Hood River County has risen from $65 to $108 million and trips to the County steadily increase.[25] Just under half of tourists to Hood River County lodged in hotels or motels. [26] In 2016, 970,000 tourists logged overnight stays in the County, meaning that on average, 10.7% of people staying in Hood River County were visitors, not residents.[27]

Table C.12 Annual Visitor Estimates in Person Nights (2017)

	Person Trips (thousands)	Person Nights (Thousands)	Visitor Spending ($Millions)
Hotel, Motel, STVR	280.7	530.9	66.4
Private Home	100.5	305.8	9.7
Other Overnight	57.0	184.5	4.8
All Overnight	438.2	1021.2	80.9

Source: Source: Oregon Tourism Commission, Oregon Travel Impacts: 1991-2016p, Dean Runyan Associates

Difficulty locating or accounting for travelers increases their vulnerability in the event of a natural disaster. Furthermore, tourists are often unfamiliar with evacuation routes, communication outlets, or even the type of hazard that may occur (MDC Consultants, n.d.). Tourism increases traffic and congestion on Highway 35 by Mt. Hood and can clog major transportation corridors. County staff and tourists can both be stranded in event of transportation congestion.

[24] 2015 Oregon Natural Hazards Mitigation Plan, Mid-Columbia Region 5 Risk Assessment
25 Source: Oregon Tourism Commission, Oregon Travel Impacts: 1991-2016p, Dean Runyan Associates
26 2015 Oregon Natural Hazards Mitigation Plan, Mid-Columbia Region 5 Risk Assessment; Oregon Travel Impacts: 1991–2013, April 2014. Dean Runyan Associates
27 Visitors to Hood River County Logged Nearly One Million Overnight Stays in 2016
Oregon Employment Department, Septmeber 2017; https://www.qualityinfo.org/-/visitors-to-hood-river-county-logged-nearly-one-million-overnight-stays-in-2016

Synthesis

The characteristics and qualities of the community population such as age, race, education, income, health and safety are significant factors that can influence the community's ability to cope, adapt to and recover from natural disasters. The current status of socio demographic capacity indicators can have long term impacts on the economy and general stability of a community, ultimately affecting an area's overall level of resilience.

In Hood River County, notable trends include:

- 25.8% of the County population consists of children, and the elderly population is growing; both require extra care and attention before, during, and after disaster situations
- The region is visited by over 2 million tourists annually, who require education and preparedness for hazard event, and extra care during an event; they also clog transportation corridors
- 15% of County residents do not speak English "very well," and may require language specific outreach
- The County has high income variability and high renting population indicating variable abilities to cope with disaster conditions

Regional Economic Capacity

Economic resilience to natural disasters is more complex than simply restoring employment or income to the local community. Building a resilient economy requires an understanding of how employment sectors, workforce, resources and infrastructure are interconnected. Once inherent strengths or systematic vulnerabilities become apparent, both the public and private sectors can act to increase the resilience of the local economy. The Oregon Natural Hazards Mitigation Plan details employment, unemployment, and industry information for the Mid-Columbia Region.

Regional Affordability

The evaluation of regional affordability can capture the likelihood of individuals' ability to prepare for hazards, through retrofitting homes or purchasing insurance. Regional affordability is a mechanism for generalizing how well community residents can get back on their feet without Federal, State or local assistance.

Median Income

Median income can be used as an indicator of the strength of a region's economic stability. Table C.13 shows that between 2009 and 2016 the median household income in Hood River County has risen more slowly than the state and nation as a whole, indicating a slower recovery from the 2009 recession, but overall has experienced higher income growth over the past two decades. The County's median income still hovers below state and national averages.

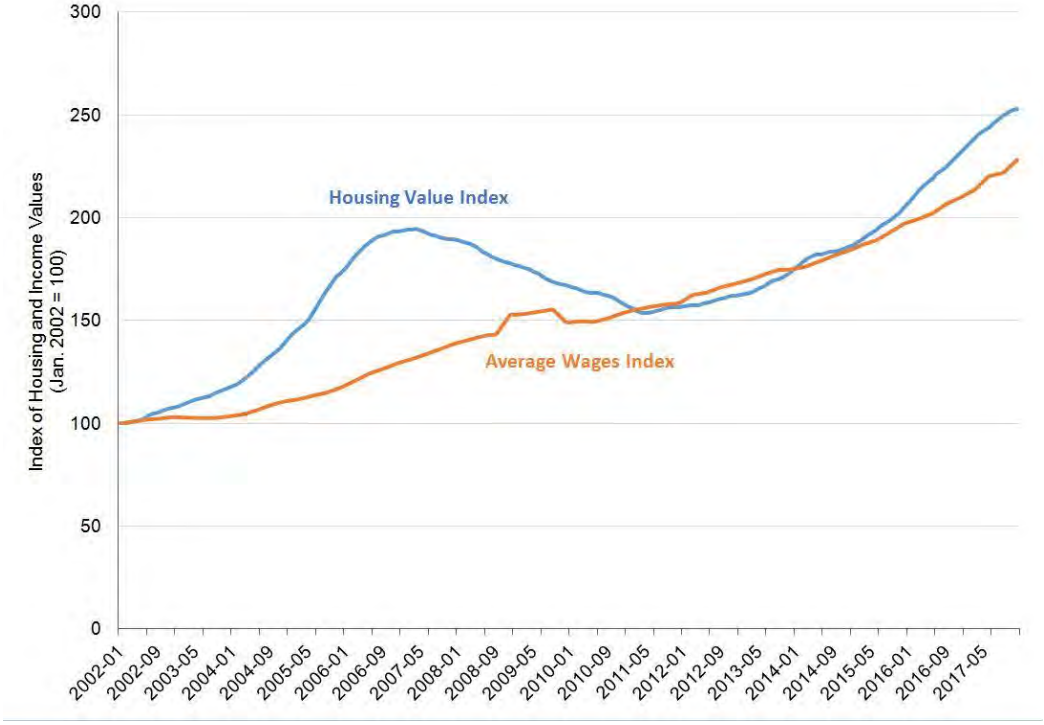
Table C.13: Median Household Income

	2009	2016	Change 2009-2016	Average Annual Growth Rate
Hood River County	$53,289	56,581	6.2%	0.9%
Oregon	$52,474	57,532	9.6%	1.4%
United States	$50,221	57,617	14.7%	2.1%

Source: ACS 2016 (5-Year Estimates) (SE), ACS 2016 (5-Year Estimates), Social Explorer Table T57; U.S. Census Bureau

The cost of living in Hood River County is steadily increased, and over the past several years has outstripped local incomes. Figure C.5 below demonstrates this pattern; it also shows the local reflection of the national housing burst in 2008-2010.

Figure C.5 Hood River County Housing Affordability Index



Source: Kale Donnelly, State of Oregon Employment Department, personal communication 5/21/2018

Economic Diversity

Economic diversity is a general indicator of an area's fitness for weathering difficult financial times. Business activity in the Columbia Gorge region is fairly homogeneous and consists mostly of agriculture and manufacturing small businesses.

Economic diversity is a general indicator of an area's fitness for weathering difficult financial times. One method for measuring economic diversity is through use of the Herfindahl Index, a formula that compares the composition of county and regional economies with those of

states or the nation as a whole. Using the Herfindahl Index, a diversity ranking of 1 indicates the county with the most diverse economic activity compared to the state as a whole, while a ranking of 36 corresponds with the least diverse county economy. The table below describes the Herfindahl Index Scores for counties in the region.

Table C.14 shows that Clackamas County has an economic diversity rank of 9 as of 2013, this is on a scale between all 36 counties in the state where 1 is the most diverse economic county in Oregon and 36 is the least diverse. The Hood River County's ranking has increased since 2008.

Table C.14 Regional Herfindahl Index Scores

	2016			2013		
County	Employment	Number of Industries	State Rank	Employment	Number of Industries	State Rank
Hood River	12,016	171	31	10,993	168	31
Clackamas	140,827	274	1	132,209	266	1
Gilliam	539	41	34	711	45	35
Multnomah	416,693	285	4	380,236	280	2
Sherman	526	34	35	441	33	34
Wasco	9,783	161	30	8,415	158	30

Source: Oregon Employment Department

While illustrative, economic diversity is not a guarantor of economic vitality or resilience. Hood River County, ranked 25 in terms of economic diversity, is listed as non-distressed, while Wasco County ranked at 17 is identified as distressed. The economic distress measure is based on indicators of decreasing new jobs, average wages and income, and is associated with an increase of unemployment.[28]

Employment and Wages

Data provided by the State of Oregon Employment Department indicate that Hood River County's labor force (defined as the population of 16 and older which is in the labor force) has risen unsteadily over the past two decades. Two declines in labor force occurred in 2005 and 2012-2016. The labor force has increased from 13,112 in 2008 to 14,548 in 2018, an 11% increase.[29] However, many of those jobs are in the manufacturing and leisure and hospitality industries, which pay lower wages. Figure C.5 demonstrates the average wage for the common industries employing Hood River County residents.

[28] Business Oregon – Oregon Economic Data "Distressed Communities List", http://www.oregon4biz.com/Publications/Distressed-List/

[29] Oregon Employment Department - "Local Area Employment Statistics", http://www.qualityinfo.org/olmisj/labforce -updated with 2011 and 2015

There was a decrease in unemployment in Hood River County from 2011 to 2015, reflecting national trends according to the Oregon Employment Department. The decrease in the rate was impressive, from 7.7 to 3.5. [30] All surrounding counties in the region also show a decrease in unemployment since 2011. As of March 2018, total non-farm employment for the County was 11,790 individuals,[31] and total employment in the County was 14,071.[32]

Table C.15: Regional Unemployment

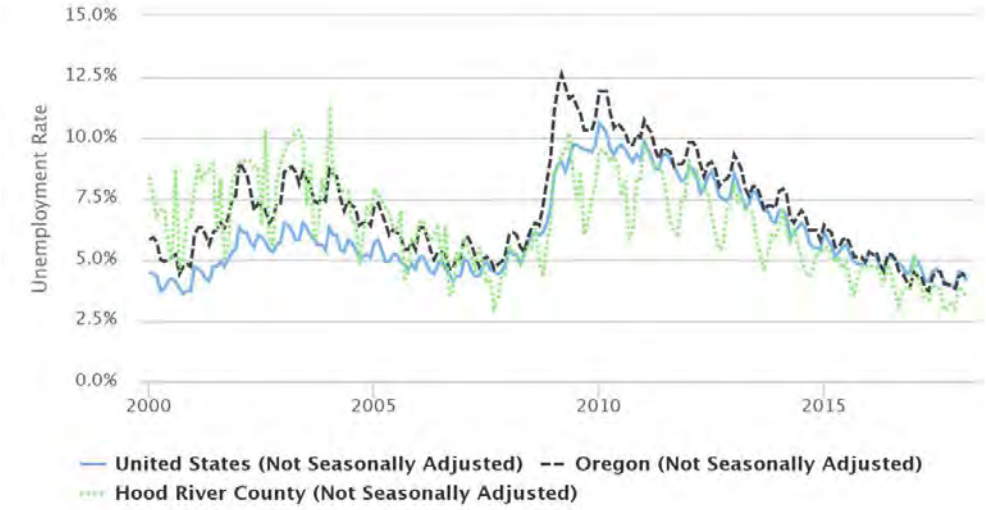
County	2005 Unemployment Rate	2015 Unemployment Rate	Percent Change from 2005
Hood River	6.4	3.5	-45%
Wasco	7.1	5.3	-25%
Clackamas	5.5	5.3	-4%
Gilliam	5.7	5.2	-9%
Sherman	6.9	4.3	-38%
Oregon	6.2	5.8	-7%

Source: Oregon Employment Department, Qualityinfo.org/east-cascades

Employment data from the Oregon Employment Department demonstrate a cyclical employment pattern in the Hood River and Wasco County region, with a seasonal peak in the fall (September/October) for Hood River County and a seasonal peak in the summer (July) in Wasco County.[33] These peaks typically respond to the slowing of the primary tourist season along the Columbia River, as well as most agricultural operations, with the approach of fall and winter in the region. Figure C.6 illustrates this pattern. It should also be noted that the U.S. Census estimates only 6,569 residents work full-time year round (47%) and 4828 work part-time or seasonally (35%). The remaining 2,472 did not report work.[34]

[30] Oregon Employment Department - "Local Area Employment Statistics", http://www.qualityinfo.org/olmisj/labforce -updated with 2011 and 2015
[31] Oregon Employment Department – "Current Employment Statistics", http://www.qualityinfo.org/olmisj/CES
[32] Oregon Employment Department - "Local Area Employment Statistics" http://www.qualityinfo.org/olmisj/labforce
[33] Oregon Employment Department
[34] American Community Surveys, 2012-2016 5 year estimates, U.S. Census, ACS Table C18121

Figure C.6: Not Seasonally Adjusted Unemployment Rates, 2000-2017



Source: Oregon Employment Department, Qualityinfo.org

As opposed to measurements of the labor force and total employment, Covered Employment provides a quarterly count of all employees covered by Unemployment Insurance. Table C.16 displays the County Covered Employment and payroll figures for Hood River and other nearby counties in 2016. Of all industry employment in Hood River County, 38% of jobs pay under$15/hour and 61% of jobs pay under $20.hour.[35]

Table C.16: 2016 County Covered Employment and Payroll

County	Employees	Annual Payroll	Average Pay
Wasco	11,912	$492,945,117	$38,024
Hood River	13,287	$484,020,772	$36,428
Sherman	845	$38,341,478	$45,374
Gilliam	778	$30,632,810	$39,373
Wheeler	287	8,460,577	$29,479
Oregon	1,841,5433	$91,095,669,122	$49,467

Source: Wasco County Natural Hazards Mitigation Plan, 2017

In 2016, there were 1,041 employment establishments operating in Hood River County, and 90.1% of those establishments had fewer than 20 employees.[36] 63% of Hood River County businesses have 1-4 employees.[37] After both winter storm and wildfire hazard events in 2017, Hood River County led the state in number of applications for small business disaster loans. Small businesses are typically more susceptible to financial uncertainty, and have a strong economic ripple effect if they are unable to pay employees. If a business is financially unstable before a natural disaster occurs, financial losses (resulting from both damage

[35] Unemployment Insurance Wage Records; Oregon State Department of Employment
[36] U.S. Census Bureau; 2016 County Business Patterns, American Fact Finder
[37] OregonProspector, Business Oregon;
http://www.oregonprospector.com/default.aspx?DID=COMMUNITIES_41027; Retrieved 5/14/18

caused and the recovery process) may have a bigger impact than they would for larger and more financially stable businesses.[38]

Industry

Major Regional Industry

Key industries represent major employers and are significant revenue generators. Different industries face distinct vulnerabilities to natural hazards. Communities can target mitigation activities towards industries' specific sensitivities. Natural hazard event impacts on one industry can reverberate throughout the regional economy, especially when hazard impact basic sector industries.[39]Basic sector industries are those that are dependent on sales outside of the local community, including farm and ranch, information, and wholesale trade industries. Non-basic sector industries depend on local sales for their business, such as retail trade, construction, and health and social assistance.[40]

Employment by Industry

Economic resilience to natural disasters is particularly important for the major employment industries in the region. If major employment industries are negatively impacted by a natural hazard, such that employment is affected, the impact will be felt throughout the regional economy.[41]

The economy of Hood River County has historically been based on agriculture, forestry, and recreation. Orchard crops constitute the major share of the agricultural sector (covering 15,000 acres), and form a keystone of the county's economy. Health, education, and social services employment has been steadily increasing, and now constitutes a significant portion of the economy as well. Forestry jobs and income are declining, and while recreation related industry is increasing, many associated jobs are low wage and part-time.

The physical expansion of the local agriculture and forest based industries are limited by topographic constraints. Moreover, the respective industries are highly affected by ever-evolving state and national polices, as well as impacts from climate change and decisions resulting from geo-political conditions. The agricultural industry is historically characterized by seasonal employment fluctuations, which have caused the county to appear to have a high unemployment rate. Notwithstanding the foregoing, an increasing number of orchards continue to partition/divide their holdings or tracts to maximize residential development opportunities or take advantage of non-traditional agri-tourism/commercial types of activities in conjunction with agriculture. The world-class scenic and recreational attributes of the Gorge also draws a large influx of visitors and recreationalists to the area and region, especially during the summer months.[42]

Table C.17 describes the employment in Hood River County by number of firms, number of employees, average wage, growth over the past five years, and projected growth. The two industries with the most employees, as of 2017 estimates, are educational services,

[38] State of Oregon Natural Hazards Mitigation Plan, Region 5 Mid-Columbia Risk Assessment
[39] State of Oregon Natural Hazards Mitigation Plan, Region 5 Mid-Columbia Risk Assessment
[40] Ibid.
[41] Ibid.
[42] Hood River County Comprehensive Land Use Plan

healthcare, and social assistance (21.0%), natural resources, agriculture, foresting and mining (14.6%). Tourist related industries, including retail trade, and arts and recreation services form a substantial percentage of the economy as well. Over the past decades, Hood River County has diversified economically and shifted from reliance on basic industries. Sectors that are anticipated to be major employers in the future also warrant special; the most detailed industry projections are calculated on the regional level (included in table C.17). For the Columbia Gorge region, which includes Hood River County, the greatest growth will occur in the Leisure and Hospitality, Private Educational and Health Services, Construction, and Information Industries.[43]

Table C.17 Employment Sector and Wages

	2017				Percent Change in Employment (2012-2017)	Employment Forecast* (2014-2024)
Employment Sector	**Firms**	**Employees**	**Percent Workforce**	**Average Wage**		
Total Payroll Employment	1,337	13,782	100%	$38,091	9%	11%
Total Private	1,285	12,493	91%	$37,054	10%	12%
Natural Resources and Mining	190	2,481	18%	$25,361	-2%	11%
Construction	120	433	3%	$42,337	39%	16%
Manufacturing	74	1,729	13%	$44,800	38%	12%
Trade, Transportation & Utilities	228	2,066	15%	$33,765	8%	6%
Wholesale Trade	63	426	3%	$49,889	-17%	3%
Retail Trade	141	1,446	10%	$26,723	16%	7%
Transportation, Warehousing, & Utilities	23	193	1%	$51,108	29%	7%
Information	26	144	1%	$51,824	10%	14%
Financial Activities	61	240	2%	$49,580	10%	4%
Professional and Business Services	178	1,083	8%	$74,402	16%	13%
Education and Health Services	125	1,539	11%	$47,912	-15%	15%
Leisure and Hospitality	133	2,331	17%	$20,274	21%	17%
Other Services	146	440	3%	$29,931	33%	9%
Private Non-Classified	6	7	0%	$48,697	-13%	15%
Government	52	1,290	9%	$48,103	5%	5%
Federal	8	115	1%	$63,579	2%	-6%
State	10	138	1%	$40,642	24%	2%
Local	34	1,036	8%	$47,426	3%	7%

Source: Oregon Employment Department, qualityinfo.org

[43] East Cascades Industry Employment Projections 2014-2024, Oregon Employment Department; June, 2016

Between 2007 and 2017, nonfarm employment rose by 1,340 jobs (13%), all of which can be attributed to private industry growth. Manufacturing contributed 450 of those jobs (33%); professional and business services provided 390 of those jobs (29%), and food and drinking services created 270 jobs (20.1%). Education and health services, local government education, and wholesale trade all lost jobs between 2007 and 2017, with most losses occurring before 2015.[44]

HIGH REVENUE SECTORS

The three nonfarm sectors with the highest revenue in 2012 were retail trade (24%), manufacturing (23%), and health care and social assistance (10%). Overall, the economy has diversified since 2012 and increased in total revenue. Table C.18 shows the revenue generated by each economic sector. The retail and basic industry sectors are also particularly susceptible to hazard disruption.

Table C.18 Revenue by Sector

Economic Sector	2012 Revenue
Accommodation and food services	$62,118,000
Administrative/support and waste management/remediation services	$11,098,000
Arts, entertainment, and recreation	$29,017,000
Educational services	$1,782,000
Health care and social assistance	$130,751,000
Manufacturing	$304,290,000
Other services (except public administration)	$20,717,000
Professional, scientific, and technical services	$84,405,000
Professional, scientific, and technical services	$84,405,000
Real estate and rental and leasing	$10,006,000
Retail trade	$315,357,000
Transportation and warehousing(104)	$23,840,000
Wholesale trade	$110,485,000
Total	$1,103,866,000

Source: American Factfinder, 2012 Economic Census, EC1200A1

The retail trade sector of Hood River County brought in the most revenue during 2012, generating more than $315 million. [45] The sector is highly dependent on tourism and importing of goods for sale in commercial establishments, tying it directly to the county's transportation infrastructure, particularly Interstate 84. Retail trade revenue could be significantly impacted depending on the severity of a natural disaster and the pace of recovery.

Manufacturing generated over $304 million in revenue for Hood River County in 2012. The sector is slightly volatile and dependent on demand for goods nationally and internationally,

[44] State of Oregon Employment Department, "Hood River County's 10-year Growth Rate at 13 Percent On Strength of 2016 and 2017 Job Gains"
[45] American Factfinder, Economic Census, EC1200A1.

but recent military contracting with INSITU and other companies has brought some stability to the industry. Again, damage to county infrastructure, especially transportation corridors, could inhibit transportation of goods or affect the basic working conditions required for normal production levels.

In 2012, the *health care and social assistance* sector generated $130 million, making it the third largest earning sector in Hood River County. The sector is a relatively stable revenue generator, and relies largely on the local presence of older residents and elderly facilities. The populations requiring such services on a daily basis will likely continue requiring assistance. In Medical needs may increase during and immediately after a disaster event due to physical or stress induced injuries and trauma. The physical infrastructure of this sector will be essential for maintaining the capacity of service that it currently provides.

Accommodation and food services generated over $62 million in revenue during 2012. A large portion of the sector's revenue is generated through leisure and hospitality, serving regional residents with disposable income and tourists. Both demographics would change their spending behavior; tourists would refrain from visiting the impacted area, and local residents would concentrate spending on essential items rather than luxury expenditures.

The majority of Hood River County's revenue generating sectors are highly dependent upon transportation networks in order to receive shipped goods (e.g. food supplies and products), export goods to outside markets, and maintain accessibility to traveling motorists. Therefore disruption of the transportation system could have severe consequences for all of the before mentioned sectors.

In the event that any of the county's primary sectors are impacted by a disaster, particularly the manufacturing and retail sectors, Hood River County may experience a significant disruption of economic productivity and should therefore plan accordingly.

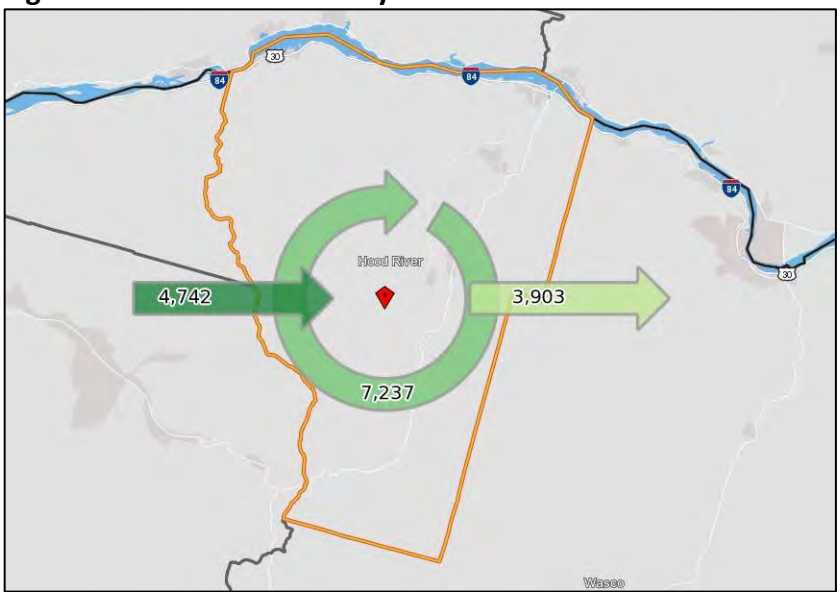
Labor and Commute Shed

Hazards can happen at any time during the day or night. The time of a hazard event impacts how effective advance warning to residents and first responders, who can take immediate preparedness and protection measures, will be. A snow storm during the work day will have different impacts than one that comes during the night. During the day, a hazard has the potential to segregate the population by age or type of employment (e.g., school children at school or office workers in downtown areas). This may complicate some aspects of initial response such as transportation or the identification of wounded or missing. Conversely, a hazard at midnight may occur when most people are asleep and unable to receive an advance warning through typical communication channels. The following labor shed and commute shed analysis is intended to document where County residents work and where people who work in Hood River County reside.

As shown in Figure C. 8 and Table C.19, overall the workforce is highly mobile between Hood River, Wasco, Clackamas and Multnomah Counties. While the majority of Hood River County residents are employed within the county (65%), there are also a significant number of workers who commute to locations outside the county to work. It is possible that some workers do not physically commute every day or on a regular basis and instead telecommute or otherwise have remote locations. Internal County estimates are higher than state reported data; County staff estimates that 50% of County employees commute along I-

84 or interstate bridges. County operations would be significantly impacted in the event of a disruption to I-84 or the interstate bridges.

Figure C.8 Hood River County Commute Shed



Source: U.S. Bureau of the Census, On The Map.

Table C.19: Commute Shed (Where workers are employed who live in Hood River County), 2015

Location	Number	Percent
Hood River County	7237	65%
Hood River	3273	29%
Odell CDP	629	6%
Cascade Locks	136	1%
Multnomah County	572	5%
Portland	426	4%
Wasco County	760	7%
The Dalles	640	6%
Clackamas County	269	2%
Klickitat County, WA	459	4%
Washington County	276	3%
Marion County	224	2%
Skamania County, WA	179	2%
Deschutes County	145	1%
All Other Locations	1009	9%
Total	16234	

Source: U.S. Census Bureau, OnTheMap, All Jobs Area Profile Analysis, 2015

Table C.20 below tells the statistical story about where workers live who are employed in Hood River County. The majority of workers employed in the county are also residents

(60.4%). However, 39.6% of people employed in the County live elsewhere. The location outside of Hood River County where the highest numbers of workers come from is neighboring Wasco County. However a substantial number of workers live west of Hood River in Multnomah, Clackamas and Washington Counties, while many others live across the river in Klickitat and Skamania Counties.

Table C.20: Labor Shed (Where workers live who are employed in Hood River County), 2015

Location	Number	Percent
Hood River County	7,237	60%
Hood River	2,265	19%
Odell CDP	781	7%
Cascade Locks	290	2%
Wasco County	1,076	9%
The Dalles	651	5%
Klickitat County, WA	575	5%
Multnomah County	509	4%
Portland	385	3%
Clackamas County	372	3%
Skamania County, WA	256	2%
Washington County	226	2%
Marion County	122	1%
Cowlitz County	112	1%
Clark County	162	1%
All Other Locations	1,332	11%
Total	16,351	100%

Source: U.S. Census Bureau, OnTheMap, All Jobs Area Profile Analysis, 2015

There is a great deal of commuting and worker exchange between communities in the region. This pattern may result in response or recovery staff that live outside of the county being unable to commute to work, or employees separated from families during a disaster situation.

Synthesis

Regional economic capacity refers to the present financial resources and revenue generated in the community to achieve a higher quality of life. Forms of economic capital include income equality, housing affordability, economic diversification, employment, and industry. 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.

Considering its comparatively low unemployment rate, and the moderate diversity of its economy, Hood River County may experience an easier recovery than other counties with

reliance on basic industries.[46] However, the County also experiences high income stratification and a lack of affordable housing, indicating the recovery would vary significantly among residents. It is important to consider what might happen to the county economy if the largest revenue generators and employers (the natural resources, leisure and hospitality, and health care and social assistance industries), were heavily impacted by a disaster; which could occur in the event of an I-84 closure, which results from winter storms, wildfires, landslides, and earthquake events To an extent, and to the benefit of Hood River County, these particular industries are a mix of basic and non-basic industries, dependent on both external markets and local residents. The small business community is a vital part of Hood River County economy and culture, and is particularly vulnerable to disruption from natural hazards. Immediate strategies and actions to reduce vulnerability from an economic perspective should focus on risk management for the county's dominant industries (e.g. business continuity planning) as well as the county's dependence on main transportation arteries.

Built Capacity

Housing Building Stock

Hood River County continues to experience significant development pressure on zoned resource lands outside the UGBs and within the Columbia River Gorge National Scenic Area. Moreover, development of non-resource lands within the UGBs is also significant.

Housing types vary in disaster resistance, and therefore warrant different considerations. Table C.21 identifies the type of housing most common throughout Hood River County. . Mobile structures, which account for 10.8% of the housing in Hood River County, are particularly vulnerable to certain natural hazards, such as windstorms, and special attention should be given to securing the structures as they are more prone to damage than wood-frame construction.[47]

Table C.21: Hood River County Housing Type Summary, 2016

Housing Type	Number	Percent
1 unit	6,061	73.8%
2 to 10 units	706	8.6%
10 or more unites	550	6.7%
20 or more units	353	4.3%
Mobile home	887	10.8%
Boat, RV, van, etc.		-
Total	8,213	

Source: U.S. Census Bureau, American Community Survey, 5 year Estimates, 2012-2016, American Fact Finder

Multi-unit structures increase vulnerability due to the increased number of people living in close proximity. A structural weakness in a multiunit structure will have an amplified impact on the population. According to the data presented in Table C.21, roughly 20% of housing in

[46] 2015 Oregon Natural Hazards Mitigation Plan, Region 5 Mid-Columbia Region Profile
[47] 2015 Oregon Natural Hazards Mitigation Plan, Region 5 Mid-Columbia Region Profile

Hood River County is made up of multi-family dwellings, a significant increase from 14% in 2009.

Table C.21 also indicates that the overwhelming majority of Hood River County's housing stock is single-family homes. This suggests that hazard mitigation and outreach should specifically address preparedness for detached housing structures.

Residential construction activity has experienced a significant increase over the past decade. The number of permits steadily decreased between 2004 and 2010 (from 157 48 annually). This mirrored the residential market decline throughout the nation. Structural building permits issued over the most recent three years for Hood River County were: 471 (2015); 547 (2016); 630 (2017), indicating that the County has returned to pre-recession levels.[48] Most of these permits were for additions or replacements; in 2017 only 20 permits were issued for new single family dwellings.

Table C.22 shows that just over 33% of the housing stock in Hood River County was built after 1990 when the more stringent building codes were put in place, leaving about 66% with questionable seismic stability, and nearly 34% with very questionable seismic stability (percentage of homes built before 1960).[49] Outreach regarding retrofitting and insurance can be targeted to owners of older structures.[50]

Table C.22: Hood River County Housing Stock by Age, 2016

Year Structure Built	Number	Percent
Built 2014 or later	53	0.6%
Built 2010 to 2013	101	1.1%
Built 2000 to 2009	1,821	19.1%
Built 1990 to 1999	1,201	12.6%
Built 1980 to 1989	1,277	13.4%
Built 1970 to 1979	1,258	13.2%
Built 1960 to 1969	602	6.3%
Built 1950 to 1959	990	10.4%
Built 1940 to 1949	394	4.1%
Built 1939 or earlier	1,826	19.2%
Total housing units	9,523	

Source: ACS 2016 (5-Year Estimates) (SE), ACS 2016 (5-Year Estimates), Social Explorer Table T193; U.S. Census Bureau

Generally, the older a home is, the greater the risk of damage from natural disasters. Stricter building codes have only been implemented in recent decades, following improved scientific understanding of plate tectonics and earthquake risk. In Oregon, many structures built after the late 1960's began utilizing earthquake resistant designs and construction. Communities in the northwest began implementing flood elevation ordinances in the 1970's.[51] In 1990

[48] John Roberts, Hood River County Planner, Personal Communication 5/15/18
[49] Source: U.S. Census Bureau, 2012-2016 American Community Survey
[50] 2015 Oregon Natural Hazards Mitigation Plan, Region 5 Mid-Columbia Region Profile
[51] 2015 Oregon Natural Hazards Mitigation Plan, Region 5 Mid-Columbia Region Profile.

Oregon upgraded to stricter seismic standards that included earthquake loading in building design.[52]

Natural hazard mitigation and preparedness planning should also consider type of occupancy when developing outreach projects or educational campaigns. Residents who own their own home are more likely to take steps to reduce the impact of natural hazards through mitigation or insurance methods. Renters may be less likely to physically improve their units due to rental policy constraints or lack of investment, but outreach around personal preparedness or renters insurance would benefit this population. As demonstrated in Table C.23 below approximately 30.5% of the occupied housing units in Hood River County are renter-occupied.

Table C.23: Hood River County Housing Unit Occupancy Summary, 2016

Housing Units	Number	Percent
Occupied housing	8,213	86.2%
Owner-occupied	5,305	55.7%
Renter-occupied	2,908	30.5%
Vacant housing	1,310	13.8%
Total	9,523	

Source: ACS 2016 (5-Year Estimates) (SE), ACS 2016 (5-Year Estimates), Social Explorer T95 and T207; U.S. Census Bureau

The number of short term rentals and second homes within Hood River County is increasing as the area becomes more affluent and known for recreation. The Hood River County Short-Term Rentals and Second Homes ECONorthwest Study (September 17, 2015), found that short term rentals and second houses comprise 2-4% of the County housing stock outside of the City of Hood River. Furthermore, the study found that between 8 and 12% of the housing stock of the City of Hood River is used for short term rentals and second houses.[53]

Physical Infrastructure

Physical infrastructure such as dams, roads, bridges, railways and airports are critical to Hood River County communities and economies. Critical facilities are defined as facilities that are crucial to government response and recovery activities; the term may also refer to facilities or infrastructure that could cause serious secondary impacts when disrupted. Some examples include: Agriculture and food systems; communications facilities; critical manufacturing; dams; emergency services; energy generation and transmission; government facilities; healthcare and public health; information technology; transportation systems; and water. Due to the fundamental role that physical infrastructure plays both in pre and post-disaster, they deserve special attention in the context of creating resilient communities.[54] Descriptions below focus on important physical infrastructure in Hood River County.

[52] Wang Yumei and Bill Burns. "Case History on the Oregon GO Bond Task Force: Promoting Earthquake Safety in Public Schools and Emergency Facilities." National Earthquake Conference. January 2006.
[53] The Hood River County Short-Term Rentals and Second Homes ECONorthwest Study (September 17, 2015)
[54] 2015 Oregon Natural Hazards Mitigation Plan, Region 5 Mid-Columbia Region Profile

Dams

Dam failures can occur at any time and are common. Fortunately most failures result in minor damage and pose little or no risk to life safety.[55] However, the potential for severe damage still exists. The Oregon Water Resources Department has inventoried all dams located in Oregon and Hood River County using the National Inventory of Dams (NID) threat potential methodology.

There is one high hazard dam in Hood River County as well as two others with significant hazard threat potential. The dam with the high hazard threat potential is the Clear Branch Creek Dam (also known as Laurance Lake Dam), Hood River County's largest, which was last inspected in 1989.

Table C.24: Hood River County Dam, reservoir and lake Inventory and Threat Summary

Threat Potential	Number of Dams	Name of Dam	Next Inspection
High	1	Laurance/ Clear Branch Creek Dam (OR 00451) owned by Middle Fork Irrigation District	NSI (Federal dams are not state inspected)
Significant	2	Kingsley/Green Point – Upper No. 2 (OR 00127) Kingsley/Green Point – Lower No. 1 (OR 00128) owned by Farmer's Irrigation District	2019 (upper) 2019 (lower)
Low	4	Badger Lake (Hood River) (OR 00146); natural lake Ketchum (OR 00189) – natural lake bordering Wasco Co. Gehrig Dam No. 1 (OR 00740)? Emil Creek Regional Dam (OR 01653)	2019 2019 2019 2019
Low	n/a	Lost Lake (owned by USFS,) and City of Hood River's storage/distribution system from Lost Lake – owned by City of Hood River (6 million gallon storage)	

Source: Oregon Water Resources Department, Dam Inventory Query, http://apps.wrd.state.or.us/apps/misc/dam_inventory/ ; Retrieved on 8/28/17

Rail Ways

The region's major freight rail provider is the Union Pacific (UP). There are two major rail yards in the region — in The Dalles and Hinkle — operated by UP (Cambridge Systematics, 2014). The Hinkle Yard serves as UP's system yard and locomotive service and repair yard for Oregon and the greater northwest area (Cambridge Systematics, 2014). Amtrak provides

[55] Ibid.

passenger rail service along the Columbia Gorge and eastward via the Empire Builder line.[56] The Mount Hood, an Oregon Short Line Railroad, also runs in Hood River County. [57]

Railroads are major providers of regional and national cargo trade flows. The Union Pacific Line in Hood River County is limited to the stretch of tracks that follow I-84 and the Columbia River on the northern border of the county. The Mount Hood Line runs south along Highway 281 and several other roads from Hood River to Parkdale. Rails are sensitive to icing from winter storms. For industries in the region that utilize rail transport, these disruptions in service can result in economic losses. Rail accidents can also have serious implications for the local communities if hazardous materials are involved.[58] While not necessarily caused by natural hazards, train accidents such as derailments have also been a common, notable incident in recent years. In June, 2016, a train derailment in Mosier, four miles east of Hood River County, crippled transportation throughout the Gorge.[59] Derailments and routine railway sparks can also cause wildfires.

Airports

It is widely recognized that in the event of a natural disaster, public and private airports are important staging areas for emergency response activities. Public airport closures will impact the region's tourism industries, as well as the ability for people to leave the region by air. Businesses relying on air freight may also be impacted by airport closures.[60]

Hood River County has no commercial service airports, but has two privately owned airports, and two that are publicly owned, including the Ken Jernstedt Airfield (helipad) at the Hood River Fire Department.[61] The Portland International Airport in Portland is the only major commercial service airport near Hood River and surrounding Counties. However a small regional airport, The Dalles Airport, also known as the Columbia Gorge Airport, is located in Dallesport, WA, just across the Columbia River from The Dalles, OR. Larger airports are located in Yakima, WA to the northeast and in Redmond, OR to the southeast. It is likely that these airports would serve a key role in response to a major regional disaster. Access to these airports faces the potential for closure from a number of natural hazards, including wind and winter storms common to the region.[62]

Ports

There are two ports within Hood River County: The Port of Cascade Locks and the Port of Hood River. The Port of Cascade Locks includes industrial land, a marine park, and the Bridge of the Gods, and promotes recreation tourism.[63] The Port of Hood River encompasses

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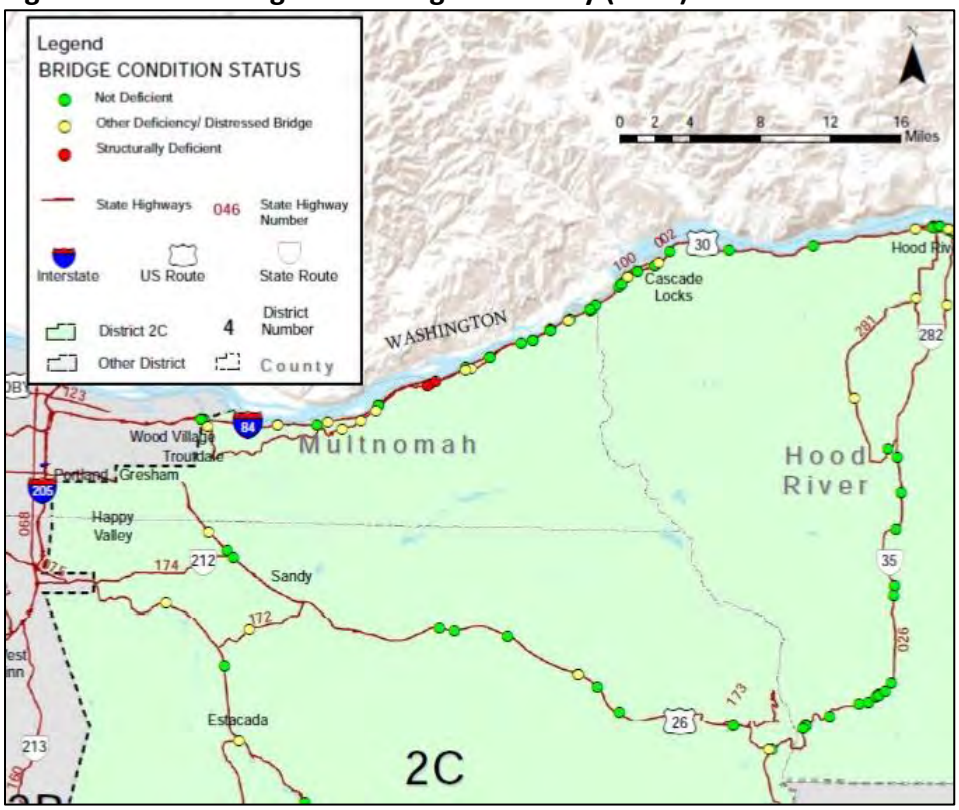
[56] 2015 Oregon Natural Hazards Mitigation Plan, Region 5 Mid-Columbia Regional Profile.
[57] Oregon Department of Transportation, State of Oregon; Oregon Railroads Map, June 2014; http://www.oregon.gov/ODOT/ROW/Documents/railroads.pdf; Retrieved 8/29/17
[58] 2015 Oregon Natural Hazards Mitigation Plan, Region 5 Mid-Columbia Regional Profile.
[59] Hood River County Emergency Manager, Barbara Ayers, Personal Communication, 5/10/18
[60] 2015 Oregon Natural Hazards Mitigation Plan, Region 5 Mid-Columbia Regional Profile.
[61] U.S. Department of Transportation, Federal Aviation Administration, Airports, Oregon, Hood River County, https://www.faa.gov/airports/airport_safety/airportdata_5010/menu/#reports; retrieved on 8/29/17
[62] Columbia Gorge Airport, http://www.columbiagorgeairport.com/index.htm, Home, Aviation Services, and Airport Facts pages; retrieved on 8/29/17
[63] Port of Cascade Locks website, http://portofcascadelocks.org/http://portofcascadelocks.org/.

industrial land, business parks, the Hood River Marina and waterfront area, Hood River Airport, and the Hood River–White Salmon Bridge.[64]

ROADS AND BRIDGES

The region's major expressway is Interstate 84. It runs East/West through Hood River County and is the main passage for automobiles, buses and trucks traveling along the Oregon side of the Columbia River. I-84 is characterized by high volumes of commuters, tourists, and semi-truck traffic, and is the major East-West corridor connecting I-5 to eastern Oregon and adjacent states (see Figure C.7).

Figure C.7: ODOT Region 2C Bridge Inventory (2016)



Source: 2016 Bridge Condition Report, Oregon Department of Transportation; http://www.oregon.gov/ODOT/Bridge/Documents/2016-Oregon-Bridge-Conditions-Report.pdf

Other major highways that service this region include:

- Oregon Route 35 connects I-84 east of the City of Hood River with the communities of Pine Grove, Odell and Mt. Hood before merging with US Highway 26 near Government Camp to the Southwest.
- Oregon Route 281 runs south from US Highway 30 at the City of Hood River, passing through the communities of Windmaster and Parkdale before merging with Oregon Route 35 at the community of Mt. Hood.

[64] Portland Hood River website, http://www.portofhoodriver.com/http://www.portofhoodriver.com/.

- Oregon Route 282, the Dee Highway, splits from Oregon Route 281 between the City of Hood River and Parkdale, passing through the community of Odell and providing an alternate route to Oregon Route 35.
- US Highway 30 runs East/West along the northern border of Hood River County, sharing the same roadbed with I-84 except for a short section where US 30 travels through the City of Hood River. Much of US Highway 30 is closed – it stops five miles west of Cascade Locks – and does not carry thru-traffic.

Exit 62 on I-84 will be expanded as part of a project conducted by the Oregon Department of Transportation (ODOT). ODOT is currently extending US Highway 30, and as part of construction has closed one lane of I-84 regularly for several years.

Daily transportation infrastructure capacity in the Columbia Gorge region is only moderately stressed by maintenance, congestion, and oversized loads. However peak loads and congestion can materialize during holiday and recreational seasons, as well as during major construction projects. Natural hazard events tend to further disrupt automobile traffic and create gridlock. Congestion on primary roads is of particular concern in periods of natural disaster events and necessary emergency evacuation.[65]

The existing condition of bridges in the region also affects risk from natural hazards. Bridge failure can have immediate and long term implications in the response and recovery of a community. Incapacitated bridges can disrupt traffic and exacerbate economic losses due to the inability to transport products and services in and out of the area, as well as complicate emergency response coordination and services.[66] The Hood River County Public Works Department is responsible for maintenance of 29 bridges around the county (includes 15 National Bridge Inventory (NBI) bridges (20' or longer), and 14 non-NBI bridges and large culverts (less than 20').[67] The Hood River Bridge is considered vulnerable and may not withstand an earthquake event.[68]

Table C.25 demonstrates the condition of bridges in Hood River County; 29% of all bridges exhibit some deficiency. The classification of a distressed bridge does not imply the bridge is unsafe; however in the event of seismic activity these bridges are of higher vulnerability to failure.

Table C.25 Hood River County Bridge Inventory

	Number of Bridges	Distressed bridges	% Distressed
State Owned	45	16	33%
County Owned	15	1	7%
City Owned	0	0	-
Port Owned	2	2	100%
Area Total	66	19	29%

Source: 2015 Oregon Natural Hazards Mitigation Plan, Region 5 Mid-Columbia Regional Profile

[65] 2015 Oregon Natural Hazards Mitigation Plan, Region 5 Mid-Columbia Regional Profile
[66] Ibid.
[67] Hood River County Public Works Department, http://www.co.hood-river.or.us/index.asp?Type=B_BASIC&SEC={BA3D2221-83E1-4F61-B92E-ACF409AD74A1}
[68] Michael McElwee, Port of Hood River Executive Director, Personal Communication 5/16/18

Utility Lifelines

Utility lifelines are the resources that the public relies on daily, (i.e., electricity, fuel and communication lines). If these lines fail or are disrupted, the essential functions of the community can become severely impaired. Utility lifelines are closely related to physical infrastructure, (i.e., dams and power plants) as they transmit the power generated from these facilities. [69]

The network of electricity transmission lines running through the Columbia Gorge region is operated by Pacific Power, which is a division of PacifiCorp, and the Bonneville Power Administration (BPA), the two entities that primarily facilitate local energy production and distribution in the area. Power is delivered at numerous sites throughout the county at BPA and PacifiCorp substations. It is further disseminated into the area through the local utility (Hood River Electric Co-op) distribution lines. The City of Cascade Locks manages and delivers water and electric utilities for the city.

Power Generation

The majority of electrical power in the region is generated through hydropower; these dams are primarily situated on the Columbia River. Hood River County has no power plants, and though there is potential, there are no large wind power installations or other renewable energy facilities located within the county.

Pacific Power

Pacific Power serves customers in Southern Washington, Oregon, Northern California, Eastern Idaho, Utah and Wyoming, including parts of Hood River County and other communities in the Columbia Gorge.[70] Pacific Power manages several substations in Hood River County.

City of Cascade Locks Utility

The City of Cascade Locks purchases electricity directly from The Bonneville Power Administration and serves a 27-mile area on the Columbia River Highway from Wyeth to Bridal Veil, which includes 50 miles of primary transmission line and 10 miles of secondary transmission line.[71]

Hood River County Electric Co-op

Hood River County Electric Co-op, a not-for-profit customer-owned utility company, provides electricity to customers in Hood River County, administering electricity produced by The Bonneville Power Administration. Today, the Hood River Co-op serves approximately

[69] Portland Bureau of Emergency Management, 2012. Portland Local Energy Assurance Plan, http://www.portlandoregon.gov/pbem/article/389162.
[70] Pacific Power website, "About Us," https://www.pacificpower.net/about/cf.html, 8/29/17
[71] History of City of Cascade Locks Electric, City of Cascade Locks website; http://www.cascade-locks.or.us/index.asp?SEC=AA8B30D4-DF28-4AA5-A19D-788D18F9CD6C&DE=05154648-7097-48B6-B5BE-31C0B5F1C1DD&Type=B_BASIC, 5/14/2018

3,500 accounts owned by more than 2,300 members. Delivery of energy is from three BPA points of power delivery through approximately 250 miles of distribution line.[72]

Petroleum and Natural Gas Service

A gas distribution line crosses the Columbia River into Hood River County near the City of Hood River. The distribution line is fed by a larger natural gas transmission line, the Williams Northwest Pipeline that borders the northern bank of the Columbia River in Washington, which is controlled by Cascade Natural Gas.[73] [74] NW Natural Gas also distributes natural gas to communities in Oregon and southwest Washington. They operate a service center in The Dalles, OR, which serves Hood River and surrounding communities. [75]

Most of the natural gas Oregon uses originates in Alberta, Canada, and Avista Utilities owns the main natural gas transmission pipeline.[76] The Gas Transmission Northwest (GTN) pipeline runs through Wasco, Gilliam, Morrow, and Umatilla Counties. [77]These lines may be vulnerable to severe, but infrequent natural hazards, such as earthquakes, which could disrupt service to natural gas consumers across the region.

Petroleum also comes from outside to inside Oregon, providing energy resources. More than 90 percent of Oregon's refined petroleum products come from the Puget Sound area of Washington State. Of note, most of the petroleum used in Oregon is stored on liquefaction prone sediments in Portland.
"Oregon's critical energy infrastructure (CEI) Hub is located in an area with significant seismic hazard. Significant liquid fuel, natural gas and electrical infrastructure and facilities are situated in this relatively small area in Portland. The energy sector facilities in the CEI Hub include: all of Oregon's major liquid fuel port terminals; liquid fuel transmission pipelines and transfer stations; natural gas transmission pipelines; liquefied natural gas storage facility; high voltage electric substations and transmission lines; and electrical substations for local distribution."[78]

Oregon imports the product by pipeline and marine vessels to the CEI Hub before it is distributed throughout Oregon to the end user. In addition, much of NW Natural's natural gas passes through the CEI Hub. (Wang, Bartlett, & Miles, 2012).

The *Oregon Fuel Action Plan* lays out a strategy to bring fuel supplies into the region to support emergency response until regional infrastructure is restored. However, according to the *Oregon Fuel Allocation Guidelines*, fuel within each jurisdiction will be used to support the initial response until an alternate supply can be brought in from outside of the region. State, county, and tribal organizations should know the location and amount of fuel available within their jurisdictions to support initial life-saving functions and begin restoring

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[72] Hood River Electric Cooperative website, https://hrec.coop/about/, 8/22/17
[73] Northwest Power website, http://www.northwest.williams.com/NWP_Portal/downloads.action, 8/29/17
[74] Cascade Natural Gas website, https://www.cngc.com/utility-navigation/about-us, 8/29/17
[75] Northwest Natural Gas website, "About Us" https://www.nwnatural.com/AboutNWNatural/TheCompany/Overview, 8/29/17
[76] Loy, W. G., ed. 2001. Atlas of Oregon, 2nd Edition. Eugene, OR: University of Oregon Press.
[77] 2015 Oregon NHMP, Region 5 Risk Assessment; Liquefied Natural Gas Pipelines Map, http://www.oregon.gov/LCD/HAZ/docs/2015ORNHMP/2015ORNHMPApproved/Approved_2015ORNHMP_11_RA5.pdf
[78] Oregon Resilience Plan, February 2013

critical lifeline services. Without roads to deliver supply, local jurisdictions can expect significant delays in fuel availability from outside of Oregon. (Oregon Department of Energy, 2016). These plans exist at the State level and can be further referenced as needed.

Telecommunications

Telecommunications infrastructure includes television, telephone, broadband internet, radio, and amateur radio (ham radio). Region 5 is part of the Columbia Gorge Operational Area which includes Hood River, Wasco, Sherman, and Gilliam Counties. There is a memorandum of understanding between these counties that facilitates the launching of emergency messages. Counties in these areas can launch emergency messages by contacting the Oregon Emergency Response System (OERS), which in turn creates emergency messages to communities statewide.[79] The County also operates an Emergency Alert System (reverse 911) through email and text services.[80]

Landline telephone, mobile wireless telephone, and broadband service providers serve Region 5. Broadband technology including mobile wireless is provided in the region via five primary technologies: cable, digital subscriber line (DSL), fiber, fixed wireless, and mobile wireless. Internet service is readily available throughout most parts of the region with a smaller number of providers and service types available in the southern parts of the region (south of I-84) (NTIA, n.d.).

Radio is readily available to those who live within Region 5 and can be accessed through car radios, emergency radios, and home sound systems. Radio is a major communication tool for weather and emergency messages. Region 5 has the Columbia Gorge Operational Area for radio transmitters. The Columbia Gorge Operational Area includes Hood River, Wasco, Sherman, and Gilliam Counties in Oregon, and Klickitat and Skamania Counties in Washington.[81] Columbia Gorge Operational Area (Hood River County, 041027) monitors KHRV-FM, 90.1, Hood River, OPB Radio Network PEP Station and monitors KMSW Premiere Satellite FEMA Feed.

Amateur radio, or ham radio, is a service provided by licensed amateur radio operators (hams) and is considered to be a possible, last effort, method of communicating when normal systems are down or at capacity. Radio Amateur Civil Emergency Services (RACES) is a special phase of amateur radio recognized by FEMA that provides radio communications for civil preparedness purposes including natural disasters (Oregon Office of Emergency Management, n.d.). The official ham emergency station call for Region 5 is Hood River County HREOC. [82] The primary backup communications strategy for Hood River County is satellite phones.

Sewage and Landfill

There are four community sewer systems in the county. The Cities of Hood River and Cascade Locks each have a community sewer system, as do the rural unincorporated

[79] 2015 Oregon NHMP, Mid Columbia Region 5 Risk Assessment
[80] Hood River County Emergency Manager, Barbara Ayers, personal communication 5/14/2018
[81] The Oregon State Emergency Alert System Plan, Version 14, February 22, 2017, http://www.sbe76.org/EAS-Plan.html, 8/29/17.
[82] 2015 Oregon NHMP, Mid Columbia Region 5 Risk Assessment

communities of Parkdale and Odell. The City of Hood River has over 40 miles of sewer mains and appurtenant facilities; and it has a wastewater treatment plant located at the west end of the Port of Hood River. The plant capacity is 3 million gallons per day.[83] The City of Cascade Locks has a wastewater treatment plant located about 1,000 feet west of Herman Creek on the south bank of the Columbia River. A draft City of Cascade Locks, Oregon, Wastewater Treatment Facilities Plan 2017 has been published and provides considerable detail.[84]

Hood River County residents are served by Hood River Garbage, Inc. Hood River Garbage picks up garbage and recycling.[85] Recyclables are primarily sent to a facility in Vancouver, WA; however, facilities throughout the Portland metropolitan area are used as needed; garbage is brought to the Northern Wasco County Sanitary Landfill.[86]

Drinking Water

The drinking water supply in Region 5 is drawn from a combination of surface, well, and spring sources. Surface water is drawn from rivers and smaller tributaries. These surface water sources are often backed up by groundwater that is drawn from an aquifer when surface water levels get low, especially in summer months. Water quality in the region's municipal supply is high. Chemical and fuel spills are a concern when surface waterways intersect with or parallel major roadways. Water quality could be threatened as older or damaged well infrastructure may not filter coliform and other bacteria as effectively as newer infrastructure. The water supply system in Hood River County includes 24 Public Water Systems, all of which are located in areas of steep terrain. The County's only well is located in the City of Cascade Locks. Much of the water infrastructure in Hood River County was constructed in the 1960's and, while sufficient, may not be resilient to hazard damage. More information on the water systems in Hood River County can be found on the Oregon Public Health website, Drinking Water Data Online.

In 2014 and years hence, the Hood River County Health Department conducted a thorough survey assessing the emergency response and preparedness capacities of the community water systems in the County. These assessments discovered a lack of capacity to communicate quickly and efficiently to the public in the event of a supply disruption. They also discovered that many Emergency Response plans for County water districts are out of date or not coordinated with the Hood River County Emergency Operations Plan.

In 2017, a pipe break led to the public boil notice for water coming from the Crystal Springs water district. During that instance, district operators discovered they lacked the personnel and communications methods to quickly and efficiently deliver water notices to the public. Furthermore, the water systems are not monitored through telemetry, but rely on human observation to discover system failures.

Rural residents draw water from surface water, groundwater wells, or springs. Surface water is usually used for irrigation, and wells are used as backup source. Groundwater wells serve

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[83] Public Works website, http://ci.hood-river.or.us/pageview.aspx?id=19165, 8/29/17
[84] Anderson Perry & Associates, Inc., http://www.cascade-locks.or.us/vertical/sites/%7BCBA69777-87EC-4CCE-94AE-A171F7FE7A86%7D/uploads/Draft_WWFP_080717.pdf, 8/29/17
[85] Hood River Garbage Inc. Home page, http://www.hoodrivergarbage.com/home, 8/29/17
[86] Jim Winterbottom, Hood River Garbage, Inc., personal communication, August 30, 2017

residential needs. In rural areas storage ponds or small dams are sometimes created on private land to provide additional on-site drinking water storage. Water quality for rural residents is primarily affected by nitrates from agricultural activities and by low flow levels, which can increase the density of pollutants.

Surface sources for drinking water are vulnerable to pollutants caused by non-point sources and natural hazards. An example of non-point source pollution is storm water runoff from roadways, agricultural operations, timber harvest, erosion, and sedimentation. Landslides, flood events, earthquakes, and liquefaction can also cause increased erosion and sedimentation in waterways. Landslides associated with winter storms have impacted County water districts in the past.

Underground water supplies and aging or outdated infrastructure — such as reservoirs, treatment facilities, and pump stations — can be severed during a seismic event. Rigid materials such as cast iron may snap under the pressure of liquefaction. More flexible materials such as polyvinyl chloride (PVC) and ductile iron may pull apart at joints under the same stresses. These types of infrastructure damages could result in a loss of water pressure in municipal water supply systems, limiting access to potable water. This can lead to unsanitary conditions that may threaten human health. Lack of water can also impact industry, such as the manufacturing sector. Moreover, if transportation infrastructure is impacted by a disaster event, repairs to water infrastructure will be delayed.[87]

Critical Facilities

Critical facilities are defined as structures and institutions necessary, in the community's opinion, for response to and recovery from emergencies. Critical facilities must continue to operate during and following a disaster to reduce the severity of impacts and accelerate recovery.[88]

These would include, but not be limited to:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, and/or chemically-reactive materials
- Hospitals, nursing homes, and housing likely to have occupants who may not be sufficiently mobile to avoid injury or death during an emergency
- Police stations, fire stations, vehicle and equipment storage facilities, and EOCs that are needed for emergency response activities before, during, and after the event
- Public and private utility facilities that are vital to maintaining or restoring normal services to affected areas before, during, and after the event

Other structures or facilities the community identifies as meeting the general criteria above.

Critical facilities are those facilities that are essential to government response and recovery activities (e.g., hospitals, police, fire and rescue stations, school districts and higher education institutions).[89] The interruption or destruction of any of these facilities would

[87] 2015 Oregon Natural Hazards Mitigation Plan, Mid Columbia Region 5 Risk Assessment
[88] *2015 Hazard Mitigation Assistance (HMA) Guidance* document. HMA is the umbrella that includes the PDM, HMGP, and FMA grant programs.
[89] 2015 Oregon Natural Hazards Mitigation Plan, Region 5 Mid-Columbia Regional Profile.

have a debilitating effect on incident management. Critical facilities in Hood River County are identified in Table C.26 below.

Table C.26: Hood River County Critical Facilities

Structure	Address	City	Type	Comments
Gorge Radio-Bicoastal Media Columbia River	1190 22nd Street	Hood River	Communications	
Hood River County 911	601 State Street, 3rd floor	Hood River	Communications	Essential services - County
CenturyLink (phone and internet - hub- County bldg)	601 State Street, 2nd floor	Hood River	Communications	Essential services - County - 911 and EOC dependency
BPA Power lines and Towers	Just west of Hood River County line	Multnomah County	Electric	Lifeline to County and region
BPA dam and hydroelectric plant	Just west of Hood River County line	Mt. Hood	Dam and electric	Critical to power grid and vulnerable in earthquake
Pacific Power	Substations 12th and 13th Street	Hood River	Electric	
Hood River Electric Cooperative	3521 Davis Street	Hood River, Odell, Parkdale	Electric	Lifeline to Odell
Fish Food Bank	Tucker Rd; Odell	County	Food	
Northwest Natural Gas	Various gas lines and meters across community	County, Hood River, Cascade Locks	Fuel	volatile gas lines in emergencies
Ace Hardware, Hood River Supply	3831 Eagle Loop	County (Odell)		
Chevron Odell Gas Station	3387 Odell Highway	County (Odell)	Fuel	
Pine Grove Pit Stop	2385 OR-35	County (Pine Grove)	Fuel	
Hood River County Public Works (City/County fuel supply)	918 18th Street	Hood River	Fuel - emergency services	essential service
76 gas station	616 Industrial St # 401	Hood River	Fuel	
Valero gas station	101 N 1st St	Hood River	Fuel	

Structure	Address	City	Type	Comments
Chevron downtown	2555 Cascade Ave	Hood River	Fuel	
Astro fuel	214 Front Street	Hood River	Fuel	
Carson Oil	2660 Dock Road	Hood River	Fuel	
Harvey's Texaco	3450 Cascade Ave	Hood River	Fuel	
Chevron waterfront	949 E Marina Dr	Hood River	Fuel	
Nobi's Gas Station	1380 Tucker Road	Hood River	Fuel	
County Administration, Board of Commissioners, EOC	601 State Street	Hood River	Government	essential services
WyEast Fire District (2 stations - 1 in Odell, 1 in Pine Grove)	2995 Van Horn Drive, 3431 Odell Hwy	Unincorporated	Government	
Hood River County Sherriff's Office, Courthouse, parole and probation, juvenile, D.A.	309 State Street	Hood River	Government	essential services
Parkdale Fire District (3 fire stations - 2 in Mt. Hood, 1 in Dee)	4895 Baseline Drive	Mt. Hood	Government	essential service
Back-Up EOC: Intertribal Fisheries Enforcement	4270 WestCliff Drive	Hood River	Government	essential service
County Public Works	918 18th Street	Hood River	Government	
Westside RFPD -1	4250 Barrett Drive	Hood River	Government	
Westside RFPD -2	1185 Tucker Road	Hood River	Government	
Wy'East Middle School	3000 WyEast Road	County (Odell)	School	Possible shelter site
Hood River Airport		County	Transportation	
Bonneville Dam	n/a	Cascade Locks	Infrastructure	
The Dalles Dam	n/a	The Dalles	Infrastructure	
Union Pacific Railway	waterfront adjacent to I-84 Countywide	County	Transportation	Extreme danger if combusted or derailed
Hood River-White Salmon Interstate Bridge	1000 E Port Marina Drive	Hood River	Transportation	Gas line on bridge
Bridge of the Gods		Cascade Locks	Transportation	
I-84	Managed by ODOT	County	Transportation	Lifeline
Highway 35	Managed by ODOT	County	Transportation	Lifeline

Structure	Address	City	Type	Comments
Crystal Springs Water	3006 Chevron Drive	Odell	Water	
Ice Fountain Water	1185 Tucker Road	Hood River	Water	
Odell Water	3641 Davis Drive	Odell	Water	
Parkdale Water		Parkdale	Water	
Dee Bridge	Lost Lake Road	County	Water	City of HR main water line attached to bridge
WA Highway 14 (Managed by WSDOT)	SR 14 Klickitat County, WA	Washington	Transportation	Lifeline. Critical transportation corridor if I-84 closes
	City of Cascade Locks			
City of Cascade Locks Power Utility (2 substations)	140 SW Wanapa Street	Cascade Locks	Electric	essential service
Bridge of the Gods (Port of Cascade Locks)				lifeline
Bonneville Power Administration			Electric	essential service
Columbia Market	450 Wa Na Pa Street	Cascade Locks	Food	
Thunder Island Brewery	515 SW Portage Rd	Cascade Locks	Food	
Chevron Gas Station	437 Wa Na Pa Street	Cascade Locks	Fuel	
Shell Gas Station	425 Wa Na Pa Street	Cascade Locks	Fuel	
Cascade Locks Fire District	25 Wa Na Pa Street	Cascade Locks	Government	essential service
City Hall, Public Works	140 SW Wanapa Street	Cascade Locks	Government	essential service
Port Facilities	427 SW Portage Road	Cascade Locks	Government	essential service
City Water and Sewer	140 SW Wanapa Street	Cascade Locks	Sanitary	essential service
Marine Park	427 SW Portage Road	Cascade Locks	Government	
Historical Houses	427 SW Portage Road	Cascade Locks	Cultural	
ODOT Cascade Locks station			Government	essential service
	City of Hood River			
Hood River Distillery	660 Riverside Drive	Hood River	Business	Extreme danger if combusted

Structure	Address	City	Type	Comments
Ace Hardware, Hood River Supply	1945 12th St	Hood River	Fuel, hardware	Lifeline fuel and supplies
Astro Gas Station	214 Front Street	Hood River	Fuel	
Valero Gas Station	101 N 1st Street	Hood River	Fuel	
Shell Gas Station	1691 12th Street	Hood River	Fuel	
Shell Gas Station	1108 E Marina Drive	Hood River	Fuel	
Height's Fuel Stop	1413 12th Street	Hood River	Fuel	
Chevron Gas Station 1	949 E Marina Drive	Hood River	Fuel	
Chevron Gas Station 2	2555 Cascade Avenue	Hood River	Fuel	
Hood River-White Salmon Interstate Bridge	1000 E Port Marina Drive	Hood River	Transportation	Lifeline. Gas line on bridge; can strand commuters and motorists if closed
Hood River County Public Works (City/County fuel supply)	918 18th Street	Hood River	Fuel - emergency services	essential service
Harvey's Texaco Gas Station	3450 Cascade Ave	Hood River	Fuel	
Union 76 Gas Station	1650 Tucker Road	Hood River	Fuel	
76 gas station	616 Industrial St # 401	Hood River	Fuel	
Valero gas station	101 N 1st St	Hood River	Fuel	
Chevron downtown	2555 Cascade Ave	Hood River	Fuel	
Astro fuel	214 Front Street	Hood River	Fuel	
Carson Oil	2660 Dock Road	Hood River	Fuel	
Harvey's Texaco	3450 Cascade Ave	Hood River	Fuel	
Chevron waterfront	949 E Marina Dr	Hood River	Fuel	
Hood River Police, Hood River City Council and Administration	211 2nd Street	Hood River	Government	Essential services

Structure	Address	City	Type	Comments
Port Facilities - Administration, Marina	1000 E Port Marina Drive	Hood River	Government	Liquefaction area. What port facilities are most critical?
City of Hood River Fire	1785 Meyer Parkway	Hood River	Government	Essential services
Hood River City Hall	211 2nd Street	Hood River	Government	Essential services
City Public Works, Building water and sewer	1200 18th Street	Hood River	Government	Essential services
Columbia Gorge Community College - Hood River	1730 College Way	Hood River	Government	Possible shelter site
Providence Hood River Memorial Hospital	810 12th Street	Hood River	Health	Essential services
One Community Health and Radio Tierra	849 Pacific Ave	Hood River	Health, Communications	Bilingual outreach and community hub
Hood River Garbage and Recycling	3440 Grignard Drive	Hood River	Sanitary	
Hood River Middle School	1602 May Street	Hood River	School	Possible shelter site
Hood River Waste Water Plant	818 Riverside Drive	Hood River	Sewage	Liquefaction area; essential services
City of Hood River Water District (Public Works)	1200 18th Street	Hood River	Water	Essential services
Safeway	2249 Cascade Avenue	Hood River	Food	Lifeline
Rosauer's Supermarket	1867 12th Street	Hood River	Food	Lifeline
Walmart	2700 Wasco Street	Hood River	Food	Lifeline in emergencies
Juanita's Market	1401 13th Street	Hood River	Food	
Mercado Guadalajara	1802 12th Street	Hood River	Food	

Source: Hood River County NHMP Steering Committee, March 2018

The County Courthouse, Public Works, Forestry, and County Business Administration Buildings are all located in the City of Hood River. The Hood River County 911 Office is located at the County Administrative Building.

Hood River County is served by the Hood River Police Department and the Hood River County Sheriff's Office. The Oregon State Police Department also provides services throughout the County. There are five fire response districts of various geographical extent

and coverage operating in Hood River County. The Oregon Department of Forestry (ODF) and the US Forest Service (USFS) also maintain fire equipment and personnel in the County during the summer fire season. All five fire districts have mutual aid agreements with each other, ODF and other state agencies. For a more thorough description of Hood River County fire response capacity, see the Hood River County Wildfire Protection Plan.[90]

Dependent Facilities

In addition to the critical facilities mentioned in Table C.20, there are other vital services delivered in the county that must be accounted for when planning for natural disaster response and recovery. Assisted living centers, skilled nursing facilities, independent living apartments, and mental health facilities are important to identify within a community because of the dependent nature of the residents. Such facilities can also serve as secondary medical facilities during an emergency, as they are equipped with nurses, medical supplies and beds. Seven vital services facilities are located in Hood River County, all in the City of Hood River.

Counseling services are offered at the Mid-Columbia Center for Living and the Providence Hood River Memorial Hospital, both located in the City of Hood River. Providence Hood River Memorial Hospital is a full-service, critical-access hospital with a 24-hour Emergency Department serving five counties in the Columbia River Gorge. The hospital has 540 employees according to the 2011 statistics on their website.[91] Mid-Columbia Center for Living is a non-profit treating mental health and substance addiction issues, and would likely be involved in disaster response.

Correctional Facilities

Hood River County has partnered with Wasco, Gilliam and Sherman Counties to form a regional entity called the Northern Oregon Regional Corrections Facilities (NORCOR) which services the four counties with both adult corrections and juvenile detention facilities. Both located in The Dalles, OR, 25 miles east of Hood River [92] Correctional facilities are built to code to resist structural failure and typically have back up power to sustain regulation of inmates following the immediate event of an emergency, though logistical planning becomes more of a challenge when the impacts of the event continue over a long duration.

Synthesis

Built capacity refers to the built environment and infrastructure that supports a community. The various forms of built capital mentioned throughout this section play significant roles in the event of a disaster. Physical infrastructure, including utility and transportation lifelines, are critical to maintain during a disaster and are essential for proper functioning and response. Community resilience is directly affected by the quality and quantity of built

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[90] Hood River County Wildfire Protection Plan, 2013, page 158 file:///Z:/Natural%20Hazards%20Mitigation%20Plan/2018%20Hood%20River%20Update/HRC%20Wildfire%20Protection%20Plan%202013.pdf

[91] Providence Overview webpage; http://oregon.providence.org/location-directory/p/providence-hood-river-memorial-hospital/overview/

[92] Hood River County Sheriff's Office, http://www.hoodriversheriff.com/what-we-do/jail-information/ and http://www.norcor.co/; retrieved 8/22/17

capital and lack of or poor condition of infrastructure can negatively affect a community's ability to cope, respond and recover from a natural disaster. Initially 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 immediate resources.

Hood River County could be easily isolated by a closure of I-84. Many of the residential and public structures within the County were built prior to updated building codes, and may be compromised during an earthquake event. Several bridges, including major interstate bridges, are not seismically sound. Both interstate bridges have improvement or replacement plans to become seismically sound over the next fifteen years. Smaller road and alternative highways may provide service access outside of the City; however they become difficult to navigate in winter conditions and may not support major evacuation.

Capital Improvements may be funded through a variety of sources including use of State Highway Funds, collected Systems Development Charges (SDC), Surface Transportation Program funds, or Statewide Transportation Improvement Program funds. While each funding source is accompanied by certain restrictions or limitations, mitigation emphases can be incorporated into these projects.

Community Connectivity Capacity

Community Connectivity is a major strength of Hood River County. The County includes many active non-profits and social service agencies who work well together. Public – private partnerships have demonstrated effective collaboration and support in recent incidents and emergencies.

Social Organizations

Social organizations play an important role in promoting hazard mitigation and in aiding recovery efforts following a natural disaster. These organizations are uniquely suited to reach vulnerable populations, which have a tendency to be more at-risk in the event of a disaster.

Below are a few methods that social organizations located throughout Hood River County can use to become involved in hazard mitigation.

- Education and Outreach – Organizations can partner with the community to educate the public or provide outreach assistance and materials on natural hazard preparedness and mitigation.
- Information Dissemination – Organizations can partner with the community to provide and distribute hazard-related information to target audiences.
- Plan/Project Implementation – Organizations may have plans and/or policies that may be used to implement mitigation activities or the organization can serve as the coordinating or partner organization to implement mitigation actions.

Cultural and Historic Resources

Cultural relates to the ideas, customs, and social behaviors of a society. Historic is significant, notable, and newsworthy. Historic and cultural resources provide residents with

a sense of belonging and can be used to teach current residents about the histories and lives of past residents.

Historic Places

The National Register of Historic Places is an official registry for the preservation of historic and cultural resources.[93] The National Register of Historic Places lists all types of facilities and infrastructure that help define a community. Table C.27 categorizes the 36 different National Historic Sites located throughout Hood River County by their distinction and function. Of note, historic structures are usually structurally fragile and unreinforced. The Oregon State Historic Preservation Office manages and administers programs to protect Oregon's historic and cultural resources.[94]

Table C.27: National Register of Historic Sites in Hood River County

Type of Structure	Number of Structures
Parks	1
Cabins, Estates, Farms, Houses, Huts, Lodges, Log Cabins	15
Banks	2
Ranger Stations	1
Hotels	5
Churches	-
Schools	3
Historic Districts	2
Buildings, Halls, City Structures	7
Total	**36**

Source: National Register of Historic Places - https://npgallery.nps.gov/NRHP/SearchResults/

Libraries and Museums

Libraries and Museums are other facilities which a community can use to stay connected. The Hood River Library is the main facility in the county; with their main facility in the City of Hood River and satellite facilities in Cascade Locks and Parkdale. These facilities serve a critical function in maintaining a sense of community; library buildings should also be considered as a common place for members of communities to gather during a disaster.

The Hood River County Library District, a special district, was created by a vote of the citizens of Hood River County on November 2, 2010 following the closure of the Hood River County Library, a department of Hood River County. The Library District is an independent unit of local government dedicated to library operation in Hood River County and is governed by an independent, unpaid Board of Directors elected by the local community.

93 https://npgallery.nps.gov/NRHP/
94 http://www.oregon.gov/oprd/HCD/SHPO/Pages/index.aspx

The History Museum of Hood River County, located in the City of Hood River, is an important source of history.[95] The museum is also overseen by a private Board of Directors, with some funding from Hood River County, and has three stated purposes: to hold in trust a collection of artifacts and documents relevant to Hood River County heritage, share the stories of these items through education, exhibits and discussion, and expand the understanding of Hood River County's heritage as it relates to the county's past, present and future.[96]

Community Stability

RESIDENTIAL GEOGRAPHIC STABILITY

Geographic stability often results in a feeling of connectedness to one's community. A person's place attachment refers to this sense of community and can often magnify efforts to help revitalize a community.[97] Those who have been in one place for a while are more likely to help with hazard mitigation efforts. Hood River has a high population of seasonal residents and a growing population of temporary renters, but the majority of residents do exhibit high residential stability.

HOMEOWNERSHIP

Another measure of community stability and place attachment is homeownership. Homeownership is an indicator that residents will most likely return to a community post-disaster, as these people are economically and socially invested in the community. Similarly, homeowners are more likely to take necessary precautions in protecting their property, Hood River County's home ownership rate is close to other counties in the region, but notably higher than the state average.

Synthesis

Community connectivity capacity places a strong emphasis on social structure, trust and norms, and the cultural resources within a community. In terms of community resilience, these emerging elements of social and cultural capital will be drawn upon to stabilize the recovery of the community. Hood River County demonstrates an active and engaged community spirit through volunteer groups, political engagement, and diverse cultural institutions. Hood River County residents typically exceed state levels of voter turnout, regional stability and regional homeownership, suggesting that the county is supporting its residents to build more resilient and better prepared communities, making them more likely to return in the event of a disaster.

Political Capital Capacity

Government Structure

Hood River County is governed by the Board of Commissioners and a home rule charter. The County Administrator's Office works for the Board of Commissioners to facilitate service

[95] The History Museum of Hood River County https://www.hoodriverhistorymuseum.org/; retrieved on 8/22/17
[96] Ibid
[97] Susan Cutter, Christopher Burton, and Christopher Emrich, "Disaster Resilience Indicators for Benchmarking Baseline Conditions," Journal of Homeland Security and Emergency Management 7, no. 1 (2010): 9.

delivery in all county programs. The County Administrator serves as the Chief Executive Officer of the county and is responsible for providing overall direction to county departments and programs consistent with the policy established by the Board of Commissioners. The Board of Commissioners has five seats, including a chair and representatives from four county districts. All Commissioners are part time, and all are elected positions. The Board of County Commissioners normally meets on the third Monday of each month at 601 State Street in the City of Hood River to conduct county business.

The building at 601 State Street houses many of the departmental offices for Hood River County including the County Administrator, 911, Emergency Management/Emergency Operations Center (EOC,) Community Development, Budget and Finance, Human Resources, Records and Assessment, Countywide Century Link communications hub and space for public meetings.

The County Courthouse at 301 State Street houses Hood River Sherriff's Office, State offices for the Circuit Court, District Attorney, the Juvenile Department, Community Corrections Department, Hood River County Prevention Dept.,

Hood River County Public Works, Parks and Building Services and Forestry departments are located in Hood River in separate buildings at 918 18th street,[98] co-located with Hood River City Public Works.

Emergency Management, Sheriff's Office, Hood River Administration and Board of Commissioners (BOCC) are responsible to ensure that essential countywide services are restored quickly after an emergency or disaster according to its County COOP (Continuity of Operations) plan.

Beyond this, Community Development and all County departments have some degree of responsibility in building overall community resilience. Each plays a role in ensuring that the county functions after an emergency or disaster and the needs of the population are met after an incident. Some divisions and departments of Hood River County government that have a more prevalent role in hazard mitigation include:

County Administrator's Office: The County Administrator's Office works with the Board of Commissioners to facilitate service delivery across county departments and programs. The County Administrator serves as the Chief Executive Officer of the county and is responsible for providing overall direction consistent with the policy established by the Board of Commissioners and also oversees Budget & Finance and Human Resources as well as Department Directors that serve as essential support and deliver community services in emergencies.

Sheriff's Office: The Sheriff's Office provides public safety services, primarily law enforcement services throughout Hood River County with the exception of the City of Hood River. The Office oversees Patrol (including marine), Criminal Investigations, Animal Control, 911 Communications, Emergency Management and Search and Rescue and serves as Incident Command in the event of emergencies and disasters.[99]

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[98] Hood River County Website, County Administrator's Office retrieved 8/22/17 http://www.co.hood-river.or.us Hood River County Prevention Department, http://www.co.hood-river.or.us/index.asp?Type=B_BASIC&SEC=BF4EF44C-F1DD-4D37-8DCC-21B1A8001C2E

[99] Hood River County Sherriff Office - http://www.hoodriversheriff.com/ (retrieved 8/22/17)

Emergency Management: Hood River County's Emergency Management coordinates agencies and communities preparedness, mitigation, response and recovery for all natural and man-made emergencies and disasters. This division recruits and manages staff for the EOC and serves as direct support and coordination for Incident Command, and offers direct communication to state (OEM- Oregon Office of Emergency Management) and federal (FEMA) emergency response agencies. This division is state/federal EMPG funded. The EOC coordinates activities to mitigate, prepare for, respond to and recover from major emergencies or disasters for all cities and communities in the County. The County Sheriff's Office and the County Administrator administer the Emergency Management program. The County Emergency Manager manages the EOC team. The Emergency Management system and EOC includes cities, service districts, volunteers, nonprofits, schools, government agencies at all levels and other organizations with emergency responsibilities collaboratively serving to prioritize county needs and request additional emergency support when local services are overwhelmed.

Public Works: County's Public Works performs routine road and bridge maintenance; emergency response to road hazards and disasters; engineering; surveying; regulation, inspection and administration of work and development within or associated with the public road right of way; fleet management. The department manages construction and maintenance of 225 miles of roadway, 29 bridges and culverts, signs and guardrails, including pavement maintenance, gravel road grading, ditch and culvert cleaning, brushing, snow and ice removal, bridge maintenance, sign maintenance, ditch cleaning, and tree trimming efforts. In 2018 and 2019, the Public Works Department will be mapping culverts to develop a culvert replacement plan. The Public Works Department and its employees have important information and can help to prioritize projects for mitigation and should be a key partner in implementation as well.[100]

Public Health: Specialized health and nursing staff helps prevent disease, injury, premature death, and disability; promoting healthy lifestyles, behaviors and environment. The team also responds to disasters, disease outbreaks and epidemics supporting the EOC and County Administration and local health care needs and facilities. Furthermore, the state-funded Health Security, Preparedness and Response Program (HSPRP) develops plans and procedures to better prepare local communities to respond, mitigate, and recover from all public health emergencies.[101]

Fair Grounds: Serves as a year round entertainment venue but is used as a staging site for fire response efforts and could be a vital emergency shelter following a disaster. Includes animal housing; large pens; infrastructure assets; office buildings and community meetings areas as well as large open fields for staging areas.

Community Development: The planning department promotes economic prosperity and diversity while maintaining the county's environmental quality and is primarily responsible for comprehensive land use planning and zoning in Hood River County, as well as for county building codes, code compliance, economic development, Geographical Information Technology (GIS), information technology, and veterans services. The department's policies give a direction to planning, establish priorities for action, serve as a basis for future

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[100] Hood River County Website, Departments, Public Works - http://www.co.hood-river.or.us/index.asp?SEC=BA3D2221-83E1-4F61-B92E-ACF409AD74A1&Type=B_BASIC (retrieved 8/22/17)

[101] Hood River County Health Department - http://www.co.hood-river.or.us/index.asp?SEC=AF40862A-8B0E-4107-B2B4-956029C71941&Type=B_BASIC; retrieved 8/22/17

decisions, provide a standard by which progress can be measured, and promote a sense of community for an improved quality of life.[102]

Hood River County Prevention Department: receives and manages grant resources to help children and families in the community. They offer bilingual services and support the EOC as staff in emergencies. Because this department is in frequent contact with families and children, often thought of as vulnerable populations due to increased sensitivity to the impacts of hazard incidents, it should be a natural partner in mitigation actions for outreach efforts and to build the county's awareness of the needs of children and families.

Financial Capacity

Hood River County experiences chronic underfunding; most departments are operating with limited staff and resources. The County relies on state or federal funds for operations; these funds are often allocated to specific purposes (Sherriff's office, forestry, planning), limiting applicability to mitigation projects. Local taxes and fees are limited by popular vote. The financial resources available to Hood River County are listed below.

Table C.28 Hood River County Financial Resources

Financial Resources	Effect on Hazard Mitigation
Capital Improvements project funding (State Highway Funds, SDC feeds, Surface Transportation Program funds, Statewide Transportation Improvement Program funds)	Mitigation components can be incorporated into capital improvement projects
Authority to levy taxes for specific purposes	Must be approved through public process; used to fund school retrofits and replacements
Impact fees for new development	Used for Public Works, include mitigation related maintenance
Community Development Block Grant	Funds county wide operational projects
Federal funding programs	Potential funding source for mitigation projects; county has received homeland security grants for preparedness, including the EMPG
State funding programs	Funds Emergency Management half time position, maintains parks and forests, funds sheriff's office; Seismic Retrofit Grant Program has been used to retrofit fire departments (Business Oregon grant)

Source: Hood River County NHMP Steering Committee, April 2018

Personnel

Hood River County staff is versatile. Staff is trained on natural hazards and mitigation to the extent possible given workloads and training resources.

[102] Hood River County Community Development; http://hrccd.co.hood-river.or.us/about-us/department-overview/;retrieved 8/22/17

Table C.29 Hood River County Staff and Personnel

Staff/Personnel Resources	Department
Planning Commission	Volunteer Committee
Mitigation Planning Committee	Volunteer Committee
Chief Building Official	Community Development
Emergency Manager	Sherriff's Office, manages all emergency management related work and public outreach, including grant writing and volunteer coordination
Community Planner with knowledge of land development and management practices	Community Development
Civil Engineer with knowledge of natural hazards	Public Works
Personnel skilled in GIS	Community Development

Source: Hood River County NHMP Steering Committee, April 2018

Education and Outreach

Hood River County maintains a strong education and outreach focus. Numerous citizen groups and non-profit (including the Hood River County Watershed Group, The Next Door, Gorge Grown Food Network, and Oregon Health Authority), as well as regional and state agencies (Columbia River Intertribal Fish Commission, Oregon Department of Forestry, US Forest Service) prioritize outreach including emergency preparedness, mitigation, and environmental protection. Hood River County is Firewise Community certified, and local fire districts regularly distribute preparedness and mitigation information.

The Emergency Management department runs ongoing public education programs focused on personal preparedness, business preparedness, evacuation planning, and fire safety. Public Health agencies, fire districts, Red Cross, and Oregon State University also implement public education programs regarding preparedness and personal mitigation. The social media webpage focusing on public safety have over 8000 followers, a third of the County population.

Public-private partnerships focusing on the "whole city" approach have been leveraged to create a thriving volunteer program. One result of these partnerships was 30 volunteers every day for two weeks during the 2017 Eagle Creek Fire. As of this 2018 NHMP update, efforts are underway to map food and fuel resources available throughout the County in the event of highway closures.

Regulatory Context: Oregon Statewide Planning Goal 7

Since 1973, Oregon has maintained a strong statewide program for land use planning, which is based on a set of 19 statewide planning goals that express the state's policies on land use and related topics, such as citizen involvement, land use planning, and natural resources.

Most of the goals are accompanied by "guidelines" or suggestions about how a goal may be applied. Oregon's statewide goals are achieved through local comprehensive planning. State law requires each city and county to adopt a comprehensive plan and the zoning and land-division ordinances needed to put the plan into effect. The local comprehensive plans must be consistent with the statewide planning goals. Plans are reviewed for such consistency by the state's Land Conservation and Development Commission (LCDC). When LCDC officially approves a local government's plan, the plan is said to be "acknowledged." It then becomes the controlling document for land use in the area covered by that plan.

STATEWIDE PLANNING GOAL 7

Goal 7: Areas Subject to Natural Disasters and Hazards has the overriding purpose to "protect people and property from natural hazards." Goal 7 requires local governments to adopt comprehensive plans (inventories, policies and implementing measures) to reduce risk to people and property from natural hazards. Natural hazards include floods, landslides, earthquakes, tsunamis, coastal erosion, and wildfires.

To comply with Goal 7, local governments are required to respond to new hazard inventory information from federal or state agencies. The local government must evaluate the hazard risk and assess the:

- frequency, severity, and location of the hazard;
- effects of the hazard on existing and future development;
- potential for development in the hazard area to increase the frequency and severity of the hazard; and
- types and intensities of land uses to be allowed in the hazard area.

Local governments must adopt or amend comprehensive plan policies and implementing measures to avoid development in hazard areas where the risk cannot be mitigated. In addition, the siting of essential facilities, major structures, hazardous facilities and special occupancy structures should be prohibited in hazard areas where the risk to public safety cannot be mitigated. The state recognizes compliance with Goal 7 for coastal and riverine flood hazards by adopting and implementing local floodplain regulations that meet the minimum National Flood Insurance Program (NFIP) requirements.

Goal 7 Planning Guidelines

In adopting plan policies and implementing measures for protection from natural hazards, local governments should consider:

- the benefits of maintaining natural hazard areas as open space, recreation, and other low density uses;
- the beneficial effects that natural hazards can have on natural resources and the environment; and
- the effects of development and mitigation measures in identified hazard areas on the management of natural resources.

Local governments should coordinate their land use plans and decisions with emergency preparedness, response, recovery and mitigation programs.

Goal 7 Implementation Guidelines
Goal 7 guides local governments to give special attention to emergency access when considering development in identified hazard areas.

- Consider programs to manage storm water runoff to address flood and landslide hazards.
- Consider non-regulatory approaches to help implement the goal.
- When reviewing development requests in high-hazard areas, require site specific reports, appropriate for the level and type of hazard. Reports should evaluate the risk to the site, as well as the risk the proposed development may pose to other properties.
- Consider measures exceeding the National Flood Insurance Program.

Existing Plan & Policies

Communities often have existing plans and policies that guide and influence land use, land development and population growth. Whenever possible, the Hood River County plans and policies seek and take advantage of opportunities to integrate hazard information and risk.

The Hood River County Natural Hazards Mitigation Plan includes a range of recommended action items that, when implemented, should reduce the county's vulnerability to natural hazards. Many of these recommendations are consistent with the goals and objectives of the county's existing plans and policies. Linking existing plans and policies to the Natural Hazards Mitigation Plan helps identify what resources already exist that can be used to implement the action items identified in the Plan. The following are a list of plans and policies already in place in Hood River County:

- Hood River County Comprehensive Land use Plan
    - Adopted: February 21, 1984, Amended: September 2011
- Hood River County Emergency Operations Plan
    - Original Release: 2006, Updated: December, 2015
    - Cities of Cascade Locks and Hood River also adopted in August 2012
- Hood River County Continuity of Operations Plan
    - Adopted: August 2015
- Hood River County Hazard Identification and Vulnerability Analysis
    - Developed: November 2011 (Updated with information and analysis from the Hazard Annexes and Risk Assessment sections of this Natural Hazards Mitigation Plan)
- Hood River County Zoning Ordinances
    - Adopted: February 21, 1984, Revised: December 2016
- Subdivision Ordinance: Article 18
- Floodplain Ordinance: Article 44
- Natural Hazard specific ordinances: Articles 42, 43, 45
- Interstate 84 Exit 63 & 64 Interchange Area Management Plan
    - Adopted December 2011
- Columbia Gorge National Scenic Area Management Plan
    - Prepared: June 2005. Amended September 2011. In July 2016, the Columbia River Gorge Commission began its 10-year technical review and update process for the Management Plan

- Hood River County Transportation System Plan
    - Adopted: July 2003, Amended November 2011
    - Includes rock fall protection priorities
- Hood River County Community Wildfire Protection Plan
    - Adopted: 2006,Updated: 2013
- Mt. Hood Coordination Plan
    - Prepared: September 2005, current June 2013
- Parks and Recreation Capital Facilities Master Plan
    - Adopted: November 1998, Revised: April 8, 2005; currently in revision
- Hood River County Bicycle Plan
    - Adopted: February 2010
- Hood River County Forestry Department Recreation Trail System Master Plan
    - Adopted: December 2010
- Hood River County Forestry Department Forest Management Plan
    - Adopted: August 2015, updated 2018
- Hood River County Energy Plan
    - Adopted: March 2018
- Hood River County Building Codes
    - Updated in alignment with Oregon state started and regularly enforced
- I-84 Closure Plan (Oregon Department of Transportation)
    - Currently in draft form

Mutual Aid Agreements

Counties often rely on the resources and personnel of neighboring jurisdictions during disaster situations. Hazards often cross political boundaries, requiring cooperation between jurisdictions for emergency management. To facilitate collaboration, Hood River County participates in numerous mutual aid agreements with neighboring jurisdictions, which provide sufficient means for the county to request help from other agencies.

Synthesis

Hood River County has strong collaborations between public, private and cross-industry sectors and has integrated hazard information and risks into relevant plans and policies. The County Planning Commission and Board of County Commissioners are active and are aware of hazard risks. However, staff resources and available funds limit possible mitigation actions. It is essential for political capital to encompass diverse government and non-government entities in collaboration; as disaster losses stem from a predictable result of interactions between the physical environment, social and demographic characteristics and the built environment.

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APPENDIX D: ECONOMIC ANALYSIS

This appendix was developed by the Oregon Partnership for Disaster Resilience at the University of Oregon's Community Service Center – now called the Institute for Policy Research and Engagement (IPRE) and used in the 2006-2007 Hood River County NHMP. It has been reviewed and accepted by the Federal Emergency Management Agency (FEMA) as a means of documenting how the prioritization of actions shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

The appendix outlines three approaches for conducting economic analyses of natural hazard mitigation projects: Benefit/Cost Analysis, Cost-Effectiveness Analysis, and STAPLE/E approach. It describes the importance of implementing mitigation activities, different approaches to economic analysis of mitigation strategies, and methods to calculate costs and benefits associated with mitigation strategies.

Information in this section is derived in part from: The Interagency Hazards Mitigation Team, *State Hazard Mitigation Plan*, (Oregon Military Department – Office of Emergency Management, 2000), and FEMA Publication 331, *Report on Costs and Benefits of Natural Hazard Mitigation*. This section is not intended to provide a comprehensive description of benefit/cost analysis, nor is it intended to evaluate local projects. It is intended to (1) raise benefit/cost analysis as an important issue, and (2) provide some background on how an economic analysis can be used to evaluate mitigation projects.

A different approach to evaluate mitigation strategies was used in the 2018 Hood River NHMP update. See Volume 1, Section 3, Mitigation Strategy, for details on evaluating and prioritizing the current mitigation actions.

Why Evaluate Mitigation Strategies?

Mitigation actions reduce the cost of disasters by minimizing property damage, injuries, and the potential for loss of life, and by reducing emergency response costs, which would otherwise be incurred. Evaluating possible natural hazard mitigation activities 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.

Evaluating mitigation projects is a complex and difficult undertaking, which is influenced by many variables. First, natural disasters affect all segments of the communities they strike, including individuals, businesses, and public services such as fire, law enforcement, utilities, and schools. Second, while some of the direct and indirect costs of disaster damages are measurable, some of the costs are non-financial and difficult to quantify in dollars. Third, many of the impacts of such events produce "ripple-effects" throughout the community, greatly increasing the disaster's social and economic consequences.

While not easily accomplished, there is value from a public policy perspective, in assessing the positive and negative impacts from mitigation activities, and obtaining an instructive benefit/cost comparison. Otherwise, the decision to pursue or not pursue various mitigation options would not be based on an objective understanding of the net benefit or loss associated with these actions.

Mitigation Strategy Economic Analyses Approaches

The approaches used to identify the costs and benefits associated with natural hazard mitigation strategies, measures, or projects fall into three general categories: benefit/cost analysis, cost-effectiveness analysis and the STAPLE/E approach. The distinction between the three methods is outlined below:

Benefit/Cost Analysis

Benefit/cost analysis is a key mechanism used by the state Oregon Military Department – Office of Emergency Management (OEM), the FEMA, and other state and federal agencies in evaluating hazard mitigation projects, and is required by the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended.

Benefit/cost analysis is used in natural hazards mitigation to show if the benefits to life and property protected through mitigation efforts exceed the cost of the mitigation activity. Conducting benefit/cost analysis for a mitigation activity can assist communities in determining whether a project is worth undertaking now, in order to reduce or avoid disaster-related damages later. Benefit/cost analysis is based on calculating the frequency and severity of a hazard, avoiding future damages, and risk. In benefit/cost analysis, all costs and benefits are evaluated in terms of dollars, and a net benefit/cost ratio is computed to determine whether a project should be implemented. A project must have a benefit/cost ratio greater than 1 (i.e., the net benefits will exceed the net costs) to be eligible for FEMA funding. Unless an alternate approach is approved by FEMA, jurisdictions must use the latest available approved FEMA benefit/cost analysis (BCA) toolkit.[1] Alternate approaches should be used with consultation from the State Hazard Mitigation Officer.

Cost-Effectiveness Analysis

Cost-effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. This type of analysis, however, does not necessarily measure costs and benefits in terms of dollars. Determining the economic feasibility of mitigating natural hazards can also be organized according to the perspective of those with an economic interest in the outcome. Hence, economic analysis approaches are covered for both public and private sectors as follows.

[1] https://www.fema.gov/benefit-cost-analysis

Investing in Public Sector Mitigation Activities

Evaluating mitigation strategies in the public sector is complicated because it involves estimating all of the economic benefits and costs regardless of who realizes them, and potentially to a large number of people and economic entities. Some benefits cannot be evaluated monetarily, but still affect the public in profound ways. Economists have developed methods to evaluate the economic feasibility of public decisions which involve a diverse set of beneficiaries and non-market benefits.

Investing in Private Sector Mitigation Activities

Private sector mitigation projects may occur on the basis of one or two approaches: it may be mandated by a regulation or standard, or it may be economically justified on its own merits. A building or landowner, whether a private entity or a public agency, required to conform to a mandated standard may consider the following options:

1. Request cost sharing from public agencies;
2. Dispose of the building or land either by sale or demolition;
3. Change the designated use of the building or land and change the hazard mitigation compliance requirement; or
4. Evaluate the most feasible alternatives and initiate the most cost effective hazard mitigation alternative.

The sale of a building or land triggers another set of concerns. For example, real estate disclosure laws can be developed which require sellers of real property to disclose known defects and deficiencies in the property, including earthquake weaknesses and hazards to prospective purchases. Correcting deficiencies can be expensive and time consuming, but their existence can prevent the sale of the building. Conditions of a sale regarding the deficiencies and the price of the building can be negotiated between a buyer and seller.

STAPLE/E Approach

Considering detailed benefit/cost or cost-effectiveness analysis for every possible mitigation activity could be very time consuming and may not be practical. There are some alternate approaches for conducting a quick evaluation of the proposed mitigation activities which could be used to identify those mitigation activities that merit more detailed assessment. One of those methods is the STAPLE/E approach.

Using STAPLE/E criteria, mitigation activities can be evaluated quickly by steering committees in a synthetic fashion. This set of criteria requires the committee to assess the mitigation activities based on the Social, Technical, Administrative, Political, Legal, Economic and Environmental (STAPLE/E) constraints and opportunities of implementing the particular mitigation item in your community. The second chapter in FEMA's How-To Guide "Developing the Mitigation Plan – Identifying Mitigation Actions and Implementation Strategies" as well as the "State of Oregon's Local Natural Hazard Mitigation Plan: An Evaluation Process" outline some specific considerations in analyzing

each aspect. The following are suggestions for how to examine each aspect of the STAPLE/E approach from the "State of Oregon's Local Natural Hazard Mitigation Plan: An Evaluation Process."

Social: Community development staff, local non-profit organizations, or a local planning board can help answer these questions.

- Is the proposed action socially acceptable to the community?
- Are there equity issues involved that would mean that one segment of the community is treated unfairly?
- Will the action cause social disruption?

Technical: The city or county public works staff, and building department staff can help answer these questions.

- Will the proposed action work?
- Will it create more problems than it solves?
- Does it solve a problem or only a symptom?
- Is it the most useful action in light of other community goals?

Administrative: Elected officials or the city or county administrator, can help answer these questions.

- Can the community implement the action?
- Is there someone to coordinate and lead the effort?
- Is there sufficient funding, staff, and technical support available?
- Are there ongoing administrative requirements that need to be met?

Political: Consult the mayor, city council or city board of commissioners, city or county administrator, and local planning commissions to help answer these questions.

- Is the action politically acceptable?
- Is there public support both to implement and to maintain the project?

Legal: Include legal counsel, land use planners, risk managers, and city council or county planning commission members, among others, in this discussion.

- Is the community authorized to implement the proposed action? Is there a clear legal basis or precedent for this activity?
- Are there legal side effects? Could the activity be construed as a taking?
- Is the proposed action allowed by the comprehensive plan, or must the comprehensive plan be amended to allow the proposed action?

- Will the community be liable for action or lack of action?
- Will the activity be challenged?

Economic: Community economic development staff, civil engineers, building department staff, and the assessor's office can help answer these questions.

- What are the costs and benefits of this action?
- Do the benefits exceed the costs?
- Are initial, maintenance, and administrative costs taken into account?
- Has funding been secured for the proposed action? If not, what are the potential funding sources (public, non-profit, and private?)
- How will this action affect the fiscal capability of the community?
- What burden will this action place on the tax base or local economy?
- What are the budget and revenue effects of this activity?
- Does the action contribute to other community goals, such as capital improvements or economic development?
- What benefits will the action provide? (This can include dollar amount of damages prevented, number of homes protected, credit under the CRS, potential for funding under the HMGP or the FMA program, etc.)

Environmental: Watershed councils, environmental groups, land use planners and natural resource managers can help answer these questions.

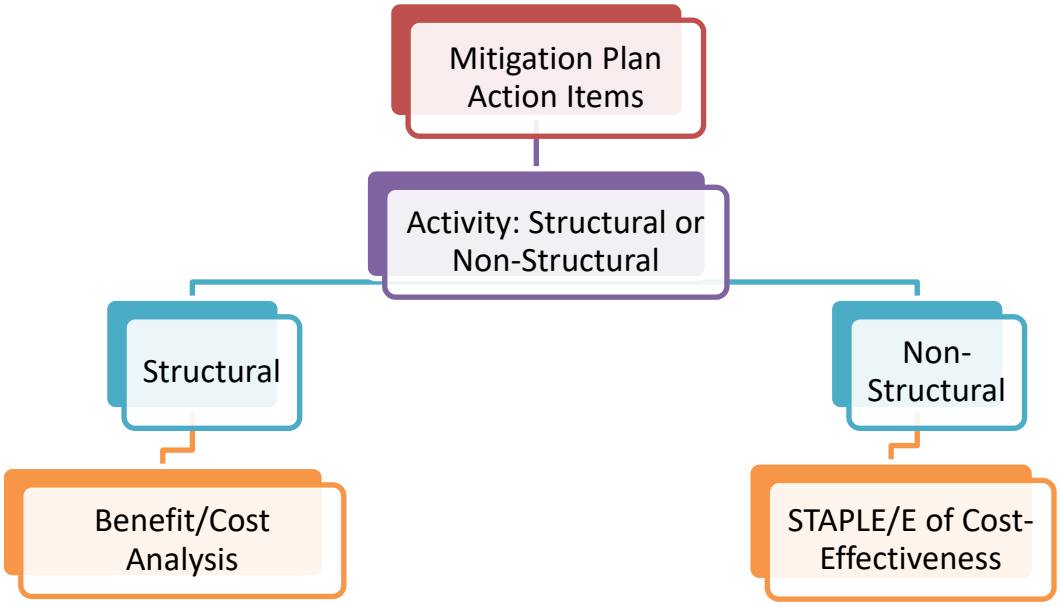
- How will the action impact the environment?
- Will the action need environmental regulatory approvals?
- Will it meet local and state regulatory requirements?
- Are endangered or threatened species likely to be affected?

The STAPLE/E approach is helpful for doing a quick analysis of mitigation projects. Most projects that seek federal funding and others often require more detailed benefit/cost analyses.

When to use the Various Approaches

It is important to realize that various funding sources require different types of economic analyses. The following figure is to serve as a guideline for when to use the various approaches.

Figure C-1 Economic Analysis Flowchart



Source: Hood River County, 2018

Implementing the Approaches

Benefit/cost analysis, cost-effectiveness analysis, and the STAPLE/E are three important tools that can be used in evaluating whether or not to implement a mitigation activity. Since none of these tools have been used in the 2018 NHMP update, the text in the 2012 NHMP about implementing them has been deleted.

Economic Returns of Natural Hazard Mitigation

The estimation of economic returns, which accrue to building or land owners as a result of natural hazard mitigation, is difficult. Owners evaluating the economic feasibility of mitigation should consider reductions in physical damages and financial losses. A partial list follows:

Building damages avoided
Content damages avoided
Inventory damages avoided
Rental income losses avoided
Relocation and disruption expenses avoided
Proprietor's income losses avoided

These parameters can be estimated using observed prices, costs, and engineering data. The difficult part is to correctly determine the effectiveness of the hazard mitigation project and the resulting reduction in damages and losses. Equally as difficult is assessing the probability that an event will occur. The damages and losses should only include those that will be borne by the owner. The salvage value of the investment can be important in determining economic feasibility. Salvage value becomes more

important as the time horizon of the owner declines. This is important because most businesses depreciate assets over a period of time.

Additional Costs from Natural Hazards

Property owners should also assess changes in a broader set of factors that can change as a result of a large natural disaster. These are usually termed "indirect" effects, but they can have a very direct effect on the economic value of the owner's building or land. They can be positive or negative, and include changes in the following:

Commodity and resource prices
Availability of resource supplies
Commodity and resource demand changes
Building and land values
Capital availability and interest rates
Availability of labor
Economic structure
Infrastructure
Regional exports and imports
Local, state, and national regulations and policies
Insurance availability and rates

Changes in the resources and industries listed above are more difficult to estimate and require models that are structured to estimate total economic impacts. Total economic impacts are the sum of direct and indirect economic impacts. Total economic impact models are usually not combined with economic feasibility models. Many models exist to estimate total economic impacts of changes in an economy. Decision makers should understand the total economic impacts of natural disasters in order to calculate the benefits of a mitigation activity. This suggests that understanding the local economy is an important first step in being able to understand the potential impacts of a disaster, and the benefits of mitigation activities.

Additional Considerations

Conducting an economic analysis for potential mitigation activities can assist decision-makers in choosing the most appropriate strategy for their community to reduce risk and prevent loss from natural hazards. Economic analysis can also save time and resources from being spent on inappropriate or unfeasible projects. Several resources and models are listed on the following page that can assist in conducting an economic analysis for natural hazard mitigation activities.

Benefit/cost analysis is complicated, and the numbers may divert attention from other important issues. It is important to consider the qualitative factors of a project associated with mitigation that cannot be evaluated economically. There are alternative approaches to implementing mitigation projects. With this in mind, opportunity rises to develop strategies that integrate natural hazard mitigation with projects related to watersheds, environmental planning, community economic development, small business development, critical infrastructure upgrades, and transportation projects,

among others. Incorporating natural hazard mitigation with other community projects can increase the viability and benefits of project implementation.

Resources

CUREe Kajima Project, *Methodologies for Evaluating the Socio-Economic Consequences of Large Earthquakes*, Task 7.2 Economic Impact Analysis, Prepared by University of California, Berkeley Team, Robert A. Olson, VSP Associates, Team Leader; John M. Eidinger, G&E Engineering Systems; Kenneth A. Goettel, Goettel and Associates, Inc.; and Gerald L. Horner, Hazard Mitigation Economics Inc., 1997.

Federal Emergency Management Agency, *Benefit/Cost Analysis of Hazard Mitigation* Projects, Riverine Flood, Version 1.05, Hazard Mitigation Economics, Inc., 1996.

Federal Emergency Management Agency, *Report on the Costs and Benefits of Natural Hazard Mitigation*. Publication 331, 1996.

Goettel & Horner Inc., Earthquake Risk Analysis Volume III: The Economic Feasibility of Seismic Rehabilitation of Buildings in the City of Portland, Submitted to the Bureau of Buildings, City of Portland, August 30, 1995.

Goettel & Horner Inc., *Benefit/Cost Analysis of Hazard Mitigation Project*s Volume V, Earthquakes, Prepared for FEMA's Hazard Mitigation Branch, Ocbober 25, 1995.

Horner, Gerald, *Benefit/Cost Methodologies for Use in Evaluating the Cost Effectiveness of Proposed Hazard Mitigation Measures*, Robert Olsen Associates, Prepared for Oregon Military Department – Office of Emergency Management, July 1999.

Interagency Hazards Mitigation Team, *State Hazard Mitigation Plan*, (Oregon State Police – Office of Emergency Management, 2000.)

Risk Management Solutions, Inc., *Development of a Standardized Earthquake Loss Estimation Methodology*, National Institute of Building Sciences, Volume I and II, 1994.

VSP Associates, Inc., *A Benefit/Cost Model for the Seismic Rehabilitation of Buildings*, Volumes 1 & 2, Federal Emergency management Agency, FEMA Publication Numbers 227 and 228, 1991.

VSP Associates, Inc., Benefit/Cost Analysis of Hazard Mitigation Projects: Section 404 Hazard Mitigation Program and Section 406 Public Assistance Program, Volume 3: Seismic Hazard Mitigation Projects, 1993.

VSP Associates, Inc., *Seismic Rehabilitation of Federal Buildings: A Benefit/Cost Model*, Volume 1, Federal Emergency Management Agency, FEMA Publication Number 255, 1994.

APPENDIX E:
GRANT PROGRAMS AND RESOURCES

Introduction

There are numerous local, state and federal funding sources available to support natural hazard mitigation projects and planning. The following section includes an abbreviated list of the most common funding sources utilized by local jurisdictions in Oregon. Because grant programs often change, it is important to periodically review available funding sources for current guidelines and program descriptions.

Post-Disaster Federal Programs

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act. The HMGP involves a paper application which is first offered to the counties with declared disasters within the past year, then becomes available statewide if funding is still available.
http://www.fema.gov/hazard-mitigation-grant-program

Physical Disaster Loan Assistance

When physical disaster loans are made to homeowners and businesses following disaster declarations by the U.S. Small Business Administration (SBA), up to 20% of the loan amount can go towards specific measures taken to protect against recurring damage in similar future disasters. http://www.sba.gov/category/navigation-structure/loans-grants/small-business-loans/disaster-loans

Pre-Disaster Federal Programs

Pre-Disaster Mitigation Grant Program

The Pre-Disaster Mitigation (PDM) program provides funds to states, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are to be awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation of funds. The PDM grant program is offered annually; applications are submitted

online. Applicants need a user profile approved by the State Hazard Mitigation Officer, which should be garnered well before the application period opens. http://www.fema.gov/pre-disaster-mitigation-grant-program

Flood Mitigation Assistance Program

The overall goal of the Flood Mitigation Assistance (FMA) Program is to fund cost-effective measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other National Flood Insurance Program (NFIP) insurable structures. This specifically includes:

- Reducing the number of repetitively or substantially damaged structures and the associated flood insurance claims;
- Encouraging long-term, comprehensive hazard mitigation planning;
- Responding to the needs of communities participating in the NFIP to expand their mitigation activities beyond floodplain development activities; and
- Complementing other federal and state mitigation programs with similar, long-term mitigation goals.

http://www.fema.gov/flood-mitigation-assistance-program

Detailed program and application information for federal post-disaster and pre-disaster programs can be found in the FY15 Hazard Mitigation Assistance Unified Guidance, available at: https://www.fema.gov/media-library/assets/documents/103279. Note that guidance regularly changes. Verify that you have the most recent edition. Flood mitigation assistance is usually offered annually; applications are submitted online. Applicants need a user profile approved by the State Hazard Mitigation Officer, which should be garnered well before the application period opens.

For Oregon Military Department, Office of Emergency Management (OEM) grant guidance on Federal Hazard Mitigation Assistance, visit: http://www.oregon.gov/OMD/OEM/pages/all_grants.aspx - Hazard_Mitigation_Grantshttps://www.oregon.gov/OEM/emresources/Grants/Pages/HMA.aspx

Contact: Angie Lane, angie.lane@state.or.us

State Programs

Seismic Rehabilitation Grant Program

The Seismic Rehabilitation Grant Program (SRGP) provides state funds to strengthen public schools and emergency services buildings so they will be less damaged during an earthquake. Reducing property damage, injuries, and casualties caused by earthquakes is the goal of the SRGP. http://www.orinfrastructure.org/Infrastructure-Programs/Seismic-Rehab/

Community Development Block Grant Program

The Community Development Block Grant Program promotes viable communities by providing: 1) decent housing; 2) quality living environments; and 3) economic opportunities, especially for low and moderate income persons. Eligible activities most relevant to natural hazards mitigation include: acquisition of property for public purposes; construction/reconstruction of public infrastructure; community planning activities. Under special circumstances, CDBG funds also can be used to meet urgent community development needs arising in the last 18 months which pose immediate threats to health and welfare.
http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs

Oregon Watershed Enhancement Board

While OWEB's primary responsibilities are implementing projects addressing coastal salmon restoration and improving water quality statewide, these projects can sometimes also benefit efforts to reduce flood and landslide hazards. In addition, OWEB conducts watershed workshops for landowners, watershed councils, educators, and others, and conducts a biennial conference highlighting watershed efforts statewide. Funding for OWEB programs comes from the general fund, state lottery, timber tax revenues, license plate revenues, angling license fees, and other sources. OWEB awards approximately $20 million in funding annually. More information at: http://www.oregon.gov/OWEB/Pages/index.aspx

Federal Mitigation Programs, Activities & Initiatives

Basic & Applied Research/Development

National Earthquake Hazard Reduction Program (NEHRP), National Science Foundation.

Through broad based participation, the NEHRP attempts to mitigate the effects of earthquakes. Member agencies in NEHRP are the US Geological Survey (USGS), the National Science Foundation (NSF), the Federal Emergency Management Agency (FEMA), and the National Institute for Standards and Technology (NIST). The agencies focus on research and development in areas such as the science of earthquakes, earthquake performance of buildings and other structures, societal impacts, and emergency response and recovery.
http://www.nehrp.gov/

Decision, Risk, and Management Science Program, National Science Foundation.

Supports scientific research directed at increasing the understanding and effectiveness of decision making by individuals, groups, organizations, and society. Disciplinary and interdisciplinary research, doctoral dissertation research, and workshops are funded in the areas of judgment and decision making; decision analysis and decision aids; risk analysis, perception, and communication; societal and public policy decision making; management science and organizational design. The program also supports small grants for exploratory research of a time-critical or high-risk, potentially transformative nature.
http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5423

Hazard ID and Mapping

National Flood Insurance Program: Flood Mapping; FEMA

Flood insurance rate maps and flood plain management maps for all NFIP communities. http://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping

National Map: Orthoimagery, DOI – USGS

Develops topographic quadrangles for use in mapping of flood and other hazards. https://nationalmap.gov/ortho.html

Mapping Standards Support, DOI-USGS

Expertise in mapping and digital data standards to support the National Flood Insurance Program. http://ncgmp.usgs.gov/standards.html

Soil Survey, USDA-NRCS

Maintains soil surveys of counties or other areas to assist with farming, conservation, mitigation or related purposes. http://soils.usda.gov/survey/printed_surveys/

Project Support

Coastal Zone Management Program, NOAA.

Provides grants for planning and implementation of non-structural coastal flood and hurricane hazard mitigation projects and coastal wetlands restoration. http://coastalmanagement.noaa.gov/https://coast.noaa.gov/czm/

Community Development Block Grant Entitlement Communities Program, US Department of Housing and Urban Development

Provides grants to entitled cities and urban counties to develop viable communities (e.g., decent housing, a suitable living environment, expanded economic opportunities), principally for low- and moderate- income persons. http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/entitlement

National Fire Plan (DOI – USDA)

The NFP provides technical, financial, and resource guidance and support for wildland fire management across the United States. This plan addresses five key points: firefighting, rehabilitation, hazardous fuels reduction, community assistance, and accountability. http://www.forestsandrangelands.gov/

Assistance to Firefighters Grant Program, FEMA

FEMA AFGM grants are awarded to fire departments to enhance their ability to protect the public and fire service personnel from fire and related hazards. Three types of grants are available: Assistance to Firefighters Grant (AFG), Fire Prevention and Safety (FP&S), and Staffing for Adequate Fire and Emergency Response (SAFER). http://www.fema.gov/welcome-assistance-firefighters-grant-program

Emergency Watershed Protection Program, USDA-NRCS

Provides technical and financial assistance for relief from imminent hazards in small watersheds, and to reduce vulnerability of life and property in small watershed areas damaged by severe natural hazard events.
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/landscape/ewpp

Rural Development Assistance – Utilities, USDA

Direct and guaranteed rural economic loans and business enterprise grants to address utility issues and development needs.
http://www.rurdev.usda.gov/Utilities_Programs_Grants.html
https://www.rd.usda.gov/about-rd/agencies/rural-utilities-service

Rural Development Assistance – Housing, USDA.

The RDA program provides grants, loans, and technical assistance in addressing rehabilitation, health and safety needs in primarily low-income rural areas. Declaration of major disaster necessary. http://www.rurdev.usda.gov/HAD-HCFPGrants.htmlhttps://www.rd.usda.gov/programs-services

Public Assistance Grant Program, FEMA.

The objective of the Federal Emergency Management Agency's (FEMA) Public Assistance (PA) Grant Program is to provide assistance to State, Tribal and local governments, and certain types of Private Nonprofit organizations so that communities can quickly respond to and recover from major disasters or emergencies declared by the President.
http://www.fema.gov/public-assistance-local-state-tribal-and-non-profit

National Flood Insurance Program, FEMA

The NFIP makes available flood insurance to residents of communities that adopt and enforce minimum floodplain management requirements. http://www.fema.gov/national-flood-insurance-program

HOME Investments Partnerships Program, HUD

The HOME IPP provides grants to states, local government and consortia for permanent and transitional housing (including support for property acquisition and rehabilitation) for low-income persons.
https://www.hud.gov/program_offices/comm_planning/affordablehousing/programs/home/

Disaster Recovery Initiative, HUD

The DRI provides grants to fund gaps in available recovery assistance after disasters (including mitigation).
http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs/dri

Emergency Management Performance Grants, FEMA

EMPG grants help state and local governments to sustain and enhance their all-hazards emergency management programs. https://www.fema.gov/emergency-management-performance-grant-program

Partners for Fish and Wildlife, DOI – FWS

The PFW program provides financial and technical assistance to private landowners interested in pursuing restoration projects affecting wetlands and riparian habitats. http://www.fws.gov/partners/

North American Wetland Conservation Fund, DOI-FWS

NAWC fund provides cost-share grants to stimulate public/private partnerships for the protection, restoration, and management of wetland habitats.
http://www.fws.gov/birdhabitat/Grants/index.shtm
https://www.grants-gov.net/cfda.php?CFDANumber=15.623

Federal Land Transfer / Federal Land to Parks Program, DOI-NPS

Identifies, assesses, and transfers available federal real property for acquisition for State and local parks and recreation, such as open space.
http://www.nps.gov/ncrc/programs/flp/index.htm

Wetlands Reserve program, USDA-NCRS

The WR program provides financial and technical assistance to protect and restore wetlands through easements and restoration agreements.
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands

Secure Rural Schools and Community Self-Determination Act of 2000, US Forest Service.

Reauthorized for FY2012, it was originally enacted in 2000 to provide five years of transitional assistance to rural counties affected by the decline in revenue from timber harvests on federal lands. Funds have been used for improvements to public schools, roads, and stewardship projects. Money is also available for maintaining infrastructure, improving the health of watersheds and ecosystems, protecting communities, and strengthening local economies. http://www.fs.usda.gov/pts/

APPENDIX F: PUBLIC OUTREACH SURVEY

The public notices of the NHMP update, posted to the County and City websites as described in Appendix B, included a link to an online survey which was posted on the Hood River Emergency Management website from April 10, 2018 through June 11, 2018, which three residents responded to. A physical copy of the survey was distributed at outreach events; twenty-nine responses were collected from this process. Outreach events are described in Section B, Planning and Public Process. Survey responses were considered during the prioritization of hazards and selection of mitigation actions by the Hood River Steering Committee. Furthermore, the survey served as a key component of public education and outreach for the NHMP. The online survey responses and in-person responses are detailed below.

Overall Survey Results

The online survey had three questions that were the same as those posed in the in-person survey. Those three questions: hazards of highest concern (question #2 online, #1 in-person), assets of highest vulnerability (question #3 online, #2 in-person), and priority mitigation activities (question #4 online, #3 in-person). Overall results of the 32 responses - online (3) plus in person (29) – are shown below in the three graphics. The two surveys, online and in-person, are shown in full below along with all responses.

Survey respondents reported the greatest concern about wildfire hazard, followed by earthquakes and then winter storms. These are the same top three hazards as the Steering Committee determination, although residents reported higher concern for earthquakes than the Steering Committee. However, survey respondents were more concerned about volcano events and windstorms than floods.

Survey respondents reported the greatest concern for County infrastructure, followed by economic assets, then human loss of life and injury. The Steering Committee similarly determined that infrastructure was the greatest vulnerability for the County, but also prioritized maintaining governance and emergency services.

Survey respondents and Steering Committee members prioritized similar mitigation activities, placing a high priority on protecting critical infrastructure, reducing damage to utilities, enhancing emergency services, and promoting interagency cooperation. These priorities are reflected in the 2018 mitigation actions.

Figure F.1 Hazards of Concern

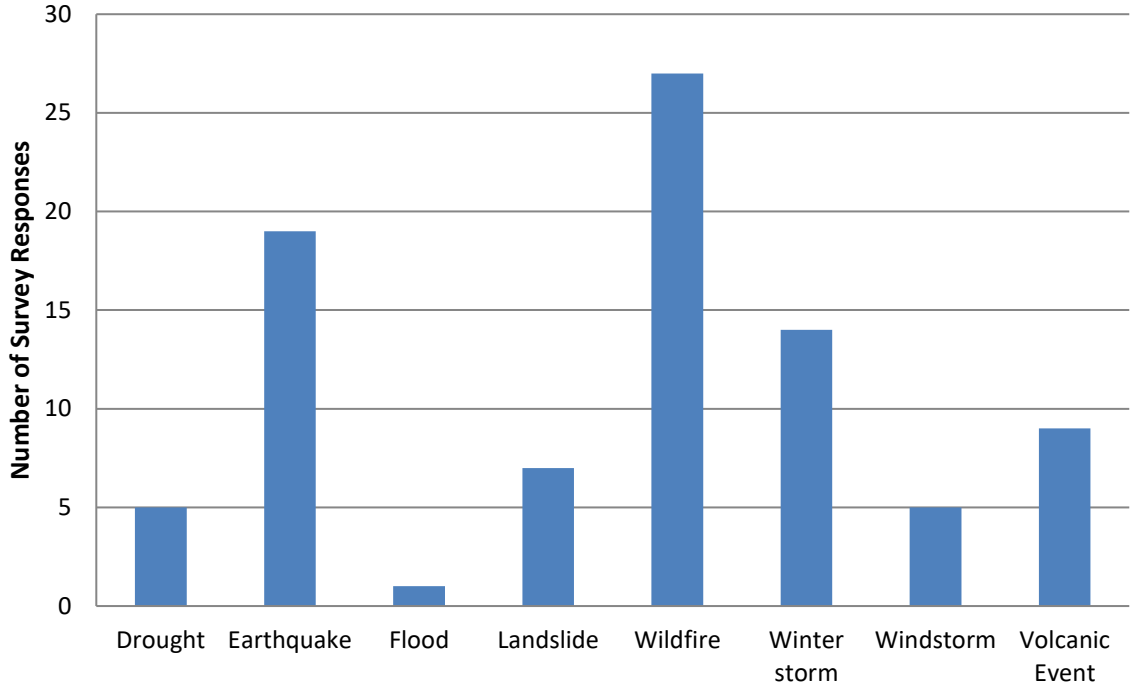


Figure F.2 Hood River County Assets of Concern

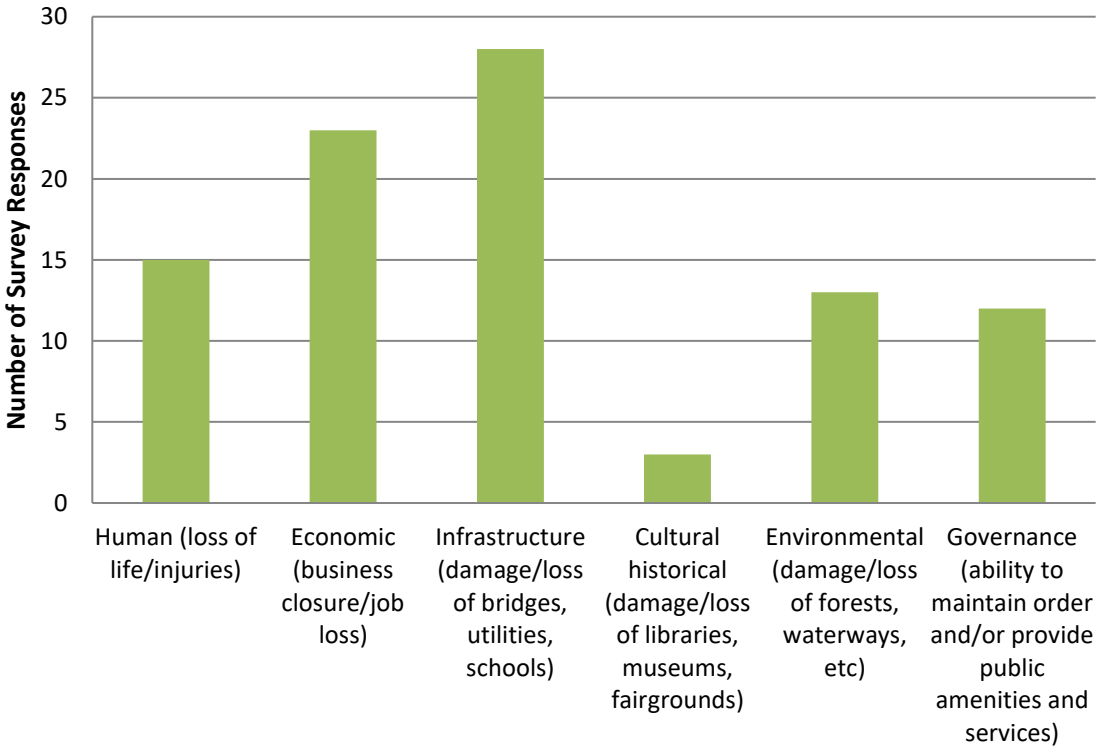
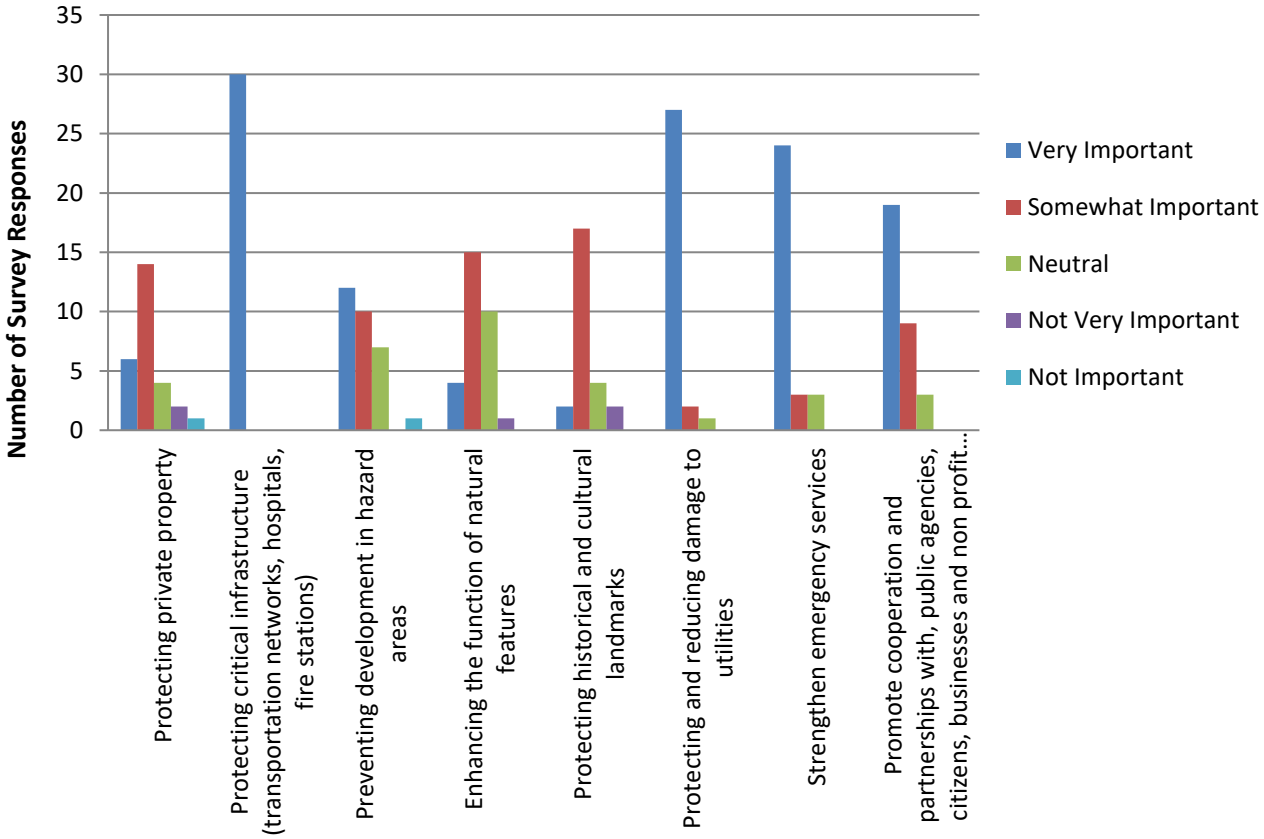


Figure F.3 Mitigation Activity Priorities



Source: Nicolia Mehrling, Hood River County, June 11, 2018

Hood River County NHMP Public Survey

Number of Survey respondents: Three

Hood River County: Hazard Mitigation Plan Feedback
Natural hazards are a common and frequent occurrence in Hood River County. We take this issue seriously.

Your participation in this survey will help us to better prioritize actions to help the county minimize or avoid disaster losses. Survey results will be incorporated into the Hood River County Natural Hazards Mitigation Plan, which will identify risks associated with natural disasters and develop long-term damage reduction strategies. This survey should take less than 5 minutes to complete.

Thank you for your help!

For more information or to get involved, contact Nicolia Mehrling at nicolia.mehrling@co.hood-river.or.us.

1. Have you heard of the Natural Hazard Mitigation Plan before this?
   - ☐ Yes
   - ☐ No
2. How concerned are you about the following natural disasters affecting Hood River County? Please assign a number to your concern, with "1" meaning "Not at all concerned," and "5" meaning "Very concerned."

Natural Disaster	Very Concerned	Somewhat Concerned	Neutral	Not Very Concerned	Not Concerned
Drought	☐	☐	☐	☐	☐
Earthquake	☐	☐	☐	☐	☐
Flood	☐	☐	☐	☐	☐
Landslide / Debris Flow	☐	☐	☐	☐	☐
Wildfire	☐	☐	☐	☐	☐
Volcanic Eruption	☐	☐	☐	☐	☐
Wind Storm	☐	☐	☐	☐	☐
Severe Winter Storm	☐	☐	☐	☐	☐

3. Of the following Hood River County assets, which do you think are the most important to protect from the impacts caused by a natural disaster? Please assign a number, with "1" meaning "not at all important" and "5" meaning "very important."

Community Assets	Potential Natural Hazard Impact	Order of Vulnerability
Human	Loss of life and/or injuries	_____
Economic	Business closures and/or job losses	_____
Infrastructure	Damage or loss of bridges, utilities, schools, etc.	_____
Cultural/Historic	Damage or loss of libraries, museums, fairgrounds, etc.	_____
Environmental	Damage or loss of forests, rangeland, waterways, etc.	_____
Governance	Ability to maintain order and/or provide public amenities and services	_____

4. Planning for natural hazards can help communities survive with fewer negative impacts. Prioritizing mitigation actions can help keep a a community functioning as close to normally as possible during and after a disaster.

   Of the following listed goals for reducing the risk from hazards, please assign a number to its level of importance, with "1" meaning "Not at all important," and "5" meaning "Very important."

Statements	Very Important	Somewhat Important	Neutral	Not Very Important	Not Important
Protect Life and Property: Protecting critical infrastructure (fire stations, hospitals, roads, utilities)	☐	☐	☐	☐	☐
Protect Life and Property: Preventing development in hazard areas	☐	☐	☐	☐	☐
Disaster Resilient Economy: Support diverse and new businesses that are sensitive to hazard risks	☐	☐	☐	☐	☐
Disaster Resilient Economy: Protect recreation, tourism, and agricultural industries through education and support	☐	☐	☐	☐	☐
Education and Outreach: Increase awareness and actions among citizens, agencies, non profit organizations, and industry	☐	☐	☐	☐	☐
Partnerships and Coordination: Promote cooperation and partnerships with, public agencies, citizens, businesses and non profit organizations at the local, regional, and state levels	☐	☐	☐	☐	☐
Acknowledge Responsibility: Acknowledge the amount of damage the County is susceptible to and associated financial costs	☐	☐	☐	☐	☐
Protect Natural Resource Systems: Preserve and rehabilitate natural systems to serve hazard mitigation functions	☐	☐	☐	☐	☐
Strengthen Emergency Services: Evaluate critical facilities, maintain active volunteer base (fire, police)	☐	☐	☐	☐	☐

5. For each activity listed below, please select the choice that applies to ANY member of your household.

For example, for the first answer, if ANY member of your household "has attended meetings or received written information on natural disasters or emergency preparedness," please select "Have done."

In your household, have you or someone in your household:	Have Done	Plan To Do	Not Done	Unable To Do
Attended meetings or received written information on natural disasters or emergency preparedness?	☐	☐	☐	☐
Talked with members in your household about what to do in case of a natural disaster or emergency?	☐	☐	☐	☐
Developed a “Household/Family Emergency Plan” in order to decide what everyone would do in the event of a disaster?	☐	☐	☐	☐

Prepared a "Disaster Supply Kit" (stored extra food, water, batteries, or other emergency supplies)?	☐	☐	☐	☐
In the last year, has anyone in your household been trained in First Aid or Cardio-Pulmonary Resuscitation (CPR)?	☐	☐	☐	☐
Prepared your home by having smoke detectors on each level of the house	☐	☐	☐	☐
Discussed or created a utility shutoff procedure in the event of a natural disaster?	☐	☐	☐	☐

6. What area of Hood River County do you live in?

   - ☐ City of Hood River
   - ☐ City of Cascade Locks
   - ☐ Hood River valley unincorporated
   - ☐ Mt. Hood unincorporated

7. How long have you lived in Hood River County?
   - ☐ Less than five years
   - ☐ 5 – 10 years
   - ☐ 11 – 20 years
   - ☐ More than 20 years

8. What is the <u>most effective</u> way for you to receive information about how to make your household and home safer from natural disasters?

   (*Please check up to three*)
   - ☐ Email
   - ☐ Mailed publications
   - ☐ Video
   - ☐ News outlets, stories and advertisements
   - ☐ Websites
   - ☐ Social Media
   - ☐ Complimentary Classes/courses
   - ☐ *Other methods:*

   Thank you for participating in our survey! Please consider visiting the Hood River County Emergency Management web page for more information on preparing for disaster situations.

Online Public Outreach Survey Results

Number of Survey respondents: Twenty-nine

1. Have you heard of the Natural Hazard Mitigation Plan before this?

Yes	No
2	1

2. How concerned are you about the following natural disasters affecting Hood River County? Please assign a number to your concern, with "1" meaning "Not at all concerned," and "5" meaning "Very concerned."

Natural Disaster	Very Concerned	Somewhat Concerned	Neutral	Not Very Concerned	Not Concerned
Drought	1			1	1
Earthquake		1		1	
Flood	1	1	1		
Landslide		2		1	
Wildfire	1				
Volcanic Eruption		1		2	
Wind Storm		1	1	1	
Winter Storm	1	1	1		

3. Of the following Hood River County assets, which do you think are the most important to protect from the impacts caused by a natural disaster? Please assign a number, with "1" meaning "not at all important" and "5" meaning "very important."

County Asset	Very Important	Somewhat Important	Neutral	Not Very Important	Not Important
Governance (ability to maintain order, provide public services: sheriff's operations, 911 services, public works, communications, etc)	3				
Infrastructure (bridges, utilities, schools, roads)	2	1			
Human (lives, health, injuries)	3				
Economic (businesses, farmland)	1	1	1		
Cultural/historic (libraries, historic buildings, fairgrounds, museums)	1	1		1	
Environmental (forests, waterways)	1	1		1	

4. Planning for natural hazards can help communities survive with fewer negative impacts. Prioritizing mitigation actions can help keep a community functioning as close to normally as possible during and after a disaster.

   Of the following listed goals for reducing the risk from hazards, please assign a number to its level of importance, with "1" meaning "Not at all important," and "5" meaning "Very important."

Statements	Very Important	Somewhat Important	Neutral	Not Very Important	Not Important
Protect Life and Property: Protecting critical infrastructure (fire stations, hospitals, roads, utilities)	1				
Protect Life and Property: Preventing development in hazard areas	1	1			
Disaster Resilient Economy: Support diverse and new businesses that are sensitive to hazard risks	1	1			
Disaster Resilient Economy: Protect recreation, tourism, and agricultural industries through education and support	1		1		
Education and Outreach: Increase awareness and actions among citizens, agencies, non profit organizations, and industry	1	1			
Partnerships and Coordination: Promote cooperation and partnerships with, public agencies, citizens, businesses and non profit organizations at the local, regional, and state levels	1				
Acknowledge Responsibility: Acknowledge the amount of damage the County is susceptible to and associated	1	1			
Protect Natural Resource Systems: Preserve and rehabilitate natural systems to serve hazard mitigation functions	1		1		
Strengthen Emergency Services: Evaluate critical facilities, maintain active volunteer base (fire, police)	1				

5. For each activity listed below, please select the choice that applies to ANY member of your household. For example, for the first answer, if ANY member of your household "has attended meetings or received written information on natural disasters or emergency preparedness," please select "Have done."

In your household, have you or someone in your household:	Have Done	Plan To Do	Not Done	Unable To Do
Attended meetings or received written information on natural disasters or emergency preparedness?	2			
Talked with members in your household about what to do in case of a natural disaster or emergency?	2			
Developed a “Household/Family Emergency Plan” in order to decide what everyone would do in the event of a disaster?		2		
Prepared a “Disaster Supply Kit” (stored extra food, water, batteries, or other emergency supplies)?		2		
In the last year, has anyone in your household been trained in First Aid or Cardio-Pulmonary Resuscitation (CPR)?		2		
Prepared your home by having smoke detectors on each level of the house	2			
Discussed or created a utility shutoff procedure in the event of a natural disaster?	1	1	0	0

6. What area of Hood River County do you live in?

City of Hood River	City of Cascade Locks	Hood River valley unincorporated	Mt. Hood unincorporated
I	0	I	0

7. How long have you lived in Hood River County?

Less than five years	5 – 10 years	11 – 20 years	More than 20 years
I	0	I	0

8. What is the most effective way for you to receive information about how to make your household and home safer from natural disasters?

(*Please check up to three*)

Email	Mailed Publications	Video	News outlets	Websites	Social Media	Complimentary Classes/courses	Other methods
2	2	0	0	1	0	0	Community meetings, articles in Hood River News

NHMP Outreach Survey (In person)

Number of Survey respondents: Twenty-nine

1. Which of the following hazards are you most concerned about? (Please mark top three)

	Drought	Earthquake	Flood	Landslide	Wildfire	Winter storm	Windstorm	Volcanic Event
# Votes	4	19	0	7	26	14	4	9
Rank	6	2	8	5	1	3	7	4

2. In your opinion, which of the following community assets are most susceptible to damage from natural hazards?

Asset	Human (loss of life/injuries)	Economic (business closure/job loss)	Infrastructure (damage/loss of bridges, utilities, schools)	Cultural historical (damage/loss of libraries, museums, fairgrounds)	Environmental (damage/loss of forests, waterways, etc)	Governance (ability to maintain order and/or provide public amenities and services)
# Votes	12	21	25	2	11	9
Rank	3	2	1	6	4	5

3. The following statements will help determine citizen priorities regarding planning for natural hazards in Hood River County. Please tell us how important each one is to you.

Statements	Very Importan	Somewhat Important	Neutral	Not Very Important	Not Important
Protecting private property	6	14	4	2	1
Protecting critical infrastructure (transportation networks, hospitals, fire stations)	29	0	0	0	0
Preventing development in hazard areas	11	9	7	0	1
Enhancing the function of natural features	3	15	9	1	
Protecting historical and cultural landmarks	2	17	4	2	0
Protecting and reducing damage to utilities	27	2	1	0	0
Strengthen emergency services	23	3	3	0	0
Promote cooperation and partnerships with, public agencies, citizens, businesses and non	17	9	3	0	0

Source: Nicolia Mehrling, Resource Assistance for Rural Environments, 2018

Appendix G: Climate Change Influence on Natural Hazards: Overview and Hood River County Projections

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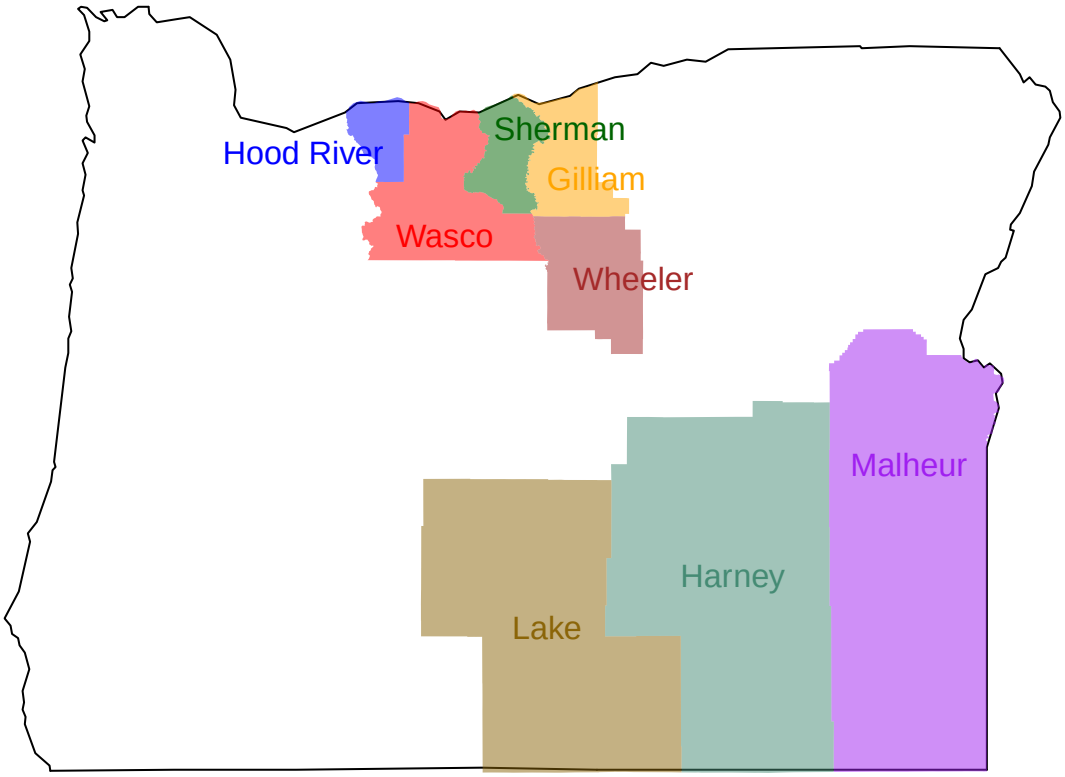
Climate Change Influence on Natural Hazards in Eight Oregon Counties

Overview of County Reports

August 2018

Prepared by
Oregon Climate Change Research Institute
www.occri.net



OCCRI

Oregon Department of Land Conservation and Development

Introduction. The Earth's climate is warming largely due to increasing amounts of greenhouse gas emissions worldwide. Climate change is expected to influence the likelihood of occurrence of existing natural hazard events such as heavy rains, river flooding, drought, heat waves, cold waves, wildfire, and air quality. Supported by the Oregon Department of Land Conservation and Development's Pre-Disaster Mitigation grants, the Oregon Climate Change Research Institute provided analyses and summaries of how climate change is expected to influence natural hazards for eight counties in Oregon.

Hood River, Wasco, Sherman, Gilliam, Wheeler, Malheur, Harney, and Lake Counties each received a report, *Future Climate Projections*, describing county-specific projected changes in climate metrics related to selected natural hazards. The reports present future climate projections for the 2020s (2010–2039 average) and 2050s (2040–2069 average) compared to the 1971–2000 average historical baseline. This overview presents a summary of projected direction of changes in climate change-related risk of natural hazard occurrence based on projections only for the 2050s compared to the historical baseline (Table 1). Projections for the 2020s are similar to those for the 2050s, but of smaller magnitude, and can be found in the county reports.

Heat Waves. Across all eight counties, extreme heat events are expected to increase in frequency, duration, and intensity due to continued warming temperatures. Under the higher emissions scenario, projected increases in the number of days with temperature at or above 90°F range on average from 12 additional days in Hood River County to 38 additional days in Malheur County (Figure 1) by the 2050s compared to the historical baseline.

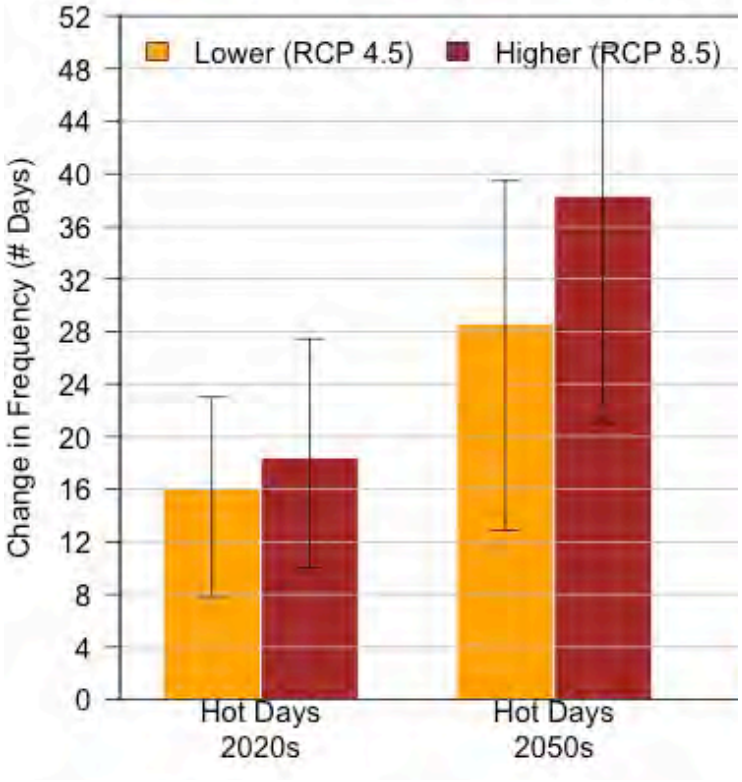


Figure 1 Projected future change in the number of hot days for Malheur County from the historical baseline for the 2020s and 2050s under a lower and higher emissions scenario. The bars and whiskers display the mean and range, respectively, of changes across 20 global climate models. Hot days are defined as days with maximum temperature of at least 90°F.

Cold Waves. Across all eight counties, cold extremes are still expected to occur from time to time, but with much less frequency and intensity as the climate warms. Under the higher emissions scenario, projected decreases in the number of days with temperature at or below freezing range on average from 7 fewer days in Sherman and Gilliam Counties to 14 fewer days in Hood River County by the 2050s compared to the historical baseline.

Heavy Rains. As the atmosphere warms and is able to hold more water vapor, the frequency and intensity of extreme precipitation events is expected to increase. Across all eight counties, the amount of precipitation on the wettest day of the year is expected to increase in the future. Under the higher emissions scenario, projected increases range on average from 14% more precipitation on the wettest day in Wheeler County to 20% more precipitation in Sherman County by the 2050s compared to the historical baseline.

River Flooding. Mid- to low-elevation tributaries, such as Hood River and John Day River, that are near freezing level in winter, receiving a mix of rain and snow, may experience an increase in winter flood risk due to warmer winter temperatures causing precipitation to fall more as rain and less as snow, as well as more intense precipitation events. The flood magnitude of the 10-year (10% exceedance probability) single-day food event is projected to increase on the Snake, John Day, and

Owyhee Rivers, but shows little change on the Columbia main stem by the 2050s compared to the historical baseline.

Drought. Counties reliant on spring and summer snowpack to supply summer water demands are projected to experience greater frequency of low spring snowpack years. Drought conditions represented by low summer soil moisture and low summer runoff are projected to become more frequent in Hood River (Figure 2), Wasco, and Wheeler Counties, but may become less frequent in the other five counties by the 2050s compared to the historical baseline.

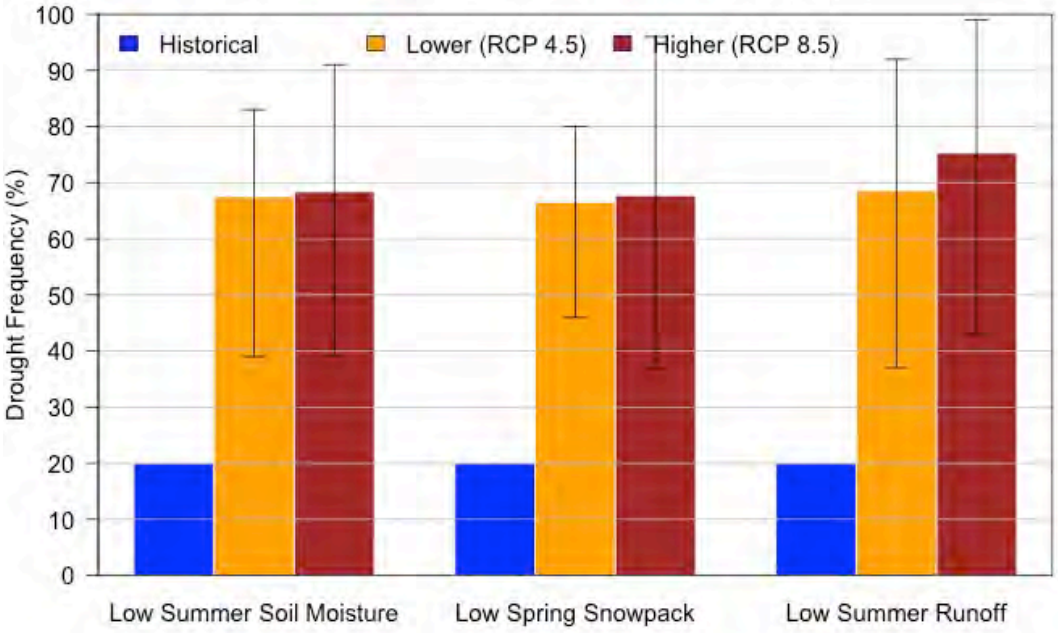


Figure 2 Frequency of the historical baseline 1-in-5 year event (by definition 20% frequency) of low summer soil moisture, low spring snowpack, and low summer runoff projected for the 2050s for Hood River County under lower and higher emissions scenarios. The bar and whiskers depict the mean and range across ten global climate models.

Wildfire. Across all eight counties, wildfire risk, as expressed through the frequency of very high fire danger days, is projected to increase under future climate change. Under the higher emissions scenario, projected increases in the frequency of very high fire danger days range on average from 38% greater frequency in Lake and Wasco Counties to 41% greater frequency in Gilliam County by the 2050s compared to the historical baseline.

Poor Air Quality. Under future climate change, the risk of wildfire smoke exposure is projected to increase across nearly all eight counties. Under a medium emissions scenario, projected increases in the frequency of days with high concentrations of wildfire-specific particulate matter between 2004–2009 and 2046–2051 range on average from 0% greater frequency in Sherman County to 122% greater frequency in Malheur County.

Windstorms. Limited research suggests very little, if any, change in the frequency and intensity of windstorms in the Pacific Northwest as a result of climate change.

Dust Storms. Limited research suggests that the risk of dust storms in summer would decrease under climate change in parts of eastern Oregon that experience an increase in vegetation cover from the carbon dioxide fertilization effect.

Increased Invasive Species. Warming temperatures, altered precipitation patterns, and increasing atmospheric carbon dioxide levels increase the risk for invasive species, insect and plant pests for forest and rangeland vegetation, and cropping systems.

Loss of Wetland Ecosystems. Freshwater wetland ecosystems are sensitive to warming temperatures and altered hydrological patterns, such as changes in precipitation seasonality and snowpack reduction.

Table 1 Summary of projected direction of changes in climate change-related risk of natural hazard occurrence across eight Oregon counties. Within each box, symbols denote the direction of expected change in risk: increasing, decreasing, or unchanging; and shading denotes the level of confidence in the projected direction of change. High confidence means nearly all models agree on the direction of change and there is strong evidence in the published literature. Medium confidence means a majority of models agree on the direction of change and there is strong to medium evidence in the published literature. Low confidence means the direction of change is small compared to the range of model responses or there is limited evidence in the published literature.

	Hood River	Wasco	Sherman	Gilliam	Wheeler	Malheur	Harney	Lake
Heat Waves	↑	↑	↑	↑	↑	↑	↑	↑
Cold Waves	↓	↓	↓	↓	↓	↓	↓	↓
Heavy Rains	↑	↑	↑	↑	↑	↑	↑	↑
River Flooding	↑	↑	↑	↑	↑	↑	↑	↑
Drought	↑	↑	=	=	↑	↑	↑	↑
Wildfire	↑	↑	↑	↑	↑	↑	↑	↑
Poor Air Quality	↑	↑	=	↑	↑	↑	↑	↑
Windstorms	=	=	=	=	=	=	=	=
Dust Storms	↓	↓	↓	↓	↓	↓	↓	↓
Increased Invasive Species	↑	↑	↑	↑	↑	↑	↑	↑
Loss of Wetland Ecosystems	↑	↑	↑	↑	↑	↑	↑	↑

Level of Confidence in Direction of Change	
	High Confidence
	Medium Confidence
	Low Confidence

Expected Direction of Change	
↑	**Risk Increasing**
↓	**Risk Decreasing**
=	**Risk Unchanging**

Future Climate Projections
Hood River County

August 2018

A Report to the Oregon Department of Landscape Conservation and Development

Prepared by
The Oregon Climate Change Research Institute

Photo credit: Hood River, Oregon by Sam Beebe, https://flic.kr/p/7aZRtA, Creative Commons License (CC BY 2.0)

OCCRI

Oregon Department of
Land Conservation
and Development

Future Climate Projections: Hood River County

A report to the Oregon Department of Landscape Conservation and Development

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August 2018

Table of Contents

Executive Summary

This report presents future climate projections for Hood River County relevant to specific natural hazards for the 2020s (2010–2039 average) and 2050s (2040–2069 average) compared to the 1971–2000 average historical baseline. The projections were analyzed for a lower greenhouse gas emissions scenario as well as a higher greenhouse gas emissions scenario, using multiple global climate models. This summary lists only the projections for the 2050s under the higher emissions scenario. Projections for both time periods and both emissions scenarios can be found within relevant sections of the main report.

Heat Waves

Extreme heat events are expected to increase in frequency, duration, and intensity due to continued warming temperatures.

In Hood River County, the frequency of hot days with temperatures at or above 90°F is projected to increase on average by 12 days (with a range of 3 to 19 days) by the 2050s under the higher emissions scenario compared to the historical baseline.

In Hood River County, the temperature of the hottest day of the year is projected to increase by 8°F (with a range of 2 to 12°F) by the 2050s under the higher emissions scenario compared to the historical baseline.

Cold Waves

Cold extremes are still expected to occur from time to time, but with much less frequency and intensity as the climate warms.

In Hood River County, the frequency of days at or below freezing is projected to decline on average by 14 days (with a range of 8 to 19 days) by the 2050s under the higher emissions scenario compared to the historical baseline.

In Hood River County, the temperature of the coldest night of the year is projected to increase by 7°F (with a range of 0 to 12°F) by the 2050s under the higher emissions scenario compared to the historical baseline.

Heavy Rains

The intensity of extreme precipitation events is expected to increase slightly in the future as the atmosphere warms and is able to hold more water vapor.

In Hood River County, the magnitude of precipitation on the wettest day and wettest consecutive five days per year is projected to increase on average by about 16% (with a range of 1% to 27%) and 11% (with a range of -4% to 29%), respectively, by the 2050s under the higher emissions scenario compared to the historical baseline.

In Hood River County, the frequency of days with at least ¾" of precipitation and the frequency of days exceeding a threshold for landslide risk is not projected to change substantially.

River Flooding

Flood risk to Hood River County from the Columbia River is not expected to change substantially based on insignificant projected changes in non-regulated flood magnitudes on the Columbia River at The Dalles.

Mid- to low-elevation tributaries, such as Hood River, that are near the freezing level in winter, receiving a mix of rain and snow, may experience an increase in winter flood risk due to warmer winter temperatures causing precipitation to fall more as rain and less as snow.

Drought

Drought conditions, as represented by low summer soil moisture, low spring snowpack, and low summer runoff, are projected to become more frequent in Hood River County by the 2050s.

Summer streamflows in the Hood River have historically been buffered by glacial melt, but the contribution of glacial melt to water supply in the Hood River basin is projected to decline by the end of the 21st century.

Wildfire

Wildfire risk, as expressed through the frequency of very high fire danger days, is projected to increase under future climate change. In Hood River County, the frequency of very high fire danger days per year is projected to increase on average by about 40% (with a range of -13 to +99%) by the 2050s under the higher emissions scenario compared to the historical baseline.

Air Quality

Under future climate change, the risk of wildfire smoke exposure is projected to increase in Hood River County. The number days with high concentrations of wildfire-specific particulate matter is projected to increase by 31% by 2046–2051 under a medium emissions scenario compared with 2004–2009.

Windstorms

Limited research suggests very little, if any, change in the frequency and intensity of windstorms in the Pacific Northwest as a result of climate change.

Dust Storms

Limited research suggests that the risk of dust storms in summer would decrease in eastern Oregon under climate change in areas that experience an increase in vegetation cover from the carbon dioxide fertilization effect.

Increased Invasive Species & Pests

Warming temperatures, altered precipitation patterns, and increasing atmospheric carbon dioxide levels increase the risk for invasive species, insect and plant pests for forest and rangeland vegetation, and cropping systems.

Loss of Wetland Ecosystems

Freshwater wetland ecosystems are sensitive to warming temperatures and altered hydrological patterns, such as changes in precipitation seasonality and reduction of snowpack.

Introduction

Industrialization has given rise to increasing amounts of greenhouse gas emissions worldwide, which is causing the Earth's climate to warm (IPCC, 2013). The effects of which are already apparent here in Oregon (Dalton *et al.*, 2017). Climate change is expected to influence the likelihood of occurrence of existing natural hazard events such as heavy rains, river flooding, drought, heat waves, cold waves, wildfire, and air quality.

Oregon's Department of Land Conservation and Development (DLCD) contracted with the Oregon Climate Change Research Institute (OCCRI) to perform and provide analysis of the influence of climate change on natural hazards. The scope of this report is limited to the geographic area encompassed by the eight Oregon counties (thus including the counties, the cities within them and the Burns Paiute Tribe) that are part of the two Pre-Disaster Mitigation (PDM) 16 grants DLCD received. Those counties include: Wasco, Hood River, Harney, Lake, Malheur, Wheeler, Sherman, and Gilliam Counties. Outcomes of this analysis include county-specific data, graphics, and text summarizing climate change projections for climate metrics related to each of the natural hazards lists in Table 1. This information will be integrated into the Natural Hazards Mitigation Plan (NHMP) updates for the eight counties, and can be used in other county plans, policies, and programs. In addition to this report, sharing of data, and other technical assistance will be provided to the counties.

Table 1 Natural hazards and related climate metrics evaluated in this project.

Heavy Rains Wettest Day ◆Wettest Five Days Landslide Threshold Exceedance	**Heat Waves** Hottest Day ◆ Warmest Night "Hot" Days ◆ "Warm" Nights
River Flooding Annual maximum daily flows	**Cold Waves** Coldest Day ◆ Coldest Night "Cold" Days ◆ "Cold" Nights
Drought Summer Flow ◆ Spring Snow Summer Soil Moisture	**Air Quality** Unhealthy Smoke Days
Wildfire Fire Danger Days	**Windstorms ◆ Dust Storms** **Increased Invasive Species & Pests** **Loss of Wetland Ecosystems**

Future Climate Projections Background

Introduction

The county-specific future climate projections prepared by OCCRI are derived from 10–20 global climate models (GCM) and two scenarios of future global greenhouse gas emissions. Future climate projections have been "downscaled"—that is, made locally relevant—and summaries of projected changes in the climate metrics in Table 1 are presented for an early 21st century period and a mid 21st century period compared to a historical baseline. (Read more about the data sources in the Appendix.)

Global Climate Models

Global climate models are sophisticated computer models of the Earth's atmosphere, water, and land and how these components interact over time and space according to the fundamental laws of physics (Figure 1). GCMs are the most sophisticated tools for understanding the climate system, but while highly complex and built on solid physical principles, they are still simplifications of the actual climate system. There are several ways to implement such simplifications into a GCM, which results in each one giving a slightly different answer. As such, it is best practice to use at least ten GCMs and look at the average and range of projections across all of them. (Read more about GCMs & Uncertainty in the Appendix.)

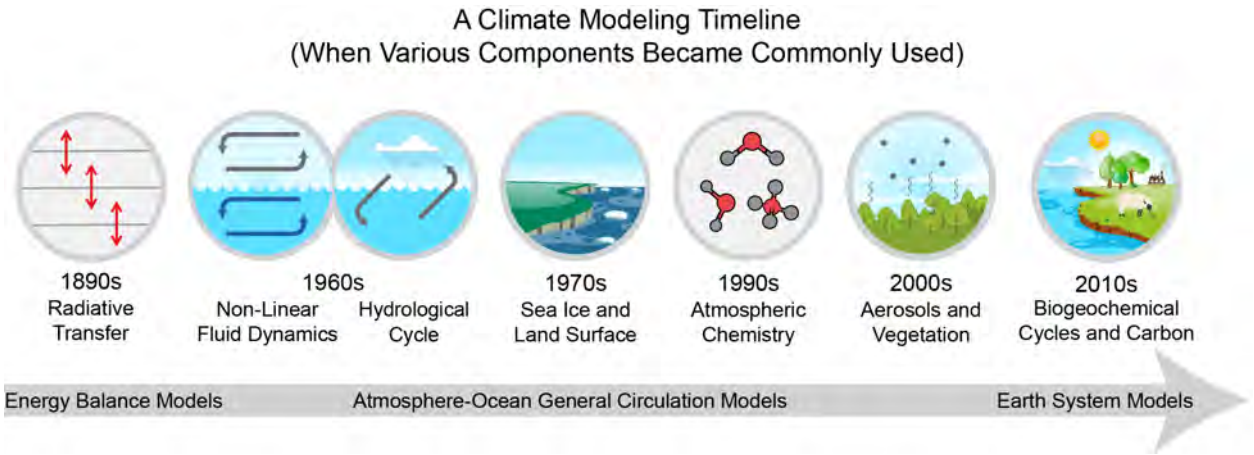


Figure 1 As scientific understanding of climate has evolved over the last 120 years, increasing amounts of physics, chemistry, and biology have been incorporated into calculations and, eventually, models. This figure shows when various processes and components of the climate system became regularly included in scientific understanding of global climate calculations and, over the second half of the century as computing resources became available, formalized in global climate models. (Source: science2017.globalchange.gov)

Greenhouse Gas Emissions

When used to project future climate, scientist give the GCMs information about the quantity of greenhouse gases that the world would emit, then the GCMs run simulations of what would happen to the air, water, and land over the next century. Since the precise amount of greenhouse gases the world will emit over the next century is unknown, scientists use several scenarios of different amounts of greenhouse gas emissions based on plausible

societal trajectories. The future climate projections prepared by OCCRI uses emissions pathways called Representative Concentration Pathways (RCPs). There are several RCPs and the higher global emissions are, the greater the increase in global temperature is expected (Figure 2). OCCRI considers a lower emissions scenario (RCP 4.5) and a higher emissions scenario (RCP 8.5) because they are the most commonly used scenarios in published literature and the downscaled data is available for these scenarios. (Read more about Emissions Scenarios in the Appendix.)

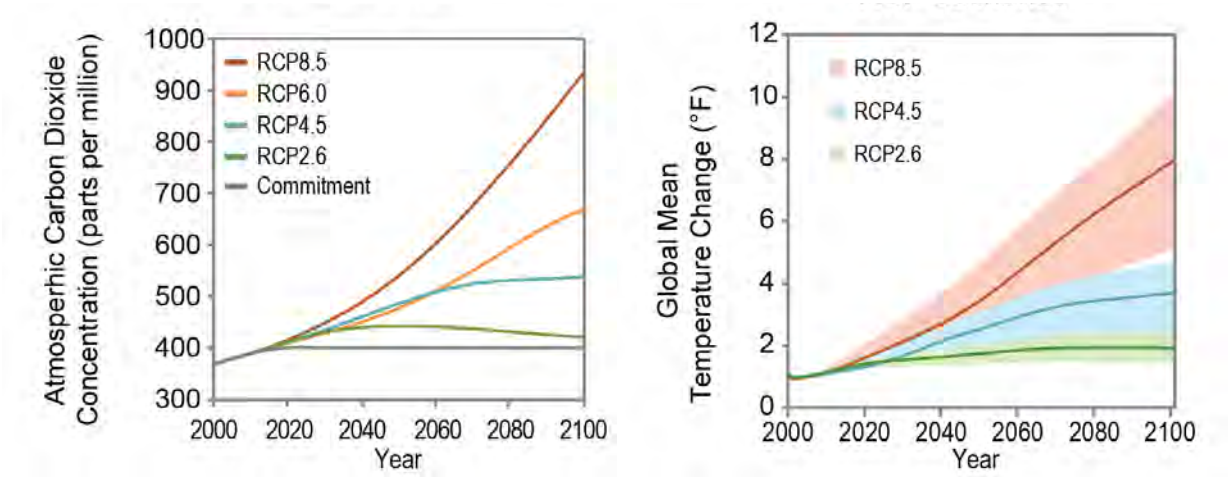


Figure 2 Future scenarios of atmospheric carbon dioxide concentrations (left) and global temperature change (right) resulting from several different emissions pathways, called Representative Concentration Pathways (RCPs), which are considered in the fourth and most recent National Climate Assessment. (Source: science2017.globalchange.gov)

Downscaling

Global climate models simulate the climate across adjacent grid boxes the size of about 60 by 60 miles. To make this coarse resolution information locally relevant, global climate model outputs have been combined with historical observations to translate large-scale patterns into high-resolution projections. This process is called statistical downscaling. The future climate projections produced by OCCRI were statistically downscaled to a resolution with grid boxes the size of about 2.5 by 2.5 miles (Abatzoglou and Brown, 2012). (Read more about Downscaling in the Appendix.)

Future Time Periods

When analyzing global climate model projections of future climate, it is best practice to compare the average across at least a 30-year period in the future to an average historical baseline across at least 30 years. For the future climate projections produced by OCCRI, two 30-year future periods are presented in comparison with a 30-year historical baseline (Table 2).

Table 2 Historical and future time periods for presentation of future climate projections

Historical Baseline	Early 21st Century "2020s"	Mid 21st Century "2050s"
1971–2000	2010–2039	2040–2069

How to Use the Information in this Report

Under a changing climate, past trends, while valuable, may no longer be, on their own, reliable predictors of future outcomes. Future projections from GCMs provide an opportunity to explore a range of plausible outcomes taking into consideration the climate system's complex response to increasing concentrations of greenhouse gases. It is important to be aware that GCM projections should not be thought of as predictions of what the weather will be like at some specified date in the future, but rather viewed as predictions of the long-term statistical aggregate of weather, in other words, "climate", if greenhouse gas concentrations follow some specified trajectory.[1]

The projections of climate variables in this report, both in the direction and magnitude of change, are best used in reference to the historical climate conditions under which a particular asset or system is designed to operate. For this reason, considering the projected changes between the historical and future periods allows one to envision how current systems of interest would respond to climate conditions that are different from what they have been. In some cases, the projected change may be small enough to be accommodated within the existing system. In other cases, the projected change may be large enough to require adjustments, or adaptations, to the existing system.

[1] Read more: https://nca2014.globalchange.gov/report/appendices/faqs#narrative-page-38784

Average Temperature

Oregon's average temperature warmed at a rate of 2.2°F per century during 1895–2015. Average temperature is expected to continue warming during the 21st century under scenarios of continued global greenhouse gas emissions; the rate of warming depends on the particular emissions scenario (Dalton *et al.*, 2017). By the "2050s" compared to the 1970–1999 historical baseline, Oregon's average temperature is projected to increase by 3.6 °F with a range of 1.8°–5.4°F under a lower emissions scenario (RCP 4.5) and by 5.0°F with a range of 2.9°F–6.9°F under a higher emissions scenario (RCP 8.5) (Dalton *et al.*, 2017). Furthermore, summers are projected to warm more than other seasons (Dalton *et al.*, 2017).

Average temperature in Hood River County is projected to warm during the 21st century at a similar rate to Oregon as a whole (Figure 3). Projected increases in average temperature in Hood River County compared to the 1971–2000 historical baseline range from 0.9–3.4°F by the 2020s and 1.6–6.9°F by the 2050s, depending on emissions scenario and climate model (Table 3).

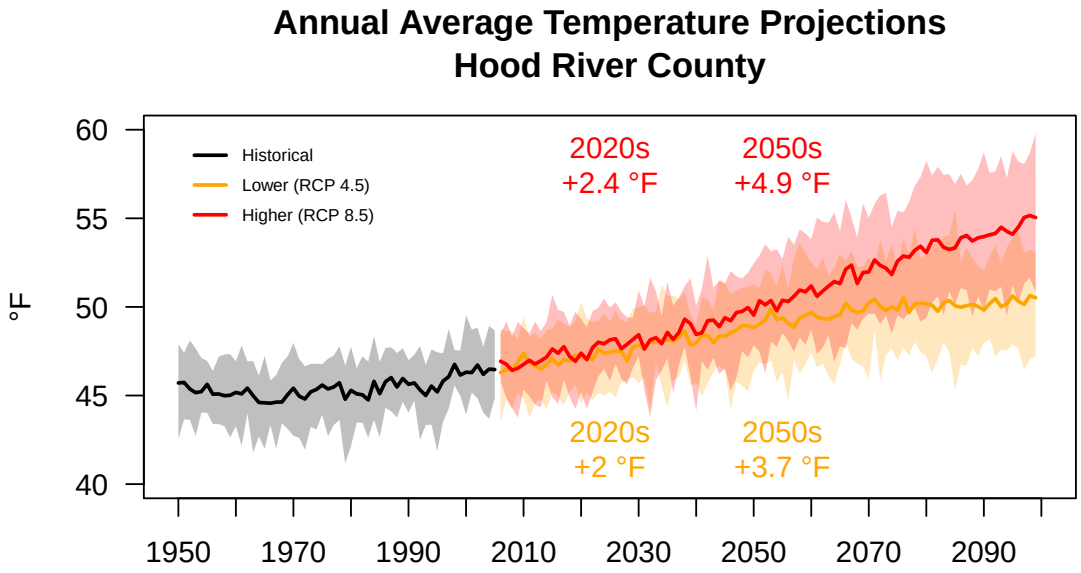


Figure 3 Annual average temperature projections for Hood River County as simulated by 20 downscaled global climate models under a lower (RCP 4.5) and a higher (RCP 8.5) greenhouse gas emissions scenario. Solid line and shading depicts the 20-model mean and range, respectively. The multi-model mean differences for the 2020s (2010–2039 average) and the 2050s (2040–2069 average) compared to the historical baseline (1971–2000 average) are shown.

Table 3 Average and range of projected future changes in Hood River County's average temperature from the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models.

	Change by Early 21st Century "2020s"	Change by Mid 21st Century "2050s"
Higher (RCP 8.5)	+2.4°F (1.4 to 3.4)	+4.9°F (2.8 to 6.9)
Lower (RCP 4.5)	+2.0°F (0.9 to 3.3)	+3.7°F (1.6 to 5.4)

Heat Waves

Extreme heat events are expected to increase in frequency, duration, and intensity in Oregon due to continued warming temperatures. In fact, the hottest days in summer are projected to warm more than the change in mean temperature over the Pacific Northwest (Dalton *et al.*, 2017). This report presents projected changes for three metrics of heat extremes for both daytime (maximum temperature) and nighttime (minimum temperature) (Table 4).

Table 4 Heat extreme metrics and definitions

Metric	Definition
Hot Days	Number of days per year maximum temperature is greater than or equal to 90°F
Warm Nights	Number of days per year minimum temperature is greater than or equal to 65°F
Hottest Day	Annual maximum of maximum temperature
Warmest Night	Annual maximum of minimum temperature
Daytime Heat Waves	Number of events per year with at least 3 consecutive days with maximum temperature greater than or equal to 90°F
Nighttime Heat Waves	Number of events per year with at least 3 consecutive days with minimum temperature greater than or equal to 65°F

In Hood River County, all the extreme heat metrics in Table 4 are projected to increase by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Table 5). For example, compared to the 1971–2000 historical baseline, by the 2050s under the higher emissions scenario, the number of hot days greater than or equal to 90°F is projected to increase by 12 days on average with a range of about 3 to 19 days. Likewise, the temperature of the hottest day of the year is projected to increase by 7.5°F on average with a range of 2.2°F to 12.1°F and the frequency of daytime heat waves is projected to increase by 1.7 events per year.

Projected changes in the frequency extreme heat days (i.e., Hot Days and Warm Nights) are shown in Figure 4. Projected changes in the magnitude of heat records (i.e., Hottest Day and Warmest Night) are shown in Figure 5. Projected changes in the frequency of extreme heat events (i.e., Daytime Heat Waves and Nighttime Heat Waves) are shown in Figure 6.

Table 5 Mean and range of projected future changes in extreme heat metrics for Hood River County from the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models.

	Change by Early 21st Century "2020s"		Change by Mid 21st Century "2050s"	
	Lower	**Higher**	**Lower**	**Higher**
Hot Days	+3.2 days (1.0–5.3)	+4.1 days (1.4–6.2)	+7.6 days (2.9–12.8)	+12.1 days (3.4–18.8)
Warm Nights	+1.0 days (0.2–1.9)	+1.3 days (0.4–2.3)	+2.9 days (0.5–6.4)	+5.9 days (1.4–14.1)
Hottest Day	+3.1°F (0.8–5.7)	+3.7°F (1.1–6.3)	+5.6°F (2.1–11.4)	+7.5°F (2.2–12.1)
Warmest Night	+2.3°F (0.8–3.9)	+2.7°F (0.7–4.5)	+4.2°F (1.1–7.3)	+6.3°F (2.8–9.5)
Daytime Heat Waves	+0.5 events (0.2–0.9)	+0.6 events (0.3–0.9)	+1.1 events (0.5–1.8)	+1.7 events (0.5–2.6)
Nighttime Heat Waves	+0.1 events (-0.0–0.3)	+0.1 events (0.0–0.3)	+0.4 events (-0.0–0.8)	+0.8 events (0.0–1.6)

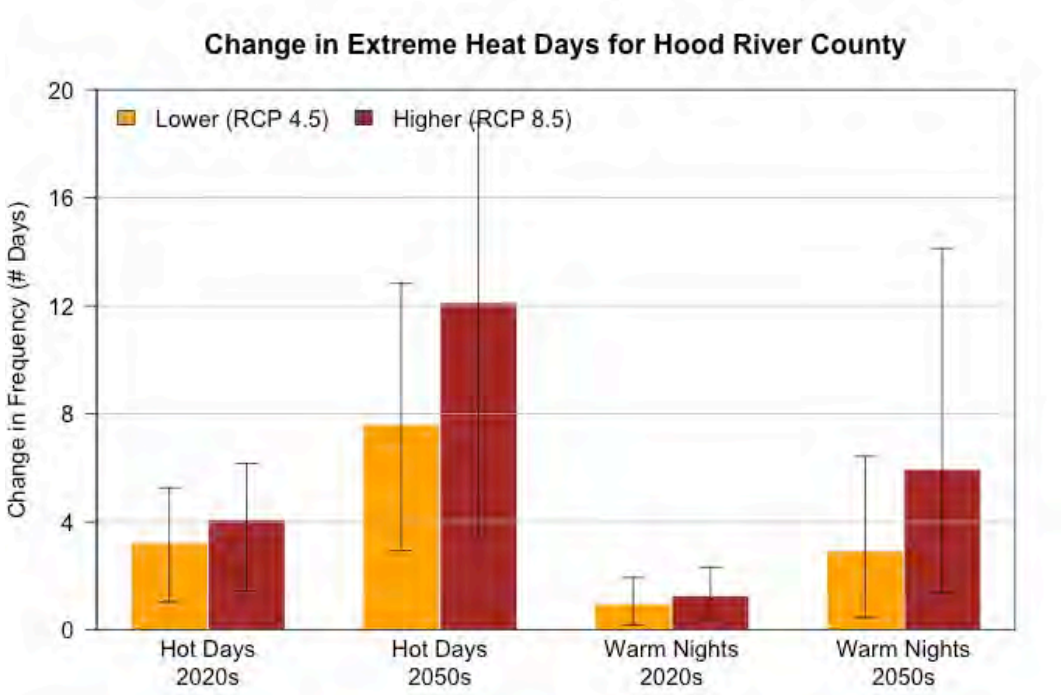


Figure 4 Projected future changes in the number of hot days (left two sets of bars) and number of warm nights (right two sets of bars) for Hood River County from the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models. The bars and whiskers display the mean and range, respectively, of changes across the 20 GCMs. Hot days are defined as days with maximum temperature of at least 90°F; warm nights are defined as days with minimum temperature of at least 65°F.

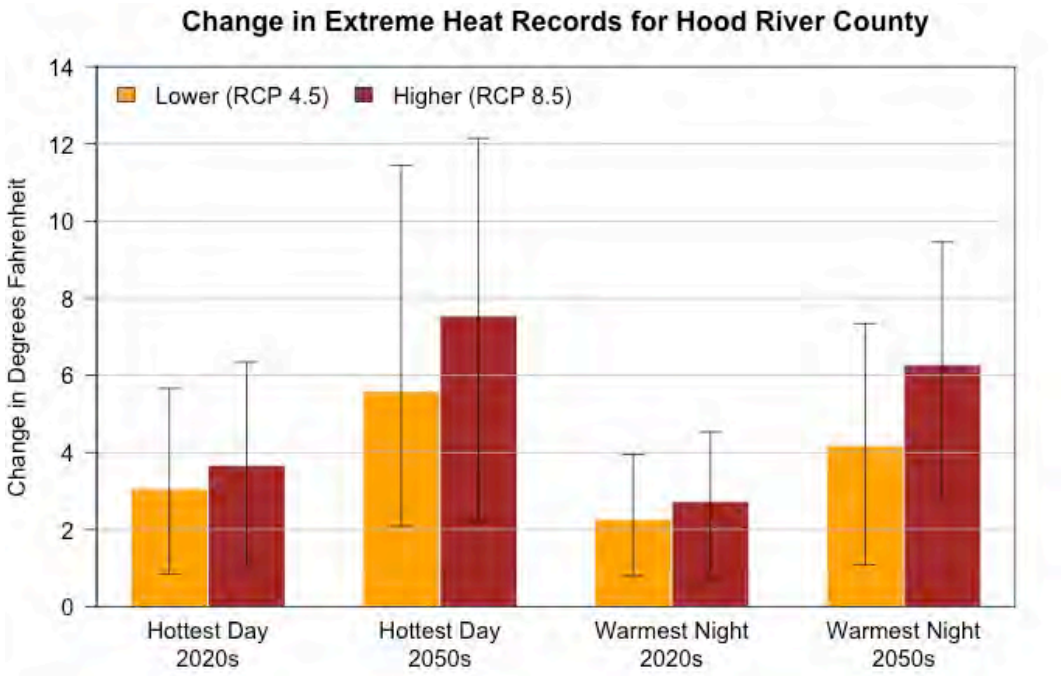


Figure 5 Projected future changes in the hottest day of the year (left two sets of bars) and warmest night of the year (right two sets of bars) for Hood River County from the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models. The bars and whiskers display the mean and range, respectively, of changes across the 20 GCMs.

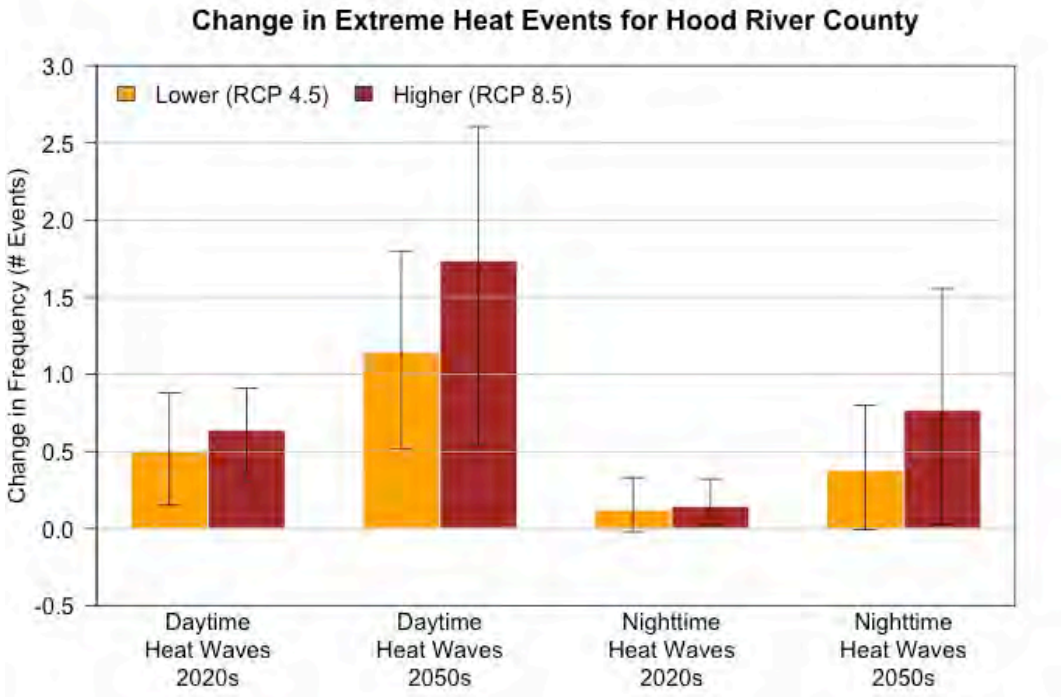


Figure 6 Projected future changes in the number of daytime heat waves (left two sets of bars) and number of nighttime heat waves (right two sets of bars) for Hood River County from the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models. The bars and whiskers display the mean and range, respectively, of changes across the 20 GCMs. Daytime heat waves are defined as events with three or more consecutive days with maximum temperature of at least 90°F; nighttime heat waves are defined as events with three or more consecutive days with minimum temperature of at least 65°F.

Key Messages:

⇒ Extreme heat events are expected to increase in frequency, duration, and intensity due to continued warming temperatures.

⇒ In Hood River County, all the extreme heat metrics in Table 4 are projected to increase by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Table 5).

⇒ In Hood River County, the frequency of hot days with temperatures at or above 90°F is projected to increase on average by 12 days (with a range of 3 to 19 days) by the 2050s under the higher emissions scenario compared to the historical baseline.

⇒ In Hood River County, the temperature of the hottest day of the year is projected to increase by 8°F (with a range of 2 to 12°F) by the 2050s under the higher emissions scenario compared to the historical baseline.

Cold Waves

Over the past century, cold extremes have become less frequent and severe in the Northwest; this trend is expected to continue under future global warming of the climate system (Vose *et al.*, 2017). This report presents projected changes for three metrics of cold extremes for both daytime (maximum temperature) and nighttime (minimum temperature) (Table 6).

Table 6 Cold extreme metrics and definitions

Metric	Definition
Cold Days	Number of days per year maximum temperature is less than or equal to 32°F
Cold Nights	Number of days per year minimum temperature is less than or equal to 0°F
Coldest Day	Annual minimum of maximum temperature
Coldest Night	Annual minimum of minimum temperature
Daytime Cold Waves	Number of events per year with at least 3 consecutive days with maximum temperature less than or equal to 32°F
Nighttime Cold Waves	Number of events per year with at least 3 consecutive days with minimum temperature less than or equal to 0°F

In Hood River County, the extreme cold metrics in Table 6 are projected to become less frequent or less cold by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Table 7). For example, by the 2050s under the higher emissions scenario, the number of cold days less than or equal to 32°F is projected to decrease by 14 days on average with a range of about 8 to 19 days. Likewise, the temperature of the coldest night of the year is projected to increase by 7.1°F on average with a range of -0.3°F to 11.9°F and the frequency of daytime cold waves is projected to decrease by 1.7 events per year.

Projected changes in the frequency extreme cold days (i.e., Cold Days and Cold Nights) are shown in Figure 7. Projected changes in the magnitude of cold records (i.e., Coldest Day and Coldest Night) are shown in Figure 8. Projected changes in the frequency of extreme cold events (i.e., Daytime Cold Waves and Nighttime Cold Waves) are shown in Figure 9.

Table 7 Mean and range of projected future changes in extreme cold metrics for Hood River County from the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models.

	Change by Early 21st Century "2020s"		Change by Mid 21st Century "2050s"	
	Lower	**Higher**	**Lower**	**Higher**
Cold Days	-6.9 days (-11.8 to -0.5)	-8.2 days (-12.8 to -2.3)	-12.2 days (-16 to -5.8)	-13.9 days (-19.3 to -7.5)
Cold Nights	-0.2 days (-0.8 to 0.5)	-0.4 days (-0.9 to 0.0)	-0.6 days (-1.1 to 0.1)	-0.6 days (-1.1 to 0.0)
Coldest Day	+1.7°F (-2.5 to 3.9)	+3.0°F (-0.3 to 5.5)	+4.9°F (0.5 to 10.2)	+5.8°F (0.3 to 9.8)
Coldest Night	+2.1°F (-3.5 to 6.3)	+3.7°F (0.1 to 8.8)	+6.0°F (0.9 to 10.5)	+7.1°F (-0.3 to 11.9)
Daytime Cold Waves	-0.8 events (-1.5 to 0.1)	-1.0 events (-1.6 to -0.3)	-1.5 events (-2.0 to -0.7)	-1.7 events (-2.5 to -1.0)
Nighttime Cold Waves	0.0 events (-0.1 to 0.1)	-0.1 events (-0.2 to 0.0)	-0.1 events (-0.2 to 0.0)	-0.1 events (-0.2 to 0.0)

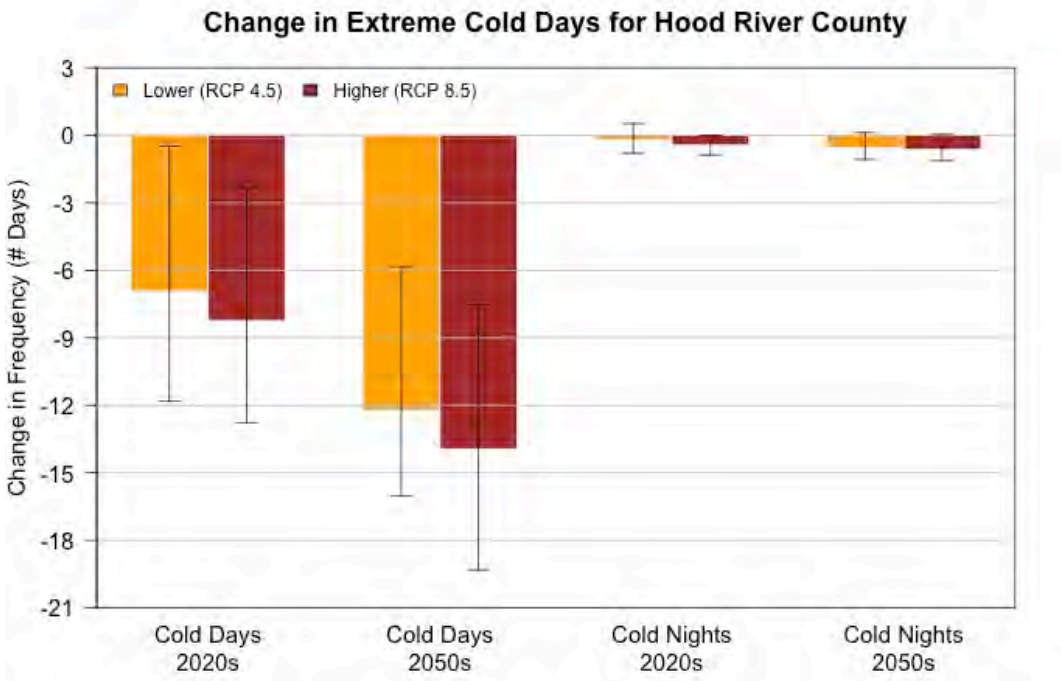


Figure 7 Projected future changes in the number of cold days (left two sets of bars) and number of cold nights (right two sets of bars) for Hood River County from the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models. The bars and whiskers display the mean and range, respectively, of changes across the 20 GCMs. Cold days are defined as days with maximum temperature at or below 32°F; cold nights are defined as days with minimum temperature at or below 0°F.

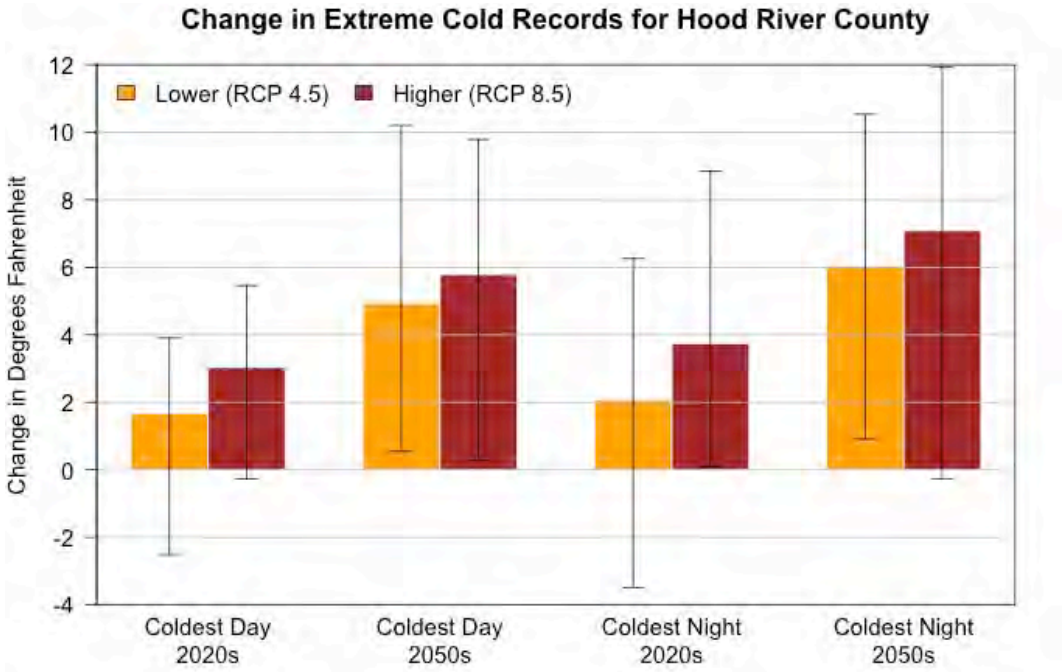


Figure 8 Projected future changes in the coldest day of the year (left two sets of bars) and coldest night of the year (right two sets of bars) for Hood River County from the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models. The bars and whiskers display the mean and range, respectively, of changes across the 20 GCMs.

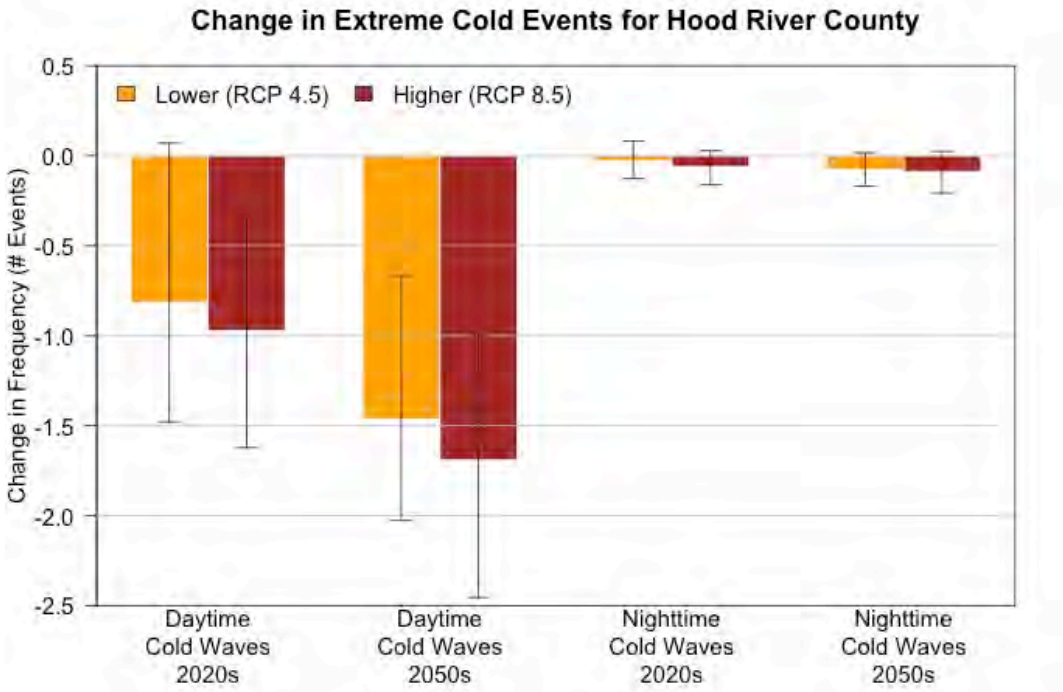


Figure 9 Projected future changes in the number of daytime cold waves (left two sets of bars) and number of nighttime cold waves (right two sets of bars) for Hood River County from the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models. The bars and whiskers display the mean and range, respectively, of changes across the 20 GCMs. Daytime cold waves are defined as events with three or more consecutive days with maximum temperature at or below 32°F; nighttime cold waves are defined as events with three or more consecutive days with minimum temperature at or below 0°F.

Key Messages:

⇒ Cold extremes are still expected to occur from time to time, but with much less frequency and intensity as the climate warms.

⇒ In Hood River County, the extreme cold metrics in Table 6 are projected to become less frequent or less cold by the 2020s and 2050s under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Table 7).

⇒ In Hood River County, the frequency of days at or below freezing is projected to decline on average by 14 days (with a range of 8 to 19 days) by the 2050s under the higher emissions scenario compared to the historical baseline.

⇒ In Hood River County, the temperature of the coldest night of the year is projected to increase by 7°F (with a range of 0 to 12°F) by the 2050s under the higher emissions scenario compared to the historical baseline.

Heavy Rains

There is greater uncertainty in future projections of precipitation-related metrics than temperature-related metrics. This is because of the large natural variability in precipitation patterns and the fact that the atmospheric patterns that influence precipitation are manifested differently across GCMs. From a global perspective, mean precipitation is likely to decrease in many dry regions in the sub-tropics and mid-latitudes and increase in many mid-latitude wet regions (IPCC, 2013). That boundary between mid-latitude increases and decreases in precipitation is positioned a little differently for each GCM, which results in some models projecting increases and others decreases in Oregon (Mote *et al.*, 2013).

In Oregon, observed precipitation is characterized by high year-to-year variability and future precipitation trends are expected to continue to be dominated by this large natural variability. On average, summers in Oregon are projected to become drier and other seasons to become wetter resulting in a slight increase in annual precipitation by the 2050s. However, some models project increases and others decreases in each season (Dalton *et al.*, 2017).

Extreme precipitation events in the Pacific Northwest are governed both by atmospheric circulation and by how it interacts with complex topography. Atmospheric rivers—long, narrow swaths of warm, moist air that carry large amounts of water vapor from the tropics to mid-latitudes—generally result in coherent extreme precipitation events west of the Cascade Range, while closed low pressure systems often lead to isolated precipitation extremes east of the Cascade Range (Parker and Abatzoglou, 2016).[2]

Observed trends in the frequency of extreme precipitation events across Oregon have depended on the location, time frame, and metric considered, but overall the frequency has not changed substantially. As the atmosphere warms, it is able to hold more water vapor that is available for precipitation. As a result, the frequency and intensity of extreme precipitation events are expected to increase slightly in the future (Dalton *et al.*, 2017). This report presents projected changes for four metrics of precipitation extremes (Table 8).

Table 8 Precipitation extreme metrics and definitions

Metric	Definition
Wettest Day	Annual maximum 1-day precipitation per water year
Wettest Five-Days	Annual maximum 5-day precipitation total per water year
Wet Days	Number of days with precipitation greater than 0.75 inches per year
Landslide Risk Days	Number of days per water year exceeding the USGS landslide threshold[3]: https://pubs.er.usgs.gov/publication/ofr20061064 o P3/(3.5-.67*P15)>1 where o P3 = Previous 3-day precipitation accumulation o P15 = 15-day precipitation accumulation prior to P3

[2] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017)

[3] This threshold was developed for Seattle, Washington and may or may not have similar applicability to other locations.

In Hood River County, the magnitude of precipitation on the wettest day and wettest consecutive five days is projected to increase on average by the by the 2020s and 2050s under both the lower and higher emissions scenarios (Table 9). However, some models project decreases in these metrics for certain time periods and scenarios. For example, by the 2050s under the higher emissions scenario, the magnitude, or amount, of precipitation on the wettest day of the year is projected to increase by 15.5% on average with a range of about 0.7 to 27.2%. Likewise, the magnitude of precipitation on the wettest consecutive five days of the year is projected to increase by 10.5% on average with a range of -3.5 to 28.9%. The average number of days per year with precipitation greater than ¾" isn't projected to change substantially. For example, by the 2050s under the higher emissions scenario, climate models project a range of changes in frequency of wet days from four fewer days to four more days per year.

Landslides are often triggered by rainfall when the soil becomes saturated. A cumulative rainfall threshold serves as a surrogate for landslide risk. For Hood River County, the average number of days per year exceeding the landslide risk threshold is projected to remain about the same. It is important to note that the landslide threshold used in this report was developed for Seattle, Washington and may or may not have similar applicability to other locations.

Projected changes in the magnitude of extreme precipitation events (i.e., Wettest Day and Wettest Five-Days) are shown in Figure 10. Projected changes in the frequency of extreme precipitation events (i.e., Wet Days and Landslide Risk Days) are shown in Figure 11.

Table 9 Mean and range of projected future changes in extreme precipitation metrics for Hood River County from the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models.

	Change by Early 21st Century "2020s"		Change by Mid 21st Century "2050s"	
	Lower	**Higher**	**Lower**	**Higher**
Wettest Day	+9.4% (-9.8 to 22)	+8.9% (-3.2 to 25.3)	+14.0% (0.0 to 26.7)	+15.5% (0.7 to 27.2)
Wettest Five-Days	+5.7% (-7.8 to 20.5)	+4.2% (-5.8 to 20.7)	+9.7% (-4.1 to 24.3)	+10.5% (-3.5 to 28.9)
Wet Days	+0.2 days (-1.3 to 2.4)	-0.2 days (-3.2 to 2.1)	+0.7 days (-2.4 to 3.5)	+0.6 days (-4.1 to 4.2)
Landslide Risk Days	-0.1 days (-2.9 to 2.4)	-0.1 days (-2.2 to 1.6)	-0.4 days (-2.3 to 2.1)	-0.1 days (-2.5 to 2.7)

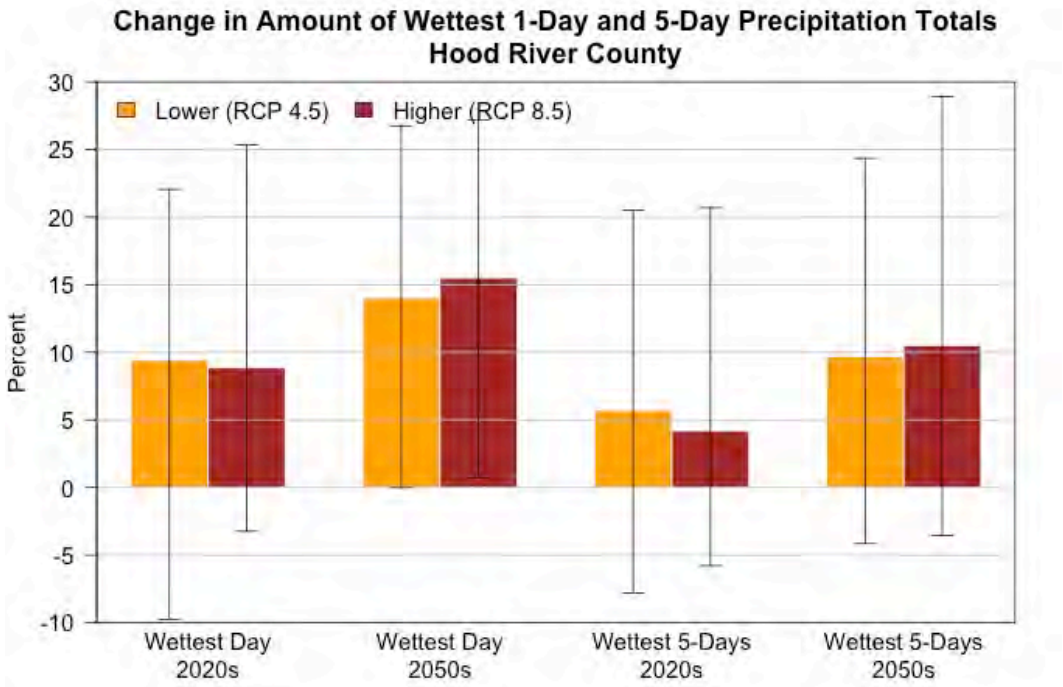


Figure 10 Projected future changes in the wettest day of the year (left two sets of bars) and wettest consecutive five days of the year (right two sets of bars) for Hood River County from the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models. The bars and whiskers display the mean and range, respectively, of changes across the 20 GCMs.

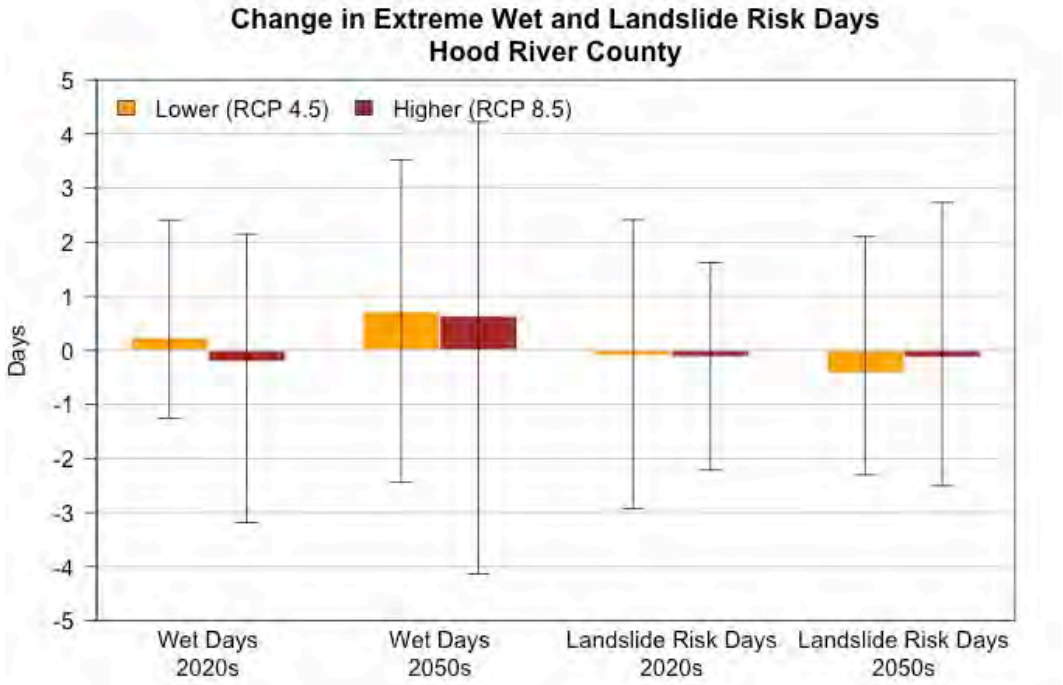


Figure 11 Projected future changes in the frequency of wet days (left two sets of bars) and landslide risk days (right two sets of bars) for Hood River County from the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 20 global climate models. The bars and whiskers display the mean and range, respectively, of changes across the 20 GCMs.

Key Messages:

⇒ The intensity of extreme precipitation events is expected to increase slightly in the future as the atmosphere warms and is able to hold more water vapor.

⇒ In Hood River County, the magnitude of precipitation on the wettest day and wettest consecutive five days per year is projected to increase on average by about 16% (with a range of 1% to 27%) and 11% (with a range of -4% to 29%), respectively, by the 2050s under the higher emissions scenario compared to the historical baseline.

⇒ In Hood River County, the frequency of days with at least ¾" of precipitation and the frequency of days exceeding a threshold for landslide risk is not projected to change substantially.

River Flooding

Future streamflow magnitude and timing in the Pacific Northwest is projected to shift toward higher winter runoff, lower summer and fall runoff, and an earlier peak runoff, particularly in snow-dominated regions (Naz *et al.*, 2016; Raymondi *et al.*, 2013).[4] These changes are expected to result from warmer temperatures causing precipitation to fall more as rain and less as snow, in turn causing snow to melt earlier in the spring; and in combination with increasing winter precipitation and decreasing summer precipitation (Dalton *et al.*, 2017).

Warming temperatures and increased winter precipitation are expected to increase flood risk for many basins in the Pacific Northwest, particularly mid- to low-elevation mixed rain-snow basins with near freezing winter temperatures (Tohver *et al.*, 2014). The greatest changes in peak streamflow magnitudes are projected to occur at intermediate elevations in the Cascade Range and the Blue Mountains (Safeeq *et al.*, 2015). Recent advances in regional hydro-climate modeling support this expectation, projecting increases in extreme high flows for most of the Pacific Northwest, especially west of the Cascade Crest (Najafi and Moradkhani, 2015; Naz *et al.*, 2016; Salathé *et al.*, 2014). One study, using a single climate model, projects flood risk to increase in the fall due to earlier, more extreme storms, including atmospheric river events, and to a shift of precipitation from snow to rain (Salathé *et al.*, 2014).[5]

Some of the Pacific Northwest's largest floods occur when copious warm rainfall from atmospheric rivers combine with a strong snowpack, resulting in rain-on-snow flooding events (Safeeq *et al.*, 2015). During 1998–2014 in the California Sierra Nevada, atmospheric rivers were associated with half of all rain-on-snow events (Guan *et al.*, 2016). As a result of climate warming, rain-on-snow events are projected to decline at lower elevations, due to decreasing snow cover, and to increase at higher elevations as the number of rainy as opposed to snowy days increases (Safeeq *et al.*, 2015; Surfleet and Tullos, 2013).[6] How such changes in rain-on-snow frequency would affect high streamflow events is varied. For example, projections for the Santiam River, OR, show an increase in annual peak daily flows with moderate return intervals (<10 years) but a decrease at higher (> 10-year) return intervals (Surfleet and Tullos, 2013).

This report describes projected changes in the mean monthly hydrograph of the Columbia River at The Dalles. Mean monthly flows do not translate directly to flood risk because floods occur at shorter time scales. However, increases in higher monthly flow may imply increases in flood likelihood, particularly if increases are projected for months when flood occurrence has been historically high. This report also describes changes in the magnitude of flood events in terms of the water year maximum daily flows with 50%, 10%, and 4% exceedance probabilities. In other words, these are the projected changes in the magnitude of the 2-year, 10-year, and 25-year return period single-day flood events, respectively. This flood analysis compares flood magnitudes between a historical baseline (1961–2010) and the 2050s (here, 2031–2080). These longer time periods, as required by the flood analysis, overlap with the time periods used throughout the rest of the report by adding a decade to

[4] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017)

[5] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017)

[6] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017)

either end. An analysis of flood risk projections for the 2020s was not done because the required time period would have overlapped the historical baseline. These analyses are exploratory and should not be used for engineering or design.

On the Columbia River at The Dalles, the monthly hydrograph is characteristic of a snow-dominated basin with peak flows during the late spring snowmelt season (Figure 12). By the 2050s, under both emissions scenarios, the peak streamflow is projected to shift earlier in the spring as warmer temperatures cause the snowpack to melt earlier. In addition, winter streamflow is projected to increase due to increased winter precipitation and that precipitation falling more as rain than snow.

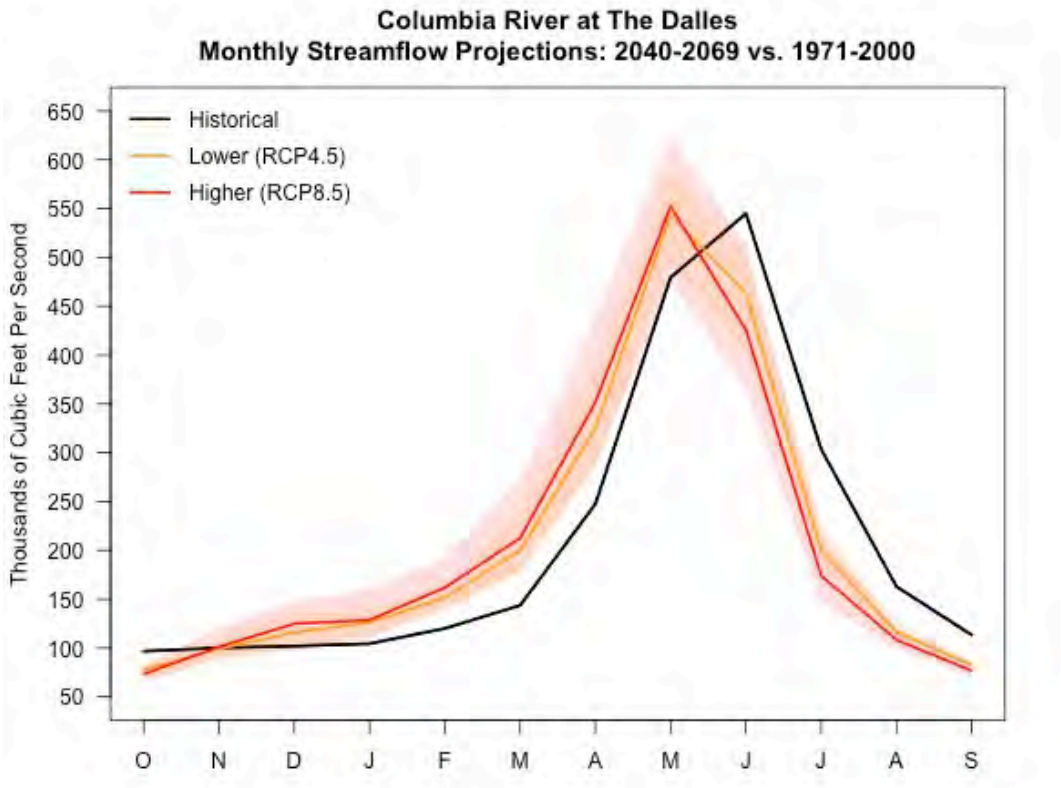


Figure 12 Simulated historical and future bias-corrected mean monthly non-regulated streamflow at the Columbia River at The Dalles for 2040–2069 compared to 1971–2000. Solid lines and shading depict the mean and range across ten global climate models. (Data source: Integrated Scenarios of the Future Northwest Environment, https://climatetoolbox.org/tool/Streamflow-Projections)

On the Columbia River at The Dalles, the magnitude of the 2-year (50% exceedance probability) and 10-year (10% exceedance probability) single-day flood events are projected, on average, to remain about the same for the period 2031–2080 compared with 1961–2010 under both the lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios (Figure 13). The magnitude of the 25-year (4% exceedance probability) single-day flood event is projected to increase by about 4% under both emissions scenarios. However, some models show increases and others show decreases in the magnitude of maximum daily streamflows for each flood frequency considered. Moreover, the wide spread in individual model projections relative to the size of the mean change implied there is not strong evidence for a substantial change in non-regulated flood magnitudes on the Columbia River at The Dalles.

The Columbia River with its series of dams is highly managed for flood control and flow regulation can overcome climate signals. Past streamflow trends on the Columbia River at the Dalles display a regulatory signal of declining spring peak flows during 1950–2011 (Hatcher and Jones, 2013).

Across the western US, the 100-year and 25-year peak flow magnitude is projected to increase at a majority of streamflow sites by the 2070–2099 period compared to the 1971–2000 historical baseline under the higher emissions scenario (RCP 8.5) (Maurer *et al.*, 2018). However, along the Columbia River bordering Oregon, peak flows are projected to decrease as a result of the complex interaction between earlier snowmelt and the transition of precipitation falling more as rain and less as snow in this snow-dominated basin (Maurer *et al.*, 2018).

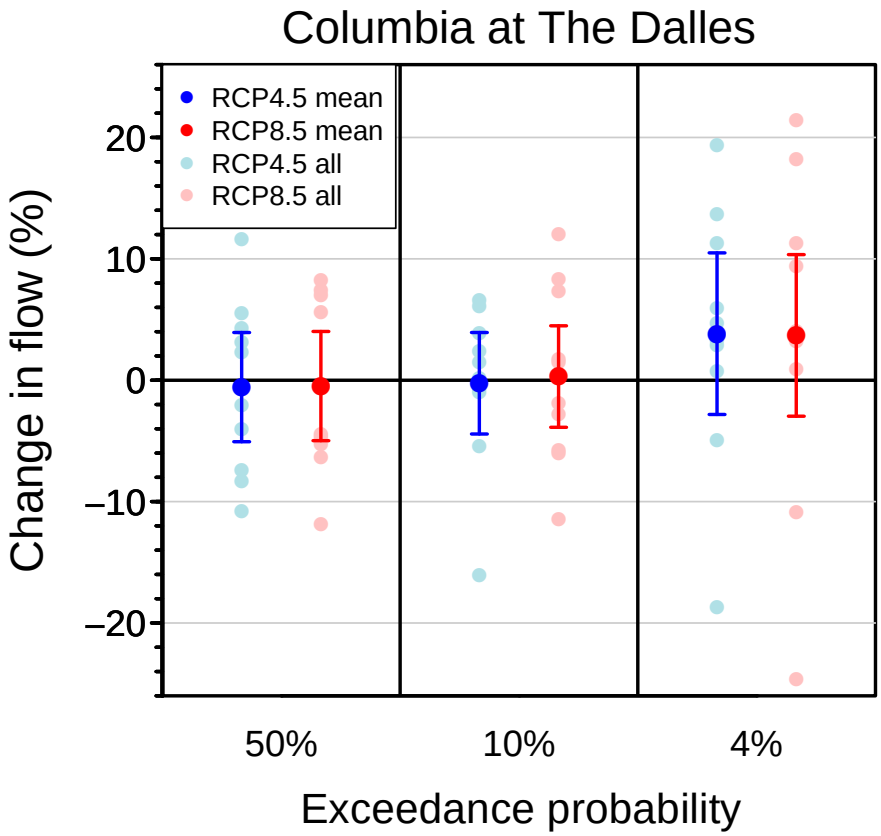


Figure 13 Projected change in water year maximum daily non-regulated streamflows with 50%, 10%, and 4% probability of exceedance for the Columbia River at The Dalles between 1961–2010 and 2031–2080 under lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios. Larger blue and red dots and bars depict the mean plus and minus two standard errors across all projections (ten global climate models). The smaller light blue and light red dots represent individual models. (Data source: Integrated Scenarios of the Future Northwest Environment, https://climate.northwestknowledge.net/IntegratedScenarios/; Figure source: David Rupp, OCCRI)

Key Messages:

- ⇒ Flood risk to Hood River County from the Columbia River is not expected to change substantially based on insignificant projected changes in non-regulated flood magnitudes on the Columbia River at The Dalles.
- ⇒ Mid- to low-elevation tributaries, such as Hood River, that are near the freezing level in winter, receiving a mix of rain and snow, may experience an increase in winter flood risk due to warmer winter temperatures causing precipitation to fall more as rain and less as snow.

Drought

This report presents future changes in three variables indicative of drought conditions—spring snowpack, summer soil moisture[7], and summer runoff. Across the western US, mountain snowpack is projected to decline leading to reduced summer soil moisture in mountainous environments (Gergel *et al.*, 2017). In parts of eastern Oregon, summer soil moisture is projected to increase on average, but the range of projected changes is large and depends on the models' projected change in precipitation, with some models projecting increases and others decreases (Gergel *et al.*, 2017).

Climate change is expected to result in lower summer streamflows in snow-dominated basins across the Pacific Northwest as snowpack melts off earlier due to warmer temperatures and summer precipitation decreases (Dalton *et al.*, 2017). See, for example, the decrease in summer flows expected for the Columbia River at The Dalles (Figure 12) by the 2050s under both lower and higher emissions scenarios.

The sensitivity of summer streamflow to climate change is influenced by the basin's hydrogeography (Safeeq *et al.*, 2014). Summer low flows on the Hood River are buffered by glacial melt from the Mount Hood headwaters during the dry season. As temperatures warm, glaciers will continue to recede. Initially, increased rates of glacial melt may actually contribute more water to streamflow. In time, however, glacial melt is expected to become less reliable as a buffer for dry season low streamflow (Frans *et al.*, 2016). The contribution of glacial melt water to water supply in the Hood River basin is projected to decline by the end of the 21st century by 14–63% under a lower emissions scenario and by 18–78% under a higher emissions scenario (Frans *et al.*, 2016) (Figure 14).

This report also presents changes in drought conditions for low spring snowpack, low summer soil moisture, and low summer runoff in terms of a change in the frequency of the historical baseline 1-in-5 year event (that is, an event having a 20% chance of occurrence in any given year). The future projections, displayed in the orange and brown bars of Figure 15, are the frequency in the future period of the magnitude of the event that has a 20% frequency in the historical period. In Hood River County, spring snowpack (that is, the snow water equivalent on April 1), summer runoff, and summer soil moisture are projected to decline under both lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios by the 2050s. This leads to the magnitude of low summer soil moisture, low spring snow pack, and low summer runoff expected with a 20% chance in any given year of the historical period being projected to occur much more frequently by the 2050s under both emissions scenarios (Figure 15). The 2020s were not evaluated in this drought analysis, but can be expected to be similar but of smaller magnitude to the changes for the 2050s.

[7] Soil moisture projections are for the total moisture in the soil column from the surface to 140 cm below the surface.

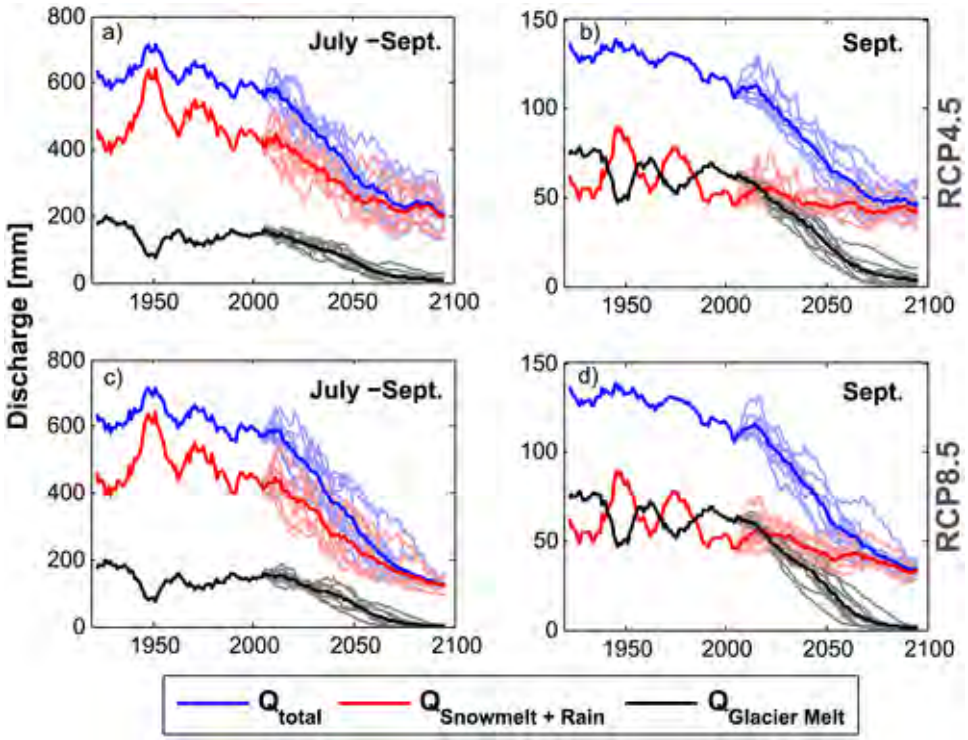


Figure 14 Historical and future (a and c) dry season (July to September) and (b and d) September discharge volume (Q) of Eliot Creek, a tributary of the Hood River, for (a and b) lower (RCP4.5) and (c and d) higher (RCP8.5) emissions scenarios. (Figure Source: Implications of decadal to century scale glacio-hydrological change for water resources of the Hood River basin, OR, USA, Volume: 30, Issue: 23, Pages: 4314-4329, First published: 07 April 2016, DOI: https://doi.org/10.1002/hyp.10872)

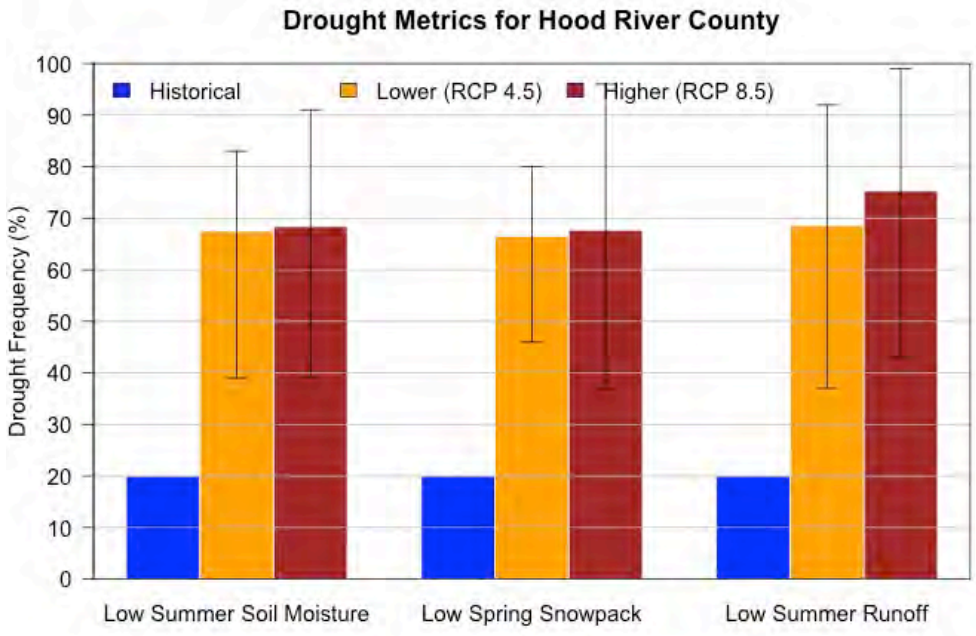


Figure 15 Frequency of the historical baseline (1971–2000) 1-in-5 year event (by definition 20% frequency) of low summer soil moisture (average of June-July-August), low spring snowpack (April 1 snow water equivalent), and low summer runoff (average of June-July-August) for the future period 2040–2069 for lower (RCP 4.5) and higher (RCP 8.5) emissions scenarios. The bar and whiskers depict the mean and range across ten global climate models. (Data Source: Integrated Scenarios of the Future Northwest Environment, https://climate.northwestknowledge.net/IntegratedScenarios/)

Key Messages:

⇒ Drought conditions, as represented by low summer soil moisture, low spring snowpack, and low summer runoff, are projected to become more frequent in Hood River County by the 2050s.

⇒ Summer streamflows in the Hood River have historically been buffered by glacial melt, but the contribution of glacial melt to water supply in the Hood River basin is projected to decline by the end of the 21st century.

Wildfire

Over the last several decades, warmer and drier conditions during the summer months have contributed to an increase in fuel aridity and enabled more frequent large fires, an increase in the total area burned, and a longer fire season across the western United States, particularly in forested ecosystems (Dennison *et al.*, 2014; Jolly *et al.*, 2015; Westerling, 2016; Williams and Abatzoglou, 2016). The lengthening of the fire season is largely due to declining mountain snowpack and earlier spring snowmelt (Westerling, 2016). Recent wildfire activity in forested ecosystems is partially attributed to human-caused climate change: during the period 1984–2015, about half of the observed increase in fuel aridity and 4.2 million hectares (or more than 16,000 square miles) of burned area in the western United States were due to human-caused climate change (Abatzoglou and Williams, 2016). Under future climate change, wildfire frequency and area burned are expected to continue increasing in the Pacific Northwest (Barbero *et al.*, 2015; Sheehan *et al.*, 2015).[8]

As a proxy for wildfire risk, this report considers a fire danger index called 100-hour fuel moisture (FM100), which is a measure of the amount of moisture in dead vegetation in the 1–3 inch diameter class available to a fire. It is expressed as a percent of the dry weight of that specific fuel. FM100 is a common index used by the Northwest Interagency Coordination Center to predict fire danger. A majority of climate models project that FM100 would decline across Oregon by the 2050s under the higher (RCP 8.5) emissions scenario (Gergel *et al.*, 2017). This drying of vegetation would lead to greater wildfire risk, especially when coupled with projected decreases in summer soil moisture. This report defines a "very high" fire danger day to be a day in which FM100 is lower (i.e., drier) than the historical baseline 10th percentile value. By definition, the historical baseline has 36.5 very high fire danger days annually. The future change in wildfire risk is expressed as the average annual number of additional "very high" fire danger days for two future periods under two emissions scenarios compared with the historical baseline (Figure 16).

[8] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017)

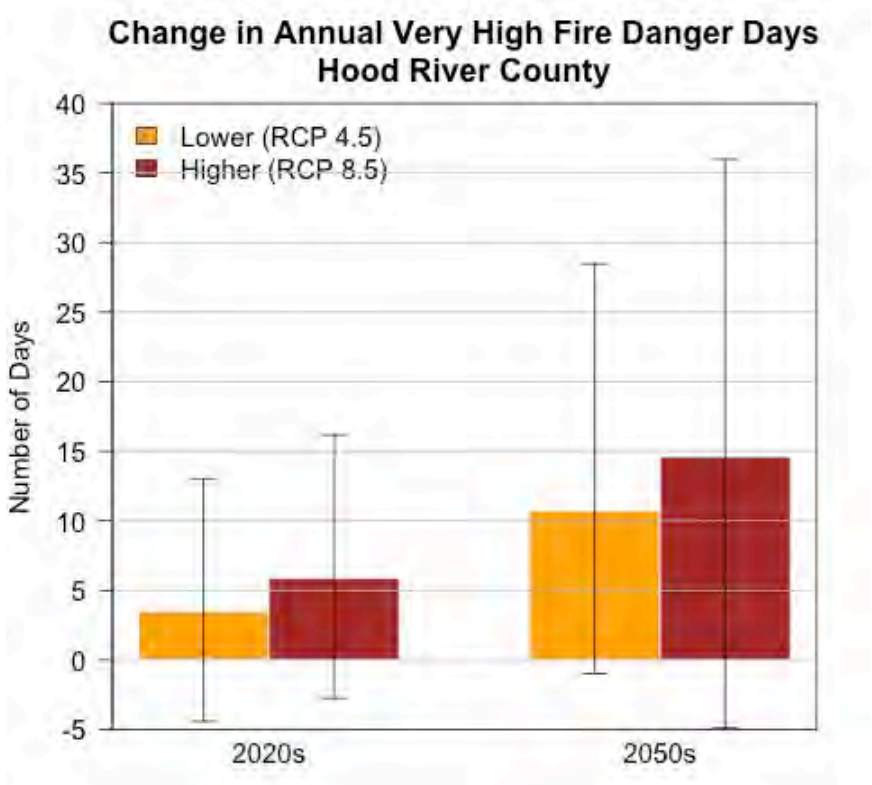


Figure 16 Projected future changes in the frequency of very high fire danger days for Hood River County from the historical baseline (1971–2000 average) for the 2020s (2010–2039 average) and 2050s (2040–2069 average) under a lower (RCP 4.5) and higher (RCP 8.5) emissions scenario based on 18 global climate models. The bars and whiskers display the mean and range, respectively, of changes across the 18 GCMs. (Data Source: Northwest Climate Toolbox, climatetoolbox.org/tool/Climate-Mapper)

Key Messages:

⇒ Wildfire risk, as expressed through the frequency of very high fire danger days, is projected to increase under future climate change in Hood River County.

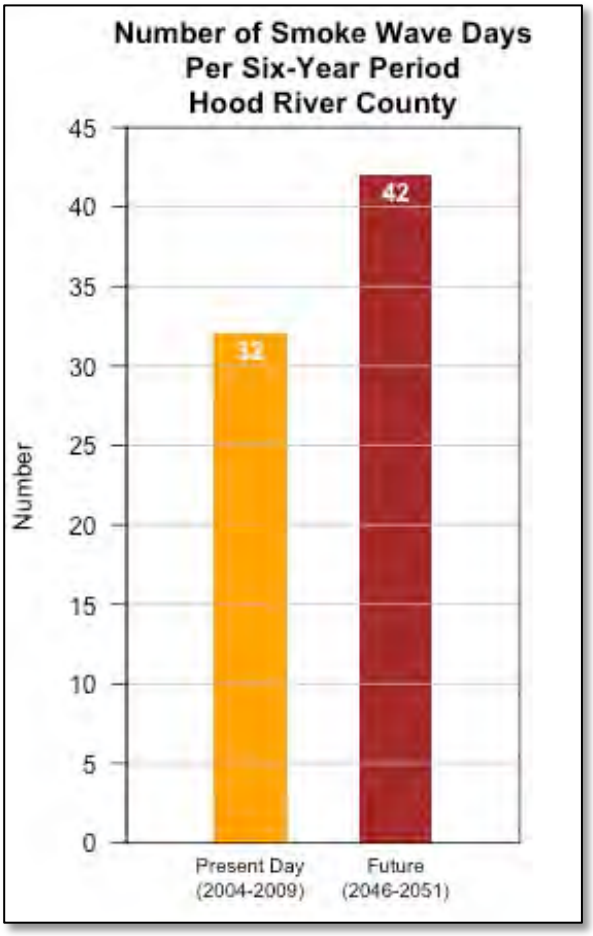
⇒ In Hood River County, the frequency of very high fire danger days per year is projected to increase on average by about 15 days (with a range of -5 to +36 days) by the 2050s under the higher emissions scenario compared to the historical baseline.

⇒ In Hood River County, the frequency of very high fire danger days per year is projected to increase on average by about 40% (with a range of -13 to +99%) by the 2050s under the higher emissions scenario compared to the historical baseline.

Air Quality

Climate change is expected to worsen outdoor air quality. Warmer temperatures may increase ground level ozone pollution, more wildfires may increase smoke and particulate matter, and longer, more potent pollen seasons may increase aeroallergens. Such poor air quality is expected to exacerbate allergy and asthma conditions and increase respiratory and cardiovascular illnesses and death (Fann *et al.*, 2016).[9] This report presents quantitative projections of future air quality measures related to fine particulate matter (PM2.5) from wildfire smoke.

Climate change is expected to result in a longer wildfire season with more frequent wildfires and greater area burned (Sheehan *et al.*, 2015). Wildfires are primarily responsible for days when air quality standards for PM2.5 are exceeded in western Oregon and parts of eastern Oregon (Liu *et al.*, 2016), although woodstove smoke and diesel emissions are also main contributors (Oregon DEQ, 2016). Across the western United States, PM2.5 levels from wildfires are projected to increase 160% by mid-century under a medium emissions pathway[11] (SRES A1B) (Liu *et al.*, 2016). This translates to a greater risk of wildfire smoke exposure through increasing frequency, length, and intensity of "smoke waves"—that is, two or more consecutive days with high levels of PM2.5 from wildfires (Liu *et al.*, 2016).[10]



The change in risk of poor air quality due to wildfire-specific PM2.5 is expressed as the number of "smoke wave" days within a six-year period in the present (2004–2009) and mid-century (2046–2051) under a medium emissions pathway[11] (Figure 17). See Appendix for description of methodology and access to the Smoke Wave data.

Figure 17 Simulated present day (2004–2009) and future (2046–2051) frequency of "smoke wave" days for Hood River County under a medium emissions scenario[11]. The bars display the mean across 15 GCMs. (Data source: Liu et al. 2016, https://khanotations.github.io/smoke-map/)

[9] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017)
[10] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017)
[11] The medium emissions pathway used is from an earlier generation of emissions scenarios. Liu et al. (2016) used SRES-A1B, which is most similar to RCP 6.0 from Figure 2.

Key Messages:

- ⇒ Under future climate change, the risk of wildfire smoke exposure is projected to increase in Hood River County.
- ⇒ In Hood River County, there is projected to be 10 more "smoke wave" days during 2046–2051 under a medium emissions scenario compared with 2004–2009.
- ⇒ In Hood River County, the number of "smoke wave" days is projected to increase by 31% by 2046–2051 under a medium emissions scenario compared with 2004–2009.

Windstorms

Climate change has the potential to alter surface winds through changes in the large-scale free atmospheric circulation and storm systems, and through changes in the connection between the free atmosphere and the surface. West of the Cascade Mountains in the Pacific Northwest, changes in surface wind speeds tend to follow changes in upper atmosphere winds associated with extratropical cyclones (Salathé *et al.*, 2015). However, there is a high degree of uncertainty in future projections of extratropical cyclone frequency (IPCC, 2013). East of the Cascades, cool air pooling is common which can impede the transport of wind energy from the free atmosphere to the surface. Changes in this factor are likely important for understanding future changes in windstorms (Salathé *et al.*, 2015). However, this is not yet well studied. Therefore, no descriptions of future changing conditions are included in this report.

Key Messages:

⇒ Limited research suggests very little, if any, change in the frequency and intensity of windstorms in the Pacific Northwest as a result of climate change.

Dust Storms

Climate, through precipitation and winds, and vegetation coverage can influence the frequency and magnitude of dust events, or dust storms, which primarily concern parts of eastern Oregon. Periods of low precipitation can dry out the soils increasing the amount of soil particulate matter available to be entrained in high winds. In addition, the amount of vegetation cover can influence the amount of soil susceptible to high winds.

One study found that in eastern Oregon, precipitation is the dominant factor affecting dust event frequency in the spring whereas vegetation cover is the dominant factor in the summer (Pu and Ginoux, 2017). The same study projected that in the summertime in eastern Oregon, dust event frequency would decrease largely due to a decrease in bareness (or an increase in vegetation cover) (Pu and Ginoux, 2017). There were no clear projected changes in other seasons or locations in Oregon. These projections compare the 2051–2100 average under a higher emissions scenario (RCP 8.5) with the 1861–2005 average.

Another study found that wind erosion in Columbia Plateau agricultural areas is projected to decrease by mid-century under a lower emissions scenario (RCP 4.5) largely due to increases in biomass production, which retain the soil (Sharratt *et al.*, 2015). The increase in vegetation cover in both studies is likely due to the fertilization effect of increased amounts of carbon dioxide in the atmosphere and warmer temperatures. Tillage practices may also influence the amount of soil available to winds. Therefore, no descriptions of future changing conditions are included in this report.

Key Messages:

⇒ Limited research suggests that the risk of dust storms in summer would decrease in eastern Oregon under climate change in areas that experience an increase in vegetation cover from the carbon dioxide fertilization effect.

Increased Invasive Species & Pests

Warming temperatures, altered precipitation patterns, and increasing atmospheric carbon dioxide levels increase the risk for invasive species, insect and plant pests for forest and rangeland vegetation, and cropping systems.

Warming and more frequent drought will likely lead to a greater susceptibility among trees to insects and pathogens, a greater risk of exotic species establishment, more frequent and severe forest insect outbreaks (Halofsky and Peterson, 2016), and increased damage by a number of forest pathogens (Vose *et al.*, 2016). In Oregon and Washington, mountain pine beetle (*Dendroctonus ponderosae*) and western spruce budworm (*Choristoneura freemani*) are the most common native forest insect pests, and both have caused substantial tree mortality and defoliation over the past several decades (Meigs *et al.*, 2015).[12]

Climatic warming has facilitated the expansion and survival of mountain pine beetles, particularly in areas that have historically been too cold for the insect (Littell *et al.*, 2013). Across the western United States, the time between generations among different populations of mountain pine beetles is similar; however, the amount of thermal units required to complete a generation cycle was significantly less for beetles at cooler sites (Bentz *et al.*, 2014). Winter survival and faster generation cycles could be favored under future projections of decreases in the number of freeze days (Rawlins *et al.*, 2016).[13]

Western spruce budworm is a destructive defoliator that sporadically breaks out in interior Oregon Douglas-fir (*Pseudotsuga menziesii*) forests (Flower *et al.*, 2014). An analysis of three hundred years of tree ring data reveals that outbreaks tended to occur near the end of a drought, when trees' physiological thresholds had likely been reached. This analysis suggests that such outbreaks would likely intensify under the more frequent drought conditions that are projected for the future (Flower *et al.*, 2014), unless increasing atmospheric carbon dioxide, which may enhance water use efficiency, mitigates drought stress.[14]

More frequent rangeland droughts could facilitate invasion of non-native weeds as native vegetation succumbs to drought or wildfire cycles, leaving bare ground (Vose *et al.*, 2016). Cheatgrass (*Bromus tectorum L.*), a lower nutritional quality forage grass, facilitates more frequent fires, which reduces the capacity of shrub steppe ecosystem to provide livestock forage and critical wildlife habitat (Boyte *et al.*, 2016). Cheatgrass is a highly invasive species in the rangelands in the West that is projected to expand northward (Creighton *et al.*, 2015) and remain stable or increase in cover in most parts of the Great Basin (Boyte *et al.*, 2016) under climate change.[15]

Crop pests and pathogens may continue to migrate poleward under global warming as has been observed globally for several types since the 1960s (Bebber *et al.*, 2013). Much

[12] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017), p. 49

[13] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017), p. 49

[14] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017), p. 49–50

[15] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017), p. 70

remains to be learned about which pests and pathogens are most likely to affect certain crops as the climate changes, and about which management strategies will be most effective.[16]

Key Messages:

⇒ Warming temperatures, altered precipitation patterns, and increasing atmospheric carbon dioxide levels increase the risk for invasive species, insect and plant pests for forest and rangeland vegetation, and cropping systems.

Loss of Wetland Ecosystems

Wetlands play key roles in major ecological processes and provide a number of essential ecosystem services: flood reduction, groundwater recharge, pollution control, recreational opportunities, and fish and wildlife habitat, including for endangered species.[17] Climate change stands to affect freshwater wetlands Oregon through changes in the duration, frequency, and seasonality of precipitation and runoff; decreased groundwater recharge; and higher rates of evapotranspiration (Raymondi *et al.*, 2013).

Reduced snowpack and altered runoff timing may contribute to the drying of many ponds and wetland habitats across the Northwest.[18] The absence of water or declining water levels in permanent or ephemeral wetlands would affect resident and migratory birds, amphibians, and other animals that rely on the wetlands (Dello and Mote, 2010). However, potential future increases in winter precipitation may lead to the expansion of some wetland systems, such as wetland prairies.[19]

In Oregon's western Great Basin, changes in climate would alter the water chemistry of fresh and saline wetlands affecting the migratory water birds that depend on them. Hotter summer temperatures would cause freshwater sites to become more saline making them less useful to raise young birds that haven't yet developed the ability to process salt. At the same time, increased precipitation would cause saline sites to become fresher thereby decreasing the abundance of invertebrate food supply for adult water birds (Dello and Mote, 2010).

Key Messages:

⇒ Freshwater wetland ecosystems are sensitive to warming temperatures and altered hydrological patterns, such as changes in precipitation seasonality and reduction of snowpack.

[16] Verbatim from the Third Oregon Climate Assessment Report (Dalton *et al.*, 2017), p. 67
[17] Verbatim from the Oregon Climate Change Adaptation Framework, p. 62
[18] Verbatim from the Climate Change in the Northwest (Dalton *et al.*, 2013), p. 53
[19] Verbatim from the Climate Change in the Northwest (Dalton *et al.*, 2013), p. 53

Appendix

Future Climate Projections Background

Read more about emissions scenarios, global climate models, and uncertainty in the Climate Science Special Report, Volume 1 of the Fourth National Climate Assessment (https://science2017.globalchange.gov).

Emissions Scenarios: https://science2017.globalchange.gov/chapter/4#section-2

Global Climate Models & Downscaling:
https://science2017.globalchange.gov/chapter/4#section-3

Uncertainty: https://science2017.globalchange.gov/chapter/4#section-4

Climate & Hydrological Data

Statistically downscaled GCM output from the Fifth phase of the Coupled Model Intercomparison Project (CMIP5) served as the basis for future projections of temperature, precipitation, and hydrology variables. The coarse resolution of GCMs output (100-300 km) was downscaled to a resolution of about 6km using the Multivariate Adaptive Constructed Analogs (MACA) method, which has demonstrated skill in complex topographic terrain (Abatzoglou and Brown, 2012). The MACA approach utilizes a gridded training observation dataset to accomplish the downscaling by applying bias-corrections and spatial pattern matching of observed large- scale to small-scale statistical relationships. (For a detailed description of the MACA method see:
http://maca.northwestknowledge.net/MACAmethod.php.)

This downscaled gridded meteorological data (i.e., MACA data) is used as the climate inputs to an integrated climate-hydrology-vegetation modeling project called Integrated Scenarios of the Future Northwest Environment (https://climate.northwestknowledge.net/IntegratedScenarios/). Snow dynamics were simulated using the Variable- Infiltration Capacity hydrological model (VIC version 4.1.2.l; (Liang *et al.*, 1994) and updates) run on a $1/16^{th}$ x $1/16^{th}$ (6 km) grid.

Simulations of historical and future climate for the variables maximum temperature (*tasmax*), minimum temperature (*tasmin*), and precipitation (*pr*) are available at the daily time step from 1950 to 2099 for 20 GCMs and 2 RCPs (i.e., RCP4.5 and RCP8.5). Hydrological simulations of snow water equivalent (*SWE*) are only available for the 10 GCMs used as input to VIC. Table X lists all 20 CMIP5 GCMs and indicates the subset of 10 used for hydrological simulations. Data for all the models available was obtained for each variable from the Integrated Scenarios data archives in order to get the best uncertainty estimates.

All simulated climate data and the streamflow data have been bias-corrected using quantile mapping techniques. Only SWE is presented without bias correction. Quantile mapping adjusts simulated values by creating a one-to-one mapping between the cumulative probability distribution of simulated values and the cumulative probability distribution of observed values. In practice, both the simulated and observed values of a variable (e.g.,

daily streamflow) over the some historical time period are separately sorted and ranked and the values are assigned their respective probabilities of exceedence. The bias corrected value of a given simulated value is assigned the observed value that has the same probability of exceedence as the simulated value. The historical bias in the simulations is assumed to stay constant into the future; therefore the same mapping relationship developed from the historical period was applied to the future scenarios. For MACA, a separate quantile mapping relationship was made for each non-overlapping 15-day window in the calendar year. For streamflow, a separate quantile mapping relationship was made for each calendar month.

Hydrology was simulated using the Variable-Infiltration Capacity hydrological model (VIC; Liang et al. 1994) run on a $1/16^{th}$ x $1/16^{th}$ (6 km) grid. To generate daily streamflow estimates, runoff from VIC grid cells was then routed to selected locations along the stream network using a daily-time-step routing model. Where records of naturalized flow were available, the daily streamflow estimates were then bias-corrected so that their statistical distributions matched those of the naturalized streamflows.

The wildfire danger day metric was computed using the same MACA climate variables to compute the 100-hour fuel moisture content according to the equations in the National Fire Danger Rating System.

Smoke Wave Data

Abstract from Liu et al. (2016):
Wildfire can impose a direct impact on human health under climate change. While the potential impacts of climate change on wildfires and resulting air pollution have been studied, it is not known who will be most affected by the growing threat of wildfires. Identifying communities that will be most affected will inform development of fire management strategies and disaster preparedness programs. We estimate levels of fine particulate matter ($PM_{2.5}$) directly attributable to wildfires in 561 western US counties during fire seasons for the present-day (2004–2009) and future (2046–2051), using a fire prediction model and GEOS-Chem, a 3-D global chemical transport model. Future estimates are obtained under a scenario of moderately increasing greenhouse gases by mid-century. We create a new term "Smoke Wave," defined as ≥2 consecutive days with high wildfire-specific $PM_{2.5}$, to describe episodes of high air pollution from wildfires. We develop an interactive map to demonstrate the counties likely to suffer from future high wildfire pollution events. For 2004–2009, on days exceeding regulatory $PM_{2.5}$ standards, wildfires contributed an average of 71.3 % of total $PM_{2.5}$. Under future climate change, we estimate that more than 82 million individuals will experience a 57 % and 31 % increase in the frequency and intensity, respectively, of Smoke Waves. Northern California, Western Oregon and the Great Plains are likely to suffer the highest exposure to wildfire smoke in the future. Results point to the potential health impacts of increasing wildfire activity on large numbers of people in a warming climate and the need to establish or modify US wildfire management and evacuation programs in high-risk regions. The study also adds to the growing literature arguing that extreme events in a changing climate could have significant consequences for human health.

Data can be accessed here: https://khanotations.github.io/smoke-map/

For the DLCD project, we looked at the variable "Total # of SW days in 6 yrs". This variable tallies all the days within each time period in which the fine particulate matter exceeded the threshold defined as the 98^{th} quantile of the distribution of daily wildfire-specific $PM_{2.5}$ values in the modeled present-day years, on average across the study area. Liu et al. (2016) used 15 GCMs from the Third Phase of the Coupled Model Intercomparison Project (CMIP3) under a medium emissions scenario (SRES-A1B). The data site only offers the multi-model mean value (not the range), which should be understood as the aggregate direction of projected change rather than the actual number expected.

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