Deschutes County Board of County Commissioner
1300 NW Wall St., Ste 200, Bend, OR 97701-1960
(541) 388-6570 – Fax (541) 385-3202 – www.deschutes.org

AGENDA REQUEST AND STAFF REPORT

For Board Business Meeting of July 20, 2015

Please see directions on the next page for completing this document

DATE: July 16, 2015

FROM: Nathan Garibay Dept.: Sheriff's Office Ph.: 541-617-3303

TITLE OF AGENDA ITEM: Approval of Resolution 2015-087, Adopting Updates to the Deschutes County Multi-Jurisdictional Natural Hazards Mitigation Plan

PUBLIC HEARING ON THIS DATE? No

BACKGROUND AND POLICY IMPLICATIONS:
The Deschutes County Sheriff's Office has been working with the County Community Development Department, the County Forester, and each of the cities within Deschutes County for approximately a year to draft updates to the County's Natural Hazards Mitigation Plan. The Oregon Office of Emergency Management ("OEM") and the Federal Emergency Management Agency ("FEMA") Region X officials have reviewed the Deschutes County Multi-Jurisdictional Natural Hazard Mitigation Plan and pre-approved it contingent upon this official adoption of the participating governments and entities. Because not all of the cities within the county have adopted the plan as of the date of the County's adoption, place holders have been included in the plan for when they do. This resolution adopts the plan for the County and states that the plan will be updated as each of the other jurisdictions adopt the plan.

Notice of the opportunity to comment on the plan was published on March 20, 2015. To date, the Sheriff's Office has not received any comments on the plan.

FISCAL IMPLICATIONS: Having the plan in place will help with using County resources efficiently because the plan will help guide when and where County resources will be used for emergency services in the event of a natural hazard.

RECOMMENDATION & ACTION REQUESTED:
MOTION: Approve Resolution 2015-087

ATTENDANCE: Nathan Garibay

DISTRIBUTION OF DOCUMENT:
Nathan Garibay

REVIEWED

LEGAL COUNSEL

For Recording Stamp Only

BEFORE THE BOARD OF COUNTY COMMISSIONERS OF DESCHUTES COUNTY, OREGON

A Resolution Adopting Updates to the Deschutes County Multi-Jurisdictional Natural Hazards Mitigation Plan	* * *	RESOLUTION NO. 2015-087

WHEREAS, Deschutes County 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 Federal Emergency Management Agency ("FEMA") pre- and post-disaster mitigation grant programs; and

WHEREAS, Deschutes County fully participated in the FEMA prescribed mitigation planning process to prepare this Deschutes County Multi-Jurisdictional Natural Hazards Mitigation Plan ("Plan"); and

WHEREAS, the Oregon Office of Emergency Management ("OEM") submitted to FEMA Region X its approval of the Plan, and

WHEREAS, the FEMA Region X officials have reviewed the Plan and pre-approved it contingent upon this official adoption of the participating governments and entities, see Exhibit A, attached and incorporated by reference herein; and

WHEREAS, upon the completion of the plan addenda for the cities of Bend, La Pine, Redmond and Sisters, the County intends to amend the Plan to include those addenda; now, therefore,

BE IT RESOLVED BY THE BOARD OF COUNTY COMMISSIONERS OF DESCHUTES COUNTY, OREGON, as follows:

Section 1. Deschutes County adopts the Deschutes County Multi-Jurisdictional Natural Hazards Mitigation Plan, attached as Exhibit B and incorporated by reference herein, as an official plan of Deschutes County.

///

Section 2. Deschutes County will submit this resolution to the OEM and FEMA Region X officials to enable final state and federal approval of the *Deschutes County Multi-Jurisdictional Natural Hazards Mitigation Plan.*

Dated this _____ of _____, 2015

BOARD OF COUNTY COMMISSIONERS
OF DESCHUTES COUNTY, OREGON

_____
ANTHONY DEBONE, Chair

_____
ALAN UNGER, Vice Chair

ATTEST:

_____
Recording Secretary

_____
TAMMY BANEY, Commissioner

U.S. Department of Homeland Security
FEMA Region X
Federal Regional Center
130 228th Street, SW
Bothell, WA 98021-8627

FEMA

June 30, 2015

Mr. Dennis Sigrist,
State Hazard Mitigation Officer
Oregon Military Department
Office of Emergency Management
P.O. Box 14370
Salem, Oregon 97309

Dear Mr. Sigrist:

As requested, the U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) has completed a pre-adoption review of the ***Deschutes County Multi-Jurisdictional Natural Hazards Mitigation Plan***. The plan successfully contains the required criteria, excluding the adoption, for hazard mitigation plans, as outlined in 44 CFR Part 201. This letter serves as Region 10's commitment to approve the plan upon receiving documentation of its adoption by the Community.

The plan will not be formally approved by FEMA until it is adopted. The communities are not eligible for mitigation project grants until the plan is formally approved by FEMA.

Please contact our Regional Mitigation Planning Manager, Kristen Meyers, at (425) 487-4543 with any questions.

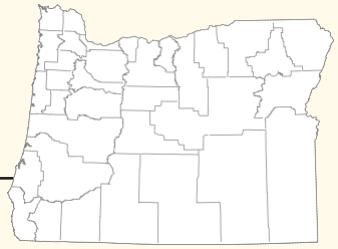
Sincerely,

for Tamra Biasco
Chief, Risk Analysis Branch
Mitigation Division

BH:bb

Deschutes County

Natural Hazards Mitigation Plan



Prepared for: Deschutes County, Bend, La Pine, Redmond, and Sisters

Photos: Oregon State Archives

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DESCHUTES COUNTY MULTI-JURISDICTIONAL NATURAL HAZARDS MITIGATION PLAN

Report for:

Deschutes County
Bend
La Pine
Redmond
Sisters

Prepared by:

Oregon Partnership for Disaster Resilience

Community Service Center
1209 University of Oregon
Eugene, Oregon 97403---1209

May 2015

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SPECIAL THANKS & ACKNOWLEDGEMENTS

Deschutes County developed this Multi---jurisdictional Natural Hazards Mitigation Plan (NHMP) through a regional partnership funded by the Federal Emergency Management Agency's Pre---Disaster Mitigation Competitive Grant Program. FEMA awarded the grant to support the update of the natural hazards mitigation plan. The county's planning process utilized a four---phased planning process, plan templates and plan development support provided by the Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon's Community Service Center. This project would not have been possible without technical and in---kind staff support provided by Deschutes County and the cities of Bend, La Pine, Redmond, and Sisters.

Partners include:

Deschutes County	FEMA Region X
City of Bend	City of La Pine
City of Redmond	City of Sisters

Oregon Military Department – Office of Emergency Management

Community Service Center, Oregon Partnership for Disaster Resilience

Project Steering Committee:

Deschutes County

Representatives from the following organizations served as steering committee members for the Deschutes County natural hazards mitigation planning process.

Convener, Nathan Garibay	Emergency Services Manager, Deschutes County Sheriff's Office
Bill Adams	Planning Director, La Pine
Melinda Campbell	GIS Analyst/ Programmer, Deschutes County
Ben Duda	Assistant Unit Forester, Oregon Department of Forestry---Sisters
Daniel Fishkin	Volunteer, Deschutes County Sheriff's Office Search and Rescue; Chair, Bend Park and Recreation District Board of Directors
Gordon Foster	Acting Unit Forester, Oregon Department of Forestry
Jeremy Giffin	Water Master – District 11, Oregon Water Resources
Phil Grieb	Government Liaison, Red Cross
Richard Grimes	Volunteer, Red Cross
William Groves	Senior Planner, Deschutes County
Dave Howe	Battalion Chief, Bend Fire

Ed Keith	County Forester, Deschutes County
Matt Martin	Associate Planner, Deschutes County
Deborah McMahon	Principal Planner, Redmond
Daniele McKay	Geology Instructor, OSU---Cascades
Karen Parmelee	Disaster Program Manager, Red Cross
Eric Porter	Planner, Sisters
Damian Syrnyk	Senior Planner, Bend
Emily Wegener	Preparedness Coordinator, Red Cross

City of Bend

Convener, Damian Syrnyk	Senior Planner, Bend
Daniel Fishkin	Volunteer, Deschutes County sheriff's Office Search and Rescue; Chair, Bend Park and Recreation District Board of Directors
Dave Howe	Battalion Chief, Bend Fire
Ed Keith	County Forester, Deschutes County

City of La Pine

Convener, Bill Adams	Planning Director, La Pine
Rick Allen	City Manager, La Pine

City of Redmond

Convener, Deborah McMahon	Principal Planner, Redmond
Keith Witcosky	City Manager
Mike Caccavano	City Engineer
Bill Duerden	Public Works Director
Heather Richards	Community Development Director

City of Sisters

Convener, Paul Bertagna	Public Works Director, Sisters
Andrew Gorayeb	City Manager, Sisters
Gary Marshall	Fire Safety Manager, Sisters/ Camp Sherman Fire

Project Managers:

Nathan Garibay, Emergency Services Manager, Deschutes County Sheriff's Office

Michael Howard, AICP, CFM, Program Specialist, Oregon Partnership for Disaster Resilience

Community Service Center Staff:

Bob Parker, AICP, Director of the Community Service Center and Community Planning Workshop, University of Oregon

Josh Bruce, AICP, Director, Oregon Partnership for Disaster Resilience

Evelyn Perdomo, Project Associate, Community Service Center

Drew Pfefferle, Project Associate, Community Service Center

Julie Foster, Grants Administrator, Community Service Center

Julie Havens, Office Coordinator, Community Service Center

About the Community Service Center

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

About the Oregon Partnership for Disaster Resilience

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

Plan Template Disclaimer

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

DESCHUTES COUNTY
MULTI-JURISDICTIONAL
NATURAL HAZARDS MITIGATION PLAN

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Volume II: Hazard Annexes

Volume III: Jurisdictional Addenda

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Volume I:
Basic Plan

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Executive Summary

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

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 permanently reducing or alleviating the losses of life, property, and injuries resulting from natural hazards through long and short---term strategies. Example strategies include policy changes, such as updated ordinances, projects, such as seismic retrofits to critical facilities; and education and outreach to targeted audiences, such as Spanish speaking residents or the elderly. Natural hazard mitigation is the responsibility of the "Whole Community" --- individuals, private businesses and industries, state and local governments, and the federal government.

Why Develop this Mitigation Plan?

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 Natural Hazard Mitigation Plan (NHMP) in order to receive federal funds for mitigation projects. Local and federal approval of this Plan ensures that the county and listed jurisdictions will remain eligible for pre--- and post---disaster mitigation project grants.

Who Participated in Developing the Plan?

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

The County Steering Committee included representatives from the following jurisdictions and agencies:

- Deschutes County
- City of Bend
- City of La Pine
- City of Redmond
- City of Sisters
- American Red Cross
- Bend Park and Recreation District
- Deschutes County Search and Rescue
- Oregon Department of Forestry
- Oregon State University --- Cascades
- Oregon Water Resources
- Sisters/ Camp Sherman Fire

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.

The Deschutes County Emergency Services Manager convened the planning process and will take the lead in implementing, maintaining and updating the plan. Deschutes County is dedicated to directly involving the public in the continual review and update of the natural hazards mitigation plan. Although members of the Steering Committee represent the public to some extent, the public will also have the opportunity to continue to provide feedback about the Plan throughout the implementation and maintenance period.

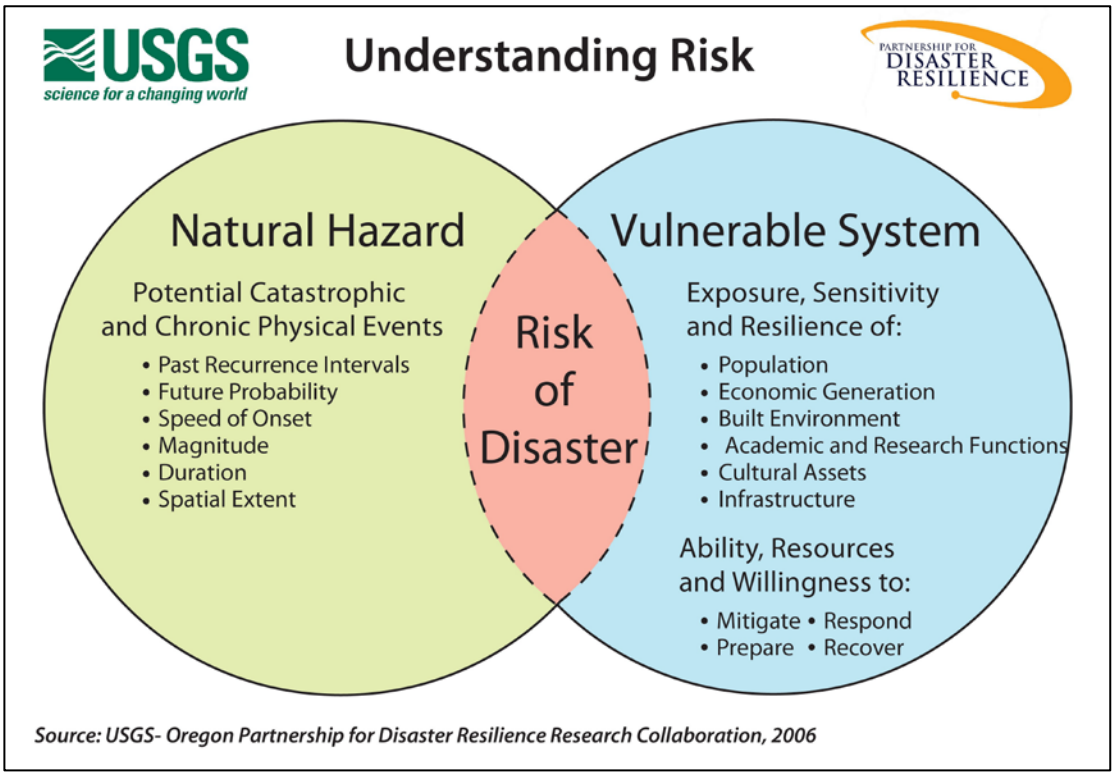
The county will ensure continued public involvement by posting the NHMP on the county's website. The Plan will also be archived and posted on the University of Oregon Libraries' Scholar's Bank Digital Archive.

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 . . .

The NHMP is intended to assist Deschutes 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 ES-1 Understanding Risk



Source: Oregon Partnership for Disaster Resilience.

By identifying and understanding the relationship between natural hazards, vulnerable systems, and existing capacity, Deschutes County is 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?

Deschutes County reviewed and updated their risk assessment to evaluate the probability of each hazard as well as the vulnerability of the community to that hazard. In addition, the steering committees for the participating cities reviewed the recently updated Deschutes County risk assessment to compare risk and vulnerability particular to their jurisdiction (see addenda for more information). Table ES---1 below summarizes hazard probability and vulnerability as determined by the county steering committee (for more information see Section 2, Risk Assessment).

Table ES-1 Risk Assessment Summary

Hazard	Probability	Vulnerability	Total Threat Score	Hazard Rank
Drought	High	Low	149	#6
Earthquake (Cascadia)	Moderate	High	191	#3
Earthquake (Crustal)	Low	Low	94	#8
Flood	High	Low	114	#7
Landslide	Low	Low	54	#9
Volcano	Low	High	173	#5
Wildfire	High	High	220	#2
Windstorm	High	Moderate	179	#4
Winter Storm	High	High	230	#1

Source: Deschutes County NHMP Steering Committee, 2015

What is the Plan's Mission?

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

The mission of the Deschutes County NHMP is to:

> ***Mission:*** *To promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the environment from natural hazards.*

This can be achieved by increasing public awareness, documenting the resources for risk reduction and loss---prevention, and identifying activities to guide the county towards building a safer, more disaster resistant community.

What are the Plan Goals?

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

Goal 1: *Protect life and reduce injuries resulting from natural hazards.*

Goal 2*: Minimize public and private property damages and the disruption of essential infrastructure and services from natural hazards.*

Goal 3: *Implement strategies to mitigate the effects of natural hazards and increase the quality of life and resilience of economies in Deschutes County.*

Goal 4: *Minimize the impact of natural hazards while protecting, restoring, and sustaining environmental processes.*

Goal 5: *Enhance and maintain local capability to implement a comprehensive hazard loss reduction strategy.*

Goal 6: *Document and evaluate progress in achieving hazard mitigation strategies and action items.*

Goal 7: *Motivate the public, private sector, and government agencies to mitigate the effects of natural hazards through information and education.*

Goal 8: *Apply development standards that mitigate or eliminate the potential impacts of natural hazards.*

Goal 9: *Mitigate damage to historic and cultural resources from natural hazards.*

Goal 10: *Increase communication, collaboration, and coordination among agencies at all levels of government and the private sector to mitigate natural hazards.*

Goal 11: *Integrate local natural hazard mitigation plans with comprehensive plans and implementing measures.*

How are the Action Items Organized?

The action items are organized within an action matrix included within Section 3, Mitigation Strategy (full descriptions are provided in Appendix A, *Action Item Forms*). Deschutes County has not identified highest priority action items at this time; the Steering Committee will identify prioritized actions during one of their semi---annual meetings following adoption and approval of the NHMP.

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

Data collection, research and the public participation process resulted in the development of the action items. The Action Item Matrix portrays the overall Plan framework and identifies linkages between the plan goals and actions. The matrix documents the title of each action along with, the coordinating organization, timeline, and the Plan goals addressed. Action items particular to each of the participating cities are included at the end of the action item matrix in Section 3, Mitigation Strategy and in the addenda.

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 . . .

The plan maintenance section of this Plan details the formal process that will ensure that the Deschutes County NHMP remains an active and relevant document. The Plan will be implemented, maintained and updated by a designated convener. The Deschutes County Emergency Services Manager is the designated convener (Plan Convener) and is responsible for overseeing the review and implementation processes. The Plan maintenance process includes a schedule for monitoring and evaluating the Plan semi---annually and producing a plan revision every five years. This section also describes how the communities will integrate public participation throughout the plan maintenance process.

Plan Adoption

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] . . .

Once the Plan is locally reviewed and deemed complete the Plan Convener submits it to the State Hazard Mitigation Officer at the Oregon Military Department – Office of Emergency Management (OEM). OEM reviews the Plan and submits it to the Federal Emergency Management Agency (FEMA – Region X) for review. This review will address the federal criteria outlined in FEMA Interim Final Rule 44 CFR Part 201.6. Once the Plan is pre---approved by FEMA, the county and cities formally adopt the Plan via resolution. The Deschutes County Plan Convener will be responsible for ensuring local adoption of the Deschutes County NHMP and providing the support necessary to ensure plan implementation. Once the resolution is executed at the local level and documentation is provided to FEMA, the Plan is formally acknowledged by FEMA and the county (and participating cities) will re---establish eligibility for the Pre---Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program funds, and the Flood Mitigation Assistance program funds.

The accomplishment of the NHMP goals and actions depends upon regular Steering Committee participation and adequate support from county and city leadership. Thorough familiarity with this 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.

The Steering Committees for Deschutes County and participating cities each met to review the Plan update process and their governing bodies adopted the NHMP as shown below:

Deschutes County adopted the plan on **[DATE], 2015**

The City of Bend adopted the plan on **[DATE], 2015**

The City of La Pine adopted the plan on **[DATE], 2015**

The City of Redmond adopted the plan on **[DATE], 2015**

The City of Sisters adopted the plan on **[DATE], 2015**

FEMA Region X approved the Deschutes County NHMP on **[DATE], 2015**. With approval of this Plan, the entities listed above are now eligible to apply for the Robert T. Stafford Disaster Relief and Emergency Assistance Act's hazard mitigation project grants through **[DATE], 2020**.

SECTION I: INTRODUCTION

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

What is Natural Hazard Mitigation?

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

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?

Deschutes County developed this Natural Hazards Mitigation Plan (NHMP or Plan) in an effort to reduce future loss of life and damage to property resulting from natural hazards. It is impossible to predict exactly when natural hazard events will occur, or the extent to which they will affect community assets. However, with careful planning and collaboration among public agencies, private sector organizations, and citizens within the community, it is possible to 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.

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[1] FEMA, *What is Mitigation?* http://www.fema.gov/what---mitigation

What Federal Requirements Does This Plan Address?

DMA2K is the latest federal legislation addressing mitigation planning. It reinforces the importance of mitigation planning and emphasizes planning for natural hazards before they occur. As such, this Act established the Pre---Disaster Mitigation (PDM) grant program and 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 State and local jurisdictions' proposed mitigation measures are based on a sound planning process that accounts for the risk to the individual and State and local jurisdictions' 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.[2] 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.[3] 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.[4] 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.[5] Additionally, a recent change in the way OEM administers the Emergency Management Performance Grant (EMPG), which helps fund local emergency management programs, also requires a FEMA---approved NHMP.

What is the Policy Framework for Natural Hazards Planning in Oregon?

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

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

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[2] Code of Federal Regulations, Chapter 44. Section 201.6, subsection (a), 2015

[3] ibid, subsection (b). 2015

[4] ibid, subsection (c). 2015

[5] ibid, subsection (d). 2015

The primary responsibility for the development and implementation of risk reduction strategies and policies lies with local jurisdictions. However, additional resources exist at the state and federal levels. Some of the key agencies in this area include 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 Deschutes County Natural Hazard Mitigation Plan Steering Committee and the Steering Committees for the cities of Bend, La Pine, Redmond, and Sisters. The Deschutes County Steering Committee formally convened on three occasions to discuss and revise the plan. Each of the participating city Steering Committees met at least 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.

An open public involvement process is essential to the development of an effective plan. In order to develop a comprehensive approach to reducing the effects of natural disasters, the planning process shall include opportunity for the public, neighboring communities, local and regional agencies, as well as, private and non---profit entities to comment on the Plan during review.[6] OPDR provided a publicly accessible project website for the general public to provide feedback on the draft NHMP via a web form. In addition, Deschutes County provided a press release on their websites to encourage the public to offer feedback on the Plan update.

In addition, OPDR administered a public opinion survey to obtain additional input from the public regarding the counties risks, vulnerabilities, hazards history, and mitigation strategies. See Appendix F for more information.

How is the Plan Organized?

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

Volume I: Basic Plan

Executive Summary

The executive summary provides an overview of the FEMA requirements plans process and highlights the key elements of the risk assessment, mitigation strategy, and implementation and maintenance strategy.

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[6] Code of Federal Regulations, Chapter 44. Section 201.6, subsection (b). 2015

Section 1: Introduction

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

Section 2: Risk Assessment

Section 2 provides the factual basis for the mitigation strategies contained in Section 3. (Additional information is included within Appendix C, which contains an overall description of Deschutes County and the cities of Bend, La Pine, Redmond, and Sisters.) This section includes a brief description of community sensitivities and vulnerabilities and an overview of the hazards addressed in Volume II of this plan. The Risk Assessment allows readers to gain an understanding of the county's, and other jurisdictions', sensitivities – those community assets and characteristics that may be impacted by natural hazards, as well as the county's, and other jurisdictions', resilience – the ability to manage risk and adapt to hazard event impacts. 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 (mitigation strategy) and also describes the components that guide implementation of the identified actions. Actions are based on community sensitivity and resilience factors and the risk assessments in Section 2 and the Hazard Annexes (Volume II).

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 five---year review meetings.

Volume II: Hazard Annexes

The hazard annexes describe the risk assessment process and summarize the best available local hazard data. A hazard summary is provided for each of the hazards addressed in the Plan. The summary includes hazard history, location, extent, vulnerability, impacts, and probability.

The hazard specific annexes included with this Plan are the following:

- Drought
- Earthquake
- Flood
- Landslide
- Volcanic Event
- Wildfire
- Windstorm, and
- Winter Storm (Snow/ Ice)

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. Each of the cities with a FEMA approved addendum went through an update to coincide with the county's update. As such, the five---year update cycle will be the same for all of the cities and the county.

The Plan includes city addenda updates for the following jurisdictions:

- City of Bend
- City of La Pine
- City of Redmond
- City of Sisters

Volume IV: Mitigation Resources

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

Appendix A: Action Item Forms

This appendix contains the detailed action item forms for each of the 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

The community profile describes the county and participating cities from a number of perspectives in order to help define and understand the regions sensitivity and resilience to natural hazards. The information in this section represents a snapshot in time of the current sensitivity and resilience factors in the region when the Plan was updated. Sensitivity factors can be defined as those community assets and characteristics that may be impacted by natural hazards, (e.g., special populations, economic factors, and historic and cultural resources). Community resilience factors can be defined as the community's ability to manage risk and adapt to hazard event impacts (e.g., governmental structure, agency missions and directives, and plans, policies, and programs).

Appendix D: Economic Analysis of Natural Hazard Mitigation Projects

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. The Oregon Partnership for Disaster Resilience developed this appendix. It has been reviewed and accepted by 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.

Appendix E: Grant Programs and Resources

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

Appendix F: Deschutes County Natural Hazards Community Survey (2015)

Appendix F includes the survey instrument and results from the preparedness survey implemented by OPDR. The survey aims to gauge household knowledge of mitigation tools and techniques to assist in reducing the risk and loss from natural hazards, as well as assessing household disaster preparedness.

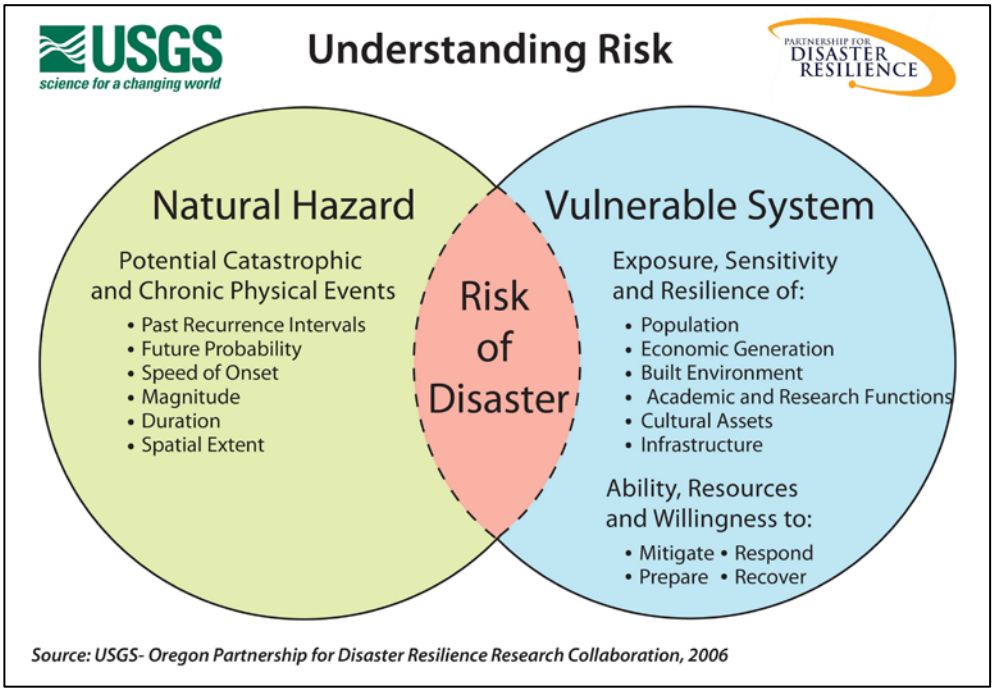
SECTION 2:
RISK ASSESSMENT

This section of the NHMP 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 information presented below, along with hazard specific information presented in the Hazard Annexes and community characteristics presented in the Community Profile Appendix, will be used as the local level rationale for the risk reduction actions identified in Section 3 – Mitigation Strategy. The risk assessment process is graphically depicted in Figure 2---1 below. Ultimately, the goal of hazard mitigation is to reduce the area where hazards and vulnerable systems overlap.

Figure 2-1 Understanding Risk

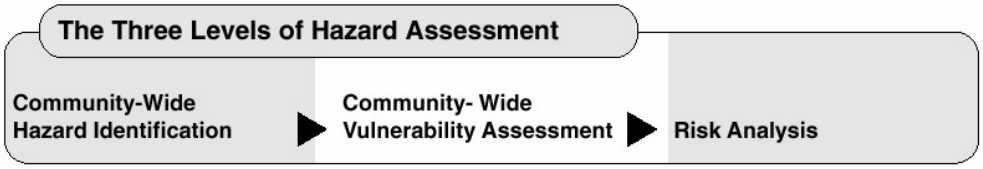


Source: Oregon Partnership for Disaster Resilience.

What is a Risk Assessment?

A risk assessment consists of three phases: hazard identification, vulnerability assessment, and risk analysis, as illustrated in the following graphic.

Figure 2-2 Three Phases of a Risk Assessment



Source: Planning for Natural Hazards: Oregon Technical Resource Guide, 1998

The first phase, **hazard identification**, involves the identification of the geographic extent of a hazard, its intensity, and its probability of occurrence. This level of assessment typically involves producing a map. The outputs from this phase can also be used for land use planning, management, and regulation; public awareness; defining areas for further study; and identifying properties or structures appropriate for acquisition or relocation.[1]

The second phase, **vulnerability assessment**, combines the information from the hazard identification with an inventory of the existing (or planned) property and population exposed to a hazard, and attempts to predict how different types of property and population groups will be affected by the hazard. This step can also assist in justifying changes to building codes or development regulations, property acquisition programs, policies concerning critical and public facilities, taxation strategies for mitigating risk, and informational programs for members of the public who are at risk.[2]

The third phase, **risk analysis**, involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment, and (2) the likelihood or probability of the harm occurring. An example of a product that can assist communities in completing the risk analysis phase is HAZUS, a risk assessment software program for analyzing potential losses from floods, hurricane winds and earthquakes. In Hazards U.S. – Multi---Hazard (HAZUS---MH) current scientific and engineering knowledge is coupled with the latest geographic information systems (GIS) technology to produce estimates of hazard---related damage before, or after a disaster occurs.

This three---phase approach to developing a risk assessment should be conducted sequentially because each phase builds upon data from prior phases. However, gathering data for a risk assessment need not occur sequentially.

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[1] Burby, *Cooperating with Nature* (Washington, DC: Joseph Henry Press, 1998), 126.

[2] Ibid, 133.

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 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 demonstrated below.

History

Weight factor for category = 2

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

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

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

Probability

Weight factor for category = 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 for category = 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 for category = 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

Hazard Identification

Deschutes County identifies eight natural hazards that could have an impact on the county (as shown in Table 2---1). For specific information pertaining to individual hazards, including location information, reference the Hazard Annexes (Volume II). Table 2---1 shows the hazards identified in the county in comparison to the hazards identified in the State of Oregon NHMP for Central Oregon (Region 6), which includes Deschutes County. The Dust Storm hazard is the only hazard identified in the state profile that is not perceived as a threat by the Deschutes NHMP steering committee; as such it was not included.

Table 2-1 Deschutes County Hazard Identification

Deschutes County	State of Oregon NHMP Region 6 Central Oregon
Drought	Drought
)	Dust Storm
Earthquake	Earthquake
Flood	Flood) Riverine
Landslide	Landslide
Volcano	Volcano
Wildfire	Wildfire
Windstorm	Windstorm
Winter Storm	Winter Storm

Source: Deschutes County NHMP Steering Committee (2014) and State of Oregon (Draft) NHMP, Region 6: Central Oregon (2015)

Drought

A drought is a period of drier than normal conditions that results in water---related problems. 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.

For more information on the Drought Hazard (including history and extent) see the Drought Annex in Volume II.

Earthquake

Oregon and the Pacific Northwest in general are susceptible to earthquakes from four sources: 1) the off---shore Cascadian Fault Zone; 2) deep intra---plate events within the subducting Juan de Fuca Plate; 3) shallow crustal events within the North American Plate; and 4) earthquakes associated with volcanic activity.[3]

The areas most susceptible to ground amplification and liquefaction have young, soft alluvial sediments, found along river and stream channels. The extent of the damage to structures and injury and death to people will depend upon the type of earthquake, proximity to the epicenter and the magnitude and duration of the event.

For more information on the Earthquake Hazard (including history and extent) see the Earthquake Annex in Volume II.

Flood

Flooding results when rain and snowmelt creates water flow that exceed the carrying capacity of rivers, streams, channels, ditches, and other watercourses. In Oregon, flooding is most common from October through April when storms from the Pacific Ocean bring intense rainfall. Most of Oregon's destructive natural disasters have been floods.[4] Flooding can be aggravated when rain is accompanied by snowmelt and frozen ground; the spring cycle of melting snow is the most common source of flood in the region. The principal types of flood that occur in Deschutes County include: spring/snow melt flooding, warm winter rain---on---snow flooding, Ice jams, flash floods, and dam failure.

For more information on the Flood Hazard (including history and extent) see the Flood Annex in Volume II.

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[4] Taylor, George H. and Chris Hannan. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press. 1999

Landslide

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. In a landslide, two forces are at work: 1) the driving forces that cause the material to move down slope, and 2) the friction forces and strength of materials that act to retard the movement and stabilize the slope. When the driving forces exceed the resisting forces, a landslide occurs. Avalanches also occur in the mountainous west portion of the county; avalanches are similar to landslides except they involve snow and ice with some movement of rock or other debris.

For more information on the Landslide Hazard (including history and extent) see the Landslide Annex in Volume II.

Volcano

The Pacific Northwest lies within the "ring of fire", an area of very active volcanic activity surrounding the Pacific Basin. Volcanic events occur regularly along the ring of fire, in part because of the movement of the Earth's tectonic plates. Volcanic events have the potential to coincide with numerous other hazards including ash fall, earthquakes, lava flows, pyroclastic flows, lahars, and debris flows, and landslides.

For more information on the Volcano Hazard (including history and extent) see the Volcano Annex in Volume II.

Wildfire

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

For more information on the Wildfire Hazard (including history and extent) see the Wildfire Annex in Volume II.

Windstorm

A windstorm is generally a short duration event involving straight---line winds and/or gusts in excess of 50 mph. Although windstorms can affect the entirety of Deschutes 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 tons of storm related debris.

For more information on the Windstorm Hazard (including history and extent) see the Windstorm Annex in Volume II.

Winter Storm

Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting Deschutes County typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

For more information on the Winter Strom Hazard (including history and extent) see the Winter Storm Annex in Volume II.

Federal Disaster and Emergency Declarations

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

President Dwight D. Eisenhower approved the first federal disaster declaration in May 1953 following a tornado in Georgia. Since then, federally declared disasters have been approved within every state as a result of natural hazard related events. As of January 2015, FEMA has approved a total of 29 major disaster declarations, two emergency declarations, and 58 fire management assistance declarations in Oregon.[5] When governors ask for presidential declarations of major disaster or emergency, they stipulate which counties in their state they want included in the declaration. Table 2---2 summarizes the major disasters declared in Oregon that affected Deschutes County, since 1955. The table shows that there have been two major disaster declarations for the county; both were weather related.

An Emergency Declaration is more limited in scope and without the long---term federal recovery programs of a Major Disaster Declaration. Generally, federal assistance and funding are provided to meet a specific emergency need or to help prevent a major disaster from occurring. There have been two emergency declarations that have affected Deschutes County.

Fire Management Assistance may be provided after a State submits a request for assistance to the FEMA Regional Director at the time a "threat of major disaster" exists. There have been ten fire management assistance declarations for the county (for a list of wildfires that have affected the county, between 1990 through 2014, see Table II---7 within Volume II, Hazard Annexes).

[5] FEMA, *Declared Disasters by Year or State*, http://www.fema.gov/news/disaster_totals_annual.fema#markS. Accessed January 9, 2015.

Table 2-2 FEMA Major Disaster, Emergency, and Fire Management Declarations for Deschutes County

Declaration Number	Declaration Date	Incident Period		Incident	Individual Assistance	Public Assistance Categories
		From	To			
DR#184	12/24/64	12/24/64	12/24/64	Heavy rains and flooding	Yes	A, B, C, D, E, F, G
DR#1510	2/19/04	12/26/03	1/14/04	Severe Winter Storm	None	A, B, C, D, E, F, G
EM#3039	4/29/77	4/29/77	4/29/77	Drought	None	A, B
EM#3228	9/7/05	8/29/05	10/1/05	Hurricane Katrina Evacuation	None	B
FMA#2034	7/25/79	7/25/79	#	Bridge Creek Fire	None	#
FMA#2035	7/26/79	7/26/79	#	Sisters Fire	None	#
FMA#2046	8/27/84	8/27/84	#	La Pine/Wampus Butte Fire	None	#
FMA#2075	8/5/90	8/4/90	#	Aubrey Hall Fire	None	#
FMA#2189	8/24/96	8/24/96	#	Skelton, Evans West Fire	None	B
FMA#2455	7/29/02	7/28/02	8/1/02	Cache Mountain Fire	None	B
FMA#2493	8/20/03	8/20/03	10/22/03	Booth Fire	None	B, H
FMA#2659	7/27/06	7/27/06	8/14/06	Black Crater Fire	None	B, H
FMA#2727	9/3/07	9/2/07	9/11/07	GW Fire	None	B, H
FMA#5056	6/8/14	6/7/14	6/14/14	Two Bulls	None	#

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

Vulnerability Assessment

Community vulnerabilities are an important component of the NHMP risk assessment. For more in---depth information regarding specific community vulnerabilities, reference Volume II, Hazard Annexes and Appendix C: Community Profile.

Population

The socio---demographic qualities of the community population such as language, race and ethnicity, age, income, and educational attainment are significant factors that can influence the community's ability to cope, adapt to and recover from natural disasters. Historically, 80 percent of the disaster burden falls on the public.[6] 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. For planning purposes, it is essential that Deschutes County and the cities of Bend, La Pine, Redmond, and Sisters consider both immediate and long---term socio---demographic implications of hazard resilience.

[6] Hazards Workshop Session Summary #16, *Disasters, Diversity, and Equity*, University of Colorado, Boulder (2000).

Population Vulnerabilities

- As of 2012, more than 15% of Deschutes County's population is over the age of 64, a number that is projected to rise to 25% by 2030. Deschutes County's elderly population is expected to grow faster than Oregon as a whole which has currently 14% of its population over the age of 64, with a projection of 21% by 2030.[7]
- The Deschutes County age dependency ratio[8] is 51.7, which is higher than that of the State of Oregon (48.6); the age dependency figure for the county is expected to increase to 69.7 by the year 2030 (largely due to the growth in population over age 64). As of 2012, La Pine has the highest age dependency ratio in the county (73.2).
- The cities of La Pine (16.9%) and Sisters (12.1%) have a high percentage of their populations over age 64 living alone.
- Even though the vast majority of the county population is reported as proficient in English, 41.6% of Spanish speakers are not proficient in English. These populations would stand to benefit from mitigation outreach, with special attention to cultural, visual and technology sensitive materials.
- Although the county ($51,468) has a higher median household income than the state ($50,036); La Pine ($28,942) has much lower median household income.
- The poverty rate of La Pine (27.7%) is almost double the county percentage (15.3%); Redmond's poverty rate is 21.6%.
- La Pine has more than 50% of its population spending more than 35% of household income on housing (mortgage or rent).[9]
- Approximately two---thirds of La Pine's population 65 years and over have a disability.

Economy

Economic diversification, employment and industry are measures of economic capacity. However, economic resilience to natural disasters is far more complex than merely restoring employment or income in the local community. Building a resilient economy requires an understanding of how the component parts of employment sectors, workforce, resources and infrastructure are interconnected in the existing economic picture. The current and anticipated financial conditions of a community are strong determinants of community resilience, as a strong and diverse economic base increases the ability of individuals, families and the community to absorb disaster impacts for a quick recovery. It is imperative that Deschutes County and the cities of Bend, La Pine, Redmond, and Sisters recognize that economic diversification is a long---term issue; more immediate strategies to reduce vulnerability should focus on risk management for the dominant industries.

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[7] Office of Economic Analysis, Department of Administrative Services. Long Term County Forecast. Long---term Oregon State's County Population Forecast, 2010---2050. Accessed December 2013.

[8] Dependency Ratio: the ratio of population typically not in the work force (less than 15, greater than 64)

[9] U.S. Census Bureau, 2008---2012 American Community Survey, Tables B25070 & B25091.

Economic Vulnerabilities

- According to the Oregon Employment Department, Deschutes County unemployment has decreased since 2009 when it was at 14.7% to 9.5% in 2013. In the event of a large—scale disaster, unemployment has the potential to rise when businesses and companies are unable to overcome the ramifications of the hazard event.
- The largest sectors of employment in Deschutes County are Trade, Transportation, and Utilities (19.5%), Education and Health Services (16.3%), Leisure and Hospitality (15.7%), and Government (13.4%).[10]
- The largest revenue sectors in Deschutes County are Health Care and Social Assistance ($351.5 million), Retail Trade ($271.9 million), and Manufacturing ($201.7 million). In the event of a natural disaster, the manufacturing sector may not be as vulnerable in the short term as other sectors; however, other large industries such as retail and wholesale trade may be significantly affected by a disaster as these basic industries tend to rely on a stable disposable income, which may decline following a disaster.
- The Construction (26%), Professional and Business Services (24%), and Education and Health Services (24%) industries are expected to have the most growth from 2012 to 2022.[11]

Environment

The capacity of the natural environment is essential in sustaining all forms of life including human life, yet it often plays an underrepresented role in community resiliency to natural hazards. The natural environment includes land, air, water and other natural resources that support and provide space to live, work and recreate.[12] Natural capital 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. When natural systems are impacted or depleted by human activities, those activities can adversely affect community resilience to natural hazard events.

Environmental Vulnerabilities

- Dynamic weather and relatively flat (east of the Cascades), arid land across Deschutes County are indicators of hazard vulnerability when combined with the changing climate and severe weather related events. Both wet and dry cycles are likely to last longer and be more extreme, leading to periods of deeper drought and more frequent flooding. Less precipitation in the summers and subsequently lower

[10] Oregon Employment Department, "2013 Covered Employment and Wages Summary Reports," http://www.qualityinfo.org/olmisj/labforce. Accessed October 2014.

[11] Oregon Employment Department "Regional Employment Projections by Industry & Occupation 2012---2022". http://www.qualityinfo.org. Accessed October 2014.

[12] Mayunga, J. "Understanding and Applying the Concept of Community Disaster Resilience: A capital---based approach. Summer Academy for Social Vulnerability and Resilience Building," (2007).

soil moisture with hotter temperatures will likely increase the amount of vegetation consumed by wildfire.

- Extended drought periods affect snowpack and agricultural irrigation.
- The combination of a growing population and development intensification can lead to the increasing risk of hazards, threatening loss of life, property and long—term economic disruption if land management is inadequate.

Built Environment, Critical Facilities, and Infrastructure

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

Housing Vulnerabilities

- It is crucial to maintain the quality of built capacity (transportation networks, critical facilities, utility transmission, etc.) throughout the area, as poor infrastructure can negatively affect Deschutes County's ability to cope, respond, and recover from a natural disaster.
- Mobile home and other non---permanent residential structures account for 9% of the housing in Deschutes County. In La Pine and Sisters mobile homes account for more than 12% of all homes respectively.[13] These structures are particularly vulnerable to certain natural hazards, such as windstorms and heavy flooding events.
- Based on U.S. Census data, more than 55% of the residential housing throughout Deschutes County was built after the current seismic building standards of 1990.[14]
- Approximately one---third of residential structures were constructed prior to the local implementation of the flood elevation requirements of the 1970's (county Flood Insurance Rate Maps –FIRMs--- were not completed until the mid---1980s).[15]
- The county has one---third of the housing units occupied by renters, versus two---thirds homeowners.[16] The cities of La Pine and Sisters have more than 50% of their housing occupied by renters. Studies have shown that renters are less likely than homeowners to prepare for hazardous events.
- The cities of La Pine (13.7%) and Sisters (18.7%) have the highest percentages of vacant units. In addition, seasonal or recreational housing accounts for approximately 11% of the county's housing stock; Black Butte Ranch, Sisters, and Sun River have the highest percentages.[17]

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[13] U.S. Census Bureau, 2008---2012 American Community Survey, Table DP04.

[14] Ibid.

[15] Ibid.

[16] Ibid.

[17] Ibid, Table B25004.

Critical Facilities and Infrastructure Vulnerabilities

- Some roads and bridges in the county are highly vulnerable to hazards, specifically earthquakes. Because bridges vary in size, materials, siting, and design, any given hazard will affect them differently. The county and cities should pay considerable attention to roads and bridges that may become obstructed that serve as primary interstate travel routes (Highways 97, 20/126), as this will likely have significant impacts on access in and out of the county and region. Oregon Department of Transportation has jurisdiction over the interstate and highways, but the cities and county may control maintenance in and around the communities.
- There is one power plant within Deschutes County, a Pacific Power station at Mirror Pond Dam in Bend operated by Pacific Power.
- There are three high hazard dams located in Deschutes County: Wickiup Reservoir, North Unit Diversion Dam, and Crane Prairie. In addition, the moraine lake dam on Whychus Creek (Carver Lake) above Sisters is identified as a potential flood concern (see Sisters Addendum in Volume III for more information).

National Flood Insurance Program (NFIP)

The Deschutes County Flood Insurance Rate Maps (FIRMs) were modernized in September 2007. The table below shows that as of November 2014, Deschutes County (including the incorporated cities) has 267 National Flood Insurance Program (NFIP) policies (90 of these are for properties developed before the initial FIRM) in force and five paid claims. The last Community Assistance Visit (CAV) for Deschutes County was on July 22, 1994 (the most recent CAV was in Sisters on April 26, 2004). The county, and cities, are not members of the Community Rating System (CRS). The table displays the number of policies by building type and shows that the majority of residential structures that have flood insurance policies are single---family homes and that there are 14 non---residential structures with flood insurance policies. According to data from 2012, the proportion of single---family homes (excluding condominiums) within the mapped special flood hazard area (SFHA, floodplain) that have flood insurance (the market penetration rate) for Deschutes County is 15.3% (105 out of 688).

The Community Repetitive Loss record for Deschutes County, Bend, La Pine, Redmond, and Sisters identifies zero repetitive loss buildings, zero severe repetitive loss buildings, and zero total repetitive loss claims.

Table 2-3 Food Insurance Detail

Jurisdiction	Current FIRM Date	Initial FIRM Date	Total Policies	Pre:FIRM Policies	Policies by Building Type				Minus Rated A Zone
					Single Family	2 to 4 Family	Other Residential	Non: Residential	
Deschutes	)	)	267	90	244	7	2	14	14
County*	9/28/07	9/29/86	171	66	158	1	0	12	11
Bend	9/28/07	9/4/87	57	21	48	5	2	2	1
La Pine	9/28/07	9/28/07	1	1	1	0	0	0	0
Redmond	9/28/07	9/28/07	0	0	0	0	0	0	0
Sisters	9/28/07	9/29/86	38	2	37	1	0	0	2

Jurisdiction	Insurance in Force	Total Paid Claims	Pre:FIRM Claims Paid	Substantial Damage Claims	Repetitive Loss Buildings	Severe Repetitive Loss Buildings	Total Paid Amount	CRS Class Rating	Last CAV
Deschutes County	$76,039,700	8	5	0	0	0	$63,794	)	)
County*	$46,890,300	3	1	0	0	0	$13,400	NP	7/22/94
Bend	$17,290,600	5	4	0	0	0	$50,393	NP	7/20/94
La Pine	$280,000	0	0	0	0	0	$0	NP	NA
Redmond	$0	0	0	0	0	0	$0	NP	NA
Sisters	$11,578,800	0	0	0	0	0	$0	NP	4/26/04

* Portion of entire county under county jurisdiction
NP) Not Participating NA) Information not Available/ Not Applicable

Source: Information compiled by Department of Land Conservation and Development, November 2014.

Vulnerability Summary

Vulnerability is a measure of the exposure of the built environment to hazards. The exposure of community assets to hazards is critical in the assessment of the degree of risk a community has to each hazard. Identifying the facilities and infrastructure at risk from various hazards can assist the county in prioritizing resources for mitigation, and can assist in directing damage assessment efforts after a hazard event has occurred. The exposure of county and city assets to each hazard and potential implications are explained in each hazard section.

Vulnerability includes the percentage of population and property likely to be affected under an “average” occurrence of the hazard. Deschutes County and the cities of Bend, La Pine, Redmond, and Sisters evaluated the best available vulnerability data to develop the vulnerability scores presented below. For the purposes of this Plan, the county and cities utilized the Oregon Military Department – Office of Emergency Management (OEM) Hazard Analysis methodology vulnerability definitions to determine hazard probability.

The table below presents the vulnerability scores for each of the natural hazards present in Deschutes County and for participating cities. As shown in the table with **bold text**, several hazards are rated with high vulnerabilities.

Table 2-4 Community Vulnerability Assessment Summary

Hazard	Deschutes County	Bend	La Pine	Redmond	Sisters
Drought	Low	Low	Low	Low	Low
Earthquake (Cascadia)	**High**	**High**	**High**	**High**	**High**
Earthquake (Crustal)	Low	Moderate	Low	Low	Low
Flood	Low	Moderate	Low	Low	**High**
Landslide	Low	Low	Low	Low	Low
Volcano	**High**	**High**	**High**	**High**	**High**
Wildfire	**High**	**High**	**High**	**High**	**High**
Windstorm	Moderate	Moderate	Moderate	Moderate	**High**
Winter Storm	**High**	**High**	**High**	**High**	**High**

Source: Deschutes County, Bend, La Pine, Redmond, and Sisters NHMP Steering Committees, 2015.

Risk Analysis

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. The table below presents the probability scores for each of the natural hazards present in Deschutes County and for the participating cities. As shown in the table with **bold text**, several hazards are rated with high probabilities.

Table 2-5 Natural Hazard Probability Assessment Summary

Hazard	Deschutes County	Bend	La Pine	Redmond	Sisters
Drought	**High**	**High**	**High**	**High**	**High**
Earthquake (Cascadia)	Moderate	Moderate	Moderate	Moderate	Moderate
Earthquake (Crustal)	Low	Low	Low	Low	Low
Flood	**High**	**High**	Moderate	Low	**High**
Landslide	Low	Low	Low	Low	Low
Volcano	Low	Low	Low	Low	Low
Wildfire	**High**	**High**	**High**	Moderate	**High**
Windstorm	**High**	**High**	**High**	**High**	**High**
Winter Storm	**High**	**High**	**High**	**High**	**High**

Source: Deschutes County, Bend, La Pine, Redmond, and Sisters NHMP Steering Committees, 2015.

The table below presents the entire updated hazard analysis matrix for Deschutes County. The hazards are listed in rank order from high to low. The table shows that hazard scores are influenced by each of the four categories combined. With considerations for past historical events, the probability or likelihood of a particular hazard event occurring, the vulnerability to the community, and the maximum threat or worst---case scenario, winter storm, wildfire, and Cascadia earthquake events rank as the top hazard threats to the county (top tier).

Windstorms, volcano, and drought events rank in the middle (middle tier). Flood, crustal earthquakes, and landslides comprise the lowest ranked hazards in the county (bottom tier).

Table 2-6 Hazard Analysis Matrix – Deschutes County

Hazard	History	Vulnerability	Maximum Threat	Probability	Total Threat Score	Hazard Rank	
Winter Storm	20	50	90	70	230	# 1	*Top Tier*
Wildfire	20	50	80	70	220	# 2	
Earthquake (Cascadia)	2	40	100	49	191	# 3	
Windstorm	16	20	80	63	179	# 4	*Middle Tier*
Volcano	2	50	100	21	173	# 5	
Drought	8	15	70	56	149	# 6	
Flood	8	10	40	56	114	# 7	*Bottom Tier*
Earthquake (Crustal)	2	5	80	7	94	# 8	
Landslide	2	5	40	7	54	# 9	

Source: Deschutes County NHMP Steering Committee, 2015.

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.

Multi-Jurisdictional Risk Assessment

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

The four participating cities in Deschutes County: Bend, La Pine, Redmond, and Sisters each held local Steering Committee meetings and completed a jurisdiction specific hazard analysis. The multi---jurisdictional risk assessment information is located within the Risk Assessment section of each city's addendum, which is located in Volume III of this NHMP.

SECTION 3: MITIGATION STRATEGY

Section 3 outlines Deschutes County's strategy to reduce or avoid long---term vulnerabilities to the identified hazards. Specifically, this section presents a mission and specific goals and actions thereby addressing the mitigation strategy requirements contained in 44 CFR 201.6(c). The NHMP Steering Committee reviewed and updated the mission, goals and action items documented in this plan. Additional planning process documentation is in Appendix B.

Mitigation Plan Mission

The Plan mission states the purpose and defines the primary functions of Deschutes County's NHMP. It is intended to be adaptable to any future changes made to the Plan and need not change unless the community's environment or priorities change.

The mission of the Deschutes County NHMP is:

> *To promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the environment from natural hazards.*

This can be achieved by increasing public awareness, documenting the resources for risk reduction and loss---prevention, and identifying activities to guide the county towards building a safer, more disaster resistant community.

The 2015 NHMP Steering Committee reviewed the 2010 plan mission statement and agreed it accurately describes the overall purpose and intent of this Plan. This is the exact wording that was present in the 2010 plan. The Steering Committee believes the concise nature of the mission statement allows for a comprehensive approach to mitigation planning.

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that Deschutes County citizens, and public and private partners can take while working to reduce the county's risk from natural hazards. These statements of direction form a bridge between the broad mission statement and particular action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

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

The 2015 Deschutes County NHMP Steering Committee reviewed the 2010 plan goals in comparison to the Draft State Natural Hazard Mitigation Plan goals and determined they would modify their goals to align with the State Natural Hazard Mitigation Plan goals.

All the Plan goals are important and are listed below in no particular order of priority. Establishing community priorities within action items neither negates nor eliminates any goals, but it establishes which action items to consider to implement first, should funding become available. Below is a list of the re---confirmed plan goals:

Goal 1: *Protect life and reduce injuries resulting from natural hazards.*

Goal 2*: Minimize public and private property damages and the disruption of essential infrastructure and services from natural hazards.*

Goal 3: *Implement strategies to mitigate the effects of natural hazards and increase the quality of life and resilience of economies in Deschutes County.*

Goal 4: *Minimize the impact of natural hazards while protecting, restoring, and sustaining environmental processes.*

Goal 5: *Enhance and maintain local capability to implement a comprehensive hazard loss reduction strategy.*

Goal 6: *Document and evaluate progress in achieving hazard mitigation strategies and action items.*

Goal 7: *Motivate the public, private sector, and government agencies to mitigate the effects of natural hazards through information and education.*

Goal 8: *Apply development standards that mitigate or eliminate the potential impacts of natural hazards.*

Goal 9: *Mitigate damage to historic and cultural resources from natural hazards.*

Goal 10: *Increase communication, collaboration, and coordination among agencies at all levels of government and the private sector to mitigate natural hazards.*

Goal 11: *Integrate local Natural Hazard Mitigation Plans with comprehensive plans and implementing measures.*

(Note: although numbered the goals are not prioritized.)

During the Steering Committee meetings for the participating jurisdictions (Bend, La Pine, Redmond, and Sisters) the Deschutes County NHMP mission statement and goal statements were reviewed and agreed upon by each community.

Existing Mitigation Activities

Existing mitigation activities include current mitigation programs and activities that are being implemented by the county in an effort to reduce the community's overall risk to natural hazards. Documenting these efforts can assist the jurisdiction to better understand risk and can assist in documenting successes. For a comprehensive list of existing mitigation activities for each specific hazard, reference Volume II, Hazard Annexes.

Government Structure

Beyond Emergency Management, most departments within the county and city governance structures have some degree of responsibility in building overall community resilience. Each plays a role in ensuring that jurisdiction functions and normal operations resume after an incident, and the needs of the population are met. For further explanation regarding how these departments influence hazard resilience, reference Appendix C, Community Profile and within the city addenda of Volume III.

Existing Plans and Policies

Communities often have existing plans and policies that guide and influence land use, land development, and population growth. Linking existing plans and policies to the NHMP helps identify what resources already exist that can be used to implement the action items identified in the Plan. Plans and policies already in existence have support from local residents, businesses and policy makers.[1] A list documenting plans and policies already in place in the county and participating cities can be found in Appendix C, Community Profile and within the city addenda of Volume III.

Community Organizations and Programs

In planning for natural hazard mitigation, it is important to know what social systems already exist within the community because of their existing connections to the public. The county and cities can use existing social systems as resources for implementing such communication---related activities because these service providers already work directly with the public on a number of issues, one of which could be natural hazard preparedness and mitigation. Appendix C, Community Profile, provides a comprehensive list of community organizations and programs, and offers a more thorough explanation of how existing community organizations and programs can be utilized for hazard mitigation.

Mitigation Plan Action Items

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 figure below illustrates some of these sources. A description of how the Plan's mitigation actions were developed is provided below.

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

Figure 3-1 Development of Action Items

Source: Oregon Partnership for Disaster Resilience, 2008.

Action Item Worksheets

Each action item 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, Action Item Forms.

Proposed Action Title

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

Alignment With Plan Goals

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

Affected Jurisdiction

Many of the action items within this Plan apply to all of the participating cities and the county; however, some actions items are specific. The list of affected jurisdictions is provided on the right side of the matrix. Each city identified as an

"affected jurisdiction" will contribute to accomplishing the specified action at a local level. The action item form in Appendix A provides more detailed information.

Alignment with Existing Plans / Policies

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

Rationale or Key Issues Addressed

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

Implementation through Existing Programs

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

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

The Deschutes County NHMP includes a range of action items that, when implemented, will reduce loss from hazard events in the County. Within the Plan, FEMA requires the identification of existing programs that might be used to implement these action items. Deschutes County and the participating cities currently address statewide planning goals and legislative requirements through their comprehensive land use plans, capital improvements plans, mandated standards, and building codes. To the extent possible, the jurisdictions will work to incorporate the recommended mitigation action items into existing programs and procedures. (Note: Deschutes County is currently participating in a review of their development code to determine options for improvement regarding the flood and wildfire hazards.)

Many of the recommendations contained in the Deschutes County NHMP are consistent with the goals and objectives of the existing plans and policies. Where possible, Deschutes County and the participating cities will implement the recommendations and actions contained in the NHMP through existing plans and policies. Plans and policies already in existence have support from local residents, businesses, and policy makers. Many land---use, comprehensive, and strategic plans get updated regularly, and can adapt easily to changing

conditions and needs.[2] Implementing the action items contained in the NHMP through such plans and policies increases their likelihood of being supported and implemented.

Coordinating Organization:

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

Internal and External Partners:

The internal and external partner organizations listed in the Action Item Worksheets are potential partners recommended by the project Steering Committee but not necessarily contacted during the development of the Plan. The coordinating organization should contact the identified partner organizations to see if they are capable of and interested in participation. This initial contact is also to gain a commitment of time and/or resources toward completion of the action items.

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

External partner organizations can assist the coordinating organization in implementing the action items in various functions and may include local, regional, state, or federal agencies, as well as local and regional public and private sector organizations.

Potential Funding Sources

Where possible, identify potential funding sources for the action item. Example funding sources can include: the federal Pre---Disaster Mitigation and Flood Mitigation Assistance Programs; state funding sources such as the Oregon Seismic Rehabilitation Grant Program; or local funding sources such as capital improvement or general funds. An action item may also have multiple funding sources.

Estimated Cost

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

Timeline

Action items include both short and long---term activities. Each action item includes an estimate of the timeline for implementation. *Short---term action items* (ST) are activities that may be implemented with existing resources and authorities in one to two years. *Long---term action items* (LT) may require new or additional resources and/or authorities, and may take from one to five years to implement. *Ongoing* action items signify that work has begun and will either exist over an indefinite timeline, or an extended timeline.

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[2] Ibid

Status

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

Priority

High priority action items are designated in order to clarify the importance of these mitigation actions for the affected jurisdictions.

Action Item Development Process

Development of action items was a multi---step, iterative process that involved brainstorming, discussion, review, and revisions. The majority of the action items were first created during the 2005 and 2010 NHMP planning process. During those processes, steering committees developed maps of local vulnerable populations, facilities, and infrastructure in respect to each identified hazard. Review of these maps generated discussion around potential actions to mitigate impacts to the vulnerable areas. The Oregon Partnership for Disaster Resilience (OPDR) provided guidance in the development of action items by presenting and discussing actions that were used in other communities. OPDR also took note of ideas that came up in Steering Committee meetings and drafted specific actions that met the intent of the Steering Committee. All actions were then reviewed by the Steering Committee, discussed at length, and revised as necessary before becoming a part of this document.

Action Item Matrix

The action item matrix portrays the overall action plan framework and identifies linkages between the Plan goals, partnerships (coordination and partner organizations), and actions. The matrix documents a description of the action, if the Steering Committee identified the action as high priority, the coordinating organization, partner organizations, timeline, and the Plan goals addressed. Refer to Appendix A, Action Item Forms for detailed information about each action item.

Note: Deschutes County has not identified highest priority action items at this time; the Steering Committee will identify prioritized actions during one of their semi---annual meetings following adoption and approval of the NHMP.

Table 3-1 Deschutes County Action Items

2015 Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Status	Jurisdictions				
							Deschutes County	Bend	La Pine	Redmond	Sisters
Multihazard #1		Integrate training and education initiatives from the Deschutes County Natural Hazards Mitigation Plan into existing regulatory documents and programs where appropriate.	Deschutes County Natural Hazards Mitigation Committee	Internal: Emergency Services, Community Development, County Forester, Road Department, Public Works, Cities; External: ODF, American Red Cross, OSU Cascades	Ongoing	Ongoing	X	X	X	X	X
MH #2		Pursue coordination of mitigation initiative development, planning, and resource allocation (funding).	Deschutes County Natural Hazards Mitigation Committee	Internal: Emergency Services, Community Development, County Forester, Road Department, Public Works; External: ODF, American Red Cross, OSU Cascades, USFS	Ongoing	Ongoing	X	X	X	X	X
MH #3		Strengthen understanding of the probability of natural hazards by continuing to support research specific to the region.	Deschutes County Natural Hazards Mitigation Committee	Internal: P External: OSU Cascades, DOGAMI, USGS, ACOE, FEMA, DLCD, OEM, University of Oregon	Ongoing	Ongoing	X	X	X	X	X
MH #4		Assess Power Grid and Determine Methods to Improve Resiliency	Deschutes County Emergency Services	Internal: Public Works, Planning, Roads; External: Utility Companies, U.S. DOE, OEM	Long Term	New	X	X	X	X	X
MH #5		Develop continuity of operations plans to ensure continued operation in the event of a natural hazard emergency.	Deschutes County Emergency Services	Internal: Public Works, Planning, Roads; External: OEM	Long Term	New	X	X	X	X	X
MH #6		Develop code language to mitigate the harmful impact of hazard trees located on private and/ or vacant property.	Deschutes County Emergency Services	Internal: County Forester, Community Development, Public Works External: Electric Utilities, ODF	Long Term	New	X	X	X	X	X
MH #7		Continue and enhance windstorm resistant construction methods where possible to reduce damage to utilities and critical facilities from windstorms. In part, this may be accomplished by encouraging electric utility providers to convert existing overhead lines to underground lines.	Deschutes County Emergency Services	Internal: Community Development, City Community Development/ Planning, and Public Works External: Electric Utilities	Long Term	New	X	X	X	X	X

Source Deschutes County NHMP Steering Committee, updated 2015

Table 3-1 Deschutes County Action Items (Continued)

2015 Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Status	Jurisdictions				
							Deschutes County	Bend	La Pine	Redmond	Sisters
Drought		*No action items are identified specific to this hazard. However, several multi9hazard action items address this hazard.*									
Earthquake #1		Support development of in0depth studies to determine county and region's vulnerability to earthquake.	Deschutes County Emergency Services	Internal: Community Development External: FEMA, DOGAMI, OEM, USGS, OSU Cascades	Long Term	Deferred	X	X	X	X	X
EQ #2		Seismically retrofit vulnerable facilities and infrastructure to increase their resiliency to seismic hazards. Consider both structural and non0 structural retrofit options.	Deschutes County Natural Hazards Mitigation Committee	Internal: Public Works, Community Development, Building, Fire, Police, Sheriff External: Deschutes County School Districts, OEM, DOGAMI, FEMA, ODE, IFA, SHPO	Long Term	NEW	X	X	X	X	X
Flood #1		Continue to coordinate mitigation activities with appropriate agencies and home and business owners/groups that include an inventory of actions to or within the floodplain.	Deschutes County Community Development	Internal: Emergency Services, Public Works, Building Division External: Oregon Water Resources, DLCD, USGS, Bureau of Reclamation, DSL, USACE, ODFW, USFS	Ongoing	Ongoing	X	X	X		X
FL #2		Maintain an inventory of all permitted in0water facilities in Deschutes County.	Deschutes County Community Development	Internal: Emergency Services External: Oregon Water Resources, USGS, Bureau of Reclamation	Long Term	Deferred	X	X			
FL #3		Comply with National Flood Insurance Program to maintain participation in program.	Deschutes County Community Development	Internal: **H** External: DLCD, FEMA	Ongoing	Ongoing	X	X	X		X
FL #4		Update the Flood Insurance Rate Maps for Deschutes County and revisit land use codes to determine if floodplain standards are still adequate.	Deschutes County Community Development	Internal: 0 External: FEMA, DOGAMI, DLCD	Long Term	Ongoing	X	X	X		X
FL #5		As funding becomes available, upgrade individual properties adjacent to or within the floodplain as appropriate.	Deschutes County Community Development	Internal: 0 External: FEMA, DOGAMI, DLCD	Long Term	Ongoing	X	X	X		X
FL #6		Analyze and implement mitigation measures related to ice jamming that occurs during winter storm events.	Deschutes County Emergency Services/ Planning	Internal: Public Works, Bend Parks and Recreation District External: Oregon Water Resources, Pacific Power, Landowners, DLCD, DOGAMI	Long Term	New	X	X			

Source: Deschutes County NHMP Steering Committee, updated 2015.

Table 3-1 Deschutes County Action Items (Continued)

2015 Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Status	Jurisdictions				
							Deschutes County	Bend	La Pine	Redmond	Sisters
FL #7		Re#evaluate debris flow and flood hazards along Whychus Creek from moraine#dammed Carver Lake. Depending on outcome of study, consider suitable mitigative measures in City of Sisters and Deschutes County.	Deschutes County Emergency Services	Internal: Community Development, Public Works; Sisters Community Development and Public Works External: USGS, USACE, FEMA, DOGAMI, OEM, DLCD, OSU Cascades	Long Term	New	X				X
Landslide		*No action items are identified specific to this hazard. However, several multi9hazard action items address this hazard.*									
Volcano #1		Continue to support on#going study of probability of volcanic eruption and potential impact.	Deschutes County Emergency Services	Internal: Health Department, Community Development, Public Works External: USGS#CVO, DOGAMI, FEMA, OEM, USGS, OSU Cascades	Long Term	Ongoing	X				
Wildfire #1		Expand public information/education initiatives in support of active hazardous fuels treatment.	Deschutes County Forester/ Project Wildfire	Internal: Emergency Services, County Forester External: Firewise Communities, USFS, BLM, ODF, DEQ	Ongoing	Ongoing	X	X	X	X	X
WF #2		Review and upgrade existing building and land use codes to address landscape, fuel amounts and structure detail that reduces the incidence or spread of wildland fire in urban/rural interface areas.	Deschutes County Community Development and County Forester	Internal: Community Development, County Forester, Emergency Services, Project Wildfire External: ODF	Ongoing	Ongoing	X	X	X	X	X
WF #3		Continue to prioritize and support fuels reduction projects on private lands utilizing FireFree and other programs; and identify and prioritize fuels reduction projects on public lands in the WUI.	Project Wildfire	Internal: Community Development, County Forester, Emergency Services, Project Wildfire External: Firewise Communities, ODF	Ongoing	Ongoing	X	X	X	X	X

Source: Deschutes County NHMP Steering Committee, updated 2015.

Table 3-1 Deschutes County Action Items (Continued)

2015 Action Item	Priority	Proposed Action Title	Lead Agency	Partner Organization(s)	Timeline	Status	Jurisdictions				
							Deschutes County	Bend	La Pine	Redmond	Sisters
Windstorm		*No action items are identified specific to this hazard. However, several multi9hazard action items address this hazard.*									
Winter Storm #1		Continue to coordinate mitigation activities to reduce risk to the public from severe winter storms.	Deschutes County Emergency Services	Internal: City and County Public Works, Public Health External: Utility companies, Vulnerable Populations Work Group, American Red Cross, other Community Organizations Active in Disasters	Ongoing	Ongoing	X	X	X	X	X
WS #2		Continue public awareness of severe winter storm mitigation activities.	Deschutes County Emergency Services	Internal: City and County Public Works, Public Health External: Vulnerable Populations Work Group, American Red Cross	Ongoing	Ongoing	X	X	X	X	X
WS #3		Continue to enhance coordination maintenance and mitigation activities to reduce risk to public infrastructure from severe winter storms.	Deschutes County Emergency Services	Internal: City and County Public Works, Public Health External: Utilities, Vulnerable Populations Work Group, American Red Cross	Ongoing	Ongoing	X	X	X	X	X

Source: Deschutes County NHMP Steering Committee, updated 2015.

SECTION 4:
PLAN IMPLEMENTATION AND MAINTENANCE

The Plan Implementation and Maintenance section details the formal process that will ensure that the MNHMP remains an active and relevant document. The Plan implementation and maintenance process includes a schedule for monitoring and evaluating the Plan semi---annually, as well as producing an updated plan every five years. Finally, this section describes how the county will integrate public participation throughout the Plan maintenance and implementation process.

Implementing the Plan

The success of the Deschutes County NHMP depends on how well the outlined action items are implemented. In an effort to ensure that the activities identified are implemented, the following steps will be taken. The Plan will be formally adopted, a coordinating body will be assigned, a convener shall be designated, the identified activities will be prioritized and evaluated, and finally, the Plan will be implemented through existing plans, programs, and policies.

Plan Adoption

The Deschutes County NHMP was developed and will be implemented through a collaborative process. After the Plan is locally reviewed and deemed complete, the Deschutes County Emergency Services Manager submits it to the State Hazard Mitigation Officer (SHMO) at the Oregon Military Department – Office of Emergency Management (OEM). OEM submits the plan to FEMA---Region X for review. This review addresses the federal criteria outlined in the FEMA Interim Final Rule 44 CFR Part 201. Upon acceptance by FEMA, the County will adopt the plan via resolution. At that point the County will gain eligibility for the Pre---Disaster Mitigation Grant Program, the Hazard Mitigation Grant Program funds, and Flood Mitigation Assistance program funds. Following adoption by the county, the participating jurisdictions should convene local decision makers and adopt the Deschutes County Multijurisdictional NHMP.

Convener

The Deschutes County Emergency Services Manager will take responsibility for plan implementation and will facilitate the Hazard Mitigation Coordinating Body meetings and will assign tasks such as updating and presenting the Plan to the rest of the members of the Coordinating Body. Plan implementation and evaluation will be a shared responsibility among all of the assigned Hazard Coordinating Body Members. The Convener's responsibilities include:

- Coordinate Steering Committee meeting dates, times, locations, agendas, and member notification;
- Documenting the discussions and outcomes of committee meetings;

- Serving as a communication conduit between the Steering Committee and the public/stakeholders;
- Identifying emergency management---related funding sources for natural hazard mitigation projects; and
- Utilizing the Risk Assessment as a tool for prioritizing proposed natural hazard risk reduction projects.

Coordinating Body

The Deschutes County Convener will form a Natural Hazard Coordinating Body for updating and implementing the NHMP. The Coordinating Body responsibilities include:

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

Members

The following jurisdictions, agencies, and/ or organizations were represented and served on the Steering Committee during the development of the Deschutes County NHMP (for a list of individuals see the Acknowledgements section of this NHMP):

- Deschutes County
- City of Bend
- City of La Pine
- City of Redmond
- City of Sisters
- American Red Cross
- Bend Park and Recreation District
- Deschutes County Sheriff's Office Search and Rescue
- Oregon Department of Forestry
- Oregon State University --- Cascades
- Oregon Water Resources
- Sisters/ Camp Sherman Fire

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

Many of the recommendations contained in the NHMP are consistent with the goals and objectives of the participating cities and county's existing plans and policies. Where possible, Deschutes County, and participating cities, should implement the recommended actions contained in the NHMP 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 action items contained in the NHMP 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:

- City and County Budgets
- Community Wildfire Protection Plans
- Comprehensive Land Use Plans
- Economic Development Action Plans
- Zoning Ordinances & Building Codes

For additional examples of plans, programs or agencies that may be used to implement mitigation activities refer to list of plans in Appendix C, *Community Profile*.

Plan Maintenance

Plan maintenance is a critical component of the NHMP. Proper maintenance of the Plan ensures that this Plan will maximize the county and participating city's efforts to reduce the risks posed by natural hazards. This section was developed by OPDR and includes a process to ensure that a regular review and update of the Plan occurs. The coordinating body and local staff are responsible for implementing this process, in addition to maintaining and updating the Plan through a series of meetings outlined in the maintenance schedule below.

Meetings

The Coordinating Body will meet on a **semi---annual basis** (twice per year) to complete the following tasks. During the first meeting, prior to the wildfire/ irrigation season, the Coordinating Body 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.

The second meeting of the year will take place in early fall, following the wildfire/ irrigation season. During the second meeting the Coordinating Body will:

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

These meetings are an opportunity for the cities to report back to the county on progress that has been made towards their components of the NHMP.

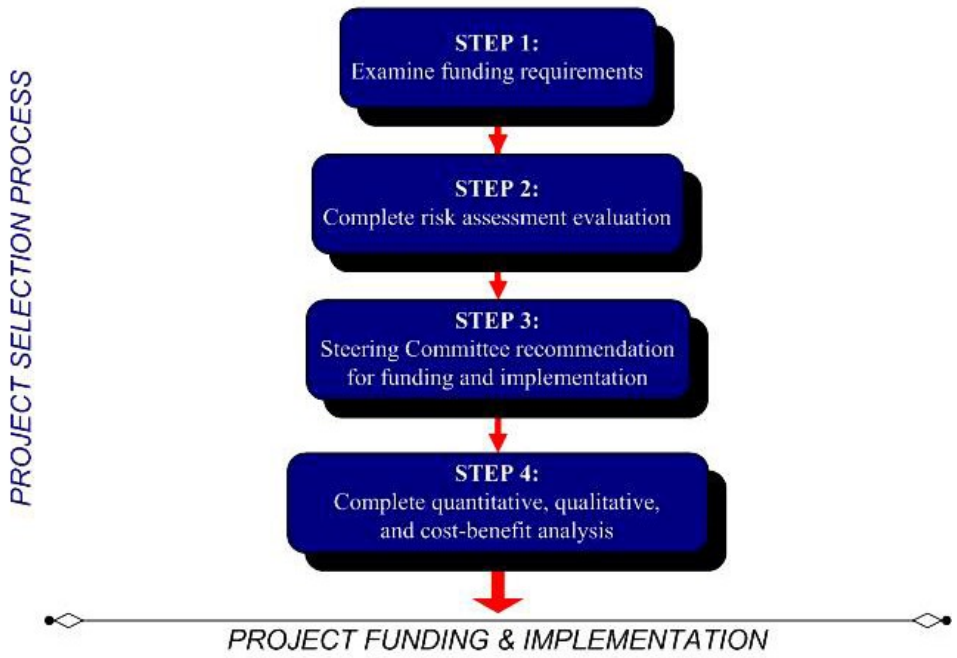
The convener will be responsible for documenting the outcome of the semi---annual meetings in Appendix B. The process the Coordinating Body will use to prioritize mitigation projects is detailed in the section below. The Plan's format allows the county and participating jurisdictions to review and update sections when new data becomes available. New data can be easily incorporated, resulting in a NHMP 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. Committee members, local government staff, other planning documents, or the risk assessment may be the source to identify projects. Figure 4---1 illustrates the project development and prioritization process.

Note: Deschutes County has not identified highest priority action items at this time; In addition to following the identified project prioritization process described below the Steering Committee will identify prioritized actions during one of their semi---annual meetings following adoption and approval of the NHMP.

Figure 4-1 Action Item and Project Review Process



Source: Oregon Partnership for Disaster Resilience, 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), local general funds, and private foundations, among others. Please see Appendix E, *Grant Programs and Resources* for a more comprehensive list of potential grant programs.

Because grant programs open and close on differing schedules, the 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 Military Department – Office of Emergency Management (OEM), 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 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.

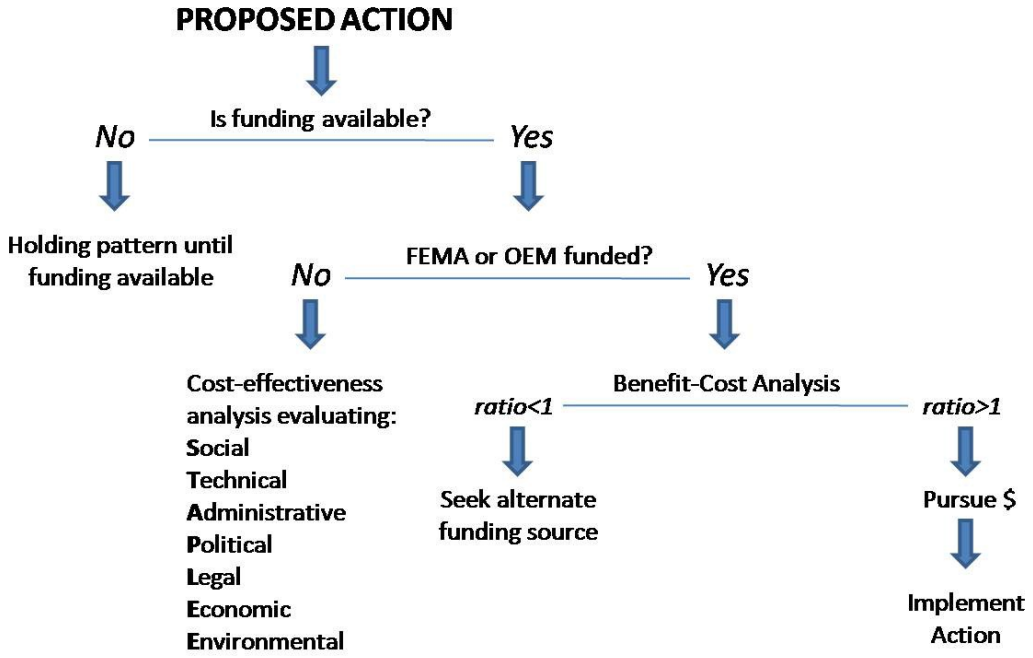
Step 3: Coordinating Body Recommendation

Based on the steps above, the Coordinating Body 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. The Coordinating Body will convene a meeting to review the issues surrounding grant applications and to share knowledge and/or resources. This process will afford greater coordination and less competition for limited funds.

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

The fourth step is to identify the costs and benefits associated with the selected natural hazard mitigation strategies, measures or projects. Two categories of analysis that are used in this step are: (1) benefit/cost analysis, and (2) cost---effectiveness analysis. Conducting benefit/cost analysis for a mitigation activity assists in determining whether a project is worth undertaking now, in order to avoid disaster---related damages later. Cost---effectiveness analysis evaluates how best to spend a given amount of money to achieve a specific goal. Determining the economic feasibility of mitigating natural hazards provides decision makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects. Figure 4.2 shows decision criteria for selecting the appropriate method of analysis.

Figure 4-2 Benefit Cost Decision Criteria



Source: Oregon Partnership for Disaster Resilience, 2010.

If the activity requires federal funding for a structural project, the Coordinating Body will use a FEMA---approved cost---benefit analysis tool to evaluate the appropriateness of the activity. A project must have a benefit/cost ratio of greater than one in order to be eligible for FEMA grant funding.

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

Continued Public Involvement and Participation

The participating jurisdictions are dedicated to involving the public directly in the continual reshaping and updating of the Deschutes County NHMP. Although members of the Coordinating Body represent the public to some extent, the public will also have the opportunity to continue to provide feedback about the Plan.

To ensure that these opportunities will continue, the County and participating jurisdictions will:

- Post copies of their plans on corresponding websites;
- Place articles in the local newspaper directing the public where to view and provide feedback; and

- Use existing newsletters such as schools and utility bills to inform the public where to view and provide feedback.

In addition to the involvement activities listed above, Deschutes County will ensure continued public involvement by posting the Deschutes County NHMP on the County's website (http://www.deschutes.org/). The Plan will also be archived and posted on the University of Oregon Libraries' Scholar's Bank Digital Archive (https://scholarsbank.uoregon.edu).

Five-Year Review of Plan

This plan will be updated every five years in accordance with the update schedule outlined in the Disaster Mitigation Act of 2000. **The Deschutes County NHMP is due to be updated by May xx, 2020.** The Convener will be responsible for organizing the coordinating body to address plan update needs. The Coordinating Body will be responsible for updating any deficiencies found in the Plan, and for ultimately meeting the Disaster Mitigation Act of 2000's Plan update requirements.

The following 'toolkit' can assist the Convener in determining which Plan update activities can be discussed during regularly---scheduled Plan maintenance meetings, and which activities require additional meeting time and/or the formation of sub---committees.

Table 4-1 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 Annexes

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VOLUME II:
HAZARD ANNEXES

Introduction

Deschutes County and the cities of Bend, La Pine, Redmond, and Sisters are subject to the following natural hazards:

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

The following sections identify and profile the location, extent, previous occurrences, vulnerability, and probability of the hazards listed above. Additional information about each hazard can be found in the Oregon Natural Hazards Mitigation Plan – Regional Risk Assessment --- Region 6: Central Oregon[1] and within this NHMP: Volume I, Section 2 – Risk Assessment.

[1] Oregon Department of Land Conservation and Development (DLCD), 2015. DRAFT Oregon Natural Hazards Mitigation Plan.

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Significant Changes Since the 2010 Plan

The Drought Hazard was not assessed in the 2010 Plan, therefore, this section provides new content to the Deschutes County NHMP.

Causes and Characteristics of the Hazard

Drought can be defined in several ways. The American Heritage Dictionary defines drought as "a long period with no rain, especially during a planting season." Another definition of drought is a deficiency in surface and sub---surface water supplies. In socioeconomic terms, drought is present when a physical water shortage begins to affect people, individually and collectively, and the area's economy.

Drought is typically measured in terms of water availability in a defined geographical area. It is common to express drought with a numerical index that ranks severity. The Oregon Drought Severity Index is the most commonly used drought measurement in the state because it incorporates both local conditions and mountain snow pack. The Oregon Drought Severity Index categorizes droughts as mild, moderate, severe, and extreme.

Meteorological or Climatological Droughts

Meteorological droughts are defined in terms of the departure from a normal precipitation pattern and the duration of the event. These droughts are a slow---onset phenomenon that can take at least three months to develop and may last for several seasons or years.

Agricultural Droughts

Agricultural droughts link the various characteristics of meteorological drought to agricultural impacts. The focus is on precipitation shortages and soil---water deficits. Agricultural drought is largely the result of a deficit of soil moisture. A plant's demand for water is dependent on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil.

Hydrological Droughts

Hydrological droughts refer to deficiencies in surface water and sub---surface water supplies. It is measured as stream flow, and as lake, reservoir, and ground water levels. Hydrological measurements are not the earliest indicators of drought. When precipitation is reduced or deficient over an extended period of time, the shortage will be reflected in declining surface and sub---surface water levels.

Drought is typically measured in terms of water availability in a defined geographical area. It is common to express drought with a numerical index that ranks severity. The Oregon Drought Severity Index is the most commonly used drought measurement in the state because it incorporates local conditions and mountain snowpack. The Oregon Drought Severity Index categorizes droughts as *mild*, *moderate*, *severe,* and *extreme*.

History of Drought in Deschutes County

Oregon records, dating back to the late 1800s, clearly associate drought with a departure from expected rainfall. Concern for mountain snowpack, which feeds the streams and rivers, came later. Droughts were particularly noteworthy during the following years:

Table II-1 History of Droughts

Date	Location	Characteristics
1904%1905	Statewide	A state%wide drought period of about 18 months
1917%1931	Statewide	A very dry period puncuated by brief wet spells in 1920%21 and 1927
1928%1941	Statewide	A significant drought affected all of Oregon from 1928 to 1941. The prolonged statewide drought created significant problems for the agricultural industry. Punctuated by a three%year intense drought period from 1938%1941.
1959%1964	Eastern Oregon	Streamflows were low throughout eastern Oregon.
1985%1994	Statewide	A dry period lasting from 1985 to 1994 caused significant problems statewide. The peak year was 1992, when the state declared a drought emergency. Malheur Lake declined in area over a six%year period from 175,000 acres to 400 acres (this was following abnormally large snow accumulations in the years preceeding the drought period which increased the size of the lake).
2000%2001	Southern, Eastern Oregon	Klamath drought intensifies; low snowpack in mountains worsens conditions. Draw down at Detroit Lake, all but curtails lake recreation. Harney County Drought Declaration by Executive Order 01%12
2001%2002	Southern, Eastern Oregon	Extreme drought conditions in the region; Deschutes County decleared state of emergency promting Drought Declaration by Executive Order 01%17
2005	Region 5, 6, and 7	February 2005 was the driest February on record since 1977, surpassing 2001's conditions. Above normal temperatures contributed to decreased water availability for the summer. Stream and river levels dropped significantly and watermasters regulated live flow use by irrigators. Drought conditions also led to the use of stored water, when it was available .

Sources: DRAFT Oregon State Natural Hazard Mitigation Plan 2015; George and Ray Hatton, The Oregon Weather Book (1999), and Oregon Secretary of State's Office, Archives Division

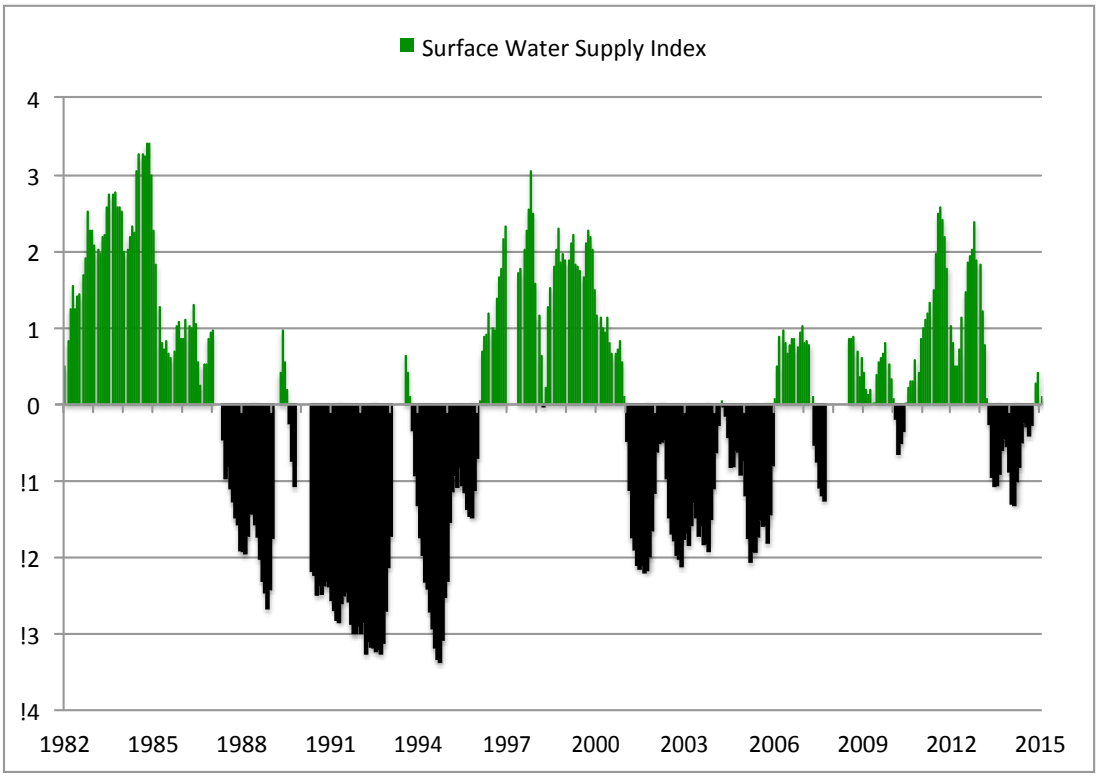
The Water Availability Committee utilizes the Surface Water Supply Index (SWSI) from the Natural Resources Conservation Service to derive the Oregon Drought Severity Index that is reported to the Drought Council[2]. The SWSI is an index of current water conditions throughout the state. The index utilizes parameters derived from snow, precipitation, reservoir and stream flow data. The data is gathered each month from key stations in each basin. The lowest SWSI value, ---4.1, indicates extreme drought conditions. The highest SWSI value, +4.1, indicates extreme wet conditions. The mid---point is 0.0, which indicates a normal water supply.[3] The table below shows the monthly history of SWSI values from 1982 to 2015. Research shows that the periods of drought have fluctuated; a severe drought period occurred from about 1987 to 1996

[2] State Emergency Operations Plan, Drought Annex, (2002)

[3] Barry Norris, "Planning for Drought," Water Resources Department (2001).

(with short periods of non---drought), between 2001 and 2006 a period of moderate drought occurred. Since about 2006, conditions in the Upper Deschutes Basin have been near normal or wet, except for a few shorter periods of mild drought conditions (including from mid---2013 to 2015).

Figure II-1 SWSI Values for the Upper Deschutes Basin (1982-2015)

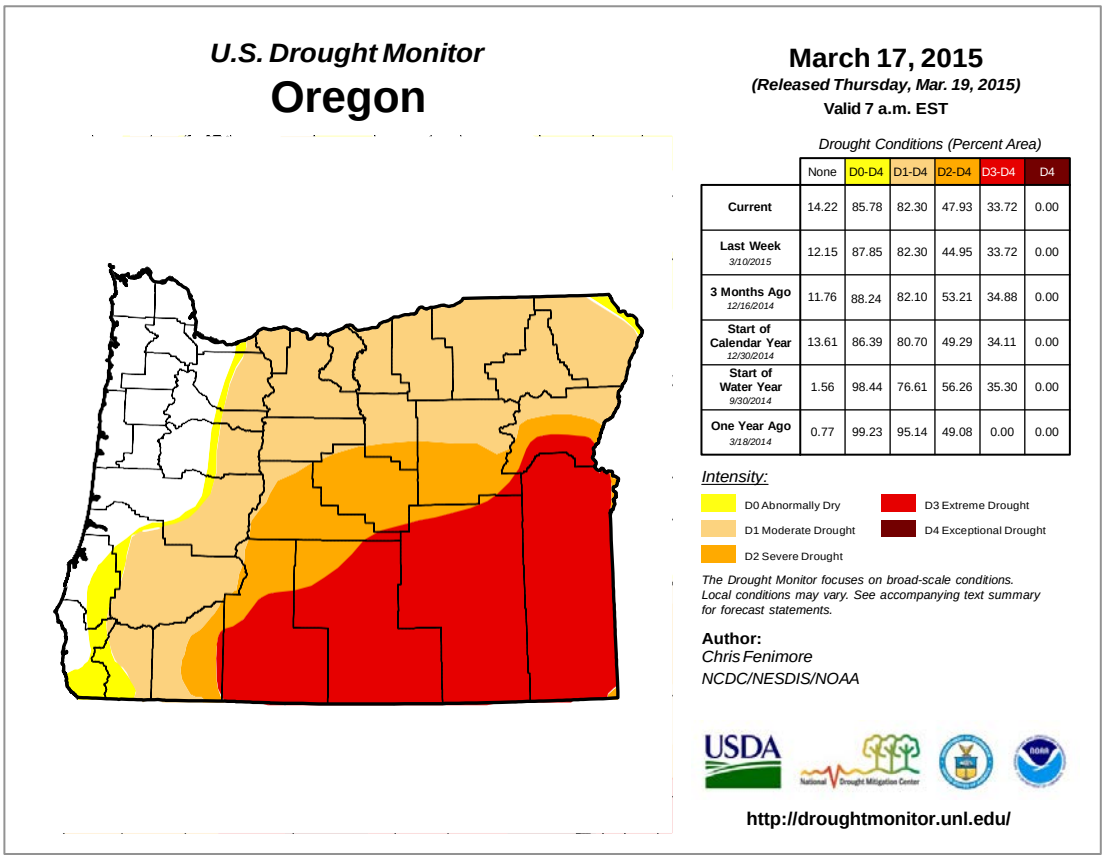


Source: Department of Agriculture---Natural Resources Conservation Service, "Surface Water Supply Index, Upper Deschutes Basin" www.or.nrcs.usda.gov. Accessed March 2015.

The figure below shows the county's current drought conditions monitor according to the National Drought Mitigation Center at the University of Nebraska, Lincoln. The measurement shown displays the percent area of drought severity conditions. It indicates that the majority of Deschutes County is currently registering D2 Severe drought. The possible impacts of a serve drought are: likely crop or pasture losses, water shortages, and imposed water restrictions.[4]

[4] USDM "U.S. Drought Monitor Classification Scheme"

Figure II-2 U.S. Drought Monitor – Oregon



Source: National Drought Mitigation Center, University of Nebraska, Lincoln. Droughtmonitor.unl.edu, Accessed March 18, 2015.

Hazard Identification

Deschutes County frequently experiences drought conditions, however, due to water availability the cities of Bend, La Pine, Redmond, and Sisters are rarely affected. At the time the plan was developed, no data existed to assist in identifying the location or extent of the drought hazard in Deschutes County. Typically, droughts occur as regional events and often affect more than one county. In severe droughts, environmental and economic consequences can be significant. In recent years, the State has addressed drought emergencies through the Oregon Drought Council. This interagency (state/federal) council meets to discuss climate outlooks, water and soil conditions, and advise the Governor as the need arises.

Probability Assessment

Droughts are not uncommon in the State of Oregon, nor are they just an "east of the mountains" phenomenon. They occur in all parts of the state, in both summer and winter. Oregon's drought history reveals many short---term and a few long---term events. The average recurrence interval for severe droughts in Oregon is somewhere between 8 and 12 years. Deschutes County's Natural Hazards Mitigation Steering Committee believes that the County's **probability of experiencing a drought is "high,"** meaning one incident is likely within the next

10 – 35 year period. Oregon has yet to undertake a statewide comprehensive risk analysis for drought, to determine probability or vulnerability for a given community. However, based upon available information the Oregon NHMPs Regional Risk Assessment supports this probability rating for Deschutes County.[5]

Vulnerability Assessment

Deschutes County is less vulnerable to drought impacts than other counties in the Region, but droughts can still be problematic. Potential impacts to community water supplies are the greatest threat. Long---term drought periods of more than a year can impact forest conditions and set the stage for potentially destructive wildfires. Additional impacts are described in the Community Hazard Issues section. The Deschutes County Natural Hazards Steering Committee rated Deschutes County as having **a "low" vulnerability to drought hazards**, meaning less than 1% of the region's population or assets would be affected by a major emergency or disaster. Oregon has yet to undertake a statewide comprehensive risk analysis for drought, to determine probability or vulnerability for a given community. However, based upon available information the Oregon NHMPs Regional Risk Assessment supports this vulnerability rating for Deschutes County.[6]

Risk Analysis

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. Table 2---6 of the Risk Assessment (Volume I) shows the county's Hazard Analysis Matrix which scores each hazard and provides the jurisdiction with a sense of hazard priorities, but does not predict the occurrence of a particular hazard. Based on the matrix the **drought hazard is rated #6, out of 9 rated hazards, with a total score of 149**.

Future Climate Variability

One of the main aspects of the probability of future occurrences is its reliance on historic climate trends in order to predict future climate trends. Many counties in eastern Oregon are experiencing more frequent and severe droughts than is historically the norm, and many climate predictions see this trend continuing into the future. Temperatures in the Pacific Northwest region increased in the 20th Century by about 1.5 degrees Fahrenheit and are projected to increasingly rise by an average of 0.2 degrees to 1.0 degrees Fahrenheit per decade. Average temperature change by 2040 is projected to be 3.2 degrees Fahrenheit, and by 2080, 5.3 degrees Fahrenheit. Temperature increases will occur throughout all seasons, with the greatest variation occurring during summer months.[7]

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5 *2015 Oregon Natural Hazard Mitigation Plan DRAFT*. Department of Land Conservation and Development, 2015.

6 Ibid.

[7] Climate Impacts Group, "Climate Change," http://cses.washington.edu

Community Hazard Issues

Drought is frequently an "incremental" hazard, meaning both the onset and end are often difficult to determine. Also, its effects may accumulate slowly over a considerable period of time and may linger for years after the termination of the event.

Droughts are not just a summer---time phenomenon; winter droughts can have a profound impact on agriculture, particularly east of the Cascade Mountains. Also, below average snowfall in higher elevations has far---reaching effects, especially in terms of hydro---electric power, irrigation, recreational opportunities and a variety of industrial uses.

Drought can affect all segments of a jurisdiction's population, particularly those employed in water---dependent activities (e.g., agriculture, hydroelectric generation, recreation, etc.). Also, domestic water---users may be subject to stringent conservation measures (e.g., rationing) and could be faced with significant increases in electricity rates. In addition, water---borne transportation systems (e.g., ferries, barges, etc.) could be impacted by periods of low water.

There also are environmental consequences. A prolonged drought in forests promotes an increase of insect pests, which in turn, damage trees already weakened by a lack of water. A moisture---deficient forest constitutes a significant fire hazard (see the Wildfire summary). In addition, drought and water scarcity add another dimension of stress to species listed pursuant to the Endangered Species Act (ESA) of 1973.

More information on this hazard can be found in the Regional Risk Assessment for Region 6 of the Oregon NHMP.

Existing Authorities, Policies, Programs, and Resources

Existing authorities, policies, programs, and resources include current mitigation programs and activities that are being implemented by city, county, regional, state or federal agencies and/or organizations.

County and Cities

Deschutes County currently addresses the drought hazard through water conservation measures and water monitoring.

State

Drought Council

The Drought Council is responsible for assessing the impact of drought conditions and making recommendations to the Governor's senior advisors. The Water Availability Committee, a subcommittee of technical people who monitor conditions throughout the state and report these conditions monthly, advises the Drought Council. In this manner the Drought Council keeps up---to---date on water conditions.

Federal

Natural Resources Conservation Service

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) has a regional service center located in Redmond (another is located in Warm Springs). The NRCS is dedicated to three main priorities involving resource preservation one among them is water quantity and quality. The NRCS incorporates a conservation implementation strategy to preserve natural resources into the future.[8]

Hazard Mitigation Action Items

There are no identified Drought action items for Deschutes County; however, several of the Multi---Hazard action items affect the Drought hazard. An action item matrix is provided within Volume I, Section 3, while action item forms are provided within Volume IV, Appendix A. To view city actions see the appropriate city addendum within Volume III.

[8] NRCS – Deschutes County "Information for Partners and Participants," http://www.or.nrcs.usda.gov

Significant Changes Since the 2010 Plan

There are no significant changes in the potential for earthquakes to occur in Deschutes County since 2010, therefore, there are no significant changes in this section from the 2010 Plan. However, the format of the section and minor content changes has occurred.

Causes and Characteristics of the Hazard

Seismic events were once thought to pose little or no threat to Oregon communities. However, recent earthquakes and scientific evidence indicate that the risk to people and property is much greater than previously thought. Oregon and the Pacific Northwest in general are 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 have some tie to the subducting, or diving, of the dense, oceanic Juan de Fuca Plate under the lighter, continental North American Plate. There is also a link between the subducting plate and the formation of volcanoes some distance inland from the offshore subduction zone.

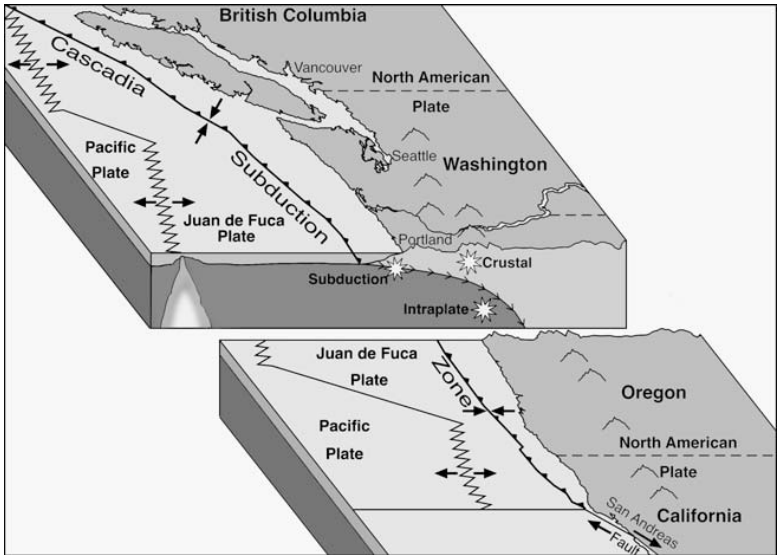
Central Oregon includes portions of five physiographic provinces including the High Cascades, Blue Mountains, Basin and Range, High Lava Plains, and Deschutes---Columbia Plateau. Consequently, its geology and earthquake susceptibility varies considerably. There have been several significant earthquakes in the region; however all have been located in Klamath and Lake Counties. Additionally, faults have been located in Deschutes, Klamath, and Lake Counties. The region has also been shaken historically by crustal and intraplate earthquakes and prehistorically by subduction zone earthquakes centered outside Central Oregon. All considered, there is good reason to believe that the most devastating future earthquakes would probably originate along shallow crustal faults in the region, or along the offshore Cascadia Subduction Zone.

Subduction Zone Earthquakes

The Pacific Northwest is located at a convergent plate boundary, where the Juan de Fuca and North American tectonic plates meet. The two plates are converging at a rate of about 1.5 inches per year[9]. This boundary is called the Cascadia Subduction Zone (CSZ, see Figure II---3). It extends from British Columbia to northern California. Earthquakes are caused by the abrupt release of slowly accumulated stress.

[9] Interagency Hazard Mitigation Team. 2012. Oregon Natural Hazards Mitigation Plan. Salem, OR: Oregon Military Department – Office of Emergency Management

Figure II-3 Cascadia Subduction Zone



Source: Shoreland Solutions. Chronic Coastal Natural Hazards Model Overlay Zone. Salem, OR: Oregon Department of Land Conservation and Development (1998) Technical Guide---3.

Although there have been no large historical earthquakes along the offshore Cascadia Subduction Zone, similar subduction zones worldwide produce large "megathrust" earthquakes with magnitudes of 8 or larger. They occur because the oceanic crust "sticks" as it is being pushed beneath the continent, rather than sliding smoothly. Over hundreds of years, large stresses build up, which are released suddenly in "megathrust" earthquakes. Such earthquakes typically have a minute or more of strong ground shaking, and are quickly followed by numerous large aftershocks.

Subduction zones similar to the Cascadia Subduction Zone have produced earthquakes with magnitudes of 8.0 or larger. Historic subduction zone earthquakes include the 1960 Chile earthquake (magnitude 9.5), the 1964 southern Alaska earthquake (magnitude 9.2), the 2004 Indian Ocean earthquake (magnitude 9.0) and the 2011 Tohoku earthquake (magnitude 9.0). Geologic evidence shows that the Cascadia Subduction Zone has generated great earthquakes of similar magnitude, most recently about 300 years ago.[10]

Deep Intraplate Earthquakes

Deep intraplate earthquakes occur at depths of 18 to 60 miles below the earth's surface in the subducting oceanic crust and can reach magnitude 7.5.[11] This type of earthquake is more common in the Puget Sound region; in Oregon these earthquakes occur at lower rates and none have occurred at damaging magnitudes.[12] The February 28, 2001 Nisqually earthquake

[10] Interagency Hazard Mitigation Team. 2012. Oregon Natural Hazards Mitigation Plan. Salem, OR: Oregon Military Department – Office of Emergency Management

[11] Planning for Natural Hazards: Oregon Technical Resource Guide, Community Planning Workshop, (July 2000), p. 8---8.

[12] Interagency Hazard Mitigation Team. 2012. Oregon Natural Hazards Mitigation Plan. Salem, OR: Oregon Military Department – Office of Emergency Management

(magnitude 6.8) in Washington State was a deep intraplate earthquake. It produced a rolling motion that was felt from Vancouver, British Columbia to Coos Bay, Oregon and east to Salt Lake City, Utah.[13]

Shallow Crustal Earthquakes

These are the most common earthquakes and occur in the North American Plate at relatively shallow depths of 6---12 miles below the surface.[14] When crustal faults slip, they can produce earthquakes of magnitudes up to 7.0. Although most crustal fault earthquakes are smaller than 4.0 and generally create little or no damage, some of them can cause extensive damage. The 1993 Klamath Falls earthquakes (magnitude 6.0 and 5.9) were crustal earthquakes.

> "Due to the amount of faulting in the area, [the 1993 Klamath Falls earthquake] is just business as usual for such a geologically active region. Historic evidence, combined with geologic evidence for large numbers of earthquakes in the prehistoric past, suggest that one or more earthquakes capable of damage (magnitude 4 – 6) hit south---central Oregon every few decades, so it pays to be prepared."
>
> James Roddey, DOGAMI

Volcanic Earthquakes

Volcanic earthquakes are usually smaller than magnitude 2.5, roughly the threshold for shaking felt by observers close to the event. Swarms of small earthquakes may persist for weeks to months before eruptions, but little or no earthquake damage would occur to buildings in surrounding communities. Some volcanic related swarms may include earthquakes as large as about magnitude 5. For the communities of Bend, La Pine, and Sunriver, shallow earthquakes in the magnitude 4---5 range that are located beneath Newberry volcano would cause walls to rattle or windows and dishes to vibrate. Both Newberry and the Three Sisters volcanoes routinely experience small magnitude earthquakes that are not felt.

While all four types of earthquakes have the potential to cause major damage, subduction zone earthquakes pose the greatest danger. A major CSZ event could generate an earthquake with a magnitude of 9.0 or greater resulting in devastating damage and loss of life. Such earthquakes may cause great damage to the coastal area of Oregon as well as inland areas in western Oregon; damage to Deschutes County will be less severe, however, it is expected that the impact of such an event will greatly affect eastern Oregon.

The specific hazards associated with earthquakes are explained below:

Ground Shaking

Ground shaking is the motion felt on the earth's surface caused by seismic waves generated by the earthquake. Ground shaking is the primary cause of earthquake damage. The strength of ground shaking depends on the magnitude of the earthquake, the type of fault that is slipping, distance from the epicenter (where the earthquake originates), and local geology. Buildings on

[13] Hill, Richard. "Geo Watch Warning Quake Shook Portland 40 Years Ago." The Oregonian. October 30, 2002.

[14] Madin, Ian P. and Zhenming Wang, Relative Earthquake Hazard Maps Report, DOGAMI, 1999.

poorly consolidated and thick soils will typically see more damage than buildings on consolidated soils and bedrock.

Ground Shaking Amplification

Ground shaking amplification refers to the soils and soft sedimentary rocks near the surface that can modify ground shaking from an earthquake. Such factors can increase or decrease the amplification (i.e., strength) as well as the frequency of the shaking. The thickness of the geologic materials and their physical properties determine how much amplification will occur. Ground motion amplification increases the risk for buildings and structures built on soft and unconsolidated soils.

Surface Faulting

Surface faulting are planes or surfaces in Earth materials along which failure occurs. Such faults can be found deep within the earth or on the surface. Earthquakes occurring from deep lying faults usually create only ground shaking.

Liquefaction and Subsidence

Liquefaction occurs when ground shaking causes wet, granular soils to change from a solid state into a liquid state. This results in the loss of soil strength and the soil's ability to support weight. When the ground can no longer support buildings and structures (subsidence), buildings and their occupants are at risk.

Earthquake-Induced Landslides and Rockfalls

Earthquake---induced landslides are secondary hazards that occur from ground shaking and can destroy roads, buildings, utilities and critical facilities necessary to recovery efforts after an earthquake. Some Deschutes County communities are built in areas with steep slopes. These areas often have a higher risk of landslides and rockfalls triggered by earthquakes.

History of Earthquakes in Deschutes County

A summary of significant earthquake events in the Deschutes County region is found in the table below.

Table II-2 Selected Earthquakes, M 5.0+ (1971-2014)

Date	Location	Magnitude	Comments
Approximate years: 1400 BCE, 1050, BCE 600 BCE 400, 750, 900	Offshore, Cascadia subduction zone	Probably 8.0G9.0	Based on studies of earthquakes and tsunamis in Willapa Bay, WA. These are the midpoints of the age ranges for these six events.
January 1700	Offshore, Cascadia Subduction zone	Approximately 9.0	Generated a tsunami that struck Oregon, Washington and Japan; destroyed Native American villages along the coast.
April 1906	North of Lakeview, OR	5.0	Three felt aftershocks.
April 1920	Crater Lake	5.0	
January 1923	Lakeview, OR	6.0	
March 1958	Southeast of Adel, OR	4.5	Damage unknown
1968	Adel	4.7G5.1	Damage to homes. 20 earthquakes of M4 or greater were recorded between 5/28/68 & 6/24/68.
September 20, 1993	Klamath County	5.9 and 6.0	Two deaths, $10 million damage, including county courthouse; rockfalls induced by ground motion.

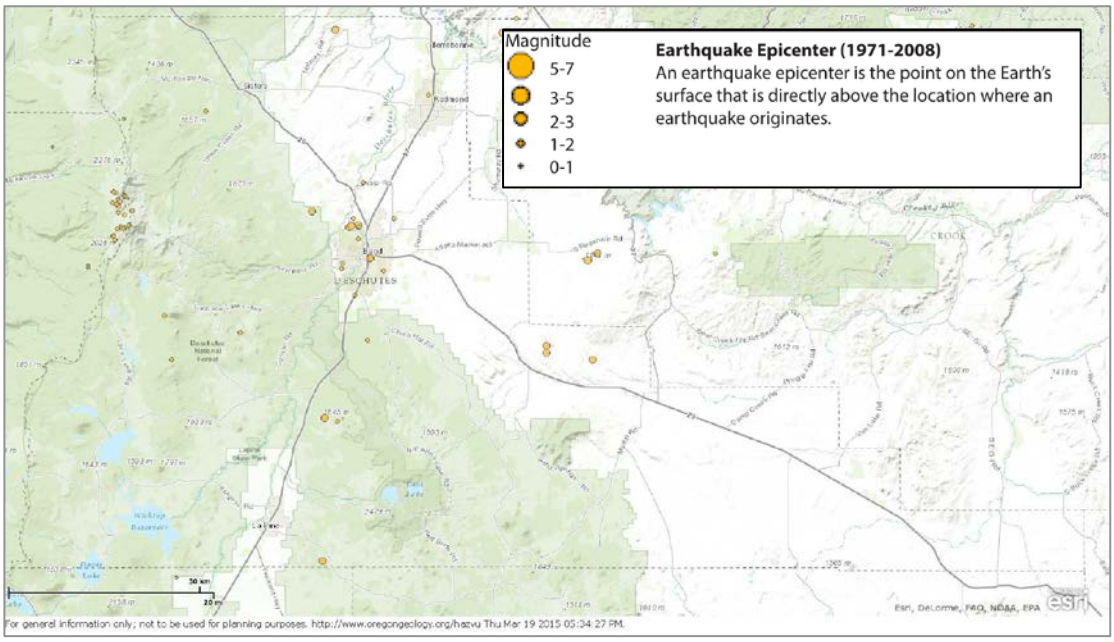
Source: Ivan Wong and others, "A Look Back at Oregon's Earthquake History, 1841---1994," in Oregon Geology, (1995), 125---139; Niewendrop and others, "Map of Selected Earthquakes fore Oregon, 1841 through 2002," DOGAMI, (2003).

The Klamath County earthquakes on September 21, 1993, caused two deaths and approximately 7.5 million dollars in damage. One person was killed when a boulder crushed the car he was driving in an earthquake---induced rock fall, and another person died of a heart attack. More than 1,000 homes and commercial buildings were damaged. [15]

Deschutes County routinely has small earthquake events. The earthquakes shown in the figure below are relatively insignificant events below M 5.0. The larger events may have been slightly felt but little to no structural/property damage resulted. There is no historic record of significant crustal earthquakes centered in the Deschutes County in the past 150 years, although Oregon has experienced crustal earthquakes that originated outside the county. Recent earthquake events in Deschutes County include a two---day swam of 100 to 200 small, unfelt earthquakes in the Three Sisters region (shown below on the left side of the map) in April 2004. Additionally, a seismic network on Newberry Volcano has recorded numerous small, unfelt earthquakes since its installation in 2011.

[15] USGS, Earthquake Hazards Program, Historic Earthquakes http://earthquake.usgs.gov/regional/states/historical.php?

Figure II-4 Earthquake Epicenters (1971-2008)

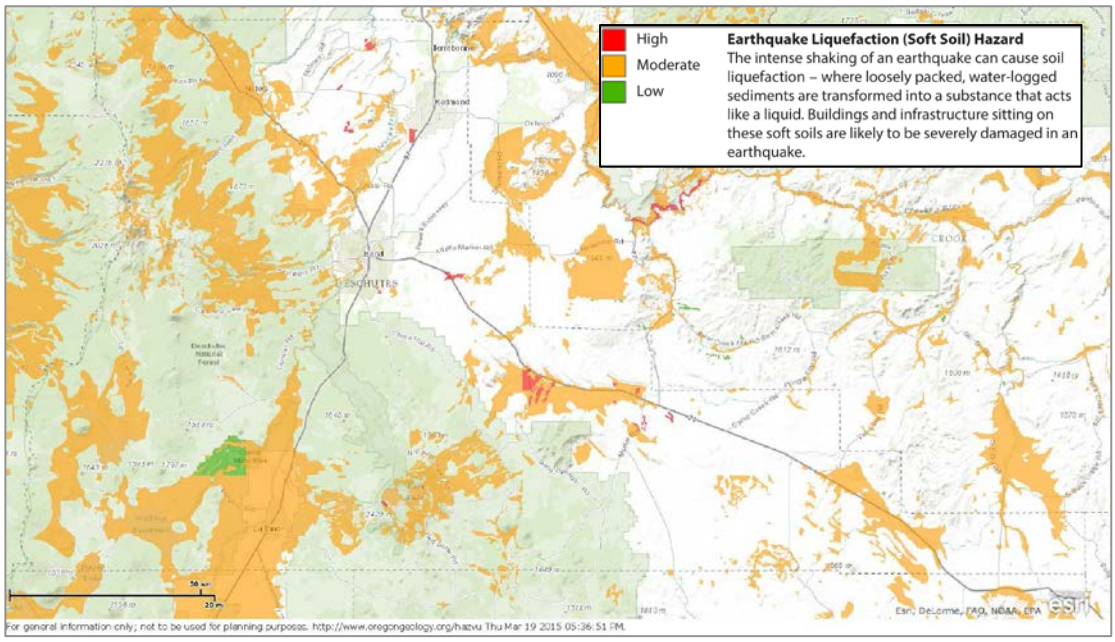


Source: Oregon HazVu: Statewide Geohazards Viewer (HazVu), accessed March 18, 2015

Hazard Identification

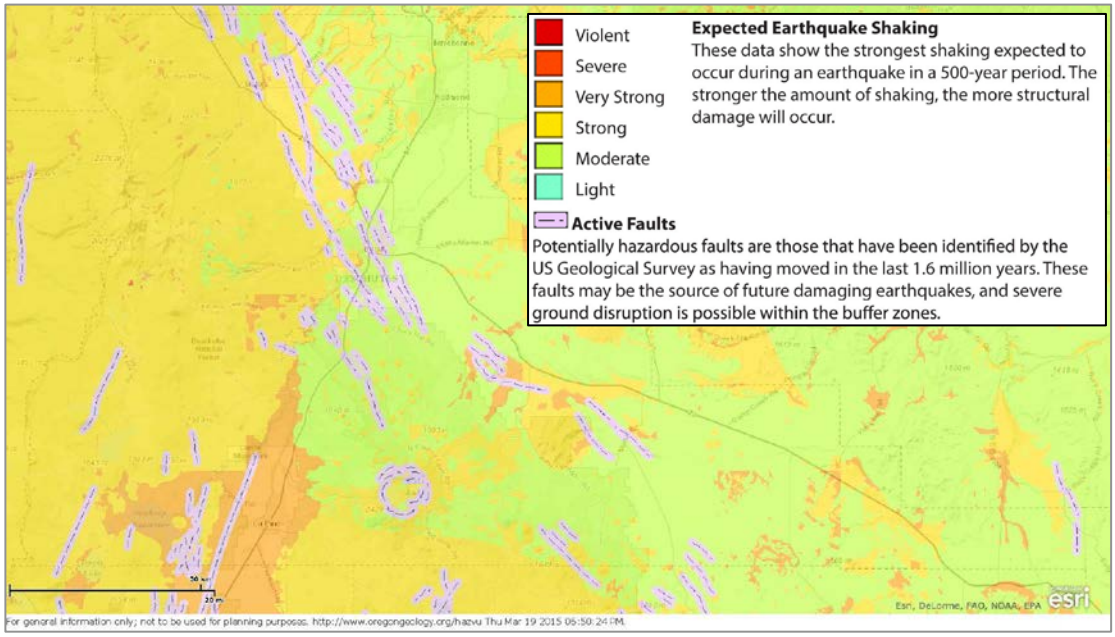
The Oregon Department of Geology and Mineral Industries (DOGAMI), in partnership with other state and federal agencies, has undertaken a rigorous program in Oregon to identify seismic hazards, including active fault identification, bedrock shaking, tsunami inundation zones, ground motion amplification, liquefaction, and earthquake induced landslides. DOGAMI has published a number of seismic hazard maps that are available for Oregon communities to use. The maps show liquefaction, ground motion amplification, landslide susceptibility, and relative earthquake hazards. OPDR used the DOGAMI Statewide Geohazards Viewer to present visual maps of recent earthquake activity (Figure II---4), liquefaction (soft soils, Figure II---5), and expected ground shaking for combined earthquake events (Figure II---6; see vulnerability assessment for more information on the combined events). 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 II-5 Earthquake Liquefaction (Soft Soil) Hazard



Source: Oregon HazVu: Statewide Geohazards Viewer (HazVu), accessed March 18, 2015

Figure II-6 Combined Earthquake Events Expected Shaking and Active Faults



Source: Oregon HazVu: Statewide Geohazards Viewer (HazVu), accessed March 18, 2015

The maps indicate the predominant risks for the county lie in the southwestern portion of the county in the La Pine and Sunriver region; it also shows greater risk in the Sisters region.

Probability Assessment

The Cascadia Subduction Zone (CSZ) generates an earthquake on average every 500---600 years. However, as with any natural processes the average time between events can be misleading. Some of the earthquakes may have been 150 years apart while some closer to 1,000 years apart.[16] Establishing a probability for crustal earthquakes is difficult given the small number of historic events in the region. Earthquakes generated by volcanic activity in Oregon's Cascade Range are possible, but likewise unpredictable. Mitigation action calls for study of the probability of earthquake events specific to Deschutes County.

Deschutes County's Natural Hazards Mitigation Steering Committee believes that the County's **probability of experiencing a crustal earthquake is "low",** meaning one incident is likely within the next 75 – 100 year period; the committee believes that the County's **probability of experiencing a Cascadia earthquake is "moderate"**, meaning one incident is likely within the next 35 – 75 year period. Based upon available information the Oregon NHMPs Regional Risk Assessment supports this probability rating for Deschutes County.[17]

Vulnerability Assessment

The Oregon Department of Geology and Mineral Industries (DOGAMI) has developed two earthquake loss models for Oregon based on the two most likely sources of seismic events: 1) the CSZ, and 2) combined earthquake events. Both models are based on HAZUS, a computerized program, currently used by the Federal Emergency Management Agency (FEMA) as a means of determining potential losses from earthquakes.

The CSZ event is based on a potential 8.5 earthquake generated off the Oregon coast. The model does not take into account a tsunami, which probably would develop from the event (but not affect Deschutes County). The 500---year crustal model does not look at a single earthquake (as in the CSZ model); it encompasses many faults, each with a 10% 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. Neither model takes unreinforced masonry building into consideration. DOGAMI investigators caution that the models contain a high degree of uncertainty and should be used only for general planning purposes. Despite their limitations, the models do provide some approximate estimates of damage. Further mention is made of potential for possible flooding in the event of an earthquake in the area of the South Sister uplift. Current research being conducted of this area will determine potential impact and flooding potential.

The Deschutes County Natural Hazards Steering Committee rated Deschutes County as having a **"low" vulnerability to the crustal earthquake hazard**, meaning less than 1% of the region's population or assets would be affected by a major emergency or disaster; the committee rated the County as having a **"high" vulnerability to the Cascadia earthquake hazard,** meaning more than 10% of the region's population or assets would be affected by a major emergency or

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[16] Y. Wang & J.L. Clark, Special Paper 29, Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses. 1999. DOGAMI.

[17] *2015 Oregon Natural Hazard Mitigation Plan DRAFT*. Department of Land Conservation and Development, 2015.

disaster. Based upon available information the Oregon NHMPs Regional Risk Assessment supports this vulnerability rating for Deschutes County.[18]

Risk Analysis

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. Table 2---6 of the Risk Assessment (Volume I, Section 2) shows the county's Hazard Analysis Matrix which scores each hazard and provides the jurisdiction with a sense of hazard priorities, but does not predict the occurrence of a particular hazard. Based on the matrix the **Cascadia earthquake hazard is rated #3, out of 9 rated hazards, with a total score of 191; while the crustal earthquake hazard is rated #8, out of 9 rated hazards, with a total score of 94**.

Community Hazard Issues

The effects of earthquakes span a large area. The degree to which earthquakes are felt, however, and the damages associated with them may vary. At risk from earthquake damage are unreinforced masonry buildings, bridges built before earthquake standards were incorporated into building codes, sewer, water, and natural gas pipelines, petroleum pipelines, and other critical facilities and private property located within the county. The areas that are particularly vulnerable to potential earthquakes in the county have been identified as those with soft, alluvial sediments and lands along stream channels.

Earthquake damage to roads and bridges can be particularly serious by hampering or cutting off the movement of people and goods and disrupting the provision of emergency response services. Such effects in turn can produce serious impacts on the local and regional economy by disconnecting people from work, home, food, school and needed commercial, medical and social services. A major earthquake can separate businesses and other employers from their employees, customers, and suppliers thereby further hurting the economy. Deschutes County is less susceptible to being isolated, unlike other areas of Oregon, due to its location along major highways, which run through multiple locations in the county. Finally, following an earthquake event, the cleanup of debris can be a huge challenge for the community.

Death and Injury

Death and injury can occur both inside and outside of buildings due to falling equipment, furniture, debris, and structural materials. Likewise, downed power lines or broken water and gas lines endanger human life. Death and injury are highest in the afternoon when damage occurs to commercial and residential buildings and during the evening hours in residential settings.[19]

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[18] Ibid.

[19] Planning for Natural Hazards: Oregon Technical Resource Guide, Community Planning Workshop, (July 2000).

Disruption of Critical Facilities

Critical facilities are police stations, fire stations, hospitals, and shelters. These are facilities that provide services to the community and need to be functional after an earthquake event. The earthquake effects outlined above can all cause emergency response to be disrupted after a significant event.[20] Tables II---3 and II---4 (below) and tables in the city addenda, display damage and collapse potential for structures including critical and essential facilities.

Economic Loss

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, businesses, and industry all suffer temporary loss of income when their source of finances are damaged or disrupted.

The potential losses from an earthquake in Deschutes County extend beyond those to human life, homes, property and the landscape. A recent earthquake damage model has not been conducted for Deschutes County, however, based upon data from a 1999 DOGAMI report rough loss estimates are available. The economic base in Deschutes County is estimated at $4,676,000,000 (in 1999 dollars); it is expected that the county will incur total direct losses valuing $5,000,000 (in 1999 dollars) for the Cascadia model and $71,000,000 (in 1999 dollars) for the 500---year model; both amount to a loss ratio of less than one---percent.[21] While the expected losses have increased due to increased development in the county, as well as inflation, the loss ratio and relative damage for the county is expected to be similar. See table on the following page for more information on expected losses.

Local business economies are at substantial risk if an earthquake damages or otherwise necessitates the closure of any of the major transportation routes in Deschutes County. As such, the economic loss to the region can exceed $3.5 million per day in the County.

[20] Y. Wang & J.L. Clark, Special Paper 29, Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses. 1999. DOGAMI.

[21] Ibid. The loss ratio is determined as a percentage of the expected losses to the county's economic base.

Table II-3 Deschutes County Earthquake Damage Summary

Deschutes County	8.5 Cascadia subduction zone event	500 year model
Injuries	1	17
Deaths	0	0
Displaced households	0	5
Short term shelter needs	0	3
Economic losses for buildings	$5 million	$71 million
Operating the day after the quake:		
Fire stations	100%	NA
Police stations	99%	NA
Schools	99%	NA
Bridges	100%	NA
Economic losses to:		
Highways	$17,000	$572,000
Airports	$40,000	$2 million
Communication systems:		
Economic losses	$2,000	$1 million
Operating the day of the quake	99%	NA
Debris generated (thousands of tons)	3	47

These figures have a high degree of uncertaintly and should be used only for general planning purposes. Because of rounding, numbers may not add up to 100%.

Because the 500 year model includes several earthquakes, the number of facilities operational the "day after" cannot be calculated.

8.5 Cascadia event	Percentage of buildings in damage categories				
Building type	None	Slight	Moderate	Extensive	Complete
Agriculture	93	1	0	0	0
Commercial	93	1	0	0	0
Education	89	1	0	0	0
Government	98	1	0	0	0
Industrial	93	2	0	0	0
Residential	98	1	0	0	0

500 year model	Percentage of buildings in damage categories				
Building type	None	Slight	Moderate	Extensive	Complete
Agriculture	75	10	7	2	0
Commercial	72	11	9	3	0
Education	71	10	7	2	0
Government	75	12	9	3	1
Industrial	69	12	10	3	1
Residential	83	10	5	1	0

Source: Y. Wang & J.L. Clark, Special Paper 29, Earthquake Damage in Oregon: Preliminary Estimates of Future Earthquake Losses. 1999. DOGAMI.

Bridge Damage

All bridges can sustain damage during earthquakes, leaving them unsafe for use. More rarely, some bridges have failed completely due to strong ground motion. Bridges are a vital transportation link – damage to them can make some areas inaccessible.

Because bridges vary in size, materials, siting, and design, earthquakes will affect each bridge differently. Bridges built before the mid 1970's often do not have proper seismic reinforcements. These bridges have a significantly higher risk of suffering structural damage during a moderate to large earthquake. Bridges built in the 1980's and after are more likely to have the structural components necessary to withstand a large earthquake.[22]

2001 Nisqually Earthquake

A 6.8 magnitude earthquake centered southwest of Seattle struck on February 28, 2001, followed by a mild aftershock the next morning, and caused more than $1 billion worth of damage. Despite this significant loss, the region escaped with relatively little damage for two reasons: the depth of the quake center and preparations by its residents. Washington initiated a retrofitting program in 1990 to strengthen bridges, while regional building codes mandated new structures withstand certain amounts of movement. Likewise, historic buildings have been voluntarily retrofitted with earthquake---protection reinforcements.

Damage to Lifelines

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

Fire

Downed power lines or broken gas mains can trigger fires. When fire stations suffer building or lifeline damage, quick response to quench fires is less likely.

Debris

After damage occurs to a variety of structures, much time is spent cleaning up brick, glass, wood, steel or concrete building elements, office and home contents, and other materials.

More information on this hazard can be found in the Regional Risk Assessment for Region 6 of the Oregon NHMP.

[22] University of Washington website: www.geophys.washington.edu/SEIS/PNSN/INFO_GENERAL/faq.html#3.

Building and Home Damage

Wood structures tend to withstand earthquakes better than structures made of brick or unreinforced masonry buildings.[23] Building construction and design play a vital role in the survival of a structure during earthquakes. Damage can be quite severe if structures are not designed with seismic reinforcements or if structures are located atop soils that liquefy or amplify shaking. Whole buildings can collapse or be displaced. For an approximation of buildings at risk of collapse by year built see Appendix C.

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 surveyed 78 facilities in Deschutes County; of these seven are within county jurisdiction (see City addenda for facilities within city jurisdiction).

DOGAMI scored each building with a 'low,' 'moderate,' 'high,' or 'very high' potential of 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.[24] To fully assess a building's potential of collapse, a more detailed engineering study completed by a qualified professional is required, but the RVS study can help to prioritize which buildings to retrofit.

The table below displays the rankings of all facilities within the county's jurisdiction; each "X" represents one building within that ranking category. Of the buildings evaluated by DOGAMI using RVS, none have very high (100% chance) collapse potential, and two buildings have high (greater than 10% chance) collapse potential. The county and cities have opted to create one action item for all the facilities that have a "high" or "very high" rating (see Appendix A). The buildings with 'high' or 'very high' collapse potential include multiple public safety and education facilities located throughout the county all of which can play a key role in during disasters events or during long---term recovery. Please see the city addenda for a list of facilities within each jurisdiction (note: some county facilities are located within city jurisdiction, as such they are represented in the applicable addendum table).

[23] Wolfe, Myer, et al. Land Use Planning for Earthquake Hazard Mitigation: A Handbook for Planners, Special Publication 14, Natural Hazards Research and Applications Information Center.

[24] State of Oregon Department of Geologic and Mineral Industries, "Implementation of 2005 Senate Bill 2 Relating to Public Safety, Seismic Safety and Seismic Rehabilitation of Public Building", May 22, 2007, Open File Report 0---07---02.

Table II-4 Rapid Visual Survey Scores

Facility	Level of Collapse Potential			
	Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools				
Three Rivers Elementary School (56900 Enterprise Dr, Sunriver)	X			
Terrebonne Community School (1199 B Ave, Terrebonne)	X		X	
Public Safety				
Cloverdale RFPD (68787 George Cyrus Rd, Cloverdale)	X		X	
Cloverdale RFPD (67433 Cloverdale Rd, Cloverdale)		X		
Sunriver Police Department (57455 Abbot Dr, Sunriver)	X			
Sunriver Fire Department (57475 Abbot Dr, Sunriver)	X			
Deschutes County Sheriff's Office P Terrebonne (8222 Hwy 97, Terrebonne)	X			

Source: DOGAMI 2007. Open File Report 0---07---02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.

Existing Authorities, Policies, Programs, and Resources

Existing authorities, policies, programs, and resources include current mitigation programs and activities that are being implemented by city, county, regional, state or federal agencies and/or organizations.

County and Cities

At an individual level, preparedness for an earthquake is minimal as perception and awareness of earthquake hazards are low. Strapping down heavy furniture, water heaters and expensive personal property as well as having earthquake insurance are steps toward earthquake mitigation.

City and county building officials enforce building codes for new construction and can coordinate inspection activities in the event of an earthquake. Deschutes County has also mapped critical facilities and major public buildings and inspections of these facilities can be assigned quickly when an earthquake occurs.

State

The Oregon State Building Codes Division adopts statewide standards for building construction that are administered by the state, cities and counties throughout Oregon. The codes apply to new construction and to the alteration of, or addition to, existing structures. Within these standards are six levels of design and engineering specifications for seismic safety that are applied to areas according to the expected degree of ground motion and site conditions. The

structural code requires a site---specific seismic hazard report for critical facilities such as hospitals, fire and police stations, emergency response facilities, and special occupancy structures, such as schools and prisons. The seismic hazard report required by the structural code for essential facilities and special occupancy structures considers factors such as the seismic zone, soil characteristics including amplification and liquefaction potential, any known faults, and potential landslides. The findings of the seismic hazard report must be considered in the design of the building. The residential code incorporates prescriptive requirements for foundation reinforcement and framing connections based on the applicable seismic zone for the area.

Retrofitting of existing buildings may be required when such buildings are altered or their occupancy is changed. Requirements vary depending on the type and size of the alteration and whether there is a change in the use of the building that is considered more hazardous.

Hazard Mitigation Action Items

There are two identified Earthquake action items for Deschutes County; in addition, several of the Multi---Hazard action items affect the earthquake hazard. An action item matrix is provided within Volume I, Section 3, while action item forms are provided within Volume IV, Appendix A. To view city actions see the appropriate city addendum within Volume III.

Significant Changes Since the 2010 Plan

Significant changes to this section include the addition of national flood insurance program information incorporating reporting on any repetitive flood loss or severe repetitive flood loss properties. In addition, the format of the section and minor content changes has occurred.

Causes and Characteristics of the Hazard

Flooding results when rain and snowmelt creates water flow that exceed the carrying capacity of rivers, streams, channels, ditches, and other watercourses. In Oregon, flooding is most common from October through April when storms from the Pacific Ocean bring intense rainfall. Most of Oregon's destructive natural disasters have been floods.[25] Flooding can be aggravated when rain is accompanied by snowmelt and frozen ground; the spring cycle of melting snow is the most common source of flood in the region.

Anticipating and planning for flood events is an important activity for Deschutes County. Federal programs provide insurance and funding to communities engaging in flood hazard mitigation. The Federal Emergency Management Association (FEMA) manages the National Flood Insurance Program (NFIP) and the Hazard Mitigation Grant Program (HMGP). The NFIP provides flood insurance and pays claims to policyholders who have suffered losses from floods. The HMGP provides grants to help mitigate flood hazards by elevating structures or relocating or removing them from flood hazard areas. These programs provide grant money to owners of properties who have suffered losses from floods, and in some cases, suffered losses from other natural hazard events.

Flood Sources

The principal flood sources in Deschutes County include: Deschutes River, Little Deschutes River, Paulina Creek, Whychus Creek, and Spring River.[26]

Flood Types

The principal types of flood that occur in Deschutes County include:

- Rain---on---Snow (warm winter) flooding
- Spring/Snowmelt flooding
- Ice jams/ Frazil Ice
- Flash floods
- Dam failure

[25] Taylor, George H. and Chris Hannan. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press. 1999

[26] FEMA, Deschutes County Flood Insurance Study, revised September 28, 2007.

The most common of these potential flooding events in Deschutes County is a rain---on--- snow event.[27]

Rain-on-Snow

The weather pattern that produces these floods occurs during the winter months and has come to be associated with La Nina events, a three to seven year cycle of cool, wet weather. Brief, cool, moist weather conditions are followed by a system of warm, moist air from tropical latitudes. The intense warm rain associated with this system quickly melts foothill and mountain snow. Above---freezing temperatures may occur well above pass levels in the Cascade Mountains (4,000---5,000 feet).[28]

Spring/ Snowmelt Flooding

Snowmelt floods occur in the spring and early summer when temperatures rise rapidly, causing rapid melting of accumulated snow. Spring runoff has caused significant riverine flooding in the County, resulting in damage along the Deschutes, Little Deschutes and Spring rivers, in addition to Paulina and Whychus Creeks, and several smaller rivers and creeks. Most spring flooding has been precipitated by a particular combination of factors: ground saturation followed by a heavy ground freeze, a heavy snowpack in higher elevations, and then spring rains and winds causing sudden snow melt.

Ice Jams

Ice jams on the Deschutes River have created flood conditions in the past and will continue to do so due to local topography. This type of flood is also associated with Frazil Ice, which contributes to jamming (particularly upstream of the former log pond formed by Shevlin Dam). Ice jams commonly happen during the winter and early spring, while the river is still frozen. Sudden warming at higher altitudes can melt waters resulting in increased runoff of water and ice into large reaches of frozen river below. On the way downstream, the ice can “jam” in narrow places on the river or against a road crossing, effectively damming the river, sometimes followed by a sudden breach and release of the water and ice.

Flash Floods

Flash floods usually result from intense storms dropping large amounts of rain within a brief period. They usually occur in the summer during thunderstorm season, appear with little or no warning and can reach full peak in only a few minutes. They are most common in arid and semi---arid areas of Oregon like Deschutes County where there is often steep topography, little vegetation and intense but short---duration rainfall. This situation would be typified by the eastern part of Deschutes County and areas without permanent streams such as the dry canyon west of Redmond.

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[27] Ibid.

[28] Ibid.

Dam Failure (Natural or man-made)

Major flooding could also result from partial or complete failure of natural dams (mountain streams that begin in glacial lakes behind dams of ice or moraines can occasionally be emptied rapidly and result in flash floods with accompanying mud flows) or man---made structures, constructed to restrict the flow of water on the county's waterways, either impounding reservoirs or diversion dams.

These types of floods are often associated with flash floods. In such situations, waters not only rise rapidly, but also generally move at high velocities and often carry large amounts of debris. In these instances a flash flood may arrive as a fast moving wall of debris, mud, water or ice. Such material can accumulate at a natural or man---made obstruction and restrict the flow of water. Water held back in such a manner can cause flooding both upstream and then later downstream if the obstruction is removed or breaks free.

Another area of heightened concern focuses on the potential of flooding related to the failure of glacial moraine dams that impound high---altitude lakes around the Three Sisters and Broken Top. In the event of volcanic eruption, earthquake or a large avalanche of rock or ice into the lakes, these dams could release floods of water and debris whose major impact could inundate parts local areas. A moraine dam impounding a small unnamed lake high on the east side of Broken Top failed in October, 1966, generating a debris flow that traveled down the Soda Creek drainage, across Highway 46 (Cascade Lakes Highway), and spread out over the broad meadow near Sparks Lake. The debris flow buried the road and covered about 250,000 square meters (about 2,700,000 square feet) of the meadow with sand and silt.[29]

Carver Lake, which lies in the headwaters of the South Fork of Whychus Creek, is judged the most likely of lakes to generate future floods or debris flows large enough to affect areas beyond the immediate hazard zone. Lesser hazards include several small lakes at the headwaters of Whychus Creek and the basin (currently with no lake) below Collier Glacier at the head of White Branch, and the unnamed lake on the east side of Broken Top which could trigger floods or debris flows in the Soda Creek drainage or the Tumalo Creek drainage.[30]

History of Floods in Deschutes County[31]

Generally, river flooding has not historically been a serious problem in Deschutes County. This is mostly due to the porous nature of the underlying volcanic rock that has a large capacity for water storage, irrigation diversion canals and reservoir retention. Consequently, the discharge rate for the Deschutes River is very low considering the size of its basins. Regular flooding events have occurred however near the headwaters of Tumalo Creek and in the Tumalo community.

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[29] O'Connor, J.E., J.H. Hardison and J.E. Costa. 2001. Debris flows from failures of Neoglacial---Age moraine dams in the Three Sisters and Mount Jefferson wilderness areas, Oregon. US Geological Survey Professional Paper 1606.

[30] Hydrologic Hazards Along Whychus Creek From a Hypothetical Failure of the Glacial Moraine Impacting Carver Lake Near Sisters, Oregon—USGS Open File Report 87---41

[31] FEMA, Deschutes County Flood Insurance Study, revised September 28, 2007. Most of the information in this section was obtained from the FIS, additional footnotes are provided as applicable.

Along Whychus Creek, the city of Sisters frequently experiences flooding, with the most significant event occurring in 1964.

The flood season on the Deschutes River extends from November through July (larger floods downstream of the Little Deschutes River typically occur in November and December). The flood of record on the Deschutes River upstream of the Little Deschutes River occurred on July 30, 1956 (discharge of 2,280 cfs, approximately a 40---year event); the flood of record on the Deschutes River downstream of the Little Deschutes River occurred on November 27, 1909 (discharge of 5,000 cfs at Benham Falls stream gage). The largest flood since 1958 occurred downstream of the Little Deschutes River in December 1964 (discharge of 3,470 cfs at Benham Falls stream gage, approximately a 175---year event).

The flood season on the Little Deschutes River extends from October through June (majority occur from April to June). Generally there are more days above bankfull stage during the spring (during spring snowmelt floods) than winter. The flood of record occurred in December 1964 (discharge of 3,660 cfs at RM 28.1 north of La Pine, greater than a 500---year event). There are ten bridges within the FIS study area for the Little Deschutes River, of those only the Ranch Bridge (RM 15.1) may be over topped by the 1---percent---annual---chance flood (100---year flood event); however the Vandervert Ranch Bridge (RM 3.1), Lazy River South Ranch Bridge (RM 16.6), Stearns Ranch Bridge (RM 28.1), and the Masten Bridge (RM 39.9) and their approaches may also be over topped by the 0.2---percent---annual---chance flood (500---year flood event).

The flood season on Whychus Creek extends from November through April (larger events occur November and December). The flood of record occurred in December 25, 1980 (discharge of 2,000 cfs at RM 26.6, approximately a 80---year event). Debris deposition on agricultural land damaging irrigation diversion works, bank erosion, and property damage in Sisters are the principle flood concerns. There are 12 bridges within the FIS study area for Whychus Creek, of those only the ranch bridge (RM 16.3) and the Elm Street Bridge (RM 21.8 in Sisters) may be over topped by the 1---percent---annual---chance flood (100---year flood event); however the ranch bridges at RM 19.3 and RM 19.4 and their approaches may also be over topped by the 0.2---percent---annual---chance flood (500---year flood event).

The Whychus Creek stream corridor is particularly vulnerable to obstructions to floodflows due to unconsolidated volcanic deposits that make up the streambed and banks that are prone to erosion. This concern is exacerbated in areas that are at, or below, the elevation of the streambank (see Sisters Addendum for more information). In addition, there is the potential for the moraine dam at Carver Lake to fail during an earthquake, volcanic event, or avalanche/ landslide (the lake contains approximately 740 acre feet of water). There have been three observed failures of the dam in the recent past.

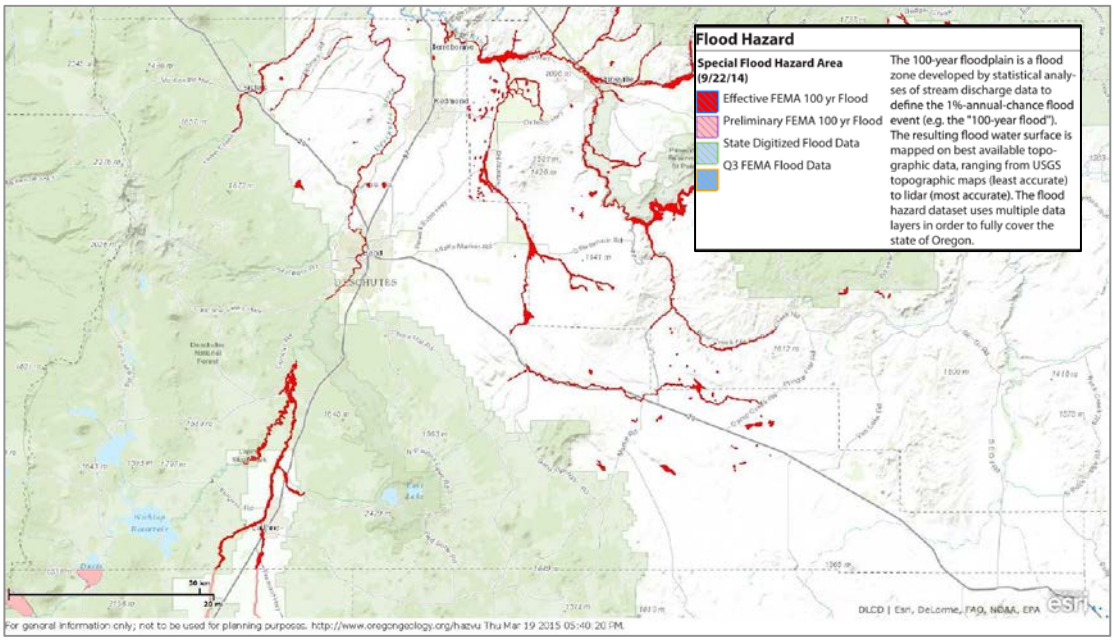
More information on the history of the flood hazard can be found in the Regional Risk Assessment for Region 6 of the 2015 Draft Oregon NHMP**.**

Hazard Identification

FEMA Flood Insurance Rate Maps (FIRMs) and the accompanying Flood Boundary and Floodway maps are the most comprehensive resource for identifying areas subject to flood hazards in Deschutes County. FIRMs and Floodway maps delineate the boundaries of areas subject to inundation by the “base flood.” The base flood is defined as an event having a 100---year

recurrence interval or a 1% probability of occurring in any year. The maps also provide, in areas of detailed study, projected water surface elevations for the base flood. In general, based on experience with the flood events of the past several decades, Deschutes County's FIRM maps have proven to be fairly accurate in depicting areas subject to riverine flooding. There have been no large flood events since the FIRMs were issued in the mid---1980s so the accuracy of the maps in relation to large flood events is untested. The special flood hazard area is depicted in the map below, for more detailed information visit the Oregon Risk MAP website and click on the "Mapping Tools" tab: http://www.oregonriskmap.com/.

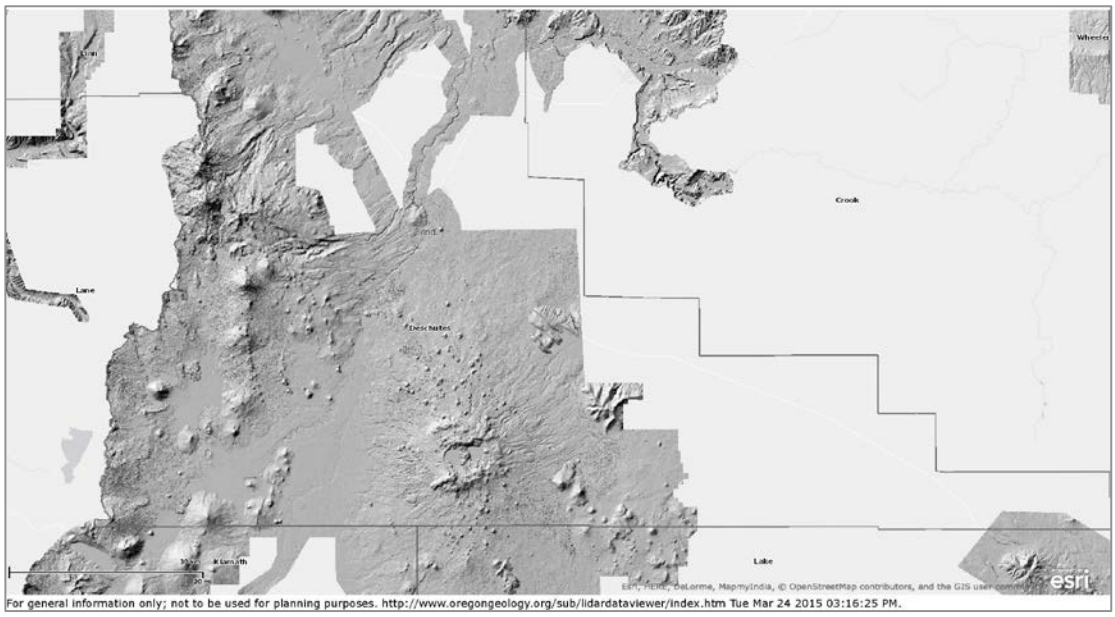
Figure II-7 Special Flood Hazard Area



Source: Oregon HazVu: Statewide Geohazards Viewer (HazVu), accessed March 18, 2015

The county's FIRMs were modernized in 2007, however, there is a concern that sediment accumulation may be occurring within the Deschutes River (and other waterways) that may impact the special flood hazard area. The county has included an action to update the flood insurance study and flood insurance rate maps utilizing existing Lidar. The figure below shows the extent of collected Lidar within Deschutes County, it shows that the areas of the mapped special flood hazard areas are included within the collected Lidar. Although the county is not currently slated to undergo a flood study/ mapping project, the existing Lidar data may be useful in conducting future projects.

Figure II-8 Shaded Relief of Collected Lidar



Source: DOGAMI Lidar Data Viewer, accessed March 24, 2015

National Flood Insurance Program (NFIP)

The Deschutes County Flood Insurance Rate Maps (FIRMs) were modernized in September 2007. The table below shows that as of November 2014, Deschutes County (including the incorporated cities) has 267 National Flood Insurance Program (NFIP) policies (90 of these are for properties developed before the initial FIRM) in force and five paid claims. The last Community Assistance Visit (CAV) for Deschutes County was on July 22, 1994 (the most recent CAV was in Sisters on April 26, 2004). The county and cities are not members of the Community Rating System (CRS). The table displays the number of policies by building type and shows that the majority of residential structures that have flood insurance policies are single---family homes and that there are 14 non---residential structures with flood insurance policies. According to data from 2012, the proportion of single---family homes (excluding condominiums) within the special flood hazard area (SFHA, floodplain) that have flood insurance (the market penetration rate) for Deschutes County is 15.3% (105 out of 688).

The Community Repetitive Loss record for Deschutes County, Bend, La Pine, Redmond, and Sisters identifies zero repetitive loss buildings, zero severe repetitive loss buildings, and zero total repetitive loss claims.

Table II-5 Flood Insurance Detail

Jurisdiction	Current FIRM Date	Initial FIRM Date	Total Policies	Pre:FIRM Policies	Policies by Building Type				Minus Rated A Zone
					Single Family	2 to 4 Family	Other Residential	Non: Residential	
Deschutes	)	)	267	90	244	7	2	14	14
County*	9/28/07	9/29/86	171	66	158	1	0	12	11
Bend	9/28/07	9/4/87	57	21	48	5	2	2	1
La Pine	9/28/07	9/28/07	1	1	1	0	0	0	0
Redmond	9/28/07	9/28/07	0	0	0	0	0	0	0
Sisters	9/28/07	9/29/86	38	2	37	1	0	0	2

Jurisdiction	Insurance in Force	Total Paid Claims	Pre:FIRM Claims Paid	Substantial Damage Claims	Repetitive Loss Buildings	Severe Repetitive Loss Buildings	Total Paid Amount	CRS Class Rating	Last CAV
Deschutes County	$76,039,700	8	5	0	0	0	$63,794	)	)
County*	$46,890,300	3	1	0	0	0	$13,400	NP	7/22/94
Bend	$17,290,600	5	4	0	0	0	$50,393	NP	7/20/94
La Pine	$280,000	0	0	0	0	0	$0	NP	NA
Redmond	$0	0	0	0	0	0	$0	NP	NA
Sisters	$11,578,800	0	0	0	0	0	$0	NP	4/26/04

* Portion of entire county under county jurisdiction

NP) Not Participating NA) Information not Available/ Not Applicable

Source: Information compiled by Department of Land Conservation and Development, November 2014.

Probability Assessment

USGS scientists and US Army Corps of Engineers studies indicate the county is at a low level of risk for catastrophic flooding. USGS studies of Carver Lake estimate the probability of a lake flash flood to be approximately 1---5% annually.[32] Potentially, the Little Deschutes and Whychus Creek are most vulnerable; however greater risks are related to future volcanic eruptions (see Volcano annex).

The Federal Emergency Management Agency (FEMA) has mapped the 10, 50, 100, and 500---year floodplains in the Region 6 counties. This corresponds to a 10%, 2%, 1% and 0.2% chance of a certain magnitude flood in any given year. In addition, FEMA has mapped the 100---year floodplain (i.e., 1% flood) in the incorporated cities. The 100---year flood is the benchmark upon which the National Flood Insurance Program (NFIP) is based.

As such, Deschutes County's Natural Hazards Mitigation Steering Committee believes that the County's **probability of experiencing a flood is "high"**, meaning one incident is likely within the next 10 – 35 year period. Based upon available information the Oregon NHMPs Regional Risk Assessment supports this probability rating for Deschutes County.[33]

Vulnerability Assessment

Growth rates described in the Community Profile section of this Plan project a continued growth pattern that will place additional development, business and human life at risk.

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[32] Hydrologic Hazards Along Whychus Creek From a Hypothetical Failure of the Glacial Moraine Impacting Carver Lake Near Sisters, Oregon—USGS Open File Report 87---41

[33] *2015 Oregon Natural Hazard Mitigation Plan DRAFT*. Department of Land Conservation and Development, 2015.

The Deschutes County Natural Hazards Steering Committee rated Deschutes County as having a **"low" vulnerability to the flood hazard**, meaning less than 1% of the region's population or assets would be affected by a major emergency or disaster. Based upon available information the Oregon NHMPs Regional Risk Assessment supports this vulnerability rating for Deschutes County.[34]

Sisters is particularly vulnerable to economic loss in the event of road closures. According to USGS Open File Report 87---41, locally high velocities, damming, erosion and sediment deposit could cause considerable property damage and possible loss of life. The stream would be especially dangerous at road crossings where bridges may fail or sections could wash away.

Risk Analysis

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. Table 2---6 of the Risk Assessment (Volume I, Section 2) shows the county's Hazard Analysis Matrix which scores each hazard and provides the jurisdiction with a sense of hazard priorities, but does not predict the occurrence of a particular hazard. Based on the matrix the **flood hazard is rated #7, out of 9 rated hazards, with a total score of 191**.

Community Hazard Issues

The extent of the damage and risk to people caused by flood events is primarily dependent on the depth and velocity of floodwaters. Fast moving floodwaters can wash buildings off their foundations and sweep vehicles downstream. Roads, bridges, other infrastructure and lifelines (pipelines, utility, water, sewer, communications systems, etc.) can be seriously damaged when high water combines with flood debris, mud and ice. Extensive flood damage to residences and other structures also results from basement flooding and landslide damage related to soil saturation. Surface water entering into crawlspaces, basements and daylight basements is common during flood events not only in or near flooded areas but also on hillsides and other areas far removed from floodplains. Most damage is caused by water saturating materials susceptible to loss (e.g., wood, insulation, wallboard, fabric, furnishings, floor coverings and appliances.)

If not properly protected from the entry of flood waters, mechanical, electrical and similar equipment can also be damaged or destroyed by flooding.

Older, pre---FIRM manufactured homes are particularly susceptible to flood damage, as many have a lower level of structural stability than "stick---built" (standard wood frame construction) homes. Current regulations require manufactured homes in floodplain zones to be both elevated and anchored to provide structural stability during flood events comparable to site built homes.

[34] Ibid.

Flood events impact businesses by damaging property and interrupting commerce. Flood events can cut off customer access and close businesses for repairs. A quick response to the needs of businesses affected by flood events can help a community maintain economic viability in the face of flood damage.

Bridges are a major concern during flood events as they provide critical links in road networks by crossing water courses and other significant natural features. However bridges and their supporting structures can also be obstructions in flood---swollen watercourses and can be damaged by debris jams and erosion scour.

More information on this hazard can be found in the Regional Risk Assessment for Region 6 of the Oregon NHMP.

Existing Authorities, Policies, Programs, and Resources

Existing authorities, policies, programs, and resources include current mitigation programs and activities that are being implemented by city, county, regional, state or federal agencies and/or organizations.

County and Cities

Current initiatives to mitigate the effects of potential flooding in Deschutes County are many. These actions are varied from projects initiated by homeowners and neighborhood associations to county policies and procedures aligned with the National Flood Insurance Program.

Home and business owners and neighborhood associations in and around the County's floodplains continue to address mitigation activities for flooding. Riparian zones have been established to reduce erosion, review of building plans/codes and emergency strategies to mitigate damage from floods are being developed.

Regardless of future investigative studies, some early warning, zoning, and planning studies are needed to prevent loss of life and property damage in areas downstream of Carver Lake. In Sisters, the potential breakout of Carver Lake represents several times the magnitude flood for which county and city governments presently plan. The flood could occur with little or no warning.

The city of Sisters is currently engaged in discussions about potential flooding from the Carver Lake scenario described above and other flooding potential. The current belief by city planners is that a rain---on---snow event is more likely to occur than a breach at Carver Lake. Therefore, the City of Sisters will continue to pursue mitigation policies that address local flooding of Whychus Creek.

Deschutes County Comprehensive Plan and Development Code

Deschutes County has enacted a Comprehensive Land Use Plan and is implementing land use regulations in compliance with ORS 197 and the Statewide Planning Goals. The County has enacted and enforces a flood hazard ordinance, which is applied to all areas mapped as subject to inundation by the base flood. The regulations are designed to reduce the risk of flood damage to new and substantially improved structures within known flood hazard areas.

Note: The University of Oregon's Community Planning Workshop (CPW) is working with the Deschutes County Community Development Department (CDD) to review sections of the Deschutes County Development Code consistent with direction provided in Comprehensive Plan Section 3.5 (Rural Growth/Natural Hazards). The review will focus on improving development regulations that address wildfire, flood, and other natural hazards.

Deschutes County Public Works

Deschutes County annually visually inspects and cleans culverts on county roads. Culverts needing replaced are identified and targeted for replacement. Culverts during past flooding events that could not handle the flow are looked at for replacement with a larger culvert.

Bridges are likewise routinely inspected and during flood events crews keep a visual check on bridges for debris buildup. After a major flood, crews are dispatched to recheck bridges for flood damage.

Federal

National Flood Insurance Program

Deschutes County participates in the National Flood Insurance Program, which enables property and business owners to qualify for federally underwritten flood insurance. Flood insurance policies in effect in the County and the coverage provided by these policies are depicted above. The County's flood ordinance, discussed above, comprises the county's NFIP qualifying flood plain regulation. These standards require all new development to be elevated above the projected level of the base flood, along with a number of other building design and construction standards intended to reduce the risk of flood damage. Strict enforcement of these regulations is required to maintain eligibility for participation in the NFIP; the Community Development Department is charged with this responsibility.

Hazard Mitigation Action Items

There are seven identified Flood action items for Deschutes County; in addition, several of the Multi---Hazard action items affect the Flood hazard. An action item matrix is provided within Volume I, Section 3, while action item forms are provided within Volume IV, Appendix A. To view city actions see the appropriate city addendum within Volume III.

Significant Changes Since the 2010 Plan

The Landslide hazard was not assessed in the 2010 Plan, therefore, this section provides new content to the Deschutes County NHMP.

Causes and Characteristics of the Hazard

Landslides are a major geologic threat in almost every state in the United States. In Oregon, a significant number of locations are at risk from dangerous landslides and debris flows. While not all landslides result in property damage, many landslides do pose serious risk to people and property. Increasing population in Oregon and the resultant growth in home ownership has caused the siting of more development in or near landslide areas. Often these areas are highly desirable to prospective homeowners owing to their location along the coast, rivers and on hillsides.

Landslides are fairly common, naturally occurring events in various parts of Oregon. In simplest terms, 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.

In a landslide, two forces are at work: 1) the driving forces that cause the material to move down slope, and 2) the friction forces and strength of materials that act to retard the movement and stabilize the slope. When the driving forces exceed the resisting forces, a landslide occurs.

Landslides can be grouped as “on---site” and “off---site” hazards. An “on---site” slide is one that occurs on or near a development site and is usually relatively slow moving. Slow moving slides cause the most property damage in developed areas. On---site landslide hazards include features called slumps, earthflows and block slides. “Off---site” slides typically are rapidly moving and begin on steep slopes at a distance from homes and development. A 1996 “off---site” slide in southern Oregon began a long distance away from homes and roads, traveled at a high velocity and resulted in five fatalities and a number of injuries, in addition to substantial property damage.

Landslides are classified based on causal factors and conditions and exist in three basic categories.

Falls

This type of landslide involves the movement of rock and soil which detaches from a steep slope or cliff and falls through the air and/or bounces or rolls down the slope. This type of slide is termed a rock fall and is very common along Oregon highways where they have been cut through bedrock in steep canyons and along the coast.

Slides

This type of landslide exists where the slide material moves in contact with the underlying surface. Here the slide moves along a plane and either slumps by moving along a curved surface (called a rotational slide) or along a flat surface (called a translational slide). While slow---moving slides can occur on relatively gentle slopes and are less likely to cause serious injuries or fatalities, they can result in significant property damages.

Flows

Flow landslides are characterized as plastic or liquid in nature where the slide material breaks up and flows during movement. A flow occurs when a landslide moves down slope as a semi---fluid mass scouring or partially scouring rock and soils from the slope along its path. A flow landslide is typically rapidly moving and tends to increase in volume as it moves down slope and scours out its channel.

Rapidly moving flow landslides are often referred to a debris flows. Other terms given to debris flows are mudslides, mudflows, or debris avalanches. Debris flows frequently take place during or following an intense rainfall event on previously saturated soil. Debris flows usually start on steep hillsides as slumps or slides that liquefy, accelerate to speeds as high as 35 miles per hour or more, and travel down slopes and channels onto gentle sloping or flat ground. Most slopes steeper than 70 percent are risk from debris flows.

The consistency of a debris flow ranges from watery mud to thick, rocky, mud---like, wet cement which is dense enough to carry boulders, trees and cars. Separate debris flows from different starting points sometimes combine in canyons and channels where their destructive energy is greatly increased. Debris flows are difficult for people to outrun or escape from and present the greatest risk to human life. Debris flows have caused most of their damage in rural areas and were responsible for most of landslide---related deaths and injuries during the 1996 storm in Oregon.

Conditions Affecting Landslides

Natural conditions and human activities can both play a role in causing landslides. Certain geologic formations are more susceptible to landslides than others. Locations with steep slopes are at the greatest risk of slides. However, the incidence of landslides and their impact on people and property can be accelerated by development. Developers who are uninformed about geologic conditions and processes may create conditions that can increase the risk of or even trigger landslides.

There are four principal factors that affect or increase the likelihood of landslides:

1. Natural conditions and processes including the geology of the site, rainfall, wave and water action and seismic tremors, including earthquakes and volcanic activity.
2. Excavation and grading on sloping ground for homes, roads and other structures.
3. Drainage and groundwater alterations that are natural or human---caused can trigger landslides. Human activities that may cause slides include broken or

leaking water or sewer lines, water retention facilities, irrigation and stream alterations, ineffective storm water management and excess runoff due to increased impervious surfaces.

4. Change or removal of vegetation on very steep slopes due to timber harvesting, land clearing and wildfire.

History of Landslides in Deschutes County

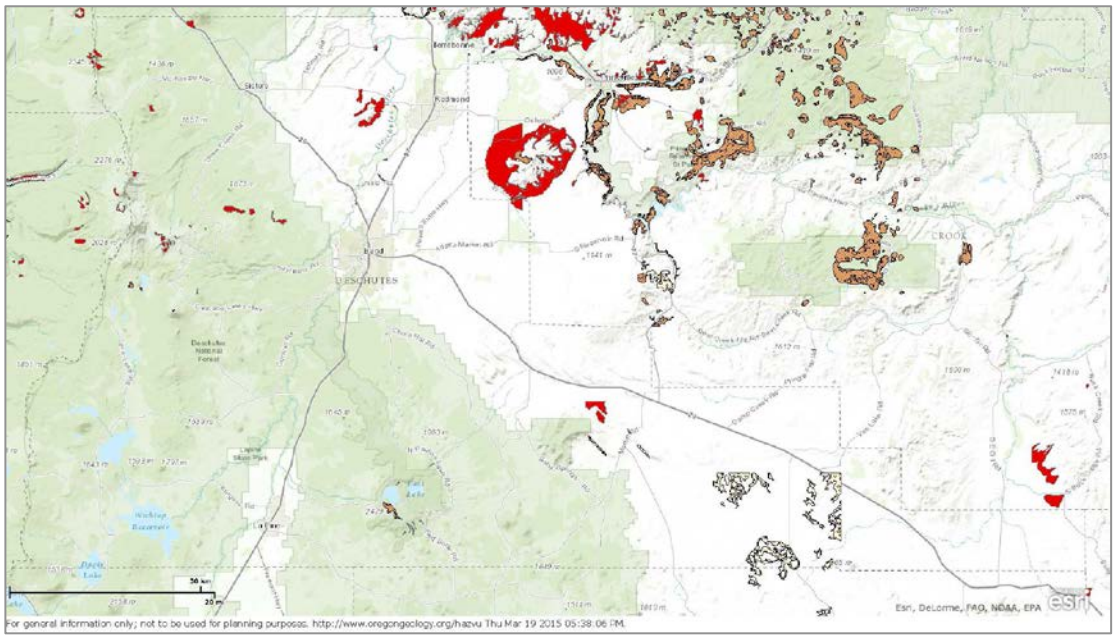
Although most landslides occur in the undeveloped forested areas of the county, landslides may also occur in more developed areas. The fatalities and losses resulting from the 1996 statewide landslide events brought about the passage of Oregon Senate Bill 12, which set site development standards, authorized the mapping of areas subject to rapidly moving landslides and the development of model landslide (steep slope) ordinances.

There is no history of major landslides in Deschutes County within developed areas. At times small debris falls have occurred, however, these have typically not caused major disruptions of normal activity (see figure below). In undeveloped areas the risk of landslides and avalanches is highest within the forested areas and in the Three Sisters Wilderness. There have been recorded landslides that affected the Carver Lake moraine dam and other rural areas; however, this activity has not led to major disruptions of normal activity.

DOGAMI maps the State Landslide Information Layer for Oregon (SLIDO); Figure II---9 relies on the 2012 SLIDO data and shows Deschutes County landslides that have been identified on published maps. The database contains only landslides that have been located on these maps. Many landslides have not yet been located or are not on these maps and therefore are not in this database. This database does not contain information about relative hazards[35] The map show that the history of landslide events is sparse, and where they do occur they are in non---populated areas.

[35] DOGAMI. Statewide Landslide Information Database for Oregon (SLIDO---2). http://www.oregongeology.org/sub/slido/index.htm

Figure II-9 Mapped Landslides and Landslide Susceptibility



Source: DOGAMI Lidar Data Viewer, accessed March 24, 2015

Hazard Identification

Geologic and geographic factors are important in identifying landslide---prone areas. Stream channels, for example, have major influences on landslides, due to undercutting of slopes by stream erosion and long---term hillside processes.

The Oregon Department of Forestry (ODF) Storm Impacts Study conducted after the 1996---97 landslide events found that the highest probability for the initiation of shallow, rapidly moving landslides was on slopes of 70 to 80 percent steepness. A moderate hazard of shallow rapid landslide initiation can exist on slopes between 50 and 70 percent.[36]

In general, areas at risk to landslides have steep slopes (25 percent or greater,) or a history of nearby landslides. In otherwise gently sloped areas, landslides can occur along steep river and creek banks. At natural slopes under 30 percent, most landslide hazards are related to excavation and drainage practices, or the reactivation of preexisting landslide hazards.[37]

The severity or extent of landslides is typically a function of geology and the landslide triggering mechanism. Rainfall initiated landslides tend to be smaller, and earthquake induced landslides may be very large. Even small slides can cause property damage, result in injuries, or take lives. Geo---engineers with the Oregon Department of Forestry estimate widespread landslide activity about every 20 years.

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[36] Storm Impacts and Landslides of 1996 Final Report. (1999) Oregon Department of Forestry.

[37] Oregon Natural Hazards Mitigation Plan, Landslide Chapter. The Interagency Hazards Mitigation Team, (2012) Oregon Military Department --- Office of Emergency Management.

The Department of Land Conservation and Development (DLCD) requires local governments to address geologically unstable areas as part of their comprehensive plans through Statewide Land Use Planning Goal 7 (Areas Subject to Natural Hazards). In Deschutes County, little planning has been done concerning landslide hazards due to the lack of risk. Goal 7 envisions a process whereby new hazard inventory information generated by federal and state agencies is first reviewed by DLCD. DLCD then notifies the County of the new information, and the County has three years to respond to the information by evaluating the risk, obtaining citizen input, and adopting or amending implementation measures to address the risk. Deschutes County has not received notice of new inventory information concerning landslides.

Probability Assessment

The probability of rapidly moving landslides occurring depends on a number of factors; these include steepness of slope, slope materials, local geology, vegetative cover, human activity, and water. There is a strong correlation between intensive winter rainstorms and the occurrence of rapidly moving landslides (debris flows); consequently, the Oregon Department of Forestry tracks storms during the rainy season, monitors rain gages and snow melt, and issues warnings as conditions warrant. Given the correlation between precipitation / snow melt and rapidly moving landslides, it would be feasible to construct a probability curve. Many slower moving slides present in developed areas have been identified and mapped; however the probability and timing of their movement is difficult to quantify. The installation of slope indicators or the use of more advanced measuring techniques could provide information on these slower moving slides.

Deschutes County's Natural Hazards Mitigation Steering Committee believes that the County's **probability of experiencing a landslide is "low,"** meaning one incident is likely within the next 75 – 100 year period. Based upon available information the Oregon NHMPs Regional Risk Assessment supports this probability rating for Deschutes County.[38]

Vulnerability Assessment

To a large degree, landslides are very difficult to predict. Both location and extent of landslide hazard are affected by a variety of variables. Many people are unaware of their exposure to landslide risk. Therefore there are a large number of structures, infrastructure, and other community assets within Deschutes County potentially vulnerable to landslides. New private development is subject to regulations which are intended to reduce risk from known landslide hazards. However, there is substantial private development in the county, which pre---dates land use or building code regulations and is therefore subject to increased risk.

The Deschutes County Natural Hazards Steering Committee rated Deschutes County as having a **"low" vulnerability to landslide hazards**; meaning less than 1% of the region's population or assets would be affected by a major emergency or disaster. Based upon available information the Oregon NHMPs Regional Risk Assessment supports this vulnerability rating for Deschutes County.[39]

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[38] *2015 Oregon Natural Hazard Mitigation Plan DRAFT*. Department of Land Conservation and Development, 2015.

[39] Ibid.

Risk Analysis

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. Table 2---6 of the Risk Assessment (Volume I) shows the county's Hazard Analysis Matrix which scores each hazard and provides the jurisdiction with a sense of hazard priorities, but does not predict the occurrence of a particular hazard. Based on the matrix the **landslide hazard is rated #9, out of 9 rated hazards, with a total score of 54**.

Community Hazard Issues

Depending upon the type, location, severity and area affected, severe property damage, injuries and loss of life can be caused by landslide hazards. Landslides can damage or temporarily disrupt utility services, roads and other transportation systems and critical lifeline services such as police, fire, medical, utility and communication systems, and emergency response. In additional to the immediate damage and loss of services, serious disruption of roads, infrastructure and critical facilities and services may also have longer term impacts on the economy of the community and surrounding area.

Increasing the risk to people and property from the effects of landslides are the following five factors:

1. Improper excavation practices, sometimes aggravated by drainage issues, can reduce the stability of otherwise stable slopes.
2. Allowing development on or adjacent to existing landslides or known landslide---prone areas raises the risk of future slides regardless of excavation and drainage practices. Homeowners and developers should understand that in many potential landslide settings that there are no development practices that can completely assure slope stability from future slide events.
3. Building on fairly gentle slopes can still be subject to landslides that begin a long distance away from the development. Sites at greatest risk are those situated against the base of very steep slopes, in confined stream channels (small canyons), and on fans (rises) at the mouth of these confined channels. Home siting practices do not cause these landslides, but rather put residents and property at risk of landslide impacts. In these cases, the simplest way to avoid such potential effects is to locate development out of the impact area, or construct debris flow diversions for the structures that are at risk.
4. Certain forest practices can contribute to increased risk of landslides. Forest practices may alter the physical landscape and its vegetation, which can affect the stability of steep slopes. Physical alterations can include slope steepening, slope---water effects, and changes in soil strength. Of all forest management activities, roads have the greatest effects on slope stability, although changing road construction and maintenance practices are reducing the effects of forest roads on landslides.
5. Deschutes County is susceptible to extreme winter storms and rainfall. High rainfall accumulation in a short period of time increases the probability of landslide.

More information on this hazard can be found in the Regional Risk Assessment for Region 6 of the Oregon NHMP.

Existing Authorities, Policies, Programs, and Resources

Existing authorities, policies, programs, and resources include current mitigation programs and activities that are being implemented by city, county, regional, state or federal agencies and/or organizations.

State

Oregon Department of Forestry (ODF)

The Oregon Department of Forestry has provided a preliminary indication of debris flows (rapidly moving landslides) in Western Oregon. Their debris flow maps include locations subject to naturally occurring debris flows and include the initiation sites and locations along the paths of potential debris flows (confined stream channels and locations below steep slopes). These maps neither consider the effects of management---related slope alterations (drainage and excavation) that can increase the hazard, nor do they consider very large landslides that could possibly be triggered by volcanic or earthquake activity. Areas identified in these maps are not to be considered "further review areas" as defined by Senate Bill 12 (1999).[40] Information used to develop the ODF Debris Flow maps include:

- Digital elevation models at 30---meter resolution, based on U.S. Geological Survey data, were used to derive slope steepness and then to develop polygons for assigned hazards. Note that actual slopes are steeper than these digitally elevated models.
- Mapped locations of Tyee soil formation and similar sedimentary geologic units.
- Oregon Department of Forestry Storm Impacts and Landslides of 1996 study; debris flow initiation and path location data.
- Stream channel confinement near steep hill slopes based on U.S. Geological Survey Digital Raster Graphics.
- Historical information on debris flow occurrence in western Oregon (from Oregon Dept. of Forestry, U.S. Forest Service, DOGAMI, Bureau of Land Management, and the Oregon Department of Transportation).
- Fan---shaped land formations below long, steep slopes.
- Areas of highest intensity precipitation do not appear to be correlated with known areas of high and extreme debris flow hazard, so precipitation intensity was not used to develop risk (hazard) ratings.[41]

Oregon Department of Geology and Mineral Industries (DOGAMI)

The Oregon Department of Geology and Mineral Industries (DOGAMI) conducted field investigations and consolidated data on Oregon landslides associated with three flood events in 1996 and 1997. They collected evidence of over 9,000 landslide and slope failure locations in the

[40] Western Oregon Debris Flow Hazard Maps: Methodology and Guidance for Map Use. (1999).

[41] Ibid.

state. The generation of a statewide landslide inventory is intended to provide a means for developing and verifying hazard models as well as to facilitate various local efforts aimed at minimizing risk and damage in future storm events. The database includes a digital Geographic Information System file with landslide locations, a digital database with details on each landslide, and an accompanying report.[42]

In addition to the slope failures report, DOGAMI is identifying and mapping further review areas. The further review areas identify where landslides have occurred and where landslides are likely to occur.[43]

Debris Flow Warning System

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

Since 2008, ODF meteorologists have not issued Debris Flow Warning for Oregon since they do not have sufficient resources. However, information is provided by the National Weather Service (NWS) and broadcast via the NOAA Weather Radio, and on the Law Enforcement Data System. The information provided does not include the Debris Flow Warning system as originally designed since the NWS does not have the geologic and geomorphology expertise. Instead they provide the following language in their flood watches that highlights the potential for landslides and debris flows[44]:

A flood watch means there is a potential for flooding based on current forecasts. Landslides and debris flows are possible during this flood event. People, structures and roads located below steep slopes, in canyons and near the mouths of canyons may be at serious risk from rapidly moving landslides.

DOGAMI provides additional information on debris flows through the media. The Department of Transportation provides warning signs to motorists in landslide prone areas during high---risk periods.[45]

Landslide Brochure

The Department of Geology and Mineral Industries (DOGAMI) developed a landslide public outreach brochure in cooperation with several other state agencies. Forty thousand copies were printed in November 1997 and were distributed widely through building code officials, county planners, local emergency managers, natural resource agency field offices, banks, real estate companies, insurance companies, and other outlets. Landslide brochures are available from

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[42] Database of Slope Failures in Oregon for Three 1996/1997 Storm Events. Hofmeister, R.J. (2000). Oregon Department of Geology and Mineral Industries – Special Paper 34.

[43] Interagency Hazard Mitigation Team. 2012. Oregon Natural Hazards Mitigation Plan. Salem, OR: Oregon Military Department – Office of Emergency Management

[44] NOAA, NWS. Letter dated December 20, 2010 from Stephen K. Todd, Meteorologist---in---Charge.

[45] Interagency Hazard Mitigation Team. 2012. Oregon Natural Hazards Mitigation Plan. Salem, OR: Oregon Military Department – Office of Emergency Management

DOGAMI, the Office of Emergency Management (OEM), Oregon Department of Forestry (ODF), and the Department of Land Conservation and Development (DLCD).[46]

Oregon State Building Code Standards

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

Both codes contain requirements for cut, fill and sloping of the lot in relationship to the location of the foundation. There are also building setback requirements from the top and bottom of slopes. The codes specify foundation design requirements to accommodate the type of soils, the soil bearing pressure, and the compaction and lateral loads from soil and ground water on sloped lots. The building official has the authority to require a soils analysis for any project where it appears the site conditions do not meet the requirements of the code, or that special design considerations must be taken. ORS 455.447 and the Structural Code require a seismic site hazard report for projects that include essential facilities such as hospitals, fire and police stations and emergency response facilities, and special occupancy structures, such as large schools and prisons. This report includes consideration of any potentially unstable soils and landslides.[47]

Hazard Mitigation Action Items

There are no identified Landslide action items for Deschutes County; however, several of the Multi---Hazard action items affect the Landslide hazard. An action item matrix is provided within Volume I, Section 3, while action item forms are provided within Volume IV, Appendix A. To view city actions see the appropriate city addendum within Volume III.

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[46] Ibid.

[47] Planning for Natural Hazards: Oregon Technical Resource Guide. Community Planning Workshop. (July 2000). Chapter 5.

Significant Changes Since the 2010 Plan

New information on the hazard and hazard identification was added to this section. As such, some sections utilize modified text from the Central Cascades Volcano Coordination Plan, particularly Appendix B: Volcanic Hazards in the Central Cascades. In addition, the format of the section and minor content changes has occurred.

Causes and Characteristics of Volcanic Eruption

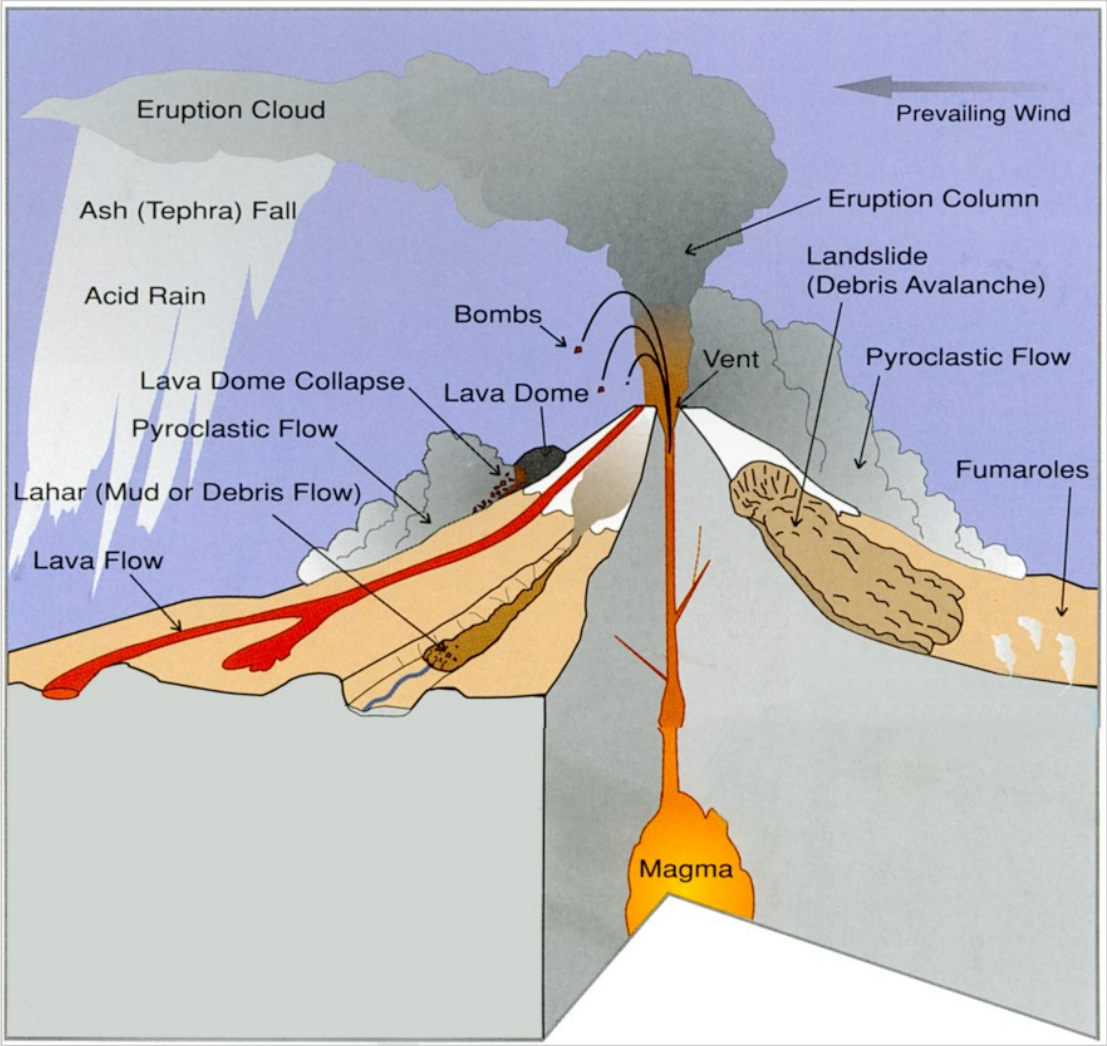
Deschutes County, and the Pacific Northwest, lie within the "ring of fire," an area of very active volcanic activity surrounding the Pacific Basin. Volcanic eruptions occur regularly along the ring of fire, in part because of the movement of the Earth's tectonic plates. The Earth's outermost shell, the lithosphere, is broken into a series of slabs known as tectonic plates. These plates are rigid, but they float on a hotter, softer layer in the Earth's mantle. As the plates move about on the layer beneath them, they spread apart, collide, or slide past each other. Volcanoes occur most frequently at the boundaries of these plates and volcanic eruptions occur when molten material, or magma, rises to the surface.

The primary threat to lives and property from active volcanoes is from violent eruptions that unleash tremendous blast forces, generate mud and debris flows, or produce flying debris and ash clouds. The immediate danger area in a volcanic eruption generally lies within a 20---mile radius of the blast site. The following section outlines the specific hazards posed by volcanoes.

Volcanoes are commonly, but not always, conical hills or mountains built around a vent that connects with reservoirs of molten rock below the surface of the earth.[48] Volcanoes are built up by an accumulation of their own eruptive products: lava or ash flows and airborne ash and rocks. When pressure from gases or molten rock becomes strong enough to cause an upsurge, eruptions occur. Gases and rocks are pushed through the vent and spill over, or fill the air with lava fragments. Figure II---10 diagrams the basic features of a volcano.

[48] Tilling, Robert I., Volcanoes, USGS General Interest Publication, (1985).

Figure II-10 Volcanic Hazard from a Composite Type Volcano



Source: Walder et al, "Volcano Hazards in the Mount Jefferson Region," 1999; W.E. Scott, R.M. Iverson, S.P. Schilling, and B.J. Fischer, Volcano Hazards in the Three Sisters Region, Oregon: U.S. Geological Survey Open---File Report 99---437, 14p., 200.,

Related Hazards

Ash / Tephra

Tephra is fragmented volcanic rock of any size ejected from a volcano. It consists of volcanic ash (sand---sized or finer particles) and larger fragments. During explosive eruptions, tephra together with a mixture of hot volcanic gas are ejected rapidly into the air from volcanic vents. Larger fragments fall down near the volcanic vent while finer particles drift downwind as a large cloud. When ash particles fall to the ground, they can form a blanket---like deposit, with finer grains carried further away from the volcano. In general, the thickness of tephra deposits decreases in the downwind direction. Tephra hazards include impact of falling fragments, respiratory problems, damage to crops and other vegetation, contamination of drinking water, roof

collapse, burial of transportation routes, and mechanical or electrical failure of car and jet engines.

During an eruption that emits tephra, deposition is controlled by the prevailing wind direction. [49] The predominant wind pattern over the Cascades is from the west, and previous eruptions seen in the geologic record have resulted in most ash fall drifting to the east of the volcanoes. [50]

Lava flows

Lava flows are streams of molten rock that erupt relatively non---explosively from a volcano and move downslope, causing extensive damage or total destruction by burning, crushing, or burying everything in their path. Secondary effects can include forest fires, flooding, and permanent reconfiguration of stream channels. [51]

Pyroclastic flows and surges

Pyroclastic flows are avalanches of ash, rocks, and gas at temperatures of 600 to 1500 degrees Fahrenheit. They typically sweep down the flanks of volcanoes at speeds of up to 150 miles per hour. Pyroclastic surges are a more dilute mixture of gas and ash. They can move even more rapidly than a pyroclastic flow and are more mobile. Both generally follow valleys, but surges sometimes have enough momentum to overtop hills or ridges in their paths. Because of their high speed, pyroclastic flows and surges are difficult or impossible to escape. If it is expected that they will occur, evacuation orders should be issued as soon as possible for the hazardous areas. Objects and structures in the path of a pyroclastic flow are generally destroyed or swept away by the impact of debris or by accompanying hurricane---force winds. Wood and other combustible materials are commonly burned. People and animals may also be burned or killed by inhaling hot ash and gases. The deposit that results from pyroclastic flows is a combination of rock and ash and is termed *ignimbrite* or *welded tuff.* These deposits may accumulate to hundreds of feet thick and can harden to resistant rock. [52]

Lahars and debris flows

Lahar is an Indonesian term that describes a hot or cold mixture of water and rock fragments flowing down the slopes of a volcano or river valley.[53] Lahars typically begin when floods related to volcanism are produced by melting snow and ice during eruptions of ice---clad volcanoes like South Sister, Mt. Hood, Mt. Rainier, or Mount Shasta. Heavy rains can also generate lahars or melting snow on steep, unconsolidated slopes of volcanoes, even if no eruption occurs. Floods and debris flows can be generated by the displacement of water from volcanic lakes, which can overtop dams or move down outlet streams.

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[49] Oregon State Natural Hazard Mitigation Plan. 2012." Volcanic Hazards Chapter," http://csc.uoregon.edu/opdr/sites/csc.uoregon.edu.opdr/files/docs/ORNHMP/OR---SNHMP_volcano_chapter.pdf

[50] Ibid.

[51] Oregon State Natural Hazard Mitigation Plan. 2012." Volcanic Hazards Chapter," http://csc.uoregon.edu/opdr/sites/csc.uoregon.edu.opdr/files/docs/ORNHMP/OR---SNHMP_volcano_chapter.pdf

[52] Ibid.

[53] USGS website: http://volcanoes.usgs.gov/Hazards/What/Lahars/lahars.html

Lahars and debris flows react much like flash flood events in that a rapidly moving mass moves downstream, picking up more sediment and debris as it scours out a channel. This initial flow can also incorporate water from rivers, melting snow, and ice. By eroding rock debris and incorporating additional water, lahars and debris flows can easily grow to more than ten times their initial size, but as they move farther away from the volcano they eventually begin to lose sediment load and decrease in size.[54]

Lahars and debris flows often cause serious economic and environmental damage. The direct impact of the turbulent flow front, along with impacts from boulders, logs, and other debris incorporated in the flow, can easily crush, abrade, or shear off at ground level just about anything in the flow path. Even if not crushed or carried away by the force of the flow, buildings and valuable land may become partially or completely buried by one or more cement---like layers of rock debris. By destroying bridges and roads, lahars and debris flows can also trap people in areas vulnerable to other volcanic hazards, especially if the debris deposits are too deep, too soft, or too hot to cross.[55]

Volcanic Landslides (debris avalanches)[56]

Landslides and debris avalanches are a rapid downhill movement of rocky material, snow, and (or) ice. Volcanic landslides range in size from small movements of loose debris on the surface of a volcano to massive collapses of the entire summit or sides of a volcano. Steep volcanoes are susceptible to landslides because they are built up partly of layers of loose volcanic rock fragments. Landslides on volcano slopes are triggered not only by eruptions, but also by heavy rainfall or large earthquakes that can cause materials to break free and move downhill.

Earthquakes

Earthquakes are another potentially hazardous event associated with volcanic eruptions. *Volcanic earthquakes* are commonly smaller than magnitude 2.5, roughly the threshold for felt shaking by observers close to the event. Swarms of small earthquakes may persist for weeks to months before eruptions, but little or no damage would occur to buildings in surrounding communities. Some volcanic related swarms may include earthquakes as large as about magnitude 5. For the communities of Bend, La Pine, and Sunriver, shallow earthquakes in the magnitude 4---5 range that are located beneath Newberry Volcano would cause walls to rattle or windows and dishes to vibrate.

History of Volcanic Events in Deschutes County

No eruptions have occurred in Deschutes County during the past 1,000 years, however the millennium before experienced numerous eruptions, including several at Three Sisters, and one eruption at Newberry Volcano. The most devastating effects of these events were restricted to what is now Wilderness or largely undeveloped areas, but ashfall from these eruptions probably

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[54] Ibid.

[55] Ibid.

[56] Wright and Pierson, Living With Volcanoes, USGS Volcano Hazards Program Circular 1973, (1992).

deposited less than one---quarter inch to one---half inch of gritty ash in areas that are now densely populated.

Although there have been no recent volcanic events in the Deschutes County area, it is important to note the area is active and susceptible to eruptive events since the region is a part of the active Cascade Volcanic Range. The figure below displays volcanoes of the western United States.

Figure II-11 Potentially Active Volcanoes of the Western United States

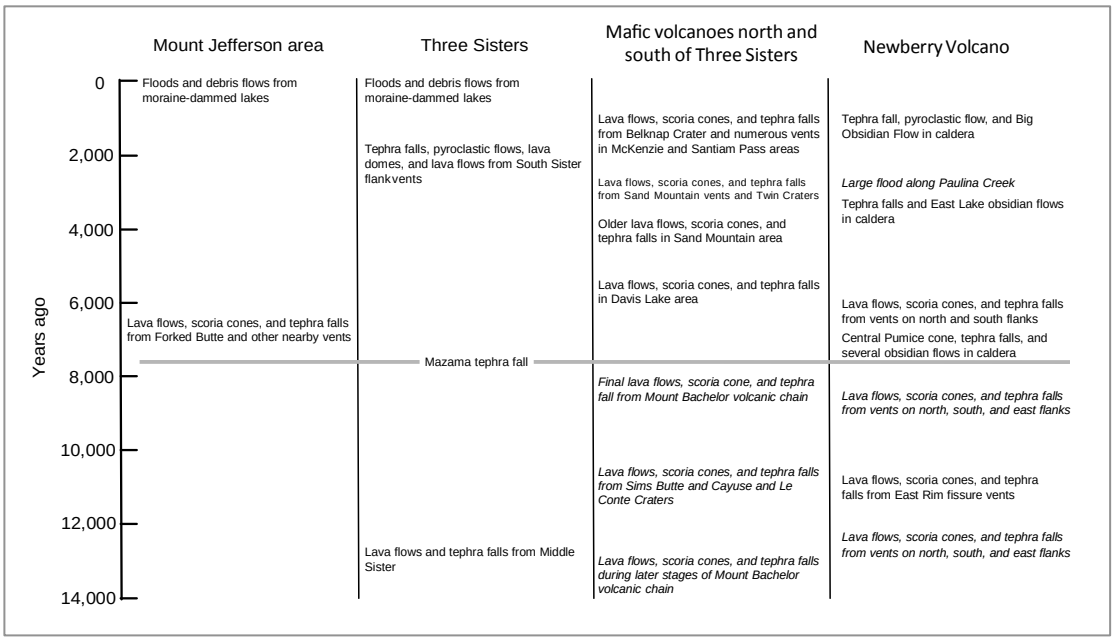
Source: USGS. http://www.volcano.si.edu/reports/usgs/maps.cfm#usa

Volcanoes in Central Oregon have been erupting for hundreds of thousands of years. Newberry Volcano, for example, has had many eruptions in the last 15,000 years as shown in the table below. The Three Sisters region has also had eruptions during this time, and the last major eruptive activity at Mt. Mazama occurred approximately 7,700 years ago, forming Crater Lake. Some of the most recent events include tephra and lava from the Big Obsidian Flow eruption at Newberry Volcano, multiple eruptions of tephra and lava from South Sister, and multiple cinder cone eruptions and lava flows in the McKenzie Pass area. All of the Cascade volcanoes are characterized by long periods of quiescence and intermittent activity. These characteristics

make predictions, recurrence intervals, and probability of future eruptions very difficult to ascertain.

Much larger eruptions than those of the past few thousand years have occurred in the region in recent geologic time, but, although their hazards are potentially much more widespread and severe, they occur much less frequently than smaller eruptions. Such potential hazards include extensive lava flows from Newberry Volcano that pose a threat to Bend and Redmond, large---scale explosive eruptions of Newberry or the Three Sisters that deposit one foot or more of pumice and ash in developed areas; or eruptions in the Three Sisters region that swiftly melt significant quantities of snow and ice to generate lahars that affect areas such as Whychus Creek and the City of Sisters.

Figure II-12 Eruptive and major debris-flow and flood events in the central Cascades of Oregon during the past 14,000 years.



Source: Central Cascades Volcano Coordination Plan. The events printed in italics are poorly dated, so their ages are less well known than those in normal font. The Mazama tephra fall was produced by the cataclysmic eruption of Mount Mazama that created Crater Lake 7,700 years ago.

Active volcanic areas in the Cascades that have the most potential to impact Deschutes County and the broader region include Mt. Saint Helens, Mt. Hood, Newbery Volcano, Mt. Bachelor, the Three Sisters and Broken Top, and Mt. Mazama/ Crater Lake.

Table II-6 Regional Volcanic History

Volcano	Comment
Mount Saint Helens	Mount St. Helens, located in southwestern Washington. It is fifty thousand years old. Over the past 521 years it has produced four major explosive eruptions and dozens of smaller eruptions. On May 18th, 1980, Mount St. Helens exploded violently after two months of intense earthquake activity and intermittent, relatively weak eruptions, causing the worst volcanic disaster in the recorded history of the United States. Mount St. Helens continued to be active, on March 8, 2005, a plume of ash and steam spewed nearly seven miles high into the air. Ten small earthquakes were measured in the area leading up to the eruption. The largest appeared to be a magnitude 2.5, according to the USGS.
Three Sisters & Broken Top	The Three Sisters are located just west of Bend. South Sister had a very small ongoing uplift, which began in 1996 and became undetectable by 2003. This uplift was about one inch a year and likely indicated movement of a small amount of magma. There is no immediate danger of a volcanic eruption or other hazardous activity. The potential exists, however, that further activity could increase danger.
Newberry Volcano	Newberry Volcano is located east of the Cascade Range and about 20 miles south east of Bend. It is about 600,000 years old and has had thousands of eruptions both from the central vent area and along its flanks. The most recent eruption was 1,300 years ago. Future eruptions are likely to include lava flows, pyroclastic flows, lahars, and ashfall. Most effects from these activities would be felt within, or up to a few miles beyond, the existing caldera. Ash could fall a few dozen miles from the eruptive center.
Mount Mazama/ Crater Lake	Crater Lake is located in the southYcentral region of Oregon. About 7,700 years ago, the ancient Mount Mazama erupted with great violence, leaving the caldera that Crater Lake now occupies. The most recent volcanic eruption was about 5,000 years ago and occurred within the caldera. No eruptions have occurred outside the caldera since 10,000 years ago. The probability of another calderaYforming eruption is very low, as is the probability of eruptions occurring outside the caldera.

Source: Oregon Natural Hazards Mitigation Plan

Mount St. Helens Case Study

On May 18, 1980, following two months of earthquakes and minor eruptions and a century of dormancy, Mount St. Helens, Washington, exploded in one of the most devastating volcanic eruptions of the 20th century. Approximately 0.67 cubic miles of volume was removed (lowering the mountain 1,314 feet), 57 people died, lahars damaged 27 bridges and nearly 200 homes, 4 billion board feet of timber was blown down, and damage exceeded 1.2 billion dollars.[57]

[57] Brantley, Steve and Bobbie Myers. Mount St. Helens – From the 1980 Eruption to 2000. USGS Fact Sheet 036---00 Online Version 1.0. http://pubs.usgs.gov/fs/2000/fs036---00/

Fortunately, most people in the area were able to evacuate safely before the eruption because the U.S. Geological Survey (USGS) and other scientists had alerted public officials to the danger. As early as 1975, USGS researchers had warned that Mount St. Helens might soon erupt. Coming more than 60 years after the last major eruption in the Cascades (Lassen Peak, 1915), the explosion of St. Helens was a spectacular reminder that the millions of residents of the Pacific Northwest share the region with live volcanoes.[58]

Hazard Identification

Western Deschutes County is on the east slope of the Cascade Range. Volcanic activity in the Cascades will continue, but questions regarding how, to what extent, and when, remain. Many volcano---associated hazards affect local areas within 5 to 10 miles (e.g., explosions, lava flows, pyroclastic flows and debris avalanches). However, lahars, or volcanic mudflows can travel considerable distances downstream valleys and wind---borne tephra (ash) can blanket areas many miles from the source.

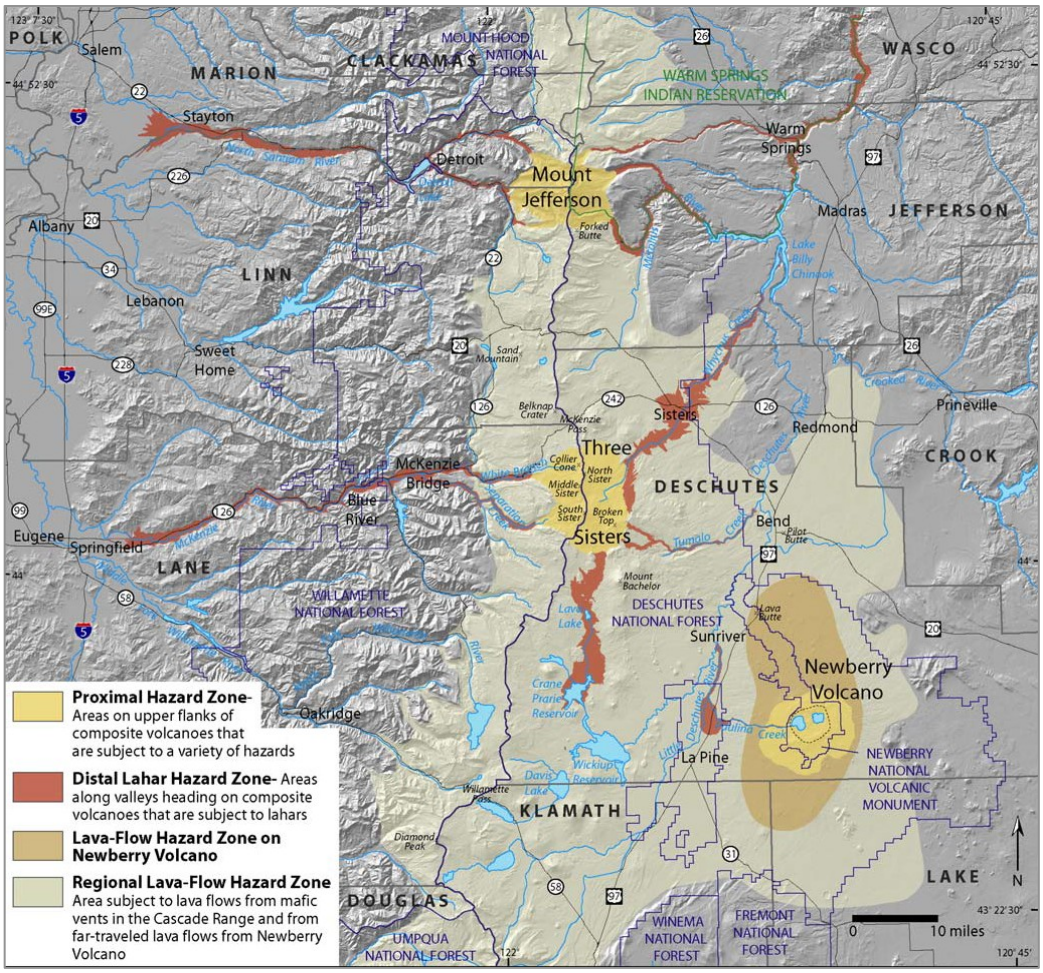
Deschutes County is therefore at risk from volcanic events and should consider the impact of volcano---related activity on communities, dams that create reservoirs, tourist destinations (e.g., Sunriver, Mt. Bachelor, Crater Lake), agriculture, highways and railroads. Deschutes County should also consider probable impacts on the local economy should a volcano---related hazard occur.

Two long---lived volcanic centers, Three Sisters to the west and Newberry Volcano to the south, and many tens of smaller volcanoes have hosted numerous eruptions in geologically recent times that range widely in size and character. Some covered sizable, currently developed areas with lava flows or swiftly moving flows of searing ash and pumice. Others only managed to produce small volumes of ash that blew downwind and were barely detectable in the geologic record, or they produced lava flows in areas now protected as Wilderness. Similar eruptions will occur in the future and, depending on their location and scale, will have minor to catastrophic effects on the County. In addition, an eruption of any one of the major Cascade volcanoes could affect the county and the region with ashfall if the wind direction is favorable.

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

[58] Dzurisin, Dan, Peter H. Stauffer, and James W. Hendley II, Living With Volcanic Risk in the Cascades, USGS Fact Sheet 165---97, (2000).

Figure II-13 Volcanic Hazards in Central Oregon



Source: Central Cascades Volcano Coordination Plan

Although the hazard map shows sharp boundaries for hazard zones, the degree of hazard does not change abruptly at these boundaries. Rather, the hazard decreases gradually as distance from the volcano increases, and decreases more rapidly as elevation above valley floors increases. Areas immediately beyond outer hazard zones should not be regarded as hazard free, because the boundaries can only be located approximately, especially in areas of low relief. Too many uncertainties exist about the source, size, and mobility of future events to locate the boundaries of zero---hazard zones precisely. Additionally, tephra (ash) hazard zones are not shown on the map, but tephra can impact large areas and the entire map region should be regarded as within the tephra hazard zone.

The **proximal hazard zone** includes areas immediately surrounding the volcanoes. This zone, which extends outward from summits for as little as 2 to as many as 10 kilometers (six miles) depending on local topography, is subject to several types of rapidly moving, devastating flows

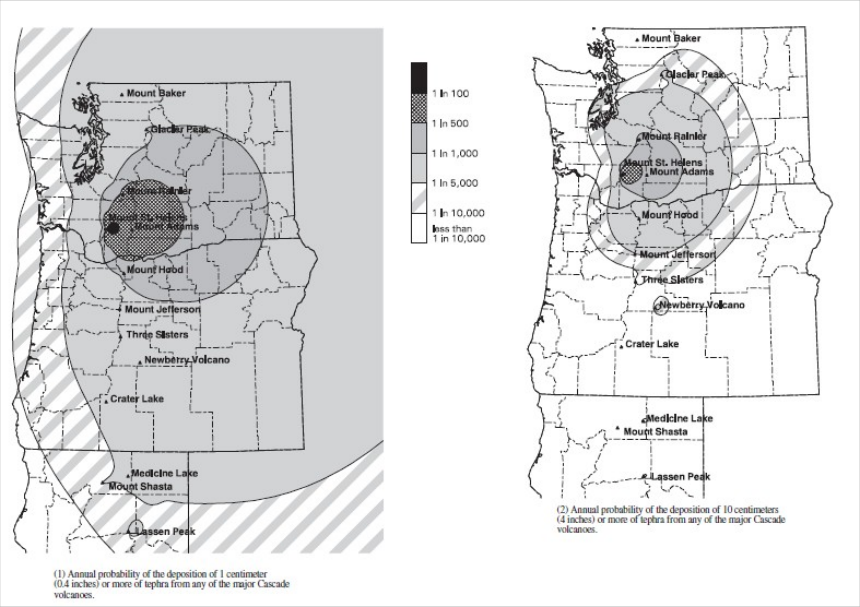
including pyroclastic flows, debris avalanches, lahars, and dam---break floods. Slower moving lava flows could also affect these zones.[59]

The **distal hazard zone** lies beyond the proximal hazard zone and is concentrated in the surrounding valleys that head on the volcanoes. Debris avalanches and lahars will tend to funnel into these valleys as they leave the slopes of the large volcanoes within the proximal hazard zone.

The **regional lava---flow hazard zone** outlines the area of the Three Sisters and Newberry Volcano region subject to lava flows from eruptions of mafic volcanoes. The zone is defined by the distribution of mafic volcanoes that erupted during roughly the past one million years. Hazards from thick tephra fall, ballistic projectiles, and small to medium pyroclastic flows would be restricted to within a few kilometers of vents, but lava flows could travel much farther. The hazard zone covers a broad area in Central Oregon, including Bend, Sisters, and areas on the lower flanks of Newberry Volcano in La Pine.

Scientists also use wind direction to predict areas that might be affected by volcanic ash; during an eruption that emits ash, the ash fall deposition is controlled by the prevailing wind direction. The predominant wind pattern over the Cascades originates from the west, and previous eruptions seen in the geologic record have resulted in most ash fall drifting to the east of the volcanoes. Regional tephra fall shows the annual probability of ten centimeters or more of ash accumulation from Pacific Northwest volcanoes. Figure II---14 depicts the potential and geographical extent of volcanic ash fall in excess of ten centimeters from a large eruption of Mt. St. Helens.

Figure II-14 Regional Tephra-fall Maps



Source: USGS "Volcano Hazards in the Mount Jefferson Region, Oregon"

[59] Scott, W.E., Iverson, R.M., Schilling, S.P., and Fisher, B.J., 1999, Volcano hazards in the Three Sisters region, Oregon: U.S. Geological Survey Open---File Report 99---437.

Note: The following sections include information that has been modified from the DRAFT Central Cascades Volcano Coordination Plan, Appendix B: Volcanic Hazards in the Central Cascades.

Three Sisters Volcanoes

Large snow---covered volcanoes of the Three Sisters volcanic center dominate Central Oregon's landscape between Santiam Pass in the north and Willamette Pass in the south. Rapidly developing areas in Deschutes County occupy the eastern border of the region, and westward several small communities dot the McKenzie River valley along its course to the Eugene---Springfield metropolitan area.[60]

The following photograph depicts an aerial view from southeast of the Three Sisters volcanic center (South, Middle, and North Sister left of center; Broken Top right of center). Light colored areas on the south flank of South Sister are 2,000---year---old lava flows.

Figure II-15 Three Sisters and Broken Top

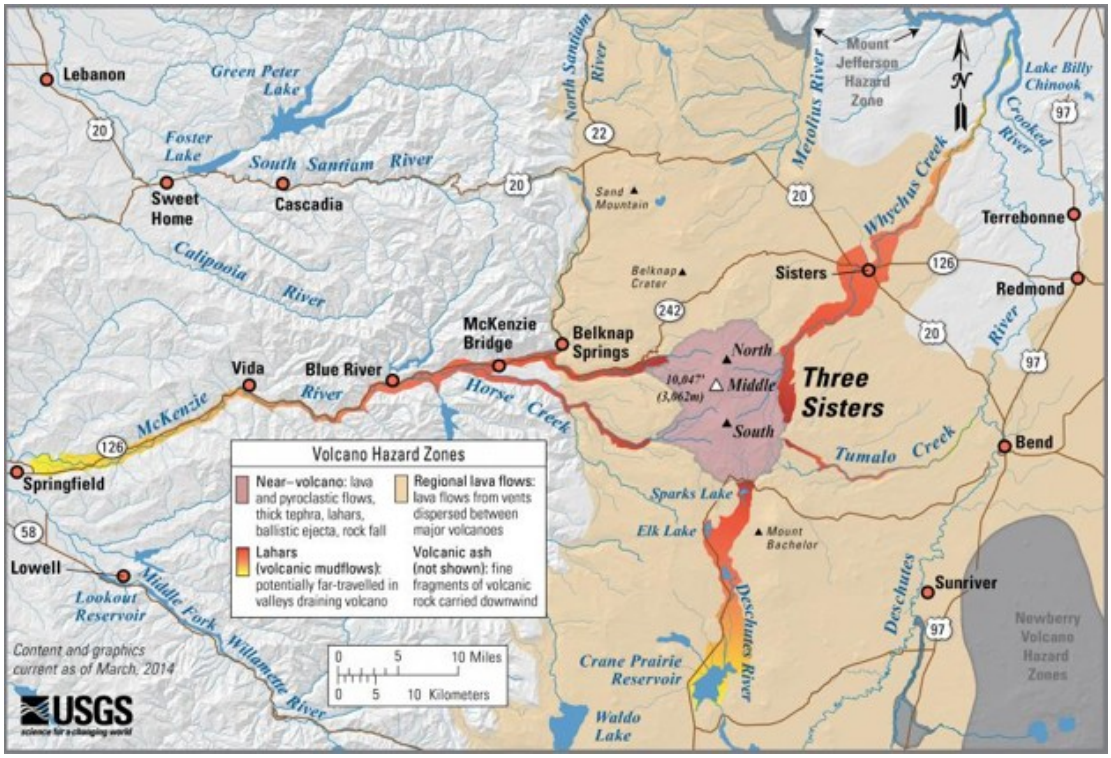
Photo by William E. Scott, USGS

Unlike other major Cascade volcanic centers, the Three Sisters center contains two young composite volcanoes, South Sister and Middle Sister, rather than one. The third sister, North Sister, and other nearby conspicuous volcanoes such as Mount Bachelor are large mafic volcanoes. Broken Top is a composite volcano that has not erupted for tens of thousands of years. Eruptions about 2,000 years ago from vents on South Sister produced blocky lava flows, such as Rock Mesa. These eruptions also produced a modest amount of pumice and ash that blanketed downwind areas. Probably no more than 1 or 2 centimeters (less than one inch) of ash fell in the area now occupied by Bend. Similar, but larger, eruptions occurred during the last ice age, which ended about 12,000 years ago, and had more widespread effects. Such eruptions occurred from both Middle Sister and South Sister. Three eruptions during the past one---half million years have been significantly larger and produced pyroclastic flows that swept over present---day Bend and Sisters. Fortunately such eruptions are rare—the last one occurred more than 200,000 years ago—and there is no sign that the Three Sisters system is capable of

[60] Ibid.

producing such an eruption during our lifetimes. The figure below demonstrates the volcanic hazards associated with the Three Sisters.

Figure II-16 Volcanic Hazards of the Three Sisters



Source: Central Cascades Volcano Coordination Plan. Hazard zones are simplified from the USGS hazard assessment for the Three Sisters volcanic area. Tephra (ash) hazard zones are not shown, but tephra can impact large areas and the entire map region should be regarded as within the tephra hazard zone.

Owing to the prevailing westerly winds in central Oregon, areas east of the Three Sisters have the greatest probability of being affected by **tephra falls** from future eruptions. Eruptions that produce higher eruption clouds and greater volumes of tephra will affect progressively larger areas. Although seldom life threatening, ash fall can greatly disrupt life. Darkness and swirling clouds of ash limit visibility and affect transportation. Ash contributes to slippery conditions on wet roads. Ash is also electrically conductive, especially if wet, and abrasive, so it can severely affect electrical and mechanical systems. Ash is also extremely dangerous to aircraft in flight.

Eruptions that disrupt watersheds by removing vegetation and adding large quantities of sediment from tephra fall, pyroclastic flows, debris avalanches, and lahars, typically initiate a period of years to decades during which streams carry increased sediment loads and channels become unstable and migrate. Such effects propagate downstream and can disrupt channels and flood plains far from where direct impacts of eruptions end. The Eugene---Springfield area along the lower McKenzie River and Sunriver and Bend along the Deschutes River below Wickiup Reservoir could be vulnerable to such events in the years following eruptions. Similarly the Tumalo Creek watershed that supplies part of Bend's municipal water, although not likely to be affected directly by volcanic flows, is likely to receive ash fall from any eruption in the Three Sisters area.

South, Middle, and North Sister as well as Broken Top are high, steep---sided peaks that could also produce debris flows and avalanches without volcanic activity. Avalanches of modest volume (less than about 10 million cubic meters) are the most probable and would affect areas primarily within the proximal hazard zone. Nevertheless, even modest---sized avalanches that contain sufficient water could transform into debris flows that travel well into distal hazard zones. Very large avalanches, those involving hundreds of millions of cubic meters of rock debris would likely be preceded by pronounced volcano deformation driven by intrusion of magma. Such activity would be detectable by seismometers and volcano surveys, and thus would elicit advance warning. Drainage systems that originate in the Three Sisters area are all potentially at risk from lahars, debris flows, floods, and avalanches. The location and size of these events will depend on the triggering mechanism and its character.

- Separation Creek and White Branch lead to several small communities in the McKenzie valley, including McKenzie Bridge and Blue River, which could be in the paths of lahars flowing westward. Large---volume lahars could reach communities farther west. Oregon Highway 126 and municipal water and hydroelectric facilities could be affected by lahars and excess sediment in the McKenzie River.
- The Sisters area represents the largest concentration of residents and development in a lahar---hazard zone. The city lies less than 30 kilometers (19 miles) downstream from Middle and South Sisters along Whychus Creek. Below Sisters, Whychus Creek flows into a deep canyon and joins the Deschutes River. Whychus Creek and its tributaries drain the east flanks of North, Middle, and South Sister and the north flank of Broken Top. The broad fan of Whychus Creek around Sisters is of particular concern with regard to potential lahar or debris flow inundation because Whychus Creek drains a large sector of the major volcanoes and the distance to Sisters is relatively short (about 30 kilometers or 20 miles). Typical flow velocities for lahars and debris flows through terrain along Whychus Creek yield travel times to Sisters of as little as 30 minutes to one hour, depending on lahar size and point of origin.
- Tumalo Creek drains the area east of Broken Top and is unlikely to experience large lahars owing to lack of much volcano mass in its headwaters. Nevertheless, small lahars or debris flows might descend Tumalo Creek if rapid sedimentation in Crater Creek diverted debris over a low divide into Tumalo Creek. A moraine dam impounding a small unnamed lake on the east side of Broken Top could be a potential source for such a lahar or debris flow. This dam failed in October of 1966, generating a debris flow that traveled down the Soda Creek drainage, across Highway 46 (Cascade Lakes Highway), and spread out over the broad meadow near Sparks Lake. The debris flow buried the road and covered about 250,000 m^2 (about 2,700,000 ft^2) of the meadow with sand and silt.[61]
- Broad basins in the upper Deschutes valley, such as those occupied by Sparks, Elk, and Lava lakes, provide traps for lahars and sediment moving south, as do Wickiup and Crane Prairie Reservoirs.

[61] O'Connor, J.E., J.H. Hardison and J.E. Costa. 2001. Debris flows from failures of Neoglacial---Age moraine dams in the Three Sisters and Mount Jefferson wilderness areas, Oregon. US Geological Survey Professional Paper 1606.

Newberry Volcano

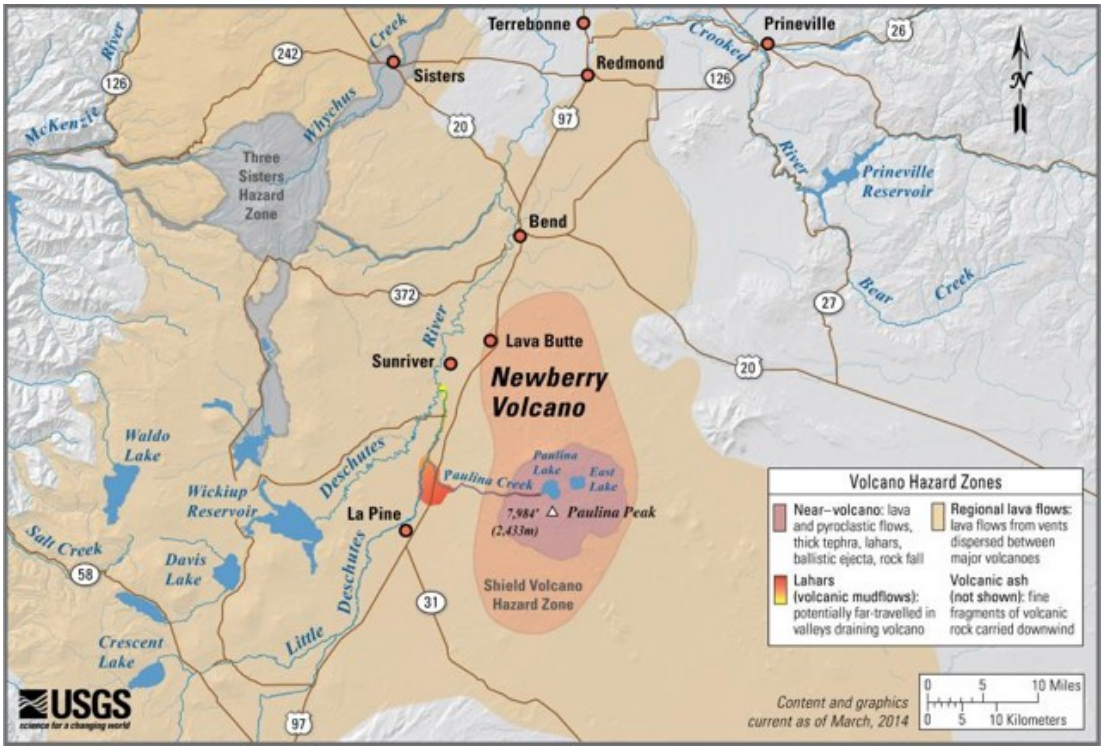
Overview—Newberry Volcano is among the largest and most voluminous of Cascade volcanoes. Although it is not of great height, it is very broad. Newberry lavas extend about 120 kilometers (75 miles) north to south and 43 kilometers (27 miles) east to west. The edifice covers more than 3,000 square kilometers (1,200 square miles), making it by area the largest volcano of the Cascades volcanic chain. Beyond the edifice, Newberry lava flows cover an additional 700 square kilometers (270 square miles), and reach about 25 kilometers (16 miles) north of Redmond. Hundreds of volcanic vents exist on the flanks of Newberry, many arranged in linear arrays, or rift zones, that extend far down the flanks. The youngest rift---zone eruption occurred about 7,000 years ago. At that time, a 32---kilometer long (20---mile long) fissure system opened extending northwest from the caldera. On this Northwest Rift Zone, lava fountains and small explosive eruptions created cinder cones, such as 150---meter high (500---foot high) Lava Butte, and wind spread blankets of cinders and ash downwind, often preceding lava flows. Lava flows from Lava Butte traveled more than 8 kilometers (5 miles) from the vent and temporarily dammed the Deschutes River.

Lava flows—Most of the City of Bend east of the Deschutes River is built on lava flows from Newberry Volcano. Potential future eruptions from rift zones on the north flank of Newberry represent the most credible lava---flow threat to a large settled area in the United States outside of Hawai'i. Lava flows advance relatively slowly compared to rapid flows such as lahars and pyroclastic flows, so they rarely threaten human life. But advancing lava flows ensure almost total destruction from burial and incineration. Lava flows can crush or bury structures, roads, railroads, power lines, gas lines, and other important infrastructure. They can also dam rivers and streams, causing floods and contamination of drinking water, and they can ignite fires. Once lava begins to flow from a vent, scientists are typically able to forecast which areas down slope are at greatest risk.

Explosive eruptions—Newberry has also produced notable explosive eruptions. Most of these originated from vents located in the broad depression, or caldera, that forms the summit of the volcano. The most recent eruption in the caldera occurred 1,300 years ago. It generated ash clouds that deposited tephra as far east as the Oregon---Idaho border, small pyroclastic flows, and lava of the Big Obsidian Flow. Larger events occurred in the more distant geologic past at Newberry, including some that transported tephra over broad areas of the western United States and sent pyroclastic flows down the volcano's flanks.

During potential future explosive eruptions, cinder cone eruptions on the volcano's flanks could generate modest amounts of tephra that would accumulate near the erupting vent. Explosive eruptions from Newberry caldera could send large amounts of ash several kilometers in to the atmosphere where it could be blown by wind to populated regions and become a hazard to aviation. Close to the vents, the ash deposits could be several meters thick, but would typically thin quickly with distance from the vents.

Figure II-17 Volcanic Hazards of Newberry Volcano



Source: Central Cascades Volcano Coordination Plan. Hazard zones are simplified from the USGS hazard assessment for the Three Sisters volcanic area. Tephra (ash) hazard zones are not shown, but tephra can impact large areas and the entire map region should be regarded as within the tephra hazard zone.

Volcanic gases—The presence of the summit caldera and closed basins within it create conditions favorable for accumulation of heavier---than---air volcanic gases, notably carbon dioxide, which could lead to dangerous conditions if increased emission of gas occurs during volcanic unrest or an eruption. Heavier---than---air gases could result in asphyxiation for anyone within the caldera.

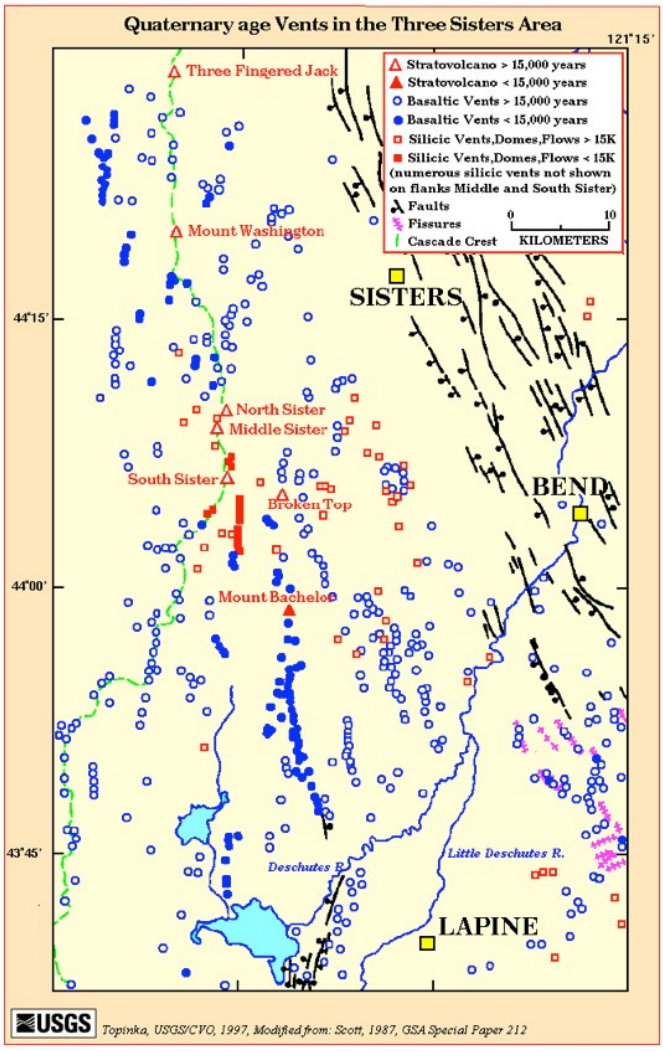
Geothermal—Several lines of evidence indicate that an active magma system exists beneath Newberry Volcano. Currently, both lakes within the caldera, Paulina and East Lake, contain hot springs with temperatures as high as 135 degrees F. A USGS drill hole made in 1981 found temperatures higher than 500---degrees at a depth of 3,000 feet. Several areas on the flanks of Newberry Volcano are being explored as potential sources for geothermal energy. High temperatures encountered now by hot spring users, and by geothermal drillers could become elevated during volcanic reawakening. Additionally, if a volcanic vent opened beneath the caldera lakes or through groundwater, the eruption would almost certainly be highly explosive and would deposit wet, muddy tephra over the immediate area.

Hydrologic hazards—As has happened in the past, rapid release of water from Paulina Lake or from rapid snowmelt could produce lahars, debris flows, or floods that descend Paulina Creek and inundate the Paulina Prairie area north of La Pine.

Fields of Mafic Volcanoes

Hundreds of geologically young volcanoes composed of cinders, ash, and lava flows dot the Central Oregon landscape among the major volcanic centers. Many, such as Collier Cone on the north flank of North Sister, occur on or near larger composite volcanoes; others occur many miles from larger volcanoes. Some of these, such as Pilot Butte cinder cone in Bend, occur within densely populated areas. Some of these volcanoes are cinder cones (e.g. Collier Cone, Pilot Butte, Lava Butte); others, such as Mount Bachelor, are large shield volcanoes that stand more than 1,000 meters (3,300 feet) above their bases and can be more than 10 kilometers (6 miles) wide. The figure below shows how common these vents are in the Central Oregon landscape.

Figure II-18 Geologically Young Vents in the Three Sisters Area



Source: USGS. Blue circles show fields of mafic vents scattered throughout the Central Oregon Cascades. Solid circles indicate vents younger than 15,000 years, open circles indicate vents older than 15,000 years.

The youngest mafic volcano in the region is Belknap Crater, north of McKenzie Pass, which formed about 1,500 years ago. Geologic evidence suggests that the eruptions forming mafic volcanoes may have lasted for centuries in the case of the largest cones, to weeks to months for

smaller ones. In some cases, vents in linear chains more than 10 kilometers (6 miles) were erupting concurrently, or nearly so. Since the last ice age waned, about 12,000 years ago, vents of mafic volcanoes have been concentrated in a narrow zone about 80 kilometers (50 miles) long, extending from south of Mount Bachelor to north of Santiam Junction. A few scattered vents in the area between Davis Lake and Oregon Highway 58 and a few south of Mount Jefferson were also active during this time period.

Future eruptions of mafic volcanoes are possible anywhere in the broad central Cascades region, although eruptions are probably more likely to occur in the greater Three Sisters area, judging from the volcanic history of the past 14,000 years. Tephra from eruptions of mafic volcanoes will affect areas chiefly east of the Cascade crest. Tephra falls from ongoing eruptions of mafic volcanoes could last months to years, or even longer, would be a chronic nuisance in Deschutes County. Once an eruption begins, ultimate extent of lava flows will depend on vent location, local topography, and the total volume and rate of lava erupted, but scientists will be able to make forecasts about areas at greatest risk. Future lava---flow eruptions in the central Cascades are more likely to occur away from populated areas and are more likely to impact forests and stream channels, but could also impact major highways and power---line corridors.

Probability Assessment

The annual probability of volcanic activity in or affecting Deschutes County can only be estimated with great uncertainty, but, depending on the type of eruption, ranges from roughly 1 in 1,000 to 1 in 10,000. However, as precursors of volcanic unrest begin the probability of eruption increases greatly. The precursors might include increased seismic activity, temperature and chemical changes in groundwater, ground deformation and release of volcanic gases.

The average annual probability of future mafic eruptions is roughly 1 in 1,500. Because most recent activity has been concentrated in the area between the North Sister and Santiam Pass, future activity is probably more likely there than in other parts of the lava flow hazard zone to the south and east, which includes most of the settled areas in the region. Furthermore, because only a relatively small part of the entire lava flow hazard zone is affected during one eruptive episode, the annual probability of any given point in the hazard zone being affected is considerably less than the average annual probability of 1 in 1,500. The US Geological Survey estimates the range of annual probabilities falls between 1 in 10,000, for some areas near the Cascade Crest around Three Sisters and on the upper flanks of Newberry Volcano, to 1 in 1,000,000 elsewhere. Because ashfall from such eruptions covers much larger areas than lava flows, the probability of ashfall affecting an area is greater.

When a volcano erupts here again, areas close to the erupting vent will be severely affected. A proximal hazard zone roughly 20 kilometers (12 miles) in diameter surrounding the volcano could be affected within minutes of the onset of eruption or large landslide. Distal hazard zones that follow river valleys downstream could be inundated by lahars or debris flows (rapid flows of water---laden rock and mud) generated either by melting of snow and ice during eruption or by large landslides.[62]

[62] Ibid.

On the basis of no prior events in the past 10,000 years, it is estimated that a lahar voluminous enough to inundate the largest of the distal hazard zones in any valley has an annual probability of less than 1 in 10,000. A lahar voluminous enough to inundate the smallest of the distal hazard zones in any valley has a greater annual probability, perhaps from 1 in 1,000 to 1 in 10,000. Still smaller lahars or debris flows that result from phenomena such as moraine---dam failures are much more likely to occur (annual probability greater than 1 in 100 in potentially affected valleys), but are apt to inundate only parts of the smallest distal hazard zones immediately adjacent to streams.

Major drainage systems that head in the Three Sisters area (Separation Creek, White Branch, Whychus Creek, and Tumalo Creek) are all potentially at risk from lahars during future eruptions, or from debris flows and floods. The location and size of these events will depend on the site of the triggering mechanism and its character.

At least four times in the past 700,000 years, explosive eruptions that were probably sited east of the present location of Broken Top and the Three Sisters produced pyroclastic flows, a mobile, hot (hundreds of degrees) mixture of rock fragments, ash, and gas that swept over a broad area from Sisters to south of Bend. Such an event today would be catastrophic for Deschutes County, but fortunately, events of this magnitude are infrequent. Furthermore, there is no evidence that the large volume of magna necessary to drive such an eruption is present in the Three Sisters region today, nor would such a volume likely be generated in the near future.[63]

The annual probability of explosive eruptions at Newberry Volcano affecting the caldera and immediately adjacent areas is about 1 in 3,000 (four eruptive periods, one basaltic and three rhyolitic, in 12,000 years). The probability of such an eruption occurring in a 30---year period, the duration of many home mortgages or a human generation, is roughly 30 times the annual probability or 1 in 100.

The valley of Paulina Creek, which drains from Paulina Lake through the west rim of Newberry Caldera, is the most likely drainage on Newberry to carry damaging lahars and floods. In addition to lahars and floods caused by pyroclastic flows melting snow, a lahar could be generated along Paulina Creek by lake overflow. Pyroclastic flows entering the lake or explosive eruptions in the lake itself could displace water into the Paulina Creek drainage. Lahars or floods from Paulina Lake could reach the La Pine valley within 30 minutes.[64]

Where Paulina Creek leaves the confines of its canyon, it diminishes in gradient and forms a broad alluvial fan. Lahars could spread across Paulina Prairie and extend north along the floodplain of Paulina Creek to its confluence with the Little Deschutes River. The 100---year floodplain of the Little Deschutes River downstream from Paulina Creek is also included in the hazard zone for lahars and flooding in the event of volcanically induced surges of water from Paulina Lake.

The U.S. Geological Survey defines two lava flow hazard zones for Newberry on the basis of likelihood of future lava flows within each zone. Lava flow hazard zone LA encompasses the area

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[63] Central Cascades Volcano Coordination Plan, 2007.

[64] Scott, W.E., Iverson, R.M., Schilling, S.P., and Fisher, B.J., 1999, Volcano hazards in the Three Sisters region, Oregon: U.S. Geological Survey Open---File Report 99---437.

more likely to be the site of flank vents or to be covered by lava, including the caldera. Zone LB includes two main areas: (1) areas on the lower flanks of Newberry that have relatively few flank vents and are chiefly covered by large lava flows from vents farther upslope and (2) lava flows from vents elsewhere in the Cascade Range or Basin and Range.

The outer boundary of lava flow hazard zone LA is determined by encircling the part of the volcano with greatest density of vents as determined by geologic mapping. As shown on the hazard map, the outline of zone LA broadly defines the elongate shape of Newberry Volcano itself, consistent with the idea that the volcano has grown by the repeated eruption of lava from vents preferentially located on the north and south flanks and in the summit region. The probability that a flank eruption will affect a given area in zone LA can be estimated only approximately because the frequency of such eruptions prior to the last ones about 7,000 years ago are poorly known. The U.S. Geological Survey infers that the annual probability of a flank eruption occurring in zone LA is roughly 1 in 5,000 to 1 in 10,000.

Lava flow hazard zone LB encompasses the entire hazard map area beyond zone LA. Zone LB includes areas on the lower flanks and down slope from Newberry Volcano and elsewhere in the region that have been affected by lava flows less frequently than areas in zone LA. The U.S. Geological Survey estimates that the annual probability of an eruption in this zone or of lava flows invading this zone from vents in zone LA is roughly 1 in 100,000, or less, on the basis of the frequency of lava flow coverage in the past one million years and the few, widely scattered vents in the region.

Deschutes County's Natural Hazards Mitigation Steering Committee believes that the County's **probability of experiencing a volcanic event is "low,"** meaning one incident is likely within the next 75 – 100 year period (or longer). Based upon available information the Oregon NHMPs Regional Risk Assessment supports this probability rating for Deschutes County.[65]

Vulnerability Assessment

All of the Pacific Northwest is vulnerable to impacts from volcanic activity. Like the rest of Central Oregon, Deschutes County has some risk of being impacted by volcanic activity in the Cascade Range. Figure II---13 shows the identified hazard zones for volcanic activity.

The Deschutes County Natural Hazards Steering Committee rated Deschutes County as having a **"high" vulnerability to volcanic hazards**; meaning more than 10% of the region's population or assets would be affected by a major emergency or disaster. Based upon available information the Oregon NHMPs Regional Risk Assessment supports this vulnerability rating for Deschutes County.[66] However, the communities of Bend, La Pine, and Sisters may be at greater risk since they are located closer to the main volcanoes and are more at risk for inundation by lava and pyroclastic flows, lahars and debris flows, or ash fall.

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[65] *2015 Oregon Natural Hazard Mitigation Plan DRAFT*. Department of Land Conservation and Development, 2015.

[66] Ibid.

Risk Analysis

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. Table 2---6 of the Risk Assessment (Volume I) shows the county's Hazard Analysis Matrix which scores each hazard and provides the jurisdiction with a sense of hazard priorities, but does not predict the occurrence of a particular hazard. Based on the matrix the **volcano hazard is rated #5, out of 9 rated hazards, with a total score of 173**.

Community Hazard Issues

Volcanic eruptions can send ash airborne, spreading the ash for hundreds or even thousands of miles. An erupting volcano can also trigger lahars, debris flows, floods, earthquakes, rockfalls, and avalanches. Volcanic ash can cause respiratory problems, electrical storms, agricultural damage, roof collapse, and can contaminate water supplies and severely disrupt transportation.[67] Lava flows can crush or bury everything in their path, including structures, roads, railroads, power lines, gas lines, and other important infrastructure; lava flows can also dam rivers and streams, causing floods and contamination of drinking water, and they can ignite fires.

Businesses and individuals can make plans to respond to volcano emergencies. Planning is prudent because once an emergency begins, public resources can often be overwhelmed, and citizens may need to provide for themselves and make informed decisions. Knowledge of volcano hazards can help citizens make a plan of action based on the relative safety of areas around home, school, and work.[68]

Building and Infrastructure Damage

Ashfall of 0.4 inches is capable of creating serious although temporary disruptions of transportation, operations, sewage disposal and water systems. The history associated with the Mount St. Helens eruption in 1980 resulted in closed highways, airports and other transportation systems for several days to, in some cases, weeks.

Ash can cause substantial problems for internal---combustion engines and other mechanical and electrical equipment. Additionally, it can contaminate filters, oil systems and scratch surfaces. Fine ash can cause short circuits in electrical transformers, which in turn cause power outages. Specifically in Deschutes County, ash can cause problems for the hi---tech manufacturing industry represented here.

The potential losses in Deschutes County extend beyond those to human life, homes, property and the landscape. Lahars and flooding, resulting from eruptions that melt snow and ice can result in severe damage to roads, bridges, pipelines and buildings. Highway 20 in Sisters, gas

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[67] Dzurisin, Dan, Peter H. Stauffer, and James W. Hendley II, Living With Volcanic Risk in the Cascades, USGS Fact Sheet 165---97, (2000).

[68] Scott, W.E. et al, Volcano Hazards in the Three Sisters Region, Oregon, USGS Open---File Report 99---437, (2001).

pipelines and high---capacity power lines on the flanks of Newberry Volcano are especially vulnerable.

Local business economies are at substantial risk if fallout from a volcanic event necessitates the closure of any of the major transportation routes in Deschutes County. The estimated loss per day is $3.5 million.[69]

Pollution and Visibility

Ash and tephra fallout from an eruption column can blanket areas within a few miles of the vent with a thick layer of pumice and ash. High altitude winds may carry finer ash from tens to hundreds of miles from the volcano, affecting downwind communities and posing a hazard to aircraft. Fine ash in water supplies will cause brief muddiness and chemical contamination. Ash suspended in the atmosphere is especially a concern for airports, where aircraft machinery could be damaged or clogged. Additionally, ashfall decreases visibility and disrupts daily activities.

Economic Impacts

Volcanic eruptions can disrupt the normal flow of commerce and daily human activity without causing severe physical harm or damage. Ash a few millimeters thick can halt traffic, possibly up to one week, and cause rapid wear of machinery, clog air filters, block drains and water intakes, kill or damage agriculture and severely impact tourism and the economy of the region. The interconnectedness of the region's economy can be disturbed after a volcanic eruption.

Infrastructure can be impacted, particularly in Sisters which is particularly vulnerable to lahars and flooding. Transportation of goods between Deschutes County and nearby communities and trade centers could be deterred or halted. Subsequent airport closures can disrupt airline schedules for travelers. Fine ash can cause short circuits in electrical transformers, which in turn cause electrical blackouts. Volcanic activity can also force nearby recreation areas to close for safety precautions long before the activity ever culminates into an eruption. The interconnectedness of the region's economy would be disturbed after a volcanic eruption due to the interference of tephra fallout with transportation facilities such as the regional highways.

Death and Injury

Inhalation of volcanic ash can cause respiratory discomfort, damage or result in death for sensitive individuals miles away from the volcano. Likewise, emitted volcanic gases such as fluorine and sulfur dioxide can kill vegetation for livestock or cause a burning discomfort in the lungs. Hazards to human life from debris flows are burial or impact by boulders and other debris.

More information on this hazard can be found in the Regional Risk Assessment for Region 6 of the Oregon NHMP.

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[69] Stutler, J. Informal survey during B & B Complex Fire, 2003.

Existing Authorities, Policies, Programs, and Resources

Existing authorities, policies, programs, and resources include current mitigation programs and activities that are being implemented by city, county, regional, state or federal agencies and/or organizations.

State

Central Cascades Volcano Coordination Plan, 2007

The purpose of this plan is to coordinate the actions that various agencies must take to minimize the loss of life and damage to property before, during, and after hazardous geologic events at Central Cascades volcanoes. OEM and the USGS are partnering to update the plan in 2015, the first coordination meeting occurred on February 27, 2015.

State Natural Hazard Risk Assessment

The state risk assessment chapter on volcanic events provides a useful overview of volcanic risks in Oregon and documents historic volcanic activity. It also recommends a multi---hazard approach, given the uncertainty of most of Oregon being impacted by volcanic hazards in the foreseeable future.

A major existing strategy to address volcanic hazards is to publicize and distribute volcanic hazard maps through DOGAMI and USGS. The volcanoes most likely to constitute a hazard to Oregon communities have been the subject of USGS research. Open---file reports (OFR) address the geologic history of these volcanoes and lesser---known volcanoes in their immediate vicinity. These reports also cover associated hazards and possible mitigation strategies. They are available for volcanoes near Deschutes County including: Mount Saint Helens, Three Sisters, Newberry Volcano, and Crater Lake.

Federal

Volcano Monitoring

USGS and Pacific Northwest Seismic Network at the University of Washington conduct seismic monitoring of major Cascade volcanoes in Washington and Oregon. The USGS serves as the primary dissemination agency for emergency information. As activity changes, USGS scientists provide update advisories and meet with local, state, and federal officials to discuss the hazards and appropriate levels of emergency response.[70]

Techniques for monitoring active or potentially active volcanoes focus on three areas—earthquakes (seismicity), ground deformation, and volcanic gases. Magma intruding a volcanic system breaks rock and causes slippage on faults, thereby creating earthquakes; it adds material at depth and heats and pressurizes ground water, thereby bowing up the ground surface; and it releases volcanic gases, mainly water vapor, carbon dioxide, and sulfur dioxide. Heat and

[70] Central Cascades Volcano Coordination Plan, 2007.

volcanic gases from magma warm and add telltale chemicals to the ground water, which affects the composition of spring water throughout the area.

Some monitoring occurs in real---time or near real---time as data are telemetered from field sites to base stations; other monitoring is done on a periodic basis and requires visits to the field or gathering data from satellites.

Earthquakes in central Oregon are detected and located in real---time by the Pacific Northwest Seismic Network (PNSN) at the University of Washington, a cooperative undertaking of the university, USGS, and University of Oregon. Compared to areas that have frequent earthquakes, the station spacing in central Oregon is relatively large, so only earthquakes greater than magnitude (M) 1 or 2 are able to be located routinely. Six stations added in the Three Sisters area since ongoing uplift was recognized in 2001 have reduced the magnitude threshold for location there to about M 0.5 to 1, if all stations are operating. Eight stations were added in the Newberry Volcano area in 2011. These stations, along with a very sensitive seismic array installed by a geothermal energy company on the west flank of the volcano, have significantly reduced the magnitude threshold for location of earthquakes on Newberry. In addition, a cache of instruments at USGS Cascades Volcano Observatory is available to rapidly augment the existing networks should conditions warrant.

Continuous Global Positioning System (CGPS) receivers are able to track ground deformation in real time for a single point on Earth's surface. At present CGPS receivers at Redmond, Mount Bachelor, and two near South Sister operate in real time. Such a sparse network is of limited use in understanding the complex nature of ground deformation in a volcanic environment. Eight CGPS receivers were installed at Newberry Volcano, along with seismometers, in 2011. This network significantly improved monitoring capabilities at Newberry.

Broader regional coverage is afforded by periodic USGS surveys (typically annual or every few years; more often if conditions warrant) of an array of benchmarks in the Three Sisters and Newberry areas by temporary deployment of GPS instruments. Both areas also have a system of precisely surveyed lines along roads or trails that are used for tilt leveling, a procedure that is capable of measuring slight crustal movements. Another technique called InSAR uses satellite radar data to detect crustal movements over broad areas.

USGS scientists measure output of volcanic gases by airborne surveys. Flights to central Oregon volcanoes are made every few years in order to develop baseline information; additional flights occur as conditions warrant. During times of increased concern, flights could occur as often as atmospheric conditions allow. Annual sampling and chemical and isotopic analysis of spring water from the area permit a broad regional view of how magmatic intrusion is affecting the chemical composition of shallow ground water.

By combining the results of these and other techniques and an understanding of a volcano's past behavior, the goal of volcano monitoring is to issue forecasts as accurately as possible about the state of a volcanic system and the probability for the onset of potentially hazardous conditions. Once an eruption has begun, monitoring information is used to forecast the character and expected outcome of the eruption, as well as its end.[71]

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[71] USGS---Volcano Hazards Program, http://volcanoes.usgs.gov/observatories/cvo/

Emergency Coordination

During times of volcanic crisis, USGS scientists will monitor events closely and, together with PNSN and the Oregon Department of Geology and Mineral Industries, issue information statements, alert warnings, updates, and briefing as necessary to keep public officials, the media, and the public aware of potential hazards and other pertinent information. The USGS and the National Weather Service will work together to provide warnings about lahars, floods, and downwind ash---fall hazards.

Currently, agencies require information on hazards that affect nearby areas much like airlines and the Federal Aviation Administration require information on tephra plumes that can be hazardous to aircraft hundreds of miles from the source. The information required by these two groups is not always the same, and therefore the USGS in cooperation with various agencies, has developed two hierarchies of alert levels; one directed toward emergency response on the ground and the other towards ash hazards to aircraft.

The USGS issues statements of ground---based hazards which are transmitted as appropriate to state and federal agencies including FEMA and the National Weather Service. The counties receive information from Oregon Emergency Management then transmit the notifications as appropriate to local emergency management networks.[72]

Warning Systems

The best warning of a volcanic eruption is one that specifies when and where an eruption is most likely to occur and what type and size eruption should be expected. Such accurate predictions are sometimes possible but still warrant further research. The most accurate warnings are those in which scientists indicate an eruption is probably hours to days away based on significant changes in a volcano's earthquake activity, ground deformation and gas emission. Experience from around the world has shown that most eruptions are preceded by such changes over a period of days to weeks.

A volcano may begin to show signs of unrest several months to a few years before an eruption. In these cases a warning that specifies when it might erupt months to years ahead of time are extremely rare. The strategy that the USGS uses to provide volcano warnings in the Cascade Range volcanoes in Washington and Oregon involves a series of alert levels that correspond generally to increasing levels of volcanic activity. As a volcano becomes increasingly active or as incoming data suggest that a given level of unrest is likely to lead to a significant eruption, the USGS declares a corresponding higher alert level. This alert level ranking thus offers the public and civil authorities a framework they can use to gauge and coordinate their response to a developing volcano emergency.

Education and Outreach

General information on volcano hazards may be found on the USGS Volcano Hazards website: http://volcanoes.usgs.gov.

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[72] Scott, W.E. et al, Volcano Hazards in the Three Sisters Region, Oregon, USGS Open---File Report 99---437, (2001).

USGS Open File Reports describe the geographic extent of impacts from volcanic activity originating in the Cascades and can be found on the USGS Cascades Volcano Observatory website: http://volcanoes.usgs.gov/observatories/cvo/.

Hazard Mitigation Action Items

There is one identified Volcano action item for Deschutes County; in addition, several of the Multi---Hazard action items affect the Volcano hazard. An action item matrix is provided within Volume I, Section 3, while action item forms are provided within Volume IV, Appendix A. To view city actions see the appropriate city addendum within Volume III.

Significant Changes Since the 2010 Plan

There are no significant changes to this section; information has been updated as needed to include new incidences of the hazard since 2010 (including large wildfires). In addition, the format of the section and minor content changes has occurred.

Causes and Characteristics of the Hazard

Wildfire is a natural and necessary component of ecosystems across the country. Central Oregon is no exception. Historically, wildland fires have shaped the forests and wildlands valued by residents and visitors. These landscapes however, are now significantly altered due to fire prevention efforts, modern suppression activities and a general lack of large scale fires, resulting in overgrown forests with dense fuels that burn more intensely than in the past. In addition, the recent explosion in population has led to increased residential development into forested land, in the wildland urban interface (WUI). Assessment of wildfire vulnerability and the identification of mitigation actions is largely dealt with at the community level through each of the County's Community Wildfire Protection Plans; further information on the CWPPs is provided below beginning on page II---80.

The impact on communities from wildfire can be huge. In 1990, Bend's Awbrey Hall Fire destroyed 21 homes, caused $9 million in damage and cost more than $2 million to suppress. The 1996 Skeleton fire in Bend burned over 17,000 acres and damaged or destroyed 30 homes and structures. Statewide that same year, 218,000 acres burned, 600 homes were threatened and 44 homes were lost. These wildfire events provided an impetus for addressing wildland urban interface development and hazardous fuel mitigation statewide.

Wildfire can be divided into three categories: interface, wildland, and firestorms. Interface fires are the most likely to happen in Deschutes County. Deschutes County experiences a large interface fire occurring each summer that prompts at least one neighborhood evacuation.

Interface Fires

Essentially an interface fire occurs where wildland and developed areas meet. In these locations, both vegetation and structural development combine to provide fuel. The wildland/urban interface (sometimes called rural interface in small communities or outlying areas) can be divided into three categories.

1. The classic wildland/urban interface exists where well---defined urban and suburban development presses up against open expanses of wildland areas.
2. The mixed wildland/urban interface is more typical of the problems in areas of exurban or rural development: isolated homes, subdivisions, resorts and small communities situated in predominantly wildland settings.
3. The occluded wildland/urban interface where islands of wildland vegetation exist within a largely urbanized area.

Wildland Fires

A wildland fire's main fuel source is natural vegetation. Often referred to as forest or rangeland fires, these fires occur in national forests and parks, private timberland, and on public and private rangeland. A wildland fire can become an interface fire if it encroaches on developed areas.

Firestorms

Firestorms are events of such extreme intensity that effective suppression is virtually impossible. Firestorms often occur during dry, windy weather and generally burn until conditions change or the available fuel is consumed. These events typically produce their own weather and wind events as well; as such, the high winds and dry weather are not just the conditions that drive the fire behavior. The disastrous 1991 East Bay Fire in Oakland, California is an example of an interface fire that developed into a firestorm.

Conditions Contributing to Wildfires

Ignition of a wildfire may occur naturally from lightning or from human causes such as debris burns, arson, smoking, and recreational activities or from an industrial accident. Once started, four main conditions affect the fire's behavior: fuel, topography, weather and development.

Fuel is the material that feeds a fire. Fuel is classified by volume and type. As a western state, Oregon is prone to wildfires due to its prevalent conifer, brush and rangeland fuel types.

Topography influences the movement of air and directs a fire's course. Slope is a key factor in fire behavior. Unfortunately, hillsides with steep topographic characteristics are also desirable areas for residential development.

Weather is the most variable factor affecting wildfire behavior. High risk areas in Oregon share a hot, dry season in the summer months and early fall with high temperatures and low humidity.

The increase in residential development in interface areas has resulted in greater wildfire risk. Fire has historically been a natural wildland element and can sweep through vegetation that is adjacent to a combustible home; additionally, fires at lower elevations historically have lower intensity. Typically it is the embers/ fire brands that ignite homes rather than the flaming front; as such, defensible space and fire resistant building materials are often the best mitigation strategies. New residents in remote locations are often surprised to learn that in moving away from built---up urban areas, they have also left behind readily available fire services providing structural protection.

History of Wildfires in Deschutes County

Table II---7 lists the significant large wildland fires in the region including Crook, Deschutes and Jefferson counties over the last decade. These fires required a substantial emergency management response from the region.

Table II-7 Large Wildfire History (1990 to present)

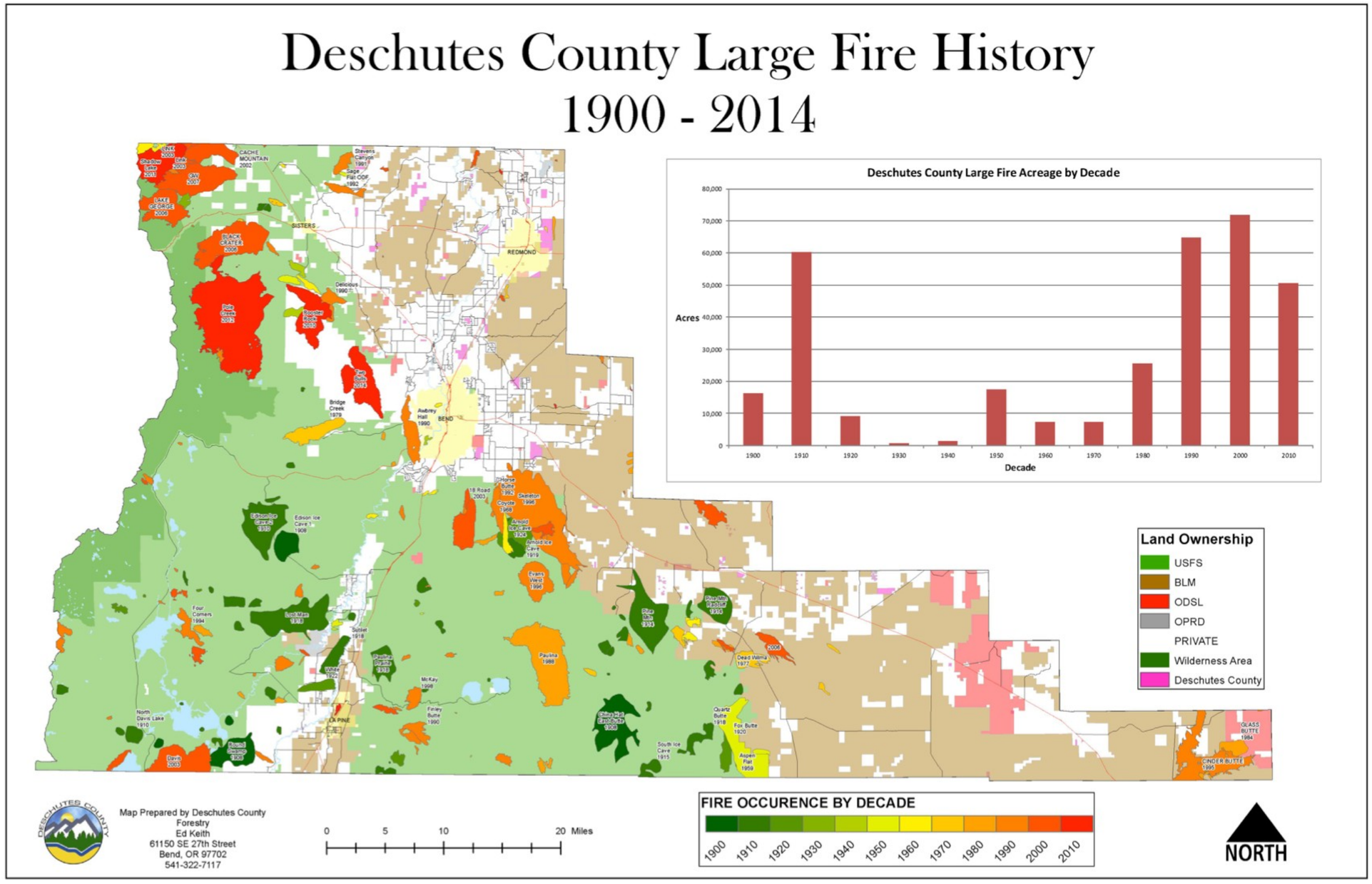
Date	Fire Name	Acres Burned
2014	Two Bulls	6,908
2013	Burgess Road	168
2012	Pole Creek	26,795
2011	Shadow Lake	10,402
2010	Roster Rock	6,120
2009	Black Butte II	569
2008	Summit Springs Complex	1,973
2007	GW	8,570
2006	Lake George	5,652
	Black Crater	9,412
2005	Park	139
2003	Davis	21,123
	Link	3,716
	18 Road Fire	3,811
	B & B Complex	90,769
2002	Eyerly	23,573
	Cache Mountain	4,451
2001	Crane Complex	713
2000	Hash Rock	18,500
1998	Elk Lake	252
	McKay	1,150
1996	Little Cabin	2,400
	Ashwood U Donnybrook	100,000+
	Smith Rock	300
	Skeleton	17,794
	Evans West	4,231
1995	Cinder Butte	11,132
1994	Four Corners	1,524
1992	Sage Flat ODF	1,106
	Horse Butte	1,629
1991	Stevens Canyon	1,080
1990	Awbrey Hall	3,032
	Delicious	2,042
	Finley Butte	1,320

Source: Deschutes County Forestry, 2014.

The local structural and wildland fire organizations have significantly refined the coordinated emergency response system for these types of destructive interface fires. Under the leadership of the Central Oregon Fire Chiefs Association (COFCA), the pre---planned interface fire mutual aid and task force system has effectively integrated the operational response process for structural and wildland fire fighting resources from all three counties. This response system is recognized

as one of the most effective interagency efforts in the state. As is the case with the regional focus of Table II---7, much of the wildland fire section of this plan is presented with a regional focus on Crook, Deschutes and Jefferson counties. The scope and multi---jurisdictional nature of local wildland fire demand has driven development of a regional approach that addresses: pre---incident planning, training, initial and extended response during incidents, and recovery activities. Fire service leadership broadly acknowledges the benefit of this type of coordinated approach as essential to meeting the local wildfire challenge.

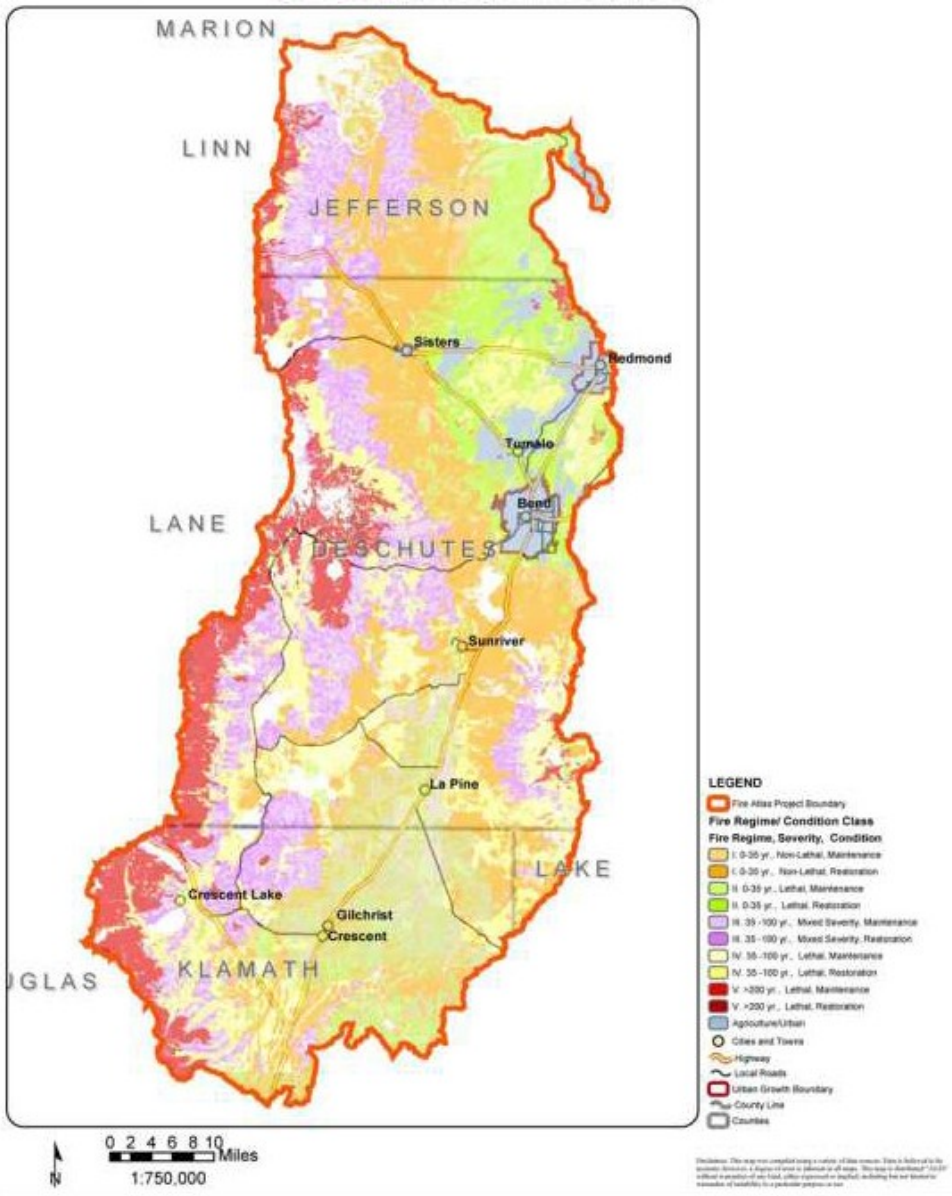
Figure II-19 Large Wildfire History



Source: Deschutes County Forester, 2014.

Another measure of the scope and impact of the wildland fire issue, particularly in the wildland---urban interface (WUI) is illustrated by data developed in the Central Oregon Fire Atlas. The Nature Conservancy produced the Fire Atlas as a part of their Fire Learning Network initiative. The Fire Atlas focuses on 2.05 million acres in Klamath, Deschutes and Jefferson counties and was used by stakeholders and community members to visualize wildfire risk in relation to regional landscapes and vegetation regimes, their location in relation to communities, and the history of past wildfires.[73]

Figure II-20 Central Oregon Fire Atlas



Source: Central Oregon Fire Atlas

[73] See more at: https://www.conservationgateway.org/News/Pages/deschutes---fln---helps---commu.aspx#sthash.0k6rrEmA.dpuf

The tables below illustrate not only the escalating size of large wildland fires in Deschutes County, but also the increasing impact on the citizens, values---at---risk and infrastructure of the county.

Table II-8 Acres Burned by Decade

Decade	Acres Burned
1900 % 1909	16,200
1910 % 1919	60,400
1920 % 1929	9,200
1930 % 1939	600
1940 % 1949	1,400
1950 % 1959	17,400
1960 % 1969	7,400
1970 % 1979	7,400
1980 % 1989	25,600
1990 % 1999	64,700
2000 % 2009	71,900
2010%2014	50,500
Summary	
1900%1999	210,300
2000%present	122,400

Source: Deschutes County Forestry, 2014

The significant story here is that central Oregon has experienced high intensity wildland fires on 37% more acreage in the last 15 years than in the previous 100 years combined. The following table details the structures lost since 1981. The table shows that the majority of structures lost occurred during events in 1990 and 1996; since 2003 there have been no homes lost in the county due to wildland fire.

Table II-9 Structures Lost to Wildland Fire

Year	Structures Lost
2003	2
2001	5
1996	30
1990	22
1981	5
Total	64

Source: Central Oregon Interagency Dispatch Records, 2009

The escalating size and intensity of these interface fires is the subject of continuing research in several scientific disciplines. These include the arenas of forest health, hazardous fuels treatment and community infrastructure protection; as well as studies of the impacts of climate change. These issues are likewise the subject of significant public discourse. Over the last two decades, community awareness and participation has developed substantially regarding the

interface fire threat. Participation hazardous fuel reduction and wildfire preparedness activities within neighborhoods in Deschutes County increases with each passing fire season.

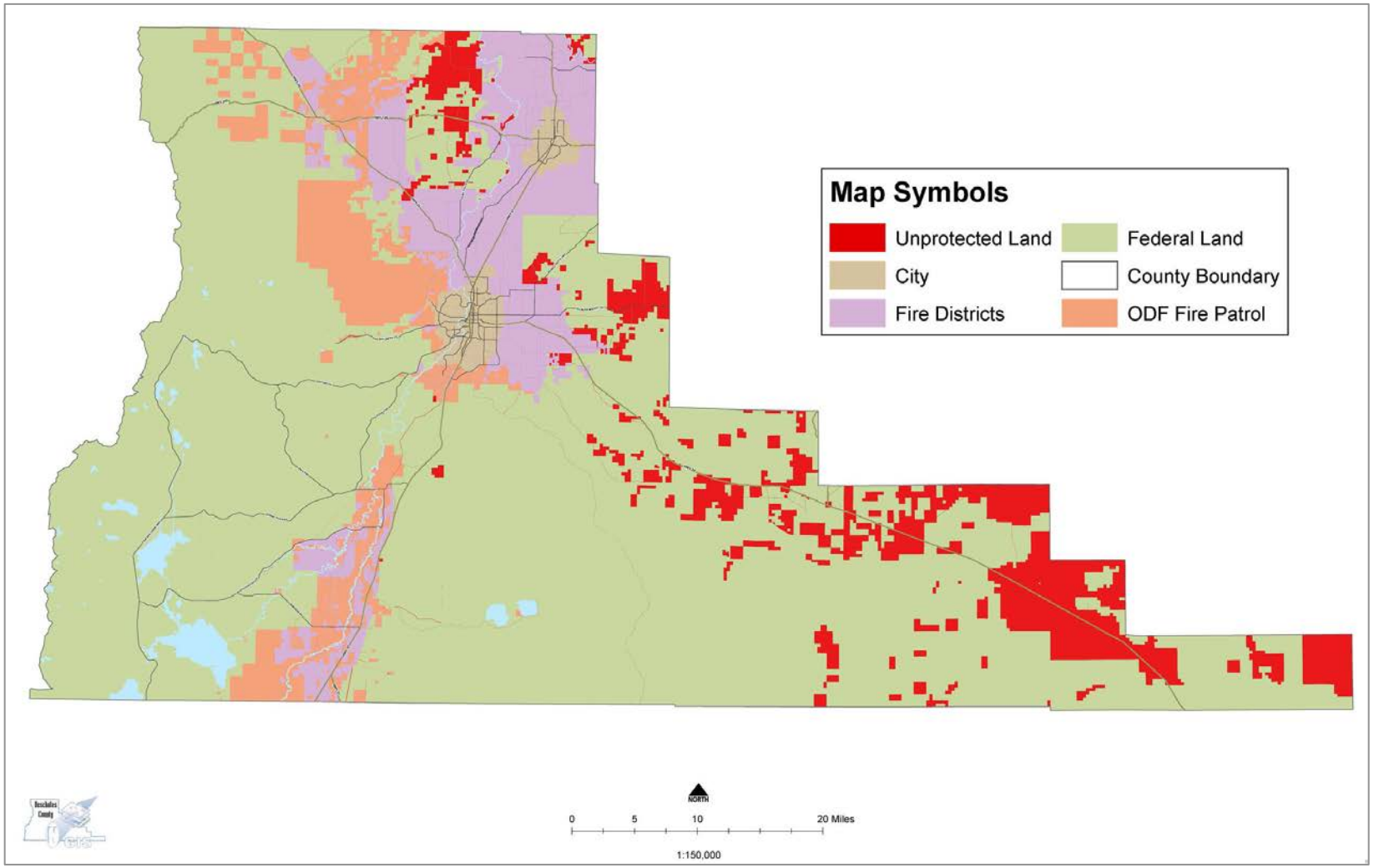
Central Oregon population growth has become a companion issue. In 1980, Deschutes County population was estimated to be 62,500. In 20 years, by 2000, it had nearly doubled to 115,367 and by 2013 it had increased another 41% to 162,525. The 2004 Coordinated Population Forecast for Deschutes County (updated in 2009) estimates the 2025 county population to be 240,811. This trend of rapid population growth will have significant impacts on citizen exposure, infrastructure vulnerability, and economic losses to the effects of wildland fire.

Deschutes County includes approximately 175,400 acres of unprotected lands (see Figure II---21 for a map of the protected and unprotected lands within Deschutes County). Throughout eastern Oregon approximately eight million acres of unprotected, privately owned wildland areas exist. In Deschutes County there are several examples of residential development that do not have structural or wildland fire protection. These include the Lower Bridge area east of Sisters, and the Brothers and Hampton areas along Highway 20 on the eastern edge of the county. In addition, there are approximately 100,000 acres of privately owned rangeland east of Bend that do not have wildland fire protection. Alfalfa, a community located east of Bend, recently passed a bond measure to fund a fire district that will provide fire protection to its residents. The fire district is still in the planning phases and is not currently providing services; however services are forecasted to be available as soon as 2016.

Because these types of areas have no fire protection organizations and because of the light, flashy nature of the fuel types present in some areas, wildland fires have the potential to get quite large often spreading to the point where they become a threat to protected areas. In Deschutes County, county code 8.21 has been developed that outlines a system for landowners to respond to the wildland fire threat with defensible space and fire breaks on private property in the unprotected areas.

There are likewise substantial resource commitments and fiscal costs associated with emergency response to wildland fire incidents. This impact on local organizations was demonstrated by the multiple agency organizational response each fire season. Notable recent incidents that exemplify the impact on local organizations are Pole Creek (2012), Burgess Road (2013) and Two Bulls (2014). The costs associated with multiple day mobilization of law enforcement, search and rescue, structural fire assets and state fire resources can quickly deplete local and state agency budgets. Residential evacuation triggers American Red Cross mobilization and when major transportation routes are impacted, Oregon Department of Transportation and County Road Department personnel are also mobilized. Depending on the scope and specifics of an individual fire, additional agency and non---governmental support organizations may also be mobilized to help mitigate the impact on citizens and community infrastructure.

Figure II-21 Deschutes County Fire Protection



Source: Deschutes County Forester, 2015

The rapid rates of spread and higher fire intensity observed in the recent past have raised the awareness level of the public and local public safety officials. Public safety and structural mobilization, at some level, occurs shortly after the initial smoke report for every wildland fire with wildland urban interface threat potential in Deschutes County. In 2013, a human caused wildfire burning in Klamath County, just south the city of La Pine, which is the southern most city in Deschutes County prompted the mobilization of Deschutes County resources. The Stagecoach Fire prompted the evacuation of a largely rural community and quickly grew to more than 380 acres within one operational period. Due to the rapid rate of spread Klamath County called for assistance from Deschutes County Sheriff, Search and Rescue, and Oregon State Police. The Stagecoach Fire also impacted Highway 97, the most travelled highway in the state of Oregon. These mobilization costs are incurred whether or not the fire directly impinges on population concentrations and structural development. Impacts on state highways from smoke, the fire front or the need to shut down a highway segment to facilitate an evacuation brings Oregon Department of Transportation and Oregon State Police into the picture. In a similar manner, even modest scale residential evacuations trigger sheltering and support activities from the American Red Cross.

The Two Bulls fire, June 2014, led to the evacuation of more than 3,000 structures on the west side of Bend. Millions of dollars in industrial timberland owned by Cascade Timber were burned and many recreational events planned for early June were cancelled due to the health & public safety implications. This incident occurred 10 miles northwest of Bend and involved a mixture of private lands (protected by the Oregon Department of Forestry) and Deschutes National Forest.

Pole Creek, September 2012, primarily impacted Sisters and the surrounding area while burning nearly 27,000 acres. The health and environmental impacts caused by the high intensity nature of Pole Creek still echo through Central Oregon. Ash and hot embers from Pole Creek were found in the Eagle Crest resort, which is more than 10 miles to the East.The Davis and Link fires and the B&B Complex from 2003 illustrate this impact. The Davis Fire started in Klamath County just to the southwest of La Pine, ultimately burning 21,181 acres. While this fire remained on the Deschutes National Forest, the threat to downwind communities required a massive mobilization of law enforcement, search and rescue, Oregon Department of Transportation and structural fire resources from both Klamath and Deschutes Counties to address the potential spread. Ash fell from this incident as far away as Prineville in Crook County, 60 miles to the northeast.

The Link Fire started near Link Lake in Jefferson County to the northwest of Black Butte Ranch. In 2002, the nearby Cache Mountain Fire quickly spread over six miles from its point of origin into Black Butte Ranch leading to an expedited evacuation of the community and ultimately the destruction of two residences. While the 2003 Link Fire did not spread out of the wildland area, the lessons learned from the Cache Fire experience triggered public safety concerns and preparation for another evacuation.

The B & B Complex, because of its size and duration, created a large---scale impact on local government agencies, local community public safety and the regional economy in part due to the closure of Highway 20 access over Santiam Pass for two weeks during the peak of the tourist season. Economic losses suffered in Sisters, Camp Sherman and Black Butte Ranch triggered the declaration of an economic disaster and businesses in these communities were able to take advantage of the U.S. Small Business Administration Economic Injury Disaster Loan Program.

Much of the public policy discussion associated with the wildland urban interface at federal, state and local levels have been focused on resources and public safety issues. While that will continue to be an important component of future initiatives, these examples of rapidly moving, high intensity fires with long---range spotting demonstrate the need for coordinated fuels treatment strategies and public education efforts that address fire behavior and preparedness issues for several miles beyond private and public land boundaries.

Hazard Identification

Deschutes County is generally considered within two vegetative ecosystems:

- the "high desert" dominated by Western juniper, sagebrush and a variety of grass species to the east, and
- to the west, a transition from dry---site ponderosa and lodgepole pine to mixed conifer to a sub---alpine mix of tree species near the crest of the Cascades.

The boundary between these two general eco---types is driven for the most part by elevation, precipitation and soil moisture---holding capacity.

Central Oregon Fire Adapted Ecosystems

Most central Oregon ecosystems, particularly those at low and mid elevations adjacent to most community and residential development, are described as fire adapted. Vegetative species in these areas have evolved in and are dependent on relatively short fire return intervals. Over the last 100+ years, fire suppression and forest management activities have altered this natural fire return interval. This has created species shifts and increases in stand density and forest fuels. This change has increased susceptibility of the forest to insects, diseases and to wildland fire.[74] Inventory and analysis of this shift by the Central Oregon Fire Management Service (COFMS) stratifies the national forest and adjacent lands into one of three Condition Classes based on the number of "missed" fire cycles.[75]

Vegetative Mapping for Fire Regime and Condition Class

The Deschutes National Forest, Ochoco National Forest and the Prineville District of the Bureau of Land Management, working together as Central Oregon Fire Management Services (COFMS) review, and edit if necessary, the Central Oregon Fire Management Plan on an annual basis. Included in that plan is an extensive Fire Regime and Condition Class analysis of the condition of the vegetation on the public lands managed by the agencies.

Because of the wide variability in vegetative types in central Oregon, the Fire Regime – Condition Class approach was selected as the best method to describe the range of conditions present on the ground.

Fire Regime --- Condition Class considers the type of vegetation and the departure from its natural fire behavior return interval. Five natural (historical) fire regimes are classified based on

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[74] Fitzgerald, S., OSU Extension Wildland Forest Specialist, interview March 2004.

[75] Central Oregon Fire Management Plan, Central Oregon Fire Management Service.

the average number of years between fires (fire frequency) combined with the severity of the fire on dominant overstory vegetation. Western juniper, for example has a fire return interval of approximately 30 years with high potential for stand replacement fires. Therefore, it falls within Fire Regime II.

Table II-10 Fire Regimes

Fire Regime Group	Fire Frequency	Fire Severity	Plant Association Group
I	0 $ 35 years	Low severity	Ponderosa pine, manzanita, bitterbrush
II	0 $ 35 years	Stand replacement	Western juniper
III	35 $ 100+ years	Mixed severity	Mixed conifer dry
IV	35 $ 100+ years	Stand replacement	Lodgepole pine
V	> 200 years	Stand replacement	Western hemlock, mixed conifer wet

Source: Deschutes County CWPPs

Condition Class categorizes a departure from the natural fire frequency based on ecosystem attributes. In Condition Class 1, the historical ecosystem attributes are largely intact and functioning as defined by the historical natural fire regime. In other words, the stand has not missed a fire cycle. In Condition Class 2, the historical ecosystem attributes have been moderately altered. Generally, at least one fire cycle has been missed. In Condition Class 3, historical ecosystem attributes have been significantly altered. Multiple fire cycles have been missed. The risk of losing key ecosystem components (e.g. native species, large trees, soil) is low for Class 1, moderate for Class 2, and high for Class 3.

Table II-11 Condition Class

Condition Class	Attributes
Condition Class 1	*Fire regimes are within or near an historical range. *The risk of losing key ecosystem components is low. *Fire frequencies have departed from historical frequencies (either increased or decreased) by no more than one return interval. *Vegetation attributes are intact and functioning within an historical range.
Condition Class 2	*Fire regimes have been moderately altered from their historical range. *The risk of losing key ecosystem components has increased to moderate. *Fire frequencies have departed (either increased or decreased) from historical frequencies by more than one return interval. This change results in moderate changes to one or more of the following: fire size, frequency, intensity, severity or landscape patterns. *Vegetation attributes have been moderately altered from their historic ranges.
Condition Class 3	*Fire regimes have been significantly altered from their historical range. *The risk of losing key ecosystem components is high. *Fire frequencies have departed (either increased or decreased) by multiple return intervals. This change results in dramatic changes to one or more of the following: fire size, frequency, intensity, severity, or landscape patterns. *Vegetation attributes have been significantly altered from their historic ranges.

Source: Deschutes County CWPPs

While each of the fire regimes described exist in Deschutes County, Fire Regime I and Fire Regime II generally describe the forest condition that is present at the lower elevations adjacent to the more densely populated, wildland urban interface (WUI) areas of the county. The forest vegetative species shift cited above however is causing a greater presence of Fire Regime III at lower elevations with an increasing dominance of non---native species and increased fuels loading in those sites. This results in higher levels of fire intensity, crowning and spotting potential.

In Deschutes County, the majority of public lands are in Condition Class 2 or 3, having missed one or two (or more) fire return intervals. Ground vegetation and tree saplings have grown unchecked by natural fire contributing significantly to the potential for extreme fire behavior including crowning, torching and spotting.

Fire Behavior

Wildland fire behavior is comprised of three components: fuels, topography and weather. While these three parameters individually define fire behavior, their interactive dynamics offer insight for effective mitigation approaches. The fire behavior triangle helps demonstrate the relationship between these three parameters.

The **fuels** aspect of fire behavior takes into consideration loading, size and shape, compactness, horizontal and vertical continuity and chemical composition. Each of these parameters offers opportunities for effective hazardous fuels treatment mitigation actions. Due to the dry nature of most areas of Deschutes County, many of the brush species contain a significant amount of volatile, highly flammable oils and resins (e.g. bitterbrush). These relatively low profile fuels can

generate very intense, high flame length fire behavior. This is similar to fires observed in the chaparral fires in southern California.

Topography takes into account elevation and slope position and steepness, aspect and shape of the country. Deschutes County's west boundary lies at the crest of the Cascade Mountains generally about 6,000 to 7,000 feet. The elevation falls off to the east, transitioning through the lower slopes and foothills of the Cascades, crossing the Deschutes River and progressing down to about 3,000 feet in the high desert. This generally gives the area an east and south aspect, which provides strong solar exposure throughout most of the day. The Cascades also act as a barrier to the prevailing westerly winds. This creates a rain shadow effect that limits precipitation on the east side of the mountains and contributes to gusty, turbulent, dry cold front passages that have historically contributed to high intensity fires with rapid rates of fire spread and medium to long range spotting.

As mentioned above and described in Appendix C, Central Oregon weather is strongly affected by the Cascade Mountains. The relatively low precipitation, particularly at lower elevations adjacent to areas of community development, strong solar radiation and gusty wind patterns combine to generate a fairly dry environment.

There are some opportunities to compensate for the wildland interface fire exposure effects of local dry climatic conditions and weather patterns by consideration of topographic features during home construction and development planning. Overall, however, the greatest potential to impact fire behavior lies with hazardous fuels management, varying in scope from defensible space around individual homes and structures to well planned, landscape scale treatments to mimic the effects of periodic low intensity fire.

In Central Oregon, forests ecologically within the historical norm are also more fire tolerant and are less susceptible to high intensity, stand replacement fires. Ultimately, fire behavior is related to the structure of the forest fuels. Hazardous fuels treatment strategies are the subject of ongoing research efforts.[76]

The Wildland Urban Interface of Deschutes County

Over the last ten years, public recognition of the term "wildland urban interface" (WUI) has become greater with increased incidences of wildland fires, loss of residences, and highly visible smoke columns. The term "wildland urban interface" describes the boundary and intermixture of structural development adjacent to and within areas dominated by wildland fire vegetation. Fire suppression tactics in interface areas, both structural and wildland, are continually adapting to provide better safety for firefighter and the public.

Probability Assessment

In Oregon, wildfires are inevitable. Although usually thought of as being a summer occurrence, wildland fires can occur during any month of the year. The vast majority of wildfires burn during June to October time period. Dry spells during the winter months, especially when combined with winds and dead fuels, may result in fires that burn with intensity and a rate of spread that

[76] Science Basis for Changing Forest Structure to Modify Wildfire Behavior and Severity by Russell T. Graham, Sarah McCaffrey, and Theresa B. Jain. RMRS---GTR---120, USDA Forest Service, 2004.

cause difficultly for local resources that typically don't have their full staffing in the winter season. The threat of wildfire continues today. However, wildfire risk to human welfare and economic and ecological values is more serious today than in the past because of the buildup of flashy fuels, changes in vegetation composition over time, construction of houses in proximity to forests and rangelands, increased outdoor recreation, and a lack of public appreciation of wildfire.[77]

The natural ignition of forest fires is largely a function of weather and fuel; human---caused fires add another dimension to the probability. Dry and diseased forests can be mapped accurately and some statement can be made about the probability of lightning strikes. Each forest is different and consequently has different probability and recurrence estimates. Wildfire has always been a part of these ecosystems and sometimes with devastating effects. The intensity and behavior of wildfire depends on a number of factors including fuel, topography, weather, and density of development. There are a number of often---discussed strategies to reduce the negative impacts of these phenomena. They include land---use regulations, management techniques, site standards, and building codes. All of these have a bearing on a community's ability to prevent, withstand, and recover from a wildfire event.

Deschutes County's Natural Hazards Mitigation Steering Committee believes that the County's **probability of experiencing a wildfire event is "high,"** meaning at least one incident is likely within the next 10 – 35 year period (as the history of wildfires indicates, it is likely that Deschutes County will experience a wildfire on an annual basis). Based upon available information the Oregon NHMPs Regional Risk Assessment supports this probability rating for Deschutes County.[78]

Future Climate Variability

One of the main aspects of the probability of future occurrences is its reliance on historic climate trends in order to predict future climate trends. Counties east of the Cascade Mountain Range in Oregon are experiencing more frequent and severe wildfires than is historically the norm, and many climate predictions see this trend continuing into the future. Temperature increases will occur throughout all seasons, with the greatest variation occurring during summer months. Hotter temperatures mean more combustible vegetation. This information was considered while developing the probability of wildfire occurrence for the county.

Vulnerability Assessment

Wildfires are a natural part of forest and grassland ecosystems. Past forest practices included the suppression of all forest and grassland fires. This practice, coupled with hundreds of acres of dry brush or trees weakened or killed through insect infestation, has fostered a dangerous situation. Present state and national forest practices include the reduction of understory vegetation through thinning, mastication and prescribed (controlled) burning.

Each year a significant number of people build homes within or on the edge of the urban/wildland interface, thereby increasing wildfire hazards. Many Oregon communities

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[77] Ibid

[78] *2015 Oregon Natural Hazard Mitigation Plan DRAFT*. Department of Land Conservation and Development, 2015.

(incorporated and unincorporated) are within or abut areas subject to serious wildfire hazards, complicating firefighting efforts and significantly increasing the cost of fire suppression.

Each Community Wildfire Protection Plan (CWPP) utilized a variety of hazard assessment tools depending on the vegetation ecotypes of the Communities at Risk within each CWPP. At a minimum however, each CWPP utilized the Oregon Department of Forestry Assessment of Risk Factors which is based on five categories of evaluation that include a variety of information designed to identify and evaluate wildland fire risk across Oregon: risk of wildfire occurrence, hazard, protection capability, human and economic values protected and structural vulnerability.

Over the last five years, collaborative groups in each of seven CWPP areas met to conduct these assessments and determine priorities for fuels reduction activities on public and private lands. Each CWPP and year of update (and next expected revision) is listed below:

- Greater Bend CWPP (2011, expected revision 2016)
- Greater La Pine CWPP (2015, expected revision 2020)
- Greater Redmond CWPP (2011, expected revision 2016)
- Greater Sisters Country CWPP (2014, expected revision 2019)
- Sunriver CWPP (2015, expected revision 2020)
- East and West Deschutes County CWPP (2012, expected revision 2017)
- Upper Deschutes River Coalition CWPP (2013, expected revision 2018)

Based on the numerical outputs of this assessment, each of the Communities at Risk receives a score for each category and a total score. Utilizing the scores, the Communities at Risk can be ranked for prioritization. The following table details the priorities determined under each CWPP.

Table II-12 Summary of CWPP Priorities in Communities at Risk

CWPP Areas	Communities at Risk 2 Priorities	Change since 2010
Bend WUI	Highest Southwest, West, Southeast, West UGR, Northwest	This is a new category
	High East UGR, Northeast, North	This is a new category
La Pine WUI	Highest Priorities Day Road Corridor, 6th & Dorrance, Finely Butte	Wickiup Acres, Masten Road Area moved down
	Next Highest (Higher) Priorities Newberry, City of La Pine, Ponderosa Pines	This is a new category
	High Priorities Huntington South, Little Deschutes River, Newberry Estates, Ponderosa Pines and Section 36.	Newberry and Ponderosa Pines moved up, Huntington and Section 36 removed,
Redmond WUI	First Priorities Northwest, Southwest, Northeast, Southeast, and Urban Northwest	Category name change from Highest to First
	High Priorities Urban Northeast, Urban Southwest, Urban Southeast	Category name change from High to Second Removed
Sisters WUI	Extreme Risk Priority Communities Whychus Canyon, Whychus Creek	Camp Sherman, Black Butte Ranch Removed
	Very High Risk Priority Communities Indian Ford Creek, Metolius	Tollgate, Squaw Creek, Crossroads, Plainview, Sisters, Panoramic Removed
	High Risk Priority Communities City of Sisters, Fryrear Butte, McKenzie Canyon	Suttle Lake, Sage Meadow, Forked Horn, Aspen Lakes, Cascade Meadow
Sunriver WUI	Highest priority is treating public lands surrounding Sunriver and private lands inside Sunriver	No change
East & West Deschutes County WUI	Highest Priorities: *Public Lands:* Reservoirs, West Evacuation Routes, All West Lakes, Tumalo Falls, Paulina & East Lakes and their Evacuation Routes, Newberry Visitors Center and Lava River Cave *Private Lands*: Alfalfa, Millican, Brothers, Pine Mountain, Hampton North of Hwy 20 and Glass Butte Road.	No change
	High Priorities *Public Lands:* Edison Trailhead, Other West Trailheads, Round Mountain, Newberry Lava Cast Forest, Sugar Pine Butte *Private Lands:* Fox Butte Rd, Evacuation Routes, Hampton South of Hwy 20.	No change
Upper Deschutes River Coalition WUI	Highest Priorities Three Rivers, Little Deschutes Corridor, Foster Road Corridor	Big River moved down
	Higher Priorities Haner Park, Big River	This is a new category
	High Priorities Wild River, Fall River	Haner Park moved up

Source: Deschutes County CWPPs
Notes: Sunriver only has one rating area. The priorities for this CWPP can be found in the action plan rather than the a risk assessment.
In both the La Pine & Sister's revisions the base map with the rating areas was re---evaluated with different rating areas to inlcude more structures (as such the names of areas changes, but the boundaries remained the same).

The Deschutes County CWPPs utilized the Oregon Department of Forestry Assessment of Risk methodology to determine community risk. The assessment used a scoring matrix with six factors: likelihood of fire occurring (Risk), hazard (based on weather, topography, and fuel), protection capability, protection capability, values protected, and structural vulnerability[79]. The

[79] Deschutes County CWPPs. Sunriver did not perform the analysis since all of it's area was considered equal.

hazard assessment information was used to develop a scoring matrix that would provide results that was used for prioritizing the WUI areas.

The Deschutes County Natural Hazards Steering Committee rated Deschutes County as having a **"high" vulnerability to wildfire hazards**; meaning more than 10% of the region's population or assets would be affected by a major emergency or disaster. Based upon available information the Oregon NHMPs Regional Risk Assessment supports this vulnerability rating for Deschutes County.[80]

Risk Analysis

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. Table 2---6 of the Risk Assessment (Volume I) shows the county's Hazard Analysis Matrix which scores each hazard and provides the jurisdiction with a sense of hazard priorities, but does not predict the occurrence of a particular hazard. Based on the matrix the **wildfire hazard is rated #2, out of 9 rated hazards, with a total score of 220**.

Community Hazard Issues

Threat to Life and Property

The interface between urban and suburban areas and these resource lands are producing increased exposure to life and property from wildfire. In many cases, existing fire protection services cannot adequately protect new development. Wildfires that also involve structures present complex and dangerous situations to firefighters.

Personal Choices

Many interface areas, found at lower elevations and drier sites, are also desirable real estate. More people in Oregon are becoming vulnerable to wildfire by choosing to live in wildfire---prone areas.[81]

A community at risk is a geographic area within and surrounding permanent dwellings (at least one home per 40 acres) with basic infrastructure and services, under a common fire protection jurisdiction, government, or tribal trust or allotment, for which there is a significant threat due to wildfire.

Private Lands

Private development located outside of rural fire districts where structural fire protection is not provided is at risk. In certain areas fire trucks cannot negotiate steep grades, poor road surfaces,

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[80] Ibid.

[81] National Wildland/Urban Interface Fire Protection, Fire protection in the Wildland/Urban Interface: Everyone's responsibility, Washington D.C., (1998).

narrow roads, flammable or inadequately designed bridges, or traffic attempting to evacuate the area. Little water during the fire season, and severe fuel loading problems add to the problem. In some areas, current protection resources are stretched thin, thus both property in the interface and traditionally protected property in the forests and cities are at greater risk from fire. While the Firewise program has increased knowledge of the fire risk and preparedness for fire season however, many property owners in the interface are not aware of the problems and threats that they face, and owners in some areas have done little to manage or offset fire hazards or risks on their own property.

Drought

Recent concerns about the effects of climate change, particularly drought, are contributing to concerns about wildfire vulnerability. Unusually dry winters and hot summers increase the likelihood of a wildfire event, and place importance on mitigating the impacts of wildfire before an event takes place.

More information on this hazard can be found in the Regional Risk Assessment for Region 6 of the Oregon NHMP.

Existing Authorities, Policies, Programs, and Resources

Existing authorities, policies, programs, and resources include current mitigation programs and activities that are being implemented by city, county, regional, state or federal agencies and/or organizations.

Local fire prevention and hazardous fuels treatment efforts have been an integral component of the local interagency coordination picture since the early 1980's. The challenge of an expanding wildland urban interface was recognized in Deschutes County two decades ago. The local fire service response system reflects that long period of interface fire experience and the recognized value of pre---incident mitigation activities.

County and Cities

Project Impact

Deschutes County was designated an Oregon Project Impact community in 1999. At the time, this national---level program was established "to reduce the human and economic costs of disasters through prevention, preparation and mitigation." Deschutes County was one of only a few areas across the nation identified to focus on wildland fire related mitigation activities. A steering committee was established by the Deschutes County Board of Commissioners to provide oversight and accountability for use of the funds. The original $300,000 grant allowed Project Impact to construct an additional escape route out of an at---risk community and fund additional activities for the next three years.

In 2002, a consultant and a sub---group of the steering committee began to explore development of a business plan for a follow---on organization to Project Impact. Project Wildfire was established. Based on the foundation of the Project Impact experience and as stated previously, Project Wildfire continues to provide coordination of a variety of wildland fire mitigation activities including the FireFree program, the facilitation of the 7 Community Wildfire Protection

Plans, serves as a source of wildfire mitigation and preparedness information for local groups, and secures grant funding to support fuel mitigation activities in local at risk communities.

FireFree

The FireFree program is a nationally recognized model for homeowner education and mitigation programs in the wildland urban interface. Created in 1997 following the devastating Skeleton Fire in Bend, FireFree creates awareness and educates residents about the risks of wildland fire to homes and property and the ten simple steps they can take to reduce those risks. FireFree encourages homeowners to take responsibility for risk mitigation by creating defensible space around their property and disposing of debris. To find the ten FireFree steps, the FireFree program has an established website www.firefree.org.

FireFree is the local grass root, call---to---action program in Deschutes County for residents to prepare their property for wildfire. The FireFree events culminate every spring and fall with FireFree community clean up days where residents can dispose of their yard debris created by maintaining or creating defensible space, for free at surrounding disposal sites. FireFree is coordinated by Project Wildfire as a collaborative effort among local fire agencies, forestry departments, private businesses and the insurance industry.

Project Wildfire

Project Wildfire is the result of a Deschutes County effort to create long---term wildfire mitigation strategies and provide for a disaster---resistant community. Its mission is to prevent deaths, injuries, property loss and environmental damage resulting form wildfires in Deschutes County. Created by Deschutes County Ordinance 8.24.010, Project Wildfire is the community organization that facilitates, educates, disseminates and maximizes community efforts toward effective fire planning and mitigation. Project Wildfire is governed by a 27---member steering committee that is defined by County Ordinance 8.24.020 as a 50---50 balanced mix between fire agency representatives, private residents, elected officials, Deschutes County 911, Deschutes County Emergency Management, Insurance, and many other at large community members.

Project Wildfire has established a web site (www.projectwildfire.org) to help showcase the wide variety of hazardous fuels treatment, prevention projects, and public information and educational opportunities.

Wildland and Structural Fire Services Program Coordination

Both wildland and structural fire agencies provide a range of services including:

- educational and prevention services;
- pre---season planning and incident response consistent with statutory, jurisdictional and regulatory responsibility; and
- fire response on private and public lands within Deschutes County.

Fire agencies in central Oregon have responded to expanding community development, increasing population and increasing wildland urban interface fire load (risk) by developing a well coordinated structural and wildland response system.

The structural agency Interface Task Force system and the interagency efforts of Oregon Department of Forestry, USFS, and BLM preplanned initial and extended attack system have been established for the tri---county region. The wildland and structural fire resources are routinely merged at the fire scene to meet specific demands of interface fire situations. During the 2014 summer beginning in June, the Interface Task Force system was activated on a weekly basis. These task forces are regularly utilized several times per year both in the tri---county area and in other portions of the state. Central Oregon Interagency Dispatch Center (COIDC) fielded 900 incidents between ODF, USFS & BLM; the COFMS district hosted 17 IMTs (the average is 2 or 3 IMTS).

The effectiveness of these systems continues to work well because of annual coordination and update processes and the strong interagency working relationships between all of the jurisdictional and supporting organizations. The Bridge Creek and Cold Springs/Tollgate fires in the late 1970's initiated the refinement of the wildland---preplanned system, coordination with structural resources and a culture of progressive coordination. The system undergoes annual evaluation and revision through the Central Oregon Fire Chiefs Association.

Multi-Agency Incident Coordination

In the mid 1980s, central Oregon fire agencies routinely held table---top and scaled field exercises or "disaster drills." Initially, these drills addressed wildland interface fires. Later, "all---risk" hazards including flood, loss of transportation routes, petroleum spills, etc., were merged into the drills. These drills helped identify components of the response process that were most subject to breakdown. These components were re---engineered and integrated into the preplanned response system. The drills have become important to the ongoing development of a more integrated, interagency initial and reinforced response system, particularly for wildland urban interface fires.

The local Multi---Agency Coordination (MAC) system was created following the 1990 Awbrey Hall wildland fire. MAC, a formalized process for priority setting and coordination among jurisdictional agencies, was initially established in the City of Bend Public Works building. This facility was used for both periodic exercises and for a variety of incidents. In mid 1995 MAC was moved to the Deschutes County Sheriff Office, a new facility with accommodations that include a large conference/training area. Multi---agency coordination training and drills are now held in that facility for a wide variety of agency personnel.

Reinforced Incident Response Capacity

Central Oregon has a unique capacity to quickly provide expanded staffing to larger scale fire incidents. The US Forest Service, Bureau of Land Management and the Oregon Department of Forestry have a large pool of personnel trained and certified to meet the requirements of all management positions within the Incident Command System. Formerly, the Central Oregon Interagency Type 2 Incident Management Team was organized in the late 1970's. Its purpose was to provide a local team of personnel to manage developing interface fire incidents until further assistance could be mobilized to the area. At the time, Oregon Department of Forestry or federal incident management teams (IMT) would require six to ten hours to mobilize and travel to central Oregon. Because of the Interagency Management Team in central Oregon a significant level of experience and capacity has been developed.

Central Oregon fire managers recognized the probability of the Type 2 Central Oregon IMT not having the capacity to function as originally intended and it was disbanded. This is a result of the following:

1. With a high number of current large wildland fire incidents that occur nationally and regionally, high demand exists for both federal and state IMT services. They have been heavily mobilized to incidents throughout the western U.S. for a significant period each year and the Central Oregon Type 2 IMT may not be available.
2. Demand increases due to intensified fire behavior resulting from weather conditions and hazardous fuels build---up.

The current Oregon interagency IMT dispatching system has identified four Type 2 IMTs with personnel scheduled on a one week on and three weeks off rotation as a stopgap measure.

Opportunity exists to leverage ICS trained personnel for incidents other than wildland fire. The National Association of State Foresters (NASF) published "Fire and Ice: The Roles of State and Federal Forestry Agencies in Disaster Management and Response" in 1999.[82] In cooperation with FEMA and USDA Forest Service the report focused on the value of Incident Command System (ICS) trained wildland fire management personnel in support of multijurisdictional incident response. With current budgets, fiscal limitations exist when using wildland fire agency personnel in support of all---risk incidents.

A formal Central Oregon Cooperative Wildland Fire Agreement exists among wildland and structural fire agencies. While wildland fire agencies are funded to address wildland fire issues there are statutory and agency---specific limitations to expending dedicated fire fighting funds for "all risk" incidents. During a Declaration of Emergency, wildland fire agencies can be partially reimbursed through the federal response framework.

Central Oregon Fire Chiefs Association

The Central Oregon Fire Chiefs Association (COFCA) provides a formal forum for fire chiefs in Crook, Deschutes, Bureau of Indian Affairs (BIA), and Jefferson counties to integrate any refinements to the interface fire response system for their individual structural and wildland agencies. COFCA also provides the leadership umbrella for a variety of local interagency prevention, investigation and training groups.

Wildland Fire Prevention

Central Oregon wildland and structural fire services have a long tradition of effective organization---specific and cooperative programs. In dry, fire---prone regions such as central Oregon, fire prevention programs address two facets of preventing destructive wildfires: 1) ignition prevention, and 2) large, catastrophic fire prevention.

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[82] "Fire and Ice: The Roles of State and Federal Forestry Agencies in Disaster Management and Response." National Association of

State Foresters in cooperation with FEMA and the USDA Forest Service, September, 1999.

An example of a cooperative ignition prevention effort is the Central Oregon Fire Prevention Cooperative (COFPC). This effort was organized in 1978 to provide a forum for coordination of common fire prevention needs between the state and federal wildland fire agencies and structural fire service agencies in Crook, Deschutes, Bureau of Indian Affairs (BIA) and Jefferson counties. COFPC provides a mechanism to maximize effective use of staffing and fiscal resources from all of the cooperating agencies. Its purpose is to conduct a wide variety of ignition prevention, youth education, public service and public education initiatives. COFPC remains active today and has received state, regional and national recognition for its efforts.

The second category includes activities intended to mitigate the impact of large fires. Examples focus on broad hazardous fuels treatment strategies to keep fires at more manageable levels and the development of defensible space around individual homes. There are a variety of local programs currently active and several more in the developmental stage throughout the county.

Project Wildfire is a successful example of a collaborative approach to large wildland fire mitigation. A national leader and model for wildland fire mitigation; Project Wildfire takes advantage of public and private partnerships and collective resources to prevent deaths, injuries, property loss and environmental damage from wildland fire.

In the years since the 2005 Natural Hazard Mitigation Plan, Project Wildfire has become the facilitator and "caretaker" of seven Community Wildfire Protection Plans and the coordinator of the FireFree Program. Project Wildfire succeeds where an individual or one agency cannot. Project Wildfire is also committed to developing wildland fire prevention and education strategies and implementing hazardous fuels reduction programs across the County.

Community Wildfire Protection Plans

Through the CWPP process, the overwhelmingly clear answer to the wildland fire mitigation question is to reduce the potential for extreme fire behavior by reducing the amount of hazardous fuels in high risk areas on both public and private lands. Since the inception of CWPPs, Deschutes County has secured approximately $6 million in funding under the National Fire Plan, Western States and FEMA grant programs to educate communities and treat hazardous fuels in and around communities at risk.

The wildland fire mitigation efforts in Deschutes County span a variety of agencies and groups. The County has facilitated treatment on over 2,000 acres of hazardous vegetation on private lands each year since 2005. While this number does not sound significant on the surface, it is rather formidable when one considers that these fuels treatments were achieved on private properties ¼ to ½ acres at a time. Since Project Wildfire's establishment in 1999, over 110,000 acres have been treated within and around communities. Complimentary Federal Land projects more than double this figure.

The CWPPs identified priority Communities at Risk and the US Forest Service has responded by treating national forest land in the WUIs since 2005.

These successful projects however are also due in part to the level of collaboration experienced in Deschutes County. As stated earlier, Project Wildfire and the CWPP Committees and other groups such as the Nature Conservancy's Fire Learning Network and Central Oregon Intergovernmental Council routinely engage community members from all areas concerned about wildland fire. This includes representatives from the timber industry as well as

environmental groups. It is not uncommon to see Timber Industry Consultants at the same planning table as Sierra Club members. This collaborative approach to fuels management on public lands includes all interested parties from the beginning. The results we continue to see in central Oregon are broadly accepted fuels treatment projects that proceed without litigation and protest.

Deschutes County is also home to one of the first ten funded Collaborative Forest Landscape Restoration projects, which is restoring the federal forest to a more resilient condition while improving the fuel conditions in the WUI. Called the Deschutes Collaborative Forest Project (DCFP).

Emergency Operations Plans

The county, and cities, have Emergency Operations Plans (EOP). The EOPs describe how the jurisdictions will organize and respond to emergencies and disasters. The plan includes specific information related to wildfires.

Rangeland Fire Protection Associations

Rangeland Fire Protection Associations (RFPAs) provide wildfire protection of private land within Deschutes County. RFPAs (formed under ORS 477.315) protect over 3.2 million acres of private land in eastern Oregon with support from the Oregon Department of Forestry (ODF). RFPAs operate as independent associations of landowners that provide their own protection with the support of the ODF (chiefly technical support for grants, grant writing, procurement of equipment and fire fighting training)[83]. The ODF provides a small source of funding for the RFPAs, however, the majority of funds come from federal grants (primarily Volunteer Fire Assistance and Rural Fire Assistance). Additional fees are collected from voluntary membership dues. The RFPA has a responsibility to protect private lands of members and non---members alike per the agreement formed with ODF when the RFPA is formed.

The following two RFPAs are active within Deschutes County:

- Brothers/ Hampton RFPA (established 2006)
- Post Paulina RFPA (established 2006)

State

In part because of Deschutes County's 1990 Awbrey Hall Fire, the 1993 State Legislature initiated a process to identify wildfire hazard and declare wildfire hazard zones. The legislation provided a mechanism for counties to supersede local provisions requiring the use of flammable roofing materials such as wood shake. A second provision requires that addresses of structures be clearly identified. This process is complete in Deschutes County with the implementation of provisions in the Deschutes County Building Code. This is of particular significance because a combustible roof is the most vulnerable structure component to ember attack in interface wildfire situations. By Deschutes County Ordinance, installation of combustible roofing materials is no longer allowed on new structures or replacement roof systems.

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[83] Foster, Gordon. Oregon Department of Forestry. "Status of Rangeland Fire Protection Associations". 2011. http://www.oregon.gov/odf/fire/fpfc/rfawhite.pdf. Accessed March 2013.

The Oregon Forestland-Urban Interface Fire Protection Act of 1997 (Senate Bill 360)

Administered by the Oregon Department of Forestry (ODF), Senate Bill 360 enlists the aid of property owners toward the goal of turning wildland urban interface properties into less volatile zones where homes can survive and firefighters may more safely and effectively defend them against wildland fire. Senate Bill 360 applies only to interface areas on private land within the boundary of an Oregon State Department of Forestry District.

The law requires property owners in identified areas to reduce excess vegetation around structures and along driveways. In some cases, depending on the rating classification of the property, it is also necessary to create additional fuel breaks along property lines and roadsides.

The process of identifying wildland urban interface areas follows steps and definitions described in Oregon Administrative Rules. Briefly, the identification criteria include:

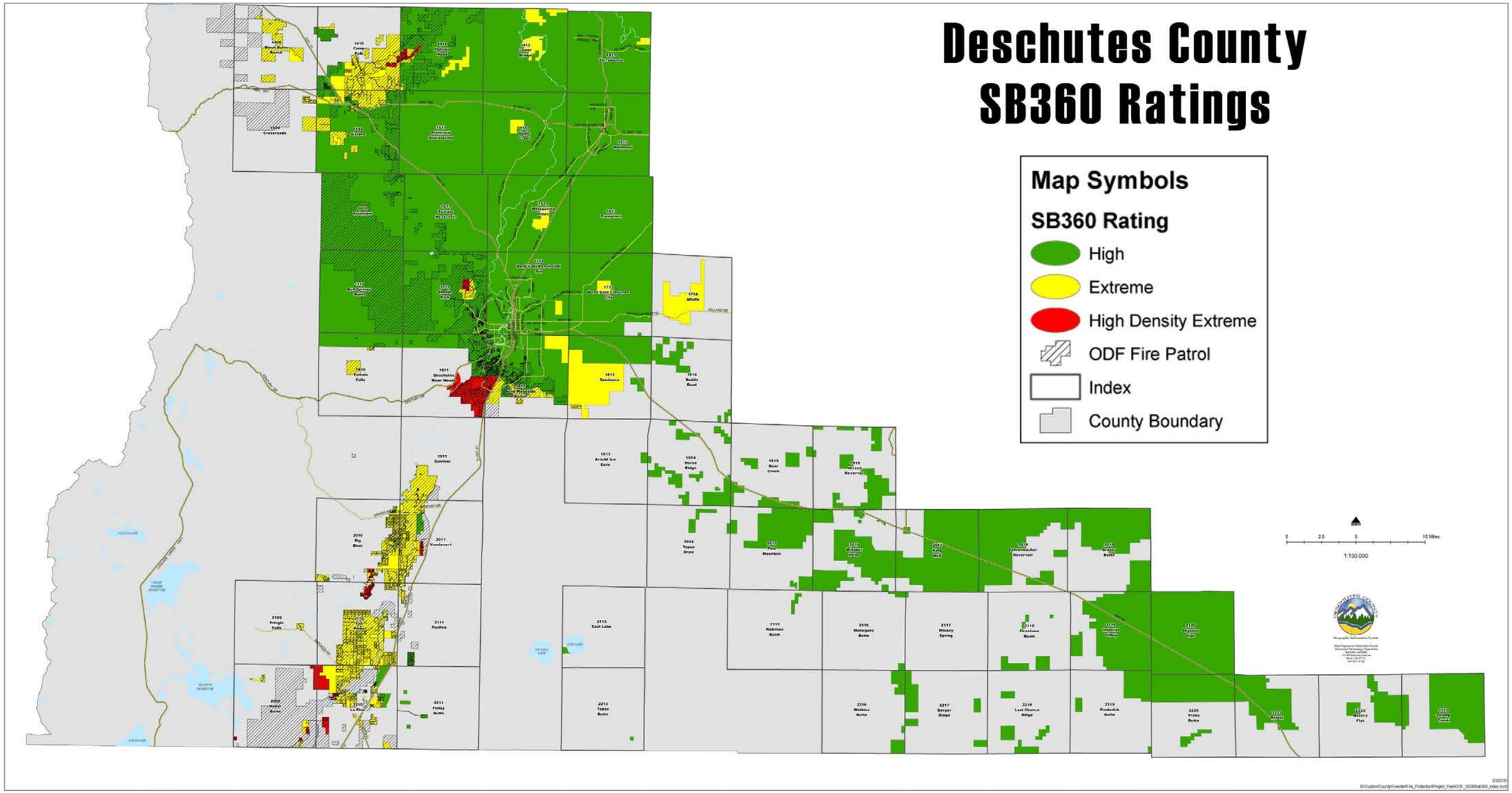
- Lands within the county that are also inside an Oregon Department of Forestry protection district.
- Lands that meet the state's definition of "forestland."
- Lands that meet the definition of "suburban" or "urban"; in some cases, "rural" lands may be included within a wildland urban interface area for the purpose of maintaining meaningful, contiguous boundaries.
- Lots that are developed, 10 acres in size or smaller, and which are grouped with other lots with similar characteristics in a minimum density of four structures per 40 acres.

A classification committee identified wildland urban interface areas in each county where Senate Bill 360 is applied. Once areas are identified, a committee applies fire risk classifications to the areas. The classifications range from "low" to "high density extreme," and the classification is used by a property owner to determine the size of a fuel break that needs to be established around a structure. The classification committee reconvenes every five years to review and recommend any changes to the classifications.

The Oregon Department of Forestry is the agency steward of this program. It supplies information about the act's fuel reduction standards to property owners. ODF also mails each of these property owners a certification card, which may be signed and returned to ODF after the fuel reduction standards have been met. Certification relieves a property owner from the act's fire cost recovery liability. This takes effect on properties that are within a wildland urban interface area and for which a certification card has not been received by the Department of Forestry. In these situations, the state of Oregon may seek to recover certain fire suppression costs from a property owner if a fire originates on the owner's property, the fuel reduction standards have not been met, and ODF incurs extraordinary suppression costs. The cost---recovery liability under the Oregon Forestland--- Urban Interface Fire Protection Act is capped at $100,000.

In Deschutes County, Senate Bill 360 Ratings fall into High, Extreme and High---Density Extreme categories (see Figure II---22 below). The provisions of Senate Bill 360 also contain Optional Standards to accommodate a variety of circumstances and landowner preferences. Additional fuel breaks along property lines and roadsides are required for those properties that fall under the Extreme and High Density Extreme ratings.

Figure II-22 Deschutes County SB 360 Ratings



Source: Deschutes County Forester, 2015

Each of the Community Wildfire Protection Plans incorporates Senate Bill 360 ratings where appropriate to provide additional risk assessment information. It also incorporates the Senate Bill 360 standards when listing recommendations for defensible space and fuel breaks on private property:

- A minimum 30---foot primary fuel break around structures for properties rated High. Up to an additional 70 feet of fuel breaks are required depending on rating and roof composition. A fuel break consists of: Removal of dead/dry/flammable brush around home, roof, chimney, decks and under nearby trees; removal of low hanging branches on trees; and reposition of wood piles at least 20 feet away from home during fire season.
- A minimum fuel break of 12 feet wide and 13.5 feet tall along driveways are also required if they are over 150 feet long.

Federal

In 2002, President George Bush established the Healthy Forests Initiative (HFI) to improve regulatory processes to ensure more timely decisions, greater efficiency and better results in reducing the risk of high intensity wildfire. This initiative allowed forest management agencies for the first time, to expedite the environmental compliance process for the purpose of reducing hazardous fuels on public lands.

In 2003, the US Congress passed historical bi---partisan legislation: the Healthy Forests Restoration Act (HFRA). This legislation expands the initial effort under the Healthy Forests Initiative and directs federal agencies to collaborate with communities in developing a Community Wildfire Protection Plan (CWPP), which includes the identification and prioritization of areas needing hazardous fuels treatment. It further provides authorities to expedite the National Environmental Policy Act (NEPA) process for fuels reduction projects on federal lands. The act also requires that 50% of funding allocated to fuels projects be used in the wildland urban interface.[84]

At the time of compiling data, resources and information for the 2005 Natural Hazard Mitigation Plan, HFRA was new on the scene and the complete impact of its legislative reach was unknown.

As a result of the authorities under HFRA, communities in Deschutes County now have the opportunity to participate in advising where federal agencies place their fuels reduction efforts. With a Community Wildfire Protection Plan in place, community groups can apply for federal grants to treat hazardous fuels and address special concerns to reduce the risk of catastrophic loss as a result of wildland fire.

Although some of the authorities under the Healthy Forests Initiative have been subsequently challenged in federal courts, all have been successfully appealed and the original intent and authorities under each remain the same.

As the Deschutes County CWPPs are revised, the plans now include specific language regarding the National Cohesive Fire Management Strategy. In 2009, Congress passed the Federal Land

[84] "Healthy Forests Restoration Act of 2003" (H.R. 1904); One Hundred Eighth Congress; Administrative implementation information available at www.fireplan.gov.

Assistance, Management, and Enhancement (FLAME) Act and called for a National Cohesive Wildland Fire Management Strategy to address wildland fire related issues across the nation in a collaborative, cohesive manner. The Cohesive Strategy was finalized in 2014 and represents the evolution of national fire policy:

"*To safely and effectively extinguish fire, when needed; use fire where allowable; manage our natural resources; and as a Nation, live with wildland fire.*"

The primary, national goals identified as necessary to achieving the vision are:

Resilient landscapes: Landscapes across all jurisdictions are resilient to fire---related disturbances in accordance with management objectives.

Fire---adapted communities: Human populations and infrastructure can withstand a wildfire without loss of life and property.

Wildfire response: All jurisdictions participate in making and implementing safe, effective, efficient risk---based wildfire management decisions.

Hazard Mitigation Action Items

There are three identified wildfire action items for Deschutes County; in addition, several of the Multi---Hazard action items affect the wildfire hazard. An action item matrix is provided within Volume I, Section 3, while action item forms are provided within Volume IV, Appendix A. To view city actions see the appropriate city addendum within Volume III.

Significant Changes Since the 2010 Plan

The Windstorm hazard was not assessed in the 2010 Plan, therefore, this section provides new content to the Deschutes County NHMP.

Causes and Characteristics of the Hazard

Extreme winds occur throughout Oregon. The most persistent high winds take place along the Oregon Coast and in the Columbia River Gorge. High winds in the Columbia Gorge are well documented. The Gorge is the most significant east---west gap in the Cascade Mountains between California and Canada. Wind conditions in central Oregon are not as dramatic as those along the coast or in the Gorge yet can cause dust storms or be associated with severe winter conditions such as blizzards. A majority of the destructive surface winds striking Oregon are from the southwest. Some winds blow from the east but most often do not carry the same destructive force as those from the Pacific Ocean.

A windstorm is generally a short duration event involving straight---line winds and/or gusts in excess of 50 mph. Although windstorms can affect the entirety of Deschutes 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 tons of storm related debris.

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

History of Windstorms in Deschutes County

The Columbus Day storm in 1962 was the most destructive windstorm ever recorded in Oregon in terms of both loss of life and property. Damage from this event was the greatest in the Willamette Valley, where the storm killed 38 people and left over $200 million in damage. Windstorms occur yearly; more destructive storms occur once or twice per decade. The following table shows windstorms that have affected Deschutes County between 1951 and 2007. Since 2007 there have been 27 additional windstorm events that included wind speeds between:35 and 80 mph (many of these wind events are accompanied by heavy rains and/ or thunderstorms).[85]

[85] NOAA Storm Events Database, http://www.ncdc.noaa.gov/stormevents/

Table II-13 Partial History of Significant Windstorms (1951 to 2007)

Date	Affected Area	Comments
Nov., 1951	Statewide	Widespread damage, transmission and utility lines, wind speeds 40=60 mph, gust 75=80 mph
Dec., 1951	Statewide	Wind Speed up to 60 mph in Willamette Valley, 75 mph gusts; damage to building and utility lines.
Dec., 1955	Statewide	Wind speeds 55=65mph, with 69 mph gusts. Considerable damage to buildings and utility lines.
Nov., 1958	Statewide	Wind speeds up to 51 mph, with 71 mph gusts. Major highways blocked by fallen trees.
Oct., 1962	Almost all of Oregon	Oregon's most famous and most destructive windstorm, the Columbus Day Storm, produced a barometric pressure low of 960 mb
Mar., 1971	Most of Oregon	Storm center moved into NW Washington, bringing cold front heading east and damaging winds on March 26.
Nov., 1981	Pacific Northwest	Back=to=back storms on the 13th and 15th of November
Jan., 1990	Statewide	Severe windstorm
Dec., 1991	NE and Central Oregon	Severe windstorm
Dec., 1995	Statewide	Strongest windstorm since Nov. 1981; barometric pressure of 966.1 mb at Astoria, and an Oregon record low 953 mb off the coast; major disaster declaration FEMA=1107=DR=OR
Apr., 2003	Deschutes County	$10,000 in property damage
Nov., 2003	Deschutes County	$2,000 in property damage
Oct., 2005	Central Oregon	A strong wind gust blew a Ponderosa Pine tree over onto a home in southeast Bend. The property damage from this event is estimated at $50,000
Nov., 2005	Central Oregon	A strong wind gust blew over a Ponderosa Pine Tree which fell on two mobile homes causing extensive damage at Sisters Mobile Home Park. The property damage from this event is estimated at $40,000.
Jun., 2006	Jefferson, Deschutes, Crook Counties	Strong winds and hail caused $7 million in insurance claims for damage to automobiles and homes
Oct., 2007	Central Oregon	A cold front brought strong winds with gusts 40=50 mph which knocked down trees and power lines in Sisters. One tree fell onto a house.

Sources: Oregon State Natural Hazard Mitigation Plan DRAFT 2015, Taylor, G.H. and Hatton, R.R., 1999, The Oregon Weather Book, A State of Extremes: Corvallis, Oregon, Oregon State University Press, NOAA Storm Events Database

Hazard Identification

A windstorm is generally a short duration event involving straight---line winds and/or gusts in excess of 50 mph. Windstorms can affect developed areas of the county with significant tree stands and major infrastructure, especially above ground utility lines. The lower wind speeds typical of eastern Deschutes County can still be high enough to knock down trees and power lines, and cause other property damage.

As of the 2014 Oregon Residential Specialty Code, Oregon Basic Wind Speeds for 50 Year Mean Recurrence Interval, Deschutes County is listed within the lowest wind speed category as an area impacted by 85 mph area wind speeds.

For winter weather events (including high winds,) the National Weather Service monitors gauging stations and provides public warnings for storms and high winds.

Windstorms in Deschutes County usually occur from October to March, and their extent is determined by their track, intensity (the air pressure gradient they generate), and local terrain.[86] The National Weather Service uses weather forecast models to predict oncoming windstorms, while monitoring storms with weather stations in protected valley locations throughout Oregon.[87]

Extreme weather events are experienced in all regions of Oregon. The regions that experience the highest wind speeds are in the Central and North Coast of Region 1. The table below shows the wind speed probability intervals that structures 33 feet above the ground would expect to be exposed to within a 25, 50 and 100 year period. The table shows that structures in Deschutes County, within Region 6, can expect to be exposed to lower wind speeds than most regions within the state.

Table II-14 Probability of Severe Wind Events by NHMP Region

	25#Year Event (4% annual probability)	50#Year Event (2% annual probability)	100#Year Event (1% annual probability)
Region 1: Oregon Coast	75 mph	80 mph	90 mph
Region 2: North Willamette Valley	65 mph	72 mph	80 mph
Region 3: Mid/Southern Willamette Valley	60 mph	68 mph	75 mph
Region 4: Southwest Oregon	60 mph	70 mph	80 mph
Region 5: Mid-Columbia	75 mph	80 mph	90 mph
Region 6: Central Oregon	60 mph	65 mph	75 mph
Region 7: Northeast Oregon	70 mph	80 mph	90 mph
Region 8: Southeast Oregon	55 mph	65 mph	75 mph

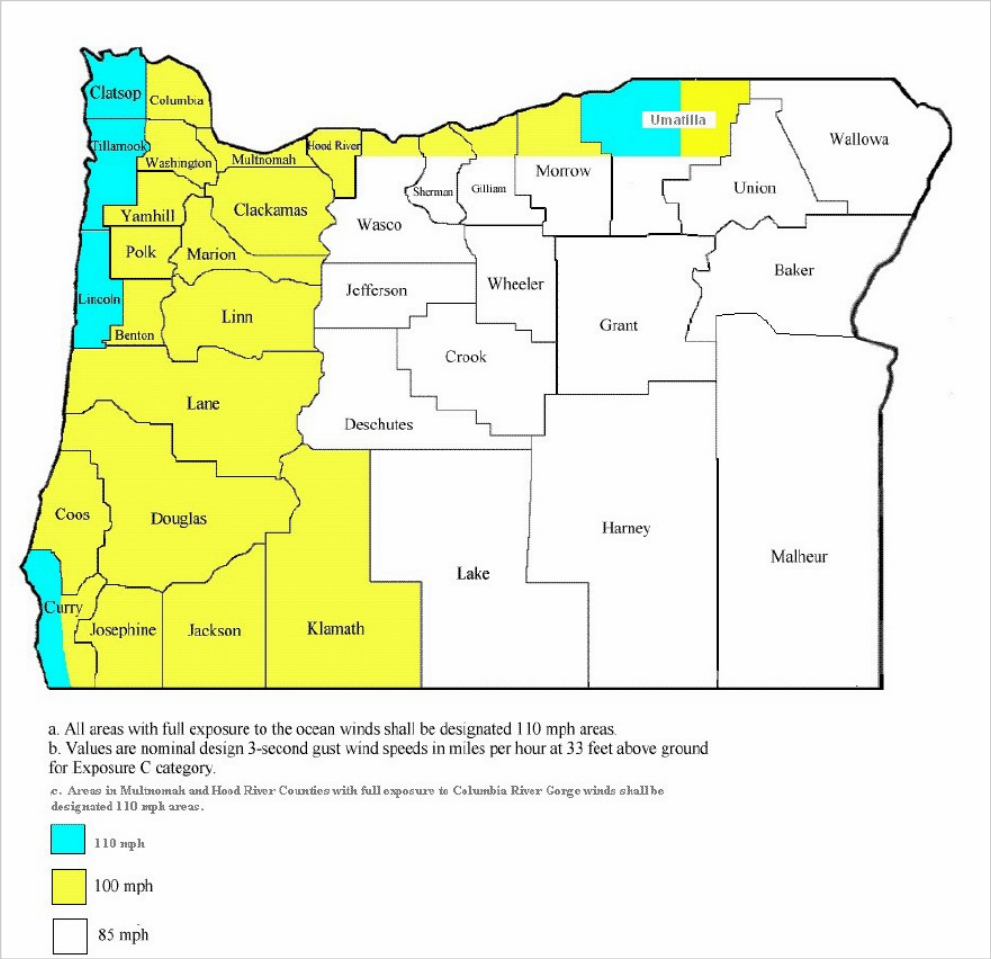
Source: Oregon State Natural Hazard Mitigation Plan, 2009

Figure II---23 visualizes the maximum wind speed that structures 33 feet above the ground would expect to be exposed to; for Deschutes County that expected wind speed is less than most of the state at 85 mph.

[86] State of Oregon Natural Hazards Mitigation Plan. Oregonshowcase.org, March 2006. http://www.oregonshowcase.org/downloads/pdf/stateplan/OR---SNHMP_wind_chapter_2009.pdf

[87] "Some of the Area's Windstorms." National Weather Service, Portland. http://www.wrh.noaa.gov/pqr/paststorms/wind.php

Figure II-23 Oregon Building Codes Wind Speed Map



Source: Oregon Residential Specialty Code, 2014..

Probability Assessment

Windstorms affect Deschutes County on nearly a yearly basis. More destructive storms occur once or twice per decade. According to the State NHMP Region 6 – Central Oregon where Deschutes County is located is likely to experience windstorms of 60 mph during a 25---year cycle. It should be noted that some of the report incidents are localized events that do not affect large areas of the county or cities.

Deschutes County's Natural Hazards Mitigation Steering Committee believes that the County's **probability of experiencing a windstorm event is "high,"** meaning one incident is likely within the next 10 – 35 year period. Based upon available information the Oregon NHMPs Regional Risk Assessment supports this probability rating for Deschutes County.[88]

[88] *2015 Oregon Natural Hazard Mitigation Plan DRAFT*. Department of Land Conservation and Development, 2015.

Vulnerability Assessment

Many buildings, utilities, and transportation systems within Deschutes County are vulnerable to wind damage. This is especially true in open areas, such as natural grasslands or farmlands. It is also 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 are especially troublesome. They can block roads and rails for long periods of time, impacting emergency operations. In addition, up---rooted or shattered trees can down power and/or utility lines and effectively bring local economic activity and other essential facilities to a standstill. Much of the problem may be attributed to a shallow or weakened root system in saturated ground. In Deschutes County, trees are more likely to blow over during the winter (wet season). Also, irrigation wheel lines frequently get tangled in windstorms, and ultimately affect the agriculture economy.

The Deschutes County Natural Hazards Steering Committee rated Deschutes County as having a **"moderate" vulnerability to windstorm hazards**; meaning between one and ten---percent of the region's population or assets would be affected by a major emergency or disaster (particularly if utility lines are damaged). Based upon available information the Oregon NHMPs Regional Risk Assessment supports this vulnerability rating for Deschutes County.[89]

Risk Analysis

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. Table 2---6 of the Risk Assessment (Volume I) shows the county's Hazard Analysis Matrix which scores each hazard and provides the jurisdiction with a sense of hazard priorities, but does not predict the occurrence of a particular hazard. Based on the matrix the **windstorm hazard is rated #4, out of 9 rated hazards, with a total score of 179**.

Community Hazard Issues

The damaging effects of windstorms may extend for distances of 100 to 300 miles from the center of storm activity. Positive wind pressure is a direct and frontal assault on a structure, pushing walls, doors, and windows inward.

Negative pressure also affects the sides and roof: passing currents create lift and suction forces that act to pull building components and surfaces outward. The effects of winds are magnified in the upper levels of multi---story structures. As positive and negative forces impact and remove the building protective envelope (doors, windows, and walls), internal pressures rise and result in roof or leeward building component failures and considerable structural damage.

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[89] Ibid.

Windstorms can result in collapsed or damaged buildings, damaged or blocked roads and bridges, damaged traffic signals, streetlights, and parks, among others. Roads blocked by fallen trees during a windstorm may have severe consequences to people who need access to emergency services. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted.

Historically, falling trees have been the major cause of power outages in Deschutes County. Overhead power lines can be damaged even in relatively minor windstorm events.

Industry and commerce can suffer losses from interruptions in electric service and from extended road closures. They can also sustain direct losses to buildings, personnel, and other vital equipment. There are direct consequences to the local economy resulting from windstorms related to both physical damages and interrupted services.

Windstorms can be particularly damaging to manufactured homes and other non---permanent housing structures, which, in 2012, accounted for 9.1% of the housing units in Deschutes County, special attention should be given to securing these types of structures.

More information on this hazard can be found in the Regional Risk Assessment for Region 6 of the Oregon NHMP.

Existing Authorities, Policies, Programs, and Resources

Existing authorities, policies, programs, and resources include current mitigation programs and activities that are being implemented by city, county, regional, state or federal agencies and/or organizations.

County and Cities

The county, cities, and utility districts routinely maintain hazard trees to keep utility lines and other infrastructure safe from damage in wind events.

State

The Oregon Building Code (both residential and other codes) sets standards for structures to withstand 80 mph winds. It is based on the International Residential Code and the International Building code.

Existing strategies and programs at the state level are usually performed by Public Utility Commission (OPUC), Building Code Division (BCD), Oregon Department of Forestry (ODF), Oregon Emergency Management (OEM), Oregon Department of Transportation (ODOT), and the Oregon Emergency Response System (OERS), who all have vital roles in providing windstorm warnings statewide.

The Public Utility Commission ensures the operators manage, construct and maintain their utility lines and equipment in a safe a reliable manner. These standards are listed on the following website: http://www.puc.state.or.us/PUC/safety/index.shtml

The OPUC promotes public education and requires utilities to maintain adequate tree and vegetation clearances from high voltage utility lines and equipment.

Oregon Emergency Management strives to reduce any damage and impacts caused by windstorms by working in partnership with PUC, ODOT. ODF promotes mitigation strategies and programs that reduce tree---caused damage to utility systems and highway corridors.

Federal

FEMA has recommended having a safe room in homes or small businesses to prevent residents and workers from "dangerous forces" of extreme winds to avoid injury or death. This recommendation is provided through FEMA's resource manual: Taking Shelter From the Storm[90].

Hazard Mitigation Action Items

There are no identified windstorm action items for Deschutes County; however, several of the Multi---Hazard action items affect the windstorm hazard. An action item matrix is provided within Volume I, Section 3, while action item forms are provided within Volume IV, Appendix A. To view city actions see the appropriate city addendum within Volume III.

[90] http://www.fema.gov/safe---room---resources/fema---p---320---taking---shelter---storm---building---safe---room---your---home---or---small---business

Significant Changes Since the 2010 Plan

There are no significant changes in the potential for winter storms to occur in Deschutes County since 2010; therefore, there are no significant changes in this section from the 2010 Plan. However, the format of the section and minor content changes has occurred.

Causes and Characteristics of Winter Storms

The National Climatic Data Center has established climate zones in the United States for areas that have similar temperature and precipitation characteristics. Oregon's latitude, topography, and proximity to the Pacific Ocean give the state diversified climates. Deschutes County is primarily located within Zone 7: South Central Area, south and western portions of the county are located within Zone 5: High Plateau. The climate in Zone 7 generally consists of wet winters and dry summers.[91] These wet winters result in potentially destructive winter storms that produce heavy snow, ice, rain and freezing rain, and high winds. Severe storms affecting Oregon with snow and ice typically originate in the Gulf of Alaska or in the central Pacific Ocean. Winter storms occur over eastern Oregon regularly during November through February.[92] Cold arctic air sinks south along the Columbia River basin, filling the valleys with cold air.[93]

Figure II-24 Oregon Climate Divisions

Source: Oregon Climate Service,

[91] Oregon Climate Service, "Climate of Deschutes County,"

[92] Oregon State Natural Hazards Mitigation Plan "Winter Storms Chapter", 2012

[93] Ibid

The principal types of winter storms that occur in Deschutes County include:

Snow Storm

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

Ice Storms

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

Extreme Cold

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

History of Winter Storms in Deschutes County

Destructive storms producing heavy snow, ice and cold temperatures occurred throughout the County's history, most notably in 1916, 1920, 1937, 1950, 1985, 1986, 1988, 1990, 1992---93 and the winter of 1998---99. Records indicate storms occurring between 1916 and 1937 were marked by heavy snow drifts and cold temperatures. Records also indicate people and communities were generally prepared and equipped to cope with the extreme weather conditions.

The severe winter storm of 1950 impacted the entire state of Oregon. While many places experienced high winds, cold weather and snow, the impact in Deschutes County was high snow fall and drifts. Transportation of supplies imported to the Deschutes Basin was limited. In general, Deschutes County and the region are well prepared for severe winter storms thus reducing the impact of inclement weather.[94]

In recent years, the challenge facing the region is the significant increase in population and growth in tourism as a local industry. Both of these shifts have generally brought new population to the area, particularly with little or no experience with living and working in severe winter weather. This condition impacts shelter, access to medical services, transportation, utilities, fuel sources and telecommunication systems. In severe winter storm conditions, travelers must seek accommodations, sometimes in communities where lodging is limited or overextended. A significant amount of supplies including food and fuel are transported into the Deschutes Basin and in severe winter conditions, these necessities are often limited when road conditions are unfavorable. Likewise, unfavorable road conditions make emergency response operations more difficult to a more fragile population.

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[94] Taylor, George H. and Hannan, Chris, The Oregon Weather Book, (1999) Oregon State University Press.

Recent shifts in climate patterns beginning in the 1960's has resulted in snowfall and cold weather shifts. While there have been record snowfalls, they are less frequent. The number of severe cold days has been fewer and less frequent. Fluctuating temperatures within storm events also creates the likelihood of ice dams.

Hazard Identification

Winter storms occur in all parts of the county. The extent depends upon air temperatures, the level of moisture in the atmosphere, and elevation.

A severe winter storm is generally a prolonged event involving snow and cold temperatures. The characteristics of severe winter storms are determined by the amount and extent of snow, air temperature, and event duration. Severe storms have various impacts in different parts of the county. There may be a 20 degree temperature difference from Terrebonne in the north part of the county and La Pine in the south part of the county. The National Weather Service Pendleton office monitors the stations and provides public warnings on storm, snow and cold temperature events as appropriate.

Probability Assessment

The recurrence interval for severe winter storms throughout Oregon is about every 13 years; however, there can be many localized storms between these periods. Winter storms do occur in eastern Oregon regularly from November through February. Deschutes County experiences winter storms a couple times every year, to every other year.

Deschutes County's Natural Hazards Mitigation Steering Committee believes that the County's **probability of experiencing a winter storm event is "high,"** meaning one incident is likely within the next 10 – 35 year period. Based upon available information the Oregon NHMPs Regional Risk Assessment supports this probability rating for Deschutes County.[95]

Vulnerability Assessment

Perhaps the most advantageous aspect of Central Oregon's cold and snowy winters is the fact that the region is typically prepared, and those visiting the region usually come prepared. As can be expected, however, there are occasions when preparation cannot meet the challenge. In Deschutes County, extreme cold and heavy snow can disrupt farming practices. Likewise, schools have trouble heating their buildings. The constant freezing and melting of snow around manholes often lead to potholes, and power outages can be frequent in adverse weather. Finally, extreme cold can cause breaks in water pipelines when temperatures drop below 10 F. Specific estimates of property and infrastructural damages for winter storm events are not available at this time.

The Deschutes County Natural Hazards Steering Committee rated Deschutes County **as having a "high" vulnerability to winter storm hazards**; meaning that more than 10---percent of the region's population or assets would be affected by a major emergency or disaster. Based upon

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[95] *2015 Oregon Natural Hazard Mitigation Plan DRAFT*. Department of Land Conservation and Development, 2015.

available information the Oregon NHMPs Regional Risk Assessment supports this vulnerability rating for Deschutes County.[96]

Risk Analysis

The risk analysis involves estimating the damage, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment (assessed in the previous section), and (2) the likelihood or probability of the harm occurring. Table 2---6 of the Risk Assessment (Volume I) shows the county's Hazard Analysis Matrix which scores each hazard and provides the jurisdiction with a sense of hazard priorities, but does not predict the occurrence of a particular hazard. Based on the matrix the **winter storm hazard is rated #1, out of 9 rated hazards, with a total score of 230**.

Community Hazard Issues

Life and Property

Severe winter storms contribute to threats on life and property. Injury and death are often associated with traffic accidents on snow and/or ice covered roads, physical exertion linked to shoveling snow and other activities involved in traveling through snow, and hypothermia from prolonged exposure to the cold. When streets and roads are affected by severe snow and ice, emergency vehicles including police, fire and medical may experience difficulty in reaching targeted destinations.

Roads

County, state, city and many private roads are routinely monitored for snow and ice. Jurisdictions and many private land owners in the rural---urban interface plow snow on a regular basis. Extreme snow fall and ice conditions usually place more demand on local jurisdictions, staff and budgets. Impassible roads hamper emergency response operations.

Power Lines

Extreme cold temperatures have caused power outages that interrupt services and damage property. Many outlying ranches and farms have generators and are generally self--- sufficient in these events. However as the general population becomes more urban, fewer numbers of people have resources such as wood stoves, a traditional back up source for heat. Rising population growth and new infrastructure, particularly tourism related, create higher probability for damage to occur from severe winter storms as more life and property are exposed to risk.

Water Lines

The most frequent water system problems related to extreme cold weather are breaks in water mainlines. Breaks occur during severe cold event impacting residents and business. Inadequate

[96] Ibid.

insulated potable water and fire sprinkler pipes can rupture and cause extensive damage to property. Aligned with the extreme population growth, Deschutes County has a significant number of new residential and commercial structures which have been built under current codes that recognize severe cold weather conditions.

Creek flooding within a single storm event, or between events and fluctuating temperatures may lead to the build up of ice dams in creeks. In the winter of 2003, an ice dam release on Whychus Creek caused ice and debris to build up and recede on the creek as it passed through Sisters. This release caused the creek level to rise to its high water mark, but broke loose before flooding homes.

More information on this hazard can be found in the Regional Risk Assessment for Region 6 of the Oregon NHMP.

Existing Authorities, Policies, Programs, and Resources

Existing authorities, policies, programs, and resources include current mitigation programs and activities that are being implemented by city, county, regional, state or federal agencies and/or organizations.

County and Cities

County and municipal Public Works and Road Departments have plans in place to mitigate and respond to severe winter storms. The plans are updated annually and routinely implemented. Utility companies have existing restoration plans that include routine upgrade and repair, emergency restoration, and public education. Additionally,

schools and employers of large scale businesses and agencies have “snow---day” plans. These schedules routinely plan a minimum of five to eight “snow---days” per year.

State

Studded tires can be used in Oregon from November 1 to April 1. They are defined under Oregon Law as a type of traction tire. Research shows that studded tires are more effective than all-
---weather tires on icy roads, but can be less effective in most other conditions.

Highway maintenance operations are guided by local level of service (LOS) requirements. In general, classifications of highways receive more attention. Routes on the National Highway System network, primary interstate expressways and primary roads, will be cleared more quickly and completely. In Deschutes County, this includes Highway 97 and Highway 26. Critical areas like mountain passes will have snow---chain requirements for vehicles, and many local streets are “snow emergency routes” that will be cleared of parked cars. Parking lot and sidewalk snow removal is mostly the responsibility of property owners, sometimes by local ordinance.

Oregon Department of Transportation (ODOT) spends about $16 million per year on snow and ice removal from the state highway system though winter maintenance practices. These practices include: snow plowing, sanding roadways for ice, and using anti---icing chemicals.

Through the educational collaboration between the Oregon Department of Forestry and the Pacific Northwest Chapter, International Society of Arboriculture (ISA) the *How to Recognize and Prevent Tree Hazards* activity brochure was created.

TripCheck provides traffic incident, weather, and highway condition reports, as well as useful links to bus, rail, airport, and truck information. The website provides road condition images from approximately 140 road cameras, including over 40 in rural areas such as mountain passes where knowing road conditions can be crucial to safety: http://www.TripCheck.com/.

Federal

The National Weather Service issues severe storm watches and warnings when appropriate to alert government agencies and the public of possible or impending weather events. The watches and warnings are broadcast over NOAA weather radio and are forwarded to the local media for retransmission using the Emergency Alert System.

Hazard Mitigation Action Items

There are three identified winter storm action items for Deschutes County; in addition, several of the multi---hazard action items affect the winter storm hazard. An action item matrix is provided within Volume I, Section 3, while action item forms are provided within Volume IV, Appendix A. To view city actions see the appropriate city addendum within Volume III.

Volume III:
Jurisdictional Addenda

Jurisdictional Addenda area provided for the following cities:

- Bend BA---1
- La Pine ..... To be provided
- Redmond RA---1
- Sisters ..... To be provided

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CITY OF BEND ADDENDUM

Introduction

This document serves as the City of Bend's Addendum to the Deschutes County Natural Hazard Mitigation Plan (NHMP). The City's Addendum is considered part of the county's multi---jurisdictional plan, and meets the following requirements: (1) Multi---jurisdictional Plan Adoption §201.6(c)(5), (2) Multi---jurisdictional Participation §201.6(a)(3), (3) Multi---Jurisdictional Risk Assessment §201.6(c)(2) (iii), and (4) Multi---jurisdictional Mitigation Strategy §201.6(c)(3) (iv).

A description of the city specific planning and adoption process follows, along with detailed community specific action items; for detailed information see Volume IV, Appendix B. Information about the city's risk relative to the county's risk to natural hazards is documented in this addendum's Hazard Analysis and Issue Identification section. The section considers how the city's risk differs from or matches that of the county's; additional information on Risk Assessment is provided within Volume I, Section 2 of this NHMP.

How was the Plan Developed?

The NHMP was developed by the Deschutes County Natural Hazard Mitigation Plan steering committee, while this addendum was created by the City of Bend steering committee. The Deschutes County Emergency Manager was designated as the NHMP's convener and will take the lead in implementing, maintaining and updating the plan. Locally, Damian Syrnyk, Bend Senior Planner, convened a local steering committee for the purpose of developing the city's addendum.

The local steering committee was closely involved throughout the development of the plan and served as the local oversight body for the plan's development. The local steering committee met on two separate occasions: January 28th and February 11th, 2015 (see Appendix B for more information). Steering committee members contributed data and maps, reviewed and provided guidance towards the community profile, risk assessment, mitigation strategy (action items), and implementation and maintenance plan. The addendum reflects effort from the formal meetings and during subsequent informal meetings between members of the steering committee and with OPDR.

An open public involvement process is essential to the development of an effective plan. In order to develop a comprehensive approach to reducing the effects of natural disasters, the planning process should include opportunities for the public, neighboring communities, local and regional agencies, as well as, private and non---profit entities to comment on the plan.[1] OPDR provided a publicly accessible project website for the general public to provide feedback on the draft NHMP via a web form. In addition, Deschutes County and the City of

[1] Code of Federal Regulations, Chapter 44. Section 201.6, subsection (b). 2015

Bend provided press releases on their websites to encourage the public to offer feedback on the plan update.

In addition, OPDR administered a public opinion survey to obtain additional input from the public regarding the county's risks, vulnerabilities, hazards history, and mitigation strategies. See Volume IV, Appendix F for more information.

Updating the mitigation plan is a requirement to gain eligibility for the Federal Emergency Management Agency's Pre---Disaster Mitigation, Hazard Mitigation, and Flood Mitigation Assistance grant Programs. This project is funded through the Federal Emergency Management Agency's (FEMA) FY12 Pre---Disaster Mitigation Competitive Grant Program (PDMC – PL---10---OR---2012---002).

The Bend Addendum to the Deschutes County NHMP was adopted on [insert date] and the NHMP was approved by FEMA on [insert date].

For more information on the composition of the steering committee and the process see this NHMP's Volume I, Acknowledgements and Executive Summary, and Volume IV, Appendix B.

Action Item Matrix

The City's action items were developed through a two---stage process during the 2015 NHMP development. In stage one, OPDR facilitated a work session with the steering committee to discuss the city's risk and to identify potential issues. In the second stage, OPDR, working with the local steering committee, developed potential actions based on the hazards and the issues identified by the steering committee. In addition, there are 21 County Action Items that include Bend as an "Affected Jurisdiction". For additional information see the discussion near the end of this document.

The City's actions are listed below in matrix format. For more detailed information on each action, see the action forms within Attachment 1 of this addendum.

Table BA-1 City of Bend Action Items

2015 Action Item	High Priority	Mitigation Action Title	Champion	Partner Organization(s)	Timeline	Status
Multihazard #1		Identify, improve, and sustain collaborative programs focusing on the real estate and insurance industries, public and private sector organizations, and individuals.	Growth Management	Internal: Police Department, Fire Department External:Deschutes County Emergency Services, RFPD #2	LonglTerm	New
MH #2		Develop public and private partnerships to foster natural hazard program coordination and collaboration.	Growth Management	Internal: Police Department, Bend Fire Department External: Deschutes County Emergency Services, RFPD #2	ShortlTerm	New
MH #3	Yes	Develop inventories of atIrisk buildings and infrastructure, and prioritize mitigation projects based on those providing the most benefit (at the least cost) to the population of the City of Bend.	Growth Management	Internal: Public Works, Engineering and Infrastructure, Bend Airport External: Deschutes County Emergency Services; OEM, DOGAMI, FEMA, IFA	LonglTerm	New
MH #4		Strengthen emergency services by maintaining the City of Bend Emergency Operations Plan, linking emergency services with hazard mitigation programs, and enhancing public education.	Growth Management	Internal: Police, Fire, Public Works, City Administration External: Deschutes County Emergency Services; Bend Park and Recreation District	ShortlTerm	New
MH #5		Use technical knowledge of natural ecosystems and events to link natural resource management and land use organizations to mitigation activities and technical assistance.	Growth Management	Internal: I External: Deschutes County Emergency Services, Forester; DOGAMI, WRD, ODF	LonglTerm	New
MH #6		Develop benchmarks for a disasterIresistant and resilient community	Growth Management	Internal: Police Department, Fire Department External: Deschutes County Emergency Services, Community Development	ShortlTerm	New
MH #7		Develop and implement, or enhance, strategies for debris management for natural hazard (winter storm, wind, flood, etc.) events.	Growth Management	Internal: Police, Fire, Public Works Departments External: Deschutes County Emergency Services, RFPD #2, Road Department; ODOT	ShortlTerm	New
Earthquake #1		Seismically retrofit vulnerable facilities and infrastructure to increase their resiliency to seismic hazards. Consider both structural and nonIstructural retrofit options.	Growth Management	Internal: Community Development, Engineering and Infrastructure Planning, Public Works External: Deschutes County Community Development; Bend Metro Park and Recreation District, Bend – LaPine Schools, Deschutes County Library	LonglTerm	New
EQ #2		Improve local capabilities to perform earthquake building safety evaluations and to record and manage building inventory data.	Growth Management	Internal: Community Development, Engineering and Infrastructure Planning External: Deschutes County Community Development, Emergency Services	LonglTerm	New

Source: City of Bend NHMP Steering Committee, 2015

Table BA-1 City of Bend Action Items (continued)

2015 Action Item	High Priority	Mitigation Action Title	Champion	Partner Organization(s)	Timeline	Status
Flood #1		Identify critical public infrastructure and facilities located in flood hazard areas and implement mitigation and preparedness measures for those facilities..	Growth Management	Internal: Public Works, Engineering and Infrastructure Planning External: Deschutes County Community Development, Emergency Services, Road Department; ODOT	LongKTerm	New
FL #2		Identify floodway obstructions and implement mitigation measures to remove obstructions.	Growth Management	Internal: Engineering and Infrastructure Planning External: Deschutes County Community Development, Emergency Services, Roads; DSL, ODFW	LongKTerm	New
FL #3		Develop strategies to enhance the use of open space within the floodplain for flood mitigation, fish habitat, and water quality issues.	Growth Management	Internal: Engineering and Infrastructure Planning, Community Development External: Deschutes County Community Development; Bend Park and Recreation District; DSL, ODFW, DLCD	LongKTerm	New
Volcano #1		Identify critical facilities and industries that may be affected by ash fall and develop and implement ash fall emergency response and mitigation projects.	Growth Management	Internal: Engineering and Infrastructure Planning, Utilities, Streets External: Deschutes County Community Development, Emergency Services	LongKTerm	New
VE #2		Collaborate with the USGS's Cascade Volcano Observatory and related agencies to create ash fall warning messages that are more appropriate for Bend.	Growth Management	Internal: Communications, Police, Fire External: Deschutes County Emergency Services, Communications, 911; USGS, OSUKCascades, OEM	LongKTerm	New
Wildfire #1		Inventory alternative firefighting water sources and encourage the development of additional sources.	Growth Management	Internal: Fire Department, Engineering and Infrastructure Planning External:Deschutes County Forester, Emergency Services, 911; Project Wildfire,	ShortKTerm	New
WF #2		Encourage creation and adoption of wildlandKurban interface maps to direct development requirements that assist wildfire mitigation.	Growth Management	Internal: Fire Department, Community Development, Information Technology (GIS) External: Deschutes County Forester, Community Development, Emergency Services, 911; Project Wildfire	ShortKTerm	New
WF #3		Increase communication, coordination, and collaboration between wildlandK urban interface property owners, city and county planners, and fire prevention crews and officials to address inherent risks in wildlandKurban interface areas, available prevention/ protection measures, and federal mitigation assistance programs.	Growth Management	Internal: Community Development; Fire Department External: Deschutes County Forester, Community Development; RFPD #2, Emergency Services; Project Wildfire	ShortKTerm	New
WF #4		Implement fire mitigation activities in a manner consistent with the goals of promoting sustainable ecological management and community stability.	Growth Management	Internal: Community Development, Engineering and Infrastructure Planning External: Deschutes County Forester, Community Development; Project Wildfire; DLCD, ODFW; USFS, BLM	ShortKTerm	New

Source: City of Bend NHMP Steering Committee, 2015.

How Will the Plan be Implemented?

The City Council will be responsible for adopting the City of Bend addendum to the Deschutes 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 considered part of the county plan, the city will look for opportunities to partner with the County to maintain the plan, and coordinate mitigation efforts through the implementation of action items, etc. The City's steering committee will convene after re---adoption of the City of Bend addendum on the same semi---annual schedule as the county. The City's Senior Planner will serve as the convener and will be responsible for convening the local steering committee. The convener will also remain active in the County's planning process. The steering committee will seek to involve senior staff and decision makers throughout the duration of the five---year implementation and maintenance of the NHMP addendum.

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 Bend 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.

The City of Bend currently has the following plans that relate to natural hazard mitigation:

Table BA-2 Existing Plans

Document	Year
General Plan	1998
Development Code (Flood, Section 10.10.22A.4)	2014
Emergency Operations Plan	2009
Transportation System Plan	2013
Greater Bend CWPP*	2011
Water Pubilc Facility Plan	2013
Sewer Public Facility Plan	2014
Stormwater Public Facility Plan	2014

Source: City of Bend

The steering committee and the community's leadership have the option to add or implement action items at any time. This allows the steering committee to consider mitigation strategies as new opportunities arise, such as funding for action items that may not be of the highest priority. When new actions are identified, they should be documented using an action item form (see Attachment 2). Once a proposed action form has been submitted to the convener, the action will become part of the City's addendum.

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. The City Addendum along with the County Plan will be posted on---line on the University of Oregon's Scholars Bank https://scholarsbank.uoregon.edu/xmlui/handle/1794/1907 so that the public may view the plan at any time.

In addition, natural hazards information dissemination is conducted throughout the year when opportunities present themselves via the city offices and website.

Plan Maintenance

The Deschutes County Natural Hazards Mitigation Plan 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.

The remainder of this addendum includes three sections:

1. Community Profile and Asset Identification,
2. Hazard Identification and Risk Assessment, and
3. Mitigation Strategy section.

COMMUNITY PROFILE
ASSET IDENTIFICATION

This section provides city specific asset identification. For information on the characteristics of Bend, 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.

Asset Identification

The following assets were identified by the steering committee in 2015:

Critical and Essential Facilities

- City Hall – 710 NW Wall Street, Bend, OR 97701
- Public Works:
  - Transportation – 1375 NE Forbes Road, Bend OR 97701
  - Utilities Business Office – 62975 Boyd Acres Road, Bend, OR 97701
  - Water Reclamation Facility – McGrath Road in unincorporated Deschutes County
  - Bridge Creek water intake facility – Skyline Road (unincorporated Deschutes County)
- Police Department and Municipal Court – 555 NE 15th Street
- Fire Department – offices and fire stations in Bend:
  - Administration – 1212 SW Simpson Ave, Bend, OR 97702
  - Station 301 – 1212 SW Simpson Ave, Bend, OR 97702
  - Station 303 – 61080 Country Club Dr, Bend, OR 97702
  - Station 305 – 63377 SW Jamison Street, Bend, OR 97701
- Bend Municipal Airport --- 63136 Powell Butte Road, Bend, OR 97701

Deschutes County Critical and Essential Facilities (located in Bend):

- Administration – 1300 NW Wall St
- Sheriff, Adult Community Justice – 63360 NW Brita St, Building 3
- 9---1---1 Services – 20355 Poe Sholes Drive
- Adult Corrections (Jail) 63333 Highway 20
- Community Development – 117 NW Lafayette Ave
- County Annex, Health Dept. – 1128 NW Harriman St
- Community Justice Center – 63360 NW Britta St, Building 1
- County Courthouse Building – 1164 NW Bond Street
- County Sheriff's Complex – 63333 Highway 20

- Health Services Building – 2577 NE Courtney Drive
- Justice Building – 1100 NW Bond Street
- KIDS Center (Health Services) 1375 NW Kingston
- Mike Maier Building (Children and Families Commission) – 1130 NW Harriman St
- Property & Facilities/Information Technology Building – 14 NW Kearney Ave
- Road Department – 61150 SE 27th Street
- Rosie Bareis Community Campus – 1010 NW 14th St
- School Based Health Center – 2150 NE Daggett Lane
- Wall St Services Building (Health Services) – 1340 NW Wall Street

Special Districts with Offices in Bend

- Pacific Power – electric power utility
- Cascade Natural Gas – natural gas utility – 64500 OB Riley Road
- Bend Broadband (cable, landline phone, internet provider) – 63090 Sherman Road
- CenturyLink – cable, landline phone, internet provider

Bend-La Pine School District (schools located in Bend)

- Elementary Schools:
  - Amity Creek – 437 NW Wall Street
  - Bear Creek – 51 SE 13th St
  - Elk Meadow – 60800 Brookswood Boulevard
  - High Lakes – 2500 NW High Lakes Loop
  - Highland Magnet – 701 NW Newport Avenue
  - Juniper Elementary – 1300 NE Norton Avenue
  - Pine Ridge – 19840 Hollygrape St
  - RE Jewell Elementary – 20550 Murphy Rd
  - Westside Village Magnet – 1101 NW 12th St
  - William E. Miller – 300 NW Crosby Drive
- Middle Schools in Bend:
  - Cascade – 19619 Mountaineer Way
  - Pilot Butte – 1501 NE Neff Road
  - Sky View – 63555 NE 18th St
  - REALMS (Rimrock Expeditionary Learning) – 63175 OB Riley Road
- High Schools in Bend:
  - Bend – 230 NE 6th St
  - Marshall – 1291 NE 5th St
  - Mountain View – 2755 NE 27th St
  - Summit – 2855 NE Clearwater Drive

Colleges and Universities

- Central Oregon Community College – 2600 NW College Way
- Oregon State University, Cascades Campus:
  - Main offices --- 2600 NW College Way
  - Graduate & Research Center – 650 SW Columbia St

Social Service Providers

Included below is a list of social service providers. For additional service providers see Attachment 3.

- Deschutes County Health Services – 2577 NE Courtney Drive, Bend, OR
- Neighbor Impact – 20310 Empire Ave, #A100, Bend, OR 97701
- Housing Works
- American Red Cross, Mountain River Chapter – 815 SW Bond, Suite 110, Bend, OR 97702
- Salvation Army, Deschutes County – 515 NE Dekalb Ave, Bend, OR 97701
- St. Vincent De Paul – 950 SE 3rd, Bend, OR 97701
- Or Department of Human Services – Self Sufficiency Program – 1300 NW Wall St, Suite 101, Bend, OR 97701
- State of Oregon – Seniors and People with Disabilities – 1300 NW Wall Street, Suite 102, Bend, OR 97702
- Emergency shelters:
    - Bethlehem Inn – 3705 N. Highway 97, Bend, OR 97701
    - Cascade Youth and Family Center – 19 SW Century Drive, Bend, OR 97702
    - Saving Grace – 1425 NW Kingston Ave, Bend, OR 97701
    - Two shelters that are confidential and provide shelter for homeless, pregnant, and/or parenting teens
    - The Shepherd's House
- Child programs:
    - Boys and Girls Club of Central Oregon – 500 NW Wall Street, Bend, OR 97701
    - Alyce Hatch Center – 1406 NW Juniper, Bend, OR 97701
    - Cascade Youth and Family Center – 19 SW Century Drive, Bend, OR 97702
    - Central Oregon Family Resource Center – 1130 NW Harriman St, Suite B, Bend, OR 97701

Population

Bend's estimated population as of July 1, 2014 is 79,985 people. The city's population has grown an estimated 3,346 people or 4.4% since the 2010 Census[2]. The acknowledged Coordinated Population Forecast for Bend is 109,389 people by the year 2025, which represents an increase of 29,404 people or 37% between 2014 and 2025[3].

Bend's population growth has occurred in all parts of the city, with more occurring on Bend's west side and in southwest Bend. The groups that have seen the largest increases in household growth include Latino and Hispanic households and households composed of members 65 years and older.

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[2] Portland State University, Population Research Center, "Annual Population Estimates", 2014.

[3] 2004 Coordinated Population Forecast for Deschutes County – updated 2009

Land Use

The City of Bend's acknowledged comprehensive plan is the Bend Area General Plan. The Oregon Land Conservation and Development Commission first acknowledged the plan in 1981. The City last completed a major update of the plan in 1998. Since that time, the City has updated the plan chapters on demographics and population (2004); economic development (2005); transportation (2013), and public facilities and services (2013---2014). The City implements the plan through the Bend Development Code, which was adopted in 2006.

The City is currently working on a project to evaluate the capacity of the UGB for needed housing and economic opportunities, which is expected to include an expansion of the UGB. The project is on schedule to be completed with local adoption in spring of 2016. The plan amendments and implementing development code changes will touch on needed housing, employment land, land for public parks and schools, transportation, and public facilities (e.g. water and sanitary sewer).

Bend Park and Recreation District

The Bend Park and Recreation District operates and maintains 81 parks and open spaces, and 65 miles of trail.[4] The district has its own tax district and is governed by a five member elected board of directors that is managed by an Executive Director. The districts parks include 36 neighborhood parks (155 acres), 24 community parks (543 acres), 3 regional parks (954 acres), and 18 natural areas (906 acres) and more than 24 facility buildings.[5]

Tourist Locations

- Drake Park – adjacent to flood plain
- Pilot Butte – Highway 20
- Shevlin Park
- Pine Nursery Park
- Farewell Bend Park adjacent to Old Mill District
- Several public golf courses:
    - River's Edge
    - Awbrey Glen
    - Bend Golf and Country Club
- Old Mill District (shopping & entertainment) 450 SW Powerhouse Drive #2

Economy

Bend is the largest city east of the Cascade Mountains, and the seventh largest in Oregon. As such, it serves as a large regional hub for retail sales, health care, higher education, and leisure, hospitality, and tourism. The growing traded sector industries in Bend include:

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[4] Bend Park and Recreation District website, http://www.bendparksandrec.org, accessed April 2, 2015.

[5] Bend Park and Recreation District, "Parks, Recreation, and Green Spaces Comprehensive Plan", February 2012 update.

- Bioscience
- Aviation and aerospace
- Outdoor recreation equipment and apparel;
- Software;
- Specialty manufacturing;
- Corporate and administrative offices, and;
- Brewing and Distilling.

The seasonally adjusted unemployment rate for Deschutes County (in which Bend is the largest city and county seat) was 6.5% in February. The number of employed persons was 75,831, and the civilian labor force was 81,516. Total nonfarm payroll employment in February 2015 was 70,050.

Cultural and Historic Resources

The sites (Table BA---3) and structures (Table BA---4) listed below represent the city's official list of historic places compiled by the city and county, and approved by the Oregon Land Conservation and Development Commission.[6]

Table BA-3 Historic Sites – City of Bend

Sites Designated with Plaques	Location
A.M. Drake Homesite	Drake Park
Foley Landmark	Pilot Butte State Park
1813 Rock	129 NW Idaho Street
Bend School Landmark	Drake Park
Central Oregon Pioneers' Landmark	Pioneer Park
Johns Landmark	Drake Park
Oregon Trunk Freight Warehouse Site	Railroad tracks & NW Division
Pilot Butte Inn Site	1133 NW Wall Street
ShevlinMHixon Mill site	Shevlin Center near dam
Weist Homesite Landmark	1315 NE Third Street
Historic Structure	**Location**
A. J. Tucker Blacksmith Shop	200M202 NW Greenwood Avenue
Athletic Club Gymnasium	520 NW Wall Street Bend
August Nelson Building	838 NW Bond Street Brooks
Scanlon Craneshed building	721 SW Industrial Way
Charles Boyd Homestead	20410 Bend River Mall Drive
Cozy Hotel	327 NW Greenwood Avenue
Delaware Grocery	845 NW Delaware Avenue
Deschutes County Library Building	507 NW Wall Street
Downing Hotel	1033 NW Bond Street

Source: Bend Area General Plan, 1998.

[6] Bend Area General Plan, 1998.

Table BA-3 Historic Structures – City of Bend

Historic Structure	Location
Evan A. Sather Home	7 NW Tumalo Avenue
First Presbyterian Church	157 NW Franklin Avenue A.L.
French Home	429 NW Georgia Avenue Hoover's
George Palmer Putnam House	606 NW Congress Street
H. E. Allen House	875 Brooks Street Bend
James E. Reed House	45 NW Greeley Avenue
John I. West Building	130 NW Greenwood Avenue
Kenwood School	701 NW Newport Avenue
Keyes House	912 NW Riverside Boulevard
Liberty Theatre	849T851 NW Wall Street
Lucas House	42 NW Hawthorne Avenue
Mountain View (Mayne) Hospital	515 NW Kansas Avenue
N.P. Smith Pioneer Hardware Building	935T937 NW Wall Street
Nels and Lillian Andersen House	63160 Nels Anderson Road
Niswonger House	44 NW Irving Avenue
O'Donnel Building	921T933 NW Wall Street
O'Kane Building	115 NW Oregon Avenue
Old Bend High School Building	520 NW Wall Street
Old Clinic	731 NW Franklin Avenue
Old U.S. Post Office	777 NW Wall Street
Pierson Blacksmith Shop	211 NW Greenwood Avenue
Railroad Depot	1160 NE Division Street Bend
Reid School	129 NW Idaho Avenue
Sawyer House	434 Drake Road
ShevlinTHixon Executive House	545 NW Congress Street
Spheir Building	901 NW Bond Street
St. Francis Catholic Church	494 NW Lava Road
Stover House	1 Rocklyn Road
Thomas McCann House	440 NW Congress Street
Trinity Episcopal Church	469 NW Wall Street
Tweet irrigation dam	Division St. near Yale Avenue
Universal Garage	124T128 NW Greenwood Avenue Steidl
Water & Light Co. Powerhouse/dam	Foot of Vermont Street Bend Woolen
Mill	1854 NE Division Street
Wright Hotel	215 NW Greenwood Avenue

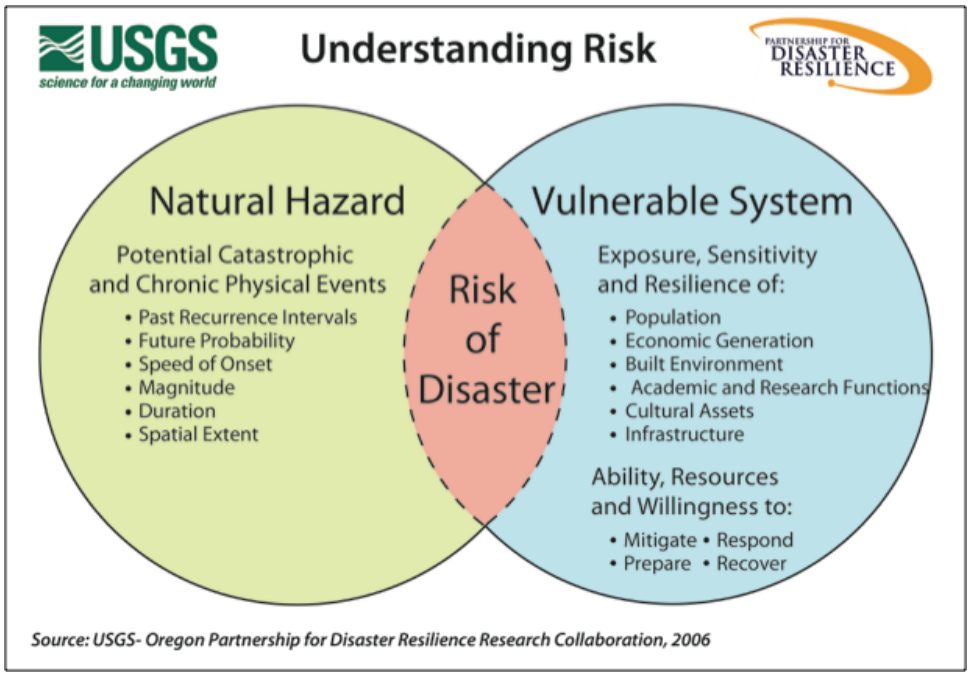
Source: Bend Area General Plan, 1998.

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 information presented below, along with hazard specific information presented elsewhere in this addendum, within the Hazard Annexes (Volume II), and community characteristics presented in the Community Profile (Appendix C), will be used as the local level rationale for the risk reduction actions identified in this addendum. The risk assessment process is graphically depicted in Figure BA---1 below. Ultimately, the goal of hazard mitigation is to reduce the area where hazards overlap vulnerable systems.

Figure BA-1 Understanding Risk



Source: Oregon Partnership for Disaster Resilience

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 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 (3 Risk Assessment) for more information.

Hazard Analysis

On February 11th, 2015, the City of Bend addendum 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 the City of Bend, which are discussed throughout this addendum.

Table BA---4 shows the HVA matrix for Bend 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.

Table BA-4 Hazard Analysis Matrix – City of Bend

Hazard	History	Probability	Vulnerability	Maximum Threat	Total Threat Score	Hazard Rank	
Wildfire	20	70	50	100	240	# 1	
Winter Storm	20	70	50	90	230	# 2	*Top*
Windstorm	20	70	25	80	195	# 3	*Tier*
Earthquake (Cascadia)	2	49	40	100	191	# 4	
Volcano	2	21	50	100	173	# 5	*Middle*
Drought	8	56	15	70	149	# 6	*Tier*
Flood	16	56	25	50	147	# 7	
Earthquake (Crustal)	2	7	25	80	114	# 8	*Bottom*
Landslide	2	7	5	20	34	# 9	*Tier*

Source: City of Bend NHMP Steering Committee, 2015.

Three chronic hazards (wildfire, winter storm, and windstorm) and one catastrophic hazard (Cascadia earthquake) rank as the top four hazard threats to the city (Top Tier). The volcano, drought, and flood hazards comprise the next three highest ranked hazards (Middle Tier), while crustal earthquake and landslide hazards comprise the lowest ranked hazards (Bottom Tier).

Table BA---5 categorizes the probability and vulnerability scores from the hazard analysis for the city and compares the results to the assessment completed by the Deschutes County NHMP Steering Committee (areas of differences are noted with **bold** text within the city ratings).

Table BA-5 Probability and Vulnerability Comparison

Hazard	Bend		County	
	Probability	Vulnerability	Probability	Vulnerability
Drought	High	Low	High	Low
Earthquake (Cascadia)	Moderate	High	Moderate	High
Earthquake (Crustal)	Low	**Moderate**	Low	Low
Flood	High	**Moderate**	High	Low
Landslide	Low	Low	Low	Low
Volcano	Low	High	Low	High
Wildfire	High	High	High	High
Windstorm	High	Moderate	High	Moderate
Winter Storm	High	High	High	High

Source: City of Bend NHMP Steering Committee and Deschutes County NHMP Steering Committee, 2015.

Drought

A drought is a period of drier than normal conditions that results in water---related problems. 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.

The steering committee determined that the city's probability for drought is **high** (which is the same as the county's rating) and that their vulnerability to drought is **low** (which is the same as the county's rating).

The city has ample high quality surface and groundwater supplies fed primarily by the Bridge Creek watershed and from the Deschutes regional aquifer. Groundwater supplies are utilized as a supplemental water source when snowmelt or heavy precipitation increases the surface water turbidity. In addition, the City of Bend actively reclaims water and encourages water conservation through their WaterWise program.

For more information on the Drought Hazard (including history and extent) see the Drought Annex in Volume II.

Earthquake

Oregon and the Pacific Northwest in general are susceptible to earthquakes from four sources: 1) the off---shore Cascadian Fault Zone; 2) deep intra---plate events within the subducting Juan de Fuca Plate; 3) shallow crustal events within the North American Plate; and 4) earthquakes associated with volcanic activity.[7]

The areas most susceptible to ground amplification and liquefaction have young, soft alluvial sediments, found along river and stream channels. The extent of the damage to structures and injury and death to people will depend upon the type of earthquake, proximity to the epicenter and the magnitude and duration of the event.

The steering committee HVA evaluated both crustal earthquakes and a Cascadia earthquake. The steering committee determined that the city's probability of experiencing a crustal earthquake is **low** (which is the same as the county's rating) and that their vulnerability to a crustal earthquake is **moderate** (which is higher than the county's rating). The steering committee determined that the city's (and State's) probability of experiencing a Cascadia earthquake is **moderate** (which is the same as the county's rating) and that their vulnerability to a Cascadia earthquake is **high** (which is the same as the county's rating).

The concentration of residents, businesses, and infrastructure within the City of Bend is greater than anywhere else in the county. Additionally, much of the city's critical infrastructure is constructed of un---reinforced masonry (which is especially vulnerable to seismic events) and built prior to the current seismic safety standards of the 1990s. Although there are several faults located in the Bend vicinity (Table II---6), the city is not particularly susceptible to liquefaction, and is not expected to be experience very strong to violent shaking in an earthquake event (see Tables II---5 and II---6). As such, the city's greatest vulnerability to earthquakes has more connection to the age of the city's infrastructure and buildings than to the particular geology of the area. The city considers itself to have high vulnerability to a Cascadia earthquake event due to secondary effects of the hazard, including access to transportation routes, energy resources, communications, and the need to assist with refugees of the damage that is expected west of the Cascades.

As noted above the city has a high concentration of buildings that are built prior to 1990, which increases the city's vulnerability to the earthquake hazard. Information on specific buildings' estimated seismic resistance, determined by DOGAMI in 2007, is shown in Tables BA---6 to 8 below. The tables below display the rankings of all facilities within the city's jurisdiction; each "X" represents one building within that ranking category.

Table BA---6 shows evaluated school facilities. Of the school facilities evaluated by DOGAMI using RVS, two (2) have very high (100% chance) collapse potential, and 18 buildings have high (greater than 10% chance) collapse potential.

Taylor, George H. and Chris Hannan. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press. 1999

Table BA-6 Rapid Visual Survey Scores: Schools

Facility	Level of Collapse Potential			
	Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Elementary Schools				
Amity Creek Elem. School (437 NW Wall St, Bend)			XX	
Bear Creek Elementary School (51 SE 13th St, Bend)	XXX	XXX		
Buckingham Elementary School (62560 Hamby Rd, Bend)			X	
Elk Meadow Elementary School (60880 Brookswood Blvd, Bend)			X	
Ensworth Elementary School (2150 NE Dagget Ln, Bend)	X			
High Lake Elementary School (2500 NW High Lakes Lp, Bend)	X			
Highland School at Kenwood Elem. School (701 NE Newport, Bend)			XX	
Juniper Elem. School (1300 NE Norton St, Bend)		XXXX	X	X
RE Jewell Elementary School (20550 Murphy, Bend) S Addition Admin Office (Aug. 2008) S Remodel Admin Office (Aug. 2008)			X	
Lava Ridge Elementary School (20805 Cooley Rd, Bend)	X			
Pine Ridge Elementary School (19840 Hollygrape St, Bend)	X			
Tumalo Elementary School (19835 2nd St, Bend)	X	X	XXXXX	
Westside Village Magnet School at Kingston Elementary School (1101 NW 12th St, Bend)	X			
Middle Schools				
Cascade Middle School (19619 Mountaineer Way, Bend) S Addition of Gymnasium, Admin office (Aug. 2008) S Remodel Admin Offices, bathrooms (Aug. 2008)			XX	
High Desert Middle School (61111 27th St, Bend)			X	
Pilot Butte Middle School (1501 NE Neff, Bend)	XX	XXX		X
Sky View Middle School (63555 NE 18th St, Bend)	X			

Source: DOGAMI 2007. Open File Report 0---07---02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.

Table BA-6 Rapid Visual Survey Scores: Schools (continued)

Facility	Level of Collapse Potential			
	Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100%)
High Schools				
Bend Senior High School (230 NE 6th St, Bend)	X	XXXXXXX	X	
Marshall High School (1291 NE 5th St, Bend)		XX		
Mountain View Senior High School (2755 NE 27th St, Bend) D Addition Classroom (435 sf) (Aug. 2008) D Remodel Classroom (898 sf) (Aug. 2008)	XX	XXXX	X	
Summit High School (2855 NW Clearwater Dr, Bend)	X			

Source: DOGAMI 2007. Open File Report 0---07---02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.

Table BA---7 shows evaluated community college facilities. Of the buildings evaluated by DOGAMI using RVS, none have very high (100% chance) collapse potential, and nine (9) buildings have high (greater than 10% chance) collapse potential.

Table BA-7 Rapid Visual Survey Scores: Community College

Facility	Level of Collapse Potential			
	Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Central Oregon Community College ; Bend Campus				
Bookstore	X			
Boyle Education Center			X	
Cascade Hall	X			
Grandview Student Union Center			X	
Juniper		X		
Library	X			
Mazama Gym			X	
Modoc (Old Library)			X	
Ochoco Hall			X	
Pence			X	
Pinckney Art Center			X	
Pioneer Hall			X	
Ponderosa			X	

Source: DOGAMI 2007. Open File Report 0---07---02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.

Table BA---8 shows evaluated public safety and hospital facilities. Of the buildings evaluated by DOGAMI using RVS all have low (< 1% chance) collapse potential.

Table BA-8 Rapid Visual Survey Scores: Public Safety and Hospital

Facility	Level of Collapse Potential			
	Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Public Safety				
Bend Police Department (555 NE 15th St, Bend)	X			
Bend FD < East Station 304 (62420 Hamby Rd, Bend)	X			
Bend FD < South Station 303 (61080 Country Club Rd, Bend)	X			
Bend FD < Tumalo Station 302 (19850 4th St, Bend)	X			
Bend FD < West Station 301 (1212 SE Simpson Ave, Bend)	X			
Deshutes County RFPD #2 (63377 Jamison St, Bend)	X			
Deschutes County Sheriff's Office/ EOC (63333 W Hwy 20, Bend)	X			
Hospitals				
St. Charles Medical Center < Bend (2500 NE Neff Rd, Bend)	XX			

Source: DOGAMI 2007. Open File Report 0---07---02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.

The county and cities have opted to create one action item for all the facilities that have a "high" or "very high" rating (see Appendix A). The buildings with 'high' or 'very high' collapse potential include multiple education facilities located throughout the city, all of which can play a key role in during disaster events or during long---term recovery.

For more information on the Earthquake Hazard (including history and extent) see the Earthquake Annex in Volume II.

Flood

Flooding results when rain and snowmelt creates water flow that exceed the carrying capacity of rivers, streams, channels, ditches, and other watercourses. In Oregon, flooding is most common from October through April when storms from the Pacific Ocean bring intense rainfall. Most of Oregon's destructive natural disasters have been floods.[8] Flooding can be aggravated when rain is accompanied by snowmelt and frozen ground; the spring cycle of melting snow is the most common source of flood in the region. The principal types of flood that occur in Bend include: spring/snow melt flooding, warm winter rain---on---snow flooding, Ice jams, flash floods, and dam failure.

[8] Taylor, George H. and Chris Hannan. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press. 1999

The steering committee determined that the city's probability for flood is **high** (which is the same as the county's rating) and that their vulnerability to flood is **moderate** (which is higher than the county's rating).

The city's high ratings are due to the fact that Bend is bisected by the Deschutes River which is susceptible to various winter and spring flood events including ice jamming. Ice jams on the Deschutes and Little Deschutes rivers have created flood conditions in the past and will continue to do so due to local topography. Ice jams commonly happen during the winter and early spring, while the river is still frozen. Sudden warming at higher altitudes can melt waters resulting in increased runoff of water and ice into large reaches of frozen river below. On the way downstream, the ice can "jam" in narrow places on the river or against a road crossing, effectively damming the river, sometimes followed by a sudden breach and release of the water and ice. In addition, the city is concerned that changes in the character of the river channel (sediment buildup) will effect river flooding if a large event occurs. Short duration flash floods also impact the community's stormwater system, including the ability of pipes and ditches to convey short precipitation, causing damage and economic impacts. Action items are included to address the concerns with ice jamming and the changes to river character.

National Flood Insurance Program (NFIP)

The Deschutes County Flood Insurance Rate Maps (FIRMs) were modernized in 2007. The table below shows that as of November 2014, Bend has 57 National Flood Insurance Program (NFIP) policies in force and four (4) paid claims. The city's last Community Assistance Visit (CAV) was July 20, 1994. The city is not a member of the Community Rating System (CRS). The table displays the number of policies by building type and shows that the majority of residential structures that have flood insurance policies are single---family homes (48) and that there are two (2) non---residential structures with flood insurance policies. Additionally, there is one property that is a minus rated A---zone property.

The community repetitive flood loss record for Bend does not include any repetitive flood loss, or severe repetitive flood loss, buildings and has not had any repetitive loss claims.

Table BA-9 Food Insurance Detail

Jurisdiction	Current FIRM Date	Initial FIRM Date	Total Policies	Pre:FIRM Policies	Policies by Building Type				Minus Rated A Zone
					Single Family	2 to 4 Family	Other Residential	Non: Residential	
Bend	9/28/07	9/4/87	57	21	48	5	2	2	1

Jurisdiction	Insurance in Force	Total Paid Claims	Pre:FIRM Claims Paid	Substantial Damage Claims	Repetitive Loss Buildings	Severe Repetitive Loss Buildings	Total Paid Amount	CRS Class Rating	Last CAV
Bend	$17,290,600	5	4	0	0	0	$50,393	NP	7/20/94

Source: Information compiled by Department of Land Conservation and Development, November 2014.

For more information on the Flood Hazard (including history and extent) see the Flood Annex in Volume II.

Landslide

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. In a landslide, two forces are at work: 1) the driving forces that cause the material to move down slope, and 2) the friction forces and strength of materials that act to retard the movement and stabilize the slope. When the driving forces exceed the resisting forces, a landslide occurs.

The steering committee determined that the city's probability for landslide is **low** (which is the same as the county's rating) and that their vulnerability to landslide is **low** (which is the same as the county's rating).

The city has had no problems with landslides in city limits in known history and is located in a generally stable area (the city is generally located on basalt with six---inches of top soil). A few neighborhoods within the city (Awbrey Butte, etc.) are located on steep hillsides but have not experienced problems in the past.

For more information on the Landslide Hazard (including history and extent) see the Landslide Annex in Volume II.

Volcano

The Pacific Northwest lies within the "ring of fire", an area of very active volcanic activity surrounding the Pacific Basin. Volcanic events occur regularly along the ring of fire, in part because of the movement of the Earth's tectonic plates. Volcanic events have the potential to coincide with numerous other hazards including ash fall, earthquakes, lava flows, pyroclastic flows, lahars, and debris flows, and landslides.

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 **high** (which is the same as the county's rating).

Were a volcanic event to occur in the Cascades region of Oregon, Bend could be at risk for ash fall, depending on the severity of the event and the direction of the wind. Due to Bend's proximity to the Three Sisters and Newberry Crater, in relation to other areas within eastern Oregon, the effects of a volcanic event may be more disruptive to normal business, economic activity, and health.

For more information on the Volcano Hazard (including history and extent) see the Volcano Annex in Volume II.

Wildfire

Wildfires occur in areas with large amounts of flammable vegetation that require a suppression response due to uncontrolled burning. Fire is an essential part of Oregon's ecosystem, but can also pose a serious threat to life and property particularly in the state's growing rural communities. Wildfire can be divided into three categories: interface, wildland, and firestorms. The increase in residential development in interface areas has resulted in greater wildfire risk. Fire has historically been a natural wildland element and

can sweep through vegetation that is adjacent to a combustible home. New residents in remote locations are often surprised to learn that in moving away from built---up urban areas, they have also left behind readily available fire services providing structural protection.

The 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 the same as the county's rating).

The city experiences the effects of wildfire frequently (example, Two Bulls Fire in 2014 and Awbrey Hall in 1990; see Wildfire Annex Figure II---14 for a map of the large wildfire history). As of 2011, the estimated population within the East and West Bend UGRs is 76,870 including approximately 30,700 structures (as of 2013 the population of Bend is 78,280 and it is expected to grow an additional 31,000 people by 2025)[9]. The Greater Bend Area Community Wildfire Protection Plan (CWPP, August 2011, to be updated in 2015/16) relies upon (1) the Oregon Department of Forestry Assessment of Risk Factors and (2) the classification ratings of individual areas under the Oregon Forestland---Urban Interface Fire Protection Act of 1997 (Senate Bill 360) to determine fire risk within the Greater Bend Wildland---Urban Interface (WUI). According to the Senate Bill 360 ratings Bend (East UGR and West UGR) are rated as High fire risk (see map in Attachment 4); and according to the ODF Assessment all areas within the Greater Bend WUI are rated with a High probability of wildfire risk occurring and Extreme vulnerability (except for East UGR which is rated High)[10]. In addition to general concerns for the safety of residents and structures the city's primary drinking water is sourced from the Bridge Creek watershed (west of the city) and is considered vulnerable to wildfire. Rangeland surrounding the city to the east acts as a natural firebreak, and WUI areas in and near Bend are regularly maintained through fuel reduction projects specified within the Greater Bend Area CWPP. For more information on wildfire risk and fuels reduction projects see the Greater Bend Area CWPP and visit the Project Wildfire website: http://www.projectwildfire.org/.

For more information on the Wildfire Hazard (including history and extent) see the Wildfire Annex in Volume II and the Greater Bend CWPP.

Windstorm

A windstorm is generally a short duration event involving straight---line winds and/or gusts in excess of 50 mph. Although windstorms can affect the entirety of Deschutes 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 tons of storm related debris.

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[9] Lighthall, Kate. 2011. Greater Bend Community Wildfire Protection Plan, U.S. Census Bureau. 2000 Decennial Census, Table P001, and 2004 Coordinated Population Forecast for Deschutes County – updated 2009

[10] The ODF Assessment takes into account the likelihood of a fire occurring, hazard rating, protection capability, human and economic values protected, structural vulnerability to determine the overall score. For detailed information review the CWPP available on the Project Wildfire website: http://www.projectwildfire.org/

The steering committee determined that the city's probability for windstorm is **high** (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).

Historical wind events have uprooted trees, damaged roofs and windows, and damaged utility lines. Windstorms have not caused disastrous local damage but are a persistent problem. Windstorms are often associated with microbursts (thunderstorms). A primary windstorm vulnerability for the community is damage to utility lines, including fiber optics, which are key to the economic sectors of the community.

For more information on the Windstorm Hazard (including history and extent) see the Windstorm Annex in Volume II.

Winter Storm

Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting Deschutes County typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

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).

Bend is located at a higher elevation east of the Cascades, which is a major contributor to winter storms. Major winter storms can and have occurred in the Bend area, and while they typically do not cause significant damage; they are frequent and have the potential to impact economic activity. Road closures on Highway 97, or the passes to the Willamette Valley (Highways 58 and 126), due to winter weather are a common occurrence and can interrupt commuter and large truck traffic. The city budgets funds for seasonal winter storm needs, such as clearing roads.

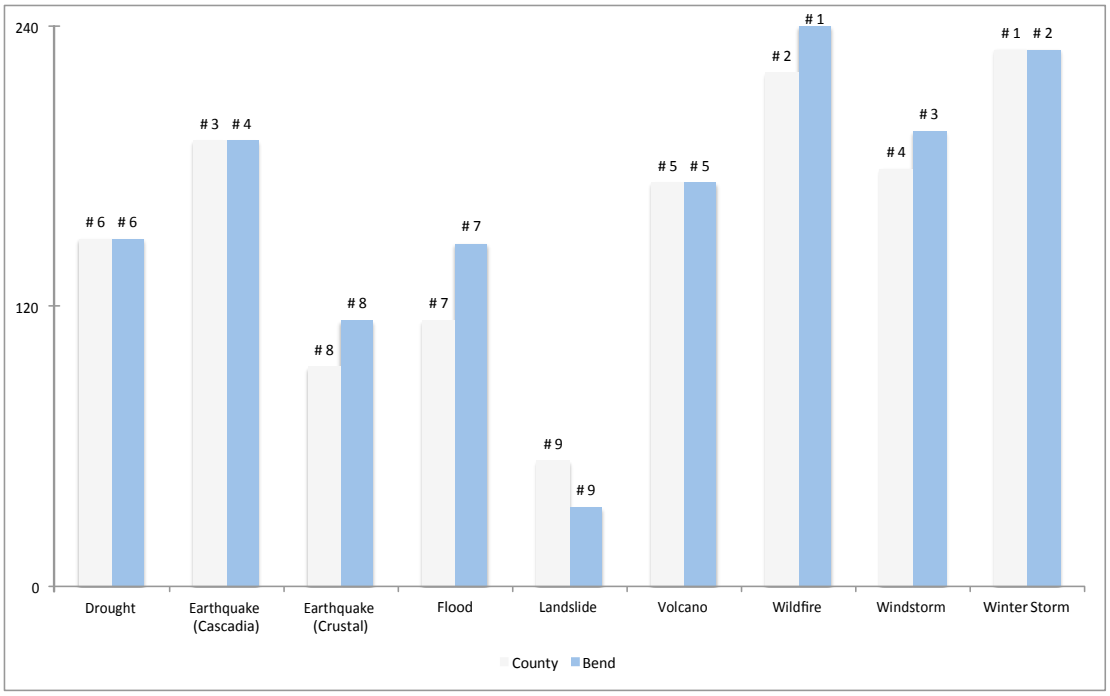
For more information on the Winter Storm Hazard (including history and extent) see the Winter Storm Annex in Volume II.

Summary

The figure below presents a summary of the hazard analysis for the City of Bend and compares the results to the assessment completed by the Deschutes County NHMP Steering Committee.

In terms of history, probability, vulnerability, and maximum threat, the hazard analysis for the city overall rated their threat to the wildfire, windstorm, flood, and crustal earthquake hazards higher than the county. The top two hazards for the city and the county are wildfire and winter storm; the city rates windstorm as it's third highest rated hazard and the county rates the Cascadia earthquake events as it's next highest rated hazard event.

Figure BA-2 Overall Hazard Analysis Comparison – Bend and Deschutes County



Source: City of Bend NHMP Steering Committee and Deschutes County NHMP Steering Committee, 2015.

MITIGATION STRATEGY

Mitigation Plan Mission

The plan mission states the purpose and defines the primary functions of Deschutes County's NHMP. It is intended to be adaptable to any future changes made to the plan and need not change unless the community's environment or priorities change.

The mission of the Deschutes County NHMP is:

> *To promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the environment from natural hazards.*

This can be achieved by increasing public awareness, documenting the resources for risk reduction and loss---prevention, and identifying activities to guide the county towards building a safer, more disaster resistant community.

The Bend steering committee reviewed the 2015 NHMP plan mission statement and agreed it accurately describes the overall purpose and intent of this plan. The Steering Committee believes the concise nature of the mission statement allows for a comprehensive approach to mitigation planning.

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that Deschutes County citizens, and public and private partners can take while working to reduce the county's risk from natural hazards. These statements of direction form a bridge between the broad mission statement and particular action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

The Bend Addendum steering committee reviewed and agreed to the 2015 Deschutes County NHMP plan goals. All the plan goals are important and are listed below in no particular order of priority. Establishing community priorities within action items neither negates nor eliminates any goals, but it establishes which action items to consider to implement first, should funding become available. Below is a list of the 2015 NHMP goals:

Goal 1: *Protect life and reduce injuries resulting from natural hazards.*

Goal 2*: Minimize public and private property damages and the disruption of essential infrastructure and services from natural hazards.*

Goal 3: *Implement strategies to mitigate the effects of natural hazards and increase the quality of life and resilience of economies in Deschutes County.*

Goal 4: *Minimize the impact of natural hazards while protecting, restoring, and sustaining environmental processes.*

Goal 5: *Enhance and maintain local capability to implement a comprehensive hazard loss reduction strategy.*

Goal 6: *Document and evaluate progress in achieving hazard mitigation strategies and action items.*

Goal 7: *Motivate the public, private sector, and government agencies to mitigate the effects of natural hazards through information and education.*

Goal 8: *Apply development standards that mitigate or eliminate the potential impacts of natural hazards.*

Goal 9: *Mitigate damage to historic and cultural resources from natural hazards.*

Goal 10: *Increase communication, collaboration, and coordination among agencies at all levels of government and the private sector to mitigate natural hazards.*

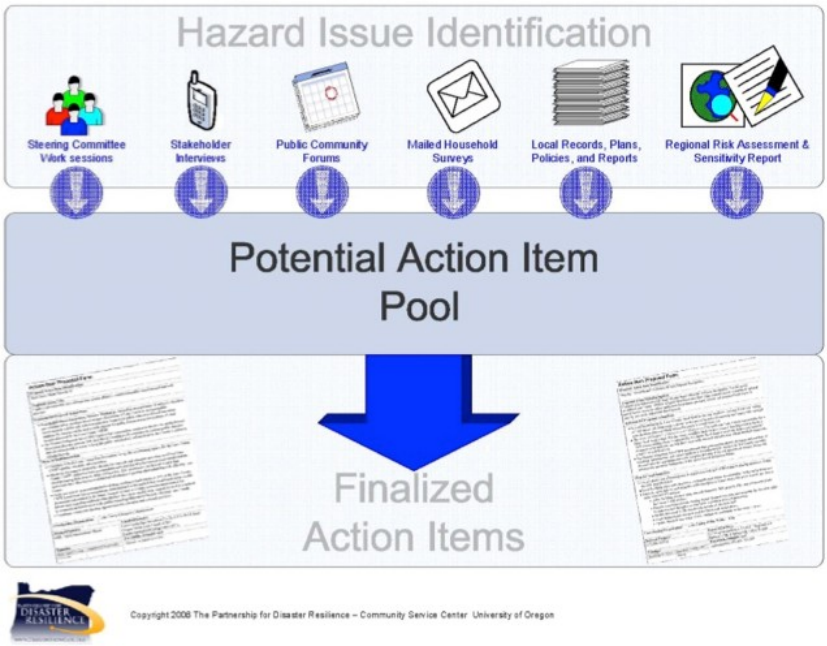
Goal 11: *Integrate local NHMPs with comprehensive plans and implementing measures.*

(Note: although numbered the goals are not prioritized.)

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 figure below illustrates some of these sources. A description of how the plan's mitigation actions were developed is provided below.

Figure BA-3 Development of Action Items



Source: Oregon Partnership for Disaster Resilience (2008)

Action Item Worksheets

Each action item 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 within Volume I, Section 3 (Mitigation Strategy). The City specific action item worksheets are located in Attachment 1, *Action Item Forms*.

The City is also a party to several actions described in the County NHMP; each jurisdiction listed on the County Action Item forms as an "Affected Jurisdiction" will contribute to and work towards completion of that action as it pertains to their jurisdiction. **There are 21 County Action Items that include Bend as an "Affected Jurisdiction".** For detailed information on each County level action item form see Volume I, Section 3, *Mitigation Strategy* and Volume IV, Appendix A, *Action Item Forms*.

Action Item Development Process

Development of action items was a multi---step, iterative process that involved brainstorming, discussion, review, and revisions. Action items were developed by the steering committee and were influenced by actions first identified in the City of Bend Emergency Operations Plan (2009). A number of actions identified by the County steering committee include the City as an affected jurisdiction; these actions are broad actions that include implementation components at both the county and city level. All actions were reviewed by the committee and revised as necessary before becoming a part of this document.

ATTACHMENT 1:
ACTION ITEM FORMS

Action Item Forms

The action item forms portray the overall action plan framework and identify linkages between the plan goals, partnerships (coordination and partner organizations), and actions. Table BA---10 provides a list of actions for the city. The pages that follow include individual forms for each mitigation action.

Table BA-10 Mitigation Actions

Action Item	High Priority	Timeline	Status	Related Hazards							
				Drought	Earthquake	Flood	Landslide	Volcano	Wildfire	Windstorm	Winter Storm
MH #1		Long%Term	New		X	X	X	X	X	X	X
MH #2		Short%Term	New	X	X	X	X	X	X	X	X
MH #3	Yes	Long%Term	New		X	X	X	X	X	X	X
MH #4		Short%Term	New	X	X	X	X	X	X	X	X
MH #5		Long%Term	New	X	X	X	X	X	X	X	X
MH #6		Short%Term	New	X	X	X	X	X	X	X	X
MH #7		Short%Term	New		X	X	X	X	X	X	X
EQ #1		Long%Term	New		X						
EQ #2		Long%Term	New		X						
FL#1		Long%Term	New			X					
FL #2		Long%Term	New			X					
FL #3		Long%Term	New			X					
VE #1		Long%Term	New					X			
VE #2		Long%Term	New					X			
WF #1		Short%Term	New						X		
WF #2		Short%Term	New						X		
WF #3		Short%Term	New						X		
WF #4		Short%Term	New						X		

Source: City of Bend NHMP Steering Committee

Mitigation Action: Multi---hazard #1 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Identify, improve, and sustain collaborative programs focusing on the real estate and insurance industries, public and private sector organizations, and individuals.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009)
Rationale for Proposal (Why is this important?):
This action is important to raise awareness about hazard mitigation with professions who regularly interact with homebuyers, home sellers, and those who finance real estate transactions.

Ideas for Implementation (How will it get done?):	**Action Status Report**
Provide background pieces, white papers, and/or information to local builder and realtors associations, local government communications professionals, and presentations to governing bodies.	**Added in 2015**

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Police Department, Fire Department	Deschutes County Emergency Services, Deschutes County Rural Fire Protection District #2

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
OEM (Public Private Partnership), DLCD, Local Funding Resources		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Multi---hazard #2 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Develop public and private partnerships to foster natural hazard program coordination and collaboration.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009)
Rationale for Proposal (Why is this important?):
This action is important to ensure all agencies charged with or choosing to pursue natural hazards mitigation planning are coordinating efforts to be more effective and prevent duplication of efforts.

Ideas for Implementation (How will it get done?):	**Action Status Report**
	Added in 2015

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Police Department, Bend Fire Department	Deschutes County Emergency Services, Deschutes County Rural Fire Protection District #2

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Local Funding Resources, County Emergency Manager		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Multi---hazard #3 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Develop inventories of at---risk buildings and infrastructure, and prioritize mitigation projects based on those providing the most benefit (at the least cost) to the population of the City of Bend.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
DOGAMI RVS (2007), City of Bend EOP (2009)
Rationale for Proposal (Why is this important?):
Retrofitting of vital infrastructure, such as schools, emergency service, and other community buildings, provides important improvements that reduce hazard exposure and the cost and time associated with recovery (Source: American Planning Advisory Service Report Number 483/484). The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6(c)(3)(ii)]. Identifying critical and essential facilities for retrofit will help to identify major infrastructure issues and appropriate mitigation actions to protect critical and essential facilities.

Ideas for Implementation (How will it get done?):	**Action Status Report**
Conduct detailed structural evaluation that outlines recommendations for building deficiencies, and provides a cost estimate	**Added in 2015**
Conduct structural evaluation and make recommendations (structural and non---structural) for fix. Align projects with regular maintenance programs.	**Added in 2015**
Develop public/ private partnerships with building contractors and architects to pursue specific retrofitting projects.	**Added in 2015**
Ensure schools and universities, government infrastructure, and critical facilities meet current seismic standards.	**Added in 2015**
Apply for grant funding.	**Added in 2015**

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Public Works, Engineering and Infrastructure, Bend Airport	Deschutes County Emergency Services, OEM, DOGAMI, FEMA, IFA

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Seismic Rehabilitation Grant Program, Flood Mitigation Assistance Grant Program,		■ Ongoing

Hazard Mitigation Grant Program, Pre- --Disaster Mitigation Grant Program, Resource Assistance for Rural Environments		■ Short Term (1---2 years) ■ Long---Term (3---5 years)
Form Submitted by:	2015 NHMP Committee	
Action Item Status:	New	

Mitigation Action: Multi---hazard #4 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Strengthen emergency services by maintaining the City of Bend Emergency Operations Plan, linking emergency services with hazard mitigation programs, and enhancing public education.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009)
Rationale for Proposal (Why is this important?):
The City of Bend last adopted the emergency operations plan or EOP in 2009. This action is important to update and maintain the plan so the City is prepared to respond effectively to natural hazards.

Ideas for Implementation (How will it get done?):	**Action Status Report**
Update the 2009 Bend EOP.	**Added in 2015**

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Police, Fire, Public Works, City Administration	Deschutes County Emergency Services, Bend Park and Recreation District

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Local Funding Resources, County Emergency Management/ NHMP Steering Committee		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Multi---hazard #5 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Use technical knowledge of natural ecosystems and events to link natural resource management and land use organizations to mitigation activities and technical assistance.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009)
Rationale for Proposal (Why is this important?):
This action is important to help inform the next update to the Community Wildfire Protection Plan (CWPP). The CWPP was last updated in 2011. The recent work on the Bend urban growth boundary remand has highlighted the need to better link planning for natural hazard mitigation (e.g. wildfire) with long range planning for the City.

Ideas for Implementation (How will it get done?):	**Action Status Report**
	Added in 2015

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
	Deschutes County Emergency Services, Deschutes County Forester, DOGAMI, Oregon Water Resources, Oregon Department of Forestry

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Local Funding Resources, County and City staff		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Multi---hazard #6 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Develop benchmarks for a disaster---resistant and resilient community.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009)
Rationale for Proposal (Why is this important?):
The State of Oregon the Oregon Resilience Plan in 2013, and is working to complete the State's Natural Hazards Mitigation Plan this year. This action is important to ensure consistency in benchmarking for hazard mitigation and resilience planning.

Ideas for Implementation (How will it get done?):	**Action Status Report**
Coordinate with County Community Development and cities to update comprehensive plans to include benchmarks in their Goal 7 plan elements	**Added in 2015**

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Police Department, Fire Department	Deschutes County Emergency Services, Deschutes County Community Development

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Local Funding Resources, County and City staff, UO Community Service Center/ OPDR, OSU Cascades		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Multi---hazard #7 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Develop and implement, or enhance, strategies for debris management for natural hazard (winter storm, wind, flood, etc.) events.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009)
Rationale for Proposal (Why is this important?):
Debris from natural hazards can be a potential threat to citizens, interfere with travel, and act as an attractive nuisance.

Ideas for Implementation (How will it get done?):	**Action Status Report**
Collaborate with County to create a joint debris removal plan.	**Added in 2015**

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Police, Fire, Public Works Departments	Deschutes County Emergency Services, Deschutes County Rural Fire Protection District #2, Deschutes County Road Department, ODOT

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Local Funding Resources, County Road Department, and City Public Works		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Earthquake #1 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Seismically retrofit vulnerable facilities and infrastructure to increase their resiliency to seismic hazards. Consider both structural and non---structural retrofit options.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009)
Rationale for Proposal (Why is this important?):

Ideas for Implementation (How will it get done?):	**Action Status Report**
Conduct structural evaluations of critical and essential facilities (including historical buildings), and infrastructure and make recommendations (structural and non---structural) for fix.	**Added in 2015**
Align projects with regular maintenance programs.	**Added in 2015**

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Community Development, Engineering and Infrastructure Planning, Public Works	Deschutes County Community Development, Bend Park and Recreation District, Bend – LaPine Schools, Deschutes County Library,

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Seismic Rehabilitation Grants (IFA), Local Funding Resources		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Earthquake #2 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Improve local capabilities to perform earthquake building safety evaluations and to record and manage building inventory data.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009)
Rationale for Proposal (Why is this important?):
This action is important to ensure new construction and remodeling of existing buildings and structures can be constructed to withstand potential earthquakes.

Ideas for Implementation (How will it get done?):	**Action Status Report**
Coordinate training for local building officials, including plans examiners and building inspectors, to perform earthquake safety evaluations.	**Added in 2015**
Provide similar training to private building and home inspectors	**Added in 2015**

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Community Development, Engineering and Infrastructure Planning	Deschutes County Community Development, Deschutes County Emergency Services

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Local Funding Resources, partner with County and Oregon Building Codes Division (BCD)		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Flood #1 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Identify critical public infrastructure and facilities located in flood hazard areas and implement mitigation and preparedness measures for those facilities.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009)
Rationale for Proposal (Why is this important?):
The City has completed recent updates to its transportation (2013), water (2013), and sewer collection (2014) system plans. Completing this task will help inform the next round of updates to these plans that are expected to take place after the City completes work on the UGB Remand Project.

Ideas for Implementation (How will it get done?):	**Action Status Report**
Coordinate with County, ODOT, utilities, and irrigation districts to develop inventory of critical public infrastructure.	**Added in 2015**
Identify and program improvements to these facilities for mitigating flood hazards	**Added in 2015**

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Public Works, Engineering and Infrastructure Planning	Deschutes County: Community Development, Emergency Services, Road Departments ;Oregon Department of Transportation

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Local Funding Resources for identification, consider application for FEMA non---disaster mitigation grant		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Flood #2 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Identify floodway obstructions and implement mitigation measures to remove obstructions.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009)
Rationale for Proposal (Why is this important?):

Ideas for Implementation (How will it get done?):	**Action Status Report**
	Added in 2015

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Engineering and Infrastructure Planning	Deschutes County Community Development, Emergency Services, Roads; Oregon Department of State Lands, Oregon Department of Fish and Wildlife

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Local Funding Resources, Department of State Lands, Oregon Department of Fish and Wildlife		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Flood #3 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Develop strategies to enhance the use of open space within the floodplain for flood mitigation, fish habitat, and water quality issues.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009)
Rationale for Proposal (Why is this important?):
Under Oregon planning law, the City's General Plan must address and satisfy Goals 5 (Open Spaces, Natural Areas, Habitat) and Goal 7 (Natural Hazards). This action is important because it provides an avenue for the City to address two goals with a set of strategies focused on flood mitigation.

Ideas for Implementation (How will it get done?):	**Action Status Report**
	Added in 2015

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Engineering and Infrastructure Planning, Community Development	Bend Park and Recreation District; Deschutes County Community Development; Oregon Department of State Lands, Oregon Department of Fish and Wildlife, DLCD

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Local Funding Resources (City and County Planning with technical assistance from DLCD)		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Volcano #1 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Identify critical facilities and industries that may be affected by ash fall and develop and implement ash fall emergency response and mitigation projects.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009), Central Cascades Volcano Coordination Plan (2007) to be updated in 2015
Rationale for Proposal (Why is this important?):
Do not currently review volcanic activity

Ideas for Implementation (How will it get done?):	**Action Status Report**
Collaborate with owners/ operators of critical facilities and industries on ash fall emergency response and mitigation projects	**Added in 2015**

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Engineering and Infrastructure Planning, Utilities, Streets	Deschutes County: Community Development, Emergency Services

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Local Funding Resources, OSU Cascades, DOGAMI, USGS		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Volcano #2 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Collaborate with the USGS's Cascade Volcano Observatory and related agencies to create ash fall warning messages that are more appropriate for Bend.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009), Central Cascades Volcano Coordination Plan (2007) to be updated in 2015
Rationale for Proposal (Why is this important?):
While not eminent, creating warning messages now will ensure the City and coordinating partners are ready to respond to a volcanic event.

Ideas for Implementation (How will it get done?):	**Action Status Report**
	Added in 2015

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Communications, Police, Fire	USGS, OSU---Cascades, OEM, Deschutes County Emergency Services, Deschutes County Communications, Deschutes County 911

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Local Funding Resources, OSU Cascades, DOGAMI, USGS		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Wildfire #1 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Inventory alternative firefighting water sources and encourage the development of additional sources.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009), Greater Bend CWPP (2011)
Rationale for Proposal (Why is this important?):
This action is important because it will help inform updates to both the Bend EOP and the Bend CWPP. The CWPP is intended to be updated every five years, with the next update coming up in sometime between 2016 and 2017.

Ideas for Implementation (How will it get done?):	**Action Status Report**
	Added in 2015

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Fire Department, Engineering and Infrastructure Planning	County Forester, Project Wildfire, Deschutes County Emergency Services, Deschutes County 911

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Local Funding Resources (City/ County)		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Wildfire #2 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Encourage creation and adoption of wildland---urban interface maps to direct development requirements that assist wildfire mitigation.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009), Greater Bend CWPP (2011)
Rationale for Proposal (Why is this important?):
HB 3623, encouraging the amendment to create inventories that expand beyond private lots development – i.e., Wildfire boundaries may be more expansive and not a clean line.

Ideas for Implementation (How will it get done?):	**Action Status Report**
Incorporate this work as a task in the next Community Wildfire Protection Plan for Bend (update 2011 CWPP)	**Added in 2015**

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Fire Department, Community Development, Information Technology (GIS)	Deschutes County Forester, Project Wildfire, Deschutes County Community Development, Deschutes County Emergency Services, Deschutes County 911

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Local Funding Resources, Project Wildfire, Greater Bend CWPP		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Wildfire #3 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Increase communication, coordination, and collaboration between wildland---urban interface property owners, city and county planners, and fire prevention crews and officials to address inherent risks in wildland---urban interface areas, available prevention/ protection measures, and federal mitigation assistance programs.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009), Greater Bend CWPP (2011)
Rationale for Proposal (Why is this important?):
This action is important to improve communication and collaboration between agencies and staff involved with land development and planning (e.g. city and county planners) and those professionals working in wildfire mitigation and response. This is an opportunity to update the respective comprehensive plans and land use regulations of the cities and Deschutes County to ensure future development in wildland urban interface areas can occur to reduce and mitigate risks of wildfire.

Ideas for Implementation (How will it get done?):	**Action Status Report**
	Added in 2015

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Community Development; Fire Department	Deschutes County Forester, Project Wildfire, Deschutes County Community Development; Deschutes County Rural Fire Protection District #2, Deschutes County Emergency Services

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
ODF, Local Funding Resources, FEMA and other federal grant funding		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Wildfire #4 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Implement fire mitigation activities in a manner consistent with the goals of promoting sustainable ecological management and community stability.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City of Bend EOP (2009), Greater Bend CWPP (2011)
Rationale for Proposal (Why is this important?):
This action is important to carry out any future mitigation developed through an updated to the Community Wildfire Protection Plan (CWPP). The CWPP was last updated in 2011. The next update should begin and be completed 2016---2017.

Ideas for Implementation (How will it get done?):	**Action Status Report**
	Added in 2015

Champion/ Responsible Organization:	Growth Management

Internal Partners:	**External Partners:**
Community Development, Engineering and Infrastructure Planning	Deschutes County Forester, Project Wildfire, Deschutes County Community Development, Oregon Department of Land Conservation and Development, Oregon Department of Fish and Wildlife, USFS, BLM

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
ODF, Local Funding Resources, FEMA and other federal grant funding, USFS, BLM		■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

ATTACHMENT 2:
ACTION ITEM FORM TEMPLATE

Mitigation Action:[Number] **Mitigation Action:: (What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11	☐ Yes

Alignment with Existing Plans/Policies:
Rationale for Proposal (Why is this important?):
Ideas for Implementation (How will it get done?): **Action Status Report**

Champion/ Responsible Organization:	

Internal Partners:	**External Partners:**

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		☐ Ongoing ☐ Short Term (1---2 years) ☐ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

ATTACHMENT 3:
SOCIAL SERVICE PROVIDERS

This page intentionally left blank. See next pages for listing of Department of Human Services facilities. Volume IV, Appendix C also has a list of social service providers.

DESCHUTES, CROOK AND JEFFERSON COUNTIES
Oregon Department of Human Services - Aging and People with Disabilities
1135 SW Highland Ave, Redmond, OR 97756

LICENSED ADULT FOSTER HOMES

Effective October 2014

BEND

Provider		Information	C.M.	RN
Acea, Sherry *Mashie House* 20370 Mahsie Ct Bend, OR 97702	541-383-4673	5 beds Class 3 Lie# 523180		
Acea, Sherry / Lantz, Michael *Cottage Care* 61148 SE Benham Rd Bend, OR 97702	541-383-2364	4 beds Class 3 Lie# 515367		
Alexander, Raquel *Klahani Home For Ladies & Gentlemen* 20580 Klahani Bend, OR 97702	541-382-1284	5 beds Class 3 Lie# 540146		
Alloy, Vicki *Honoring Elders, LLC* 2820 NE Faith Dr Bend, OR 97701	541-306-6906	5 Beds Class 3 Lie# 524775	**Private**	
Betterton, Molly *Mountain Home* 2209 NE Wells Acres Rd Bend, OR 97701	541-385-4740	5 beds Class 3 Lie# 578521		
Chance, Connie *Pioneer Retreat* 2110 NE Shepard Rd Bend, OR 97701	541-389-6652	4 beds Class 2 Lie# 565858		
Chavez-Lopez, Bertha *Bright Star I* 61659 SE zih St Bend, OR 97702	541-317-0224	5 beds Class 2 Lie# 509358		
Chavez-Lopez, Bertha *Bright Star II* 61653 SE 27 h St Bend, OR 97702	541-385-1842	5 beds Class 2 Lie# 517120		
Chavez Francis *Helping Hands Foster Care* 1652 NE Wells Acres Rd Bend, OR 97701	541-385-1090	2 beds Class 3 Lie# 524953		
Chavez, Martina *The Golden House Inn* 2975 NE Pacific Crest Bend, OR 97701	541-306-4902	5 beds Class 2 Lie# 523841		
Clark, Pauline *Nisika Home* 61234 Nisika Ct	541-389-8684	5 beds Class 3 Lie# 518535		

Bend, OR 97702				
NOT TAKING NEW CLIENTS		3 beds		
Cobos, Tom & Carol	541-389-0353	Class 2		
Golden Years Foster Home		Lie# 500330		
22060 Neff Rd. - PO Box 484				
Bend, OR 97709				
Coffman, Jessica	541-306-6310	5 beds		
Helping Hands Senior Home Care		Class 3		
1435 NE Sharkey Terrace		Lie# 523767		
Bend, OR 97701				
Curtis-Kellogg, Skyleah	541-382-	5 beds		
9334 Skyleah R. Kellogg AFR		Class 3		
1933 NW Hill		Lie# 518563		
Bend, OR 97701				
Doty, Michelle	541-306-6088	5 beds		
High Desert Haven		Class 3		
1940 SE Arborwood Ave		Lie# 521219		
Bend, OR 97702				
Douglas, Nicki	541-330-6009	5 beds		
Angel Haven		Class 3		
20873 SE Greenmont Dr		Lie# 507243		
Bend, OR 97702				
Dovolis, Lauren/Gina Turner	541-330-1945	5 beds		
Cobblestone Inn	541-420-3286	Class 3		
20776 NE Liberty Ln.		Lie# 518158		
Bend, OR 97701				
Dovolis, Lauren/Gina Turner	541-382-4659	5 beds		
Gemstone Inn	541-420-3286	Class 3		
2646 NE Genet Ct		Lie# 518157		
Bend, OR 97701				
Dovolis, Lauren/Gina Turner	541-385-3178	5 beds		
River Rock Inn	541-420-3286	Class 3		
2809 Great Homed Pl		Lie# 523280		
Bend, QR 97701				
Dovolis, Lauren/Gina Turner	541-385-3132	5 beds		
Sandstone Inn	541-420-3286	Class 3		
2805 Great Homed Pl, 97701		Lie# 523278		
Dovolis, Lauren/Gina Turner	541-330-4083	4 Beds		
Moonstone Inn	541-420-3286	Class 3		
2813 Great Homed Pl		Lie# 523997		
Bend, OR 97701				
Fox, Christine	541-383-5910	5 betls	**Private**	
Precious Moments AFC		Class 3		
65920 Old Bend/Redmond Hwy		Lie# 520645		
Bend, OR 97701				
Giberson, Deborah	541-330-8632	5 beds		
Hummingbird Glen		Class 3		
63077 Marsh Orchid Dr		Lie# 522445		
Bend, OR 97701				
Giberson, Deborah & David	541-408-9818	3 beds		
Hummingbird Way		Class 3		

63071 March Orchid Dr Bend, OR 97701		Lie# 524340	
Grant, Stephanie *Butler Market Home* 915 Butler Mkt. Rd Bend, OR 97701	541-389-6021	5 beds Class 3 Lie# 514932	
Johnson, Nora *Shoshone Lodge* 21322 Starling Dr Bend, OR 97701	541-408-9776	5 beds Class 3 Lie# 512452	
Johnson, Victoria and Jason *The Ranch* 59694 Calgary Loop Bend, OR 97702	541-390-0801 541-306-6227	5 beds Class 2 Lie# 517712	**Private**
Johnson, Victoria and Jason *The Lodge* 22179 Calgary Dr Bend, OR 97702	541-390-0801 541-306-6227	5 beds Class 2 Lie# 518929	**Private**
Johnson, Victoria and Jason *Ridgewater* 61136 Hilmer Creek Dr Bend, OR 97702	541-390-0801 541-647-6902	5 beds Class 3 Lie# 524409	**Private**
Jones, Sherron *Terrango Glen Senior Care* 534 SE Wildcat Dr Bend, OR 97702	541-389-9540	5 Beds Class 3 Lie# 507721	
Kennedy, Merry *Stonebrook Inn* 3387 Stonebrook Loop Bend, OR 97701	541-389-5356	5 beds Class 3 Lie# 525054	
LaFrance, Barbara *Josee 's House* 60895 SW McMullin Dr Bend, OR 97702	541-647-1031	2 beds Class 3 Lie# 520402	
Lee, Judy *Lee's Leisure/and* 62134 Cody Jr. Rd Bend, OR 97701	541-385-0977	5 beds Class 3 Lie# 535844	
Manser, Diana Bear Creek Haven Foster Care 1231 NE Bear Creek Rd Bend, OR 97701	541-388-8513	4 beds Class 2 Lie# 523959	**Private**
McKeldin, *Mike* *Baroness House* *2880 NE Baroness Pl* Bend, *OR 97701*	*541-617-8945*	4 beds Class 3 Lie# 518484	
O'Hara, Kimberly *Amethyst Inn* 60992 Amethyst St Bend, OR 97701	541-617-8564	**4** beds Class 3 Lie# 518701	
Rice, Donita	541-388-2415	5 beds	

Donita 's Comfort Care 613 SW Pelton Pl Bend, OR 97702		Class 2 Lie# 502139	
Ruppel, Sharon *Sparkling "R"Adult Foster Care* 63747 O.B. Riley Rd Bend, OR 97701	541-388-2348	5 beds Class 3 Lie# 504659	
Scott, Cameron *A Home for Dad and Mom* 61161 Cottonwood Dr Bend, OR 97702	541-330-8773	4 beds Class 2 Lie# 511300	**Private**
Vallembois, Judy *We Care Adult Foster Home* 1352 NW Albany St Bend, OR 97701	541-385-1174	5 beds Class 3 Lie# 524964	

REDMOND/C Jl JIII RANCH CULVER/T SISTERS				
Provider		Information	C.M.	RN
Aragon, Jessica *Mabuhay Manor AFH* 928 NW Spruce Place Redmond, OR 97756	541-923-7400	3 beds Class 3 Lie# 521283		
Bryant, Tina *Bryant's Adult Home Living* 1345 NW Canyon Dr Redmond, OR 97756	541-504-4109	5 beds Class 2 Lie# 503728		
Hachenberg, Vicki *Ridgeview Adult Care* 610 E Ridgeview Dr Culver, OR 97734	541-546-7374	4 Beds Class 3 Lie# 568019		
Horner, Amada *Autumn House* 2616 SW Salmon Ave Redmond, OR 97756	541-316-1580	4 beds Class 3 Lie# 522241		
Horner, Amada *Amada's Home Care* 2475 SW 26th St Redmond, OR 97756	541-526-5681	4 beds Class 3 Lie# 518708		
Kitchin, Carlene *Central Oregon Adult Foster Care* 1532 NW Jack Pine Ave Redmond, OR 97756	541-548-6631	5 beds Class 3 Lie# 521178		
Mills, Janell *Home Sweet Home* 2618 NE Sedgewick Ave Redmond, OR 97756	541-548-1397 541-480-8420	5 beds Class 2 Lie# 521389		
Negrete, Marlene *In His Hands*	541-504-1113	3 beds Class 2	**Private**	

543 NW 17"' Redmond, OR 97756		Lie# 522694
Partridge, Virginia *Partridge Inn* 3130 SW Canal Blvd / PO Box 2417 Redmond, OR 97756	541-548-3012	3 beds Class 3 Lie# 516487 .
Powell, Irene *Irene M Powell AFH* 2500 SW 83'd St Redmond, OR 97756	541-923-3882	5 beds Class 3 Lie# 505228
Powell, Irene *Irene M Powell AFH* 2247 SW Pumice Ave Redmond, OR 97756	541-923-7390	Sheds Class 3 Lie# 543822
Roe, Deborah *The Hari Homestead* 5170 SW Wickiup Ave Redmond, OR 97756	541-548-0198	5 Beds Class 3 Lie# 522807
Richard, Sheila *Sheila's Care Home* 2362 sw 29'h Redmond, OR 97756	541-548-6152	5 beds Class 2 Lie# 510187
Thornton, Connie *Haven House* 10541 N. Hwy 97 Terrebonne, OR 97760	541-815-5082	5 beds Class 3 Lie# 509366
Tidwell, Wanda *Angel's Aware Home* 1422 NE 5th Redmond, OR 97756	541-548-6196	4 beds Class 2 Lie# 514883
Tolle, Leah and David *Absolute Serenity AFC* 119 N Rope St. Sisters, OR 97759	541-588-6119	4 beds Class 3 Lie# 520644
Williams, Judy *Rockin' Chair Cottage* 2620 SW Xero Ave Redmond, OR 97756	541-526-1792	4 beds Class 2 Lie# 525208
Williams, Patricia *Angel's Embrace Adult Care Home* 1239 SW 34th Place. Redmond, 97756	541-548-5682	2 beds Class 3 Lie# 500183

LA PINE

Provider		Information	C.M.	RN
Cram, Bryon *Happy Trails Adult Foster Care*	541-536-9900	4 beds Class 2		

51417 Evans Way / PO Box 3087 La Pine, OR 97739	Lie# 520819
Fee, Dianne 541-536-7869 Rosalies Helping Hands 16158 Elkhorn Ln / PO Box 986 La Pine, OR 97739	3 beds Class 2 Lie# 524506
Lindquist, Theresa 541-536-5830 *Big Timber Care Home* 53664 Big Timber Dr./ PO Box 1994 La Pine, OR 97739	3 beds Class 3 Lie# 539569
McVay, Barbara 541-536-1916 *Cascade Lakes AFH* 50792 S Huntington Rd La Pine, OR 97739	5 beds Class 3 Lie# 522195

PRINEVILLE

Provider	Information	C.M.	RN
Alger, Cheryl 541-447-1997 *McCallister Sisters Foster Care* 284 SE Willowdale Dr Prineville, OR 97754	4 beds Class 2 Lie# 518853		
Arnold, Delene 541-447-7876 *Easy Living Care Home* 6142 SE David Way Prineville, OR 97754	2 Beds Class 2 Lie# 513019		
Doty, Michelle 541-362-5120 High Desert Haven 1163 Bitterbrush Rd Prineville, OR 97754	5 Beds Class 3 Lie# 523807		
Gatlin, Charlotte 541-416-0109 *Char's Adult Foster Home* 777 NW Martingale Rd Prineville, OR 97754	5 beds Class 2 Lie#525224		
Koehn, Betty Louise/Badgett, Theresa 541-447-2008 *Mill Creek Lodge Senior Care* 4845 NE Mill Creek Rd Prineville, OR 97754	5 beds Class 3 Lie#521424		
Moyer, Carolyn 541-416-3638 *Covenant Care An Adult Residential Home* 960 NE Manzanita St Prineville, OR 97754	2 beds Class 3 Lie# 525252		
Smith, Mark 541-362-5137 *Mt View Care Home 1* 780 NW Martingale Rd Prineville, OR 97754	5 Beds Class 2 Lie# 524143		
Smith, Mark 541-447-5773 *Mt View Care Home 11* 820 NE Oehoeo Avenue Prineville, OR 97754	5 beds Class 3 Lie# 524544		

Whitehurst, Marilyn *Whitehurst Adult Care* 549 NW 5th St Prineville, OR 97754	541-447-3291	5 beds Class 3 Lie# 516099
Wood, Andrea *Martingale House* 282 Willow Ave Prineville, OR 97754	541-416-8477	4 Beds Class 2 Lie# 524974

Residential Care Facilities – Central Oregon

Name	Phone Number	Case Manager
Alterra Clare Bridge 1099 NW Watt Way - Bend 97701	541-385-4717	
Amorosa House 175 NE 16th Bldg "A" - Madras 97741	541-475-5301	
Ashley Manor 2853 Conners - Bend 97701	541-383-4400	
Ashley Manor 572 NE Oak St. - Madras 97741	541-475-7635	
Ashley Manor 228 SW Meadowlakes Dr -Prineville 97754	541-447-5816	
Ashley Manor 1600 SW Rimrock Way -Redmond 97756	541-504-8855	
Aspen Ridge Alzheimers 1025 NE Purcell -Bend 97701	541-385-8500	
Bend Villa Court 1801 NE Lotus -Bend, 97701	541-389-0046	
Mt Bachelor Memory Care **20225 Powers Rd – Bend 97702**	541-233-5054	
Prairie House **51480 Morson, LaPine - 97739**	541-536-8559	
Touchmark Mt Bachelor Village 19800 SW Touchrnark Way - Bend, 97702	541-383-1515	**Private**

Assisted Living Facilities – Central Oregon

Name	Phone Number	Case Manager
Aspen Court 470 NE Oak - Madras, Or 97741	541-475-6425	**Private**
Aspen Ridge Retirement 1025 NE Purcell -Bend, 97701	541-385-8500	
Awbrey House 2825 Neff Road -Bend, OR 97701	541-317-8464	**Private**
Brookside Place 3550 SW Canal Blvd., Redmond, 97756	541-504-1600	
The Carriage House 150 Williamson Dr. - Prineville, 97754	541-416-0500	**Private**

Cougar Springs 1942 SW Canyon Dr. - Redmond, 9775	541-316-4400
East Cascade 175 NE 16th - Madras, 97741	541-475-5303
Fox Hollow 2599 Studio Rd NE - Bend, 97701	541-383-2030
The Heights 3000 SW 23rd - Redmond, 97756	541-923-5452
High Desert 2660 NE MaryRose - Bend, 97701	541-312-2011
High Lookee Lodge 2321 Ollalie Lane - Warm Springs, 97761	541-553-1182
Ochoco Village 830 NE Elm Street – Prineville, 97754	541-416-3600
Prairie House 51485 Morson St. - LaPine, 97739	541-536-8559
The Summit 127 SE Wilson Ave - Bend, 97701	541-317-3544

Central Oregon Nursing Home Facilities

	TC		TC
Cascade View Nursing and Alzheimer's Care Center 541-382-7161 119 SE Wilson - Bend, 97702		**Pilot Butte Rehab** 541-382-5531 (Central Oregon Healthcare) 1876 NE Hwy 20 - Bend, 97701	
Bend Transitional Care 541-382-0479 2366 NW Lakeside PL - Bend, 97701		**East Cascade Living Center** 541-475-3882 175 16th St, Bldg E. - Madras, 97734	
Ochoco Nursing Home 541-447-7667 950 NE Elm St. - Prineville, 97754		**Redmond Health Care Center** 541-548-5066 3025 Reservoir Dr. - Redmond, 97756	

Classification of Adult Foster Homes

Classification	Qualifications of provider	Type of care provided
Class I	Less than two years experience providing direct care. Completion of basic training course.	Residents may need assistance in up to four activities of daily living (ADLs)
Class II	Two or more years experience providing direct care. Completion of basic training	Residents may need assistance in all ADLs, but are dependant in no more than three.

	course.	
Class III	Health care professionals or others with at least three years experience providing care to people who are dependant. Completion of basic training course.	Residents may be dependant in four or more ADLs. The home may have only one resident at a time who is totally dependant.

DHS may allow, by written exception, a person to live in any classification of a home. The provider must be able to meet your needs, the needs of the other residents, and all health and safety standards.

You are encouraged to check the public records of any home and review information regarding substantiated complaints. If you have any questions contact Aging *and People with Disabilities* office at 541-548-2206.

ATTACHMENT 4: CWPP MAP

This page intentionally left blank. See next page for a map from the CWPP that shows the CWPP subregions and SB 360 ratings. For more information see the community wildfire protection plan located on the Project Wildfire website: http://www.projectwildfire.org/

GREATER BEND CWPP BOUNDARY - SB360 RATINGS

NORTH

NORTHWEST

NORTHEAST

WEST - UGR

EAST - UGR

WEST

SOUTHEAST

SOUTHWEST

CROOK COUNTY

UPPER TUMALO RESERVOIR

THREE CREEK LAKE

Bend Drinking Water Protection Area

TUM LAKE

TUMALO LAKE

HWY 20

HWY 97

CLINE FALLS RD

SW CANAL BLVD

OLD BEND REDMOND HWY

POWELL BUTTE HWY

COOLEY RD

ROBAL RD

RODRIGUEZ RD

LOS RILEY RD

N 1ST ST

EMPIRE AVE

POYDACRES RD

BUTLER MARKET RD

ALFALFA MARKET RD

WILLARD RD

NEFF RD

NE 27TH ST

NE 8TH ST

NW 14TH ST

NW 9TH ST

NW WALL ST

SKYLINERS RD

SIMPSON AVE

SW CENTURY DR

SW REED MARKET RD

SW WILSON AVE

SE 9TH ST

BEAR CREEK RD

SE 15TH ST

SE 27TH ST

POWERS RD

CENTURY DR

BROOKSWOOD BLVD

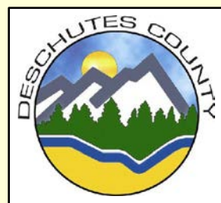
KNOTT RD

BAKER RD

CENTURY

3RD

BEND



Map Prepared by Deschutes County
Information Technology Department
Melinda Campbell
14 NW Kearney Avenue
Bend, OR 97701
541-617-4730

Legend

- Bend CWPP - Subregions
- Bend Drinking Water Protection Area

SB360 Rating

- High
- Extreme
- High Density Extreme

0 1.5 3 6 Miles

NORTH

1:143,510

1/12/2011

La Pine Addendum – to be provided

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CITY OF REDMOND ADDENDUM

Introduction

This document serves as the City of Redmond's Addendum to the Deschutes County Natural Hazard Mitigation Plan (NHMP). The City's Addendum is considered part of the county's multi---jurisdictional plan, and meets the following requirements: (1) Multi---jurisdictional Plan Adoption §201.6(c)(5), (2) Multi---jurisdictional Participation §201.6(a)(3), (3) Multi---Jurisdictional Risk Assessment §201.6(c)(2) (iii), and (4) Multi---jurisdictional Mitigation Strategy §201.6(c)(3) (iv).

A description of the city specific planning and adoption process follows; for detailed information see Volume IV, Appendix B. Information about the city's risk relative to the county's risk to natural hazards is documented in this addendum's Hazard Analysis and Issue Identification section. The section considers how the city's risk differs from or matches that of the county's; additional information on Risk Assessment is provided within Volume I, Section 2 of this NHMP. The community's mitigation strategy is provided herein along with community specific action items; action items that have a city role but are identified at the County level are provided in Volume I, Section 3 and Volume IV, Appendix A.

How was the Plan Developed?

The NHMP was developed by the Deschutes County Natural Hazard Mitigation Plan steering committee, while this addendum was created by the City of Redmond steering committee. The Deschutes County Emergency Manager was designated as the NHMP's convener and will take the lead in implementing, maintaining and updating the plan. Locally, Deborah McMahon, Redmond Principal Planner, convened a local steering committee for the purpose of developing the city's addendum.

The local steering committee was closely involved throughout the development of the plan and served as the local oversight body for the plan's development. The local steering committee met formally on one occasion: January 28 2015 (see Appendix B for more information). Steering committee members contributed data and reviewed, and provided guidance towards the community profile, risk assessment, mitigation strategy (action items), and implementation and maintenance plan. The addendum reflects effort from the formal meeting and during subsequent informal meetings between members of the steering committee and with OPDR.

An open public involvement process is essential to the development of an effective plan. In order to develop a comprehensive approach to reducing the effects of natural disasters, the planning process should include opportunities for the public, neighboring communities, local and regional agencies, as well as, private and non---profit entities to comment on the plan.[1]

[1] Code of Federal Regulations, Chapter 44. Section 201.6, subsection (b). 2015

OPDR provided a publicly accessible project website for the general public to provide feedback on the draft NHMP via a web form. In addition, Deschutes County and the City of Redmond provided press releases on their websites to encourage the public to offer feedback on the plan update and news outlets reported on the update effort.[2]

In addition, OPDR administered a public opinion survey to obtain additional input from the public regarding the county's risks, vulnerabilities, hazards history, and mitigation strategies. See Volume IV, Appendix F for more information.

Updating the mitigation plan is a requirement to gain eligibility for the Federal Emergency Management Agency's Pre---Disaster Mitigation, Hazard Mitigation, and Flood Mitigation Assistance grant Programs. This project is funded through the Federal Emergency Management Agency's (FEMA) FY12 Pre---Disaster Mitigation Competitive Grant Program (PDMC – PL---10---OR---2012---002).

The Redmond Addendum to the Deschutes County NHMP was adopted on [insert date] and the NHMP was approved by FEMA on [insert date].

For more information on the composition of the steering committee and the process see this NHMP's Volume I, Acknowledgements and Executive Summary, and Volume IV, Appendix B.

Action Item Matrix

The City's action items were developed through a two---stage process during the 2015 NHMP development. In stage one, OPDR facilitated a work session with the steering committee to discuss the city's risk and to identify potential issues. In the second stage, OPDR, working with the local steering committee, developed potential actions based on the hazards and the issues identified by the steering committee. In addition, there are 15 County Action Items that include Redmond as an "Affected Jurisdiction".

The City's actions are listed below in matrix format. For more detailed information on each action, see the action forms within Attachment 1 of this addendum. For additional information on the County actions affecting the city see Volume I, Section 3 and Volume IV, Appendix A.

[2] MyCentralOregon.com, "Redmond's Disaster Plan is Being Updated", accessed June 10, 2015, http://www.mycentraloregon.com/2015/06/10/redmonds---disaster---plan---is---being---updated/

Table RA-1 City of Redmond Action Items

2015 Action Item	High Priority	Mitigation Action Title	Champion	Partner Organization(s)	Timeline*	Status
Multihazard #1	X	Participate in emergency preparedness and disaster planning with the County, Redmond School District and other organizations to ready the City and Citizens for emergency situations.	Community Development	Internal: Police Department, Public Works External:Deschutes County Emergency Services, Redmond F & R	ShortHTerm	New
Earthquake #1	X	Examine the airport facility needs related to emergency preparedness and its regional designation in the Oregon Resiliency Plan and the Cascadia Event.	Redmond Airport	Internal: Community Development, Engineering, Public Works External: Deschutes County Community Development, Emergency Services	ShortHTerm	New
Flood #1		Complete a stormwater drainage study and mitigate problem areas.	Public Works	Internal: Community Development External: OWRD	LongHTerm	Ongoing

Source: City of Redmond NHMP Steering Committee, 2015

* = Short---Term (1---2 years), Long---Term (3---5 years)

How Will the Plan be Implemented?

The City Council will be responsible for adopting the City of Redmond addendum to the Deschutes 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 considered part of the county plan, the city will look for opportunities to partner with the County to maintain the plan, and coordinate mitigation efforts through the implementation of action items, etc. The City's steering committee will convene after re---adoption of the City of Redmond addendum on the same semi---annual schedule as the county. The City's Principal Planner and Public Works Director will serve as the conveners and will be responsible for convening the local steering committee. The convener will also remain active in the County's planning process. The steering committee will seek to involve senior staff and decision makers throughout the duration of the five---year implementation and maintenance of the NHMP addendum.

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 Redmond 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.

The City of Redmond currently has the following plans that relate to natural hazard mitigation:

Table RA-2 Existing Plans

Jurisdiction	Document	Year
City of Redmond	Comprehensive Plan	2015
City of Redmond	Development Code (no mapped SFHA)	2015
City of Redmond	Transportation Master Plan	2009
City of Redmond	Greater Redmond CWPP*	2011
City of Redmond	Wastewater (Collection System) and Water System Master Plan	2007

Source: City of Redmond, Note: The Comprehensive Plan was last amended in 2007.

The steering committee and the community's leadership have the option to add or implement action items at any time. This allows the steering committee to consider mitigation strategies as new opportunities arise, such as funding for action items that may not be of the highest priority. When new actions are identified, they should be documented using an action item form (see Attachment 2). Once a proposed action form has been submitted to the convener, the action will become part of the City's addendum.

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. The City Addendum along with the County Plan will be posted on---line on the University of Oregon's Scholars Bank https://scholarsbank.uoregon.edu/xmlui/handle/1794/1907 so that the public may view the plan at any time.

In addition, natural hazards information dissemination is conducted throughout the year when opportunities present themselves via the city offices and website.

Plan Maintenance

The Deschutes County Natural Hazards Mitigation Plan 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.

The remainder of this addendum includes three sections:

1. Community Profile and Asset Identification,
2. Hazard Identification and Risk Assessment, and
3. Mitigation Strategy.

COMMUNITY PROFILE
ASSET IDENTIFICATION

This section provides city specific asset identification. For information on the characteristics of Redmond, 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.

Asset Identification

The following assets were identified by the steering committee in 2015:

Critical and Essential Facilities

- City Hall – 716 SW Evergreen
- Public Works:
  - Main Facility – 243 E Antler Avenue
  - Waste Water Treatment Plant – 3100 NW 19th Street
- Police Department – 777 SW Deschutes Avenue
- Redmond Municipal Airport – 2522 SE Jesse Butler Circle

Special Districts with Offices in Redmond

- Central Electric Cooperative – 2098 N Highway 97
- Pacific Power – 1440 SE Lake Road
- Redmond Fire and Rescue
  - Station 401 Headquarters – 341 NW Dogwood
  - Station 403 Airport – 911 SE Salmon
  - Station 404 Cline Falls – 100 SE 67th Street

Redmond School District (schools located in Redmond)

Elementary Schools:

- John Tuck – 209 NW 10th Street
- Ma Lynch – 1314 SW Kalama Street
- Sage – 2790 SW Wickiup Avenue
- Tom McCall – 1200 NW Upas
- Vern Patrick – 3001 SW Obsidian

Middle Schools:

- Elton Gregory – 1220 NW Upas
- Obsidian – 1334 SE Obsidian Drive

High Schools:

- Edwin Brown Education Center, 850 W Antler Avenue
- Redmond – 675 SW Rimrock Drive
- Redmond Proficiency Academy
- Downtown: 657 Glacier Avenue
- West Campus: 2105 W Antler Avenue
- Ridgeview – 4555 SW Elkhorn Avenue

Colleges and Universities

- Central Oregon Community College – 2030 SE College Loop

Hospitals

- St. Charles Medical Center – 1253 NW Canal Boulevard

Social Service Providers

See list in Volume IV, Appendix C, *Community Profile*.

Population

Redmond's estimated population as of July 1, 2014 is 26,770 people. The city's population has grown an estimated 555 people or 2.1% since the 2010 Census[3]. Redmond's acknowledged Coordinated Population Forecast is 45,724 people by the year 2025, which represents an increase of 19,134 people or 72% between 2013 and 2025.[4]

Land Use

The City of Redmond's acknowledged comprehensive plan is the "Redmond Urban Area 2020 Comprehensive Plan". The Oregon Land Conservation and Development Commission first acknowledged the plan in 1979. The City last completed a major update of the plan in 2001. Since that time, the City has updated the plan in 2006 (ORD 2006---09) and 2007 (ORD 2007---08). The City implements the plan through the Redmond Development Code, which was last updated in 2015.

Redmond has been chosen as a pilot community by the Department of Land Conservation and Development to enact the process that is provided in Oregon Administrative Rules 660---

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[3] Portland State University, Population Research Center, "Annual Population Estimates", 2014.

[4] 2004 Coordinated Population Forecast for Deschutes County – updated 2009

024---0045 to preserve large industrial lots for a regional large lot industrial need. The area chosen for this is just south of the current Redmond UGB and south of the Deschutes County Fairgrounds. On May 7, 2105, the Central Oregon Intergovernmental Council unanimously voted to endorse the South Redmond Tract as the first site in the Regional Large Lot Industrial program. With this endorsement, the property owner, Department of State Lands, will start a UGB amendment process and request annexation into the city limits and rezoning to the Large Lot Industrial described in the Oregon Administrative Rules (OARs) above. The site is about 1,000 acres and would require a UGB expansion, which is slated for later in 2015.

Building activity is rebounding and approaching robust levels for housing, followed by industrial and a somewhat lagging commercial sector. Redmond is developing a strong family---oriented culture with a full range of services for the growing population.

Redmond Park and Recreation District

The Redmond Park's Division operates and maintains 23 parks and open spaces, and 3.75 miles of trail.[5] The city's parks include five (5) mini parks (3.4 acres), nine (9) neighborhood parks (37 acres), two (2) community parks (100 acres), two (2) natural resources areas (207 acres), and four (4) special use parks, including the Juniper Golf Course (185 acres).[6]

Economy

Redmond is one of the fastest growing cities in Deschutes County. The community has a fast growing manufacturing sector (growing 22% in employment over the last three years)[7]. The growing traded sector industries in Redmond include[8]:

- Bioscience;
- Aviation and Aerospace Manufacturing;
- Specialty manufacturing;
- Building Products Manufacturing;
- Corporate and Administrative Office Centers; and
- Food Manufacturing.

The seasonally adjusted unemployment rate for Deschutes County was 6.5% in February 2015. The number of employed persons was 75,831, and the civilian labor force was 81,516. Total nonfarm payroll employment in February 2015 was 70,050.

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[5] 2030 Parks Master Plan Update, January 2008.

[6] Ibid.

[7] Economic Development for Central Oregon website, https://www.edcoinfo.com/, accessed April 28, 2015.

[8] Ibid,

Cultural and Historic Resources

The sites and structures listed below (Table RA---3) represent the city's official list of historic places compiled by the city and county, and approved by the Oregon Land Conservation and Development Commission.[9]

Table RA-3 Historic Sites – City of Redmond

Historic Site/ Name	Location
Fred Atkinson Building	5353537 S. 6th St.
J.D. Butler Building	453 S. 6th St.
Burdick Building Site	357 W. 6th St.
Theron Beogher Cottage	422 S.W. 13th St.
Presbyterian Community Church	641 S.W. Cascade Ave.
Ehret Brothers Store	251 S. 6th St.
B.H. & A.T. McMickle House	614 N.W. Cedar Ave.
Milton Odem House*	623 S.W. 12th St.
Redmond Union High School	437 S.W. 9th St.
Lew A. Smith House	1329 S.W. Evergreen
The New Redmond Hotel*	521 S. 6th St.
Joseph A. Wilcox House	636 N.W. Cedar Ave.
WWII Airport Hanger	Sisters Avenue
Francis McCormack Allen House **	655 S.W. 7th St.
John F. Hosch House**	511 S.W. 12th St.
Fritz Landaker Building**	457 S. 6th St.
Alfred Munz House**	404 E. Forest Ave.
Redmond Schoolhouse **	1429 W. Antler Ave.

Source: Redmond Comprehensive Plan, 2007; Houser, Michael, Deschutes County Historical Planner
* Site on the National Register of Historic Places
** Site designated as of Historical Interest

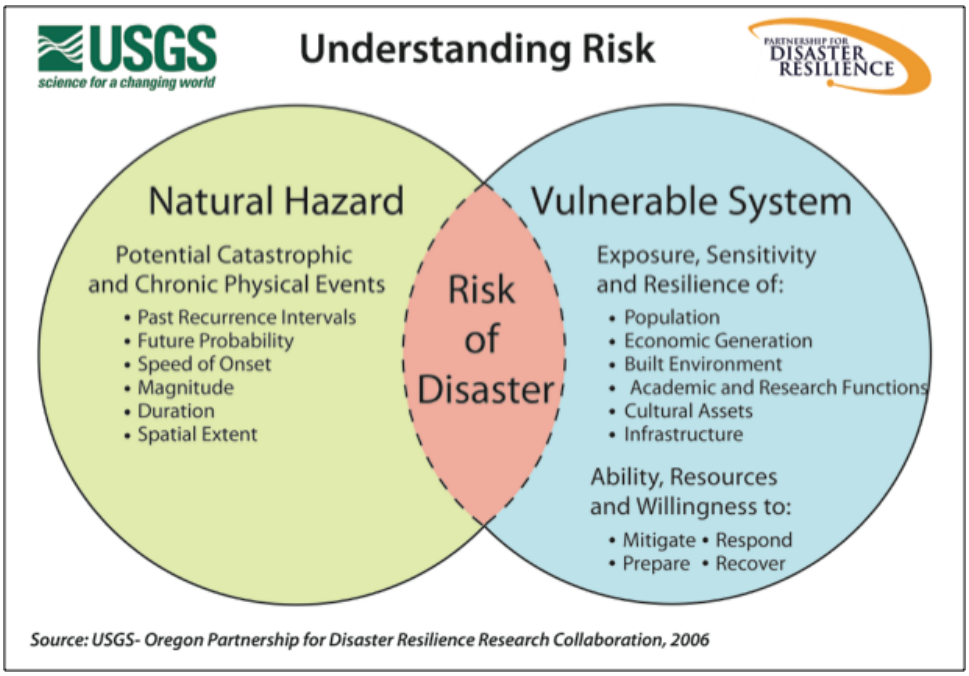
[9] Redmond Area General Plan, 1998.

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 information presented below, along with hazard specific information presented elsewhere in this addendum, within the Hazard Annexes (Volume II), and community characteristics presented in the Community Profile (Appendix C), will be used as the local level rationale for the risk reduction actions identified in this addendum. The risk assessment process is graphically depicted in Figure RA---1 below. Ultimately, the goal of hazard mitigation is to reduce the area where hazards overlap vulnerable systems.

Figure RA-1 Understanding Risk



Source: Oregon Partnership for Disaster Resilience

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 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

On January 28, 2015, the City of Redmond addendum 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 the City of Redmond, which are discussed throughout this addendum.

Table RA---4 shows the HVA matrix for Redmond 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.

Table RA-4 Hazard Analysis Matrix – City of Redmond

Hazard	History	Probability	Vulnerability	Maximum Threat	Total Threat Score	Hazard Rank	
Winter Storm	20	70	50	90	230	# 1	
Earthquake (Cascadia)	2	49	40	100	191	# 2	*Top*
Windstorm	16	63	20	80	179	# 3	*Tier*
Volcano	2	21	50	100	173	# 4	
Wildfire	6	35	40	40	121	# 5	*Middle*
Drought	8	56	15	30	109	# 6	*Tier*
Earthquake (Crustal)	2	7	5	80	94	# 7	
Flood	2	7	5	10	24	# 8	*Bottom*
Landslide	2	7	5	10	24	# 8	*Tier*

Source: City of Redmond NHMP Steering Committee, 2015.

Two chronic hazards (winter storm, and windstorm) and two catastrophic hazards (Cascadia earthquake and volcano) rank as the top four hazard threats to the city (Top Tier). The wildfire, drought, and crustal earthquake hazards comprise the next three highest ranked hazards (Middle Tier), while flood and landslide hazards comprise the lowest ranked hazards (Bottom Tier).

Table RA---5 categorizes the probability and vulnerability scores from the hazard analysis for the city and compares the results to the assessment completed by the Deschutes County NHMP Steering Committee (areas of difference are noted with **bold** text within the city ratings).

Table RA-5 Probability and Vulnerability Comparison

	Redmond		County	
Hazard	**Probability**	**Vulnerability**	**Probability**	**Vulnerability**
Drought	High	Low	High	Low
Earthquake (Cascadia)	Moderate	High	Moderate	High
Earthquake (Crustal)	Low	Low	Low	Low
Flood	**Low**	Low	High	Low
Landslide	Low	Low	Low	Low
Volcano	Low	High	Low	High
Wildfire	**Moderate**	High	High	High
Windstorm	High	Moderate	High	Moderate
Winter Storm	High	High	High	High

Source: City of Redmond NHMP Steering Committee and Deschutes County NHMP Steering Committee, 2015.

Drought

A drought is a period of drier than normal conditions that results in water---related problems. 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.

The steering committee determined that the city's probability for drought is **high** (which is the same as the county's rating) and that their vulnerability to drought is **low** (which is the same as the county's rating).

The city has ample high quality groundwater supplies fed by seven (7) production wells within the Deschutes regional aquifer. There are no issues with groundwater supply and the annual recharge to the aquifer is high and long---term water level trends show ample supply for expected population growth and water usage.[10] In addition, the city maintains five (5)

[10] CH2MHill, 2007. Wastewater (collection system) and Water System Master Plan. City of Redmond Oregon.

storage facilities (2MG each), two (2) booster pump stations, one (1) transfer pump station, and four (4) pressure reducing stations[11].

For more information on the Drought Hazard (including history and extent) see the Drought Annex in Volume II.

Earthquake

Oregon and the Pacific Northwest in general are susceptible to earthquakes from four sources: 1) the off---shore Cascadian Fault Zone; 2) deep intra---plate events within the subducting Juan de Fuca Plate; 3) shallow crustal events within the North American Plate; and 4) earthquakes associated with volcanic activity.[12]

The areas most susceptible to ground amplification and liquefaction have young, soft alluvial sediments, found along river and stream channels. The extent of the damage to structures and injury and death to people will depend upon the type of earthquake, proximity to the epicenter and the magnitude and duration of the event.

The steering committee HVA evaluated both crustal earthquakes and a Cascadia earthquake. The steering committee determined that the city's probability of experiencing a crustal earthquake is **low** (which is the same as the county's rating) and that their vulnerability to a crustal earthquake is **low** (which is the same as the county's rating). The steering committee determined that the city's (and State's) probability of experiencing a Cascadia earthquake is **moderate** (which is the same as the county's rating) and that their vulnerability to a Cascadia earthquake is **high** (which is the same as the county's rating).

Two---thirds of Redmond's building stock was built after 1990 and the codification of seismic codes. Redmond is not particularly susceptible to liquefaction, and is not expected to experience very strong to violent shaking in an earthquake event (see Volume II, Tables II---5 and II---6). As such, the city's vulnerability to earthquakes is reduced because of it's relatively new infrastructure and buildings in combination with the particular geology of the area. However, the city considers itself to have high vulnerability to a Cascadia earthquake event due to secondary effects of the hazard, including access to transportation routes, energy resources, communications, and the need to assist with refugees of the damage that is expected west of the Cascades.

Information on specific buildings' estimated seismic resistance, determined by DOGAMI in 2007, is shown in Tables RA---6 below. The table displays the rankings of all facilities within the city's jurisdiction; each "X" represents one building within that ranking category.

Of the school facilities evaluated by DOGAMI using RVS, none have very high (100% chance) collapse potential. Five (5) buildings have high (greater than 10% chance) collapse potential; however, three of these buildings are located at the former Evergreen Elementary School which is no longer used as a school facility (it is expected that these buildings will receive structural seismic upgrades and be the future home of city hall). Of the public safety

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[11] City of Redmond Website, http://www.redmond.or.us/, accessed April 28, 2015.

Taylor, George H. and Chris Hannan. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press. 1999

facilities evaluated, none have very high (100% chance) collapse potential; however, two (2) buildings have high (greater than 10% chance) collapse potential. None of the community college buildings or the hospital are rated with High or Very High collapse potentials.

Table RA-6 Rapid Visual Survey Scores

Facility	Level of Collapse Potential			
	Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Schools				
Evergreen Elem. School (437 S 9th St, Redmond)	X		XXX	
John Tuck Elementary School (209 NW 10th St, Redmond)	X	XXXX		
MA Lynch Elementary School (1314 SW Kalama St, Redmond)		XX		
Vern Patrick Elementary School (3001 SW Obsidian, Redmond)	X			
Deschutes Edge Charter School (1220 NW Upas, Redmond)			X	
Hugh Hartmant Middle School (2105 W Antler, Redmond)	X			
Obsidian Middle School (1334 SE Obsidian Ave, Redmond)			X	
Redmond High School (675 SW Rimrock Dr, Redmond)	X	XXX		
Central Oregon Community College 9 Redmond Campus				
College Center	X			
MATL	X			
One Stop Building	X			
Public Safety				
Redmond F&R Y Station 401 Headquarters (341 NW Dogwood, Redmond)	X			
Redmond F&R Y Station 403 Airport (911 SE Salmon, Redmond)			X	
Redmond F&R Y Station 404 Cline Falls (100 SE 67th St, Redmond)			X	
Hospitals				
St. Charles Medical Center Y Redmond (1253 NW Canal Blvd, Redmond)	XX			

Source: DOGAMI 2007. Open File Report 0---07---02. Statewide Seismic Needs Assessment Using Rapid Visual Assessment.

The county and cities have opted to create one action item for all the facilities that have a "high" or "very high" rating (see Appendix A). The buildings with 'high' or 'very high' collapse potential include multiple education facilities located throughout the city, all of which can play a key role in during disaster events or during long---term recovery.

For more information on the Earthquake Hazard (including history and extent) see the Earthquake Annex in Volume II.

Flood

Flooding results when rain and snowmelt creates water flow that exceed the carrying capacity of rivers, streams, channels, ditches, and other watercourses. In Oregon, flooding is most common from October through April when storms from the Pacific Ocean bring intense rainfall. Most of Oregon's destructive natural disasters have been floods.[13] Flooding can be aggravated when rain is accompanied by snowmelt and frozen ground; the spring cycle of melting snow is the most common source of flood in the region. The principal types of flood that occur in Redmond include flash floods (associated with thunderstorms) that occur frequently and may cause localized flooding that can impact development within Redmond as it did in August 2013[14]. Redmond is the only incorporated city within Deschutes County that does not have a mapped special flood hazard area (floodplain); the Deschutes River is located west of the city. However, the city does have a canal that runs through the city as part of the Central Oregon Irrigation District's (COID) Pilot Butte Canal (running from Bend, through Redmond to Terrebonne).

The steering committee determined that the city's probability for flood is **low** (which is lower than the county's rating) and that their vulnerability to flood is **low** (which is lower than the county's rating).

National Flood Insurance Program (NFIP)

The Deschutes County Flood Insurance Rate Maps (FIRMs) were modernized in 2007 and do not include a special flood hazard area for Redmond. The table below shows that as of November 2014, Redmond has zero (0) National Flood Insurance Program (NFIP) policies in force and no paid claims. The city has never had a Community Assistance Visit (CAV) and is not a member of the Community Rating System (CRS). The community repetitive flood loss record for Redmond does not include any repetitive flood loss, or severe repetitive flood loss, buildings and has not had any repetitive loss claims.

Table RA-7 Flood Insurance Detail

Jurisdiction	Current FIRM Date	Initial FIRM Date	Total Policies	Pre:FIRM Policies	Policies by Building Type				Minus Rated A Zone
					Single Family	2 to 4 Family	Other Residential	Non: Residential	
Redmond	9/28/07	9/28/07	0	0	0	0	0	0	0

Jurisdiction	Insurance in Force	Total Paid Claims	Pre:FIRM Claims Paid	Substantial Damage Claims	Repetitive Loss Buildings	Severe Repetitive Loss Buildings	Total Paid Amount	CRS Class Rating	Last CAV
Redmond	$0	0	0	0	0	0	$0	NP	NA

Source: Information compiled by Department of Land Conservation and Development, November 2014.

For more information on the Flood Hazard (including history and extent) see the Flood Annex in Volume II.

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[13] Taylor, George H. and Chris Hannan. *The Oregon Weather Book*. Corvallis, OR: Oregon State University Press. 1999

[14] "Redmond couple's home hit by flooding" KTVZ News, accessed April 29, 2015, http://www.ktvz.com/news/redmond---couples---home---hit---by---flooding/21678364

Landslide

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. In a landslide, two forces are at work: 1) the driving forces that cause the material to move down slope, and 2) the friction forces and strength of materials that act to retard the movement and stabilize the slope. When the driving forces exceed the resisting forces, a landslide occurs.

The steering committee determined that the city's probability for landslide is **low** (which is the same as the county's rating) and that their vulnerability to landslide is **low** (which is the same as the county's rating).

The city has had no problems with landslides in city limits in known history and is located in a generally stable area. A few neighborhoods within the city (around the Dry Canyon) are located on steep hillsides but have not experienced problems in the past.

For more information on the Landslide Hazard (including history and extent) see the Landslide Annex in Volume II.

Volcano

The Pacific Northwest lies within the "ring of fire", an area of very active volcanic activity surrounding the Pacific Basin. Volcanic events occur regularly along the ring of fire, in part because of the movement of the Earth's tectonic plates. Volcanic events have the potential to coincide with numerous other hazards including ash fall, earthquakes, lava flows, pyroclastic flows, lahars, and debris flows, and landslides.

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 **high** (which is the same as the county's rating).

Were a volcanic event to occur in the Cascades region of Oregon, Redmond could be at risk for ash fall, depending on the severity of the event and the direction of the wind. Due to Redmond's proximity to the Three Sisters and Newberry Crater, in relation to other areas within eastern Oregon, the effects of a volcanic event may be more disruptive to normal business, economic activity, and health.

For more information on the Volcano Hazard (including history and extent) see the Volcano Annex in Volume II.

Wildfire

Wildfires occur in areas with large amounts of flammable vegetation that require a suppression response due to uncontrolled burning. Fire is an essential part of Oregon's ecosystem, but can also pose a serious threat to life and property particularly in the state's growing rural communities. Wildfire can be divided into three categories: interface, wildland, and firestorms. The increase in residential development in interface areas has resulted in greater wildfire risk. Fire has historically been a natural wildland element and can sweep through vegetation that is adjacent to a combustible home. New residents in

remote locations are often surprised to learn that in moving away from built---up urban areas, they have also left behind readily available fire services providing structural protection.

The steering committee determined that the city's probability for wildfire is **moderate** (which is lower than the county's rating) and that their vulnerability to wildfire is **high** (which is the same as the county's rating).

Compared to other areas within the county, Redmond has a lower risk to wildfire due, in part, to it's location in relation to irrigated agricultural land. The Greater Redmond Area Community Wildfire Protection Plan (CWPP, October 2011, to be updated in 2016) relies upon (1) the Oregon Department of Forestry Assessment of Risk Factors and (2) the classification ratings of individual areas under the Oregon Forestland---Urban Interface Fire Protection Act of 1997 (Senate Bill 360) to determine fire risk within the Greater Redmond Wildland---Urban Interface (WUI). According to the Senate Bill 360 ratings all Redmond WUI communities (see Attachment 3) are rated as High fire risk. According to the ODF Assessment all urban areas within the Greater Redmond WUI are rated with a Moderate probability of wildfire risk occurring (except for the urban southwest which is rated High) and Low vulnerability[15]. The first priority areas for hazardous fuel treatments identified within the CWPP include the urban northwest community (the three other urban communities are listed as second priority)[16]. For more information on wildfire risk and fuels reduction projects see the Greater Redmond Area CWPP and visit the Project Wildfire website: http://www.projectwildfire.org/.

Table RA-8 Wildfire Communities and ODF and SB 360 Hazard Ratings

Community at Risk	Acreage	Homes	Estimated Population	ODF		SB 360	
				Probability	Vulnerability	High	Extreme
Northeast	13,797	815	2,038	Moderate	Low	97.9%	2.1%
Southeast	26,354	116	290	High	Low	100.0%	0.0%
Northwest	34,809	2,677	6,692	Moderate	Low	93.5%	6.5%
Southwest	20,388	2,437	6,092	High	Low	97.0%	3.0%
Urban Northeast	3,263	961	2,402	Moderate	Low	100.0%	0.0%
Urban Southeast	4,462	500	1,250	Moderate	Low	100.0%	0.0%
Urban Northwest	3,351	3,139	7,848	Moderate	Low	100.0%	0.0%
Urban Southwest	4,579	5,459	13,648	High	Low	100.0%	0.0%
Total	**111,003**	**16,104**	**40,260**	=	=	**97.2%**	**2.8%**

Source: Greater Redmond CWPP compiled Tables 1, 2, and 5
Note: Estimated population is based on Deschutes County's estimate formulated as 2.5 x the number of homes.

For more information on the Wildfire Hazard (including history and extent) see the Wildfire Annex in Volume II and the Greater Redmond CWPP.

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[15] The ODF Assessment takes into account the likelihood of a fire occurring, hazard rating, protection capability, human and economic values protected, structural vulnerability to determine the overall score. For detailed information review the CWPP available on the Project Wildfire website: http://www.projectwildfire.org/

[16] Greater Redmond CWPP, 2011.

Windstorm

A windstorm is generally a short duration event involving straight---line winds and/or gusts in excess of 50 mph. Although windstorms can affect the entirety of Deschutes 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 tons of storm related debris.

The steering committee determined that the city's probability for windstorm is **high** (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).

Historical wind events have uprooted trees, damaged roofs and windows, and damaged utility lines. Windstorms have not caused disastrous local damage but are a persistent problem. Windstorms are often associated with microbursts (thunderstorms). A primary windstorm vulnerability for the community is damage to utility lines, including fiber optics, which are key to the economic sectors of the community.

For more information on the Windstorm Hazard (including history and extent) see the Windstorm Annex in Volume II.

Winter Storm

Severe winter storms can consist of rain, freezing rain, ice, snow, cold temperatures, and wind. They originate from troughs of low pressure offshore that ride along the jet stream during fall, winter, and early spring months. Severe winter storms affecting Deschutes County typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from November through March.

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).

Redmond is located at a higher elevation east of the Cascades, which is a major contributor to winter storms. Major winter storms can and have occurred in the Redmond area, and while they typically do not cause significant damage; they are frequent and have the potential to impact economic activity. Road closures on Highway 97, or the passes to the Willamette Valley (Highways 58 and 126), due to winter weather are a common occurrence and can interrupt commuter and large truck traffic. The city budgets funds for seasonal winter storm needs, such as clearing roads.

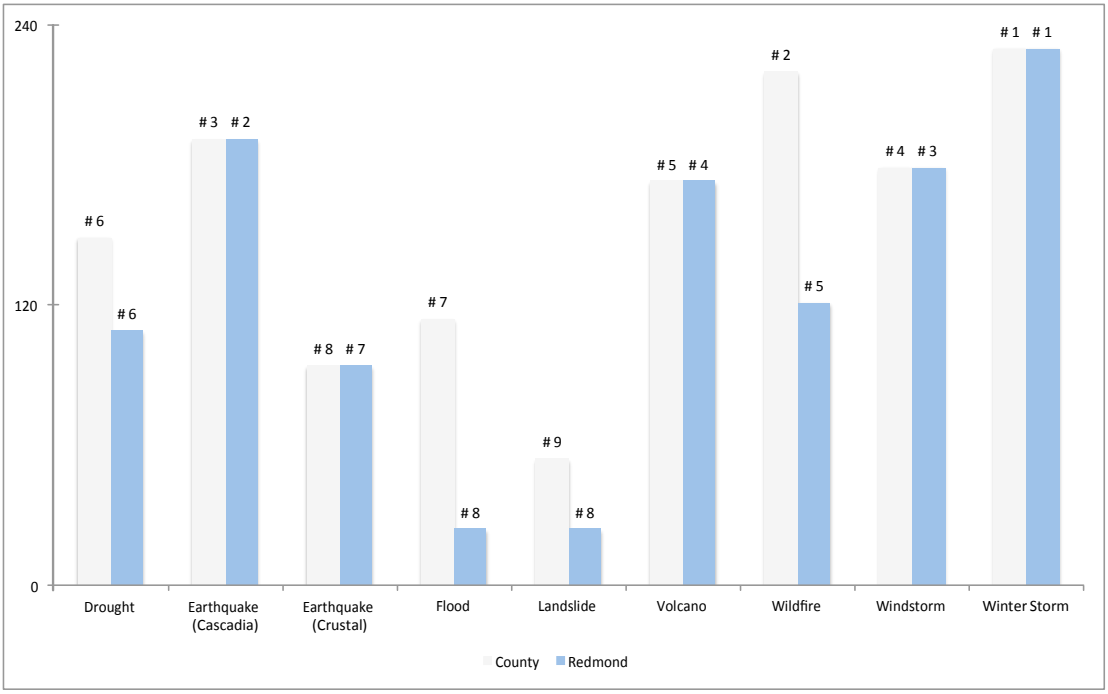
For more information on the Winter Storm Hazard (including history and extent) see the Winter Storm Annex in Volume II.

Summary

The figure below presents a summary of the hazard analysis for the City of Redmond and compares the results to the assessment completed by the Deschutes County NHMP Steering Committee.

In terms of history, probability, vulnerability, and maximum threat, the hazard analysis for the city overall rated their threat to the drought, flood, landslide, and wildfire hazards lower than the county while all other hazards were rated the same as the county's ratings.

Figure RA-2 Overall Hazard Analysis Comparison – Redmond and Deschutes County



Source: City of Redmond NHMP Steering Committee and Deschutes County NHMP Steering Committee, 2015.

MITIGATION STRATEGY

Mitigation Plan Mission

The plan mission states the purpose and defines the primary functions of Deschutes County's NHMP. It is intended to be adaptable to any future changes made to the plan and need not change unless the community's environment or priorities change.

The mission of the Deschutes County NHMP is:

> *To promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property, and the environment from natural hazards.*

This can be achieved by increasing public awareness, documenting the resources for risk reduction and loss---prevention, and identifying activities to guide the county towards building a safer, more disaster resistant community.

The Redmond steering committee reviewed the 2015 NHMP plan mission statement and agreed it accurately describes the overall purpose and intent of this plan. The Steering Committee believes the concise nature of the mission statement allows for a comprehensive approach to mitigation planning.

Mitigation Plan Goals

Mitigation plan goals are more specific statements of direction that Deschutes County citizens, and public and private partners can take while working to reduce the county's risk from natural hazards. These statements of direction form a bridge between the broad mission statement and particular action items. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items.

The Redmond Addendum steering committee reviewed and agreed to the 2015 Deschutes County NHMP plan goals. All the plan goals are important and are listed below in no particular order of priority. Establishing community priorities within action items neither negates nor eliminates any goals, but it establishes which action items to consider to implement first, should funding become available. Below is a list of the 2015 NHMP goals:

Goal 1: *Protect life and reduce injuries resulting from natural hazards.*

Goal 2*: Minimize public and private property damages and the disruption of essential infrastructure and services from natural hazards.*

Goal 3: *Implement strategies to mitigate the effects of natural hazards and increase the quality of life and resilience of economies in Deschutes County.*

Goal 4: *Minimize the impact of natural hazards while protecting, restoring, and sustaining environmental processes.*

Goal 5: *Enhance and maintain local capability to implement a comprehensive hazard loss reduction strategy.*

Goal 6: *Document and evaluate progress in achieving hazard mitigation strategies and action items.*

Goal 7: *Motivate the public, private sector, and government agencies to mitigate the effects of natural hazards through information and education.*

Goal 8: *Apply development standards that mitigate or eliminate the potential impacts of natural hazards.*

Goal 9: *Mitigate damage to historic and cultural resources from natural hazards.*

Goal 10: *Increase communication, collaboration, and coordination among agencies at all levels of government and the private sector to mitigate natural hazards.*

Goal 11: *Integrate local NHMPs with comprehensive plans and implementing measures.*

(Note: although numbered the goals are not prioritized.)

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 figure below illustrates some of these sources. A description of how the plan's mitigation actions were developed is provided below.

Figure RA-3 Development of Action Items

Source: Oregon Partnership for Disaster Resilience (2008)

Action Item Worksheets

Each action item 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 within Volume I, Section 3 (Mitigation Strategy). The City specific action item worksheets are located in Attachment 1, *Action Item Forms*.

The City is also a party to several actions described in the County NHMP; each jurisdiction listed on the County Action Item Forms as an "Affected Jurisdiction" will contribute to and work towards completion of that action as it pertains to their jurisdiction. **There are 15 County Action Items that included Redmond as an "Affected Jurisdiction".** For detailed information on each County level action item form see Volume I, Section 3, *Mitigation Strategy* and Volume IV, Appendix A, *Action Item Forms*.

Action Item Development Process

Development of action items was a multi---step, iterative process that involved brainstorming, discussion, review, and revisions. Action items were developed by the steering committee and were influenced by actions identified as part of the Sustainable City Year work program. A number of actions identified by the County steering committee include the City as an affected jurisdiction; these actions are broad actions that include implementation components at both the county and city level. All actions were reviewed by the committee and revised as necessary before becoming a part of this document.

ATTACHMENT 1:
ACTION ITEM FORMS

Action Item Forms

The action item forms portray the overall action plan framework and identify linkages between the plan goals, partnerships (coordination and partner organizations), and actions. Table RA---9 provides a list of actions for the city. The pages that follow include individual forms for each mitigation action.

Table RA-9 Mitigation Actions

Action Item	High Priority	Timeline	Status	Related Hazards							
				Drought	Earthquake	Flood	Landslide	Volcano	Wildfire	Windstorm	Winter Storm
MH #1	X	Short'Term	New	X	X	X	X	X	X	X	X
EQ #1	X	Short'Term	New		X						
FL #1		Long'Term	New			X					

Source: City of Redmond NHMP Steering Committee

Mitigation Action: Multi---hazard #1 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Participate in emergency preparedness and disaster planning with the County, Redmond School District and other organizations to ready the City and Citizens for emergency situations.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
City/ County Comprehensive Plans and Development Codes
Rationale for Proposal (Why is this important?):
Public awareness of external events and how to prepare for and deal with them is critical to community preparedness.

Ideas for Implementation (How will it get done?):	**Action Status Report**
The department will work with the U of O Sustainable Cities Initiative in developing a comprehensive emergency preparedness plan for the Cascadia Event.	**Added in 2015**

Champion/ Responsible Organization:	Community Development

Internal Partners:	**External Partners:**
Police Department, Public Works	Deschutes County Emergency Services, Redmond F & R

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Sustainable City Year --- Budgeted	$15,000	■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Earthquake #1 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Examine the airport facility needs related to emergency preparedness and its regional designation in the Oregon Resiliency Plan and the Cascadia Event.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
Airport Master Plan, Comprehensive Plan, Facilities Plan
Rationale for Proposal (Why is this important?):
Redmond's airport serves all of central Oregon and is the site of the command center.

Ideas for Implementation (How will it get done?):	**Action Status Report**
Examine operational readiness and development of the emergency plans.	**Added in 2015**
Program needed expansion and key maintenance effots.	**Added in 2015**

Champion/ Responsible Organization:	Redmond Airport

Internal Partners:	**External Partners:**
Community Development, Engineering, Public Works	Deschutes County Community Development, Deschutes County Emergency Services

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Local Resources --- Grants, Bonds	To be determined	■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Mitigation Action: Flood #1 **(What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
Complete a stormwater drainage study and mitigate problem areas.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Alignment with Existing Plans/Policies:
Stormwater Master Plan
Rationale for Proposal (Why is this important?):
Flash floods due occur in Redmond and have the potential to damage structures; the most recent large event occurred in August 2013 and the event of record occurred on June 10---17, 2006. The event of record caused flooding in the streets of downtown and other parts of Redmond. The City does not have an extensive stormwater collection system, rather the city has uses underground injection controls (dry wells) and valved interconnections between the storm and sanitary system. During large storm events street flooding is relieved by opening valves to divert stormwater to gravity sanitary sewer pipelines as allowed per the city's discharge permit for the Redmond WPCF. Other areas are relieved with the use of the city's vacuum trucks. (Redmond Wastewater (Collection System) and Water System Master Plan, 2007)

Ideas for Implementation (How will it get done?):	**Action Status Report**
Update existing Stormwater Master Plan	**Added in 2015**

Champion/ Responsible Organization:	Public Works

Internal Partners:	**External Partners:**
Community Development, Engineering	Oregon Water Resources Department

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
SDC's, grants, Local Resources	$125,000	■ Ongoing ■ Short Term (1---2 years) ■ Long---Term (3---5 years)

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

ATTACHMENT 2:
ACTION ITEM FORM TEMPLATE

Mitigation Action:[Number] **Mitigation Action:: (What do we want to do?)**	**Alignment with Plan Goals:**	**High Priority Action Item?**
	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11	☐ Yes
Alignment with Existing Plans/Policies:		
Rationale for Proposal (Why is this important?):		
Ideas for Implementation (How will it get done?):	**Action Status Report**	
Champion/ Responsible Organization:		
Internal Partners:	**External Partners:**	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
		☐ Ongoing ☐ Short Term (1---2 years) ☐ Long---Term (3---5 years)
Form Submitted by:		
Action Item Status:		

ATTACHMENT 3: CWPP MAP

This page intentionally left blank. See next page for a map from the CWPP that shows the CWPP subregions. For more information see the community wildfire protection plan located on the Project Wildfire website: http://www.projectwildfire.org/

COMMUNITY WILDFIRE PROTECTION PLAN BOUNDARY

JEFFERSON COUNTY

CROOK COUNTY

NORTHWEST

NORTHEAST

URBAN NORTHWEST

URBAN NORTHEAST

HIGHLAND

URBAN SOUTHWEST

URBAN SOUTHEAST

SOUTHWEST

SOUTHEAST

HWY 97

NE SMITH ROCK WAY

HWY 126

NW MAPLE AVE

NE NEGUS WAY

5TH

NW CANAL BLVD

NE 9TH ST

SE VETERANS WAY

SW 27TH ST

SW AIRPORT WAY

SW CANAL BLVD

HWY 20

CLINE FALLS RD

HWY 97

POWELL BUTTE HWY

UPPER TUMALO RESERVOIR

DESCHUTES COUNTY
Geographic Information System

Map Prepared by Deschutes County
Information Technology Department
Melinda Fortner
14 NW Kearney Avenue
Bend, OR 97701
541-617-4730

Map Symbols

- Redmond CWPP Boundary
- NORTHEAST
- NORTHWEST
- SOUTHEAST
- SOUTHWEST
- URBAN NORTHEAST
- URBAN NORTHWEST
- URBAN SOUTHEAST
- URBAN SOUTHWEST

0 1.25 2.5 5 Miles

NORTH

1:125,000

12/18/2006

La Pine Addendum – to be provided

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Volume IV:
Mitigation Resources

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APPENDIX A:
ACTION ITEM FORMS

The following table lists the action item number, timeline, status, priority, affected jurisdictions, and applicable hazards.

Note: See addenda for each city's action item forms and action item prioritization.

Table A---1 Action Item Table of Contents and Affected Jurisdiction

				Jurisdiction					Related Hazard							
Action Item	Timeline	Status	Priority	Deschutes	Bend	La Pine	Redmond	Sisters	Drought	Earthquake	Flood	Landslide	Volcano	Wildfire	Windstorm	Winter Storm
MH #1	Ongoing	Ongoing		X	X	X	X	X	X	X	X	X	X	X	X	X
MH #2	Ongoing	Ongoing		X	X	X	X	X	X	X	X	X	X	X	X	X
MH #3	Ongoing	Ongoing		X	X	X	X	X	X	X	X	X	X	X	X	X
MH #4	Long Term	New		X	X	X	X	X		X	X	X		X	X	X
MH #5	Long Term	New		X	X	X	X	X	X	X	X	X	X	X	X	X
MH #6	Long Term	New		X	X	X	X	X							X	X
MH #7	Long Term	New		X	X	X	X	X						X	X	X
EQ #1	Long Term	Deferred		X	X	X	X	X		X						
EQ #2	Long Term	New		X	X	X	X	X		X						
FL #1	Ongoing	Ongoing		X	X	X		X			X					
FL #2	Long Term	Deferred		X	X						X					
FL #3	Ongoing	Ongoing		X	X	X		X			X					
FL #4	Long Term	Ongoing		X	X	X		X			X					
FL #5	Long Term	Ongoing		X	X	X		X			X					
FL #6	Long Term	New		X	X						X					
FL #7	Long Term	New		X				X			X					
VE #1	Long Term	Ongoing		X									X			
WF #1	Ongoing	Ongoing		X	X	X	X	X						X		
WF #2	Ongoing	Ongoing		X	X	X	X	X						X		
WF #3	Ongoing	Ongoing		X	X	X	X	X						X		
WS #1	Ongoing	Ongoing		X	X	X	X	X							X	
WS #2	Ongoing	Ongoing		X	X	X	X	X							X	
WS #3	Ongoing	Ongoing		X	X	X	X	X							X	

Note: Deschutes County has not identified highest priority action items at this time; the Steering Committee will identify prioritized actions during one of their semi---annual meetings following adoption and approval of the NHMP.

Action Item: Multi---hazard #1	**Alignment with Plan Goals:**	**High Priority Action Item?**
Integrate training and education initiatives from the Deschutes County Natural Hazards Mitigation Plan into existing regulatory documents and programs where appropriate.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond

■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

City/ County Comprehensive Plans and Development Codes

Rationale for Proposed Action Item:

The extreme population growth in the County and the region continues to bring people to the area who are not familiar with the climate, terrain, culture, etc.

Additionally, this growth has placed new demands on the capacity of existing systems of support such as volunteer fire departments, city governments, and the service industry including hospitals, Red Cross and others.

It is critical that the majority of the population be informed and skilled in mitigation efforts, particularly related to wildland fire and severe winter storms. Efforts placed in public awareness, education and training will strengthen the County's capacity to address an event should it happen; heighten understanding and knowledge of how to prevent and mitigate impacts; and strengthen the culture and sense of responsibility for life, property and safety.

Ideas for Implementation:

Public education and training for staff should routinely be conducted. Resorts and other businesses related to tourism should be included.

Distribute education materials to home and business owners that support initiatives to reduce the risk of loss from natural hazards.

Coordinating Organization:	Deschutes County Natural Hazards Mitigation Committee

Internal Partners:	**External Partners:**
Emergency Services, Community Development, County Forester, Road Department, Public Works, Cities	ODF, American Red Cross, OSU Cascades

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Partner with OSU Cascades, Local Funding Resources		■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing

Form Submitted by:	2010 NHMP Committee (Reviewed and Updated by 2015 NHMP Committee)
Action Item Status:	Ongoing

Action Item: Multi---hazard #2	**Alignment with Plan Goals:**	**High Priority Action Item?**
Pursue coordination of mitigation initiative development, planning, and resource allocation (funding).	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond

■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

City/ County Comprehensive Plans and Development Codes

Rationale for Proposed Action Item:

The County has a good history of working together and building and sustaining systems of coordination. This is a result of facing events such as severe wildland fires and winter storms historically and recently. Stakeholders developing this plan concur that placing emphasis on coordinating efforts among public--- private, geographic, and multi--- interests is a sound investment in building capacity to mitigate hazards, using all resources to their greatest potential, and providing a basis for good communication among a wide range of individuals, groups, agencies and businesses.

Ideas for Implementation:

Establish a clear role for the Deschutes County Natural Hazards Mitigation Committee that results in a sustainable process for implementing, monitoring and evaluating mitigation activities.

Integrate hazard mitigation initiatives into City and County Comprehensive Plans. Completed in 2011 for Deschutes County (review of natural hazards regulations is underway, 2015)

Integrate planning between cities and county where appropriate. Integrate

other possible natural hazards not specifically included in this plan.

Advance coordination of resource and fund development among cities and private land owners where appropriate mitigation plans mutually benefit.

Advance coordination efforts among and with home and business owners and emergency management actions that result in reducing risk of loss from natural hazards.

Coordinating Organization:	Deschutes County Natural Hazards Mitigation Committee

Internal Partners:	**External Partners:**
Emergency Services, Community Development, County Forester, Road Department, Public Works	ODF, American Red Cross, OSU Cascades, USFS

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
County and Cities, Grants, Local Funding Resources		■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing

Form Submitted by:	2010 NHMP Committee (Reviewed and Updated by 2015 NHMP Committee)
Action Item Status:	Ongoing

Action Item: Multi---hazard #3	**Alignment with Plan Goals:**	**High Priority Action Item?**
Strengthen understanding of the probability of natural hazards, by continuing to support research specific to the region.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond

■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

Central Cascades Volcano Coordination Plan (2007) Currently in process of updating 2015 CCVC Plan

Rationale for Proposed Action Item:

While indicators of the potential for earthquake and volcanic eruption events are evident, the probability of these events occurring is low based on current studies. Scientists continue to study activities surrounding these hazards and document their findings. It will continue to be a priority for this research to continue in order to learn more about the vulnerability of the region, potential impact, and recommendations for additional mitigation actions.

The Central Cascades Volcano Coordination Plan (2007) is complete but does not currently have a local champion and has not been authorized by the participating jurisdictions. Kickoff meeting was 02/27/15

Ideas for Implementation:

Continue to work with the scientific community to review existing and emerging conditions related to natural hazards identified in the Deschutes County NHMP

Integrate research findings into county and local planning efforts.

Integrate natural hazards not included in this plan that are identified by research.

Coordinating Organization:	Deschutes County Natural Hazards Mitigation Committee

Internal Partners:	**External Partners:**
--	OSU Cascades, DOGAMI, USGS, ACOE, FEMA, DLCD, OEM, University of Oregon

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
USGS, Counties (Deschutes, Jefferson, Linn, Lane), OSU Cascades, Local Funding Resources		■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing

Form Submitted by:	2010 NHMP Committee (Reviewed and Updated by 2015 NHMP Committee)
Action Item Status:	Ongoing

Action Item: Multi---hazard #4	**Alignment with Plan Goals:**	**High Priority Action Item?**
Assess Power Grid and Determine Methods to Improve Resiliency	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond

■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

Rationale for Proposed Action Item:

The County relies on a range of energy sources to support and protect local residents, businesses, and government facilities. Accordingly, secure supplies of energy (e.g., electricity, gasoline, diesel fuel, natural gas, propane) to critical facilities/infrastructure, especially during emergency events, are of crucial importance to all segments of the community. An energy assurance plan is essentially a plan for how the County will recover and restore energy services to critical functions and facilities/infrastructure within a predetermined time after a partial or complete energy supply interruption. The Plan identifies critical facilities and critical infrastructure needing back---up power generation capacity to ensure continued operation during emergency events. The Plan establishes short---term communication protocols, actions and priorities by which critical facilities/infrastructure will be re---energized after a disruption, as well as long---term strategies for making critical facilities and critical infrastructure less vulnerable to disruptions of mainline energy sources.

Ideas for Implementation:	**Actions Taken Since 2010**
Develop a Local Energy Assurance Plan	**Added in 2015.**

Coordinating Organization:	Deschutes County Emergency Services

Internal Partners:	**External Partners:**
Public Works, Planning, Roads	Utility Companies, U.S. DOE, OEM

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
FEMA PDM, U.S. Department of Energy's Local Energy Assurance Planning Initiative, other grants, Local Funding Resources		■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Action Item: Multi---hazard #5	**Alignment with Plan Goals:**	**High Priority Action Item?**
Develop continuity of operations plans to ensure continued operation in the event of a natural hazard emergency.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond

■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

City and County Emergency Operations Plans

Rationale for Proposed Action Item:

Deschutes County is vulnerable to a number of different natural hazards that could affect the administration and management of local government. Developing continuity of operations plans for the County will assist in maintaining a basic level of government to continue to provide needed services within the community.

According to the Florida Division of Emergency Management, continuity of operations is accomplished through the development of plans, comprehensive procedures, and provisions for alternate facilities, personnel, resources, interoperable communications, and vital records/databases. The plan establishes policy and guidance to ensure the execution of the organization's most essential functions in any event which requires the relocation of selected personnel and functions to an alternate facility.

Research conducted by Richard Wilson has shown that staff turnover is likely to occur after a disaster. Veteran staff is critical after a disaster. It is important to prevent turnover so that existing personnel do not have to take on extra responsibilities during an already stressful time. Continuity planning can also help lessen turnover by ensuring competitive salaries and benefits and by reducing the amount of stress staff will have to endure.

The Disaster Mitigation Act of 2000 requires communities to develop actions that reduce the impact of a natural hazard [201.6(c)(3)(ii)]. Developing a continuity of operations plan will diminish the effects of a natural disaster by providing the cities and County of Deschutes with a framework for continuing operations in a potentially chaotic situation.

Ideas for Implementation:	**Actions Taken Since 2010**
Research and review completed continuity of operations plans to provide a foundation of expected content and issues to review.	**Added in 2015.**
Utilize existing OEM Manuals and Templates available on their website (http://www.oregon.gov/OMD/OEM/pages/plans_train/coop.aspx)	**Added in 2015.**
The COOP should ensure shelter housing for critical staff and family members such as County officials, public works employees, emergency response, and others.	**Added in 2015.**

Assess and prioritize critical positions and resources vital to the continuance of important County functions.	**Added in 2015.**
Incorporate COOP into the existing Emergency Operations Plans where applicable.	**Added in 2015.**

Coordinating Organization:	Deschutes County Emergency Services		
Internal Partners:		**External Partners:**	
Public Works, Planning, Roads		OEM	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
State Homeland Security Project, Local Funding Resources			■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing
Form Submitted by:	2015 NHMP Committee		
Action Item Status:	New		

Action Item: Multi---hazard #6	**Alignment with Plan Goals:**	**High Priority Action Item?**
Develop code language to mitigate the harmful impact of hazard trees located on private and/ or vacant property.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond

■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

Deschutes County Code

Rationale for Proposed Action Item:

Educating property owners about how to prevent power outages on their private property can help reduce impacts of windstorm events on these homeowners.

Overhead electrical lines are subject to high winds and winter storm damage. The risk is higher on the lines going to a mountaintop or peak.

All of Deschutes County is at risk for winter storms. Due to the multitude of variables, such as wind speed, direction, and temperature, each storm is capable of causing extensive damage in any part of the County.

High winds can topple trees and break limbs which in turn can result in power outages and disrupt telephone, computer, and TV and radio service.

Windstorms affect Deschutes County on nearly a yearly basis.

During winter storm access to the line by the utility is difficult. This difficulty delays the time for restoration of power to Deschutes County residents.

The Disaster Mitigation Act of 2000 requires communities to develop comprehensive actions to reduce the impacts of natural hazards.[201.6(c)(3)(ii)] Educating property owners on how to properly maintain trees to prevent power loss on power lines off the right of way will reduce the impact of severe weather in Deschutes County.

Ideas for Implementation:	**Actions Taken Since 2010**
Gather information about the maintenance and removal of hazardous trees.	**Added in 2015.**
Work with the community and partners to identify areas that are prone to damage from nearby trees and perform the necessary maintenance or removal of those trees.	**Added in 2015.**
Create a hazardous tree inventory.	**Added in 2015.**
Work with the community and Public Works Department to identify high wind and icing areas from previous outages and apply for grants to underground utilities in those areas (see MH #7)	**Added in 2015.**

Coordinating Organization:	Deschutes County Emergency Services

Internal Partners:		External Partners:	
County Forester, Community Development, Public Works		Electric Utilities, ODF	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
Local Funding Resources			■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing
Form Submitted by:	2015 NHMP Committee		
Action Item Status:	New		

Action Item: Multi---hazard #7	**Alignment with Plan Goals:**	**High Priority Action Item?**
Continue and enhance windstorm resistant construction methods where possible to reduce damage to utilities and critical facilities from windstorms. In part, this may be accomplished by encouraging electric utility providers to convert existing overhead lines to underground lines.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond

■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

Rationale for Proposed Action Item:

Overhead electrical lines are subject to high winds and winter storm damage. The risk is higher on the lines going to a mountaintop or peak. Most of the services at the top are communication sites. The communication sites are used by ODOT, State Police, county sheriff, emergency services, telephone utilities and cell phone companies. During a disaster the sites are vital for communication. During winter storm access to the line by the utility is difficult and this difficulty delays the time for restoration of power to the services. The utility company has experienced costs each year to repair and maintain the lines. Converting the lines to underground would remove the risk of damage from wind and winter storm.

The Disaster Mitigation Act of 2000 requires communities to develop comprehensive actions to reduce the impacts of natural hazards, with an emphasis on new and existing buildings and infrastructure.[201.6(c)(3)(ii)] Converting primary electrical overhead lines to mountaintop communication services with underground lines will reduce the impact of severe weather on power lines, and will continue power service to rural customers as well as ODOT, State Police, county sheriff, emergency services, telephone utilities, and cell phone companies.

Ideas for Implementation:	**Actions Taken Since 2010**
Work with the consumer---owned electric utility providers to identify "undergrounding districts" so that they can plan for future investments in the area to be undergrounded. Utilize utility franchise fees, urban renewal funds and other resources, including grants, to underground existing overhead lines. Continue to require that utilities be undergrounded with new subdivision approvals. In both rural and urban areas, identify overheard power circuits particularly vulnerable to downed trees (where are power outages are likely to occur). Areas that are difficult to access by power repair crews will be considered when prioritizing these areas for undergrounding power lines.	**Added in 2015.**

Coordinating Organization:	Deschutes County Emergency Services
Internal Partners:	**External Partners:**

Community Development, City Community Development/ Planning, and Public Works		Electric Utilities	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
Electric Utilities, FEMA PDM, landowners, Local Funding Resources			■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing
Form Submitted by:	2015 NHMP Committee		
Action Item Status:	New		

Action Item: Earthquake #1	Alignment with Plan Goals:	High Priority Action Item?
Support development of in---depth studies to determine county and region's vulnerability to earthquake.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond

■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

Regular meetings and communication with the Oregon Resilience Plan (Cascadia Earthquake scenario).

Possible opportunity to partner with OSU Cascades for research in the region.

Rationale for Proposed Action Item:

Deschutes County is susceptible to earthquakes from four sources:

Cascadia Subduction Zone: The Cascadia Subduction Zone (CSZ) is the boundary between the descending oceanic Juan de Fuca Plate and the overriding North American Plate. This area of contact, located off the Oregon coast, is capable of producing some of the largest earthquakes on Earth with magnitude (M) 9.0 or greater. Based on historical averages, there is a 10---15% chance that the CSZ could produce a M 9.0 earthquake in the next 50 years, and a 37% chance of a M 8.0 earthquake in the next 50 years. The effects of a CSZ earthquake would be felt most strongly along the coast and in the Willamette Valley, but strong shaking would also occur in central Oregon. All parts of Deschutes County are vulnerable to damage from a CSZ earthquake; unreinforced masonry buildings are especially vulnerable.

Deep intraplate earthquakes: These earthquakes occur within the Juan de Fuca Plate as it descends beneath the North American Plate. They occur at depths between 30 and 100 kilometers (about 20 to 60 miles) and can approach M 7.5. Regions in Oregon most vulnerable to these earthquakes include a broad zone from the coast to the western foothills of the Cascades, but centered in the Willamette Valley. Residents of Deschutes County might feel some shaking from deep intraplate earthquakes, but the risk of damage is low.

Shallow crustal earthquakes: These earthquakes occur on faults in the North American Plate and are associated with extension (pulling apart of the crust). They can be so shallow that they rupture or deform the ground surface, but can also occur up to 35 kilometers deep (about 20 miles) and may not be associated with faults observed at the surface. These earthquakes can reach M 7.0, causing extensive localized damage. Significant crustal earthquakes have occurred in central Oregon during historical times, but have been located in Klamath and Lake Counties. However, crustal fault zones in Klamath and Lake Counties extend into Deschutes County and all parts of Deschutes County are vulnerable to damage from these earthquakes.

Volcanic earthquakes: Volcanic earthquakes are triggered by changes in the magmatic system below volcanoes. They are common in Deschutes County near volcanic centers in the Cascades and Newberry Volcano. These earthquakes are typically less than M 2.5 (too small to be felt) but may reach M 5.0. Swarms of volcanic earthquakes can persist for weeks to months before volcanic eruptions and often serve as precursors to an eruption. The likelihood of volcanic earthquakes occurring in Deschutes County is very high, but little to no damage is likely to occur to buildings or communities.

Ideas for Implementation:	Actions Taken Since 2010

Work with OEM, DOGAMI, FEMA and USGS and expand existing studies to address scope of vulnerability.	**Deferred to 2020 Plan**
Communicate study findings with key stakeholders affiliated with public awareness, education, policy and mitigation strategies identified in study.	**Deferred to 2020 Plan**
If needed, make policy and procedures changes that support study results that mitigate earthquake hazards.	**Deferred to 2020 Plan**
Determine the impact that an event located outside the county will have on Deschutes County including west side evacuation to central Oregon.	**Deferred to 2020 Plan**

Coordinating Organization:	Deschutes County Emergency Services		
Internal Partners:		**External Partners:**	
Community Development		FEMA, DOGAMI, OEM, USGS, OSU Cascades	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
Oregon State University – Cascades, OEM, Local Funding Resources			■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing
Form Submitted by:	2010 NHMP Committee (Reviewed and Updated by 2015 NHMP Committee)		
Action Item Status:	Deferred		

Action Item: Earthquake #2	Alignment with Plan Goals:	High Priority Action Item?
Seismically retrofit vulnerable facilities and infrastructure to increase their resiliency to seismic hazards. Consider both structural and non---structural retrofit options.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond

■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

DOGAMI RVS (2007)

Rationale for Proposed Action Item:

The 2007 Statewide Seismic Needs Assessment Study conducted by DOGAMI identified buildings with a high to very high collapse potential ratings.

Occupants of these buildings are often school age children and are vulnerable to potential injury should an event occur.

Oregon Senate Bill 2 (2005) directed DOGAMI to develop a statewide seismic needs assessment that includes a FEMA 154 Rapid Visual Screening survey of specific critical facilities, including schools.

Retrofitting of vital infrastructure, such as schools, emergency service, and other community buildings, provides important improvements that reduce hazard exposure and the cost and time associated with recovery (Source: American Planning Advisory Service Report Number 483/484).

Deschutes County has a high vulnerability for seismic hazards (related to the Cascadia Earthquake event) and a moderate probability of a future seismic event occurring. Retrofitting seismically vulnerable buildings will significantly reduce the buildings' vulnerability to seismic hazards and improve the safety of occupants (emergency personnel, students, teachers, and community members that use the buildings).

The Disaster Mitigation Act of 2000 requires communities to identify actions and projects that reduce the effects of hazards on the community, particularly to buildings and infrastructure [201.6(c)(3)(ii)]. Identifying critical and essential facilities for seismic retrofit will help to identify major seismic issues and appropriate mitigation actions to protect critical and essential facilities.

Ideas for Implementation:	Actions Taken Since 2010
Conduct detailed structural evaluation that outlines recommendations for building deficiencies, and provides a cost estimate, incorporating DOGAMI's seismic assessment data to assist in retrofitting	**Added in 2015**
Apply for grant funding through the Oregon Seismic Rehabilitation Grant Program	**Added in 2015**
Apply for FEMA project grant funding.	**Added in 2015**
Conduct structural evaluations of critical and essential facilities (including historical buildings), and infrastructure and make recommendations (structural and non---structural) for fix. Align projects	**Added in 2015**

with regular maintenance programs.			
Coordinating Organization:	Deschutes County Natural Hazards Mitigation Committee		
Internal Partners:		**External Partners:**	
Public Works, Community Development, Building, Fire, Police, Sheriff		Deschutes County School Districts, Oregon Military Department --- Office of Emergency Management (OEM), Oregon Department of Geology and Mineral Industries (DOGAMI), Federal Emergency Management Agency (FEMA), Oregon Department of Education (ODE); Oregon Business Development Department --- Infrastructure Finance Authority (IFA), State Historic Preservation Office (SHPO)	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
Seismic Rehabilitation Grants (IFA), Local Funding Resources			■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing
Form Submitted by:	2015 NHMP Committee		
Action Item Status:	New		

Action Item: Flood #1	Alignment with Plan Goals:	High Priority Action Item?
Continue to coordinate mitigation activities with appropriate agencies and home and business owners/groups that include an inventory of actions to or within the floodplain.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond ■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

Comprehensive Plan, FEMA Flood Insurance Study, Flood Insurance Rate Maps

Rationale for Proposed Action Item:

Any mitigation activity within the floodplain will impact multiple stakeholders including property owners and State and Federal agencies dealing with water usage, recreation, wetlands, and wildlife habitat issues. Coordination of mitigation activities will ensure that any planned activities obtain required permits, meet the requirements and goals of relevant agencies.

Ideas for Implementation:	Actions Taken Since 2010
Establish protocol to regularly update mitigation actions and activities within the floodplain.	Deschutes County continues to regulate development and restoration activities in the floodplain in accordance with NFIP regulations. Any development activities in the floodplain are reviewed for compliance with NFIP regulations and are coordinated with property owners, the Oregon Department of State Lands, Army Corps of Engineers, Oregon Department of Fish and Wildlife, US Forest Service, and other relevant agencies. An inventory of actions to or within the floodplain is maintained through a list of land use decision records for these actions. **Ongoing.**

Coordinating Organization:	Deschutes County Community Development

Internal Partners:	External Partners:
Emergency Services, Public Works, Building Division	Oregon Water Resources, DLCD, , USGS, Bureau of Reclamation, Oregon Department of State Lands, Army Corps of Engineers, Oregon Department of Fish and Wildlife, US Forest Service,

Potential Funding Sources:	Estimated cost:	Timeline:
Planning application fees cover stakeholder coordinations, other Local Funding Resources		■ Short Term (1---2 years) ■ Long Term (3---5 years)

		■ Ongoing
Form Submitted by:	2010 NHMP Committee (Reviewed and Updated by 2015 NHMP Committee)	
Action Item Status:	Ongoing	

Action Item: Flood #2	Alignment with Plan Goals:	High Priority Action Item?
Maintain an inventory of all permitted in---water facilities in Deschutes County.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:		
■ Deschutes County	■ Bend	■ Redmond
	■ La Pine	■ Sisters

Alignment with Existing Plans/Policies:

Rationale for Proposed Action Item:
Craine Prairie Reservoir, Wickiup Reservoir, area canals that are above residential areas are chief concerns

Ideas for Implementation:	Actions Taken Since 2010
Update appropriate seismic criteria and procedures for evaluating performance of existing dams.	**Deferred to 2020 Plan.**

Coordinating Organization:	Deschutes County Community Development

Internal Partners:	External Partners:	
Emergency Services	Oregon Water Resources, USGS, Bureau of Reclamation	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Local Funding Resources, Americorps/ RARE		■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing

Form Submitted by:	2010 NHMP Committee (Reviewed and Updated by 2015 NHMP Committee)
Action Item Status:	Deferred

Action Item: Flood #3	**Alignment with Plan Goals:**	**High Priority Action Item?**
Comply with National Flood Insurance Program to maintain participation in program.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond

■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

Comprehensive Plan, FEMA Flood Insurance Study, Flood Insurance Rate Maps

Rationale for Proposed Action Item:

Compliance with the NFIP is a prerequisite for County residents to receive flood insurance.

The County currently includes about 170 flood insurance policies; roughly half of these are preferred risk policies (PRP). PRPs are not eligible to receive CRS Premium Discounts. Additionally, the county has a flood insurance market penetration of approximately 15% (as of 2012).

Increasing flood insurance coverage will allow the county to reduce vulnerability, and facilitate recovery.

Ideas for Implementation:	**Actions Taken Since 2010**
Local Floodplain Manager to work with the State Floodplain Manager at DLCD (and federal NFIP liaison, as necessary) to identify any additional actions needed to maintain NFIP compliance including assessment of staff resources, need for Community Assistance Visits, and integration of updated Regulations.	In 2007, Staff coordinated with DLCD and FEMA to update the local NFIP maps to the current version. This update included a review of County Code by FEMA and DLCD. A number of relevant updates were identified and included in the Deschutes County Code. **Ongoing.**
Work with DLCD to better identify and map floodplains.	Staff received preliminary copies of the 2007 map updates and worked with DLCD to comment on those maps prior to final issuance. **Ongoing.**
Work with DLCD to offer community education and outreach.	Community education regarding flood hazard and the NFIP is offered to property owners inquiring about purchasing or developing floodplain mapped property. A community outreach meeting was conducted in 2013 in Sunriver in response to high irrigation flows in the Deschutes River that resulted in local flooding, but no flood losses. **Ongoing.**
Outreach to property owners with residences in the special flood hazard area and offer education about the benefits of purchasing flood insurance.	**Added in 2015.**
Work with DLCD on any issues that arise from NFIP implementation monitoring activities.	County Staff coordinates regularly with our DLCD contact to resolve interpretative questions that arise

	during local implementation of the NFIP. **Ongoing.**
Track all community assistance, education and monitoring activities.	An inventory of actions to or within the floodplain is maintained through a list of land use decision records for these actions. Community education activities are conducted as issues arise. A community outreach meeting was conducted in 2013 in Sunriver in response to high irrigation flows in the Deschutes River that resulted in local flooding, but no flood losses. **Ongoing.**
Participate in and implement the Community Rating System as part of the NFIP.	Due to the low number of policies that could benefit from the County's participation in the CRS the County has deferred participation at this time. **Added in 2015** Note: In 2015 the County is reviewing their land use codes to determine if flood plain standards are adequate (elements of the CRS Higher Regulatory Standards will be considered in the review).

Coordinating Organization:	Deschutes County Community Development		
Internal Partners:		**External Partners:**	
		DLCD, FEMA	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
Local Funding Resources/ County Floodplain Manager/ DLCD			■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing
Form Submitted by:	2010 NHMP Committee (Reviewed and Updated by 2015 NHMP Committee)		
Action Item Status:	Ongoing		

Action Item: Flood #4	Alignment with Plan Goals:	High Priority Action Item?
Update the Flood Insurance Rate Maps for Deschutes County and revisit land use codes to determine if floodplain standards are still adequate.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:		
■ Deschutes County	■ Bend	■ Redmond
	■ La Pine	■ Sisters

Alignment with Existing Plans/Policies:
Comprehensive Plan, FEMA Flood Insurance Study, Flood Insurance Rate Maps

Rationale for Proposed Action Item:
Areas of concern, listed below, are presently not mapped as areas of special flood hazard. In addition, current flood insurance rate maps (FIRMs) may be significantly enhanced by use of existing LiDAR data and an evaluation of reduced channel capacity in the Deschutes River due to sediment accumulation. Areas of concern: Indian Ford (west of Sisters), Trout Creek (Sisters), Whychus Creek drainage, Tumalo Creek, Little Deschutes River (La Pine area), Deschutes River (from Wickiup through the Tumalo area at certain points).

Ideas for Implementation:	Actions Taken Since 2010
Work with appropriate agencies to update Flood Insurance Rate Maps.	In 2007, Staff coordinated with DLCD and FEMA to update the local NFIP maps to the current version. This update included a review of County Code by FEMA and DLCD. A number of relevant updates were identified and included in the Deschutes County Code. **Ongoing.**
Revisit and update land use codes to determine if floodplain standards are adequate.	In 2007, Staff coordinated with DLCD and FEMA to update the local NFIP maps to the current version. This update included a review of County Code by FEMA and DLCD. A number of relevant updates were identified and included in the Deschutes County Code. **Ongoing.** Note: In 2015 the County is reviewing their land use codes to determine if flood plain standards are adequate (elements of the CRS Higher Regulatory Standards will be considered in the review).

Coordinating Organization:	Deschutes County Community Development

Internal Partners:	External Partners:	
	FEMA, DOGAMI, DLCD	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**

DLCD, Risk MAP Funding Consideration, Local Funding Resources		■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing
Form Submitted by:	2010 NHMP Committee (Reviewed and Updated by 2015 NHMP Committee)	
Action Item Status:	Ongoing	

Action Item: Flood #5	Alignment with Plan Goals:	High Priority Action Item?
As funding becomes available, implement mitigation measures for individual properties adjacent to or within the floodplain as appropriate.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:		
■ Deschutes County	■ Bend	■ Redmond
	■ La Pine	■ Sisters

Alignment with Existing Plans/Policies:
Comprehensive Plan, FEMA Flood Insurance Study, Flood Insurance Rate Maps

Rationale for Proposed Action Item:
Although the county does not currently have repetitive flood loss properties, or severe repetitive flood loss properties, there are properties within the special flood hazard area that are vulnerable to flood. Areas of concern, listed below, are presently not mapped as areas of special flood hazard. In addition, current flood insurance rate maps (FIRMs) may be significantly enhanced by use of existing LiDAR data and an evaluation of reduced channel capacity in the Deschutes River due to sediment accumulation. Areas of concern: Indian Ford (west of Sisters), Trout Creek (Sisters), Whychus Creek drainage, Tumalo Creek, Little Deschutes River (La Pine area), Deschutes River (from Wickiup through the Tumalo area at certain points).

Ideas for Implementation:	Actions Taken Since 2010
Assess individual properties for possible mitigation measures (elevation, acquisition, relocation) to reduce or prevent future flood losses.	**Deferred to 2020 Plan.**
Implement mitigation measures (elevation, acquisition, relocation) for properties within the floodplain.	**Deferred to 2020 Plan.**

Coordinating Organization:	Deschutes County Community Development

Internal Partners:	External Partners:
	FEMA, DOGAMI, DLCD

Potential Funding Sources:	Estimated cost:	Timeline:
FEMA Flood Mitigation Assistance Project Grants; Local Funding Resources		■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing

Form Submitted by:	2010 NHMP Committee (Reviewed and Updated by 2015 NHMP Committee)

Action Item Status:	Ongoing

Action Item: Flood #6	**Alignment with Plan Goals:**	**High Priority Action Item?**
Analyze and implement mitigation measures related to ice jamming that occurs during winter storm events.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond

■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

Comprehensive Plan, FEMA Flood Insurance Study, Flood Insurance Rate Maps

Rationale for Proposed Action Item:

Ice jams on the Deschutes and Little Deschutes rivers have created flood conditions in the past and will continue to do so due to local topography. Ice jams commonly happen during the winter and early spring, while the river is still frozen. Sudden warming at higher altitudes can melt waters resulting in increased runoff of water and ice into large reaches of frozen river below. On the way downstream, the ice can "jam" in narrow places on the river or against a road crossing, effectively damming the river, sometimes followed by a sudden breach and release of the water and ice.

Ideas for Implementation:	**Actions Taken Since 2010**
	Added in 2015

Coordinating Organization:	Deschutes County Emergency Services/ Planning

Internal Partners:	**External Partners:**
Public Works, Bend Parks and Recreation District	Oregon Water Resources, Pacific Power, Landowners, DLCD, DOGAMI

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
USACE Silver Jackets Program, OWEB, DSL; Local Funding Resources		■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Action Item: Flood #7	Alignment with Plan Goals:	High Priority Action Item?
Re---evaluate debris flow and flood hazards along Whychus Creek from moraine---dammed Carver Lake. Depending on outcome of study, consider suitable mitigative measures in City of Sisters and Deschutes County.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond

■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

Results of a 1987 USGS report (Hydrologic Hazards Along Squaw [Whychus] Creek from a Hypothetical Failure of the Glacial Moraine Impounding Carver Lake near Sisters, Oregon; USGS, Open File Report 87---41) were incorporated into the2007 FEMA Flood Insurance Rate Map for Deschutes County (FIRM, Panel 0245E). USGS scientists consider the 1987 assessment in need of re---evaluation in light of new research results on past such events at Central Oregon moraine---dammed lakes and refined flood models that are now available.

Rationale for Proposed Action Item:

Carver Lake, located at 7,800 feet on the east slope of South Sister volcano, contains about 740 acre---feet (900,000 cubic meters or 32 million cubic feet) of water. The lake is dammed by a glacial moraine formed chiefly during late 19th and early 20th centuries. Several other such moraine---dammed lakes in Central Oregon have experienced rapid outflows during the past 80 years that resulted in debris flows and floods along streams draining the lakes. Carver Lake and its outlet stream, a tributary to Whychus Creek, are susceptible to similar debris flows and floods in the future. The extent and magnitude of such flows will depend on several factors, including amount of water released, rate of release, and conditions along the flow path.

A 1987 USGS report concluded that the annual probability of a flood from failure of the moraine dam of Carver Lake is 1 to 5 percent and that the magnitude of the **worst---case flow** could be ten times that of the 1---percent probability flood (100---year flood). Sisters would see rising flood waters 1.8 hours after a dam breach and the flood would peak about 30 minutes later. See P. 26 of report for a map of high and low risk areas.

If an event of this magnitude happened, locally high velocities, damming, erosion, and sediment deposition could cause considerable property damage and possible loss of life in Sisters.

Later research has questioned some aspects of the 1987 report. A report published in 2001 (USGS Professional Paper 1606, Debris flows from failures of neoglacial---age moraine dams in the Three Sisters and Mount Jefferson Wilderness Areas; http://pubs.er.usgs.gov/publication/pp1606) sheds new light on past events and outlook for future events. Among its findings:

1. Since early 1920s, at least 11 (now 12 with 2012 event at Three---Fingered Jack) rapid water releases resulted from partial or total breaching of moraine dams.
2. Partial breaches amounting to lake lowering of a few feet to a few tens of feet were halted as large boulders armored outlets and downcutting ceased.
3. All partial and complete breaches formed debris flows, the farthest reaching about 6 miles from lake; sediment---laden floods and streamflow continued tens of miles farther.
4. Probability of future events depends on such factors as likelihood of rock and ice avalanches reaching the lake and generating waves that rapidly erode outlets. If Prouty Glacier continues to thin and retreat, the likelihood of ice avalanches into the lake diminishes; the opposite would be true if Prouty Glacier

undergoes a period of substantial thickening and advance.

5. Worst---case scenarios can be defined, but the likelihood of such worst---case events may be vanishingly small.

Such findings suggest that the 1987 report overstated greatly the degree of hazard and the probability of flows causing catastrophic impacts in Sisters.

Ideas for Implementation:	**Actions Taken Since 2010**
USGS proposes to apply findings from the 2001 study and other applicable studies to define realistic scenarios for partial and complete breaching of the Carver lake moraine dam and evolution of debris flows and floods down Whychus Creek. These scenarios can be combined with modern flood---routing models and recently obtained detailed, accurate, lidar digital---elevation models, to provide refined estimates of potential for flood inundation in the low---relief fan area around the City of Sisters. On the basis of results of this study, Sisters and Deschutes County would be able to develop suitable mitigative measures, which could include, real time stream monitoring detection, early warning sirens, zoning, and planning studies to help prevent loss of life and property damage in the area downstream of the lake.	**Added in 2015**

Coordinating Organization:	Deschutes County Emergency Services

Internal Partners:	**External Partners:**	
Sisters, Community Development, Public Works	USGS, USACE, FEMA, DOGAMI, OEM, OSU Cascades	
Potential Funding Sources:	**Estimated cost:**	**Timeline:**
USACE Silver Jackets Program; Local Funding Resources		■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing

Form Submitted by:	2015 NHMP Committee
Action Item Status:	New

Action Item: Volcano #1	Alignment with Plan Goals:	High Priority Action Item?
Continue to support on---going study of probability of volcanic eruption and potential impact.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond

■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

Central Cascades Volcano Coordination Plan (2007) to be updated in 2015, local response plans, National Response Plan, Oregon State Emergency Management Plan

Rationale for Proposed Action Item:

Volcanic activity could occur anywhere in Deschutes County. Eruptions are more likely to occur near volcanic centers in the Cascades and Newberry Volcano, but lava flows and ash deposits from vents located in these areas could reach all parts of the county.

Lava flows: Future eruptions from the north flank of Newberry Volcano represent the most credible lava---flow threat to large settled areas in the United States outside of Hawai'i. Lava flows move relatively slowly and rarely threaten human life, but advancing flows ensure almost total destruction of property and infrastructure from burial and incineration. Lava flows also pose flooding hazards by damming waterways, which can initially trigger flooding upstream and later downstream if the lava dam fails. Lava flows can also initiate multiple forest fires, especially if they occur during dry months.

Ash: Due to prevailing westerly winds, areas east of the Cascades have the greatest probability of being affected by ash from future eruptions anywhere in the Cascades. Volcanic ash limits visibility and, if wet, creates slippery road conditions. It is electrically conductive and abrasive, and can severely affect electrical and mechanical systems and is extremely dangerous to aircraft. Ash and other volcanic products can add large quantities of sediment to rivers and streams. This can initiate periods of years to decades during which waterways carry increased sediments loads and river channels become unstable and migrate. Such effects propagate downstream and can disrupt channels and flood plains far from where the actual eruption occurred. In particular, the Tumalo Creek watershed that supplies part of Bend's municipal water is likely to receive ash from any eruption in the Three Sisters area.

Fields of mafic volcanoes: Hundreds of geologically young mafic volcanoes composed of cinders, ash, and lava flows dot the central Oregon landscape. Future eruptions of mafic volcanoes are possible anywhere in the central Cascades region, which includes large parts of Deschutes County. These eruptions could last for months to years or decades, producing ash and lava flows that periodically impact developed areas of Deschutes County.

Ideas for Implementation:	Actions Taken Since 2010
Continue to partner with federal and state organizations supporting studies and monitoring volcanic eruption indicators and activities.	Ongoing participation.
Participate in updating interagency communication plan for central Oregon volcanic activity.	Participates regularly in interagency communication update planning. **Ongoing**.

Coordinating Organization:	Deschutes County Emergency Services		
Internal Partners:		**External Partners:**	
Health Department		CVO (USGS Cascades Volcano Observatory), FEMA, DOGAMI, OEM, USGS, OSU Cascades	
Potential Funding Sources:		**Estimated cost:**	**Timeline:**
OSU Cascades, USGS; Local Funding Resources			■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing
Form Submitted by:	2010 NHMP Committee (Reviewed and Updated by 2015 NHMP Committee)		
Action Item Status:	Ongoing		

Action Item: Wildfire #1	Alignment with Plan Goals:	High Priority Action Item?
Expand public information/education initiatives in support of active hazardous fuels treatment.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond

■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

Upper Deschutes River Coalition CWPP, Greater La Pine CWPP, Sunriver CWPP, Greater Sisters Country CWPP, East and West Deschutes County CWPP, Greater Bend CWP, Greater Redmond CWPP

Rationale for Proposed Action Item:

Ideas for Implementation:	Actions Taken Since 2010
Explore opportunities to expand the Project Wildfire mission addressing public awareness strategies.	Project Wildfire maintains regular public awareness programs --- websites, FireFree, CWPPs, public education. Completed. Will continue. **Ongoing** Project Wildfire has convened all 7 CWPP groups and kept the plans updated with current priorities and risk assessments. All plans have been updated in the last 5 years. *See Wildfire Chapter for more information.*
Expand school enrichment education about fuels reduction and wildland fire prevention near home sites.	Regular participation in Team Teaching with COFPC in elementary school. County Forester and Project Wildfire have coordinated fuel reduction projects utilizing La Pine High School forestry students so they have hands on experience with fuel reduction projects. County Forester has presented annually to COCC wildland fire class about WUI fuels treatment in Deschutes County **(Ongoing)**

Coordinating Organization:	Deschutes County Forester/ Project Wildfire

Internal Partners:	External Partners:
Emergency Services, County Forester	Firewise Communities, USFS, BLM, ODF, DEQ,

Potential Funding Sources:		Estimated cost:	Timeline:
Obtain education funding through federal and state grants; Local Funding Resources			■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing
Form Submitted by:	2010 NHMP Committee (Reviewed and Updated by 2015 NHMP Committee)		
Action Item Status:	Ongoing		

Action Item: Wildfire #2	**Alignment with Plan Goals:**	**High Priority Action Item?**
Review and upgrade existing building and land use codes to address landscape, fuel amounts and structure detail that reduces the incidence or spread of wildland fire in urban/rural interface areas.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:		
■ Deschutes County	■ Bend	■ Redmond
	■ La Pine	■ Sisters

Alignment with Existing Plans/Policies:
City and County Comprehensive Plans/ Development Codes
Rationale for Proposed Action Item:

Ideas for Implementation:	**Actions Taken Since 2010**
Develop systems to regulate landscape, fuels and structure components for new construction.	Cities continue to require specific fire resistant components on new construction of subdivisions. County recently implemented similar system for subdivisions outside city limits. **Completed.** Will monitor and update
Develop and adopt countywide defensible space standards.	Deschutes County has adopted Senate Bill 360 standards in the unprotected areas within the county through DCC Chapter 8.21. **Completed.**
Develop countywide classification system consistent with SB 360 to educate individual property owners and encourage compliance with defensible space standards.	Classification of all private property in Deschutes County during last SB 360 re---classification process. **Completed.**

Coordinating Organization:	Deschutes County Community Development and County Forester

Internal Partners:	**External Partners:**
Community Development, County Forester, Emergency Services, Project Wildfire	ODF,

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
Funding will be necessary to notify/educate property owners of their classification and recommended standards for defensible space.		■ Short Term (1---2 years) ■ Long Term (3---5 years)

Obtain grant funding from federal and state programs, Local Funding Resources, OEM (Public awareness)		■ Ongoing
Form Submitted by:	2010 NHMP Committee (Reviewed and Updated by 2015 NHMP Committee)	
Action Item Status:	Ongoing	

Action Item: Wildfire #3	Alignment with Plan Goals:	High Priority Action Item?
Continue to prioritize and support fuels reduction projects on private lands utilizing FireFree and other programs; and identify and prioritize fuels reduction projects on public lands in the WUI.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond

■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

County CWPPs, City and County Comprehensive Plans

Rationale for Proposed Action Item:

Ideas for Implementation:	Actions Taken Since 2010
Provide opportunities for defensible space and fuels reduction through FireFree and Sweat Equity Programs. Continue to revisit CWPPs annually and update priorities for fuels reduction projects on private and public lands. Biomass accumulation reduction	Annually provide opportunities for homeowner participation in fuels reduction projects and FireFree projects. **Ongoing** Annually revisit each CWPP. Conduct new risk assessments and revise priorities on a three year rotation. **Ongoing**

Coordinating Organization:	Project Wildfire

Internal Partners:	External Partners:
Community Development, County Forester, Emergency Services, Project Wildfire	Firewise Communities, ODF

Potential Funding Sources:	Estimated cost:	Timeline:
Obtain grants and cost share agreements with landowners to participate in Sweat Equity fuels reduction programs. Partner with collaborators to fund FireFree recycling days.		■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing

Form Submitted by:	2010 NHMP Committee (Reviewed and Updated by 2015 NHMP Committee)
Action Item Status:	Ongoing

Action Item: Winter Storm #1	Alignment with Plan Goals:	High Priority Action Item?
Continue to coordinate mitigation activities to reduce risk to the public from severe winter storms.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:		
■ Deschutes County	■ Bend	■ Redmond
	■ La Pine	■ Sisters

Alignment with Existing Plans/Policies:
County and City Emergency Operations Plans

Rationale for Proposed Action Item:
Deschutes County is subject to severe winter storms. Although most residents are generally prepared for extreme and prolonged winter events can affect our population. These events can prevent access to healthcare, medications, food, and can interfere with residents' ability to heat their homes.

Ideas for Implementation:	Actions Taken Since 2010
Continue and expand partnerships with county, city, homeowner groups, businesses and other organizations on strategies that mitigate impact of snow, cold weather, ice and other events related to severe winter storms. Provide training for setting---up/ operating Emergency Operations Center (EOC) and using Incident Command System (ICS)	Continually discuss issues relating to winter storm preparedness and response through the local Emergency Management Planning Committee (EMPC) and Vulnerable Populations Work Group **(Ongoing)** **Added in 2015.**

Coordinating Organization:	Deschutes County Emergency Services

Internal Partners:	External Partners:
City and County Public Works, Public Health	Utility companies, Vulnerable Populations Work Group, American Red Cross, other Community Organizations Active in Disasters.

Potential Funding Sources:	Estimated cost:	Timeline:
Pursue grant and budgetary funding for educational outreach and partnership development, Local Funding Resources		■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing

Form Submitted by:	2010 NHMP Committee (Reviewed and Updated by 2015 NHMP Committee)
Action Item Status:	Ongoing

Action Item: Winter Storm #2	Alignment with Plan Goals:	High Priority Action Item?
Continue public awareness of severe winter storm mitigation activities.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:

■ Deschutes County ■ Bend ■ Redmond

■ La Pine ■ Sisters

Alignment with Existing Plans/Policies:

County and City Emergency Operations Plans

Rationale for Proposed Action Item:

Deschutes County is subject to severe winter storms. Although most residents are generally prepared for extreme and prolonged winter events can affect our population. These events can prevent access to healthcare, medications, food, and can interfere with residents' ability to heat their homes.

Ideas for Implementation:	Actions Taken Since 2010
Target new residents and businesses; continue coordination and expansion of public awareness system providing education about protecting life, property, and the environment from severe winter storm events.	Formation of the Emergency Management Planning Committee (EMPC) which includes public safety, public health, healthcare, public works, utilities, and business community. Use of media and public information. **Ongoing.**
Distribute educational information about alternative heating sources, equipment and supplies to use during severe winter storm and power outage.	Use of focused media releases, websites, and public information. **Ongoing.**
Develop coordinated utility restoration plans with all utility sources.	Currently in discussion with utilities to address this issue as part of the EMPC. **Ongoing.**
Develop coordinated plan for housing large numbers of residents and tourists.	Collaborated with American Red Cross on a shelter plan. Also coordinate with service organizations and churches to identify warming shelters. **Ongoing.**
Develop Coordinated Plan for Outreach to Vulnerable Populations	**Added in 2015.**

Coordinating Organization:	Deschutes County Emergency Services

Internal Partners:	External Partners:
City and County Public Works, Public Health	Vulnerable Populations Work Group, American Red Cross

Potential Funding Sources:	Estimated cost:	Timeline:
County and Cities, Pursue grant funding for		■ Short Term (1---2 years)

educational materials and distribution, Coordinate with OEM (Public awareness), Local Funding Resources		■ Long Term (3---5 years) ■ Ongoing
Form Submitted by:	2010 NHMP Committee (Reviewed and Updated by 2015 NHMP Committee)	
Action Item Status:	Ongoing	

Action Item: Winter Storm #3	**Alignment with Plan Goals:**	**High Priority Action Item?**
Continue to enhance coordination maintenance and mitigation activities to reduce risk to public infrastructure from severe winter storms.	■ 1 ■ 2 ■ 3 ■ 4 ■ 5 ■ 6 ■ 7 ■ 8 ■ 9 ■ 10 ■ 11	■ Yes

Affected Jurisdictions:		
■ Deschutes County	■ Bend	■ Redmond
	■ La Pine	■ Sisters

Alignment with Existing Plans/Policies:
County and City Emergency Operations Plans
Rationale for Proposed Action Item:
Deschutes County is subject to severe winter storms. Although most residents are generally prepared for extreme and prolonged winter events can affect our population. These events can prevent access to healthcare, medications, food, and can interfere with residents' ability to heat their homes.

Ideas for Implementation:	**Actions Taken Since 2010**
Annually meet with county and city departments responsible for maintaining infrastructures including those addressing emergencies, roads, sewers, water etc. to address upgrades and improvements needed and needs of new and emerging neighborhoods.	Annually meet with all departments to assess and consider upgrades and needs of new and emerging neighborhoods. **Ongoing.** Public Works agencies discuss and coordinate cooperative services plan/ agreement. **Ongoing** Hold Mini---MACs during severe winter storms. **Ongoing**

Coordinating Organization:	Deschutes County Emergency Services

Internal Partners:	**External Partners:**
City and County Public Works, Public Health	Utilities, Vulnerable Populations Work Group, American Red Cross

Potential Funding Sources:	**Estimated cost:**	**Timeline:**
With department budgets at an all---time low, departmental funding is unlikely in the next five years. Pursue grant funding for educational materials and distribution. Coordinate with OEM (Public awareness), Local Funding Resources		■ Short Term (1---2 years) ■ Long Term (3---5 years) ■ Ongoing

Form Submitted by:	2010 NHMP Committee (Reviewed and Updated by 2015 NHMP Committee)
Action Item Status:	Ongoing

Appendix B:
Planning and Public Process

Table of Contents

Tables

Memo

To: Federal Emergency Management Agency

From: Oregon Partnership for Disaster Resilience

Date: May 13, 2015

Re: List of changes to the 2010 Deschutes County NHMP for the 2015 Plan Update

Purpose

This memo describes the changes made to the 2010 Deschutes County Natural Hazards Mitigation Plan (NHMP) during the 2015 plan update process. Major changes are documented by plan section.

Project Background

Deschutes County partnered with the Oregon Partnership for Disaster Resilience (OPDR) and the Community Planning Workshop to update the 2010 Deschutes County Natural Hazards Mitigation Plan (NHMP). The Disaster Mitigation Act of 2000 requires communities to update their mitigation plans every five years to remain eligible for Pre---Disaster Mitigation (PDM) program funding, Flood Mitigation Assistance (FMA) program funding, and Hazard Grant Mitigation Program (HMGP) funding. OPDR met with members of the Deschutes County steering committee in September, November, and December of 2014 to update portions of the county's NHMP. During this update cycle the cities of Bend, La Pine, Redmond, and Sisters opted to participate; as such the 2015 plan is multi---jurisdictional. Formal meetings with the working groups for the three participating cities occurred during January and February 2015. OPDR and the committees made several changes to the 2010 NHMP. Major changes are documented and summarized in this memo.

2015 Plan Update Changes

The sections below only discuss *major* changes made to the 2010 Deschutes County NHMP during the 2015 plan update process. Major changes include the replacement or deletion of large portions of text, changes to the plan's organization, new mitigation action items, and the addition of city addenda to the plan. If a section is not addressed in this memo, then it can be assumed that no significant changes occurred.

The plan's format and organization have been altered to fit within OPDR's plan templates. Table B.1 below lists the 2010 plan section names and the corresponding 2015 section names, as updated (major Volumes are highlighted). This memo will use the 2015 plan update section names to reference any changes, additions, or deletions within the plan.

Table B-1 Changes to Plan Organization

2010 Deschutes County Multi3jurisdictional NHMP	2015 Deschutes County Multi3jurisdictional NHMP
Acknowledgements	Acknowledgements
/	Approval Letters and Resolutions
Table of Contents	Table of Contents
/	Volume I: Basic Plan
Executive Summary	Executive Summary
Executive Summary	Section 1: Introduction
Risk Assessment	Section 2: Risk Assessment
Multi/Hazard Goals and Initiatives	Section 3: Mitigation Strategy
Plan Maintenance	Section 4: Plan Implementation and Maintenance
Multi/Hazard Goals and Initiatives	Volume II: Hazard Annexes
/	Drought
Earthquake	Earthquake
Flood	Flood
/	Landslide
Volcanic Eruption	Volcano
Wildland Fire	Wildfire
/	Windstorm
Severe Winter Storm	Winter Storm
/	Volume III: Jurisdictional Addenda
/	City of Bend
/	City of La Pine
/	City of Redmond
/	City of Sisters
/	Volume IV: Mitigation Resources
Multi/Hazard Goals and Initiatives and Hazard Profiles	Appendix A: Action Item Fprms
Planning	Appendix B: Planning and Public Process
County Profile	Appendix C: Community Profile
Appendix A: Economic Analysis of Natural Hazard Mitigation Projects	Appendix D: Economic Analysis of Natural Hazard Mitigation Projects
Hazard Profile Mitigation Initiatives	Appendix E: Grant Programs and Resources
/	Appendix F: Deschutes County Natural Hazards Community Survey

Several new sections were added and formatting was changed throughout the 2015 Deschutes County Multi---jurisdictional NHMP.

The 2015 Appendix A is new and incorporates mitigation initiative content previously found within the Hazard Profiles. Appendix B integrates and updates the Planning section. Appendix C updates the county community profile. Appendix A from the 2010 Plan was replaced with 2015 Appendix D. Appendix E: Grant Programs is new and integrates information previously found in the Hazard Profiles. Appendix F is new.

Front Pages

1. The plan's cover has been updated.
2. Acknowledgements have been updated to include the 2015 project partners and planning participants.
3. The FEMA approval letter and county and city resolutions of adoption are included.

Volume I: Basic Plan

Volume I provides the overall plan framework for the 2015 Multi---jurisdictional NHMP update. Volume I contains the following sections: an Executive Summary; Section 1: Introduction; Section 2: Risk Assessment; Section 3: Mitigation Strategy; and Section 4: Plan Implementation and Maintenance.

Executive Summary

The 2015 NHMP includes an updated executive summary that provides information about the purpose of natural hazards mitigation planning 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 2015 plan update process, and provides an overview of how the plan is organized. Major changes to Section 1 include the following:

1. Section 1 is new to the 2015 plan and includes information formerly provided in the
2. Most of Section 1 includes new information that replaces out of date text found in the 2010 NHMP. The new text describes the federal requirements that the plan addresses and gives examples of the policy framework for natural hazards planning in Oregon.
3. Section 1 of the 2015 update, outlines the entire layout of the plan update, which has been altered as described above.

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:

1. Hazard identification, characteristics, history, probability, vulnerability, and hazard specific mitigation activities were updated. More specific information is placed within the hazard annexes of Volume II and Community Profile of Appendix C.
2. NFIP information was updated.
3. Updated Hazard Analyses were created for each of the identified hazards.
4. Hazard Analyses were created for hazards that were not included in the 2010 NHMP: Drought, Landslide, and Windstorm.
5. Updated hazard assessment (history, maximum threat, probability, and vulnerability scores) for the county (city information is included in this section and with more detail within the City Addenda of Volume III).

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:

1. The name of the section was changed from "Multi---Hazard Goals and Initiatives" to "Mitigation Strategy"
2. The goals were reviewed and updated to align with the State NHMP.
3. The previous version of this NHMP prioritized hazards rather than mitigation strategy. With this version of the plan the steering committee decided to prioritize mitigation strategies rather than hazards. At this time the prioritization of specific mitigation strategies has not occurred, the steering committee will prioritize action items at one of their semi---annual meetings.
4. The previous plan included a section on multi---hazard initiatives, the three initiatives (Increase Public Awareness, Training and Education; Increase coordination; and Support research) have been incorporated into multi---hazard actions #1, #2, and #3.
5. The addition of several new action items as documented here and in the table below (2015 Action Item number shown below):
    - MH #4 to #7, EQ #2, FL #6 and #7
6. The revision of existing actions, lead agency and partner designations (as shown in the updated forms of Appendix A).
7. County level action items designate which cities will also take part in that action; where designated as an "affected jurisdiction" on the action item form of Appendix A each jurisdiction will take part in that action (this was done in order to reduce the duplication of actions within the county and city addenda portions of the NHMP).

On December 5, 2014, the Deschutes County steering committee met to review the 2010 NHMP action items. The Deschutes County steering committee reviewed and identified which of the 2010 NHMP's action items had been completed or not, or whether they should be deleted. Action items were deleted for a number of reasons, including not meeting basic action item criteria such as being measurable, assignable, or achievable. Steering Committee members reviewed edits to the actions over the next several months. The cities of Bend, La Pine, Redmond, and Sisters met following the county's meeting to review the county's updates and to add their own action items.

New action items are based upon continuous community needs, the identification of new hazards, deferred action items, and 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 Appendix A. Several of these actions were identified at the steering committee meeting and later drafted by OPDR and steering committee members, reviewed and accepted by the committee.

Progress towards action items is provided on the action item forms within Appendix A.

Section 4: Plan Implementation and Maintenance

The steering committee did not formally meet since the previous version of this NHMP. Progress towards action items is documented in the action item forms of Appendix A. The steering committee agreed to meet semi---annually (before and after fire/irrigation season) and the Deschutes County Emergency Manager will continue to be the plan convener

(documentation for the city conveners is within the jurisdictional addenda of Volume III). The steering committee will discuss options to integrate the NHMP into other planning documents (including the comprehensive plan) during their semi---annual meetings. Deschutes County is currently reviewing their Development Code to identify policy options for flood and wildfire.

Volume II: Hazard Annexes

All hazard annexes were reformatted and updated to include new history, data, maps, vulnerability information and resources as available. Specific changes are included in a text box at the beginning to each hazard profile section. New hazard profiles were provided for the Drought, Landslide, and Windstorm hazards. Action items were updated as referenced in Volume I, Section 3: Mitigation Strategy and Appendix A.

Volume III: Jurisdictional Addenda

The cities of Bend, La Pine, Redmond, and Sisters were included in the 2015 version of the NHMP for the first time.

Volume IV: Mitigation Resources

The previous NHMP included one appendix describing the Economic Analysis of Natural Hazard Mitigation Projects; that appendix was updated and included as Appendix D in the 2015 NHMP. Below is a summary of the appendices included in the 2015 NHMP:

Appendix A: Action Item Forms

Action item forms were created and utilize updated information provided by the steering committee and jurisdictional working groups. The action item forms reference the status of the action item, timeline, and track progress made toward the action since 2010.

Appendix B: Planning and Public Process

This planning and public process appendix reflects changes made to the Deschutes County NHMP and documents the 2015 planning and public process.

Appendix C: Community Profile

The community profile has been updated to conform with the OPDR template and includes information for Deschutes County, and the cities of Bend, La Pine, Redmond, and Sisters.

Appendix D: Economic Analysis of Natural Hazard Mitigation Projects

Updates are provided for the economic analysis of natural hazard mitigation projects.

Appendix E: Grant Programs and Resources

Grant programs and resources were previously listed in the NHMP's hazard profiles. Some of the previously provided resources were deemed unnecessary since this material is covered within the Oregon NHMP and appropriate resources are provided within the Hazard Annexes of Volume II. Updates were made to the remaining grant programs and resources.

Appendix F: Deschutes County Natural Hazards Community Survey

This survey was conducted with the 2015 update of the NHMP and was utilized to inform the development of mitigation strategies and identification of community vulnerabilities. It is provided herein as documentation and to serve as a resource for future planning efforts.

2015 NHMP
PUBLIC PARTICIPATION PROCESS

2015 NHMP Update

Deschutes 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 Deschutes County, Bend, La Pine, Redmond, and Sisters are also given the opportunity to provide feedback about the Plan. The Plan will undergo review on an annual basis.

Deschutes County made the Plan available via the Oregon Partnership for Disaster Resilience's website for public comment from March 20, 2015 through the FEMA review period. The cities of Bend, La Pine, Redmond, and Sisters were included within the press release that was provided in local newspapers.

Public Involvement Summary

During the public review period there were zero comments received via the OPDR project page for the Deschutes County NHMP update. Members of the steering committee provided edits and updates to the NHMP during this period as reflected in the final document.

Press Release

Deschutes County Sheriff's Office
63333 Highway 20 West
Bend, Oregon 97701
(541) 388-6655

MEDIA RELEASE

Deschutes County seeks additional public input on update to Natural Hazards Mitigation Plan

BY: Sgt. Nathan Garibay, Emergency Services Manager

Deschutes County is currently in the process of updating the existing Natural Hazards Mitigation Plan (NHMP). This work is being performed in cooperation with the University of Oregon's Community Service Center H Oregon Partnership for Disaster Resilience and the Oregon Military Department's Office of Emergency Management utilizing funds obtained from the Federal Emergency Management Agency's (FEMA) PreHDisaster Mitigation Grant Program. With reHadoption of the plan, Deschutes County will maintain its eligibility to apply for federal funding towards natural hazard mitigation projects.

This local planning process includes a wide range of representatives from city and county government, emergency management personnel, nonHgovernmental organizations and outreach to members of the public in the form of an electronic survey. This NHMP also affects the cities of Bend, La Pine, Redmond, and Sisters.

A natural hazards mitigation plan provides communities with a set of goals, action items, and resources designed to reduce risk from future natural disaster events. 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 shortHterm and longHterm 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.

An electronic version of the updated **draft** Deschutes County NHMP will be available for formal public comment beginning **March 20, 2015**. To view the draft please visit

http://csc.uoregon.edu/opdr/deschutes.

If you have any questions regarding the Deschutes County NHMP or the update process in general, please contact: Nathan Garibay, Deschutes County Emergency Services Manager at (541) 617H3303 or Nathan.Garibay@deschutes.org; or Michael Howard, Project Specialist for the Oregon Partnership for Disaster Resilience at (541) 346H8413 or mrhoward@uoregon.edu.

Deschutes County Sheriff's Office

Steering Committee

Steering committee members possessed familiarity with the Deschutes 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, action item review and development and information sharing to update the plan and to make the plan as comprehensive as possible. The steering committee met on the following dates:

- **Meeting #1: Kickoff, Hazard Identification**: November 4, 2014
- **Meeting #2: Risk Assessment, Mitigation Strategy, Implementation and Maintenance:** December 5, 2014

In addition several members of the steering committee participated in the FEMA G---318 Workshop – Local Mitigation Planning, held in Bend September 25---26, 2014.

The steering committee formed under the guidance of Nathan Garibay, Deschutes County Emergency Services Manager. The steering committee invested considerable time into the mitigation plan. For a full list of steering committee member see the Acknowledgements section of this NHMP.

The following pages provide copies of meeting agendas and sign---in sheets from county and city steering committee meetings.

Kick-Off and Hazard Identification and Update Work Session Materials

Meeting: **Deschutes County Natural Hazards Mitigation Plan Update: Kickoff Meeting**

Date: November 4, 2014

Time: 1:00 PM – 4:00 PM

Location: 9-1-1 Services Building (20355 Poe Sholes Drive, Bend, OR)

I. Introductions and Background (15 minutes)
- a. Community Service Center Introduction
- b. Project Context
- c. Committee Introductions

II. Natural Hazards Mitigation Planning (20 minutes)
- a. Emergency Management Overview
- b. Natural Hazard Mitigation Plans (NHMP) Overview
- c. NHMP Update Process

III. Community Profile Update and Vulnerabilities (35 minutes)
- a. Community Profile Overview
- b. Vulnerability Inventory

Break (10 minutes)

IV. Work Session
- a. Activity 1: Natural Hazards Historical Update (80 minutes)
- b. Activity 2: Mitigation Actions Review

V. Wrap-Up & Next Steps (20 minutes)
- a. Questions
- b. Next Steps
- c. Schedule Future Meetings

Oregon Partnership for Disaster Resilience
Community Service Center • 1209 University of Oregon
Eugene • Oregon • 97403-1209
Phone: 541.346.7326 • Fax: 541.346.2040

Meeting Sign-In

Deschutes County NHMP Update: Meeting #2: Kickoff/ Hazard ID November 4, 2014
Bend, Oregon

Please complete your contact information and initial next to your name

FIRST	LAST	AGENCY	TITLE	EMAIL	ROUNDTRIP MILEAGE (if applicable)
Melinda	Campbell				
Diane	Canaday				
Ben	Duda	ODF - Sisters	Assistant Unit Forester	BDUDA@ODF.STATE.OR.US	
Dan	Fishkin	Deschutes Co. Search & Rescue BPRD - Board Member	Volunteer SAR Chair, BPRD	DFishkin@Bendbroadband.com	
Nathan	Garibay	Deschutes Co	Emergency Manager	nathan.garibay@deschutes.org	
William	Groves	Deschutes CO	Sr. Planner	WILLG@DESCHUTES.ORG	
Peter	Gutowsky				
David	Howe				
Ed	Keith				
Matt	Martin	Deschutes Co.	Assoc. Planner	matt.martin@deschutes.org	
Stuart	Martinez				
Deborah	McMahon	Redmond	Principal Planner	deborah.McMahon@ci.Redmond.OR.US	30
Eric	Porter	Sisters	Planner	eporter@ci.sisters.or.us	

FIRST	LAST	AGENCY	TITLE	EMAIL	ROUNDTRIP MILEAGE (if applicable)
Karen	Parmelee	Red Cross	Disaster Program Manager	Karen.parmelee@redcross.org	
Eric	Porter				
PHIL	GRIEB	RED CROSS	GOVT. LIAISON	wolfridge1273eyahoo.com	
Emily	Wegener	Red Cross	Preparedness Coordinator	emily.wegener@redcross.org	
[illegible]	Duda	ODF	Assistant Unit Forester	BDUDA@ODF.STATE.OR.US	
GORDON	FOSTER	ODF	Acting Unit Forester	grfoster@odf.state.or.us	
ED	KELLY	DES CO	County Forester	ed.keith@deschutes.org	
Nathan	Garibay	Des Co	Emergency Mgr	nathan.garibay@deschutes.org	
DAMIAN	SYRNYK	CITY OF BEND GMD	SENIOR PLANNER	dsyrnyk@landoregon.gov	
Melinda	Campbell	Deschutes County – IT	GIS Analyst/Programmer	melinda.campbell@deschutes.org	

Mitigation Strategy, Implementation and Maintenance Work Session Materials

Meeting:	Natural Hazards Mitigation Plan Update: Meeting 3
Date:	December 5, 2014
Time:	1:00 pm A 5:00 pm
Location:	Deschutes County Sherriff's Office (63333 Hwy 20, Bend, OR)

AGENDA

I.	**Welcome and Meeting Goals**	5 minutes
II.	**Public Involvement Strategies** • Survey Status	10 minutes
III.	**Proposed Hazards List Changes and History (review)**	10 minutes
IV.	**Risk Assessment and Identification**	60 minutes
	****5OMinute Break****	
V.	**Mission and NHMP Goals Review and Update** • Alignment with State NHMP Goals?	15 minutes
VI.	**Mitigation Strategies** • Vulnerability Themes? • Review of existing actions • New actions • Prioritization	90 minutes
	****5OMinute Break****	
VII.	**Plan Implementation and Maintenance**	30 minutes
VIII.	**WrapOUp & Next Steps** • Questions • WrapAup meeting in January/ February, (Date & Location TBD) • City addenda meetings: January/ February (Dates TBD)	10 minutes

Oregon Partnership for Disaster Resilience
Community Service Center • 1209 University of Oregon
Eugene • Oregon • 97403-1209
Phone: 541.346.7326 • Fax: 541.346.2040

Meeting Sign-In

Deschutes County NHMP Update: Meeting #3: Vulnerabilities/Risk Assessment December 5, 2014
Bend, Oregon

Please check/ complete, your contact information and **initial next to your name**

FIRST	LAST	INITIAL	AGENCY	TITLE	EMAIL	ROUNDTRIP MILEAGE (if applicable)
Melinda	Campbell	MC				
Diane	Canaday					
Ben	Duda	BD	ODF Sisters	Assistant Unit Forester	bduda@odf.state.or.us	
Dan	Fishkin	DF	Deschutes S & R, BPRD Board Member	Volunteer SAR Chair, BPRD	dfishkin@bendbroadband.com	
Gordon	Foster		ODF	Acting Unit Forester	grfoster@odf.state.or.us	
Nathan	Garibay		Deschutes County	Emergency Manager	Nathan.garibay@deschutes.org	
William	Groves	WG	Deschutes County	Senior Planner	willg@deschutes.org	
Peter	Gutowsky					
David	Howe					
Ed	Keith	EK				
Matt	Martin	MM	Deschutes County	Associate Planner	Matt.martin@deschutes.org	
Stuart	Martinez					

FIRST	LAST	INITIAL	AGENCY	TITLE	EMAIL	ROUNDTRIP MILEAGE (if applicable)
Deborah	McMahon		Redmond	Principal Planner	Deborah.mcmahon@ci.redmond.or.us	
Karen	Parmelee		Red Cross	Disaster Program Mana_ger	karenpermeleft@redcross.org	
Eric	Porter		Sisters	Planner	eporter@ci.sisters.or.us	
Damian	Symyk	q.;p;:	City of Bend GMD	Senior Planner	dsymyk@bendoregon.gov	
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City of Bend Addendum Meeting #1 Agenda: January 28, 2015

Meeting:	**Natural Hazards Mitigation Plan Update: City of Bend Addendum** **Risk Assessment, Mitigation Strategies, Implementation and Maintenance**
Date:	January 28, 2015
Time:	3:00 pm – 5:00 pm
Location:	City Hall, 710 NW Hall St., Bend, 97709

I. Welcome and Introductions **(5 minutes)**
- a. Overview of NHMP process

II. Review Hazard Identification **(15 minutes)**
- a. Jurisdiction Specific Hazard Inventories

III. Review Vulnerability Information **(30 minutes)**

IV. Jurisdiction Specific Risk Assessment – Exercise **(30 minutes)**
- a. Review 2014 County Assessment
- b. Complete City risk assessment

V. Overview of Mitigation Strategies Process Review Mission and Goals **(10 minutes)**
- a. Review County NHMP Mission and Goals

VI. Complete Jurisdiction Specific Mitigation Strategy **(20 minutes)**
- a. Review County action item updates and prioritization
- b. Develop jurisdiction specific mitigation actions
- c. Prioritize jurisdiction specific action items

VII. Overview of Implementation and Maintenance **(5 minutes)**

VIII. Next Steps **(5 minutes)**
- a. Complete city addenda
- b. Prepare final draft of the NHMP for County and City Review
- c. Provide the Office of Emergency Management a Review Opportunity
- d. Submit updated plan to FEMA for review

DISASTER RESILIENCE

Meeting Sign-In

Deschutes County NHMP Update: City Addendum Meeting: Bend January 28, 2015
Bend, Oregon

Please check/ complete, your contact information and initial next to your name

FIRST	LAST	AGENCY/ DEPARTMENT	TITLE	EMAIL

City of Bend Addendum Meeting #2 Agenda: February 11, 2015

Meeting:	**Natural Hazards Mitigation Plan Update: City of Bend Addendum** **Risk Assessment, Mitigation Strategies, Implementation and Maintenance**
Date:	February 11, 2015
Time:	1:30 pm – 3:00 pm
Location:	City Hall, 710 NW Hall St., Bend, 97709

I. Review Hazard Identification **(15 minutes)**
- a. Jurisdiction Specific Hazard Inventories

II. Review Vulnerability Information **(15 minutes)**

III. Jurisdiction Specific Risk Assessment – Exercise **(20 minutes)**
- a. Review 2014 County Assessment
- b. Complete City risk assessment

IV. Overview of Mitigation Strategies Process Review Mission and Goals **(10 minutes)**
- a. Review County NHMP Mission and Goals

V. Complete Jurisdiction Specific Mitigation Strategy **(20 minutes)**
- a. Review County action item updates and prioritization
- b. Develop jurisdiction specific mitigation actions
- c. Prioritize jurisdiction specific action items

VI. Overview of Implementation and Maintenance **(5 minutes)**

VII. Next Steps **(5 minutes)**
- a. Complete city addenda
- b. Prepare final draft of the NHMP for County and City Review
- c. Provide the Office of Emergency Management a Review Opportunity
- d. Submit updated plan to FEMA for review

PARTNERSHIP FOR DISASTER RESILIENCE
CSC.UOREGON.EDU/OPDR

Meeting Sign-In

Deschutes County NHMP Update:
City Addendum Meeting #2: Bend February 11, 2015 (1:30 – 3:00 pm)
Bend, Oregon

Please check/ complete, your contact information and initial next to your name

FIRST	LAST	AGENCY/ DEPARTMENT	TITLE	EMAIL
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City of La Pine Addendum Meeting #1 Agenda: February 11, 2015

Meeting:	**Natural Hazards Mitigation Plan Update: City of Sisters Addendum** **Risk Assessment, Mitigation Strategies, Implementation and Maintenance**
Date:	February 11, 2015
Time:	4:00 – 5:30 pm
Location:	City Hall, 16345 Sixth Street, La Pine, OR 97739

I. Welcome and Introductions **(5 minutes)**
   a. Overview of NHMP process

II. Review Hazard Identification **(15 minutes)**
   a. Jurisdiction Specific Hazard Inventories

III. Review Vulnerability Information **(30 minutes)**

IV. Jurisdiction Specific Risk Assessment – Exercise **(30 minutes)**
   a. Review 2014 County Assessment
   b. Complete City risk assessment

V. Overview of Mitigation Strategies Process Review Mission and Goals **(10 minutes)**
   a. Review County NHMP Mission and Goals

VI. Complete Jurisdiction Specific Mitigation Strategy **(20 minutes)**
   a. Review County action item updates and prioritization
   b. Develop jurisdiction specific mitigation actions
   c. Prioritize jurisdiction specific action items

VII. Overview of Implementation and Maintenance **(5 minutes)**

VIII. Next Steps **(5 minutes)**
   a. Complete city addenda
   b. Prepare final draft of the NHMP for County and City Review
   c. Provide the Office of Emergency Management a Review Opportunity
   d. Submit updated plan to FEMA for review

PARTNERSHIP FOR DISASTER RESILIENCE
CSC.UOREGON.EDU/OPDR

Meeting Sign-In

Deschutes County NHMP Update:
City Addendum Meeting: La Pine February 11, 2015 (4:00 to 5:30 pm)
La Pine, Oregon

Please check/ complete, your contact information and initial next to your name

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City of Redmond Addendum Meeting #1 Agenda: January 28, 2015

Meeting:	**Natural Hazards Mitigation Plan Update: City of Redmond Addendum** **Risk Assessment, Mitigation Strategies, Implementation and Maintenance**
Date:	January 28, 2015
Time:	1:00 pm – 2:30 pm
Location:	City Hall, 716 SW Evergreen Ave., Redmond, OR 97756

I. Welcome and Introductions **(5 minutes)**
- a. Overview of NHMP process

II. Review Hazard Identification **(15 minutes)**
- a. Jurisdiction Specific Hazard Inventories

III. Review Vulnerability Information **(20 minutes)**

IV. Jurisdiction Specific Risk Assessment – Exercise **(20 minutes)**
- a. Review 2014 County Assessment
- b. Complete City risk assessment

V. Overview of Mitigation Strategies Process Review Mission and Goals **(10 minutes)**
- a. Review County NHMP Mission and Goals

VI. Complete Jurisdiction Specific Mitigation Strategy **(10 minutes)**
- a. Review County action item updates and prioritization
- b. Develop jurisdiction specific mitigation actions
- c. Prioritize jurisdiction specific action items

VII. Overview of Implementation and Maintenance **(5 minutes)**

VIII. Next Steps **(5 minutes)**
- a. Complete city addenda
- b. Prepare final draft of the NHMP for County and City Review
- c. Provide the Office of Emergency Management a Review Opportunity
- d. Submit updated plan to FEMA for review

PARTNERSHIP FOR DISASTER RESILIENCE

CSC,UORI:GUN.rDli/OrDit

Meeting Sign-In

Deschutes County NHMP Update: City Addendum Meeting: Redmond January 28, 2015
Redmond, Oregon

Please check/ complete, your contact information and initial next to your name

FIRST	LAST	AGENCY/ DEPARTMENT	TITLE	EMAIL
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City of Sisters Addendum Meeting #1 Agenda: February 11, 2015

Meeting:	**Natural Hazards Mitigation Plan Update: City of Sisters Addendum** **Risk Assessment, Mitigation Strategies, Implementation and Maintenance**
Date:	February 11, 2015
Time:	9:00 am – 11:00 am
Location:	City Hall, 520 E. Cascade Avenue, Sisters, 97759

I. Welcome and Introductions **(5 minutes)**
- a. Overview of NHMP process

II. Review Hazard Identification **(15 minutes)**
- a. Jurisdiction Specific Hazard Inventories

III. Review Vulnerability Information **(30 minutes)**

IV. Jurisdiction Specific Risk Assessment – Exercise **(30 minutes)**
- a. Review 2014 County Assessment
- b. Complete City risk assessment

V. Overview of Mitigation Strategies Process Review Mission and Goals **(10 minutes)**
- a. Review County NHMP Mission and Goals

VI. Complete Jurisdiction Specific Mitigation Strategy **(20 minutes)**
- a. Review County action item updates and prioritization
- b. Develop jurisdiction specific mitigation actions
- c. Prioritize jurisdiction specific action items

VII. Overview of Implementation and Maintenance **(5 minutes)**

VIII. Next Steps **(5 minutes)**
- a. Complete city addenda
- b. Prepare final draft of the NHMP for County and City Review
- c. Provide the Office of Emergency Management a Review Opportunity
- d. Submit updated plan to FEMA for review

Meeting Sign-In

Deschutes County NHMP Update:
City Addendum Meeting: Sisters February 11, 2015 (9:00-11:00am)
Sisters, Oregon

Please check/ complete, your contact information and **initial next to your name**

FIRST	LAST	AGENCY/ DEPARTMENT	TITLE	EMAIL
Andrew	Gorayeb	City of Sisters	City Manager	agorayeb@ci.sisters.or.us
Gary [redacted]	Marshall	Sisters/Camp Sherman Fire	Fire Safety Manager	gmarshall@sistersfire.com
Paul	Bertagna	City of Sisters	Public Works Director	pbertagna@ci.sisters.or.us

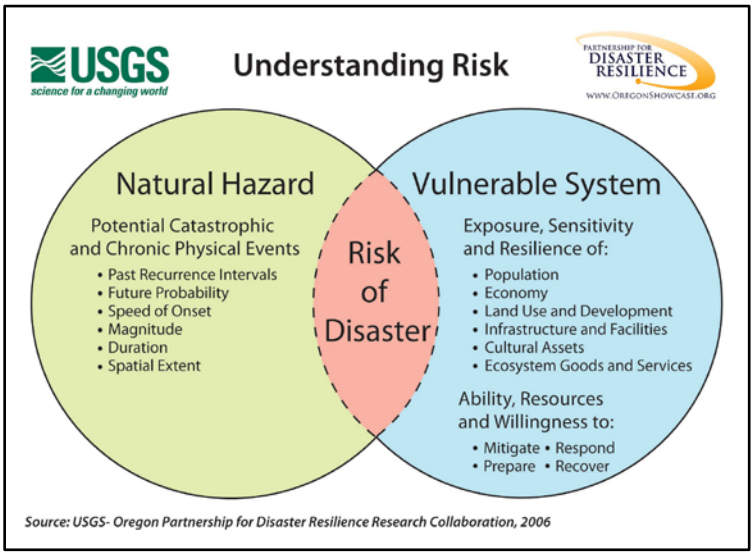
APPENDIX C: COMMUNITY PROFILE

Community resilience can be defined as the community's ability to manage risk and adapt to natural hazard impacts. In order to help define and understand the County's sensitivity and resilience to natural hazards, the following capacities must be examined:

- **Natural Environment**
- **Social/ Demographic**
- **Economic**
- **Built Environment**
- **Community Connectivity**
- **Political**

The Community Profile describes the sensitivity and resilience to natural hazards of Deschutes County, and its incorporated cities, as they relate to each capacity. It provides a snapshot in time when the plan was developed and will assist in preparation for a more resilient county. The information in this section, along with the hazard assessments located in the Hazard Annex, should be used as the local level rationale for the risk reduction actions identified in Section 3 – Mitigation Strategy. The identification of actions that reduce the county's sensitivity and increase its resiliency assist in reducing overall risk of disaster, the area of overlap in the figure below.

Figure C-1 Understanding Risk



Source: Oregon Partnership for Disaster Resilience

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.[1] 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

Deschutes County is located in Central Oregon along the eastern side of the Cascades, and covers 3,055 square miles. The region is diverse and comprised of high desert, mountain ranges, plateaus, river valleys, canyons, lava plains and partly forested mountains, with elevations ranging from 2,700 feet to 10,358 at the peak of South Sister. [2]

The county is located within several eco---regions: the Eastern Cascades Slopes and Foothills, the Cascades, Northern Basin and Range, and the Blue Mountains. The Deschutes River Valley lies in the northeast section of the county and covers the area of Bend, Redmond, and Sisters. La Pine is located within the Eastern Cascades Slopes and Foothills area in the southwest portion of the county. The Northern Basin and Range eco---region in southeast Deschutes County consists of pluvial lake basins. In the Eastern Cascades Slopes and Foothills, located across the County, the eco---region includes ponderosa pine/ bitterbrush woodland, cold wet pumice plateau basin and pumice plateau forests. Lastly, the Cascades eco---region in Deschutes County is located along the western border and in some southern areas in the County. The Cascades eco---region geography includes Cascade Crest Montane Forests and Cascades Subalpine/alpine. [3]

Deschutes River Basin

The Deschutes River Basin covers the majority of the County. Groundwater inflow on stream flows and volcanic activity influence the characteristics of upper Deschutes River Basin. Recent geology activity such as lava flows, pumice, and ash along with the glacial movement has reworked much of the area. It has allowed subsurface flows to travel in large quantities and at relatively rapid rates. This has resulted in a steady hydrologic flow with minimal fluctuations compared to rivers dominated by surface runoff.[4]

Climate

Climate refers to the temperatures, weather patterns, and precipitation in the region. This section covers historic climate information. Estimated future climate conditions and possible impacts are also provided (for a more detailed analysis refer to the State Risk Assessment.

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[1] Mayunga, J. 2007. Understanding and Applying the Concept of Community Disaster Resilience: A capital---based approach. Summer Academy for Social Vulnerability and Resilience Building.

[2] Monroe, William. Deschutes County Comprehensive Plan. Resource Element 1979.

[3] Loy, W. G., ed. 2001. Atlas of Oregon, 2nd Edition. Eugene, OR: University of Oregon Press

[4] Deschutes County/City of Bend River Study. April 1986

Temperature

There is a large temperature range in Deschutes County. Deschutes climate is typical of a high desert with cool nights and sunny days. Mean summer temperatures range from highs around 90 degrees Fahrenheit to lows around 40 degrees Fahrenheit. Mean winter temperatures range from highs around 50 degrees Fahrenheit to lows around 10 degrees Fahrenheit. The table below shows the mean annual rainfall ranges and temperatures for January and July for the various eco---regions of the county.

Table C-1 Average Rainfall and Temperatures

Ecoregion	Mean Annual Rainfall Range (inches)	Mean Temperature Range (°F) January min/max	Mean Temperature Range (°F) July min/max
Cascades			
Cascade Crest Montane Forest	55 to 100	21/35	43/72
Cascades Subalpine/ Alpine	75 to 140	36/48	52/68
Eastern Cascades Slopes and Foothills			
Ponderosa Pine/ Bitterbrush Woodland	16 to 35	20/40	40/82
Pumice Plateau	16 to 30	14/37	38/80
Pumice Plateau Basins	20 to 25	12/38	38/80
Blue Mountains			
Deschutes River Valley	8 to 12	22/41	46/84
Northern Basin and Range			
Pluvial Lake Basins	8 to 12	17/38	42/82
High Lava Plains	8 to 14	17/35	54/88

Source: US EPA. Ecoregions of Oregon: http://www.epa.gov/wed/pages/ecoregions/or_eco.htm

Temperatures in the Pacific Northwest region increased in the 20th Century by about 1.5 degrees Fahrenheit. Climate projection models indicate that temperatures could increasingly rise by an average of 0.2 degrees to 1.0 degrees Fahrenheit per decade. Average temperature change is projected to be 3.2 degrees Fahrenheit by 2040 and 5.3 degrees Fahrenheit by 2080. Temperature increases will occur throughout all seasons, with the greatest differences occurring in the summer months.[5]

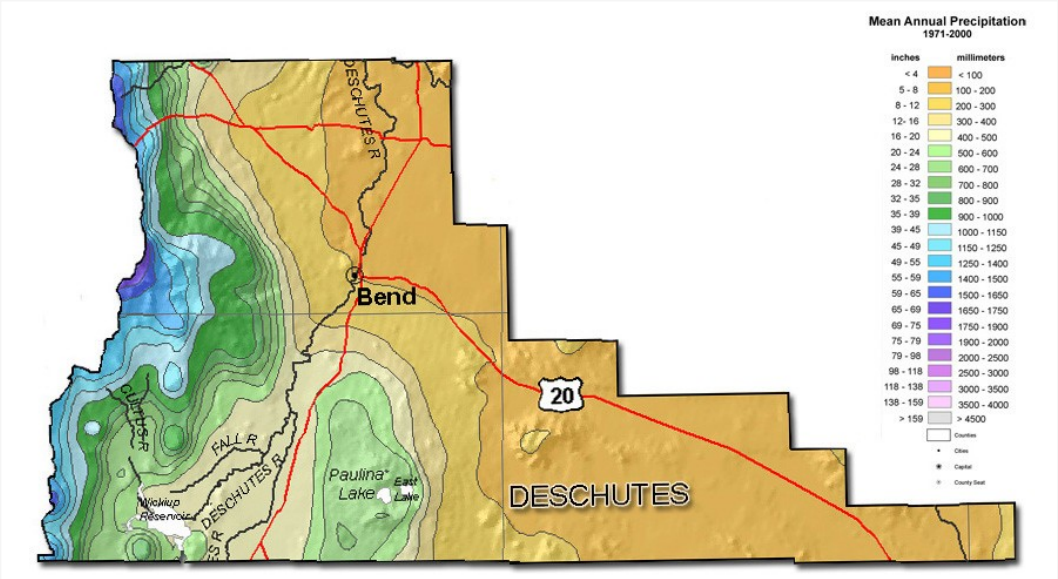
Precipitation

The region receives relatively low levels of precipitation, approximately 8---35 inches per year (increased levels of precipitation occur in the mountains to the west of the populated areas of the county). This is in contrast to the 37 to 50 inches normally seen in other parts of the Pacific Northwest. There is large annual temperature variation with mean temperatures anywhere from the high fifties to seventies, and the maximum high temperature up to 102 degrees Fahrenheit from June to September, to average highs of low teens in the winter months. In most winters, there are frequent and severe winter storms characterized by temperature, wind velocity, ground saturation, and snow pack. Winter storms can slow or

[5] Climate Impacts Group, "Climate Change," http://cses.washington.edu/cig/pnwc/cc.shtml#anchor6.

halt traffic, damage power lines, and kill livestock. Summer precipitation is relatively low, increasing the risk of wildfire and requiring irrigation for crops.

Figure C-2 Deschutes County Average Annual Precipitation



Source: The Oregon Climate Service, NOAA Climate Stations. "1971---2000 Climate of Deschutes County".

Total precipitation in the Pacific Northwest region may remain similar to historic levels but climate projections indicate the likelihood of increased winter precipitation and decreased summer precipitation.[6]

Increasing temperatures affects hydrology in the region. Spring snowpack has substantially decreased throughout the Western part of the United States, particularly in areas with milder winter temperatures, such as the Cascade Mountains. In other areas of the West, such as east of the Cascades Mountains, snowfall is affected less by the increasing temperature because the temperatures are already cold and more by precipitation patterns.[7]

Hazard Severity

Dynamic weather and diverse geography across Deschutes County are indicators of hazard vulnerability when combined with the changing climate and severe weather related events. Both wet and dry cycles are likely to last longer and be more extreme, leading to periods of deeper drought and more frequent flash flooding. Less precipitation in the summers and subsequently lower soil moisture with hotter temperatures will likely increase the amount of vegetation, such as rangeland and grasslands, consumed by wildfire.

[6] Ibid.

[7] Mote, Philip W., et. al., "Variability and trends in Mountain Snowpack in Western North America," http://cses.washington.edu/db/pdf/moteetalvarandtrends436.pdf

Synthesis

The physical geography, weather, climate and land cover of an area represent various interrelated systems that affect overall risk and exposure to natural hazards. The projected climate change models representing Central Oregon indicate the potential for increased effects of hazards, particularly drought and wildfire due to changing climate of the region. Central Oregon is projected to have warmer and drier summers with less precipitation. In addition, winter temperatures will be warmer, which means a decrease in mountain snowpack. These factors combined with periods of population growth and development intensification can lead to increasing risk of hazards, threatening loss of life, property and long---term economic disruption if land management is inadequate.

Social/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 significant factors that can influence the community's ability to cope, adapt to and recover from natural disasters. Population vulnerabilities can be reduced or eliminated with proper outreach and community mitigation planning.

Deschutes CommunitiesDeschutes County has a variety of residential community types: incorporated cities, unincorporated urban communities, rural communities, rural service centers, resort communities, and destination resorts.[8] Listed below are the residential communities by type:

Incorporated Cities

Incorporated cities can levy taxes on residents and are required to provide services such as electricity, sewer, and water. The following list shows incorporated cities and their date of incorporation:

- Bend (1/19/1905)
- La Pine (12/11/2006)
- Redmond (7/16/1910)
- Sisters (4/9/1946)

Urban Unincorporated Communities

Urban unincorporated communities have a minimum of 150 permanent residential dwellings, have three or more land use types, and are served by community sewer and water systems. Sunriver is the only unincorporated urban community in Deschutes County. The community is approximately 3,375 acres, was master planned in 1965, and has an estimated 1,733 permanent residents (during peak tourist seasons the population expands to about 12,000 residents). Additional information on Sunriver can be found in the Deschutes Comprehensive Plan Section 4.5.

Rural Communities

Rural communities are primarily composed of residential land, but also have some employment land (commercial, industrial), and public land that serve the surrounding area. There are two rural communities in Deschutes County:

- Terrebone – Located about six miles north of Redmond, this community was platted in 1909 and is the gateway to Smith Rock State Park, a premier rock climbing venue. The community has a population of about 1,100, which is expected to grow 2.2% per year to a forecasted population of 1,343 by 2025 according to the County Population Forecast (Ordinance 2004---012). According to a 2009 vacant lands inventory the community had 322 undeveloped lots (499 developed).

[8] Deschutes County, Oregon Adopted Budget Fiscal Year 2015.

- Tumalo---Located about three miles northwest of Bend the community was platted in 1904 and is a small farming community with most farms on fewer than five acres. The community has a population of about 420, which is expected to grow 2.2% per year to a forecasted population of 527 by 2025 according to the County Population Forecast (Ordinance 2004---012). According to a 2009 vacant lands inventory the community had 122 undeveloped lots (196 developed). The community of Tumalo is bisected by the Deschutes River and includes land that is within the special flood hazard area.

Resort Communities

Resort communities were established for recreation or resort purposes predate the establishment of the destination resort designation. These communities primarily contain temporary residential units, and some permanent residences, and commercial and industrial services to support the community. Deschutes County has two resort communities:

- Black Butte Ranch---Founded in 1970 this community has 1,830 acres, with 1,252 lots for seasonal and permanent residents; in addition there are 82 acres of industrial uses that support the community.
- Inn of the Seventh Mountain/ Widgi Creek---Located about five miles southwest of Bend, this community was developed in the late 1960's with an expansion that occurred in 1983. The 260 acre community has 333 condominium units, 107 single family homes, a golf course, and commercial developed primarily geared towards residents/ tourists. The community is completely surrounded by the Deschutes National Forest.

Destination Resorts

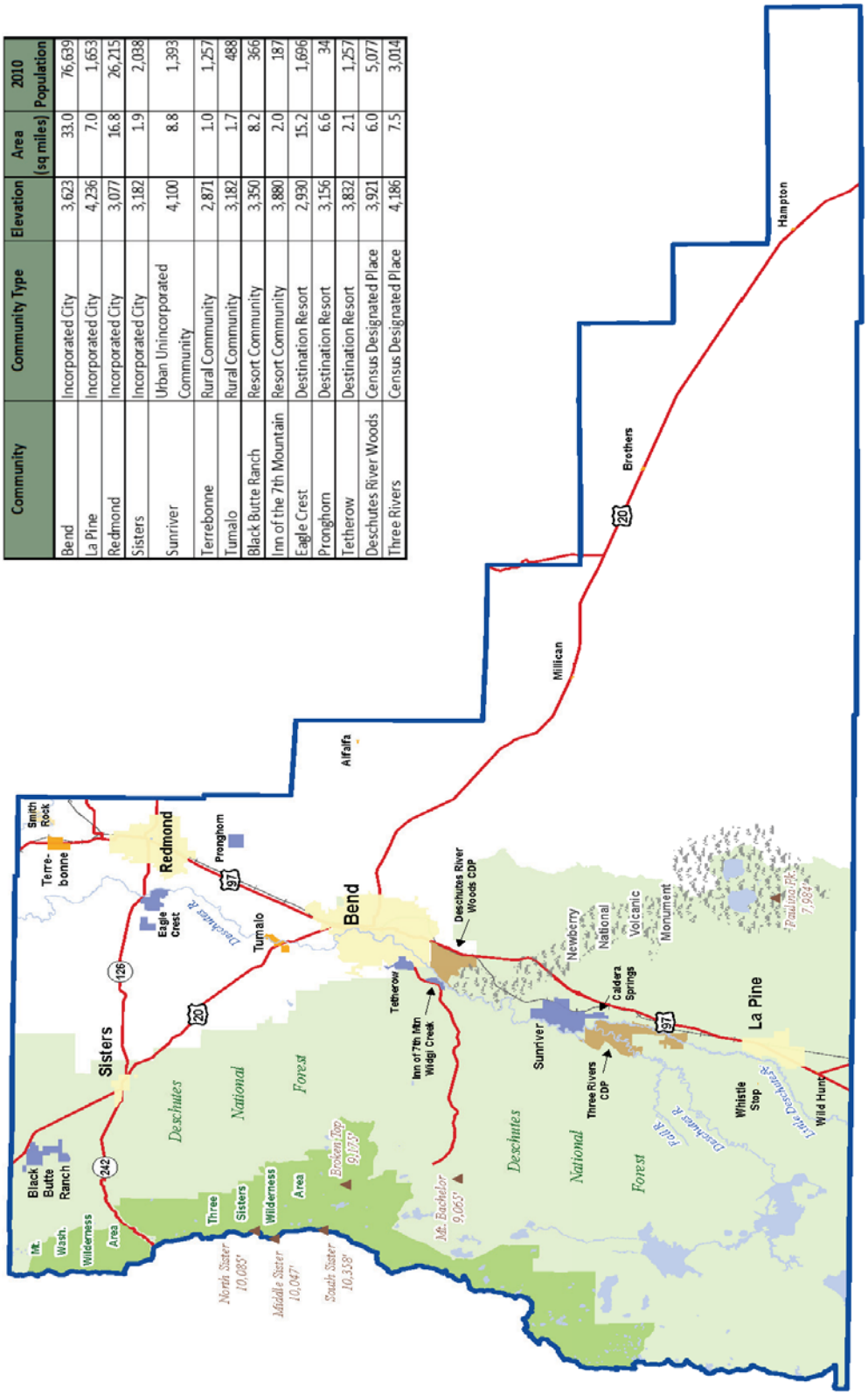
Destination resorts communities are self---contained developments that include developed recreational amenities in a natural setting. These communities were permitted under revised statewide planning laws in 1982 Within Deschutes County these communities must be a minimum of 160 acres (half dedicated to open space), include a minimum of 150 overnight units and have no more than twice the number of residential units as overnight units, commercial uses are limited to serving the resort, and a minimum of $7 million must be invested in visitor accommodations and recreational facilities. Deschutes County has four destination resorts:Caldera Springs---Directly south of Sunriver, 400 acres with 320 homesites, Eagle Crest, Pronghorn, and Tetherow.

Rural Service Centers

The comprehensive plan designates six areas as rural service centers (unincorporated communities that were developed prior to 1979 and recognized as exception areas from Goals 3 and 4): Alfalfa, Brothers, Hampton, Millican, Whistlestop, and Wildhunt.

Figure C-3 Deschutes County Map

Community	Community Type	Elevation	Area (sq miles)	2010 Population
Bend	Incorporated City	3,623	33.0	76,639
La Pine	Incorporated City	4,236	7.0	1,653
Redmond	Incorporated City	3,077	16.8	26,215
Sisters	Incorporated City	3,182	1.9	2,038
Sunriver	Urban Unincorporated Community	4,100	8.8	1,393
Terrebonne	Rural Community	2,871	1.0	1,257
Tumalo	Rural Community	3,182	1.7	488
Black Butte Ranch	Resort Community	3,350	8.2	366
Inn of the 7th Mountain	Resort Community	3,880	2.0	187
Eagle Crest	Destination Resort	2,930	15.2	1,696
Pronghorn	Destination Resort	3,156	6.6	34
Tetherow	Destination Resort	3,832	2.1	1,257
Deschutes River Woods	Census Designated Place	3,921	6.0	5,077
Three Rivers	Census Designated Place	4,186	7.5	3,014



Source: Deschutes County Fiscal Year 2015 Adopted Program Budget

Population

The majority of people across Deschutes County reside in Bend or within the unincorporated areas of the county. Between 2000 and 2013, Deschutes County experienced a 40.9% increase in population. The County Coordinated Population Forecast projects that by 2025 Deschutes County's population will increase by about 78,300 people, a 48% increase.[9]

Bend is by far the most populated city in the county, followed by Redmond; Sisters and La Pine are significantly smaller communities. The table below shows that population growth between 2000 and 2013 occurred in the cities of Bend, Redmond, and Sisters. La Pine was incorporated in December 2006; as such there is no data for 2000 to assess growth. Overall, the population of incorporated areas increased by 63.5% and unincorporated areas grew by 10.2% from 2000---2013. The County Coordinated Population Forecast projects that Redmond and Sisters will be the fastest growing communities between 2013 and 2025 and Bend will have the largest growth in population.

Table C-2 Population Estimate and Forecast for Deschutes County Cities

			2000@2013			2013@2025	
	2000	2013	Population Change	Percent Change	2025 Forecast	Population Change	Percent Change
Deschutes	115,367	162,525	47,158	40.9%	240,811	78,286	48.2%
Bend	52,029	78,280	26,251	50.5%	109,389	31,109	39.7%
La Pine	n/a	1,670	1,670	n/a	2,352	682	40.8%
Redmond	13,481	26,590	13,109	97.2%	45,724	19,134	72.0%
Sisters	959	2,115	1,156	120.5%	3,747	1,632	77.2%
Unincorporated	48,898	53,870	4,972	10.2%	79,599	25,729	47.8%

Source: U.S. Census Bureau. 2000 Decennial Census, Table P001, Portland State University, Population Research Center, "Annual Population Estimates", and 2004 Coordinated Population Forecast for Deschutes County – updated 2009.

Urban and rural growth patterns can impact how agencies, cities and counties prepare for emergencies, because changes in development can increase risk associated with hazards. The table below shows urbanization trends in Region 6, including Deschutes County. Deschutes County is becoming more urban, and to a greater extent than the state of Oregon.

[9] Deschutes County Community Development Department, 2014.

Table C-3 Urban and Rural Populations 2000-2010

Jurisdiction	2013		2025		Population Change 2013D2025		Average Annual Growth Rate
	Population	Percent of County	Population	Percent of County	Population Change	Percent Change	
Bend	78,280	48.2%	109,389	45.4%	31,109	39.7%	2.8%
LaPine	1,670	/	2,352	1.0%	682	40.8%	2.9%
Redmond	26,590	16.4%	45,724	19.0%	19,134	72.0%	4.6%
Sisters	2,115	1.3%	3,747	1.6%	1,632	77.2%	4.9%
Sub$Total	*108,655*	*66.9%*	*161,212*	*66.9%*	*52,557*	*48.4%*	*3.3%*
Not Incorporated	53,870	33.1%	79,599	33.1%	25,729	*47.8%*	3.3%
Deschutes Total	162,525	100%	240,811	100%	78,286	*48.2%*	3.3%

Source: U.S. Census Bureau. 2000 Decennial Census, Table P002 & U.S. Census Bureau. 2010 Decennial Census, Table P02. Note: The U.S. Census Bureau defines "urban" as either an "urbanized area" of 50,000 or more people, or an "urban cluster" of at least 2,500 people (but less than 50,000). Wheeler County does not meet either definition, therefore all of it's populations is considered rural even though the county includes incorporated cities.

Population size itself is not an indicator of vulnerability. More important is the location, composition, and capacity of the population within the community. Research by social scientists demonstrates that human capital indices such as language, race, age, income, education and health can affect the integrity of a community. Therefore, these human capitals can impact community resilience to natural hazards. As an example, Deschutes County's trend towards urbanization suggests that the population may be becoming less self---reliant and more reliant on external goods and services.

Tourists

Tourists are not counted in population statistics; and are therefore considered separately in this analysis. Tourism activities in Deschutes County are largely centered on outdoor activities, touring, and special events. Three---fourths of all trips to the region occur between April and September.[10] The table below shows the estimated number of person nights in private homes, hotels and motels, and other types of accommodations. The table shows that, between 2011---2013, visitors in Deschutes County lodge in private homes slightly more than in hotels/ motels but the share of each lodging type is fairly evenly distributed. Tourists' lodging in private homes suggests these visitors are staying with family and friends. For hazard preparedness and mitigation purposes, outreach to residents in Deschutes County will likely be transferred to these visitors in some capacity. However there has been a steady increase in visitors lodging in hotel/motels over while private home lodging has decreased. Visitors staying at hotel/motels are less likely to benefit from local preparedness outreach efforts aimed at residents. Visitors that stay in other accommodations are generally staying in vacation homes or at campgrounds.

[10] Longwoods Travel USA.(2011) Regional Visitor Report 2011, The Central Region. Retrieved April 29, 2014 from http://industry.traveloregon.com/research/archive/

Table C-4 Annual Visitor Estimates in Person Nights

	2011 Number	Percent	2012 Number	Percent	2013 Number	Percent
Deschutes	5,649	100%	5,895	100%	6,058	100%
Hotel/Motel	1,821	32.2%	1,957	33.2%	2,067	34.1%
Private Home	2,040	36.1%	2,104	35.7%	2,148	35.5%
Other	1,788	31.7%	1,834	31.1%	1,843	30.4%

Source: Oregon Tourism Commission, Oregon Travel Impacts: 1991---2013, Dean Runyan Associates, http://www.deanrunyan.com/doc_library/ORImp.pdf

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. Knowing whether the region's visitors are staying in friends/relatives homes in hotels/motels, or elsewhere can be instructive when developing outreach efforts.[11]

Language

Special consideration should be given to populations who do not speak English as their primary language. Language barriers can be a challenge when disseminating hazard planning and mitigation resources to the general public, and it is less likely they will be prepared if special attention is not given to language and culturally appropriate outreach techniques.[12]

There are various languages spoken across Deschutes County; the primary language is English. Overall, 2.7% of the total population in Deschutes County is not proficient in English. The table below shows that there is about a 3% lower percentage of people who do not speak English "very well" within the county compared to the state as a whole. Sisters has the highest percentage of residents who do not speak English "very well"; while Bend has the largest population. Outreach materials used to communicate with, plan for, and respond to non---English speaking populations, and those who do not speak English very well, should take into consideration the language needs of these populations.

[11] MDC Consultants (n.d.). When Disaster Strikes – Promising Practices. Retrieved March 18, 2014, from http://www.mdcinc.org/sites/default/files/resources/When%20Disaster%20Strikes%20---%20Promising%20Practices%20--- %20Tourists.pdf

[12] State of Oregon Natural Hazards Mitigation Plan, Region 6 Regional Profile.

Table C-5 Deschutes County Language Barriers

	Speak English "Very Well"		Speak English less than "very well"	
	Estimate	Percent	Estimate	Percent
Oregon	3,376,744	93.8%	224,905	6.2%
Region 6	252,787	96.9%	8,096	3.1%
Deschutes	145,397	97.3%	3,989	2.7%
Bend	69,629	96.7%	2,408	3.3%
La Pine	1,394	98.8%	17	1.2%
Redmond	23,274	96.1%	955	3.9%
Sisters	1,890	95.8%	83	4.2%

Source: U.S. Census Bureau, 2008---2012 American Community Survey, Table DP02.

Race

The impact in terms of loss and the ability to recover may also vary among minority population groups following a disaster. Studies have shown that racial and ethnic minorities can be more vulnerable to natural disaster events. This is not reflective of individual characteristics; instead, historic patterns of inequality along racial or ethnic divides have often resulted in minority communities that are more likely to have inferior building stock, degraded infrastructure, or less access to public services. The table below describes Deschutes County's population by race and ethnicity.

The majority of the population in Deschutes County is racially white (93.3%). Approximately, 7% of the population is ethnically Hispanic or Latino; the cities of Bend and Redmond have higher percentages of Hispanic or Latino residents than other parts of the county. It is important to identify specific ways to support all portions of the community through hazard mitigation, preparedness, and response. Culturally appropriate, and effective outreach can include both methods and messaging targeted to diverse audiences. For example, connecting to historically disenfranchised populations through already trusted sources or providing preparedness handouts and presentations in the languages spoken by the population will go a long way to increasing overall community resilience.

Table C-6 Deschutes Race and Hispanic or Latino Origin

Race	Deschutes	Bend	La Pine	Redmond	Sisters
Total Population	158,884	77,063	1,671	26,186	2,115
One Race	97.7%	97.5%	98.3%	97.9%	98.3%
White	93.3%	93.2%	93.6%	91.3%	94.7%
Black or African American	0.3%	0.4%	0.0%	0.4%	0.0%
American Indian and Alaska Native	0.8%	0.4%	1.4%	0.7%	0.2%
Asian	1.1%	1.5%	1.8%	0.6%	0.0%
Native Hawaiian and Other Pacific Islander	0.2%	0.1%	1.8%	0.3%	0.0%
Some Other Race	2.0%	1.9%	1.0%	4.4%	3.3%
Two or More Races	2.3%	2.5%	1.7%	2.1%	1.7%
Hispanic or Latino (of any race)	7.4%	8.3%	5.1%	12.6%	6.8%
Not Hispanic or Latino	92.6%	91.7%	94.9%	87.4%	93.2%

Source: U.S. Census Bureau, 2008---2012 American Community Survey, Table DP05.

Age

Of the factors influencing socio demographic capacity, the most significant indicator in Deschutes County may be age of the population. As depicted in the table below, as of 2012, 15.1% of the county population is over the age of 64, a percentage that is projected to rise to 20.8% by 2020 and to 25.5% by 2030. The Deschutes County age dependency ratio[13] is 51.7, which is higher than the State of Oregon, 48.6; La Pine has the highest ratio for the cities at 73.2. The age dependency ratio indicates a higher percentage of dependent aged people to that of working age; this trend is projected to continue with Deschutes County rates in 2020 of 58.9 and 69.7 in 2030.

Table C-7 Deschutes Population by Vulnerable Age Groups

2012		< 15 Years		> 64 Years			
Jurisdiction	Total	Number	Percent	Number	Percent	15 to 64	Age Dependency Ratio
Oregon	3,836,628	714,810	18.6%	540,527	14.1%	2,581,291	48.6
Deschutes	158,884	30,187	19.0%	23,965	15.1%	104,732	51.7
Bend	77,063	15,383	20.0%	10,225	13.3%	51,455	49.8
La Pine	1,671	485	29.0%	221	13.2%	965	73.2
Redmond	26,186	6,033	23.0%	3,088	11.8%	17,065	53.4
Sisters	2,115	357	16.9%	333	15.7%	1,425	48.4
2020							
Oregon	4,252,101	741,416	17.4%	787,928	18.5%	2,722,757	56.2
Deschutes	182,455	29,716	16.3%	37,941	20.8%	114,798	58.9
2030							
Oregon	4,768,000	819,851	17.2%	1,021,190	21.4%	2,926,959	62.9
Deschutes	214,289	33,413	15.6%	54,575	25.5%	126,301	69.7

Source: U.S. Census Bureau, 2008---2012 American Community Survey, Table DP05; Office of Economic Analysis, Department of Administrative Services, Long Term County Forecast, "State and County Population Forecasts by Age and Sex, 2000---2040", accessed July 2014.

The age profile of an area has a direct impact both on what actions are prioritized for mitigation and how response to hazard incidents is carried out. School age children rarely make decisions about emergency management. Therefore, a larger youth population in an area will increase the importance of outreach to schools and parents on effective ways to teach children about fire safety, earthquake response, and evacuation plans. Furthermore, children are more vulnerable to the heat and cold, have few transportation options and require assistance to access medical facilities.[14] Older populations may also have special needs prior to, during and after a natural disaster. Older populations may require assistance in evacuation due to limited mobility or health issues. Additionally, older populations may

[13] The age dependency ratio is derived by dividing the combined under 15 and 65---and---over populations by the 15---to---64 population and multiplying by 100. A number close to 50 indicates about twice as many people are of working age than non---working age. A number that is closer to 100 implies an equal number of working age population as non---working age population. A higher number indicates greater sensitivity.

[14] State of Oregon Natural Hazards Mitigation Plan, Region 6 Central Oregon Regional Profile.

require special medical equipment or medications, and can lack the social and economic resources needed for post---disaster recovery.[15]

Gender

Deschutes County has slightly more females than males (Male: 49.4%, Female 50.6%), which is a similar ratio to that of the state.[16] 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.[17]

Families and Living Arrangements

Two ways the census defines households are by type of living arrangement and family structure. A householder may live in a "family household" (a group related to one another by birth, marriage or adoption living together); in a "nonfamily household" (a group of unrelated people living together); or alone. Deschutes County is predominately comprised of family households (67.8%). Of all households, 25.2% are one---person non---family households. Bend has the highest percentage, and largest population, of non---family households, while La Pine and Sisters have the highest percentage of people 65 years or older living alone.

Table C-8 Family versus Non-family Households

	Total Households	Family Households		Nonfamily Households		Householder Living Alone			
						All Ages		> 64	
	Estimate	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent
Oregon	1,512,718	964,274	63.7%	548,444	36.3%	421,620	27.9%	150,529	10.0%
Region 6	113,148	76,376	67.5%	36,772	32.5%	28,515	25.2%	11,126	9.8%
Deschutes	64,459	43,686	67.8%	20,773	32.2%	15,759	24.4%	6,215	9.6%
Bend	32,362	19,891	61.5%	12,471	38.5%	9,408	29.1%	3,438	10.6%
La Pine	663	442	66.7%	221	33.3%	201	30.3%	112	16.9%
Redmond	9,964	6,959	69.8%	3,005	30.2%	2,372	23.8%	945	9.5%
Sisters	821	571	69.5%	250	30.5%	200	24.4%	99	12.1%

Source: U.S. Census Bureau, 2008---2012 American Community Survey, Table DP02

The table below shows household structures for families with children. Nearly 305 of all households within the county are family household that have children; Bend has the lowest percentage of family households with children (28.9%) and Redmond has the highest percentage (35.3%). There are about twice as many single parent households that are headed by females than by males; Redmond has the highest percentage of single parent households. These populations will likely require additional support during a disaster and will inflict strain on the system if improperly managed.

[15] Wood, Nathan. Variations in City Exposure and Sensitivity to Tsunami Hazards in Oregon. U.S. Geological Survey, Reston, VA, 2007.

[16] U.S Census Bureau. Census 2010---Total Population, 2010. Prepared by Social Explorer. http://www.socialexplorer.com/6f4cdab7a0/explore (October 20, 2014).

[17] Ibid.

Table C-9 Family Households with Children by Head of Household

	Total Households	Family Households with Children		Single Parent (male)		Single Parent (female)		Married Couple with Childern	
	Estimate	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent
Oregon	1,512,718	415,538	27.5%	35,855	2.4%	93,575	6.2%	286,108	18.9%
Region 6	113,148	31,005	27.4%	3,373	3.0%	6,349	5.6%	21,283	18.8%
Deschutes	64,459	18,223	28.3%	1,805	2.8%	3,273	5.1%	13,145	20.4%
Bend	32,362	9,368	28.9%	820	2.5%	1,688	5.2%	6,860	21.2%
La Pine	663	211	31.8%	12	1.8%	12	1.8%	187	28.2%
Redmond	9,964	3,515	35.3%	555	5.6%	954	9.6%	2,006	20.1%
Sisters	821	260	31.7%	31	3.8%	71	8.6%	158	19.2%

Source: U.S. Census Bureau, 2008---2012 American Community Survey, Table DP02
Note: The table shows the percent of total households represented by each family household structure category.

Income

Household income and poverty status are indicators of socio demographic capacity and the stability of the local economy. Household income can be used to compare economic areas as a whole, but does not reflect how the income is divided among the area residents. The 2012 median household income across Deschutes County is $51,468; this is slightly higher than the State of Oregon median income of $50,036. The table below shows decreses in real incomes across Deschutes County and cities. Bend has the highest median household income, followed by Sisters.

Table C-10 Median Household Income

	2009	2012	Percent Change
Oregon	$52,474	$50,036	+4.6%
Deschutes	$57,697	$51,468	+10.8%
Bend	$57,719	$52,601	+8.9%
La Pine	$32,765	$28,942	+11.7%
Redmond	$46,915	$41,021	+12.6%
Sisters	$53,025	$49,306	+7.0%

Source: U.S. Census Bureau, 2008---2012 American Community Survey, Table DP03.
Note: 2009 dollars are adjusted for 2012 using Bureau of Labor Statistics' Consumer Price Index Inflation Calculator.

The table below identifies the percentage of individuals and children under 18 that are below the poverty level in 2012. It is estimated that 13.1% of individuals and 18.3% of with children under 18 live below the poverty level across the county. Poverty rates in Deschutes County are lower than that of Oregon State. La Pine and Redmond have rates that are slightly higher than the county rates for the same two categories. While Sisters does not have the highest rate for either category, it is notable that the total population in poverty and children under 18 in poverty has more than tripled from 2009---2012.

Table C-11 Poverty Rates

	Total Population in Poverty			Children Under 18 in Poverty		
	Number	Percent	Percent Change*	Number	Percent	Percent Change*
Oregon	584,059	15.5%	17.7%	175,303	20.6%	17.6%
Region 6	41,857	15.3%	28.3%	13,224	21.5%	22.1%
Deschutes	20,633	13.1%	53.9%	6,559	18.3%	60.5%
Bend	9,248	12.1%	47.1%	2,943	16.5%	44.8%
La Pine	460	27.7%	6.7%	208	39.7%	15.6%
Redmond	5,616	21.6%	102.7%	2,064	29.2%	110.0%
Sisters	311	14.7%	314.7%	131	26.8%	336.7%

Source: U.S. Census Bureau, 2005---2009 & 2008---2012 American Community Survey, Table S1701.

Cutter's research suggests that lack of wealth contributes to social vulnerability because individual and community resources are not as readily available. Affluent communities are more likely to have both the collective and individual capacity to more quickly rebound from a hazard event, while impoverished communities and individuals may not have this capacity –leading to increased vulnerability. Wealth can help those affected by hazard incidents to absorb the impacts of a disaster more easily. Conversely, poverty, at both an individual and community level, can drastically alter recovery time and quality.[18]

Federal assistance programs such as food stamps are another indicator of poverty or lack of resource access. Statewide social assistance programs like the Supplemental Nutritional Assistance Program (SNAP) and Temporary Assistance for Needy Families (TANF) provide assistance to individuals and families. In Deschutes County, TANF reaches approximately 922 families per month and SNAP helps to feed just fewer than 31,000 people (17,000 households) per month (about 19% of the region's population).[19] Those reliant on federal assistance are more vulnerable in the wake of disaster because of a lack of personal financial resources and reliance on government support.

[18] Cutter, S. L. (2003). Social Vulnerability to Environmental Hazards. *Social Science Quarterly*.

[19] Sabatino, J. (2014). *Oregon TANF Caseload, "One and Two Parent Families Combined",* District 10; November 2014 data, and Sabatino, J. (2014). *Oregon SNAP Program Activity, "SSP, APD and AAA Combined",* District 10; November 2014 data. Retrieved from State of Oregon Office of Business Intelligence website: http://www.oregon.gov/dhs/assistance/Pages/data/main.aspx, November 2014.

Education

Educational attainment of community residents is also identified as an influencing factor in socio demographic capacity. 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 have negative effects on the resiliency of the community.

According to the U.S. Census, 93% of the Deschutes County population over 25 years of age has graduated from high school or received a high school equivalency, with approximately 30.5% going on to earn a Bachelor's Degree. La Pine has the lowest rate of high school graduates. Bend and Sisters have the highest percentages of their populations with a Bachelor's degree or higher. Conversely, La Pine and Redmond have significantly lower percentages of their populations that have Bachelor's degrees or higher.

Table C-12 Educational Attainment 2012

Jurisdiction	Oregon	Region 6	Deschutes County	Bend	La Pine	Redmond	Sisters
Population 25 years and over	2,612,044	192,919	110,886	53,314	990	16,187	1,335
Less than 9th grade	4.1%	2.9%	2.0%	2.3%	2.9%	2.1%	2.0%
9th to 12th grade, no diploma	6.8%	7.0%	5.0%	3.5%	17.2%	9.1%	5.5%
High school graduate or GED	24.8%	27.4%	23.3%	17.7%	35.6%	30.0%	21.9%
Some college, no degree	27.0%	28.2%	29.0%	28.4%	27.8%	31.5%	21.9%
Associate's degree	8.1%	9.4%	10.1%	10.4%	5.8%	10.1%	12.2%
Bachelor's degree	18.5%	16.7%	20.3%	26.1%	8.7%	12.1%	18.7%
Graduate or professional degree	10.8%	8.4%	10.2%	11.6%	2.1%	5.0%	17.8%
Percent without Highschool Degree	*10.8%*	*9.9%*	*7.0%*	*5.8%*	*20.1%*	*11.2%*	*7.6%*
Percent High School Graduate or Higher	*89.2%*	*90.1%*	*93.0%*	*94.2%*	*79.9%*	*88.8%*	*92.4%*
Percent Bachelor's Degree or Higher	*29.2%*	*25.1%*	*30.5%*	*37.7%*	*10.8%*	*17.1%*	*36.5%*

Source: U.S. Census Bureau, 2008---2012 American Community Survey, Table DP02.

In relation to the high school graduation rate, it is important to note the progress ratings of the county school districts. The Oregon Department of Education Federal Adequate Yearly Progress Report (2011---2012) indicates that three schools in the County have a federal designation for Title I schools; the majority of other schools received an *Outstanding* or *Satisfactory* score.[20] The quality of education received at K---12 area schools likely influences the level of higher education achieved. These circumstances can have long---term impacts on future regional employment, income and ultimately community stability and resilience.

[20] Oregon Department of Education. Adequate Yearly Progress (AYP) Reports and Report Card Download. http://www.ode.state.or.us/data/reportcard/ReportArchive.aspx. Deschutes County school districts include: Bend---LaPine Administrative School District (1 out of 28 is Priority, 2 out of 28 are Focus schools, 16 out of 28 are Outstanding, 10 of 28 are Satisfactory, and 1 out of 28 Needs Improvement), Redmond School District (2 out of 11 are Outstanding, 9 out of 11 are Satisfactory), Sisters School District (3 out od 3 schools are Oustanding).

Health

Individual and community health play an integral role in community resiliency, as indicators such as health insurance, people with disabilities, dependencies, homelessness and crime rate paint an overall picture of a community's well---being. These factors translate to a community's ability to prepare, respond to, and cope with the impacts of a disaster.

The Resilience Capacity Index recognizes those who lack health insurance or are impaired with sensory, mental or physical disabilities, have higher vulnerability to hazards and will likely require additional community support and resources. The percentage of population in Deschutes County without health insurance (20%) is the same percentage as that of the State. All cities within Deschutes County, except La Pine, have lower rates of uninsured individuals than Oregon. The percentage of uninsured changes with age, the highest rates of uninsured are within the 18 to 64 year category; La Pine has the highest rate of this age group that is uninsured. Overall the county has a higher percentage of people under age 18 that are uninsured than Oregon; Bend and Sisters have the highest rate of this age group that is uninsured. The ability to provide services to the uninsured populations may burden local providers following a natural disaster. Since the survey was conducted more than 200,000 Oregonians have enrolled in health care coverage through the Affordable Care Act (ACA) coverage expansion; future surveys should capture the effects of this coverage expansion[21].

Table C-13 Health Insurance Coverage

		Without Health Insurance				
		Total Population		Under 18 years	18 to 64 years	65 years and older
Jurisdiction	Population	Number	Percent			
Oregon	3,829,588	603,893	20.0%	7.7%	22.1%	0.5%
Deschutes	159,714	28,734	20.0%	10.5%	25.2%	0.4%
Bend	77,653	14,387	18.5%	11.3%	25.1%	0.4%
La Pine	1,625	347	21.4%	7.3%	31.9%	3.0%
Redmond	26,423	4,788	18.1%	4.8%	28.3%	0.0%
Sisters	2,262	427	18.9%	10.1%	27.0%	0.0%

Source: U.S. Census Bureau, 2009---2013 American Community Survey, Table S2701.

[21] Oregon Health Authority, Oregon Health Insurance Survey: 2013 Data Reports, http://www.oregon.gov/oha/ohpr/rsch/pages/insurance_data.aspx#State_Health_Insurance_Program

The table below describes disability status of the population. As of 2012, 12.1% of the Deschutes County population, 19,066 people, identifies with one or more disabilities; this rate is below the State percentage. La Pine has the highest percentage of it's total population with a disability (22.7%) and also the highest percentage of individuals 65 years and over with a disability (61%). The county's percentage of individuals under 18 years with a disability (5.8%) is greater than the state percentage by more than one percentage point; Sisters is the only city without a higher percentage.

Table C-14 Deschutes County Disability Status

	Total Population*	With a disability		Under 18 years with a disability		65 years and over with a disability	
	Estimate	Estimate	Percent	Estimate	Percent**	Estimate	Percent**
Oregon	3,796,881	511,297	13.5%	39,439	4.6%	200,374	37.8%
Region 6	274,535	39,778	14.5%	3,558	5.7%	15,570	34.9%
Deschutes	158,076	19,066	12.1%	2,111	5.8%	7,369	31.0%
Bend	76,610	8,524	11.1%	997	5.5%	3,316	32.9%
La Pine	1,663	377	22.7%	30	5.7%	130	61.0%
Redmond	26,029	2,953	11.3%	389	5.4%	938	31.0%
Sisters	2,115	310	14.7%	20	4.1%	153	45.9%

*Non---institutionalized population

**Percent of age group

Source: U.S. Census Bureau, 2008---2012 American Community Survey, Table DP02.

In 2011, Oregon Housing and Community Services (OHCS) conducted a homeless count to identify the number of homeless, their age and their family type. The OHCS study found that 1,775 individuals in Deschutes County identify as homeless. The primary age groups of those identified are adults 24---44 years, children age 6---11 years, and 12---17 years (in order from most to least).[22] The homeless have little resources to rely on, especially during an emergency. It will likely be the responsibility of the county and local non---profit entities to provide services such as shelter, food and medical assistance. Therefore, it is critical to foster collaborative relationships with agencies that will provide additional relief such as the American Red Cross and homeless shelters. It will also be important to identify how to communicate with these populations, since traditional means of communication may not be appropriate or available.

Synthesis

For planning purposes, it is essential Deschutes County consider both immediate and long---term socio---demographic implications of hazard resilience. Immediate concerns include the growing elderly population and language barriers associated with a culturally diverse community. Even though the vast majority of the population is reported as proficient in English, there is still a small amount of the population not proficient in English. These populations would serve to benefit from mitigation outreach, with special attention to cultural, visual and technology sensitive materials. The current status of other Social/---demographic capacity indicators such as graduation rate, quality of schools, high violent crime rate, and poverty level higher and median household income lower than the State can have long---term impacts on the economy and stability of the community ultimately affecting future resilience.

[22] Oregon Housing and Community Services, "2011 Point in Time Homeless Count". http://www.ohcs.oregon.gov/OHCS/RA_2011_Point_In_Time_Homeless_Counts.shtml
Note: More recent counts have occurred, but the data has not yet been approved and released.

Economic Capacity

Economic capacity refers to the financial resources present and revenue generated in the community to achieve a higher quality of life. Income equality, housing affordability, economic diversification, employment and industry are measures of economic capacity. However, economic resilience to natural disasters is far more complex than merely restoring employment or income in the local community. Building a resilient economy requires an understanding of how the component parts of employment sectors, workforce, resources and infrastructure are interconnected in the existing economic picture. Once any inherent strengths or systematic vulnerabilities become apparent, both the public and private sectors can take action to increase the resilience of the local economy.

Regional Affordability

The evaluation of regional affordability supplements the identification of Social/demographic capacity indicators, i.e. median income, and is a critical analysis tool to understanding the economic status of a community. This information can capture the likelihood of individuals' ability to prepare for hazards, through retrofitting homes or purchasing insurance. If the community reflects high---income inequality or housing cost burden, the potential for home---owners and renters to implement mitigation can be drastically reduced. Therefore, regional affordability is a mechanism for generalizing the abilities of community residents to get back on their feet without Federal, State or local assistance.

Income Equality

Income equality is a measure of the distribution of economic resources, as measured by income, across a population. It is a statistic defining the degree to which all persons have a similar income. The table below illustrates the county and cities level of income inequality. The Gini index is a measure of income inequality. The index varies from zero to one. A value of one indicates perfect inequality (only one household has any income). A value of zero indicates perfect equality (all households have the same income).[23]

Deschutes County's income distribution is approximately reflective of the State as a whole. The cities within the county vary slightly with the greatest income equality within the cities of Bend, La Pine, and Sisters. Based on social science research, the region's cohesive response to a hazard event may be affected by the distribution of wealth in communities that have less income equality[24].

[23] University of California Berkeley. Building Resilient Regions, Resilience Capacity Index. http://brr.berkeley.edu/rci/.

[24] Susan Cutter, Christopher G. Burton, and Christopher T. Emrich. 2010. "Disaster Resilience Indicators for Benchmarking Baseline Conditions," Journal of Homeland Security and Emergency Management 7, no.1: 1---22

Table C-15 Regional Income Equality

Jurisdiction	Income Inequality Coefficient
Oregon	0.4517
Deschutes	0.4460
Bend	0.4558
La Pine	0.4426
Redmond	0.3981
Sisters	0.4400

Source: U.S. Census Bureau, 2008---2012 American Community Survey, Table B19083.

Housing affordability is a measure of economic security gauged by the percentage of an area's households paying less than 35% of their income on housing.[25] Households spending more than 35% are considered housing cost burdened. The table below displays the percentage of homeowners and renters reflecting housing cost burden across the region.

In comparison to the State, Deschutes County has a greater percentage of homeowners with a mortgage spending more than 35% of their income on housing. Among homeowners without a mortgage, La Pine has the greatest rate of households with housing cost burdens. Amongst homeowners with a mortgage, La Pine and Redmond have the highest rates of housing cost burden. Among renters, La Pine, Redmond, and Sisters residents have the greatest rates of households with housing cost burdens. In general, the population that spends more of their income on housing has proportionally fewer resources and less flexibility for alternative investments in times of crisis.[26] This disparity imposes challenges for a community recovering from a disaster as housing costs may exceed the ability of local residents to repair or move to a new location. These populations may live paycheck to paycheck and are extremely dependent on their employer, in the event their employer is also impacted it will further the detriment experienced by these individuals and families.

Table C-16 Households Spending > 35% of Income on Housing

Jurisdiction	Owners		Renters
	With Mortgage	Without Mortgage	
Oregon	30.8%	11.6%	41.8%
Deschutes	38.5%	11.1%	40.9%
Bend	36.1%	11.8%	38.0%
La Pine	54.5%	24.8%	52.8%
Redmond	43.0%	10.0%	46.3%
Sisters	36.4%	3.3%	46.8%

Source: U.S. Census Bureau, 2008---2012 American Community Survey, Tables B25070 & B25091.

[25] University of California Berkeley. Building Resilient Regions, Resilience Capacity Index. http://brr.berkeley.edu/rci/.

[26] Ibid.

Economic Diversity

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 Hachman Index, a formula that compares the composition of county and regional economies with those of states or the nation as a whole. Using the Hachman Index, a diversity ranking of 1 indicates the Oregon 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. Deschutes County ranked 4th out of the 36 counties in the state overall. The table below describes the Hachman Index Scores for counties in the region. Another measure of economic diversity is the Herfindahl Index, which ranks Deschutes County 4thout of 36 Oregon counties in terms of the economic diversity of the county's 240 industries.[27]

Table C-17 Regional Hachman Index Scores

	2009		2012	
County	Value	Rank	Value	Rank
Crook	0.29	24	0.29	24
Deschutes	0.75	4	0.76	4
Jefferson	0.08	35	0.07	34
Klamath	0.57	8	0.62	8
Lake	0.09	33	0.10	32
Wheeler	0.16	29	0.15	29

Source: Oregon Employment Department

While illustrative, economic diversity is not a guarantor of economic vitality or resilience. For example as of 2014, though Deschutes County is ranked #4 in the state for economic diversity per the Hachman Index, it is listed as "economically distressed" by the Oregon Business Development Commission. 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]

[27] Oregon Employment Department, 2013.

[28] Business Oregon – Oregon Economic Data "Distressed Communities List", http://www.oregon4biz.com/Publications/Distressed---List/

Employment and Wages

According to the Oregon Employment Department, unemployment has declined since 2009. However, the central region of Oregon including Deschutes County remains higher than the State unemployment rate.

Table C-18 Unemployment Rates in Region 6

	2009	2010	2011	2012	2013	Change (2009-2013)
Oregon	11.1%	10.8%	9.7%	8.8%	7.7%	(3.4%
Region 6	14.7%	14.2%	12.8%	11.8%	10.1%	(4.6%
Crook	17.9%	17.1%	15.3%	14.2%	12.3%	(5.7%
Deschutes	14.7%	14.3%	12.7%	11.4%	9.5%	(5.2%
Jefferson	14.8%	14.4%	13.4%	12.3%	10.7%	(4.1%
Klamath	13.9%	13.3%	12.4%	11.9%	10.7%	(3.2%
Lake	12.4%	13.6%	13.3%	12.8%	11.1%	(1.3%
Wheeler	9.0%	10.6%	9.8%	7.7%	7.1%	(2.0%

Source: Oregon Employment Department, "Local Area Employment Statistics". http://www.qualityinfo.org/olmisj/labforce. Accessed July 2014.

The table below displays the payroll and employee figures for Deschutes County. As of 2013, there were 63,294 individuals employed in the County, with an average wage of $37,751. Deschutes County, and every other county in the region except for Klamath, has gained employment since the last update of this plan. In addition, average pay has decreased for counties in the region except for Crook and Lake County during this time period.

Table C-19 Deschutes Employment and Average Pay

Jurisdiction	Employment 2009	2013	Percent Change	Average Pay 2009	201	Percent Change
Region 6	95,922	99,434	3.7%	$37,022	$36,869	.0.4%
Crook	5,192	5,827	12.2%	$33,871	$40,154	18.5%
Deschutes	60,564	63,294	4.5%	$38,338	$37,751	.1.5%
Jefferson	5,725	6,170	7.8%	$35,124	$34,194	.2.6%
Klamath	21,858	21,504	.1.6%	$35,070	$34,548	.1.5%
Lake	2,308	2,334	1.1%	$34,012	$34,626	1.8%
Wheeler	275	305	10.9%	$26,567	$25,871	.2.6%

Source: Oregon Employment Department, "2009 and 2013 Covered Employment and Wages Summary Report". http://www.qualityinfo.org/olmisj/labforce. Accessed October 2014.
Note: 2009 dollars are adjusted for 2013 using Bureau of Labor Statistics' Consumer Price Index Inflation Calculator.

In 2012, there were 741 employment establishments of which about 91% had fewer than 20 employees.[29] The prevalence of small businesses in Deschutes County is an indication of

[29] U.S. Census Bureau, 2012 County Business Patterns (NAICS). http://censtats.census.gov/cgibin/cbpnaic/cbpsect.pl, accessed August 2014.

sensitivity to natural hazards because small businesses are more susceptible to financial uncertainty. If a business is financially unstable before a natural disaster occurs, financial losses (resulting from both damage caused and the recovery process) may have a bigger impact than they would for larger and more financially stable businesses.

Industry

Major Regional Industry

Key industries are those that represent major employers and are significant revenue generators. Different industries face distinct vulnerabilities to natural hazards, as illustrated by the industry specific discussions below. Identifying key industries in the region enables communities to target mitigation activities towards those industries' specific sensitivities. It is important to recognize that the impact that a natural hazard event has on one industry can reverberate throughout the regional economy.

This is of specific concern when the businesses belong to the basic sector industry. Basic sector industries are those that are dependent on sales outside of the local community; they bring money into a local community via employment. The farm and ranch, information, and wholesale trade industries are all examples of basic industries. Non---basic sector industries are those that are dependent on local sales for their business, such as retail trade, construction, and health services.

Employment by Industry

Economic resilience to natural disasters is particularly important for the major employment industries in the region. If these industries are negatively impacted by a natural hazard, such that employment is affected, the impact will be felt throughout the regional economy. Thus, understanding and addressing the sensitivities of these industries is a strategic way to increase the resiliency of the entire regional economy.

The table below identifies Employment by industry. The top five industry sectors in Deschutes County with the most employees, as of 2013, are Trade, Transportation & Utilities (12,337), Education & Health Services (10,333), Leisure & Hospitality (9,909), Professional & Business Services (6,879) and Local Government (6,385). While Deschutes County has some basic industries, such as Natural Resources and Mining and Manufacturing; four out of their five largest employers are of the non---basic nature and thus they rely on local sales and services. Trending towards basic industries can lead to higher community resilience. The sectors of growth within Deschutes County are Education & Health Services (14.1%), State Government (12.5%), Other Services (14.0%) and Leisure and Hospitality (10.2%).

Table C-20 Total Employment by Industry 2013, Expected Growth 2022

Jurisdiction	2013				Percent Change in Employment (2009@2013)	Employment Forecast (2012@2022)
	Firms	Employees	Percent Workforce	Average Pay		
Total Payroll Employment	6,669	63,294	100%	$37,751	4.5%	16%
Total Private	6,440	54,800	86.6%	$36,568	5.0%	18%
Natural Resources and Mining	75	533	0.8%	$35,577	3.3%	20%
Construction	856	3,513	5.6%	$38,919	H7.0%	26%
Manufacturing	283	4,209	6.6%	$41,389	7.4%	19%
Trade, Transportation & Utilities	1,216	12,337	19.5%	$32,459	0.3%	12%
Information	125	1,406	2.2%	$51,604	1.4%	4%
Financial Activities	698	3,207	5.1%	$48,700	H7.2%	14%
Professional and Business Services	1,170	6,879	10.9%	$41,948	4.1%	24%
Education and Health Services	723	10,333	16.3%	$49,128	14.1%	24%
Leisure and Hospitality	580	9,909	15.7%	$18,322	10.2%	20%
Other Services	695	2,457	3.9%	$26,978	14.0%	13%
Private NonHClassified	21	18	0.0%	$45,631	H18.2%	H
Government	229	8,494	13.4%	$45,383	1.4%	7%
Federal	39	864	1.4%	$63,360	H5.5%	H6%
State	40	1,245	2.0%	$41,558	12.5%	12%
Local	150	6,385	10.1%	$43,696	0.4%	8%

Source: Oregon Employment Department, "2009 and 2013 Covered Employment and Wages Summary Reports" and "Regional Employment Projections by Industry & Occupation 2012---2022". http://www.qualityinfo.org. Accessed October 2014.

High Revenue Sectors

In 2007, the three sectors with the highest revenue were Health Care & Social Assistance, Retail Trade, and Manufacturing. The table below shows the revenue generated by each economic sector (Note: not all sectors are reported, i.e., Professional, Scientific & Technical Services). All of the sectors combined generated almost $1,256,184 billion in revenue for the County.

Deschutes County relies on both basic and non---basic sector industries and it is important to consider the effects each may have on the economy following a disaster. Basic sector businesses have a multiplier effect on a local economy that can spur the creation of new jobs, some of which may be non---basic. The presence of basic sector jobs can help speed the local recovery; however, if basic sector production is hampered by a natural hazard event, the multiplier effect could be experienced in reverse. In this case, a decrease in basic sector purchasing power results in lower profits and potential job losses for the non---basic businesses that are dependent on them.[30]

[30] State of Oregon Natural Hazards Mitigation Plan, Region 4 Southwest Oregon Regional Profile.

Table C-21: Revenue of Top Sectors in Deschutes County (Employer)

Sector Meaning (NAICS code)	Sector Revenue ($1,000)	Percent of Total Revenue
Retail Trade	$271,931	21.6%
Manufacturing	$201,741	16.1%
Health Care and Social Assistance	$351,476	28.0%
Wholesale Trade	$93,917	7.5%
Accomodation and Food Services	$121,088	9.6%
Professional, Scientific & Technical Services	D	M
Real Estate & Rental & Leasing	$48,236	3.8%
Administrative and Support and Waste Management and Remediation Services	$89,917	7.2%
Other Services (except Public Administration)	$46,489	3.7%
Arts, Entertainment and Recreation	$31,389	2.5%
Information	$96,728	7.7%
Total	$1,256,184	100%

Note: D = Withheld to avoid disclosing data for individual companies
Source: U.S. Census Bureau, 2007 Economic Census, Table EC0700A1.

Health Care & Social Assistance was the largest revenue generator in 2007, generating $351.5 million that year or 28% of revenue in the County. Health Care and Social Assistance is a relatively stable revenue sector. It largely relies on the local presence of older residents and elderly facilities. It is likely the populations that require such services on a daily basis will continue requiring assistance, such as those living in residential care facilities. With Deschutes County's elderly population expected to increase, growth in this sector will likely continue. However, in the event of a disaster medical needs may increase due to physical or stress induced injuries and trauma. The physical infrastructure of this sector will be essential in maintaining the capacity of service that they currently exhibit.

In 2007, the *Retail Trade* sector generated $271.9 million, making it among the largest earning sectors in Deschutes County.[31] The *Retail Trade* sector typically relies on local residents and tourists and their discretionary spending ability. Residents' discretionary spending diminishes after a natural disaster when they must pay to repair their homes and properties. In this situation, residents will likely concentrate their spending on essential items that would benefit some types of retail (e.g., grocery) but hurt others (e.g., gift shops). The potential income from tourists also diminishes after a natural disaster as people are deterred from visiting the impacted area. Retail trade is also largely dependent on wholesale trade and the transportation network for the delivery of good for sale. Disruption of the transportation system could have severe consequences for retail businesses. In summary, depending on the type and scale, a disaster could affect specific segments of retail trade, or all segments.

[31] U.S. Census Bureau, 2007 Economic Census. Table 1 Selected Statistics by Economic Sector.

The *Manufacturing* sector was the third largest revenue generator in 2007, generating $201.7 million, or 16.1%, of the county's revenue. It is highly dependent upon the transportation network in order to access supplies and send finished products to outside markets. As a base industry, manufacturers are not dependent on local markets for sales, which contribute to the economic resilience of this sector.

In the event that any of these primary sectors are impacted by a disaster, Deschutes County may experience a significant disruption of economic productivity.

Future Employment in Industry

Sectors that are anticipated to be major employers in the future also warrant special attention in the hazard mitigation planning process. Between 2012 and 2022, the largest employment growth is anticipated within Construction (26%), Professional and Business Services (24%) and Education and Health Services (24%).[32] Natural Resources and Mining is expected to increase by 20% while manufacturing is expected to increase by 19%.

Synthesis

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. Because the Health and Social Assistance industry as well as the Government sector are key to post---disaster recovery efforts, the region is bolstered by its major employment sectors. The county is expected to grow at a high rate over the next 10 years with much of the growth within the healthcare and construction industries.[33] It is important to consider what might happen to the county economy if the largest revenue generators and employers are impacted by a disaster.

[32] Oregon Employment Department, "Employment Projections by Industry and Occupations: 2012---2022 Oregon and Regional Summary", http://qualityinfo.org/pubs/projections/projections.pdf, accessed October 2014.

[33] State of Oregon Natural Hazards Mitigation Plan, Region 6 Central Oregon Regional Profile

Built Environment Capacity

Built Environment capacity refers to the built environment and infrastructure that supports the community. The various forms, quantity, and quality of built capital mentioned above contribute significantly to community resilience. Physical infrastructures, including utility and transportation lifelines, are critical during a disaster and are essential for proper functioning and response. The lack or poor condition of infrastructure can negatively affect a community's ability to cope, respond and recover from a natural disaster. Following a disaster, communities may experience isolation from surrounding cities and counties due to infrastructure failure. These conditions force communities to rely on local and immediately available resources.

Land Use and Development Patterns

The majority of the county has a low population density. Sixty---six percent of the population resides in the four incorporated cities. Three of the incorporated cities are located in the northern half of the county and one is located in the southern half. The majority of land (about 80% of 1,529,522 acres) in Deschutes County is publicly owned (76.6% Federal Government, 2.8% State Government, 0.6% County Government); the remaining lands are owned privately.[34] About 91% of the county lies within the Deschutes Basin, which covers 10,000 square miles throughout Central Oregon. Other land uses include agriculture and surface mining.[35] Wildfires pose a threat for the forested areas of the high desert Western ecosystem; of particular concern are the areas within the Wildland---Urban Interface.

According to the Draft State Natural Hazards Mitigation Plan (2015):

> Development pressure has been high in the Bend, Sisters, and Redmond areas in the past few decades. Between 1974 and 2009, the Bend area lost 13 percent of its land in resource land uses to more developed uses. However, since 1984 that rate has declined --- annual average rates of conversion of land in resource land uses to low---density or urban uses in Deschutes County was 88 percent less in the 2005---2009 period when compared to the 1974---1984 period. Similar trends, although less pronounced, are seen in Klamath County.
>
> Responding to rapid growth and changing demographics, in 2011 Deschutes County completed a multi--- year effort to establish the 2030 Comprehensive Plan Update (Plan 2030). This new plan incorporates updated goals and policies, community plans, and new projects like the South County Plan, destination resort remapping, a 2030 Transportation System Plan, and a South County Local Wetland Inventory.[36]

Housing

In addition to location, the characteristics of the housing stock affect the level of risk posed by natural hazards. The table below identifies the types of housing most common

[34] Deschutes County Comprehensive Plan. 2011.

[35] Ibid.

[36] Department of Land Conservation and Development, Oregon Natural Hazards Mitigation Plan (Draft), 2015 and Land Use Change on Non---Federal Land in Oregon and Washington, September, 2013, USFS, ODF

throughout the county. Of particular interest are mobile homes, which account for about 9.1% of the housing in Deschutes County. Mobile homes are particularly vulnerable to certain natural hazards, such as windstorms, and special attention should be given to securing the structures, because they are more prone to wind damage than wood---frame construction.[37] In other natural hazard events, such as earthquakes and floods, moveable structures like mobile homes are more likely to shift on their foundations and create hazardous conditions for occupants. La Pine (12.5%) and Sisters (12.3%) have a higher percentage of mobile structures than other parts of the county; while Bend (2,042) and Redmond (706) have the greatest number.

Table C-22 Housing Profile

	Total Housing Units	Single Family		MultiBFamily		Mobile Homes	
		Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Oregon	1,673,593	1,140,319	68.1%	460,852	27.5%	139,768	8.4%
Region 6	138,082	102,288	74.1%	17,474	12.7%	18,017	13.0%
Deschutes	80,039	61,145	76.4%	11,557	14.4%	7,308	9.1%
Bend	36,562	26,938	73.7%	7,568	20.7%	2,042	5.6%
La Pine	885	663	74.9%	111	12.5%	111	12.5%
Redmond	10,654	7,878	73.9%	2,070	19.4%	706	6.6%
Sisters	1,232	926	75.2%	155	12.6%	151	12.3%

Source: U.S. Census Bureau, 2008---2012 American Community Survey, Table DP04.
Note: the percentages listed in the table above do not reflect the number of structures that are built within special flood hazard areas, or that are at risk of seismic damage.

Aside from location and type of housing, the year structures were built has implications. Seismic building standards were codified in Oregon building code starting in 1974; more rigorous building code standards were passed in 1993 that accounted for the Cascadia earthquake fault.[38] Therefore, homes built before 1993 are more vulnerable to seismic events. Also in the 1970's,FEMA began assisting communities with floodplain mapping as a response to administer the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Upon receipt of floodplain maps, communities started to develop floodplain management ordinances to protect people and property from flood loss and damage. The table below illustrates the number and percent of homes built between 1970 and 2012. Regionally about one---quarter of the housing stock was built prior to 1970, before the implementation of floodplain management ordinances; however, within Deschutes County less than 13% of the housing stock was built prior to 1970. Countywide, just under 44% of the housing stock was built before 1990 and the codification of seismic building standards. Approximately 57% of the county's housing stock was built after 1990 (Redmond and Sisters have about two---thirds of their housing units built after 1990).

[37] Ibid.

[38] State of Oregon Building Codes Division. *Earthquake Design History: A summary of Requirements in the State of Oregon*, February 7, 2012. http://www.oregon.gov/OMD/OEM/osspac/docs/history_seismic_codes_or.pdf

Table C-23 Year Structure Built

	Total Housing Units	Pre 1970		1970 to 1989		1990 or later	
		Number	Percent of Total	Number	Percent of Total	Number	Percent of Total
Oregon	1,673,593	609,062	36.4%	518,569	31.0%	545,962	32.6%
Region 6	138,082	32,008	23.2%	42,128	30.5%	63,946	46.3%
Deschutes	80,039	10,166	12.7%	24,414	30.5%	45,459	56.8%
Bend	36,562	5,808	15.9%	9,610	26.3%	21,144	57.8%
La Pine	885	111	12.5%	258	29.2%	516	58.3%
Redmond	10,654	1,483	13.9%	2,130	20.0%	7,041	66.1%
Sisters	1,232	167	13.6%	258	20.9%	807	65.5%

Source: U.S. Census Bureau, 2008---2012 American Community Survey, Table DP04.

As the previous table indicates, the majority of the housing stock is single---family homes, a trend that is continuing with new construction. The table below shows that 17,012 or approximately 95% of residential permits issued between 2000 and 2013 were for single---family units. This suggests that hazard mitigation and outreach should specifically address preparedness for detached housing structures.

Since 2007, residential construction activity has decreased significantly. The table below shows that within the period 2008 to 2010 construction of residential units declined significantly when compared with previous time periods. Residential construction activity is a key indicator of community stability, and can demonstrate positive community growth. However, in recent years with the downfall of the residential market this is less of an accurate indicator as activity all across the nation was impacted. As the table shows residential construction has begun to rebound in recent years but still falls below the levels of previous periods. Between January 1 and September 30, 2014 there were 1,066 new houses permitted countywide (658 in Bend, 130 in Redmond, 34 in Sisters, 4 in La Pine, and 240 in unincorporated Deschutes County) suggesting that the trend is continuing.[39]

Table C-24 Building Permits (Units)

Building Type	2002 to 2004	2005 to 2007	2008 to 2010	2011 to 2013	Total (200292013)
Deschutes County	9,570	9,529	1,508	2,577	23,184
Unincorporated	2,102	2,373	476	597	5,548
Bend	5,552	5,146	730	1,707	13,135
Redmond	1,824	1,763	261	221	4,069
Sisters	81	247	41	52	421

Source: U.S. Census Bureau, "Annual New Privately---Owned Residential Building Permits", http://censtats.census.gov, accessed December 2014.

[39] Deschutes County Community Development Department (2014)

The table below shows the percent growth of the region's housing units in urban areas between 2000 and 2010 (40.7%) is almost twice the percent growth in rural areas (21.2%). Deschutes County gained the most urban housing units (approximately 21,150) and had the highest growth rate in urban housing (69.0%).

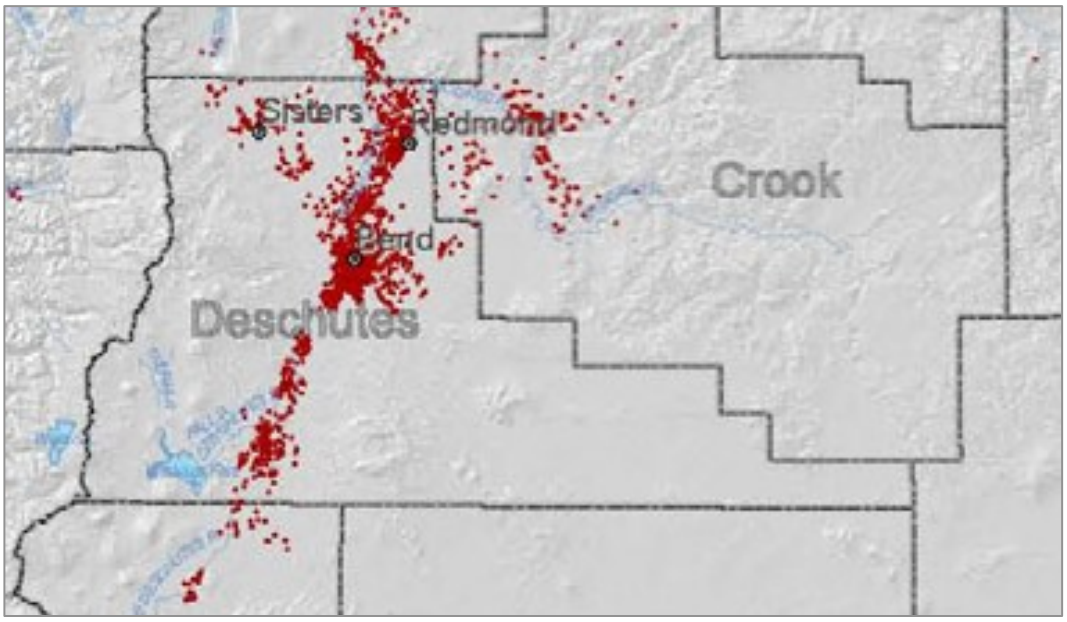
Table C-25 Urban and Rural Housing Units in Region 6

	Urban			Rural		
	2000	2010	Percent Change	2000	2010	Percent Change
Oregon	1,131,574	1,328,268	17.4%	321,135	347,294	8.1%
Region 6	57,098	80,325	40.7%	47,792	57,939	21.2%
Crook	4,190	4,884	16.6%	4,074	5,318	30.5%
Deschutes	30,684	51,844	69.0%	23,899	28,295	18.4%
Jefferson	2,735	3,382	23.7%	5,584	6,433	15.2%
Klamath	17,950	18,684	4.1%	10,933	14,090	28.9%
Lake	1,539	1,531	.0.5%	2,460	2,908	18.2%
Wheeler	0	0	.	842	895	6.3%

Source: U.S. Census Bureau. 2000 Decennial Census, Table H002 & 2010 Decennial Census, Table H2

The figure below shows population density in Deschutes County. The area's population is clustered around the Highway 20 and 97corridors and the cities of Bend, La Pine, Redmond, and Sisters. In addition to the county's incorporated cities there are also significant populations in the rural communities of Black Butte Ranch and Sun River; the populations in these two communities are significantly higher during summer than winter.

Figure C-4 Population Density in Deschutes County



Source: Integrated Water Resources Strategy: 2010 Open House Map Gallery, Water Resources Department, State of Oregon

The National Flood Insurance Program's (NFIP's) Flood Insurance Rate Maps (FIRMs) delineate flood---prone areas. They are used to assess flood insurance premiums and to regulate construction so that in the event of a flood, damage minimized. The table below shows the initial and current FIRM effective dates for Deschutes County communities. For more information about the flood hazard, NFIP, and FIRMs, please refer the Flood Hazard Chapter and Risk Assessment (Volume II).

Table C-26 Community Flood Map History

	Initial FIRM	Current FIRM
Deschutes	August 16, 1988	September 28, 2007
Bend	September 4, 1987	September 28, 2007
La Pine	September 28, 2007	September 28, 2007
Sisters	September 29, 1986	September 28, 2007

Source: Federal Emergency Management Agency, Community Status Book Report;
(M) – No elevation determined, All Zone A, C and X

Other Development

Critical Facilities

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). The interruption or destruction of any of these facilities would have a debilitating effect on incident management.

Critical facilities in Deschutes County are identified in table below. Lifelines and other physical infrastructure, such as transmission lines, power generation facilities, levees and dams are critical, further information can be obtained in the "lifelines" subsection. This information provides the basis for informed decisions about the infrastructure and facilities already in place that can be used to reduce the vulnerability of the county to natural hazards.

Table C-27 Deschutes County Critical Facilities

	Hospitals			Law Enforcement	Fire and Rescue Stations	School Districts*	Universities and Colleges
	# Hospitals	# Beds	Trauma Level				
Deschutes	2	274	%	4	11	3	2
Bend	1	226	2	2	3	1	2
La Pine	0	%	%	0	1	1	0
Sisters	0	%	%	0	1	1	0
Redmond	1	48	3	1	2	1	0

Source: Oregon Department of Human Services, "Oregon Hospitals: 2008---09---20", and USA Cops: The Nations Law Enforcement Site, and Oregon State Police Oregon Office of State Fire Marshal, "Fire Department List", and Oregon Department of Education, "Education Institutions".
Note: * The County has three school districts, the Bend---La Pine School District includes the cities of Bend and La Pine.

Dependent Facilities

In addition to the critical facilities mentioned above in the table above, there are other facilities that are vital to the continued delivery of health services and may significantly impact the public's ability to recover from emergencies. Assisted living centers, nursing homes, residential mental health facilities, and psychiatric hospitals are important to identify within the community because of the dependent nature of the residents; and also these facilities can serve as secondary medical facilities as they are equipped with nurses, medical supplies and beds.

Deschutes County has approximately 28 facilities that provide services for assisted living, retirement, and nursing homes; in addition there are three residential mental health or substance abuse facilities[40]. Saint Charles Medical Group, located in Bend, is the only inpatient psychiatric facility east of the Cascades. Most of the dependent facilities are located within Bend; however, a few are located in Redmond.

Correctional Facilities

Correctional facilities are incorporated into physical infrastructure as they play an important role in everyday society by maintaining a safe separation from the public. There are two correctional facilities located in Deschutes County. The Deschutes County Adult Jail, located in Bend and adjacent to the sheriff's office.[41] The Juvenile Detention Facility in Bend offers year---round schooling and self---improvement groups like TruThought, Skill Streaming, and drug and alcohol information.[42]

Infrastructure Profile

Physical infrastructure such as dams, levees, roads, bridges, railways and airports support Deschutes County communities and economies. 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.

Dams

Dam failures can occur rapidly and with little warning.[43] Fortunately, most failures result in minor damage and pose little or no risk to life safety.[44] However, the potential for severe damage still exists. The Oregon Water and Resources Department has inventoried all dams located in Oregon and Deschutes County. There are three dams categorized as high hazard; Wickiup Reservoir, North Unit Diversion Dam, and Crane Prairie dams that are located on

[40] Oregon Care Planning Council, http://www.carefororegon.org/, December 2014

[41] Deschutes County, County Adult Jail, http://www.deschutescountyjail.org/ , August 2014

[42] Deschutes County Detention, http://www.deschutes.org/Community---Justice/Juvenile---Community---Justice/Youth---Services/Juvenile---Detention---Facility.aspx.

[43] Federal Emergency Management Agency. Dam Failure. www.fema.gov/hazard/damfailure/index.shtm. Accessed November 18, 2011.

[44] Ibid.

the Deschutes River. Wickiup Reservoir is of particular concern since it is the largest dam in Deschutes County and it was last inspected 14 years ago in July 2000.[45]

Table C-28 Deschutes County Dam Inventory

Threat Potential	Number of Dams	Rivers
High	3	Deschutes
Significant	3	Deschutes, Dry River, Whychus
Low	12	Closed Basin (Natural Lake), Off Channel, Whychus, Three Creek, Tumalo Creek
Total	**18**	G

Source: Oregon water Resources Department, "Dam Inventory Query", http://apps.wrd.state.or.us/apps/misc/dam_inventory/, Accessed July 2014.

Railroads

Railroads are major providers of regional and national cargo trade flows. The region's major (Class I) freight rail providers are the Union Pacific (UP) and the Burlington Northern---Santa Fe (BNSF) railroads. The Burlington Northern Santa Fe Railway runs through Deschutes County and along the Oregon Washington border.

Amtrak provides passenger rail service from the Willamette Valley south through Klamath County and southward to Los Angeles, California via the Coast Starlight line; (the nearest station is in Chemult).[46]

Rails are sensitive to icing from winter storms that can occur in the Central Oregon region. For industries in the region that utilize rail transport, these disruptions in service can result in economic losses. The potential for rail accidents caused by natural hazards can also have serious implications for the local communities if hazardous materials are involved.

Airports

Deschutes County has four public airports, twelve private airports, and three private heliports.[47] One heliport is owned by St. Charles Medical Center. Of the public airports, two are municipal airports, respectively owned and operated by the City of Bend and City of Redmond. The Redmond Municipal Airport---Roberts Field is the only commercial airport in the region.[48] The airport serves four passenger airlines (American Airlines, Alaska Air, Delta Air, United/ United Express) providing direct service to Denver, Los Angeles, Portland, San Francisco, Salt Lake City, and Seattle.[49] Access to these facilities could become closed in the event of natural hazards. Another important consideration in identifying area air resources

[45] Oregon water Resources Department, "Dam Inventory Query", http://apps.wrd.state.or.us/apps/misc/dam_inventory/, accessed October 2014.

[46] State of Oregon Natural Hazards Mitigation Plan, Region 6 Central Oregon Regional Profile

[47] FAA Airport Facilities Data. 2014. http://www.faa.gov/airports/airport_safety/airportdata_5010/menu/ Accessed August 2014.

[48] Redmond Airport Website, http://www.flyrdm.com/

[49] Ibid.

is the type and condition of runway surfaces at these various facilities, as they will impact the ability to utilize the airport and respond to major disasters.

Energy

There are no power plants located within Deschutes County; however, Pacific Power and Light (Pacific Power) and Central Oregon Irrigation District have power generator facilities at some in---water facilities. The county is served by several investor---owned, public, and cooperative and municipal utilities. The Bonneville Power Administration is the areas wholesale electricity distributor. Pacific Power is the primary investor---owned utility company serving Deschutes County. The county's electric cooperatives include: Central Electric Cooperative, Harney Electric Cooperative, and Midstate Electric Cooperative.

Roads

The region's major expressways are Highway 97 and Highway 20. Highway 97 bisects the center of Deschutes County and is a main passage for automobiles and trucks traveling from states to central Oregon. It merges with Highway 26 and connects Bend with Portland, a distance of 162 miles. It also merges with Interstate---5 and connects Bend with California.

- Highway 20 runs east---west across the State and connects Deschutes County with Newport on the coast and Idaho.

Other major highways that service this region include:

- Highway 372 also known as the Cascade Lakes Scenic Byway connects Bend to the Cascade Mountains and access to recreational activities.
- Highway 126 connects coastal, western, and central parts of Oregon.

Daily, transportation infrastructure capacity in the Central Oregon region is stressed by maintenance and lack of infrastructure in some areas. For example, some county roads are too narrow for fire equipment vehicles. Additionally, natural hazards can further disrupt automobile traffic and create gridlock this is of specific concern in periods of evacuation and there are few alternative routes, especially in remote parts of the county.[50]

Bridges

Because of earthquake risk, the seismic vulnerability of the county's bridges is an important issue. Non---functional bridges can disrupt emergency operations, sever lifelines, and disrupt local and freight traffic. These disruptions may exacerbate local economic losses if industries are unable to transport goods. The county's bridges are part of the state and interstate highway system that is maintained by the Oregon Department of Transportation (ODOT) or that are part of regional and local systems that are maintained by the region's counties and cities.

The table below shows the structural condition of bridges in the region. A distressed bridge (Di) is a condition rating used by the Oregon Department of Transportation (ODOT) indicating that a bridge has been identified as having a structural or other deficiency, while a

[50] State of Oregon Natural Hazards Mitigation Plan, Region 4 Southwest Oregon Regional Profile.

deficient bridge (De) is a federal performance measure used for non---ODOT bridges; the ratings do not imply that a bridge is unsafe.[51] The table shows that the county has a lower percentage of bridges that are distressed and/ or deficient (14%), than does the state (21%). About 31% of the region's county and city owned bridges are distressed, compared to 11% of ODOT bridges.

Table C-29 Bridge Inventory

	State Owned			County Owned			City Owned			Other Owned			Area Total			Historic
	Di	ST	%D*	De	ST	%D	De	ST	%D	De	ST	%D	D	T	%D	Covered
Oregon	610	2,718	22%	633	3,420	19%	160	614	26%	40	115	35%	1,443	6,769	21%	334
Region 6	21	144	15%	27	240	11%	8	57	14%	4	9	44%	60	449	13%	12
Deschutes	5	48	11%	8	47	17%	5	35	14%	1	4	25%	19	132	14%	2

Source: Oregon Department of Transportation, 2014; Oregon Department of Transportation (2013), Oregon's Historic Bridge Field Guide

Note: Di = ODOT bridges Identified as distressed with structural or other deficiencies; De = Non---ODOT bridge Identified with a structural deficiency or as functionally obsolete; D = Total od Di and De bridges; ST = Jurisdictional Subtotal; %D = Percent distressed (ODOT) and/or deficient bridges; * = ODOT bridge classifications overlap and total (ST) is not used to calculate percent distressed, calculation for ODOT distressed bridges accounts for this overlap.

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.

Deschutes County receives oil and gas from Alaska by way of the Puget Sound through pipelines and tankers. Most of the natural gas Oregon uses originates in Alberta, Canada. TransCanada owns the main natural gas transmission pipeline in Central Oregon while Cascade Natural Gas supplies the greater part of Central Oregon.[52] The electric, oil, and gas lifelines that run through the County are both municipally and privately owned.[53] The network of electricity transmission lines running through the county may be vulnerable to severe, but infrequent natural hazards, such as windstorm, winter storms, and earthquakes.

Seismic lifeline routes help maintain transportation facilities for public safety and resilience in the case of natural disasters. Following a major earthquake, it is important for response and recovery agencies to know which roadways are most prepared for a major seismic event. The Oregon Department of Transportation has identified lifeline routes to provide a

[51] Oregon. Bridge Engineering Section (2012). 2012 Bridge Condition Report. Salem, Oregon: Bridge Section, Oregon Department. of Transportation.

[52] Ibid.

[53] Loy, W. G., Allan, S., & Patton, C. P. (1976). *Atlas of Oregon*. Eugene: University of Oregon and Economic Development for Central Oregon, retrieved from http://www.edcoinfo.com/business---resources/utilities/natural---gas/default.aspx

secure lifeline network of streets, highways, and bridges to facilitate emergency services response after a disaster.[54]

System connectivity and key geographical features were used to identify a three---tiered seismic lifeline system. Routes identified as Tier 1 are considered to be the most significant and necessary to ensure a functioning statewide transportation network. The Tier 2 system provides additional connectivity to the Tier 1 system, it allows for direct access to more locations and increased traffic volume capacity. The Tier 3 lifeline routes provide additional connectivity to the systems provided by Tiers 1 and 2. The figure below shows Tiers 1, 2, and 3 seismic lifeline routes.[55]

The Tier 1 system in Central Oregon consists of the following corridors:

- I---84 from the The Dalles to Biggs Junction
- US 97

There are no Tier 2 corridors in the Central Geographic Zone

The Tier 3 corridor in the Central Geographic Zone consists of:

- US 197

Synthesis

Given the unique dependent, rural nature of Deschutes County, maintaining the quality of built capacity throughout the area is critical. The planning considerations seemingly most significant for the county are contingency planning for medical resources and lifeline systems due to the imminent need for these resources. As mentioned above, functionality of hospitals and dependent care facilities are a significant priority in providing for Deschutes County residents. One factor that is critical to consider in planning is the availability of medical beds in local hospitals and dependent care facilities. In the event of a disaster, medical beds may be at a premium providing not just for the growing elderly population, but the entire county. Some of these facilities may run at almost full capacity on a daily basis, hospitals should consider medical surge planning and develop memorandums with surrounding counties for medical transport and treatment. Other facilities to consider are utility lifelines and transportation lifelines such as, airports, railways, roads and bridges with surrounding counties to acquire utility service and infrastructure repair.

While these elements are traditionally recognized as part of response and recovery from a natural disaster, it is essential to start building relationships and establishing contractual agreements with entities that may be critical in supporting community resilience.

[54] CH2MHILL, Prepared for Oregon Department of Transportation. Oregon Seismic Lifeline Routes Identification Project, *Lifeline Selection Summary Report,* May 15 2012.

[55] Ibid.

Community Connectivity Capacity

Community connectivity capacity places strong emphasis on social structure, trust, norms, and 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. Social and cultural capitals are present in all communities; however, it may be dramatically different from one city to the next as these capitals reflect the specific needs and composition of the community residents.

Social Systems and Service Providers

Social systems include community organizations and programs that provide social and community---based services, such as employment, health, senior and disabled services, professional associations and veterans' affairs for the public. In planning for natural hazard mitigation, it is important to know what social systems exist within the community because of their existing connections to the public. Often, actions identified by the plan involve communicating with the public or specific subgroups within the population (e.g. elderly, children, low income, etc.). The County can use existing social systems as resources for implementing such communication---related activities because these service providers already work directly with the public on a number of issues, one of which could be natural hazard preparedness and mitigation. The presence of these services are more predominantly located in urbanized areas of the County, this is synonymous with the general urbanizing trend of local residents.

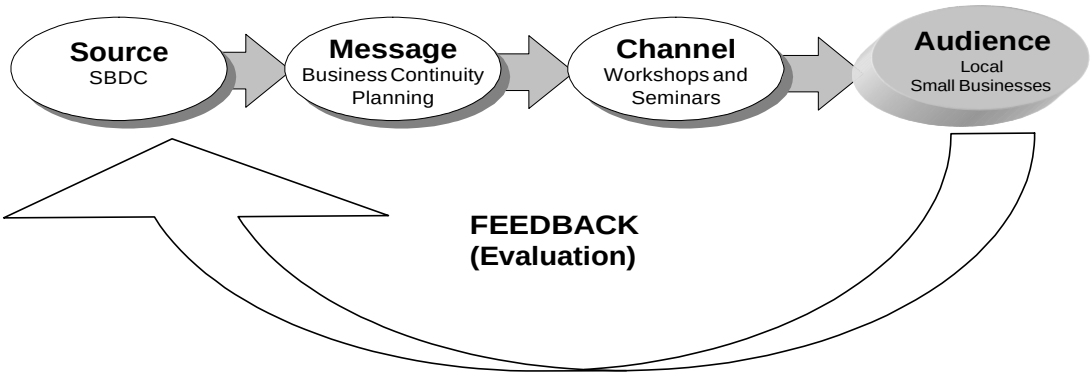
The following is a brief explanation of how the communication process works and how the community's existing social service providers could be used to provide natural hazard related messages to their clients.

There are five essential elements for communicating effectively to a target audience:

- The source of the message must be credible,
- The message must be appropriately designed,
- The channel for communicating the message must be carefully selected,
- The audience must be clearly defined, and
- The recommended action must be clearly stated and a feedback channel established for questions, comments and suggestions.

An example of an existing social system whose communication system can be linked to natural hazard mitigation is the Bend Chamber of Commerce. The Chamber (the source) provides local businesses (the audience) with information on business contingency planning (the message) through speakers at meetings (the channel). To target small businesses, Deschutes County can provide the Chamber with information on developing business continuity plans and strategies for recovering from a natural hazard. When local small businesses attend the Chamber's luncheons and seminars they can pick up this natural hazard mitigation information. This example is graphically presented in the following figure:

Figure C-5 Communication Process



Source: Adapted from the U.S. Environmental Protection Agency Radon Division's outreach program

The following table provides a list of existing social systems within Deschutes County. The table provides information on each organization or program's service area, types of services offered, populations served, and how the organization or program could be involved in natural hazard mitigation. The three involvement methods identified in the table are defined below:

- Education and outreach – organization could partner with the community to educate the public or provide outreach assistance on natural hazard preparedness and mitigation.
- Information dissemination – organization could partner with the community to provide hazard related information to target audiences.
- Plan/project implementation – organization may have plans and/or policies that may be used to implement mitigation activities or the organization could serve as the coordinating or partner organization to implement mitigation actions.

The information provided in the table can also be used to complete action item worksheets by identifying potential coordinating agencies and internal and external partners.

Table C-30 Deschutes County Social Service Providers

Name and Contact Information	Description	Service Area	Populations Served							Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	English Second Language	Families	Low Income	
Boys & Girls Club. Redmond 1379 SW 15th Street Redmond, OR 97756 Phone: 541H504H9060	To inspire and enable all young people, especially those from disadvantaged circumstances, to realize their full potential as productive, responsible, and caring citizens	Redmond		X					X	• Education and outreach • Information dissemination
Boys & Girls Club. East Bend 1701 Tempest Drive Bend, OR 97702 Phone: 541H385H3009	To inspire and enable all young people, especially those from disadvantaged circumstances, to realize their full potential as productive, responsible, and caring citizens	Bend		X					X	• Education and outreach • Information dissemination
Central Oregon Intergovernmental Council 2363 SW Glacier Place Redmond, OR 97756 Phone: 541H548H8163 Fax: 541H548H9548	To provide education, retraining and economic development services	Crook, Deschutes and Jefferson counties and the cities of Bend, Culver, Madras, Metolius, Prineville, Redmond and Sisters							X	• Information dissemination
Healthy Beginnings 1029 NW 14th Street Bend, OR 97701	Provides physical, developmental and behavioral screenings to children age five and younger.	Deschutes County		X					X	
Money Management International 1010 NW 14th Street, Suite 100 Bend, OR 97701	Offers financial counseling and workshops.	Deschutes County	X					X	X	
CaCoon 2577 NE Courtney Drive Bend, OR 97701 Phone: 541H322H7400 Fax: 541H322H7465	CaCoon (Care COordinatiON) program that serves families with children who have a chronic health condition or disability.	Deschutes County		X	X			X	X	• Education and outreach • Information dissemination
Veteran's Services 1130 NW Harriman Street Bend, OR 97701 Phone: 541H38H3214	The Veterans' Service Office assists veterans and their dependents with submitting claims to the Veterans' Administration for several benefit programs related to disability.	Jefferson County			X	X				• Information dissemination
Deschutes Onsite Clinic 1340 NW Wall Street Bend, OR 97701 Phone: 541H317H3190	Provides health care to Deschutes County employees and their family members.	Deschutes Couty		X	X	X		X		• Education and outreach • Information dissemination
Economic Development for Central Oregon (EDCO) 109 NW Greenwood Ave Suite 102 Bend, OR 97701 Phone: 541H388H3236	EDCO is a private nonHprofit organization dedicated to building a vibrant and thriving regional economy by attracting new investment and jobs through marketing, recruitment and working with existing employers.	Jefferson County, Crook, Deschutes	X						X	Coordinating mitigation activities with economic development in Jefferson County.
Girl Scouts of Oregon and SW Washington 908 NE 4th Street, Suite 101 Bend, OR 97701 Phone: 541H389H8146	To provide numerous volunteer services to community members in addition to preparing girls and young women for active participation in community life.	Central Oregon	X	X	X	X		X	X	• Education and outreach • Information dissemination
OSU Extension Service Deschutes Counnty 3893 SW Airport Way Redmond, OR 97756 Phone: 541H548H6088	Provide researchHbased objective information to help people solve problems, develop leadership, and manage resources wisely surrounding the topics of horticulture, forestry and natural resources, youth development, family and community development, and nutrition	Deschutes County	X	X				x		• Education and outreach • Information dissemination • Plan/project implementation

Table C-30 Deschutes County Social Service Providers (continued)

Name and Contact Information	Description	Service Area	Populations Served							Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	English Second Language	Families	Low Income	
High Desert Food and Farm Alliance P.O. Box 1782 Bend, OR 97701 Phone: 541l504l3307	The High Desert Food and Farm Alliance is a nonIprofit whose mission is to support a sustainable community based food system in Central Oregon so that community members can have access to fresh and healthy food.	Deschutes County						X	X	• Education and outreach • Information dissemination
The Rotary Club of Greater Bend P.O. Box 6561 Bend, OR 97708	Rotary is a worldwide organization of business and professional leaders that provides humanitarian service, encourages high ethical standards in all vocations, and helps build goodwill and peace in the world.	Deschutes County	X	X	X	X		X	X	• Education and outreach • Information dissemination
Deschutes County Search and Rescue Foundation P.O. Box 5722 Bend, OR 97708 Phone: 541l357l7273	"The mission of the Foundation is to increase resources, raise funds, and promote public awareness in support of search and rescue volunteer activities conducted by the Deschutes County Sheriff's Office."	Deschutes County		X	X	X		X	X	• Education and outreach • Information dissemination • Plan/project implementation
Redmond Area Park and Recreation District 2241 SW Canal Blvd Redmond, OR 97756 Phone: 541l526l1847	Provides park and recreation facilities for community members in the Redmond Area	Redmond Area		X				X		• Education and outreach • Information dissemination"
Sisters Park and Recreation District 11650 W. McKinney Butte Rd Sisters, OR 97759 Phone: 541l549l2091	Provides youth and adult programs in Sisters. The park districit is a nonIprofit organization which procides sports and recreation opportunities to community members.	Sisters		X		X		X		• Education and outreach • Information dissemination"
La Pine Park and Recreation P.O Box 664 La Pine, OR 97739 Phone: 541l536l2223	Provides adult education opportunities, after school programs for children, and activities for seniors.	LaPine		X		X		X		• Education and outreach • Information dissemination"
Bend Park and Recreation District 799 SW Columbia Street Bend, OR 97702 Phone: 541l399l7275	Maintains parkland around the community and offers recreational activities for children, families, and seniors.	Bend		X		X		X		• Education and outreach • Information dissemination"
Bend Senior Center 1600 SE Reed Market Rd Bend, OR 97702 Phone: 541l288l1133	Provides recreational activities and social activities and events for seniors in Bend.	Bend			X	X				• Education and outreach • Information dissemination
The Bend Kiwanis Club P.O. Box 102 Bend, OR 97709 Phone: 541l617l0003	The Bend Kiwanis Club supports the purchase park land in the community, Boy and Girl Scout clubs, scholarships, and other local nonprofits.	Bend		X				X		• Education and outreach • Information dissemination
Bend Elks Lodge #1371 63120 Boyd Acred Rd Bend, OR 97701 Phone: 541l389l7439	The group, made up of people who work to create a stronger community by supporting local and national charities that benefit children, the disabled, the elderly and lowl income populations.	Deschutes County		X	X	X		X	X	• Education and outreach • Information dissemination

Table C-30 Deschutes County Social Service Providers (continued)

Name and Contact Information	Description	Service Area	Populations Served							Involvement with Natural Hazard Mitigation
			Businesses	Children	Disabled	Elders	English Second Language	Families	Low Income	
Sisters Area Chamber of Commerce 291 E Main St Sisters, OR 97759 Phone: 541G549G0251	Provide economic development assistance to local businesses.	Sisters	X							• Education and outreach • Information dissemination • Plan/project implementation
Redmond Chamber of Commerce 446 SW 7th St. Redmond, OR 97756 Phone: 541G923G5191	Provide economic development assistance to local businesses.	Redmond	X							• Education and outreach • Information dissemination • Plan/project implementation
La Pine Chamber of Commerce P.O. Box 616 La Pine, OR 97739 Phone: 541G536G8410	Provide economic development assistance to local businesses.	La Pine	X							• Education and outreach • Information dissemination • Plan/project implementation
Bend Chamber of Commerce 777 NW Wall Street, Suite 200 Bend, OR 97701 Phone: 541G385G9929	Provide economic development assistance to local businesses.	Bend	X							• Education and outreach • Information dissemination • Plan/project implementation
Deschutes County Personnel Office 1300 NW Wall Street, 2nd Floor Bend, OR 97701 Phone: 541G716G4722 Fax: 541G330G4626	Employment service	Deschutes County							X	• Information dissemination
Mid Oregon Personnel Services, INC. 2248 NE Division St Bend, OR 97701 Phone: 541G382G0445 Fax: 541G389G6094	Employment Service	Deschutes County							X	• Information dissemination
Opportunity Foundation of Central Oregon P.O. Box 430 835 Hwy 126 Redmond, OR 97756 Phone: 541G548G2611 Fax: 541G548G9573	The Opportunity Foundation of Central Oregon (OFCO) is a benchmark organization that is a leader in providing services to people in Central Oregon with disabilities.	Jefferson, Crook and Deschutes Counties			X					• Education and outreach • Information dissemination
Oregon Council for Hispanic Advancement 2600 NW College Way Bend, OR 97701 Phone: 541G330G4363 Fax: 541G317G3070	OCHA is a champion for Hispanics in Oregon, ensuring equity in education and economic opportunity by empowering Latino youth. OCHA's educational and advocacy activities empower Hispanics to make positive changes in their lives to optimize their future success.	Deschutes County					X		X	• Education and outreach • Information dissemination
Salvation Army 515 NE Dekalb Avenue Bend, OR 97701 Phone 541G389G8888	The group provides emergency assistance to people in need.	Bend							X	• Education and outreach • Information dissemination
NeighborImpact Redmond Administrative Office 2303 SW First Street Redmond, OR 97756 Phone: 541G548G2380	The Head Start Program helps make sure that children 3G4 years old from lowG income families are ready for school.	Crook and Deschutes County	X							• Education and outreach • Information dissemination

Civic Engagement

Civic engagement and involvement in local, state and national politics are important indicators of community connectivity. Those who are more invested in their community may have a higher tendency to vote in political elections. The 2012 Presidential General Election resulted in 80.7% voter turnout in the County as of November 16th, 2012.[56] These results are relatively equal to voter participation reported across the State (82.8%).[57] Other indicators such as volunteerism, participation in formal community networks and community charitable contributions are examples of other civic engagement that may increase community connectivity.

Cultural Resources

Historic Places

Historic and cultural resources such as historic structures and landmarks can help to define a community and may also be sources for tourism revenue. Protecting these resources from the impact of disasters is important because they have an important role in defining and supporting the community. According to the National Register Bulletin, "a contributing resource is a building, site, structure, or object adds to the historic associations, historic architectural qualities, or archeological values for which a property is significant because it was present during the period of significance, related to the documented significance of the property, and possesses historical integrity or is capable of yielding important information about the period; or it independently meets the National Register criteria."[58] If a structure does not meet these criteria, it is considered to be non---contributing.

The table below identifies the number of eligible/significant (ES) and eligible/contributing (EC) historical sites in Deschutes County. The table also shows how many ES and EC sites are listed on the National Register and are located and in incorporated cities, and how many contributing and non---contributing resources are located at ES and EC sites. Overall, there are a total of 641 historically registered places in Deschutes County.

Table C-31 Deschutes County Historic Places

Eligible Sites	Total Sites	Listed on the National Register	Contributing Resources	Non8 contributing	Located in Incorporated Cities
ES#Significant	64	38	553	294	84%
EC#Contributing	577	244	569	133	94%

Source: Oregon Historic Sites Database

[56] Daily Ballot Return, http://www.Deschutesco.org/dailyballotreturn, accessed March 2013.

[57] Oregon Blue Book, Voter Participation. http://bluebook.state.or.us/state/elections/elections04.htm

[58] U.S. Department of the Interior, National Park Service, Cultural Resources, National Register Bulletin 16A: "How to Complete the National Register Registration Form".

Libraries and Museums

Libraries and museums develop cultural capacity and community connectivity as they are places of knowledge and recognition, they are common spaces for the community to gather, and can serve critical functions in maintaining the sense of community during a disaster. They are recognized as safe places and reflect normalcy in times of distress. There are currently five community libraries in Deschutes County located in Bend, La Pine, Redmond, Sisters, and Sunriver. There are approximately three museums in Deschutes County, which have an emphasis on the history and culture of the region.

Cultural Events

Other such institutions that can strengthen community connectivity are the presence of festivals and organizations that engage diverse cultural interests. Examples of events and institutions include the Art in the High Desert on the banks of the Deschutes River and the Bend Film Festival. Not only do these events bring revenue into the community, they have potential to improve cultural competence and enhance the sense of place. Cultural connectivity is important to community resilience, as people may be more inclined to remain in the community because they feel part of the community and culture.

Community Stability

Residential Geographic Stability

Community stability is a measure of rootedness in place. It is hypothesized that resilience to a disaster stems in part from familiarity with place, not only for navigating the community during a crisis, but also accessing services and other supports for economic or social challenges.[59] The table below estimates residential stability across the region. It is calculated by the number of people who have lived in the same house and those who have moved within the same county a year ago, compared to the percentage of people who have migrated into the region. Deschutes County overall has geographic stability rating of about 94% (i.e., 94% of the population lived in the same house or moved within the county). The figures of community stability are relatively consistent across the region; La Pine (82.8%) and Sisters (92.8%) show the least geographically stable population while Bend (94%) have the most geographically stable populations. Bend and Redmond have the greatest percent of their populations that lived in the same house one year ago; while La Pine and Sisters have less population that was in the same house one year ago than other cities.

[59] Cutter, Susan, Christopher Burton, Christopher Emrich. "Disaster Resilience Indicators for Benchmarking Baseline Conditions". Journal of Homeland Security and Emergency Management.

Table C-32 Regional Residential Stability

Jurisdiction	Population	Geographic Stability	Same House	Moved Within Same County
Deschutes County	157,270	94.1%	83.4%	10.8%
Bend	76,416	94.0%	80.8%	13.2%
La Pine	1,636	82.8%	73.2%	9.7%
Redmond	25,647	93.4%	79.6%	13.7%
Sisters	2,076	92.8%	73.8%	19.0%

Source: U.S. Census Bureau, 2008---2012 American Community Survey, Table B07003.

Homeownership

Housing tenure describes whether residents rent or own the housing units they occupy. Homeowners are typically more financially stable but are at risk of greater property loss in a post---disaster situation. People may rent because they choose not to own, they do not have the financial resources for home ownership, or they are transient.

Collectively, over two---thirds of the occupied housing units in Deschutes County are owner---occupied. The county has a 4% higher owner occupied rate than the state. Conversely, one---third are renter occupied. The cities of Bend and Redmond have the highest percentage of owner---occupied households in the county. The city of Sisters has the highest renter---occupied rate. The county has about a 2% higher vacancy rate than the state; Sisters has the highest vacancy rate, while Bend has the highest number of vacant units. [60] In addition, seasonal or recreational housing accounts for approximately 11% of the county's housing stock; Black Butte Ranch, Sisters, and Sun River have the highest percentages.

Table C-33 Housing Tenure and Vacancy

	Occupied Units	Owner@occupied		Renter@occupied		Vacant^	
		Estimate	Percent	Estimate	Percent	Estimate	Percent
Oregon	1,512,718	945,824	62.5%	566,894	37.5%	105,417	6.3%
Region 6	113,148	75,355	66.6%	37,793	33.4%	11,694	8.5%
Deschutes	64,459	42,620	66.1%	21,839	33.9%	6,466	8.1%
Bend	32,362	18,931	58.5%	13,431	41.5%	3,039	8.3%
La Pine	663	311	46.9%	352	53.1%	121	13.7%
Redmond	9,964	5,683	57.0%	4,281	43.0%	583	5.5%
Sisters	821	379	46.2%	442	53.8%	230	18.7%

Source: U.S. Census Bureau, 2008---2012 American Community Survey, Tables DP04 & B25004.
^ = Functional vacant units, computed after removing seasonal, recreational, or occasional housing units from vacant housing units.

According to Cutter, wealth increases resiliency and recovery from disasters. Renters often do not have personal financial resources or insurance to assist them post---disaster. On the other hand, renters tend to be more mobile and have fewer assets at risk of natural

[60] U.S. Census Bureau, 2008---2012 American Community Survey, Table DP04 and Table B25004.

hazards.[61] In the most extreme cases, renters lack sufficient shelter options when lodging becomes uninhabitable or unaffordable post---disaster.

Synthesis

Deschutes County has distinct social and cultural resources that work in favor to increase community connectivity and resilience. Sustaining social and cultural resources, such as social services and cultural events, may be essential to preserving community cohesion and a sense of place. The presence of larger communities makes additional resources and services available for the public. However, it is important to consider that these amenities may not be equally distributed to the rural portions of the county and may produce implications for recovery in the event of a disaster.

In the long---term, it may be of specific interest to the county to evaluate community stability. A community experiencing instability and low homeownership may hinder the effectiveness of social and cultural resources, distressing community coping and response mechanisms.

Political Capacity

Political capacity is recognized as the government and planning structures established within the community. In terms of hazard resilience, 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.[62] Resilient political capital seeks to involve various stakeholders in hazard planning and works towards integrating the Natural Hazard Mitigation Plan with other community plans, so that all planning approaches are consistent.

Government Structure

All mitigation is local, and the primary responsibility for development and implementation of risk reduction strategies and policies lies with local jurisdictions. There are numerous partners and resources at the state and federal levels that have a role in natural hazards and natural hazard mitigation.

State and Federal

Key state agencies that are important in assisting Deschutes County include:[63]

Oregon Military Department's Office of Emergency Management (OEM) is responsible for disaster mitigation, preparedness, response, and recovery at the state level and the administration of federal funds after a major disaster declaration.

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[61] Cutter, S. L. (2003). Social Vulnerability to Environmental Hazards. *Social Science Quarterly*.

[62] Mileti, D. 1999. Disaster by Design: a Reassessment of Natural Hazards in the United States. Washington D.C.: Joseph Henry Press.

[63] 2010 Deschutes County Natural Hazard Mitigation Plan

Building Code Division (BCD) and local Community Development Departments are responsible for building code construction and for some hazards that are building---specific in their occurrence (such as earthquakes); also included are provisions for expansive soils, and damage assessment of buildings following an earthquake.

Oregon Department of Forestry (ODF) is responsible for all aspects of wildland fire protection on designated private and state forest lands. Private unprotected lands exist in central Oregon and are not designated for protection by ODF. ODF administers forest practice regulations, including landslide mitigation on non---federal lands;

USDA Forest Service and USDI Bureau of Land Management provides wildland fire protection on the federal lands within Deschutes. Together, they are identified as the Central Oregon Fire Management Service (COFMS). COFMS includes the Deschutes National Forest, the Ochoco National Forest, the Crooked River National Grassland, and the Prineville District of the BLM. These four units are managed cooperatively under combined leadership.

Oregon Department of Geology and Mineral Industries (DOGAMI) is responsible for geological hazard characterization, public education, the development of partnerships aimed at reducing risk, and exceptions (based on science---based refinement of tsunami inundation zone delineation) to state mandated tsunami zone restrictions.

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

Oregon Water Resources Department, South Central Region: The State of Oregon Water Resources Department deals with water supply needs and restores and protects streamflows and watersheds through enforcing Oregon's water laws.

County

The **Board of County Commissioners**, comprised of three elected officials, elected at large, serves as the public's elected advocates and is the policymaking body of Deschutes County government. The Board's duties include executive, judicial (quasi---judicial) and legislative authority over policy matters of countywide concern. The executive duties include establishment of the budget, which is done with the aid of the three lay members of the Budget Committee. To implement policy and manage the day---to---day operations of the County, the Board appoints a county administrator.

The Board's charge also includes creation and enforcement of County ordinances and, in general, the resolution of any problems arising between the citizenry and various County departments. In addition, the Board is involved in a host of regional and community efforts.

The County Counsel provides legal advice to county employees, elected officials, and county boards.

Almost all governing departments within Deschutes County have some degree of responsibility in contributing to community resilience. Every department plays a role in ensuring that county functions and normal operations resume after an incident, and the needs of the population are met.

Some divisions and departments of Deschutes County government that have a role in hazard mitigation are:[64]

Economic Development: Supports business and industrial development, performs demographic and grant research, and is responsible for economic and community development in the county.

Environmental Health: Issues permits for septic systems and manages solid waste licensing and consultation programs.

Health Department: Offers preventative and community health services for county residents, such as immunizations, family planning, HIV testing and counseling, emergency preparedness, WIC, breast and cervical cancer programming, and maternal child health nurse home visiting programs.

Geographic Information System (GIS) division: Supports County Government by creating, managing, and analyzing spatial county data.

Community Development Department: Evaluates land use applications and submits staff report to planning commission, and responsible for zoning permits and facilitating comprehensive planning process.

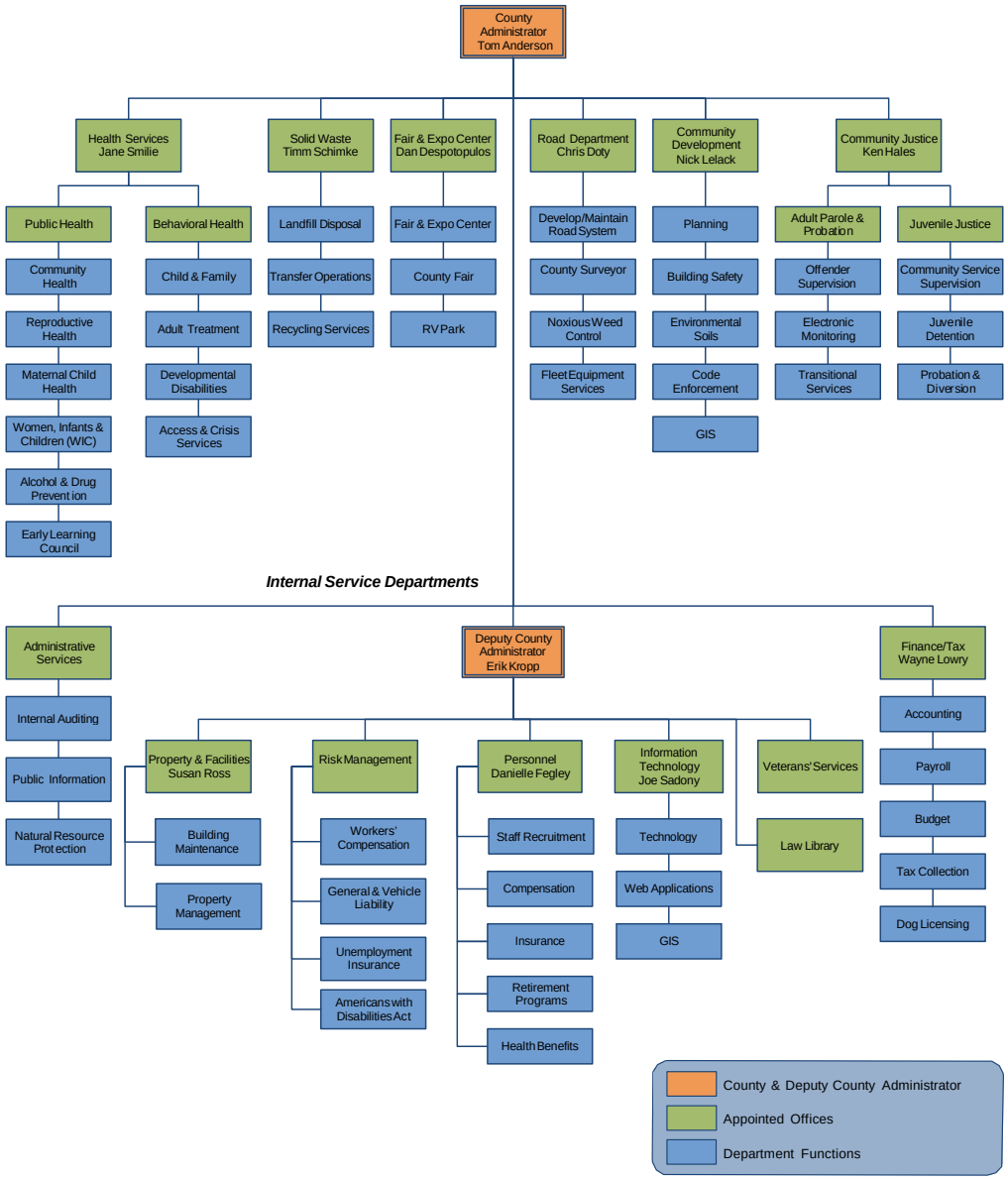
Road Department: Responsible for county road and bridge maintenance and construction, as well as shop and weed control.

Sheriff's Office: Responsible for Sheriff's administration, civil, concealed handgun licenses, corrections and jail, dispatch, emergency services, patrol, and investigation.

Surveyor: Maintains a record of all surveys performed in the county by the county surveyor or licensed land surveyor and makes them available to the public. Protects, maintains, and reestablishes public land survey corners.

[64] Ibid.

Figure C-6 Deschutes County Organizational Chart



Source: Deschutes County Fiscal Year 2015 Adopted Program Budget

The county's incorporated communities have the following government structures as illustrated in the table below, for more information see the city addenda.

Table C-34 Participating City Government Structure

	Bend	La Pine	Redmond	Sisters
Government Form	Manager/Council	Manager/Council	Manager/Council	Manager/Council
City Manager/ Administrator	Yes	Yes	Yes	Yes
Mayor	Yes	Yes	Yes	Yes
City Council	7:Person	5:Person	7:Person	4:Person
Building	Yes	:	Yes	Yes
Parks/ Recreation	Yes	Yes	Yes	Yes
Planning	Yes	Yes	Yes	Yes
Public Works	Yes	Yes	Yes	Yes
Police	Yes	Yes**	Yes	Yes**
Fire	Yes	Yes	Yes	Yes
Information Technology	Yes	No	Yes	Yes

Source: City and County Websites

*Deschutes County Building Division provides services to Redmond through a contract

** Deschutes County Sheriff Substations in La Pine and Sisters

Existing Plans and Policies

Communities often have existing plans and policies that guide and influence land use, land development, and population growth. Such existing plans and policies can include comprehensive plans, zoning ordinances, and technical reports or studies. Plans and policies already in existence have support from local residents, businesses and policy makers. Many land---use, comprehensive, and strategic plans get updated regularly, and can adapt easily to changing conditions and needs.[65]

The Deschutes County Natural Hazards Mitigation Plan includes a range of recommended action items that, when implemented, will 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. Implementing the natural hazards mitigation plan's action items through existing plans and policies increases their likelihood of being supported and getting updated, and maximizes the county's resources. In addition to the plans listed below the county and incorporated cities also have zoning ordinances (including floodplain development regulations) and building regulations.

The table below is a list of plans and policies already in place in Deschutes County that have a connection to natural hazards mitigation, for more information on city plans/ policies review the city addenda:

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

Table C-35 Existing Plans

Jurisdiction	Document	Year
Deschutes County	Natural Hazards Mitigation Plan	2010
Deschutes County	Comprehensive Plan	2011
Deschutes County	Newberry Country Plan	2013
Deschutes County	Development Code (Flood, Ch. 18.96, 18.108, 19.72)	2007
Deschutes County	East & West Deschutes County CWPP	2012
Deschutes County	Sunriver CWPP	2010
Deschutes County	Upper Deschutes River Coalition CWPP	2013
Deschutes County	Emergency Operations Plan	2010
Deschutes County	Intelligent Transportation Systems Plan	2011
City of Bend	General Plan	1998
City of Bend	Development Code (Flood, Section 10.10.22A.4)	2014
City of Bend	Emergency Operations Plan	2009
City of Bend	Transportation System Plan	2013
City of Bend	Greater Bend CWPP*	2011
City of Bend	Water Pubilc Facility Plan	2013
City of Bend	Sewer Public Facility Plan	2014
City of Bend	Stormwater Public Facility Plan	2014
City of La Pine	Comprehensive Plan	2010
City of La Pine	Development Code (Flood, Section 9.12)	2012
City of La Pine	Transportation System Plan	2013
City of La Pine	Greater La Pine CWPP*	2015
City of Redmond	Comprehensive Plan	2007
City of Redmond	Development Code (no mapped SFHA)	[
City of Redmond	Transportation Master Plan	2009
City of Redmond	Greater Redmond CWPP*	2011
City of Redmond	Wastewater (Collection System) and Water System Master Plan	2007
City of Sisters	Comprehensive Plan	2012
City of Sisters	Transportation System Plan	2010
City of Sisters	Development Code (Flood, Section 2.10)	2012
City of Sisters	Greater Sisters Area Emergency Operations Plan	2009
City of Sisters	Greater Sisters Country CWPP*	2014
City of Sisters	Water System Master Plan	2005
City of Sisters	Water Management and Conservation Plan	2011
City of Sisters	Wastewater System Capital Facilities Plan	2006

Source: City and County Websites, * --- portions of these CWPPs include lands within County jurisdiction.

Existing Mitigation Activities

Current mitigation programs and activities are being implemented in an effort to reduce the community's overall risk to natural hazards. Documenting these efforts can assist the community in better understanding its risk and can assist in documenting successes. The list below consists of countywide efforts; city---specific mitigation activities are listed in the city addendums.

Note: OEM has not documented any state--- or federally---funded mitigation projects in Deschutes County (neither pre---disaster nor recovery mitigation).

Deschutes County Community Development Department

The community development department is responsible for providing comments and expertise on land use applications. The department reviews natural hazard impacts to development through enforcement of the county comprehensive plan and development code.

County Forester/ Project Wildfire

The County Forester helps private landowners create defensible space around their homes and helps coordinate fire adapted communities throughout Deschutes County. The County Forester works with federal, state, county, and municipality law enforcement agencies to resolve issues during wildland fires through programs, such as FireFree and Project Impact.

The FireFree program is a nationally recognized model for homeowner education and mitigation programs in the wildland urban interface. Created in 1997 following the devastating Skeleton Fire in Bend, FireFree creates awareness and educates residents about the risks of wildland fire to homes and property and the ten simple steps they can take to reduce those risks. FireFree encourages homeowners to take responsibility for risk mitigation by creating defensible space around their property and disposing of debris. Project Wildfire, is a collaborative effort among local fire agencies, forestry departments, private businesses, and the insurance industry coordinates FireFree.[66]

Project Wildfire was established in 2002. Project Wildfire continues to provide coordination of a variety of wildland fire mitigation activities including the FireFree program, the facilitation of Community Wildfire Protection Plans, and serves as a source of information for local groups interested in obtaining grant funding to support mitigation activities.

Project Wildfire has established a web site (www.projectwildfire.org) to help showcase the wide variety of hazardous fuels treatment, prevention projects and public information and educational opportunities.[67]

Deschutes County Emergency Services

The overall emergency management responsibility rests with the Deschutes County Sheriff. An appointed Emergency Manager is delegated to oversee the Emergency Management Program. The position is responsible for coordinating the plans of the different components of the emergency management system and assist in coordination and support of: fire, police, emergency medical services, public works, volunteers, and other groups involved with the community's management of emergencies.

[66] Firefree. http://www.firefree.org/ (accessed on October 24, 2014)

[67] Project Wildfire Business Plan, March 2003

Bureau of Land Management (BLM Prineville District)

Deschutes County is located in the Bureau of Land Management's Prineville District. Prineville is the largest district in Oregon with 1.65 million acres scattered over 13 million acres. The districts mitigation projects have the potential to positively impact both the natural and human environment in the county and include the following:[68]

- Fuels Reduction – Treatments have occurred in the La Pine and Cline Buttes area for hazardous fuels.
- John Day Basin Resource Management Plan – will provide guidance for any decisions made about 450,000 acres of public land in the John Day Basin for the next 20 years
- River Management Plans – contains management actions necessary to protect and enhance resource values and resolve key issues that exist within river corridors

As addressed above, many governmental entities are responsible for work relevant to hazards planning; however, from this perspective it is challenging to decipher whether these structures work collaboratively in practice towards improving hazard mitigation. On a similar note, in short of reviewing each of the relevant policy documents it is questionable whether the documents effectively integrate hazard initiatives into implementation policy. Further analysis is needed to evaluate the effectiveness of political capital in terms of community resilience.

[68] http://www.blm.gov/or/districts/prineville/index.php

Appendix D: Economic Analysis of Natural Hazard Mitigation Projects

This appendix was developed by the Oregon Partnership for Disaster Resilience at the University of Oregon's Community Service Center. 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.

The appendix outlines three approaches for conducting economic analyses of natural hazard mitigation projects. 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 Federal Emergency Management Agency 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 economic analysis can be used to evaluate mitigation projects.

Why Evaluate Mitigation Strategies?

Mitigation activities 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, police, 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.

What are some Economic Analysis Approaches for Evaluating Mitigation Strategies?

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 Federal Emergency Management Agency, 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 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.

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.

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.

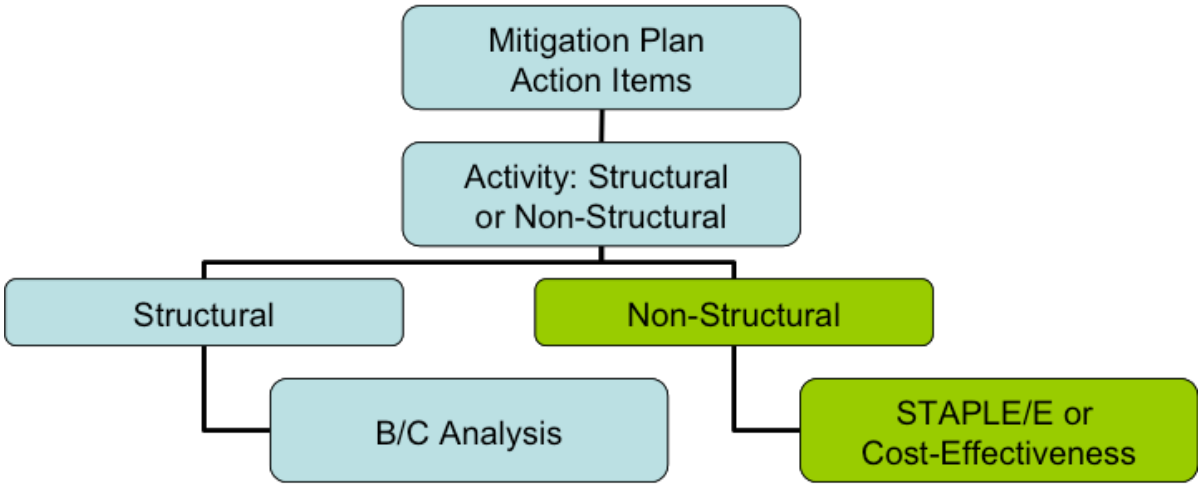
- How will the action impact the environment?
- Will the action need environmental regulatory approvals?
- Will it meet local and state regulatory requirements?
- Are endangered or threatened species likely to be affected?

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 D-1 Economic Analysis Flowchart



Source: Oregon Partnership for Disaster Resilience. 2005.

Implementing the Approaches

Benefit/cost analysis, cost---effectiveness analysis, and the STAPLE/E are important tools in evaluating whether or not to implement a mitigation activity. A framework for evaluating mitigation activities is outlined below. This framework should be used in further analyzing the feasibility of prioritized mitigation activities.

1. Identify the Activities

Activities for reducing risk from natural hazards can include structural projects to enhance disaster resistance, education and outreach, and acquisition or demolition of exposed properties, among others. Different mitigation projects can assist in minimizing risk to natural hazards, but do so at varying economic costs.

2. Calculate the Costs and Benefits

Choosing economic criteria is essential to systematically calculating costs and benefits of mitigation projects and selecting the most appropriate activities. Potential economic criteria to evaluate alternatives include:

- ***Determine the project cost***. This may include initial project development costs, and repair and operating costs of maintaining projects over time.
- ***Estimate the benefits***. Projecting the benefits, or cash flow resulting from a project can be difficult. Expected future returns from the mitigation effort depend on the correct specification of the risk and the effectiveness of the project, which may not be well known. Expected future costs depend on the physical durability and potential economic obsolescence of the investment. This is difficult to project. These considerations will also provide guidance in selecting an appropriate salvage value. Future tax structures and rates must be projected. Financing alternatives must be researched, and they may include retained earnings, bond and stock issues, and commercial loans.
- ***Consider costs and benefits to society and the environment***. These are not easily measured, but can be assessed through a variety of economic tools including existence value or contingent value theories. These theories provide quantitative data on the value people attribute to physical or social environments. Even without hard data, however, impacts of structural projects to the physical environment or to society should be considered when implementing mitigation projects.
- ***Determine the correct discount rate***. Determination of the discount rate can just be the risk---free cost of capital, but it may include the decision maker's time preference and also a risk premium. Including inflation should also be considered.

3. Analyze and Rank the Activities

Once costs and benefits have been quantified, economic analysis tools can rank the possible mitigation activities. Two methods for determining the best activities given varying costs and benefits include net present value and internal rate of return.

- ***Net present value***. Net present value is the value of the expected future returns of an investment minus the value of the expected future cost expressed in today's dollars. If the net present value is greater than the projected costs, the project may be determined feasible for implementation. Selecting the discount rate, and identifying the present and future costs and benefits of the project calculates the net present value of projects.
- ***Internal rate of return***. Using the internal rate of return method to evaluate mitigation projects provides the interest rate equivalent to the dollar returns expected from the project. Once the rate has been calculated, it can be compared to rates earned by investing in alternative projects. Projects may be feasible to implement when the internal rate of return is greater than the total costs of the project. Once the mitigation projects are ranked on the basis of economic criteria, decision---makers can consider other factors, such as risk, project effectiveness, and economic, environmental, and social returns in choosing the appropriate project for implementation.

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, and small business development, among others. Incorporating natural hazard mitigation with other community projects can increase the viability 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 Projects* 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 Oregon Natural Hazard Mitigation Plan includes a comprehensive list of funding sources (refer to Oregon NHMP Chapter 2 Section F(1)). 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. http://www.fema.gov/hazard---mitigation---grant---program

Physical Disaster Loan Program

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. 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 FY13 Hazard Mitigation Assistance Unified Guidance, available at: https://www.fema.gov/media---library/assets/documents/33634. Note that guidance regularly changes. Verify that you have the most recent edition.

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_Grants

Contact: Dennis Sigrist, dennis.sigrist@oem.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 Hazard 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 Digital Orthophoto Program, DOI – USGS

Develops topographic quadrangles for use in mapping of flood and other hazards. http://www.ndop.gov/

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/

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--- in come 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. 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

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.html

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. http://www.hud.gov/offices/cpd/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. http://www.fema.gov/fy---2012---emergency---management---performance---grants---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

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: Deschutes County Natural Hazards Community Survey

Survey Purpose and Use

The purpose of this survey was to gauge the overall perception of natural disasters, determine a baseline level of loss reduction activity for residents in the community, and assess citizen's support for different types of individual and community risk reduction activities.

Data from this survey directly informs the natural hazard planning process. Deschutes County can use this survey data to enhance action item rationale and ideas for implementation. Other community organizations can also use survey results to inform their own outreach efforts. Data from the survey provides the county with a better understanding of desired outreach strategies (sources and formats), a baseline understanding of what people have done to prepare for natural hazards, and desired individual and community strategies for risk reduction.

Background

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. Development of the Natural Hazards Mitigation Plan update process for Deschutes County was pursued in compliance with subsections from 44 CFR 201.6 guidelines.

Citizen involvement is a key component in the natural hazard mitigation planning process. Citizens should have the opportunity to voice their ideas, interests and concerns about the impact of natural disasters on their communities. To that end, the DMA2K requires citizen involvement in the natural hazard mitigation planning process. It states: "An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

1. An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval
2. An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non---profit interests to be involved in the planning process."

According to Bierle[1], the benefits of citizen involvement include the following: (1) educate and inform public; (2) incorporate public values into decision making; (3) substantially improve the quality of decisions; (4) increase trust in institutions; (5) reduce conflict; and (6) ensure cost effectiveness.

Methodology

In the fall of 2014, the Oregon Partnership for Disaster Resilience (OPDR) administered a survey via an on---line survey that was distributed via the county's emergency manager and placed on city, county, and special district websites. A total of 234 surveys were completed out of 389 initiated (60% completion rate).

The survey consisted of 44 questions divided into four sections: natural hazard information, community natural hazard mitigation strategies and priorities, mitigation and preparedness activities in your household, and general household information. OPDR designed the survey to determine public perceptions and opinions regarding natural hazards. Questions also focused on the methods and techniques survey respondents prefer to use in reducing the risks and losses associated with natural hazards.

The intent of this survey was not to be statistically valid but instead to gain the perspective and opinions of resident's regarding natural hazards in the region. Our assessment is that the results reflect a range attitudes and opinions of residents throughout the county.

Survey Results

This section presents the compiled data and analysis for the 2014 Deschutes County Risk MAP Public Opinion Survey. We provide a copy of the survey instrument as Attachment A of this report.

Natural Hazard Information

This section reports the experiences of survey respondents involving natural hazards, and their exposure to preparedness information.

The survey results indicate that about 55---percent of the respondents or someone in their household has personally experienced natural disasters in the past five years, see Table F---1 below.

Table F---1: Direct Experience with Natural Disasters in Respondent County

Answer	Percent	Number
Yes	55%	192
No	45%	156
Total	100%	348

Source: 2015 Deschutes County Natural Hazards Survey

[1] Bierle, T. 1999. "Using social goals to evaluate public participation in environmental decisions." *Policy Studies Review*. 16(3/4), 75---103.

Of those respondents who have experienced a natural disaster in the last five years, 76---percent experienced winter storms (snow/ ice), 61---percent experienced wildfire, and 39---percent experienced windstorms. Table F---2 illustrates the disasters experienced in the past five years in Deschutes County. In addition to the hazards listed below respondents also experienced: thunderstorms, hail, and extreme cold weather.

Table F---2: Type of Natural Disaster Experienced in Past Five Years

	Percent	Number
Winter Storm (Snow/Ice)	76%	146
Wildfire	61%	118
Windstorm	39%	74
Drought	8%	15
Flood	6%	12
Avalanche	2%	4
Dust Storm	2%	3
Earthquake	1%	2
Landslide	1%	1
Volcanic Eruption	0%	0
Other	5%	9

Source: 2015 Deschutes County Natural Hazards Survey

The survey asked respondents to rank their personal level of concern for specific natural disasters affecting their community. Table F---3 shows that the hazards of highest concern for respondents include wildfires, winter storms, and droughts with roughly 70 to 97---percent of respondents marking the "very concerned" or "somewhat concerned" choices. To a lesser degree respondents demonstrated concern over windstorm, earthquake, and volcanic eruption. Of lesser concern was the flood hazard. Dust Storms, landslides, and avalanches are the hazards respondents are least concerned about with roughly 85---percent of respondents marking the "not very concerned" or "not concerned" choices.

Table F---3: Level of Concern About Natural Disasters Affecting Deschutes County

	Very Concerned	Somewhat Concerned	Not Very Concerned	Not Concerned	Total Responses	Mean
Wildfire	70%	27%	1%	2%	330	1.36
Winter Storm (Snow/Ice)	31%	43%	18%	7%	321	2.02
Drought	27%	43%	16%	13%	314	2.16
Windstorm	11%	41%	33%	15%	317	2.52
Earthquake	10%	37%	35%	18%	318	2.61
Volcanic Eruption	7%	35%	37%	21%	316	2.71
Flood	3%	23%	41%	33%	317	3.04
Dust Storm	1%	14%	40%	44%	307	3.27
Landslide	1%	14%	43%	43%	310	3.28
Avalanche	1%	16%	32%	50%	310	3.32

Source: 2015 Deschutes County Natural Hazards Survey

In addition to the concerns listed above respondents also listed the following concerns: severe lightning storms, extreme cold weather, sinkholes and quicksand, ground water

shortage, canal and dam breeches, and environmental degradation (forest thinning, development in forest and EFU zones). Non---natural hazard related concerns include pandemics, rail/ tanker disasters, animal attacks, and economic disasters,

Next, the survey asked if survey recipients had received information about how to increase the safety of their households and homes from natural hazards. Table F---4 shows that over three---fourths (76---percent) of respondents indicated that they have received information regarding home and family safety from natural disasters at some time in the past.

Table F---4: Respondents Who Have Received Information Concerning Natural Disaster Home Safety

Answer	Percent	Number
Yes	76%	257
No	24%	81
Total	100%	338

Source: 2015 Deschutes County Natural Hazards Survey

Of respondents who had received information, 33---percent received the information within the last six months and 29---percent received information six months to one year ago (see Table F---5). This suggests that, while outreach is occurring, it is reaching about two---thirds of the households in Deschutes County, and that more than one---third of the households have not received any information in over a year.

Table F---5: Most Recent Date of Contact for Information Concerning Natural Disaster Home Safety

	Percent	Number
Within the last 6 months	33%	83
Between 6 and 12 months	29%	74
Between 1 and 2 years	21%	52
Between 3 and 5 years	13%	32
5 years or more	4%	11
Total	100%	252

Source: 2015 Deschutes County Natural Hazards Survey

Of the respondents who received information on natural hazard preparedness, government agencies (63---percent) and the news media (58---percent) were cited most often as being the source of the information. Table F---6 shows the sources most respondents last received information from. Eighteen respondents cited non---profit organizations as the source of their information; the cited non---profits include:

- Community Emergency Response Teams (CERTs),
- Homeowners Association,
- LDS Church,
- NeighborImpact,
- Neighborhood associations,
- OES (Amateur Radio),
- Private School,

- Rural Fire Protection Districts (RFPDs),
- The Shaken seminar at Tower Theater, and
- Southern Baptist Disaster Team.

Additionally, 23 respondents cited an other resource as the source of their information, including:

- Emergency Personnel and Agencies,
- Employers,
- Fire Free,
- Friends,
- Individual initiative/ On---line research (including 72---hour kits, food and water storage information),
- Lectures,
- Oregon State Defense Force (OSDF),
- Project Wildfire, and
- Work (source of employment related to natural hazards).

For detailed information on survey responses see the "other" comments section at the end of this report.

Table F---6: Most Recent Provider of Natural Disaster Home Safety Information

	Percent	Number
Government agency	63%	159
News media	58%	147
Utility company	25%	64
American Red Cross	20%	50
Social media (e.g., Facebook, Twitter, etc.)	20%	50
Insurance agent or company	19%	47
Neighbor/ friend	14%	36
University or research institution	9%	22
Other nonSprofit organization (please specify):	7%	18
Not Sure	6%	15
Elected official	2%	6
Other (please specify):	9%	23

Source: 2015 Deschutes County Natural Hazards Survey
Note: Total percentage exceeds 100% because respondents had the option to choose more than one category.

Survey respondents provided an interesting contrast between the sources that they had recently received information from, and those that they perceived to be the most trustworthy. Not surprisingly survey respondents held the highest level of confidence in their own research and knowledge. Respondents had more confidence in local government (87% some or lots of confidence) than state government (72% some or lots of confidence) or FEMA (66% some or lots of confidence). Friends (69% some or lots of confidence) were seen with more confidence than neighbors (51% some or lots of confidence). Local utility companies were perceived with more confidence (69% some or lots of confidence) than

national utility companies (36% some or lots of confidence). Table F---7 shows the sources respondents trust the most for providing this information.

Table F---7: Most Trusted Providers of Information for Natural Disaster Home Safety

	Lots of Confidence	Some Confidence	Not much Confidence	No Confidence	Don't Know	Total Responses	Mean
Yourself	40%	53%	4%	1%	2%	288	1.73
Local Government	29%	58%	11%	1%	1%	295	1.88
State Government	18%	54%	24%	3%	1%	296	2.16
Friend	15%	54%	24%	5%	3%	285	2.27
News media	8%	61%	23%	7%	0%	295	2.31
FEMA	17%	49%	23%	6%	5%	298	2.31
Local Utilities	16%	53%	20%	4%	6%	286	2.31
University or research institution	20%	43%	20%	8%	10%	280	2.46
Neighbor	8%	43%	32%	11%	6%	287	2.64
Insurance agent or company	7%	41%	35%	13%	4%	282	2.66
National Utilities	3%	33%	37%	10%	17%	271	3.04
National NonNprofit (please specify):	18%	9%	15%	2%	55%	128	3.68
Local NonNprofit (please specify):	13%	14%	9%	4%	60%	128	3.85
Local Community Leaders (please specify):	5%	17%	16%	5%	58%	121	3.94
Elected Official (please specify):	5%	10%	13%	14%	58%	135	4.09
Other (please specify):	11%	5%	6%	3%	74%	62	4.24

Source: 2015 Deschutes County Natural Hazards Survey

In addition to the named sources in the table above respondents cited the followed specific agencies, organization, and resources:

National Non---profits:

- American Radio Relay League
- American Red Cross
- Firewise

Local Non---profits:

- Central Oregon Avalanche Association,
- Central Oregon Land Watch,
- Deschutes Collaborative Forest Project,
- Neighborhood Associations,
- Homeowners Associations,
- Land Trusts,
- La Pine Community Kitchen,
- NeighborImpact,
- Project Wildfire,
- Salvation Army, and
- Southern Baptist Disaster Team (High Desert).

Local Community Leaders

- County Commissioners
- Search and Rescue
- Sheriff

Elected Officials:

- All,
- Governor,
- Mayor,
- Search and Rescue, and
- Sheriff.

Other:

- County government,
- Fire department/ rural fire protection districts,
- Law enforcement/ search and rescue,
- Project Wildfire, and
- Social Media.

For detailed information on survey responses see the “other” comments section at the end of this report.

When asked what the most effective way was to receive information, respondents indicated that television news (54%), emergency services (52%), fact sheets/ brochures (47%), and email newsletters (46%) were the most effective. Table F---8 shows the effectiveness rating of information dissemination methods expressed by survey respondents.

Table F---8: Most Effective Method for Respondents to Receive Information Concerning Natural Disaster---Related Home Safety

	Percent	Number
Television news	54%	164
Emergency services (police/ fire)	52%	158
Fact sheet/ brochure	47%	143
Email newsletters	46%	139
Newspaper stories	40%	120
Online news outlets	38%	116
Radio news	38%	115
Social media (e.g., Facebook, Twitter)	36%	110
Mail	35%	107
Public workshops/ meetings	31%	93
University or research institution	18%	54
Radio ads	16%	48
Schools	15%	44
Television ads	14%	41
Outdoor advertisements (billboards, etc.)	11%	34
Books	10%	29
Newspaper ads	8%	24
Magazine	7%	20
Chamber of Commerce	5%	15
Other (please specify):	8%	24

Source: 2015 Deschutes County Natural Hazards Survey

Community Vulnerabilities, Natural Hazard Mitigation Strategies, and Priorities

This section outlines the assets that survey respondents felt would be vulnerable to natural hazards in the region. The section also describes citizens' priorities for planning for natural hazards and the community---wide strategies respondents support.

The survey asked respondents to rank categories of community assets in terms of their vulnerability. These questions were intended to help the county determine citizen priorities when planning for natural hazards, by comparing the level of importance that they attach to specific community assets and risk reduction activities. Table F---9 illustrates that respondents found environmental assets to be by far the most vulnerable (over 94---percent marking "very vulnerable" or "somewhat vulnerable"), followed by infrastructure related assets (over 83---percent), and then economic assets (over 86---percent). Human related assets were next (about 73%). Survey respondents found governance assets to be the fourth most vulnerable (over 61---percent), followed by cultural/ historical assets (over 58---percent).

Table F---9: Respondent Perceptions of Community Vulnerability

Question	Very Vulnerable	Somewhat Vulnerable	Neutral	Not Very Vulnerable	Not Vulnerable	Total Responses	Mean
Environmental " Damage or loss of forests, rangeland, waterways, etc.	68%	26%	5%	1%	0%	291	1.40
Infrastructure " Damage or loss of bridges, utilities, schools, etc.	37%	46%	15%	1%	1%	293	1.83
Economic " Business closures and/or job losses	33%	53%	12%	1%	1%	291	1.85
Human " Loss of life and/or injuries	27%	46%	24%	3%	0%	293	2.04
Governance " Ability to maintain order and/or provide public amenities and services	15%	46%	33%	4%	1%	293	2.30
Cultural/Historic " Damage or loss of libraries, museums, fairgrounds, etc.	13%	45%	35%	5%	1%	292	2.36

Source: 2015 Deschutes County Natural Hazards Survey

Next, the survey asked respondents to indicate the importance that they attach to particular types of public and private community assets. As shown in Table F---10, respondents indicated that hospitals (89%), and fire/police stations (83%) are “very important” to them. In addition, 69---percent indicated that schools (K---12), highway mountain passes (65%), and major bridges (61%) are also “very important” to them. Parks were the least important to survey respondents, followed closely by museums/historic buildings.

Table F---10: Respondent Community Asset Valuation

	Very Important	Somewhat Important	Neutral	Not Very Important	Not Important	Total Responses	Mean
Hospitals	89%	10%	1%	0%	0%	291	1.12
Fire/Police Stations	83%	16%	1%	0%	0%	290	1.18
Schools (K>12)	69%	22%	8%	1%	0%	290	1.41
Highway Mountain Pass	65%	29%	5%	1%	0%	291	1.43
Major Bridges	61%	30%	7%	2%	0%	288	1.49
Elder>care Facilities	44%	38%	13%	2%	2%	290	1.81
Small Businesses	37%	45%	16%	2%	0%	289	1.83
Major Employers	33%	46%	18%	2%	1%	289	1.93
City Hall / Courthouse	29%	44%	22%	4%	1%	290	2.03
College / University	27%	43%	24%	5%	1%	289	2.10
Museums/Historic Buildings	19%	50%	23%	7%	2%	291	2.22
Parks	27%	34%	27%	8%	4%	291	2.26

Source: 2015 Deschutes County Natural Hazards Survey

In addition to the assets listed above respondents also listed the following assets as important: national forests, recreational assets/ parks/trails, natural environment/ wildlife, utility infrastructure (electric, water, sewer), private residences, water resources/ aquifer, jails, roads, tourism, and air quality.

To gauge attitudes towards who should engage in different types of mitigation strategies, the survey asked respondents to indicate who should be responsible for various mitigation activities. Table F---11 shows that survey respondents overwhelmingly believe the public sector should be responsible for mitigating fire/ police stations, major bridges, highway mountain passes, K---12 schools, and city halls/ courthouses. There is general agreement by respondents that the public sector should be responsible for mitigating parks, and colleges/ universities. However, respondents are split between believing the public or private sector

should be responsible for the mitigation of hospitals, elder---care facilities, and museums/ historic buildings. There is general agreement by respondents that the private sector should be responsible for the mitigation of major employers and small businesses.

Table F---11: Respondent Preferences for Who Should Mitigate Specific Assets

	Public Sector (Government)	Private Sector (Business)	Individual Citizens	Non;Profit Organizations (NGOs, Churches, Red Cross, etc.)	Total Responses
Fire/Police Stations	97%	1%	1%	1%	275
Major Bridges	95%	4%	1%	1%	274
Highway Mountain Pass	97%	2%	1%	0%	269
Schools (KE12)	90%	3%	3%	4%	285
City Hall / Courthouse	93%	4%	2%	1%	274
Parks	67%	9%	13%	12%	299
College / University	68%	17%	6%	9%	286
Hospitals	42%	46%	2%	10%	297
ElderEcare Facilities	31%	53%	4%	12%	293
Museums/Historic Buildings	27%	27%	13%	33%	300
Major Employers	6%	88%	5%	1%	274
Small Businesses	4%	85%	10%	1%	279

Source: 2015 Deschutes County Natural Hazards Survey
Note: An error in the report occurred with this question. Prior to January 26, 2015 survey respondents were not allowed to mark multiple choices; the error was resolved on January 26, 2015 to allow future respondents to mark multiple choices.

Additional assets listed by respondents include: recreational assets, natural environment, private residences/ property, and water resources/ aquifer.

Table F---12 summarizes the results for priorities regarding planning for natural hazards in the region. The survey then asked respondents to indicate the level of importance they would place on a number of policies and priorities within their communities. The protection of critical facilities (e.g. transportation networks, hospitals, fire stations) received the strongest level of support with 96---percent of respondents finding it to be very important. Similarly, survey respondents found strengthening emergency services (76%), protecting and reducing damage to utilities (74%), and promoting cooperation among public agencies, citizens, non---profit organizations, and businesses (73%) to be very important.

Roughly 60---percent of survey respondents felt that disclosing natural hazard risks during real estate transactions was very important, while protecting private property was considered very important by 45---percent of respondents. Preventing development in hazard areas was considered very important by 48---percent of respondents, and enhancing the function of natural features (e.g. streams, wetlands) was considered very important by 47---percent of respondents. Protecting historical and cultural landmarks was the lowest priority for survey respondents.

Table F---12: Respondent Natural Hazard Planning Priorities

	Very Important	Somewhat Important	Neutral	Not Very Important	Not Important	Total Responses	Mean
Protecting critical facilities (e.g. transportation networks, hospitals, fire stations)	96%	4%	0%	0%	0%	275	1.04
Strengthening emergency services (e.g.D police, fire, ambulance) Protecting	76%	20%	4%	1%	0%	275	1.29
and reducing damage to utilities Promoting	74%	23%	2%	0%	0%	273	1.29
cooperation among public agencies, citizens, nonDprofit organizations, and businesses Disclosing	73%	24%	3%	0%	0%	275	1.31
natural hazard risks during real estate transactions Protecting	60%	29%	9%	1%	1%	276	1.55
private property Preventing	45%	45%	8%	2%	1%	276	1.68
development in hazard areas Enhancing	48%	38%	10%	3%	1%	273	1.72
the function of natural features (e.g. streams, wetlands) Protecting	47%	32%	14%	4%	3%	274	1.83
historical and cultural landmarks	23%	44%	26%	5%	2%	276	2.18

Source: 2015 Deschutes County Natural Hazards Survey

Only 15---percent of survey respondents believe that Deschutes County is very prepared to respond to natural hazards, while 71---percent believe that they are somewhat prepared. About 15---percent of respondents believe Deschutes County is not very prepared or not prepared to respond to natural hazards.

Table F---13: Perception of Deschutes County's Preparedness to Respond to Natural Hazards

Answer	Percent	Number
Very Prepared	15%	38
Somewhat Prepared	71%	177
Not Very Prepared	12%	30
Not Prepared	2%	4
Total	100%	249

Source: 2015 Deschutes County Natural Hazards Survey

Just over one---half of survey respondents feel they are somewhat aware of mitigation activities that Deschutes County is taking to reduce individual risk (life or property) from natural hazards; over 20---percent believe that they are very aware of such activities.

Table F---14: Aware of Deschutes County's Mitigation Activities

Answer	Percent	Number
Very Aware	21%	47
Somewhat Aware	51%	116
Not Very Aware	29%	65
Total	100%	228

Source: 2015 Deschutes County Natural Hazards Survey

Mitigation and Preparedness Activities in your Household

This section provides an overview of household level natural hazard mitigation and preparedness activities in Deschutes County.

Over 67---percent percent of respondents reported to have talked with members of their households about what to do in the case of a natural disaster or emergency. In addition, 48---percent had prepared a "Disaster Supply Kit" which entails storing extra food, water, and other emergency supplies, while 56---percent were trained in first aid or CPR during the past year. About 97---percent of respondents had placed smoke detectors on every level of the home while almost 60% of respondents reported to have attended meetings or received information on natural disasters or emergency preparedness, 42% developed a "Household/Family Emergency Plan," and 25% discussed/created a utility shutoff procedure in the event of a natural disaster. Figure F---15 summarizes all of the activities that respondents indicated they have done, plan to do, have not done, or were unable to do to prepare for natural disasters.

Table F---15: Activities that Respondents Have Done, Plan to Do, Have Not Done, or are Unable to Do

	Have Done	Plan to Do	Not Done	Unable to Do	Total Responses	Mean
Prepared your home by having smoke detectors on each level of the house?	97%	1%	1%	0%	272	1.04
Talked with members in your household about what to do in case of a natural disaster or emergency?	67%	16%	14%	3%	272	1.52
Prepared a Disaster Supply Kit (Stored extra food, water, batteries, or other emergency supplies)?	48%	28%	24%	0%	272	1.77
Attended meetings or received written information on natural disasters or emergency preparedness?	57%	8%	34%	1%	272	1.79
Developed a Household/Family Emergency Plan in order to decide what everyone would do in the event of a disaster?	42%	32%	24%	1%	271	1.85
In the last year, has anyone in your household been trained in First Aid or CardioUPulmonary Resuscitation (CPR)?	56%	4%	39%	1%	271	1.85
Discussed or created a utility shutoff procedure in the event of a natural disaster?	25%	29%	44%	1%	271	2.21

Source: 2015 Deschutes County Natural Hazards Survey

General Household Information

Demographic questions provide a statistical overview of the characteristics of the respondents. This section asked respondents about their primary and secondary residences, work places, age and gender, level of education, median income, race, ethnicity, and length of residence in the state of Oregon.

PRIMARY HOME RESIDENCY

Table F---16 lists the zip codes reported by survey respondents, 97---percent report their primary residence to be in Deschutes County. Over 70% survey respondents lived within a Bend zip code.

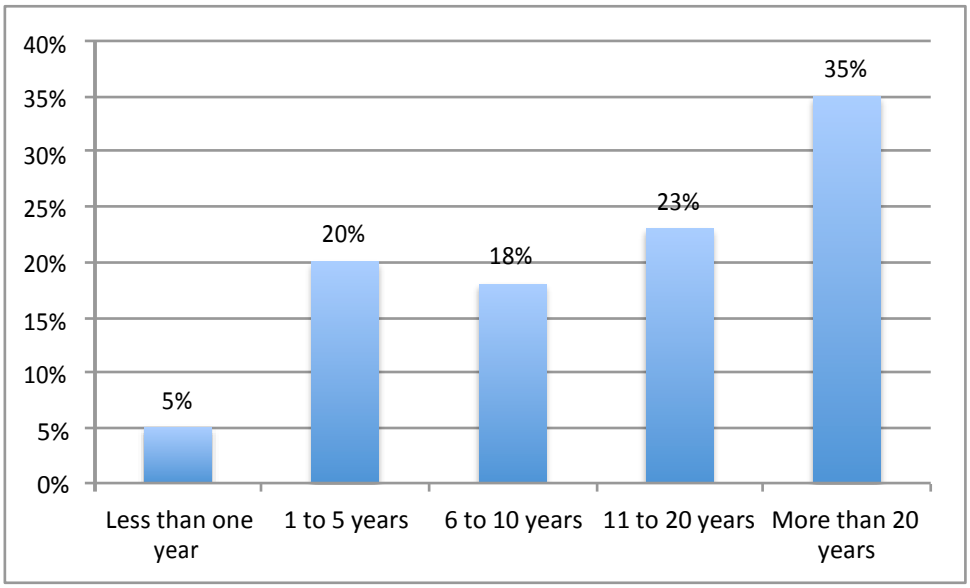
Table F---16: Respondent Zip Code of Primary Home

Zip	Location	Number	Percent
97701	Bend (North)	89	40.1%
97702	Bend (South)	68	30.6%
97707	Sunriver	10	4.5%
97739	La Pine	10	4.5%
97756	Redmond	22	9.9%
97759	Sisters	21	9.5%
Other	D	2	0.9%
	Total	**222**	100%

Source: 2015 Deschutes County Natural Hazards Survey

Fifty---eight---percent of survey respondents with primary homes in Deschutes County have lived in the county for 11 years or more, while approximately 25---percent have lived in Deschutes County for five years or less.

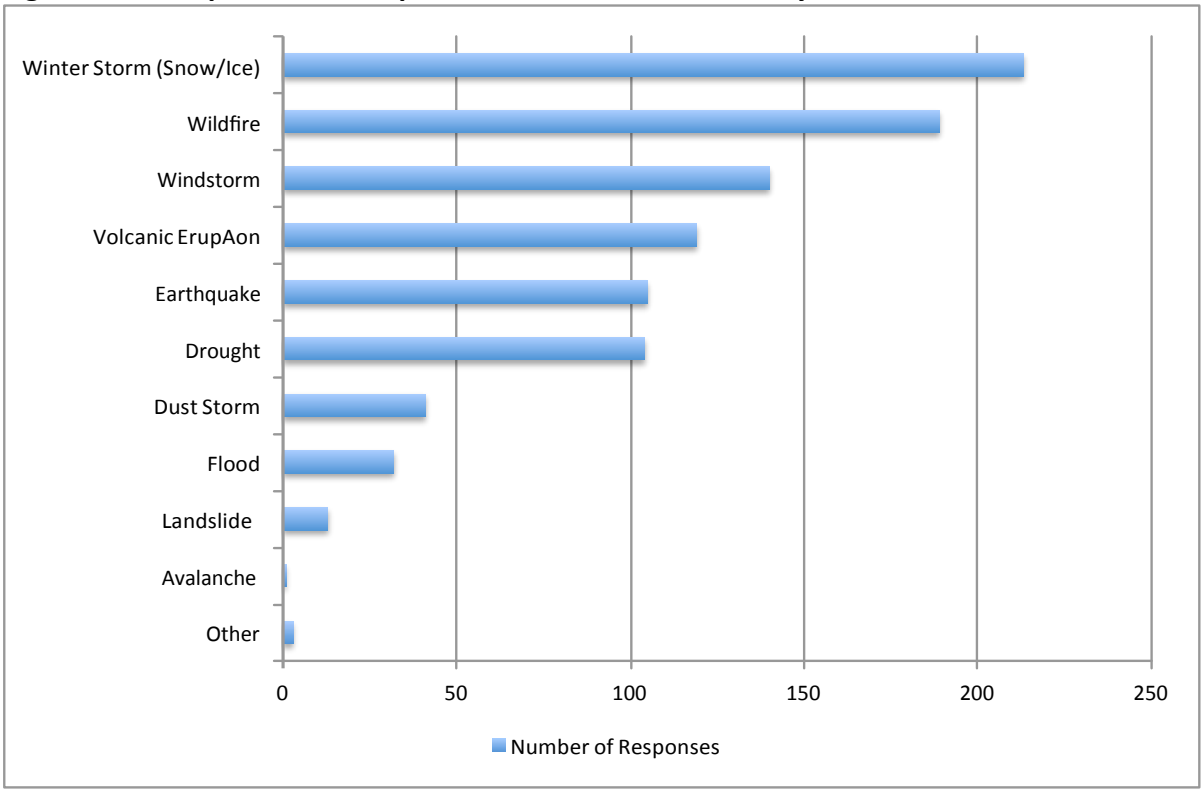
Figure F---1: Length of Deschutes County Residency – Primary Home



Source: 2015 Deschutes County Natural Hazards Survey

Respondents most frequently indicated that their primary home is located in the winter storm (snow/ ice), wildfire, and/or windstorm hazard zones. Respondents were least likely to report that their primary home was located in the flood, landslide, and/ or avalanche hazard zones. Respondents listed canal breech, sinkholes, and groundwater table loss as other zones that their primary home is located within (for a complete list see appendices).

Figure F---2: Respondent Perception of Hazard Zones --- Primary Home Location



Source: 2015 Deschutes County Natural Hazards Survey

The land area covered by the floodwaters of the base flood is the Special Flood Hazard Area (SFHA). The SFHA is the area where the National Flood Insurance Program's (NFIP's) floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies. Table F---17 indicates that only one---percent of respondents report that their primary home is located within the SFHA; however, 22---percent of respondents were not aware if their home was located within the SFHA. Of those that responded that their homes were in the SFHA, two of the three had flood insurance policies for their primary residences.

Table F---17: Primary Residence Located in SFHA

Answer	Percent	Number
Yes	1%	3
No	77%	204
Don't Know	22%	59
Total	100%	266

Source: 2015 Deschutes County Natural Hazards Survey

The Healthy Forests Restoration Act defines the Wildland Urban Interface (WUI) as an area within the zone of transition between unoccupied land and human development that is at---risk of wildfire. Deschutes County identifies WUI areas within Community Wildfire Protection Plans (CWPPs). Table F---18 indicates that almost 40% of respondents are aware

that their home is within a WUI (note: the question did not provide a "don't know" response).

Table F---18: Primary Residence Located in WUI

Answer	Percent	Number
Yes	38%	62
No	62%	101
Total	100%	163

Source: 2015 Deschutes County Natural Hazards Survey

Cleaning your property of debris and maintaining your landscaping are important first steps to minimize damage and loss due to wildfire. Respondents who had their primary residence located within a WUI most commonly cleared leaves and other debris from gutters, eaves, porches, and decks (92%), disposed of lawn clippings and other vegetated debris from lawns and planting areas (91%), removed dead vegetation (88%), and/ or kept lawn hydrated and mowed (87%). Respondents were less likely to have screened or boxeF---in areas below patios and decks (34%).

Table F---19: Primary Residence Defensible Space Techniques

	Percent	Number
Clear leaves and other debris from gutters, eaves, porches, and decks.	92%	237
Dispose of lawn clippings and other vegetated debris from lawns and planting areas.	91%	235
Remove dead vegetation from under deck and/ or from within 10 feet of house.	88%	226
Keep lawn hydrated and maintained (mowed).	87%	224
Remove stored items from under decks or porches.	75%	192
Inspect shingles and roof tiles and replace/ repair those that are loose or missing.	73%	187
Prune trees so lowest branches are 6 to 10 feet from the ground.	67%	171
Enclose underOeave and soffit vents or screen with metal wire mesh to prevent ember entry.	52%	134
Remove flammable materials (firewood stacks, propane tanks, dry vegetation) from within 30 feet of your home and outbuildings (garages, sheds).	52%	133
Cover exterior attic vents with metal wire mesh to prevent sparks from entering home.	51%	131
Screen or boxOin areas below patios and decks metal with wire mesh to prevent debris and combustible materials from accumulating.	34%	88

Source: 2015 Deschutes County Natural Hazards Survey

HOUSING CHARACTERISTICS: PRIMARY HOME IN DESCHUTES COUNTY

Homeownership is an important variable in education and outreach programs, and knowledge of the percentage of homeowners in a community can help target the programs. Additionally, homeowners might be more willing to invest time and money in making their homes more disaster resistant. Almost 90---percent of survey respondents that have a primary home in Deschutes County are homeowners.

Table F---20: Ownership – Primary Home

Answer	Percent	Number
Own	88%	231
Rent	12%	31
Total	100%	262

Source: 2015 Deschutes County Natural Hazards Survey

Ninety---percent of survey respondents who have a primary home in Deschutes County live in single family homes, 5---percent live in manufactured homes, and one---percent in apartments; the other four---percent live in duplexes, condo/townhouses, or some other form of housing (responses for "other" include apartment within a single---family home, and a barn).

Table F---21: Housing Type – Primary Home

Housing Type	Percent	Number
Single'family home	90%	246
Duplex	1%	2
Apartment in a 3 to 4 unit structure	1%	3
Apartment in a 5 or more unit structure	0%	1
Condominium/ Townhouse	1%	3
Manufactured home	5%	15
Other:	1%	3
Total	100%	273

Source: 2015 Deschutes County Natural Hazards Survey

SECONDARY/ VACATION HOME RESIDENCY

Approximately seven---percent of survey respondents own a secondary/ vacation home in Deschutes County. Table F---22 shows the zip codes for the respondents' secondary/ vacation homes; the majority of these residences are within Bend.

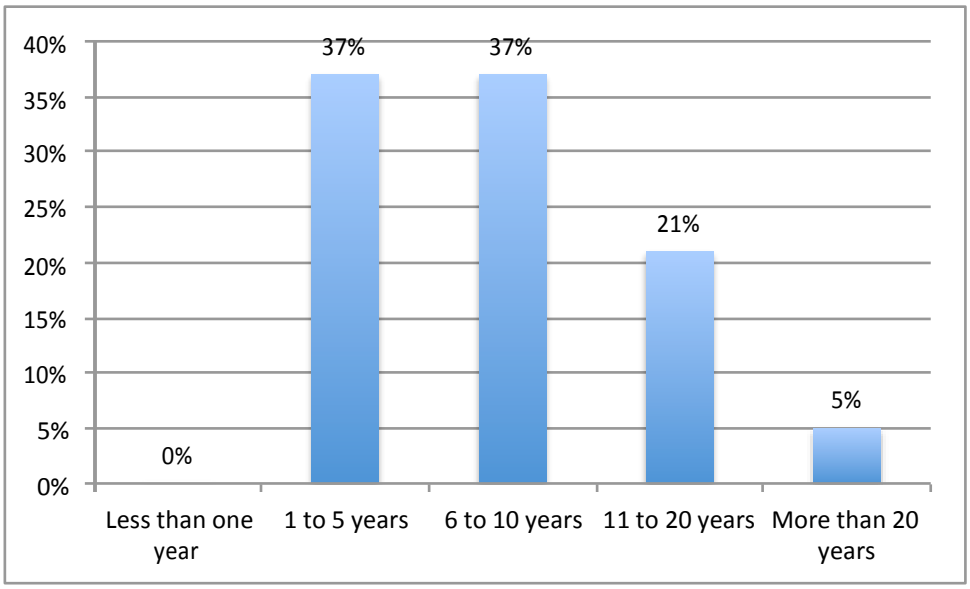
Table F---22: Respondent Zip Code of Secondary Home

Zip	Location	Number	Percent
97701	Bend (North)	7	41.2%
97702	Bend (South)	4	23.5%
97707	Sunriver	1	5.9%
97739	La Pine	0	0.0%
97756	Redmond	4	23.5%
97759	Sisters	1	5.9%
	Total	**17**	100%

Source: 2015 Deschutes County Natural Hazards Survey

Almost seventy---five---percent of survey respondents with secondary homes in Deschutes County reported owning that home for 10 years or less; while approximately five---percent have owned their secondary home for 20 years or more.

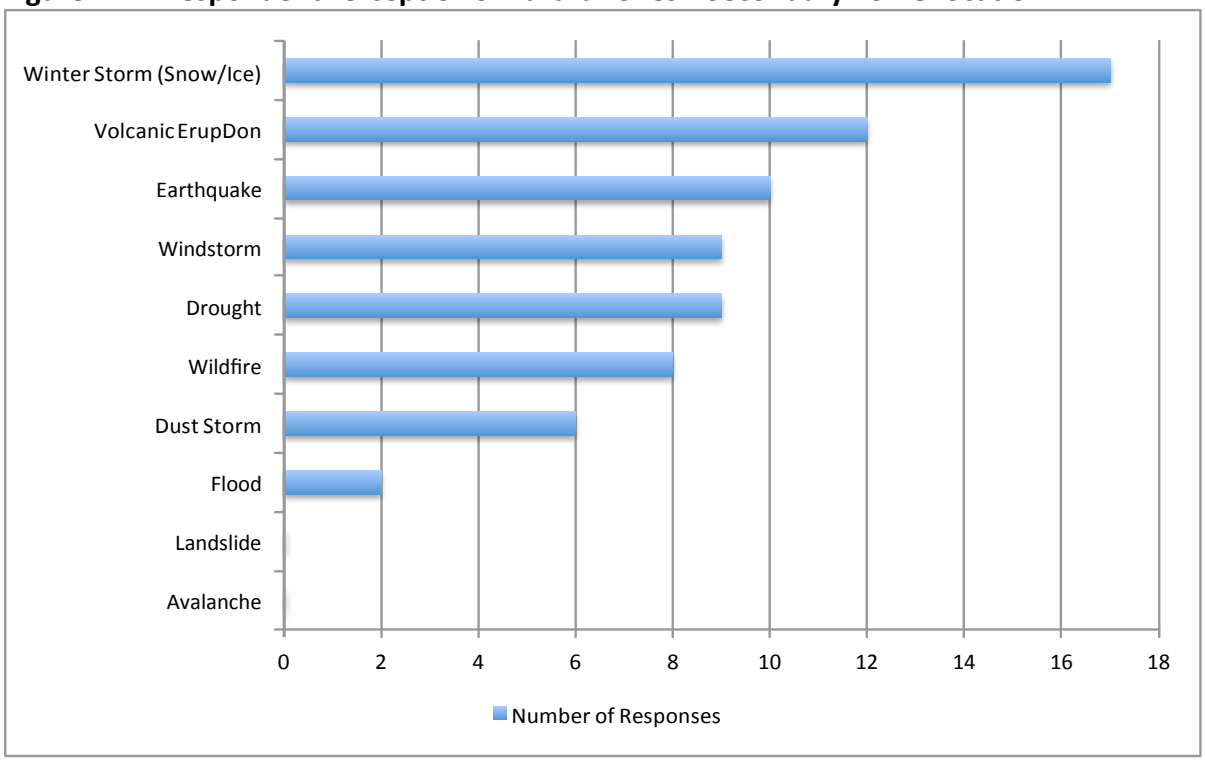
Figure F---3: Length of Deschutes County Ownership – Secondary Home



Source: 2015 Deschutes County Natural Hazards Survey

Respondents most frequently indicated that their secondary home is located in the winter storm, volcanic eruption, and/ or earthquake hazard zones. Respondents were less likely to report that their secondary home was located in the flood, landslide, or avalanche hazard zones.

Figure F---4: Respondent Perception of Hazard Zones --- Secondary Home Location



Source: 2015 Deschutes County Natural Hazards Survey

The land area covered by the floodwaters of the base flood is the Special Flood Hazard Area (SFHA). The SFHA is the area where the National Flood Insurance Program's (NFIP's) floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies. Table F---23 indicates that none of the respondents report that their secondary/ vacation home is located within the SFHA; however, 37---percent of respondents were not aware if their home was located within the SFHA.

Table F---23: Secondary/ Vacation Residence Located in SFHA

Answer	Percent	Number
Yes	0%	0
No	63%	12
Don't Know	37%	7
Total	100%	19

Source: 2015 Deschutes County Natural Hazards Survey

The Healthy Forests Restoration Act defines the Wildland Urban Interface (WUI) as an area within the zone of transition between unoccupied land and human development that is at---risk of wildfire. Deschutes County identifies WUI areas within Community Wildfire Protection Plans (CWPPs). Table F---24 indicates that none of respondents are aware that their home is within a WUI (note: the question did not provide a “don’t know” response).

Table F---24: Secondary/ Vacation Residence Located in WUI

Answer	Percent	Number
Yes	0%	0
No	100%	3
Total	100%	3

Source: 2015 Deschutes County Natural Hazards Survey

Cleaning your property of debris and maintaining your landscaping are important first steps to minimize damage and loss due to wildfire. Respondents who had their secondary/ vacation residence located within a WUI most commonly cleared leaves and other debris from gutters, eaves, porches, and decks (100%), removed dead vegetation (100%), and/ or removed flammable materials from within 30 feet of the residence (86%). Respondents were less likely to have enclosed under---eave and soffit vents (14%).

Table F---25: Secondary/ Vacation Residence Defensible Space Techniques

	Percent	Number
Clear leaves and other debris from gutters, eaves, porches, and decks.	100%	7
Remove dead vegetation from under deck and/ or from within 10 feet of house.	100%	7
Remove flammable materials (firewood stacks, propane tanks, dry vegetation) from within 30 feet of your home and outbuildings (garages, sheds).	86%	6
Prune trees so lowest branches are 6 to 10 feet from the ground.	71%	5
Keep lawn hydrated and maintained (mowed).	71%	5
Inspect shingles and roof tiles and replace/ repair those that are loose or missing.	71%	5
Remove stored items from under decks or porches.	57%	4
Dispose of lawn clippings and other vegetated debris from lawns and planting areas.	57%	4
Cover exterior attic vents with metal wire mesh to prevent sparks from entering home.	43%	3
Screen or boxNin areas below patios and decks metal with wire mesh to prevent debris and combustible materials from accumulating.	29%	2
Enclose underNeave and soffit vents or screen with metal wire mesh to prevent ember entry.	14%	1

Source: 2015 Deschutes County Natural Hazards Survey

HOUSING CHARACTERISTICS: SECONDARY HOME IN DESCHUTES COUNTY

Nearly two---thirds of survey respondents with a secondary home indicate that they lease their home for either short or long---term periods.

Table F---26: Lease (short or long) Secondary Home

Answer	Percent	Number
Yes	63%	12
No	37%	7
Total	100%	19

Source: 2015 Deschutes County Natural Hazards Survey

Of those that lease their secondary home 75---percent indicate that they do not use the services of a property management company to manage their rental arrangements.

Table F---27: Secondary Home Rental Managed by a Property Management Company

Answer	Percent	Number
Yes	25%	3
No	75%	9
Total	100%	12

Source: 2015 Deschutes County Natural Hazards Survey

The majority of secondary homes of survey respondents are single family home (74%); "other" types include ranch homes/ acreage and rustic cabins.

Table F---28: Housing Type – Secondary Home

Housing Type	Percent	Number
Single'family home	74%	14
Duplex	0%	0
Apartment in a 3 to 4 unit structure	0%	0
Apartment in a 5 or more unit structure	0%	0
Condominium/ Townhouse	11%	2
Manufactured home	5%	1
Other:	11%	2
Total	100%	19

Source: 2015 Deschutes County Natural Hazards Survey

PRIMARY WORKPLACE LOCATION

Eighty---percent of survey respondents work in Deschutes County.

Table F---29: Respondent Zip Code of Primary Workplace

Answer	Percent	Number
Yes	80%	213
No	20%	54
Total	100%	267

Source: 2015 Deschutes County Natural Hazards Survey

Of those that responded that they work in Deschutes County over 80---percent reported that their primary workplace is in Bend.

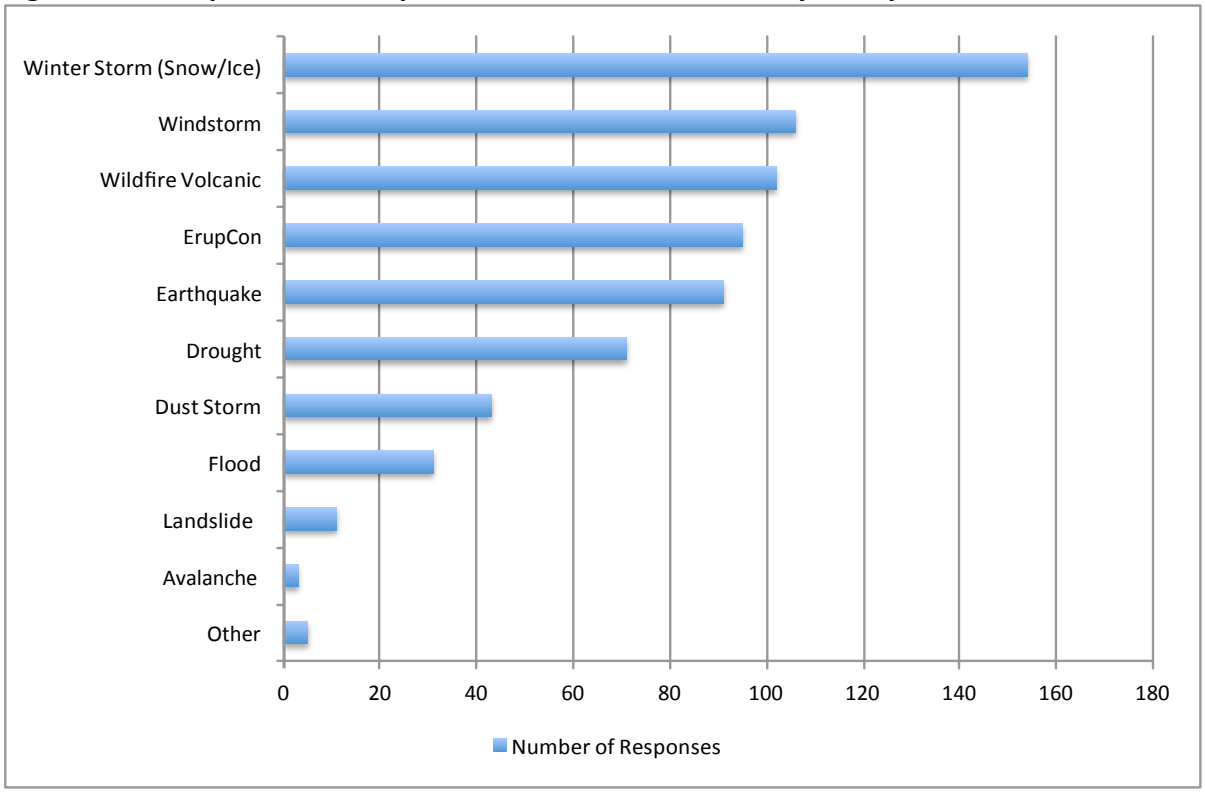
Table F---30: Respondent Zip Code of Primary Workplace

Zip	Location	Number	Percent
97701	Bend (North)	136	63.3%
97702	Bend (South)	37	17.2%
97707	Sunriver	5	2.3%
97739	La Pine	4	1.9%
97756	Redmond	15	7.0%
97759	Sisters	16	7.4%
Other	C	2	0.9%
	Total	**215**	100%

Source: 2015 Deschutes County Natural Hazards Survey

Respondents most frequently indicated that their primary workplace is located in the winter storm (snow/ ice), windstorm, and/or wildfire hazard zones. The flood, landslide, and avalanche hazard zones were the least likely to be reported as a zone that their primary workplace was located within. Other zones reported by respondents include the sinkhole and groundwater loss hazard areas.

Figure F---5: Respondent Perception of Hazard Zones --- Primary Workplace Location



Source: 2015 Deschutes County Natural Hazards Survey

AGE AND GENDER

Table F---31 shows the age range of survey respondents. Fifty---five percent of survey respondents were between the ages of 45 to 64.

Table F---31: Age of Survey Respondents

Answer	Percent	Number
18 or under	0%	0
19 to 24	2%	5
25 to 34	10%	21
35 to 44	19%	41
45 to 54	26%	56
55 to 64	29%	63
65 or over	13%	29
Total	100%	215

Source: 2015 Deschutes County Natural Hazards Survey

Table F---32 displays the gender of survey respondents; women accounted for 53---percent of the sample.

Table F---32: Gender of Survey Respondents

Answer	Percent	Number
Male	47%	100
Female	53%	112
Total	100%	212

Source: 2015 Deschutes County Natural Hazards Survey

LEVEL OF EDUCATION

Survey respondents varied in terms of levels of education. More than 50---percent of survey respondents reported having a bachelor's degree or higher; 35---percent had some college/ trade school or an associates degree.

Table F---33: Level of Education

Answer	Percent	Number
Not a high school graduate	0%	0
High school graduate/ GED	4%	8
Some college/ trade school	22%	48
Associates degree	13%	27
Bachelor's degree	35%	76
Master's degree or higher	25%	54
Other (please specify):	1%	3
Total	100%	216

Source: 2015 Deschutes County Natural Hazards Survey

HOUSEHOLD INCOME

About six---percent of respondents had household incomes of less than $35,000, 35---percent had incomes from $35,000---$74,999, 25---percent had incomes between $75,000---$99,999, while just over 33---percent had incomes of $100,000 or more.

Table F---34: Household Income

Answer	Percent	Number
Less than $15,000	1%	3
$15,000 to $34,999	5%	11
$35,000 to $74,999	35%	72
$75,000 to $99,999	25%	51
$100,000 to $199,999	28%	57
$200,000 or more	5%	10
Total	100%	204

Source: 2015 Deschutes County Natural Hazards Survey

RACE AND ETHNICITY

Ninety---five---percent of survey respondents specified white as their race; of those that replied, only 9 (roughly five---percent) specified a race other than white. Table F---35 presents the results.

Table F---35: Respondent Race

Answer	Percent	Number
White	95%	200
Black or African American	0%	1
American Indian or Alaskan Native	1%	2
Asian	0%	0
Native Hawaiian or Other Pacific Islander	0%	1
Some other race	0%	1
Other (please specify):	2%	5
Total	100%	210

Source: 2015 Deschutes County Natural Hazards Survey

With respect to ethnicity, just two---percent of survey respondents self identified as Hispanic or Latino, whereas US Census figures suggest that the number should be higher for the county; nearly 8---percent of the population in the county is reported as Hispanic or Latino.

Table F---36: Respondent Ethnicity

Answer	Percent	Number
Hispanic or Latino	2%	4
Not Hispanic or Latino	98%	191
Total	100%	195

Source: 2015 Deschutes County Natural Hazards Survey

Written Responses to Open-Ended Questions

This section includes the transcripts of respondent answers when checking the "other" option provided in some questions. In addition, we've included comments provided by respondents at the end of the survey.

Question 2: Which of the following natural hazards have you or someone in your household experienced during the past five years? Other:

- Thunder storm
- '---38 freezing
- Hail Damage
- Severe Hail storm
- extreme cold, blizzard
- Winter Storm --- cold
- snow avalanche 9 years ago
- Evacuation due to wildfire
- thunder storm

Question 3: Please indicate your level of concern about the following natural disasters affecting Deschutes County? Other:

- Cascadia
- Under "Earthquake" my concern is effects of a quake on the Cascadia Subduction Zone
- Severe Lightning Storm
- Zombie Apocalypse
- Rail/tanker disaster
- Wild animal attack
- economic disaster
- Canal breech
- cold
- Sinkholes
- quicksand
- reckless thinning of forests rather than burns
- County wanting more development in Forest and rural EFU zones
- overuse of water
- Pandemic
- Ground water shortage
- Prineville dam breech
- Hailstorm
- Not enough attention to catch arsonists

Question 5: From whom have you received information about how to make members of your household and your home safer from natural disasters? Other:

- On line research for 72 hour emergency kits and long term food and water storage for extended need
- employer
- friend
- Sunriver Home Owners
- OSDF---Oregon State Defense Force
- lectures
- Desch Co SO
- firefighter in household knows of safety concerns
- Project Wildfire
- Sunriver Police & Fire
- Community organization
- FireFree
- HOA
- I read a lot and observe.
- work
- homeowners assn
- fire dept
- Lane County

- Friend
- self, I am a medical and disaster professional
- Work
- Fire Depatment
- retired 45 yrs USFS

Question 5: Other Non---profit Organization:

- Neighborhood Association
- CERT
- Rural FPD
- NeighborImpact
- Shaken seminar at Tower Theatre
- Dept. of Forestry
- Bend Police Dept.
- RED CROSS
- fema website
- Private school
- Internet self---research
- Southern Baptist Disaster Team
- Homeowner's assn
- LDS Church
- Local HOA
- Red cross
- OES (Amateur radio)
- Orchard District Neighborhood Association

Question 6: How much confidence do you have in the following entities regarding their ability to provide you with information about how to make your household and home safer from natural disasters? Other:

- Local government, county not city
- Rural FPD
- There are a variety of prep resources and networks available that really get detailed about the nuts and bolts of disaster preparedness
- law encorcement/search and rescue
- Local Fire Department
- Social Media
- president
- Project Wildfire
- Sunriver Police & Fire
- Self---study via internet search results
- GIS entreprenuers
- my dad

Question 6: National Non---profit:

- American Red Cross
- American Red Cross
- Red Cross
- American Red Cross
- Red Cross
- Red Cross
- Red Cross
- red cross
- ARC
- red cross
- Red Cross
- Red Cross
- Public Healthy Department
- Red Cross
- Am red Cross
- red cross
- Red Cross
- Am Red Cross
- NOAA
- Red Cross
- Red Cross
- Red Cross
- Red Cross
- Red Cross, CDC
- red cross
- Red Cross

- red cross
- Red cross
- American Red Cross
- ARRL
- American Red Cross, Firewise

Question 6: Local Non---profit:

- Neighborhood Association
- Mtn River Red Cross
- American Red Cross
- American RED CROSS
- Neighbor Impact
- SAlvation Army
- red cross
- Red Cross
- Southern Baptist Disaster Team, High Desert
- Homeowners assn
- red cross
- Central Oregon Avalance Association
- Central Oregon LandWatch
- LaPine Community Kitchen
- Forest Service
- Dept. of Forestry
- Red Cross
- ARC
- CAP
- Deschutes Collaborative Forest Project
- Project Wildfire
- Fire dept
- Neighborhood Association
- Land Trust

Question 6: Local Community Leaders:

- Search and Rescue
- County Commisioners
- County Commiss
- search and rescue
- all
- Sheriff
- Mayor Ken Mulenex
- Bend Police Dept.
- Various
- Forest Service
- Sheriff's Office
- fire dept & odf
- Neighborhood Assoc.
- Cindy & Bill Rainey
- Church
- Police

Question 6: Elected Officials:

- govenor
- all
- Search and Rescue
- Mayor?
- governer
- Mayor
- Sheriff
- City of Bend Mayor
- mayor
- Sheriff's Dept.
- County Commissioners
- Council meetings
- sheriff
- County Commissioners
- Walden
- Greg Walden
- Deschutes County Sheriff
- Deschutes Sheriff's Dept
- County Commissioner

- City Council
- Sheriff
- City Councilor

Question 7: What are the most effective ways for you to receive information about how to make your household and home safer from natural disasters? Other:

- Online, not for profit
- Online disaster prep forums and websites
- community involvement
- online websites for emergency preparedness from a respected agency
- Trusted web---sites
- CERT Trainng
- Local experts, engineers, etc.
- Jack Cohen
- websites
- Home Shows
- HOA
- Email alerts
- Fire Department
- websites
- text alert system would be very handy!
- TV ads on Hulu
- Website
- Neighborhood Association
- search and rescue
- Fairs
- Mobile Phone App
- work Email as I work for local government
- Internet/Local News Website
- Sirius/XM

Question 9: Next we would like to know what specific types of community assets are most important to you. (Check the corresponding box for each asset) Other:

- national forest
- Recreational assets (economic driver)
- Natural Environment
- Utility Company Infrastructure
- Healthy forests
- private residences
- Fresh WATER SOURCES
- Sewer and water utilities
- Aquafer --- Ground water
- local parks
- jails
- Water resources
- roads
- Potential evacuation routes are very limited here
- jail
- Major roads
- Natural, environmentally sensitive areas already stressed from population
- Wildlife, this should be in Q#8 also
- groundwater table
- Recreational trail networks
- major highways and collectors for evacuations
- land closures/gridlock to rivers,
- courthouses
- Wildlife
- utilities(water,sewer,electric)
- Forestland, tourism, air quality

Question 10: Now we would like to know whom you think should be responsible for mitigating the impacts from natural hazards on specific types of community assets. Other:

Note: An error in the report occurred with this question. Prior to January 26, 2015 survey respondents were not allowed to mark multiple choices; the error was resolved on January 26, 2015 to allow future respondents to mark multiple choices.

- Recreational assets
- Natural Environment
- This is not allowing multiple choices
- I couldn't check more than one box so please decline entire page
- private residences
- MOST ASSETS ARE
- Playgrounds for Children
- private property/homes
- Aquafer --- Ground Water
- impossible to check more than one box!
- all should be responsible. was unable to " check multiple boxes"
- multiple boxes can not be checked
- survey broken can't check multiple boxes
- this page will not allow multiple answers
- Form would not let me actually check more than one box --- impact mitigation should be shared in appropriate circumstances.
- jail
- Environmental assets
- multiples not allowed
- SDC for emergency mgmt
- groundwater table
- SHARED RESPONSIBILITY
- Dog Parks
- public land fuel hazards
- arsonists need to be fined

Question 18: Is your primary home located in any of the following hazard zones within Deschutes County? Other:

- Zombie Apocalypse
- Canal breech
- Sinkholes
- blocked North/South highway corridor --- from Train/Hazard mat'ls shipped on rail
- groundwater table loss

Question 23: Please tell us your primary home type? Other:

- apartment within a single family home
- barn

Question 28: Is your secondary/ vacation home located in any of the following hazard zones within Deschutes County? Other:

- Sinkholes

Question 33: Please tell us your secondary/ vacation home type? Other:

- ranch/acreage
- rustic cabin

Question 38: Is your primary workplace located in any of the following hazard zones within Deschutes County? Other:

- sinkholes
- groundwater loss

Question 41: Please indicate your highest level of education: Other:

- Doctor
- Keep commercial development in commercial zones, ie.e. not in rural EFU zones

Question 43: Please specify your race: Other:

- human
- american
- mixed caucasian, native american
- Caucasian

Additional Comments

We received the following comments in response to the "Please feel free to provide any additional comments in the space provided" box at the end of the survey.

Note: An error in the report occurred with question 10. Prior to January 26, 2015 survey respondents were not allowed to mark multiple choices; the error was resolved on January 26, 2015 to allow future respondents to mark multiple choices.

- Question 10 claimed to allow for multiple boxes to be checked to indicate shared responsibility. Unfortunately, they were radio buttons, not check boxes, so I was unable to do that, which to my mind makes the answers I gave less accurate than they might have been.
- Where the survey stated that multiple choices could be marked, the survey would not allow.
- Question 10 did not allow multiple choices as indicated. This affected my responses.
- Not able to check multiple boxes when directions indicated it was possible.
- This is another waste of tax payer money
- Question no. 10 did not allow for multiple selections as instructed. Therefore, I was not able to mark all that I felt applied. I think a lot of what no. 10 covered applies to multiple parties (gov't, small business and especially individual citizens). Please make that note. Thanksl
- On question 10, "Whom you think should be responsible for mitigating the impacts from natural hazards..." your instructions mention "check multiple boxes if you consider it to be a shared responsibility" however your form was built with radio buttons rather than check---boxes, so multiple selection is not allowed.
- In question #10, I was unable to choose more than one answer. The survey was thought---provoking; I wrote down a few steps that my family needs to discuss. Thanks for the reminders.
- During the fire last year here in bend, our combined county folks did a wonderful job keeping us all update by several media outlets. Kudos to Deschutes County.
- Thanks for asking for input
- The area of the test where you asked to identify responsibilities of different parts of the community it was suggested that if the responsibility is shared that you click multiple boxes but the survey did not allow me to do this.
- "Thank you! ! "
- "Question #10 does not allow for checking multiple boxes to indicate more than one entity is responsible.
- My answers may be a bit skewed as a federal wildland firefighter retiree of 34 years specializing in fire prevention and assessing homes in the WUI.
- Get the Congress to quit raiding wildland fire prevention funds to fight fires that should have been prevented, or at least prevented from becoming so large due to neglectful forestry practices.
- My spouse and I are retired/on disability, so do not work in Deschutes County. We have participated in the Fire Free Program. We live in Romaine Village which is an urban interface area. A lot of the Bend city area is heavily forested, and considered urban interface. We get extremely nervous when forest fires get close to the city."
- Unable to check more than one box for the questions that say it can be done."

- No information was provided about natural hazards during the purchase of my home last year. The house is located near the Two Bulls fire area.
- Survey is broken. One questions suggests you click multiple boxes to indicate shared responsibilities. The survey was designed with radio buttons, which does not allow it.
- "I lived in Alaska (for 30 years) until I moved here in 2009. I learned a lot about hazard mitigation there, for avalanche, winter storms, earthquakes, wildfires and volcanic eruptions. Although I am not living directly in an active volcano area, the ash would most likely affect this area if there were an eruption nearby. That can significantly effect people with chronic respiratory problems, as well as healthy people, if it gets into lungs and eyes,
- BTW, the page that asks who should be responsible for hazard mitigation (public, private sector, individuals, non profits) does not allow multiple answers to the same item. I would have put multiple responsibilities if possible, as I believe that we should all pitch in and help before, during and after a disaster, if we are able."
- It appears to me that Deschutes County is more interested in immediate economic development at the expense of long term protection of natural resources. Water supply and global warming are going to have devastating long term effects for future generations if they are not addressed now for the long term. We can't expect to keep on using and using and ecouraging development that continues to use these resources and then expect some magic wand to get us out of crisis many years down the road.
- "Living on the SW side of Bend on the east side of the river, we are concerned with evacuation procedures should there be a wildfire. South of us it is very dense, combustible woods. There are very few roads out of this area. Hwy 97 has a cement strip down the middle of it making it so that cars can only turn south and from very few roads. If I wildfire came through here it seems like it could be a mass disaster, potentially with lives lost, as cars jammed up unable to vacate the area.
- With roadwork happening through the summer necessitating detours on Brookswood, it could potentially even be worse this coming fire season.
- We would like more education and information for people living in this area about how an evacuation would happen if necessary.
- Thanks, Tim & Susan Higdon"
- retired .... household of 1
- "After being evacuated for 3 days from my home in SW Bend during the Awbrey Hall fire, I have made certain to fireproof my property which has 30 ponderosas n a half acre and to remind new neighbors to do so also. I have prepared an emergency kit and list and revise both periodically.
- One problem that worries me is the HWY 97 barrier south of town that limits evacuation routes from my neighborhood at the east end of Ponderosa Street. Eventually, the frontage road and Murphy extension should alleviate that problem but who knows how long that will take. "
- Retired
- "Deschutes County is pushing for more development irregardless of your topics above.
- I think there is a systems disconnect because of this.

- For instance, the County approves new homes right along the Deschutes River in proximity to wintertime freeze/ and wintertime high water --- which we'll be seeing more of with global warming.
- Additionally, Deschutes County is pushing to legitimize more development in Forest and EFU zones (places that were platted prior to land use laws) this places more people in rural areas where there are neither County maintained roads or fire/emergency management services --- this is dumb.
- Deschutes County does maintain rural roads since 2008 ! think about where growth is occuring and who is footing the transportation bill.
- Additionally Deschutes County keeps revving up to add more commercial human population visiting rural farmlands where there is no emergency evacuation plan, and where agricultural buildings are used for hosting commercial events. (Large Outdoor Mass Gatherings, Outdoor Mass Gatherings, Vineyards hosting all things commercial, Weddings,) These agricultural buildings are not designed for human fire/life needs, and wells that furnish these rural farm places are not set up for gpm pumping in the event a fire is needing to be put out by water.
- I suggest that your UofO smart planners engage with Deschutes County to give some smart planning tips that growth and development should occur where there is infrastructure and transportation meaning in the Cities and not spread across and dotting and sprawling across the countryside.
- Thanks"
- "I would like to know how to receive instructions from disaster managers in the event of any kind of public emergency. I've lived in areas where various hazards were routine, both natural and manmade, and there were sirens, emergency broadcasts, and a saturation of instructions about what to do if we heard the sirens as well as dedicated shelter locations. In Deschutes County, there are none of these precautions that I know of. We can use common sense, which we have done, to plan what to do in case of loss of electricity in a winter storm, but that's about the extent of our disaster planning. We live in a location that could easily fall victim to wildfire, but we have no instruction about what to do------in fact a bordering property experienced a structure fire a couple of years ago, in the middle of summer, in drought conditions, that spread rapidly towards us and all we did was spray the property line to deter spreading to our property, but it was pitifully inadequate and when firemen arrived, they were so busy with the actual fire that we didn't even expect to get any information from them. We have no official word about what to do in the unlikely but possible event of earthquake or volcano activity. How would we know if our water is safe? Where would we go if we were in danger? I realize that natural and man---made disasters are thankfully rare in Deschutes County, but it might be prudent to consider some of these things before the fact. I'm not a fan of meetings, which invariably tend to be dominated by a handful of people who imagine their comments to be invaluable. However, printed material made available to all citizens, with a contact number to answer questions would be really helpful. And this survey is an excellent idea.
- There is a lot more restoration work that needs to happen in the Deschutes National Forest to make the surrounding communities safer. Helping facilitate this process and broader understanding of this need among community members is crucial!

- "this is a very long survey ----- with no indication anywhere of where one is in terms of finishing it... Adn if you want my phone number in a specific format, why not set up tdhe survey form to input it that way?
- one of the major risks to our natural assets is uncontrolled property development, especially it's impact on surface and groundwater supplies (not to mention untilities). this is a case of human---made conditions actually creating a hazard."
- "We own two homes and spend 6 months in each property. One home is in Deschutes County. Fire is our primary concern; wind damage is a secondary concern. Volcanic eruption is another possible hazard. We are not worried by earthquake hazard.

Another concern that is not listed in your survey is the health hazard caused by natural fires and those set off by the Forest Service. These have been a major irritation in recent summers in Sisters."

Attachment A – Deschutes County Public Opinion Survey

Default Question Block

Deschutes County is partnering with the Federal Emergency Management Agency (FEMA) and the Oregon Partnership for Disaster Resilience at the University of Oregon to better understand your, and Deschutes County's, risk to natural hazards and to help reduce that risk.

This questionnaire is designed to help gauge your perceptions and opinions regarding the risk of and vulnerability to natural hazards in Deschutes County and it's cities. In addition, we would like information regarding the methods and techniques you prefer for reducing the risks and losses associated with these events. The information you provide about vulnerability to natural hazards could help improve public/private coordination of hazard mitigation and risk reduction efforts within the county. The development and administration of this survey is made possible from funds provided through a Pre-Disaster Mitigation grant provided by FEMA.

Your completed survey indicates your willingness to take part in the study. Your participation in this study is voluntary. All individual survey responses are strictly confidential and are for research purposes only.

NATURAL HAZARD INFORMATION

1. During the past five years, within Deschutes County, have you or someone in your household directly experienced a natural hazard such as a wildfire, severe windstorm, flood, severe winter storm or other type of natural hazard?

- Yes
- No

2. Which of the following natural hazards have you or someone in your household experienced during the past five years?

(*Please check all that apply*)

- ☐ Avalanche
- ☐ Drought
- ☐ Dust Storm
- ☐ Earthquake
- ☐ Flood
- ☐ Landslide
- ☐ Volcanic Eruption
- ☐ Wildfire
- ☐ Windstorm
- ☐ Winter Storm (Snow/Ice)
- ☐ Other: _____
- ☐ Other: _____

3. Please indicate your level of concern about the following natural hazards affecting Deschutes County?

	Very Concerned	Somewhat Concerned	Not Very Concerned	Not Concerned	Don't Know
Avalanche	○	○	○	○	○
Drought	○	○	○	○	○
Dust Storm	○	○	○	○	○
Earthquake	○	○	○	○	○
Flood	○	○	○	○	○
Landslide	○	○	○	○	○
Volcanic Eruption	○	○	○	○	○
Wildfire	○	○	○	○	○
Windstorm	○	○	○	○	○
Winter Storm (Snow/Ice)	○	○	○	○	○
Other (please specify): _____	○	○	○	○	○
Other (please specify): _____	○	○	○	○	○

4. Have you ever received information about how to make members of your household and your home safer from natural hazards?

- ○ Yes
- ○ No

If "YES", how recently?

- ○ Within the last 6 months
- ○ Between 6 and 12 months
- ○ Between 1 and 2 years
- ○ Between 3 and 5 years
- ○ 5 years or more

5. From whom have you received information about how to make members of your household and your home safer from natural disasters?

(***Please check all that apply***)

- ☐ News media
- ☐ Government agency
- ☐ Insurance agent or company
- ☐ Utility company
- ☐ University or research institution
- ☐ Neighbor/ friend
- ☐ American Red Cross
- ☐ Other non-profit organization (please specify): _____
- ☐ Elected official
- ☐ Social media (e.g., Facebook, Twitter, etc.)
- ☐ Not Sure
- ☐ Other (please specify): _____

6. How much confidence do you have in the following entities regarding their ability to provide you with information about how to make your household and home safer from natural disasters?

	Lots of Confidence	Some Confidence	Not much Confidence	No Confidence	Don't Know
News media	○	○	○	○	○
FEMA	○	○	○	○	○
State Government	○	○	○	○	○
Local Government	○	○	○	○	○
Elected Official (please specify):	○	○	○	○	○
National Non-profit (please specify):	○	○	○	○	○
Local Non-profit (please specify):	○	○	○	○	○
Local Community Leaders (please specify):	○	○	○	○	○
National Utilities	○	○	○	○	○
Local Utilities	○	○	○	○	○
Neighbor	○	○	○	○	○
Friend	○	○	○	○	○
Yourself	○	○	○	○	○
Insurance agent or company	○	○	○	○	○
University or research institution	○	○	○	○	○
Other (please specify):	○	○	○	○	○

7. What are the most effective ways for you to receive information about how to make your household and home safer from natural disasters?

(*Please check all that apply*)

- ☐ Newspaper stories
- ☐ Newspaper ads
- ☐ Television news
- ☐ Television ads
- ☐ Radio news
- ☐ Radio ads
- ☐ Email newsletters
- ☐ Online news outlets
- ☐ Social media (e.g., Facebook, Twitter)
- ☐ Schools
- ☐ Outdoor advertisements (billboards, etc.)
- ☐ Books
- ☐ Mail
- ☐ Emergency services (police/ fire)
- ☐ Fact sheet/ brochure
- ☐ Chamber of Commerce
- ☐ Public workshops/ meetings
- ☐ Magazine
- ☐ University or research institution
- ☐ Other (please specify):
- ☐ Other (please specify):
- ☐ Other (please specify):

COMMUNITY NATURAL HAZARD MITIGATION STRATEGIES AND PRIORITIES

In order to assess community risk, we need to understand which community assets may be vulnerable to natural hazards. Vulnerable assets are those community features, characteristics, or resources that may be impacted by natural hazards (e.g. special populations, economic components, environmental resources). The next set of questions will focus on determining what assets in your community are most vulnerable to natural hazards.

8. Community assets are features, characteristics, or resources that either make a community unique, or allow the community to function. Listed below are categories of community assets followed by potential natural hazard impacts.

Please tell us how vulnerable you feel each of the following categories of community assets are to the listed natural hazard impacts in Deschutes County?

	Very Vulnerable	Somewhat Vulnerable	Not Very Vulnerable	Not Vulnerable	Don't Know
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	○	○	○	○	○

9. Next we would like to know how important or not important specific types of community assets are to you.

(*Check the corresponding box for each asset)*

	Very Important	Somewhat Important	Neither Important nor Unimportant	Unimportant	Very Unimportant	Don't Know
Elder-care Facilities	○	○	○	○	○	○
Schools (K-12)	○	○	○	○	○	○
Hospitals	○	○	○	○	○	○
Major Bridges	○	○	○	○	○	○
Fire/Police Stations	○	○	○	○	○	○
Museums/Historic Buildings	○	○	○	○	○	○
Major Employers	○	○	○	○	○	○
Small Businesses	○	○	○	○	○	○
College / University	○	○	○	○	○	○
City Hall / Courthouse	○	○	○	○	○	○
Parks	○	○	○	○	○	○
Highway Mountain Pass	○	○	○	○	○	○
Other (please specify):	○	○	○	○	○	○
Other (please specify):	○	○	○	○	○	○

10. Now we would like to know whom you think should be responsible for mitigating the impacts from natural hazards on specific types of community assets.

(*Check the corresponding box for each asset, check multiple boxes if you consider it to be a shared responsibility by more than one group.)*

	Public Sector (Government)	Private Sector (Business)	Individual Citizens	Non-Profit Organizations (NGOs, Churches, Red Cross, etc.)
Elder-care Facilities	☐	☐	☐	☐
Schools (K-12)	☐	☐	☐	☐
Hospitals	☐	☐	☐	☐
Major Bridges	☐	☐	☐	☐
Fire/Police Stations	☐	☐	☐	☐
Museums/Historic Buildings	☐	☐	☐	☐
Major Employers	☐	☐	☐	☐
Small Businesses	☐	☐	☐	☐
College / University	☐	☐	☐	☐
City Hall / Courthouse	☐	☐	☐	☐
Parks	☐	☐	☐	☐
Highway Mountain Pass	☐	☐	☐	☐
Other (please specify):	☐	☐	☐	☐
Other (please specify):	☐	☐	☐	☐

11. Natural hazards can have a significant impact on a community, but planning for these events can help lessen the impacts. The following statements will help determine citizen priorities for planning for natural hazards.

Please tell us how important each one is to you.

	Very Important	Somewhat Important	Neither Important nor Unimportant	Unimportant	Very Unimportant	Don't Know
Protecting private property	○	○	○	○	○	○
Protecting critical facilities (e.g. transportation networks, hospitals, fire stations)	○	○	○	○	○	○
Preventing development in hazard areas	○	○	○	○	○	○
Enhancing the function of natural features (e.g. streams, wetlands)	○	○	○	○	○	○
Protecting historical and cultural landmarks	○	○	○	○	○	○
Protecting and reducing damage to utilities	○	○	○	○	○	○
Strengthening emergency services (e.g.- police, fire, ambulance)	○	○	○	○	○	○
Disclosing natural hazard risks during real estate transactions	○	○	○	○	○	○
Promoting cooperation among public agencies, citizens, non-profit organizations, and businesses	○	○	○	○	○	○

12. In your opinion how prepared is Deschutes County to respond to natural hazard events?

Very Prepared	Somewhat Prepared	Not Very Prepared	Not Prepared	Don't Know
○	○	○	○	○

13. Are you aware of mitigation activities that Deschutes County is taking to reduce individual risk (life or property) from natural hazard events?

Very Aware	Somewhat Aware	Not Very Aware	Not Aware
○	○	○	○

MITIGATION AND PREPAREDNESS ACTIVITIES IN YOUR HOUSEHOLD

Households can mitigate and prepare for natural disaster emergencies in order to prevent damage to property, injuries, and losses of life. The precautions you take and training you receive can make a big difference in your ability to recover from a natural disaster or emergency. Access to basic services, such as electricity, gas, water, telephones and emergency care may be cut off temporarily, or you may have to evacuate at a moment's notice.

The following question focuses on your household's preparedness for disaster events.

14. In the following list, please check those activities that you have done in your household, plan to do in the near future, have not done, or are unable to do.

(Please check one answer for each preparedness activity)

	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?	○	○	○	○

GENERAL HOUSEHOLD INFORMATION

Finally, we would appreciate any information you are willing to share with us about you and your household. This information will remain confidential and is for survey comparison purposes only.

15. Do you live in Deschutes County?

- [ ] I live in Deschutes County
- [ ] I do not live in Deschutes County

16. Please indicate the zip code of your primary home below:

17. How long have you lived in Deschutes County?

- ○ Less than one year
- ○ 1 to 5 years
- ○ 6 to 10 years
- ○ 11 to 20 years
- ○ More than 20 years

18. Is your primary home located in any of the following hazard zones within Deschutes County?

(*Please check all that apply*.)

	My Home is in this Zone	Don't Know
Avalanche	☐	☐
Drought	☐	☐
Dust Storm	☐	☐
Earthquake	☐	☐
Flood	☐	☐
Landslide	☐	☐
Volcanic Eruption	☐	☐
Wildfire	☐	☐
Windstorm	☐	☐
Winter Storm (Snow/Ice)	☐	☐
Other (please specify):	☐	☐
Other (please specify):	☐	☐

The land area covered by the floodwaters of the base flood is the Special Flood Hazard Area (SFHA). The SFHA is the area where the National Flood Insurance Program's (NFIP's) floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies.

19. Is your primary home within the Special Flood Hazard Area (SFHA)?

- ○ Yes
- ○ No
- ○ Don't Know

20. Is your primary home currently covered against the flood hazard by a flood insurance policy?

- Yes
- No
- Don't Know

Just a few inches of water from a flood can cause tens of thousands of dollars in damage. From 2008 to 2012, the average residential flood claim amounted to more than $38,000. Flood insurance is the best way to protect yourself from devastating financial loss.

Flood insurance is available to homeowners, renters, condo owners/renters, and commercial owners/renters. Costs vary depending on how much insurance is purchased, what it covers and the property's flood risk.

All policy forms provide coverage for buildings and contents. However, you might want to discuss insuring personal property with your agent, since contents coverage is optional. Typically, there's a 30-day waiting period from date of purchase before your policy goes into effect. That means now is the best time to buy flood insurance.

To learn more visit the NFIP Homeowners webpage by clicking the **Flood Smart Link** provided at the end of this survey.

The Healthy Forests Restoration Act defines the Wildland Urban Interface (WUI) as an area within the zone of transition between unoccupied land and human development that is at-risk of wildfire. Deschutes County identifies WUI areas within Community Wildfire Protection Plans (CWPPs).

21. Is your primary home within an identified WUI area?

- Yes
- No
- Don't Know

Cleaning your property of debris and maintaining your landscaping are important first steps to minimize damage and loss due to wildfire.

22. Have you completed any of the following defensible space techniques at your primary home?

(*Please check all that apply*.)

- ☐ Clear leaves and other debris from gutters, eaves, porches, and decks.
- ☐ Remove dead vegetation from under deck and/ or from within 10 feet of house.
- ☐ Remove stored items from under decks or porches.
- ☐ Screen or box-in areas below patios and decks metal with wire mesh to prevent debris and combustible materials from accumulating.
- ☐ Remove flammable materials (firewood stacks, propane tanks, dry vegetation) from within 30 feet of your home and outbuildings (garages, sheds).
- ☐ Prune trees so lowest branches are 6 to 10 feet from the ground.
- ☐ Keep lawn hydrated and maintained (mowed).
- ☐ Dispose of lawn clippings and other vegetated debris from lawns and planting areas.
- ☐ Inspect shingles and roof tiles and replace/ repair those that are loose or missing.
- ☐ Cover exterior attic vents with metal wire mesh to prevent sparks from entering home.
- ☐ Enclose under-eave and soffit vents or screen with metal wire mesh to prevent ember entry.

About the Firewise Communities Program

Brush, grass and forest fires don’t have to be disasters. The National Fire Protection Association's (NFPA) Firewise Communities Program encourages local solutions for safety by involving homeowners in taking individual responsibility for preparing their homes from the risk of wildfire. Firewise is a key component of Fire Adapted Communities – a collaborative approach that connects all those who play a role in wildfire education, planning and action with comprehensive resources to help reduce risk.

The program is co-sponsored by the USDA Forest Service, the US Department of the Interior, and the National Association of State Foresters.

To learn more visit the Firewise Communities webpage by clicking the link provided at the end of this survey.

23. Please tell us your primary home type?

	My Primary Home is a:
Single-family home	○
Duplex	○
Apartment in a 3 to 4 unit structure	○
Apartment in a 5 or more unit structure	○
Condominium/ Townhouse	○
Manufactured home	○
Other:	○

24. Do you own or rent your primary home?

- ○ Own
- ○ Rent

25. Do you own a secondary/ vacation home in Deschutes County?

- ○ Yes
- ○ No

26. Please indicate the zip code of your secondary/ vacation home below:

27. How long have you owned a secondary/ vacation home in Deschutes County?

- ○ Less than one year
- ○ 1 to 5 years
- ○ 6 to 10 years
- ○ 11 to 20 years
- ○ More than 20 years

28. Is your secondary/ vacation home located in any of the following hazard zones within Deschutes County?

(*Please check all that apply*.)

	My Secondary Home is in this Zone	Don't Know
Avalanche	☐	☐
Drought	☐	☐
Dust Storm	☐	☐
Earthquake	☐	☐
Flood	☐	☐
Landslide	☐	☐
Volcanic Eruption	☐	☐
Wildfire	☐	☐
Windstorm	☐	☐
Winter Storm (Snow/Ice)	☐	☐
Other (please specify):	☐	☐
Other (please specify):	☐	☐

The land area covered by the floodwaters of the base flood is the Special Flood Hazard Area (SFHA). The SFHA is the area where the National Flood Insurance Program's (NFIP's) floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies.

29. Is your secondary/ vacation home within the Special Flood Hazard Area (SFHA) on NFIP maps?

- Yes
- No
- Don't Know

30. Is your secondary/ vacation home currently covered against the flood hazard by a flood insurance policy?

- Yes
- No
- Don't Know

Just a few inches of water from a flood can cause tens of thousands of dollars in damage. From 2008 to 2012, the average residential flood claim amounted to more than $38,000. Flood insurance is the best way to protect yourself from devastating financial loss.

Flood insurance is available to homeowners, renters, condo owners/renters, and commercial owners/renters. Costs vary depending on how much insurance is purchased, what it covers and the property's flood risk.

All policy forms provide coverage for buildings and contents. However, you might want to discuss insuring personal property with your agent, since contents coverage is optional. Typically, there's a 30-day waiting period from date of purchase before your policy goes into effect. That means now is the best time to buy flood insurance.

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31. Is your secondary/ vacation home within an identified WUI area?

- ○ Yes
- ○ No
- ○ Don't Know

Cleaning your property of debris and maintaining your landscaping are important first steps to minimize damage and loss due to wildfire.

32. Have you completed any of the following defensible space techniques at your secondary/ vacation home?

(*Please check all that apply*.)

- ☐ Clear leaves and other debris from gutters, eaves, porches, and decks.
- ☐ Remove dead vegetation from under deck and/ or from within 10 feet of house.
- ☐ Remove stored items from under decks or porches.
- ☐ Screen or box-in areas below patios and decks metal with wire mesh to prevent debris and combustible materials from accumulating.
- ☐ Remove flammable materials (firewood stacks, propane tanks, dry vegetation) from within 30 feet of your home and outbuildings (garages, sheds).
- ☐ Prune trees so lowest branches are 6 to 10 feet from the ground.
- ☐ Keep lawn hydrated and maintained (mowed).
- ☐ Dispose of lawn clippings and other vegetated debris from lawns and planting areas.
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To learn more visit the Firewise Communities webpage by clicking the link provided at the end of this survey.

33. Please tell us your secondary/ vacation home type?

	My secondary/ vacation home is a:
Single-family home	○
Duplex	○
Apartment (3 to 4 units in structure)	○
Apartment (5 or more units in structure)	○
Condominium/ Townhouse	○
Manufactured home	○
Other:	○

34. Do you rent out your secondary/ vacation home?

- ○ Yes
- ○ No

35. Does a property management company manage the rental arrangements for your secondary/ vacation home?

- Yes
- No

36. Do you work in Deschutes County?

- Yes
- No

37. Please indicate the zip code of your primary workplace location below:

38. Is your primary workplace located in any of the following hazard zones within Deschutes County?

(*Please check all that apply*.)

	My Workplace is in this Zone	Don't Know
Avalanche	☐	☐
Drought	☐	☐
Dust Storm	☐	☐
Earthquake	☐	☐
Flood	☐	☐
Landslide	☐	☐
Volcanic Eruption	☐	☐
Wildfire	☐	☐
Windstorm	☐	☐
Winter Storm (Snow/Ice)	☐	☐
Other (please specify):	☐	☐
Other (please specify):	☐	☐

39. Please indicate your age:

- ○ 18 or under
- ○ 19 to 24
- ○ 25 to 34
- ○ 35 to 44
- ○ 45 to 54
- ○ 55 to 64
- ○ 65 or over

40. Gender:

- Male
- Female

41. Please indicate your highest level of education:

- Not a high school graduate
- High school graduate/ GED
- Some college/ trade school
- Associates degree
- Bachelor's degree
- Master's degree or higher
- Other (please specify):

42. What is your total household income?

- Less than $15,000
- $15,000 to $34,999
- $35,000 to $74,999
- $75,000 to $99,999
- $100,000 to $199,999
- $200,000 or more

43. Please specify your race:

- White
- Black or African American
- American Indian or Alaskan Native
- Asian
- Native Hawaiian or Other Pacific Islander
- Some other race
- Other (please specify): _____

44. Please specify your ethnicity:

- Hispanic or Latino
- Not Hispanic or Latino

For more information on Flood Insurance please visit official National Flood Insurance Program website: https://www.floodsmart.gov

For more information on the Firewise Program please visit the program website: http://firewise.org

If you would like to receive emails from Deschutes County to stay updated on the progress of the update of their Natural Hazards Mitigation Plan, Community Wildfire Protection Plans, local preparedness activities/ information, and/ or other natural hazards related information please provide your contact information below:

First Name:

Last Name:

Email:

Phone:

Address:

City:

State:

Zipcode:

Please feel free to provide any additional comments in the space provided:

THANK YOU VERY MUCH FOR PROVIDING THIS INFORMATION

The Oregon Partnership for Disaster Resilience at the University of Oregon's Community Service Center prepared this survey.

For more information, please contact the Oregon Partnership for Disaster Resilience at 1209 University of Oregon, Eugene, OR 97403-1209, call (541) 346-3588, or visit ***http://csc.uoregon.edu/opdr/***