Chapter 2 RISK ASSESSMENT

In This Chapter

The Oregon NHMP Risk Assessment chapter is divided into three sections: (a) Introduction, (b) State Risk Assessment, and (c) Regional Risk Assessment. Following is a description of each section.

1. **Introduction:** States the purpose of the risk assessment and explains risk.
2. **State Risk Assessment:** Includes the following components:
   - Oregon Hazards: Profiles each of Oregon's hazards by identifying each hazard, its generalized location, and presidentially declared disasters; introduces how the state is impacted by climate change; characterizes each hazard that impacts Oregon; lists historic events; identifies the probability of future events; and introduces how climate change is predicted to impact each hazard statewide.
   - Oregon Vulnerabilities: Includes an overview and analysis of the state's vulnerability to each hazard by identifying which communities are most vulnerable to each hazard based on local and state vulnerability assessments; providing loss estimates for state-owned/leased facilities and critical/essential facilities located in hazard areas; and identifying seismic lifeline vulnerabilities.
   - Future Enhancements: Describes ways in which Oregon is planning to improve future state risk assessments.
3. **Regional Risk Assessment:** Includes the following components for each of the eight Oregon NHMP Natural Hazard Regions:
   - Summary: Summarizes the region's statistical profile and hazard and vulnerability analysis and generally describes projected impacts of climate change on hazards in the region.
   - Profile: Provides an overview of the region's unique characteristics, including a natural environment profile, social/demographic profile, economic profile, infrastructure profile, and built environment profile.
   - Hazards and Vulnerability: Further describes the hazards in each region by characterizing how each hazard presents itself in the region; listing historic hazard events; and identifying probability of future events based on local and state analysis. Also includes an overview and analysis of the region's vulnerability to each hazard; identifies which communities are most vulnerable to each hazard based on local and state analysis; provides loss estimates for state-owned/leased facilities and critical/essential facilities located in hazard areas; and identifies the region's seismic lifeline vulnerabilities.

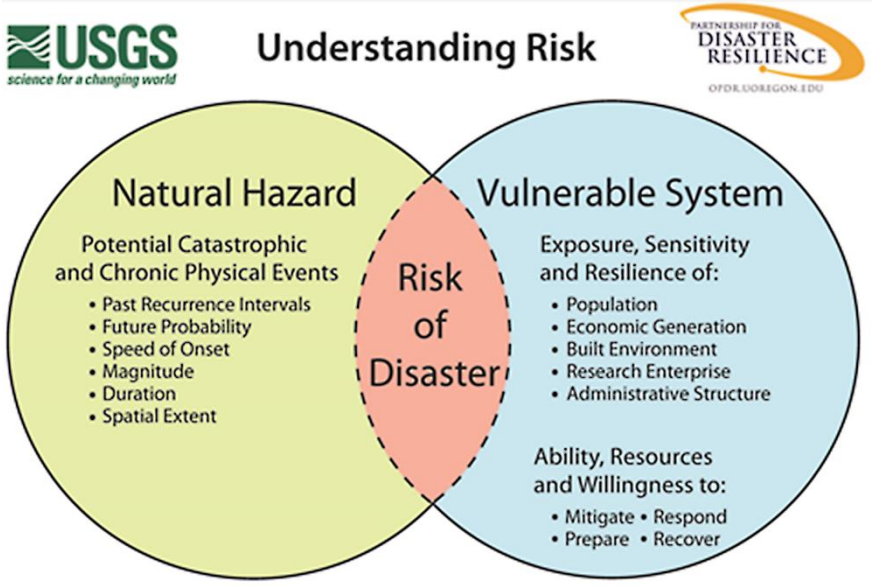
2.1 Introduction

Requirement 44 CFR §201.4(c)(2), [The plan must include] risk assessments that provide the factual basis for activities proposed in the strategy portion of the mitigation plan. Statewide risk assessments must characterize and analyze natural hazards and risks to provide a statewide overview. This overview will allow the State to compare potential losses throughout the State and to determine their priorities for implementing mitigation measures under the strategy, and to prioritize jurisdictions for receiving technical and financial support in developing more detailed local risk and vulnerability assessments.

The purpose of the Oregon NHMP Risk Assessment is to identify and characterize Oregon's natural hazards, determine which jurisdictions are most vulnerable to each hazard, and estimate potential losses to vulnerable structures and infrastructure and to state facilities from those hazards.

It is impossible to predict exactly when natural hazards will occur or the extent to which they will affect communities within the state. However, with careful planning and collaboration, it is possible to minimize losses that can result from natural hazards. The identification of actions that reduce the state's sensitivity and increase its resilience assist in reducing overall risk — the area of overlap in **Figure 2-1**. The Oregon NHMP Risk Assessment informs the State's mitigation strategy, found in **Chapter 3**.

Figure 2-1. Understanding Risk



Source: Wood (2007)

Assessing the state's level of risk involves three components: characterizing natural hazards, assessing vulnerabilities, and analyzing risk. Characterizing natural hazards involves determining hazards' causes and characteristics, documenting historic impacts, and identifying future probabilities of hazards occurring throughout the state. The section in this risk assessment titled "Oregon Hazards" characterizes each of the state's natural hazards.

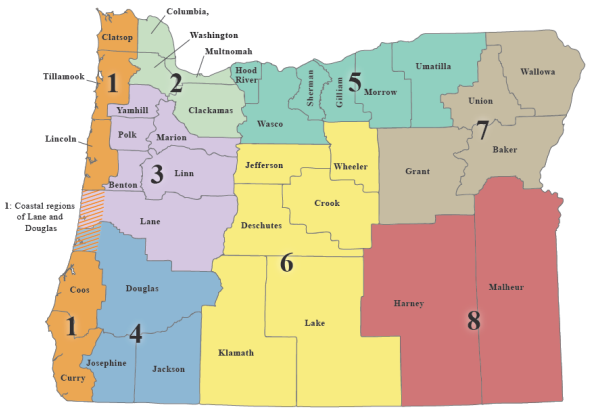
A vulnerability assessment combines information from the hazard characterization with an inventory of the existing (or planned) property and population exposed to a hazard and attempts to predict how different types of property and population groups will be affected by each hazard. Vulnerability is determined by a community's exposure, sensitivity, and resilience to natural hazards as well as by its ability to mitigate, prepare for, respond to, and recover from a disaster. The section Oregon Vulnerabilities identifies and assesses the state's vulnerabilities to each hazard identified in the Oregon Hazards section of this risk assessment.

A risk analysis involves estimating damages, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (a) the magnitude of the harm that may result, defined through vulnerability assessments; and (b) the likelihood or probability of the harm occurring, defined in the hazard characterization. Together, the "Oregon Hazards" and "Oregon Vulnerabilities" sections form the risk analysis at the state level.

This Plan also analyzes risk at the regional level. Regional risk assessments begin with a description of the region's assets in the Regional Profile section. The Profile is followed by a characterization of each hazard and identification of the vulnerabilities and potential impacts of each hazard. Regions are defined in the Oregon NHMP Natural Hazards Regions map (**Figure 2-2**):

- **Region 1 – Coast:** Clatsop, Tillamook, Lincoln, coastal Lane, coastal Douglas, Coos, and Curry Counties;
- **Region 2 – Northern Willamette Valley/Portland Metro:** Colombia, Clackamas, Multnomah, and Washington Counties;
- **Region 3 – Mid/Southern Willamette Valley:** Benton, Lane, Linn, Marion, Polk, and Yamhill Counties;
- **Region 4 – Southwest:** Douglas (non-coastal), Jackson, and Josephine Counties;
- **Region 5 – Mid-Columbia:** Gilliam, Hood River, Morrow, Sherman, Umatilla, and Wasco Counties;
- **Region 6 – Central:** Crook, Deschutes, Jefferson, Klamath, Lake, and Wheeler Counties;
- **Region 7 – Northeast:** Baker, Grant, Wallowa, and Union Counties; and
- **Region 8 – Southeast:** Harney and Malheur Counties.

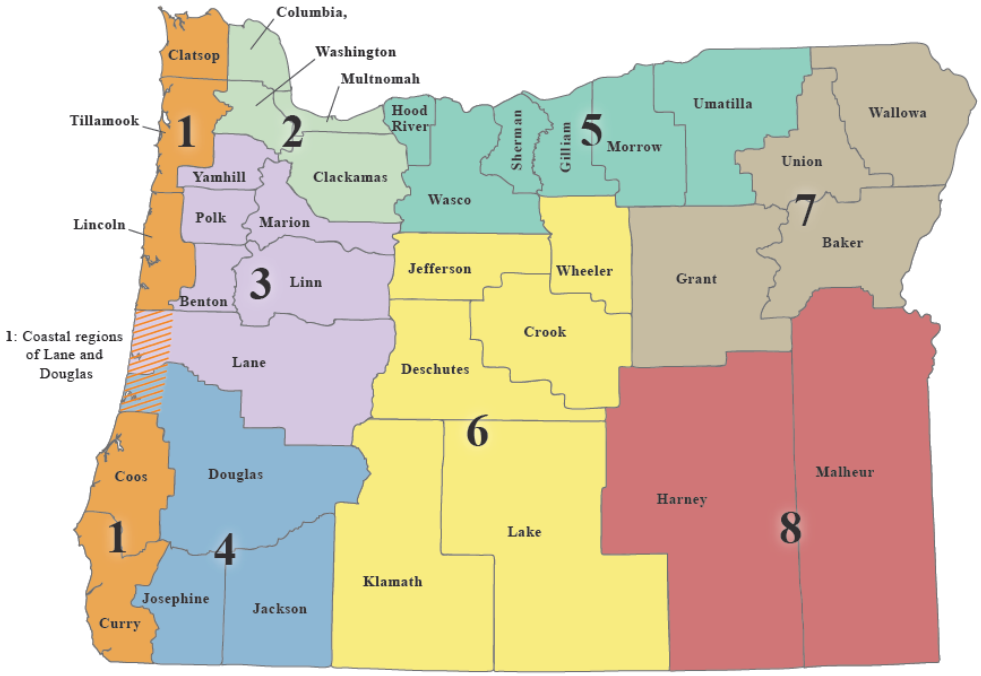
Figure 2-2. Oregon NHMP Natural Hazards Regions



2.3 Regional Risk Assessments

The purpose of the Regional Risk Assessment is to assess risks at a regional scale by profiling the characteristics, natural hazards, and vulnerabilities within the eight Oregon NHMP Natural Hazard Regions (Figure 2-81). Each region has its own Risk Assessment. Together, the eight Regional Risk Assessments combine to describe the State's overall risk to natural hazards.

Figure 2-81. Oregon NHMP Natural Hazards Regions



Each Regional Risk Assessment includes three sections:

1. The **Summary** provides a general overview of (a) the Regional Profile, (b) the Regional Hazards and Vulnerability, and (c) how climate change models predict hazards in the region will be impacted based on statewide data.
2. The **Profile** section provides an overview of the region's unique characteristics including profiles of the natural environment, social and demographic situation, economic environment, infrastructure, and built environment.

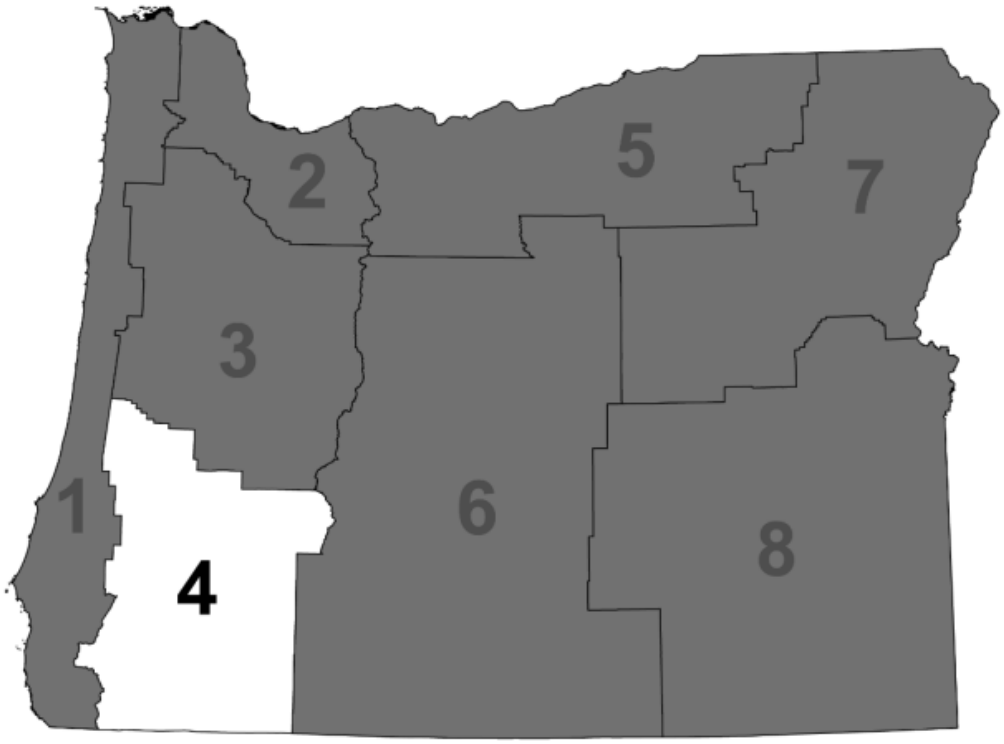
   The research of Susan Cutter, Professor of Geography at the University of South Carolina, Columbia, on vulnerability and environmental hazards provides the framework for discussion of vulnerability in the Regional Profile section. Cutter's framework helps to illustrate the geographic variability of vulnerability and allows policy makers to better understand how to prepare for, mitigate, and reduce vulnerability (Cutter et al., 2003; Cutter, 2006).

3. The **Hazards and Vulnerability** section first identifies each hazard and its characteristics in the region. Then, the historical events that have impacted the region are listed. Lastly, probabilities and vulnerabilities are discussed as identified by local and state risk assessments. Vulnerabilities to and potential impacts from each hazard in the region are described including the identification and analysis of the region's State owned/leased facilities and critical/essential facilities located within hazard zones and seismic lifeline vulnerabilities.

Regional Risk Assessments add to the current body of literature and technical resource guides available to Oregon communities. The three levels of government — federal, state, and local — will find the Regional Risk Assessments useful when assessing natural hazards and vulnerabilities and when planning mitigation activities. Local governments can use the Regional Risk Assessments in the development of their jurisdiction's natural hazards mitigation plan. Information from these assessments is intended to be used as a springboard for more detailed community profiles. Likewise, information from local plans helps to inform the Oregon NHMP risk assessment overall.

2.3.4 Region 4: Southwest Oregon

*Douglas (non-coastal), Jackson, and Josephine Counties



*Note: The coastal portion of Douglas County is within Region 1. Where data are available for the coastal areas of Douglas County, the data are provided within the Region 1 profile; otherwise, countywide datasets are reported in this profile.

2.3.4.1 Summary

Regional Profile

The region's demographic, economic, infrastructure and development patterns indicate that some populations, structures and places may be more vulnerable to certain natural hazards than others. Mitigation efforts directed at these vulnerabilities may help boost the area's ability to bounce back after a natural disaster.

Social vulnerability across the region is driven by low median household incomes and a high proportion of senior citizens. There are several indicators of vulnerability at the county level, including: high numbers of tourists in Jackson County; a large share of seniors with disabilities in Douglas County; homelessness on the rise in Jackson and Josephine Counties; fewer college degrees in Douglas and Josephine Counties; and increases in poverty in Douglas and Jackson Counties.

Region 4 was hit particularly hard by the financial crisis that began in 2007 and continues to suffer from significantly low job recovery rates and below average wages. There are few key industries and employment sectors in Southwest Oregon. The area is particularly vulnerable during winter months when there are fewer employment opportunities.

Transportation networks across the state are vulnerable to seismic events. Following a CSZ earthquake, access along I-5 may be limited due to bridge collapse. Roughly 18% of the state-owned bridges in Southwest Oregon are distressed.

Energy facilities and conveyance systems in the region help support the regional economy and are vulnerable to damage and service disruptions due to natural hazard events. The region has multiple dams, hydroelectric and biomass power-generation facilities that service the state. Of the state-owned dams in the region, 28 have High Threat Potential and 42 have Significant Threat Potential. Natural gas pipelines run through Josephine and Douglas Counties and are vulnerable to seismic activity.

Older centralized water infrastructure is vulnerable to pollution and flooding, which can have implications for public health and water quality. During high-water events, the region's drinking water is vulnerable to high levels of pollutants entering waterways through combined sewer overflows (CSOs). Medford is the only city in the region that requires low impact development (LID) stormwater mitigation strategies in its development code.

Region 4 is developing at about half the rate of the state. The majority of growth is occurring in cities along I-5, particularly within Jackson County. Mobile homes comprise significant share of housing units and are inherently vulnerable to natural hazards. Roughly two thirds of homes in this region were built prior to current seismic building standards, making them especially vulnerable.

Hazards and Vulnerability

Region 4 is affected by eight of the state's 11 natural hazards. Coastal hazards, dust storms, and tsunamis do not directly impact this region.

Droughts: Droughts can affect commerce, agriculture, fisheries, and overall quality of life in all three counties. Jackson and Josephine Counties were declared federal primary natural disaster areas by the U.S. Department of Agriculture in 2013.

Earthquakes: Four types of earthquakes affect Region 4 (a)shallow crustal events, (b) deep intra-plate events within the subducting Juan de Fuca plate, (c) the offshore Cascadia Subduction Zone (CSZ) Fault, and (d) earthquakes associated with renewed volcanic activity. The CSZ is the chief earthquake hazard for Southwest Oregon. The region is particularly vulnerable due to the large area susceptible to earthquake-induced landslide, liquefaction, and ground shaking. In a 500-year model for a CSZ event or combined crustal events, all three of the region's counties rank among the top 15 counties with the highest expected earthquake damages and losses. The state's seismic lifelines along Interstate-5 and east-west routes that connect the region to the rest of the state are highly vulnerable to seismic events. There are 434 state-owned/leased facilities, valued at over $164.4 million, within this region's earthquake hazard zone. Of these, 34 are critical/essential facilities. An additional 1,069 non-state-owned/leased critical/essential facilities are also located within this hazard zone.

Floods: Floods affect Southwest Oregon in the form of riverine flooding often preceded by rapid snow melt and heavy rain. All of the region's counties are considered moderately vulnerable to flooding. There are 18 repetitive flood loss properties in Region 4. There are 102 state-owned/leased facilities, valued at approximately $45.4 million, located in the region's flood hazard zone. Of these, four are considered critical/essential facilities. An additional 80 non-state-owned/leased critical/essential facilities are also located in this hazard zone.

Landslides: Landslides can occur throughout the region, though more tend to occur in areas with steeper slopes, weaker geology, and higher annual precipitation. Rain-induced landslides can occur during winter months. Earthquakes can trigger landslides in the region. Vulnerability is increased in populated areas – such as in the Cities of Ashland and Medford – and in the Klamath Mountains. There are 434 state-owned/leased facilities, valued at over $164.4 million, located in this hazard zone in Region 4. Of these, 34 are critical/essential facilities. An additional 1,069 non-state-owned/leased critical/essential facilities are also located within this hazard zone.

Volcanoes: Volcanic activity may occur within the eastern areas of the region's counties that coincide with the crest of the Cascade mountain range. Particular areas of vulnerability include Crater Lake, upper reaches of the Umpqua and Clearwater Rivers, and the OR-62 corridor. Most volcanic activity is considered local. However, lahars and ashfall can travel many miles and small mountain communities, dams, reservoirs, energy-generating facilities, and highways may be vulnerable. There are no state-owned/leased facilities and no critical/essential facilities located in a volcanic hazard zone within Region 4.

Wildfires: In Southwest Oregon the combination of proximity of communities to wildland areas; high summer temperatures; rugged terrain; and likelihood of summer thunderstorm activity contribute to the region's vulnerability to wildfire. Wildfires are most common during the late

summer. Based on data from the 2013 West Wide Wildfire Risk Assessment, in Region 4 Douglas and Jackson Counties have a high percentage of wildland acres in the Fire Risk, Wildland Development Areas, Fire Effects, or Fire Threat categories, making them especially vulnerable. Other areas of vulnerability are within wildland-urban interface communities. There are 198 state-owned/leased facilities located in this region's wildfire hazard zone, with a value of approximately $44 million. Of these, 11 are identified as critical/essential facilities. An additional 408 non-state-owned/leased critical/essential facilities are also located in this hazard zone.

Windstorms: Windstorms can occur when Pacific Ocean winds travel inland in a northeasterly direction. These storms generally impact the region's buildings, utilities, tree-lined roads, transmission lines, residential parcels, and transportation systems along open areas such as grasslands and farmland.

Winter Storms: Cold weather and high precipitation impact the region annually. Severe winter storms can shut down the I-5 corridor passage through the Siskiyou Mountains, which can adversely impact the economy regionally and statewide.

Climate Change

The most reliable information on climate change to date is at the state level. The state information indicates that hazards projected to be impacted by climate change in Region 4 include drought, wildfire, flooding, and landslides. Climate models project warmer drier summers and a decline in mean summer precipitation for Oregon. Coupled with projected decreases in mountain snowpack due to warmer winter temperatures, all eight regions are expected to be affected by increased incidences of drought and wildfire. In addition, flooding and landslides are projected to occur more frequently throughout western Oregon. An increase in extreme precipitation is projected for some areas in Region 4 and could result in a greater risk of flooding characterized by increased magnitude and shorter return intervals in certain basins. Landslides in Oregon are strongly correlated with rainfall, so increased rainfall — particularly extreme events — will likely trigger more landslides. While winter storms and windstorms affect Region 4, there is little research on how climate change influences these hazards in the Pacific Northwest. For more information on climate drivers and the projected impacts of climate change in Oregon, see the section **Introduction to Climate Change**.

2.3.4.2 Profile

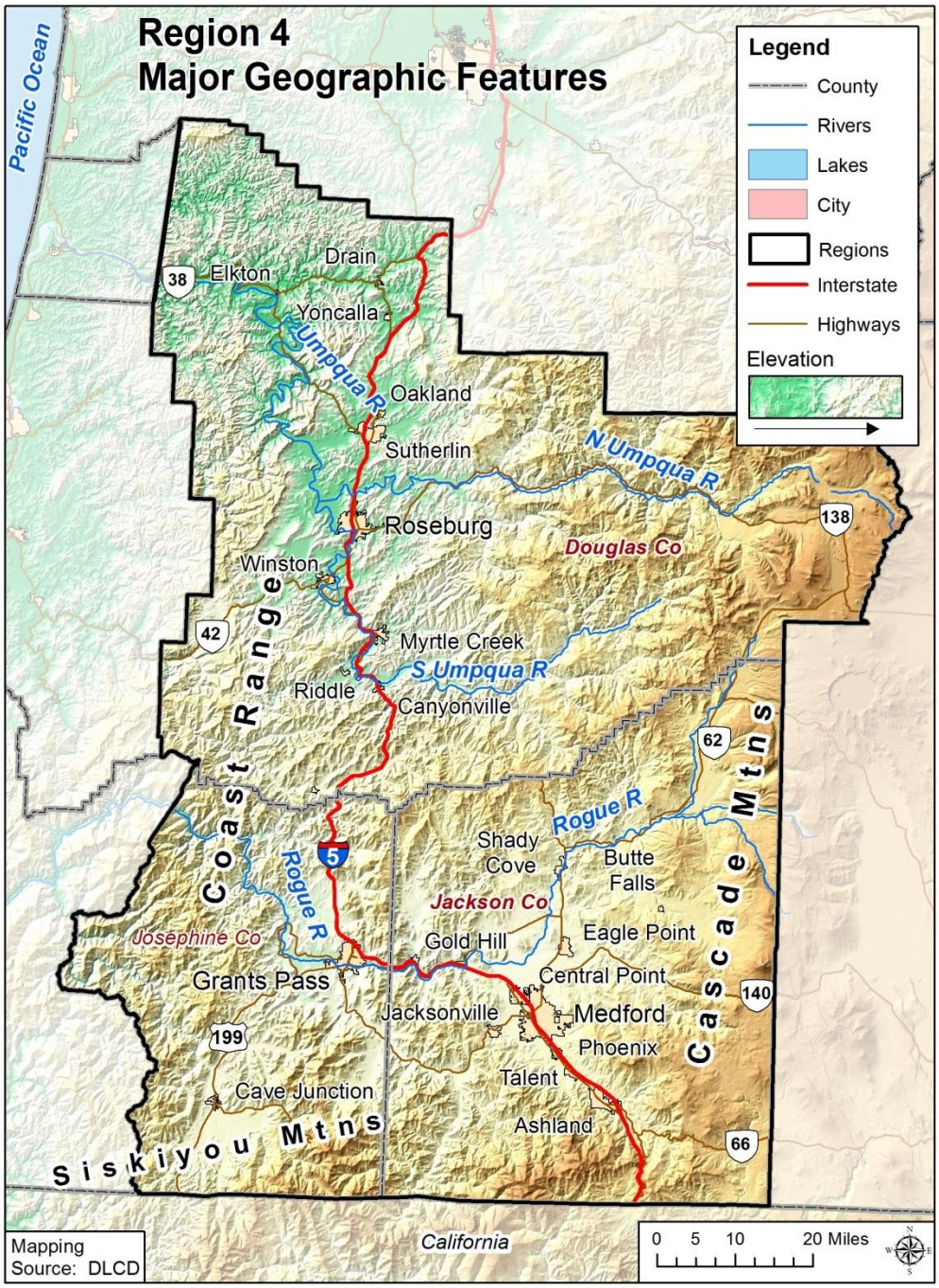
Requirement: 44 CFR §201.4(d): The Plan must be reviewed and revised to reflect changes in development…

Natural Environment

Geography

Southwestern Oregon is approximately 9,461 square miles in size, and includes Douglas (non-coastal), Jackson, and Josephine Counties. Mountain ranges and watersheds shape the region's topography. Region 4 begins at the Cascades in the east, and extends to the Klamath Mountains and Coast Range in the west. It extends from the Rogue-Umpqua Divide in the North to the Siskiyou Mountains at the California border in the south. Three rivers shape the region's main watersheds: the Umpqua River, the Rogue River, and the Illinois River (Downing, 2012).

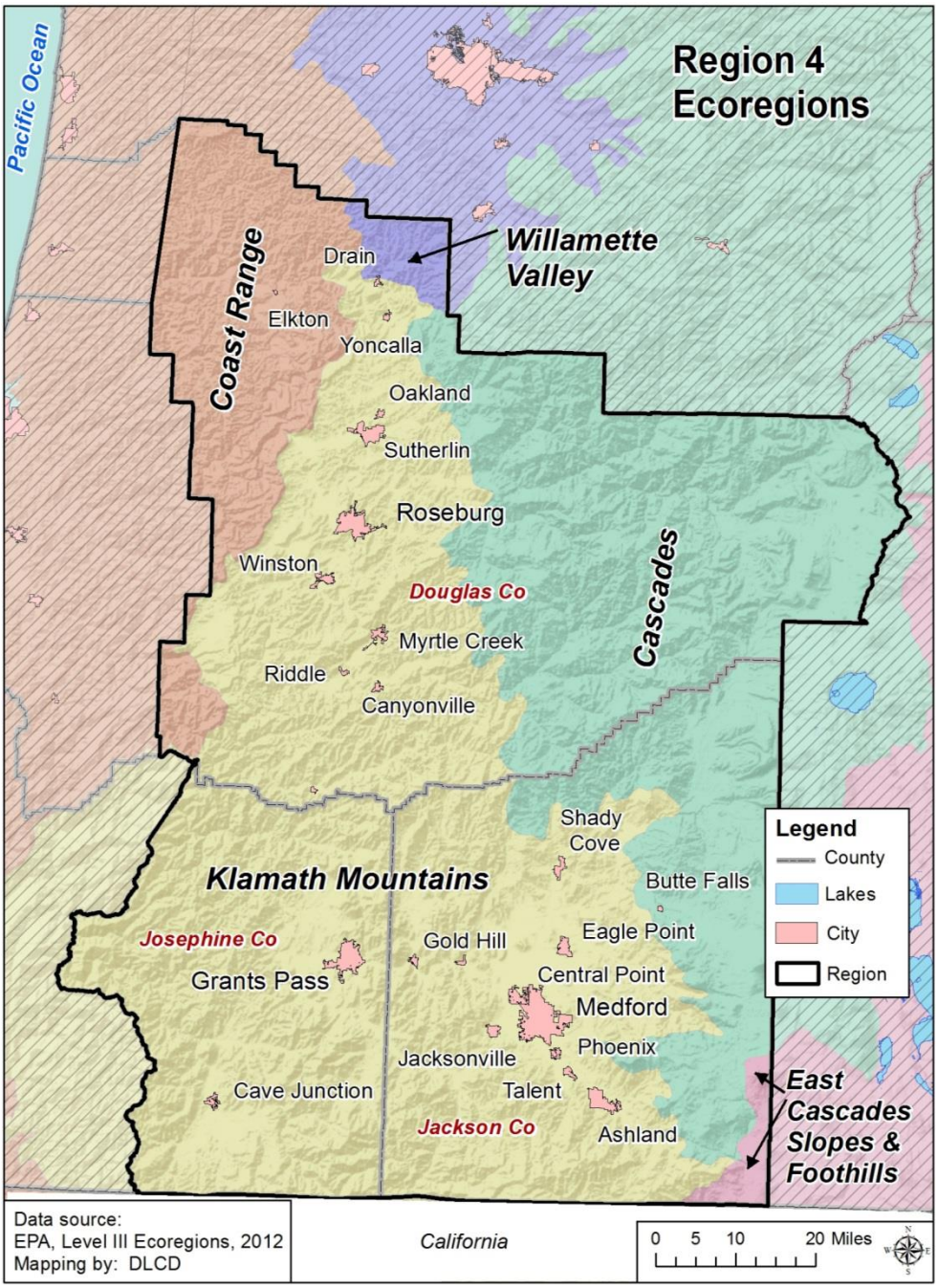
Figure 2-139. Region 4 Major Geographic Features



Source: Department of Land Conservation and Development, 2014

The U.S. EPA's ecoregions are used to describe areas of ecosystem similarity. Region 4 is composed of three ecoregions: the Cascades, the Klamath Mountains, and the Coast Range (Figure 2-140).

Figure 2-140. Region 4 Ecoregions



Cascades: This ecoregion is underlain by volcanic soils. Naturally occurring mixed conifer forests have given way to predominantly Douglas fir forests that are managed for commercial logging. Logging activities have put a strain on the ecological health of streams in the area (Ecoregions of Oregon, http://www.epa.gov/wed). Waterways in the steeper valleys support threatened cold-

water salmonids including Chinook salmon, steelhead, and bull trout. Streams, lakes, reservoirs, rivers, and glacial lakes at higher elevations are key sources of water (Ecoregions of Oregon, http://www.epa.gov/wed).

Coast Range: The east slope of the Coast Range is located within Region 4. Sedimentary soils in this ecoregion are prone to failure following clearcuts, which may be of concern as the commercial Douglas fir forests located here are highly productive commercial logging areas. Landslides can impact the safety of nearby infrastructure and health of the region's waterways. The ecoregion's sedimentary soils can create more concerns for stream sedimentation than areas with volcanic soils (Ecoregions of Oregon, http://www.epa.gov/wed).

Klamath Mountains: A mixture of conifer and hardwood forests covers the Klamath Mountains ecoregion. A mosaic of soil types including sedimentary, granitic, metamorphic, and extrusive rocks underlies these forests. More extensive areas of hardwood and broadleaf evergreen canopies are evident in this ecoregion than in the Cascade Mountains ecoregion. Oregon white oak savannahs and woodlands, both habitat types that have been threatened by Douglas fir encroachment and human development, are present in foothills areas. This ecoregion has a dry, Mediterranean climate, which is prone to long summer droughts. The ecoregion's water quality and habitat continue to be negatively impacted by mine tailings (Ecoregions of Oregon, http://www.epa.gov/wed).

Climate

Climate refers to the temperatures, weather patterns, and precipitation in the region. This section covers historic climate information only. For estimated future climate conditions and possible impacts refer to the **State Risk Assessment** for statewide projections.

Region 4's diverse ecoregions have varying climatic conditions. Precipitation generally occurs in the winter months. Wet winters and dry summers influence risk to droughts, floods, landslides, wildfires, and winter storms. When considering the climate, snowfall should also be taken into account. Flooding can be a direct result of rain-on-snow events. Likewise, the amount of snowpack in a region can also impact the ability of communities to cope with drought. **Table 2-237** shows mean annual precipitation and temperatures for the three ecoregions in Region 4 (Ecoregions of Oregon, http://www.epa.gov/wed). Variations in temperature and precipitation vary widely by sub-ecoregion and microclimates. For more detailed and locally relevant climate data refer to the Oregon Climate Service.

Table 2-237. Average Precipitation and Temperature Ranges in Region 4 Ecoregions

Ecoregion	Mean Annual Precipitation Range (inches)	Mean Temperature Range (°F) January min/max	Mean Temperature Range (°F) July min/max
Cascades*	45–140	16/45	38/85
Klamath Mountains*	20–130	24/50	49/89
Coast Range	60–130	32/48	48/78
Willamette Valley	45–60	32/46	50/80
Eastern Cascades slopes and foothills	25–40	20/34	47/82

*Data have been generalized from all the sub-ecoregions of the ecoregion in Region 4.

Source: Thorson et al. (2003)

Demography

Population

Population forecasts are an indicator of future development needs and trends. Community demographics may indicate where specific vulnerabilities may be present in the aftermath of a natural hazard (Cutter et al., 2003). If a population is forecast to increase substantially, a community's capacity to provide adequate housing stock, services, or resources for all populations after a disaster may be stressed or compromised.

From 2000 to 2013 Region 4 as a whole has grown 3.1% less than the state overall. Jackson County has grown the most. By 2020, counties in Region 4 are projected to grow at about the same rate as the state overall.

Table 2-238. Population Estimate and Forecast for Region 4

Ecoregion	Mean Annual Rainfall (inches)	Mean Temperature (°F) January min/max	Mean Temperature (°F) July min/max
Cascades*	45-120	26/45	44/85
Klamath Mountains*	25-70	28/49	50/87
Coast Range	60-130	32/48	48/78

Source: Population Research Center, Portland State University, 2013; U.S. Census Bureau, 2010 Decennial Census. Table DP-1; Office of Economic Analysis, Long-Term Oregon State's County Population Forecast, 2010-2050, 2013

Tourists

Tourists are not counted in population statistics; and are therefore considered separately in this analysis. Tourism activities in Region 4 are largely centered on touring (traveling to experience scenic beauty, history, and culture), special events, and outdoor activities (Longwoods Travel USA, 2011b). The average travel party contains 3.1 persons and 68% of their trips originate from Oregon or California. In this region, the average trip length is 4.2 nights (Longwoods Travel USA, 2011b). More than half the tourists in this region visit Jackson County. In 2013, most visitors in Region 4 lodged in private homes.

Difficulty locating or accounting for travelers increases their vulnerability in the event of a natural disaster. Furthermore, tourists are often unfamiliar with evacuation routes, communication outlets, or even the type of hazard that may occur (MDC Consultants, n.d.). Targeting natural hazard mitigation outreach efforts to places where tourists lodge can help increase awareness and minimize the vulnerability of this population.

Table 2-239. Annual Visitor Estimates in Person Nights in Region 4

	2011		2012		2013	
	Number	Percent	Number	Percent	Number	Percent
Region 4	8,860	—	9,088	—	9,348	—
Douglas	2,321	100%	2,341	100%	2,394	100%
Hotel/Motel	534	23.0%	533	22.8%	553	23.1%
Private Home	1,083	46.7%	1,091	46.6%	1,112	46.4%
Other	704	30.3%	717	30.6%	729	30.5%
Jackson	4,788	100%	4,952	100%	5,102	100%
Hotel/Motel	1,449	30.3%	1,517	30.6%	1,613	31.6%
Private Home	2,580	53.9%	2,665	53.8%	2,706	53.0%
Other	759	15.9%	770	15.5%	783	15.3%
Josephine	1,751	100%	1,795	100%	1,852	100%
Hotel/Motel	435	24.8%	448	25.0%	483	26.1%
Private Home	1,041	59.5%	1,066	59.4%	1,084	58.5%
Other	275	15.7%	281	15.7%	285	15.4%

Source: Dean Runyan Associates (2014)

Persons with Disabilities

Disabilities appear in many forms. While some disabilities may be easily identified, others may be less perceptible. Disabled populations, while difficult to identify and measure, are disproportionately affected during disasters (Cutter et al., 2003). About 4% more people in Region 4 identify as having a disability than do people throughout the state. Most people reporting a disability in Region 4 reside in Douglas County — over 20% of its population. About 43% of Douglas County's seniors (65 and older) are disabled. Local natural hazard mitigation plans should specifically target outreach programs toward helping disabled residents better prepare for and recover from hazard events.

Table 2-240. People with a Disability by Age Groups in Region 4, 2012

	Total Population*	With a Disability (Total Population)		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 4	390,890	68,927	17.6%	4,429	5.3%	30,069	39.5%
Douglas	106,680	22,852	21.4%	1,531	7.0%	9,710	43.3%
Jackson	202,450	32,259	15.9%	2,333	5.3%	13,651	38.2%
Josephine	81,760	13,816	16.9%	565	3.4%	6,708	37.2%

*Total population does not include institutionalized population.

**Percent of age group.

Source: U.S. Census Bureau, 2008–2012 American Community Survey 5-Year Estimates, Table DP02

Homeless Population

Population estimates of the homeless in Oregon are performed each January. These are rough estimates and can fluctuate with many factors, including the economy or season. The overwhelming majority of homeless are either single adult males or families with children. Communities located along major transportation corridors, such as I-5, tend to have higher concentrations of homeless people (Thomas et al., 2008). Over the 3-year period between 2009 and 2011 the homeless population has been gradually increasing in Jackson and Josephine Counties.

Extra attention is needed to care for and serve homeless communities. Some homeless people choose to remain hidden or anonymous, making it especially difficult to mitigate harm to them from natural hazard events. Accessible shelter and social services are key emergency considerations for the homeless community.

Table 2-241. Homeless Population Estimate for Region 4

	2000	2013	Percent Change (2000 to 2013)	2020 Projected	Percent Change (2013 to 2020)
Oregon	3,421,399	3,919,020	14.5%	4,252,100	8.5%
Region 4	357,394	397,975	11.4%	430,346	8.1%
Douglas	100,399	108,850	8.4%	116,113	6.7%
Jackson	181,269	206,310	13.8%	223,458	8.3%
Josephine	75,726	82,815	9.4%	90,776	9.6%

Source: Oregon Point in Time Homeless Count, Oregon Housing and Community Services
http://www.oregon.gov/ohcs/pages/ra_point_in_time_homeless_count.aspx

Gender

The gender breakdown in Region 4 (roughly 50:50) is similar to that of the state (U.S. Census Bureau, n.d.). It is important to recognize that women tend to have more institutionalized obstacles than men during recovery due to sector-specific employment, lower wages, and family care responsibilities (Cutter et al., 2003).

Age

Region 4 has a 5.5% greater share of seniors than the state average. Senior citizens may require special consideration due to sensitivity to heat and cold, reliance upon transportation to obtain medication, and comparative difficulty in making home modifications that reduce risk to hazards. In addition, the elderly may be reluctant to leave home in a disaster event. This implies the need for targeted preparatory programming that includes evacuation procedures and shelter locations accessible to the elderly (Morrow, 1999).

The percentage of children is slightly lower than the statewide average. Special considerations should be given to young children, schools, and parents during the natural hazard mitigation process. Young children are more vulnerable to heat and cold, have fewer transportation options, and require assistance to access medical facilities. Parents may lose time from work and money when their children's childcare facilities and schools are impacted by disasters (Cutter et al., 2003).

Table 2-242. Population by Vulnerable Age Groups, in Region 4, 2012

	Total Population	Under 18 Years Old		65 Years and Older	
	Estimate	Estimate	Percent	Estimate	Percent
Oregon	3,836,628	864,243	22.5%	540,527	14.1%
Region 4	393,640	83,166	21.1%	77,314	19.6%
Douglas	107,391	21,870	20.4%	22,733	21.2%
Jackson	203,613	44,437	21.8%	36,177	17.8%
Josephine	82,636	16,859	20.4%	18,404	22.3%

Source: U.S. Census Bureau, 2008–2012 American Community Survey 5-Year Estimates, Table DP05

Language

A majority of the region's population speaks English very well. Conversely, compared to state numbers, roughly 3–5% more of the region's population does not speak English very well. Hazard mitigation outreach materials used to communicate with and plan for this community should take into consideration their language needs.

Table 2-243. English Usage in Region 4, 2012

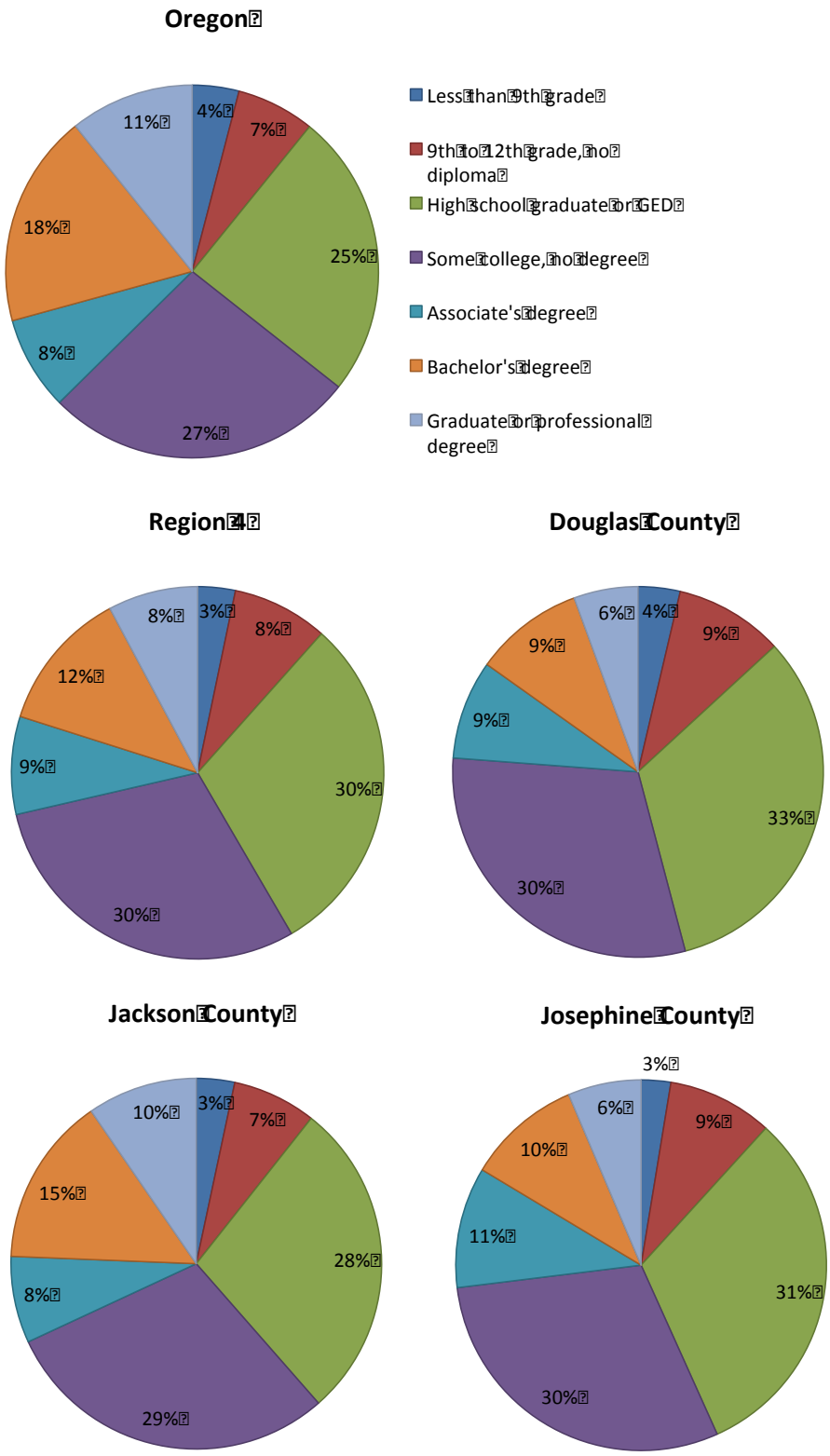
	Speak English "Very Well"		Speak English Less Than "Very Well"	
	Estimate	Percent	Estimate	Percent
Oregon	3,376,744	93.8%	224,905	6.2%
Region 4	362,946	97.6%	9,058	2.4%
Douglas	100,869	99.0%	1,037	1.0%
Jackson	184,577	96.3%	7,095	3.7%
Josephine	77,500	98.8%	926	1.2%

Source: U.S. Census Bureau, 2008–2012 American Community Survey 5-Year Estimates, Table DP02

Education Level

Studies (Cutter et al., 2003) show that education and socioeconomic status are deeply intertwined, with higher educational attainment correlating to increased lifetime earnings. Furthermore, education can influence a person's and community's ability to understand warning information and to access resources before and after a natural disaster. In Southwestern Oregon, 5% more of the population has a high school degree or GED compared to state percentages. In Josephine and Douglas Counties, the share of bachelor's degrees is roughly 8% lower than the state average. Five percent fewer persons have a graduate or professional degree than the state average.

Figure 2-141. Educational Attainment in Region 4, 2012



Source: U.S. Census Bureau, 2008–2012 American Community Survey 5-Year Estimates, Table DP02

Income

The impact of a disaster in terms of loss and the ability to recover varies among population groups. “The causes of social vulnerability are explained by the underlying social conditions that are often quite remote from the initiating hazard or disaster event” (Cutter, 2006, p. 76). Historically, 80% of the disaster burden falls on the public. Of this number, a disproportionate burden is placed upon those living in poverty. People living in poverty are more likely to be isolated, are less likely to have the savings to rebuild after a disaster, and are less likely to have access to transportation and medical care.

The financial crisis that began in 2007 significantly affected Region 4. Across the region, median household incomes were below statewide numbers in 2009 and dropped roughly 8% by 2012. About 7% of households in Southwest Oregon earn less than $35,000 per year. Jackson County has the highest percent of its households earning more than $75,000 per year.

Table 2-244. Median Household Income in Region 4

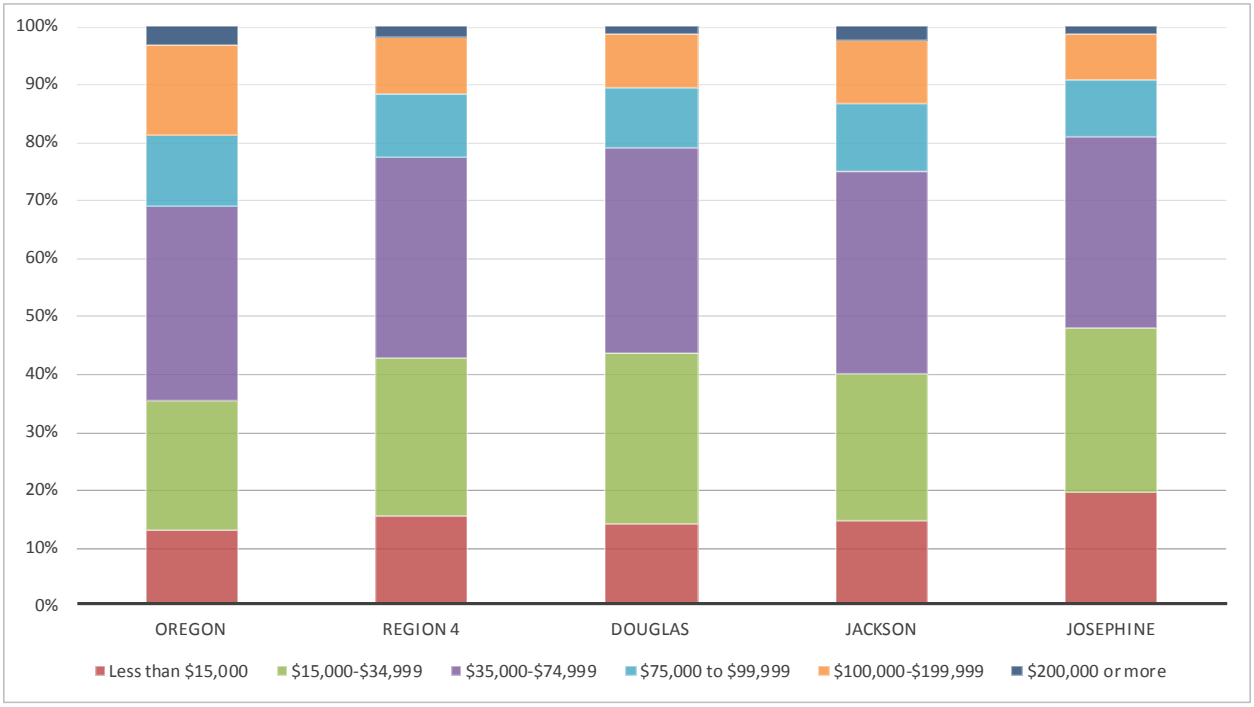
	2009	2012	Percent Change
Oregon	$52,474	$50,036	-4.6%
Region 4	N/A	N/A	N/A
Douglas	$43,154	$40,096	-7.1%
Jackson	$47,773	$43,664	-8.6%
Josephine	$40,085	$36,699	-8.4%

Note: 2009 dollars are adjusted for 2012 using Bureau of Labor Statistics’ Consumer Price Index Inflation Calculator.

N/A = data not aggregated at the regional level.

Source: U.S. Census Bureau. 2005–2009 and 2008–2012. American Community Survey – 5-Year Estimates. Table DP03.

Figure 2-142. Median Household Income Distribution in Region 4, 2012



Source: U.S. Census Bureau, 2008–2012 American Community Survey 5-Year Estimates, Table DP03

Since 2009, about 7% more of the region's population has entered into poverty. Josephine County has the highest percentage of its population living in poverty — 20% of individuals and close to 31% of its children. Notably, Douglas County saw an increase in overall poverty of roughly 35%, and an almost 40% increase among its children.

Table 2-245. Poverty Rates in Region 4, 2012

	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 4	68,524	17.6%	24.4%	21,063	25.7%	23.9%
Douglas	18,877	17.8%	34.5%	5,956	27.7%	39.5%
Jackson	33,346	16.6%	22.5%	10,032	22.9%	22.0%
Josephine	16,301	20.0%	18.0%	5,075	30.8%	12.6%

*Percent change since 2009

Source: U.S. Census Bureau. 2005–2009 and 2008–2012. American Community Survey – 5-Year Estimates, Table S1701

Low-income populations require special consideration when mitigating loss to a natural hazard. Often, those who earn less have little to no savings and other assets to withstand economic setbacks. When a natural disaster interrupts work, the ability to provide housing, food, and basic necessities becomes increasingly difficult. In addition, low-income populations are hit especially

hard as public transportation, public food assistance, public housing, and other public programs upon which they rely for day-to-day activities are often impacted in the aftermath of the natural disaster. To reduce the compounded loss incurred by low-income populations post-disaster, mitigation actions need to be specially tailored to ensure safety nets are in place to provide further support to those with fewer personal resources (Cutter et al., 2003).

Housing Tenure

Wealth can increase the ability to recover following a natural disaster (Cutter et al., 2003), and homeownership, versus renting, is often linked to having more wealth. Renters often do not have personal financial resources or insurance to help recover post-disaster. On the other hand, renters tend to be more mobile and have fewer assets at risk. In the most extreme cases, renters lack sufficient shelter options when lodging becomes uninhabitable or unaffordable due to natural disaster events.

Collectively, counties in Region 4 have a slightly greater home-ownership rate compared to the state overall. Douglas County has the highest share of its households being owner occupied. Jackson County has the greatest percent of its population renting. Douglas County has the greatest percentage of vacant properties. Compared to the state overall, there is a smaller share of seasonal and recreational homes in Southwest Oregon (U.S. Census Bureau, 2008–2012 American Community Survey, Table DP04 and Table B25004).

Table 2-246. Housing Tenure in Region 4, 2012

	Total 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 4	161,421	104,869	65.0%	56,552	35.0%	12,416	7.0%
Douglas	43,678	30,362	69.5%	13,316	30.5%	4,258	8.7%
Jackson	83,370	51,646	61.9%	31,724	38.1%	5,534	6.1%
Josephine	34,373	22,861	66.5%	11,512	33.5%	2,624	6.9%

^ = Functional vacant units, computed after removing seasonal, recreational, or occasional housing units from vacant housing units.

Source: U.S. Census Bureau, 2008–2012 American Community Survey, 5-Year Estimates, Table DP04 and Table B25004.

Families and Living Arrangements

Family care and obligations can create additional hardship during post-disaster recovery, especially for single-parent households. Region 4 is predominantly composed of family households. All three counties have a lower share of family households with children compared to the state.

Table 2-247. Family vs. Non-family Households in Region 4, 2012

	Total Households	Family Households		Nonfamily Households		Householder Living Alone	
	Estimate	Estimate	Percent	Estimate	Percent	Estimate	Percent
Oregon	1,512,718	964,274	63.7%	548,444	36.3%	421,620	27.9%
Region 4	161,421	105,456	65.3%	55,965	34.7%	45,352	28.1%
Douglas	43,678	29,279	67.0%	14,399	33.0%	11,609	26.6%
Jackson	83,370	53,966	64.7%	29,404	35.3%	23,426	28.1%
Josephine	34,373	22,211	64.6%	12,162	35.4%	10,317	30.0%

Source: U.S. Census Bureau, 2008–2012 American Community Survey, 5-Year Estimates, Table DP04

Table 2-248. Family Households with Children by Head of Household in Region 4, 2012

	Family Households with Children		Single Parent (Male)		Single Parent (Female)		Married Couple with Children	
	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent
Oregon	415,538	27.5%	35,855	2.4%	93,575	6.2%	286,108	18.9%
Region 4	38,994	24.2%	4,285	2.7%	10,089	6.3%	24,620	15.3%
Douglas	9,556	21.9%	939	2.1%	2,619	6.0%	5,998	13.7%
Jackson	21,617	25.9%	2,241	2.7%	5,579	6.7%	13,797	16.5%
Josephine	7,821	22.8%	1,105	3.2%	1,891	5.5%	4,825	14.0%

Note: The table shows the percent of total households represented by each family household structure category.

Source: U.S. Census Bureau, 2008–2012 American Community Survey 5-Year Estimates, Table DP04

Social and Demographic Trends

The social and demographic analysis shows that Region 4 is particularly vulnerable during a hazard event in the following categories:

- High numbers of tourists visit Jackson County.
- A high percentage of the senior population in Douglas County has a disability.
- The homeless population in Jackson and Josephine Counties is increasing.
- The region has a higher share of seniors than the state overall.
- In each county 3–5% more of the population does not speak English very well.
- A smaller share of the population has a college degree, especially in Douglas and Josephine Counties.
- Median household incomes are significantly lower than the state's.
- There has been a greater increase in the share of population living in poverty, including children, in Douglas and Jackson Counties, than in the state overall.

Economy

Economic characteristics include the financial resources present and revenue generated in the community to achieve a higher quality of life. Employment characteristics, income equality, employment, and industry sectors 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 employment sectors, workforce, resources, and infrastructure are interconnected in the existing economic picture.

Employment

Employment status and salary level may impact the resilience of individuals and families in the face of disasters as well as their ability to mitigate for natural hazards (Cutter et al., 2003). Since the end of the financial crisis that began in 2007, job recovery in Region 4 has lagged behind state's average. As of May 2013 Douglas County has recovered only 17% of jobs lost in the recession while 65% of jobs statewide have been recovered. Similarly, job recovery in Jackson County has occurred disproportionately in low-wage jobs. Regionally, unemployment rates have been declining steadily since 2009, but remain 2.4% higher than statewide averages. Jackson County has the largest labor force in the region and the lowest unemployment rate. Notably, average salaries in Southwest Oregon are 18% to 29% lower than the statewide average.

Table 2-249. Unemployment Rates in Region 4 2009-2013

	2009	2010	2011	2012	2013	Change (2009-2013)
Oregon	11.1%	10.8%	9.7%	8.8%	7.7%	-3.4%
Region 4	13.7%	13.4%	12.4%	11.5%	10.1%	-3.6%
Douglas	15.5%	14.7%	13.4%	12.3%	10.8%	-4.6%
Jackson	12.6%	12.6%	11.8%	11.0%	9.5%	-3.1%
Josephine	14.3%	14.2%	12.8%	12.1%	10.9%	-3.4%

Source: Oregon Employment Department, 2014

"The potential loss of employment following a disaster exacerbates the number of unemployed workers in a community, contributing to a slower recovery from the disaster" (Cutter et al., 2003). Retail trade and tourism employment ebb and flow seasonally. The winter months tend to see the lowest employment rates due to less tourism and fewer employment opportunities in outdoor industries such as construction and agriculture (Tauer, 2014). Therefore, during winter months the region's economic vulnerability to a hazard event is heightened.

Table 2-250. Employment and Unemployment Rates in Region 4, 2013

	Civilian Labor Force	Employed Workers		Unemployed	
	Total	Total	Percent	Total	Percent
Oregon	1,924,604	1,775,890	92.3%	148,714	7.7%
Region 4	173,595	156,059	89.9%	17,536	10.1%
Douglas	43,207	38,531	89.2%	4,676	10.8%
Jackson	97,698	88,405	90.5%	9,293	9.5%
Josephine	32,690	29,123	89.1%	3,567	10.9%

Source: Oregon Employment Department, 2014

Table 2-251. Employment and Payroll in Region 4, 2013

	Employees	Average Pay	Percent State Average
Oregon	1,679,364	$45,010	100%
Region 4	135,543	$35,647	79.2%
Douglas	34,651	$35,382	78.6%
Jackson	78,171	$36,873	81.9%
Josephine	22,721	$31,831	70.7%

Source: Oregon Employment Department, 2014

Employment Sectors and Key Industries

In 2012 the five major employment sectors in Region 4 were: (a) Trade, Transportation, and Utilities; (b) Government; (c) Education and Health Services; (d) Leisure and Hospitality; and (e) Manufacturing. **Table 2-252** shows the distribution of total employment across all sectors. Wood products have historically been the main industry within the manufacturing sector in Region 4. In recent years, however, employment in wood products manufacturing has declined, and there has been an increase in food products manufacturing in Jackson and Josephine Counties (Oregon Employment Department, 2012; Employment Projections by Industry and Occupation: 2010–2020 Oregon and Regional Summary, retrieved Feb 19, 2014 from http://www.qualityinfo.org). Lumber and wood products continue to be one of the largest employment sectors in Douglas County, employing 10% of the private sector. Douglas County contains nearly 2.8 million acres in commercial forestland and is the second largest producer of timber in the state (Oregon Employment Department, n.d., Region 6 overview, retrieved Feb. 19, 2014, from http://www.qualityinfo.org/).

Table 2-252. Covered Employment by Sector in Region 4, 2013

		Douglas County		Jackson County		Josephine County	
Industry	**Region 4**	**Employment**	**Percent**	**Employment**	**Percent**	**Employment**	**Percent**
Total All Ownerships	135,546	34,651	100%	78,171	100%	22,724	100%
Total Private Coverage	113,739	26,920	77.7%	67,111	85.9%	19,708	86.7%
Natural Resources & Mining	4,309	1,635	4.7%	2,257	2.9%	417	1.8%
Construction	4,855	1,026	3.0%	3,092	4.0%	737	3.2%
Manufacturing	13,866	4,401	12.7%	7,052	9.0%	2,413	10.6%
Trade, Transportation & Utilities	28,735	6,289	18.1%	17,505	22.4%	4,941	21.7%
Information	2,001	266	0.8%	1,473	1.9%	262	1.2%
Financial Activities	5,152	1,068	3.1%	3,078	3.9%	1,006	4.4%
Professional & Business Services	11,716	3,281	9.5%	6,515	8.3%	1,920	8.4%
Education & Health Services	22,388	4,495	13.0%	13,681	17.5%	4,212	18.5%
Leisure & Hospitality	15,341	3,159	9.1%	9,505	12.2%	2,677	11.8%
Other Services	5,351	1,297	3.7%	2,935	3.8%	1,119	4.9%
Private Non-Classified	22	(c)	—	18	0.0%	(c)	—
Total All Government	21,807	7,731	22.3%	11,060	14.1%	3,016	13.3%
Federal Government	3,292	1,363	3.9%	1,681	2.2%	248	1.1%
State Government	4,101	1,021	2.9%	2,321	3.0%	759	3.3%
Local Government	14,414	5,347	15.4%	7,058	9.0%	2,009	8.8%

Note: (c) = confidential, information not provided by Oregon Employment Department to prevent identifying specific businesses.

Source: Oregon Employment Department, 2013

Each industry faces distinct vulnerabilities to natural hazards. Identifying key industries in the region enables communities to target mitigation activities toward those industries' specific sensitivities. Each of the primary private employment sectors has sensitivity to natural hazards, as follows.

Trade, Transportation, and Utilities: Retail Trade is the largest employment subsector within the Trade, Transportation, and Utilities sector. Retail Trade is vulnerable to disruptions in the disposable income of regional residents and to disruptions in the transportation system. Residents' discretionary spending diminishes after natural disasters as spending priorities tend to focus on essential items. Disruption of the transportation system could sever connectivity of people and retail hubs. Retail businesses are concentrated in the larger cities of the region and are most numerous in Jackson County.

Education and Health Services: The Health and Social Assistance industries play important roles in emergency response in the event of a disaster. The importance of the health care and social assistance sector is underscored in Region 4 because of the region's increasing numbers of retirees. Health care is a relatively stable revenue sector regionally with an abundant distribution of businesses primarily serving a local population.

Leisure and Hospitality: This sector primarily serves regional residents with disposable income and tourists. The behavior of both of these social groups would be disrupted by a natural disaster. Regional residents may have less disposable income and tourists may choose not to visit a region with unstable infrastructure.

Manufacturing: This sector is highly dependent upon transportation networks in order to access supplies and send finished products to outside markets. For these reasons the manufacturing sector may be susceptible to disruptions in transportation infrastructure. However, manufacturers are not dependent on local markets for sales, which may contribute to the economic resilience of this sector. Within the region, manufacturers are primarily based in Douglas and Jackson counties. The timber manufacturing industry is particularly vulnerable to droughts, landslides, and wildfires.

Revenue by Sector

In 2007 Trade (Retail and Wholesale), Manufacturing, and Healthcare and Social Assistance were the highest revenue grossing industries in Region 4. (Note that revenue data from the 2012 Economic Census will not be released prior to the publication of this Plan.) Combined, these three industries generated over $12.7 billion (86% of total revenue) for the region (**Table 2-253**).

Table 2-253. Revenue of Top Industries (in Thousands of Dollars) in Region 4, 2007

	Total Revenue (in Thousands)	Trade (Retail and Wholesale)	Manufacturing	Health Care and Social Assistance
Oregon	$277,017,733	44.4%	24.1%	7.3%
Region 4	$14,823,762	44.9%	27.1%	13.8%
Douglas	$3,708,424	31.5%	40.6%	13.8%
Jackson	$8,949,774	49.9%	22.8%	13.1%
Josephine	$2,165,564	47.3%	21.8%	16.5%

Source: U.S. Census, Economic Census. 2007, Table ECO700A1

Sectors anticipated to be major employers in the future warrant special attention, especially in the hazard mitigation planning process so workforces and employers can be more prepared to respond and adapt to needs that arise after a natural hazard event. According to the Oregon Employment Department, between 2012 and 2022, the largest job growth in Region 4 is expected to occur in the following sectors: (a) Education and Health Services; (b) Trade, Transportation, and Utilities (including retail trade); (c) Professional and Business Services; (d) Leisure and Hospitality; and (e) Manufacturing (Oregon Employment Department, 2014).

Identifying sectors with a large number of businesses and targeting mitigation strategies to support those sectors, can help the region's resiliency. The Trade, Transportation, and Utilities sector includes the most businesses in the region. The Other Services sector has the second most businesses. The Professional and Business Services sector, Education and Health Services sector, Leisure and Hospitality sector round out the top five sectors in Southwestern Oregon (Oregon Employment Department, 2012). While many of these are small businesses, employing fewer than 20 employees, collectively they represent 68% of the business units in the region. Due to their small size and large collective share of the economy, these businesses are particularly sensitive to temporary decreases in demand, such as may occur following a natural hazard event.

Economic Trends and Issues

Current and anticipated financial conditions of a community are strong determinants of community resilience, since a strong and diverse economic base increases the ability of individuals, families, and communities to absorb impacts of a disaster and recover more quickly. The economic analysis shows that Region 4 is particularly vulnerable during a hazard event due to the following characteristics:

- Significantly high unemployment rates in Douglas and Josephine Counties;
- Lower regional wages — 71% to 82% of state average salaries; and
- An economy heavily dependent on a few key industries.

Considering the high regional unemployment and an economy heavily dependent on a few key industries, Region 4 may experience greater difficulty recovering after a disaster than a region with a more diverse economic base. Supporting the growth of dominant industries and employment sectors, as well as emerging sectors identified in this analysis, could help the region become more resilient to economic downturns that often follow a hazard event (Stahl et al., 2000).

Infrastructure

Transportation

Roads

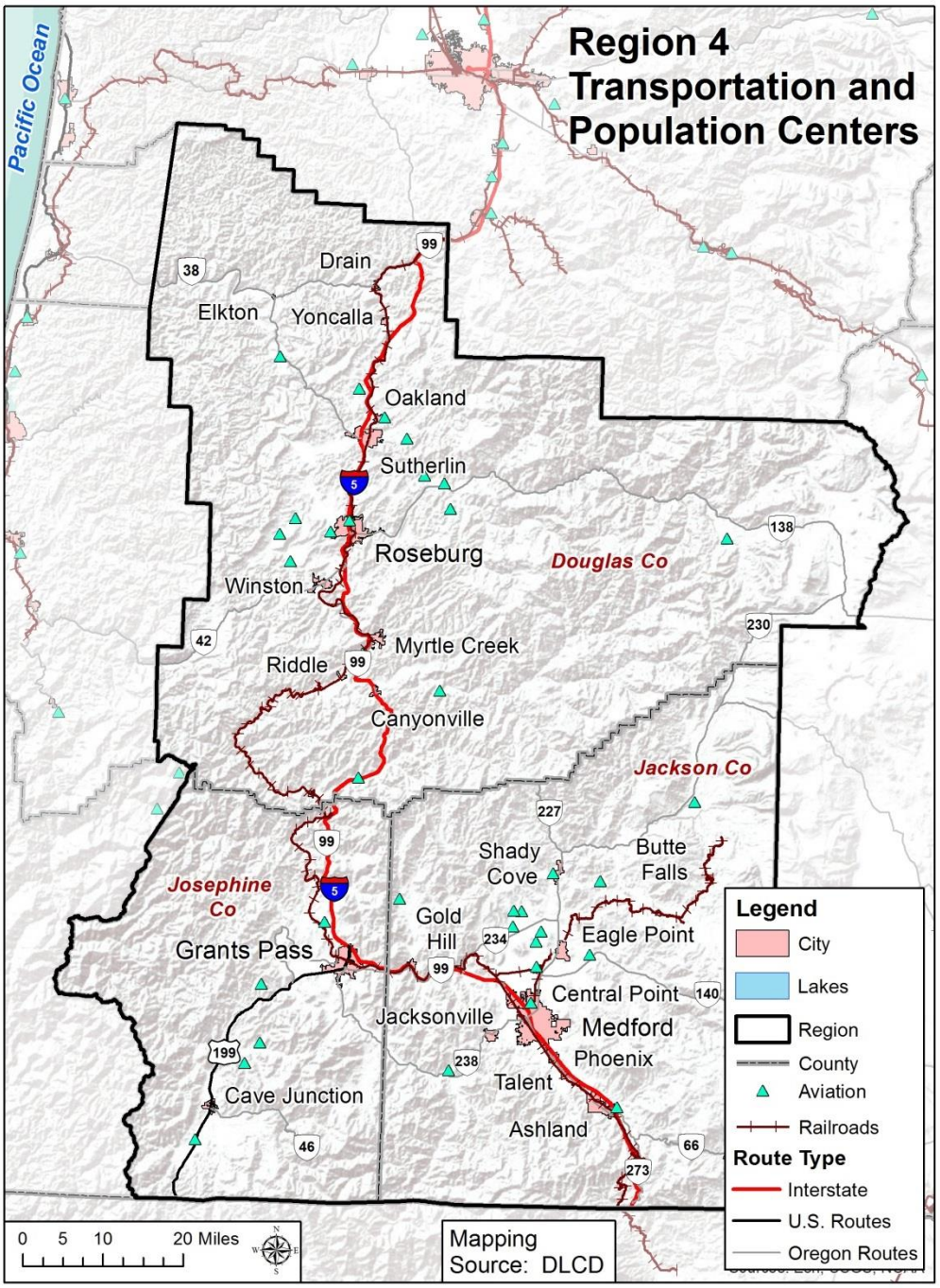
The largest population bases in Region 4 — the Cities of Ashland, Grants Pass, Medford, and Roseburg — are located along I-5. I-5 runs north-south through Region 4 and is the main passage for automobiles and trucks traveling along the West Coast.

Region 4's growing population centers bring more workers, automobiles and trucks onto roads. A high percentage of workers driving alone to work coupled with interstate and international freight movement on the I-5 corridor create additional stresses on transportation systems. Some of these include added maintenance, congestion, oversized loads, and traffic accidents.

Natural hazards and emergency events can further disrupt automobile traffic, create gridlock, and shut down local transit systems, making evacuation and other emergency operations difficult. Hazards such as localized flooding can render roads unusable. Likewise, a severe winter storm has the potential to disrupt the daily driving routine of thousands of people.

According to the Oregon Department of Transportation's (ODOT's) Seismic Lifeline Report (**Appendix 9.1.13**), the region has exposure to earthquakes, especially a Cascadia Subduction Zone event. Therefore, the seismic vulnerability of the region's lifelines, including roadways and bridges, is an important issue. For information on ODOT's Seismic Lifeline Report findings for Region 4 see **Seismic Lifelines**.

Figure 2-143. Region 4 Transportation and Population Centers



Source: Oregon Department of Land Conservation and Development, 2014

Bridges

Because of earthquake risk in Region 4, the seismic vulnerability of the region'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 region's bridges are part of the state and interstate highway system that is maintained by the Oregon Department of Transportation (ODOT) or are part of regional and local systems that are maintained by the region's counties and cities.

Table 2-254 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 deficient bridge (De) is a federal performance measure used for non-ODOT bridges. The ratings do not imply that a bridge is unsafe (ODOT, 2012, 2013). About 18% of the region's ODOT bridges are distressed, compared to 22% for the state.

Table 2-254. Bridge Inventory for Region 4

	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 4	64	362	18%	81	508	16%	14	56	25%	4	10	40%	163	905	18%	11
Douglas	28	174	18%	44	252	17%	6	23	26%	2	6	33%	80	440	18%	6
Jackson	24	128	21%	16	152	11%	8	32	25%	0	0	-	48	300	16%	4
Josephine	12	60	21%	21	104	20%	0	1	0%	2	4	50%	35	165	21%	1

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.

Source: ODOT (2012, 2013)

Railroads

Railroads that run through Region 4 support cargo and trade flows. The region's rail providers are the Central Oregon & Pacific and the White City Terminal Railroad. There is no passenger rail line through the region. The Central Oregon & Pacific Line follows I-5 through the region, then runs west through Lane County and loops back into Region 4 through Reedsport. The White City Terminal Railroad is a short spur off the Central Oregon & Pacific Line in Jackson County (Loy et al., 1976). Oregon's rail system is critical to the state's economy, energy, and food systems. Rail systems export lumber and wood products, pulp and paper, and other goods produced in Oregon and carry products from other states to and through Oregon by rail (Cambridge Systematics, 2014).

Rails are sensitive to icing from winter storms that can occur in Region 4. Disruptions in the rail system can result economic losses for the region. The potential for harm from rail accidents can also have serious implications for local communities, particularly if hazardous materials are involved.

Airports

Rogue Valley International-Medford Airport is the only commercial airport in the region and is the third busiest airport in Oregon (Federal Aviation Administration, 2012). The airport is owned, operated and administered by Jackson County Aviation Authority. It serves eight hubs and four air carriers with approximately 56 arriving and departing flights daily (Jackson County, Oregon, airport website, http://www.co.jackson.or.us/SectionIndex.asp?SectionID=5).

In the event of a natural disaster, public and private airports are important staging areas for emergency response activities. Public airport closures will impact the region's tourism industries, as well as the ability for people to leave the region by air. Businesses relying on air freight may also be impacted by airport closures.

Table 2-255. Public and Private Airports in Region 4

	Number of Airports by FAA Designation				
	Public Airport	**Private Airport**	**Public Heliport**	**Private Heliport**	**Total**
Region 4	10	26	0	13	49
Douglas	4	12	0	4	20
Jackson	4	11	0	7	22
Josephine	2	3	0	2	7

Source: FAA Airport Master Record (Form 5010), 2014

Energy

Electricity

Several power supply companies serve Region 4. The Bonneville Power Administration is the area's wholesale electricity distributor. The majority of the region is powered by PacifiCorp (Pacific Power and Light). The Coos-Curry Electric Cooperative and the Douglas Electric Cooperative serve portions of Douglas and Josephine Counties. The Umpqua Indian Utility Cooperative serves the Cow Creek Band of Umpqua Tribe of Indians, including the site of the Seven Feathers Casino Resort located in Douglas County north of Grants Pass and south of Roseburg.

Table 2-256 lists electric power-generating facilities within Region 4. The region has a total of eight power-generating facilities: three are hydroelectric power facilities, and five are categorized as "other" (primarily biomass). In total the power-generating facilities have the ability to produce up to 391 megawatts of electricity.

Table 2-256. Power Plants in Region 4

	Hydro-electric	Natural Gas	Wind	Coal	Other*	Total
Region 4	3	0	0	0	5	8
Douglas	1	0	0	0	3	4
Jackson	2	0	0	0	1	3
Josephine	0	0	0	0	1	1
Energy Production (MW)	**305**	**0**	**0**	**0**	**86**	**391**

* "Other" includes biomass, geothermal, landfill gas, solar, petroleum, and waste.

Source: Army Corps of Engineers; Biomass Power Association; Calpine Corporation; Eugene Water and Electric Board; Iberdola Renewables; Idaho Power Company; Klamath Energy LLC; Oregon Department of Energy; Owyhee Irrigation District; Form 10K Annual Report (2013), PacifiCorp; Form 10K Annual Report (2013), Portland General Electric; U.S. Geothermal, Inc.

Hydropower

The majority of electrical power in Region 4 is generated through hydropower. Dams for hydropower generation are primarily situated on the Applegate, Rogue, and Umpqua Rivers. Dams operated by the Bonneville Power Administration (BPA) provide hydro-generated electricity to the state's consumer owned utilities. Major BPA dams in the region are located on the Applegate and Rogue Rivers.

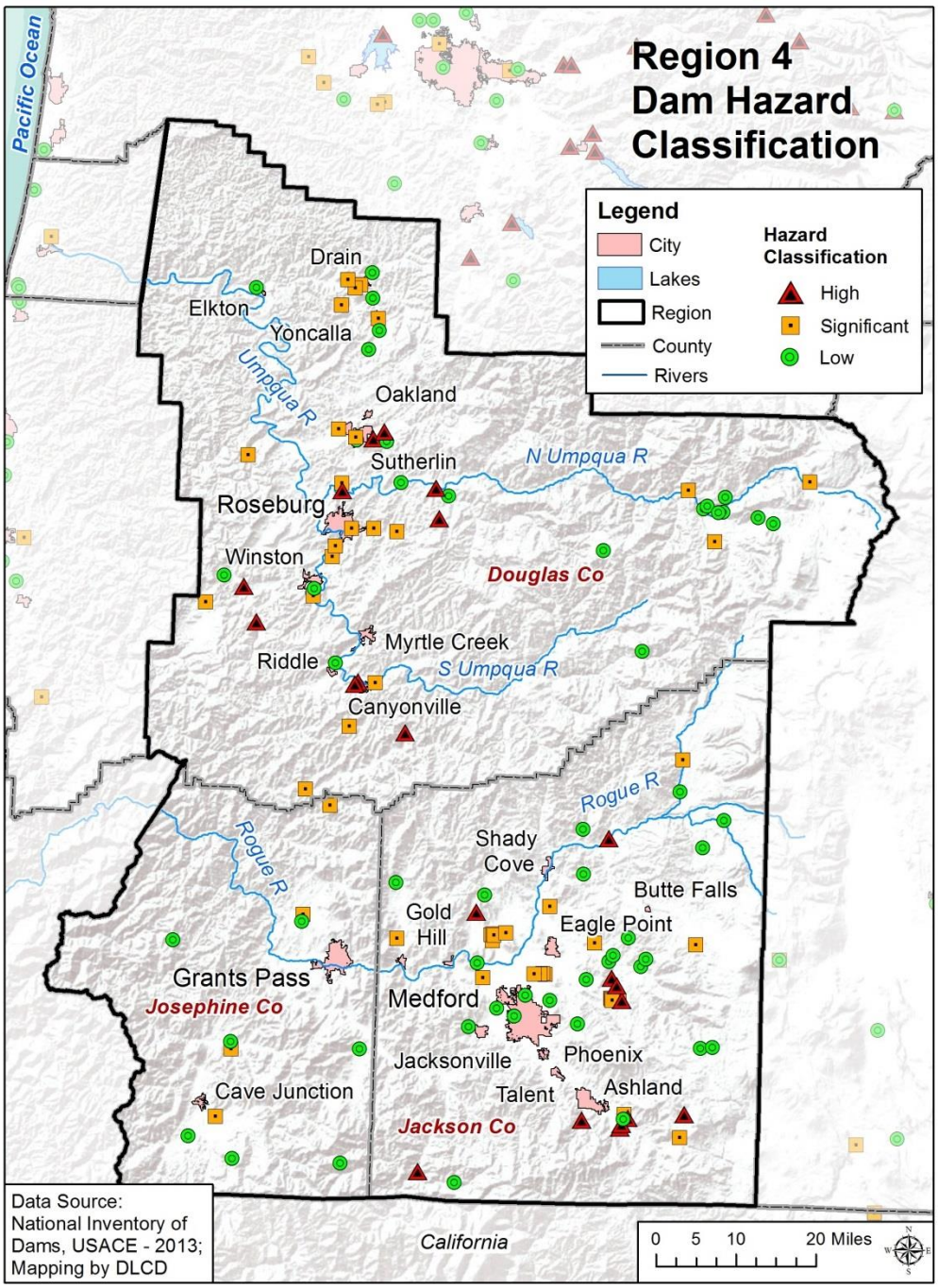
Minor dam failures can occur at any time. Most dam failures result in minor damage to structures and pose little or no risk to life safety. However, the potential for severe damage and fatalities does exist (major dam failures have occurred most recently near Hermiston, 2005, and Klamath Lake, 2006) (Association of Dam Safety Officials, n.d.). The Oregon Water Resources Department maintains an inventory of all large dams located in Oregon (using the National Inventory of Dams (NID) threat potential methodology). Table 2-257 lists the number of dams included in the inventory. The majority of dams in the region are located in Douglas and Jackson Counties. There are 28 High Threat Potential dams and 42 Significant Threat Potential dams in the region.

Table 2-257. Threat Potential of Dams in Region 4

	Threat Potential			
	High	Significant	Low	Total Dams
Region 4	28	42	113	183
Douglas	13	20	52	85
Jackson	14	19	42	75
Josephine	1	3	19	23

Source: Oregon Water Resources Department, Dam Inventory Query 2014

Figure 2-144. Region 4 Dam Hazard Classification

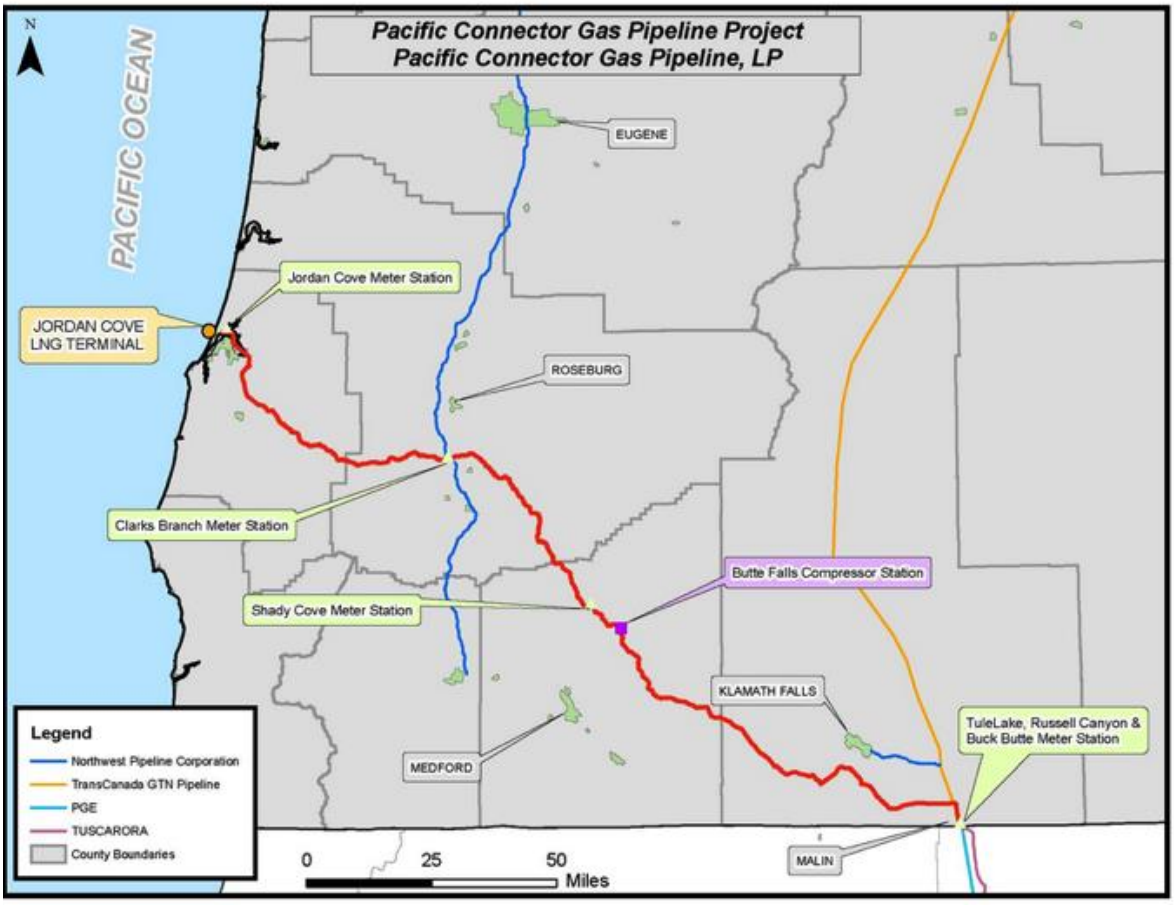


Source: National Inventory of Dams, USACE, 2013

Natural Gas

Although natural gas does not provide the most energy to the region, it does contribute a significant amount of energy to Pacific Power's portfolio. Liquefied natural gas (LNG) is transported via pipelines throughout the United States. **Figure 2-145** shows existing LNG pipelines and the proposed Pacific Connector Gas Pipeline (in red) (Oregon Department of Environmental Quality, 2014). One pipeline, owned by the Northwest Pipeline Corporation, runs though Douglas and Josephine Counties. LNG pipelines, like other buried pipe infrastructure, are vulnerable to earthquakes and can cause danger to human life, safety, and environmental impacts in the case of a spill.

Figure 2-145. Liquefied Natural Gas Pipelines in Region 4



Source: Oregon Department of Environmental Quality, 2014

Utility Lifelines

Southwestern Oregon primarily receives oil and gas from Alaska by way of the Puget Sound through pipelines and tankers. The region is at the southern end of this pipeline network. Oil and gas are supplied by Northern California through a separate network. The electric, oil, and gas lifelines that run through the county are both municipally and privately owned (Loy et al., 1976). These utility lifelines may be vulnerable to severe, but infrequent natural hazards, such as earthquakes.

The network of electrical transmission lines running through Region 4 is operated by Pacific Power and Light and primarily facilitates local energy production and distribution (Loy et al., 1976). Most of the natural gas Oregon uses originates in Alberta, Canada. Avista Utilities owns the main natural gas transmission pipeline (Loy et al., 1976).

Telecommunications

Telecommunications infrastructure includes television, telephone, broadband internet, radio, and amateur radio (ham radio). Region 4 is part of the Southern Oregon Operational Area under The Oregon State Emergency Alert System Plan (Oregon Office of Emergency Management (2013), which also includes Coos, Curry, and Klamath Counties. There is a memorandum of understanding between these counties that facilitates the launching of emergency messages for counties by Jackson County. Counties in this area can launch emergency messages by contacting the Oregon Emergency Response System (OERS) which in turn creates emergency messages to communities statewide.

Beyond day-to-day operations, maintaining communication capabilities during disaster events and other emergency situations helps to keep citizens safe by keeping them informed of the situation's status, areas to avoid, and other procedural information. Additionally, responders depend on telecommunications infrastructure to be routed to sites where they are needed.

Television

Television serves as a major provider for local, regional, and national news and weather information and can play a vital role in emergency communications. The local primary stations identified as emergency messengers by the Oregon State Emergency Alert System Plan are:

- KOBI-TV Channel 5, Medford; and
- Channel 49, Grants Pass.

Telephone and Broadband

Landline telephone, mobile wireless telephone, and broadband service providers serve Region 4. Broadband technology including mobile wireless is provided in the region via five primary technologies: cable, digital subscriber line (DSL), fiber, fixed wireless, and mobile wireless. Internet service is becoming more readily available in the region with a greater number of providers and service types available within major communities and along major transportation corridors (I-5, US-199, etc.) (NTIA, n.d.). Landline telephones are common throughout the region; however, residents in rural areas rely more heavily upon the service since they may not have cellular reception outside of major transportation corridors.

Wireless providers sometimes offer free emergency mobile phones to those impacted by disasters, which can aid in communication when landlines and broadband service are unavailable.

Radio

Radio is readily available to those who live within Region 4 and can be accessed through car radios, emergency radios, and home sound systems. Radio is a major communication tool for weather and emergency messages. Radio transmitters for the Southern Oregon Operational Area are (Oregon Office of Emergency Management, 2013):

- WWF-97, 162.475 MHZ, Ashland;
- WXL-85, 162.400 MHZ, Medford; and
- WXL-98, 162.550 MHZ, Roseburg.

Ham Radio

Amateur radio, or ham radio, is a service provided by licensed amateur radio operators (hams) and is considered to be an alternate means of communicating when normal systems are down or at capacity. Emergency communication is a priority for the Amateur Radio Relay League (ARRL). Region 4 is served by ARES District 5. Radio Amateur Civil Emergency Services (RACES) is a special phase of amateur radio recognized by FEMA that provides radio communications for civil preparedness purposes including natural disasters (Oregon Office of Emergency Management, n.d.). The official ham emergency station calls for Region 4 include (American Relay Radio League Oregon Chapter, www.arrloregon.org):

- Douglas County: K7AZW;
- Jackson County: K7VS; and
- Josephine County: none available at this time.

Water

Water infrastructure includes drinking water, stormwater, and wastewater systems. All of these systems possess some level of vulnerability to natural hazards that can have repercussions on human health, ecosystems, and industry.

Drinking Water

In Region 4 the majority of the municipal drinking water supply is obtained from surface water. In Jackson and Josephine Counties, the Rogue River provides municipal water supplies to most cities. The City of Cave Junction is an exception, obtaining water from the Illinois River. In Douglas County, most cities source their water from the Umpqua River and its tributaries.

Rural residents may get water from groundwater wells or surface water. Most rural residents in Douglas County use surface water sources for potable water. The majority of rural residents in Jackson and Josephine Counties use domestic wells outside of municipal boundaries. Areas with sedimentary and volcanic soils may be subject to high levels of arsenic, hydrogen sulfide, and fecal coliform bacteria, which can impact the safety of groundwater sources.

Surface sources for drinking water are vulnerable to pollutants caused by non-point sources and natural hazards. Non-point source pollution is a major threat to surface water quality, and may include stormwater runoff from roadways, agricultural operations, timber harvest, erosion, and

sedimentation. Landslides, flood events, and earthquakes and resulting liquefaction can cause increased erosion and sedimentation in waterways. Acid mine drainage from the Formosa mine, a U.S. Environmental Protection Agency Superfund site, is another non-point source of pollution. Acid mine drainage threatens the health of Middle Creek in southern Douglas County, a tributary to the Umpqua River.

Underground water supplies and aging or outdated infrastructure — such as reservoirs, treatment facilities, and pump stations — can be severed during a seismic event. Rigid materials such as cast iron may snap under the pressure of liquefaction. More flexible materials such as polyvinyl chloride (PVC) and ductile iron may pull apart at joints under the same stresses. These types of infrastructure damages could result in a loss of water pressure in municipal water supply systems, limiting access to potable water. This can lead to unsanitary conditions that may threaten human health. Lack of water can also impact industry, such as the manufacturing sector. Moreover, if transportation infrastructure is impacted by a disaster event, repairs to water infrastructure will be delayed.

Stormwater and Wastewater

In urbanized areas severe precipitation events may cause flooding that leads to stormwater runoff. A non-point source of water pollution, stormwater runoff can adversely impact drinking water quality. It can also lead to environmental issues such as increasing surface water temperatures that can adversely affect habitat health. Furthermore, large volumes of fast-moving stormwater that enter surface waterways can cause erosion issues.

Stormwater can also impact water infrastructure. Leaves and other debris can be carried into storm drains and pipes, which can clog stormwater systems. In areas where stormwater systems are combined with wastewater systems (combined sewers), flooding events can lead to combined sewer overflows (CSOs). CSOs present a heightened health threat as sewage can flood urban areas and waterways. Underground stormwater and wastewater pipes are also vulnerable to damage by seismic events.

In Region 4, most local building codes and stormwater management plans emphasize use of centralized storm sewer systems to manage stormwater. Requirements for stormwater mitigation vary in Region 4. Low impact development (LID) mitigation strategies can alleviate or lighten the burden on a jurisdiction's storm sewer system by allowing water to percolate through soil onsite or detaining water so water enters the storm sewer system at lower volumes, at lower speeds, and at lower temperatures. While some jurisdictions in Region 4 refer to LID techniques in their stormwater management plans, Medford is the only city that requires LID stormwater mitigation strategies in its development code. Promoting and requiring decentralized LID stormwater management strategies could help reduce the burden of new development on storm sewer systems, and increase a community's resilience to many types of hazard events.

Infrastructure Trends and Issues

Physical infrastructure is critical for everyday operations and is essential following a disaster. Lack or poor condition of infrastructure can negatively affect a community's ability to cope with, respond to, and recover from a hazard event. Diversity, redundancy, and consistent maintenance of infrastructure systems help create system resiliency (Meadows, 2008).

Older and structurally unsound bridges in Region 4 compromise transportation systems. The effects of bridge and road failures on the economy and health of the Region's residents could be devastating. About 18% of the region's bridges owned by the state are distressed.

The infrastructure associated with power generation and transmission plays a critical role in supporting the regional economy and is vulnerable to severe, but infrequent, natural hazards. There are eight power-generating facilities in Southwest Oregon. Three are hydroelectric power facilities. The others are primarily biomass facilities. The major Bonneville Power Administration dams in the region are on the Applegate and Rogue Rivers. Of the state-owned dams in the region, 28 have High Threat Potential and 42 have Significant Threat Potential.

Buried natural gas transmission lines run through Douglas and Josephine Counties and are vulnerable to seismic activity.

Decentralization and redundancy in the region's telecommunication systems can help boost the area's ability to communicate before, during, and after a disaster event. It is important to note that broadband and mobile telephone services do not cover many rural areas of the region that are distant from major transportation corridors. This may present a communication challenge in the wake of a hazard event. Encouraging residents to keep AM/FM radios available for emergency situations could help increase the capacity for communicating important messages throughout the region.

Water systems in the region are particularly vulnerable to hazard events because they tend to be older, centralized, and lack system redundancies Drinking water is primarily sourced from surface water. The region is at risk in case of high levels of pollutants entering waterways through CSO's during high-water events. The implementation of decentralized low impact development (LID) stormwater systems can increase the region's capacity to better manage high-precipitation events. Medford is the only city that requires LID stormwater mitigation strategies in its development code.

Built Environment

Development Patterns

Balancing growth with hazard mitigation is key to planning resilient communities. Therefore, understanding where development occurs and the vulnerabilities of the region's building stock is integral to developing mitigation efforts that move people and property out of harm's way. Eliminating or limiting development in hazard prone areas can reduce exposure to hazards, and potential losses and damages.

Since 1973, Oregon has maintained a strong statewide program for land use planning. The foundation of Oregon's program is 19 land use goals that "help communities and citizens plan for, protect and improve the built and natural systems." These goals are achieved through local comprehensive planning. The intent of Goal 7, Areas Subject to Natural Hazards, is to protect people and property from natural hazards (Department of Land Conservation and Development, website: http://www.oregon.gov/http://www.oregon.gov/).

Settlement Patterns

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 its population is considered rural even though the county has incorporated cities.

Between 2000 and 2010 urban populations in Region 4 have grown by about 14%; more than 4 times the percent growth in rural areas. Jackson and Josephine Counties are experiencing the most urban growth in people and housing. Growth in Douglas County is more evenly distributed between urban and rural areas. Unsurprisingly, populations tend to cluster around major road corridors and waterways. This holds true for the major cities of Ashland, Medford, Grants Pass and Roseburg.

Table 2-258. Urban and Rural Populations in Region 4

	Urban			Rural		
	2000	2010	Percent Change	2000	2010	Percent Change
Oregon	2,694,144	3,104,382	15.2%	727,255	726,692	-0.1%
Region 4	238,659	271,312	13.7%	118,735	122,274	3.0%
Douglas	58,411	63,332	8.4%	41,988	44,335	5.6%
Jackson	141,112	162,458	15.1%	40,157	40,748	1.5%
Josephine	39,136	45,522	16.3%	36,590	37,191	1.6%

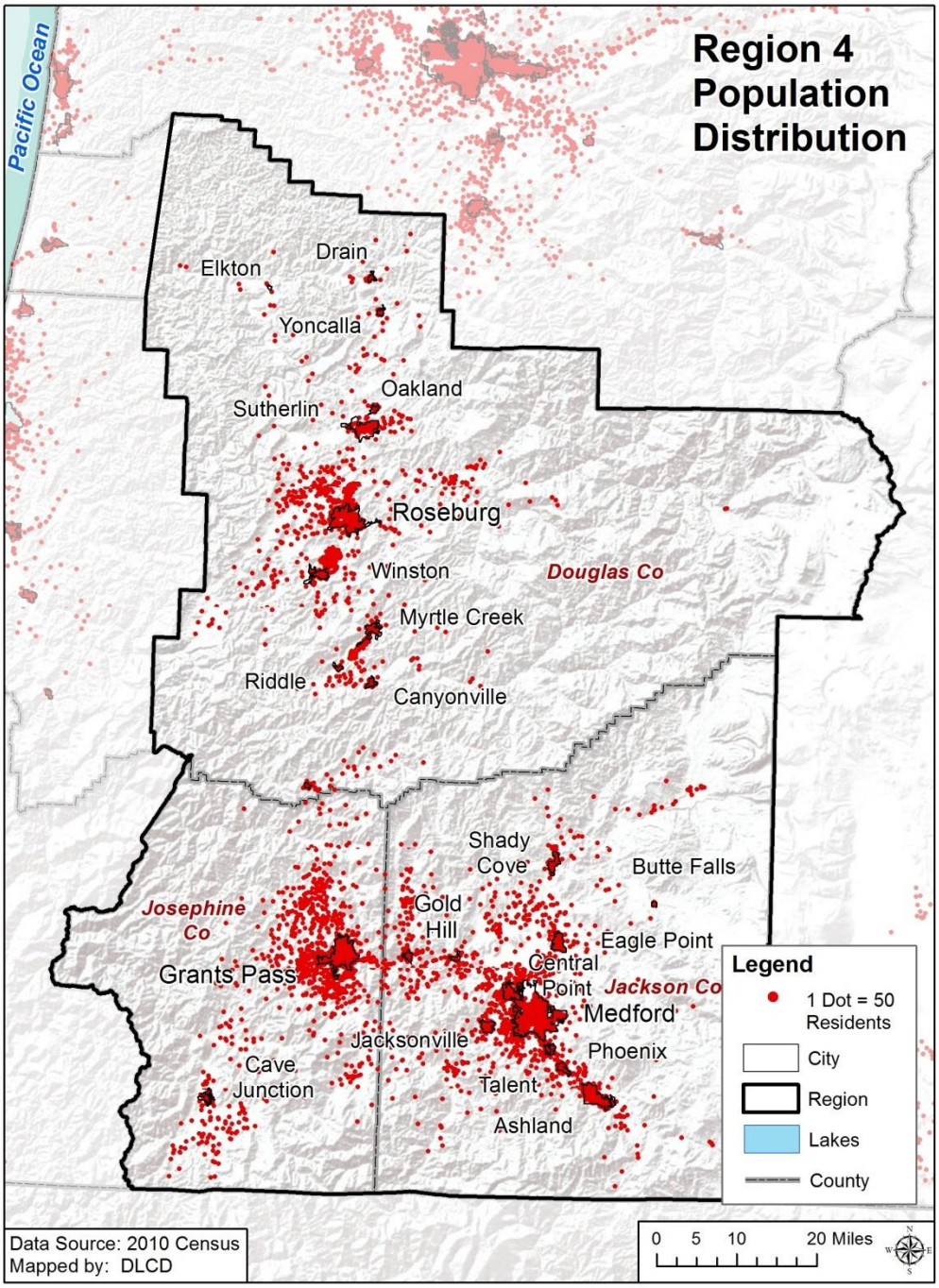
Source: U.S. Census Bureau. 2000 Decennial Census, Table P002 and 2010 Decennial Census, Table P2

Table 2-259. Urban and Rural Housing Units in Region 4

	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 4	101,546	121,709	19.9%	50,714	56,144	10.7%
Douglas	25,273	28,553	13.0%	18,011	20,362	13.1%
Jackson	59,255	72,470	22.3%	16,482	18,467	12.0%
Josephine	17,018	20,686	21.6%	16,221	17,315	6.7%

Source: U.S. Census Bureau. 2000 Decennial Census, Table H002 and 2010 Decennial Census, Table H2

Figure 2-146. Region 4 Population Distribution



Source: U.S. Census, 2012

Land Use and Development Patterns (Lettman, 2011)

Land use for Region 4 is dominated by forestry (78%), with the majority of land owned by the Federal Government. Agricultural activities (15%) are the second major land use, for primarily field crops, orchard and livestock.

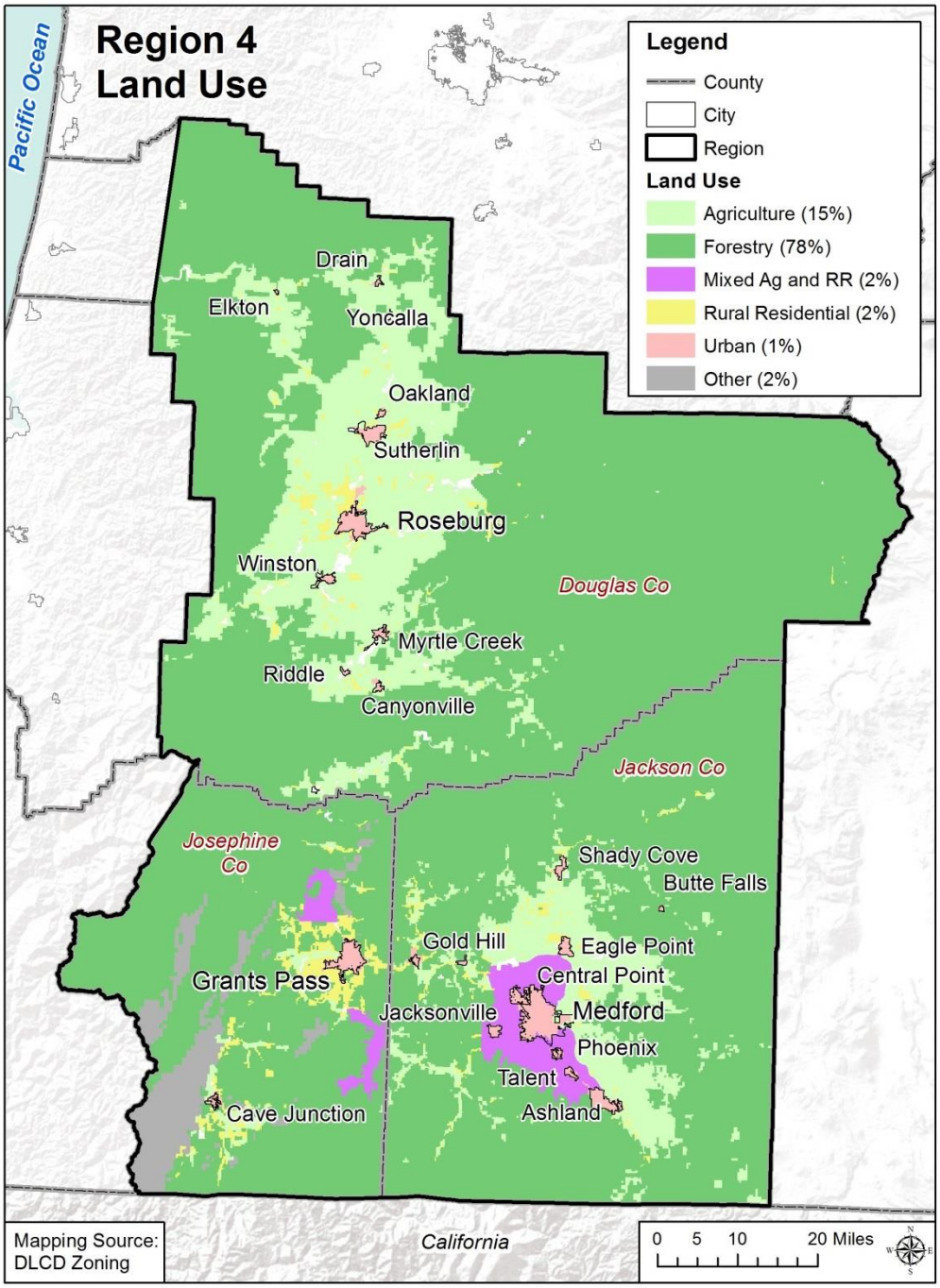
Under Oregon's land use system, each urban area is required to define an Urban Growth Boundary (UGB). Housing tracts, shopping malls, and other kinds of urban development are not allowed to sprawl past that boundary, while agricultural lands and open space outside a UGB are preserved. In Region 4, Roseburg has a significant area to the north along I-5 that can accommodate growth. Grants Pass has room to expand in several directions. Other communities, such as Medford, Central Point, and Jacksonville have little land reserved for urban expansion.

During the 25-year period between 1984 and 2009, Josephine County had a high rate of conversion of private land to developed uses. 14% of the county's 237,000 acres of private land in forest and agricultural uses was converted to low-density residential or urban uses — most of this change occurred between 1974 and 1984. However, the rates of conversion of private land in resource land uses to low-density residential or urban uses declined in the region and almost stopped between 2000 and 2009. Strong farm and forest land protections played a role in this decline. State statutes and rules establish standards for dwellings, uses and land divisions in rural areas to limit incompatible development and land fragmentation and to ensure that newly created farm and forest parcels remain commercially viable for farm and forest use (Lettman, 2011).

These changing land use development patterns and protections contribute to a slowing of the growth in the region's wildland-urban interface and other developed areas. While this does not necessarily lessen the wildfire risk in Region 4, it does provide the communities an opportunity to use tools such as the Josephine and Jackson County Integrated Fire Plans to reach vulnerable communities with wildfire risk assessment, outreach, and education.

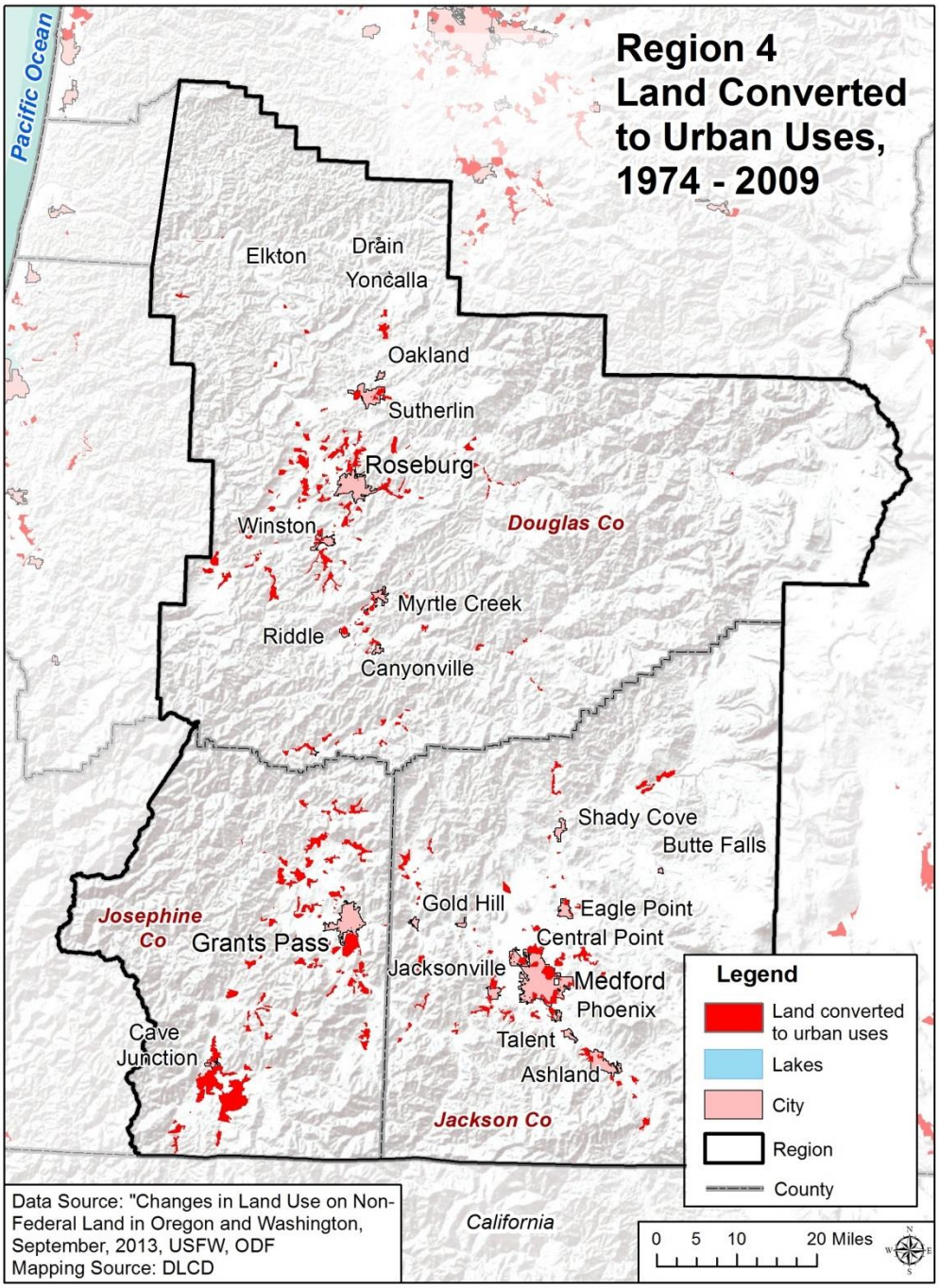
Regional problem solving activities are also addressing land use and development issues and how to guide growth. The "Greater Bear Creek Valley Regional Problem Solving Project" involves Jackson County and six cities in the Rogue Valley in guiding urban growth and development, while preserving priority farmland and floodplain.

Figure 2-147. Region 4 Land Use



Source: Department of Land Conservation and Development

Figure 2-148. Region 4 Land Converted to Urban Uses, 1974-2009



Source: Land Use Change on Non-Federal Land in Oregon and Washington, September, 2013, USFS, ODF

Housing

In addition to location, the character of the housing stock can also affect the level of risk a community faces from natural hazards. The majority of the region's housing stock is single-family homes. A significant portion of Douglas and Josephine Counties' housing stock is mobile homes. In natural hazard events such as earthquakes and floods, mobile homes are more likely to shift on their foundations and create hazardous conditions for occupants and their neighbors (California Governor's Office of OES, 1997).

Table 2-260. Housing Profile for Region 4, 2012

	Total Housing Units	Single Family		Multi-Family		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 4	177,544	124,002	69.8%	25,846	14.6%	26,540	14.9%
Douglas	48,775	33,820	69.3%	5,613	11.5%	8,820	18.1%
Jackson	90,814	63,378	69.8%	15,730	17.3%	11,469	12.6%
Josephine	37,955	26,804	70.6%	4,503	11.9%	6,251	16.5%

Note: The percentages listed above do not reflect the number of structures that are built within special flood hazard areas or that are at risk of seismic damage.

Source: U.S. Census Bureau. 2008–2012, American Community Survey 5-Year Estimates, B25024

Aside from location and type of housing, the year structures were built (**Table 2-261**) has implications. Seismic building standards were codified in Oregon building code starting in 1974. More rigorous building code standards passed in 1993 accounted for the Cascadia earthquake fault (Judson, 2012). Therefore, homes built before 1994 are more vulnerable to seismic events.

Also in the 1970s, FEMA began assisting communities with floodplain mapping as part of administering 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. Regionally 32% of the housing stock was built prior to 1970, before the implementation of floodplain management ordinances. More than one third of the region's housing stock was built after 1990 and the codification of seismic building standards. A larger share of housing in Jackson and Josephine Counties was built after 1990 than does Douglas County.

Table 2-261. Age of Housing Stock in Region 4, 2012

	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 4	177,544	56,763	32.0%	59,336	33.4%	61,445	34.6%
Douglas	48,775	18,489	37.9%	16,749	34.3%	13,537	27.8%
Jackson	90,814	27,815	30.6%	28,322	31.2%	34,677	38.2%
Josephine	37,955	10,459	27.6%	14,265	37.6%	13,231	34.9%

Source: U.S. Census Bureau. 2008–2012, American Community Survey 5-Year Estimates, B25034

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 is minimized. **Table 2-262** shows the initial and current FIRM effective dates for Region 4 communities. For more information about the flood hazard, NFIP, and FIRMs, please refer to the State Risk Assessment, **Flood** section.

Table 2-262. Community Flood Map History in Region 4

	Initial FIRM	Current FIRM
Douglas County	December 15, 1978	February 17, 2010
Canyonville	November 1, 1978	February 17, 2010
Drain	August 1, 1979	February 17, 2010
Elkton	September 5, 1979	February 17, 2010
Glendale	September 29, 1978	February 17, 2010
Myrtle Creek	February 15, 1978	February 17, 2010
Oakland	June 19, 1985	February 17, 2010
Reedsport	April 3, 1984	February 17, 2010
Riddle	August 1, 1979	February 17, 2010
Roseburg	June 1, 1977	February 17, 2010
Sutherlin	February 17, 2010	February 17, 2010 (M)
Winston	December 31, 1974	February 17, 2010
Yoncalla	February 17, 2010	February 17, 2010 (M)
Jackson County	April 1, 1982	May 3, 2011
Ashland	June 1, 1981	May 3, 2011
Butte Falls	June 30, 1976	June 30, 1976 (M)
Central Point	September 30, 1980	May 3, 2011
Eagle Point	September 30, 1980	May 3, 2011
Gold Hill	September 17, 1980	May 3, 2011
Jacksonville	December 4, 1979	May 3, 2011
Medford	April 15, 1981	May 3, 2011
Phoenix	May 3, 1982	May 3, 2011
Rogue River	January 2, 1980	May 3, 2011
Shady Cove	September 30, 1980	May 3, 2011
Talent	February 1, 1980	May 3, 2011
Josephine County	June 1, 1982	December 3, 2009
Cave Junction	June 1, 1982	December 3, 2009
Grants Pass	April 15, 1981	December 3, 2009

(M) = no elevation determined; all Zone A, C, and X.

Source: Federal Emergency Management Agency, Community Status Book Report

State-Owned/Leased and Critical/Essential Facilities

In 2014 the Department of Geology and Mineral Industries updated the 2012 Oregon NHMP inventory and analysis of state-owned/leased facilities and critical/essential facilities. Results from this report relative to Region 4 can be found in **Table 2-263**. The region contains 2.2% of the total value of state-owned/leased critical/essential facilities.

Table 2-263. Value of State-Owned/Leased Critical and Essential Facilities in Region 4

	Total Property Value (State Facilities)	Percent State Total
Oregon	$7,339,087,023	100%
Region 4	$164,409,632	2.2%
Douglas	$66,660,507	0.9%
Jackson	$60,819,133	0.8%
Josephine	$36,929,992	0.5%

Source: The Department of Geology and Mineral Industries

Built Environment Trends and Issues

The trends within the built environment are critical to understanding the degree to which urban form affects disaster risk. Region 3 is largely urban with development focused around the major cities along I-5 including Ashland, Medford, Grants Pass and Roseburg. Douglas County's urban population is growing at about half the state's rate. The region's housing stock is largely single-family homes. The region has about twice the percentage of mobile homes than the state, with Douglas County having the greatest share of mobile units and Jackson County having the greatest number of units overall. Over 38% of homes in Jackson County were built after 1990 to current seismic building standards. All of the region's FIRMs have been modernized or updated.

2.3.4.3 Hazards and Vulnerability

Droughts

Characteristics

In Region 4, drought conditions can affect commerce, agriculture, fisheries, and overall quality of life. All three counties in Region 4 experienced drought conditions in 1992, 1994, 2001 and 2002. The Governor has not issued a formal drought declaration in Region 4 since 2002. In August 2013, the U.S. Department of Agriculture declared Jackson and Josephine Counties, along with Klamath and Lake Counties in Region 6, as federal primary natural disaster areas due to damages and losses caused by recent drought.

The lack of snow in the basin forced the Mount Ashland Ski Resort to close the 2013-14 season on March 13, 2014. For the first time in its 50-year history, Mount Ashland did not open for skiing or snowboarding (http://www.mtashland.com/News.asp?NewsID=400). On March 19, 2014, the Jackson County Commission declared a local drought disaster and had plans to ask the state for assistance. USDA reports showed snowpack in the Rogue Basin at 31% of average. The NRCS reported that without significant spring rainfall, water users in the Rogue and Umpqua

basins could anticipate a water shortage in summer 2014. In early May, the Governor issued a drought emergency declaration for Jackson County. Josephine County was declared a few weeks later. Communities, such as Ashland, did not plant any new trees or shrubs to help offset drought-related concerns, and also decided to move forward on a new water pipeline to bring Medford water to Ashland for potential emergency use during the late summer months.

Historic Drought Events

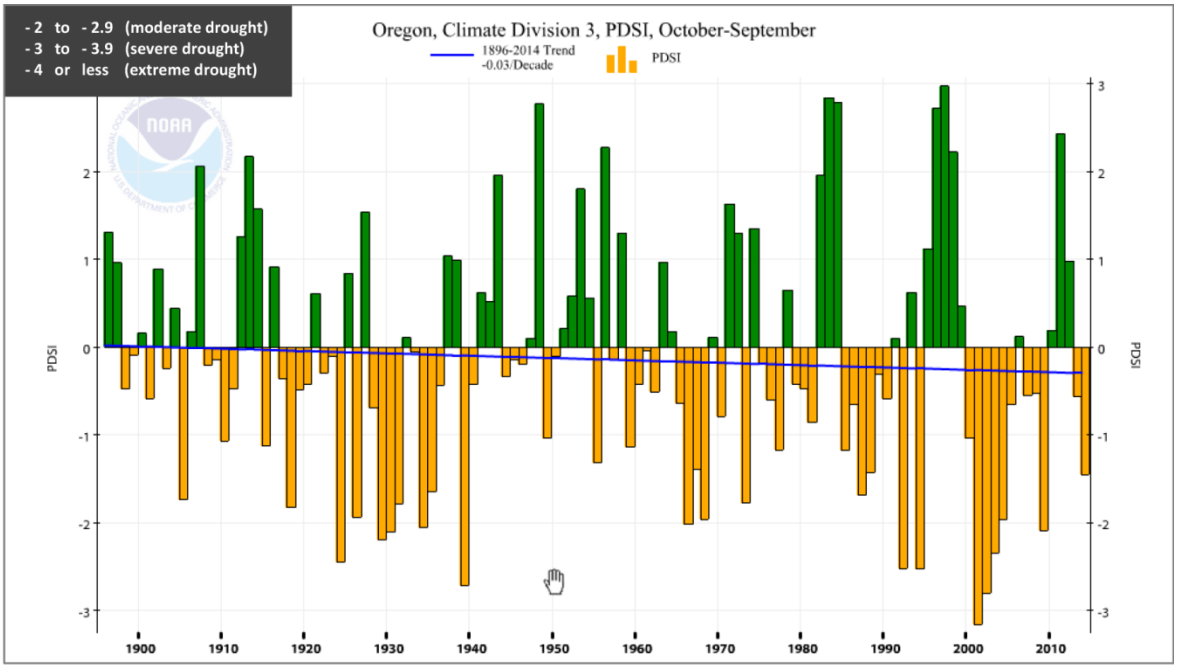
Table 2-264. Historic Droughts in Region 4

Date	Location	Description
1939	statewide	the 1920s and 1930s, known more commonly as the Dust Bowl, were a period of prolonged mostly drier than normal conditions across much of the state and country; water year 1939 was one of the more significant drought years in Region 4 during that period
1976-77	SW Oregon eastern Oregon	despite an insignificant PDSI value, the 1976-77 drought affected agriculture in Region 4; the water year was significantly drier than normal, but temperatures were near normal; the 1976-77 drought is included in this table because of the very large water year precipitation departures
1992	statewide	1992 fell toward the end of a generally dry period, which caused problems throughout the state
1994	SW Oregon eastern Oregon	In 1994, Governor's drought declaration covered 11 counties located within regions 4, 5, 6, 7, and 8
2001	SW Oregon eastern Oregon	Governor-declared drought in effect for all counties in Region 4 during 2001 as well as most counties in Regions 5, 6, 7, and 8
2002	coast; SW Oregon eastern Oregon	2001 Drought Declaration still in effect; five additional counties declared
2014	Regions 4, 6, 7, 8	Governor has declared drought in 10 counties in Oregon, including Region 4's Josephine and Jackson Counties

Sources: Taylor and Hatton (1999); Oregon Secretary of State's Archives Division. NOAA's Climate at a Glance. Western Regional Climate Center's Westwide Drought Tracker http://www.wrcc.dri.edu/wwdt. Personal Communication, Kathie Dello, Oregon Climate Service, Oregon State University.

Hazard Region 4, which encompasses Jackson, Josephine, and Douglas Counties, is prone to frequent droughts. Historic drought information can be obtained from the National Climatic Data Center, which provides climate data showing wet and dry conditions, using the Palmer Drought Severity Index (PDSI) that dates back to 1895. The Palmer Index is not the best indicator of water availability for Oregon because it does not account for snow or ice (delayed runoff), however, it has the advantage of providing the most complete, long-term record. During this record, the index shows that the southwestern valley experienced an extreme drought on one occasion (2001) and moderate drought on several occasions in the 1920s and 1930s, the early 1990s, the early 2000s and again in 2009 (**Figure 2-149**). Water Year 2014 has been a very dry for this area as well, with reservoir levels well below normal. The snowpack in this region peaked significantly below normal and set many record lows for snowpack levels at long term monitoring sites.

Figure 2-149. Palmer Drought Severity Index for Region 4



Source: National Climatic Data Center, http://www.ncdc.noaa.gov/cag/

Probability and Vulnerability

As stated in the State Risk Assessment, **Section 2.2.2.4, Local and State Vulnerability Assessment Comparison**, different methods are used to assess risk at local and state levels. All methods employ history, probability, and vulnerability data to determine probability and vulnerability scores for each hazard. These scores identify high-priority areas to which local and state governments can target mitigation actions. The challenge with these varied methodologies is that access to, interpretation of, and scale of the data are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and vulnerability scores are even quite different. The state recognizes these inconsistencies and has prioritized the analysis of local and state probability and vulnerability scores during the next plan update. A description of how the High (H), Moderate (M), and Low (L) scores in the local probability and vulnerability tables in this section were determined is provided in the State Risk Assessment **Section 2.2.2.2, Local Vulnerability Assessments**. The complete "OEM Hazard Analysis Methodology" is located in **Appendix 9.1.16**.

Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers the probability that Region 4 will experience drought is shown in **Table 2-265**. In some cases, counties either did not rank a particular hazard or did not find it to be a significant consideration. These cases are noted with a dash (—). See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-265. Local Probability Assessment of Drought in Region 4

	Douglas (Non-Coastal)	Jackson	Josephine
Probability	—	M	—

Source: Oregon Office of Emergency Management, November 2013, County Hazard Analysis Scores

State Assessment

Despite impressive achievements in the science of climatology, estimating drought probability and frequency continues to be difficult. This is because of the many variables that contribute to weather behavior, climate change and the absence of long historic databases.

A comprehensive risk analysis is needed to fully assess the probability and impact of drought to Oregon communities. Such an analysis should be completed statewide to analyze and compare the risk of drought across the state.

Vulnerability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the region's vulnerability to drought is shown in **Table 2-266**. These cases are noted with a dash (—). See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-266. Local Vulnerability Assessment of Drought in Region 4

	Douglas (Non-Coastal)	Jackson	Josephine
Vulnerability	—	M	—

Source: Oregon Office of Emergency Management, November 2013, County Hazard Analysis Scores

State Assessment

Oregon has not undertaken a comprehensive statewide analysis to identify which communities are most vulnerable to drought. However, based on a review of Governor drought declarations since 1992, Region 4 is vulnerable to drought-related impacts. All three counties — Douglas, Josephine, and Jackson — have each received 4 drought declarations since 1992. These occurred in 1992, 1994, 2001, and 2002.

Earthquakes

Characteristics

The geographic position of this region makes it susceptible to earthquakes from four sources: (a) the off-shore Cascadia Fault Zone, (b) deep intra-plate events within the subducting Juan de Fuca plate, (c) shallow crustal events within the North America Plate, and (d) earthquakes associated with renewed volcanic activity.

This part of Oregon has experienced no historic earthquakes of any significance that were centered in the region. However, the region has been shaken historically by crustal and intraplate earthquakes and prehistorically by subduction zone earthquakes centered outside the area. All considered, there is good reason to believe that the most devastating future earthquakes would probably originate along shallow crustal faults in the region and along the Cascadia Fault Zone. The magnitude 7.3 deep-seated intraplate event centered near Brookings in 1873 was probably felt throughout Southwest Oregon. There have been no known intraplate events in the region's history or pre-history. The 1993 Klamath Falls earthquake was felt in the region, but no damage was reported.

Earthquakes produced through volcanic activity could possibly reach magnitudes of 5.5. The 1980 Mount St. Helens eruption was preceded by a magnitude 5.1 earthquake. Despite the fact that Cascade volcanoes are some distance away from the major population centers in Region 2, earthquake shaking and secondary earthquake-related hazards such as lahars could cause major damage to these centers.

Historic Earthquake Events

Table 2-267. Significant Earthquakes Affecting Region 4

Date	Location	Magnitude (M)	Remarks
Approximate Years: 1400 BCE*, 1050 BCE, 600 BCE, 400, 750, 900	offshore, Cascadia Subduction Zone	probably 8-9	based on studies of earthquake and tsunami at Willapa Bay, Washington; these are the mid-points of the age ranges for these six events
Jan. 1700	offshore, Cascadia Subduction Zone	approximately 9.0	generated a tsunami that struck Oregon, Washington, and Japan; destroyed Native American villages along the coast
Nov. 1873	Brookings area	7.3	chimneys fell at Port Orford, Grants Pass, and Jacksonville; no aftershocks; origin probably Gorda block of the Juan de Fuca plate; intraplate event
Apr. 14, 1920	Fort Klamath, Oregon	5.0	three shocks felt at Fort Klamath; center: probably in the vicinity of Crater Lake
Mar. 1993	Scotts Mills	5.6	$28 million in damage; damage to homes, schools, businesses, state buildings (Salem); crustal event (FEMA-985-DR-Oregon)
Sep. 1993	Klamath Falls	5.9 to 6.0	two earthquakes causing two deaths and extensive damage; $7.5 million in damage to homes, commercial, and government buildings; crustal event (FEMA-1004-DR-Oregon)

*BCE: Before Common Era.

Source: Wong and Bolt (1995)

Probability and Vulnerability

As stated in the **State Risk Assessment**, section, different methods are used to assess risk at local and state levels. All methods employ history, probability, and vulnerability data to determine probability and vulnerability scores for each hazard. These scores identify high-priority areas to which local and state governments can target mitigation actions. The challenge with these varied methodologies is that access to, interpretation of, and scale of the data are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and vulnerability scores are even quite different. The state recognizes these inconsistencies and has prioritized the analysis of local and state probability and vulnerability scores during the next plan update. A description of how the High (H), Moderate (M), and Low (L) scores in the local probability and vulnerability tables in this section were determined is provided in the State Risk Assessment **Section 2.2.2.2, Local Vulnerability Assessments**. The complete "OEM Hazard Analysis Methodology" is located in **Appendix 9.1.16**.

Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the probability that Region 4 will experience earthquakes is shown in **Table 2-268**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-268. Local Probability Assessment of Earthquake in Region 4

	Douglas (Non-Coastal)	Jackson	Josephine
Probability	M	M	M

Source: Oregon Office of Emergency Management, November 2013, County Hazard Analysis Scores

State Assessment

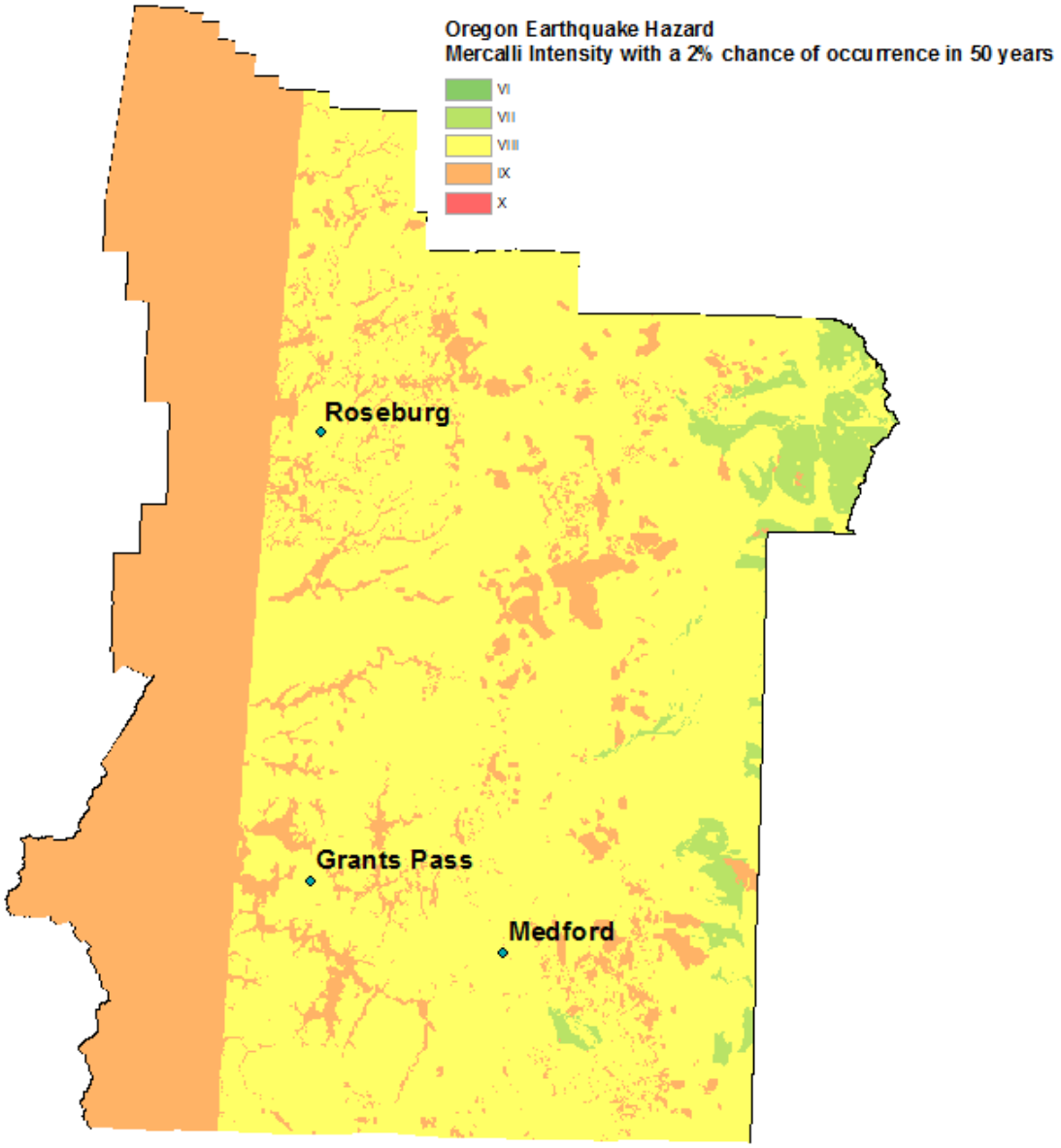
The probability of damaging earthquakes varies widely across the state. In Region 4 the hazard is dominated by Cascadia subduction earthquakes originating from a single fault with a well-understood recurrence history.

The probabilistic earthquake hazard for Region 4 is depicted in **Figure 2-150**. This map shows the expected level of earthquake damage that has a 2% chance of occurring in the next 50 years. The map is based on the 2008 USGS National Seismic Hazard Map and has been adjusted to account for the effects of soils following the methods of Madin and Burns (2013). In this case, the strength of shaking calculated as peak ground acceleration and peak ground velocity is expressed as Mercalli intensity, which describes the effects of shaking on people and structures. This map incorporates all that is known about the probabilities of earthquake on all Oregon faults, including the Cascadia Subduction Zone (CSZ).

For Oregon west of the crest of the Cascades, the CSZ is responsible for most of the hazard shown in **Figure 2-150**. The paleoseismic record includes 18 magnitude 8.8–9.1 megathrust earthquakes in the last 10,000 years that affected the entire subduction zone. The return period for the largest earthquakes is 530 years, and the probability of the next such event occurring in the next 50 years ranges from 7 to 12%. An additional 10–20 smaller, magnitude 8.3–8.5,

earthquakes affected only the southern half of Oregon and northern California. The average return period for these is about 240 years, and the probability of a small or large subduction earthquake occurring in the next 50 years is 37-43%

Figure 2-150. Probabilistic Earthquake Hazard in Region 4



Color zones show the maximum level of earthquake shaking and damage (Mercalli Intensity Scale) expected with a 2% chance of occurrence in the next 50 years. A simplified explanation of the Mercalli levels is:

VI	Felt by all, weak buildings cracked;
VII	Chimneys break, weak buildings damaged, better buildings cracked;
VIII	Partial collapse of weak buildings, unsecured wood frame houses move;
IX	Collapse and severe damage to weak buildings, damage to wood-frame structures; and
X	Poorly built structures destroyed, heavy damage in well-built structures.

Source: Madin and Burns (2013)

Vulnerability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the region's vulnerability to earthquakes is shown in **Table 2-269**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-269. Local Vulnerability Assessment of Earthquake in Region 4

	Douglas (Non-Coastal)	Jackson	Josephine
Vulnerability	M	H	H

Source: Oregon Office of Emergency Management, November 2013, County Hazard Analysis Scores

State Assessment

Region 4 is especially vulnerable to earthquake hazards because much of the area is susceptible to earthquake-induced landslides, liquefaction, or strong ground shaking. Based on DOGAMI's projected loss estimates to either a CSZ event or to combined crustal events using a 500-year model, all three counties in Region 4 are among the top 15 counties in the state projected to experience the greatest losses and damages.

In 2007, DOGAMI (Lewis, 2007) 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 a total of 3,349 buildings, giving each 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 (Lewis, 2007). 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 prioritize buildings for further study. **Table 2-270** shows the number of buildings surveyed in each county with their respective rankings.

Table 2-270. Building Collapse Potential in Region 4

Region 4 Counties	Level of Collapse Potential			
	Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100%)
Douglas*	74	45	40	10
Jackson	139	13	87	22
Josephine	37	15	16	1

*Does not include the Douglas County coastal communities of Gardiner, Reedsport, and Winchester Bay.

Source: Lewis (2007)

The Oregon Department of Geology and Mineral Industries (DOGAMI) has also developed two earthquake loss models for Oregon based on the two most likely sources of seismic events: (a) a Cascadia Subduction Zone (CSZ) 8.5 event, and (b) combined crustal events (using a 500-year

Model). Loss and damage estimates based on these models are founds in Table 2-271 and Table 2-272. For more information on these models, see the State Risk Assessment section.

Table 2-271. Projected Dollar Losses in Region 4, Based on an M8.5 Subduction Event and a 500-Year Model

Region 4 Counties	Economic Base Loss in Thousands (1999)	Greatest Absolute Loss in Thousands (1999) From an 8.5 CSZ Event	Greatest Absolute Loss in Thousands (1999) from a 500-Year (Crustal) Event
Douglas	$4,631,000	$275,000	$546,000
Jackson	$7,829,000	$538,000	$1,191,000
Josephine	$3,240,000	$593,000	$848,000

Source: Wang and Clark (1999)

Table 2-272. Estimated Damages and Losses in Region 4 Associated with Two Earthquake Models

	M8.5 CSZ Event			500-Year Model[1]		
Damage/Loss Type	Douglas	Jackson	Josephine	Douglas	Jackson	Josephine
Injuries	151	428	418	294	930	585
Deaths	2	8	7	4	18	11
Displaced households	255	650	573	534	1,458	872
Economic losses for buildings[2]	$275 m	$538 m	$593 m	$546 m	$1.2 b	$847 m
Operational the "day after" the event[3]:						
Fire stations	66%	75%	22%	N/A	N/A	N/A
Police stations	57%	62%	45%	N/A	N/A	N/A
Schools	44%	70%	34%	N/A	N/A	N/A
Bridges	74%	84%	73%	N/A	N/A	N/A
Economic losses to:						
Highways	$43 m	$10 m	$16 m	$69 m	$34 m	$29 m
Airports	$5 m	$2 m	$5 m	$9 m	$8 m	$10 m
Communications	$7 m	$2 m	$4 m	$12 m	$9 m	$8 m
Debris generated (thousands of tons)	222	434	476	411	889	614

Notes:

[1]Every part of Oregon is subject to earthquakes. The 500-year model is an attempt to quantify the risk across the state. The estimate does not represent a single earthquake. Instead, the 500-year model includes 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. More and higher magnitude earthquakes than used in this model may occur (DOGAMI, 1999).

[2]There are numerous unreinforced masonry structures (URMs) in Oregon, the currently available default building data does not include any URMs. Thus, the reported damage and loss estimates may seriously under-represent the actual threat" (Wang, 1998, p. 5)

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

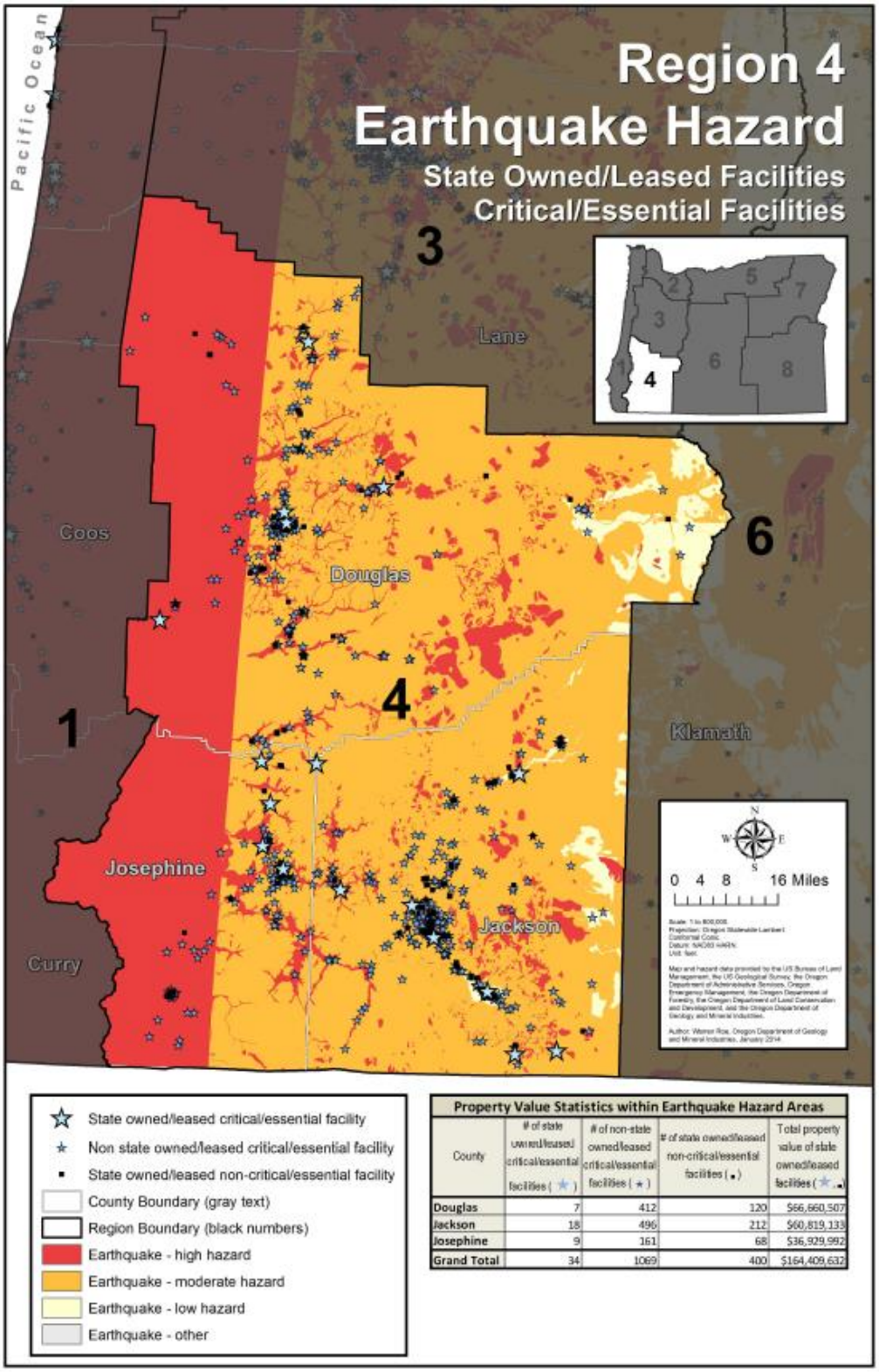
Source: Wang and Clark (1999)

STATE-OWNED/LEASED FACILITIES AND CRITICAL AND ESSENTIAL FACILITIES

The following information is based on a state-owned/leased facility and critical/essential facility vulnerability assessment update completed by DOGAMI in 2014. See the State Risk Assessment, **Oregon Vulnerabilities** section for more information

Of 5,693 state facilities evaluated, 434 totaling $164.4 million worth of property fall into an earthquake hazard zone in Region 4 (**Figure 2-151**). Among the 1,141 critical or essential state facilities, 34 are in an earthquake hazard zone in Region 4. Additionally, 1,069 non-state-owned/leased critical or essential facilities in Region 4 are located in an earthquake hazard zone.

Figure 2-151. State-Owned/Leased Facilities and Critical/Essential Facilities in an Earthquake Zone in Region 4



Property Value Statistics within Earthquake Hazard Areas

County	# of state owned/leased critical/essential facilities (★)	# of non-state owned/leased critical/essential facilities (★)	# of state owned/leased non-critical/essential facilities (▪)	Total property value of state owned/leased facilities (★ , ▪)
Douglas	7	412	120	$66,660,507
Jackson	18	496	212	$60,819,133
Josephine	9	161	68	$36,929,992
Grand Total	34	1069	400	$164,409,632

Source: DOGAMI

SEISMIC LIFELINES

"Seismic lifelines" are the state highways ODOT has identified as most able to serve response and rescue operations, reaching the most people and best supporting economic recovery. The process, methodology, and criteria used to identify them are described in **Section 2.2.2.6, Seismic Transportation Lifeline Vulnerabilities**, and the full report can be accessed at **Appendix 9.1.13**, *Statewide Loss Estimates: Seismic Lifelines Evaluation, Vulnerability Synthesis, and Identification* (OSLR). According to that report, seismic lifelines in Region 4 have the following vulnerabilities.

The following geographic zones identified in the OSLR are located within Region 4:

- *South I-5 Geographic Zone:* Region 4 is primarily in this geographic zone where the only recommended seismic lifeline is I-5 from Eugene to the California border. The entire area is likely to experience sustained ground shaking, with many roadways in areas subject to landslide and rockfall or liquefaction. All of I-5 in this zone was designated a Tier 1 route (highest priority roadway) due to its importance in the region and the lack of alternate corridors.
- *Cascades Geographic Zone:* Region 4 also includes the southerly portion of the Cascades Geographic Zone. The only seismic lifeline in this area is the Tier 2 route (second highest priority roadway) on OR-140 from Medford to US-97 in Klamath County, the southernmost route that can also serve as a connection from Medford to the Klamath Falls area in a seismic event. OR-140 is a mountain road that has risks related to dam failure, landslide, and rockfall and also runs through some high-water-table areas.
- *Coastal Geographic Zone:* Region 4 includes a Tier 3 lifeline (third highest priority) in the Coastal Zone: US-199 from I-5 to the Oregon-California border, connecting with US-101 near Crescent City, California. US-199 has a high risk of rockfall approaching its western end and also runs closely along a riverbed so may be vulnerable to liquefaction damage.

REGIONAL IMPACT. Routes in Region 4 are vulnerable to ground shaking, landslides, rockfall, and liquefaction.

- Ground Shaking: In Region 4 ground shaking will be the most significant vulnerability in populated areas. Unreinforced structures, roadbeds, and bridges will be damaged to varying extents from either a CSZ or Klamath Falls event.
- Landslides and Rockfall: Many roadways in the foothills within and around the valley include landslide prone features. A major seismic event will increase landslide and rockfall activities and may reactivate ancient slides that are currently inactive.
- Liquefaction: Structures in wetland, alluvial and other saturated areas, including the many Umpqua and Rogue River crossings, may be subject to liquefaction damage; the total area of such impacts will vary with the extent of saturated soils at the time of the event.

REGIONAL LOSS ESTIMATES. Economic losses caused by a CSZ event were not calculated for the specific zones of study or for specific highway facilities. The economic loss assessment statewide considered only the losses directly due to highway closures, so for example, it does not include productivity losses due to business site damage. The highway-related losses include

disconnection from supplies and replacement inventory and the loss of tourists and other customers who must travel to do business with affected businesses.

MOST VULNERABLE JURISDICTIONS. Inland Douglas, Jackson, and Josephine Counties are generally equally vulnerable to ground shaking from a CSZ event. A Klamath Falls event has the potential to affect Ashland and Jackson County more that it would Josephine or Douglas County. All three counties have steep rural areas and to some extent steep developed areas that may experience landslides. All three have some transportation facilities along river beds or river crossings that may be vulnerable to liquefaction. The biggest risk is from a CSZ event with an epicenter off the southern Oregon coast.

Floods

Characteristics

A number of large floods have been recorded in Southwest Oregon, many of which were very destructive. Recurrence is virtually assured, since some areas at risk are rapidly urbanizing. This region has the distinction of having two major rivers – the Umpqua and Rogue Rivers – that have their origins in the Cascade Mountains and continue to flow through the Coast Range to the Pacific Ocean. Their headwaters receive an abundance of mountain snow. At lower elevations they may receive runoff from intense Pacific storms, which are not uncommon in western Oregon. A combination of rapidly melting snow and intense rain can produce disastrous flood conditions. **Table 2-273** lists some significant floods that affected southwest Oregon communities. **Table 2-274** includes tributary streams that also have produced disastrous floods.

The physical beauty of the area has attracted a large number of people to various stream valleys, where they are placed at risk despite National Flood Insurance Program (NFIP) requirements. This is somewhat offset by Oregon's land use program, which generally prohibits the subdivision of farm and forestland for residential purposes.

Historic Flood Events

Table 2-273. Significant Historic Flood Events Affecting Region 4

Date	Location	Characteristics	Type of Flood
Mar. 1931	western Oregon	wet, mild weather; bridges and homes destroyed	rain on snow
Oct. 1950	southwest Oregon	severe flooding in Region 4; six fatalities; bridges and roads destroyed	rain on snow
Jan. 1962	western Oregon	heavy rain (3-4 inches in Rogue Valley); 84 people evacuated; great loss of farmland	rain on snow
Dec. 1964	entire state	infamous 1964 flood that has become an Oregon benchmark; record flows on Rogue and Umpqua Rivers	rain on snow
Jan. 1974	western Oregon	series of storms with mild temperatures; large snowmelt with rapid runoff	rain on snow
Jan. 1986	entire state	significant flooding in western Oregon attributable to warm, intense rain	snow melt
Jan. 1990	western Oregon	significant flooding in western Oregon	rain on snow
Nov. 1996	entire state	tropical air mass; intense rain; landslides; power outages (FEMA-1149-DR-Oregon)	rain on snow
Dec. 1996	entire state	mild weather continues; severe flooding in Ashland; FEMA declaration (FEMA-1160-DR-Oregon)	rain on snow
Dec. 2005	Douglas, Jackson and Josephine Counties	$2,840,000; damage estimate includes areas outside of Region 4	
June 2006	Jackson	heavy rain brought flash flooding to Jacksonville, but no reported damages	riverine
Aug. 2007	Jackson	heavy rains caused flash flooding near Ashland, no major estimated damages	riverine
Nov. 2012	Jackson	heavy rains resulted in at least 4 NFIP losses in the area around Central Point	riverine
Jan. 2012	Douglas	heavy rains resulted in at least two NFIP losses in the Roseburg areas	riverine

Source: Taylor and Hatton (1999); Hazards and Vulnerability Research Institute (2007). The Spatial Hazard Events and Losses Database for the United States, Version 5.1 [Online Database]. Columbia, SC: University of South Carolina. Available from http://www.sheldus.org; 2014 BureauNet; National Climatic Data Center, Storm Events, available at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvnt~Storms

Table 2-274. Principal Flood Sources by County in Region 4

Douglas (Non-Coastal)	Jackson	Josephine
North and South Umpqua Rivers and tributaries	Rogue River and tributaries	Rogue River and tributaries
Tributaries: Scholfield Creek Deer Creek North and South Myrtle Creeks Cow Creek Newton Creek	Tributaries: Jump Off Joe Creek Louse Creek Waters Creek Applegate River Slate Creek Murphy Creek Illinois Creek East and West Forks of the Illinois River Deer Creek	Tributaries: Lazy Creek Larson Creek Griffin Creek Pleasant Creek Foots Creek Little Butte Creek Lone Pine Creek Lassen Creek Crooked Creek Daisy Creek Evans Creek Wagner Creek Ashland Creek Colman Creek Clay Creek Bear Creek

Sources: FEMA, April 21, 1999, Douglas County Flood Insurance Study (FIS); and FEMA, May 15, 2002, Jackson County FIS; and FEMA, Sept 27, 1991, Josephine County FIS

Probability and Vulnerability

As stated in the State Risk Assessment, **Section 2.2.2.4, Local and State Vulnerability Assessment Comparison**, different methods are used to assess risk at local and state levels. All methods employ history, probability, and vulnerability data to determine probability and vulnerability scores for each hazard. These scores identify high-priority areas to which local and state governments can target mitigation actions. The challenge with these varied methodologies is that access to, interpretation of, and scale of the data are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and vulnerability scores are even quite different. The state recognizes these inconsistencies and has prioritized the analysis of local and state probability and vulnerability scores during the next plan update. A description of how the High (H), Moderate (M), and Low (L) scores in the local probability and vulnerability tables in this section were determined is provided in the State Risk Assessment **Section 2.2.2.2, Local Vulnerability Assessments**. The complete "OEM Hazard Analysis Methodology" is located in **Appendix 9.1.16**.

Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the probability that Region 4 will experience flooding is shown in **Table 2-275**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-275. Local Probability Assessment of Flood in Region 4

	Douglas (Non-Coastal)	Jackson	Josephine
Probability	H	H	H

Source: Oregon Office of Emergency Management, November 2013, County Hazard Analysis Scores

State Assessment

The Federal Emergency Management Agency (FEMA) has mapped most flood-prone streams in Oregon. The maps depict the 1% flood (100-year) upon which the National Flood Insurance Program is based. All of the Region 4 counties have digital Flood Insurance Rate Maps (FIRM); however, most of the modeling used to compile these maps is old and could be outdated. The effective FIRM maps are:

- Douglas, February 2010;
- Jackson, May 2011; and
- Josephine, December 2009.

Damaging floods occur approximately every 10-15 years.

According to the Draft Jackson County Hazard Mitigation Plan (2012) the most significant of the FEMA-determined floodplains and floodways surround the Rogue River, Bear Creek, Ashland Creek and Applegate River. Properties in and near the floodplains in the cities of Rogue River and Shady Cove are subject to frequent flooding events (http://www.co.jackson.or.us/Page.asp?NavID=3903, accessed 3/21/2014). The Rogue and Applegate Rivers also are sources of flooding in Josephine County, along with Slate Creek and the Illinois River. Rogue River flooding affects the City of Grants Pass and Illinois River flooding affects the City of Cave Junction (http://www.oregonriskmap.com/index.php/county-profiles/county-profiles/143-example-county-profile-template-sp-23168, accessed 3/21/2014).

In Douglas County the highest stream flows in the Umpqua River basin usually occur during November through March as a result of heavy winter rains augmented by snowmelt. Most of the flooding occurs in the valley areas of the South Umpqua and Umpqua Rivers, although the tributary streams of Cow Creek, Calapooya Creek, and Elk Creek also have extensive flood plains. Most of the land subject to flooding along the South Umpqua River is below Days Creek. Because these valleys are the most densely populated and intensively developed in Douglas County, the principal flood problems occur along this stream. Flood potential also exists along the Umpqua River between Elkton and the confluence of the North and South Umpqua Rivers. In the Glendale-Azalea valley of Cow Creek, much bank erosion and channel shifting occurs during floods (http://www.oregonriskmap.com/index.php/county-profiles/county-profiles/142-douglas, accessed 3/21/2014).

Vulnerability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers the region's vulnerability to flooding is shown in **Table 2-276**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-276. Local Vulnerability Assessment of Flood in Region 4

	Douglas (Non-Coastal)	Jackson	Josephine
Vulnerability	H	M	M

Source: Oregon Office of Emergency Management, November 2013, County Hazard Analysis Scores

State Assessment

The Oregon Department of Land Conservation and Development (DLCD) created a countywide flood vulnerability index by compiling data from NOAA's Storm Events Database and from FEMA's National Flood Insurance Program. Data were calculated statewide for the period 1978 through 2013 for five input datasets: number of events, structure and crop damage estimates in dollars and NFIP claims number and dollar amounts. The mean and standard deviation were calculated for each input. Then, each county was assigned a score ranging from 0 to 3 for each of these inputs according to **Table 2-277**.

Table 2-277. Scoring for Vulnerability Index

Score	Description
3	county data point is greater than 2.5 times standard deviation for the input data set
2	county data point is greater than 1.5 times standard deviation for the input data set
1	county data point is within standard deviation
0	no data reported

Source: DLCD

DLCD summed the scores for each of the five inputs to create a county-by-county vulnerability index. The maximum possible score is 15. A score over 6 indicates that at least one variable significantly exceeds average values.

Each county in Region 4 received a flood vulnerability score of 6, which is about average. A portion of Douglas County is in Region 1, but the vulnerability scoring process could only calculate scores countywide.

Josephine and Jackson County's Hazard Mitigation Plans report flood hazard probability is high but vulnerability as moderate. No explanation of these results was provided (http://www.co.jackson.or.us/Page.asp?NavID=3903, accessed 3/21/2014; http://jocosheriff.us/your-sheriffs-office/emergency-management/nhmp, accessed 3/21/2014)., Douglas County cited insufficient information to estimate countywide vulnerability (http://www.co.jackson.or.us/Page.asp?NavID=3903, accessed 3/21/2014).

FEMA has identified 18 Repetitive Loss properties in Region 4, none of which are Severe Repetitive Loss properties.

Communities can reduce the likelihood of damaging floods by employing floodplain management practices that exceed NFIP minimum standards. DLCD encourages communities that adopt such standards to participate in FEMA's Community Rating System (CRS), which results in reduced flood insurance costs. Douglas and Jackson Counties participate in CRS, as do the cities of Ashland, Central Point, Grants Pass, Medford, Rogue River, Roseburg, and Talent.

Table 2-278. Flood Severe/Repetitive Losses and Community Rating System Communities by County in Region 4

County	RL	SRL	# of CRS Communities per County
*Douglas	6	—	2
Jackson	7	—	6
Josephine	5	—	1
Totals	**18**	**0**	**9**

*Includes non-coastal sections of Douglas County

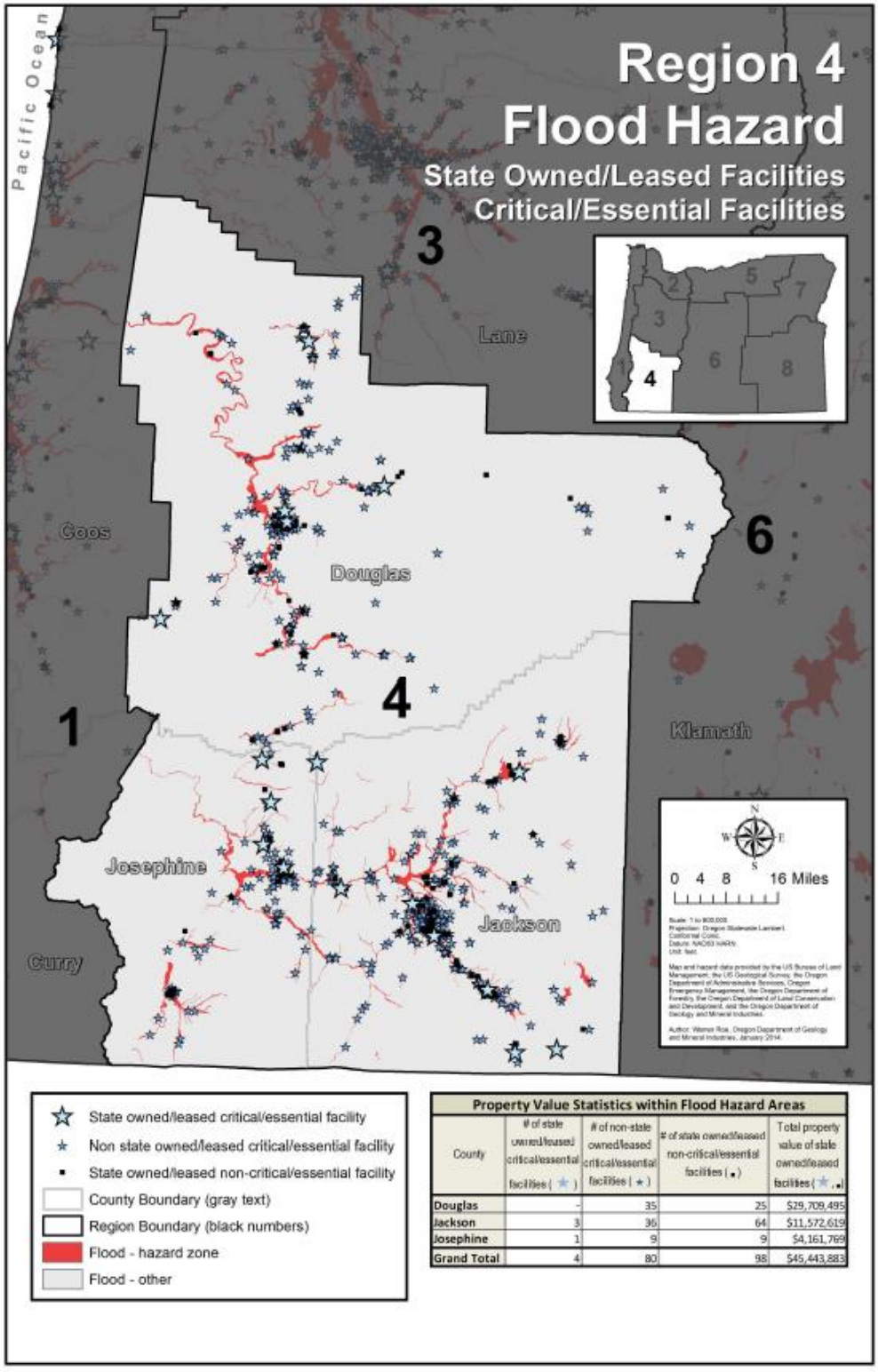
Source: FEMA NFIP BureauNet, http://bsa.nfipstat.fema.gov/, accessed 12/1/2014

State-Owned/Leased Facilities and Critical and Essential Facilities

The following information is based on a state-owned/leased facility and critical/essential facility vulnerability assessment update completed by DOGAMI in 2014. See the State Risk Assessment, **Oregon Vulnerabilities** section for more information.

Of the 5,693 state facilities evaluated, 102 are currently located within a flood hazard zone in Region 4 and have an estimated total value of $45.4 million (**Figure 2-152**). Of these, four are identified as a critical or essential facility. An additional 80 non-state-owned/leased critical or essential facilities are located in a flood hazard zone in Region 4.

Figure 2-152. State-Owned/Leased Facilities and Critical/Essential Facilities in a Flood Zone in Region 4



Property Value Statistics within Flood Hazard Areas

County	# of state owned/leased critical/essential facilities (★)	# of non-state owned/leased critical/essential facilities (★)	# of state owned/leased non-critical/essential facilities (▪)	Total property value of state owned/leased facilities (★, ▪)
Douglas	-	35	25	$29,709,495
Jackson	3	36	64	$11,572,619
Josephine	1	9	9	$4,161,769
Grand Total	4	80	98	$45,443,883

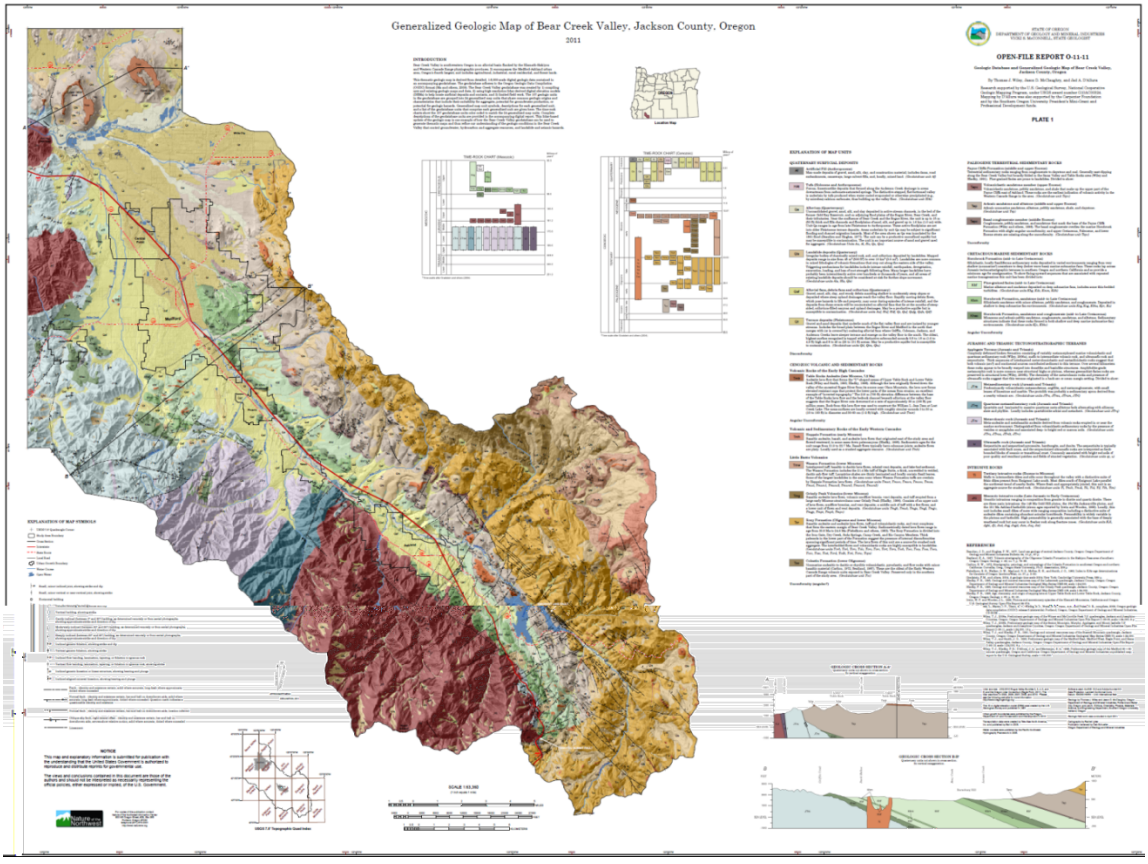
Source: DOGAMI

Landslides

Characteristics

Landslides occur throughout this region of the state, although areas with steeper slopes, weaker geology, and higher annual precipitation tend to have more landslides. In general, the Klamath Mountains have a high incidence of landslides. On occasion, major landslides sever major transportation routes such as U.S. or state highways and rail lines, causing temporary but significant economic damage. For example, new geologic mapping of the Medford area found 1,734 landslide, debris fan, and colluvium deposits indicating a high level of hazard in this small area (**Figure 2-153**).

Figure 2-153. Generalized Geologic Map of Bear Creek Valley, Jackson County, Oregon



Source: Wiley et al. (2011)

Historic Landslide Events

Table 2-279. Historic Landslide Events in Region 4

Date	Location	Incident
Jan. 1974	near Canyonville, Oregon	nine employees working in a telephone building were killed when the building was pushed by a mudslide into Canyon Creek
Feb. 1996		heavy rains and rapidly melting snow contributed to hundreds of landslides / debris flows across the state; many occurred on clear cuts that damaged logging roads
Nov. 1996	Lane and Douglas Counties	heavy rain triggered mudslides (Lane and Douglas Counties); eight fatalities and several injuries (Douglas County)

Source: Taylor and Hatton (1999)

Probability and Vulnerability

As stated in the State Risk Assessment, **Section 2.2.2.4, Local and State Vulnerability Assessment Comparison**, different methods are used to assess risk at local and state levels. All methods employ history, probability, and vulnerability data to determine probability and vulnerability scores for each hazard. These scores identify high-priority areas to which local and state governments can target mitigation actions. The challenge with these varied methodologies is that access to, interpretation of, and scale of the data are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and vulnerability scores are even quite different. The state recognizes these inconsistencies and has prioritized the analysis of local and state probability and vulnerability scores during the next plan update. A description of how the High (H), Moderate (M), and Low (L) scores in the local probability and vulnerability tables in this section were determined is provided in the State Risk Assessment **Section 2.2.2.2, Local Vulnerability Assessments**. The complete "OEM Hazard Analysis Methodology" is located in **Appendix 9.1.16**.

Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the probability that Region 4 will experience landslides is shown in **Table 2-280**. In some cases, counties either did not rank a particular hazard or did not find it to be a significant consideration. These cases are noted with a dash (—). See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-280. Local Probability Assessment of Landslide in Region 4

	Douglas (Non-Coastal)	Jackson	Josephine
Probability	H	H	—

Source: Oregon Office of Emergency Management, November 2013, County Hazard Analysis Scores

State Assessment

Landslides are found in every county in Oregon. There is a 100% probability of landslides occurring in this region in the future. Although we do not know exactly where and when they will occur, they are more likely to happen in the general areas where landslides have occurred in the past. Also, they will likely occur during heavy rainfall events or during a future earthquake.

Vulnerability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the region's vulnerability to landslides is shown in **Table 2-281**. In some cases, counties either did not rank a particular hazard or did not find it to be a significant consideration. These cases are noted with a dash. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-281. Local Vulnerability Assessment of Landslides in Region 4

	Douglas (Non-Coastal)	Jackson	Josephine
Vulnerability	M	L	—

Source: Oregon Office of Emergency Management, November 2013, County Hazard Analysis Scores

State Assessment

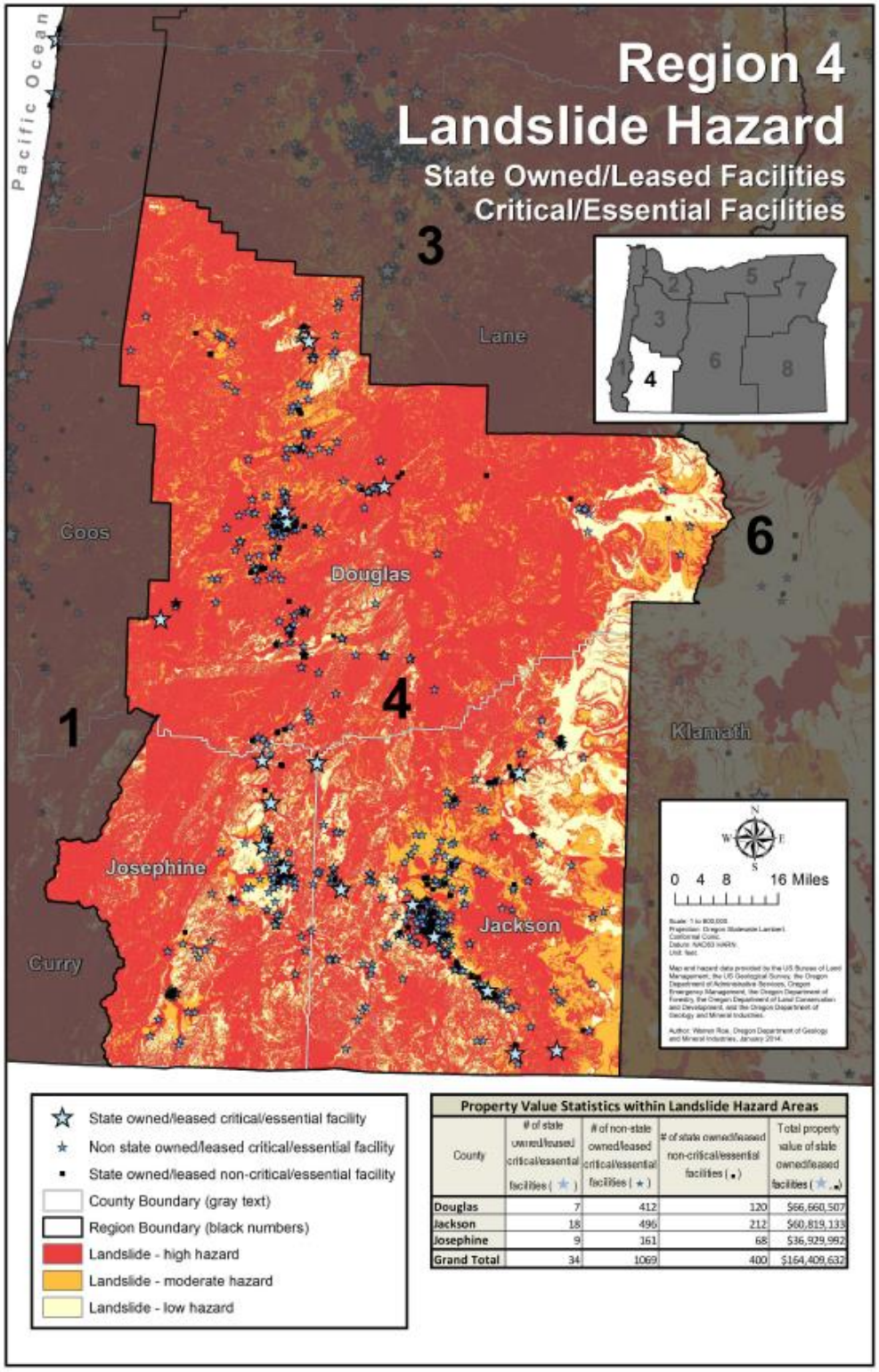
Many of the communities in this region are vulnerable to landslides; for example, the city of Medford and Ashland have a moderate exposure to landslides.

STATE-OWNED/LEASED FACILITIES AND CRITICAL AND ESSENTIAL FACILITIES

The following information is based on a state-owned/leased facility and critical/essential facility vulnerability assessment update completed by DOGAMI in 2014. See the State Risk Assessment, **Oregon Vulnerabilities** section for more information.

Of the 5,693 state facilities evaluated, 434 are located within landslide hazard areas in Region 4, totaling roughly $164.4 million (**Figure 2-154**). This includes 34 critical or essential facilities. An additional 1,069 critical or essential facilities not owned/leased by the state are located within a landslide hazard zone in Region 4.

Figure 2-154. State-Owned/Leased Facilities and Critical/Essential Facilities in a Landslide Hazard Zone in Region 4



Property Value Statistics within Landslide Hazard Areas

County	# of state owned/leased critical/essential facilities (★)	# of non-state owned/leased critical/essential facilities (★)	# of state owned/leased non-critical/essential facilities (▪)	Total property value of state owned/leased facilities (★, ▪)
Douglas	7	412	120	$66,660,507
Jackson	18	496	212	$60,819,133
Josephine	9	161	68	$36,929,992
Grand Total	34	1069	400	$164,409,632

Source: DOGAMI

Volcanoes

Characteristics

The eastern boundaries of Douglas and Jackson Counties coincide with the crest of the Cascade Mountains, a volcanic range. The Cascade Mountains are still active as has been demonstrated by Mount St. Helens in Washington State. Volcanic activity in the Cascades will continue, but questions regarding how, to what extent, and when, remain. Both Douglas and Jackson Counties are at some risk from volcano-associated hazards however remote. Josephine County is west of the Cascade Mountains and is not subject to the same risks.

Southwest Oregon communities are close to several prominent volcanic peaks, one of which is a national park (Crater Lake). The other peaks include Mount Bailey (elevation 8,363 ft), Mount Thielsen (9,182 ft), and Mount McLaughlin (9,495 ft). Of the three, Crater Lake (6,178 ft) may pose the greatest risk. It is a caldera and the remnant of a mountain (Mount Mazama) that probably had an elevation between 10,800 and 12,000 ft. The massive eruption, which produced the caldera, took place about 7,700 years ago. The long history at Mount Mazama strongly suggests that this volcanic center will be active in the future (Bacon et al., 1997). The presence of the lake means that any future eruption likely will be violent; there are many examples of explosive activity brought about by magma coming into contact with water.

Douglas and Jackson Counties should consider the impact of volcano-related activity on small mountain communities, tourist attractions (e.g., Crater Lake) dams, reservoirs, and highways. These counties also should consider probable impacts on the local economy (e.g., wood products, tourism, and recreation).

Historic Volcanic Events

Table 2-282. Historic Volcanic Events in Region 4

Date	Location	Description
about 7,780 to 15,000 YBP	Cinnamon Butte, southern Cascades	basaltic scoria cone and lava flows
about 7,700 YBP	Crater Lake Caldera	formation of Crater Lake caldera, pyroclastic flows, widespread ashfall

Note: YBP is years before present.

Sources: U.S. Geological Survey, Cascades Volcano Observatory: http://volcanoes.usgs.gov/observatories/cvo/; Bacon et al. (1997)

Probability and Vulnerability

As stated in the State Risk Assessment, **Section 2.2.2.4, Local and State Vulnerability Assessment Comparison**, different methods are used to assess risk at local and state levels. All methods employ history, probability, and vulnerability data to determine probability and vulnerability scores for each hazard. These scores identify high-priority areas to which local and state governments can target mitigation actions. The challenge with these varied methodologies is that access to, interpretation of, and scale of the data are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and

vulnerability scores are even quite different. The state recognizes these inconsistencies and has prioritized the analysis of local and state probability and vulnerability scores during the next plan update. A description of how the High (H), Moderate (M), and Low (L) scores in the local probability and vulnerability tables in this section were determined is provided in the State Risk Assessment **Section 2.2.2.2, Local Vulnerability Assessments**. The complete "OEM Hazard Analysis Methodology" is located in **Appendix 9.1.16**.

Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the probability that Region 4 will experience volcanic hazards is shown in **Table 2-283**. In some cases, counties either did not rank a particular hazard or did not find it to be a significant consideration. These cases are noted with a dash (—). See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-283. Local Probability Assessment of Volcanic Activity in Region 4

	Douglas (Non-Coastal)	Jackson	Josephine
Probability	—	L	—

Source: Oregon Office of Emergency Management, November 2013, County Hazard Analysis Scores

State Assessment

There is virtually no risk from volcanoes in Josephine County, other than the possibility of ashfall. Ashfall could come from several sources in the Cascade Range, including Mount Shasta in California or Crater Lake in Oregon. The probability of ashfall totaling 1 cm or more in Josephine County, from any Cascade volcano, is about 1 in 10,000.

Douglas and Jackson Counties are at greater risk of volcanic hazards. The probability of a 1 cm or greater ashfall varies from 1 in 5,000 to 1 in 10,000 (Sherrod et al., 1997).

Based on the total number of eruptive episodes in the past 100,000 years, the average recurrence interval in the Crater Lake area is about 10,000 years. The annual probability of an eruption then, is about 1 in 10,000; the 30-year probability is about 1 in 330 (Bacon et al., 1997). The probability of an event is summarized in **Table 2-284** for each of the counties in Region 4.

Table 2-284. Probability of Volcano-Related Activity in Region 4

Volcano-Related Hazard	Douglas	Josephine	Jackson	Remarks
Volcanic ash (annual probability of 1 cm or more accumulation from eruptions throughout the Cascade Range)	1 in 5,000 to 1 in 10,000	1 in 10,000	1 in 5,000 to 1 in 10,000	Sherrod et al. (1997)
Lahar	Source: Crater Lake	no risk	Source: Crater Lake	Bacon et al. (1997)
Lava flow	no risk	no risk	no risk	Bacon et al. (1997)
Debris flow / avalanche	no risk	no risk	Source: Crater Lake	Bacon et al. (1997)
Pyroclastic flow	Source: Crater Lake	no data available	Source: Crater Lake	Bacon et al. (1997)

Sources: Sherrod et al. (1997); Bacon et al. (1997)

Vulnerability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the region's vulnerability to volcanic hazards is shown in **Table 2-285**. In some cases, counties either did not rank a particular hazard or did not find it to be a significant consideration. These cases are noted with a dash (—). See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-285. Local Vulnerability Assessment of Volcanic Activity in Region 4

	Douglas (Non-Coastal)	Jackson	Josephine
Vulnerability	—	L	—

Source: Oregon Office of Emergency Management, November 2013, County Hazard Analysis Scores

State Assessment

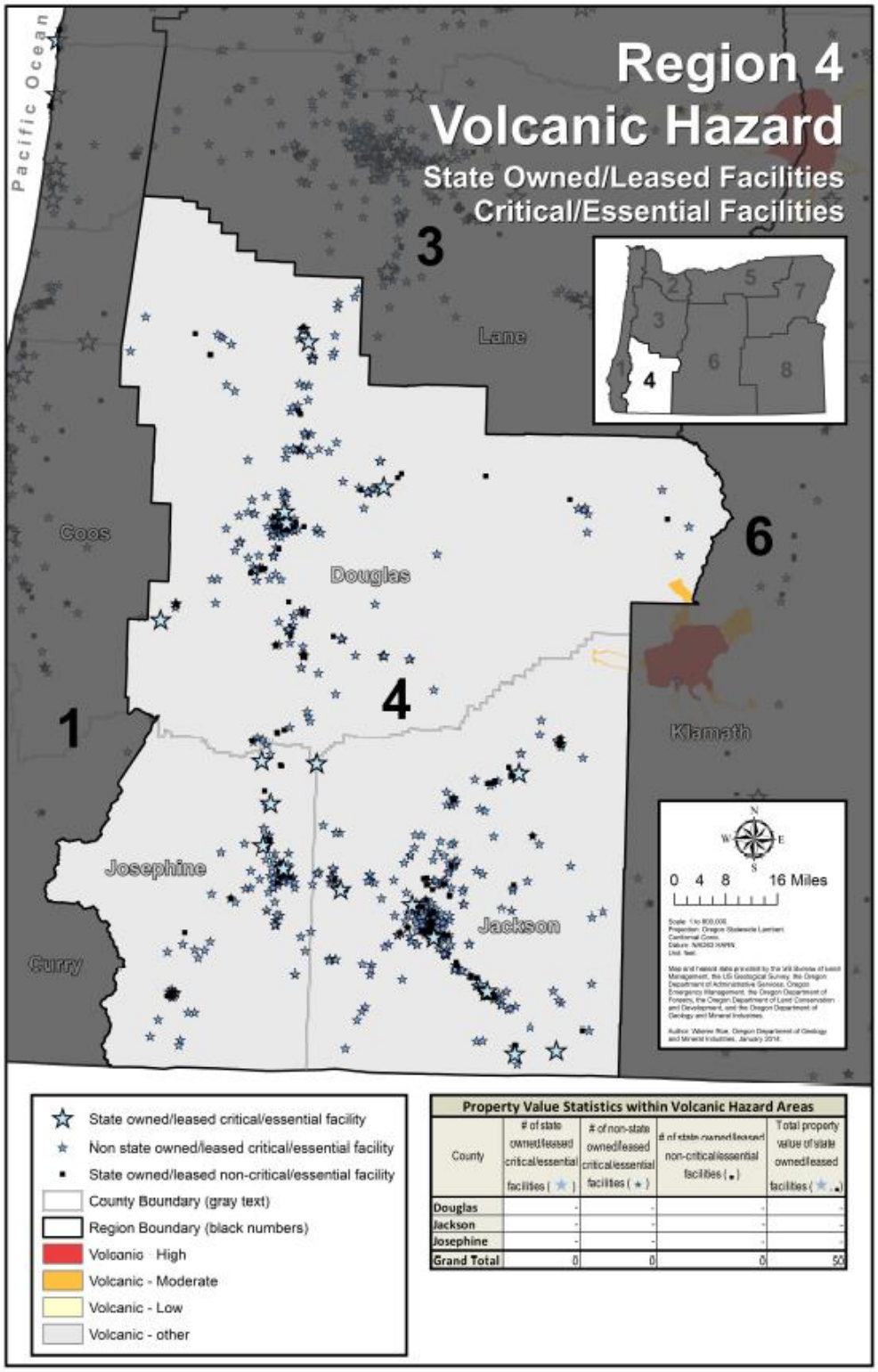
The U.S. Geological Survey has addressed volcanic hazards in the Crater Lake region (Bacon et al., 1997). This report includes maps depicting the areas at greatest risk. The park itself is in the greatest risk category. In Douglas County, the upper reaches of the Umpqua and Clearwater rivers are subject to volcano-associated hazards, as is the OR-62 corridor in Jackson County (Bacon et al., 1997; http://pubs.usgs.gov/of/1997/0487/). There is virtually no risk from volcanoes in Josephine County, other than the possibility of ashfall.

STATE-OWNED/LEASED FACILITIES AND CRITICAL AND ESSENTIAL FACILITIES

The following information is based on a state-owned/leased facility and critical/essential facility vulnerability assessment update completed by DOGAMI in 2014. (See the State Risk Assessment, **Oregon Vulnerabilities** for more information.

Of the 5,693 state facilities evaluated, none are located within a volcanic hazard area in Region 4. Furthermore, there are no non-state-owned/leased critical or essential facilities located within a volcanic hazard zone in Region 4 (**Figure 2-155**).

Figure 2-155. State-Owned/Leased Facilities and Critical/Essential Facilities in a Volcanic Activity Hazard Zone in Region 4



Property Value Statistics within Volcanic Hazard Areas

County	# of state owned/leased critical/essential facilities (★)	# of non-state owned/leased critical/essential facilities (★)	# of state owned/leased non-critical/essential facilities (▪)	Total property value of state owned/leased facilities (★ , ▪)
Douglas	-	-	-	-
Jackson	-	-	-	-
Josephine	-	-	-	-
Grand Total	0	0	0	50

Source: DOGAMI

Wildfires

Characteristics

While the residents in Region 4 enjoy moderate winters, during the summer residents can expect long drought periods, low humidity with temperatures that sometimes exceed 100 °F, and frequent lightning storms. Some landscapes are affected by autumn east winds that occur when stable air pushes across a mountain range and then descends on the leeward side. The air becomes warmer and drier as it descends and can lead to increased, sometimes extreme, fire behavior in lower lee-side locations.

Summers in Region 4 bring perfect weather conditions for extreme wildfires. Lightning strikes are frequent during the summer months, and the numerous strikes have the potential to ignite numerous fires.

Fire exclusion in Region 4 has created vegetation and fuel conditions for large and catastrophic fires that are more difficult to suppress than smaller fires. Throughout the watersheds, forests present a continuous fuel supply both vertically, in small, thin trees and dead branches (*ladder fuels*), and horizontally, in an abundance of dead and downed material. When a fire gets started in such a forest, the dead branches, sticks, twigs, and other material increase fire intensity and, with ladder fuels present, provide great opportunity for the fire to reach the forest canopy, resulting in a stand-killing crown fire. These conditions also affect the means in which prescribed fire and fuels treatment are applied to the landscape.

Current climate conditions, especially in drought years, influence the frequency, intensity, duration, and extent of fire. Summers are dry and lightning prone because a Pacific coast high-pressure system typically blocks precipitation for much of the season. In the upper elevations, where temperatures are low and rainfall is high, fires are less frequent than in the valleys. Larger climatic factors such as long-term global variations related to El Niño or to sunspot cycles also influence fire regimes, but this influence is confounded by local climatic variations, recent land management activities, and burns.

Historic Wildfire Events

Table 2-286 describes some of the more noteworthy fires in Oregon's history.

Table 2-286. Historic Wildfires in Region 4

Year	Name of Fire	County	Acres Burned	Remarks
1951	Hubbard Creek, Russell Creek, Vincent Creek Fires	Douglas	16,094	the Hubbard Creek Fire burned 15,774 acres and destroyed 18 homes; the Russell Creek Fire burned 350 acres and killed one person; the Vincent Creek Fire burned 23,000 acres near Scottsburg
1966	Oxbow Fire	Douglas	43,368	the Oxbow Fire killed one person
1987	Bland Mountain	Douglas	10,300	near Canyonville; 14 structures lost, 2 people killed
1992	E. Evans Creek	Jackson	10,135	four structures lost
1994	Hull Mountain	Jackson	8,000	one life and 44 structures were lost; the fire was an act of arson
1994	Sprignett Butte	Jackson	1,631	arson
2000	Antioch road	Jackson	376	
2002	Squires Peak/Wall Creek	Jackson	3,125	
2002	Timbered Rock	Jackson	27,111	
2002	Biscuit	Curry, Josephine	500,000	estimated to be one of Oregon's largest in recorded history, the Biscuit Fire encompassed most of the Kalmiopsis Wilderness
2003	Cove Road	Jackson	700	3 miles east of Ashland
2004	Bland Mtn. #2	Douglas	4,700	two homes lost
2008	Doubleday	Jackson	1,244	threatened Butte Falls
2010	Oak Knoll Fire	Jackson County	< 100	Oak Knoll Fire in Ashland destroyed 11 homes in less than 45 minutes
2013	Douglas Complex	Douglas, Josephine, Wasco, Grant	48,324	combined with fires in Region 5, 6, and 7, the most acres burned in since 1951 on lands protected by the Oregon Department of Forestry
2013	Brimstone	Josephine	2,377	part of southern Oregon fire storm that included the Douglas Complex above
2013	Big Windy	Josephine	26,725	part of southern Oregon fire storm that included Brimstone and Douglas Complex; one firefighter death

Source: 2013 Fire Statistics, Oregon Department of Forestry

Probability and Vulnerability

As stated in the State Risk Assessment, **Section 2.2.2.4, Local and State Vulnerability Assessment Comparison**, different methods are used to assess risk at local and state levels. All methods employ history, probability, and vulnerability data to determine probability and vulnerability scores for each hazard. These scores identify high-priority areas to which local and state governments can target mitigation actions. The challenge with these varied methodologies is that access to, interpretation of, and scale of the data are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and vulnerability scores are even quite different. The state recognizes these inconsistencies and has prioritized the analysis of local and state probability and vulnerability scores during the next plan update. A description of how the High (H), Moderate (M), and Low (L) scores in the local probability and vulnerability tables in this section were determined is provided in the State Risk Assessment **Section 2.2.2.2, Local Vulnerability Assessments**. The complete "OEM Hazard Analysis Methodology" is located in **Appendix 9.1.16**.

Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the probability that Region 4 will experience wildfire is shown in **Table 2-287**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-287. Local Probability Assessment of Wildfire in Region 4

	Douglas (Non-Coastal)	Jackson	Josephine
Probability	H	H	H

Source: Oregon Office of Emergency Management, 2013, County Hazard Analysis Scores

State Assessment

Hot and dry summers combined with frequent lightning events, rugged terrain, and an abundance of fuels makes Region 4 a hotbed of fire activity. Historically, some of Region 4's largest fires have been caused by human activity. While lightning-caused fires accounted for nearly 70% of the fires in 2013, the 10-year average for lightning-caused fires is closer to 25%.

Vulnerability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the region's vulnerability to wildfire is shown in **Table 2-288**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-288. Local Vulnerability Assessment of Wildfire in Region 4

	Douglas (Non-Coastal)	Jackson	Josephine
Vulnerability	H	M	M

Source: Oregon Office of Emergency Management, November 2013, County Hazard Analysis Scores

State Assessment

Region 4 is one of the state's regions most susceptible to wildfire. Based on data from the 2013 West Wide Wildfire Risk Assessment, all counties in Region 4 have a high percentage of wildland acres subject to Fire Risk, Wildland Development Areas, Fire Effects, or Fire Threat, making them especially vulnerable. Note: WWRA data does not differentiate between coastal and non-coastal Douglas County. Therefore, all of Douglas County is considered most vulnerable to wildfire.

Douglas, Josephine, and Jackson Counties are made up of several smaller communities that lie within the wildland-urban interface and have a distinct vulnerability to wildfire given their proximity to forestland, high summer temperatures, rugged terrain, and likelihood of summer thunderstorm activity. The human element is a factor as well with several populations intermixed in wildland areas. Arson continues to be a concern in this part of the state as well as the high number of fires caused by debris burning and equipment use.

Table 2-289. Region 4 Wildland-Urban Interface Communities

Douglas		Jackson	Josephine
Azalea	Lelomo Lake	Antelope Creek	Galice
Camas Valley	Lookingglass	Applegate	Grants Pass
Canyonville	Myrtle Creek	Ashland	Illinois Valley
Curtin	Oakland	Butte Falls	Merlin
Days Creek	Rice Hill	Colestin	Murphy
Diamond Lake	Riddle	Crow Foot	Oregon Caves
Dillard	Roseburg	Elk Creek	Selma
Dixonville	Steamboat	Gold Hill	Sunny Valley
Drain	Sutherlin	Green Springs	Wilderville
Dry Creek	Tenmile	Jacksonville	Williams
Elkton	Tiller	Lake Creek	Wolf Creek
Fair Oaks	Toketee	Medford	
Glenbrook	Tri City	Prospect	
Glendale	Umpqua	Rogue River	
Glide	Union Gap	Sams Valley	
Green Acres	Wilber	Shady Cove	
Winston	Wolf Creek	Trail	
Yoncalla		Union Creek	
		Upper Applegate	
		Wimer	

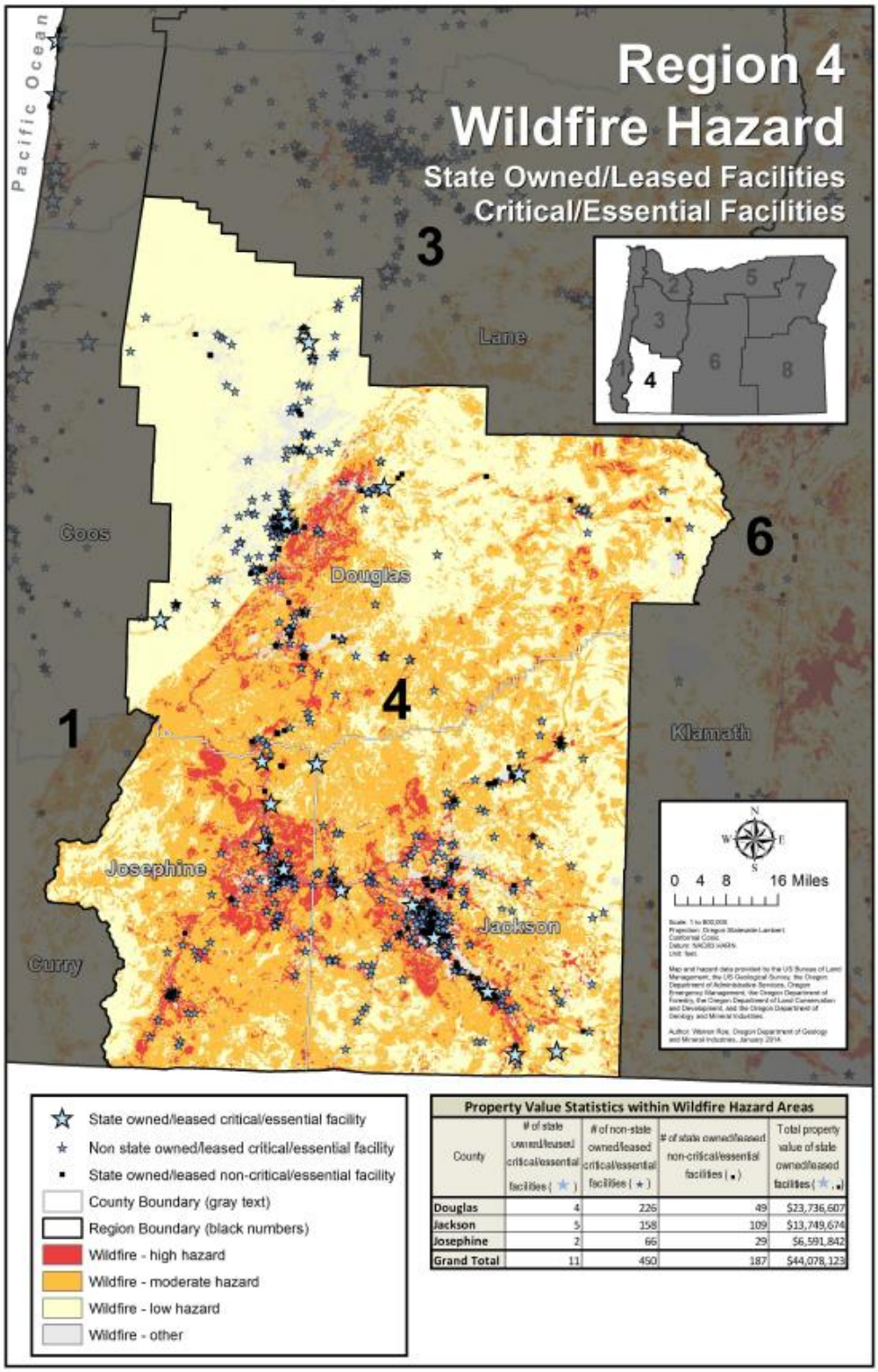
Source: ODF Statewide Forest Assessment September, 2006

STATE-OWNED/LEASED FACILITIES AND CRITICAL AND ESSENTIAL FACILITIES

The following information is based on a state-owned/leased facility and critical/essential facility vulnerability assessment update completed by DOGAMI in 2014. See the State Risk Assessment, **Oregon Vulnerabilities** for more information.

Of the 5,693 state facilities evaluated, 198 are within a wildfire hazard zone in Region 4 and total about $44 million in value (**Figure 2-156**). Among state-owned/leased critical or essential facilities, 11 have a wildfire hazard in any category. An additional 408 non-state-owned/leased critical or essential facilities are located in Region 4.

Figure 2-156. State-Owned/Leased Facilities and Critical/Essential Facilities in a Wildfire Zone in Region 4



Property Value Statistics within Wildfire Hazard Areas

County	# of state owned/leased critical/essential facilities (★)	# of non-state owned/leased critical/essential facilities (★)	# of state owned/leased non-critical/essential facilities (▪)	Total property value of state owned/leased facilities (★ , ▪)
Douglas	4	226	49	$23,736,607
Jackson	5	158	109	$13,749,674
Josephine	2	66	29	$6,591,842
Grand Total	11	450	187	$44,078,123

Source: DOGAMI

Windstorms

Characteristics

Extreme winds (other than tornadoes) are experienced in all of Oregon's eight regions. A majority of the destructive surface winds in Oregon are from the southwest. Under certain conditions, very strong east winds may occur, but these usually are limited to small areas in the vicinity of the Columbia River Gorge or other low mountain passes. The much more frequent and widespread strong winds from the southwest are associated with storms moving onto the coast from the Pacific Ocean. If the winds are from the west, they may be stronger on the coast than in the interior valleys because of the north-south orientation of the Coast Range and Cascades. These mountain ranges obstruct and slow down the westerly surface winds. The most destructive winds are those which blow from the south, parallel to the major mountain ranges. The Columbus Day Storm of 1962 was a classic example of such a storm, and its effects were so devastating that it has become the benchmark from which other windstorms in Oregon are measured. The storm caused significant damage in Region 4.

Tornadoes have not been recorded in Jackson, Josephine, or central Douglas Counties.

Historic Windstorm Events

Table 2-290. Historic Windstorms in Region 4

Date	Affected Area	Characteristics
Apr. 1931	western Oregon	unofficial wind speeds reported at 78 mph; damage to fruit orchards and timber
Nov. 10-11, 1951	statewide	widespread damage; transmission and utility lines; wind speed 40–60 mph; gusts 75–80 mph
Dec. 1951	statewide	wind speed 60 mph in Willamette Valley; 75-mph gusts; damage to buildings and utility lines
Dec. 1955	statewide	wind speeds 55–65 mph with 69-mph gusts; considerable damage to buildings and utility lines
Nov. 1958	statewide	wind speeds at 51 mph with 71-mph gusts; every major highway blocked by fallen trees
Oct. 1962	statewide	Columbus Day Storm; Oregon's most destructive storm to date; 116 mph winds in Willamette Valley; estimated 84 houses destroyed, with 5,000 severely damaged; total damage estimated at $170 million
Mar. 1971	most of Oregon	greatest damage in Willamette Valley; homes and power lines destroyed by falling trees; destruction to timber in Lane County
Nov. 1981	most of Oregon	highest winds since Oct. 1962; wind speed 71-mph in Salem; marinas, airports, and bridges severely damaged
Jan. 1990	statewide	heavy rain with winds exceeding 75 mph; significant damage; one fatality
Dec. 1995	statewide	followed path of Columbus Day Storm; wind speeds 62 mph in Willamette Valley; damage to trees (saturated soil a factor) and homes
Nov. 1997	western Oregon	wind speed 52 mph in Willamette Valley; trees uprooted; considerable damage to small airports
Feb. 2002	western Oregon	strongest storm to strike western Oregon in several years; many downed power lines (trees); damage to buildings; water supply problems (lack of power); estimated damage costs: $6.14 million
Feb. 2004	Jackson County	heavy winds caused $4,000 in damages in Jackson County
Dec. 2006	Douglas and Josephine Counties	high winds up to 90 mph caused $150,000 in damages in Douglas and Josephine; the storm also impacted Coos and Curry Counties for a storm damage total of $300,000
July 2007	Josephine and Jackson Counties	severe thunderstorms with winds up to 60 mph down numerous trees damaging vehicles and trailers; $100,000 in damage in Jackson County; lightning struck the steeple of a church in Josephine County, causing $60,000 in damages

Sources: Taylor and Hatton (1999); Hazard Mitigation Team Survey Report, Severe Windstorm in Western Oregon, February 7, 2002 (FEMA-1405-DR-OR); Hazards and Vulnerability Research Institute (2007). The Spatial Hazard Events and Losses Database for the United States, Version 5.1 [Online Database]. Columbia, SC: University of South Carolina. Available from http://www.sheldus.org ; National Climatic Data Center, Storm Events, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms

Probability and Vulnerability

As stated in the State Risk Assessment, **Section 2.2.2.4, Local and State Vulnerability Assessment Comparison**, different methods are used to assess risk at local and state levels. All methods employ history, probability, and vulnerability data to determine probability and vulnerability scores for each hazard. These scores identify high-priority areas to which local and state governments can target mitigation actions. The challenge with these varied methodologies is that access to, interpretation of, and scale of the data are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and vulnerability scores are even quite different. The state recognizes these inconsistencies and has prioritized the analysis of local and state probability and vulnerability scores during the next plan update. A description of how the High (H), Moderate (M), and Low (L) scores in the local probability and vulnerability tables in this section were determined is provided in the State Risk Assessment **Section 2.2.2.2, Local Vulnerability Assessments**. The complete "OEM Hazard Analysis Methodology" is located in **Appendix 9.1.16**.

Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the probability that Region 4 will experience windstorms is shown in **Table 2-291**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-291. Local Probability Assessment of Windstorm in Region 4

	Douglas (Non-Coastal)	Jackson	Josephine
Probability	H	H	H

Source: Oregon Office of Emergency Management, 2013, County Hazard Analysis Scores

State Assessment

The 100-year event in Region 4 consists of 1-minute average winds of 80 mph. A 50-year event is 70 mph. A 25-year event has average winds of 60 mph.

Vulnerability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the region's vulnerability to windstorms is shown in **Table 2-292**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-292. Local Vulnerability Assessment of Windstorm in Region 4

	Douglas (Non-Coastal)	Jackson	Josephine
Vulnerability	M	H	H

Source: Oregon Office of Emergency Management, November 2013, County Hazard Analysis Scores

State Assessment

Many buildings, utilities, and transportation systems within Region 4 are vulnerable to wind damage. This is especially true in open areas, such as natural grasslands or farmlands. It also is true in forested areas, along tree-lined roads and electrical transmission lines, and on residential parcels where trees have been planted or left for aesthetic purposes. Structures most vulnerable to high winds include insufficiently anchored manufactured homes and older buildings in need of roof repair.

Fallen trees are especially troublesome. They can block roads and rails for long periods and can affect emergency operations. In addition, uprooted 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. Many roofs have been destroyed by uprooted ancient trees growing next to a house. In some situations, strategic pruning may be the answer. Prudent counties will work with utility companies to identify problem areas and establish a tree maintenance and removal program.

Winter Storms

Characteristics

Severe winter weather in Region 4 can be characterized by extreme cold, snow, ice, and sleet. In higher elevations such as the lower Cascade Range and the Siskiyou Mountains and passes, moderate to heavy snowfall is expected on an annual basis. Some Region 4 communities are unprepared, financially and otherwise, for the impact of severe winter storms. An historical summary of extreme winter conditions in this region is shown in **Table 2-293**.

Historic Winter Storm Events

Table 2-293. Severe Winter Storms in Region 4

Date	Location	Characteristics
Dec. 1861	statewide	snow covered entire Pacific Northwest 1–3 feet
Jan. 1916	statewide	two snow storms, each totaling 5 inches or more
Jan. 1932	SW Oregon mountains	Crater Lake record snowfall: 879 inches
Jan.- Feb. 1937	statewide	heavy snow throughout state
Jan. 1950	statewide	heaviest snowfall since 1890; highway closures; considerable property damage
Jan. 1951	Crater Lake, Oregon	new annual record snowfall at Crater Lake
Jan. 1956	western Oregon	packed snow became ice; automobile accidents throughout region
Mar. 1960	statewide	snowfall: 3–12 inches; over 100 accidents in Marion County
Jan. 1969	statewide	Lane County surpassed old snowfall record; 47 inches in Eugene ; $3 to $4 million in property damage
Jan. 1980	statewide	a series of storms bringing snow, ice, wind, and freezing rain; six fatalities
Feb. 1985	statewide	2-4 inches of snow in western valleys; massive power failures (tree limbs broke power lines)
Feb. 1986	Cascades, Oregon	heavy snowfall
Mar. 1988	statewide	strong winds and heavy snow
Feb. 1989	statewide	heavy snowfall and record low temperatures
Nov. 1989	Siskiyou, Oregon	unusually heavy snowfall
Dec. 1992	western Oregon	heavy snow; interstate highway closed
Feb. 1993	western Oregon	record snowfall at Salem airport
Winter 1998-1999	statewide	series of storms; one of the snowiest winters in Oregon history
Winter 2003-2004	statewide	most significant winter storm in several years brought snowfall to most of Oregon; largest snowstorm in the Siskiyou Pass (Jackson County) in a quarter century; shut down I- 5

Source: Taylor and Hatton (1999)

Source: Oregon Department of Transportation, 2008. *State Natural Hazards Mitigation Plan*, Winter Storm chapter.

Probability and Vulnerability

As stated in the State Risk Assessment, **Section 2.2.2.4, Local and State Vulnerability Assessment Comparison**, different methods are used to assess risk at local and state levels. All methods employ history, probability, and vulnerability data to determine probability and vulnerability scores for each hazard. These scores identify high-priority areas to which local and state governments can target mitigation actions. The challenge with these varied methodologies is that access to, interpretation of, and scale of the data are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and vulnerability scores are even quite different. The state recognizes these inconsistencies and has prioritized the analysis of local and state probability and vulnerability scores during the next plan update. A description of how the High (H), Moderate (M), and Low (L) scores in the local probability and vulnerability tables in this section were determined is provided in the State Risk Assessment **Section 2.2.2.2, Local Vulnerability Assessments**. The complete "OEM Hazard Analysis Methodology" is located in **Appendix 9.1.16**.

Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the probability that Region 4 will experience winter storms is shown in **Table 2-294**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-294. Local Probability Assessment of Winter Storms in Region 4

	Douglas (Non-Coastal)	Jackson	Josephine
Probability	H	H	H

Source: Oregon Office of Emergency Management, November 2013, County Hazard Analysis Scores

State Assessment

Winter storms occur annually in Region 4. On the basis of historical data, severe winter storms could occur about every 4 years in this region. We can expect to have continued annual storm events in this region. However, there are no solid statistical data available upon which to base these judgments. There is no statewide program to study the past, present, and potential impacts of winter storms in the state of Oregon at this time. Higher elevations through the Siskiyou Mountains and the Cascade Range are expected to have higher annual snowfall amounts and this is planned for at the state and local level.

Vulnerability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the region's vulnerability to winter storms is shown in **Table 2-295**. See the State Risk Assessment for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-295. Local Vulnerability Assessment of Winter Storms in Region 4

	Douglas (Non-Coastal)	Jackson	Josephine
Vulnerability	H	H	H

Source: Oregon Office of Emergency Management, November 2013, County Hazard Analysis Scores

State Assessment

All three counties in Region 4 are impacted by severe winter storms. The I-5 corridor passes through the Siskiyou Mountains in this region and is key to intermodal transportation. As well as the link to California and commodity flow. Severe winter storms can shut down this vital link for extended periods and can have a direct adverse impact on Oregon's economy.