Chapter 2 RISK ASSESSMENT

In This Chapter

The Oregon NHMP Risk Assessment chapter is divided into three sections: 1) introduction, 2) state risk assessment, and 3) regional risk assessment. Following is a description of each section.

1. **Introduction:** States the purpose of the risk assessment and understanding 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; characterizing each hazard that impacts Oregon; listing historic events; identifying the probability of future events; and introducing 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.

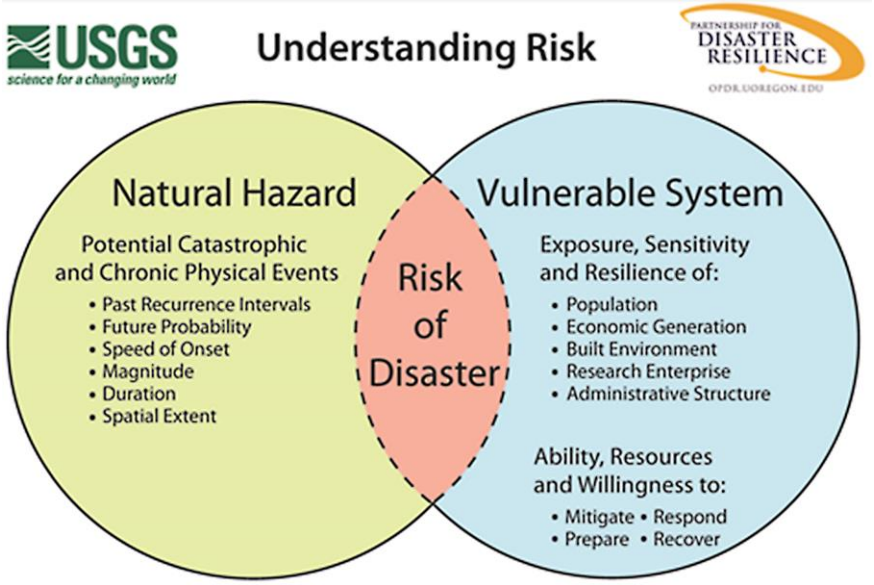
2.1 Introduction

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 the 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 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 the damages, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: 1) the magnitude of the harm that may result, defined through vulnerability assessments, and 2) 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.

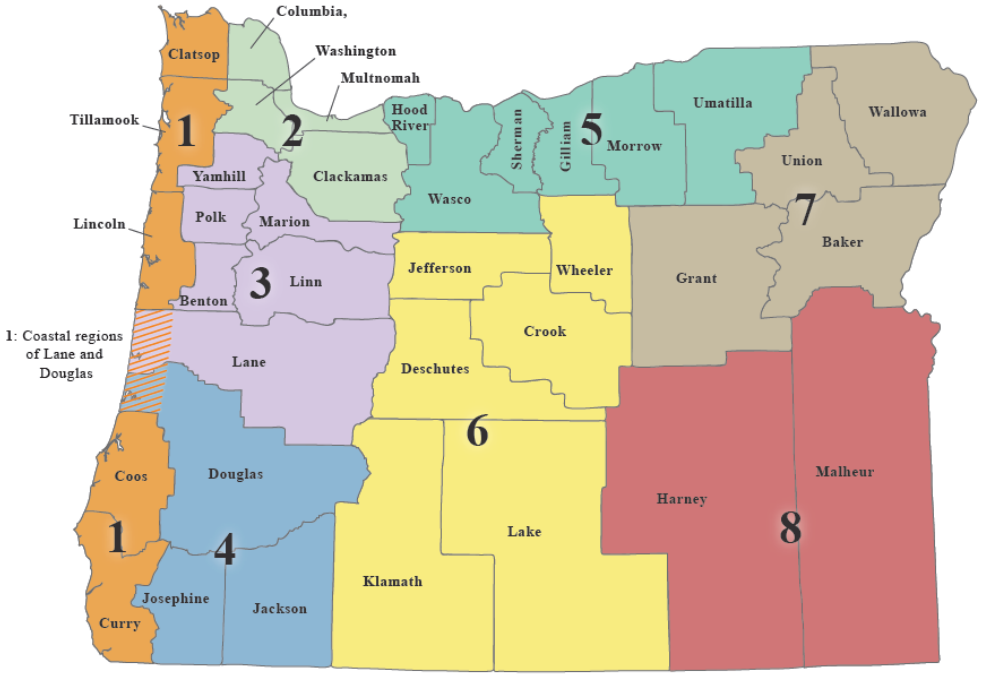
This plan also analyzes risk at the regional level. Regional risk assessments begin with a description of the region's assets in the Regional Profile section. The Profile is followed by a characterization of each hazard and identification of the vulnerabilities and potential impacts of each hazard. Regions are defined by the Oregon NHMP Natural Hazard Regions, which include:

- 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
- Region 8: Southeast: Harney and Malheur Counties

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 2-80**). 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 2-80. Oregon NHMP Natural Hazard 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.

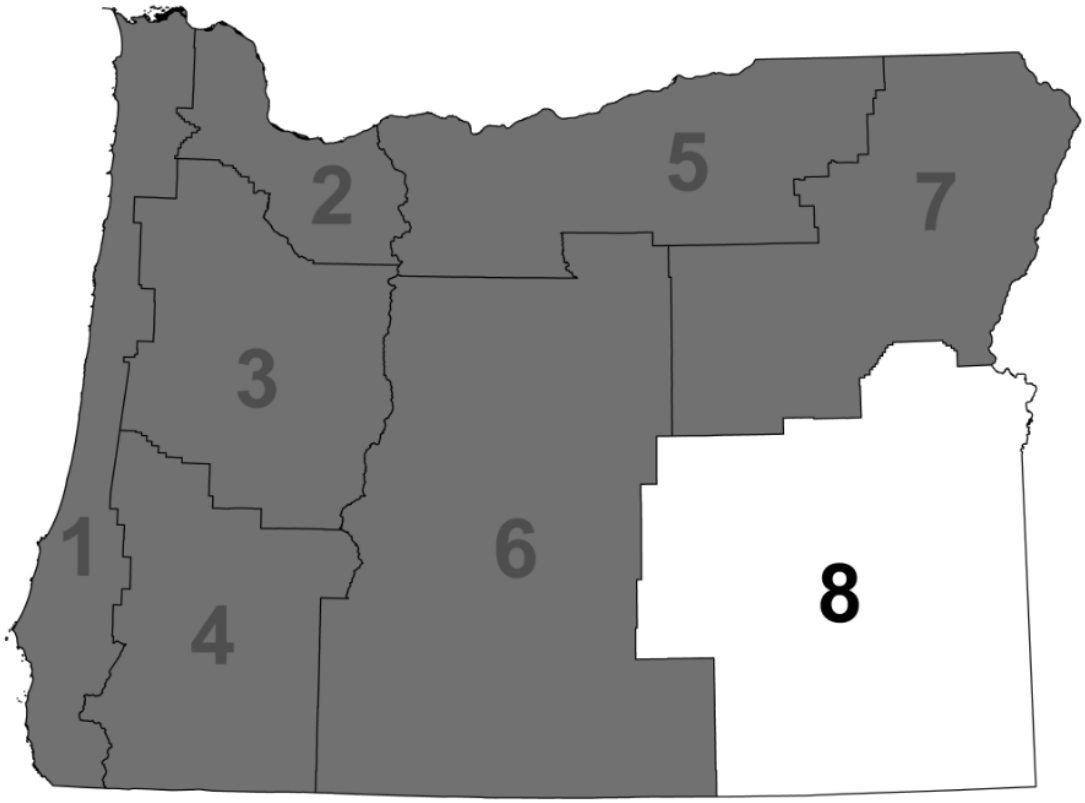
   The research of Susan Cutter, Professor of Geography at the University of South Carolina, Columbia, on vulnerability and environmental hazards provides the framework for discussion of vulnerability in the Regional Profile section. Cutter's framework helps to illustrate the geographic variability of vulnerability 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.

2.3.8 Region 8: Southeast Oregon

Harney and Malheur Counties



2.3.8.1 Summary

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.

Regionally, social vulnerability in Region 8 is driven by a declining population, low median household incomes and high levels of poverty. In Harney County there is also a high percentage of the population with disabilities and a high percentage of seniors. In Malheur County there are more tourists, higher percentages of people who do not speak English very well, a significant drop in already low incomes, and more family households with children.

This region is still recovering from the financial crisis that began in 2007. There are few key industries and employment sectors in Northeast Oregon. Regional wages remain below state averages. Harney County continues to suffer from a high unemployment. Damage or service interruption to roads, bridges, rail systems andports can have devastating effects the region's economy. Roads and railways are susceptible to winter storms and flooding. Many of the bridges in the area are distressed or deficient.

Wells and rivers are primary sources of drinking water for the region. The quality of these water bodies can be threatened by regional agricultural practices that use pesticides and herbicides and by naturally occurring minerals in the soil. Malheur Lake is especially vulnerable to high mineral content in soils.

Southeast Oregon has two power-generating facilities, one hydroelectric facility and one geothermal facility. Oil and natural gas pipelines and electricity transmission lines running through this region support the regional economy and are vulnerable to disruptions and damage due to natural hazard events.

Region 8 is largely rural and is losing population. The region has a high share of mobile homes and homes built before floodplain management and seismic building standards. This coupled with the lack of modernized Flood Insurance Rate Maps (FIRMs) increase the vulnerability of development in Southeast Oregon.

Hazards and Vulnerability

Region 8 is affected by nine of the 11 natural hazards that affect Oregon communities. Coastal hazards and tsunamis do not directly impact this region.

Drought: Droughts are common in Region 8, and have a significant economic impact on agricultural, livestock, and natural resources. The U.S. Department of Agriculture designated drought in Malheur and Harney County as primary natural disasters in May and June of 2013. Malheur County is considered one of the most vulnerable counties to drought in Oregon.

Dust Storms: Dust Storms occur when strong winds carry fine silt, sand, and clay particles into the air. These storms may carry particles over hundreds of miles, over 10,000 feet, and at least 25 miles per hour. Dust Storms are most common over areas of dry land prevalent within this region. Malheur County is considered one of the most vulnerable counties to dust storms in the state.

Earthquakes: Two types of earthquakes affect Region 8—shallow crustal events and earthquakes associated with volcanic activity. Region 8 is moderately vulnerable to earthquake-induced landslides, liquefaction, and ground shaking. There are 211 State-owned/leased facilities in this region, valuing over $284.5 million. Of these, 53 are critical/essential facilities. An additional 153 non-State-owned/leased critical/essential facilities are also located within this hazard zone.

Flooding: Floods affect Southeast Oregon in the form of riverine flooding often preceded by rapid snowmelt during unseasonably warm winters, ice jams, and closed basin playa flooding. Flash floods and associated summer thunderstorms are also possible. Both counties are considered to have a moderately low vulnerability to the flood hazard. However, the City of Burns has a high ratio of special flood hazard area to city area. There are 36 State-owned/leased facilities located in the region's flood hazard zone valuing approximately $14.7 million. Of these, six are considered critical/essential facilities. An additional 48 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. In general, landslide vulnerability for Region 8 is low to moderate. However, there are some areas that have very high landslide risk: the Summer Lake area along Highway 31, around Lakeview, and along Highway 395. There are 266 State-owned/leased facilities in this region valuing over $303 million. Of these, 64 are critical/essential facilities. An additional 192 non-State-owned/leased critical/essential facilities are also located within this hazard zone.

Volcanoes: Though the volcanic Cascade Range is not in Region 8 and vulnerability to effects of volcanic eruptions is low, there is some threat of distal ash fall from Cascade volcanic eruptions. More locally, the region is also vulnerable to small eruptions of lava from the numerous youthful volcanic cones scattered across Harney and Malheur Counties. The communities in Southeast Oregon most vulnerable to volcanic activity are the Cities of Burns, Ontario, and Jordan Valley.

Wildfire: The region's arid climate, frequent lightning strikes, large tracts of ponderosa pine forests (primarily in the northern part of Harney County), and grasslands all contribute to Northeast Oregon's vulnerability to wildfire. Past management practices that suppressed all wildfires and favored growth of a brushy understory and accumulation of dead or dying trees

leads to devastating fires today. State and federal agencies seek to alleviate the problem through a controlled burning program. Areas of higher vulnerability are within wildland-urban interface communities. There are 117 State-owned/leased facilities located in this region's wildfire hazard zone with a value of approximately $41 million. Of these, 19 are identified as critical/essential facilities. An additional 135 non-State-owned/leased critical/essential facilities are also located in this hazard zone.

Windstorms: Windstorms in Region 8 are commonly associated with thunderstorms. Wind storms can be especially problematic in burn areas, where dust becomes airborne causing reductions in visibility and localized damage. Windstorms generally affect the region's buildings, utilities, tree-lined roads, transmission lines, residential parcels and transportation systems along open areas such as grasslands and farmland. Small tornadoes also have the potential to impact this region.

Winter Storms: This region is known for winter storms that bring colder weather and 24 inches of snow annually. These storms are more frequent at higher elevations in the Wallowa Mountains. Winter storms can disrupt transportation along the Interstate-5 corridor and over mountain passes. Moderate to heavy snow fall is expected in this region and therefore residents and tourists are usually prepared for them.

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 8 include drought and wildfire. 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 an increased incidence of drought and wildfire. An increase in drought could result in the increase incidence of dust storms; though no current research is available on the direct effects of future climate conditions on the incidence of dust storms. Areas that have historically been both hotter and drier than the statewide average—such as Eastern Oregon counties—are at somewhat higher risk of increased drought and wildfire than the state overall. While winter storms and windstorms affect Region 8, there is insufficient research available indicating any change in the incidence of either in Oregon due to changing climate conditions. For more information on climate drivers and the projected impacts of climate change in Oregon, see the section **Introduction to Climate Change**.

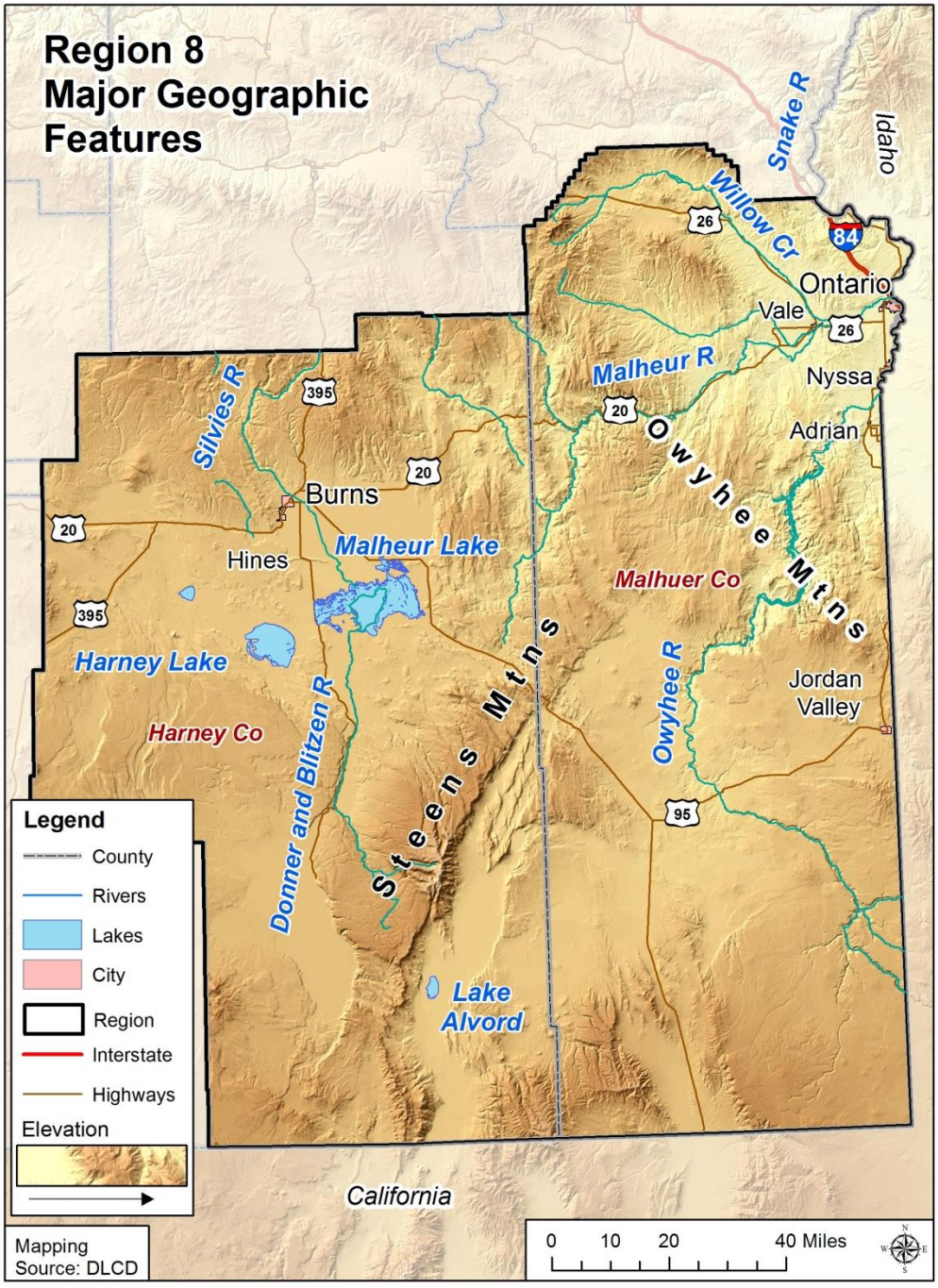
2.3.8.2 Profile

Natural Environment

Geography

Southeastern Oregon is approximately 20,023 square miles in size and includes Harney and Malheur Counties. The region is bordered to the east by Idaho and to the south by Nevada and California. The Blue Mountains lie in the northern part of the region. The Steens Mountain is a prominent landmass in the region and major rivers in the region include the Malheur and Owyhee.

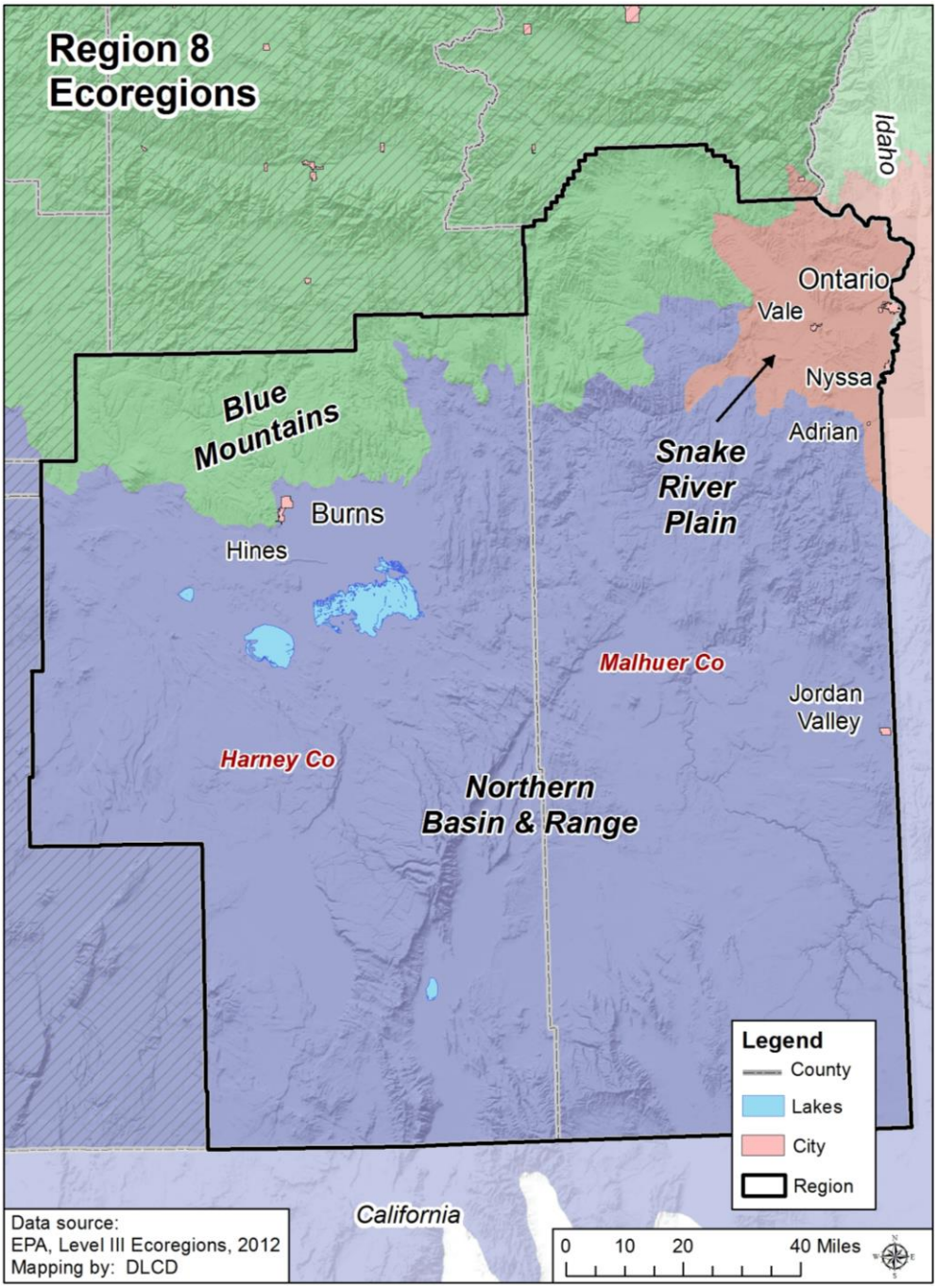
Figure 2-216. Region 8 Major Geographic Features



Source: Department of Land Conservation and Development, 2014

The U.S. EPA's ecoregions are used to describe areas of ecosystem similarity. Region 8 is comprised of three ecoregions: Northern Basin and Range, Blue Mountains and Snake River Plain (**Figure 2-217**).

Figure 2-217. Region 8 Ecoregions



Blue Mountains: The Region 8 section of tis ecoregion is complex and diverse with many subecoregions with unique conditions. In general, the Blue Mountains have dry Continental climate with Marine intrusions because of proximity to the Columbia Gorge. The landscape varies between steep sloped mountains of volcanic origin, scattered cinder cones, foothills, and scattered buttes and the Cold Basins, which contain cold, wet valleys, and basins. Forested areas may have ponderosa pine, mixed fir, or juniper canopies. Unforested areas are generally sagebrush steppes or wetlands with vegetation such as sedges and associated grasses. Land uses in the area are primarily livestock grazing and wildlife habitat (Thorson et al., 2003).

Northern Basin and Range: This ecoregion dominates Region 8 with dissected lava plains, rolling hills, alluvial fans, valleys, deep river canyons, and scattered mountains. Because of the ecoregion's location in the rain shadow of the Cascades and Blue Mountains, most areas are arid aside from the semiarid uplands. Basaltic rock, tuffaceous rock, or other volcanic ash generally underlies the geology, while soil generally varies between sediments, alluvial, colluvial and fluvial deposits, and rock outcrops. Land cover varies between sagebrush steppe, grasslands, rare wetlands, and Aspen stands in riparian meadows, and unvegetated deserts. Landuses in this ecoregion include recreation, wildlife habitat including federal wildlife refuges, and limited livestock grazing (Thorson et al., 2003).

Snake River Plan: The Region 8 portion of the Snake River Plain ecoregion is classified as the "Unwooded Alkaline Foothills" and "Treasure Valley," which are underlain by volcanic and sedimentary rocks with alkaline lacustrine sediments and alluvium, loess, lacustrine and alluvial fan deposits at the surface. The landscape includes valleys, incised rivers, canals, rolling foothills, hills, benches, alluvial fans, and badlands. The land cover is dominated by sagebrush steppe with Wyoming big sagebrush, basin big sagebrush and associated grasses. Land uses in this ecoregion include croplands, primarily for potatoes, onions, beets, alfalfa, hay, wheat and sugar, as well as pastureland, and wildlife habitat (Thorson et al., 2003).

Climate

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

Region 8 has diverse ecoregions with varying climatic conditions with the majority of the region's land divided almost equally between the three ecoregions. The region's predominantly arid climate supports limited agricultural activities, primarily livestock grazing. The region is subject drought, floods, landslides, and wildfires. 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 2-481** shows mean annual precipitation and temperatures for the three ecoregions in Region 8. Temperature and precipitation vary widely by subecoregion and microclimates. For more detailed and locally relevant climate data refer to the Oregon Climate Service.

Table 2-481. Average Precipitation and Temperature Ranges in Region 8 Ecoregions

Ecoregion	Mean Annual Precipitation Range (inches)	Mean Temperature Range (°F) January min/max	Mean Temperature Range (°F) July min/max
Northern Basin and Range*	6–45	17/42	42/88
Blue Mountains*	9–35	16/39	43/84
Snake River Plain*	8–12	19/35	57/96

*Data have been generalized from all the sub-ecoregions of the ecoregion in Region 8.

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 forecasted to increase substantially, a community's capacity to provide adequate housing stock, services, or resources for all populations post disaster may be stressed or compromised.

Overall, between 2000 and 2013, Region 8 lost population. Harney County lost a greater share of its population. By 2020, the region is expected to grow at about half the rate of the state with Malheur County projected to grow at a higher rate than Harney.

Table 2-482. Population Estimate and Forecast for Region 8

	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 8	39,224	38,700	-1.3%	40,127	3.7%
Harney	7,609	7,260	-4.6%	7,404	2.0%
Malheur	31,615	31,440	-0.6%	32,723	4.1%

Source: Population Research Center, Portland State University, 2013; U.S. Census Bureau, 2000 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 8 are largely centered on outdoor activities (hiking/backpacking, visiting national/state parks etc.), touring (traveling to experience scenic beauty, history and culture), and special events (such as fairs, festivals or sporting events) (Longwoods Travel USA., 2011d). Note that the Longwoods Travel Report includes all of the Region 8 counties; Baker, Grant, Union, and Wallowa (Region 7); and Morrow, Umatilla, and parts of Gilliam Counties within the Eastern Region. Approximately 8% (2.2 million) of all overnight visitor trips to Oregon included time within Region 8. Three fourths of all trips to the region occur between April and September and the average travel party contains 3.8 persons. The average trip length is 4.3 nights (Longwoods Travel USA., 2011d).

Annually there are about twice as many tourists in Malheur County than Harney County. Visitors to Malheur County are more likely to stay in hotels, motels, or private homes. In Harney County visitors are just as likely to be lodged in hotels, motels, private homes, or other accommodations.

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 outreach efforts to places where tourist lodge can help increase awareness of hazards in the area and minimize the vulnerability of this population group.

Table 2-483. Annual Visitor Estimates in Person Nights in Region 8

	2011		2012		2013	
	Number	Percent	Number	Percent	Number	Percent
Region 8	874	—	892	—	866	—
Harney	249	100%	259	100%	251	100%
Hotel/Motel	84	33.7%	93	35.9%	87	34.7%
Private Home	74	29.7%	74	28.6%	70	27.9%
Other	91	36.5%	92	35.5%	94	37.5%
Malheur	625	100%	633	100%	615	100%
Hotel/Motel	221	35.4%	228	36.0%	214	34.8%
Private Home	307	49.1%	308	48.7%	303	49.3%
Other	97	15.5%	97	15.3%	98	15.9%

Source: Oregon Travel Impacts: 1991–2013, April 2014. Dean Runyan Associates, http://www.deanrunyan.com/doc_library/ORImp.pdf

Persons with Disabilities

Disabilities appear in many forms. While some disabilities may be easily identified, others may be less perceptible. Persons with disabilities, while difficult to identify and measure, are disproportionately affected during disasters (Cutter et al., 2003). More people in Region 8 identify as having a disability than do people throughout the state. Most of the region's people with disabilities, both children (under 18) and seniors (65 and older), reside in Harney County. More than half of Harney County's seniors report a disability, and over 40% of Malheur County's do as well. Local natural hazard mitigation plans should specifically target outreach programs toward helping disabled residents better prepare for and recover from hazard events.

Table 2-484. People with a Disability by Age Groups in Region 8, 2012

	Total Population*	With a Disability		Under 18 years with a Disability		65 Years and Over with a Disability	
	Estimate	Estimate	Percent	Estimate	Percent**	Estimate	Percent**
Oregon	3,796,881	511,297	13.5%	39,439	4.6%	200,374	37.8%
Region 8	35,427	5,991	16.9%	411	4.3%	2,694	46.2%
Harney	7,219	1,532	21.2%	120	7.4%	736	54.2%
Malheur	28,208	4,459	15.8%	291	3.7%	1,958	43.7%

*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 Interstate 84, tend to have higher concentrations of homeless populations (Thomas et al., 2008). The numbers of homeless people in Region 8 increased from 2009 to 2010, and then decreased by 2011. Almost all homeless persons in the region reside in Malheur County.

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 due to natural hazard events. Accessible shelter and social services are key emergency considerations for the homeless community.

Table 2-485. Homeless Population Estimate for Region 8

	2009	2010	2011	Three Year Average
Oregon	17,122	19,208	22,116	19,482
Region 8	205	124	56	128
Harney	3	16	3	7
Malheur	202	108	53	121

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

There are 8% more males than females in Southeast Oregon (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

The senior population in Malheur County is proportional to that of the state. A 5% greater share of the population in Harney County are 65 years and older. Senior citizens may require special consideration due to their sensitivities to heat and cold, their reliance upon transportation for medications, and their comparative difficulty in making home modifications that reduce risk to hazards. In addition, the elderly may be reluctant to leave their homes in a disaster event. This implies the need for targeted preparatory programming that includes evacuation procedures and shelter locations accessible to the elderly populations (Morrow, 1999).

Similar to the state, about one quarter of the region's population are children. 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 and money when their children's childcare facilities and schools are impacted by disasters (Cutter et al., 2003).

Table 2-486. Population by Vulnerable Age Groups, in Region 8, 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 8	38,416	9,543	24.8%	6,085	15.8%
Harney	7,359	1,646	22.4%	1,404	19.1%
Malheur	31,057	7,897	25.4%	4,681	15.1%

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

Language

Almost 11% of the people in Malheur County do not speak English "very well." The number of people in Harney County who do not speak English "very well" is negligible. Outreach materials used to communicate with and plan for this community should take into consideration their language needs.

Table 2-487. English Usage in Region 8, 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 8	32,743	91.5%	3,055	8.5%
Harney	6,925	99.4%	40	0.6%
Malheur	25,818	89.5%	3,015	10.5%

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). 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.

Median household incomes in Malheur County have been particularly impacted since the financial crisis that began in 2007—a 12% decrease between 2009 and 2012. Median household incomes in Region 8 counties are between $10,300 and $12,800 below those across the state.

Table 2-488. Median Household Income in Region 8

	2009	2012	Percent Change
Oregon	$52,474	$50,036	-4.6%
Region 8	n/a	n/a	n/a
Harney	$41,506	$39,674	-4.4%
Malheur	$42,260	$37,191	-12.0%

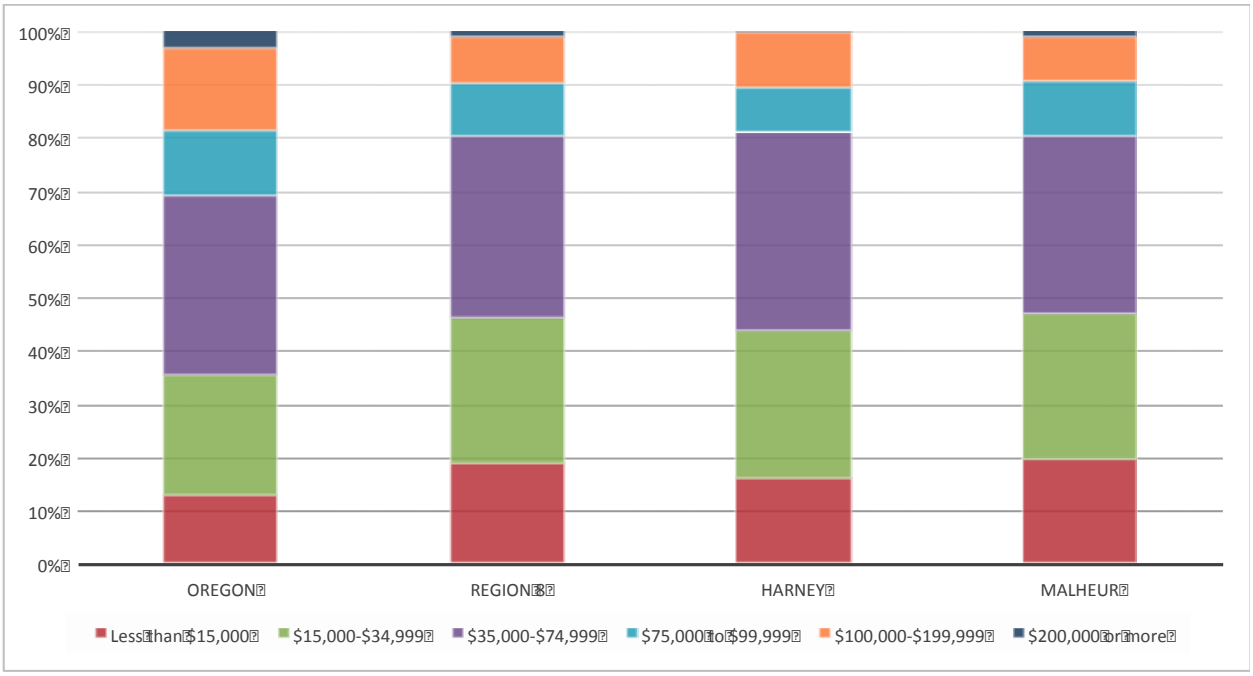
Note: 2009 dollars are adjusted for 2012 using Bureau of Labor Statistics' Consumer Price Index Inflation Calculator.

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.

The region has 11% more of its households making less than $35,000 annually compared to households statewide. Also compared to the state, 22% less of the region's households are in upper income brackets, making more than $75,000,

Figure 2-218. Median Household Income Distribution in Region 8, 2012



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

The region has 8% more individuals living in poverty than the state, and about 12% more children in poverty. One-quarter of Malheur County's population lives in poverty. Child poverty increased by more than 56% in Harney County. Overall, the poverty rate in both counties has increased by at least double the State's.

Table 2-489. Poverty Rates in Region 8, 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 8	8,372	23.8%	44.8%	3,024	32.3%	31.8%
Harney	1,379	19.1%	39.0%	467	29.0%	56.7%
Malheur	6,993	25.0%	46.1%	2,557	33.0%	28.1%

*Percent change since 2009

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

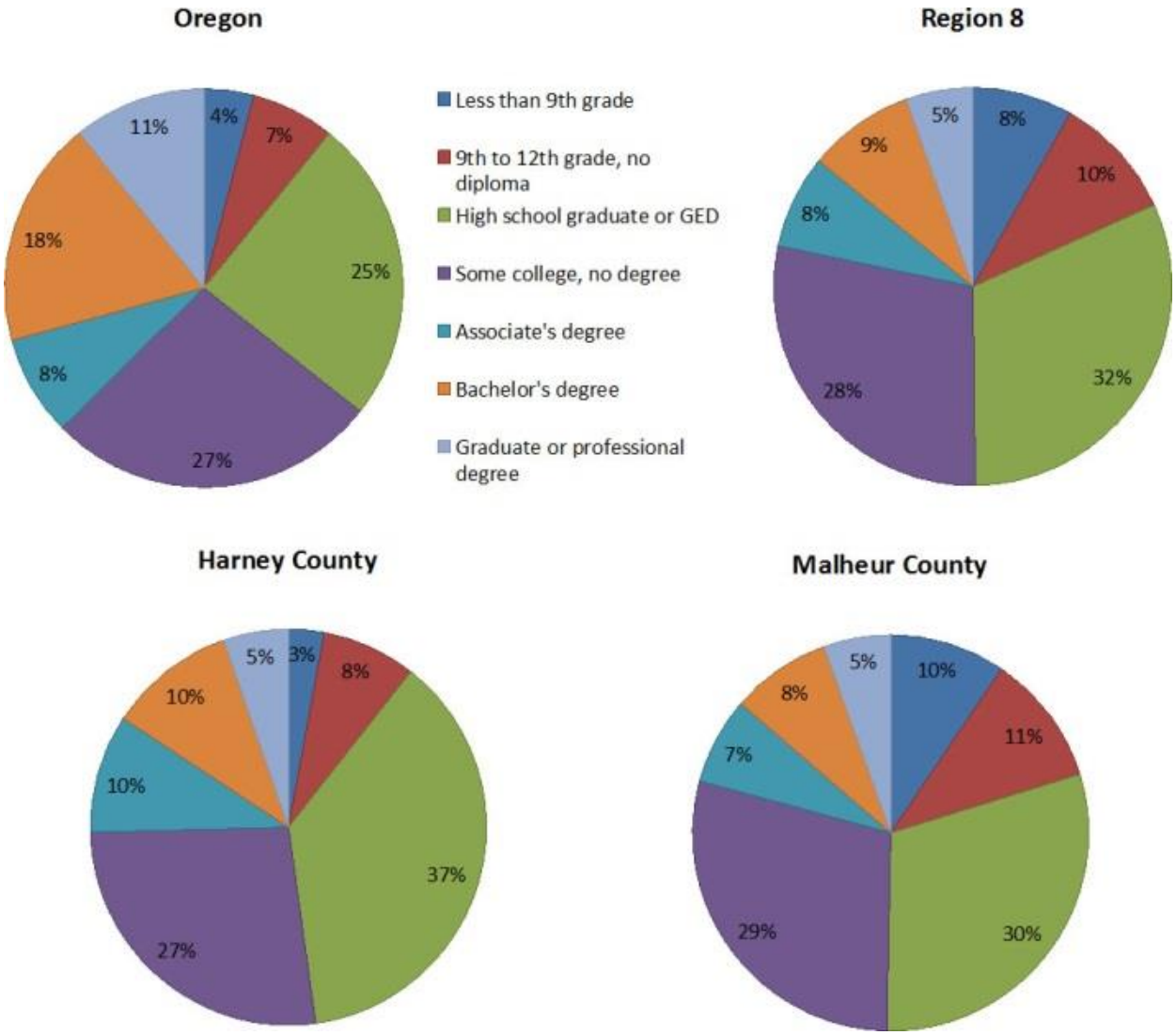
Low-income populations require special consideration when mitigating loss to a natural hazard. Often, those who make less have little to no savings and other assets to withstand economic setbacks. When a natural disaster interrupts work, the ability to provide housing, food, and basic necessities becomes 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).

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. The region has a 7% higher share of high school graduates (including GEDs) and a 15% lower share of persons with a college degree compared to state percentages.

Education can influence the ability to access resources, while lack of resources may constrain the ability to understand warning information (Cutter et al., 2003). Therefore, levels of education within the region should be considered when designing hazard outreach materials to local communities.

Figure 2-219. Educational Attainment in Region 8, 2012



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

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.

Similar to statewide numbers, about 36% of housing units in the region are rentals. The share of vacant units in Malheur County is almost double the share statewide vacancies state. Harney County has a greater share of seasonal and recreational homes (U.S. Census Bureau, 2008-2012 American Community Survey, Table DP04 and Table B25004).

Table 2-490. Housing Tenure in Region 8, 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 8	13,320	8,567	64.3%	4,753	35.7%	1,654	10.7%
Harney	3,186	2,045	64.2%	1,141	35.8%	350	9.2%
Malheur	10,134	6,522	64.4%	3,612	35.6%	1,304	11.2%

^ = 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 8 is predominately comprised of family households. Roughly one third of of households in Malheur County have families with children. Similar to statewide numbers, there are about twice as many single parent households that headed by females than by males.

Table 2-491. Family vs. Non-family Households in Region 8, 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 8	13,320	9,090	68.2%	4,230	31.8%	3,637	27.3%
Harney	3,186	2,119	66.5%	1,067	33.5%	877	27.5%
Malheur	10,134	6,971	68.8%	3,163	31.2%	2,760	27.2%

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

Table 2-492. Family Households with Children by Head of Household in Region 8, 2012

	Family Households with Children		Single Parent (Male)		Single Parent (Female)		Married Couple with Childern	
	Estimate	Percent	Estimate	Percent	Estimate	Percent	Estimate	Percent
Oregon	415,538	27.5%	35,855	2.4%	93,575	6.2%	415,538	27.5%
Region 8	4,018	30.2%	400	3.0%	853	6.4%	4,018	30.2%
Harney	784	24.6%	83	2.6%	171	5.4%	784	24.6%
Malheur	3,234	31.9%	317	3.1%	682	6.7%	3,234	31.9%

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

This analysis shows that Region 8 has a greater number of people than the state average who are predisposed to be particularly vulnerable during a hazard event, in the following categories:

- Population is declining, marginal growth expected by 2020;
- Tourists in Malheur County;
- High share of the population with a disability (individuals, children and seniors) in Harney County;
- High share of seniors in Harney County;
- High percentage of the population that does not speak English "very well" in Malheur County;
- Low median household incomes overall, and a significant drop in Malheur County;
- High levels of poverty; and
- Family households with children in Malheur County.

Economy

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 against natural hazards (Cutter et al., 2003). "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). The region is still recovering from the financial crisis that began in 2007. Recent statistics show that nonfarm job counts are down in the region's counties (Tauer, 2014). Harney County's unemployment rate is 5% higher than the state. Average salaries are only 72% of the state average.

Table 2-493. Unemployment Rates in Region 8, 2009–2013

	2009	2010	2011	2012	2013	Change (2009–2013)
Oregon	11.1%	10.8%	9.7%	8.8%	7.7%	-3.4%
Region 8	11.9%	11.7%	11.1%	10.5%	9.4%	-2.5%
Harney	16.1%	15.7%	14.7%	12.8%	12.3%	-3.8%
Malheur	10.7%	10.7%	10.2%	9.9%	8.7%	-2.0%

Source: Oregon Employment Department, 2014

Table 2-494. Employment and Unemployment Rates in Region 8, 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 8	15,727	14,245	90.6%	1,482	9.4%
Harney	3,129	2,743	87.7%	386	12.3%
Malheur	12,598	11,502	91.3%	1,096	8.7%

Source: Oregon Employment Department, 2014

Table 2-495. Employment and Payroll in Region 8, 2013

	Employees	Average Pay	Percent State Average
Oregon	1,679,364	$45,010	100%
Region 8	14,572	$32,171	71.5%
Harney	2,175	$32,786	72.8%
Malheur	12,397	$32,063	71.2%

Source: Oregon Employment Department, 2014

Employment Sectors and Key Industries

In 2013, the five major employment sectors in Region 8 were: Government (28.7%), Trade Transportation and Utilities (23.7%), Education and Health Services (13.1%), Natural Resources and Mining (9.2%), and Leisure and Hospitality (9.0%). Table 2-496 shows the distribution of total employment across all sectors. Region 8 is composed of Oregon Employment Department Region 14 (Southeast Oregon). The Southeast Oregon Region (Grant, Harney, Malheur) is expected to have a 9% increase in employment between 2012 and 2022 (Oregon Employment Department, n.d.b).

Table 2-496. Covered Employment by Sector in Region 8, 2013

		Harney		Malheur	
Industry	**Region 8**	**Employment**	**Percent**	**Employment**	**Percent**
Total All Ownerships	14,572	2,175	100%	12,397	100%
Total Private Coverage	71.3%	1,184	54.4%	9,200	74.2%
Natural Resources & Mining	9.2%	166	7.6%	1,172	9.5%
Construction	1.8%	66	3.0%	202	1.6%
Manufacturing	6.2%	(c)	-	897	7.2%
Trade, Transportation & Utilities	22.5%	352	16.2%	2,932	23.7%
Information	1.4%	13	0.6%	186	1.5%
Financial Activities	2.4%	56	2.6%	297	2.4%
Professional & Business Services	3.7%	82	3.8%	454	3.7%
Education & Health Services	12.7%	178	8.2%	1,672	13.5%
Leisure & Hospitality	9.0%	222	10.2%	1,096	8.8%
Other Services	2.3%	44	2.0%	291	2.3%
Private Non-Classified	0.0%	(c)	-	(c)	-
Total All Government	28.7%	991	45.6%	3,197	25.8%
Federal Government	3.1%	243	11.2%	216	1.7%
State Government	9.2%	130	6.0%	1,215	9.8%
Local Government	16.4%	618	28.4%	1,767	14.3%

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.

Education and Health Services: The industries in these sectors play important roles in emergency response in the event of a disaster. Health care is a relatively stable revenue sector regionally with an increasing distribution of businesses primarily serving a local and aging population.

Natural Resources and Mining: The primary industries within this sector regionally are largely crop and animal production. These industries tend to fluctuate seasonally and are vulnerable to a variety of natural hazard (winter storms, floods, etc.). In addition to the loss of farm production, wages could be lost due to natural disasters. In addition, these industries are dependent upon transportation systems that are vulnerable to disasters.

The ***Leisure and Hospitality*** 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.

Revenue by Sector

In 2007 Trade (Retail and Wholesale), Manufacturing, and Healthcare and Social Assistance were the highest revenue grossing industries in Region 8. (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 $691 million (89% of total revenue) for the region. Trade (Retail and Wholesale) is the largest grossing reported sector in the region. *Note: Due to the small size and few industries in the region the collected data are withheld in several categories to avoid disclosing data for individual companies. Data are aggregated to the county level.*

Table 2-497. Revenue of Top Industries (in Thousands of Dollars) in Region 8, 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 8	$778,079	73.9%	—	14.9%
Harney	$114,461	79.1%	—	D
Malheur	$663,618	73.0%	D	17.5%

Source: U.S. Census, Economic Census. 2007, Table ECO700A1. Notes: D = Withheld to avoid disclosing data for individual companies; data are included in higher level totals, and "-" = data not provided.

Sectors that are 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 8 is expected to occur in the following sectors: natural resources and mining; education and health services; Trade, Transportation, and Utilities (including retail trade); government; and leisure and hospitality (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 Region, 20.2% of all businesses. Government (particularly local government) has the second most number of businesses. Natural Resources and Mining, Education and Health Services sector, and the Leisure and Hospitality round out the top five sectors in the region (Oregon Employment Department, 2012). While many of these are small businesses, employing fewer than 20 employees, collectively they represent almost two thirds of the businesses 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 8 is particularly vulnerable during a hazard event due to the following characteristics:

- Consistently higher unemployment in Harney County; and
- Lower regional wages

Southeastern Oregon is still recovering from the financial crisis that began in 2007. The health care industrial sector and the regions aging population, service, and professional occupations spur much of the growth in employment within the region. Supporting the growth of dominant industries and employment sectors, as well as emerging sectors identified in this analysis, can help the region become more resilient to economic downturns that often follow a hazard event (Stahl et al., 2000).

Infrastructure

Infrastructure analyzed in this Plan includes transportation networks, power transmission systems, telecommunications, and water systems.

Transportation

Roads

The largest population bases in Region 8 are located along the region's major freeways, Interstate 84, and Highways 20, 26, and 95. Interstate 84 runs north/south and is the main passage for automobiles and trucks traveling east of the Cascade Range between Portland and Idaho. **Figure 2-220** shows Region 8's highways and population centers. Highways 20, 26, and 95

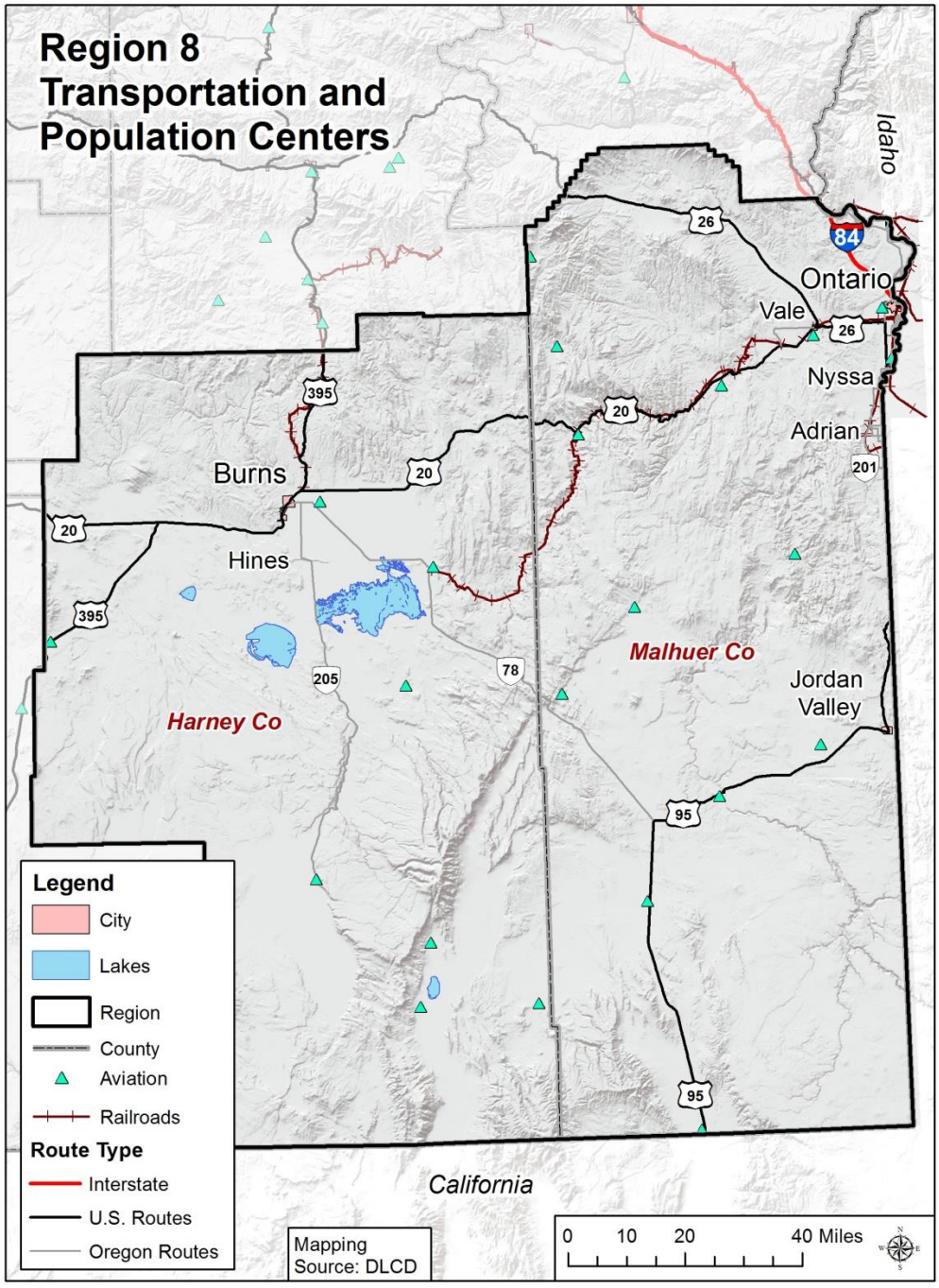
provide access east and west into Idaho and central Oregon counties. Highway 395 provides access into Lake County. Additional access is provided within Idaho to adjacent counties via Highways 30 and 95.

Region 8'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 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 evacuations 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, the projected impacts of a CSZ event are considered negligible in this part of the state. However, economic disruption from major losses in the larger markets of the state will affect the economy in this region. For information on ODOT's Seismic Lifeline Report findings for Region 8, see **Seismic Lifelines**.

Figure 2-220. Region 8 Transportation and Population Centers



Source: Oregon Department of Transportation, 2014

Bridges

Because of earthquake risk in Region 8, 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 that are part of regional and local systems that are maintained by the region's counties and cities. For information on ODOT's Seismic Lifeline Report findings for Region 8, see **Seismic Lifelines**.

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). The region has a lower percentage of bridges that are distressed and/or deficient than the state overall

Table 2-498. Bridge Inventory for Region 8

	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 8	7	111	6%	17	176	10%	0	0	0%	0	0	0%	24	287	8%	3
Harney	2	37	5%	9	71	13%	0	0	0%	0	0	0%	11	110	10%	0
Malheur	5	74	7%	8	105	8%	0	0	0%	0	0	0%	13	177	7%	3

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 8 support cargo and trade flows. The region's major freight rail providers are the Union Pacific (UP) and the Burlington Northern-Santa Fe (BNSF) railroads. The rail line follows the Interstate 84 corridor and another non-class I rail line provides access to the City of Vale. There are no active rail lines in Harney County. There are two rail yards in the region—in Ontario and Nyssa—operated by UP (Cambridge Systematics, 2014). There is no passenger rail available in Region 8.

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 products from other states that are shipped to and through Oregon by rail (Cambridge Systematics, 2014).

Rails are sensitive to icing from winter storms that can occur in Region 8. 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

There are no commercial airports in the region, however. There are several general aviation public airports including the Burns and Ontario Municipal airports.

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 airfreight may also be impacted by airport closures.

Table 2-499. Public and Private Airports in Region 8

	Number of Airports by FAA Designation				
	Public Airport	**Private Airport**	**Public Helipad**	**Private Helipad**	**Total**
Region 8	6	17	0	1	24
Harney	1	8	0	0	9
Malheur	5	9	0	1	15

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

Energy

Electricity

The region is served by several investor-owned, public, cooperative and municipal utilities. The Bonneville Power Administration is the area's wholesale electricity distributor. Idaho Power is the primary investor-owned utility company serving Harney and Malheur Counties. The regions electric cooperatives include the Harney Electric Cooperative (Harney, Malheur), and the Oregon Trail Electric Cooperative (Harney

Table 2-500 lists electric power generating facilities that are within Region 8. The region has a total of two power-generating facilities: one is a hydroelectric power facility, and the second is categorized as "other" (geothermal). There is no power generating facilities in Harney County. In total the power generating facilities have the ability to produce up to 40 megawatts (MW) of electricity.

Table 2-500. Power Plants in Region 8

	Hydro-electric	**Natural Gas**	**Wind**	**Coal**	**Other***	**Total**
Region 8	1	0	0	0	1	2
Harney	0	0	0	0	0	0
Malheur	1	0	0	0	1	2
Energy Production (MW)	35	0	0	0	5	40

*"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), PacifiCorps; Form 10K Annual Report (2013), Portland General Electric; U.S. Geothermal, Inc.

Hydropower

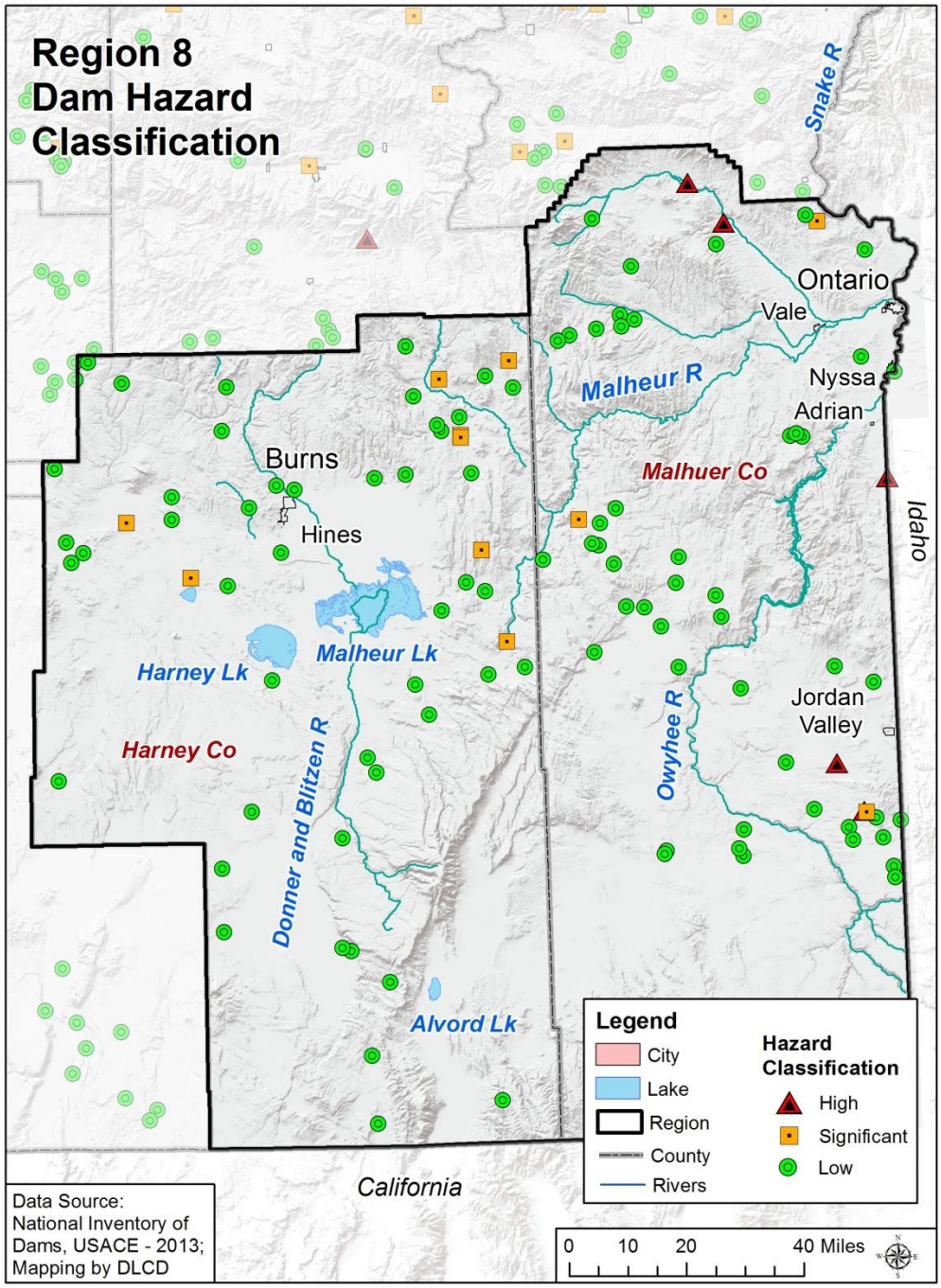
There are several major dams owned by Idaho Power along the Lower Snake River just north of the Southeast region, which produce a significant amount of hydropower. Minor dam failures can occur at any time. Most dam failures result in minor damage to structures and pose little or no risk to life safety. However, the potential for severe damage and fatalities does exist. Major dam failures have occurred most recently near Hermiston, 2005, and Klamath Lake, 2006. 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 2-501** lists the number of dams included in the inventory. The majority of dams in the region are located in Malheur County (146). All 10 of the High Threat Potential dams are within Malheur County. There are also 13 Significant Threat Potential dams in the region.

Table 2-501. Threat Potential of Dams in Region 8

	Threat Potential			Total Dams
	High	Significant	Low	
Region 8	10	13	216	239
Harney	0	9	84	93
Malheur	10	4	132	146

Source: Oregon Water Resources Department, Dam Inventory Query, 2014

Figure 2-221. Region 8 Dam Hazard Classification

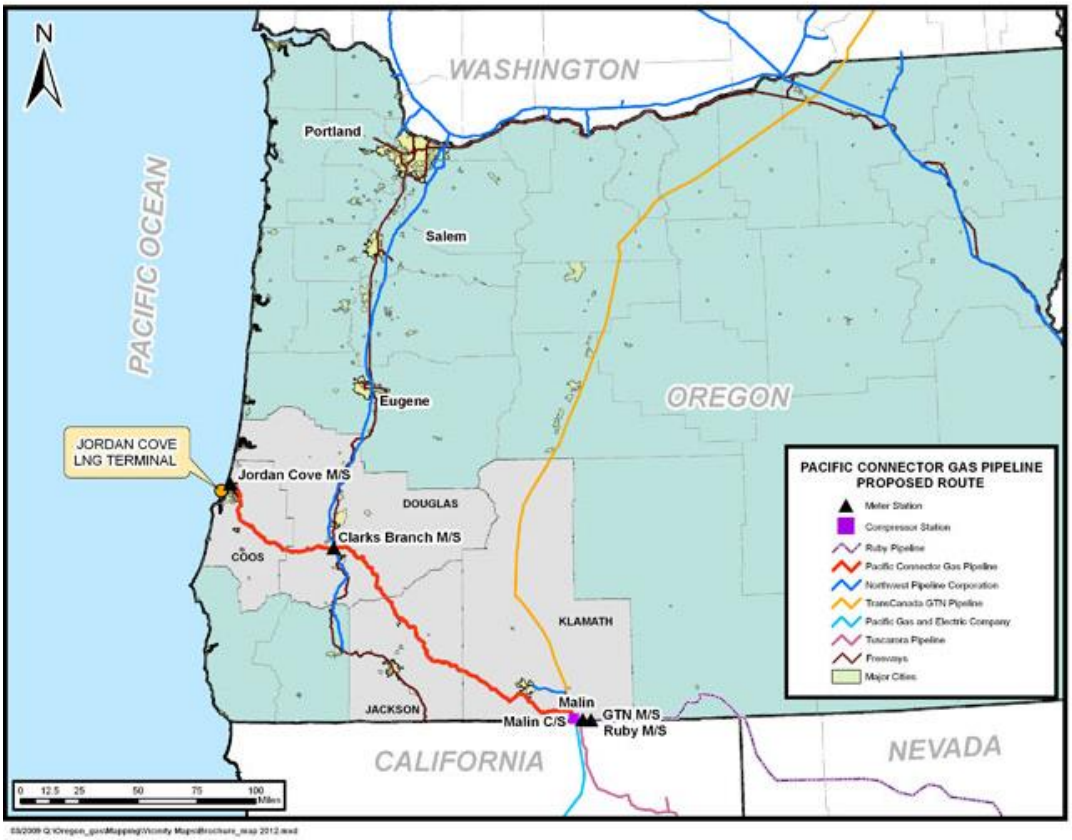


Source: National Inventory of Dams, USACE, 2013

Natural Gas

Although natural gas does not provide the most energy to the region, it does contribute a significant amount of energy to the region's energy portfolio. Liquefied Natural Gas (LNG) is transported via pipelines throughout the United States. **Figure 2-222** shows the Northwest Pipeline, which runs through Malheur County (near Ontario, shown in blue). (http://www.northwest.williams.com/NWP_Portal/extLoc.action?Loc=FilesNorthwestother&File=pipelineInfo.html). LNG pipelines, like other buried pipe infrastructure are vulnerable to earthquakes and can cause danger to human life and safety, as well as environmental impacts in the case of a spill.

Figure 2-222. Liquefied Natural Gas Pipelines in Region 8



Source: Williams Corporation

Utility Lifelines

The northeast corner of Malheur County is an important throughway for oil and gas pipelines and electricity transmission lines. The infrastructure associated with power generation and transmission plays a critical role in supporting the regional economy. These lines may be vulnerable to severe, but infrequent natural hazards, such as earthquakes.

Southeastern 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 from a separate network. The electric, oil, and gas lifelines that run through the region are both municipally and privately owned (Loy et al., 1976).

The network of electricity transmission lines running through Region 8 is operated primarily by Idaho Power, Pacific Power, and regional electrical cooperatives (and supplied by the Idaho Power Company and Bonneville Power Administration) and primarily facilitates local energy production and distribution (Loy et al., 1976). Most of the natural gas Oregon uses originates in Alberta, Canada. The Williams Company owns the main natural gas transmission pipeline in southeastern Oregon.

Telecommunications

Telecommunications infrastructure includes television, telephone, broadband internet, radio, and amateur radio (Ham radio). Region 8 is part of the Lake-Harney Operational Area under The Oregon State Emergency Alert System Plan (Oregon OEM, 2013). There is a memorandum of understanding between these counties that facilitates the launching of emergency messages. Counties in these areas can launch emergency messages by contacting the Oregon Emergency Response System (OERS), which in turn creates emergency messages to communities statewide.

Beyond day to day operations, maintaining communications 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 Oregon State Emergency Alert System Plan does not identify a local primary station for emergency messages, however, messages are provided via the three state primary networks: Oregon Public Broadcasting (Portland), KOBI TV (Medford), and KWAX-FM (Eugene).

Telephone and Broadband

Landline telephone, mobile wireless telephone, and broadband service providers serve Region 8. Broadband technology (including mobile wireless) is provided in the region via five primary technologies: cable, digital subscriber line (DSL), fiber, fixed wireless, and mobile wireless. Internet service is readily available throughout most parts the region with a smaller number of providers and service types available in the more remote parts of the region (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 8 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 Eastern Oregon Operational Area include:

Local Primary Station:

- KBHN-FM 1230 KHZ (Burns)

State Primary Station:

- KOBN-FM, 90.1 MHZ (Burns)

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 communications is a priority for the Amateur Radio Relay League (ARRL). ARES District 6 provides service to Region 8. 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 8 are (American Relay Radio League Oregon Chapter, www.arrloregon.org):

- Harney County: KF7CIS
- Malheur County: K&RHB

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 southeastern Oregon, the majority of municipal drinking water is supplied from groundwater wells, including in the cities of Burns and Hines. The City of Ontario primarily draws its drinking water from the Snake River. The City of Nyssa also has water rights for municipal water on the Snake River as a secondary water source. The City of Vale primarily relies on the Malheur River for drinking water and has groundwater wells as a backup water source. Rural areas in Malheur County draw drinking water from the Owyhee River, Beulah Reservoir, and Billy Creek. In Harney County, rural drinking water is drawn primarily from groundwater wells.

Irrigation water is generally pulled from surface sources and distributed through established irrigation districts in Malheur County. In Harney County, irrigation water is drawn from a combination of groundwater wells and surface sources including the Silvies, Donner und Blitzen River, and smaller tributary creeks.

There are several threats to the region's water quality and quantity. In Malheur County agricultural products—such as pesticides and herbicides—leech nitrates into ground and surface water. Other concerns for water quality in Malheur County include naturally occurring arsenic and phosphorus in the soil and bacterial contaminants such as Escherichia col (E. coli). Naturally occurring arsenic and other minerals threatens water quality in Harney County. Mineral

concentrations become higher in proximity to Malheur Lake and during drought seasons, increasing water quality threats in Harney County.

Water shortages have become common in Region 8. 2011 was the last year with a predictable water supply. The region had drought declarations for three consecutive years, from 2012 to 2014.

Low levels of snowpack can lead to severe shortages in a region that is already subject to annual shortages. Low precipitation levels can lead to low levels of groundwater recharge, which could impact both agricultural and municipal supplies. Additionally, no new water rights are available for surface water; although groundwater rights are still available in Malheur County.

At the time of this writing, water supply in irrigation districts is not meeting demand to sustain local agricultural operations. In 2014, irrigation water supplies are expected to be unavailable two and a half months less than usual. This is compounded by the fact that Harney County currently has no above ground reservoir for municipalities or rural residents.

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, thus 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 urban flooding, leading to stormwater runoff– and this can become a serious issue. Stormwater is one non-point source of water pollution and may impact drinking water quality. Other environmental impacts of stormwater runoff include increased temperatures in surface water quality, adversely affecting habitat health, flooding, and erosion due to the fast moving large volumes of water entering surface waterways from storm sewer systems.

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, a.k.a. 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 8, county and building codes (city and county) emphasize use of centralized storm sewer systems to manage stormwater. Low impact development (LID) mitigation strategies can alleviate or lighten the burden to 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 speed, and at lower temperatures. LID strategies are not required any community in Region 8. 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 every day operations and is essential following a disaster. Lack, or poor condition, of infrastructure can negatively affect a community's ability to cope, respond and recover from a hazard event. Diversity, redundancy and consistent maintenance in infrastructure systems help to create system resiliency (Meadows, 2008).

Damage or service interruption to roads, bridges, and rail systems can have devastating effects the region's economy. Hazards such as flooding and winter weather can close the highways that connect communities in Region 8 to the rest of the state and neighboring states. Eight percent of all bridges in Southeast Oregon are distressed or deficient. In Malheur County there are two rail yards, and rails that support cargo and trade flows and are vulnerable to icy conditions.

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. Two power-generating facilities are located here, a hydroelectric and a geothermal facility. The majority of the region's dams are located in Malheur County. Ten have 10 High Threat Potential dams and 13 have Significant Threat Potential. The northeast corner of Malheur County is an important throughway for oil and gas pipelines and electricity transmission lines. The infrastructure associated with power generation and transmission plays a critical role in supporting the regional economy and are vulnerable to severe, but infrequent, natural hazards.

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 may not cover rural areas of the region that are distant from Interstate 84. 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.

Drinking water is primarily sourced from groundwater wells, the Snake River, Malheur River Owyhee River, Beulah Reservoir, and Billy Creek. These water bodies are vulnerable to pollution from agricultural pesticides and herbicides. Naturally occurring mineral concentrations become higher in proximity to Malheur Lake and during drought seasons. These increasing water quality vulnerability in Harney County. No communities in the region require Low Impact Development (LID) regulations.

Built Environment

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

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/).

Settlement Patterns

Contrary to statewide patterns of urban growth and rural decline between 2000 and 2010, Region 8's urban populations shrunk—by about -13%—and rural populations grew—by roughly 15%. More growth occurred in Harney County overall, including a greater increase in housing units in both urban and rural communities. The region's population is clustered around the Interstate 84 corridor and the cities of Burns, Hines, Ontario, and Vale.

Table 2-502. Urban and Rural Populations in Region 8

	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 8	23,194	20,283	-12.6%	16,030	18,452	15.1%
Harney	4,330	4,131	-4.6%	3,279	3,291	0.4%
Malheur	18,864	16,152	-14.4%	12,751	15,161	18.9%

Note: The U.S. Census Bureau defines "urban" as either an "urbanized area" of 50,000 or more people, or an "urban cluster" of at least 2,500 people (but less than 50,000). Grant and Wallowa Counties do not meet either definition, therefore all of their populations are considered rural even though the counties include incorporated cities.

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

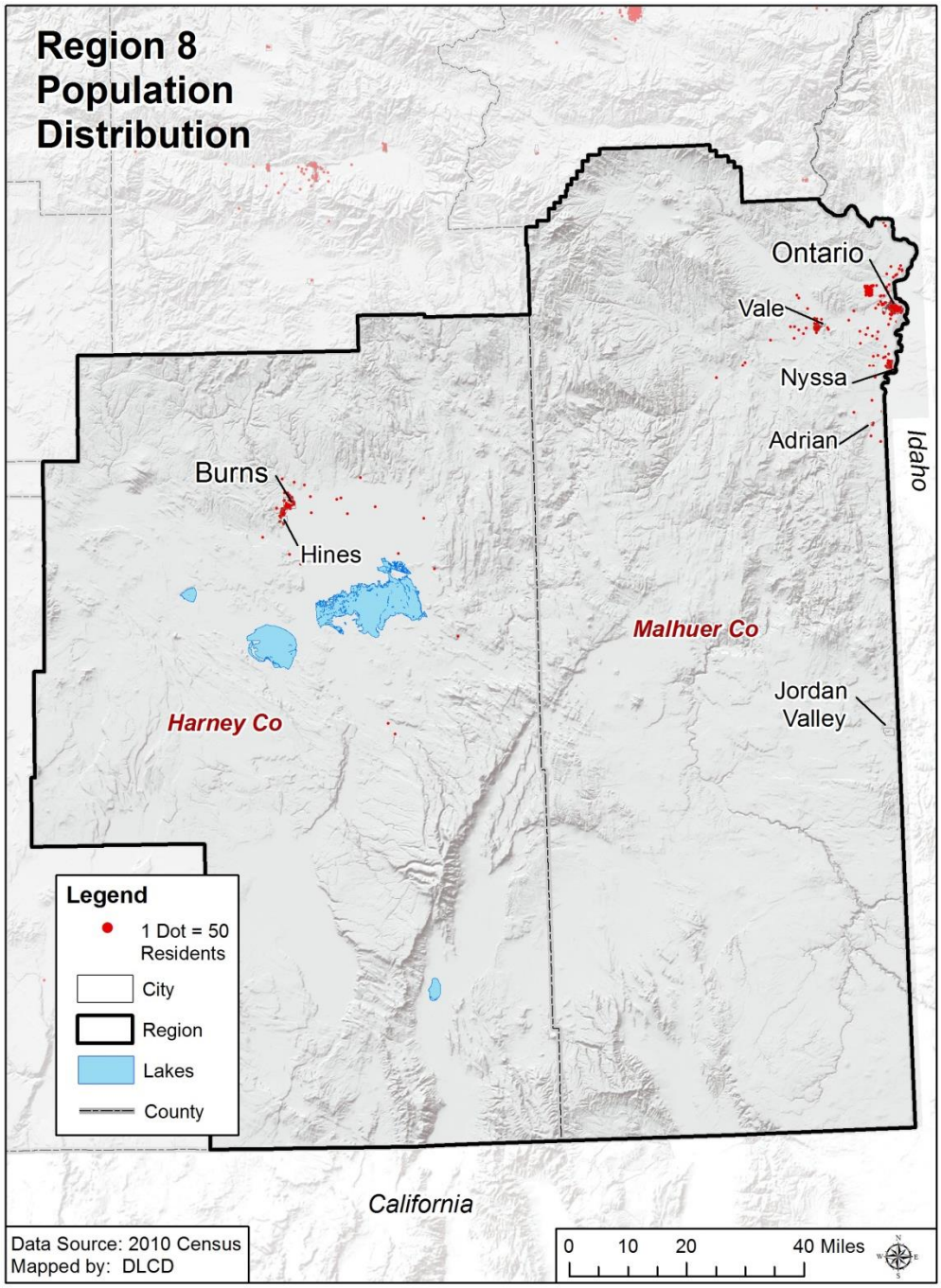
Table 2-503. Urban and Rural Housing Units in Region 8

	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 8	8,186	8,453	3.3%	6,580	7,074	7.5%
Harney	1,990	2,111	6.1%	1,543	1,724	11.7%
Malheur	6,196	6,342	2.4%	5,037	5,350	6.2%

Note: The U.S. Census Bureau defines "urban" as either an "urbanized area" of 50,000 or more people, or an "urban cluster" of at least 2,500 people (but less than 50,000). Grant and Wallowa Counties do not meet either definition, therefore all of their populations are considered rural even though the counties include incorporated cities.

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

Figure 2-223. Region 8 Population Distribution



Source: US Census, 2012

Land Use and Development Patterns

Similar to Northeast Oregon (Region 7), the past 40 years have seen a slower pace of development of private land in Southeast Oregon than in Western Oregon. In this time period very little loss of private land in forest, agriculture, and range uses occurred. Applicable land use programs have limited rural residential and urban development and have maintained large parcel sizes. Demand for large scale development has historically been very low. To the extent it has occurred, it has generally been located along existing transportation corridors (DLCD, internal communications, 2014).

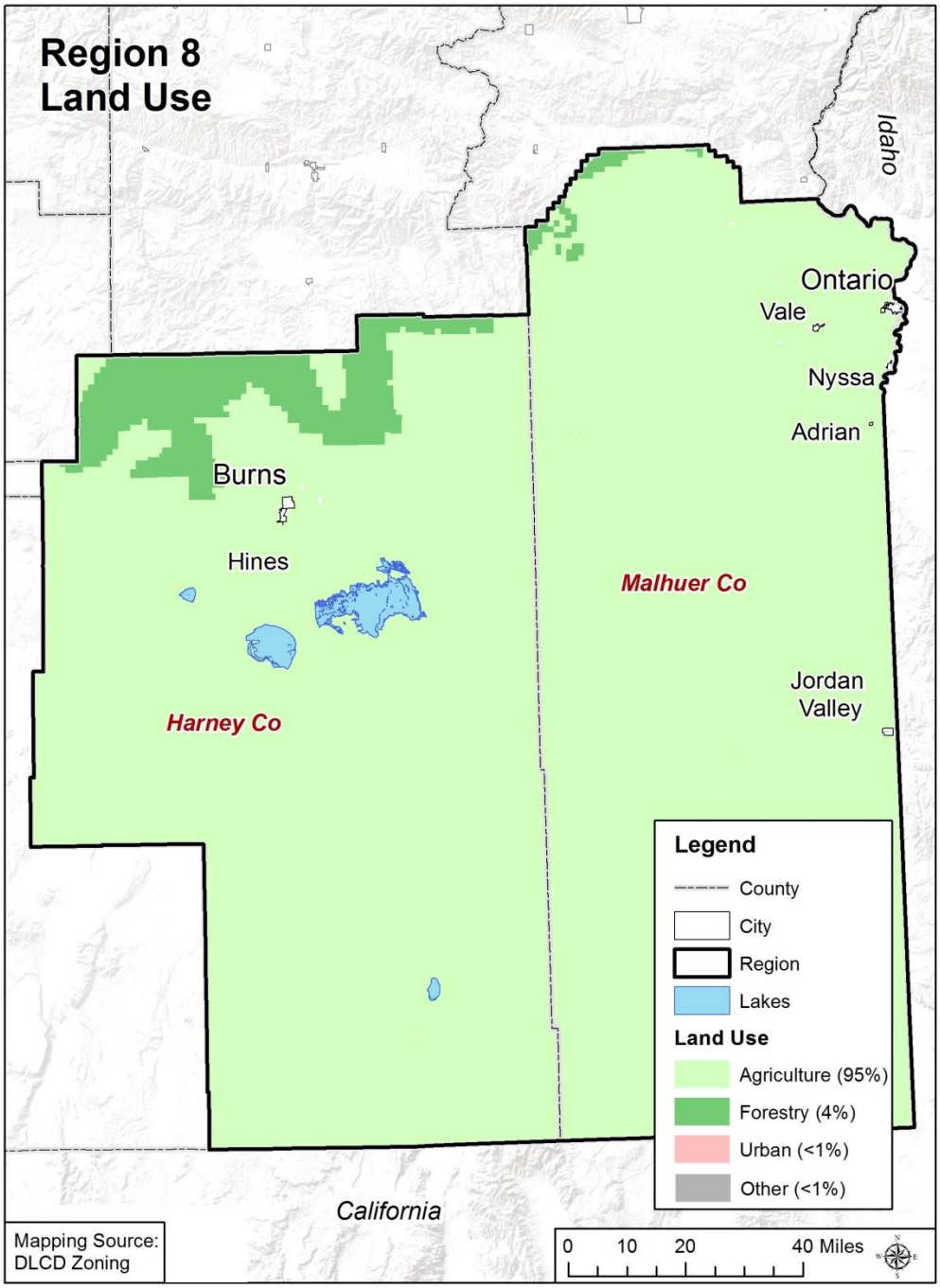
Malheur County's land ownership is just more than one fifth privately owned (22% private land) and a little less than four fifths publically owned (73% federal land and 4.5% state land). Harney County is similar, with 72% federal land, 25% private, and 3% state land.

Overall, Region 8 is overwhelmingly rangeland, with the Bureau of Land Management (BLM) controlling over 70% of the land. The land cover is largely grasslands and shrubs. Irrigated fields in the county's northeast corner, known as Western Treasure Valley, are the center of intensive and diversified farming.

The region's wide-open spaces have a total of only seven incorporated cities. Ontario, relatively close to a major metropolitan area in Boise, Idaho is economically active. Burns-Hines is an important center for commerce as well as tourism. Timber and logging remained important to that local economy until the 1990s, when the area's last lumber mill closed for lack of timber.

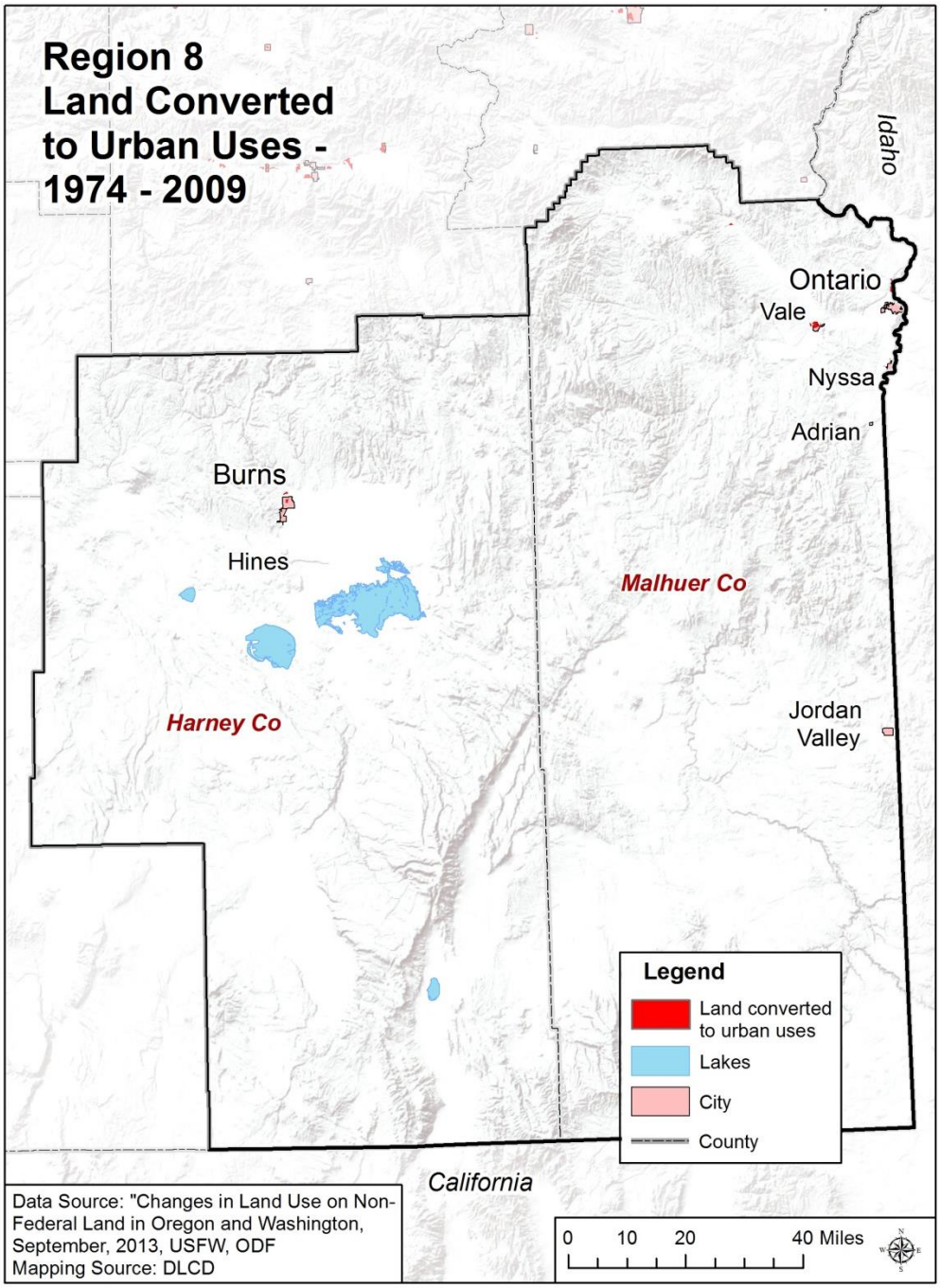
The Bureau of Land Management is considering a management plan designed protect the habitat of the sage grouse, possibly tightening uses of its land and capping how much human disturbance is allowed on the bird's core habitat. A number of stakeholders are working together to address loss of habitat while hoping to minimize potential impact on rangeland users.

Figure 2-224. Region 8 Land Use



Source: Department of Land Conservation and Development, 2014

Figure 2-225. Region 8 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. Similar to the state, about two thirds of the region's housing stock is single-family homes. In contrast to overall state numbers, the region has about half the percentage of multi-family homes and more than double the percentage of mobile homes. Notably, 30% of homes in Harney County's are mobile units. This is important because, in natural hazard events, such as earthquakes and floods, moveable structures like mobile homes are more likely to shift on their foundations and create hazardous conditions for occupants (California Governor's Office of Emergency Services, 1997).

Table 2-504. Housing Profile for Region 8, 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 8	15,490	10,423	67.3%	1,968	12.7%	3,094	20.0%
Harney	3,815	2,324	60.9%	346	9.1%	1,145	30.0%
Malheur	11,675	8,099	69.4%	1,622	13.9%	1,949	16.7%

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

Aside from location and type of housing, the year structures were built has implications. Seismic building standards were codified in Oregon building code starting in 1974. More rigorous building code standards were passed in 1993 that accounted for the Cascadia earthquake fault (Judson, 2012). Therefore, homes built before 1993 are more vulnerable to seismic events. Also in the 1970s, FEMA began assisting communities with floodplain mapping as a response to administer the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Upon receipt of floodplain maps, communities started to develop floodplain management ordinances to protect people and property from flood loss and damage (see tables below for more information on floodplain maps). Regionally, about 45% of the housing stock was built prior to 1970, before the implementation of floodplain management ordinances. About 80% of the housing stock was built before 1990 and the codification of seismic building standards.

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.

Table 2-505. Age of Housing Stock in Region 8, 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 8	15,490	6,784	43.8%	5,491	35.4%	3,215	20.8%
Harney	3,815	1,682	44.1%	1,139	29.9%	994	26.1%
Malheur	11,675	5,102	43.7%	4,352	37.3%	2,221	19.0%

Source: U.S. Census Bureau. 2008–2012. American Community Survey 5-Year Estimates, Table 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 minimized. **Table 2-506** shows the initial and current FIRM effective dates for Region 8 communities. For more information about the flood hazard, NFIP, and FIRMs, please refer to the State Risk Assessment, **Flood** section.

Table 2-506. Community Flood Map History in Region 8

	Initial FIRM	Current FIRM
Harney County	Apr. 17, 1984	Apr. 17, 1984
Burns	Aug.15, 1984	Dec. 22, 1998
Hines	Sep. 28, 1984	Nov. 3, 1989
Burns-Paiute Reservation	Sep. 28, 1984	Sep. 28, 1984
Malheur County	Sep. 29, 1986	Sep. 29, 1986
Adrian	Sep. 19, 1984	Sep. 19, 1984
Jordan Valley	Sep. 19, 1984	Sep. 19, 1984
Nyssa	Dec. 14, 1982	Dec.14, 1982 (M)
Ontario	Apr. 17, 1984	Apr. 17, 1984
Vale	Sep. 4, 1987	Sep. 4, 1987

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

Source: Federal Emergency Management Agency, Community Status Book Report

State-Owned/Leased and Critical and 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 8 can be found in **Table 2-507**. The region contains 4.1% of the total value of State-owned/leased facilities and critical/essentialfacilities.

Table 2-507. Value of State-Owned/Leased Critical and Essential Facilities in Region 8

	Total Property Value (State Facilities)	Percent State Total
Oregon	$7,339,087,023	100%
Region 8	$302,954,349	4.1%
Harney	$25,925,826	0.4%
Malheur	$277,028,523	3.8%

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 8 is largely a rural county with urban development focused along Interstate 84 and around the population centers of Burns, Hines, Ontario, and Vale. The region is losing population and most new population is in the smaller rural communities. The region's housing stock is largely single-family homes, with only about one half the state's percentage of multi-family homes. The region has more than double the state's percentage of mobile homes—Harney County has almost four times statewide numbers. About 45% of the homes were built before 1970 and floodplain management standards; and 80% was built before 1990 current seismic standards. Because none of the region's FIRMs have been modernized or updated, the area's maps are not as up to date as other areas of the state. The region's share of state owned facilities are mostly within Malheur County.

2.3.8.3 Hazards and Vulnerability

Drought

Characteristics

Droughts are a common occurrence in Region 8 and can have a significant economic impact on agricultural, livestock, and natural resources. In 2013, for example, most irrigation reservoirs started the season at a third of capacity, with some irrigation districts running out of water by mid-to late June. The Governor has declared a drought emergency in Region 8 numerous times since 1992. In May and June of 2013, the U.S. Department of Agriculture designated Malheur and Harney Counties as primary natural disaster areas due to damages and losses caused by drought.

Because of late winter 2014 reservoir storage levels and predicted streamflow forecasts, the Natural Resources Conservation Service predicted water shortages for the summer of 2014. Governor Kitzhaber issued drought emergencies for both Malheur and Harney Counties. Owyhee Reservoir peaked at 197,000 acre-feet in 2014. In December, the Capitol Press reported that irrigation water supplies for Malheur County farms that rely on water from the Owyhee Project began to run out in July and were completely shut off by August, two months earlier than normal (http://infoweb.newsbank.com/resources/openurl?ctx_ver=z39.88-2004&rft_dat=news/1522AB0187C74988&rft_id=info:sid/infoweb.newsbank.com&rft_val_format=info:ofi/fmt:kev:mtx:ctx&svc_dat=NewsBank&req_dat=0DC38C612B5C2835).

Historic Drought Events

Table 2-508. Historic Droughtsin Region 8

Year	Location	Description
1930s	statewide	generally, a very dry period for much of Oregon; Malheur County experiences its most extreme drought years in 1931, 1934, and 1935
1988	Region 7, 8	extreme drought for Malheur County (PDSI value of -4.14); this was also a severe drought year for northeast Oregon
1992	statewide	Governor declared drought emergency for all 36 counties in Oregon. 1992 was a severe drought year for Malheur County.
1994	Regions 4–8	in 1994, Malheur County received a Governor drought declaration, along with 10 other counties located within regions 4, 5, 6, and 7
2001	eastern and southern Oregon	Governor-declared drought emergency for Harney County and 17 other counties throughout the state
2002	eastern and southern Oregon	Governor-declared drought emergency for Malheur and Harney Counties; total of 23 counties under a drought emergency during 2002
2003	eastern and southern Oregon	Governor-declared drought emergency issued for Malheur and Harney Counties; most counties remain under a drought emergency from the 2001 and 2002 declarations through June 2003
2004	Regions 5–8	Governor-declared drought emergency issued for Malheur County, along with three counties from neighboring regions
2007	Regions 6–8	Governor-declared drought emergency issued for Malheur and Harney County, along with four other counties in Region 6 and 7
2013	Region 5–8	Governor-declared drought emergency issued for Malheur County, along with four other counties in neighboring regions
2014	Regions 4, 6–8	Governor-declared drought emergency issued for Malheur and Harney Counties, along with eight other counties in other regions

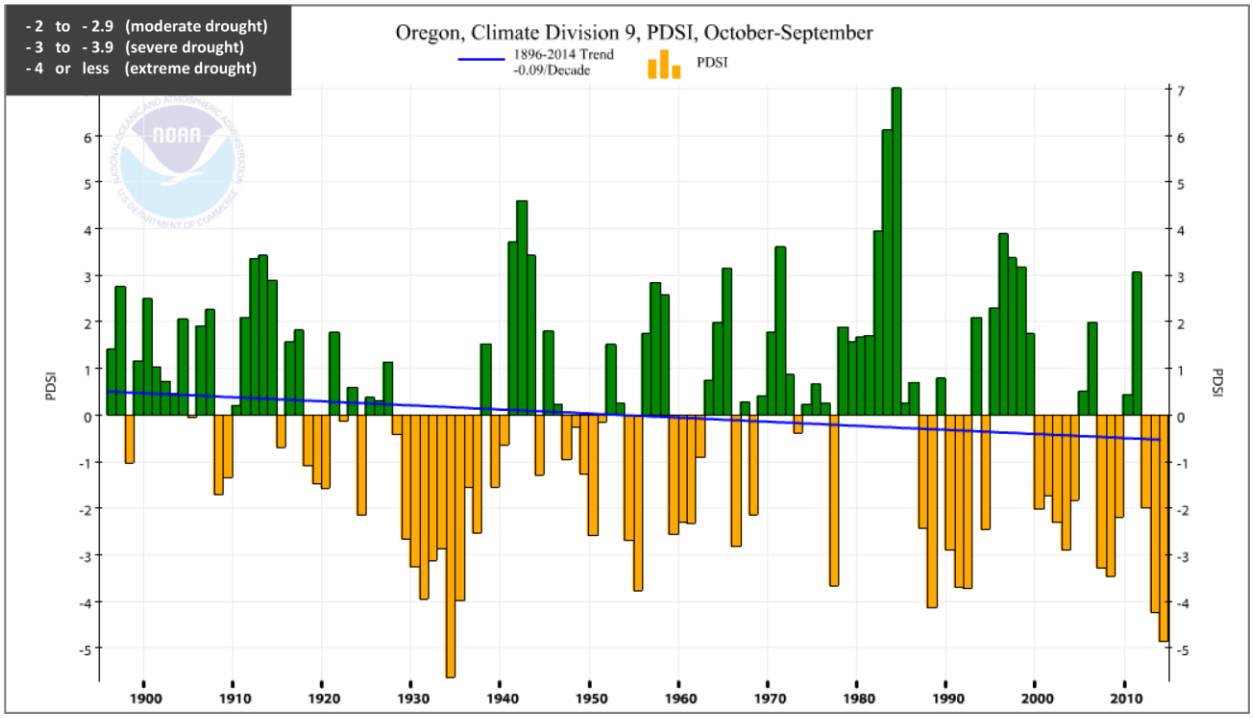
Sources: Taylor and Hatton (1999); and the Oregon Secretary of State's Archives Division. NOAA's Climate at a Glance. Western Regional Climate Center's Westwide Drought Tracker http://www.wrcc.dri.edu/wwdt. Personal Communication, Kathie Dello, Oregon Climate Service, Oregon State University.

Historic drought information can also be obtained from the National Climatic Data Center, which provides historical climate data showing wet and dry conditions, using the Palmer Drought Severity Index (PDSI) that dates back to 1895. The PDSI is not the best indicator of water availability for Oregon as it does not account for snow or ice (delayed runoff), but it has the advantage of providing the most complete, long-term drought record.

The following PDSI graph shows years where drought or dry conditions affected the south eastern area of Oregon, known as Climate Division 9, which encompasses Malheur County only.

Based on this index, 1934 was a very extreme drought year for Malheur County (PDSI: -5.63). Water Years 1931, 1935, 1988, and 2013 were also extreme drought years. Malheur County has experienced a combined total of 31 years of moderate, severe, or extreme drought conditions during this period of record, more than any other climate region in the state.

Figure 2-226. Palmer Drought Severity Index for Region 8



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 is 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 (High, Moderate, Low) that Region 8 will experience drought is depicted in **Table 2-509**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-509. Local Probability Assessment of Drought for Region 8

	Harney	Malheur
Probability	H	H

Source: Oregon Office of Emergency Management, 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. Oregon has yet to undertake a comprehensive risk analysis for drought on a statewide basis to determine probability or vulnerability for a given community.

With that said, the likelihood that Malheur and Harney County will experience drought conditions in the near future is very likely. As mentioned, the Governor has declared drought in both counties on several occasions since 1992. During the 100-year period of 1895-1995, both counties experienced severe or extreme drought conditions 10–15% of the time.

Vulnerability

Local Assessment

Based on the OEM Hazard Analysis conducted by county emergency program managers, the region's vulnerability (High, Moderate, Low) to drought is depicted in **Table 2-510**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-510. Local Vulnerability Assessment of Drought for Region 8

	Harney	Malheur
Vulnerability	M	H

Source: Oregon Office of Emergency Management, 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 drought declarations issued by the Governor, Malheur County could be considered one of the most vulnerable communities to drought and its related impacts. Since 1992, Malheur County has been under an emergency drought declaration on eight different occasions: 1992, 1994, 2002, 2003, 2004, 2007, 2013, and most recently, in February 2014. Harney County shares a similar recurrent pattern of drought emergencies: 1992, 2001, 2002, 2003, 2007, and 2014, and can also be considered vulnerable to drought-related impacts.

Ranching, farming, and other agricultural activities greatly contribute to the economy of both counties. Malheur County ranks fourth in the state for agricultural sales, with $373 million in gross farm and ranch sales in 2012. Drought can have a significant impact on the agricultural community and associated businesses that rely on this industry.

Dust Storms

Characteristics

There is little about the dust storms in this region that differs from the description in the State Risk Assessment, **Dust Storms** section, except to note that agricultural practices likely play less of a role here than in Region 5. All the same, Southeast Oregon farmers, ranchers, homeowners, resort properties, and wildlife sometimes find themselves vying for limited water. This competition for scarce water can affect the locations and amounts of dust lifted into the atmosphere, and blown on the wind.

Historic Dust Storm Events

Table 2-511. Historic Dust Storms in Region 8

Date	Location	Description
Aug. 2012[1]	Harney and Malheur Counties	a massive dust storm due to 50–60 mph winds produced by thunderstorms eventually blew on into Idaho; some media reports indicate this event darkened the skies in some areas for more than two hours
Mar. 2013[2]	Malheur County	dust from this storm is reported to have accelerated snowmelt in a Southwestern Idaho mountain range. "Nobody on our staff has ever witnessed anything similar," said Adam Winstral, Research Hydrologist with the U.S. Department of Agriculture

Sources: (1) Dust, an emerging problem in the Great Basin: insights from 2012, January 23, 2013; YouTube, Brenda Burns, published August 6, 2012 and Zeronieo, published August 14, 2012; Mother Recounts Her Encounter with an Oregon Dust Storm, Yahoo Voices, August 8, 2012; (2) The Oregonian (oregonlive.com) and Associated Press, March 29, 2013; Idaho Statesman (Rocky Barker), March 28, 2013

Brenda Burns and her family were traveling through Malheur County around 4:30 p.m. on August 5, 2012 when they noticed something ominous in the distance. What they saw was a massive wall of dust heading in their direction. According to ktvb.com, the massive dust storm that started in Eastern Oregon packed winds between 50 to 60 miles an hour, and carried the debris into Idaho. "It took about 27 minutes to totally overtake our position," said Mrs. Burns. "It was so wide… that it cut us off from returning the way we came… We really had no direction to go… The initial cloud blackout lasted about 30 minutes, but we were inside the dust storm for over two and a half hours… At one point my husband and I thought maybe it was some kind of pyroclastic cloud. It really looked that ominous. It was very frightening…"

"Mother Recounts Her Encounter with an Oregon Dust Storm," *Yahoo Voices*, August 8, 2012

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 is 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 (High, Moderate, Low) that Region 8 will experience dust storms is depicted in **Table 2-512**. 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 2-512. Local Probability Assessment of Dust Storms for Region 8

	Harney	Malheur
Probability	—	M

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

State Assessment

The fact that the two storms noted in the Historic Events table (**Table 2-511**) both occurred within the most recent few years of record suggests that the probability of these events may be increasing in Region 8. This hypothesis would benefit from research.

Vulnerability

Local Assessment

Based on the OEM Hazard Analysis conducted by county emergency program managers, the region's vulnerability (High, Moderate, Low) to dust storms is depicted in **Table 2-513**. 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 2-513. Local Vulnerability Assessment of Dust Storms for Region 8

	Harney	Malheur
Vulnerability	—	L

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

State Assessment

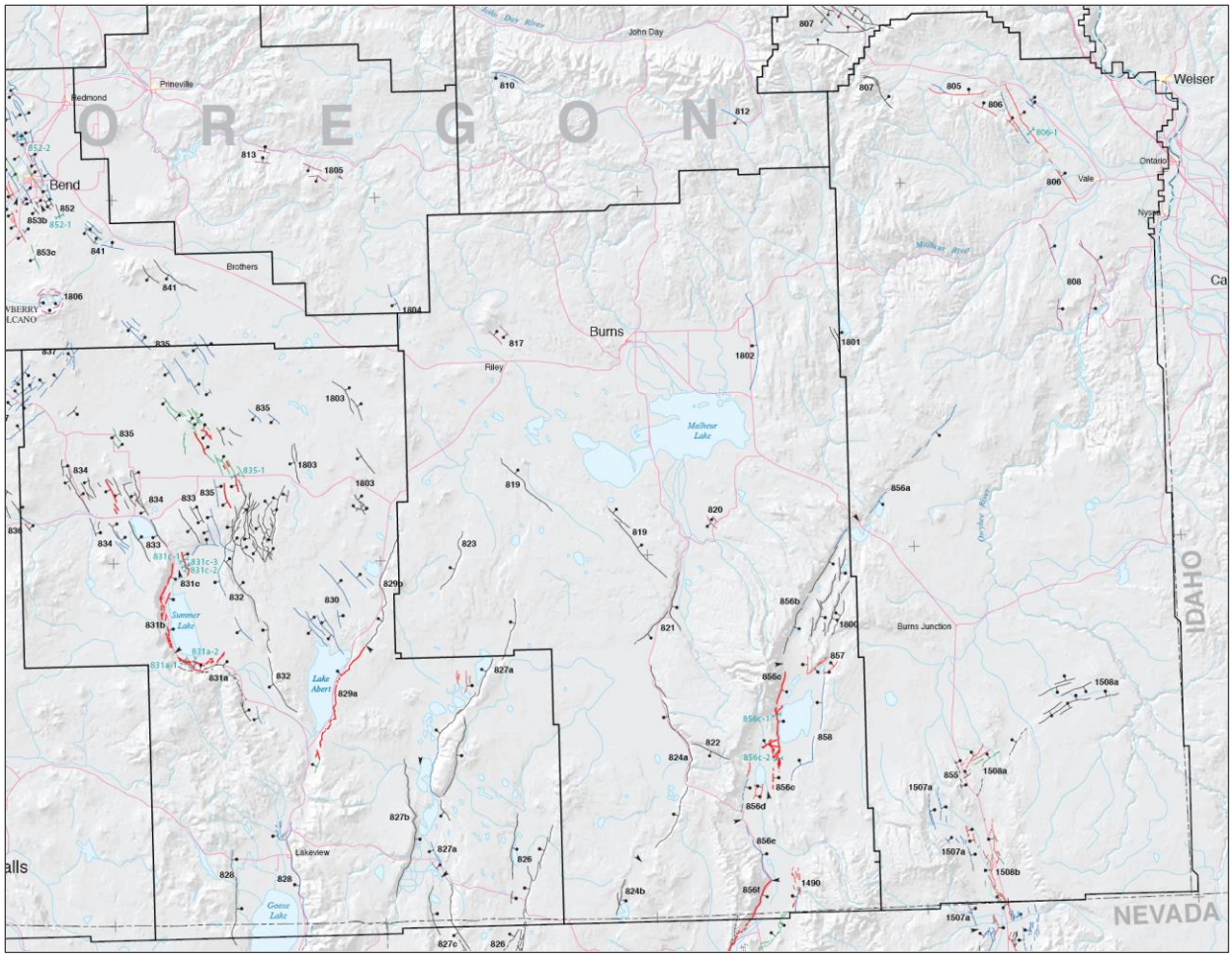
Malheur County is most vulnerable to dust storms in this region. Harney County is also vulnerable. Poor visibility leading to motor vehicle crashes is the worst potential impact of these storms; often these crashes result in fatalities and major injuries. Other impacts include poor air quality, including dust infiltration of equipment and engines; loss of productive soil; and an increase in fine sediment loading of creeks and rivers.

Earthquake

Characteristics

The geographical position of this region makes it susceptible to earthquakes from two sources: crustal events and volcanic-earthquakes. Generally, crustal faults can produce earthquakes with magnitudes up to roughly M7.0. The map below shows the location of the known crustal faults which could affect the region. Because only certain faults have been studied in detail and determined to be active, there may be many more crustal faults in the region capable of producing earthquakes which have not yet been identified. **Figure 2-227** shows the location of faults in Region 8. (Note that Region 8 maps include Lake County [Region 6] as Lake County was included in the Pre-Disaster Mitigation Planning Grant along with Harney and Malheur Counties.)

Figure 2-227. USGS map of Quaternary Faults and Folds in Region 8

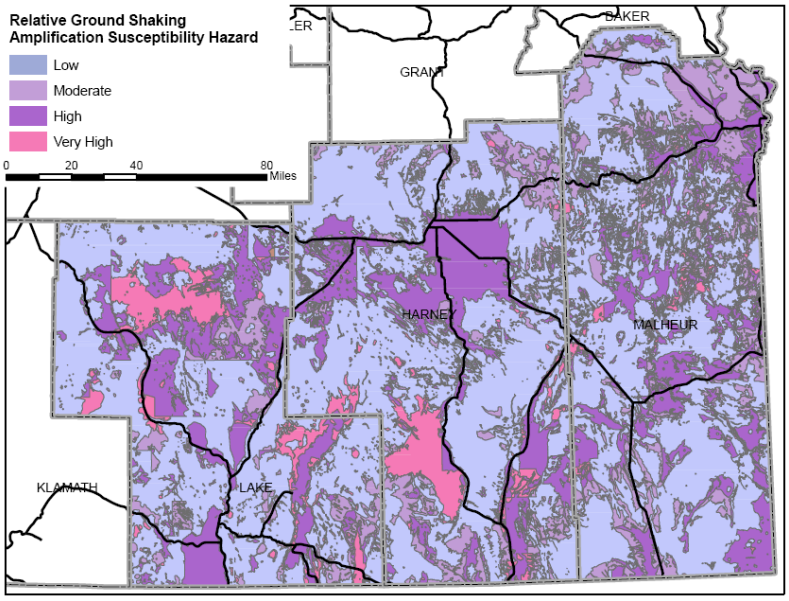


Source: Personius et al. (2003)

When all of these earthquakes sources are added together, the general earthquake hazard in the region can be displayed as a whole and is reflected in the USGS national seismic hazard maps. When compared to the rest of the United States, most of the region is within a relatively moderate seismicity area.

Figure 2-228 displays the areas in the region with greater and lesser ground shaking amplification hazard. The five class scale of hazard generally corresponds to the NEHRP soil class scale: None (not depicted on map), Low, Moderate, High, and Very High.

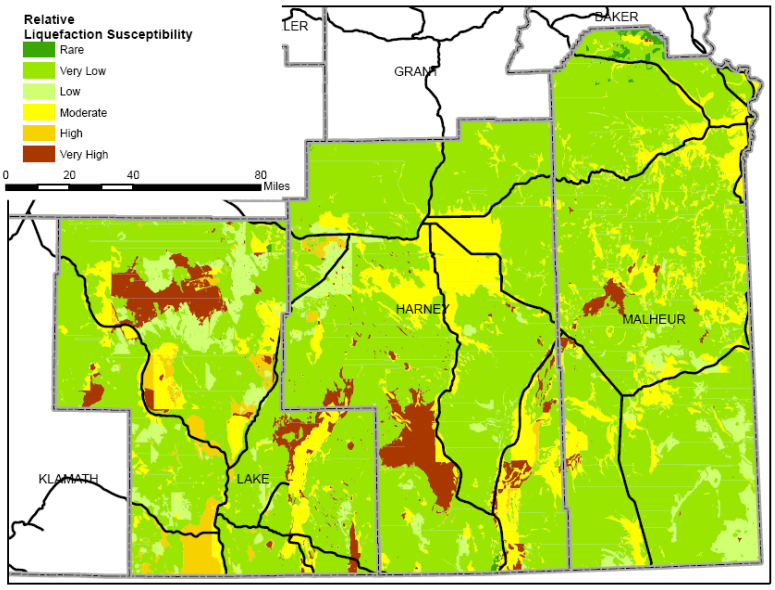
Figure 2-228. Map of Relative Ground Shaking Amplification in Region 8



Source: Burns (2007)

Figure 2-229 displays the areas in the region with greater and lesser liquefaction hazard.

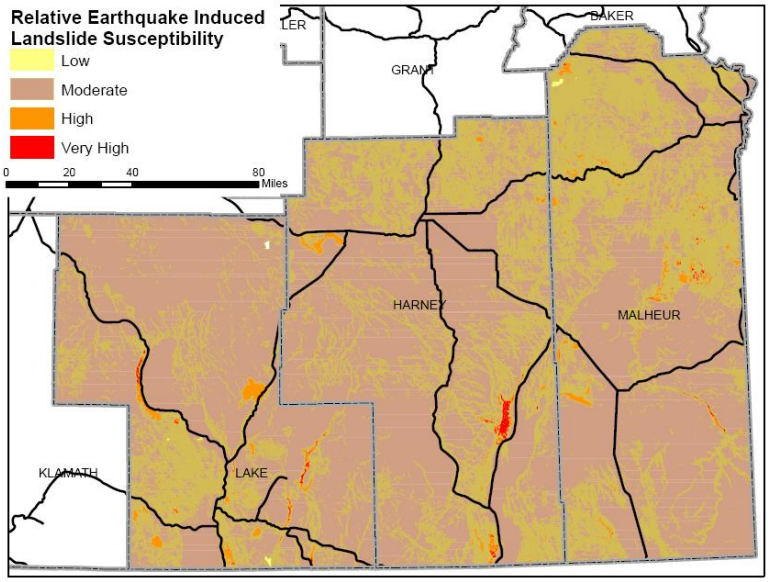
Figure 2-229. Map of the Relative Liquefaction Susceptibility Hazard in Region 8



Source: Burns (2007)

Figure 2-230 displays the areas in the region with greater and lesser earthquake induced landslide hazard.

Figure 2-230. Map of the Relative Earthquake Induced Landslide Susceptibility Hazard in Region 8



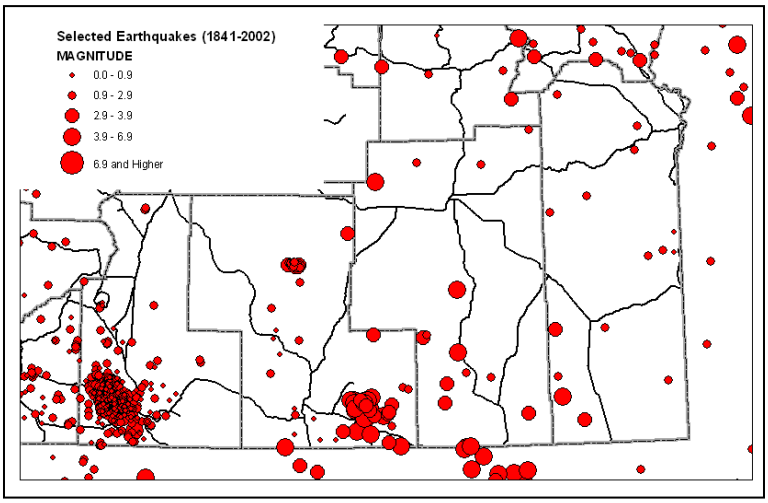
Source: Burns (2007)

Region 8 has experienced many earthquakes as shown. Several earthquake sequences (swarms) have occurred in the region within the last 20 years. There are also identified faults in the region that have been active in the last 20,000 years. The region has also been shaken historically by crustal and intraplate earthquakes and prehistorically by subduction zone earthquakes centered outside the area. **Figure 2-231** maps earthquakes in the region from 1841 to 2002, and **Table 2-514** provides a general history of earthquakes in Oregon.

When all of these earthquakes sources are added together, the general earthquake hazard in the region can be displayed as a whole and is reflected in the USGS national seismic hazard maps. When compared to the rest of the United States, most of the region is within a relative moderate seismicity area.

Figure 2-231 displays over 1,000 earthquakes that have been recorded in the region during the last century. Since the instrument network in the region has been very sparse until the mid 2000s, it is likely that thousands of earthquakes have occurred in the region, but were not recorded and thus do not appear on this map.

Figure 2-231. Map of Selected Earthquakes in Region 8, 1841–2002



Source: Niewendorp, C.A., Neuhaus, M.E., 2003

Historic Earthquake Events

Table 2-514. Historical Earthquakes Affecting Region 8

Date	Location	Magnitude	Comments
Approximate years: 1400 BCE 1050 BCE 600 BCE 400, 750, 900	offshore, Cascadia Subduction Zone	probably 8-9	these are the midpoints of the age ranges for these six events
Jan. 26, 1700	offshore, Cascadia Subduction Zone	~9	generated a tsunami that struck Oregon, WA and Japan; destroyed Native American villages along the coast
Nov. 23, 1873	near Brookings, Oregon at the Oregon/CA border	6.8	may have been an intraplate event because of lack of aftershocks; felt as far away as Portland and San Francisco
Mar. 1893	Umatilla	VI-VII (Modified Mercalli Intensity)	damage: unknown
July 15, 1936	Milton-Freewater	6.4	damage: $100,000 damage (in 1936 dollars); two foreshocks and many aftershocks felt
Apr. 13, 1949	Olympia, WA	7.1	fatalities: eight; damage: $25 million damage (in 1949 dollars); cracked plaster, other minor damage in northwest Oregon
Jan. 1951	Hermiston	V (Modified Mercalli Intensity)	damage: unknown
Nov. 5, 1962	Portland/ Vancouver	5.5	shaking up to 30 seconds; damage: chimneys cracked, windows broken, furniture moved
Apr. 12, 1976	near Maupin	4.8	sounds described as distant thunder, sonic booms, and strong wind
Apr. 25, 1992	Cape Mendocino, CA	7.0	subduction earthquake at the triple-junction of the Cascadia Subduction Zone and the San Andreas and Mendocino faults
Mar. 25, 1993	Scotts Mill	5.6	center: Mount Angel-Gates Creek fault; damage: $30 million, including Molalla High School and Mount Angel church
Sep. 20, 1993	Klamath Falls	5.9 and 6.0	fatalities: two; damage: $10 million, including county courthouse; rockfalls

*BCE: Before Common Era

Sources: Wong and Bolt (1995); Pacific Northwest Seismic Network

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 is 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 (High, Moderate, Low) that Region 8 will experience earthquakes is depicted in **Table 2-515.** In some cases, counties either did not rank a particular hazard or did not find it to be a significant consideration, noted with a dash (—). See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-515. Local Probability Assessment of Earthquakes for Region 8

	Harney	Malheur
Probability	L	M

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

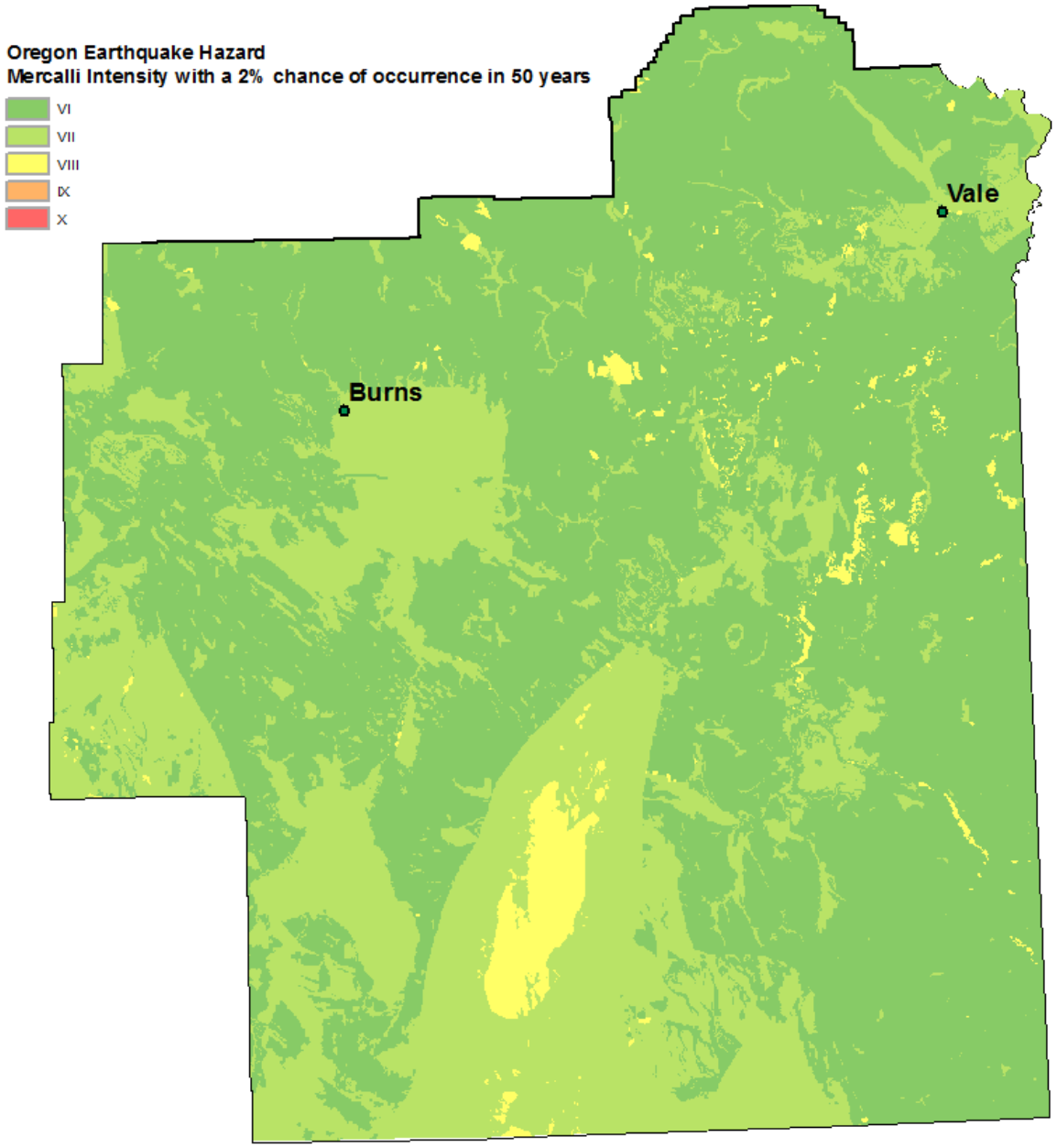
State Assessment

The probability of damaging earthquakes varies widely across the state. In Region 8, the hazard is dominated by local faults and background seismicity. We define the probability of earthquake hazards occurring in Oregon in the following two ways.

For Region 8, we show the probabilistic hazard in **Figure 2-232**. 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, and is more readily understandable for a general audience. These maps incorporate all that is known about the probabilities of earthquake on all Oregon faults, including the Cascadia Subduction Zone.

For Oregon west of the crest of the Cascades, the Cascadia subduction zone is responsible for most of the hazard shown in **Figure 2-232**. The paleoseismic record includes 18 M 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 M 8.3–8.5 earthquakes only affected 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 2-232. Region 8 Probabilistic Earthquake Hazard



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
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 (High, Moderate, Low) to earthquakes is depicted **Table 2-516**. In some cases, counties either did not rank a particular hazard or did not find it to be a significant consideration, noted with a dash (—). See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-516. Local Vulnerability Assessment of Earthquakes for Region 8

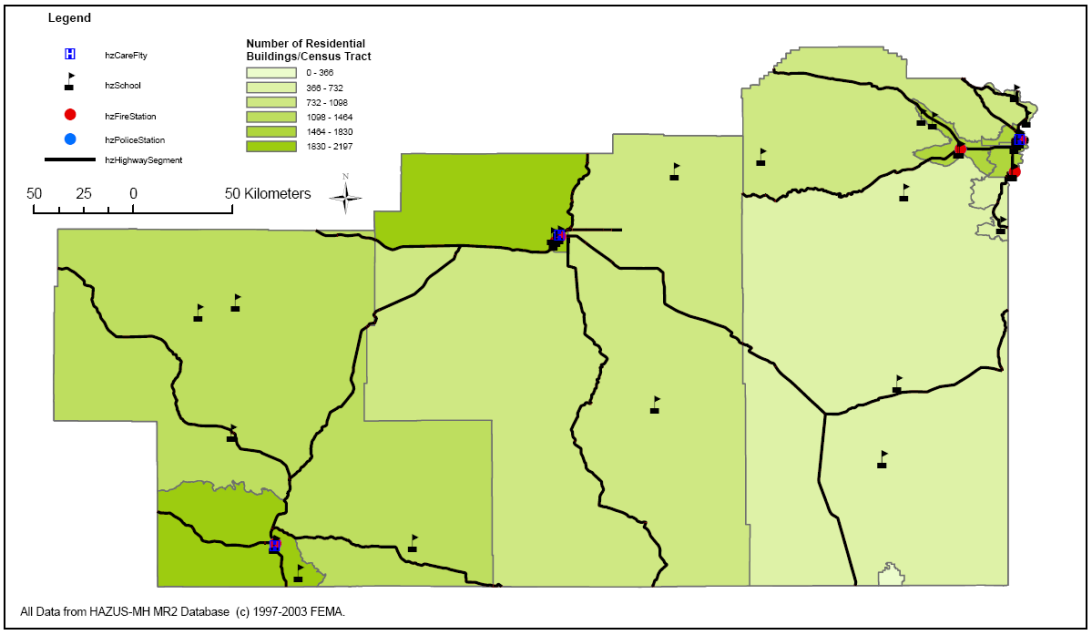
	Harney	Malheur
Vulnerability	L	M

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

State Assessment

Region 8 is moderately vulnerable to earthquake hazards from earthquake-induced landslides, liquefaction, and ground shaking. Most of the people and infrastructure are located in one of the major cities in the region which are located along an interstate (I-84) and/or the regional highways (Hwy 20 and Hwy 395). **Figure 2-233** shows a map of the generalized exposure of buildings to earthquakes in Region 8.

Figure 2-233. Region 8 Generalized Exposure



Source: HAZUS-MH MR2 database, Burns, 2007.

The Oregon Department of Geology and Mineral Industries (DOGAMI) has developed two earthquake loss models for Oregon based on the two sources of seismic events: 1) a M6.9

arbitrary crustal event, and () 2,500 year probabilistic driving earthquake scenario. Both models are based on HAZUS-MH, a computer program used by the Federal Emergency Management Agency (FEMA) as a means of determining potential losses from earthquakes. The arbitrary crustal event is based on a potential M6.9 earthquake generated from an arbitrarily chosen fault using the HAZUS software, and assuming a worst-case scenario. The 2,500 probabilistic driving earthquake does not look at a single earthquake, instead it encompasses many faults and potential earthquake sources, each with a 2% chance of producing an earthquake in the next 50 years. The analysis assumes that each fault will produce a single "average" earthquake during this time.

DOGAMI investigators caution that the analysis contains a high degree of uncertainty and should be used only for general planning purposes. Despite their limitations, the analysis does provide some approximate estimates of damage. Results are found in **Table 2-517**, **Table 2-518**, **Table 2-519**, **Table 2-520**, **Table 2-521**, and **Table 2-522**.

Table 2-517. School and Emergency Response Buildings' Collapse Potential in Region 8

	Level of Collapse Potential			
County	**Low (< 1%)**	**Moderate (>1%)**	**High (>10%)**	**Very High (100%)**
Harney	5	3	7	3
Malheur	16	6	5	23

Source: Lewis (2007)

Table 2-518. Building, Transportation, and Utility Exposure in Region 8

County	**Building Exposure**	**Transportation Exposure**	**Utility Exposure**	**Total Exposure**
Harney	$448,000,000	$2,281,900,000	$733,200,000	$3,463,100,000
Malheur	$1,441,000,000	$4,396,900,000	$810,300,000	$6,648,200,000
Region Total	$1,889,000,000	$6,678,800,000	$1,543,500,000	$10,111,300,000

Source: W. J. Burns (DOGAMI), 2007 (unpublished), Geologic hazards of the southeast Oregon region

Table 2-519. Building, Transportation, and Utility Losses, in Region 8, Associated with a 2,500-Year Probable M6.5 Driving Earthquake Scenario

County	**Building Losses**	**Transportation Losses**	**Utility Losses**	**Total Losses**	**Loss Percent of Total**
Harney	$9,260,000	$21,600,000	$2,000,000	$32,860,000	0.9%
Malheur	$143,370,000	$47,000,000	$19,680,000	$210,050,000	3.2%
Region Total	$152,630,000	$68,600,000	$21,680,000	$264,590,000	2.6%

Source: W. J. Burns (DOGAMI), 2007 (unpublished), Geologic hazards of the southeast Oregon region

Table 2-520. Building, Transportation, and Utility Losses, in Region 8, Associated with a (M) 6.9 Arbitrary Crustal Earthquake Event

REGION 8 County	Building Losses	Transportation Losses	Utility Losses	Total Losses	Loss Percent of Total
Harney	$1,600,000	$39,200,000	$390,000	$41,191,000	1.1%
Malheur	$453,470,000	$114,100,000	$36,820,000	$604,390,000	9.0%
Region Total	$455,070,000	$153,300,000	$37,210,000	$645,581,000	6.4%

Source: W. J. Burns (DOGAMI), 2007 (unpublished), Geologic hazards of the southeast Oregon region

Table 2-521. Estimated Losses, in Region 8, Associated with A M6.9 Arbitrary Crustal Earthquake Event

Region 8 Counties	Harney	Malheur
Injuries (5 pm time frame)	3	444
Death (5 pm time frame)	0	28
Displaced households	0	1,224
Economic losses from buildings	$1.6 mil	$453.47 mil
Operational day after quake:		
Fire stations	0%	25%
Police stations	0%	50%
Schools	29%	48%
Bridges	98%	93%
Economic losses to:		
Highways	$29.8 mil	$107.10 mil
Airports	$8.6 mil	$4.8 mil
Communications	$0.04 mil	$0.03 mil
Debris generated (million tons)	0	0

Source: W. J. Burns (DOGAMI), 2007 (unpublished), Geologic hazards of the southeast Oregon region

Table 2-522. Estimated Losses, in Region 8, Associated With A 2,500-Year Probable M6.5 Driving Earthquake Scenario

Region 8 Counties:	Harney	Malheur
Injuries (5 pm time frame)	3	106
Deaths (5 pm time frame)	0	5
Displaced Households	2	357
Economic losses from buildings	$9.26 m	$143.37 m
Operational the day after the quake		
Fire stations	100%	100%
Police stations	100%	100%
Schools	100%	100%
Bridges	100%	100%
Economic Losses to /for:		
Highways	$14.3 m	$34.3 m
Airports	$6.9 m	$11.8 m
Communication systems	$ 0.01 m	$0.01 m
Debris generated (million tons)	0	0

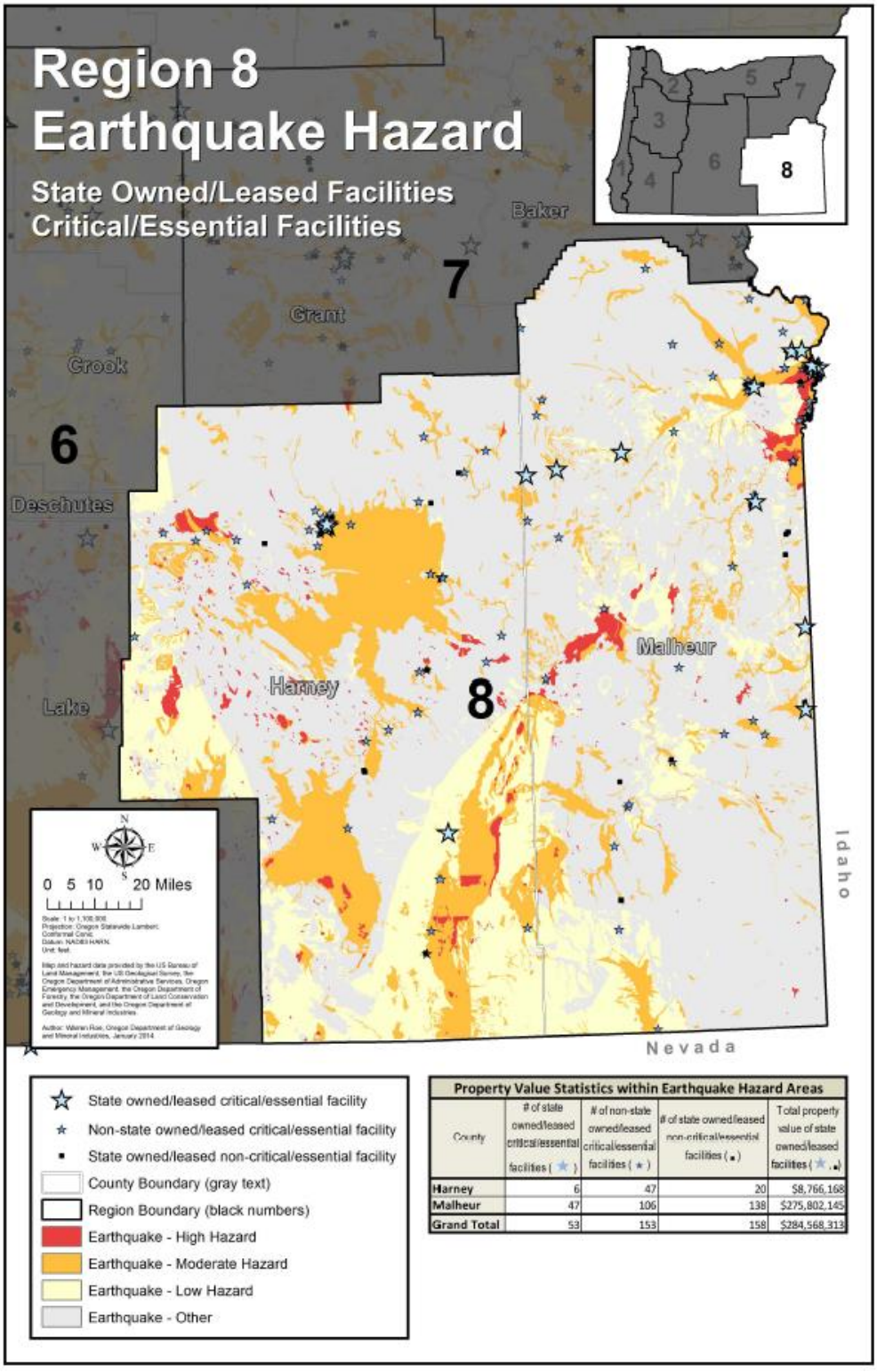
Source: W. J. Burns (DOGAMI), 2007 (unpublished), Geologic hazards of the southeast Oregon region

STATE-OWNED/LEASED FACILITIES AND CRITICAL AND ESSENTIAL FACILITIES

The following information is based on a State 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, 211 totaling roughly $284.5 million worth of property fall into an earthquake hazard zone in Region 8 (**Figure 2-234**). Among the 1,141 critical/essential State facilities, 53 are in an earthquake hazard zone in Region 9. Additionally, 153 non-State critical/essential facilities in the region are located in an earthquake hazard zone.

Figure 2-234. State-Owned/Leased Facilities and Critical/Essential Facilities in an Earthquake Zone in Region 8



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 (★ , ▪)
Harney	6	47	20	$8,766,168
Malheur	47	106	138	$275,802,145
Grand Total	53	153	158	$284,568,313

Source: DOGAMI

SEISMIC LIFELINES

Because the projected impacts of a CSZ event are considered negligible in this part of the state, this region was not part of the Oregon Department of Transportation's (ODOT) Oregon Seismic Lifeline Report (OSLR).

REGIONAL IMPACT. Within this region, significant adverse impacts from the CSZ event and secondary hazards (landslides, liquefaction etc.) are not anticipated.

REGIONAL LOSS ESTIMATES. Losses in this Region are expected to be nonexistent to low locally. Economic disruption from major losses in the larger markets of the state will affect the economy in this Region.

MOST VULNERABLE JURISDICTIONS. Vulnerability of this whole region to a CSZ event is low. Loss of life, property and business are not expected to be issues in this area. However, impacts to import and export infrastructure and basic supply lines could have short to mid-term economic impacts. With an intact surface transportation system to the east, adaptation is expected to be relatively easy.

Flood

Characteristics

Although flooding occurs throughout Oregon, the climate, local geology and the relatively low population of region 8 lessen its effects. Southeast Oregon contains a variable landscape that greatly influences flood conditions. The region is subject to a variety of flood conditions, including:

1. Spring run-off from rain and melting snow
2. Warming and rain during the winter months (rain-on-snow)
3. Ice-jam flooding
4. Local flash flooding
5. Closed basin playa flooding

Most flooding throughout the region is linked to the spring cycle of melting snow. However, rain-on-snow events, associated with La Niña years in which cool, moist weather conditions are followed by a system of warm, moist air from tropical latitudes, can quickly melt foothill and mountain snow causing floods. Some of Oregon's most devastating floods are associated with these events.

Ice jams on the Snake and Malheur rivers have created flood conditions in the past. Ice jams happen during the winter and early spring, while the river is still frozen. Sudden warming of higher altitude snow and ice results in increased runoff and break-up of river ice. On the way downstream, floating ice can "jam" in a narrow reach of the drainage or against a road crossing, causing a dam. Subsequent breach of the dam releases a torrent of water.

Summer thunderstorms are common throughout the region. During these events, normally dry gulches quickly become raging torrents, a flash flood. Although flash flooding occurs throughout Oregon, local geology in the region can increase this hazard. Bedrock, composed mostly of igneous rocks, is exposed at the surface throughout much of the region. Consequently, runoff is increased significantly.

Many parts of Harney and Malheur Counties are characterized by interior drainage or closed basins called playas. Some playas contain lakes that grow and diminish with the seasons and from year to year. Harney and Malheur lakes are good examples. At times, they are almost dry, but conditions change with prolonged periods of rainfall or snowmelt. Since the water has nowhere to go except into the lakes, the lakes just keep filling up until they overflow. Evaporation is the primary way the water levels recede and it can take years to significantly reduce swollen lake levels through this slow process.

With some exceptions, Malheur County is physically different. This area contains the Owyhee uplands and the Snake River plains, whose streams flow into the Snake River, a tributary of the Columbia. Several reaches of the Snake River have flood control structures. Consequently, it is less of a problem than other rivers in the region.

The interior drainage or closed basin lakes and creeks and rivers in southeastern Oregon have a long history of flooding (**Table 2-523**). Most of the lake water originates from high mountain snowpack above the basin. Flooding follows winters with deep snow accumulation. Such was the case in 1982 and subsequent years, when high lake levels caused economic damage within

the region (especially in Harney County). Farms, ranches, homesteads, utilities, highways, and a railroad branch line are at risk.

Unusually warm winter conditions, as in 1957 and 1964, produced severe flooding.

Historic Flood Events

Table 2-523. Significant Flood Events in Region 8

Date	Location	Description	Remarks
1897	Harney County	severe flooding on Silvies River	flood of record on the Silvies River (300-year flood)
1904	Harney and Malheur Counties	severe flooding on Silvies and Malheur Rivers	
1910	Malheur County	severe Malheur River flooding	flood of record on the Malheur River
1921	Harney County	severe flooding on Silvies River	
1943	Harney County	severe flooding on Silvies River	
1952	Harney and Malheur Counties	severe flooding on Jordan Creek, the Silvies and Malheur rivers	
Feb. 1957	Harney and Malheur Counties	severe flooding on Jordan Creek, the Silvies and Malheur rivers	warm rain on snow / frozen ground
Dec. 1964	entire state	severe flooding throughout region	warm rain on snow / frozen ground
1982	Harney County	severe flooding from Harney and Malheur lakes	Long history: not the first lake floods; others floods followed
Dec. 1985	Malheur County	ice jam flooding	40 miles of ice on Snake River between Farewell Bend and Ontario; at least 35 people evacuated
June 1989	Malheur County	flash flood; crops damaged; high winds	vicinity of Nyssa
Mar. 1993	Malheur and Harney Counties	widespread flooding in rural areas; highways closed	warm rain on heavy snow pack; flood of record on Owyhee River
May 1998	Malheur and Harney Counties	widespread flooding. Mudslides in Malheur County	persistent rain on mountain snow pack
May 2005	Harney County	$10,000 in property damage	
Apr. 2011	Harney County	widespread basin flooding	Oregon DOT closed and breached U.S. 20 at milepost 132.6 on April 8, 2011, for flood relief; the breach was done at the request of Harney County Emergency Operations Center to avoid damage to nearby residences; larger culverts were later installed

Sources: FEMA, Malheur County Flood Insurance Study (FIS), 09/29/86; Harney County FIS, 12/22/98; Taylor and Hatton. (1999). The Oregon Weather Book, p. 96-103; Hazards & 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

Table 2-524. Principal Flood Sources in Region 8

Harney County	Malheur County
Silvies River	Snake River
Silver Creek	Malheur River
Silver Lake	Bully Creek
Cow Creek	Willow Creek
Donner und Blitzen River	Jordan Creek
McCoy Creek	Indian Creek
Trout Creek	Clover Creek
Whitehorse Creek	Owyhee River
Harney Lake	Cottonwood Creek
Malheur Lake	

Sources: FEMA, Malheur County Flood Insurance Study (FIS), 09/29/86; FEMA, Harney County FIS, 12/22/98

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 is 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 (High, Moderate, Low) that Region 8 will experience flooding is depicted in **Table 2-525**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-525. Local Probability Assessment of Floods for Region 8

	Harney	Malheur
Probability	H	H

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

State Assessment

Table 2-523 provides some indication of flooding in Region 8 (not all flooding is shown). Significant flooding occurs regularly, at least once every 5-7 years.

The Federal Emergency Management Agency (FEMA) has mapped the 10, 50, 100, and 500-year floodplains in the Region 8 counties. This corresponds to a 10%, 2%, 1%, and 0.2% chance of a certain magnitude flood in any given year. In addition, FEMA has mapped the 100-year floodplain (i.e., 1% flood) in the incorporated cities. The 100-year flood is the benchmark upon which the National Flood Insurance Program (NFIP) is based.

All of the Region 8 counties have Flood Insurance Rate Maps (FIRM); however, the maps are old. The FIRM maps were issued at the following times:

- Harney, April 17, 1984
- Malheur, September 29, 1986

A remapping initiative is underway in Harney County.

Vulnerability

Local Assessment

Based on the OEM Hazard Analysis conducted by county emergency program managers the region's vulnerability (High, Moderate, Low) to flooding is depicted in Table 2-526. See the State Risk Assessment for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-526. Local Vulnerability Assessment of Floods for Region 8

	Harney	Malheur
Vulnerability	M	H

Source: Oregon Office of Emergency Management, 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 2-527**.

Table 2-527. Scoring for Vulnerability Index

Score	Description
3	county data point is greater than 2.5 times standard deviation for the input dataset
2	county data point is greater than 1.5 times standard deviation for the input dataset
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.

Both Harney and Malheur Counties received a flood vulnerability score of 5. This low score is likely misleading because flood risks do exist in the population centers located along the regional highways (Hwy 20 and Hwy 395). The City of Burns was one of the top 10 cities in terms of the ratio of Special Flood Hazard Area to city area.

FEMA has identified no Repetitive Loss properties in Region 8 (FEMA NFIP BureauNet, http://bsa.nfipstat.fema.gov/, accessed 12/1/2014).

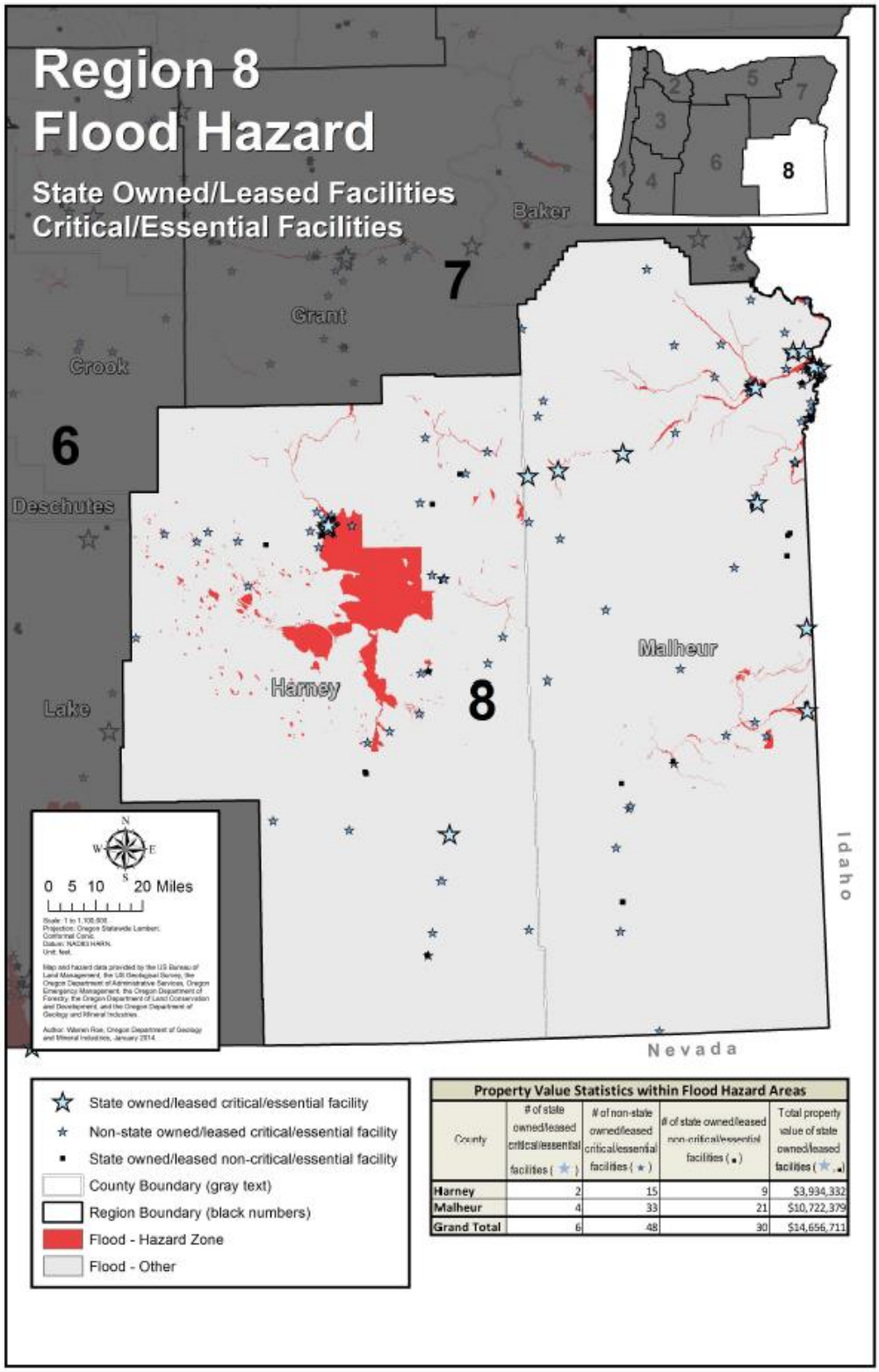
Communities can reduce the likelihood of damaging floods by employing floodplain management practices that exceed NFIP minimum standards. DLCD encourages communities that adopt such standards to participate in FEMA's Community Rating System (CRS), which results in reduced flood insurance costs. This region has no CRS communities

STATE-OWNED/LEASED FACILITIES AND CRITICAL AND ESSENTIAL FACILITIES

The following information is based on a State 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, 36 are currently located within a flood hazard zone in Region 8 and have an estimated total value of $14.7 million (**Figure 2-235**). Of these, 6 are identified as a critical or essential facility. An additional 48 non-state owned/leased critical/essential facilities are located in a flood hazard zone in Region 8.

Figure 2-235. State-Owned/Leased Facilities and Critical/Essential Facilities in a Flood Hazard Zone in Region 8



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 (★, ▪)
Harney	2	15	9	$3,934,332
Malheur	4	33	21	$10,722,379
Grand Total	6	48	30	$14,656,711

Source: DOGAMI

Landslide

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. On occasion, major landslides occur on US or State Highways that sever these major transportation routes (including rail lines) causing temporary but significant economic damage.

Historic Landslide Events

There are no readily known significant landslides in this region.

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 is 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 (High, Moderate, Low) that Region 8 will experience landslides is depicted in **Table 2-528**. 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 2-528. Local Probability Assessment of Landslides for Region 8

	Harney	Malheur
Probability	M	H

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

State Assessment

The probability of future landslides in the southeastern Oregon region is moderate. The probability of an area to have a landslide is increased depending on the factors that reduce the stability without causing failure. When several of these factors are combined, such as an area

with steep slopes, weak geologic material, and previous landslide movement, the probability of future landsliding is increased. There is a strong correlation between intensive winter rainstorms and the occurrence of rapidly moving landslides (debris flows).

Vulnerability

Local Assessment

Based on the OEM Hazard Analysis conducted by county emergency program managers, the region's vulnerability (High, Moderate, Low) to landslides is depicted in **Table 2-529**. 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 2-529. Local Vulnerability Assessment of Landslides for Region 8

	Harney	Malheur
Vulnerability	L	M

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

State Assessment

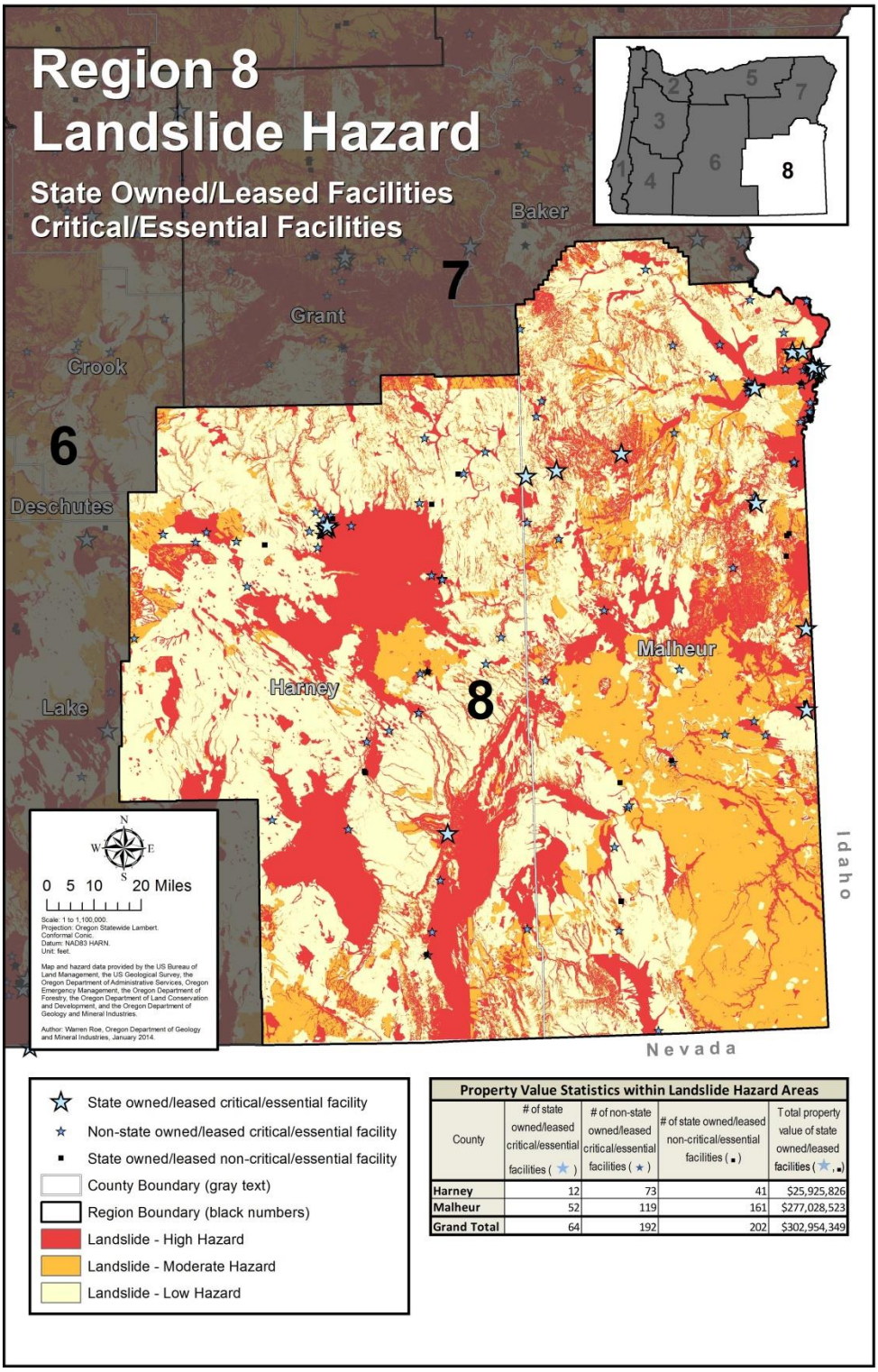
Landslides pose significant threats to people and infrastructure. Landslides have caused damage and loss in the region and it is very likely that they will again. Most of the people and infrastructure in Region 8 are located in one of the major cities in the region which are located along highways. The generalized landslide hazard for the region is low to moderate, however there are areas within the region that have very high hazard risk, such as the Summer Lake area along Highway 31 and around Lakeview and along Highway 395.

STATE-OWNED/LEASED FACILITIES AND CRITICAL AND ESSENTIAL FACILITIES

The following information is based on a State 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, 266 are currently located within a landslide hazard zone in Region 8 and have an estimated total value of $303 million (**Figure 2-236**). Of these, 64 are identified as a critical or essential facility. An additional 192 non-state owned/leased critical/essential facilities are located in a flood hazard zone in Region 8.

Figure 2-236. State-Owned/Leased Facilities and Critical/Essential Facilities in a Landslide Hazard Zone in Region 8



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 (★, ▪)
Harney	12	73	41	$25,925,826
Malheur	52	119	161	$277,028,523
Grand Total	64	192	202	$302,954,349

Source: DOGAMI

Volcano

Characteristics

The volcanic Cascade Range is not within Region 8 counties, but there is some risk from volcanic ash, derived from these volcanoes. This fine-grained material, blown aloft during a volcanic eruption, can travel many miles from its source. For example, during the May 1980, Mount St. Helens eruption, the cities of Yakima (80 miles away) and Spokane (150 miles away), Washington, were inundated with ash. Ash fall can reduce visibility to zero, and bring street, highway, and air traffic to an abrupt halt. The material is noted for its abrasive properties and is especially damaging to machinery.

Ash fall deposition is largely controlled by the prevailing wind direction. The predominant wind pattern over the Cascade Range is from the west to the east. Previous eruptions documented in the geologic record indicate most ash fall drifting to and settling in areas to the east of the Cascade volcanoes. Geologic hazard maps have been created for most of the volcanoes in the Cascade Range by the U.S Geological Survey Volcano Hazards Program at the Cascade Volcano Observatory in Vancouver, WA and are available at http://volcanoes.usgs.gov/observatories/cvo/.

Besides the distant Cascade volcanoes to the west, there are numerous examples of local volcanic activity throughout southeastern Oregon, such as the abundant thermal hot springs, and some large volcanic fields (e.g., Diamond and Jordan Craters), which attest to its not too distant volcanic past. Jordan Craters, located about 36 miles southwest of Adrian, is thought to have erupted lava roughly 3,200 years ago.

Historic Volcanic Events

Table 2-530. Historic Volcanic Events in Region 8

Date	Location	Description
< 7,000 YBP	Diamond Craters, eastern Oregon	lava flows and tephra in Diamond Craters field
< 3,200 YBP	Jordan Craters, eastern Oregon	lava flows and tephra in Jordan Craters field

Source: Source: U.S. Geological Survey, Cascades Volcano Observatory: http://volcanoes.usgs.gov/observatories/cvo/

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 is 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 (High, Moderate, Low) that Region 8 will experience volcanic hazards is depicted in **Table 2-531**. 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 2-531. Local Probability Assessment of Volcanic Activity in Region 8

	Harney	Malheur
Probability	L	L

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

State Assessment

Mount St. Helens remains a probable source of ash as shown in the map below. It has repeatedly produced voluminous amounts of this material and has erupted much more frequently in recent geologic time than any other Cascade volcano. It blanketed Yakima and Spokane, Washington during the 1980 eruption and again in 2004. The location, size, and shape of the area affected by ash are determined by the vigor and duration of the eruption and the wind direction.

The eruptive history of the nearby Cascade volcanoes to this region can be traced to late Pleistocene times (approximately 700,000 years ago) and will no doubt continue. But the central question remains: When? The most recent series of events at Newberry Volcano, which occurred about 1,300 years ago, consisted of lava flows and ash fall. Newberry Volcano's recent history also includes pyroclastic flows and numerous lava flows. Volcanoes in the Three Sisters region, such as Middle and South Sister, and Crater Lake have also erupted explosively in the past. These eruptions have produced pyroclastic flows, lava flows, lahars, debris avalanches, and ash. Any future eruptions at these volcanoes would most likely resemble those that have occurred in the past.

Geoscientists have provided some estimates of future activity in the vicinity of Newberry Caldera and its adjacent areas. They estimate a 1 in 3,000 chance that some activity will take place in a 30-year period. The estimate for activity at Crater Lake for the same time period is significantly smaller at 0.003 to 0.0003. In the Three Sisters region, the probability of future activity is roughly 1 in 10,000 but any restlessness would greatly increase this estimate.

Local eruptions within Region 8 occurred most recently at Diamond Craters about 6000 years ago and younger activity at Jordan Craters dates after 3,200 years ago. These events consisted of short-lived effusion of basaltic lava and blanketing of the surrounding landscape with basaltic ash. These volcanoes are today extinct, but future eruptions in Southeast Oregon will occur.

However, neither the timing nor the location of such events can be forecast in the absence of volcanic unrest.

Vulnerability

Local Assessment

Based on the OEM Hazard Analysis conducted by county emergency program managers, the region's vulnerability (High, Moderate, Low) to volcanic hazards is depicted in **Table 2-532**. 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 2-532. Local Vulnerability Assessment of Volcanic Activity in Region 8

	Harney	Malheur
Vulnerability	L	M

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

State Assessment

The region's vulnerability to the effects of volcanic eruptions are low. Areas within Region 8 could be affected by distal ash fall from Cascade volcanic eruptions and more locally by small eruptions of lava from the numerous youthful volcanic cones scattered across Harney and Malheur Counties. Most of the people and infrastructure are located in one of the major cities in the region which are located along an interstate (I-84) and/or the regional highways (Hwy 20 and Hwy 395). The most vulnerable communities are Burns, Ontario, and Jordan Valley. The region's total exposure for buildings and transportation systems alone is roughly $15 billion.

Wildfire

Characteristics

Southeastern Oregon contains large tracts of ponderosa pine forests, primarily in the northern part of Harney County. Less extensive forests occur in Malheur County near Ironside and in scattered mountain ranges throughout the region. These areas are highly vulnerable to wildfire because of natural aridity and the frequency of lightning strikes. Grasslands, which naturally cover most of the region, also are problematic. Wildfire always has been a part of these ecosystems. Past management practices, which included the suppression of all wildfires, has favored the growth of a brushy understory and the accumulation of dead or dying trees. This leads to devastating fires. State and federal agencies seek to alleviate the problem through a controlled (i.e., prescribed) burning program. **Table 2-533** lists some of the significant wildfires that have occurred in the region.

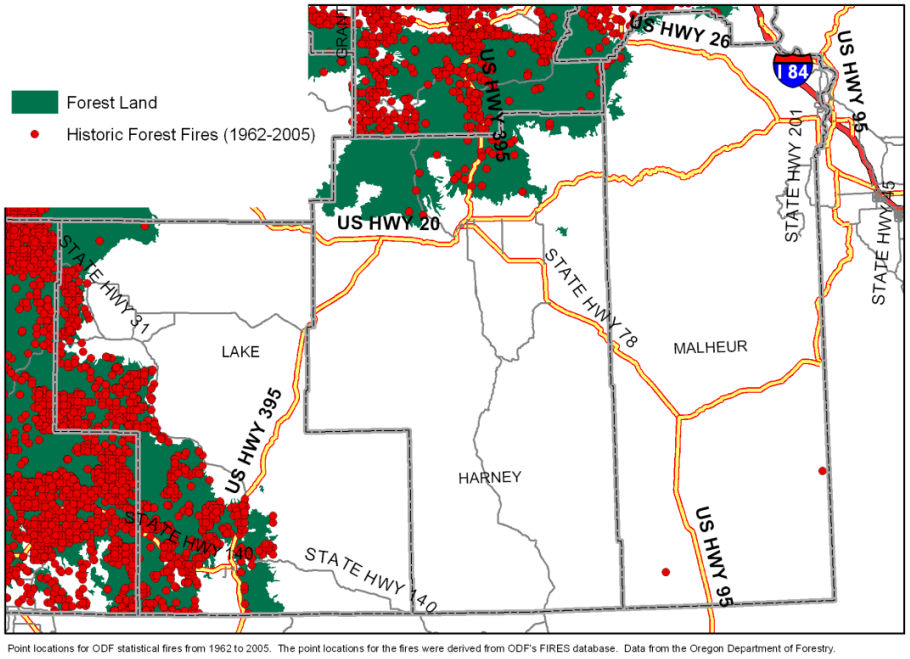
Historic Wildfire Events

Table 2-533. Significant Wildfires in Region 8

Date	Name of Fire	Location	Acres Burned
1998	Ontario	Malheur County	
2000	Jackson	Malheur County	79,875
2001	Sheepshead	Malheur County	51,452
2007	Egley	Harney	140,360

Source: Oregon Department of Forestry, 2013

Figure 2-237. Map of Historic Forest Fires in Region 8



Source: The Oregon Department of Forestry Database and extent of forested land (http://egov.oregon.gov/ODF/GIS).

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 is 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 (High, Moderate, Low) that Region 8 will experience wildfire is depicted in **Table 2-534**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-534. Local Probability Assessment of Wildfire for Region 8

	Harney	Malheur
Probability	H	H

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

State Assessment

The forests and grasslands of Region 8 are highly susceptible to wildfire and many of the cities and unincorporated communities, in addition to rangelands and agricultural lands, are vulnerable to its effects. Wildfires are an annual occurrence and have varied in size from under 10 acres to over 100,000 acres.

Fire cause is largely associated with fires started by lightning. Human causes are mostly associated with abandoned campfires, debris burning, or fires started along the interstate and highways (faulty vehicle equipment, cigarettes tossed out of windows of vehicles, etc.).

The hilly or mountainous topography exacerbates wildfire hazards: these areas can cause a wildfire to spread rapidly and burn larger areas in a shorter period of time, especially as fires migrate uphill. Wildfire has been known to move at speeds of 30 mph or higher on grasslands.

Large fires have, at times, exceeded the capability of structural and wildland resources, not only calling for the declaration of the Conflagration Act, but also requiring National Incident Management Teams to manage fires at the project fire level.

Vulnerability

Local Assessment

Based on the OEM Hazard Analysis conducted by county emergency program managers, the region's vulnerability (High, Moderate, Low) to wildfire is depicted in **Table 2-535**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-535. Local Vulnerability Assessment of Wildfire for Region 8

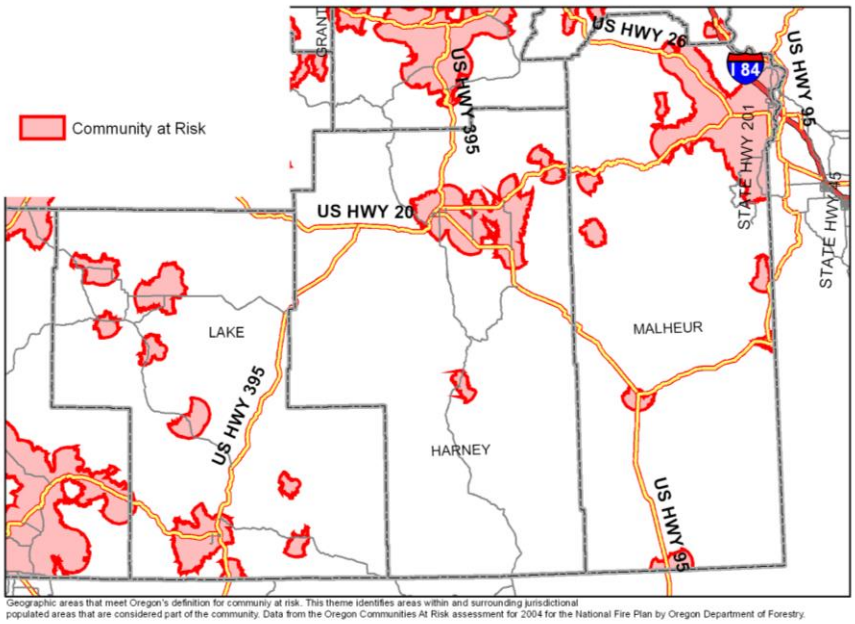
	Harney	Malheur
Vulnerability	H	H

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

State Assessment

The generalized wildfire hazard for the region is moderate to high; however, there are areas within the region that have a very high hazard. Most of the people and infrastructure are located in one of the major cities in the region which are located along I-84, Hwy 20 and Hwy 395 (**Figure 2-238**). The region's total exposure for buildings and transportation systems alone is roughly 11.5 billion dollars.

Figure 2-238. Map of Region 8 Communities at Risk of Wildfire



Source: ODF

Preliminary analyses indicate a high likelihood of damage and losses from future wildfire in the region. Threatened assets include businesses, farmland, ranchland, grazing land, hunting and recreation land. Action should be taken to reduce the damage and losses through predisaster mitigation and prepare for effective emergency response after the disaster. Special action should be taken for critical facilities including schools and emergency facilities and infrastructure such as roadways.

Wildland fire protection in unincorporated areas is protected by Rangeland Fire Protection Associations or BLM. Where the majority of BLM land is leased for ranching operations, large wildfires can have significant economic impacts on ranchers' stock and range allotments, as burned land is unfit for grazing use for several years after a fire.

Known sage-grouse habitat is a top wildfire suppression priority in this region. Rangeland Protection Associations and Oregon Department of Forestry are planning to implement Conservation Measures prior to January 2015, to reduce the negative impacts of wildland fire on sagebrush plant communities within the range of the sage-grouse.

The communities in Region 8 are particularly vulnerable because they are scattered throughout the landscape on large acreages with highly flammable vegetation. Many communities have no structural fire protection, and wildland agencies would have extended response times.

Table 2-536. Wildland-Urban Interface Communities in Region 8

Harney	Malheur
Andrews	Adrian
Blitzen	Arock
Burns-Hines	Brogan
Crane	Danner
Diamond	Harper
Drewsey	Jamieson
Fields	Jordan Valley
Frenchglen	Juntura
Narrows	McDermitt
Double O	Nyssa Heights
	Ontario Heights
	Oregon Slope
	Vale
	Ironside

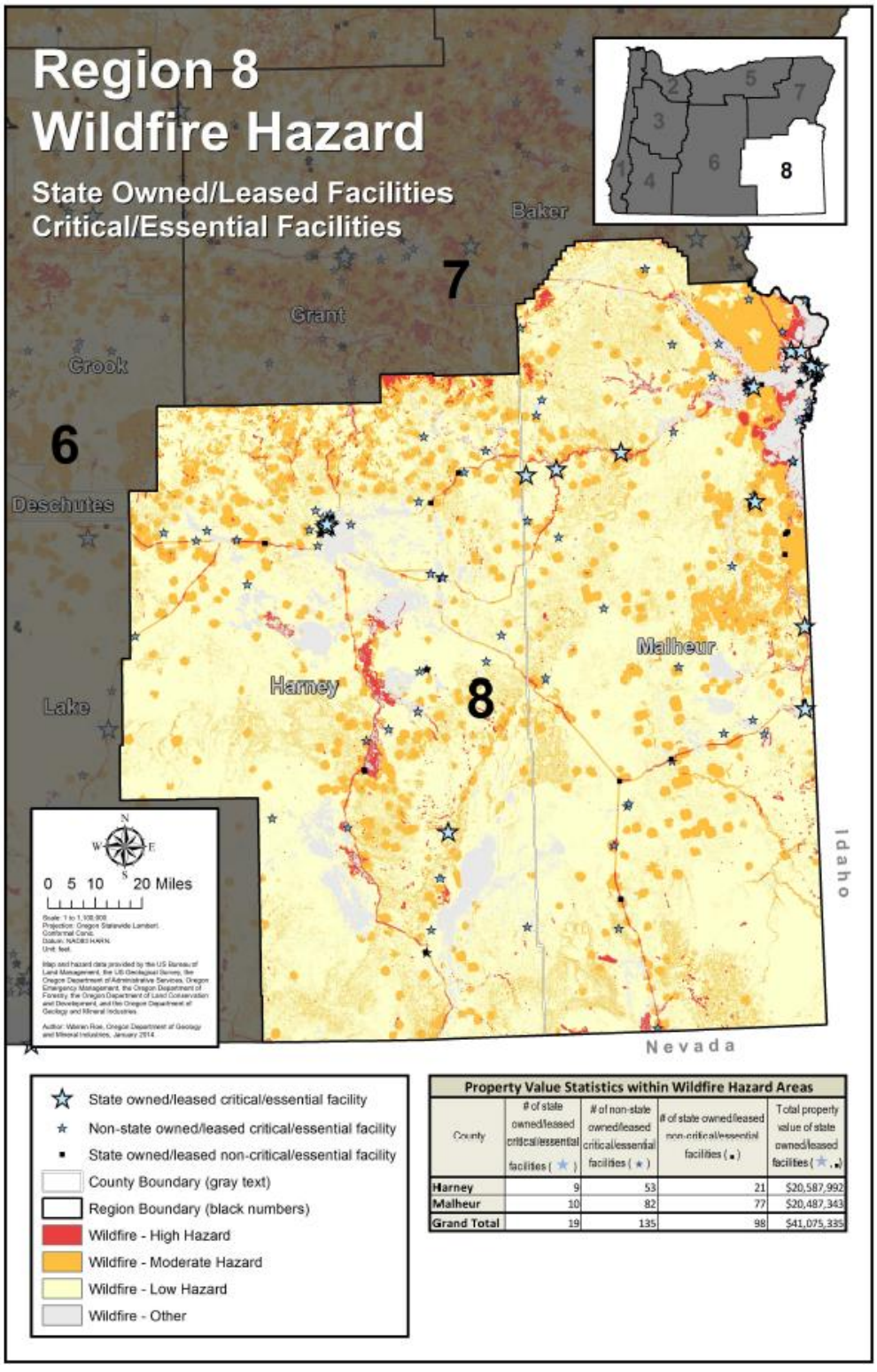
Source: Oregon Dept. of Forestry Statewide Forest Assessment September, 2006

STATE-OWNED/LEASED FACILITIES AND CRITICAL AND ESSENTIAL FACILITIES

The following information is based on a State 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, 117 are within a wildfire hazard zone in Region 8 and total roughly $41 million in property value (**Figure 2-239**). Among those, 19 are state critical/essential facilities. An additional 135 non-State critical/essential facilities are also located in Region 8.

Figure 2-239. State-Owned/Leased Facilities and Critical/Essential Facilities in a Wildfire Hazard Zone in Region 8



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 (★ , ▪)
Harney	9	53	21	$20,587,992
Malheur	10	82	77	$20,487,343
Grand Total	19	135	98	$41,075,335

Source: DOGAMI

Windstorm

Characteristics

High winds in the intermountain areas of Region 8 are not uncommon. There is little in the way of mountain protection for much of these counties; the landscape is flat and open with the exception of a few areas. Winds in Harney and Malheur Counties are often associated with thunderstorms, which have strong outflow and coincidentally strong surface winds. Windstorms can be problematic in burn areas, where dust may be lifted and transported across the landscape, causing reductions in visibility and localized damage.

Tornadoes

Small to moderate sized tornadoes have been recorded in virtually every area of Oregon. Six have been recorded in Region 8 (**Table 2-537**), but others probably have occurred. Wind speeds have varied; estimates are somewhere between 40 to 112 mph, corresponding to "gale" (F0 on the Fujita Scale of Tornado Intensity) and "moderate" (F1 on the Fujita Scale) tornadoes. Damage was estimated to be an amount between $5,000 and $50,000 (Taylor and Hatton 1999).

Historic Windstorm Events

Table 2-537. Historic Windstorms in Region 8

Date	Affected Area	Characteristics
Apr. 1931	northeast 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
Aug. 1966	Malheur County	tornado between Nyssa and Ontario; telephone poles and some farm buildings destroyed
June 1967	Malheur County	two tornadoes reported; some damage
June 1969	Malheur County	tornado reported 40-60 miles south of Jordan Valley (Malheur County)
Mar. 1971	most of Oregon	greatest damage in Willamette Valley; homes and power lines destroyed by falling trees; destruction to timber in Lane County
Apr. 1974	Malheur County	tornado path parallel to Oregon- Idaho border; farm building destroyed
Nov. 1981	statewide	60-mph winds common throughout state
Jan. 1990	statewide	severe wind storm
Jan. 1991	most of Oregon	severe wind storm
Dec. 1991	NE and central Oregon	severe wind storm
Dec. 1992	northeastern mountains, Oregon	severe wind storm
May 1994	eastern Oregon	strong winds in Treasure Valley area (Ontario); blowing dust caused many car accidents
May 2005	Malheur County	hail storm causes $3,000 in crop damage
July 2006	Harney County	wind storm produces winds of 75 mph
Aug. 2006	Harney County	three high wind storms in Harney County with winds measured at 67, 58 and 58 mph, respectively
Aug. 2007	Harney County	high wind storm produces winds of 58 mph
Apr. 2010	Harney County	75-mph winds caused $200,000 in property damage, including 52 downed power poles

Source: Taylor and Hannan, 1999, *The Oregon Weather book;* 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

Table 2-538. Tornadoes Recorded in Region 8

County	Date	Location	Damage
Malheur	Aug. 1966	Adrian to Oregon border just north of Ontario, Oregon	several farm buildings destroyed; trees uprooted; telephone poles displaced
Malheur	June 1967	13 miles west of Sheaville, Oregon	two tornadoes; limited in extent and duration; one damaging; the other, no damage
Malheur	June 1967	remote	some damage
Malheur	June 1969	40–60 miles west of Jordan Valley, Oregon	grain fields damaged
Malheur	Apr. 1974	10 miles SW of Nyssa, Oregon	farm buildings destroyed

Source: Taylor and Hatton, 1999, pp. 123-137

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 is 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 (High, Moderate, Low) that Region 8 will experience windstorms is depicted in **Table 2-539**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-539. Local Probability Assessment of Windstorms for Region 8

	Harney	Malheur
Probability	M	H

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

State Assessment

The 100-year storm in this region is defined as one-minute average winds of 75 mph. A 50-year storm includes winds of 65 mph. A 25-year storm has winds of up to 55 mph.

Vulnerability

Local Assessment

Based on the OEM Hazard Analysis conducted by county emergency program managers, the region's vulnerability (High, Moderate, Low) to windstorm is depicted in **Table 2-540**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-540. Local Vulnerability Assessment of Windstorms for Region 8

	Harney	Malheur
Vulnerability	L	M

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

State Assessment

Many buildings, utilities, and transportation systems within Region 7 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, which can affect emergency operations. In addition, up-rooted or shattered trees can down power and/or utility lines and effectively bring local economic activity and other essential facilities to a standstill. Much of the problem may be attributed to a shallow or weakened root system in saturated ground. Many roofs have been destroyed when uprooted trees growing next to a house fall during a windstorm. In some situations, strategic pruning may be the answer. Prudent counties will work with utility companies to identify problem areas and establishing a tree maintenance and removal program.

Winter Storm

Characteristics

Within the State of Oregon, Region 8 communities are known for cold, snowy winters. Winter weather in Region 8 can be characterized by extreme cold, snow, ice, and sleet. There are annual winter storm events in Region 8 with an average of 24 inches of snow; most communities are prepared for them. In the elevated areas of the Wallowa Mountains severe winter storms are more frequent. Moderate to heavy snow fall is prepared for and expected on an annual basis in this region.

Historic Winter Storm Events

Table 2-541. Significant Winter Storms in Region 8

Date	Location	Remarks
Dec. 1861	entire state	storm produced 1–3 feet of snow throughout Oregon
Dec. 1892	northern counties, Oregon	15–30 inches of snow fell throughout the northern counties
Jan. 1916	entire state	two storms; heavy snowfall, especially in mountainous areas
Jan. and Feb. 1937	entire state	deep snow drifts
Jan. 1950	entire state	record snow falls; property damage throughout state
Mar. 1960	entire state	many automobile accidents; two fatalities
Jan. 1969	entire state	heavy snow throughout state
Jan. 1980	entire state	series of string storms across state; many injuries and power outages
Feb. 1985	entire state	2 feet of snow in northeast mountains; downed power lines; fatalities reported
Feb. 1986	central /eastern Oregon	heavy snow; traffic accidents; broken power lines
Mar. 1988	entire state	strong winds; heavy snow
Feb. 1990	entire state	heavy snow throughout state
Nov. 1993	Cascade Mountains, Oregon	heavy snow throughout region
Feb. 1994	southeastern Oregon	heavy snow throughout region
Winter 1998-99	entire state	one of the snowiest winters in Oregon history (snowfall at Crater Lake: 586 inches)

Source: Taylor and Hatton, 1999, p. 118–122

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 is 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 (High, Moderate, Low) that Region 8 will experience winter storms is depicted in **Table 2-542**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-542. Local Probability Assessment of Winter Storms for Region 8

	Harney	Malheur
Probability	H	H

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

State Assessment

There is no statewide program or statistical data to study the past, present and potential future impacts of winter storms in the state of Oregon at this time. Based on historical events data alone, Oregon can expect to have continued annual winter storm events in this region. Also based on historical events, severe winter storms are estimated to impact the region approximately every four years.

Vulnerability

Local Assessment

Based on the OEM Hazard Analysis conducted by county emergency program managers, the region's vulnerability (High, Moderate, Low) to winter storms is depicted in **Table 2-543**. See the **State Risk Assessment** for background information on the OEM Hazard Analysis and scoring methodology.

Table 2-543. Local Vulnerability Assessment of Winter Storms for Region 8

	Harney	Malheur
Vulnerability	M	M

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

State Assessment

Within the State of Oregon, Region 8 communities are known for cold, snowy winters. This is advantageous in at least one respect: in general, the region is prepared, and those visiting the region during the winter usually come prepared. However, there are occasions when preparation cannot meet the challenge. Drifting, blowing snow has often brought highway traffic to a standstill. Also, windy, icy conditions have often closed mountain passes and canyons to certain classes of truck traffic. In these situations, travelers must seek accommodations,

sometimes in communities where lodging is very limited. Local residents also experience problems. During the winter, heating, food and the care of livestock and farm animals are everyday concerns. Access to farms and ranches can be extremely difficult and present a serious challenge to local emergency managers. Road closures due to winter weather are more common in this region. In general, the impacts of winter storms to southeastern Oregon communities are less significant because communities are prepared for long winters.