

Chapter 2 RISK ASSESSMENT

In This Chapter

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

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

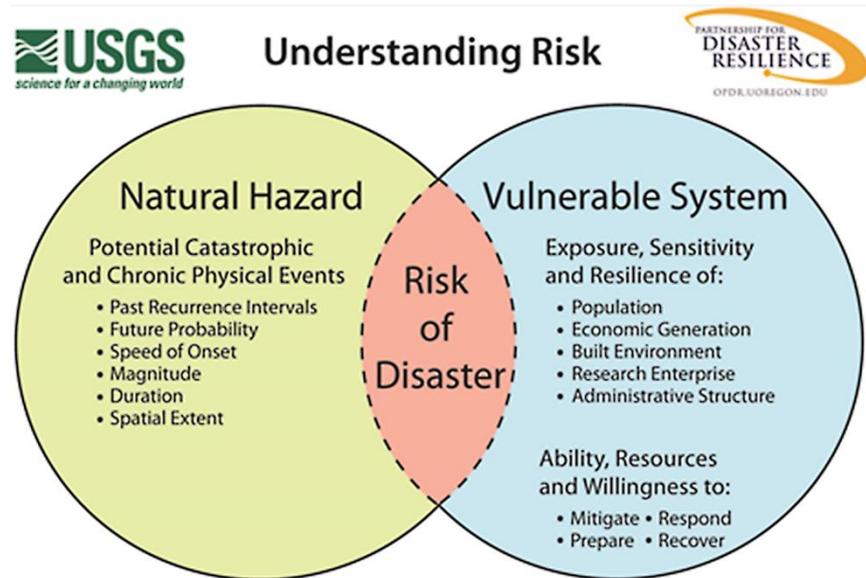
2.1 Introduction

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

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

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

Figure 2-1. Understanding Risk



Source: Wood (2007)

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

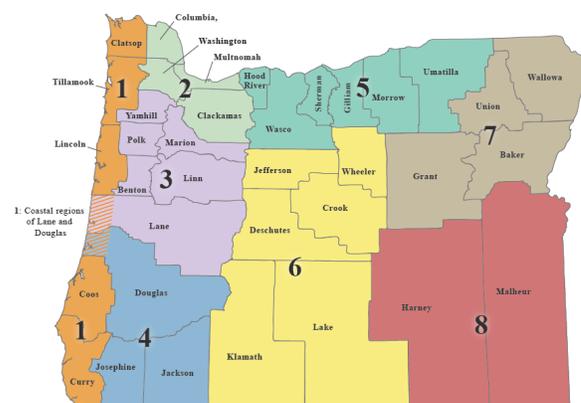
A vulnerability assessment combines information from the hazard characterization with an inventory of the existing (or planned) property and population exposed to a hazard and attempts to predict how different types of property and population groups will be affected by each hazard. Vulnerability is determined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

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

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

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

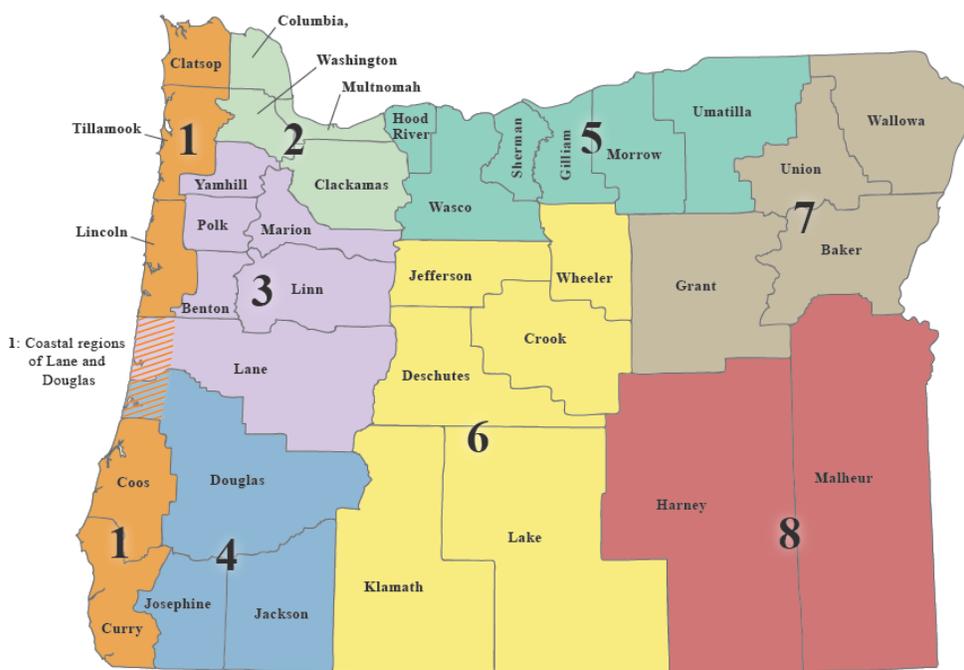
Figure 2-2. Oregon NHMP Natural Hazards Regions



2.3 Regional Risk Assessments

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

Figure 2-81. Oregon NHMP Natural Hazards Regions



Each Regional Risk Assessment includes three sections:

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

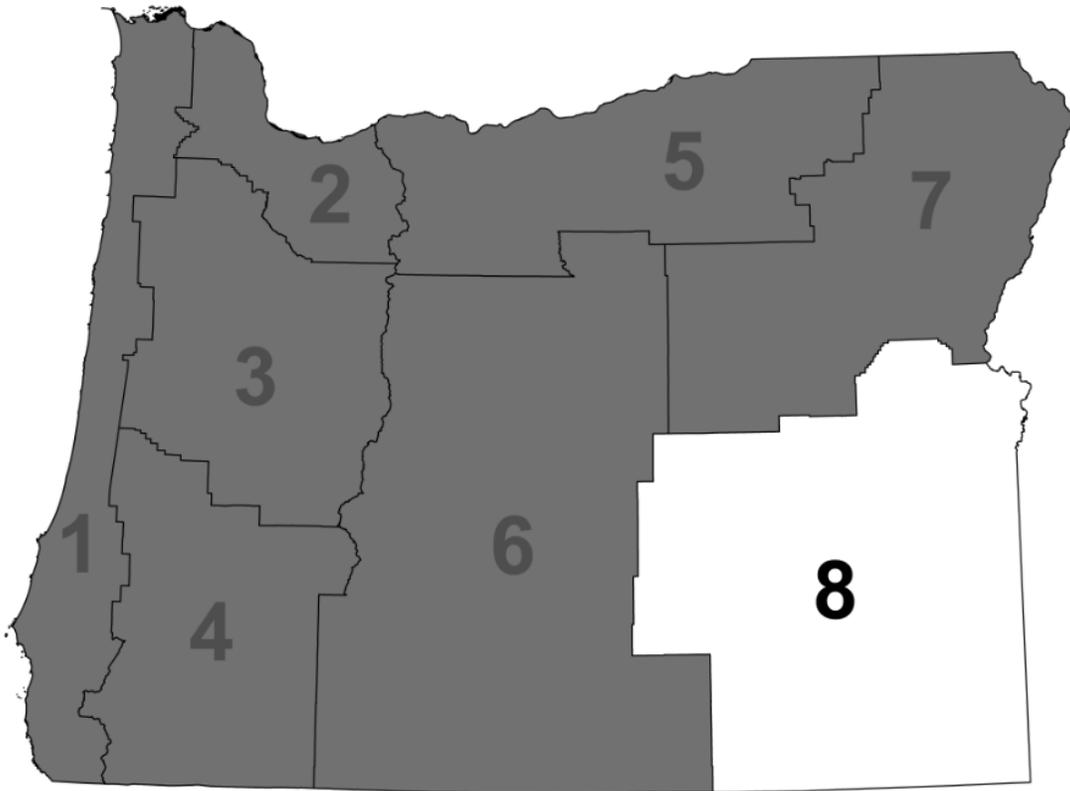
The research of Susan Cutter, Professor of Geography at the University of South Carolina, Columbia, on vulnerability and environmental hazards provides the framework for discussion of vulnerability in the Regional Profile section. Cutter's framework helps to illustrate the geographic variability of vulnerability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

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

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

2.3.8 Region 8: Southeast Oregon

Harney and Malheur Counties





2.3.8.1 Summary

Profile

Region 8's demographic, economic, infrastructure, and development patterns indicate that some populations, structures, and places may be more vulnerable to certain natural hazards than others. Mitigation efforts directed at these vulnerabilities may help boost the area's ability to bounce back after a natural disaster.

Social vulnerability in Region 8 is driven by a declining population, low median household incomes, and high levels of poverty. In Harney County there are also a high percentages of seniors and people with disabilities. 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 Region 8. Regional wages remain below the state average. Harney County continues to suffer from high unemployment. Damage or service interruption to roads, bridges, rail systems, and ports 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.

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

Region 8 is largely rural and is losing population. The region has a high percentages 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) increases the vulnerability of development in Region 8.



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.

Droughts: 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 droughts in Malheur and Harney County as primary natural disasters in May and June of 2013. Malheur County is considered one of the counties most vulnerable to drought in Oregon.

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

Earthquakes: Two types of earthquakes affect Region 8: (a) shallow crustal events and (b) 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, valued at over \$284.5 million, in this region. Of these, 53 are critical/essential facilities. An additional 153 non-state-owned/leased critical/essential facilities are also located within this hazard zone.

Floods: 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, valued at approximately \$14.7 million, located in the region's flood hazard zone. 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 OR-31, around Lakeview, and along US-395. There are 266 state-owned/leased facilities in this region, valued at 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 ashfall 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.

Wildfires: 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 Region 8'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 have led 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 burned areas, where dust becomes airborne reducing visibility and causing 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 cold weather and 24 inches of snow annually. Moderate to heavy snowfall is expected in this region, and 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 little research on how climate change influences these hazards in the Pacific Northwest. For more information on climate drivers and the projected impacts of climate change in Oregon, see the section [Introduction to Climate Change](#).



2.3.8.2 Profile

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

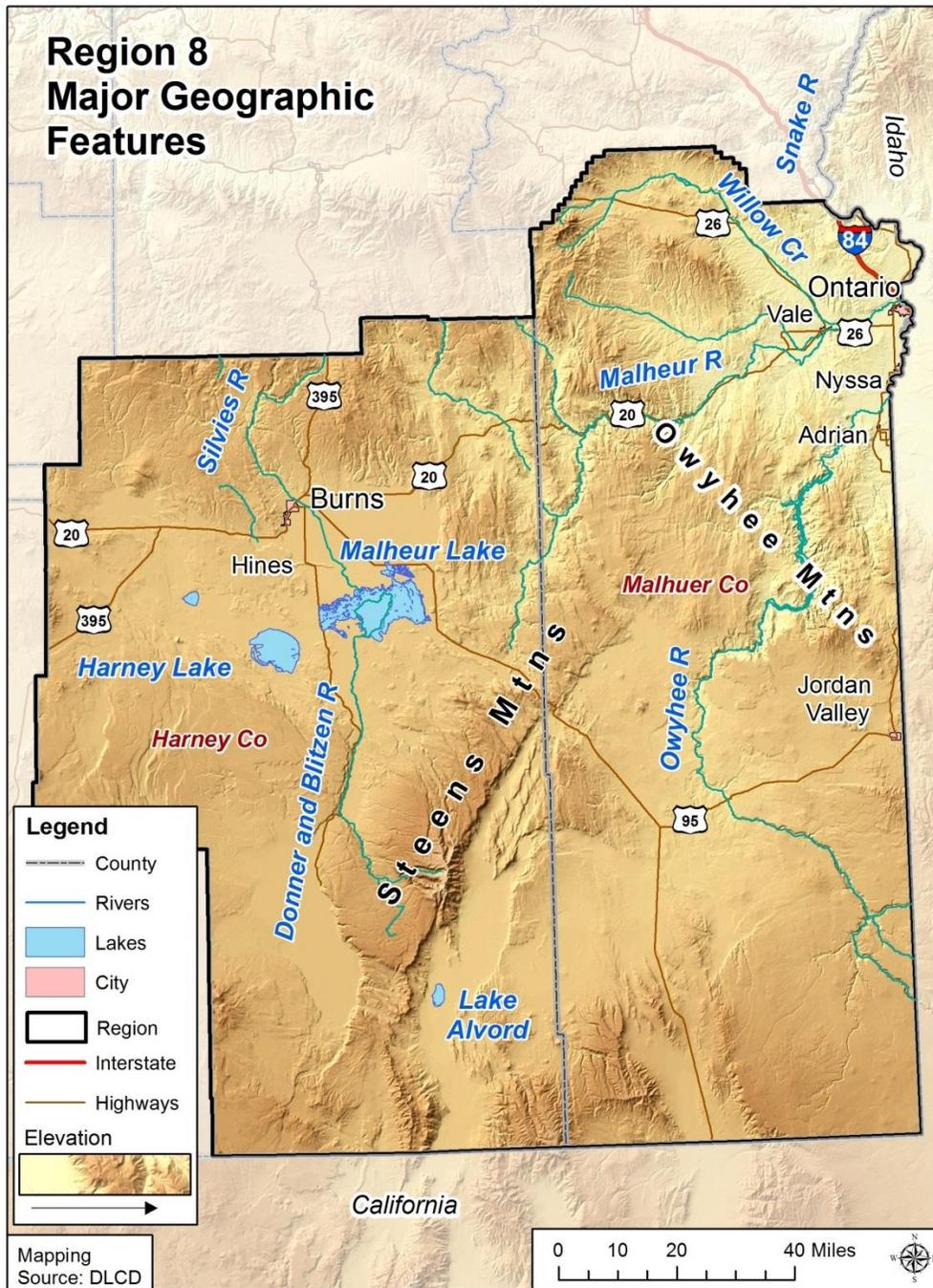
Natural Environment

Geography

Region 8 is approximately 20,023 square miles in size and contains 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. Steens Mountain is a prominent landmass in the region and major rivers in the region include the Malheur and Owyhee.



Figure 2-217. Region 8 Major Geographic Features

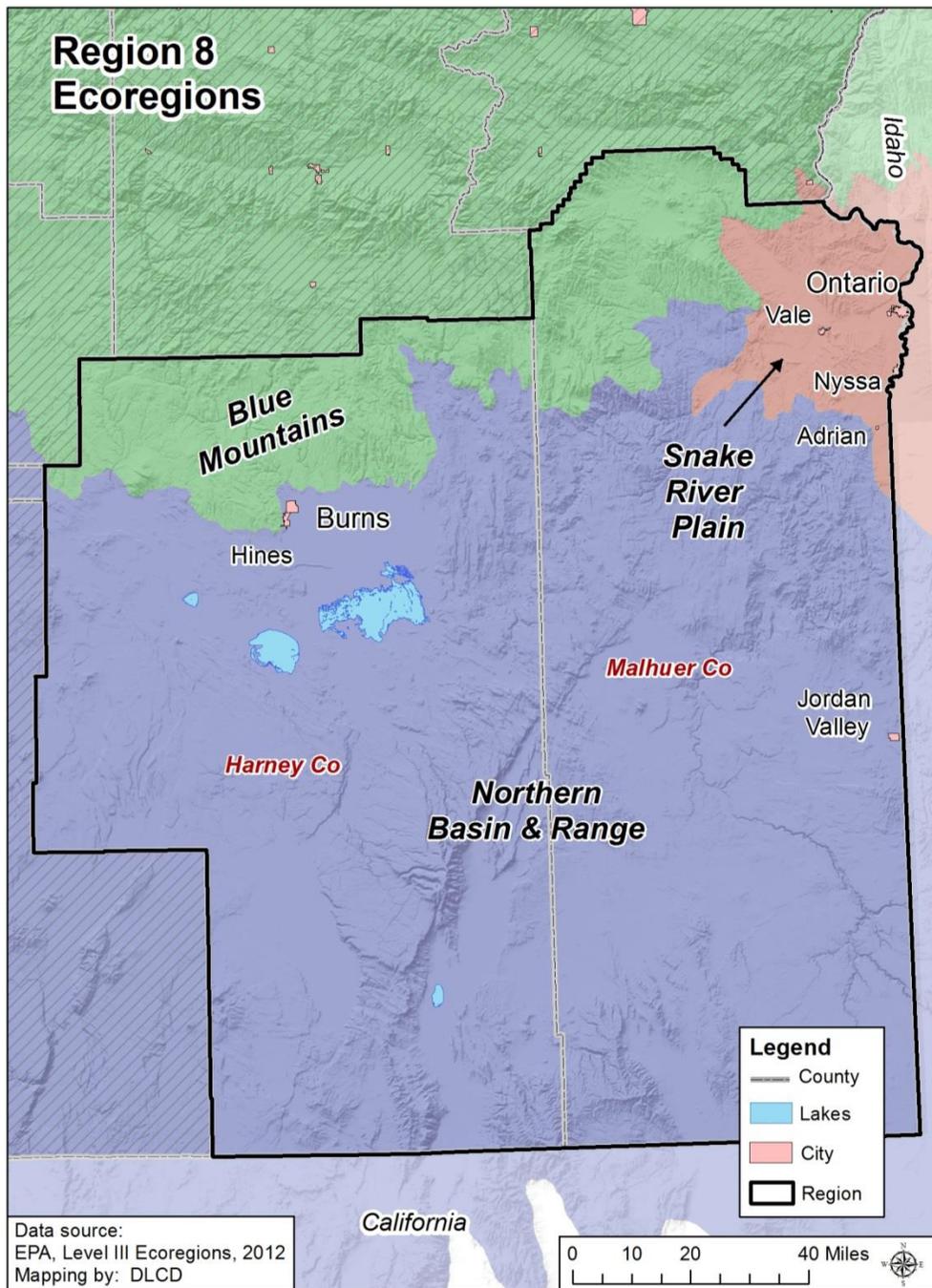


Source: Department of Land Conservation and Development, 2014

The U.S. EPA’s ecoregions are used to describe areas of ecosystem similarity. Region 8 is composed of three ecoregions: Northern Basin and Range, Blue Mountains, and Snake River Plain ([Figure 2-218](#)).



Figure 2-218. Region 8 Ecoregions



Blue Mountains: The Region 8 section of this ecoregion is complex and diverse having many sub-ecoregions with unique conditions. The landscape varies between steep sloped mountains of volcanic origin, scattered cinder cones, foothills, 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 or semi-arid. Basaltic rock, tuffaceous rock, or volcanic ash are dominant rock types, while soil generally varies between sediments, alluvial, colluvial and fluvial deposits, and rock outcrops. Land cover varies between sagebrush steppe, grasslands, rare wetlands, aspen stands in riparian meadows, and unvegetated deserts. Land uses in this ecoregion include recreation, wildlife habitat including federal wildlife refuges, and limited livestock grazing (Thorson et al., 2003).

Snake River Plain: 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 (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. The majority of the region’s land is in the Northern Basin and Range ecoregion. The region’s predominantly arid climate supports limited agricultural activities, primarily livestock grazing. The region is subject to droughts, 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 sub-ecoregion 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 forecast to increase substantially, a community’s capacity to provide adequate housing stock, services, or resources for all populations after a disaster may be stressed or compromised.

Overall, between 2000 and 2013, Region 8 lost population. Harney County lost a greater share of its population than Malheur County. 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 mitigation outreach efforts to places where tourists lodge can help increase awareness and minimize the vulnerability of this population.



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. Disabled populations, 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 I-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 live 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 from 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 | 3-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 Region 8 (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 similar to that of the state. A 5% greater share of the population in Harney County is 65 years and older. Senior citizens may require special consideration due to sensitivity to heat and cold, reliance upon transportation to obtain medication, and comparative difficulty in making home modifications that reduce risk to hazards. In addition, the elderly may be reluctant to leave home in a disaster event. This implies the need for targeted preparatory programming that includes evacuation procedures and shelter locations accessible to the elderly (Morrow, 1999).

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 from work 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, p. 76). Historically, 80% of the disaster burden falls on the public. Of this number, a disproportionate burden is placed upon those living in poverty. People living in poverty are more likely to be isolated, are less likely to have the savings to rebuild after a disaster, and are less likely to have access to transportation and medical care.

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. Harney County’s decrease in median household income over the same period is about the same as the state’s.

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.

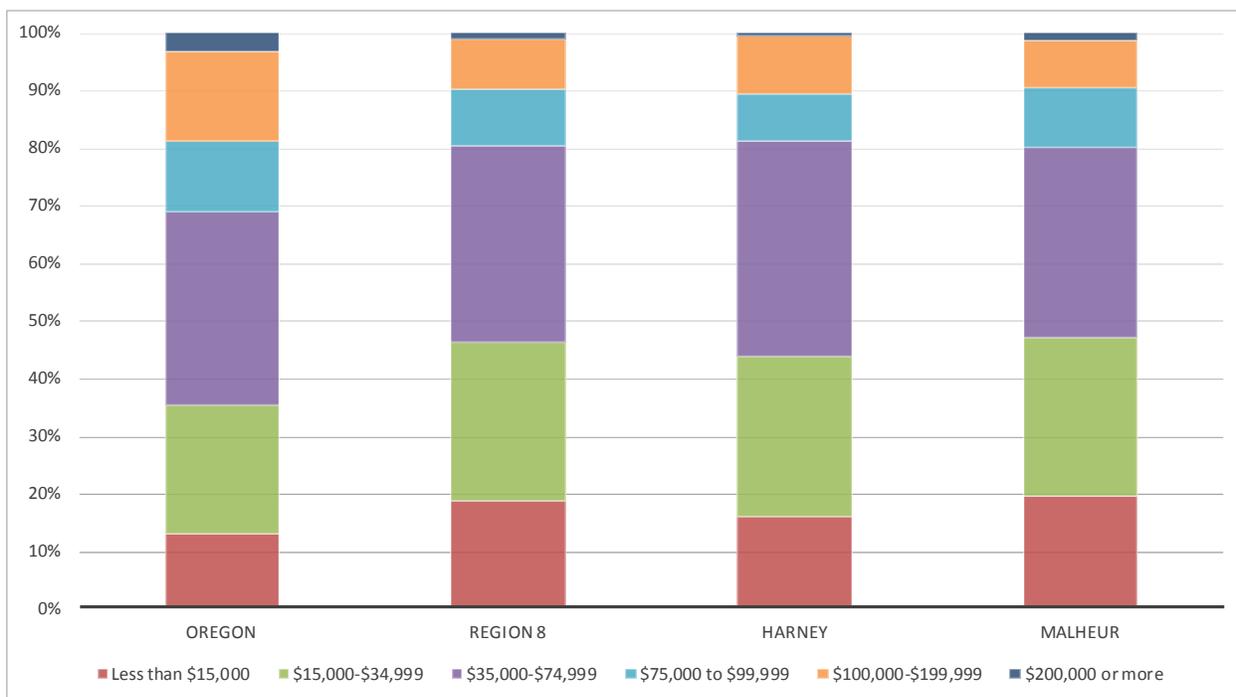
N/A = data not aggregated at the regional level.

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

Eleven percent more of Region 8’s households earn less than \$35,000 annually compared to households statewide. Also compared to the state, 22% fewer of the region’s households are in upper income brackets, earning more than \$75,000.



Figure 2-219. Median Household Income Distribution in Region 8, 2012



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

Eight percent more individuals and about 12% more children in Region 8 live in poverty than the state overall. One quarter of Malheur County’s population lives in poverty. Child poverty increased by more than 56% in Harney County between 2009 and 2012. Overall, the poverty rate in both counties increased more than twice as fast as 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 from a natural hazard. Often, those who earn less have little to no savings and other assets to withstand economic setbacks. When a natural disaster interrupts work, the ability to provide housing, food, and basic necessities becomes increasingly difficult. In addition, low-income populations are hit especially hard as public transportation, public food assistance, public housing, and other public programs upon which they rely for day-to-day activities are often impacted in the aftermath of the natural disaster. To reduce the compounded loss incurred by low-income populations post-disaster, mitigation actions need to be specially tailored to ensure safety nets are in place to provide further support to those with fewer personal resources (Cutter et al., 2003).

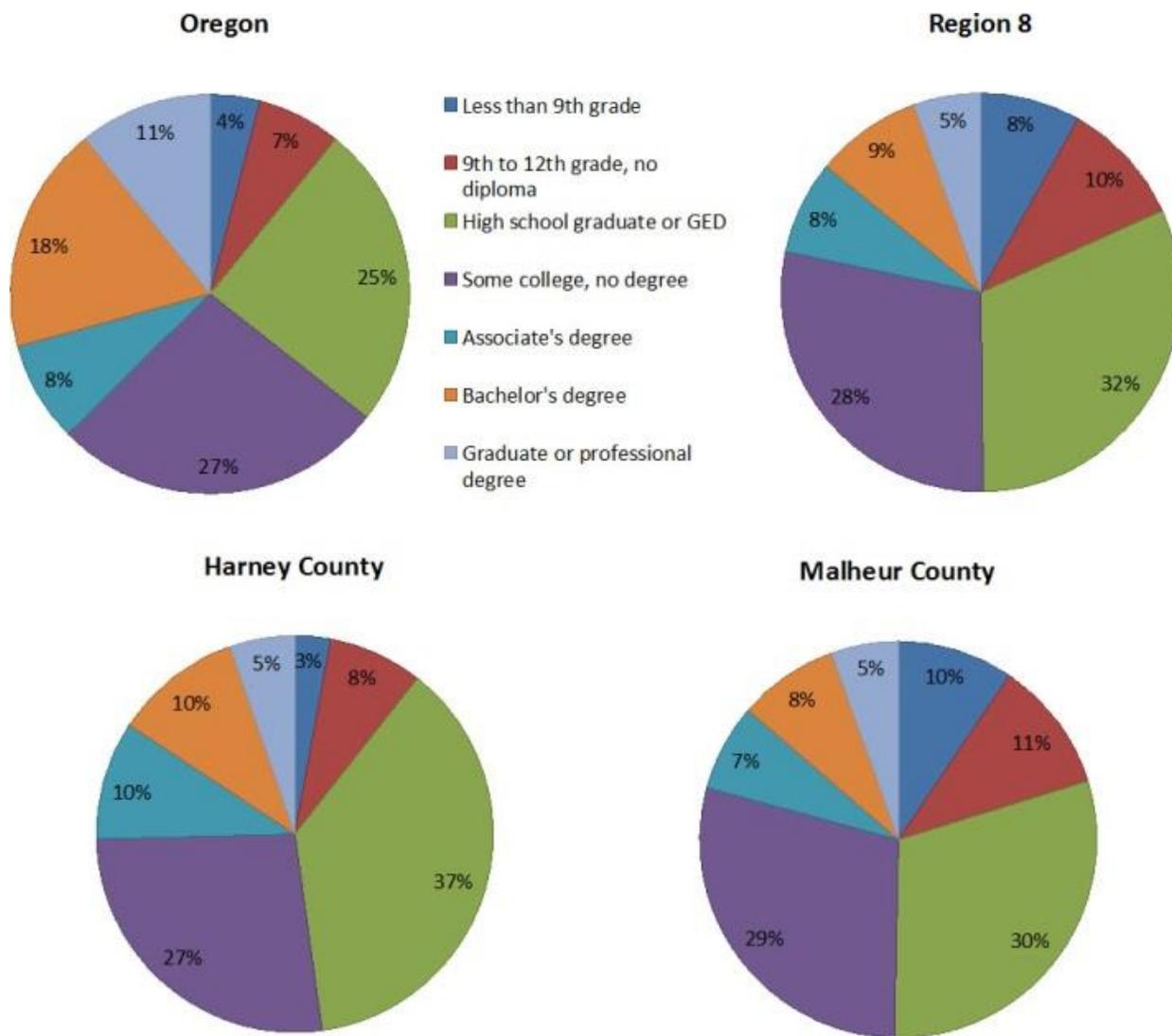
Education Level

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 2-220. 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 predominantly composed of family households. Roughly one third of households in Malheur County have families with children. Similar to statewide numbers, there are about twice as many single-parent households 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 Children | |
|-----------------|---------------------------------|---------|----------------------|---------|------------------------|---------|------------------------------|---------|
| | 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, because:

- Population is declining, with marginal growth expected by 2020.
- Less than 20% of the population reports a disability, but of these over 50% are children and seniors.
- In Malheur County a high percentage of the population does not speak English “very well.”
- Region 8 has low median household incomes overall; Malheur County has suffered a significant drop.
- The region has high poverty levels.
- Malheur County has a higher percentage of family households with children than the state overall.

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’s. 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: (a) Government; (b) Trade, Transportation, and Utilities; (c) Education and Health Services; (d) Natural Resources and Mining; and (e) Leisure and Hospitality. [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

| Industry | Region 8 | Harney | | Malheur | |
|-----------------------------------|----------|------------|---------|------------|---------|
| | | 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.). Further, 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.

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

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 the workforce and employers can be more prepared to respond and adapt to needs that arise after a natural hazard event. Between 2012 and 2022, the largest job growth in Region 8 is expected to occur in the following sectors: (a) Natural Resources and Mining; (b) Education and Health Services; (c) Trade, Transportation, and Utilities (including retail trade); (d) Government; and (e) 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, 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.

Region 8 is still recovering from the financial crisis that began in 2007. The health care industry sector and the region's service and professional occupations sectors 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

Transportation

Roads

The largest population bases in Region 8 are located along the region's major highways: I-84, US-20, US-26, and US-95. I-84 runs north-south and is the main passage for automobiles and trucks traveling east of the Cascade Range between Portland and Idaho. [Figure 2-221](#) shows Region 8's highways and population centers. US-20, US-26, and US-95 provide access east and west into Idaho and central Oregon counties. US-395 provides access into Lake County. Additional access is provided within Idaho to adjacent counties via US-30 and US-95.



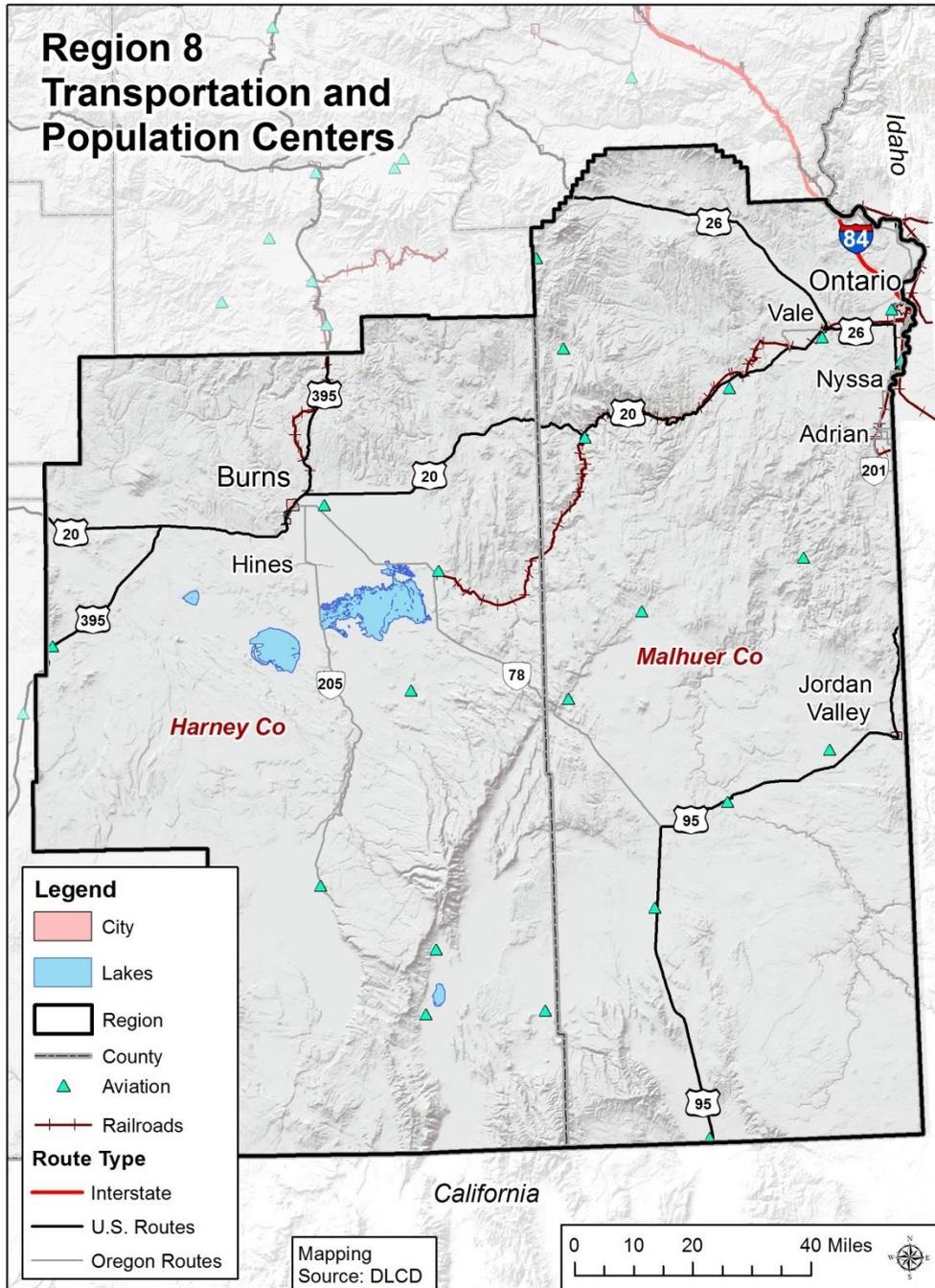
Region 8's growing population centers bring more workers, automobiles, and trucks onto roads. A high percentage of workers driving alone to work coupled with interstate and international freight movement create additional stresses on transportation systems. Some of these include added maintenance, congestion, 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 ([Appendix 9.1.13](#)), 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 2-221. 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 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 Covered |
|-----------------|-------------|-------|-----|--------------|-------|-----|------------|-----|-----|-------------|-----|-----|------------|-------|-----|------------------|
| | Di | ST | %D* | De | ST | %D | De | ST | %D | De | ST | %D | D | T | %D | |
| 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 I-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 air freight may also be impacted by airport closures.

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

| | Number of Airports by FAA Designation | | | | Total |
|-----------------|---------------------------------------|-----------------|----------------|-----------------|-------|
| | Public Airport | Private Airport | Public Helipad | Private Helipad | |
| 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 region’s 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 two power-generating facilities: one hydroelectric power facility and one geothermal facility. 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), PacifiCorp; 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 Region 8, 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. 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. Most 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.

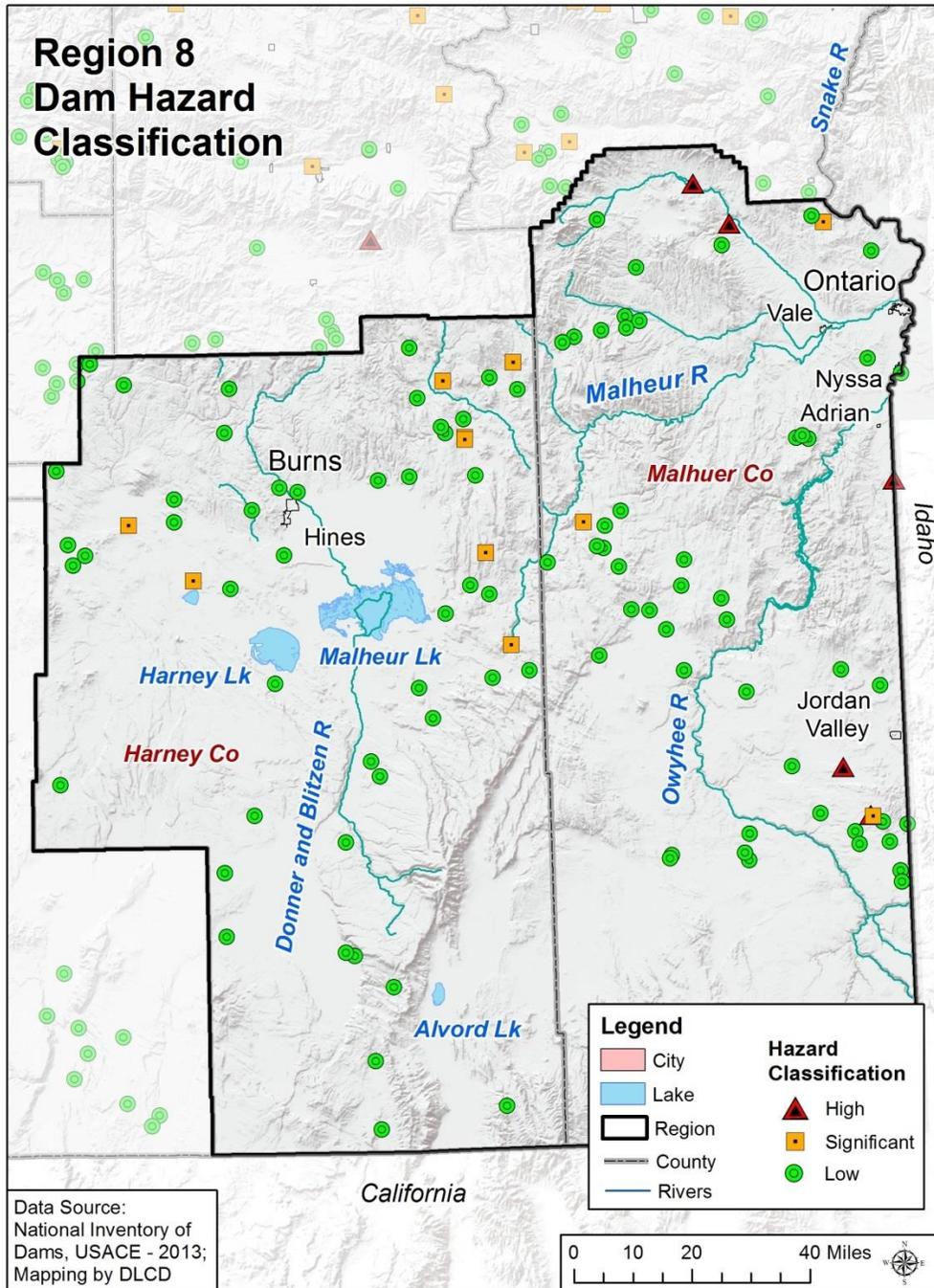
Table 2-501. Threat Potential of Dams in Region 8

| | 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 2-222. Region 8 Dam Hazard Classification



Source: National Inventory of Dams, USACE, 2013

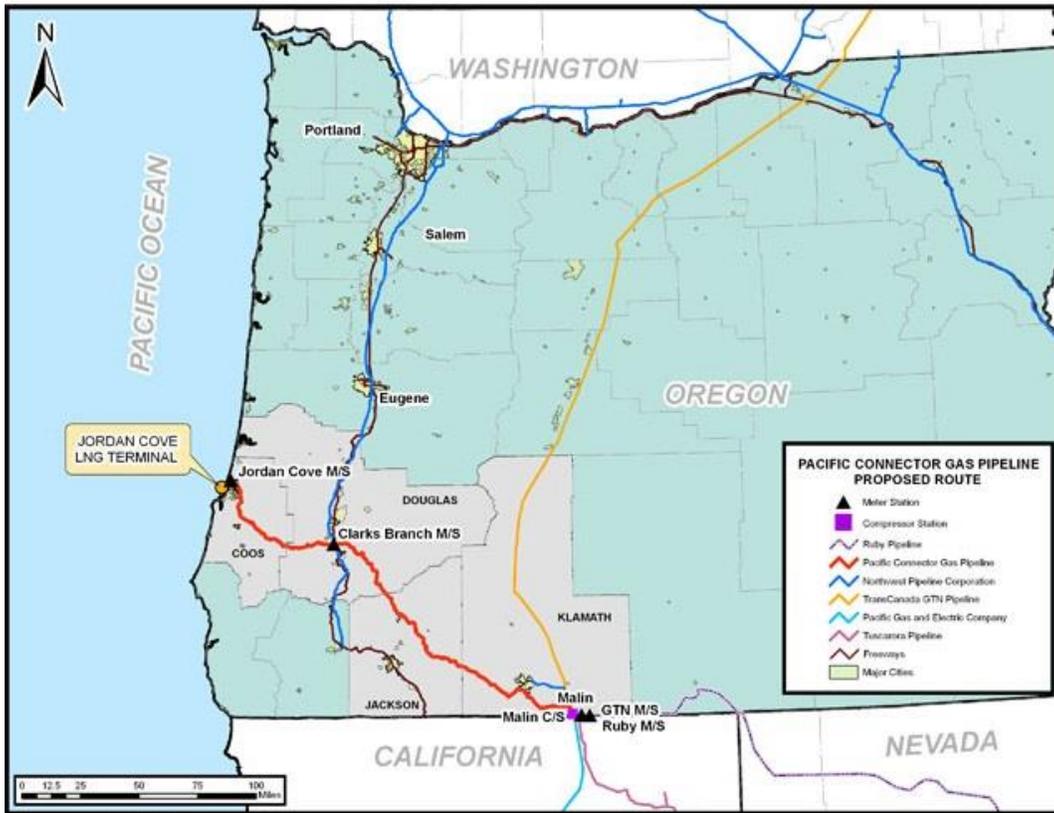


Natural Gas

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 2-223** 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 2-223. 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 electrical 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.



Region 8 primarily receives oil and gas from Alaska by way of the Puget Sound through pipelines and tankers. The electric, oil, and gas lifelines that run through the region are both municipally and privately owned (Loy et al., 1976).

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

Television

Television serves as a major provider for local, regional, and national news and weather information and can play a vital role in emergency communications. The 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), KOB! 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 are:

Local Primary Station:

- KBHN-FM, 1230 KHZ (Burns); and

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 communication 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; and
- 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 coli* (*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, limiting access to potable water. This can lead to unsanitary conditions that may threaten human health. Lack of water can also impact industry, such as the manufacturing sector. Moreover, if transportation infrastructure is impacted by a disaster event, repairs to water infrastructure will be delayed.

Stormwater and Wastewater

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

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

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

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 Region 8 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 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 electrical transmission lines. 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.

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 areas that are distant from major transportation routes. 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, increasing water quality vulnerability in Harney County. No communities in the region require low impact development (LID) regulations.

Built Environment

Development Patterns

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



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

Settlement Patterns

The U.S. Census Bureau defines “urban” as either an “urbanized area” of 50,000 or more people or an “urban cluster” of at least 2,500 people (but less than 50,000). Wheeler County does not meet either definition; therefore all of its population is considered rural even though the county has incorporated cities.

Contrary to statewide patterns of urban growth and rural decline between 2000 and 2010, Region 8’s urban populations shrank by about 13% and rural populations grew by roughly 15%. Harney County experienced a greater increase in housing units in both urban and rural communities. The region’s population is clustered around the I-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

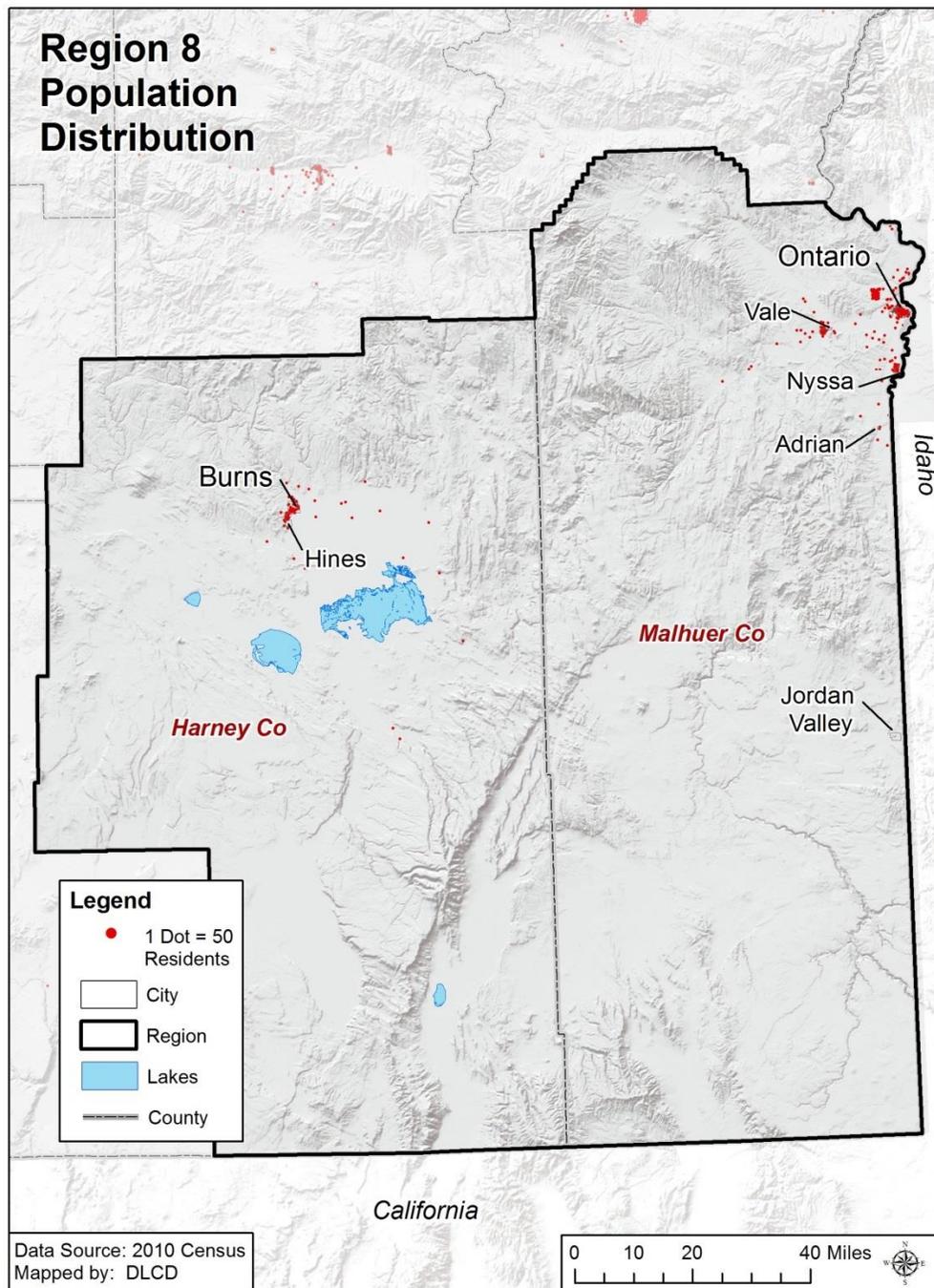
| | Urban | | | Rural | | |
|-----------------|-----------|-----------|----------------|---------|---------|----------------|
| | 2000 | 2010 | Percent Change | 2000 | 2010 | Percent Change |
| Oregon | 1,131,574 | 1,328,268 | 17.4% | 321,135 | 347,294 | 8.1% |
| Region 8 | 8,186 | 8,453 | 3.3% | 6,580 | 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 2-224. Region 8 Population Distribution



Source: U.S. Census, 2012



Land Use and Development Patterns

Similar to Region 7, the past 40 years have seen a slower pace of development of private land in Region 8 than in western Oregon. In this time period very little loss of private land in forest, agriculture, and range uses occurred. 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.

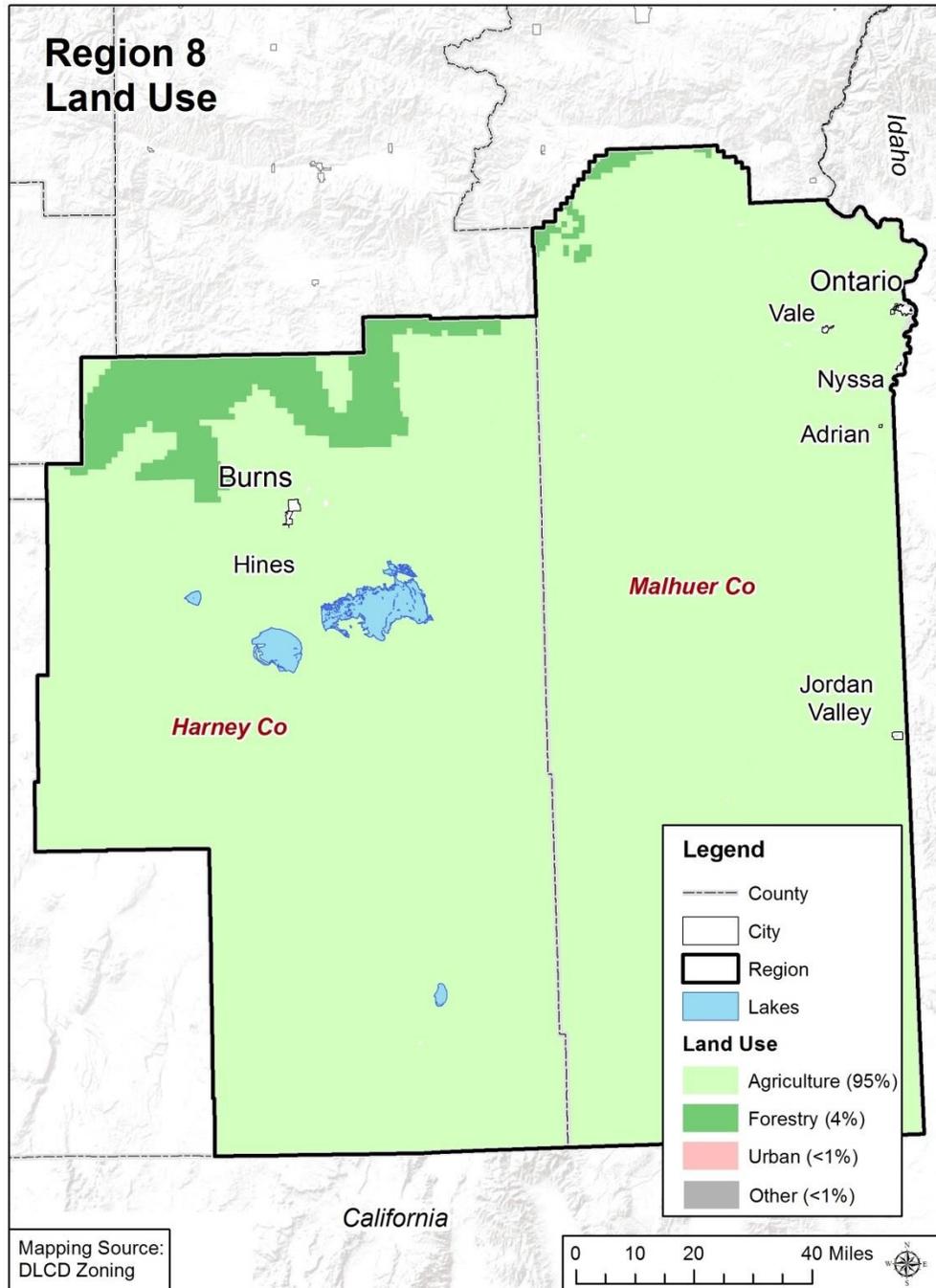
Overall, Region 8 is overwhelmingly rangeland, with the Bureau of Land Management (BLM) controlling over 70% of the land. The land cover is largely grasslands and shrubs. Irrigated fields in the county's northeast corner, known as Western Treasure Valley, are the center of intensive and diversified farming.

The region's wide-open spaces have a total of only seven incorporated cities. Ontario, relatively close to the Boise, Idaho, metropolitan area 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.



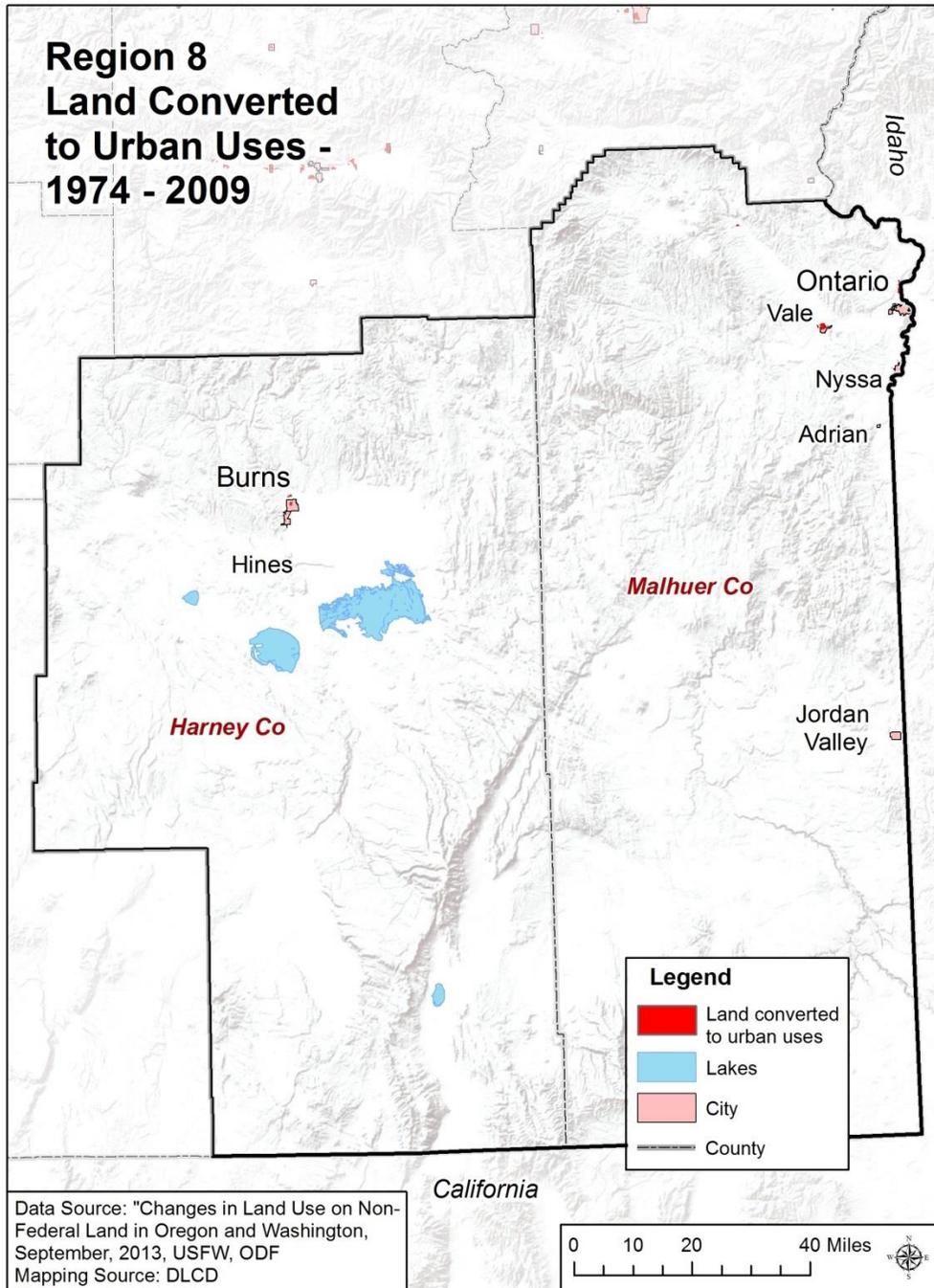
Figure 2-225. Region 8 Land Use



Source: Department of Land Conservation and Development, 2014



Figure 2-226. 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 are mobile units. In natural hazard events such as earthquakes and floods, mobile homes are more likely to shift on their foundations and create hazardous conditions for occupants and their neighbors (California Governor’s Office of 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% |

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

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

Aside from location and type of housing, the year structures were built ([Table 2-505](#)) has implications. Seismic building standards were codified in Oregon building code starting in 1974. More rigorous building code standards passed in 1993 accounted for the Cascadia earthquake fault (Judson, 2012). Therefore, homes built before 1994 are more vulnerable to seismic events.

Also in the 1970s, FEMA began assisting communities with floodplain mapping as part of administering the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Upon receipt of floodplain maps, communities started to develop floodplain management ordinances to protect people and property from flood loss and damage. Regionally, 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.

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 is 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/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/essential facilities.

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 I-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 4 times statewide numbers. About 45% of the homes were built before 1970 and floodplain management standards; 80% were built before 1990 seismic standards. None of the region’s FIRMs has been modernized or updated. The region’s share of state-owned facilities is mostly within Malheur County.



2.3.8.3 Hazards and Vulnerability

Droughts

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_form=at=info:ofi/fmt:kev:mtx:ctx&svc_dat=NewsBank&req_dat=0DC38C612B5C2835).



Historic Drought Events

Table 2-508. Historic Droughts in 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 | Regions 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.



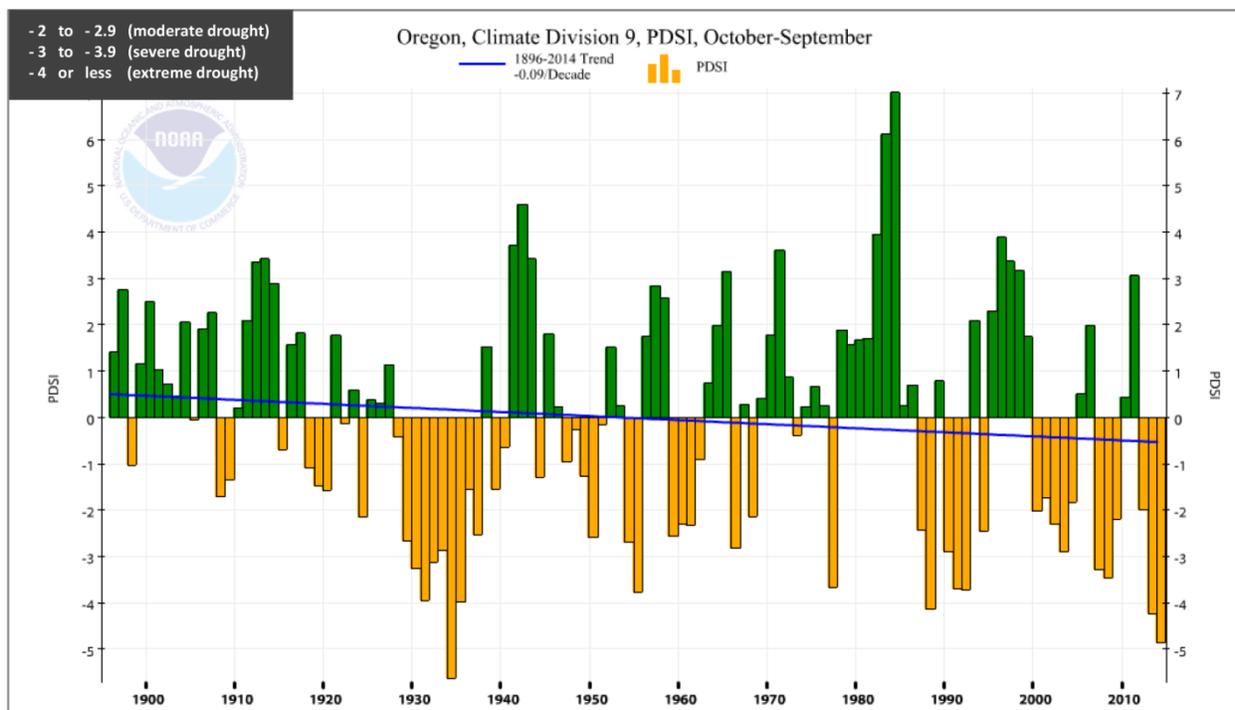
Historical drought information can also be obtained from the National Climatic Data Center, which provides historical climate data showing wet and dry conditions, using the Palmer Drought Severity Index (PDSI) that dates back to 1895. The PDSI is not the best indicator of water availability for Oregon 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.



Figure 2-227 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 2-227. 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 are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and vulnerability scores are even quite different. The state recognizes these inconsistencies and has prioritized the analysis of local and state probability and vulnerability scores during the next plan update. A description of how the High (H), Moderate (M), and Low (L) scores in the local probability and vulnerability tables in this section were determined is provided in the State Risk Assessment [Section 2.2.2.2, Local Vulnerability Assessments](#). The complete “OEM Hazard Analysis Methodology” is located in [Appendix 9.1.16](#).

Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers the probability that Region 8 will experience drought is shown 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 to drought is shown 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 communities most vulnerable 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, Region 8 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 2 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 Zeronio, 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 are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and vulnerability scores are even quite different. The state recognizes these inconsistencies and has prioritized the analysis of local and state probability and vulnerability scores during the next plan update. A description of how the High (H), Moderate (M), and Low (L) scores in the local probability and vulnerability tables in this section were determined is provided in the State Risk Assessment [Section 2.2.2.2, Local Vulnerability Assessments](#). The complete “OEM Hazard Analysis Methodology” is located in [Appendix 9.1.16](#).

Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers the probability that Region 8 will experience dust storms is shown 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 more research.



Vulnerability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the region’s vulnerability to dust storms is shown 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.

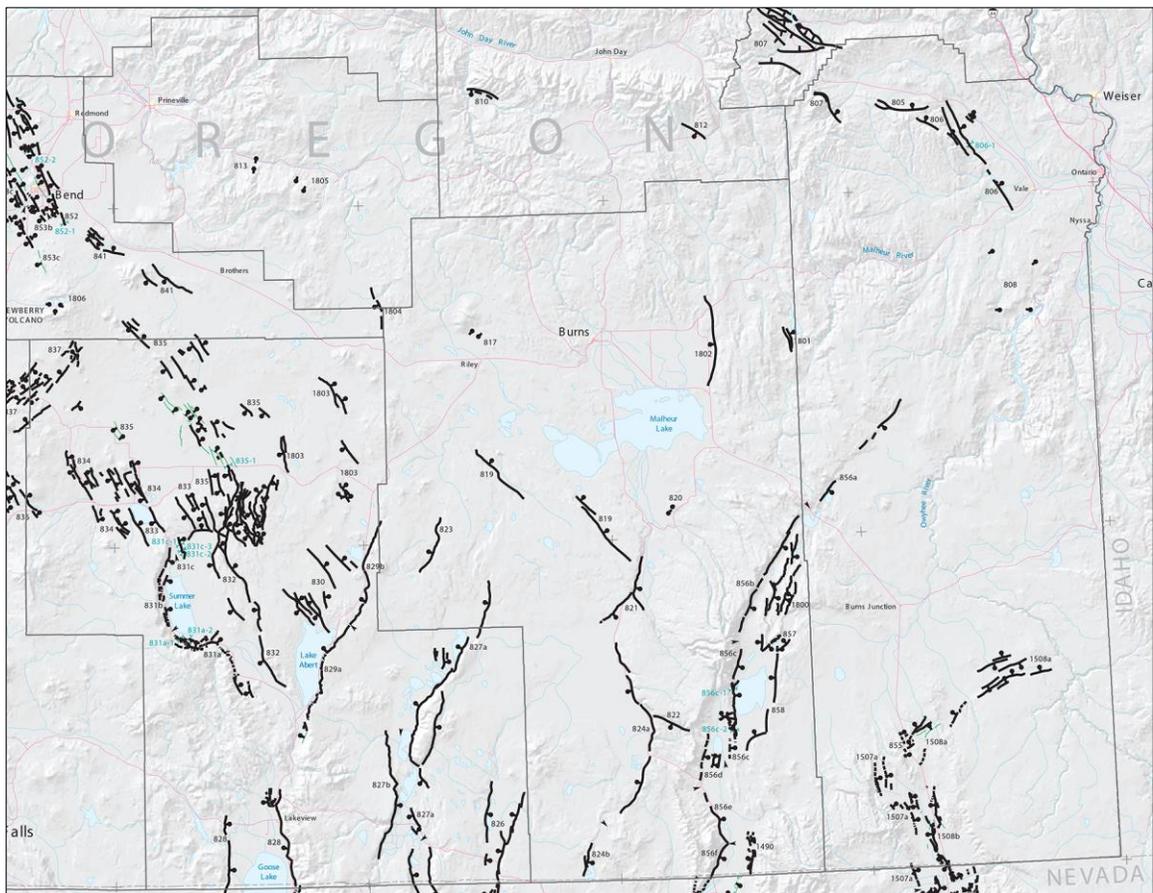


Earthquakes

Characteristics

The geographic 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. 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 2-228](#) shows the locations of faults in Region 8.

Figure 2-228. Quaternary Faults and Folds in Region 8



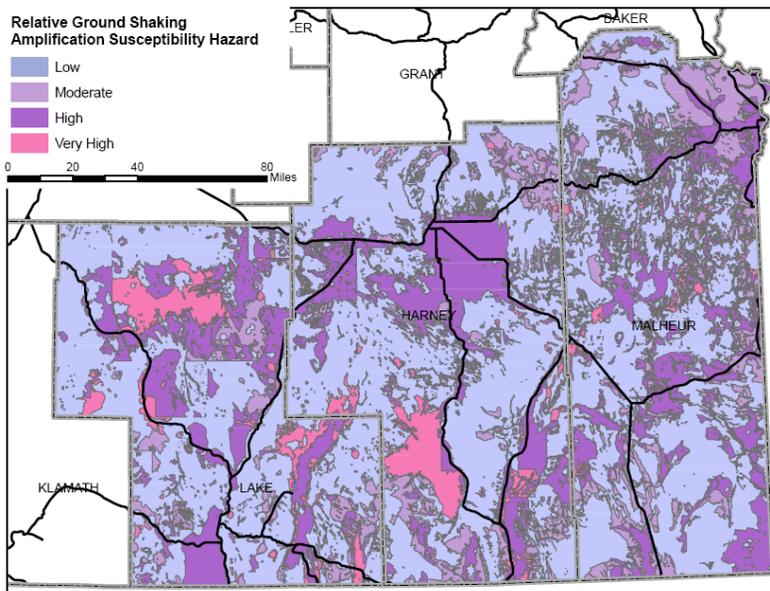
Source: Modified from Personius et al. (2003)

When all of these earthquake 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 2-229](#) displays the relative ground shaking amplification hazard throughout Region 8.

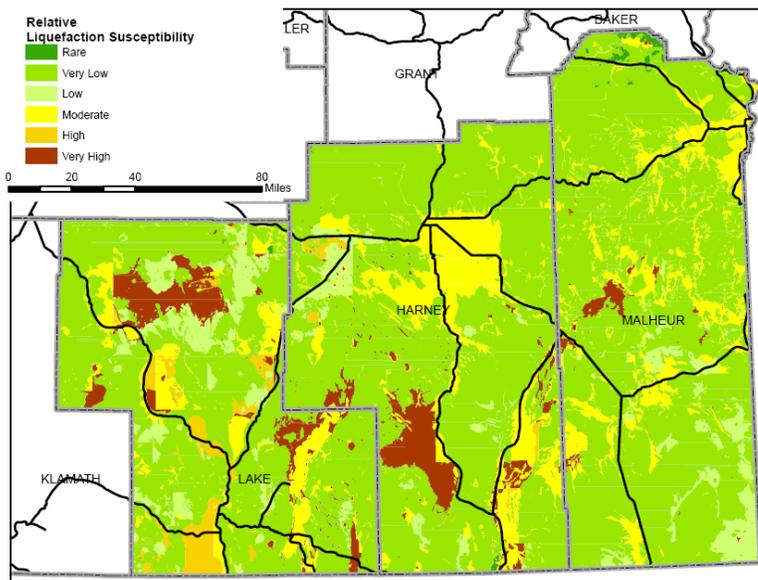
Figure 2-229. Relative Ground Shaking Amplification Hazard in Region 8



Source: Burns (2007)

During seismic shaking, deposits of loose saturated sands can be subjected to contraction resulting in an increase in pore water pressure. If the increase in pore water pressure is high enough, the deposit becomes “liquefied,” losing its strength and its ability to support loads. [Figure 2-230](#) displays the relative liquefaction hazard throughout Region 8.

Figure 2-230. Relative Liquefaction Susceptibility Hazard in Region 8

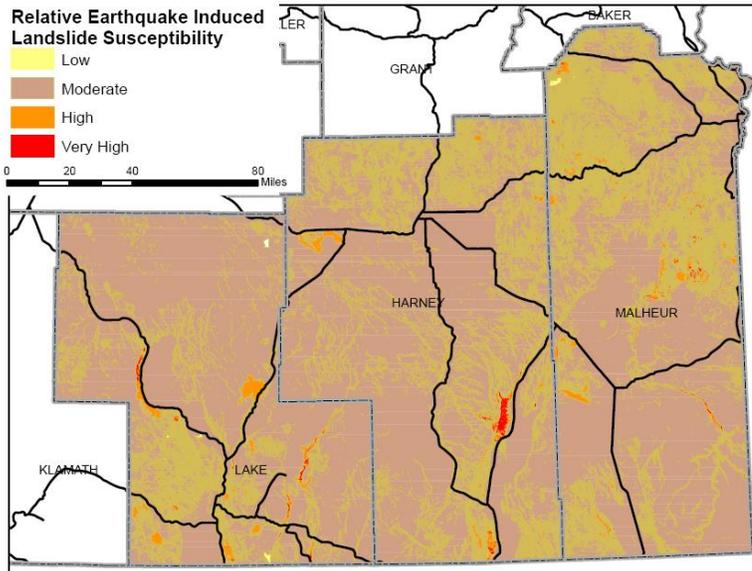


Source: Burns (2007)



Strong ground shaking can also cause landslides and reactivate dormant landslides. Commonly, slopes that are marginally stable prior to an earthquake become unstable and fail. Some landslides result from liquefaction that causes lateral movement of soil, or lateral spread. [Figure 2-231](#) displays the relative earthquake induced landslide hazard throughout Region 8.

Figure 2-231. Relative Earthquake Induced Landslide Susceptibility Hazard in Region 8



Source: Burns (2007)

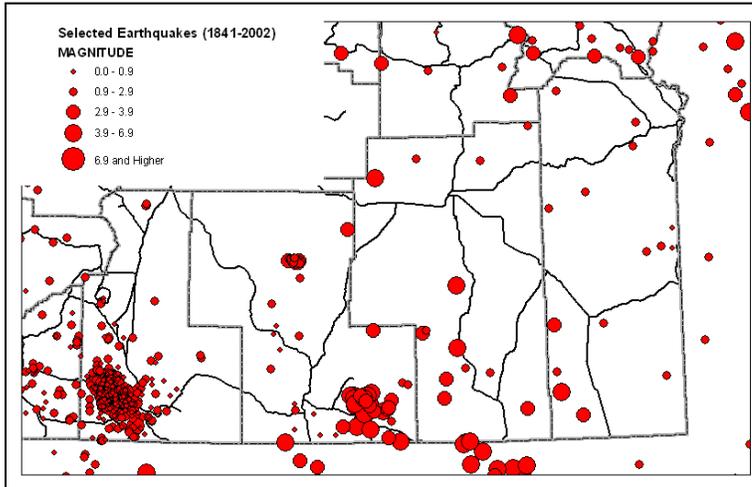
Region 8 has experienced many earthquakes. Several earthquake sequences (swarms) have occurred in the region within the last 20 years. There are also identified faults in the region that have been active in the last 20,000 years. The region has also been shaken historically by crustal and intraplate earthquakes and prehistorically by subduction zone earthquakes centered outside the area. [Figure 2-232](#) 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 earthquake 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 2-232 displays over 1,000 earthquakes that have been recorded in the region during the last century. Because the instrument network in the region was very sparse until the mid-2000s, it is likely that thousands of earthquakes have occurred in the region but were not recorded.

Figure 2-232. Selected Earthquakes in Region 8, 1841–2002



Source: Niewendorp and Neuhaus (2003)



Historic Earthquake Events

Table 2-514. Significant 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 | about 9 | generated a tsunami that struck Oregon, Washington, and Japan; destroyed Native American villages along the coast |
| Nov. 23, 1873 | near Brookings, Oregon at the Oregon-California 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, Washington | 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, California | 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 are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and



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

Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the probability that Region 8 will experience earthquakes is shown in [Table 2-515](#). 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

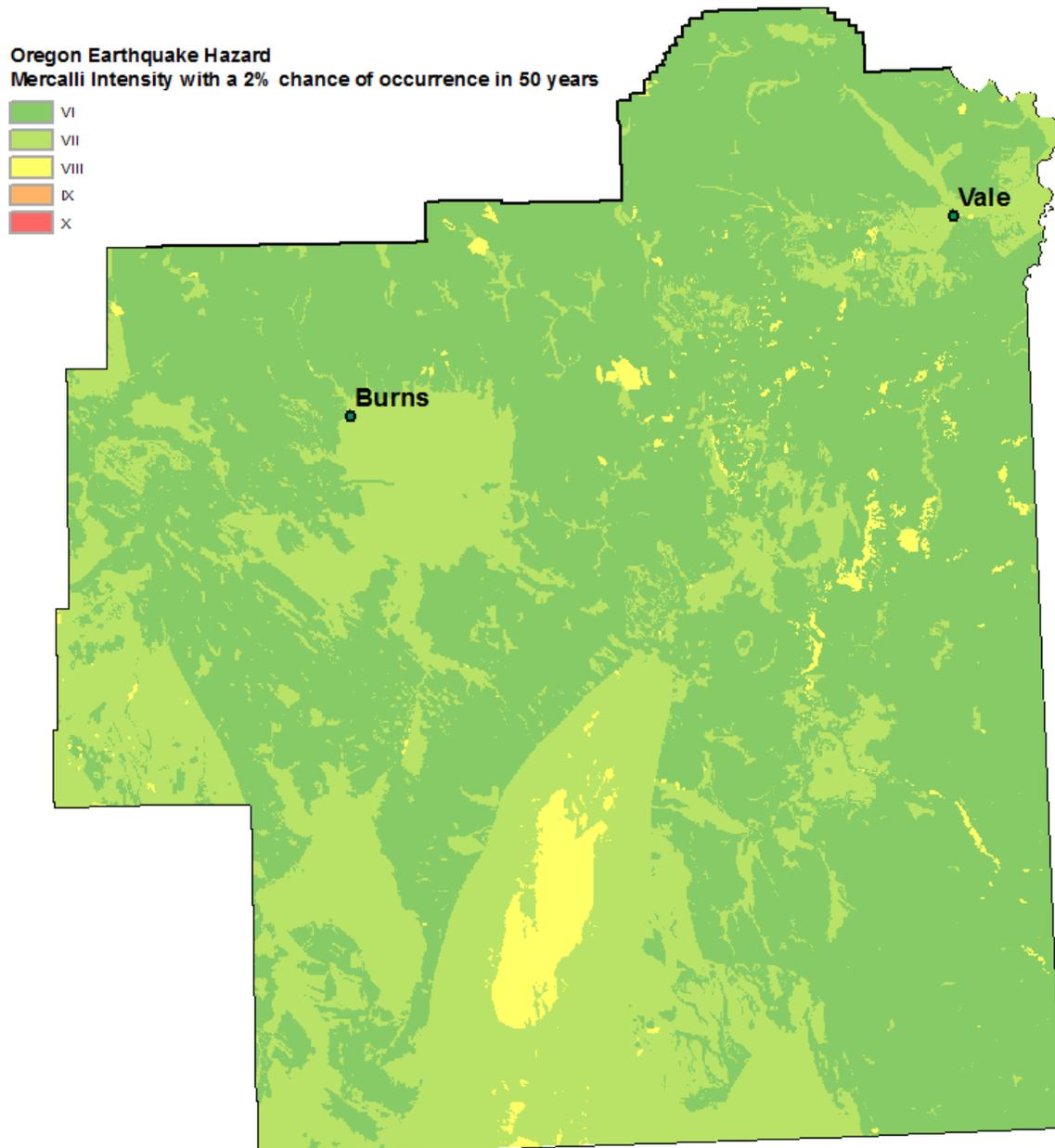
The probability of damaging earthquakes varies widely across the state. In Region 8, the hazard is dominated by local faults and background seismicity.

The probabilistic earthquake hazard for Region 8 is depicted in [Figure 2-233](#). This map shows the expected level of earthquake damage that has a 2% chance of occurring in the next 50 years. The map is based on the 2008 USGS National Seismic Hazard Map and has been adjusted to account for the effects of soils following the methods of Madin and Burns (2013). In this case, the strength of shaking calculated as peak ground acceleration and peak ground velocity is expressed as Mercalli intensity, which describes the effects of shaking on people and structures. This map incorporates all that is known about the probabilities of earthquake on all Oregon faults, including the Cascadia Subduction Zone.

The Cascadia subduction zone is responsible for most of the hazard shown in [Figure 2-233](#). The paleoseismic record includes 18 M8.8–9.1 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 M8.3–8.5 earthquakes affected only the southern half of Oregon and northern California. The average return period for these is about 240 years, and the probability of a small or large subduction earthquake occurring in the next 50 years is 37–43%.



Figure 2-233. Probabilistic Earthquake Hazard in Region 8



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

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

Source: Madin and Burns (2013)



Vulnerability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the region’s vulnerability to earthquakes is depicted [Table 2-516](#). 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

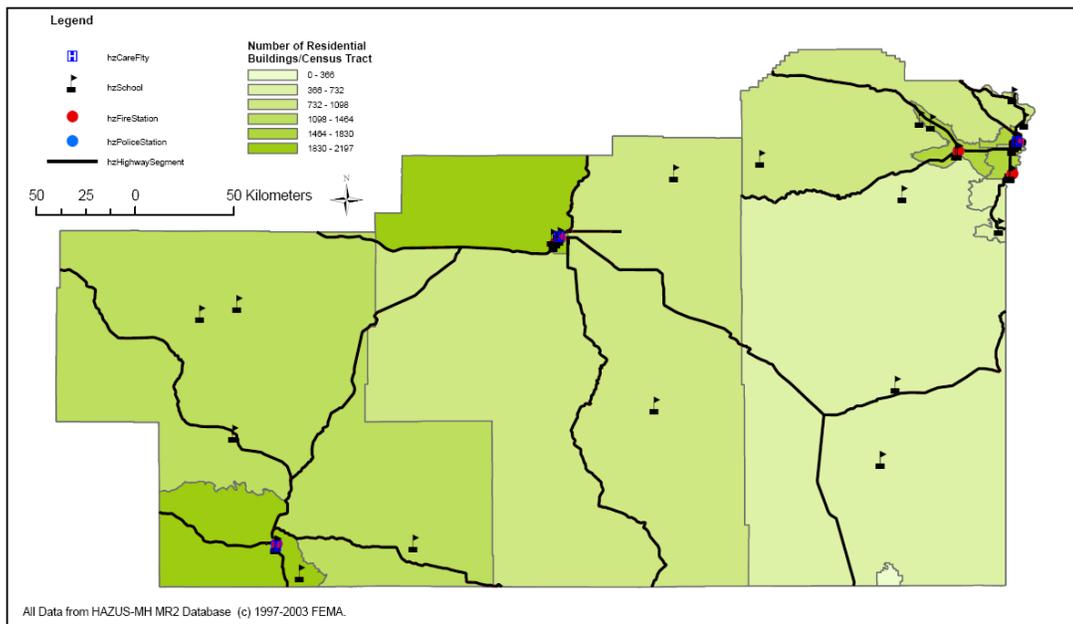
| | Harney | Malheur |
|---------------|--------|---------|
| Vulnerability | L | M |

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 region’s people and infrastructure are located in the major cities along I-84, US-20, and US-395. [Figure 2-234](#) shows a map of the generalized exposure of buildings to earthquakes in Region 8.

Figure 2-234. Region 8 Generalized Earthquake 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: (a) a M6.9 arbitrary crustal event, and (b) 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-year 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

| County | Level of Collapse Potential | | | |
|---------|-----------------------------|----------------|-------------|------------------|
| | 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

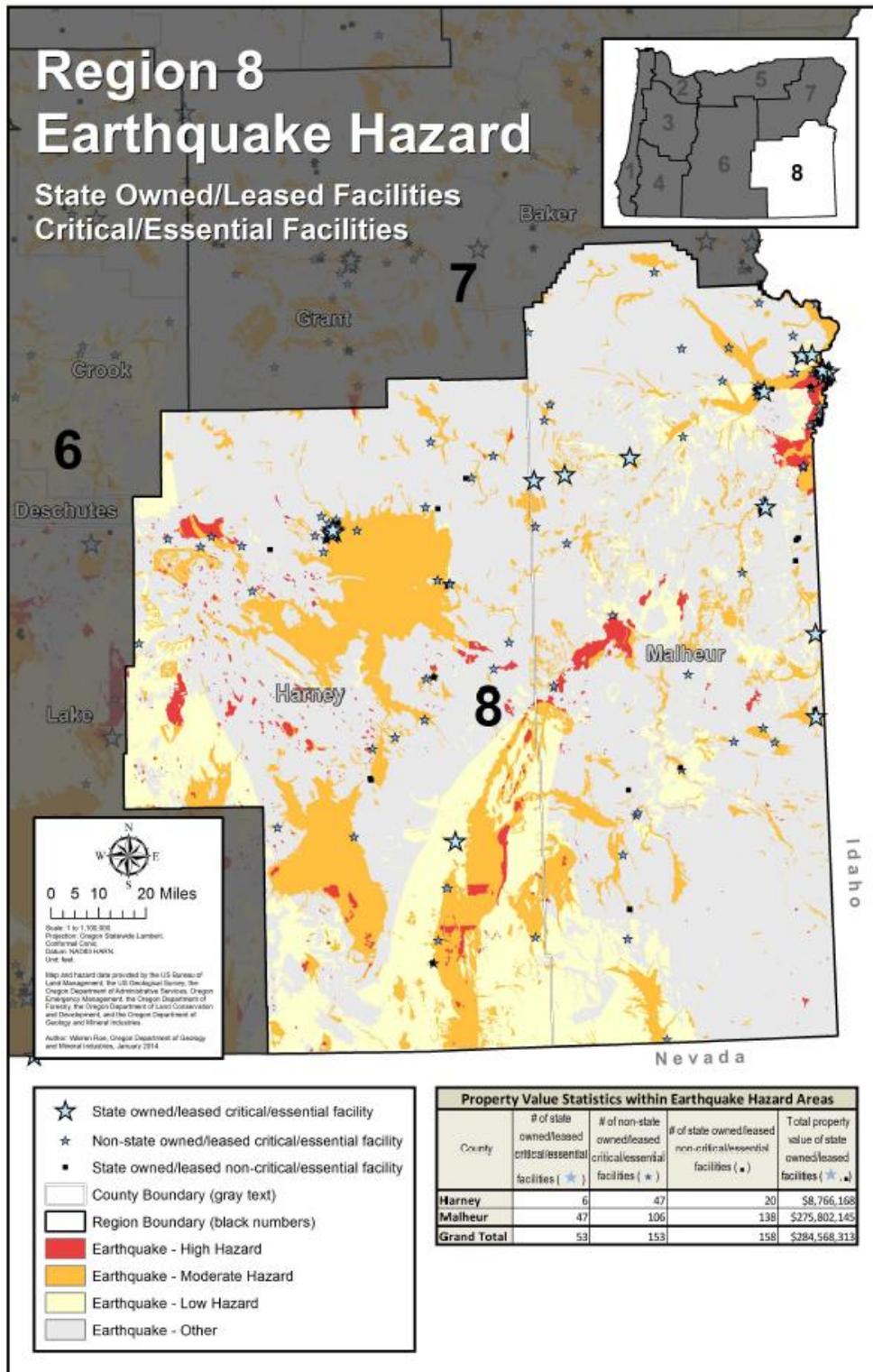
STATE-OWNED/LEASED FACILITIES AND CRITICAL AND ESSENTIAL FACILITIES

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 valued at \$284.5 million are located in an earthquake hazard zone in Region 8 ([Figure 2-235](#)). 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 2-235. State-Owned/Leased Facilities and Critical/Essential Facilities in an Earthquake Zone in Region 8



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; [Appendix 9.1.13](#)).

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. 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.



Floods

Characteristics

Although flooding occurs throughout Oregon, the climate, local geology and the relatively low population of Region 8 lessen its effects. Region 8 contains a variable landscape that greatly influences flood conditions. The region is subject to a variety of flood conditions, including: (a) spring runoff from rain and melting snow, (b) warming and rain during the winter months, (c) ice-jam flooding, (d) local flash flooding, and (e) 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 and Vulnerability Research Institute (2007). The Spatial Hazard Events and Losses Database for the United States, Version 5.1 [Online Database]. Columbia, SC: University of South Carolina. Available from <http://www.sheldus.org>



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 are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and vulnerability scores are even quite different. The state recognizes these inconsistencies and has prioritized the analysis of local and state probability and vulnerability scores during the next plan update. A description of how the High (H), Moderate (M), and Low (L) scores in the local probability and vulnerability tables in this section were determined is provided in the State Risk Assessment [Section 2.2.2.2, Local Vulnerability Assessments](#). The complete “OEM Hazard Analysis Methodology” is located in [Appendix 9.1.16](#).

Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the probability that Region 8 will experience flooding is shown 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.

In Region 8 counties, the Federal Emergency Management Agency (FEMA) has mapped the 10, 50, 100, and 500-year floodplains, corresponding to 10%, 2%, 1%, and 0.2% chance, respectively, 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, and
- 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 to flooding is shown 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 data set |
| 2 | county data point is greater than 1.5 times standard deviation for the input data set |
| 1 | county data point is within standard deviation |
| 0 | no data reported |

Source: DLCD



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

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 US-20 and US-395. The City of Burns is 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) Program, which results in reduced flood insurance costs. No Region 8 communities participate in the CRS Program

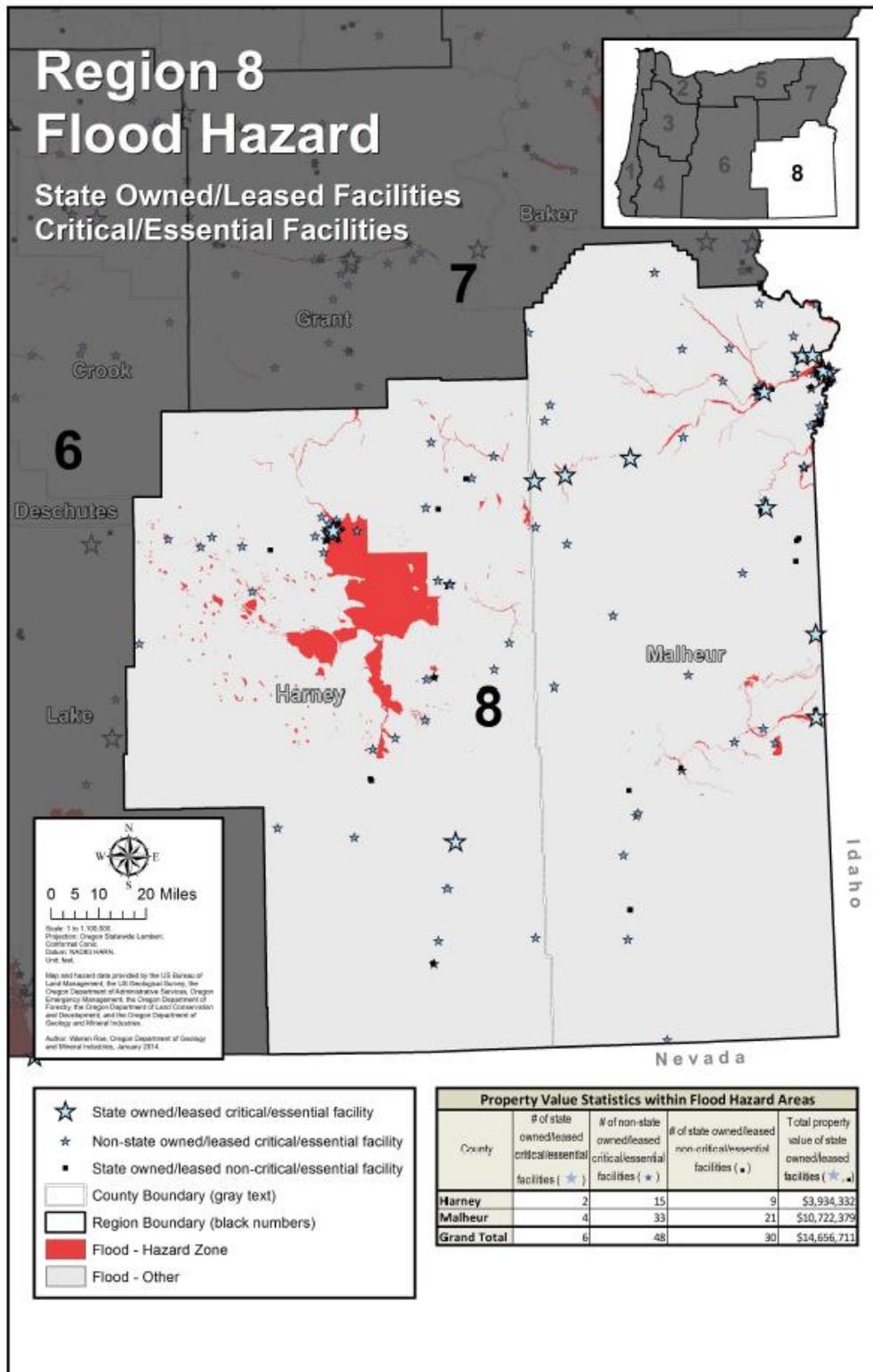
STATE-OWNED/LEASED FACILITIES AND CRITICAL AND ESSENTIAL FACILITIES

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 2-236](#)). 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 2-236. State-Owned/Leased Facilities and Critical/Essential Facilities in a Flood Hazard Zone in Region 8



Source: DOGAMI



Landslides

Characteristics

Landslides occur throughout this region of the state, although areas with steeper slopes, weaker geology, and higher annual precipitation tend to have more landslides. On occasion, major landslides sever major transportation routes such as U.S. or state highways and 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 are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and vulnerability scores are even quite different. The state recognizes these inconsistencies and has prioritized the analysis of local and state probability and vulnerability scores during the next plan update. A description of how the High (H), Moderate (M), and Low (L) scores in the local probability and vulnerability tables in this section were determined is provided in the State Risk Assessment [Section 2.2.2.2, Local Vulnerability Assessments](#). The complete “OEM Hazard Analysis Methodology” is located in [Appendix 9.1.16](#).

Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the probability that Region 8 will experience landslides is shown 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 to landslides is shown 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 Region 8, 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 OR-31, around Lakeview, and along US-395.

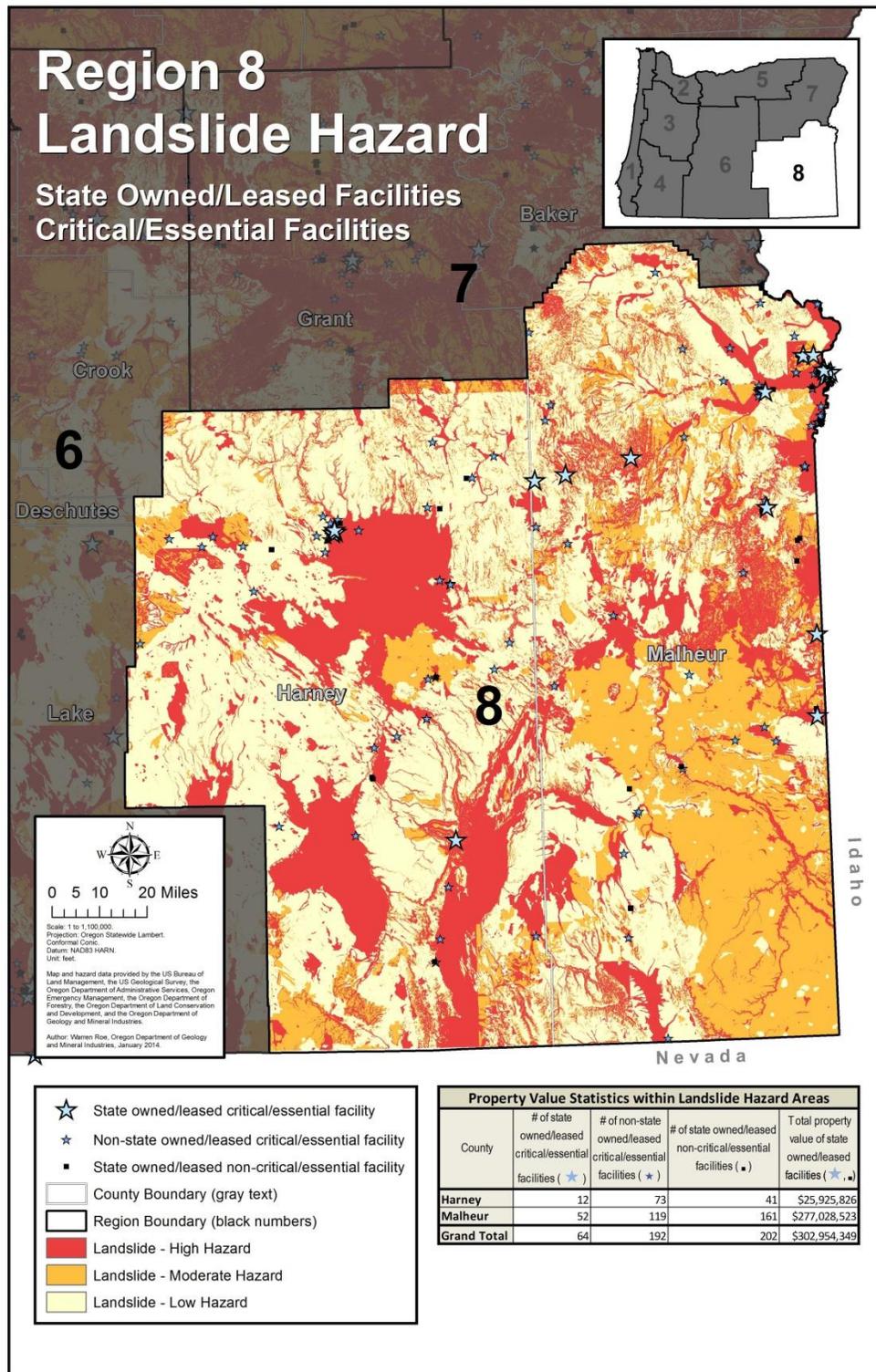
STATE-OWNED/LEASED FACILITIES AND CRITICAL AND ESSENTIAL FACILITIES

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 2-237](#)). 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 2-237. State-Owned/Leased Facilities and Critical/Essential Facilities in a Landslide Hazard Zone in Region 8



Source: DOGAMI



Volcanoes

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 and Spokane, Washington, 80 and 160 miles away, respectively, were inundated with ash. Ash 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.

Ashfall is largely controlled by the prevailing wind direction. The predominant wind direction over the Cascade Range is west to east. Previous eruptions documented in the geologic record indicate most ashfall drifting to and settling in areas 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, Washington 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 |

Note: YBP is years before present.

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 are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and vulnerability scores are even quite different. The state recognizes these inconsistencies and has prioritized the analysis of local and state probability and vulnerability scores during the next plan update. A description of how the High (H), Moderate (M), and Low (L) scores in the local



probability and vulnerability tables in this section were determined is provided in the State Risk Assessment [Section 2.2.2.2, Local Vulnerability Assessments](#). The complete “OEM Hazard Analysis Methodology” is located in [Appendix 9.1.16](#).

Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the probability that Region 8 will experience volcanic hazards is shown 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. 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 ashfall. Newberry Volcano’s history also includes pyroclastic flows and numerous lava flows. Volcanoes in the Three Sisters region, such as Middle and South Sister, and at 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 now 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 to volcanic hazards is shown 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 ashfall 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 region’s people and infrastructure are located in the major cities along I-84, US-20, and US-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.



Wildfires

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

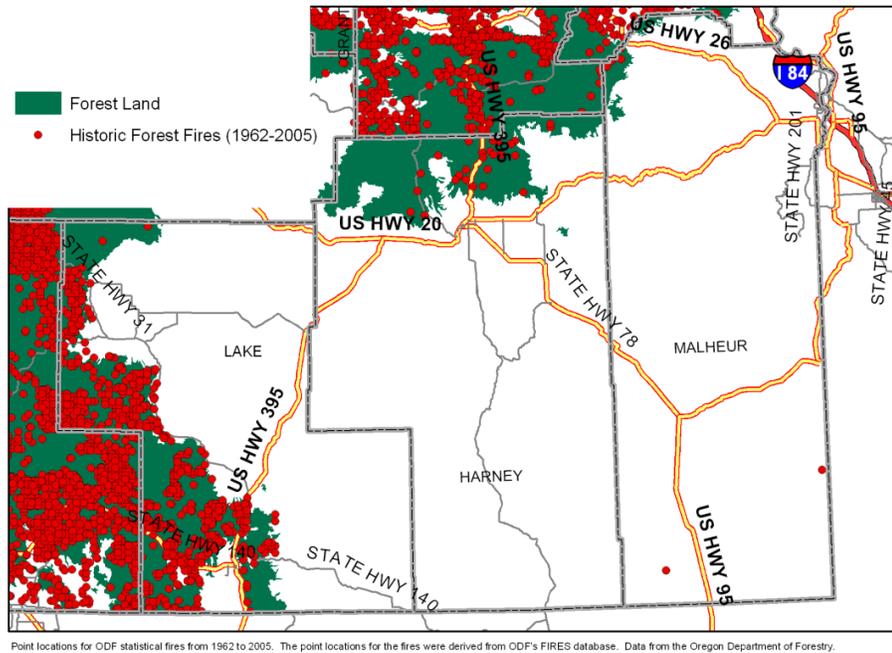
Table 2-533. Significant Wildfires in Region 8

| 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 2-238. 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 are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and vulnerability scores are even quite different. The state recognizes these inconsistencies and has prioritized the analysis of local and state probability and vulnerability scores during the next plan update. A description of how the High (H), Moderate (M), and Low (L) scores in the local probability and vulnerability tables in this section were determined is provided in the State Risk Assessment [Section 2.2.2.2, Local Vulnerability Assessments](#). The complete “OEM Hazard Analysis Methodology” is located in [Appendix 9.1.16](#).



Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the probability that Region 8 will experience wildfire is shown 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.

Most wildfires 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.).

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 to wildfire is shown 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 |

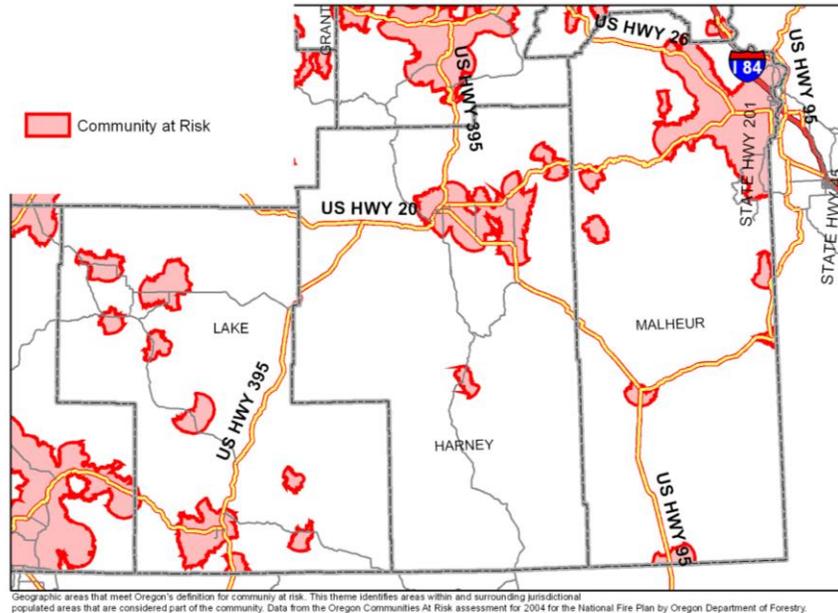
Source: Oregon Office of Emergency Management, 2013 County Hazard Analysis Scores



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 region’s people and infrastructure are located in the major cities along I-84, US-20, and US-395 (Figure 2-239). The region’s total exposure for buildings and transportation systems alone is roughly 11.5 billion dollars.

Figure 2-239. 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, rangeland, grazing land, and hunting and recreation land. Action should be taken to reduce the damage and losses through pre-disaster 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, prior to January 2015, conservation measures 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

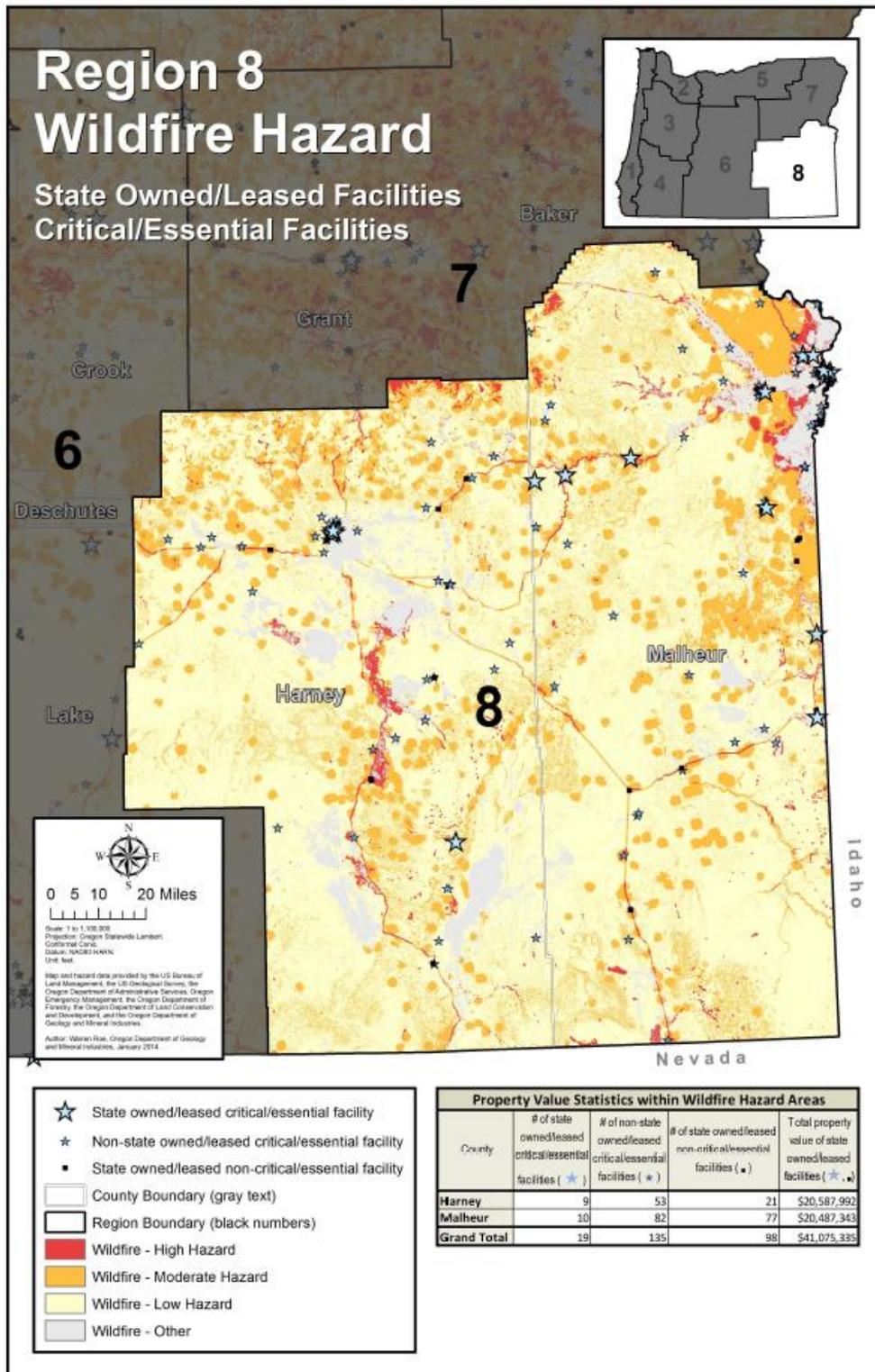
STATE-OWNED/LEASED FACILITIES AND CRITICAL AND ESSENTIAL FACILITIES

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 2-240](#)). Among those, 19 are state critical/essential facilities. An additional 135 non-state critical/essential facilities are also located in Region 8.



Figure 2-240. State-Owned/Leased Facilities and Critical/Essential Facilities in a Wildfire Hazard Zone in Region 8



Source: DOGAMI



Windstorms

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 burned 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 are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and vulnerability scores are even quite different. The state recognizes these inconsistencies and has prioritized the analysis of local and state probability and vulnerability scores during the next plan update. A description of how the High (H), Moderate (M), and Low (L) scores in the local probability and vulnerability tables in this section were determined is provided in the State Risk Assessment [Section 2.2.2.2, Local Vulnerability Assessments](#). The complete “OEM Hazard Analysis Methodology” is located in [Appendix 9.1.16](#).

Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the probability that Region 8 will experience windstorms is shown 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 to windstorm is shown 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, uprooted or shattered trees can down power 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 Storms

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. Moderate to heavy snowfall 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 snowfalls; 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 are not necessarily the same at local and state levels. As a result, local and state probability and vulnerability scores for a specific hazard in a specific community are not always the same. In some instances, probability and vulnerability scores are even quite different. The state recognizes these inconsistencies and has prioritized the analysis of local and state probability and vulnerability scores during the next plan update. A description of how the High (H), Moderate (M), and Low (L) scores in the local



probability and vulnerability tables in this section were determined is provided in the State Risk Assessment [Section 2.2.2.2, Local Vulnerability Assessments](#). The complete “OEM Hazard Analysis Methodology” is located in [Appendix 9.1.16](#).

Probability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the probability that Region 8 will experience winter storms is shown 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

On the basis of historical data, severe winter storms could occur about every 4 years in this region. We can expect to have continued annual storm events in this region. However, there are no solid statistical data available upon which to base these judgments. There is no statewide program to study the past, present, and potential impacts of winter storms in the state of Oregon at this time.

Vulnerability

Local Assessment

Based on the OEM hazard analysis conducted by county emergency program managers, the region’s vulnerability to winter storms is shown in [Table 2-543](#). 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.