

# Executive Summary

## Introduction

The Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) was signed into law on November 23, 1988 and provides the legal authority for most federal disaster response activities, particularly Federal Emergency Management Agency (FEMA) activities and programs. The Disaster Mitigation Act of 2000 (DMA 2000) amended the Stafford Act, emphasizing the need for state, local, and Indian Tribal entities to coordinate hazard mitigation efforts. It made the existing requirement for states to have natural hazard mitigation plans a prerequisite for disaster assistance, and provided an incentive in the form of additional funding for states that enhance coordination and integration of mitigation planning and activities. The State of Oregon's Natural Hazard Mitigation Plan (NHMP) is such an "enhanced plan." Oregon has received and made good use of the additional incentive funding following past disasters. Oregon also continues to advance coordination and integration of natural hazard mitigation planning with other state plans and programs.

The Code of Federal Regulations Title 44, Part 201 (44 CFR Part 201) implements DMA2K by establishing requirements for developing and updating state, local, and Indian Tribal natural hazard mitigation plans (NHMPs). An amendment to 44 CFR Part 201 effective May 27, 2014, extended the state and Indian Tribal NHMP planning cycle from 3 to 5 years. The first Oregon NHMP was completed in 1992; it was updated in 2000, 2004, 2006, 2009, 2012, and now 2015.

The stated mission of this Plan is to *Create a disaster-resilient state of Oregon*, which is elucidated by its vision that ultimately *Natural hazard events result in no loss of life, minimal property damage, and limited long-term impacts to the economy*. From this guidance and the Plan's risk assessment flow 11 goals and well over one hundred specific actions calibrated to advance disaster resilience through natural hazard mitigation in the State of Oregon.

Disasters occur as a predictable interaction among three broad systems: natural systems, the built environment, and social systems. What is not predictable is exactly when natural hazards will occur or the extent to which they will affect communities within the state.

Hazard mitigation is defined at 44 CFR 201.2 as *any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards*. Benefits of hazard mitigation activities include fewer injuries and deaths; less damage to buildings, critical facilities, and infrastructure; diminished interruption in essential services; reduced economic hardship; minimized environmental harm; and quicker, lower-cost recovery.

The Oregon NHMP contains the most complete and up-to-date description of Oregon's natural hazards and their probability, the state's vulnerabilities, its mitigation strategies and implementation capability. Oregon's counties and cities can rely upon this information when preparing local natural hazard mitigation plans.

The Oregon NHMP is one component of the first volume of the Oregon Emergency Management Plan, administered by the Oregon Military Department's Office of Emergency Management.

# Risk Assessment

## Introduction

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.

Assessing the state’s level of risk involves three components: characterizing natural hazards, assessing vulnerabilities, and analyzing risk. Characterization involves determining cause and characteristics, documenting historic events, and evaluating future probability of occurrence.

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.

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

Regional risk assessments begin with a description of the region’s natural environment, demographics, economy, infrastructure, and built environment followed by a region-specific hazard characterization, vulnerability assessment, and risk analysis.

## Oregon Hazards Overview

Oregon is subject to 11 natural hazards:

- Coastal Hazards
- Droughts
- Dust Storms
- Earthquakes
- Floods
- Landslides
- Tsunamis
- Volcanoes
- Wildfires
- Windstorms
- Winter Storms

Each hazard is analyzed statewide and at a regional level. The regions used for this analysis are shown in [Figure ES-1](#) and are physiographic regions delineated specifically for the purposes of the Oregon NHMP risk assessment. The hazards impacting each region are identified in [Table ES-1](#).

Figure ES-1. Oregon NHMP Natural Hazard Regions

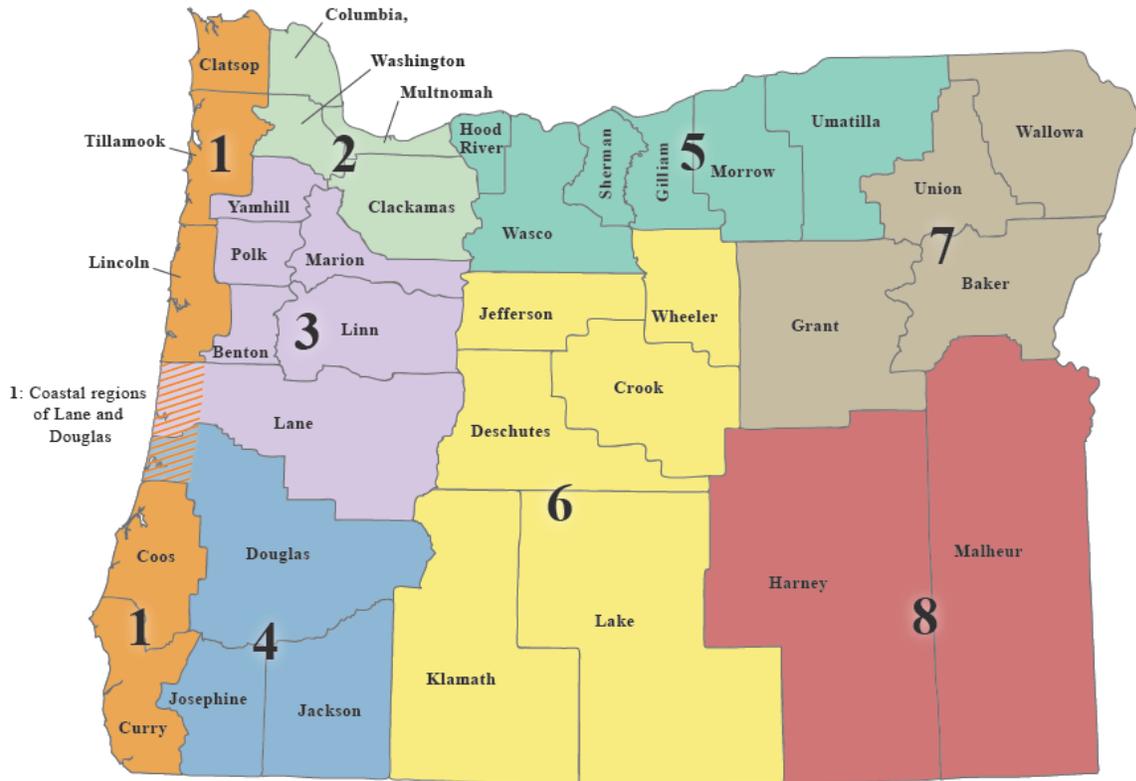


Table ES-1. Hazards Impacting Natural Hazard Mitigation Regions

Hazard	Region							
	1	2	3	4	5	6	7	8
Coastal Hazards	✓							
Droughts	✓	✓	✓	✓	✓	✓	✓	✓
Dust Storms					✓	✓	✓	✓
Earthquakes	✓	✓	✓	✓	✓	✓	✓	✓
Floods	✓	✓	✓	✓	✓	✓	✓	✓
Landslides	✓	✓	✓	✓	✓	✓	✓	✓
Tsunamis	✓							
Volcanoes	✓	✓	✓	✓	✓	✓	✓	✓
Wildfires	✓	✓	✓	✓	✓	✓	✓	✓
Windstorms	✓	✓	✓	✓	✓	✓	✓	✓
Winter Storms	✓	✓	✓	✓	✓	✓	✓	✓

## Introduction to Climate Change in Oregon

Climate is an important element in certain natural hazards, even though in itself, climate is not a distinct natural hazard.

Climate change is an important stressor that significantly influences the incidence — and in some cases the location — of natural hazards and hazard events. Climate change is anticipated to affect the frequency, magnitude, or both of some natural hazards in Oregon. Over the period 1895-2011 (the observed record), temperatures across the Pacific Northwest have increased by 1.3°F while annual precipitation amounts have remained within the normal range of annual variability. During the same period, Cascade Mountain snowpacks have declined, and higher temperatures are causing earlier spring snowmelt and spring peak streamflows. On the coast, increasing deep-water wave heights in recent decades are likely to have increased the frequency of coastal flooding and erosion. In Oregon's forested areas, large areas have been impacted by disturbances that include wildfire in recent years, and climate change is probably one major factor. A three-fold increase in heat-related illness has been documented in Oregon with each 10 °F rise in daily maximum temperature.

Every climate model shows an increase in temperature for the Pacific Northwest, with the magnitude of the increase depending on rate or magnitude of global greenhouse gas emissions. Each season will be warmer in the future, and the largest amount of warming will occur in the summer.

Sea levels and wave heights are the primary climate-related drivers that influence rates of coastal erosion. Recent research indicates that sea levels along Oregon's coast are rising and that significant wave heights off the Oregon coast are increasing. Rising sea levels and increasing wave heights are both expected to increase coastal erosion and coastal flooding. Increased coastal erosion can lead to loss of natural buffering functions of beaches, tidal wetlands, and dunes, and will likely increase damage to private property and infrastructure situated on coastal shorelands.

Warmer, drier conditions are projected to increase the incidence of drought, wildfire, and dust storms in all eight regions in the state, and particularly in southwest, central, and eastern Oregon. More frequent droughts are likely to cause significant economic damage to the agriculture industry through reduced yields and quality of some crops. Droughts can also significantly increase demand for groundwater and surface water, impacting drinking water supply and aquatic systems. Drought-dried soils increase the potential for wildfire and dust storms. More frequent and intense wildfires are likely to damage larger areas, posing greater risk to human health through exposure to smoke and greater ecosystem and habitat damage. Increased risk of wildfire also leads to increased potential for economic damage (e.g., property infrastructure, commercial timber, recreational opportunities) at the urban-wildland interface.

The projected increase in extreme precipitation is expected to result in a greater risk of flooding in certain basins. Generally, western Oregon basins (Oregon NHMP Natural Hazard Regions 1–4) are projected to experience increased flood risk in future decades. In other areas of the state, flood risk may decrease in some basins and increase in others. Areas thought to be outside the floodplain may begin to experience flooding, increasing vulnerability of structures not built to floodplain management standards. Increased rainfall and extreme precipitation events are also likely to trigger more landslides. More floods and landslides will increase damage to property and infrastructure. Transportation systems may also be affected, potentially impacting distribution of water, food, and essential services.

**Table ES-2** shows which hazards in each Oregon NHMP Natural Hazard Region are expected to be impacted by climate change.

**Table ES-2. Climate Change Impacts Projected for Each Oregon NHMP Natural Hazard Region**

Hazard	Region							
	1	2	3	4	5	6	7	8
Coastal Erosion / Sea Level Rise	X							
Droughts	X	X	X	X	X	X	X	X
Dust Storms	X	X	X	X	X	X	X	X
Wildfires	X	X	X	X	X	X	X	
Winter Storms					unknown			
Floods	X	X	X	X				
Landslides	X	X	X	X				
Windstorms					unknown			

Three important Oregon initiatives address climate change across the state. The [Oregon Climate Assessment Report](#) (Dello & Mote, 2010) was the first ever comprehensive scientific assessment of climate change in Oregon. This report was updated by the [2013 Northwest Climate Assessment Report](#) (Dalton et al., 2013). In addition, the [Oregon Climate Change Adaptation Framework](#) (2010) was a collaborative effort among state agencies and institutes to begin to establish a rigorous framework for addressing the effects of climate change in Oregon. Oregon's framework is the first state-level adaptation strategy based on *climate risks* as opposed to *affected sectors*. It identifies 11 climate-related risks for which the state must plan. Five of those 11 — droughts, coastal erosion, wildfires, floods, and landslides — are directly identified in the Oregon NHMP. Three other hazards in the Oregon NHMP — windstorms, winter storms, and dust storms — have an underlying climate component. Together, these bodies of work inform the state about changing climate conditions in Oregon and their principal effects on the natural hazards addressed in the Oregon NHMP.

Climate change is intentionally treated separately from hazards in this Plan, except for describing how climate change is predicted to impact the probability of a hazard occurring in the future. This is because the most localized scale of the best available climate change data is the Pacific Northwest region. Since the Pacific Northwest region is relatively homogenous in its climate, projections for the Pacific Northwest are relevant for planning in Oregon. Data for individual hazards are available at state and some local scales. As climate change data become available at more local scales they will be included in future Oregon NHMP updates.

## State and Regional Risk Assessments

### Methodology

Currently, to identify the probability of each hazard and the communities most vulnerable to each hazard, each is assessed at the county level and statewide. Local emergency program managers, usually with the assistance of a team of local public safety officials, perform county-level assessments. At the state level, state agencies' subject matter experts perform the assessments. The local and state assessments are presented together in the Regional Risk Assessments.

Local risk assessments employ the same methodology statewide. FEMA developed the methodology and together with the state adjusted it for Oregon. The local risk assessment team first identifies the community's relevant hazards, then scores each one in four categories: history, probability, vulnerability, and maximum threat. Total scores range from 24 (low) to 240 (high). This method provides local jurisdictions with a sense of hazard priorities, or relative risk. It is also intended to provide comparison of the same hazard between local jurisdictions statewide.

Although this methodology is consistent statewide, the reported raw scores for each county are based on partially subjective rankings for each hazard. Because the rankings are used to describe the relative risk of a hazard within a county, and because each county conducted the analysis with a different team of people using slightly different assumptions, comparisons between local risk assessments must be treated with caution.

The state relies on subject matter experts in one or more agencies to determine the best method or combination of methods to establish probability of and vulnerability to each hazard. Due to the wide range of data available for each hazard, the method used to assess risk varies from hazard to hazard. In general, each hazard is assessed using a combination of exposure, historical, and scenario analyses. Hazards for which more data exist have undergone a more robust analysis.

### *State and Local Vulnerability Comparison*

Some state and local vulnerability assessments are quite consistent, while others are starkly inconsistent. Similarities and differences between state and local level vulnerability assessments have not been analyzed. The state has prioritized communication and education among state and local staff responsible for assessing vulnerability to improve understanding and consistency for future local and state plan updates.

### *New Risk Assessment Methodology*

During this update, the Risk Assessment Subcommittee of the State Interagency Hazard Mitigation Team conceptualized a new risk assessment methodology that would be standardized statewide and across all hazards. When this new concept becomes a fully developed model, it is expected to identify the drivers of vulnerability and provide a comparison of vulnerability at the local level, improving the ability of the state to weigh various mitigation actions and direct resources to the most vulnerable areas.

## **Profiles**

The descriptions of the natural environment, demographics, economy, infrastructure, and built environment in each Regional Risk Assessment's "Profile" section shows that region's existing strengths and weaknesses, highlighting potential vulnerabilities to natural hazard events. Together with information about the natural hazards that may impact each region, this understanding better enables policy makers to develop and implement effective mitigation actions. Following is a brief, general summary of the eight Oregon NHMP Natural Hazard Regions' social, economic, infrastructure, and built environment profiles.

### *Demographic Profile*

The demographic profile of Oregon's population varies widely from region to region. The Coast and Willamette valley have high numbers of tourists who may not be aware of the type and degree of hazard risk or preparedness needs in the area. Homelessness is on the rise in portions of the Willamette Valley and Southwest Oregon. In all regions except the Northern Willamette Valley and Southeast Oregon, there are high percentages of seniors. Conversely, in the Northern Willamette Valley and Southeast Oregon, there are high percentages of children. Educational attainment among the populations of some coastal communities and in Southwest Oregon, the Mid-Columbia Region, and Northeast Oregon tends to be lower. The share of persons who do not speak English very well is greater for some communities in Willamette Valley, Mid-Columbia, and Southeast Oregon.

### *Economic Profile*

Communities along the Oregon Coast and in Central, Southeast, and Southwest Oregon were hit particularly hard by the financial crisis that began in 2007 and are still experiencing low job recovery rates. Because these regions have few key industries, rebounding is especially difficult. In general, wages are higher in the Northern Willamette Valley. Unemployment rates are higher in the regions outside the Coast and Willamette Valley.

### *Infrastructure Profile*

Counties in all eight regions have transportation, energy, and water facilities or conveyance systems that are vulnerable to natural hazard events. The state's energy hub in the Portland Harbor area of the lower Willamette River is highly vulnerable to a seismic event due to liquefiable soils and to the age and poor condition of many facilities.

### *Built Environment Profile*

Populations tend to cluster around transportation corridors. The majority of growth is occurring in the Willamette Valley. Each region outside the Willamette Valley has at least one county with a high proportion of mobile homes, which are inherently vulnerable to natural hazards. Also, in at least one county, half or more of the structures were built prior to current floodplain management or seismic standards.

## **Hazards and Vulnerability**

### *Coastal Hazards*

Wave-induced coastal erosion (both short- and long-term), wave runup and wave-induced flood hazards, wind-blown sand, coastal landslides, earthquakes, and potentially catastrophic tsunamis generated by the Cascadia Subduction Zone (CSZ) all affect Oregon's coastal strip. The region's natural landforms have restricted development to low-lying areas, chiefly along dunes, barrier spits, or along coastal bluffs subject to varying rates of erosion, and to low-lying areas adjacent to the numerous estuaries. Intense chronic storms at the coast gradually cause damage over time, impacting property, infrastructure, and ecosystem services.

Counties most vulnerable to coastal hazards: Tillamook, Lincoln, Clatsop, and Curry

Other communities considered vulnerable to coastal hazards: A few communities scattered through Coos County and the coastal area of Lane County, for example, adjacent to the south Coquille jetty in Bandon, along Lighthouse Beach near Cape Arago, Heceta Beach, and adjacent to the mouth of the Siuslaw River.

State-owned/leased facilities in the coastal erosion zone: There are 28 state-owned/leased facilities representing approximately \$7 million in the coastal erosion zone. One of these is a state-owned/leased critical or essential facility.

### *Droughts*

Oregon is continuously confronted with drought and water scarcity issues, despite its rainy reputation. Droughts can occur in Oregon in both summer and winter months. These events generally affect areas east of the Cascades and some specific locales across the state. Severe or prolonged drought can impact Oregon's public health, infrastructure, facilities, economy, and environment.

Counties most vulnerable to droughts: Klamath and Baker

Other counties considered vulnerable to droughts: Lake, Malheur, Sherman, Gilliam, and Morrow

### *Dust Storms*

Dust storms occur most frequently in arid regions of Central and Eastern Oregon. With wind speeds of at least 25 miles per hour, dust storms can spread over hundreds of miles and rise over 10,000 feet. Airborne dust particles, or dust aerosols, alter the climate by intercepting sunlight traveling toward the earth's surface. Dust storms impact air quality, erode topsoil, and increase fine sediment loading in creeks and rivers. Dust storms can also damage equipment and engines and can cause vehicle collisions.

Counties most vulnerable to dust storms: Morrow and Umatilla

Other counties considered vulnerable to dust storms: Baker, Deschutes, Harney, Jefferson, Klamath, Lake, Malheur, Union, and Wasco

### *Earthquakes*

Oregon is susceptible to four types of earthquakes: subduction zone, crustal, intraplate and volcano-induced earthquakes. The greatest threat to Oregon is a Cascadia Subduction Zone (CSZ) event. A CSZ event will primarily impact western Oregon. The heavily populated metropolitan areas of Portland, Salem, and Eugene will experience major damage and loss of life.

Since the publication of the 2012 Oregon NHMP, five major initiatives have taken place that boost the state's understanding of its earthquake risk.

First, the Oregon Department of Transportation (ODOT) conducted the [Statewide Loss Estimates: Oregon Highways Seismic Options Report](#) project that identified priority state-owned lifelines in a CSZ event. A three-tier roadway system was devised:

- Tier 1 provides access from Central Oregon, Washington, and California, and provides access to each region within the study area
- Tier 2 extends the reach of the Tier 1 system throughout seismically vulnerable areas of the state and provides lifeline route redundancy in the Portland Metro Area and Willamette Valley
- Tier 3, together with Tiers 1 and 2, provides an interconnected network with redundant paths to serve all of the study area

Second, DOGAMI published Open File Report O-13-09, Earthquake Risk Study for Oregon's Critical Energy Infrastructure Hub (Wang et al., 2013; <http://www.oregongeology.org/sub/earthquakes/cei-hub-report.pdf>). This report highlights the concentration of critical energy facilities in the Portland area and the potential statewide impacts of a seismic event affecting this hub.

Third, in 2013 the Cascadia Region Earthquake Workgroup (CREW) issued an updated scenario for a CSZ magnitude 9.0 event ([Appendix 9.1.20](#)). It explains the latest science and expected impacts, and suggests mitigation strategies.

Fourth, the Oregon Seismic Safety Policy Advisory Commission (OSSPAC) developed the [Oregon Resilience Plan](#) that was commissioned by a legislative resolution. The ORP estimated the impacts of a magnitude 9.0 CSZ earthquake on the state's population, buildings, and infrastructure. According to the ORP, recovery time estimates for coastal infrastructure in a Medium CSZ event will be:

- Electricity and natural gas, 3–6 months
- Drinking water and sewer systems, 1–3 years
- Healthcare facilities, 3 years

The ORP does not estimate recovery times for police and fire stations or the coastal transportation system. Recovery of the transportation system will no doubt be measured in years. Because the coast's economy is dependent on the transportation system, economic recovery would also be many years.

The ORP recommends actions for improving resilience to the CSZ event and that they be implemented over a 50-year period. Some examples:

- Comprehensively assessing key structures and systems
- Retrofitting Oregon's public buildings
- Helping Oregon's private sector improve resilience
- Revising public policies to streamline recovery and increase public preparedness

Finally, SB 33 (2013) established the Oregon Resilience Task Force to develop a plan to implement the ORP. The Task Force reported to the Oregon Legislature in October 2014 ([Appendix 9.2.6](#)).

The 10 counties projected to incur the most loss and damage due to a CSZ earthquake (most to least): Multnomah, Lane, Coos, Washington, Marion, Benton, Lincoln, Josephine, Clatsop, and Jackson

The 10 counties projected to incur the most loss and damage due to combined crustal earthquakes (most to least): Multnomah, Washington, Lane, Marion, Clackamas, Coos, Jackson, Benton, Linn, and Klamath

Other communities vulnerable to earthquakes: Seaside is the most vulnerable coastal town.

State-owned/leased facilities in an earthquake hazard zone: Almost all state facilities representing over \$7 billion are in an earthquake hazard zone. 1,141 state-owned/leased critical or essential facilities are located in an earthquake zone.

### *Floods*

Oregon has an extensive history of flooding, and there are localized risks of flooding across the state. Types of flooding in Oregon include riverine flooding, flash floods, coastal floods, shallow area flooding, urban flooding, playa flooding, and floods caused by ice jams and dam failure. In La Niña years, floods can be severe. In addition, channel migration has created hazardous conditions along developed river banks. The National Flood Insurance Program (NFIP) identifies 251 communities in Oregon as flood-prone including locations in all 36 counties, 212 cities, and three Indian Tribal Nations. Damage and loss of life occur when flood waters come into contact with the built environment or other areas where people congregate. In addition to taking lives and damaging property, floods can cause stream channels to migrate and erode and can precipitate landslides.

FEMA has identified 302 buildings in Oregon as repetitive loss properties, the majority of which are residential structures. There are only 11 severe repetitive loss properties in Oregon.

Counties most vulnerable to floods based on number of and dollar amount of National Flood Insurance Program (NFIP) claims: Clackamas, Columbia, and Tillamook

The 10 cities with the greatest percentage of land area in a 1% annual flood zone are (most to least): Helix, Scio, Burns, Warrenton, Seaside, Vernonia, Sheridan, Lone, Adams, and Athena

State-owned/leased facilities in a flood hazard zone: There are 788 state-owned/leased facilities representing nearly \$900 million in flood hazard areas. 41 are state-owned/leased critical or essential facilities.

### *Landslides*

Landslides occur across the state. In general, counties in Oregon have hundreds to thousands of existing landslides. Typically, areas with more relief and steeper slopes, such as the Coast Range and Cascade Mountains, tend to have more landslides. Three main factors influence an area's susceptibility to landslides: geometry of the slope, geologic material, and water. Landslides in Oregon are typically triggered by periods of heavy rainfall alone or with rapid snowmelt. Earthquakes, volcanoes, and human activities also trigger landslides. Average annual repair costs for landslides in Oregon exceed \$10 million. As population increases in Oregon and development encroaches upon landslide-susceptible terrain, greater losses are likely to result. Major landslides have severed key transportation routes such as highways and rail lines causing temporary but significant statewide economic damage. Landslides that close US-101 or any of the highways connecting the I-5 corridor to the coast have a significant effect on commerce in the Oregon Coast Region.

Counties most vulnerable to landslides: Clackamas, Linn, Douglas, Coos, Lane, Tillamook, Multnomah, Benton, Jackson, Clatsop, Lincoln, Marion, Washington, Curry, Columbia, Hood River, and Yamhill

Other counties vulnerable to landslides: Multnomah, Clackamas, and Washington

State-owned/leased facilities in a landslide hazard area: There are 5,146 facilities representing nearly \$7 billion in “High” and “Moderate” landslide hazard zones. 1,038 are state-owned/leased critical or essential facilities.

### *Tsunamis*

The entire Oregon coast is at risk from distant and local tsunamis. Distant tsunamis caused by earthquakes on the Pacific Rim strike the Oregon coast frequently but few have caused significant damage or loss of life. Local tsunamis caused by a Cascadia Subduction Zone (CSZ) event happen much less frequently but will cause catastrophic damage and, without effective mitigation actions, great loss of life. Most locally-generated tsunamis will be higher and travel farther inland (overland and up river) than distant tsunamis. By the time a tsunami wave hits the coastline, it may be traveling at 30 mph and have heights of 20 to approximately 100 feet. The tsunami wave will break up into a series of waves that will continue to strike the coast for a day or more, with the most destructive waves arriving in the first 4-5 hours after the local earthquake. Significant loss of life and profound damage due to a local tsunami caused by a CSZ event is likely.

Counties most vulnerable to tsunami: All coastal counties. Clatsop and Tillamook counties have the greatest vulnerability. Gearhart, Cannon Beach, Rockaway Beach, Pacific City, Neskowin, Salishan Spit, Cutler City in Lincoln City, South Beach in Newport, and downtown Waldport are all extremely difficult to evacuate.

State-owned/leased facilities in a tsunami hazard zone: There are 676 state-owned/leased facilities representing approximately \$134 million located in a tsunami zone. Of those, 105 are state-owned/leased critical or essential facilities.

### *Volcanoes*

Volcanic activity can impact central Oregon, the Cascade Range, Southeast Oregon, and the Northern Basin and Range ecoregion ([Figure 2-218, Region 8 Ecoregions](#)). Potentially hazardous volcanoes in Oregon exist along the crest of the Cascade Range and to a lesser extent in the Northern Basin and Range ecoregion. Volcanic hazards that can impact the state include ashfall that can travel long distances, lahars (volcanic debris flows), lava flows (streams of molten rock), pyroclastic flows and surges (avalanches of rock and gas at temperatures of 600–1500 °F), landslides, earthquakes, flooding, and channel migration.

Counties most vulnerable to volcanic hazards: Clackamas, Douglas, Deschutes, Hood River, Jackson, Jefferson, Klamath, Lane, Linn, Marion, Multnomah, and Wasco

State-owned/leased facilities in a volcanic hazard zone: There are 601 state-owned/leased facilities representing approximately \$355 million located in a volcanic hazard zone. Of those, 55 are located in “Moderate” or “High” volcanic hazard zones. Of the 77 state-owned/leased

critical or essential facilities located in a volcanic hazard zone, one is in a “High” volcanic hazard zone and the rest are in a “Low” volcanic hazard zone.

### *Wildfires*

Wildfires occur throughout the state and may start at any time of the year when weather and fuel conditions combine to allow ignition and spread. Wildfires impact primarily southwest, central, and northeast Oregon, with localized risks statewide. The majority of wildfires take place between June and October. Wildfires may be broadly categorized as agricultural, forest, range, or wildland-urban interface (WUI) fires. Common sources of wildfire in Oregon include lightning, equipment use, railroad activity, recreational activity, debris burning, arson, and smoking.

The West Wide Wildfire Risk Assessment (WWRA) was published in 2013. The WWRA identified that six Oregon counties each have over 1 million wildland acres at moderate risk of wildfire. 751,672 Oregonians live in wildland development areas that are at risk of wildfire. Over 12 million acres of forest are at moderate to high risk of wildfire in Oregon.

Counties most vulnerable to wildfire: Deschutes, Douglas, Grant, Jackson, Jefferson, Josephine, Klamath, Umatilla, Union, Wallowa, and Wasco

Other counties vulnerable to wildfire: All other counties in Oregon

State-owned/leased facilities in a wildfire hazard zone: Roughly half of all state facilities representing approximately \$1.05 billion are located in a wildfire hazard zone. Of these, 330 are state-owned/leased critical or essential facilities.

### *Windstorms*

The risk of windstorms is localized across the state. Windstorms are especially common in exposed coastal areas and in the mountains of the Coast Range, occur most frequently from October through March. Communities in the Willamette Valley and Columbia River Gorge also experience strong winds. The wind itself, the debris it carries, and the trees it may blow down cause injury and damage property and infrastructure. The harmful effects of windstorms may extend for distances of 100 to 300 miles from the storm’s center of activity.

Counties most vulnerable to wind storms: Benton, Clatsop, Coos, Columbia, Curry, Douglas, Gilliam, Hood River, Lane, Lincoln, Linn, Marion, Morrow, Multnomah, Polk, Sherman, Tillamook, and Washington

### *Winter Storms*

Winter storms bring freezing rain, sleet, black ice, heavy snow, ice accumulation, extreme cold, and snow avalanches to areas across the state. These storms may last several days and can paralyze a community. People can become homebound; motorists can become trapped in their vehicles; utilities and other services can be disrupted, and crops and other vegetation can be damaged by freezing temperatures. Airport and other transportation system closures can stop the flow of supplies and disrupt essential services.

Counties most vulnerable to winter storms: Linn, Benton, Marion, Polk, Yamhill, Columbia, Washington, Multnomah, Clackamas, Lane, Douglas, Josephine, and Jackson

## Mitigation Strategy

Oregon’s mission, vision, and goals for natural hazard mitigation are purposefully aspirational, providing the foundation for the state’s overall mitigation strategy. Natural hazard mitigation planning in Oregon is funded by the state, post-disaster FEMA mitigation grants, and non-disaster FEMA grant funding.

Given the current economic climate, it is important to acknowledge that state resources are limited. Oregon is not unique in that regard. Even so, Oregon is committed to remaining at the forefront of mitigation planning and will continue to innovate and leverage limited resources to reduce losses resulting from natural hazards in our state. The mitigation strategy presented in this 2015 Oregon NHMP reflects that commitment.

MISSION Create a disaster-resilient state of Oregon.

VISION Natural hazard events result in no loss of life, minimal property damage, and limited long-term impacts to the economy.

- GOALS
- 1 Protect life and reduce injuries resulting from natural hazards.
  - 2 Minimize public and private property damages and the disruption of essential infrastructure and services from natural hazards.
  - 3 Increase the resilience of local, regional, and statewide economies.
  - 4 Minimize the impact of natural hazards while protecting, restoring, and sustaining environmental processes.
  - 5 Enhance and maintain state capability to implement a comprehensive statewide hazard loss reduction strategy.
  - 6 Document and evaluate Oregon’s progress in achieving hazard mitigation.
  - 7 Motivate the public, private sector, and government agencies to mitigate against the effects of natural hazards through information and education.
  - 8 Eliminate development within mapped hazardous areas where the risks to people and property cannot be mitigated.
  - 9 Minimize damage to historic and cultural resources.
  - 10 Increase communication, collaboration, and coordination among agencies at all levels of government and the private sector to mitigate natural hazards.
  - 11 Integrate local NHMPs with comprehensive plans and implementing measures.

## Goals: Linking the Risk Assessment and Mitigation Actions

The risk assessment speaks directly to protection of life and property; infrastructure and services; and local, regional, and state economic resilience, the topics of Goals 1, 2, and 3. The vulnerability assessments for each hazard and the potential loss estimates highlight the importance of informing and educating citizens about the risks and what they can do to reduce potential losses, including eliminating development where risks cannot be mitigated, the topics of Goals 7 and 8. Environmental stewardship, the topic of Goal 4, plays a role in mitigating some hazards, and must be considered in designing mitigation projects. While not specifically called out in the goal language, mitigation of repetitive loss and severe repetitive loss properties is unquestionably supported by these goals.

The risk assessment also brought to light similarities and differences between state and local vulnerability assessments, highlighting the need to develop a statewide standardized risk assessment methodology across all hazards. Enhancing communication and education among state and local staff responsible for assessing vulnerability is also an important element of improving the risk assessment.

The need for more communication between state and local agencies was also highlighted in county-level risk assessments. Goal 10 identifies this need directly. During this update, goals from all 36 Oregon County NHMPs were reviewed for consistency with the state NHMP goals. Goals 9, 10, and 11 were added to better align state and local natural hazard mitigation planning goals.

While these and other issues raised by the risk assessment sparked discussion around the Plan goals, they also suggested some new mitigation actions. In particular, these mitigation actions were developed in direct response to those issues:

- #15 Develop new standardized risk assessment methodology across all hazards, at the state and local levels.
- #31 Improve state agency procedures for tracking data on state-owned and -leased buildings and critical or essential facilities.
- #59 Schedule three opportunities over the life of this Plan for state-local dialogue on vulnerability assessments to improve consistency and mutual understanding.
- #77 Develop an improved methodology for gathering data and identifying the communities most vulnerable to drought and related impacts.
- #78 Establish a program for studying winter storms and their impacts statewide. As a part of that program, develop a system for gathering snowfall data statewide.

The connections between the risk assessment, goals, and mitigation actions are clear.

## Mitigation Actions

### Identification, Evaluation, Prioritization

2012 Oregon NHMP mitigation actions were reviewed to ascertain their status. They were evaluated against statutory criteria (cost-effective, technically feasible, environmentally sound),

SMART criteria (specific, measurable, achievable, realistic, time-oriented), and whether they were integrated with other state initiatives. As a result, some were revised, some were considered complete or would not be completed, new actions were added, and all were placed into one of three categories: priority, ongoing, removed. Next the actions in the priority category were prioritized. They were evaluated against the STAPLEE criteria (social, technical, administrative, political, legal, economic, and environmental) in two steps: first scoring using a worksheet that weighted most of the criteria, then ranking by the implementing agency as to the likelihood that it would be funded and undertaken during the life of the 2015 Oregon NHMP. Finally, the actions in the ongoing category were ranked according to the number of hazards then the number of goals addressed. A mitigation action crosswalk shows the disposition of the 2012 Oregon NHMP mitigation actions in the 2015 Oregon NHMP.

## Changes in Mitigation Action Priorities

While specific actions or wording of actions may have changed, in terms of themes mitigation action priorities have remained aligned with those of the 2012 Oregon NHMP:

- Obtaining legislative support for implementation of natural hazards policies and mitigation actions
- Implementing Statewide Goal 7, including supporting local government integration of NHMPs with comprehensive plans; and developing, distributing, and assisting local governments with implementing risk reduction techniques and model codes
- Enhancing coordination of state and local mitigation planning
- Enhancing implementation of the Community Rating System statewide
- Inventorying and protecting state-owned and -leased buildings from natural hazards
- Improving reliability and resiliency of critical infrastructure statewide

## Funding Sources for Mitigation Actions

Oregon's mitigation activities are funded directly and most visibly through FEMA grant programs as well as NOAA grants. These grants require a non-federal cost share which is provided by State, local, or private funding sources. The State provides direct funding for earthquake mitigation projects through its Seismic Rehabilitation Grant Program. The Oregon Disaster Assistance Loan and Grant Account provides post-disaster mitigation funds to local governments and school districts.

## Mitigation Successes

Oregon maintains documentation of "mitigation success stories." These are completed mitigation actions that have shown to be successful by either (a) avoiding potential losses; or (b) demonstrating cost-effectiveness through benefit-cost analysis, qualitative assessment, or both. Likewise, actions that support mitigation efforts, like risk or vulnerability assessment studies, are included. Mitigation success stories are completed by or with input from the action's coordinating agency. Thirteen mitigation success stories from the period 2012–2014 are showcased in the 2015 Oregon NHMP.

## Capability Assessment

### State Capability Assessment

There have been a number of positive changes in Oregon's natural hazard mitigation capability since 2012. Among them are:

- The Oregon Department of Land Conservation and Development (DLCD) accepted responsibility for the Oregon NHMP and hired two planners focused on natural hazard mitigation, including implementation of Statewide Planning Goal 7.
- Completion of *Oregon Seismic Lifeline Routes (OSLR) Identification* project that establishes a three-tiered system of seismic lifelines to help prioritize investment in seismic retrofits on state-owned highways and bridges.
- Publication of the *Oregon Resilience Plan*, highlighting the state's vulnerabilities in the event of a Cascadia earthquake and tsunami and identifying mitigation actions. Publication of *Preparing for a Cascadia Subduction Zone Tsunami: A Land Use Guide for Oregon Coastal Communities* (<http://www.oregon.gov/lcd/ocmp/docs/publications/tsunamiguide20140108.pdf>), which provides information on planning techniques to mitigate loss from a Cascadia earthquake and tsunami event.
- Began work on integrating Community Wildfire Protection Plans with local NHMPs and comprehensive plans.
- *The North Coast Resilience Project*, a cooperative endeavor of DLCD, Oregon Partnership for Disaster Resilience (OPDR), and Oregon Sea Grant is engaging north coast communities in hazard mitigation and resilience planning.
- *The Regional Framework for Climate Adaptation* is aligning agency climate adaptation priorities and building capacity at the state and local levels to plan for climate variability and change.
- Initiation of two Community Rating System (CRS) Users Groups to encourage current participants to maintain their participation and increase their ratings, and to encourage non-participating communities to join the CRS Program.
- The Oregon Climate Change Research Institute and Oregon Climate Service joined the State IHMT and lent expertise to the 2015 Oregon NHMP in the areas of climate change, droughts, and windstorms.
- The State Department of Administrative Services hired two new staff who are working on improving data on state-owned/leased buildings and critical and essential facilities.

Oregon continues to maintain robust pre- and post-disaster natural hazard mitigation policy and program frameworks, coordinated through the State Interagency Hazard Mitigation Team.

Funding comes from FEMA and NOAA grant programs, as well as the state's Seismic Rehabilitation Grant Program, Oregon Disaster Assistance Loan and Grant Account. The federal grant programs require a non-federal cost share which is funded by the state, local governments, and private entities. The State General Fund covers in-kind services performed by state employees. State funding to support hazard mitigation and risk reduction remains limited. However, Oregon has an excellent track record of leveraging limited local resources to successfully complete mitigation planning and projects throughout the state.

## Local Capability Assessment

Local natural hazard mitigation policies, programs, and capabilities along with a general assessment of their effectiveness are presented in table format as is the status of each community's NHMP and its participation in the National Flood Insurance Program and Community Rating System.

## Coordinating State and Local Mitigation Planning

The State of Oregon continues to build local capacity in developing and implementing risk reduction strategies through plan development support, professional assistance, resource sharing, and technical assistance. Local mitigation planning continues to be accomplished in great measure through the state's Pre-Disaster Mitigation (PDM) Planning Program, systematically providing funding and technical assistance to local governments for natural hazards mitigation planning on a five-year rotational basis to ensure that local governments maintain FEMA-approved NHMPs. While some municipalities elect not to participate, all 36 counties in Oregon currently participate.

In 2014, the Oregon Military Department's Office of Emergency Management (OEM) and OPDR developed a "pre-application" process to screen local communities interested in participating in regional FEMA PDM grant applications. Because it was so successful, the state intends to continue using the pre-application process. Over the past 3 years, Oregon has used PDM funds to support plan updates in 21 of Oregon's 36 counties. In addition, the state supported Yamhill County's NHMP update with state general funds through its Emergency Management Performance Grant (EMPG) Program.

OPDR is a chief source of direct technical hazard mitigation planning assistance for local governments in Oregon. OPDR assists local jurisdictions with grant writing, local plan development, plan update, process facilitation, stakeholder engagement, public outreach, and hazard research services and serves as a liaison between local communities and state, federal and NGO partners during the mitigation planning process.

Direct State technical planning assistance for local NHMPs is provided primarily by OEM, DLCD, and the Oregon Department of Geology and Mineral Industries (DOGAMI). OEM houses the State Hazard Mitigation Officer (SHMO) who assists with mitigation project development, execution, and grant compliance. Others provide oversight of mitigation plans; assistance with mitigation for natural, cultural, and historic resources; public information and outreach, particularly for earthquake and tsunami hazards; and tsunami evacuation planning. DOGAMI develops specific technical hazard information, risk and vulnerability assessment products.

DLCD houses the National Flood Insurance Program (NFIP) and Risk Mapping, Assessment, and Planning (Risk MAP) Program Coordinators. The NFIP Coordinator implements the NFIP and the CRS Program, assisting local government staff, citizens, and other stakeholders with NFIP implementation through an extensive and intensive outreach program and regular Community Assistance Visits (CAVs). The Risk MAP Coordinator works closely with FEMA, DOGAMI, OEM, OPDR, local governments, and citizens in developing and providing access to natural hazard data. Planners provide local governments assistance in complying with Statewide Planning Goal 7 and beginning in 2014, all three provide assistance with various aspects of updating and developing local NHMPs.

Technical assistance is also provided indirectly, in the form of access to products and information.

## Planning Process

### Developing the Plan

Two major changes occurred in the planning process during this update cycle.

First, DLCD accepted responsibility for updating and maintaining the Oregon NHMP. Prior to this, OPDR had facilitated Oregon NHMP updates. DLCD hired two natural hazards planners to manage the plan update and implement other natural hazard mitigation initiatives. The transfer of responsibility and hiring process consumed the first year of the update cycle, significantly abbreviating the project timeline.

Second, effective May 27, 2014, amendments to 44 CFR 201 changed the state mitigation planning update cycle from 3 to 5 years. Due to contract obligations, Oregon is completing the 3-year update already in progress.

The State requested and received a one-year no-cost extension for the project to ease the abbreviated timeline and better align the grant performance period with the state legislative session. The 2015 Oregon NHMP is therefore the result of an approximately two-and-a-half-year, collaborative interagency plan update process.

DLCD managed and facilitated the update process with oversight and direction from the State IHMT, guidance from FEMA, and in close cooperation with OEM and the State Hazard Mitigation Officer, DOGAMI, and OPDR. Many other state and federal agencies also contributed substantively and substantially to the update. New to the process are the Oregon Climate Change Research Institute (OCCRI), the Oregon Climate Service (OCS), and the Silver Jackets. OCCRI and the OCS lent expertise in the areas of climate change, drought, and windstorms. The Silver Jackets, a U.S. Army Corps of Engineers program and new sub-committee of the State IHMT, fosters collaboration among several federal and State agencies and has been successful in advancing flood hazard mitigation during this update cycle.

During this abbreviated planning cycle, the entire 2012 Oregon NHMP was reviewed, revised, and reorganized. The State IHMT served as the steering committee for the update, receiving reports, discussing issues, and providing direction at its quarterly meetings. Information was distributed and public input solicited through a new project website and associated listserv, and a new State IHMT website. Comments received from local governments were addressed and posted on the project website. Information was presented at a joint meeting of the Land Conservation and Development Commission and the DOGAMI Governing Board, as well as at FEMA's Local Mitigation Planning Training.

### Maintaining the Plan

The State will prepare three annual progress reports before beginning the next plan update in 2018. Progress on state mitigation actions will be monitored through the annual reporting process. OEM will continue systematically monitoring the implementation of FEMA-funded mitigation actions and projects for which it is the grantee at both state and local levels.

The next update process will begin with evaluation of the 2015 Plan using the information from the annual reports and a set of evaluation criteria. The approach to the update will be discussed and decided by the State IHMT. Issues and conditions that could affect the next update include:

- Potentially changing the suite of hazards addressed by the Oregon NHMP;
- Prioritizing hazards addressed by the Oregon NHMP;
- The extent of progress on developing the new risk assessment model;
- The availability of new or updated hazard, probability, and vulnerability data, including climate change and cultural and historic resources;
- The extent of progress on enhancing coordination of state and local natural hazard mitigation planning;
- The extent of progress on establishing the 2015 Oregon NHMP as a “living document” that can be updated as necessary during the life of the Plan; and
- Addressing any new requirements in FEMA’s revised state NHMP guidance to be issued in 2015.

## Enhanced Plan

In 2012, Oregon lost enhanced plan status due to program management issues. Much effort has been expended during this update cycle on making the changes necessary to regain enhanced plan status. OEM and the State Hazard Mitigation Officer led the charge, working closely with FEMA. On February 27, 2015, FEMA re-approved the 2012 Oregon NHMP as an enhanced plan.

Enhanced plan approval constitutes FEMA’s recognition that a state has demonstrated its commitment to maintaining a comprehensive natural hazard mitigation program and supporting that commitment through skilled and effective management of mitigation funding, projects, and planning; support of local mitigation plans and projects; integration of mitigation plans and projects with other state and federal plans, programs, and initiatives; and continual progress in implementation. This exceptional level of effort and demonstration of excellence yields dividends in the form of increased federal mitigation funding after disaster strikes.