SECTION 2

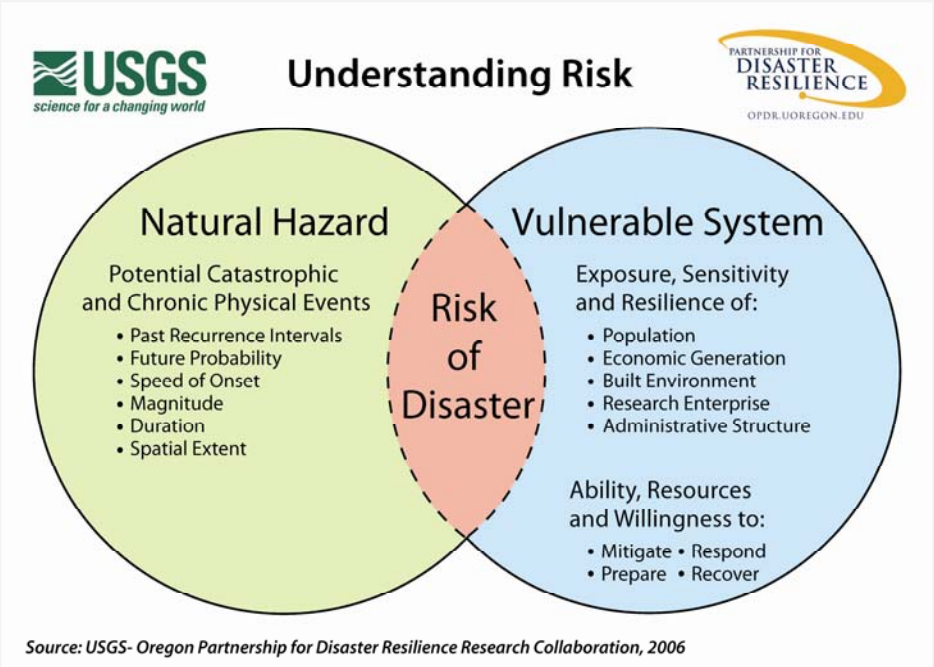
RISK ASSESSMENT

The purpose of the State Natural Hazards Risk Assessment is to identify and characterize Oregon's natural hazards, determine which counties are most vulnerable to each hazard and estimates potential losses to state facilities from those hazards.

> ***Requirement 44 CFR §201.4(c)(2),*** 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.

Natural disasters occur as the result of interactions among three broad systems: the natural environment (e.g. climate, river systems, geology, forest ecosystems, etc.), the built environment (e.g. cities, buildings, roads, utilities, etc.), and societal systems (e.g. cultural institutions, community organizations, economic climate, service providers, etc.) It is impossible to predict exactly when natural hazards will occur, or the extent to which they will affect communities within the state. However, with careful planning and collaboration, it is possible to minimize the losses that can result from natural hazards. The identification of actions that reduce the state's sensitivity and increase its resilience assist in reducing overall risk, or the area of overlap in the figure below.

Figure: 2.1 Understanding Risk



Source: USGS- Oregon Partnership for Disaster Resilience Research Collaboration, 2006

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. A vulnerability assessment combines information from the hazard identification with an inventory of the existing (or planned) property and population exposed to a hazard, and attempts to predict how different types of property and population groups will be affected. Vulnerability is determined by a community's exposure, sensitivity, and resilience to natural hazards, as well as its ability to mitigate, prepare for, respond to, and recover from a disaster. Finally, a risk analysis involves estimating the damages, injuries, and costs likely to be incurred in a geographic area over a period of time. Risk has two measurable components: (1) the magnitude of the harm that may result, defined through the vulnerability assessment, and (2) the likelihood or probability of the harm occurring.

Hazard Overview

Requirement: 44 CFR §201.4(c)(2)(i): Th[e] risk assessment shall include… (i) (a)n overview of the type and location of all natural hazards that can affect the State, including information on previous occurrences of hazard events, as well as the probability of future hazard events, using maps where appropriate;

The state of Oregon is subject to 11 primary hazard types. Table 2.1 lists each hazard and describes in general terms where the hazard is located.

Table 2.1: Oregon Hazard Overview

Hazard	Generalized Locations
Coastal Erosion	West Oregon Coast
Drought	Generally east of the Cascades, with localized risks statewide
Dust Storm	Generally east of the Cascades, with localized risks statewide
Earthquake	
Cascadia Subduction	Primarily Western Oregon
Other Active EQ Faults	Localized Risks Statewide
Wildfire	Primarily Southwest, Central and Northeast Oregon, with localized risks statewide
Flood	Localized risks statewide
Landslide/ Debris Flow	Localized risks statewide
Tsunami	West Oregon Coast
Volcano	Central Oregon – Cascade Range
Windstorm	Localized Risks Statewide
Winter Storm	Localized Risks Statewide

Source: OPDR

Since 1955 (the year the U.S. began formally tracking natural disasters), Oregon has received 27 major disaster declarations, two emergency declarations and 49 fire management assistance declarations. Table 2.2 below lists each of the major disaster declarations, the hazard that the disaster is attributed to and counties

impacted. Since 1955, Clatsop, Douglas, Lincoln, Tillamook and Yamhill Counties have each been impacted by ten or more federally declared, non-fire related disasters. Of the 27 major disasters to impact Oregon, the vast majority have resulted from storm events; notably, flooding impacts from those events are reported in over two-thirds of the major disaster declarations.

Table 2.2: FEMA Major Disaster Declarations for Oregon

Disaster	Incident Period	Disaster Type	Baker	Benton	Clackamas	**Clatsop**	Columbia	Coos	Crook	Curry	Deschutes	**Douglas**	Gilliam	Grant	Harney	Hood River	Jackson	Jefferson	Josephine	Klamath	Lake	Lane	**Lincoln**	Linn	Malheur	Marion	Morrow	Multnomah	Polk	Sherman	Siletz IR	**Tillamook**	Umatilla	Union	Wallowa	Warm Springs IR	Wasco	Washington	Wheeler	**Yamhill**
DR-1964	3/11/2011	Tsunami						x		x													x																	
DR-1956	1/13-1/21/2011	Winter storms / flooding / mudslides / landslides / debris flows			x	x			x			x											x									x								
DR-1824	12/13-1/26/2008	Winter storms / flooding			x	x	x																			x		x	x			x						x		x
DR-1733	12/1-12/17/2007	Storms / flooding / landslides / mudslides				x	x																						x			x						x		x
DR-1683	12/14-12/15/2006	Winter storms / flooding		x		x	x																x						x		x	x					x		x	x
DR-1672	11/5-11/8/2006	Storms / flooding / landslides / mudslides				x										x							x									x								
DR-1632	12/18/2005-1/21/2006	Storms / flooding / landslides / mudslides		x	x	x	x	x	x	x		x	x				x	x	x				x	x					x	x		x				x			x	x
DR-1510	12/26/2003-1/14/2004	Winter storms	x	x	x	x	x		x		x	x	x	x	x	x		x			x	x	x	x	x	x	x	x	x	x		x	x	x	x		x		x	x
DR-1405	2/7-2/8/2002	Wind storm						x		x		x										x		x																
DR-1221	5/28-6/3/1998	Flooding							x																															
DR-1160	12/25/1996-1/6/1997	Winter storm / flooding						x				x					x		x	x	x	x													x					
DR-1107	12/10-12/12/1995	Storms / high winds		x		x	x					x										x	x	x								x						x		x
DR-1099	2/4-2/21/1996	Storms / flooding		x	x	x	x	x			x	x	x			x		x	x			x	x	x		x	x	x	x	x		x	x	x	x		x	x		x
DR-1061	7/8-7/9/1995	Flash flooding																																			x			
DR-1036	5/1-10/31/1994	El Nino effects																																						
DR-1004	9/20/1993	Earthquakes																		x																				
DR-985	3/25/1993	Earthquake			x																					x												x		x
DR-853	1/6-1/9/1990	Storms / flooding				x																										x								
DR-413	1/25/1974	Storms / snow melt / flooding		x	x		x	x		x		x	x			x	x		x			x	x			x			x			x			x		x	x		x
DR-319	1/21/1972	Storms / flooding			x	x		x				x										x	x	x				x				x						x		
DR-301	2/13/1971	Storms / flooding				x																										x								
DR-184	12/24/1964	Heavy rains / flooding	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x		x	x	x	x
Total number of disasters by county			2	7	9	**13**	9	8	5	5	3	**10**	5	2	2	5	4	4	5	3	3	8	**11**	7	2	6	3	5	8	4	1	**14**	3	3	5	1	6	8	4	**10**
DR-144	2/25/1963	Flooding	No individual county impact data available																																					
DR-136	10/16/1962	Storms																																						
DR-69	3/1/1957	Flooding																																						
DR-60	7/20/1956	Storm/flooding																																						
DR-49	12/29/1955	Flooding																																						

Source: Oregon Emergency Management

The reported federal disaster declarations (including fire manamgent assistance declarations) document that storm events, floods and wildfires have been the primary chronic hazards with major disaster impacts in Oregon over the last half century. The data also show a trend geographically of a greater number of major federal disaster declarations in the northwest corner of the state. Anecdotally, this pattern plays out for non-federally declared hazard events in the state as well.

The following subsections summarize type, location and history information for each of the hazard types listed above. For detailed information on Oregon's natural hazards, refer to the hazard reports presented in Section 3: *Hazard Chapters*. County specific hazard risk information is presented graphically in the

regional profiles of Appendix 2-A, and on Oregon's on-line, regional hazards viewer:

http://infographics.uoregon.edu/hazardmaps/webapp/beta.html

One of the most prominent aspects of Oregon's weather and climate is its variability. This variability ranges over many time and space scales, from small-scale phenomena such as wind gusts and localized thunderstorms, to larger-scale features like fronts and storms, to even more prolonged features such as droughts and floods. Fluctuations occur on multi-seasonal, multi-year, multi-decade and even multi-century time scales. Examples of these longer time-scale fluctuations include an abnormally hot and dry summer, an abnormally cold and snowy winter, a consecutive series of abnormally mild or exceptionally severe winters, and even a mild winter followed by a severe winter. Human inputs into our geophysical environment are also imposing cumulative impacts with measurable changes to global climate, sea-level and even localized weather. These human inputs along with the normal climate cycles may be working together in unpredictable ways and lead to future climate scenarios that do not resemble past, historic cycles. For example, recent research suggests that a warming climate reinforces the possibility that El Niño events could be stronger and more frequent while La Niña episodes may be weaker and less frequent.

Coastal Erosion Hazard

Coastal erosion is the process of beaches, dunes, and coastal bluffs responding to constantly changing oceanic processes (waves, near-shore currents and tides). The regional, oceanic, and climatic environments that result in intense storms in large part determine the severity of coastal erosion related problems. Chronic hazards resulting from these natural processes include beach, dune, and bluff erosion, landslides, slumps, gradual weathering of sea cliffs, and flooding of low-lying coastal lands during major storms.

While coastal bluffs gradually erode over the long-term, they can also respond very rapidly at times by sliding away (in some cases, only in a matter of a few hours) so that homes and sections of highway are damaged or destroyed. Beaches are essentially dynamic features, as sand is constantly shifted about. This is especially noticeable in major storms, when the shoreline rapidly retreats. Periodically, homes built too close to the sea are destroyed. At other times, large quantities of sand migrate back onto beaches, burying homes built atop coastal dunes or sand spits.

In Oregon, coastal erosion occurs only in the seven western counties that abut the Pacific Ocean. Given the dynamic interactions that occur where the ocean meets land the probability of future coastal erosion events is extremely high. Figure 2.2 shows known hazard location data.

Figure 2-2: Coastal Erosion Hazard

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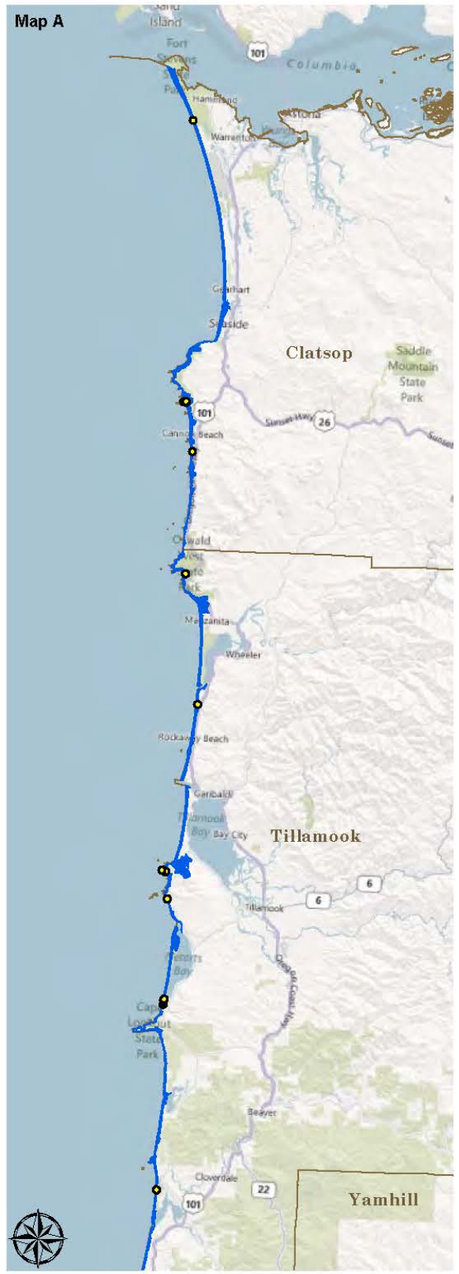
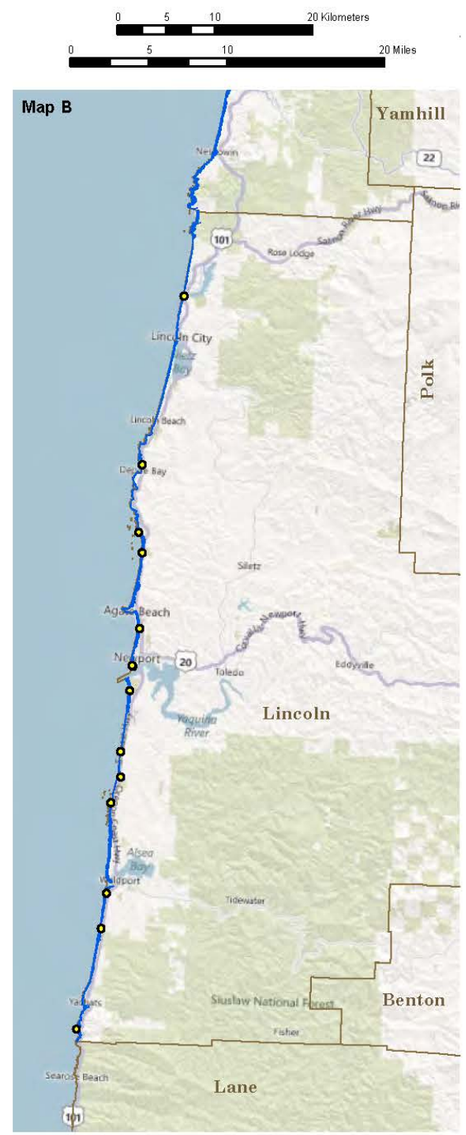
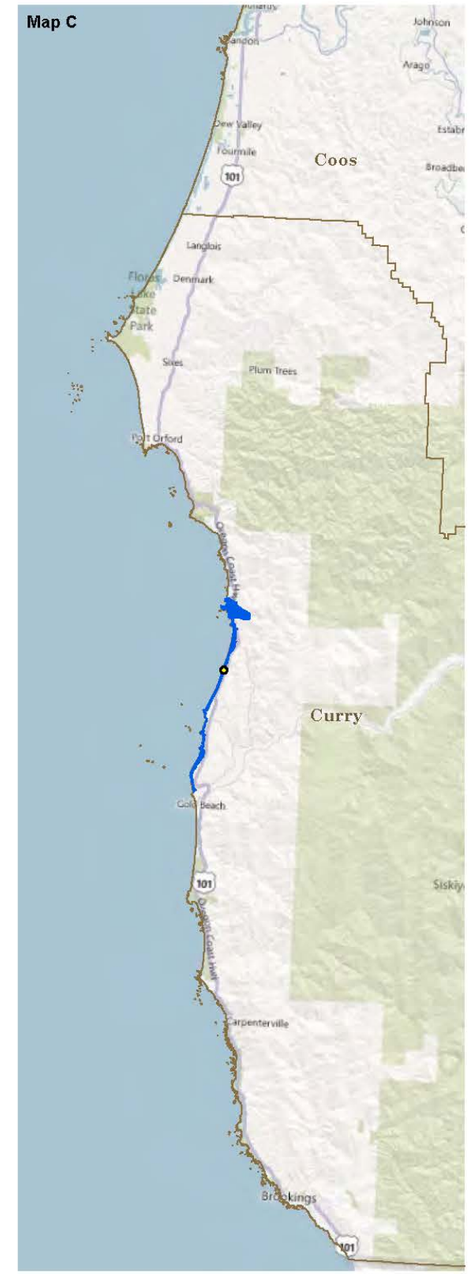


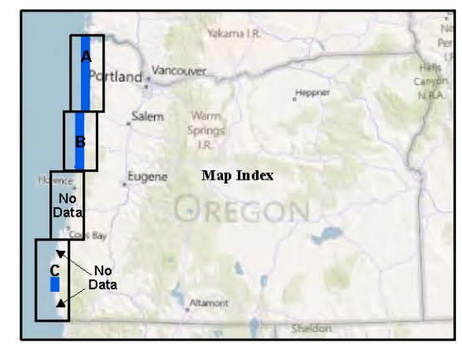




Summary Statistics

Coastal Erosion Hazard Statistics	
Facility Count	36
Replacement Value Total	$7,925,683
Property Value Total	$7,993,441

Coastal Erosion by County		
County	**# of Facilities**	**Total Property Value**
Clatsop	7	$819,125
Tillamook	13	$4,026,188
Lincoln	15	$3,028,128
Lane	no coastal erosion data	
Douglas	no coastal erosion data	
Coos	no coastal erosion data	
Curry	1	$120,000
Total	**36**	**$7,993,441**



The points shown represent state owned facilities within the coastal erosion hazard zone. However, the hazard data does not encompass the entire coastline of Oregon. Lane, Douglas, Coos, and a portion of Curry County do not have coastal erosion hazard data available for this study.

The point locations and property values reflect data provided by the Oregon Department of Administrative Services (DAS) in 2010. The points were located based on addresss data and research performed by the Oregon Department of Geology and Mineral Industries (DOGAMI) staff.

Legend

- State Owned Facility within Coastal Erosion Hazard Area
- Coastal Erosion Hazard Zone
- County Boundary

Map Created by: Rachel Lyles, Department of Geology and Mineral Industries (DOGAMI)
Basemap Source: Microsoft Bing Maps Services
Other Data Sources: Oregon Spatial Data Library and DOGAMI
State owned facility data was provided by the State of Oregon, Department of Adminstrative Services (DAS) and geolocated by DOGAMI.

Projection: Oregon Statewide Lambert Conformal Conic
Datum: NAD83 HARN Unit: International Feet

Drought Hazard

The State of Oregon is confronted with continuing challenges associated with drought and water scarcity. Prior to the current economic downturn, these challenges were exacerbated in central and southern Oregon as well as parts of the Willamette Valley by rapidly growing population. Statewide, increased demand is being placed on a renewable, yet finite resource - water. The terms "drought" and "water scarcity" are not necessarily synonymous. Water scarcity implies that demand is exceeding the supply. The combined effects of drought and water scarcity are far-reaching and merit special consideration.

The Oregon Drought Severity Index is the most commonly used drought measurement in the state. It incorporates precipitation, runoff, evaporation, and soil moisture as well as local conditions and snowpack. However, there are several different types of drought, all of which differ in the impact that water shortages can cause. The various types of drought include the following:

Meteorological or climatological drought: defined in terms of the departure from a normal precipitation pattern, and the duration of this departure.

Agricultural drought – Links the various characteristics of meteorological drought to agricultural impacts, focusing on precipitation shortages and soil-water deficits.

Hydrological drought – the deficiencies in surface water and sub-surface water supplies, measured in stream flow and as lake, reservoir and ground water levels.

Socio-economic drought – occurs when physical water shortage begins to affect people, individually and collectively. Most socioeconomic definitions of drought associate it with supply, demand, and economic good.

Droughts are not just a summer-time phenomenon; winter droughts can have a profound impact on the state's agricultural sector, particularly east of the Cascade Mountains. Below average snowfall in Oregon's higher elevations has a far-reaching effect on the entire state, especially in terms of hydroelectric power, irrigation, recreational opportunities and a variety of industrial uses. There also are environmental consequences. A prolonged drought in Oregon's forests promotes an increase of insect pests, which in turn, damages trees already weakened by a lack of water. A moisture deficient forest constitutes a significant fire hazard, and drought and water scarcity also add stress to species listed pursuant to the Endangered Species Act (ESA) of 1973.

Dust Storm Hazard

A dust storm is a strong, violent wind that carries fine particles such as silt, sand, clay, and other materials, often for long distances. Dust storms can spread over hundreds of miles and have wind speeds of at least 25 miles per hour. Although dust storms can form in any dry area where dirt can easily be picked up by wind, they occur most frequently over deserts and regions of dry soil. Dust storms can be produced on windy days by the interaction of strong winds, fine grained surface material, and landscapes with little vegetation, and the winds involved can be as small as 'dust devils' or as large as fast moving regional air masses.

Dust storms usually arrive with little warning and advance in the form of a big wall of dust and debris. The dust can be blinding, and also threatening to driver

safety. Although dust storms may last only a few minutes at any given location, they can leave serious car accidents in their wake. Dust storms may also result in erosion of topsoil, dust in electronic equipment and aircraft engines, and poor air quality. Approximately half of the dust in today's atmosphere results from environmental changes caused by human activity, including agriculture, overgrazing, and the cutting of forests. Dust storms can also have positive effects, however; dust and ash deposited on the ground in new locations is eventually soaked into the soil by rain, providing important nutrients for plants in those locations.

The arid regions of Central and Eastern Oregon can experience sudden dust storms on windy days. These are produced by the interaction of strong winds, fine-grained surface material, and landscapes with little vegetation. The winds involved can be as small as "dust devils" or as large as fast moving regional air masses.

Farmers, ranchers, homeowners, resort owners, and wildlife in Central and Southeast Oregon sometimes find themselves vying for limited water. Competition for scarce water can affect the locations and amounts of dust in the atmosphere that's blown on the wind.

Earthquake Hazard

Oregon is in an area of the Pacific Northwest that is predisposed to major earthquakes. These earthquakes can be generated off the coast of Oregon along the sloping boundary between the descending Juan de Fuca plate and the North American plate. This tectonic feature, known as the Cascadia Subduction Zone, could produce an earthquake of a magnitude 8.0 to 9.0, or greater. While earthquakes along this zone only occur every 500 to 600 years on average, plate movement can produce catastrophic earthquakes. Intervals between individual catastrophic seismic events range from 150 to 1000 years. Ground shaking experienced during such an earthquake is the primary cause of earthquake damage. The severity of ground shaking depends on the magnitude of the earthquake, the type of fault movement, and distance from the epicenter. In addition, Western Oregon is underlain by a large and complex system of faults that can produce lower level magnitude earthquakes.

Earthquake damage occurs because structures have been built that cannot withstand severe shaking. Damage and loss of life can be severe if structures are not designed to withstand shaking, are on ground that amplifies shaking, or ground that liquefies due to shaking. Buildings, ports, and lifelines (highways, telephone lines, gas, water, etc.) suffer damage in earthquakes. Severe ground shaking can cause additional hazards to occur, such as landslides and slope failures, lateral spreading and slumping, or liquefaction. The severity of these hazards depends on several factors, including soils and slope conditions, proximity to the fault, earthquake magnitude, the type of earthquake, and on-site development decisions.

Active faults occur throughout Oregon and the probability of a future earthquake event is high. Figure 2.3 shows known hazard location data.

Figure 2-3: Earthquake Hazard

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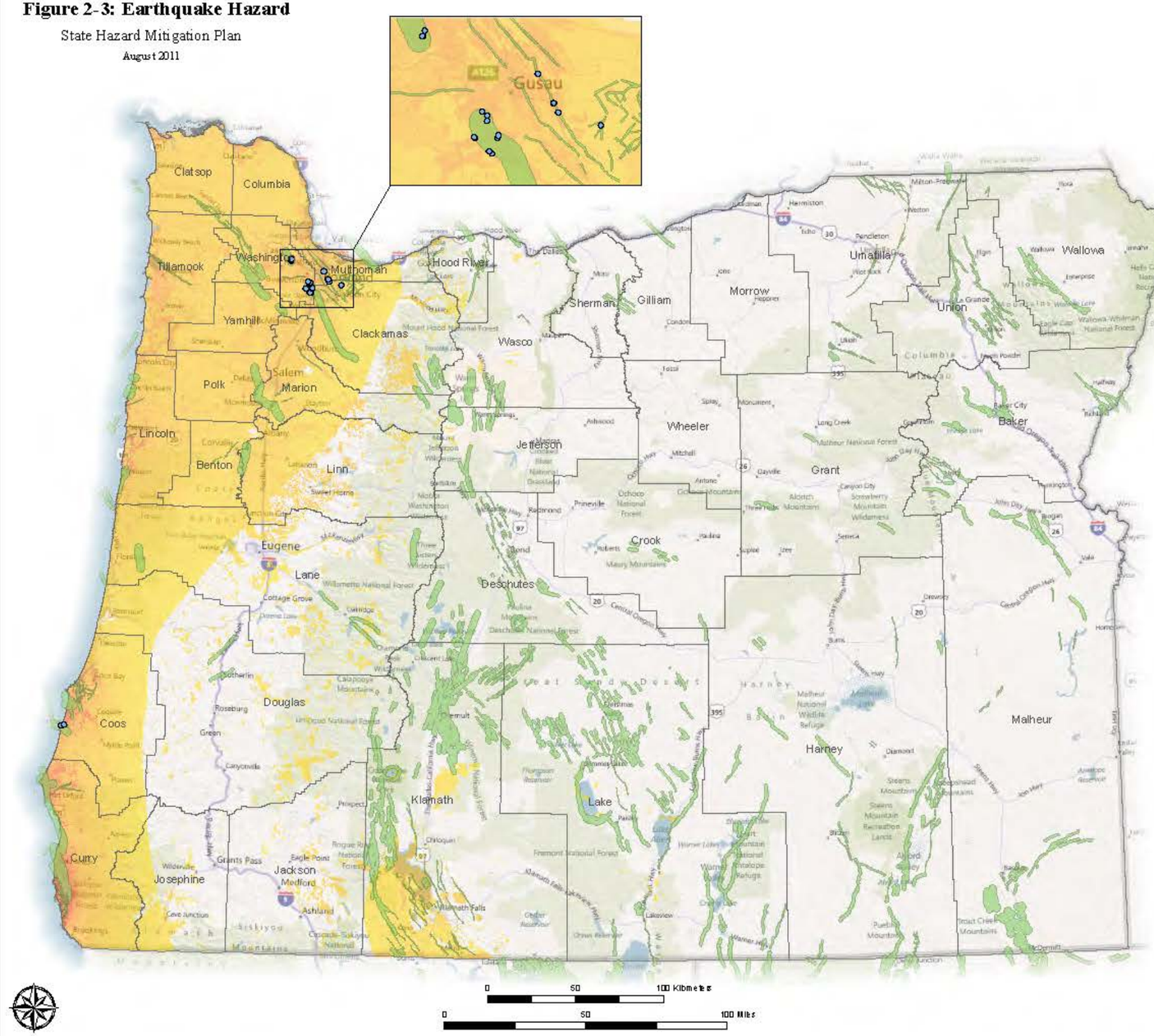

Summary Statistics

The earthquake hazard is defined for the state facility vulnerability assessment by a compilation of three data layers. These are: liquefaction potential, a 500 year probabilistic earthquake ShakeMap, and active fault buffers. Please see the text associated with this figure for a full explanation of these hazard datasets. The points shown represent state owned facilities located within two of the three hazard layers: active fault buffers and the 500 year ShakeMap.

To prioritize the facilities for the earthquake hazard for the State Hazard Mitigation Plan, a select set of the highest scores will be selected. The highest score selected set is defined as any facility within an active fault buffer, and within the 500 year ShakeMap hazard (very strong to extreme perceived shaking categories), and within a high liquefaction potential category. The sum of the scoring values for this selected set of equals a value of 30. There are 29 facilities out of 5,802 that meet this criteria. The estimated replacement value and total property value are shown in the table below.

Earthquake Hazard Top Scoring Facility Statistics	
Facility Count	29
Replacement Value Total	$80,981,017
Property Value Total	$102,390,359

Legend

500 year ShakeMap - Perceived Shaking

- Very Strong
- Severe
- Violent
- Extreme

- State Owned Facility
- County Boundary
- Active Fault Buffer

Map Created by: Rachel Lyles, Department of Geology and Mineral Industries (DOGAMI)
Basemap Source: Microsoft Bing Maps Services
Other Data Sources: DOGAMI, USGS, and DAS
State owned facility data was provided by the State of Oregon, Department of Adminstrative Services (DAS) and geolocated by DOGAMI.

Projection: Oregon Statewide Lambert Conformal Conic
Datum: NAD83 HARN Unit: International Feet

Fire – Wildland Urban Interface (WUI) Hazard

Wildfires are a common and widespread natural hazard in Oregon. Fire is a critical component of the forest and rangeland ecosystems found in all portions of the state. Over 41 million acres of forest and rangeland in Oregon are susceptible to wildfire, which may occur during any month of the year, but usually occur between July and October. In addition to wildland-urban interface fires, Oregon experiences wildland fires that do not threaten structures, and also occasionally has prescribed fires. The principal type affecting Oregon communities is the interface fire, which occurs where wildland and developed areas intermingle with both vegetation and structures combining to provide fuel. As more people have moved into wildland interface areas, the number of large wildfires impacting homes has escalated dramatically. The areas of highest risk are in central, southwest, and northeast Oregon. Fuel, slope, weather, and development are key components in wildfire hazard identification. Fire risk may be measured by an overall risk hazard rating or a protection capability rating. Protection capability risk is defined by an area with inadequate wildfire protection capabilities, see hazard chapter in Section 3 for more information. Figure 2.4 and Figure 2.5 show known hazard information.

Figure 2-4: Fire (Wildland-Urban Interface Hazard) Overall Risk Hazard Rating

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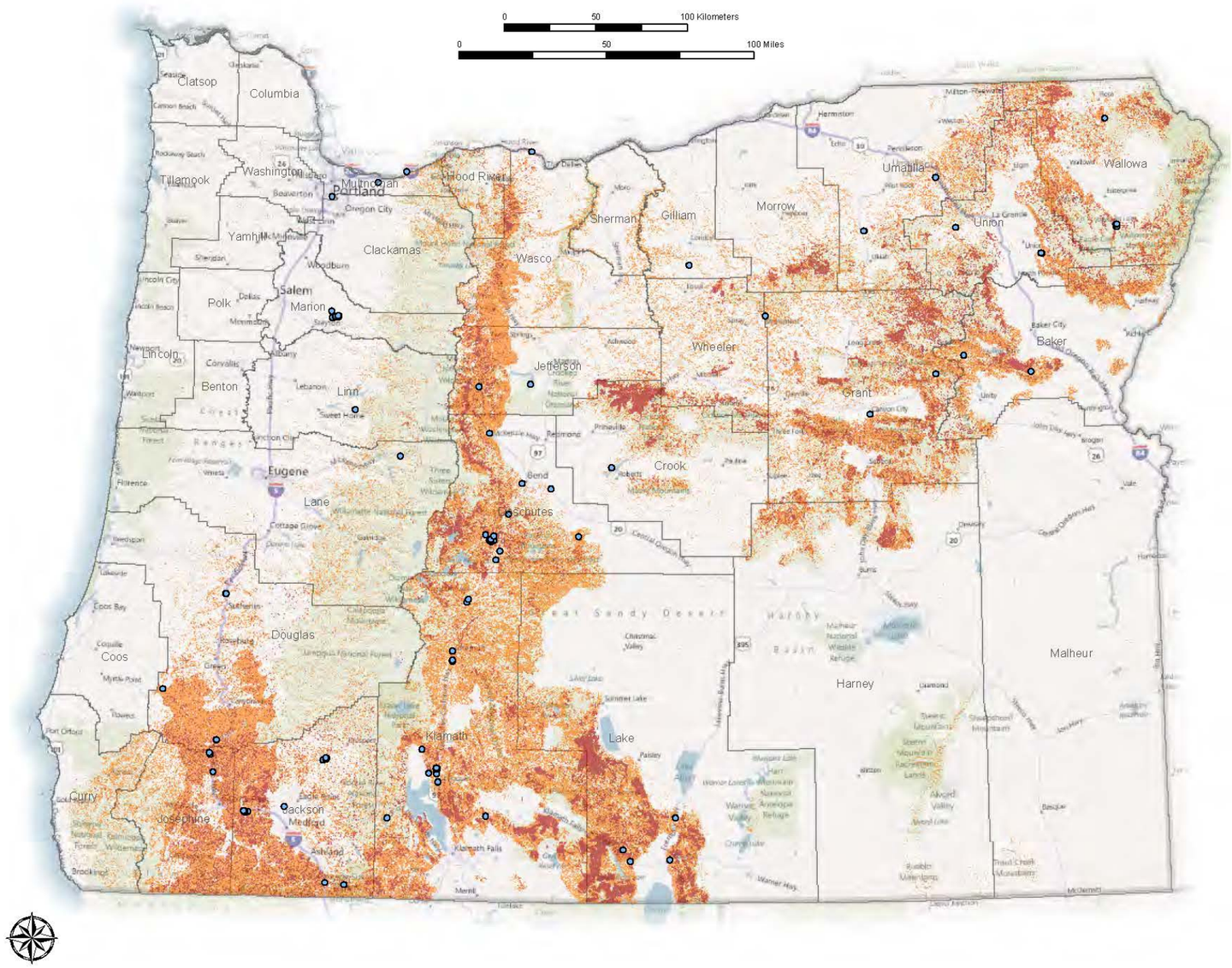

Summary Statistics

Fire Hazard Statistics (Within High/Very High Overall Risk Hazard Rating)	
Facility Count	203
Replacement Value Total	$32,748,211
Property Value Total	$37,067,469

Fire Hazard Within High/Very High Overall Risk Hazard Rating (by County)

County	# of Facilities	Total Property Value	County	# of Facilities	Total Property Value
Baker	3	$376,234	Lake	6	$232,018
Crook	1	$56,000	Lane	1	$69,540
Deschutes	43	$16,517,337	Linn	1	$15,000
Douglas	13	$1,105,104	Marion	14	$1,960,517
Gilliam	2	$30,000	Multnomah	3	$221,000
Grant	3	$392,365	Umatilla	4	$409,000
Jackson	37	$2,599,041	Union	5	$624,746
Jefferson	3	$1,014,834	Wallowa	14	$1,310,143
Josephine	4	$3,868,121	Wasco	1	$120,000
Klamath	45	$6,146,469			

For the purpose of this study, the fire hazard area is defined using two datasets from the Oregon Department of Forestry (ODF): an overall risk hazard rating and a protection capability rating. This map only shows the facilities within the high or very high risk areas of the overall risk hazard rating data layer. This risk hazard rating is an overall assessment based upon a calculated value from the the four Cummunities at Risk ratings: Risk, Hazard, Protection Capability, and Value. Please contact an ODF representative for more information on their datasets and fire related vulnerability studies.

Legend

State Owned Facility within a Moderate or High Fire Protection Capability Risk

County Boundary

Overall Risk Hazard Rating

Very High Risk Area

High Risk Area

Map Created by: Rachel Lyles, Department of Geology and Mineral Industries (DOGAMI)
Basemap Source: Microsoft Bing Maps Services
Other Data Sources: Oregon Department of Forestry
State owned facility data was provided by the State of Oregon, Department of Adminstrative Services (DAS) and geolocated by DOGAMI.

Projection: Oregon Statewide Lambert Conformal Conic
Datum: NAD83 HARN Unit: International Feet

Figure 2-5 Fire (Wildland-Urban Interface Hazard) Protection Capability Risk

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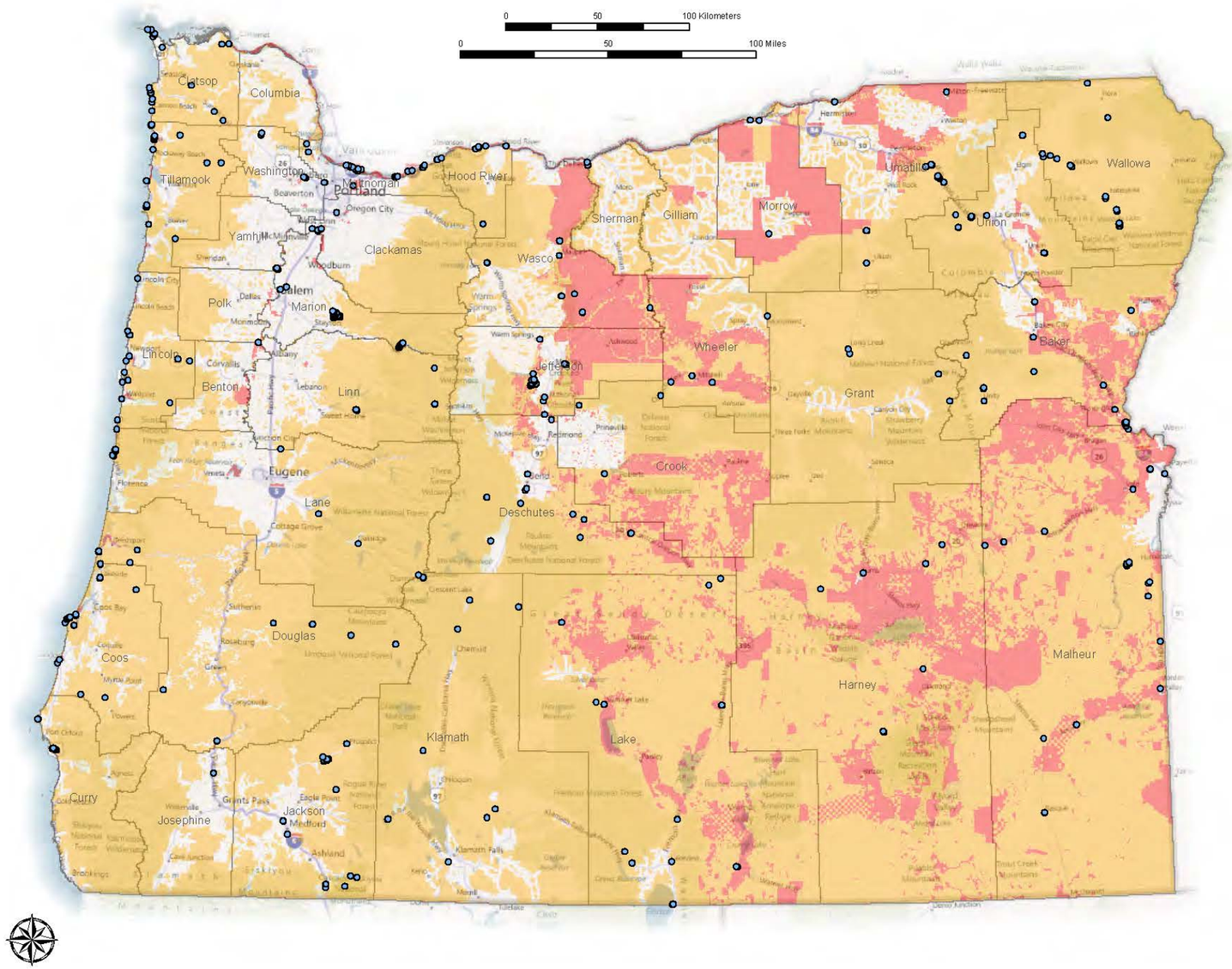


Summary Statistics

Fire Hazard Statistics (Within Moderate/High Protection Capability Risk)	
Facility Count	1,380
Replacement Value Total	$411,756,432
Property Value Total	$465,729,714

Fire Hazard Within Moderate/High Protection Capability Risk (by County)

County	# of Facilities	Total Property Value	County	# of Facilities	Total Property Value
Baker	60	$4,742,080	Lane	25	$32,548,593
Benton	4	$225,000	Lincoln	24	$8,147,501
Clackamas	31	$3,595,241	Linn	42	$13,973,704
Clatsop	46	$18,238,108	Malheur	65	$27,442,382
Coos	109	$42,410,636	Marion	202	$32,491,900
Crook	3	$189,110	Morrow	8	$771,317
Curry	18	$867,047	Multnomah	72	$27,825,051
Deschutes	42	$6,012,306	Sherman	2	$30,000
Douglas	48	$3,964,128	Tillamook	107	$21,062,156
Grant	18	$2,685,051	Umatilla	71	$6,375,879
Harney	20	$1,697,729	Union	22	$11,980,297
Hood River	20	$2,292,262	Wallowa	49	$11,077,221
Jackson	52	$7,735,742	Wasco	23	$2,762,524
Jefferson	103	$158,723,778	Washington	7	$1,740,433
Josephine	1	$103,131	Wheeler	6	$785,229
Klamath	31	$8,792,443	Yamhill	1	$646,979
Lake	48	$3,794,758			

For the purpose of this study, the fire hazard area is defined using two datasets from the Oregon Department of Forestry (ODF): an overall risk hazard rating and a protection capability rating. This map only shows the facilities within the moderate or high risk areas of the protection capability risk data layer. This risk is defined as an area with inadequate wildfire protection capabilities. Please contact an ODF representative for more information on their datasets and fire related vulnerability studies.

Legend

State Owned Facility within a Moderate or High Fire Protection Capability Risk

County Boundary

Fire Protection Capability Risk

High Risk Area

Moderate Risk Area

Map Created by: Rachel Lyles, Department of Geology and Mineral Industries (DOGAMI)
Basemap Source: Microsoft Bing Maps Services
Other Data Sources: Oregon Department of Forestry
State owned facility data was provided by the State of Oregon, Department of Adminstrative Services (DAS) and geolocated by DOGAMI.

Projection: Oregon Statewide Lambert Conformal Conic
Datum: NAD83 HARN Unit: International Feet

Flood Hazard

Floods are a chronic and widespread natural hazard in Oregon. The National Flood Insurance Program (NFIP) reports that 251 communities in Oregon are prone to flooding, including all 36 counties. Oregon floods generally occur from October through April, when large-scale weather systems from the Pacific Ocean generate prolonged rainfall or 'rain on snow' events that result in large amounts of snowmelt and runoff. Riverine flooding occurs when the excess precipitation and runoff exceed the capacity of rivers or stream channels. Some coastal flooding may be caused by storm surges associated with tropical storms and hurricanes.

Other sources of flooding include flash floods (resulting from locally intense thunderstorms, ice jams and dam failures), shallow area and urban flooding, and playa flooding. Flooding can also be aggravated when streams are altered by human activity, such as through channelization of streams or loss of wetlands. Flood hazards can cause severe property damage and loss of life. Oregon's largest economic loss from natural disasters has resulted from flooding. Figure 2.6 shows known hazard information.

Severe Repetitive Loss

Repetitive loss properties have been deemed as high priority by the NFIP. Repetitive loss properties (RL) are those which have experienced multiple flood insurance claims. Severe repetitive loss (SRL) properties are defined as residential properties that are covered under an NFIP flood insurance policy, and:

a) That has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000, or
b) For which at least two claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

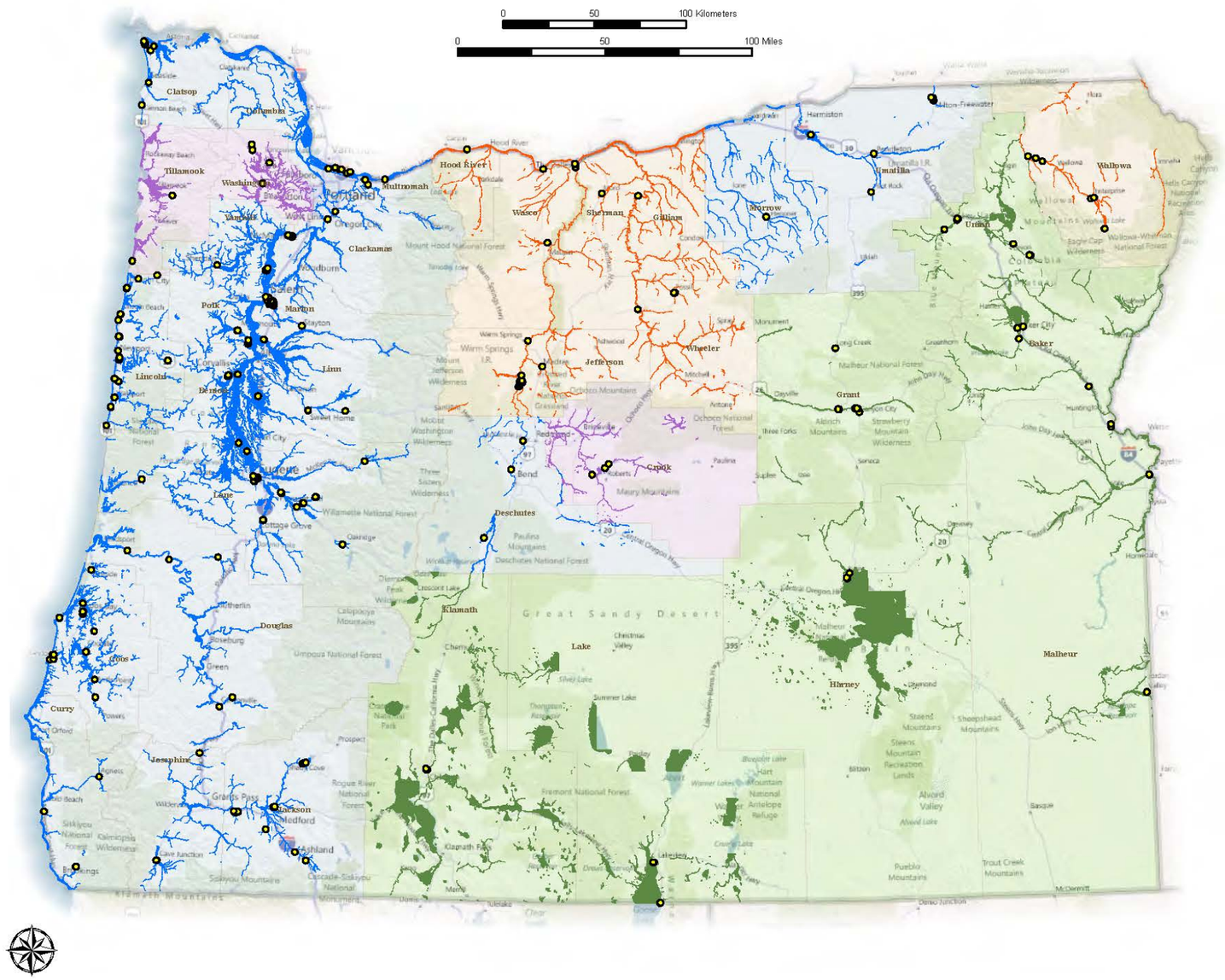
For both (a) and (b) above, at least two of the referenced claims must have occurred within any ten-year period, and must be greater than 10 days apart.

In Oregon, RL/SRL properties represent about 1% of all insured properties, and account for about 14% of all claims paid (19% of the dollar amount paid). Most (80%) of Oregon's repetitive loss properties pre-date the FIRMs. These properties are referred to as "pre-FIRM"; they were built in floodplains before FEMA FIRMs became available. Because of this, the property owners do not pay the true, actuarial cost of flood insurance. The RL lists provided by FEMA can have value for hazard mitigation planning because their locations may be indicative of persistent flood or drainage problems that may or may not be reflected on a FIRM. See Table 2.6 below for a listing of the counties with SRL properties

Figure 2-6: Flood Hazard

State Hazard Mitigation Plan

August 2011



Summary Statistics

Flood Hazard Statistics	
Facility Count	622
Replacement Value Total	$378,447,890
Property Value Total	$507,131,473

Flood Hazard by County

County	# of Facilities	Total Property Value	County	# of Facilities	Total Property Value
Baker	8	$1,075,388	Lane	73	$190,709,258
Benton	23	$15,745,510	Lincoln	51	$7,316,558
Clackamas	3	$170,402	Linn	18	$9,883,656
Clatsop	49	$4,615,499	Malheur	9	$3,826,856
Coos	36	$10,198,162	Marion	128	$232,022,354
Crook	3	$215,500	Morrow	1	$127,895
Curry	5	$540,480	Multnomah	12	$157,839
Deschutes	3	$76,411	Polk	9	$571,544
Douglas	7	$1,710,371	Sherman	10	$236,540
Gilliam	1	$30,000	Tillamook	2	$888,667
Grant	10	$1,479,061	Umatilla	16	$3,436,335
Harney	9	$4,461,065	Union	14	$1,056,025
Hood River	1	$30,000	Wallowa	7	$2,714,921
Jackson	39	$2,202,130	Wasco	3	$1,667,912
Jefferson	25	$2,421,472	Washington	11	$239,600
Josephine	8	$4,056,631	Wheeler	4	$117,186
Klamath	14	$825,000	Yamhill	1	$22,275
Lake	9	$2,282,973	**Total**	**622**	**$507,131,473**

The points shown represent state owned facilities within the flood hazard area. This hazard area is characterized by 100 yr floodplain data depicted using multiple qualities (ie. data accuracy, status, source). This data layer is a compilation of the most accurate flood data available for the State.

The point locations and property values reflect data provided by the Oregon Department of Administrative Services (DAS) in 2010. The points were located based on addresss data and research performed by the Oregon Department of Geology and Mineral Industries (DOGAMI).

Legend

- State Owned Facility within Flood Hazard Area
- Effective FEMA 100 yr Floodplain
- Preliminary FEMA 100 yr Floodplain
- Q3 Flood Data
- State Digitized Flood Data

Map Created by: Rachel Lyles, Department of Geology and Mineral Industries (DOGAMI)
Basemap Source: Microsoft Bing Maps Services
Other Data Sources: Oregon Spatial Data Library and DOGAMI
State owned facility data was provided by the State of Oregon, Department of Adminstrative Services (DAS) and geolocated by DOGAMI.

Projection: Oregon Statewide Lambert Conformal Conic
Datum: NAD83 HARN Unit: International Feet

Landslide & Debris Flows Hazard

Landslides are relatively common, naturally occurring events in parts of Oregon. Landslides include any detached mass of soil, rock, or debris that move down a slope or stream channel. Landslides are typically triggered by periods of heavy rainfall and/or rapid snowmelt, as well as earthquakes, volcanoes, and human activities (excavation, deforestation). Certain geologic formations are more susceptible to landslides than others. In general, locations with very steep slopes are most susceptible to landslides, and the landslides occurring on steep slopes tend to move more rapidly and are therefore more dangerous than other landslides.

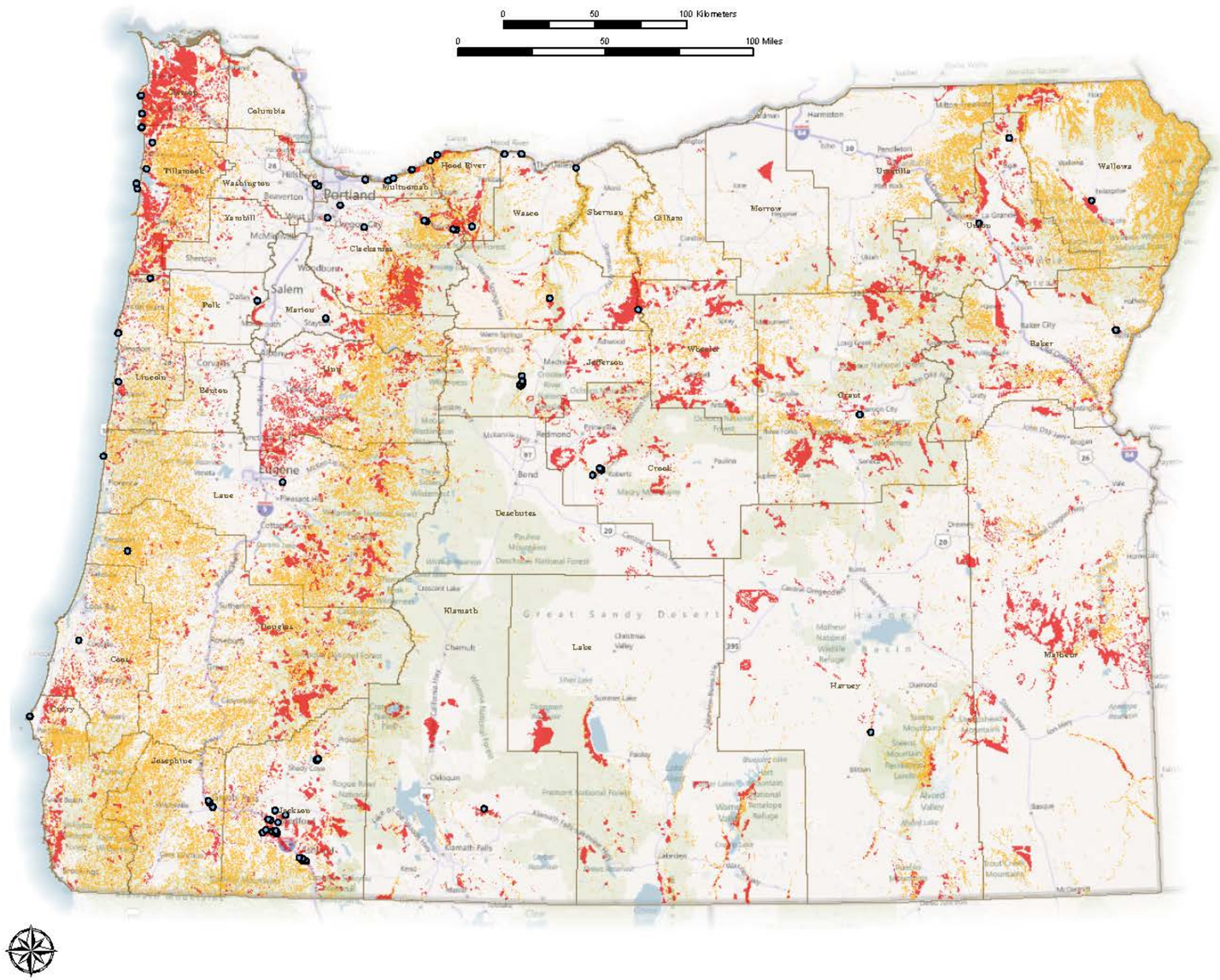
The size of landslides is typically a function of geology and the landslide triggering mechanism. Rainfall initiated landslides tend to be smaller; earthquake induced landslides may be very large; and landslides associated with volcanic eruptions can include volumes approaching one cubic mile of material. Debris flows are a specific type of landslide that is characterized by a high volume of water (semi-fluid mass), typical channelized flow, and rapid velocities (rapidly moving landslides). Landslides and debris flows of any size can pose a serious threat to personal safety, transportation corridors, fuel and energy conduits, and community facilities.

Although landslides occur frequently in Oregon, most landslides occur in very sparsely populated areas within or near the Coast and Cascade Mountains. On occasion, major landslides occur on US Highway 101 or on I-84 that sever these major transportation routes causing temporary but significant economic damage to these regions of the state. Although less frequent, landslides and debris flows do occur that result in the death of people located in their paths. Figure 2.7 shows known hazard information.

Figure 2-7: Landslide Hazard

State Hazard Mitigation Plan

August 2011



Summary Statistics

Landslide Hazard Statistics	
Facility Count	255
Property Value Total	$200,737,058

Landslide Hazard by County		
County	**# of Facilities**	**Total Property Value**
Baker	6	$1,511,340
Clackamas	11	$1,691,309
Clatsop	6	$430,000
Coos	1	$32,592
Crook	20	$1,372,728
Curry	5	$1,150,097
Douglas	1	$30,000
Grant	1	$17,829
Harney	2	$693,602
Hood River	5	$3,116,399
Jackson	97	$162,971,529
Jefferson	37	$3,810,218
Josephine	8	$2,356,067
Klamath	1	$15,000
Lane	2	$28,000
Lincoln	6	$1,635,545
Marion	5	$595,972
Multnomah	15	$6,767,815
Polk	2	$135,000
Sherman	1	$15,000
Tillamook	8	$3,488,423
Union	4	$6,488,712
Wallowa	3	$2,019,881
Wasco	7	$334,000
Wheeler	1	$30,000
Total	**255**	**$200,737,058**

The points shown represent state owned facilities within the landslide hazard area. This hazard area is characterized by historic landslide locations, landslide deposits, and steep slopes.

The point locations and property values reflect data provided by the Oregon Department of Administrative Services (DAS) in 2010. The points were located based on addresss data and research performed by the Oregon Department of Geology and Mineral Industries (DOGAMI).

Legend

- State Owned Facility within Landslide Hazard Area
- County Boundary
- Historic Landslide
- Landslide Deposit
- Steep Slope

Map Created by: Rachel Lyles, Department of Geology and Mineral Industries (DOGAMI)
Basemap Source: Microsoft Bing Maps Services
Other Data Sources: Oregon Spatial Data Library and DOGAMI
State owned facility data was provided by the State of Oregon, Department of Adminstrative Services (DAS) and geolocated by DOGAMI.

Projection: Oregon Statewide Lambert Conformal Conic
Datum: NAD83 HARN Unit: International Feet

Tsunamis Hazard

A tsunami is a series of waves caused by earthquakes under the ocean, volcanic events, or landslides into or under the ocean. Tsunamis are low frequency natural hazards, but can be very destructive, capable of traveling great distances from their source. Tsunamis pose a real threat to Oregon coastal communities from Cascadia Subduction Zone earthquakes and also from distant earthquakes near Alaska or Asia. The time of arrival of tsunami waves depends on a location's distance from the source event. For example, if a major earthquake occurs along the Cascadia Subduction Zone, a tsunami could follow within 5 to 30 minutes. Waves generated by distant sources may arrive hours after the earthquake has occurred.

Damage from a tsunami comes not only from the tsunami wave itself. The rapid retreat of water prior to arrival of the tsunami wave and the debris carried by the tsunami wave add to the destructive potential. In addition, fires started by the preceding earthquake are often spread by the tsunami waves. As was seen in the Sumatra 2004 and Japan 2011 tsunamis, flood inundation from a tsunami may be extensive, as tsunamis can travel up rivers and streams that lead to the ocean. Delineating the inland extent of flooding is an important aspect of preparing for tsunamis.

In Oregon, tsunamis occur only in the seven western counties that abut the Pacific Ocean. Given the high risk for a Cascadia Subduction zone earthquake the risk for tsunami is extremely high. Figures 2.8 and 2.9 show known hazard location data.

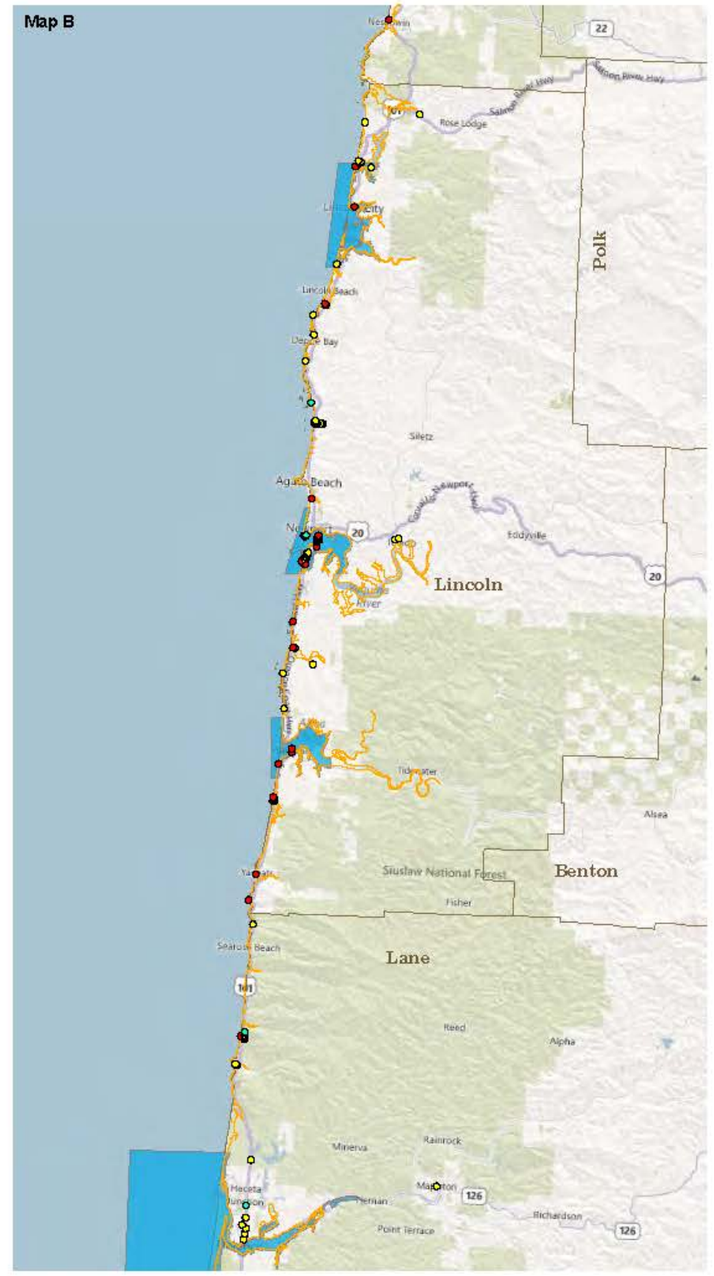


Figure 2-8: Tsunami Hazard

Map 1 of 2

State Hazard Mitigation Plan

August 2011

The points shown represent state owned facilities within the tsunami hazard zone. This hazard zone was compiled from multiple DOGAMI data sources. Please see the accompanying text for a detailed description of the methodology used to define the tsunami hazard zone for the entire coastline of Oregon.

The point locations and property values reflect data provided by the Oregon Department of Administrative Services (DAS) in 2010. The points were located based on addresss data and research performed by the Oregon Department of Geology and Mineral Industries (DOGAMI) staff.

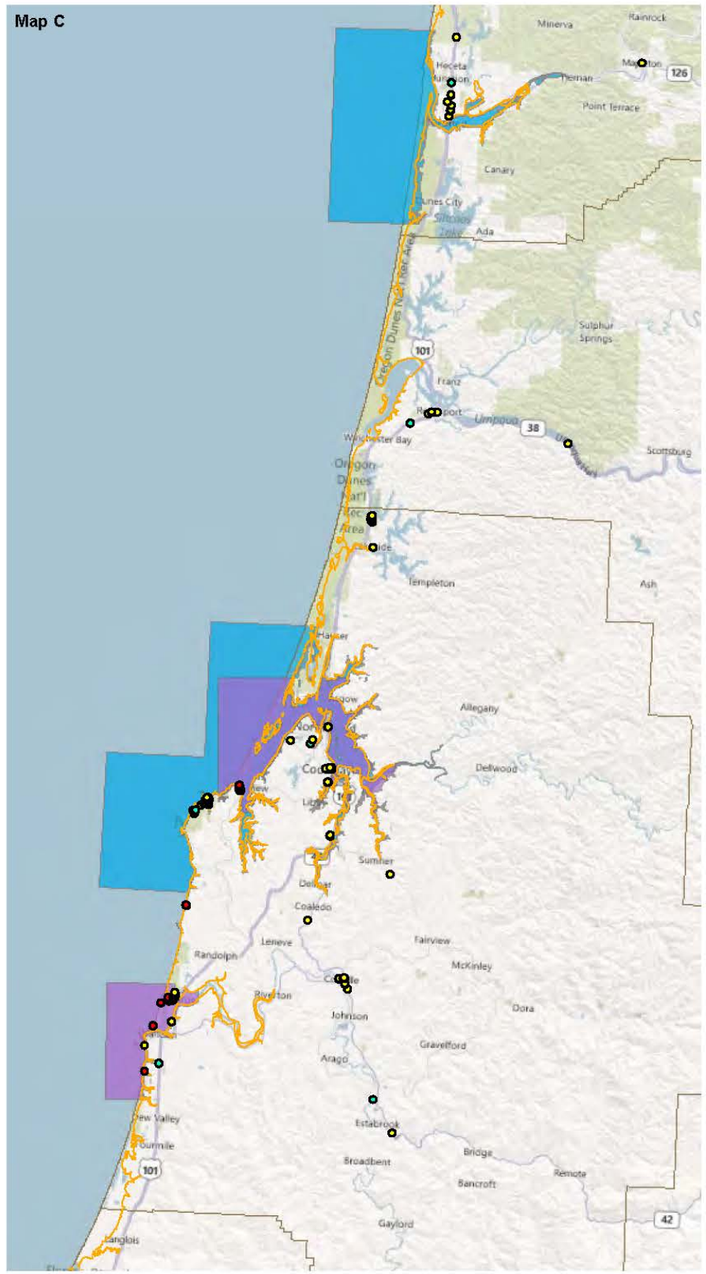
Legend

State Owned Facility within Tsunami Hazard Area

- Facility located between 80 ft. and 100 ft. (elevation) north of Cape Blanco, or between 95 ft. and 120 ft. (elevation) south of Cape Blanco
- Facility located landward of SB 379 line, but below 80 ft. (elevation) north of Cape Blanco, or below 95 ft. (elevation) south of Cape Blanco
- Facility located seaward of SB 379 line or within a DOGAMI Special Study Inundation Area
- County Boundary
- OR 455.446 Inundation Line (SB 379)
- DOGAMI Special Paper 41 Inundation Line
- DOGAMI Tsunami Study (Cannon Beach)
- DOGAMI Tsunami Study (Bandon)
- DOGAMI IMS Studies Inundation Areas

Map Created by: Rachel Byles, Department of Geology and Mineral Industries (DOGAMI)
Basemap Source: Microsoft Bing Maps Services
Other Data Sources: Oregon Spatial Data Library and DOGAMI
State owned facility data was provided by the State of Oregon, Department of Administrative Services (DAS) and geolocated by DOGAMI.

Projection: Oregon Statewide Lambert Conformal Conic
Datum: NAD83 HARN Unit: International Feet



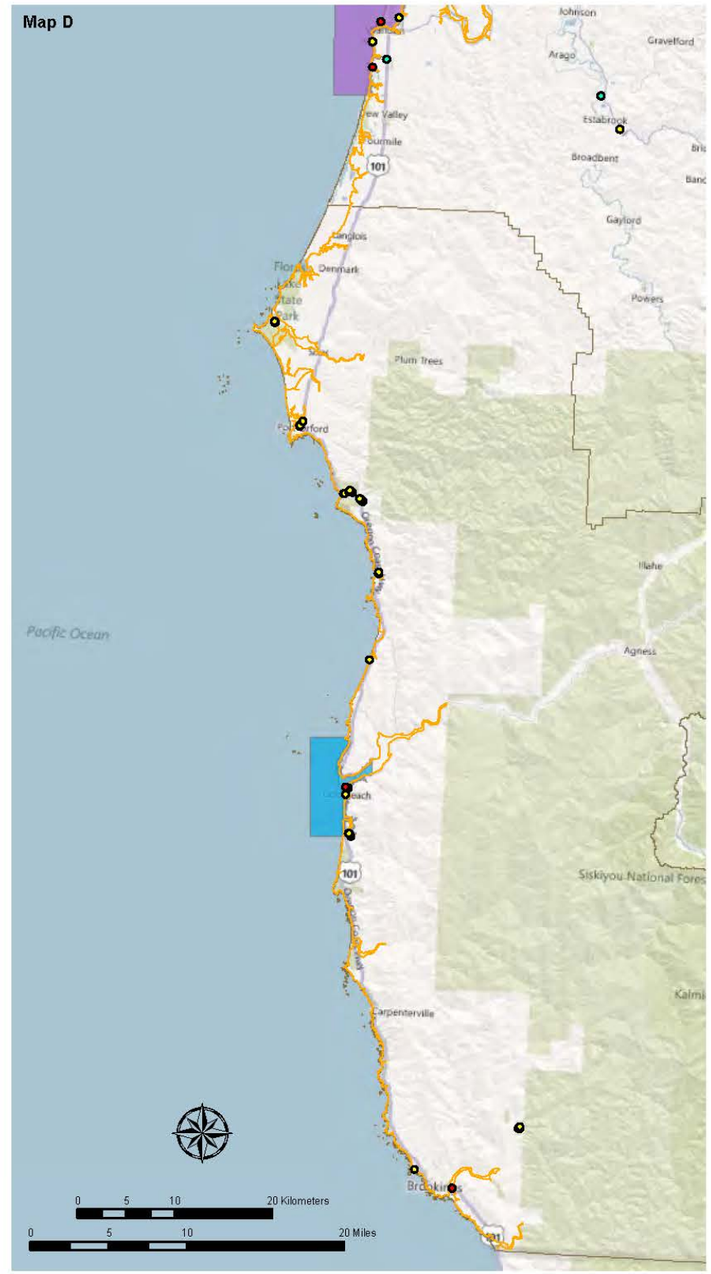
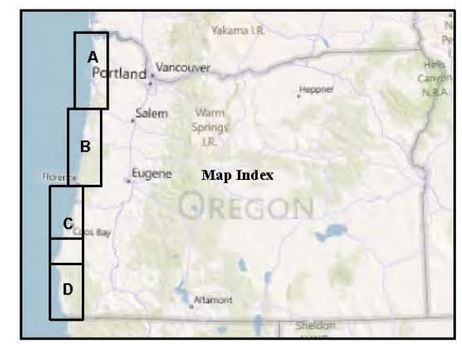


Figure 2-9: Tsunami Hazard cont.

Map 2 of 2

Tsunami Hazard Statistics	
Facility Count	690
Replacement Value Total	$187,880,541
Property Value Total	$234,292,773

Tsunami Hazard by County		
County	**# of Facilities**	**Total Property Value**
Clatsop	137	$94,970,857
Tillamook	111	$40,585,468
Lincoln	162	$43,085,126
Lane	30	$3,782,926
Douglas	9	$1,397,648
Coos	185	$41,838,868
Curry	56	$8,631,881
Total	**690**	**$234,292,773**



Legend

State Owned Facility within Tsunami Hazard Area

- Facility located between 80 ft. and 100 ft. (elevation) north of Cape Blanco, or between 95 ft. and 120 ft. (elevation) south of Cape Blanco
- Facility located landward of SB 379 line, but below 80 ft. (elevation) north of Cape Blanco, or below 95 ft. (elevation) south of Cape Blanco
- Facility located seaward of SB 379 line or within a DOGAMI Special Study Inundation Area
- County Boundary
- OR 455.446 Inundation Line (SB 379)
- DOGAMI Special Paper 41 Inundation Line
- DOGAMI Tsunami Study (Cannon Beach)
- DOGAMI Tsunami Study (Bandon)
- DOGAMI IMS Studies Inundation Areas

Map Created by: Rachel Lyles, Department of Geology and Mineral Industries (DOGAMI)
Basemap Source: Microsoft Bing Maps Services
Other Data Sources: Oregon Spatial Data Library and DOGAMI
State owned facility data was provided by the State of Oregon, Department of Adminstrative Services (DAS) and geolocated by DOGAMI.

Projection: Oregon Statewide Lambert Conformal Conic
Datum: NAD83 HARN Unit: International Feet

Volcano

Volcanoes in the Cascade Range are a result of the complex interaction of tectonic plates along the Cascadia Subduction Zone. As the Juan de Fuca plate subducts beneath the North American plate, it heats up and begins to melt. This provides the heat and molten rock needed to create the magma chambers that lie kilometers deep underneath the Cascades.

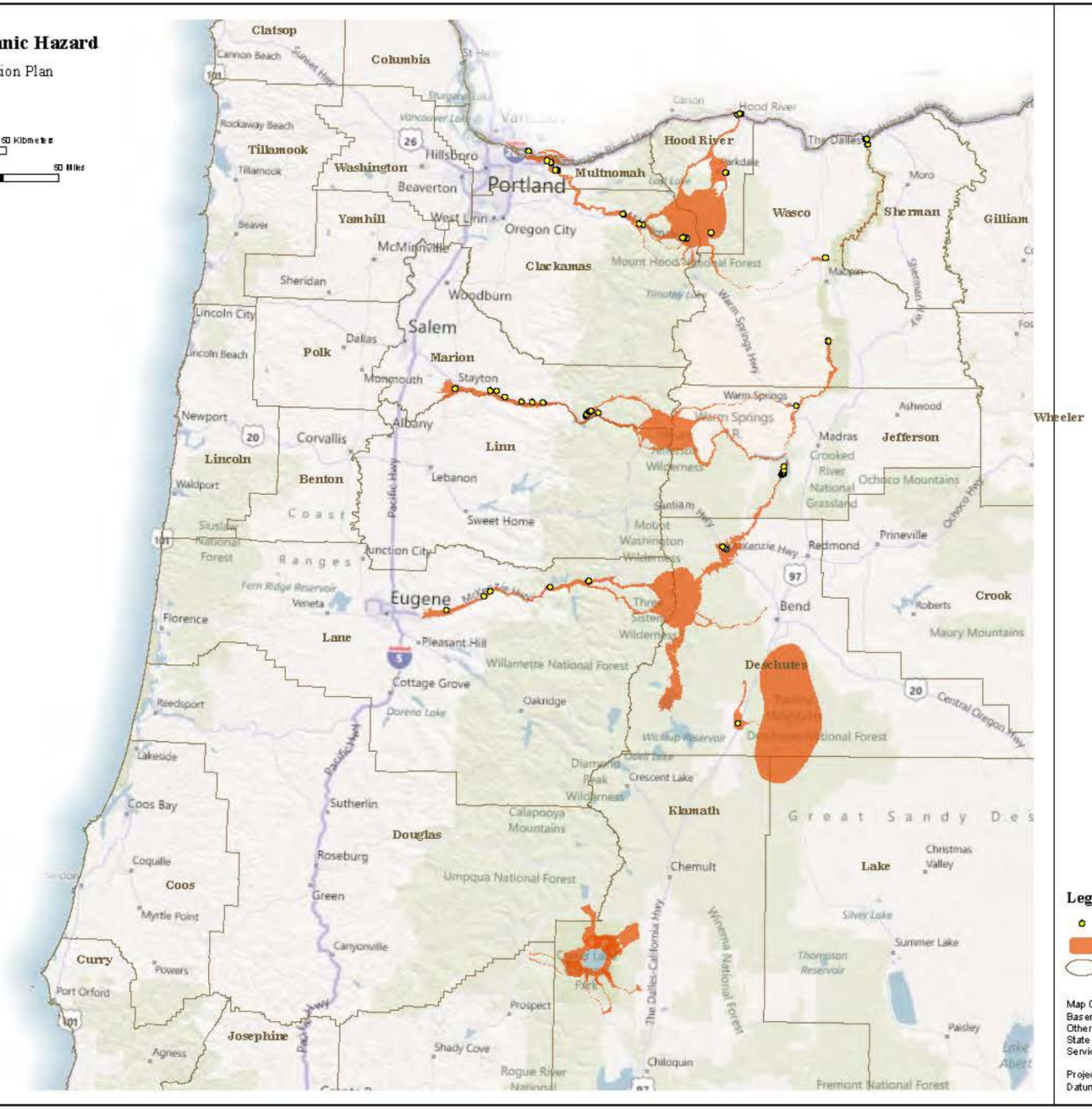
Cascade Range volcanoes are stratovolcanoes, built layer by layer (called strata by geologists) by a combination of lava flows, pyroclastic flows, and volcanic ash. Eruptions often build more height, as lava is extruded to the surface and ash falls on its flanks. Intermittent slope failures in the form of debris avalanches also sculpt the distinctive cone shape. Eruptions from stratovolcanoes can be very explosive, although the explosions are usually aimed upwards. Sometimes, as in the case of Mount St. Helens in May 1980, they erupt laterally so that part of the volcano is blown outwards. This is not the typical eruption for the Cascade Range.

Hazards occurring during and after a volcanic eruption include ashfall, lava flows, pyroclastic flows and surges, lahars, debris flow, and landslides. Volcanic eruptions result in a unique combination of hazards; not all of them are present in all eruptions, and the degree of damage can vary. It is important to know that during an active period for a volcano, many individual eruptions may occur and each eruption may vary in intensity and length. In Oregon, volcanic activity occurs within the counties that include portions of the Cascade Range. Figure 2.10 shows known hazard location data.

Figure 2-10: Volcanic Hazard

State Hazard Mitigation Plan

August 2011



Summary Statistics

Volcanic Hazard Statistics	
Facility Count	125
Replacement Value Total	$18,003,396
Property Value Total	$24,691,033

Volcanic Hazard by County		
County	**# of Facilities**	**Total Property Value**
Clackamas	17	$5,533,233
Deschutes	4	$1,728,621
Hood River	12	$3,187,163
Jefferson	13	$1,094,336
Lane	10	$4,622,800
Marion	33	$6,999,844
Multnomah	16	$725,400
Sherman	12	$319,836
Wasco	8	$479,800
Total	**125**	**$24,691,033**

The volcanic hazard in Oregon is primarily from six volcanos or regions comprised of: Mount Jefferson, Mount Hood, the Crater Lake region, the greater Newberry region, and the Three Sisters region. The points shown represent those that lie within the volcanic hazard area.

The point locations and property values reflect data provided by the Oregon Department of Administrative Services (DAS) in 2010. The points were located based on addresss data and research performed by the Oregon Department of Geology and Mineral Industries (DOGAMI) staff.

Legend

- State Owned Facility within Volcanic Hazard Area
- Volcanic Hazard Area
- County Boundary

Map Created by: Rachel Lyles, Department of Geology and Mineral Industries (DOGAMI)
Basemap Source: Microsoft Bing Maps Services
Other Data Sources: Oregon Spatial Data Library and DOGAMI
State owned facility data was provided by the State of Oregon, Department of Adminstrative Services (DAS) and geolocated by DOGAMI.

Projection: Oregon Statewide Lambert Conformal Conic
Datum: NAD83 HARN Unit: International Feet

Windstorms

High winds occur frequently in Oregon, and they are especially common in coastal regions and in the mountains of the Coast Range between October and March. From unofficial but reliable observations, it is reasonable to assume that gusts well above 100 mph occur several times each year across the higher ridges of the Coast and Cascades Ranges. At the most exposed Coast Range ridges, it is estimated that wind gusts of up to 150 mph and sustained speeds of 110 mph will occur every five to ten years. The Willamette Valley may face 40 to 60 mile per hour winds from a 100 mph+ storm on the coast. Also, the Columbia River Gorge funnels very strong winds, often from east to west.

The damaging effects of windstorms may extend for distances of 100 to 300 miles from the center of storm activity. Isolated wind phenomena in the mountainous regions have more localized effects. Near-surface winds and associated pressure effects exert loads on walls, doors, windows, and roofs, sometimes causing considerable damage. When severe windstorms strike a community, downed trees, power lines, and damaged property are major hindrances to response and recovery.

Winter Storms

Winter storms occur annually in Oregon, bringing snow to Oregon's mountains and much of Eastern Oregon. Every four years, on average, winter storms bring extreme cold temperatures, heavy snowfall, sleet, freezing rain, and high winds to Oregon's western valley floors. Because these storms are infrequent and tend to last only a few days, residents in Western Oregon are often unprepared for such events.

A major winter storm can last for days and can include high winds, freezing rain or sleet, heavy snowfall, and cold temperatures. People can become marooned at home without utilities or other services. Severe cold can damage crops and other vegetation and freeze pipes, causing them to burst. Unusually cold temperatures are especially dangerous in areas not accustomed to them because residents are generally unprepared and may not realize the dangers severe cold presents. Heavy snowfall and blizzards can trap motorists in their vehicles and make walking to find help a deadly mistake. Heavy snow can immobilize a region and paralyze a city, stranding commuters, closing airports, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can cause roofs to collapse and knock down trees and power lines. Homes and farms may be isolated for days. In rural areas, unprotected livestock can be lost. In urban areas, the cost of snow removal, damage repair, and lost business can have severe economic impacts.

State Vulnerabilities

Requirement: 44 CFR §201.4(c)(2)(ii): Th[e] risk assessment shall include… (ii) (a)n overview and analysis of the State's vulnerability to the hazards described . . . based on estimates provided in local risk assessments as well as the State risk assessment. The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events. State owned or operated critical facilities located in the identified hazard areas shall also be addressed.

Oregon Emergency Management periodically collects perceived hazard vulnerability information from each of the 36 counties in the state. The information in generated at the local level to meet the State's Emergency Management Grant Program (EMPG) requirements or to inform local county NHMPs. To assess vulnerability, each community follows an OEM refined FEMA assessment methodology. Table 2.3 presents locally perceived vulnerability for each of Oregon's 11 primary hazards by county.

Table 2.3: Local Perceived Hazard Vulnerability

County	Coastal Erosion	Drought	Dust Storm	Earthquake	Wildfire	Flood	Landslide/ Debris Flow	Tsunami	Volcano	Wind Storm	Winter Storm	Local NHMP Sourced
Baker		High		Low	Medium	High				[Moderate]	High	Northeast Oregon Multi-Jurisdictional NHMP (2007)
Benton		Low		High	Moderate	Moderate	Low		Low	Moderate	Moderate	
Clackamas		Low		High	Moderate	Moderate	Low		High	Low	Moderate	
Clatsop	High	Moderate		High	High	High	High	High	Moderate	Moderate	High	
Columbia		Low		High	Moderate	High			Moderate	High	High	
Coos	[Moderate]	Moderate		High	Moderate	High	Low	High		High		Coos County NHMP (2010)
Crook				Low	Moderate	High	Low		High	Moderate	High	
Curry	[High]	[High]		High	High	High	Low	High	High	High		Curry County NHMP (2010)
Deschutes				High	High	Moderate	Low		High		High	
Douglas*				High	High	Moderate-High	Moderate	Moderate		Moderate	Moderate	
Gilliam		Moderate		Low	Moderate	Low	[Low]			[Low]	High	Gilliam County NHMP (2007)
Grant		High		Moderate	High	High	Moderate		Low	[High]	High	Northeast Oregon Multi-Jurisdictional NHMP (2007)
Harney		Moderate		[High]	Moderate	Moderate	Low		[Moderate]		Moderate	Harney County NHMP (2007)
Hood River		High		Moderate	Moderate	Moderate	Moderate		Low	High	High	
Jackson		Moderate		High	Low	Low	Low		Low		High	
Jefferson		High		Low	High	Moderate	Moderate		Moderate	[Moderate]	High	Jefferson County NHMP (2008)
Josephine				High	Moderate	Moderate				High	High	
Klamath		High		High	Moderate	Moderate			Low		High	
Lake		Moderate		High	Moderate	Moderate	[Low]		[Low]	[Moderate]	High	Lake County NHMP (2007)
Lane*		Moderate		Moderate-High	Moderate-High	High	Low-Moderate	High	Moderate	Moderate-High	Low-High	
Lincoln	[Moderate]	Moderate	Low	Moderate	Moderate	Low	[High]	Moderate	Low	High		Lincoln County Multi-Jurisdictional NHMP (2009)
Linn				High	Moderate	High	[Low]		High	Moderate	High	Linn County NHMP (2005)
Malheur		High		Low	Moderate	Low	Low		Low	Low	High	
Marion				High	Moderate	Moderate			Moderate	High	High	
Morrow		[Moderate]	Moderate	High	Moderate	High	Moderate			Moderate	[High]	Morrow County Pre-Disaster Mitigation Plan (2006)
Multnomah				High	Moderate	High	Moderate		High	High	High	
Polk				High	Moderate	High			Moderate	High		
Sherman		Moderate		Low	Moderate	Moderate	Moderate		Low	[Moderate]	Moderate	Sherman County Multi-Jurisdictional NHMP (2008)
Tillamook		Low	Low	High	High	High	High	High	Moderate	High	High	
Umatilla				Moderate	Moderate	Moderate				High	High	
Union		Low	Moderate	Moderate	Moderate	High	Low			Moderate	High	
Wallowa		High		Moderate	High	High	Moderate		Low	High	High	
Wasco		High		Moderate	Moderate	Low	Moderate		Low	High	High	
Washington		Moderate		Moderate	Moderate	Moderate	Low		High	High	High	
Wheeler		[High]		Moderate	High	Moderate	[High]		[High]	[Moderate]	High	Wheeler County Multi-Jurisdictional NHMP (2007)
Yamhill		High		Moderate	Moderate	High				Moderate	Moderate	

Figure 1: Oregon Statewide Hazard Analysis Summary (2008) Except where noted by brackets.

[], Vulnerability Index from Local Plan - Index not available in the Oregon Statewide Hazard Analysis Summary. Plan appears in far right column as applicable

* The Oregon Statewide Hazard Analysis Summary broke down Douglas County and Lane County in Central and Coastal combined for this analysis.

The following subsections summarize relevant vulnerability information for each hazard. Where state agencies have provided additional analysis of jurisdictional vulnerabilty, that information is provided.

Coastal Erosion Vulnerability

Chronic hazards are clearly evident along Oregon's shores, including beach, dune, and bluff erosion, landslides, slumps, gradual weathering of sea cliffs, and flooding of low-lying coastal lands during major storms. The damage caused by chronic hazards is usually gradual and cumulative. The regional, oceanic, and climatic environments that result in intense winter storms determine the severity of chronic hazards along the coast. This hazard threatens property in its path and, in extreme events, can threaten human life as well

The Department of Geology and Mineral Industries is the agency with primary oversight of the Coastal Erosion hazard. Based on agency staff review of the available hazard data,[1] DOGAMI ranks Tillamook, Lincoln, Clatsop and Curry Counties one through four respectively as the counties most vulnerable to coastal erosion in the state. Table 2.4 shows that there are 10 state owned buildings located within the active or high hazard coastal erosion zone, one of which is listed as a critical facility.

Table 2.4: State Facilities Located in the Active or High Coastal Erosion Hazard Zone

Agency	Building Name	Critical or Essential	Building Replacement	Total Property Value
ODOT	Cape Perpetua Radio	Y	$40,420	$60,630
OPRD	Lower Restroom Ecola Point Parking Lot on trail to beach in DU 17	N	$120,000	$120,000
OPRD	Upper Restroom Ecola Point Parking Lot near Parking Lot DU 14	N	$120,000	$120,000
OPRD	Picnic Shelter Ecola	N	$25,000	$25,000
OPRD	Depoe Bay Whale Watching Center	N	$1,666,000	$1,698,748
OPRD	Restroom Day Use	N	$120,000	$120,000
OPRD	Restroom 1ST StreetC Street	N	$120,000	$120,000
OPRD	Restroom Peter Iredale	N	$240,000	$240,000
OPRD	Vault ToiletDU Area	N	$30,000	$30,000
OPRD	Lighthouse Historic	N	$2,708,712	$2,708,712
		Total Value	**$5,190,132**	**$5,243,090**

Source: DOGAMI State Owned Building Study, DAS 2010

[1] Coastal erosion data is not currently available for Lane, Douglas, Coos and portions of Curry counties.

Drought Vulnerability

When a drought occurs, it may affect all regions of the state. However, most of Oregon's urban areas usually fare much better during a drought than rural, less populated regions of the state. By encouraging or invoking water conservation measures during a drought, urban areas can reduce their demand for water.

This is not the case in rural areas. These areas are much more dependent on water for irrigation to maintain and increase agricultural production. Several regions of the state, devoted to agricultural production, have been affected by droughts in the past. Generally, the regions outside the Willamette Valley and the coast feel the greatest impact from a drought. Based upon local hazard analyses, the following counties indicated the greatest vulnerability to droughts: Baker, Gilliam, Harney, Jefferson, Klamath, Malheur, Sherman, Union, Wallowa, Wasco and Wheeler.

The Water Resources Department (WRD) is the agency with primary oversight of the Drought hazard. Based on agency staff review of the available hazard data, WRD ranks the Oregon Cranberry Growers Alliance (South Coast counties), Lake County Water-Users (Lake County), Klamath Water Users (Klamath Basin), Eagle Point Irrigation District (Rogue Basin) and Malheur Drainage Irrigation District (Malheur County) as the most vulnerable to drought in the state.

Dust Storm

The arid regions of Central and Eastern Oregon can experience sudden dust storms on windy days. These are produced by the interaction of strong winds, fine-grained surface material, and landscapes with little vegetation. The winds involved can be as small as "dust devils" or as large as fast moving regional air masses.

Farmers, ranchers, homeowners, resort owners, and wildlife in Central and Southeast Oregon sometimes find themselves vying for limited water. Competition for scarce water can affect the locations and amounts of dust in the atmosphere that's blown on the wind. The Oregon Department of Transportation (ODOT) is the agency with primary oversight of the Dust Storm hazard.

Earthquake:

Oregon is quite vulnerable to earthquakes (and tsunamis, which often accompany major seismic events) because of the state's proximity to the Cascadia Subduction Zone just off the Pacific Coast. Also, Oregon is vulnerable to damage because of its topography and geology; many of its local soil profiles are prone to liquefaction during the shaking that would occur during a Cascadia event. Depending on the epicenter, areas receiving major damage from an 8.0 – 9.0 magnitude earthquake would include most of the counties in Western Oregon; the heavily populated metropolitan areas of Portland, Salem, and Eugene would certainly experience major damage.

A major earthquake (> 8.5) would be devastating if it occurred in the Portland metropolitan area. The Northern Willamette Valley/Portland Metro Region is the most densely populated with a total population of almost 1.5 million people. A major earthquake would likely do extensive damage to many of the region's 1382

bridges and overpasses as few bridges have been retrofitted to withstand this type of event. In addition, many structures are located on soils likely to experience liquefaction from the shaking that would occur. Most of the state's major medical facilities exist in this region. That is good only if they can be accessed after such an event. This region also has 49 dams that could be affected by a major earthquake.

Depending on where the epicenter is located, this magnitude of earthquake would likely cause extensive damage to structures and infrastructure in the Mid/Southern Willamette Valley Region as well. The city of Salem, Oregon's state capital, is only 46 miles south of Portland. To gain a perspective of the potential damage from a major earthquake, 169 of the state's 380 facilities are located in or near Salem. To replace these state facilities would cost over $850 million dollars. Marion County, where Salem is located, has over 20 dams and 400 bridges that could also be affected.

The long-term effects from a major earthquake would be felt for years. Major damage would likely occur to most of the region's public and private buildings, its vast road network, to its rail lines and power transmission lines, and to the state's most important employment centers.

A major earthquake that occurs in the southern, central, or eastern areas of Oregon would be catastrophic to that region. It may also be catastrophic to the state economically if key facilities and infrastructure (i.e., highways, bridges, rail lines, power transmission lines, and dams) are damaged to the degree that links with the Portland metropolitan region and the rest of the state could not quickly be repaired. However, the length of time for the state to recover from such a disaster occurring in an area away from the Portland metropolitan area should be much shorter than if the same event occurred near Portland.

The Department of Geology and Mineral Industries (DOGAMI) is the agency with primary oversight of the Earthquake hazard. Based on agency staff review of the available hazard data, DOGAMI lists, Benton, Clatsop, Coos, Columbia, Curry, Douglas, Jackson, Josephine, Klamath, Lane, Linn, Polk, Tillamook, Washington and Yamhill Counties as having the highest hazard to earthquake in the state. Table 2.5 shows that there are 29 state owned buildings located within the earthquake hazard zone, three of which are listed as critical facilities.

Table 2.5: Highest Scoring State Facilities Located within an Earthquake Hazard Zone

Building Name	Critical or Essential	Building Replacement Value	Total Property Value
Lighthouse Coquille	N	$3,051,815	$3,078,175
	N	$0	$13,889
DMV Coquille Office	N	$0	$5,738
1180 Tualatin	N	$0	$111,053
	N	$0	$470,105
Willowbrook Business Center	N	$0	$335,573
1189 King City	N	$0	$109,784
Portland	N	$0	$1,498,952
1238 Clackamas Sunnyside	N	$0	$109,079
1048 Tigard	N	$0	$217,482
SOCP TIGARD GROUP HOME	N	$0	$778,370
1094 Milwaukie	N	$0	$144,484
N. Tualatin Processing Center / Cascade Business Center	N	$0	$1,895,333
Tigard	N	$0	$914,100
Milwaukie PM Office Bldg	N	$760,737	$1,141,106
Milwaukie MS Open Storage	N	$12,000	$15,000
Milwaukie MS De-Icer Pump House	N	$16,425	$24,637
Milwaukie MS Open Storage	N	$12,000	$18,000
Milwaukie MS Fuel Station	N	$5,322	$7,983
Milwaukie MS Generator Bldg	N	$10,327	$12,909
Milwaukie MS Main Shop	N	$430,731	$538,414
Milwaukie MS Sign/Strp Bldg	N	$213,640	$267,050
Gaines Hall at OHSU	N	$0	$75,709
Public Health Lab	N	$0	$9,999,700
DEQ Health Laboratory	N	$76,373,075	$76,407,388
Hillsboro - VIP	N	$0	$269,814
Tualatin Substation	Y	$0	$0
Milwaukie M/W Bldg	Y	$94,945	$142,417
DEQ Public Health Lab	Y	$0	$3,788,116
	Total Value	**$80,981,017**	**$102,390,359**

Source: DOGAMI State Owned Building Study, DAS 2010

Flood:

Flooding is the most troublesome of the chronic disasters as it causes severe property damage, occasionally, loss of life, and has resulted in Oregon's greatest economic losses from any of the natural hazards.

As mentioned previously, the entire State of Oregon is susceptible to flooding. However, some regions are more likely to experience this hazard than others. Different types of flooding occur from various sources depending on the region of the state. Flooding from winter storms is the most common, particularly in western Oregon. In eastern Oregon, flood events occur as flash floods, spring runoff, ice jam flooding, lake flooding associated with high winds, basin playa flooding, and flooding from the breaching of natural debris dams.

From a state perspective, 256 communities and all 36 counties in Oregon have experienced flooding. However, as a region, the Coast-Lower Columbia has not identified flooding as its greatest hazard. The areas of the state most vulnerable to flooding are Tillamook County and the South/Central Willamette Valley Counties. Based upon local hazard analysis the South/Central Willamette Region is most vulnerable to damage and loss associated with flooding. Individual counties in Oregon where flooding was identified as a major concern, are: Baker, Grant, Josephine, Linn, Malheur, Marion, Polk, Tillamook, Union, Wallowa, and Wasco.

Table 2.6: Counties with Severe Repetitive Flood Loss Properties

County	Severe RFL Properties
Clackamas	3
Clatsop	1
Lane	1
Lincoln	1
Marion	1
Tillamook	1
Washington	1

Source: DLCD

The following Oregon cities have the highest percentage of land area in the 1% annual flood zone:

Table 2.7: Cities with the highest Percent of Land Area in 1% Annual Flood Zone

City	County	Percent Lane Area Within 1% Flood Zone
Milton Freewater	Umatilla	77%
Helix	Umatilla	70%
Athena	Umatilla	62%
Scio	Linn	60%
Burns	Harney	52%
Detroit	Marion	50%
Warrenton	Clatsop	47%
Rivergrove	Clackamas	47%
North Bend	Coos	43%
Spray	Wheeler	43%
Vernonia	Columbia	42%
Rockaway Beach	Tillamook	42%
Sheridan	Yamhill	41%
Junction City	Lane	40%
Elkton	Douglas	40%

Source: DLCD (2009)

The following Oregon cities have the highest percentage of population in the 1% annual flood zone:

Table 2.8: Cities with the highest Percent of Population in 1% Annual Flood Zone

Rank (Population)	Rank (Percent)	City	Percent Area in 1% Floodplain	Population	Population at Risk
1	1	Milton-Freewater	0.77	6,545	5,040
2	9	North Bend	0.43	9,855	4,277
3	13	Sheridan	0.41	6,020	2,486
4	7	Warrenton	0.47	4,785	2,249
5	14	Junction City	0.40	5,460	2,206
6	5	Burns	0.52	3,025	1,567
7	11	Vernonia	0.42	2,370	991
8	3	Athena	0.62	1,270	781
9	12	Rockaway Beach	0.42	1,380	574
10	4	Scio	0.60	790	475
11	8	Rivergrove	0.47	350	164
12	2	Helix	0.70	230	161
13	6	Detroit	0.50	275	136
14	15	Elkton	0.40	255	102
15	10	Spray	0.43	160	69

Source: DLCD (2009), Population data: Portland State University Population Research Center (2009)

Table 2.9 shows that there are 20 state owned buildings located within a flood hazard area, all of which are listed as critical facilities.

Table 2.9: Critical or Essential State Facilities Located within a Flood Hazard Area

Agency Name	Building Name	Critical or Essential	Replacement Value	Total Property Value
Mil. Dept.	Hangar 2	Y	$12,406,275	$12,406,275
Mil. Dept.	Eugene Armory	Y	$5,369,001	$5,377,525
ODF	Salem Fire Cache #I	Y	$1,636,658	$3,376,941
Mil. Dept.	Milton-Freewater Armory	Y	$2,249,976	$2,254,976
Mil. Dept.	Hangar 3	Y	$1,417,962	$1,417,962
Mil. Dept.	Salem AASF Hangar Storage	Y	$438,261	$438,261
ODOT	Burns Butte M/W Bldg	Y	$184,249	$276,373
ODOT	Cape Perpetua Radio	Y	$40,420	$60,630
ODOT	Coos Bay M/W Bldg	Y	$34,065	$51,098
OPRD	Haz Mat Storage Four Drum Hardcover w spill Pallet	Y	$25,000	$25,000
OPRD	Haz Mat Storage Gas and Pesticides	Y	$19,800	$19,800
OPRD	Haz Mat Storage Combustible Materials Shed	Y	$15,000	$15,000
OPRD	Haz mat Storage shed	Y	$15,000	$15,000
Mil. Dept.	Salem FMS Hazardous Material Storage	Y	$14,233	$14,233
Mil. Dept.	Salem AASF Hazardous Material Storage Building	Y	$12,810	$12,810
Mil. Dept.	ARC Fire Suppression Vault	Y	$11,088	$11,088
ODOT	Seaside MS Haz Mat Storage	Y	$4,708	$7,062
Mil. Dept.	Forest Grove Utility Vault-Fire Suppression	Y	$1,255	$1,255
OSP	NCC / Emergency Coord. Facility	Y	$180,000	$0
OSP	Milton-Freewater	Y	$0	$0
		Total Value	**$24,075,761**	**$25,781,289**

Source: DOGAMI State Owned Building Study, DAS 2010

Landslide and Debris Flows

Although landslides occur frequently in Oregon, most landslides occur in very sparsely populated areas within or near the Coast and Cascade Mountains. On occasion, major landslides occur on US Highway 101 or on I-84 that sever these major transportation routes (including rail lines) causing temporary but significant economic damage to these regions of the state. Although less frequent, landslides and debris flows do occur that result in the death of people located in their paths.

Because of its importance to the state's economy, landslides occurring in Multnomah County present the greatest danger from this type of disaster. Landslides in Tillamook County, particularly those that close US Highway 101 have a significant effect on commerce in the Oregon Coast Region. Landslides occurring in Lincoln County have closed US Highway 101.

The Department of Geology and Mineral Industries is the agency with primary oversight of the Landslide hazard. Based on agency staff review of the available hazard data, DOGAMI lists, Benton, Clatsop, Coos, Columbia, Curry, Douglas,

Jackson, Josephine, Klamath, Lane, Lincoln, Polk, Tillamook, Washington and Yamhill Counties as having the highest hazard to landslide in the state. Table 2.10 shows that there are 9 state owned buildings located within the landslide hazard zone, all of which are listed as critical facilities.

Table 2.10: Critical or Essential State Facilities Located within a Landslide Hazard Zone

Agency Name	Building Name	Critical or Essential	Building Replacement Value	Total Property Value
OPRD	Haz Mat Storage Old Gas Service	Y	$25,000	$25,000
OPRD	Marina Haz Mat Storage Gas Shed	Y	$25,000	$25,000
OPRD	Haz Mat Storage Shed Coverall Fuel Tank Cover	Y	$5,000	$5,000
OSP	DOGKENNEL,	Y	$0	$0
OPRD	Haz Mat Storage Gas Storage Building	Y	$46,000	$46,000
OSP	Enterprise Patrol Office	Y	$0	$0
OSP	Central Point Patrol Office	Y	$96,000	$0
OSP	Grants Pass Patrol Office	Y	$0	$0
OMD	Ashland Armory	Y	$4,127,375	$4,132,918
		Total Value	**$4,324,375**	**$4,233,918**

Source: DOGAMI State Owned Building Study, DAS 2010

Tsunamis

The Oregon Coast Region borders the Pacific Ocean on its western edge, and thus is the only region that would be directly affected by tsunamis. All of Oregon's 60 cities and unincorporated communities facing the Pacific Ocean or located on Oregon's bays and estuaries are vulnerable to damage from tsunamis to varying degrees.

Because tsunamis typically occur as a result of a seismic or volcanic event, the timing and magnitude of such events adds to the difficulty in adequately preparing for such disasters. If a major earthquake occurs along the Cascadia Subduction Zone, a tsunami could follow within 5 to 30 minutes. Although tsunami evacuation routes have been posted all along the Oregon Coast, damage to bridges and roadways from an earthquake could make evacuation quite difficult even if a tsunami warning were given. In addition, if a major earthquake and tsunami occur during the "tourist season," causalities and fatalities from these disasters would be far greater than if the same events occurred during the winter months.

It is also important to consider where the force of a tsunami would be the greatest. Cities facing the Pacific Ocean on the northern Oregon Coast are more vulnerable to inundation and have the greater potential for loss of life than coastal cities in central and southern Oregon. The northern coastal cities generally have lower elevations and are easily accessible from Oregon's most populated areas. Oregon Emergency Management (OEM) is the agency with primary oversight of the Tsunami hazard. Based on agency staff review of the available hazard data, OEM lists, Clatsop and Tillamook counties as having the highest hazard to tsunami in the state. Table 2.11 shows that there are 20 state

owned buildings located within a tsunami hazard zone, all which are listed as critical facilities.

Table 2.11: State Facilities Located within a Tsunami Hazard Zone

Agency Name	Building Name	Critical or Essential	Replacement Value	Total Property Value
ODOT	Cape Perpetua Radio	Y	$40,420	$60,630
ODOT	Seaside MS Haz Mat Storage	Y	$4,708	$7,062
OPRD	Haz Mat Storage Fuels and Combustible Storage	Y	$60,000	$65,000
OPRD	Haz Mat Storage Gas and Pesticides	Y	$19,800	$19,800
OPRD	Water Treatment Building	Y	$137,224	$137,224
OPRD	Haz Mat Storage Fuel Shed Old Service Station	Y	$25,000	$25,000
OPRD	Haz Mat Storage Fuel Tank Roof	Y	$25,000	$25,000
OPRD	Haz Mat Storage Paint Shed	Y	$25,000	$25,000
ODOT	Coos Bay M/W Bldg	Y	$34,065	$51,098
ODOT	Port Orford Hazmat Bldg	Y	$138,870	$173,587
OSP	Gold Beach Patrol Office	Y	$0	$0
OMD	Camp Rilea Armory	Y	$3,768,977	$3,776,123
ODOT	Astoria M/W Bldg	Y	$37,094	$55,641
ODOT	Davis Slough MS Haz Mat Storage	Y	$29,844	$44,767
ODOT	Coquille M/W Bldg	Y	$9,920	$14,880
ODOT	Florence MS Hzmt and Oil Storage	Y	$9,024	$11,280
OSP	Coos Bay Patrol Office	Y	$0	$0
OSP	Tillamook Patrol	Y	$0	$0
OPRD	Haz Storage Gas Shed and Extended Roof	Y	$48,750	$48,750
OSP	Florence Patrol Office Building E	Y	$0	$0
		Total Value	**$4,413,696**	**$4,540,842**

Source: DOGAMI State Owned Building Study, DAS 2010

Volcanoes

Oregon's vulnerability to volcanic events varies statewide. The Cascade Mountains, which separate Western Oregon from Central Oregon, poses the greatest threat for volcanic activity. Those regions that include the Cascade Mountains are most vulnerable to the effects of a volcanic event. Within the State of Oregon, there are several volcanoes that may pose a threat of eruption; these include Mount Hood, which most recently erupted about 200 years ago, the Three Sisters, and Mt. Jefferson, which has not erupted for about 15,000 years, but is not considered to be extinct. Volcanic eruptions from volcanoes in Washington State, like the Mt. St. Helens eruption in 1980, can also significantly impact Oregon.

Deschutes County is most vulnerable in the Central Oregon Region because the region's most populous city, Bend, is located here and the greatest numbers of "composite" volcanic mountains are located near the county's population centers. Klamath and Jefferson counties are also vulnerable within this region. Other regions are also vulnerable to damage from volcanic eruptions. If Mt. Hood erupted, the Northern Willamette Valley/Portland Metro Region and the Mid-

Columbia Region would both be impacted. Because of Mt. Hood's proximity to Portland, the Columbia River, the I-84 freeway, and major dams on the Columbia River, the potential for a large disaster exists.

The Department of Geology and Mineral Industries is the agency with primary oversight of the Volcano hazard. Based on agency staff review of the available hazard data, DOGAMI lists Clackamas, Douglas, Deschutes, Hood River, Jefferson, Klamath, Linn, Marion, Multnomah and Wasco counties as having the highest hazard to volcano in the state. Table 2.12 shows that there are 19 state owned buildings located within a volcanic (proximal or distal) hazard zone, two of which are listed as critical facilities.

Table 2.12: Critical or Essential State Facilities Located within a Volcanic (Proximal or Distal) Hazard Zone and State Owned Facilities with the Proximal Hazard Zone

Agency	Building Name	Critical or Essential	Building Replacement Value	Total Property Value
ODOT	Govt Camp Maintenance Sta Bldg	N	$1,657,417	$2,071,772
ODOT	Bennett Pass Equip Shed	N	$788,480	$985,600
ODOT	Govt Camp MS Dormitory	N	$932,071	$937,071
ODOT	Mt. Hood Jct Sand Shed	N	$366,531	$458,164
ODOT	Govt Camp RA Rest Sta	N	$448,113	$452,594
ODOT	Govt Camp Fuel Station	N	$246,063	$369,094
ODOT	Bennett Pass Sand Shed	N	$183,430	$229,288
ODOT	Govt Camp MS Trl Shelter	N	$229,034	$229,034
ODOT	Govt Camp Sand Shed	N	$158,634	$198,292
ODOT	Govt Camp MS House104	N	$166,224	$167,224
ODOT	Govt Camp MS House103	N	$162,229	$163,229
ODOT	Govt Camp MS House102	N	$160,733	$161,733
ODOT	Govt Camp MS House101	N	$160,733	$161,733
ODOT	Bennett Pass Fuel House	N	$67,952	$101,928
OLCC	1244 Government Camp	N	$0	$23,362
ODOT	Salmon Rv Rd Equip Enclosed Stor	N	$11,603	$14,503
ODOT	Bennett Pass Propane Shelter	N	$8,009	$12,014
OSP	Gov't Camp	Y	$0	$0
OPRD	Haz Mat Storage Gas Shed SA	Y	$15,000	$15,000
		Total Value	**$5,762,256**	**$6,751,635**

Source: DOGAMI State Owned Building Study, DAS 2010

Windstorm

It is not uncommon for Oregon to experience several windstorms during the winter months. The Oregon Coast has several relatively harsh storms during the winter months. Although major damage from these storms is infrequent, the Oregon Coast Region of the state is the most vulnerable to windstorms. The seven coastal counties in the Oregon Coast Region often face 60 to 100 mile an hour winds sometime during the year. While the coast is experiencing severe winds, the Willamette Valley may also face 40 to 60 mile per hour winds from the same storm. Also, the Columbia River Gorge funnels very strong winds, often from east

to west. The Northern Willamette Valley/Portland Metro and Mid-Columbia Regions are most vulnerable to this type of wind event.

Major windstorms that can impact large areas of the state, like the Columbus Day windstorm of 1962, are relatively rare. These storms can cause major damage to many areas of the state with the Oregon coastal counties typically suffering the most damage from this type of hazardous event.

The Public Utility Commission (PUC) is the agency with primary oversight of the Windstorm hazard. Based on agency staff review of the available hazard data, PUC lists, Benton, Clatsop, Coos, Columbia, Curry, Douglas, Gilliam, Hood River, Lane, Lincoln, Linn, Marion, Morrow, Multnomah, Polk, Sherman, Tillamook, and Washington as the most vulnerable to damage and loss associated with windstorms.

Winter Storm

Winter storms occur annually in Oregon bringing snow to Oregon's mountains and to much of Eastern Oregon. These winter storms are welcomed by Oregon's skiers and the ski industry and are tolerated by those people traveling the numerous mountain passes and Eastern Oregon highways kept open during the winter by the Oregon Department of Transportation. Approximately every four years, winter storms bring extreme cold temperatures, snow, sleet and ice to Oregon's western valley floors. Because these storms are infrequent and tend to last only a few days, residents in Western Oregon are often unprepared for such events.

The Oregon Department of Transportation (ODOT) is the agency with primary oversight of the Winter Storm hazard. Based on agency staff review of the available hazard data, ODOT lists the Northern Willamette Valley/Portland Metro Region and the Mid/Southern Willamette Region are most vulnerable to damage and loss associated with winter storms because Oregon's most densely populated cities are located within these regions. The Portland metropolitan area is the most vulnerable not only because it is the most densely populated but also because of its proximity to the Columbia River Gorge. It is not uncommon to have severe ice and sleet storms occurring as cold artic winds blow down the Gorge over east Multnomah County and Portland. These storms have delayed air traffic and even closed the Portland International Airport in the past, thus negatively affecting Oregon's economy. Winter storms often bring ice and sleet that makes driving extremely dangerous. Ice and sleet storms can cripple the movement of goods and services, thus negatively impacting Oregon's economy.

Regional Profiles and Natural Hazard Risk Assessments: Summary

The purpose of the Regional Profiles and Natural Hazard Risk Assessments (see Appendix 2-A) is to assess statewide risks by profiling natural hazards and assessing vulnerabilities within eight regions of the State. Together, the eight risk assessments combine to describe the State's overall risk to natural hazards. The 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 Profiles and Risk Assessments useful when assessing natural hazards and planning mitigation activities.

Local governments can use the Regional Profiles and Risk Assessments in the development of their jurisdiction's natural hazards mitigation plan; information from the regional profiles is intended to be used as a springboard for more detailed community profiles. Likewise, since local plans serve as the foundation for the Oregon NHMP, local governments are encouraged to review and update the Regional Profiles and Risk Assessments using best available local data. As such, information from local plans helps to improve the Oregon NHMP's overall risk assessment. Each Regional Profile and Risk Assessment includes:

Regional Figures: Infrastructure maps and regional hazard assessment maps are provided within each report. Infrastructure maps provide information about the general location of schools, hospitals, bridges, power stations, and dams. Regional hazard assessment maps display counties' risk scores for each hazard. The scores, ranging from 24 (low) to 240 (high), reflect counties' perceived risk for each hazard[2].

Regional Profile: Using the best available data, the regional profile summarizes and describes the population and demographics, economy, development trends, transportation and critical infrastructure. Primary data sources for the regional profiles included Oregon Employment Department's 2002 Regional Profiles, the 2000 US Census, Oregon Economic Community Development Department, and the Department of Land Conservation and Development.

Natural Hazard Risk Assessment: The regional natural hazard risk assessment section describes the causes and characteristics of natural hazards in the region, as well as historical impacts, and county probability and vulnerability scores. These assessments were based on best available data related to historical events, repetitive losses, local county hazards rankings and general development trends. It should be noted that repetitive flood loss properties are specifically addressed in local mitigation plans and are not specifically identified in the regional risk assessments.

Regional State Facilities Tables: The state of Oregon has prepared an analysis of state owned and managed facilities. This analysis is a first step at assessing which state owned structures are most vulnerable to the various hazards identified by region. From this overview, it is clear that a more detailed assessment in the future will yield a clearer picture of those structures specifically threatened by certain disasters and the potential damage that may occur. This analysis is broken down by region and is included in the regional profiles.

Newly included in the Risk Assessments are the results from DOGAMI's Statewide Rapid Visual Screenings. Oregon Senate Bill 2 (2005) directed DOGAMI, in consultation with project partners, to develop a Statewide seismic needs

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[2] The scores are current as of November 2008, updated scores will not be available until summer 2012. To obtain the most current scores, see http://csc.uoregon.edu/opdr/ or contact Oregon Military Department – Office of Emergency Management http:///www.oregon.gov/OMD/OEM.

assessment that included seismic safety surveys of K-12 public school buildings, community college buildings with a capacity of 250 or more persons, hospital buildings with acute inpatient care facilities, fire stations, police stations, sheriffs' offices and other law enforcement agency buildings. The Statewide needs assessment consisted of rapid visual screenings (RVS) of these buildings; results from the assessment can be viewed on DOGAMI's website, and within each of the State's eight Regional Profiles and Natural Hazard Risk Assessments.

Additionally, included in the Region 1, *Oregon Coast Risk Assessment*, are the results from a 2007 vulnerability assessment conducted by USGS (in partnership with the U.S. Department of the Interior). The report is titled "Variations in City Exposure and Sensitivity to Tsunami Hazards in Oregon."

The Regional Profiles and Natural Hazard Risk Assessments are included as Appendix 2-A of this Section.

Infrastructure Overview[3]

The following maps from the Atlas of Oregon display a wealth of information describing Oregon's major population centers, the major transportation networks, a snapshot of the key employment and manufacturing centers located in various parts of the State, and a description of Oregon's power and energy distribution systems.

Population Maps:

http://csc.uoregon.edu/opdr/opdr/sites/csc.uoregon.edu.opdr/files/poptransecon_0.pdf

The first map from the Atlas of Oregon is titled "Population and Transportation." Through "color-coding," it displays Oregon's major population centers and the State's overall population density ranging from the high density areas of the Willamette Valley to the very low density areas of southeastern Oregon. Note: population data from the Oregon Atlas was developed in 2001 and has not been updated.

Transportation Map:

http://csc.uoregon.edu/opdr/opdr/sites/csc.uoregon.edu.opdr/files/poptransecon_0.pdf

This map displays the State's vast highway system connecting the eight regions of the State. Displayed in blue on the map are the two interstate highways, I-5 traversing north and south connecting Oregon with the states of California and Washington. I-84 connects to I-5 in Portland and serves a portion of the Northern Willamette, the Mid-Columbia, and Northeast Regions of the State before connecting with the State of Idaho to east. There are also two additional north-south routes serving regions of the State that parallel I-5. US Highway 101 serves the entire Oregon Coast region connecting California and the City of Brookings in the south to the City of Astoria before crossing into the State of Washington to the north. The other main route is US Highway 97 that runs from California and the City of Klamath Falls through the Cities of Bend, Redmond and Madras, located in the Central Oregon Region, and connecting to I-¬84 at Biggs Junction,

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[3] Note: The figures listed in this section are from the *Atlas of Oregon, 2nd Edition, (2001),* for updated information see the Regional Profiles of Appendix 2-A.

located in the Mid-Columbia Region, before crossing the Columbia River into Washington State.

The transportation map also displays eight highways that connect I-5 with US Highway 101, and six highways that connect I-5 with US Highway 97. All of these connecting highways provide passage over or around the Coast Range or Cascade Range of mountains that separate many of Oregon's regions. These routes often provide a challenge for travelers during the winter with some routes occasionally blocked by winter storms or landslides.

Finally, Oregon has seven major airports that link Oregon with the nation's air transportation system. Of greatest importance to Oregon is the Portland International Airport. Because of its location adjacent to the Columbia River and its proximity to the Columbia River Gorge, the Portland International Airport is vulnerable to severe winter (ice) storms, a relatively common natural hazard that affects this region. The Redmond Airport's runways were built to accommodate large aircraft so that this facility could serve as a back-up in the event that the Portland airport is impacted by a large scale disaster.

Economy Map:

http://csc.uoregon.edu/opdr/opdr/sites/csc.uoregon.edu.opdr/files/poptransecon_0.pdf

Besides providing an overview of Oregon's economy, this map identifies the various economic centers located throughout the State. The City of Portland and the numerous cities in the Portland metropolitan area, provide the greatest contribution to Oregon's economy. The Portland metropolitan area is located in the Northern Willamette Region. The Mid/Southern Willamette Region is also a significant contributor to Oregon's economy. This region includes some of Oregon's largest cities, like Salem, the State capital, Eugene, Corvallis and Albany. Other areas of the State that are significant contributors to Oregon's economy are generally located along the I-5 and I-84 corridors and on US Highways 97 and 101. Note: data from the Oregon Atlas was developed in 2001 and has not been updated.

Power and Energy Distribution Maps:

http://csc.uoregon.edu/opdr/opdr/sites/csc.uoregon.edu.opdr/files/power_0.pdf

These maps display Oregon's hydropower facilities and power grids and pipelines. Hydropower plants account for most of Oregon's electricity generation. Coal and natural gas each account for 5% to 10% of Oregon's electricity generation. Additionally, most of Oregon's petroleum products, including gasoline, come from Northern Alaska. Natural gas burned in Oregon comes mostly from Alberta, Canada. Although a small amount of natural gas is produced in Columbia County, most comes by pipeline from Canada and several Rocky Mountain states. Long-distance gas transmission service is provided throughout the State. Note: data from the Oregon Atlas was developed in 2001 and has not been updated.

By looking carefully at these maps and by reviewing the Regional Profiles provided in this plan, it is apparent that specific types of hazards can affect regions of the State differently. For example, a major wildfire could have a greater impact on southern Oregon's economy, where wood products and agriculture are significant contributors to this region's economic base, than in the Northern

Willamette Region, which is less dependent on resource-based industries. On the other hand, a major earthquake centered in the Northern Willamette Region could severely damage that region's economy while an earthquake of the same magnitude would have less of an impact if it occurred in a sparsely populated, more resource-dependent region of the State.

With the information displayed on these maps and the hazard analysis information provided for the eight regions of the State, assumptions can be been made regarding the impact that certain types of disasters may have on Oregon, and the State's ability to recover.

STATE'S NATURAL HAZARDS VIEWER:

HTTP://INFOGRAPHICS.UOREGON.EDU/HAZARDMAPS/WEBAPP/BETA.HTML

The State's Natural Hazard Viewer is an online interface that visually describes natural hazard risk throughout the State. Information displayed in the Viewer is periodically compiled by OEM from work done by Oregon's 36 counties. . As such, the Viewer can help to determine which counties are most threatened and most vulnerable to natural hazard events.

Each county in Oregon is required to periodically update their hazard analysis. As part of the hazard analysis, each county develops risk scores for the natural hazards that affect their communities. These scores range from 24 (low) to 240 (high), and reflect the county's perceived risk for each particular hazard. The hazard analysis methodology was first developed by the Federal Emergency Management Agency (FEMA) circa 1983, and gradually refined by Oregon Emergency Management (OEM) over the years. Vulnerability and probability are the two key components of the methodology. Vulnerability examines both typical and maximum credible events, and probability endeavors to reflect how physical changes in the jurisdiction and scientific research modify the historical record for each hazard. Vulnerability accounts for approximately 60% of the total score, and probability approximately 40%.

This method provides local jurisdictions with a sense of hazard priorities, or relative risk. It doesn't predict the occurrence of a particular hazard in a community, but it does "quantify" the risk of one hazard compared with another. By doing this analysis, local planning can first be focused where the risk is greatest. Among other things, the hazard analysis can:

- Help establish priorities for planning, capability development, and hazard mitigation;
- Serve as a tool in the identification of hazard mitigation measures;
- Be one tool in conducting a hazard-based needs analysis;
- Serve to educate the public and public officials about hazards and vulnerabilities; and
- Help communities make objective judgments about acceptable risk.

Because the hazard analysis methodology is used consistently throughout the State, the State can estimate (based on local perceptions of risk) which jurisdictions are most vulnerable to damages and losses associated with various hazard events. The Hazard Viewer compiles the scores from local hazard analyses, and visually displays the scores by county.

Note: the Natural Hazards Viewer addresses all hazards in the plan except Coastal Erosion.

Although the prescribed methodology for local hazard analyses 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 working with slightly different assumptions, comparing scores between counties must therefore be treated with caution. Please see Implementation/ Maintenance action item MP-7 for information about how the IHMT plans to address the subjective nature of these assessments.

Upon completion of their hazard analyses, counties are able to classify their hazards into risk categories (e.g. High Risk, Moderate Risk, and Low Risk). Risk categories, or classes, are generated through "equal-interval" classification, for which each risk category represents an equal range of the original scale. For example, in the case of a six-class map, the Low Risk category represents the bottom sixth of the range or 24 to 60, and the High Risk category represents the top sixth of the range from 204 to 240. The Hazards Viewer allows viewers to change the number of classes on the map. In doing so, overall patterns, or regional variations within hazards can be seen. Data in the Natural Hazards Viewer is current through December 2008[4].

State Facility Vulnerability Assessment

A vulnerability assessment combines information from the hazard identification with an inventory of the existing (or planned) property and population exposed to hazard, and attempts to predict how different types of property and population groups will be affected. The following sections combine to provide an overview of Oregon's vulnerability to natural hazards.

Statewide Vulnerabilities

Oregon is vulnerable to many natural hazard events. Because of Oregon's size and its physiographic diversity, a disaster occurring in one part of the State may be traumatic to that region while having minimal effect on the State as a whole. Conversely, a disaster that cripples the northern Willamette Valley could be devastating to the entire State.

Chronic Hazards

Oregon has a number of natural hazards that occur frequently; windstorms, wildfires, winter storms, flooding, and landslides occur somewhere in Oregon every year. Any one of these hazardous events can become a major disaster if it impacts one or more of Oregon's largest population centers. The most likely natural hazards to occur and impact a large number of Oregonians are flooding, windstorms, wildfires and winter storms.

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[4] OEM is requiring counties to update their analyses for the local fiscal year that ends on June 30, 2012. OEM and OPDR will update the Hazards Viewer to reflect these county updates during the Summer of 2012.

Certain areas within Oregon are more likely to experience one of these four chronic hazards than other areas in the State. Major windstorms, for example, occur during the autumn and winter months, and are likely to impact one or more of the seven counties along the Oregon coast. Likewise, wildfires frequently occur in the Southwest and Central Oregon Regions during the late summer months. Although they do not occur every year, winter ice storms have the greatest impact on the Columbia River Gorge area and in particular, the east Multnomah portion of the North Willamette Region.

Catastrophic Hazards

The three most potentially catastrophic disasters to occur in Oregon are a major subduction zone earthquake, a locally-generated tsunami, or a volcanic eruption. Of these three, a major earthquake (M 8-9) with its epicenter in the Pacific Ocean immediately adjacent to the Oregon coast (likely to be followed by a major tsunami) would be the most devastating natural disaster in terms of loss of life, damage to State facilities, buildings and infrastructure, and its overall impact on the State's economy. Recovering from such an event would be very difficult, expensive, and time-consuming. DOGAMI has completed several studies that assess the potential impacts of earthquakes on Oregon's population, economy, and infrastructure. Likewise, USGS recently completed a tsunami vulnerability assessment for communities along the Oregon Coast.

Development in Hazard Prone Areas

At the time of this update, resources were not available to describe whether changes in local jurisdictions have occurred with regard to hazard prone areas and loss estimates. Since the 2006 plan, there have been no significant changes in State policies related to development in hazard prone areas. (See Section 4: *Mitigation Strategies* for a listing of statewide policies that influenced local development decisions). Local policies related to development in hazard prone areas are not yet monitored or documented on a statewide level. Cities and counties in Oregon are, however, required to adopt and maintain comprehensive plans that guide land use and development activities. These comprehensive plans house policies that guide development and reflect the requirements set forth in the statewide land use Goal 7 – Areas Subject to Natural Hazards.

As local jurisdictions begin to update their natural hazard mitigation plans, the State will encourage locals to specifically address changes in development with regard to hazard prone areas. The State will review local updates during the next Oregon NHMP update in 2012, and will be better equipped to describe changes in local developments with regard to hazard prone areas.

Requirement: 44 CFR §201.4(c)(2)(ii): *Risk Assessments.* This risk assessment shall include… (ii) (a)n overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments as well as the State risk assessment. The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events. State owned or operated critical facilities located in the identified hazard areas shall also be addressed;

Requirement: 44 CFR §201.4(c)(2)(iii): *Risk Assessments.* This risk assessment shall include… (iii) (a)n overview and analysis of potential losses to the identified vulnerable structures, based on estimates provided in local risk assessments as well as the State risk assessment. The State shall estimate the potential dollar losses to State owned or operated buildings, infrastructure, and critical facilities located in the identified hazard areas.

Vulnerability Assessment

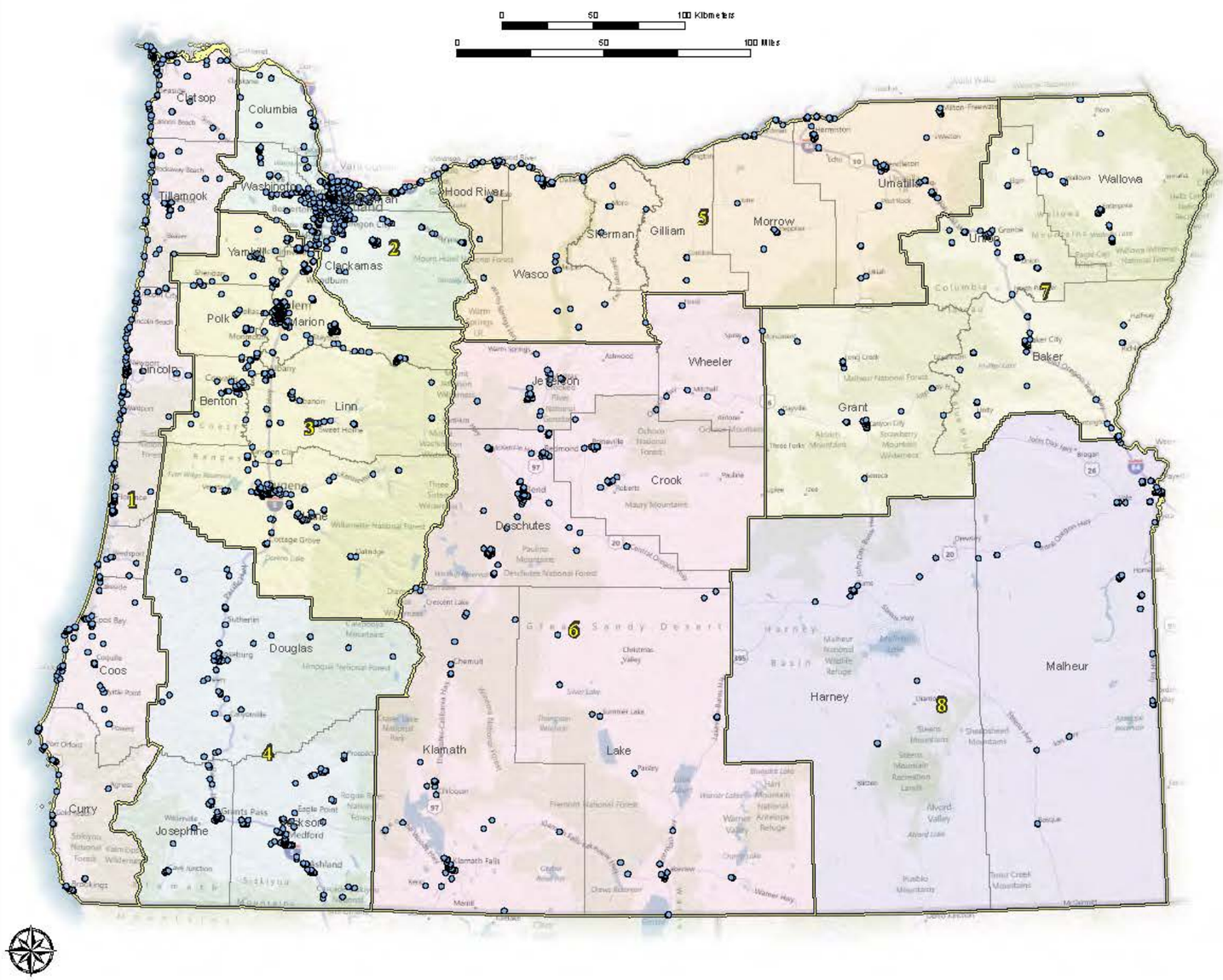
According to data from the Department of Administrative Services (DAS), the State of Oregon owns or leases, buildings and contents, totaling over 11 billion dollars in value. Because of this investment, it is important that the State assess the vulnerability of these assets to the many natural hazards that occur in Oregon. These include: landslide, flood, volcano, tsunami, earthquake, fire, and coastal erosion hazards. The Department of Geology and Mineral Industries (DOGAMI) assembled the best available statewide data for these hazards in order to prioritize/rank the state owned facilities that are most vulnerable. The assessment included all facilities provided by DAS with priority given to those facilities determined to be critical or essential. Notably, the DAS data does not specifically identify critical and essential facilities. Thus, DOGAMI added a critical/essential facility field to the DAS data based on indicative descriptors within the "building name" and "building usage" fields. The field added by DOGAMI is used to identify facilities that could possibly meet the critical/essential facility criteria, but this assessment is based on limited data and information. It is also important to note that this study does not assess the vulnerability of all critical and essential facilities, but only those that are owned or leased by the State.

The DAS database lists 5,977 total facilities within the State which are owned or operated by 134 different State agencies. DOGAMI used the DAS list to locate facilities using Geographic Information Systems (GIS). Because the data from DAS was incomplete in many cases (missing or incorrect addresses, city names, or zip codes), DOGAMI rated each facility to indicate the level of confidence in the accuracy of the facilities' location using a scale of high, medium, low, or approximate. For those facilities with an initial low or approximate rating, DOGAMI performed additional research to increase the confidence rating.. DOGAMI's analysis resulted in the inclusion of 5,802 facilities in the vulnerability assessment; the assessment excludes 175 facilities because of low or approximate location confidence rating. Figure 2.11 shows the distribution of these 5,802 state owned facilities within the eight NHMP Hazard Mitigation Regions.

Figure 2-11: Distribution of State Owned Facilities

State Hazard Mitigation Plan

August 2011



Summary Statistics

Total Property Value Statistics	
Count	5802
Mean	$1,934,513
Median	95000
Mode	15000
Standard Deviation	$9,393,259
Minimum	0
Maximum	$358,644,161
Sum	**$11,224,043,963**

Property Value Statistics by OEM Region		
OEM Region	**# of Facilities by Region**	**Total Property Value**
1	980	$340,411,414
2	757	$2,113,096,712
3	1951	$6,474,325,503
4	447	$363,125,111
5	475	$722,028,553
6	646	$474,262,307
7	359	$446,876,261
8	187	$289,918,103
Total	**5802**	**$11,224,043,963**

Summary statistics were calculated to provide general information about the number and distribution of the state owned facilities. The point locations and property values reflect data provided by DAS in 2010. The points were located based on address data and research performed by DOGAMI staff. There are an additional 175 state owned buildings not shown on this map due to insufficient address/location-based data.

Legend

- State Owned Facility
- Oregon Emergency Management (OEM) Hazard Mitigation Region
- County Boundary

Map Created by: Rachel Lyles, Department of Geology and Mineral Industries (DOGAMI)
Basemap Source: Microsoft Bing Maps Services
Other Data Sources: Oregon Spatial Data Library
State owned facility data was provided by the State of Oregon, Department of Adminstrative Services (DAS) and geolocated by DOGAMI.

Projection: Oregon Statewide Lambert Conformal Conic
Datum: NAD83 HARN Unit: International Feet

HAZARD DATA LIMITATIONS

In order to prioritize the most vulnerable facilities for each hazard, DOGAMI developed a scoring system to accommodate multiple data layers used to make a hazard compilation dataset. This system also accounts for varying degrees of accuracy and limitations of the data. The assessment evaluates each hazard individually (no comprehensive or multi-hazard assessments), with its own unique scoring system. The details of the scoring system for each hazard are explained in the following paragraphs.

Table 2.13: State Owned Facility Vulnerability Assessment - Hazard Score Summary

Hazard Data	Notes	Scores
Coastal Erosion	data from the Oregon Department of Geology and Mineral Industries (DOGAMI)	
Coastal Erosion Hazard Zones	low, moderate, high and active zones no data for Lane, Douglas and Coos Counties, partial data for Curry County	low = 1, moderate = 4, high = 8, active = 10
Flood	data from Federal Emergency Management Agency (FEMA) and Oregon Department of Land Conservation and Development (DLCD)	
100 year Floodplain (Special Flood Hazard Area - SFHA)	Effective, preliminary, and Q3 FEMA data current as of May 2010. State digitized data from DLCD.	SFHA = 8, Q3 SFHA = 3
Floodways	Floodways from data listed above.	Floodway = 10
Earthquake	data created by DOGAMI; data from U.S. Geological Survey (USGS)	
Liquefaction Susceptibility	none, low, moderate, and high	N = 0, L = 3, M = 6, H = 10
500-yr ShakeMap	very strong to extreme perceived shaking categories	within very strong to extreme categories = 10 outside these categories = 0
Active Fault Lines	buffer calculated based on a minimum 150 ft. setback, plus a factor for accuracy and scale. Formula is: 150 + (accuracy factor * scale factor) example: 150 + (2*600) = 1350 ft. buffer fault accuracy factor: located = 1, approximate = 1.5, inferred = 2, burried/concealed = 2.5 orginal fault scale factor: 24K = 150ft, 50-62.5K = 300ft, 100K = 600ft, 125K = 750ft, 250k = 1500ft, 500K = 3000ft If attributes listed "no data" for the accuracy or scale, then the worst/most conservative numbers were used in the buffer calculation.	within buffer = 10, ouside buffer = 0
Volcanic	data from the USGS Cascades Volcano Observatory (CVO)	
volcanic distal and proximal hazard zones	areas include: Mount Hood, Crater Lake, Newberry, Mount Jefferson, and the Three Sisters Hazard zones: distal and proximal	proximal = 10, distal = 5
Fire	data from the Oregon Department of Forestry (ODF)	
ODF Hazard data	Overall at risk hazard rating (categories are low, medium, high, and very high)	low = 0, Medium = 3, High = 6, Very High = 10
ODF Protection data	Rating for protection capability risk (Risks associated with inadequate wildfire protection capabilities)	Low = 0 Medium = 5 High = 10
Tsunami	data from DOGAMI	
SB 379	OR 455.446 Tsunami Inundation Line (commonly known as SB 379)	seaward of SB 379 = 10
Tsunami Inundation Zone	IMS Studies 2, 03, 11, 12, 13, 21, 23, 25, GMS99, SP 41, and SP 43	within inundation zone = 10
Elevation based criteria	landward of SB 379, but below 80 ft. (elevation) North of Cape Blanco, or below 95 ft. (elevation) South of Cape Blanco	within elevation criteria defined = 7
Elevation based criteria	between 80 ft. and 100 ft. (elevation) North of Cape Blanco, or between 95 ft. and 120 ft. (elevation) South of Cape Blanco	within elevation criteria defined = 4
Landslide	data from DOGAMI	
Historic Landslide Buffer	derived from SLIDO vs. 2 DOGAMI publication	within buffer of historic landslide point = 10
Mapped Landslide	derived from SLIDO vs. 2 DOGAMI publication	within mapped landslide = 8
Mapped Fan/Colluvium	derived from SLIDO vs. 2 DOGAMI publication	within mapped fan or talus/colluvium = 6
Steep Slope Zone	steep slope = 26 degrees or higher	located on steep slope = 3

Source: DOGAMI

Coastal Erosion

Coastal erosion is a complex process involving many natural and human factors. It is a chronic hazard along many areas of the Oregon Coast, especially sand spits, bluffed coastline, and dune-backed beaches.

Chronic hazards are clearly evident along Oregon's shores, including beach, dune, and bluff erosion, landslides, slumps, gradual weathering of sea cliffs, and flooding of low-lying coastal lands during major storms. The damage caused by chronic hazards is usually gradual and cumulative. The regional, oceanic, and climatic environments that result in intense winter storms determine the severity of chronic hazards along the coast. The coastal erosion hazard threatens property in its path and, in extreme events, can threaten human life as well.

The state facility vulnerability assessment uses the results from several DOGAMI coastal erosion studies which delineate low, moderate, high, and active coastal erosion zones. However, this data does not cover the entire Oregon coastline. Coastal erosion hazard zones have not been created for Lane, Douglas, and Coos Counties, and only partial data coverage exists for Curry County. To address these gaps in data, DOGAMI excluded those portions of the coast from the analysis. The assessment scores each facility based on its location within one of the four identified hazard zones. The assessment gives the highest score to facilities within an active coastal erosion zone. The scores decrease by the amount of risk associated with the zone, with the low coastal erosion zone given the lowest score.

Coastal Erosion Hazard Facility Summary

Of the 5,802 facilities evaluated, 36 are currently located within a coastal erosion zone representing a value of approximately $8 million dollars. Figure 2.2 (Coastal Erosion Hazards) shows all 36 state owned facilities located within a coastal erosion hazard zone. One of the 36 (ODOT Cape Perpetua Radio building) is identified as a critical or essential facility and is also located in an active coastal erosion zone. Overall, four facilities are in an active erosion zone and six facilities are in a high erosion zone.

Table 2.4 identifies all of the state owned facilities located within an active or high coastal erosion hazard zone. Appendix 2-B includes the full DAS data; the purple row highlights the one critical or essential facility located within these two zones. Table 2.14 shows the 24 most valuable state owned facilities within all coastal erosion hazard zones. The highlighted facilities are those valued at over $1 million dollars each. These data also identify the hazard score for each facility which identifies which hazard zone (low, medium, high, or active) the facility is located within.

Table 2.14: 24 Most Valuable Facilities within the Coastal Erosion Hazard Zone

Agency Name	Building Name	Critical or Essential	Building Replacement Value	Total Property Value
OPRD	Lighthouse Historic	N	$2,708,712	$2,708,712
OPRD	Depoe Bay Whale Watching Center	N	$1,666,000	$1,698,748
OPRD	Meeting Hall Restroom	N	$412,476	$412,476
OPRD	Restroom Peter Iredale	N	$240,000	$240,000
OPRD	Restroom NW corner of parking	N	$240,000	$240,000
OPRD	Restroom	N	$124,000	$124,000
OPRD	Lower Restroom Ecola Point Parking Lot on trail to beach in DU 17	N	$120,000	$120,000
OPRD	Upper Restroom Ecola Point Parking Lot near Parking Lot DU 14	N	$120,000	$120,000
OPRD	Restroom Day Use	N	$120,000	$120,000
OPRD	Restroom 1ST StreetC Street	N	$120,000	$120,000
OPRD	Restroom	N	$120,000	$120,000
OPRD	Restroom Shower A B Loop	N	$120,000	$120,000
OPRD	Restroom A B Loop	N	$120,000	$120,000
OPRD	Manhattan Beach RestroomNorth End of Parking Lot	N	$120,000	$120,000
OPRD	Restroom	N	$120,000	$120,000
OPRD	Ophir Day Use restroom bldg	N	$120,000	$120,000
OPRD	Bob Straub Building Restroom	N	$120,000	$120,000
OPRD	Plumbed Restroom	N	$120,000	$120,000
OPRD	Restroom	N	$120,000	$120,000
OPRD	Restroom at DU Beach Parking Lot 01	N	$120,000	$120,000
OPRD	Beverly Beach Restroom DU Area near Parking Lot	N	$120,000	$120,000
OPRD	Agate Beach Restroom at Parking Lot in DU Area	N	$120,000	$120,000
OPRD	RestroomDay Use area	N	$120,000	$120,000
OPRD	Pavilion Yaquina Bay Fisherman's Memorial	N	$100,000	$100,000
		Total Value	**$7,531,188**	**$7,563,936**

Source: DOGAMI

Coastal erosion data limitations and notes for zones along bluff-backed shorelines:

1. Erosion rates used to estimate widths of hazard zones are based on interpretation of relatively short historical series of aerial photography (1939 to present) and very limited lidar data acquired before 2008. Photos were georeferenced but not necessarily orthorectified and spatial locations may have considerable error.

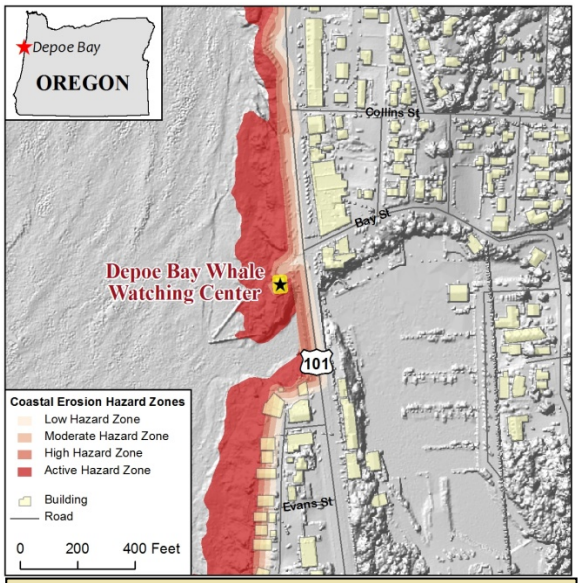


Figure 2.12. This lidar-based map is an example of one of the 36 state owned facilities located within a coastal erosion hazard zone. The Depoe Bay Whale Watching Center is valued at $1.6 million and is located in a high hazard zone.

2. Low hazard zones incorporate hypothetical landslide block failures assumed to fail in the event of a M9 Cascadia earthquake. This may or may not happen.

3. The moderate hazard zone is simply defined by half the distance between the high and low hazard zones for bluff-backed shorelines.

4. Coastal erosion hazard zones have not been created for Lane, Douglas, and Coos Counties, and only partial data coverage exists for Curry County. Therefore, state owned facilities along the coastline in these areas are not accounted for in this study.

For more detailed information, please see the following DOGAMI Publications used in this facility assessment: OFR O-01-03 (Tillamook County: Cascade Head to Cape Falcon); OFR O-01-04 (Clatsop County: Gearhart to Ft. Stevens); OFR O-04-09 (Lincoln County: Cascade Head to Seal Rock); OFR O-04-20 (Curry County: Sisters Rocks to North Gold Beach); OFR O-07-03 (Lincoln County: Seal Rock to Cape Perpetua); and OFR O-09-06 (Clatsop County: Seaside to Cape Falcon).

Data Improvements Needed

As previously stated, the coastal erosion hazard dataset used the best available data from detailed studies conducted by DOGAMI. However, this data does not cover the entire coastline and outside of very small, specific areas, the overall coastal erosion hazard in Lane, Douglas, Coos and Curry counties is relatively low. Therefore, DOGAMI recommends conducting detailed coastal erosion studies on a case-by-case basis within these counties. This recommendation should be included as a specific action item in the Oregon NHMP. Also, the data provided by DAS has incomplete building information including addresses, city names, zip codes, square footage, year built, construction type, and building replacement and total property values. It also does not have verified identification of those facilities that meet the criteria of a critical or essential facility. The state owned facility data should be improved for a more robust and comprehensive

evaluation. Inclusion of this recommendation as an action item in the Oregon NHMP is discussed elsewhere in this report.

**Please see Table 2.13: *State Owned Facility Vulnerability Assessment - Hazard Score Summary* for information regarding the scores used in this study. In addition, the ODPR website, http://csc.uoregon.edu/opdr/stateplan, includes a link to the full DAS state owned facility data depicting all hazard scores for each facility assessed in this study.

Earthquake

An earthquake is a sudden movement of a fault in the earth's crust, abruptly releasing strain that has accumulated over a long time. The movement along the fault produces waves of strong shaking that spread in all directions. If the earthquake occurs near populated areas, it may cause many deaths and injuries, and extensive property damage.

Oregon is affected by the Cascadia Subduction Zone where the Juan de Fuca plate slides underneath the North American plate. Earthquakes along this giant fault zone occur on average every 400-500 years, and can be extremely large. Oregon is also underlain by a large and complex system of faults that can produce damaging earthquakes. Although these smaller faults produce smaller earthquakes, they are often close to populated areas and damage can be great to structures nearby.

Earthquakes can trigger other geologic and soils failures that contribute to damage. While surface fault rupture can produce damage to facilities and infrastructure astride the fault, losses from this are minor compared to those resulting from strong ground shaking and associated ground failures. These include landslides, lateral spreading and slumping, and liquefaction.

The state facility vulnerability assessment used a combination of datasets that represent key geologic factors that contribute to earthquake hazard damage. This assessment utilizes three statewide earthquake hazard datasets created by DOGAMI to assess the exposure of state owned facilities to these hazards. They include: liquefaction susceptibility; ground shaking amplification factors (estimated strength of shaking for a 500 year probabilistic earthquake); and potentially active fault zones (buffer of faults based on the accuracy and scale of the original source information).

Liquefaction Susceptibility

Deposits of loose sand or silt that are saturated with water commonly liquefy when shaken strongly or repeatedly by an earthquake. The liquefied materials loose most of their ability to support overlying soil layers and structures, and buildings and bridges sink and tilt, while riverbanks may slump and flow into the river channel. In many large earthquakes, much of the damage that occurs is due to liquefaction. Although liquefaction is very damaging, it only affects specific geologic deposits. DOGAMI created a data layer for this assessment that generally represents where there are deposits that are susceptible to liquefaction if a strong earthquake were to occur. DOGAMI assigned liquefaction susceptibility values to the geologic units depicted in the Oregon Geologic Data Compilation (OGDC v5), and then categorized the values into Low, Moderate, and

High susceptibility categories. Bedrock is not susceptible to liquefaction, so all areas that are mapped as bedrock in OGDC are assigned to the liquefaction susceptibility category of "none." The state facility vulnerability assessment scored the facilities based on the liquefaction susceptibility category it is within, with the highest score applied to the 'High' category. See the assessment score summary in Table 2.13 for more information.

Ground Shaking Amplification Factors

Soft or loose soil and near-surface geologic deposits can greatly amplify the shaking in an earthquake. Research sponsored by U.S. Geological Survey (USGS) and Federal Emergency Management Agency (FEMA) has defined a series of site classes that can be used to calculate the amount of amplification that will occur. These are called NEHRP (National Earthquake Hazard Reduction Program) site classes and range from A (very hard rock, no amplification) to F (very soft soil with special characteristics that require detailed investigation). The site classes are formally defined on the basis of the velocity of shear waves (one form of earthquake shaking) in the upper 30 m (100 ft) of the earth's surface. Where shear wave velocity data are not available, general relationships between geologic material and site class have been established. DOGAMI used published and unpublished DOGAMI studies to create a statewide NEHRP site class data layer.

The USGS produces standardized seismic hazard maps for the nation through its National Seismic Hazard Mapping (NSHM) project. These take into account all possible earthquake sources and show the strength of shaking expected at several different probability levels including 10% chance in 50 years, 5% chance in 50 years, and 2% chance in 50 years. These maps show highly technical shaking parameters that are not readily understood by a non-technical audience and that do not relate simply to general earthquake damage. The maps also do not include the amplification effects of soft soils (as described above). DOGAMI created a derivative product that incorporates the site classes from the statewide NEHRP data and values representing perceived strength of shaking and general potential for damage. The state facility vulnerability assessment scored any facility that fell into a category of very strong to extreme perceived shaking as being vulnerable to an earthquake hazard. See the assessment score summary in Table 2.13 for more information.

Potentially Active Faults

Faults are considered active either when a large number of recorded earthquakes can be accurately located and shown to be along the fault, or where the fault has moved in geologically recent times and left a mark on the landscape or in young geologic deposits. These distinctions can be very difficult to make, and even more difficult to make accurately. The potentially active fault database created by DOGAMI for the state facility vulnerability assessment is a compilation of two primary fault databases; one from USGS, and the other from DOGAMI (OGDC v5).

Oregon's digital geologic database (OGDC v5) contains tens of thousands of mapped faults, the vast majority of which have been inactive for millions of years. The USGS (through its NSHM project) has also compiled databases of potentially active faults for many states including Oregon. The USGS databases/maps are

based on literature and include all faults for which there is some published evidence of movement (therefore earthquakes) in the past 10,000, 130,000, 750,000 or 1,600,000 years. However, the actual locations of the potentially active faults in this database were often taken from small scale compilation maps, and generally are not accurately drawn. Most of these faults are also contained in the OGDC database, but without detailed information regarding their potential activity. Therefore, to prepare the best available database of potentially active faults for Oregon, DOGAMI compared the faults in both databases and selected the version that reflected the most accurate location. In addition, the detailed information (attributes) from the USGS database was also carried forward and attached to each fault in the compilation regardless of its origin. The result is a fault database that combines the USGS information about fault activity with the most accurate available fault location.

In order to score the facilities for the vulnerability assessment, DOGAMI created buffers of the faults proportional to the accuracy and scale of the original source information. Therefore, faults with less accuracy and drawn at a smaller source scale (ex. scale 1:500,000) have a larger buffer than faults accurately located and drawn on a large scale (ex. scale 1:24,000). In the end, any facility located within an active fault buffer was scored as a vulnerable facility to the earthquake hazard. See the assessment score summary in Table 2.12, page 2-45, for more information.

Earthquake Hazard Facility Summary

Table 2.15 below summarizes the number of state owned facilities located within each of the earthquake hazard data layers as previously described. The table also includes the number of critical or essential facilities identified within each hazard. Note that individual buildings may be double or triple counted in Table 2.15.

Table 2.15: Summary of State Owned Facilities Located Within Earthquake Hazard Data Layers

Liquefaction Potential		500-year ShakeFigure		Active-Fault Buffer	
Total Facilities	Critical or Essential	Total Facilities	Critical or Essential	Total Facilities	Critical or Essential
770	29	3,296	118	423	22

Source: DOGAMI

To prioritize the facilities for the earthquake hazard for the State Hazard Mitigation Plan, a select set of the highest scores will be selected. The highest score selected set is defined as any facility within an active fault buffer, and within the 500 year ShakeFigure hazard (very strong to extreme perceived shaking categories), and within a high liquefaction potential category. The sum of the scoring values for this selected set of equals a value of 30. There are 29 facilities out of 5,802 that meet this criterion. They have a total property value estimated at $102 million dollars and are shown on Figure 2.3 (Earthquake Hazard). Three of the 29 are identified as critical or essential facilities.

Table 2.5 shows the 29 top scoring facilities. Table 2.16, shows the 10 most valuable facilities located within the earthquake hazard. Appendix 2-B includes

the full DAS data; the green highlighted column shows incomplete DAS data where the earthquake zone column is empty. Using this analysis, the DAS data should be updated to better reflect this hazard. There are also zero dollar values in the building replacement cost column which affect the estimated property values reported. Based on these findings, DOGAMI recommends including action items in the Oregon NHMP to reflect these needed improvement to the DAS data.

Table 2.16: 10 Most Valuable Facilities within an Earthquake Hazard Zone

Building Name	Critical or Essential	Building Replacement Value	Total Property Value
Main Facility	N	$358,636,793	$358,644,161
Millar Library	N	$51,956,445	$193,556,687
State Capitol	N	$152,645,795	$158,756,873
Medium Security Correctional Facility	N	$117,180,000	$118,005,987
Autzen Stadium	N	$96,422,000	$111,136,955
Klamath Hall	N	$74,607,000	$100,753,264
State Data Center	N	$23,181,749	$100,633,233
William W. Knight Law Center	N	$66,404,000	$92,239,095
Willamette Hall	N	$57,747,000	$77,018,731
DEQ Health Laboratory	N	$76,373,075	$76,407,388
	Total Value	**$1,075,153,857**	**$1,387,152,374**

Source: DOGAMI

Data Limitations

It is important to note that the methodology used for this vulnerability study is a very broad-scaled approach and does not fully assess the ability of a building to withstand the earthquake hazard. This method does not take into account structure type, construction materials, etc. which could largely affect the outcome of a vulnerability assessment. Also, the data provided by DAS does not have adequate structure information within its inventory of state owned facilities to conduct a more accurate earthquake vulnerability assessment. All state-owned facilities should have a site-specific study performed in order to more accurately assess a facilities' vulnerability to the hazard.

**Please see Table 2.13: *State Owned Facility Vulnerability Assessment - Hazard Score Summary* for information regarding the scores used in this study. In addition, the ODPR website, http://csc.uoregon.edu/opdr/stateplan, includes a link to the full DAS state owned facility data depicting all hazard scores for each facility assessed in this study.

Fire (Wildland-Urban Interface)

Wildfires are a common and widespread natural hazard in Oregon. Fire is a critical component of the forest and rangeland ecosystems found in all portions of the state. Over 41 million acres of forest and rangeland in Oregon are susceptible to wildfire, which may occur during any month of the year, but usually occur between July and October. In addition to wildland-urban interface fires, Oregon experiences wildland fires that do not threaten structures, and also occasionally has prescribed fires. The principal type affecting Oregon communities is interface fire, which occurs where wildland and developed areas intermingle with both vegetation and structures combining to provide fuel. As more people have moved into wildland interface areas, the number of large wildfires impacting homes has escalated dramatically. The areas of highest risk are in central, southwest, and northeast Oregon. Fuel, slope, weather, and development are key components in wildfire hazard identification.

The state facility vulnerability assessment used data from the Oregon Department of Forestry (ODF) to define the fire hazard areas and assess the number and value of state owned facilities at risk to fire hazard. For the purpose of this study, DOGAMI calculated fire vulnerability using two ODF datasets: an overall risk hazard rating and a protection capability rating. Protection capability risk is defined by an area with inadequate wildfire protection capabilities. For more detailed information regarding these datasets, please refer to the Oregon Wildfire Risk Assessment or contact an ODF representative (and review the WUI Fire Chapter).

Fire Hazard Facility Summary

To prioritize state owned facilities for the State Hazard Mitigation Plan, the two datasets are quantified independently of one another. Therefore, the high and very high categories of the overall risk hazard rating data layer are used, in addition to the moderate and high categories of the protection capability rating data layer. Of the 5,802 facilities evaluated, 203 fall within the overall risk hazard categories and are shown in Figure 2.4. When evaluating the facilities with the protection capability rating data, 1,380 facilities out of the 5,802, are located within the defined hazard parameters for this layer and are shown in Figure 2.5.

Based on DOGAMI's analysis, 14 state owned facilities are located in the high/very high categories of the overall hazard risk data and identified as a critical or essential facility. These facilities are valued at ~ $512K dollars. Additionally, 55 of the 1,380 facilities falling within the protection capability rating moderate and high categories are identified as a critical or essential facility. Nine of the fifty-five are within the high category alone and valued at ~ $279K dollars.

Data Limitations

It is important to note that the type of vulnerability study performed for this hazard is a very broad-scaled analysis. Because of the nature of the data used, this assessment overstates the number of facilities vulnerable to fire (low and medium categories). All state-owned facilities should have a site-specific study performed because structure risk for fire hazard can be better determined by analyzing the ignition zone surrounding the specific structure, in conjunction with

the identification of detailed structure type (roof type, construction materials, etc.). Also, the data provided by DAS does not have adequate structure information within its inventory of state owned facilities to conduct a more accurate fire hazard vulnerability assessment.

**Please see Table 2.13: *State Owned Facility Vulnerability Assessment - Hazard Score Summary* for information regarding the scores used in this study. In addition, the ODPR website, http://csc.uoregon.edu/opdr/stateplan, includes a link to the full DAS state owned facility data depicting all hazard scores for each facility assessed in this study.

Flood

Floods are a common and widespread natural hazard in Oregon. Flooding typically results from large-scale weather systems generating prolonged rainfall and from "rain on snow" events that cause large amounts of snowmelt.

In Oregon, these conditions are most common from October through April when storms from the Pacific Ocean bring intense rainfall. Flooding can be aggravated when streams are altered by human activity, such as through channelization of streams or loss of wetlands. Many types of flood hazards exist in Oregon, including riverine floods, flash floods (resulting from locally intense thunderstorms, ice jams and dam failures), coastal floods, shallow area and urban flooding and playa flooding. Flood hazards can cause severe property damage and loss of life. Oregon's largest economic loss from natural disasters has resulted from flooding.

The state facility vulnerability assessment uses a combination of FEMA effective and preliminary flood zone data, state digitized flood zone data, and FEMA Q3 data. DOGAMI scored facilities based on their location within a floodway, the 100 year floodplain (SFHA), or the Q3 100 year floodplain. Of highest concern, floodways are areas within the Special Flood Hazard Area (SFHA) that contain the channel of a river or other watercourse. Development in floodways is strongly discouraged and is allowed under very limited circumstances. Floodways entail a higher degree of risk for flooding and facilities within a floodway have been scored the highest value. The second area of flooding concern is the SFHA. Any facility within the SFHA and outside the floodway (for scoring purposes), is considered to be at risk for flooding and was scored the second highest value. This category includes the SFHA from FEMA effective and preliminary data and the state digitized flood zone data. Finally, the FEMA Q3 data is the least accurate of all of the flood data sources, but in rural areas of Oregon, it is the only data available. Therefore, state owned facilities within a Q3 flood zone were scored with the lowest non-zero value. Facilities outside these specific flood zones were given a score of zero. See Table 2.13, page 2-45, for the score values assigned to each flood data source.

Flood Hazard Facility Summary

Of the 5,802 facilities evaluated, 571 are currently located within the SFHA and have an estimated total value of roughly $500 million dollars. Twenty of the 571 are identified as a critical or essential facility, with one of the twenty located in a

floodway. Of the 571 facilities located in the SFHA, 55 are located in a floodway and have a high risk for flooding.

Table 2.9 shows the critical and essential facilities located within a flood hazard area; the ten most valuable facilities located within a floodway are shown in Table 2.17. Appendix 2-B includes the full DAS data; the green highlighted column shows incomplete DAS data where the flood zone column is empty. Based on this analysis, DOGAMI recommends that the DAS data be updated to better reflect the flood hazard. There are also a number of zero dollar values which affect the estimated property values reported.

Table 2.17: 10 Most Valuable Facilities within a Floodway (Flood Hazard)

Agency Name	Building Name	Critical or Essential	Building Replacement Value	Total Property Value
OSU	Oak Creek Building	N	$849,372	$976,778
DOC	City Water Pump House	N	$87,450	$587,450
ODOT	Santiam River RA NB Toilet Bldg	N	$506,038	$511,098
ODOT	Santiam River RA SB Toilet Bldg	N	$506,038	$511,098
DOC	Mill Creek Pump House	N	$163,298	$213,298
OSU	Oak Creek/Forestry Greenhouse	N	$184,104	$211,720
OPRD	Restroom Upriver	N	$198,450	$198,450
OPRD	Ian McLeod House	N	$175,000	$175,000
ODFW	OSU	N	$0	$127,895
ODOT	NB Ashland Scale House	N	$80,957	$121,435
		Total Value	**$2,750,707**	**$3,634,221**

Source: DOGAMI

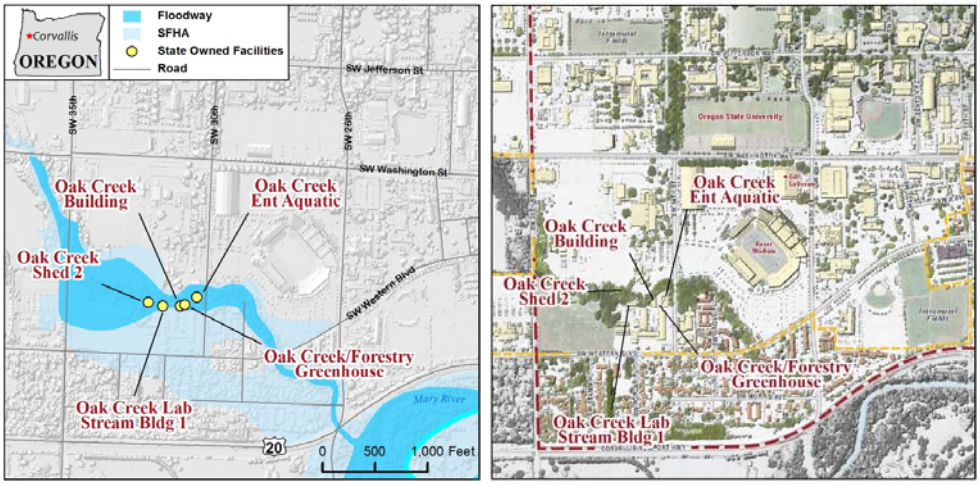
Data Improvements Needed

The flood hazard dataset used multiple data layers in order to fully cover the state of Oregon. FEMA is currently updating several counties of data which is shown in Figure 2.6 (Flood Hazards) as preliminary data. The effective FEMA data is the most recently updated data for the state. Both the state digitized flood data and the FEMA Q3 data layers need revision and update because of inaccuracy (created on poor topography source data) and the overall age of the data. These findings demonstrate the need for enhanced flood data in certain areas of the state. Therefore, DOGAMI recommends including flood data enhancement as an action in the Oregon NHMP.

As previously stated, the data provided by DAS has incomplete building information including addresses, city names, zip codes, square footage, year built, construction type, and building replacement and total property values. It also does not have verified identification of those facilities that meet the criteria of a critical or essential facility. Incomplete DAS data applies to all of the hazards considered in this assessment. Therefore, DOGAMI recommends including the update of DAS state owned building data as an action item in the Oregon NHMP.

**Please see Table 2.13: *State Owned Facility Vulnerability Assessment - Hazard Score Summary* for information regarding the scores used in this study. In addition, the ODPR website, http://csc.uoregon.edu/opdr/stateplan, includes a link to the full DAS state owned facility data depicting all hazard scores for each facility assessed in this study.

Figures 2.13 and 2.14: The maps shown here depict state owned facilities located within the floodway (left), and the same buildings identified on a DOGAMI lidar-derived city map of Corvallis (right).



Source: DOGAMI

Landslides and Debris Flow

Landslides are common, naturally occurring events in some parts of Oregon. Landslides occur when earth materials fall, slide, or flow down a slope or stream channel. They are classified by the type and rate of movement and the type of materials involved.

Landslides pose significant threat to many communities in Oregon and create challenges to development in steep terrain, coastal regions, and other landslide-prone areas. Landslides threaten transportation corridors, fuel and energy conduits, and community facilities. While not all landslides result in property damage, many landslides impact roads and other infrastructure, and can pose a serious life-safety hazard.

The state facility vulnerability assessment used the recent DOGAMI landslide inventory publication titled SLIDO-2 (Statewide Landslide Information Database for Oregon, release 2) and a steep slope factor to determine which state owned facilities are vulnerable to the landslide hazard. DOGAMI used a buffer of historic landslide point locations, other landslide inventory data layers (deposits, scarps, and scarp flanks), and a data layer depicting slopes greater than or equal to 26 degrees to define the hazard (steep slopes).

Landslide Hazard Facility Summary

Of the 5,802 facilities evaluated, 255 are located within a landslide hazard area and have a total property value estimated at $200 million dollars. Nine of the 255 are identified as a critical or essential facility and are located on a mapped landslide or fan/colluvium deposit. The landslide hazard area and the 255 state owned facilities are shown on Figure 2.7.

Table 2.10 lists the nine facilities identified as a critical or essential building. Appendix 2-B includes the full DAS data and has the facility score highlighted in purple. There are 32 facilities located within a landslide hazard area that have an estimated property value over $1 million dollars each. Table 2.18 shows 20 of the 32 most valuable buildings located within a landslide hazard area.

Table 2.18: 20 Most Valuable Facilities within a Landslide Hazard Zone

Agency Name	Building Name	Critical or Essential	Building Replacement Value	Total Property Value
SOU	Cascade Complex	N	$21,391,370	$23,530,507
SOU	Roy W McNeal Hall	N	$15,875,640	$16,034,396
SOU	Stevenson Union	N	$10,865,085	$11,951,593
SOU	Britt Center	N	$8,211,720	$9,032,892
SOU	Education Psychology Building	N	$7,798,890	$8,578,779
SOU	Music Building	N	$7,189,380	$7,908,318
SOU	Central Hall	N	$7,121,235	$7,833,358
SOU	Taylor Hall	N	$7,079,325	$7,787,257
SOU	Greensprings Complex	N	$7,280,416	$7,353,220
SOU	Theatre Arts	N	$6,577,230	$7,234,953
SOU	Churchill Hall	N	$6,184,200	$6,802,620
SOU	Marion Ady Building	N	$5,813,610	$6,394,971
SOU	Computing Services	N	$5,487,405	$6,036,145
DAS	Central Point Crime Laboratory	N	$5,261,720	$5,261,720
SOU	Stadium Facility	N	$4,318,545	$4,750,399
OMD	Ashland Armory	Y	$4,127,375	$4,132,918
EOU	Community Stadium	N	$3,420,832	$3,674,971
SOU	Art	N	$3,209,250	$3,530,175
UO	Aubrey Watzek House	N	$2,865,000	$3,294,750
SOU	Cox Hall	N	$2,623,610	$2,885,971
		Total Value	**$142,701,838**	**$154,009,913**

Source: DOGAMI

Data Limitations and Improvements Needed

Although DOGAMI used the most recent release of SLIDO, this database is an inventory of landslides and it does not include mapping of areas susceptible to future landslides. Such susceptibility maps are needed in order to aid community planners and zoning regulators in discouraging future development in landslide-prone areas. Susceptibility maps are also needed to more comprehensively assess the vulnerability of the state owned facilities. Finally, a more complete list of critical or essential facilities is needed in order to fully assess the impact on

these facilities, and the DAS inventory of state owned facilities should be improved to more accurately reflect the locations of facilities and their value.

**Please see Table 2.13: *State Owned Facility Vulnerability Assessment - Hazard Score Summary* for information regarding the scores used in this study. In addition, the ODPR website, http://csc.uoregon.edu/opdr/stateplan, includes a link to the full DAS state owned facility data depicting all hazard scores for each facility assessed in this study.

Tsunami

Tsunamis are caused by earthquakes under the ocean or by landslides into or under the ocean. A tsunami, often incorrectly referred to as a "tidal wave," is a series of waves that can travel great distances from their source and inundate coastal areas. The time of arrival of tsunami waves depends on a location's distance from the source event. For example, tsunami waves from local earthquakes may arrive between 5 and 30 minutes after the earthquake has started. Waves generated by distant sources may arrive hours after the earthquake has occurred. Tsunamis pose a real threat to Oregon coastal communities from Cascadia Subduction Zone earthquakes and also from distant earthquakes near Alaska or Asia. The estimated chance in the next 50 years of a great subduction zone earthquake is between 10 and 20 percent, assuming that the recurrence is on the order of 400 ± 200 years and that the last one occurred about 300 years ago.

The state facility vulnerability assessment used multiple datasets to score the state owned facilities along the Oregon coast. Three categories are defined to score the facilities for this assessment; high, moderate, and low. DOGAMI first used the inundation line, commonly known as the SB 379 line, to score any state owned facility seaward of its location. SB 379, implemented as Oregon Revised Statutes (ORS) 455.446 and 455.447, limits construction of new essential facilities and special occupancy structures. This dataset covers the entire coastline and provides a solid basis for initial facility scoring. Second, the assessment scored the facilities based on detailed studies performed by DOGAMI since 1996, which resulted in more meticulous tsunami inundation zones. The high hazard category applies to the results of both of these assessments. DOGAMI also used an elevation based criteria to create the moderate and low categories. The assessments scored any facility outside of the previously mentioned tsunami inundation zones, but located below specific land elevations. The moderate category scored those sites that occur landward of published tsunami maps and fall below an elevation of 80 feet in northern Oregon and 95 feet in southern Oregon; for this assessment the dividing line between northern and southern Oregon is Cape Blanco. The low category scored those sites that occur landward of published tsunami maps and fall between an elevation of 80 and 100 feet in northern Oregon and 95 and 120 feet in southern Oregon; the dividing line between northern and southern Oregon is Cape Blanco. The methodology for the elevation based criteria corresponds to a process defined and used in a statewide seismic needs assessment published by DOGAMI in 2007 (OFR O-07-02). The assessment uses all three of these datasets to define an all-encompassing tsunami hazard zone.

For more detailed information on the datasets and methodologies used, please see the following DOGAMI Publications: GMS-99 (Tsunami Hazard map, Siletz Bay area, 1996); IMS-2 (Tsunami Hazard Figure, Yaquina Bay area, 1998); IMS-03 (Tsunami Hazards, Seaside-Gearhart area, 1999); IMS-11 (Tsunami Hazard Figure, Astoria area, 1999); IMS-12 (Tsunami Hazard Figure, Warrenton area, 1999); IMS-13 (Tsunami Hazard Figure, Gold Beach area, 2000); IMS-21 (Tsunami Hazard Figure, Coos Bay area, 2002); IMS-23 (Tsunami Hazard Figure, Alsea Bay area, 2003); IMS-25 (Tsunami Hazard Figure, Florence-Siuslaw River area, 2007); OFR O-07-02 (Statewide Seismic Needs Assessment: Implementation of Oregon 2005 Senate Bill 2 Relating to Public Safety, Earthquakes, and Seismic Rehabilitation of Public Buildings, 2007); SP 41 (Tsunami Hazard Assessment of the Northern Oregon Coast: A Multi-Deterministic Approach Tested at Cannon Beach, Clatsop County, OR, 2009); and SP 43 (Simulating Tsunami Inundation at Bandon, Coos County, OR, Using Hypothetical Cascadia and Alaska Earthquake Scenarios, 2011).

Tsunami Hazard Facility Summary

Of the 5,802 facilities evaluated, 690 are currently located within the tsunami hazard zone and have an estimated total value of $234 million dollars. These facilities are shown on Figures 2-8 (Tsunami Hazards 1) and 2-9 (Tsunami Hazards 2). Twenty of the 690 are identified as critical or essential facilities. Of the 690 facilities, 257 received a high score because their location is seaward of the SB 379 or within one of the inundation zones defined by a detailed DOGAMI study (not an elevation based score).

Table 2.11 shows the 20 critical or essential facilities located within the tsunami hazard zone. The 12 most valuable facilities located within the tsunami hazard zone are shown in Table 2.19. Appendix 2-B includes the full DAS data; the pink highlighted row indicates the critical or essential facility with the highest total property value. The blue highlighted cells show incomplete DAS data where zero dollar values are present which affect the estimated property values reported.

Table 2.19: 12 Most Valuable Facilities within a Tsunami Hazard Zone

Agency Name	Building Name	Critical or Essential	Building Replacement Value	Total Property Value
OSU	Marine Science Laboratory	n	$10,199,280	$11,729,172
OSU	Newport Research	n	$5,426,685	$6,240,688
UO	OIMB Terwilliger	n	$3,560,000	$4,354,507
OSU	Potts-Guin Library	n	$3,507,900	$4,034,085
OSU	MSC Education	n	$1,397,000	$3,492,550
OPRD	Lighthouse Coquille	n	$3,051,815	$3,078,175
UO	OIMB Rippery Library	n	$1,517,000	$1,755,637
DHS		n	$0	$1,755,582
UO	OIMB Research Lab	n	$1,137,000	$1,626,081
ODFW	Marine Regional Headquarters	n	$1,120,000	$1,465,101
UO	OIMB South Classroom/Dorm	n	$1,132,000	$1,322,116
UO	OIMB Dining Hall/Dorm	n	$1,012,000	$1,163,800
		Total Value	**$33,060,680**	**$42,017,494**

Source: DOGAMI

Data Improvements Needed

DOGAMI is currently scheduled to perform detailed tsunami modeling for the entire Oregon coastline through July 2013. This work is built upon the methodologies tested and used in Special Papers 41 and 43 mentioned above. The State Hazard Mitigation Plan should use this more detailed information as it becomes available to more accurately define which state owned facilities are within the tsunami hazard zone. This information is included in the Tsunami chapter of the Oregon NHMP and will be reflected in a specific action item in the plan. In addition, a more complete list of critical or essential facilities is needed in order to fully assess the impact on these facilities. This finding demonstrates the need for additional data analysis and refinement by DAS and will be included as an action item in the Oregon NHMP. Finally, the DAS inventory of state owned facilities should be improved to more accurately reflect the locations of facilities and their value. Inclusion of this recommendation as an action item in the Oregon NHMP is discussed elsewhere in this report.

**Please see Table 2.13: *State Owned Facility Vulnerability Assessment - Hazard Score Summary* for information regarding the scores used in this study. In addition, the ODPR website, http://csc.uoregon.edu/opdr/stateplan, includes a link to the full DAS state owned facility data depicting all hazard scores for each facility assessed in this study.

Volcanic

Volcanic eruptions are most likely to occur in the Pacific Rim states, which include Oregon. The primary danger area around a volcano covers approximately a 20-mile radius, although there is some danger to people within 100 miles or more. Airborne ash from a volcano can affect people hundreds of miles away from the eruption. The most common volcano-related hazards are ash (tephra), lahars, lava and debris flows, avalanches, and pyroclastic flows.

DOGAMI utilized data from the U.S. Geological Survey (USGS) Cascades Volcano Observatory (CVO) for the state facility vulnerability assessment. CVO maintains proximal and distal hazard zone data for five volcanic areas in the Western Cascades of Oregon. These areas include: Mount Hood, Crater Lake, Newberry, Mount Jefferson, and the Three Sisters. The assessment scores each facility based on whether it is located within a proximal (high risk) or distal (moderate risk) hazard zone. Any facility located within these hazard zones is considered vulnerable to volcanic hazards.

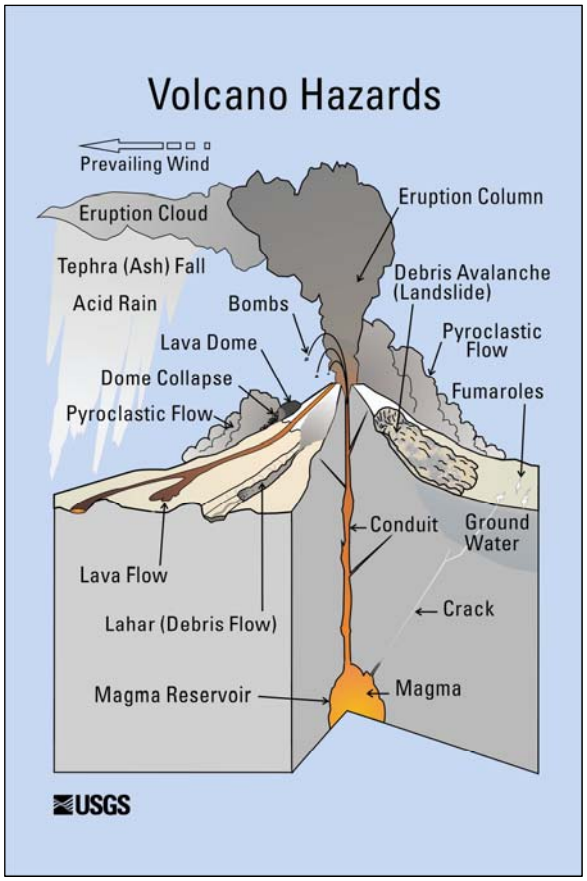


Figure 2.15. Volcano Hazards

Volcanic Hazard Facility Summary

Of the 5,802 facilities evaluated, 125 are located within a volcanic hazard area representing an approximate value of $24 million dollars. Of those, 18 are located in the proximal hazard zone which is considered to be the area of highest risk. Also included in the 125 are two facilities identified to be a critical or essential facility; one in each hazard zone.

Table 2.12 shows data for the two critical or essential facilities located within a volcanic hazard zone, as well as, all of the facilities located in the proximal hazard zone. The ten most valuable facilities within both the proximal and distal hazard zones are shown in Table 2.20. Figure 2.10 (Volcanic Hazards) depicts the volcanic hazard area and the 125 facilities located within the hazard area.

**Please see Table 2.13: *State Owned Facility Vulnerability Assessment - Hazard Score Summary* for information regarding the scores used in this study. In addition, the ODPR website, http://csc.uoregon.edu/opdr/stateplan, includes a link to the full DAS state owned facility data depicting all hazard scores for each facility assessed in this study.

Table 2.20: 10 Most Valuable Facilities Within a Volcanic (Proximal or Distal) Hazard Zone

Agency Name	Building Name	Critical or Essential	Building Replacement Value	Total Property Value
ODOT	Govt Camp Maintenance Sta Bldg	N	$1,657,417	$2,071,772
ODOT	Bennett Pass Equip Shed	N	$788,480	$985,600
ODOT	Govt Camp MS Dormitory	N	$932,071	$937,071
ODF	N Cascase/Santiam District Complex	N	$1,170,280	$2,829,443
ODOT	Detroit Maint Station Bldg	N	$1,590,888	$1,988,610
ODFW	Hatchery/ Offices/ Garage/ Shop/ Refer	N	$756,000	$1,594,353
ODOT	Sisters Maint Station Bldg	N	$1,189,933	$1,487,416
ODOT	Parkdale New Maint Station Bldg	N	$839,706	$1,049,632
ODOT	McKenzie Bridge Maint Sta Bldg	N	$740,229	$925,286
ODFW	Service Bldg. Office, Loading Dock +Roof Extension 7/00	N	$498,960	$875,361
		Total Value	**$10,163,964**	**$14,744,544**

Source: DOGAMI