REGION 1

Oregon Coast*

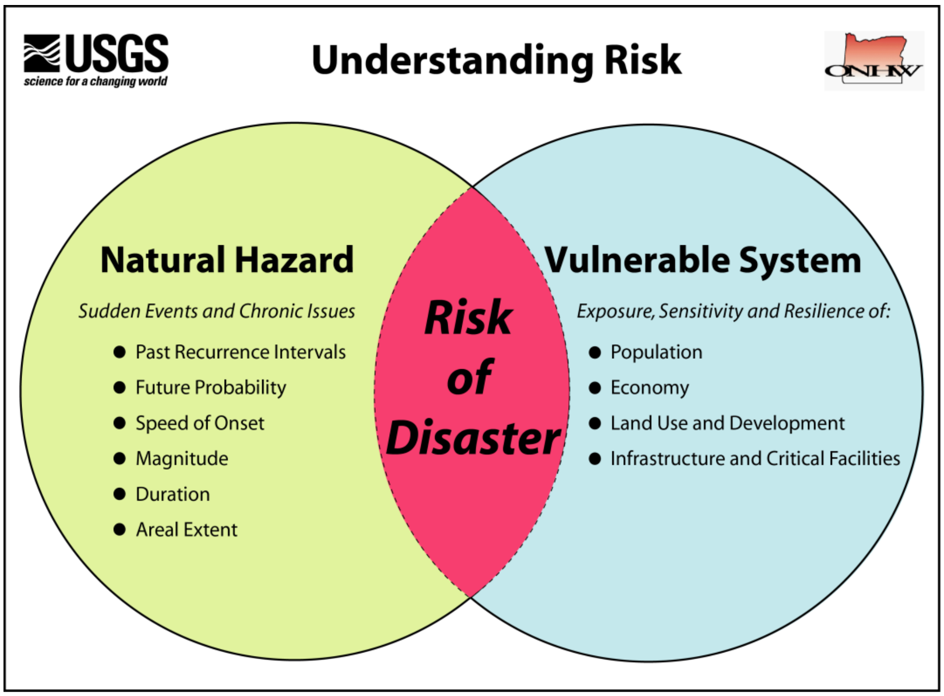
Regional Profile

* Region 1 includes all of Oregon's coastal counties: Clatsop, Coos, Curry, Douglas (coastal section), Lane (coastal section), Lincoln, Tillamook. The lower estuarine Columbia River is also included in Region 1 (Clatsop County).

Introduction and Purpose

Oregon faces a number of natural hazards with the potential to cause loss of life, injuries and substantial property damage. A natural disaster occurs when a natural hazard event interacts with a vulnerable human system. The following quote and graphic summaries the difference between natural hazards and natural disasters:

> Natural disasters occur as a predictable interaction among three broad systems: natural environment (e.g., climate, rivers systems, geology, forest ecosystems, etc.), the built environment (e.g., cities, buildings, roads, utilities, etc.), and societal systems (cultural institutions, community organization, business climate, service provision, etc.). A natural disaster occurs when a hazard impacts the built environment or societal systems and creates adverse conditions within a community.1



It is not always possible to predict exactly when a natural disaster will occur or the extent to which they may impact the community. However, communities can minimize losses from disaster events through deliberate planning and mitigation. A report submitted to Congress by the National Institute of Building Science's Multihazard Mitigation Council (MMC) highlights that for every dollar spent on mitigation society can expect an average savings of $4.[2]

How to use this Report

The Oregon Partnership for Disaster Resilience (OPDR) at the University of Oregon's Community Service Center developed this report as part of the regional planning initiative funded by the Pre-Disaster Mitigation Grant.[†] OPDR updated these reports in 2011/ 2012 using Hazard Mitigation Grant Program funds (DR-1733-0010). In addition to serving as a regional resource for local planning initiatives, these profiles inform the risk assessment section of the State's enhanced natural hazard mitigation plan.

Regional Overview

The Oregon Coast region (Region 1 as identified in the state's natural hazard mitigation plan) includes Clatsop, Coos, Curry, Douglas, Lane, Lincoln, and Tillamook Counties. Only the coastal portions of Douglas and Lane Counties are included in the Oregon Coast Region. Not all datasets referenced in this profile were available for the coastal areas only, when this was the case, data for the entire County has been provided. This region is at relatively high risk from coastal erosion, earthquakes, floods, landslides, and wind and winter storms. It also faces low to moderate risk from wildfires and volcanic events.

Organization of Report

This report includes four main sections that work together to develop a comprehensive picture of the region and its sensitivity to natural hazards.

Regional Maps

Critical Infrastructure Map

Using 2003 data from ODOT, this map shows the approximant location of critical infrastructure, including schools, hospitals, bridges, dams, and power stations. Knowing the location of critical infrastructure is important when determining the sensitivities of the region.

[†] FEMA Pre-Disaster Mitigation Agreement Number - EMS-2006-PC-0003

County Hazard Risk Analysis Maps

These maps depict the county's perceived risk for each natural hazard. Data for these maps comes from the County Hazard Risk Analysis in which each county develops risk scores for Oregon's major natural hazards. Scores are current as of March 2003.

Regional Profile and Sensitivity Analysis

Using the best readily available data, the regional profile includes a *Geographic Profile* that discusses the physical geography of the area, a *Demographic Profile* that discusses the population in the Oregon Coast region, an *Infrastructure Profile* that addresses the region's critical facilities and systems of transportation and power transmission, and an *Economic Profile* that discusses the scale and scope of the regional economy with a focus on key industries. In addition to describing characteristics and trends, each profile section identifies the traits that indicate sensitivity to natural hazards.

The data sources used in this section are all publicly available. This report examines the Oregon Coast region as a whole and by individual counties when possible.

Regional Hazards Assessment

The regional natural hazard risk assessment section describes historical impacts, general location, extent, and severity of past natural hazard events as well as the probability for future events. This information is aggregated at the regional level and provides counties with a baseline understanding of past and potential natural hazards.

These assessments were based on best available data from various state agencies related to historical events, repetitive losses, county hazard analysis rankings, and general development trends. The risk assessment was written in 2003 as part of the State Natural Hazard Mitigation Plan and updated as part of the 2012 state plan updates.

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.

Oregon Coast Region

Comprised of the state's costal line and the lower Columbia River, the Oregon Coast/Lower Columbia region has experienced an seven percent increase in population since 2000. This represents a lower rate of growth than other regions of the state. 63% of the region's population lives in incorporated areas. 28% percent of the region's houses were built before 1960, 36% between 1960 and 1980, and 36% were built after 1980. Transportation networks are an even greater consideration for the coastal region given the physical boundary of the ocean to the west and the Coast Range to the east. The average commute for workers in this region is 19 minutes each way. Seventy-three percent of the region's workers drive alone to work, 13% carpool, and five percent work from home. Most bridges in the area have not been seismically retrofitted, creating significant risk to the commuting population in areas at risk from earthquakes.

REGION FACTS*

Population: 2010 Census

Total 653,112
Rural 240,503
Urban.............................412,609

* Population and Housing data includes data outside of Region 1 for Douglas and Lane Counties.

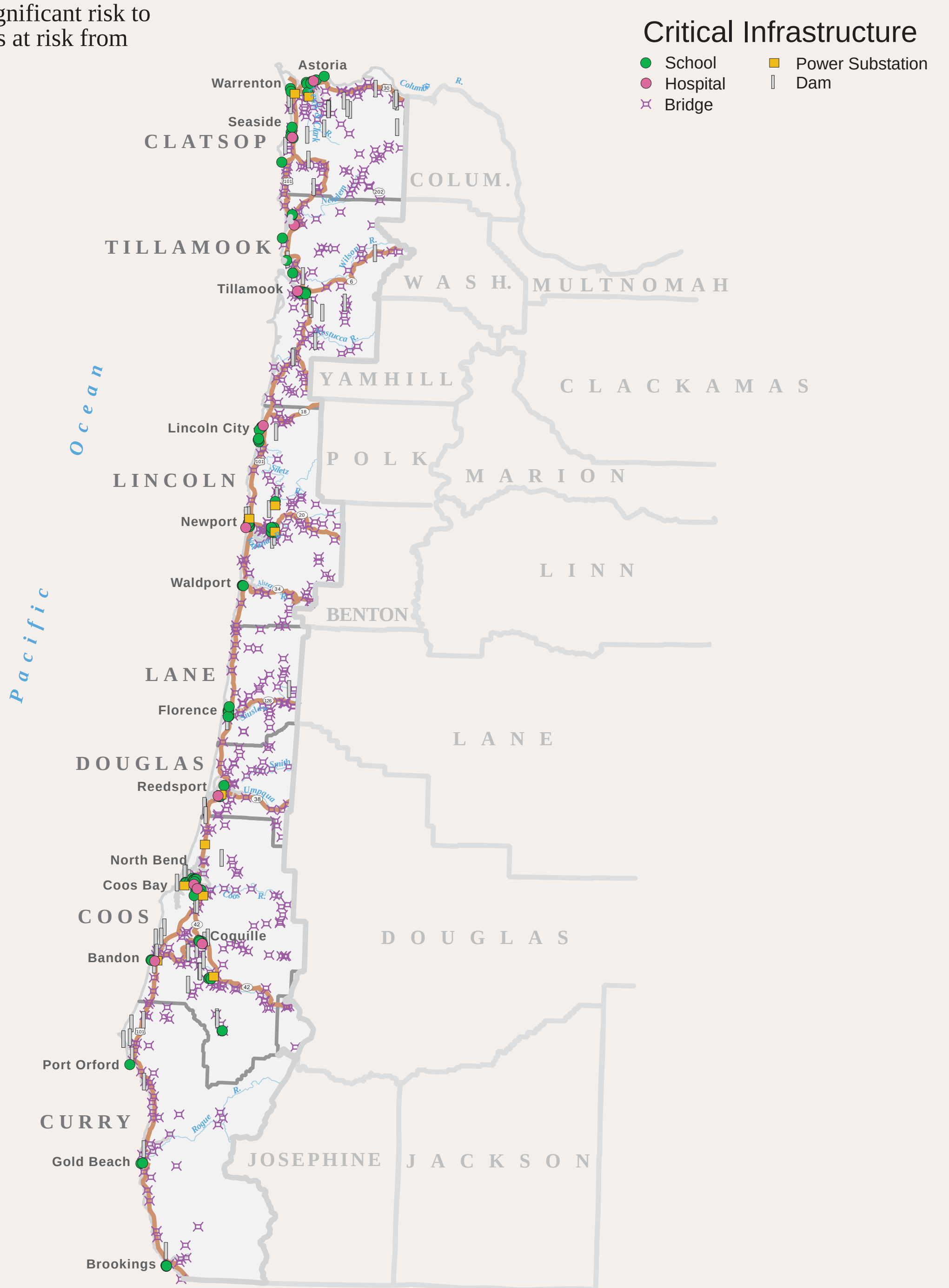
Housing:

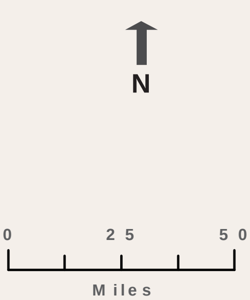
Single-Family 68%
Multi-Family 18%
Mobile Homes 13%
Boat, RV, Van, etc 1%

County	# of Hospitals	# of Hospital Beds	Police Stations	Fire & Rescue Stations	Power Plants	Dams*	Bridges
Clatsop	2	50	8	11	0	4	201
Coos	3	173	8	17	0	2	185
Curry	1	24	4	10	0	0	118
Douglas**	1	17	1	1	0	0	12
Lane**	1	21	1	1	0	0	19
Lincoln	2	50	5	8	0	5	159
Tillamook	1	29	8	7	0	0	171

* "High" Hazard Dams
**Coastal portions of Douglas and Lane Counties only.

Critical Infrastructure

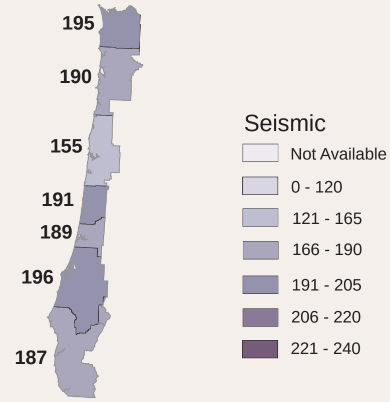




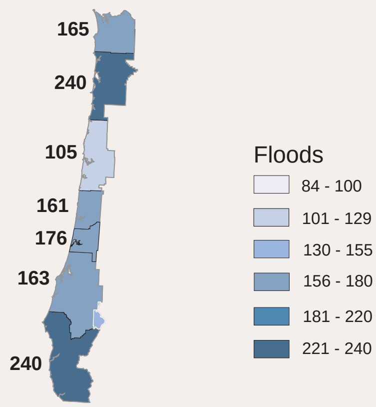
As part of the County Hazard Risk Analysis, each county develops risk scores for Oregon's major natural hazards. This score, ranging from 24 (low) to 240 (high), reflects the County's perceived risk for the particular hazard. Scores are current as of November 2008.

To obtain the most current scores, see http://www.oregonshowcase.org or contact Oregon Military Department – Office of Emergency Management http://www.oregon.gov/OMD/OEM.

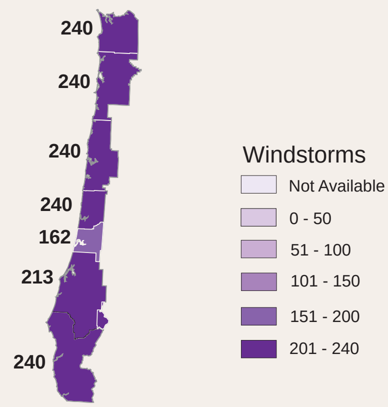
Seismic



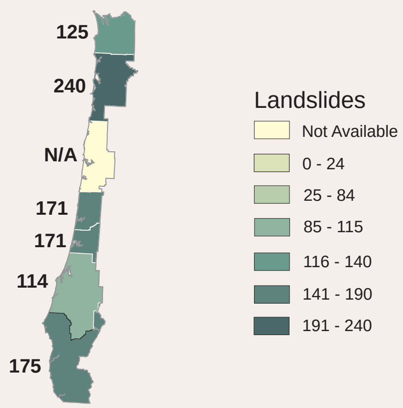
Floods



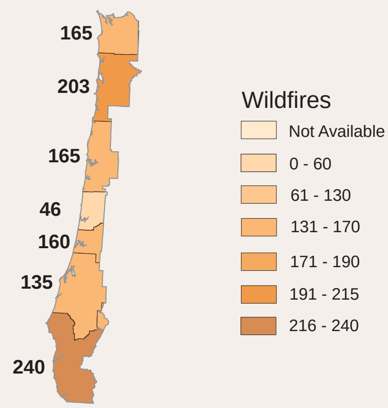
Windstorms



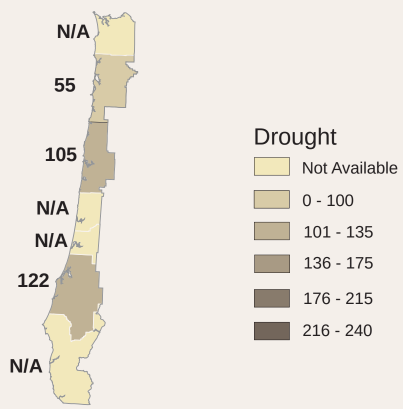
Landslides



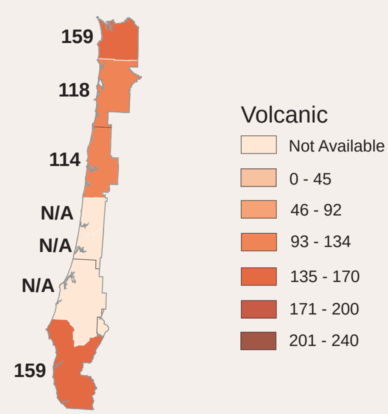
Wildfires



Drought



Volcanic



Regional Profile and Sensitivity Analysis

Section 1: Geography and Climate

The seven-county area of the Oregon Coast region is approximately 17,063 square miles. The Oregon Coast Range runs through the eastern part of the region and the Pacific Ocean borders the western part of the region. The Oregon Coast Range is volcanic in origin and is drained by hundreds of creeks, streams, rivers and lakes. Major rivers in the region include the Siuslaw, Umpqua, Nehalem, Rogue, Yaquina, Siletz, Nestucca, Trask, Wilson, Coos and Coquille. Average annual precipitation in the region ranges from 60 inches to 120 inches, with some locations receiving over 180 inches.[3]

Section 2: Demographic profile

This section describes the Oregon Coast region in terms of its population, demographics and development trends. Data is followed by a discussion of characteristics that indicate community vulnerability to natural hazards. Identifying populations that are particularly vulnerable enables communities to design targeted strategies to reduce their risk. Reviewing development trends provides further guidance on how communities can accommodate growth in a manner that increases resilience to natural hazards.

Population and Demographics

In 2010, the estimated population of the Oregon Coast Region was 653,112, representing an increase of 6.8% since 2000. This growth pattern in the Oregon Coast Region is projected to continue at a moderate rate over the next 20 years, according to the Oregon Office of Economic Analysis. Table 1 displays the population change in each Oregon Coast Region county.

Table 1. Population Growth, Oregon Coast Region, 2000-2010

County	2000 Population	2010 Population	2000-2010 Population Change	% Change 2000-2010
Clatsop	35,630	37,039	1,409	4.0%
Coos	62,779	63,043	264	0.4%
Curry	21,137	22,364	1,227	5.8%
Douglas*	100,399	107,667	7,268	7.2%
Lane*	322,959	351,715	28,756	8.9%
Lincoln	44,479	46,034	1,555	3.5%
Tillamook	24,262	25,250	988	4.1%
Regional Total	**611,645**	**653,112**	**41,467**	**6.8%**

*Data for only the coastal portions of the Counties were not available.

Sources: U.S. Census Bureau: 2000 Census Summary File 1. U.S. Census Bureau: 2010 Census Summary File 1.

The impact in terms of loss and the ability to recover varies among population groups following a disaster. Historically, 80% of the disaster burden falls on the public.[4] Of this number, a disproportionate burden is placed upon special needs groups, particularly minorities, and the poor. Minorities and the poor are more likely to be isolated in communities, are less likely to have the savings to rebuild after a disaster, and less likely to have access to transportation and medical care. Additionally, minorities and the poor are more likely to rent than own homes, and in the event of a natural disaster, where homeowners would gain homeowner insurance, renters often do not have rental insurance. As of 2009, 15.6% of the region's population was living in poverty.[5]

Median household income can be used to compare economic areas as a whole, but does not reflect how the income is divided among area residents. Table 2 displays the median household income for the Oregon Coast Region, which was $39,079 in 2009. This is below the 2009 national average of $51,425 and the state's average of $49,033. The 13.8% median household income growth between 2000 and 2009 in the region is smaller than the 19.8% State and 22.5% national increase.

Table 2. Median Household Income, Oregon Coast Region, 2000 and 2009

County	2000	2009	% Change 2000-2009
Clatsop	$36,945	$40,426	9.4%
Coos	$32,063	$36,754	14.6%
Curry	$31,131	$36,175	16.2%
Douglas*	$34,196	$40,324	17.9%
Lane*	$37,893	$42,852	13.1%
Lincoln	$33,431	$38,170	14.2%
Tillamook	$34,663	$38,851	12.1%
Regional Average:	**$34,332**	**$39,079**	**13.8%**

*Data for only the coastal portions of the Counties were not available.

Source: U.S. Census Bureau. 2005-2009. American Community Survey – 5 year estimates.

In 2009, 13.5% of the nation's population was living in poverty, nearly the same as Oregon's state poverty average of 13.6%. Oregon Coast's regional poverty level was 15.6%, slightly more than the national and state average. While the median household incomes are lower in the region than the state as a whole, the similar poverty rate may be due to a higher cost of living in the Oregon Coast Region. Table 3 details the county and regional poverty rates in 2009.

Table 3. Poverty Rates, Oregon Coast Region, 2009

	Total Population in Poverty		Children Under 18 in Poverty	
County	Number	%	Number	%
Clatsop	4,505	12.6%	1,332	16.9%
Coos	10,294	16.5%	2,652	21.4%
Curry	2,933	13.7%	580	16.1%
Douglas*	14,030	13.7%	4,270	19.3%
Lane*	54,248	16.2%	11,053	15.7%
Lincoln	7,803	17.3%	1,898	22.0%
Tillamook	3,739	15.4%	1,150	22.9%
Regional Average		**15.6%**		**17.6%**

*Data for only the coastal portions of the Counties were not available.

Source: U.S. Census Bureau. 2005-2009. American Community Survey – 5 year estimates.

For hazard mitigation, low-income populations need special considerations, because they may not have the savings to withstand economic setbacks, and if work is interrupted, housing, food, and necessities become a greater burden. Additionally, low-income households are more reliant upon public transportation, public food assistance, public housing, and other public programs, all which can be impacted in the event of a natural disaster.

The age of the population is also an important consideration in hazard mitigation planning. In 2010, 35% of the regional population was under 14 or over 65 years of age.[6] Table 4 provides a breakdown of the percentages of youth and elderly in the Oregon Coast region counties.

Table 4. Oregon Coast Region Youth and Senior Populations, 2010

	0-14		65-74		75+	
County	**Number**	**%**	**Number**	**%**	**Number**	**%**
Clatsop	6,221	16.8%	3,470	9.4%	2,690	7.3%
Coos	9,729	15.4%	6,684	12.0%	6,302	9.4%
Curry	2,790	12.5%	2,874	15.9%	3,072	12.1%
Douglas*	17,823	16.6%	10,158	11.3%	9,951	9.6%
Lane*	57,289	16.3%	23,451	8.1%	23,791	6.9%
Lincoln	6,515	14.2%	4,428	12.6%	4,200	9.0%
Tillamook	4,079	16.2%	2,598	12.1%	2,323	8.8%
Regional Total and Average %:	**104,446**	**16.0%**	**63,995**	**9.8%**	**52,508**	**8.0%**

*Data for only the coastal portions of the Counties were not available.

Source: U.S. Census Bureau: 2010 Census

The high percentage of elderly individuals, particularly in Curry County, require special consideration due to their sensitivities to heat and cold, their reliance upon transportation for medications, and their comparative difficulty in making home modifications that reduce risk to hazards.

Young people also represent a vulnerable segment of the population. With the exception of Curry and Lincoln Counties, at least 15% of the population of all coast counties is within the 0-14 year age range. Special considerations should be given to young populations and schools, where children spend much of their time, during the natural hazard mitigation process. Children are more vulnerable to heat and cold, have fewer transportation options, and require assistance to access medical facilities.

Special consideration should also be given to populations who do not speak English as their primary language. These populations can be harder to reach with preparedness and mitigation information materials. They are less likely to be prepared if special attention is not given to language and culturally appropriate outreach techniques. In the Oregon Coast Region, most citizens speak English as their primary language. However, in every county in Oregon, Spanish is the second most prominent language. Table 5 shows the percentage of the individuals in the Oregon Coast region who do not speak English as their primary language. On average, 3% of the total population in the Oregon Coast region speaks a language other than English as a primary language.

Table 5. Oregon Coast Region Population over age 5 that Speaks English less than "Very Well", 2009

County	%Population
Clatsop	3%
Coos	1%
Curry	1%
Douglas*	1%
Lane*	3%
Lincoln	4%
Tillamook	3%
Regional Average:	**3%**

*Figures only include the coastal areas of Douglas and Lane Counties.

Source: U.S. Census Bureau. 2005-2009. American Community Survey – 5 year estimates.

Housing and Development

To accommodate rapid growth, communities engaged in mitigation planning should address infrastructure and service needs, specific engineering standards and building codes. Eliminating or limiting development in hazard prone areas, such as floodplains, can reduce vulnerability to hazards, and the potential loss of life and injury and property damage. Oregon has been successful in developing land use goals that incorporate mitigation while preserving rural and protected lands within urban growth areas. Communities in the process of developing land for housing and industry need to ensure that land-use and protection goals are being met to prevent future risks.

The urban and rural growth pattern impacts how agencies prepare for emergencies as changes in development can increase risks associated with hazards. The Oregon Coast Region is growing more urban, with 10% population growth in incorporated areas between 2000 and 2010, versus a 2% population loss in unincorporated areas during the same time period. Table 6 illustrates the trend in urban area population growth in the Oregon Coast counties between 2000 and 2010.

Table 6. Urban/Rural Populations, Oregon Coast Region, 2000-2010

County	% Incorporated Population 2000	2010	% Change 2000-2010
Clatsop	63%	65%	2%
Coos	58%	62%	4%
Curry	40%	47%	7%
Douglas*	45%	49%	3%
Lane*	70%	74%	4%
Lincoln	57%	62%	3%
Tillamook	36%	38%	1%
Regional Average:	**53%**	**63%**	**10%**

*Data for only the coastal portions of the Counties were not available.

Source: Portland State University Population Estimates, 2010

In addition to location, the character of the housing stock also affects the level of risk that communities face from natural hazards. Table 7 provides a breakdown by county of the various housing types available in 2009. Mobile homes and other non-permanent housing structures, which account for over 15% of the housing in Coos, Curry, Douglas, and Lincoln counties, are particularly vulnerable to certain natural hazards, such as windstorms, and special attention should be given to securing these types of structures.

Table 7. County Housing Profile, Oregon Coast Region, 2009

County	Single-Family	Multi-Family	Mobile Homes	Boat, RV, Van, etc.
Clatsop	70.0%	23.0%	6.7%	< 1.0%
Coos	68.3%	13.5%	17.2%	< 1.0%
Curry	61.3%	11.5%	24.5%	2.6%
Douglas*	68.5%	11.4%	19.2%	1.0%
Lane*	67.3%	22.8%	9.5%	< 1.0%
Lincoln	67.3%	16.2%	15.6%	< 1.0%
Tillamook	77.3%	8.6%	13.8%	< 1.0%

*Data for only the coastal portions of the Counties were not available.

Source: U.S. Census Bureau. 2005-2009. American Community Survey – 5 year estimates.

Table 7 shows that the majority of the housing stock is in single-family homes and this trend is continuing with new construction. In 2010, an estimated 84% of new housing was single-family units.[7] This trend suggests that hazard mitigation efforts should provide outreach and information that specifically addresses preparedness in detached housing units.

Aside from location and type of housing, the year housing structures were built has implications for community vulnerability. The older a home is, the greater the risk of damage from natural disaster. This is because structures built after the late 1960s in the Northwest and California used earthquake resistant designs and construction techniques. In addition, FEMA began assisting communities with floodplain mapping during the 1970s, and communities developed ordinances that required homes in the floodplain to be elevated to one foot over Base Flood Elevation. Knowing the age of a structure is helpful in targeting outreach regarding retrofitting and insurance for owners of older structures. Table 8 illustrates the percentage of homes built per county during certain periods of time.

Table 8. Housing, Year Built, Oregon Coast Region

County	1939 or earlier - 1959	1960-1979	1980-2009
Clatsop	44%	24%	32%
Coos	35%	35%	30%
Curry	20%	30%	50%
Douglas*	29%	35%	36%
Lane*	25%	40%	35%
Lincoln	24%	34%	42%
Tillamook	31%	30%	40%

*Figures only include the coastal areas of Douglas and Lane Counties.

Source: U.S. Census Bureau. 2005-2009. American Community Survey – 5 year estimates

Section 3: Infrastructure Profile

This section of the report describes the infrastructure that supports Oregon Coast Region communities and economies. Transportation networks, systems for power transmission, and critical facilities such as hospitals and police stations are all vital to the functioning of the region. Due to the fundamental role that infrastructure plays both pre- and post-disaster it deserves special attention in the context of creating more resilient communities. The information that is provided in this section of the profile can provide the basis for informed decisions about how to reduce the vulnerability of Oregon Coast Region infrastructure to natural hazards.

TRANSPORTATION

There are two primary modes of transportation in the region: highways and railroad. There are also many small airports scattered throughout the region that are used for passenger and freight service.

Roads and Bridges

There is one major highway that runs through the Oregon Coast region. US-101 is a major transportation corridor that runs north-south through the Oregon Coast Region. This is an important transportation corridor along the Oregon Coast. A variety of highways connect coastal communities to inland communities.

- US Highway 26, intersects US-101 in Clatsop County and near Cannon Beach, respectively, on its way through the Portland Metropolitan area and points farther east;
- US Highway 42 intersects with US-101 and connects Coos Bay with Roseburg, and Interstate 5 and points north and south;
- Highway 28 intersects with US-101 and connects Reedsport with the Interstate 5 corridor just south of Cottage Grove;
- Highway 18 intersects with US-101 and connects Lincoln City with Salem and Interstate 5 and points farther north, south, and east;

- US Highway 30 intersects with US-101 and connects Astoria with the Portland Metropolitan area;
- Route 20 intersects with US-101 and connects Newport with Corvallis and Interstate 5 and points farther north, south and east; and
- US State highway 126 intersects with US-101 and connects Florence with Eugene/ Springfield, and Interstate 5 and points farther north, south and east.

Highways are also heavily utilized by local traffic. According to the 2009 American Community Survey, 73% of workers in the Oregon Coast Region commute by driving alone. The average commute for workers in the Oregon Coast Region is just over nineteen minutes each way.[8] Additionally, in 2009, 21% of employees living in counties in the Oregon Coast Region worked outside of their home county.[9] A severe winter storm or tsunami has the potential to disrupt the daily driving routine of thousands of people.

Over the last decade, the population growth in the region has contributed to an increase of automobiles on the roads:

- Average daily traffic volume on U.S. 101 recorded at the intersection of 25th Street in Newport increased by 2% between 2000 and 2009.[10]
- On U.S. 101 recorded 2.2 miles south of Rockaway, the average daily traffic between 1996 and 2010 increased by 1%.[11]
- Average daily traffic counts also increased by 5.5% between 1996 and 2010 on OR 126, 2.6 miles west of Elmira in Lane County. Judging from these trends, traffic levels will continue to increase [12]

A large increase of automobiles can place stress on roads, bridges and infrastructure within the cities, and also in rural areas where there are fewer transit roads. Natural hazards can disrupt automobile traffic and shut down local transit systems across the area or region and make evacuations difficult.

The condition of bridges in the region is also a factor that affects risk from natural hazards. Most bridges are not seismically retrofitted, which is a particularly important issue for the Oregon Coast region because of its risk from earthquakes. Incapacitated bridges can disrupt traffic and exacerbate economic losses because of the inability of industries to transport services and products to clients. Table 9 shows the number of state, county, and city maintained bridges and culverts, and the number of historic covered bridges in the region. The bridges in the region are part of the state and interstate highway and maintained by the Oregon Department of Transportation.

Table 9. Bridges and Culverts

County	State Highway Bridges	State Highway Culverts	County Highway Bridges	County Highway Culverts	City/ Municipal Highway Bridges	City/ Municipal Highway Culverts	Historic Covered Bridges	2011 Total
Clatsop	129	72	54	78	18	4	0	355
Coos	69	49	113	159	2	2	1	395
Curry	29	29	30	39	0	1	0	128
Douglas*	176	71	253	276	23	1	6	806
Lane*	288	112	417	347	68	3	18	1253
Lincoln	68	105	85	170	2	4	4	438
Tillamook	86	81	84	147	1	4	0	403

*Data for only the coastal portions of the Counties were not available.

Source: Oregon Department of Transportation, 2011, Oregon Department of Fish and Wildlife, Statewide Culvert Inventory, 2005

Railroads

Railroads are major providers of regional and national cargo and trade flows. Railroads that run through the Oregon Coast region provide vital transportation links from the Pacific to the rest of the country. There are five major coastal railroads: Willamette and Pacific (W&P), Central Oregon and Pacific (CORP), Longview Portland & Northern (LPN), Portland and Western (P&W), and Port of Tillamook Bay (POTB). These railroad lines connect to the Union Pacific (UP), CORP, and P&W north-south lines that run through the Willamette Valley farther east.[13]

Sixteen million tons of goods produced in Oregon are shipped out of state by railroad per year. The goods include lumber and wood products, pulp and paper, and miscellaneous mixed shipments.[14] Over 23 million tons of products originating in other states are annually shipped into Oregon by rail including wood, farm products, coal, and waste materials.[15] More than 22 million tons of products are shipped through Oregon annually by rail. More than 6 million tons of these products include grains and soybeans transported from the Northern Midwest to Washington.[16]

Rails are sensitive to icing from the winter storms that are common in the Oregon Coast region. For industries in the region that utilize rail transport, these disruptions in service can result in economic losses. As mentioned above, the potential for rail accidents caused by natural hazards can also have serious implications for the local communities if hazardous materials are involved.

Airports

The Oregon Coast Region has several airports. North Bend Municipal and Astoria Regional are the two largest airports in the region. Other airports in the region include Bandon State, Florence Municipal, Gold Beach Municipal, Newport Municipal, Seaside Municipal, Siletz Bay State, Tillamook, Cape Blanco State, Lakeside State, Nehalem Bay State, Pacific City State, Vernonia Airfield and Wakonda Beach State.[17] North Bend Municipal, the largest airport in the region, transported 200 tons of freight in 2003.[18]

Flights face the potential for closure from a number of natural hazards that are common in the Oregon Coast Region, including windstorms and winter storms. Airports have strict guidelines regarding when conditions are safe for flight.

Ports

Ports in the Oregon Coast Region are a major contributor to the local, regional, and national economies. There are three major deep draft ports in the region – Coos Bay/North Bend, Newport, and Astoria. In 1998, the port in Coos Bay shipped 3 million tons of goods, 97% of which were forest products. [19]

Critical Facilities

Critical facilities are those facilities that are essential to government response and recovery activities (e.g., police and fire stations, public hospitals, public schools). Critical facilities in the Oregon Coast Region are displayed in Table 10 by county.

Table 10. Oregon Coast Region Critical Facilities by County

	Hospitals				
County	# of Hospitals	# of Beds	Police Station	Fire & Rescue Station	School Districts & Colleges
Clatsop	2	50	8	11	5 SDs, 1 Community College
Coos	3	173	8	17	6 SDs, 1 Community College
Curry	1	24	4	10	3 SDs
Douglas*	2	157	9	26	14 SDs, 1 Community College
Lane*	5	578	10	23	16 SDs, 1 Community College, 1 State University, 3 Private Universities
Lincoln	2	50	5	8	1 SD, 1 Community College
Tillamook	1	29	8	7	3 SDs, 1 Community College

*Data for only the coastal portions of the Counties were not available.

Sources: State Hospital Licensing Department, USAcops.com, Oregon State Fire Marshall, Oregon Department of Education.

In addition to those listed in Table 10, there are other critical and essential facilities that are vital to the continued delivery of key governmental services or that may significantly impact the public's ability to recover from emergencies. Some of these facilities, such as correctional institutions, public services buildings, law enforcement centers, courthouses, juvenile services buildings, public works facilities, and other public facilities should be detailed in local and regional mitigation plans.

Power Generation and Transmission

Most of the Oregon Coast's oil and gas pipelines are connected to main lines that run through the Willamette Valley. The infrastructure associated with power generation and transmission plays a critical role in supporting the regional economy, and is therefore crucial to consider during the natural hazard planning process.

There are no major dams in the Oregon Coast region, but just east of the region, there are several major dams: Bonneville, Round Butte, Lookout Point, Carmen-Smith, Detroit, and Pelton dams all have maximum generating capacities of over 100 megawatts (mw's) of electricity.[20]

Dam failures can occur at any time and are quite common. Fortunately, most failures result in minor damage and pose little or no risk to life safety. However, the potential for severe damage and fatalities does exist, and the National Inventory of Dams (NID) has developed a listing of High Threat Potential Hazard dams for the nation. The state has developed a complementary inventory of dams in Oregon. Table 11 lists the dams included in the state inventory.

Table 11. Oregon Coast Region Power Plants and Dams by County

		Dams	
County	Power Plants	Dams‡ (State)	Threat Potential
Clatsop	0	6	4 High Threat
Coos	0	26	2 High Threat
Curry	0	8	0 High Threat
Douglas*	0	86	13 High Threat
Lane*	1 - 51.2 MWs	58	13 High Threat
Lincoln	0	7	5 High Threat
Tillamook	0	8	0 High Threat

*Data for only the coastal portions of the Counties were not available.

Sources: Oregon Department of Energy, Oregon State Water Resources

The electric, oil, and gas lines that run through the Oregon Coast region are privately owned. A network of electricity transmission lines, owned by Bonneville Power Administration and Pacific Power run through the Oregon Coast region.[21] Most of the natural gas Oregon uses originates in Alberta, Canada. Northwest Natural Gas serves the central region of the Oregon Coast.[22] These electric, oil, and gas lines may be vulnerable to severe, but infrequent natural hazards, such as

‡ Note: The National Inventory of Dams includes all dams with either:

a) a high or significant hazard rating

b) a low hazard dam that exceeds 25 feet in height AND 15 acre-feet storage

c) a low hazard dam that exceeds 6 feet in height AND 50 acre-feet storage earthquakes. There are three Liquid Natural Gas (LNG) projects currently being proposed in the Region – 2 in Clatsop County and one in Coos County.[23]

Section 4: Economic Profile

The following economic profile addresses the regional economy and its sensitivities to natural hazards. The sensitivities that are relevant to the Oregon Coast Region are a function of the types and diversity of industries and the composition of businesses that are present. To highlight key industries, this report will look at:

The largest revenue sectors, since interruptions to these industry sectors would result in significant revenue loss for the region.

The largest employment industries, since interruptions to these industry sectors would result in high unemployment in the region.

The industry sectors with the most businesses, since interruptions to these industry sectors would result in damage to the most businesses regionally.

By examining these key industry sensitivities and other economic sensitivities, such as industry diversity and the number of small businesses that exist in the Oregon Coast Region, informed decisions can be made about how to mitigate risk.

Economic Overview

The Oregon Coast Region enjoys some economic advantages due to its coastal location. In addition, the region's close proximity to the Coast Range, California, Washington, and the beach itself provide year-round sporting and tourism activities.

According to the Oregon Employment Department, the Oregon Coast Region economy is stabilizing after a downturn. Construction and Manufacturing are declining in all coastal counties. Tillamook, Lane and Lincoln have experienced moderate growth in the Education and Heath industries. Unemployment had decreased an average of 2% for all coastal counties between October 2010 and October 2011.[24] As of 2010, the region employed 238,546 people with a combined payroll of over eight billion dollars. Table 12 displays the payroll and employee figures per county.

Table 12. Oregon Coast Employment and Payroll by County, 2010

County	# of Employees	Annual Payroll	Average Pay
Clatsop	16,515	$517,591,154	$31,341
Coos	21,299	$665,782,970	$31,259
Curry	6,164	$184,465,719	$29,926
Douglas*	34,322	$1,143,674,197	$33,322
Lane*	134,572	$4,829,633,517	$35,889
Lincoln	17,207	$516,448,205	$30,014
Tillamook	8,426	$263,013,141	$31,063
Total	**238,546**	**$8,120,608,903**	**$34,042**

*Data for only the coastal portions of the Counties were not available.

Source: Oregon Employment Department[25]

In 2010, there were 19,333 private sector businesses in the Oregon Coast Region. Of these, 90%, or 17,448 were small businesses with less than 20 employees.[26§] The prevalence of small businesses in the Oregon Coast region is an indication of sensitivity to natural hazards because small businesses are more susceptible to financial uncertainty.[27] When a business is financially unstable before a natural disaster occurs, financial losses (resulting from both damage caused and the recovery process) may have a bigger impact than they would for larger and more financially stable businesses.[28]

The economic diversity of the businesses in the Oregon Coast Region varies markedly between counties. Lane County has the third highest statewide economic diversity, while the other counties have more homogenous economies. Low economic diversity means that certain industries are dominating the economic structure of the community, and are therefore extremely important to the Oregon Coast Region. Table 13 displays the diversity ranking for each county with 1 being the most diverse economic county in Oregon, 36 being the least diverse economic county in Oregon.

§ This data includes the number of private sector businesses for all of Lane and Douglas Counties, not just the coastal portions.

Table 13. County Economic Diversity Ranking, 2009

	Economic Diversity Index	
County	**Ranking**	**Value**
Clatsop	21	0.310
Coos	26	0.268
Curry	16	0.363
Douglas*	14	0.446
Lane*	3	0.827
Lincoln	22	0.319
Tillamook	25	0.286

*Data for only the coastal portions of the Counties were not available.

Source: Oregon Employment Department[29]

An economy that is heavily dependent upon a few key industries may have a more difficult time recovering after a natural disaster than one with a more diverse economic base. While a community with a diverse economic base may suffer from an industry sector being damaged during a natural disaster, they have a broader base of operating industry sectors to continue to rely upon. However, a community that relies upon specific key industry sectors may have a harder time recovering their economic base if one of those key industry sectors is damaged. Recognizing that economic diversification is a long-term issue, more immediate strategies to reduce vulnerability should focus on risk management for the dominant industries.

Key Industries

Key industries are those that represent major employers, major revenue generators, and for the purposes of hazard mitigation planning, industries that are represented by a high number of businesses. Different industries face distinct vulnerabilities to natural hazards, as illustrated by the industry specific discussions below. Identifying key industries in the region enables communities to target mitigation activities towards those industries specific sensitivities.

It is important to recognize that the impact that a natural hazard event has on one industry can reverberate throughout the regional economy. The effect is especially great when the businesses concerned belong to a basic sector industry. Basic sector industries are those that are dependent on sales outside of the local community; they bring money into a local community via employment. The farm and ranch, information, and wholesale trade industries are all examples of basic industries. Non-basic sector industries are those that are dependent on local sales for their business, such as retail trade, construction, and health and social assistance.

Basic sector businesses have a multiplier effect on a local economy, whereby the jobs and income they bring to a community allow for the creation of new non-basic sector jobs. Their presence can therefore help speed the recovery process following a natural disaster. If, on the other hand, basic sector industry production is hampered by a natural hazard event, the multiplier effect could be experienced in reverse. In this case, a decrease in basic sector purchasing power results in lower profits (and potentially job losses) for the local non-basic businesses that are dependent on them.

High Revenue Sectors

The Oregon Coast Region's top revenue generating industries are a mix of basic and non-basic sectors. In 2007, the three sectors in the Oregon Coast Region with the highest revenue were Manufacturing (38%), Retail Trade (34%), and Healthcare/Social Assistance (12%).[30] **

Within individual counties in the Oregon Coast Region, however, the industries' relative contribution to revenue differs. For instance, in Coos County, the Health Care and Social Assistance sector garners the second highest amount of revenue. Table 14 shows the percent of total county revenue that is contributed by various sectors.

Table 14. Percent of Revenue in Oregon Coast Counties by Industry, 2007

County	Retail Trade	Accommodation and Food Services	Health Care/ Social Assistance	Professional, Scientific and Technology	Other (except Public Admin)	Real Estate and Rental and Leasing	Arts/ Entertainment	Administrative/ Waste Services	Manufacturing
Clatsop	35%	9%	8%	1%	2%	2%	1%	1%	40%
Coos	45%	5%	21%	3%	4%	2%	n/a	3%	17%
Curry	39%	10%	11%	2%	2%	2%	1%	2%	33%
Douglas*	32%	6%	14%	2%	2%	1%	0%	2%	41%
Lane*	29%	4%	13%	4%	3%	2%	1%	2%	41%
Lincoln	34%	13%	10%	n/a	2%	3%	n/a	2%	36%
Tillamook	22%	5%	7%	1%	2%	1%	n/a	1%	61%

*Data for only the coastal portions of the Counties were not available.

Source: U.S. Census 2007

** Note: US Census Total Sales figures were not available for all sectors and counties in Region 1. These figures represent the closest estimate.

Table 15. Gross in Oregon Coast Counties for Farm and Ranch Industry, 2007

County	Dollar amount
Clatsop	16,752,000
Coos	55,256,000
Curry	32,388,000
Douglas*	81,601,000
Lane*	139,004,000
Lincoln	12,307,000
Tillamook	120,309,000

*Data for only the coastal portions of the Counties were not available.

Source: USDA National Agriculture Statistics Service[31]

In 2007, the *Manufacturing sector* generated 38% of all revenue in the Oregon Coast Region, making it the largest earning sector.[32] Manufacturers are highly dependent upon the transportation network in order to access supplies and send finished products to outside markets. As base industries they are not, however, dependent on local markets for sales, which contributes to the economic resilience of this sector.

The *retail trade sector* in the Oregon Coast region generated 34% of all revenue, making it the second-largest earning sector.[33] Retail trade is largely dependent on wholesale trade and the transportation network for the delivery of goods for sale. Disruption of the transportation system could have severe consequences for retail businesses. Retail trade typically relies on local residents and tourists and their discretionary spending ability. Residents' discretionary spending diminishes after a natural disaster when they must pay to repair their homes and properties. In this situation, residents will likely concentrate their spending on essential items that would benefit some types of retail (e.g. grocery) but hurt others (e.g. gift shops). The potential income from tourists also diminishes after a natural disaster as people are deterred from visiting the impacted area. In summary, depending on the type and scale a disaster could affect specific segments of retail trade, or all segments.

Wholesale trade is closely linked with retail trade but it has a broader client base than retail trade, with local and non-local businesses as the typical clientele. Local business spending will be likely to diminish after a natural disaster, as businesses repair their properties and wait for their own retail trades to increase. Distanced clients may have difficulty reaching local wholesalers due to transportation disruptions from a natural disaster. Both would adversely impact the profitability of this sector.

The *farm and ranch* sector is inherently dependent on the weather and is susceptible to a variety of natural hazards that afflict the Oregon Coast region, including flood, drought, and summer and winter storms. These natural hazards have the capacity to devastate seasonal crops, representing a significant financial loss for the year.

Major employment sectors

Economic resilience to natural disasters is particularly important for the major employment sectors in the region. If these sectors are negatively impacted by a natural hazard, such that employment is affected, the impact will be felt throughout the regional economy. Thus, understanding and addressing the sensitivities of these sectors is a strategic way to increase the resiliency of the entire regional economy.

The five sectors in the Oregon Coast region with the most employees in 2011 were Government (21%), Retail Trade (13%), Accommodation and Food Services (11%), Health Care and Social Assistance (13%), and Manufacturing (9%).[34]

Within the six Oregon Coast counties, the percent of county employment by various sectors differs. For example, in Clatsop and Lincoln counties, Accommodation and Food Services is a large employer, though across the region, Accommodation and Food Services accounts for a medium percentage of total employment. Table 16 shows the distribution of each county's employees across the five largest regional employment sectors.

Table 16. Percent of County Employment by the Five Largest Regional Employment Sectors, Oregon Coast Region, 2011

	Industry				
County	Government	Health Care and Social Services	Retail Trade	Manufacturing	Accommodation and Food Services
Clatsop	17%	13%	15%	11%	21%
Coos	28%	10%	13%	7%	10%
Curry	22%	n/a	16%	9%	15%
Douglas*	25%	12%	12%	12%	8%
Lane*	19%	15%	13%	9%	9%
Lincoln	23%	10%	15%	6%	22%
Tillamook	23%	10%	11%	15%	14%

*Data for only the coastal portions of the Counties were not available.

Source: Oregon Employment Department, 2011.[35]

Sectors that are anticipated to be major employers in the future also warrant special attention in the hazard mitigation planning process. Between 2005 and 2014, the largest job growth in the Oregon Coast Region is expected to occur in Professional and Business Services, Health and Educational Services and Construction.[36]

The *professional and business services* sector is sensitive to a loss of power from a disaster and to disruptions of physical transmission cables (phone lines, etc.). There may also be a disruption of employees' ability to work as a result of damages/problems at home. If prepared and organized, however, this sector has the potential to have moderate resilience to many disasters. Some of the targeted consumers of this sector's services are located outside the region and their purchasing power would not be impacted by a localized natural disaster. The sector may also be more insulated from disruptions to the transportation network than others because there is a potential for many of the employees to work from home and because some services are offered via internet and phone.

The *health and education service* sector includes medical facilities and schools, both of which are considered critical facilities. This sector is vital in the response and recovery phases of an event. If these critical facilities are not prepared, the ability of the community to recover can be diminished.

Common Business Types

Identifying sectors that are represented by a large number of businesses can guide the development of targeted mitigation strategies for those sectors. Approximately 32% of all businesses in the Oregon Coast Region fall into three industry sectors. In the Oregon Coast Region, 12% (2,539) of all businesses are engaged in *retail trade*, 10% (2,109) of all businesses are engaged in *accommodations and food services*, and another 10% (1,999) of all businesses are engaged in the health care and social assistance industry.[37]

In the event of wildfires, floods, earthquakes, or other types of destructive natural disasters, the demand for reconstruction services may be expected to increase. Business from local residents looking to re-build their homes and businesses may boost construction revenue. If transportation routes have been affected, construction businesses may have difficulty accessing necessary supplies from outside the impacted area. Protecting infrastructure and transportation will help to enable the construction sector to continue operating and re-building communities after a natural disaster.

Regional Profile and Sensitivity Conclusion

Information presented in the Community, Infrastructure, and Economic Profiles can be used to help communities identify areas of sensitivity and vulnerability to natural hazards. Once the areas of sensitivity are identified, communities should identify appropriate, corresponding action items.

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[14] Oregon Rail Plan: An Element of the Oregon Transportation Plan, 2001. http://www.oregon.gov/ODOT/RAIL/docs/railplan01.pdf.

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http://www.oregon.gov/ODOT/TD/TP/docs/otpMobility/FreightIssues.pdf

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[23] California Energy Commission. 2007. *West Coast LNG Projects and Proposals Status Update.* www.energy.ca.gov/lng/projects.html

[24] Oregon Employment Department, "Local Area Employment Statistics," http://www.qualityinfo.org/olmisj/labforce, accessed 12/7/11.

[25] Oregon Employment Department, "2010 Covered Employment and Wages Summary Report" (multiple counties), http://www.qualityinfo.org/pubs/cew/cew2010.pdf, accessed January 6, 2011.

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[35] Ibid.

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REGION 1

Oregon Coast[1]

Hazards Assessment

[1] Region 1 includes all of Oregon's coastal counties: Clatsop, Coos, Curry, Douglas (coastal section), Lane (coastal section), Lincoln, Tillamook. The lower estuarine Columbia River is also included in Region 1 (Clatsop County).

DROUGHT

Characteristics and Brief History

Droughts are not uncommon in the State of Oregon, nor are they just an "east of the mountains" phenomenon. They occur in all parts of the state, in both summer and winter months. Droughts appear to be cyclic, and can have a profound effect on the State's economy, particularly the hydropower and agricultural sectors. The environmental consequences also are far-reaching, including insect infestations in Oregon forests and a reduction in the stream flows that support endangered fish species. Severe drought conditions preceded the four disastrous Tillamook fires (1933, 1939, 1945, 1951) and pitted farmer against fish protection groups during the Klamath County drought of 2001. In recent years, the State has addressed drought emergencies through the Oregon Drought Council. This interagency (state/federal) council meets to discuss climate outlooks, water and soil conditions, and to advise the Governor as the need arises. Significant droughts are depicted in Table 1.

TABLE 1. SIGNIFICANT DROUGHTS

DATE	DESCRIPTION
1904-1905	A drought period of about 18 months throughout Oregon
1917-1931	A very dry period, punctuated by brief wet spells in 1920-21 and 1927 throughout Oregon
1939-1941	A three-year intense drought in Oregon
1976-1981	Intense drought in western Oregon; 1976-77 single driest year of century
1985-1997	Generally a dry period, capped by statewide droughts in 1992 and 1994
2000-2001	General statewide drought
2005	Federal drought declaration issued in Coos County

Source: Taylor, George H., and Ray Hatton, 1999, *The Oregon Weather Book.*

Probability

Oregon's drought history reveals many short-term and a few long-term events. The average recurrence interval for severe droughts in Oregon is somewhere between 8 and 12 years. Table 1 provides an overview of severe droughts in Oregon.

The probability that Region 1 will experience droughts is depicted in Table 2 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The scores below address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

High = One incident likely within a 10 to 35 year period.

Moderate = One incident likely within a 35 to 75 year period.

Low = One incident likely within a 75 to 100 year period.

In some cases, counties either did not rank a particular hazard or did not find it to be a significant consideration. These cases are noted with a dash (-) in the table below.

TABLE 2. Probability Assessment of Drought

	Clatsop	Coos	Curry	Douglas	Lane	Lincoln	Tillamook
Probability	-	H	-	-	-	H	L

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

Vulnerability

Region 1 is less vulnerable to drought impacts than most of Oregon, but droughts can still be problematic. Potential impacts to community water supplies are the greatest threat. Long-term drought periods of more than a year can impact forest conditions and set the stage for potentially devastating wildfires.

The region's vulnerability to drought is depicted in Table 3 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

High = More than 10% affected

Moderate = 1-10% affected

Low = Less than 1% affected

In some cases, counties either did not rank a particular hazard or did not find it to be a significant consideration. These cases are noted with a dash (-) in the table below.

TABLE 3. Vulnerability Assessment of Drought

	Clatsop	Coos	Curry	Douglas	Lane	Lincoln	Tillamook
Vulnerability	-	M	-	-	-	L	L

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

EARTHQUAKE

Characteristics and Brief History

The geographical position of Region 1 makes it susceptible to earthquakes from three sources: (1) the off-shore Cascadia Fault Zone, (2) deep intra-plate events within the subducting Juan de Fuca plate, and (3) shallow crustal events within the North America Plate. All have some tie to the subducting or diving of the dense, oceanic Juan de Fuca Plate under the lighter, continental North America Plate. Stresses occur because of this movement. (See Oregon Technical Resource Guide: Seismic Hazards.)

When crustal faults slip, they can produce earthquakes with magnitudes (M) up to 7.0 and can cause extensive damage, which tends to be localized in the vicinity of the area of slippage. Deep intraplate earthquakes occur at depths between 30 and 100 kilometers below the earth's surface. They occur in the subducting oceanic plate and can approach M7.5. Subduction zone earthquakes pose the greatest hazard. They occur at the boundary between the descending oceanic Juan de Fuca Plate and the overriding North American Plate. This area of contact, which starts off the Oregon coast, is known as the Cascadia Subduction Zone (CSZ). The CSZ could produce an earthquake up to 9.0 or greater.

There is no historic record of crustal earthquakes centered in this region in the past 156 years, although Oregon has experienced crustal earthquakes that originated outside the region. The geologic record shows that movement has occurred along numerous offshore faults as well as a few onshore faults in Coos and Tillamook counties. The faulting has occurred over the last 20,000 years. Intraplate earthquakes are very rare in Oregon, although such earthquakes originating outside of the state have been felt in this region. It is believed that the M7.3 near Brookings in 1873 was an intraplate quake.

In Region 1, earthquake hazards include severe ground shaking, liquefaction of fine-grained soils, landslides and flooding from local and tele-tsunamis. The severity of these effects depend on several factors, including the distance from the earthquake source, the ability of soil and rock to conduct seismic energy and the degree (angle) and composition of slope materials.

Since Oregon adopted the International Building Code 2003 (IBC 2003), it no longer uses the seismic zones to define the hazard. The IBC 2003 uses the maps from the USGS earthquake program, which depict a much more accurate spatial distribution of the hazard. The old Uniform Building Codes (UBC) maps displayed the hazard as spatially changing along county boundaries.

Table 4 describes significant earthquakes that have affected the region.

TABLE 4. SIGNIFICANT EARTHQUAKES

DATE	LOCATION	MAGNITUDE (M)	Comments
Approximate Years 1400 BCE* 1050 BCE 600 BCE 400 750 900	Offshore, Cascadia Subduction Zone	Probably 8-9	Based on studies of earthquake and tsunami at Willapa Bay, Washington. These are the mid-points of the age ranges for these six events.
01/1700	Offshore, Cascadia Subduction Zone	Approximately 9.0	Generated a tsunami that struck Oregon, Washington, and Japan; destroyed Native American villages along the coast
11/1873	Brookings area	7.3	Chimneys fell at Port Orford, Grants Pass, and Jacksonville. No aftershocks. Origin probably Gorda block of the Juan de Fuca plate. Intraplate event
11/1962	Portland	5.2 to 5.5	Damage to many homes (chimneys, windows, etc.). Crustal event
03/1993	Scotts Mills	5.6	$28 million in damage. Damage to homes, schools, businesses, state buildings (Salem). Crustal Event (FEMA-985-DR-OR)
09/1993	Klamath Falls	5.9 to 6.0	Two earthquakes causing two deaths and extensive damage. $7.5 million in damage to homes, commercial, and government buildings. Crustal event (FEMA-1004-DR-OR)

Source: Wong, Ivan and Bolt, Jacqueline, November 1995, A Look Back at Oregon's Earthquake History, 1841-1994, *Oregon Geology,* p.125-139.

Notes: *BCE: Before the Common Era

Probability

Scientists estimate the 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.[2]

Paleoseismic studies along the Oregon coast indicate that the state has experienced seven Cascadia Subduction Zone events possibly as large as M9 in the last 3500 years. These events are estimated to have an average recurrence interval between 500 and 600 years, although the time interval between individual events ranges from 150 to 1000 years. The last CSZ event occurred approximately 300 years ago.

The following probability estimates are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The probability scores below address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

High = One incident likely within a 10 to 35 year period.

Moderate = One incident likely within a 35 to 75 year period.

Low = One incident likely within a 75 to 100 year period.

TABLE 5. Probability Assessment of Earthquakes

	Clatsop	Coos	Curry	Douglas	Lane	Lincoln	Tillamook
Probability	M	M	M	M	M	H	M

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

Vulnerability

Region 1 is especially vulnerable to earthquake hazards. This is because of the built environment's proximity to the Cascadia Subduction Zone (CSZ), regional seismicity, topography, bedrock geology and local soil profiles. For example, a large number of buildings are constructed of unreinforced masonry (URM) or are constructed on soils that are subject to liquefaction during severe ground shaking. Also, some principal roads and highways are susceptible to earthquake-induced landslides. Bridges and tunnels need to be retrofitted to withstand ground shaking and the ability of dams to withstand earthquake forces should be considered. This is especially important as 12 dams in Region 1 have been designated as "high hazard." Problem areas within the region are readily identifiable on earthquake hazard maps prepared by the Oregon Department of Geology and Mineral Industries (DOGAMI).

In 2007, DOGAMI completed a rapid visual screening (RVS) of educational and emergency facilities in communities across Oregon, as directed by the Oregon Legislature in Senate Bill 2 (2005). RVS is a technique used by the Federal Emergency Management Agency (FEMA), known as FEMA 154, to identify,

[2] Oregon Geology, 2002

inventory, and rank buildings that are potentially vulnerable to seismic events. DOGAMI surveyed a total of 3,349 buildings, giving each a ‘low,’ ‘moderate,’ ‘high,’ or ‘very high’ potential of collapse in the event of an earthquake. It is important to note that these rankings represent a probability of collapse based on limited observed and analytical data and are therefore *approximate* rankings.[3] To fully assess a building’s potential of collapse, a more detailed engineering study completed by a qualified professional is required, but the RVS study can help to prioritize which buildings to survey.

Table 6 below shows the number of buildings surveyed in each county with their respective rankings.

TABLE 6. REGION 1 BUILDING COLLAPSE POTENTIAL

County	Level of Collapse Potential			
	Low (< 1%)	Moderate (>1%)	High (>10%)	Very High (100 %)
Clatsop	24	19	20	1
Tillamook	19	9	23	5
Lincoln	30	18	12	3
Lane*	8	4	5	-
Douglas**	3	2	10	-
Coos	41	11	48	7
Curry	15	10	10	2

Source: DOGAMI Seismic Needs Assessment, available at http://www.oregongeology.org/sub/projects/rvs/default.htm

* Includes only the Lane County coastal communities of Deadwood, Florence, Mapleton, and Swisshome

**Includes only the Douglas County coastal communities of Gardiner, Reedsport, and Winchester Bay

In addition to the RVS study, DOGAMI has also developed two earthquake loss models for Oregon based on the two most likely sources of seismic events: (1) the Cascadia Subduction Zone (CSZ), and (2) combined crustal events (500-year Model). Both models are based on HAZUS, a computerized program, currently used by the Federal Emergency Management Agency (FEMA) as a means of determining potential losses from earthquakes. The CSZ event is based on a potential 8.5 earthquake generated off the Oregon coast. The model does not take into account a tsunami, which probably would develop from the event. The

[3] State of Oregon Department of Geologic and Mineral Industries, Implementation of 2005 Senate Bill 2 Relating to Public Safety, Seismic Safety and Seismic Rehabilitation of Public Building, May 22, 2007, iv.

500-Year crustal model does not look at a single earthquake (as in the CSZ model); it encompasses many faults, each with a 10% chance of producing an earthquake in the next 50 years. The model assumes that each fault will produce a single "average" earthquake during this time. Neither model takes unreinforced masonry buildings into consideration

DOGAMI investigators caution that the models contain a high degree of uncertainty and should be used only for general planning purposes. Despite their limitations, the models do provide some approximate estimates of damage. Results are found in Tables 7-9.

Other useful resources for planning for earthquakes include the following:

- **Maps of earthquake hazard areas:** DOGAMI has mapped urban areas and relative Environmental Quality hazard maps for all of the Region 1 counties except Lane and Lincoln counties. DOGAMI has only mapped urban areas for these two counties.
- **Map of coastal critical facilities vulnerable to hazards:** DOGAMI has developed these maps for all Region 1 counties.
- **Environmental Geology of Land Use Geology maps:** DOGAMI has developed these maps for all Region 1 counties.
- **Nuclear energy/hazardous waste sites inventories**: No Region 1 counties have nuclear facilities.

TABLE 7. PROJECTED DOLLAR LOSSES BASED ON A M8.5 SUBDUCTION EVENT AND A 500-YEAR MODEL

REGION 1 COUNTIES	ECONOMIC BASE IN THOUSANDS (1999)	GREATEST ABSOLUTE LOSS IN THOUSANDS (1999) FROM AN M8.5 CSZ EVENT[1]	GREATEST ABSOLUTE LOSS IN THOUSANDS (1999) FROM A 500-YEAR MODEL[1,2]
Clatsop	$2,198,000	$549,000	$760,000
Coos	$3,263,000	$1,339,000	$1,429,000
Curry	$1,093,000	$371,000	$388,000
Douglas[3]	$4,631,000	$275,000	$546,000
Lane[3]	$15,418,000	$1,614,000	$3,044,000
Lincoln	$2,668,000	$624,000	$793,000
Tillamook	$1,539,000	$226,000	$364,000

Source: DOGAMI, 1999, Special Paper 29: Earthquake Damage in Oregon.

Table 7 Notes:

[1] "…there are numerous un-reinforced masonry structures (URMs) in Oregon, the currently available default building data does not include any URMs. Thus, the reported damage and loss estimates may seriously under-represent the actual threat" (page 126 – 1998, DOGAMI)

[2]Every part of Oregon is subject to earthquakes. The 500-year model is an attempt to quantify the risk across the state. The estimate does not represent a single earthquake. Instead, the 500-year model includes many faults, each with a 10% chance of producing an earthquake in the next 50 years. The model assumes that each fault will produce a single "average" earthquake during this time. More and higher magnitude earthquakes than used in this model may occur (DOGAMI, 1999).

[3]Entire county

TABLE 8. ESTIMATED LOSSES ASSOCIATED WITH A M8.5 SUBDUCTION EVENT

	Region 1 Counties							
	Clatsop	**Coos**	**Curry**	**Douglas**[1]	**Lane**[1]	**Lincoln**	**Tillamook**	**Remarks**
INJURIES	298	854	221	151	1,036	358	132	Cascadia Subduction Zone (CSZ) is the most dangerous fault in Oregon. The entire coastline is essentially the epicenter. The earthquake could have a magnitude 8.5 (or M9.0). The event might last as long as four minutes. Within a few minutes, a tsunami would follow. (Tsunami damages are not included in the estimates for this earthquake, and would dramatically increase losses for coastal counties). A CSZ earthquake could affect a very large area. If the entire fault ruptures, destruction could occur from northern California to Canada. The number of deaths and injuries depends on the time of day, building type, occupancy class, and traffic pattern. (DOGAMI, Special Paper 29, 1999, p.4).
DEATHS	6	16	3	2	19	7	3	
DISPLACED HOUSEHOLDS	788	2,069	430	255	2,345	592	158	
OPERATIONAL THE DAY AFTER THE QUAKE[2]:								
Fire stations	16%	10%	9%	66%	49%	26%	31%	
Police stations	15%	6%	5%	57%	42%	22%	44%	
Schools	16%	8%	6%	44%	46%	19%	32%	
Bridges	58%	44%	34%	74%	76%	51%	58%	
ECONOMIC LOSSES TO[2]:								
Highways	$18 mil	$44 mil	$48 mil	$43 mil	$39 mil	$16 mil	$25 mil	
Airports	$5 mil	$20 mil	$11 mil	$5 mil	$11 mil	$9 mil	$7 mil	
Communications	$6 mil	$25 mil	$18 mil	$7 mil	$11 mil	$9 mil	$5 mil	
DEBRIS GENERATED (thousands of tons)	383	853	267	222	1,341	446	158	

Source: DOGAMI, 1999, Special Paper 29: Earthquake Damage in Oregon.

Table 8 Notes:

[1]Entire county

[2]"…there are numerous un-reinforced masonry structures (URMs) in Oregon, the currently available default building data does not include any URMs. Thus, the reported damage and loss estimates may seriously under-represent the actual threat" (page 126 – 1998, DOGAMI).

TABLE 9. ESTIMATED LOSSES ASSOCIATED WITH A 500-YEAR MODEL[1]

COUNTIES	Clatsop	Coos	Curry	Douglas[2]	Lane[2]	Lincoln	Tillamook
INJURIES	397	845	212	294	2,254	436	181
DEATHS	8	16	3	4	45	9	4
DISPLACED HOUSEHOLDS	1,182	2,521	486	534	4,543	847	275
ECONOMIC LOSSES FOR BUILDINGS[3]	$760 mil	$1.4 bil	$328 mil	$546 mil	$3 bil	$792 mil	$364 mil
OPERATIONAL THE DAY AFTER THE QUAKE							
Fire stations	N/A[4]	N/A	N/A	N/A	N/A	N/A	N/A
Police Stations	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Schools	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bridges	N/A	N/A	N/A	N/A	N/a	N/A	N/A
ECONOMIC LOSSES TO:[3]							
Highways	$33 mil	$49 mil	$44 mil	$69 mil	$74 mil	$22 mil	$39 mil
Airports	$7 mil	$20 mil	$12 mil	$9 mil	$20 mil	$12 mil	$8 mil
Communications	$8 mil	$2 mil	$15 mil	$12 mil	$20 mil	$10 mil	$6 mil
DEBRIS GENERATED (thousands of tons)	474	864	261	411	2,424	525	224

Source: DOGAMI, 1999, Special Paper 29: Earthquake Damage in Oregon.

Table 9 Notes:

[1]Every part of Oregon is subject to earthquakes. The 500-year model is an attempt to quantify the risk across the state. The estimate does not represent a single earthquake. Instead, the 500-year model includes many faults, each with a 10% chance of producing an earthquake in the next 50 years. The model assumes that each fault will produce a single "average" earthquake during this time. More and higher magnitude earthquakes than used in this model may occur. (DOGAMI, 1999)

[2]Entire county

[3] "…there are numerous un-reinforced masonry structures (URMs) in Oregon, the currently available default building data does not include any URMs. Thus, the reported damage and loss estimates may seriously under-represent the actual threat" (page 126 – 1998, DOGAMI)

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

The region’s vulnerability to earthquakes is depicted in Table 10 below. The scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

High = More than 10% affected

Moderate = 1-10% affected

Low = Less than 1% affected

TABLE 10. Vulnerability Assessment of Earthquakes

	Clatsop	Coos	Curry	Douglas	Lane	Lincoln	Tillamook
Vulnerability	H	H	H	H	H	M	H

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

FIRES IN THE WILDLAND/URBAN INTERFACE

Characteristics and Brief History

Oregon has a very lengthy history of fire in the undeveloped wildlands and in the developing wildland/urban interface. In recent years, the cost of fire suppression has risen dramatically; a large number of homes have been threatened or burned, more fire fighters have been placed at risk, and fire protection in wildland areas has been reduced. These factors have prompted the passage of Oregon Senate Bill (SB) 360 (Forestland / Urban Interface Protection Act, 1997). This bill: (1) establishes legislative policy for fire protection, (2) defines urban/wildland interface areas for regulatory purposes, (3) establishes standards for locating homes in the urban/wildland interface, and (4) provides a means for establishing an integrated fire protection system.

Coastal and Lower Columbia River counties are heavily timbered and have a long history of devastating forest fires. Some of the history is derived from Native Americans who recall extensive forest fires before the arrival of Euro-Americans. Fires involving the wildland interface occur in portions of the state where urbanization and natural vegetation fuels allow a fire to spread rapidly from natural fuels to structures and vice versa. Especially in the early stage of such fires, structural fire suppression resources can be quickly overwhelmed increasing the number of structures destroyed. Such fires are known for the large number of structures that are simultaneously exposed to fire, increasing the total losses per structure ignited. Nationally, wildland interface fires commonly produce widespread, extreme losses. Thus far, Oregon has escaped the level of property losses experienced by neighboring states.

Table 11 describes the history of some of the significant wildland fires experienced in Region 1 and Oregon.

TABLE 11. SIGNIFICANT WILDFIRES

DATE	NAME OF FIRE	LOCATION	CHARACTERISTICS	REMARKS
1846	Yaquina	Lincoln & Lane counties	Burned over 450,000 acres.	Event related by Native American hunters
1853	Nestucca		Burned over 320,000 acres	
1868	Coos Bay	Coos	296,000 acres burned	
1922	Astoria	Downtown, City of Astoria	Many Buildings (32 city blocks burned!)	Early December structural fire most likely not related to wildfire
1933	Tillamook		240,000 acres burned	The Tillamook Forest burned every six years between 1933 and 1951. Total acreage burned was over 350,000 acres. Together, the four events are called the Tillamook Burn. Dry forest conditions seems to have been a major factor (Taylor)
1936	Bandon		143,000 acres burned	
1939	Saddle Mountain	Clatsop County	207,000 acres burned	
1945	Wilson River / Salmonberry	Tillamook County	173,000 acres	
1951	North Fork / Elkhorn	Tillamook County	33,000 acres burned	
2002	Florence/Biscuit	S.W. Oregon	Almost 500,000 acre (perimeter) burned	Largest forest fire in Oregon since arrival of Euro-Americans (FEMA Fire Suppression Authorization on 7/29/02). The perimeter contained many unburned islands within the overall acreage.

Source: Brian Ballou, 2002, A Short History of Oregon Wildfires, Oregon Department of Forestry, unpublished; and Oregon Emergency Management, State Natural Hazard Mitigation Plan, 2003, Wildland/Urban Interface chapter.

Probability

The natural ignition of forest fires is largely a function of weather and fuel; human-caused fires add another dimension to the probability. Dry and diseased forests can be mapped accurately and some statement can be made about the probability of lightning strikes. Each forest is different and consequently has different probability/recurrence estimates.

This document defines wildfire as an uncontrolled burning of forest, brush, or grassland. Wildfire always has been a part of these ecosystems and sometimes with devastating effects. Table 9 (above) provides an overview of the significant wildfires in Region 1. Wildfire results from natural causes (e.g., lightening strikes), a mechanical failure (Oxbow Fire), or human-caused (unattended campfire, debris burning, or arson). The severe fire season of 1987 resulted in a record setting mobilization of fire fighting resources. Most wildfires can be linked to human carelessness.

The intensity and behavior of wildfire depends on a number of factors including fuel, topography, weather, and density of development. There are a number of often-discussed strategies to reduce the negative impacts of these phenomena. They include land-use regulations, management techniques, site standards, building codes, and a recently passed Oregon Forestland-Urban Interface Fire Protection Act (1997). All of these things have a bearing on a community's ability to prevent, withstand, or recover from a wildfire event.

The probability that Region 1 will experience wildfires in interface areas is depicted in Table 12 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The probability scores below address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

High = One incident likely within a 10 to 35 year period.

Moderate = One incident likely within a 35 to 75 year period.

Low = One incident likely within a 75 to 100 year period.

TABLE 12. Probability Assessment of Fires in Interface Areas

	Clatsop	Coos	Curry	Douglas	Lane	Lincoln	Tillamook
Probability	H	M	H	H	L	H	M

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

Vulnerability

An understanding of risk begins with the knowledge that wildfire is a natural part of forest and grassland ecosystems. Past forest practices included the suppression of all forest and grassland fires. This practice, coupled with hundreds of acres of dry brush or trees weakened or killed through insect infestation, has fostered a dangerous situation. Present state and national forest practices include the reduction of understory vegetation through thinning and prescribed (controlled) burning.

Each year a significant number of people build homes within or on the edge of the forest (urban/wildland interface), thereby increasing wildfire hazards. Many Oregon communities (incorporated and unincorporated) are within or abut areas subject to serious wildfire hazards. In Oregon, there are about 240,000 homes worth around $6.5 billion within the urban/wildland interface. Such development has greatly complicated firefighting efforts and significantly increased the cost of fire suppression. These communities have been designated “Interface Communities” and include those in Table 13.

A detailed community inventory of factors that affect vulnerability is important in assessing risk and is beyond the scope of the statewide assessment.

When assessing the risks from natural hazards, established mitigation practices already provide benefits in reduced disaster losses. It is important for communities to understand the benefits of past mitigation practices when assessing their risks, being mindful of opportunities to further reduce losses.

Possible mitigation practices include:

- Identify and map current hazardous forest conditions such as fuel, topography, etc.;
- Identify forest / urban interface communities - List of interface communities, Federal Register, 08/17/01. V. 66, N. 160;
- Identify and map Forest Protection Districts;
- Identify and map water sources;
- Implement effective addressing system in rural forested areas;
- Clearly mark evacuation routes;
- Identify and locate seasonal forest users. Initiate information program through schools, summer camps, forest camping grounds, lodges, etc;
- Identify and map bridges that can (and cannot) support the weight of emergency vehicles. This is a basic requirement for fire suppression;
- Form committees to implement Oregon Senate Bill 360. This is required in Oregon Senate Bill 360; and
- Create road standards in interface areas to reflect fire suppression needs. Roads must be wide enough for fire suppression vehicles to turn around. Road grades cannot be too steep for large, heavy vehicles.

TABLE 13. WILDLAND/URBAN INTERFACE COMMUNITIES

COUNTIES							
Clatsop	Coos	Curry	Douglas	Lane	Lincoln	Tillamook	
Arch Cape	Bandon	Agness	Gardiner	Dunes City	Depoe Bay	Bay City	Oceanside
Astoria	Charleston	Brookings	Reedsport	Florence	E. Lincoln Co.	Beaver	Oretown
Brownsmead	Coos Bay	Gold Beach	Winchester Bay	Mapleton	Elk City	Blaine	Pacific City
Cannon Beach	Coquille	Langlois		Swisshorne	Lincoln City	Cape Meares	Pleasant Valley
Coastal Strip	Dora	Nesika Beach		Triangle Lake	Newport	Cloverdale	Rockaway
Elsie-Vinemaple	Fairview	Port Orford			Otter Rock	Foley Creek	Sandlake
Fern Hill	Green Acres				Rose Lodge	Garibaldi	Siskeyville
Ft. Clatsop	Lakeside				Seal Rock	Hebo	Tierra del Mar
Hamlet	Millington				Siletz	Hemlock	Tillamook
Hewell	Myrtle Point				Tidewater	Jordan Creek	Winema Beach
Knappa-Svensen	North Bend				Toledo	Lees Camp	Woods
Lewis & Clark	Powers				Waldport	Nehalem Bay	
Necanicum	Saunders Lake				Yachats	Neskowin	
Olney	Sumner					Netarts	
West Port							

Source: August 17, 2001, *Federal Register*: V.66, N.160.

The region's vulnerability to wildfires is depicted in Table 14 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

High = More than 10% affected

Moderate = 1-10% affected

Low = Less than 1% affected

TABLE 14. Vulnerability Assessment of Fires in Interface Areas

	Clatsop	Coos	Curry	Douglas	Lane	Lincoln	Tillamook
Vulnerability	M	M	H	H	L	M	H

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

FLOOD

Riverine Flooding

Characteristics and Brief History

In general, three types of flooding occur in this region: (1) riverine, (2) ocean flooding from high tides and wind-driven waves, and (3) flooding associated with a tsunami event. There are two distinct periods of riverine flooding in this region, winter and late spring. The most serious flooding occurs during December, January, and February. The situation is especially severe when riverine flooding, caused by prolonged rain and melting snow, coincides with high tides and coastal storm surges. In short, the rivers back up and flood the lowlands. This type of flooding is especially troublesome in the Tillamook Bay area where homes and livestock can be isolated for several days. There are other circumstances, as well. Several coastal rivers carry heavy silt loads that originated in areas burned during the "Tillamook Burn" fires (1933 to 1951) or from areas covered with volcanic ash during the Mt. St. Helens eruption (1980). Consequently, some rivers actually may be elevated above local floodplains, which increases flood hazards. The costs and long-term benefits of dredging these rivers have not been determined.

Table 15 describes the history of significant floods in the region. Table 16 describes flood sources.

TABLE 15. SIGNIFICANT FLOODS

DATE	LOCATION	DESCRIPTION	TYPE OF FLOOD
1813	NW Oregon	Said to exceed "Great Flood" of 1861 (Source: Native Americans)	unknown
12/1861	Coastal rivers	The "Great Flood"; largest flood of known magnitude on the Rogue	Rain on snow
02/1890	Coastal rivers	Widespread flooding; Siuslaw River dammed by a large debris flow	Rain on snow
01/1923	Lower Columbia	Mild temperatures; large amount of rain. Flooded roads / railroads	Rain on snow
03/1931	Western Oregon	Extremely wet and mild; saturated ground	Rain on snow
12/1933	Northern Oregon	Intense warm rains; Clatskanie River set record	Rain on snow
12/1937	Western Oregon	Heavy coastal rain; large number of debris flows	Rain on snow
10/1950	SW Oregon coast	Heavy October rain	Rain on snow
12/1953	Western Oregon	Heavy rain accompanied major windstorm; serious log hazards on Columbia	Rain on snow
12/1955	Columbia & coastal streams	Series of storms; heavy, wet snow; many homes and roads damaged	Rain on snow
12/1962	SW Oregon	Severe flooding, especially the Rogue River	Rain on snow
03/1964	Coast & Columbia River estuary	Ocean flooding	Tsunami
12/1964	Entire state	Two storms; intense rain on frozen ground	Rain on snow
01/1972	Northern coast	Severe flooding and mudslides; 104 evacuated from Tillamook	Rain on snow
01/1974	Western Oregon	Series of storms with mild temperatures; large snowmelt; rapid runoff	Rain on snow
12/1978	Coastal streams	Intense warm rain; two fatalities on Yaquina River; widespread flooding	Rain on snow
02/1986	Entire state	Warm rain and melting snow; numerous homes evacuated	Rain on snow
02/1987	Western Oregon	Heavy rain; mudslides; flooded highways; damaged homes	Rain on snow

Source: Taylor and Hannon, 1999, *The Oregon Weather Book*, pp.96-103

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

TABLE 15. SIGNIFICANT FLOODS (con't.)

DATE	LOCATION	DESCRIPTION	TYPE OF FLOOD
12/1989	Clatsop, Tillamook & Lincoln	Warm Pacific storm system. High winds. Fatalities. Mudslides	Rain on snow
01/1990	W. Oregon	Significant damage in Tillamook Co. Many streams had all-time records	Rain on snow
04/1991	Tillamook County	48-hour rainstorm. Wilson River 5 ft. above flood stage. Businesses closed	Rain on snow
02/1996	NW Oregon	Deep snow pack. Warm temperatures. Record-breaking rains.	Rain on snow
11/1996	W. Oregon	Record-breaking precipitation. Flooding. Landslides. (FEMA-1149-DR-OR)	Rain on snow
12/2005	Coos County Curry County Douglas County	$2,840,000.00 in property damage *figure also includes Jackson and Josephine Counties	Riverine
11/2006	Tillamook County	Heavy rains caused major flooding in Nehalem and Tillamook, causing $1 million in damage in Nehalem and $15 million in Tillamook	Riverine
11/2006	Lincoln County	Siletz River crested at 7 feet above flood stage	Riverine
12/2006	Coos County	Two floods in Coos County on the Coquille River inundated several roads, including Highways 42 and 42S.	Riverine
12/2007	Clatsop County	Storm total of 7.3 inches of rain, causing many rivers to overflow their banks. $9.15 million in damages	Riverine
12/2007	Tillamook County	Heavy rains led to flooding in Tillamook along the Wilson River damaging businesses, homes, the railroad to the Port. County-wide damages total 26 million.	Riverine
12/2007	Lincoln County	Siletz River had moderate flooding, causing flood damage near Siletz and Lincoln City. Total county-wide damages include $124,000 in damages inland, and $31,000 damages for coastal property.	Riverine
12/2007	Lane County	Flooding along cost, $31,000 in property damage.	Riverine
12/2007	Curry County	Rogue river exceeds flood stage, but no known damages.	Riverine
12/2008	Tillamook County	Heavy rainfall caused flooding in downtown Tillamook. Estimate of $3.8 million in damages throughout Tillamook County.	Riverine

Source: Taylor and Hannon, 1999, *The Oregon Weather Book*, pp.96-103

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

TABLE 16. PRINCIPAL RIVERENE FLOOD SOURCES

CLATSOP	COOS	CURRY	DOUGLAS	LANE	LINCOLN	TILLAMOOK
Lewis & Clark R	Coquille R	Chetco R	Umpqua R	Siuslaw R	Alsea R	Kilchis R
Little Walluski R	Willicoma R	Elk R	Smith R	Munsel Cr	Salmon R	Miami R
Necanicum R	Ten Mile Cr	Pistol R	Scholfield Cr		Siletz R	Nehalem R
Nehalem R	Palouse Cr	Rogue R			Yachats R	Nestucca R
Bear Cr	Larson Cr	Sixes R			Yaquina R	Three Rivers
Beerman Cr	Kentuck Sl	Winchuck R			Drift Cr	Tillamook R
Big Cr	Willanch Sl	Hunter Cr			Depot Cr	Trask R
Cow Cr	Pony Cr				Ollala Cr	Wilson R
Fishhawk Cr					Schooner Cr	Dogherty Sl
Humbug Cr						Hoquarten Sl
Little Cr						
Neacoxi Cr						
Neawanna Cr						
Northrup Cr						
Plymton Cr						

Sources: Federal Emergency Management Agency (FEMA), Clatsop County Flood Insurance Study (FIS), 7/17/01, FEMA, Coos County FIS, 5/15/84, FEMA, Curry County FIS, 2/04/98, FEMA, Douglas County FIS, 4/21/99, FEMA, Lane County FIS, 06/02/99, FEMA, Lincoln County FIS, 3/01/80, FEMA, Tillamook County FIS, 8/20/02.

Probability

FEMA has mapped the streams listed in Table 13 for 10, 50, 100, and 500-year flood events, with the probability of flooding in a year being 10%, 2%, 1%, and 0.2%, respectively. Areas subject to these floods are depicted on FEMA Flood Insurance Rate Maps (FIRMs), and profiled in an accompanying Flood Insurance Study (FIS). Recurrence intervals can differ between reaches of the same stream. For example, certain reaches of the Wilson River may experience a 100-year (1%) flood while other sections of the river may be having a 50-year (2%) or perhaps a 500-year (0.2%) flood event.

Flood Insurance Rate Maps (FIRM) depict flood conditions; however, many old maps are inaccurate. Communities may generate their own flood data with FEMA approval. The following is a list of Region 1 counties and the date of their most recent FIRM:

- Clatsop, June 16, 1999
- Coos, November 15, 1984
- Curry, February 04, 1998
- Douglas, April, 21, 1999
- Lane, June 02, 1999
- Lincoln, September 03, 1980
- Tillamook, August 20, 2002

Citizens of counties that participate in the Community Rating System (CRS) receive lower flood insurance rates. Douglas and Tillamook Counties participate in this program.

The probability that Region 1 will experience floods is depicted in Table 17 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The probability scores below address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

High = One incident likely within a 10 to 35 year period.

Moderate = One incident likely within a 35 to 75 year period.

Low = One incident likely within a 75 to 100 year period.

TABLE 17. Probability Assessment of Riverine Flooding

	Clatsop	Coos	Curry	Douglas	Lane	Lincoln	Tillamook
Probability	H	H	H	H	H	H	H

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

Vulnerability

Low-lying coastal areas in Region 1 are particularly vulnerable to flood hazards that can be exacerbated by high tides. The lower Siletz and Siuslaw rivers and the rivers that feed Tillamook Bay all experienced significant flood losses in 1996 and on other occasions in the following years. In fact, the significance of the 100-year flood event was lost when repetitive flood events impacting the City of Tillamook exceeded the base flood elevation numerous times especially in 1996, 1998 and 1999. Many pre- and post-FIRM buildings have experienced repetitive flood losses along Highway 101 in north Tillamook City and will likely continue to experience losses without mitigation.

The northern half of Region 1 is more susceptible to riverine flood damage that that to the south. This is because the northern half of the region is more densely populated and consequently contains much of the region's infrastructure. Physical location also makes a difference. For example, five rivers empty into Tillamook Bay, thereby increasing risk from riverine flooding on the relatively flat valley floor. Prudent emergency managers will consider physical location and at-risk populations and facilities during the preparation of all-hazard mitigation plans. Considerations include:

Structures At-Risk from a 1% Flood Event (excluding tidal / wind effects):

Pre-FIRM structures (residential and commercial)

Pre-FIRM structures (state-owned / occupied)

Repetitive Loss structures

Manufactured Homes (inside and outside manufactured home parks)

Critical Facilities At-Risk from a 1% Flood to include:

Hospital, Police, Fire, National Guard, Emergency Management (Ingress /Egress);

Transportation to include highway, rail, and airport;

Sewer and water treatment plants;

Energy facilities;

Communications

Economic Activities At- Risk from a 1% Flood to include:

Motel / hotel operations

Highway oriented businesses (especially in Tillamook area)

Buoyant materials storage (e.g., logs, fuel drums)

Food outlets (e.g., grocery stores)

Special Considerations to include:

Special populations (e.g., minority, handicapped, non-English speaking)

Institutions / incarceration facilities

Schools / Day-Care

Hazardous materials sites

The physical condition of dams

The physical condition of dams on the Umpqua and Rogue rivers warrants special consideration. These two large rivers rise in the Cascade Mountains and consequently are subject to heavy snow packs at higher elevations. Rapid snowmelt in the upper watershed can produce serious flood conditions. The flood potential is somewhat mitigated by several impoundments. Dam failure, for whatever reason, seriously threatens downstream communities --- and this is a consideration for Region 1 emergency managers. High hazard dams are discussed in the section dealing with Critical Facilities, Infrastructure, and High Hazard Installations.

The region's vulnerability to floods is depicted in Table 18 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

High = More than 10% affected

Moderate = 1-10% affected

Low = Less than 1% affected

TABLE 18. Vulnerability Assessment of Riverine Flooding

	Clatsop	Coos	Curry	Douglas	Lane	Lincoln	Tillamook
Vulnerability	M	H	H	M	H	L	H

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

A number of local governments in Region 1 have initiated and accomplished building elevation and /or buy-out programs. And the concept of a 100-year flood seems to have been replaced with that of a 1% flood. Also, dairy farmers and other businesses have made considerable progress in protecting their investments. Project Impact, which produced partnerships between local government and the business community, was probably more successful on the Oregon Coast (i.e., Region 1) than anywhere else in the state. But much remains to be done. Prudent Region 1 communities will:

Revisit the effectiveness of dikes and other hardened structures. This is especially noteworthy in the lower Rogue and Smith rivers where levees and riprap do not offer 100-year protection (Curry County FIS, pp. 6-7; Coos County FIS, p.10; Douglas Co. FIS, p.6);

Consider the costs and benefits of constructing dikes in vulnerable populated areas (e.g., City of Florence, Lane County FIS, p.12); and

Revisit problems associated with the accumulation of streamside debris. The accumulation of woody debris often forms dams which inevitability fail during periods of high water (Lane County FIS, p. 12). The result can be devastating. Much of the problem is linked to efforts to enhance fish habitat. Despite the availability of some fish-friendly floodplain ordinances, the streamside debris problem has not been resolved. There is a discernible need for county officials to discuss the problem with appropriate state and federal agencies.

Ocean Flooding / Wave Action

Characteristics and History

Flooding from wind-driven waves is a common event on the Oregon coast. This is particularly true during the winter storm season, during El Niño events, and when spring and perigean tides occur. The Federal Emergency Management Agency has identified and mapped coastal areas subject to direct wave action (V zones) and sand dune over-topping (AH and AO zones). Direct wave action was especially severe during the winter storm events of 1972 (Siletz Spit), 1978 (Nestucca Spit), and the El Niño events of 1982-83 and 1997-98. Beach and cliff erosion were significant during these periods and a number of homes were destroyed. The following lessons were learned (and oftentimes forgotten between damaging events):

- Oregon coastal processes are complex and dynamic, sometimes eroding, sometimes aggrading;
- Some sections of the Oregon coast are rising in relation to ocean levels, others remain fairly constant or are becoming lower (Komar 1992, 40-41);
- Primary frontal dunes provide protection from ocean storms;
- Sand spits are not permanent features;
- Erosion rates vary and are dependent on several factors including storm duration and intensity, composition of sea cliff, time of year, and impact of human activities (e.g., altering the base of sea cliffs, interfering with the natural movement of beach sand).

Probability

Ocean storms can be expected every year. El Niño effects, which tend to raise ocean levels, occur about every three to five years (Taylor and Hannan, 1999). V (wave velocity) zones, depicted on FEMA's Flood Insurance Rate Maps, are areas subject to 100-year events (i.e., 1% chance in any given year). The Flood Insurance Rate Maps show areas vulnerable to wave action (V zones), ponding and sheet-flow from waves over-topping dunes (AO and AH zones). All of the counties in Region 1 have hazardous areas identified on the maps. DOGAMI and FEMA also provide information about wave action.

Vulnerability

A number of buildings, parks, infrastructure, and critical facilities in Region 1 are vulnerable to ocean storms. This is most obvious in low-lying areas adjacent to bays or the ocean; It is also evident at higher elevations where buildings and infrastructure have been located on readily erodable materials (e.g., consolidated sand, weakly cemented sandstone, siltstone, etc.). The problem is historic. There are numerous examples of buildings and infrastructure destroyed by wave attack / erosion --- some of which are classic (e.g., Bay Ocean development, Salishan Spit, Jumpoff Joe, Rogue Shores, The Capes development, etc.). Buildings and infrastructure probably will continue to be built in harm's way despite stringent building requirements and enlightened planning commissions.

Unlike the East and Gulf coasts, only a few of Oregon's coastal developments are within FEMA-designated Velocity (V) zones. Those that are appear to be constructed according to V-zone standards.

A number of coastal developments are protected by primary frontal dunes (as defined in 44 CFR) that are in various stages of accretion or erosion. In some situations, FEMA has allowed accreting dunes to be lowered in order for property owners to retain unobstructed ocean views. The vulnerability of the homes has not been increased. This policy would change, however, should erosion surpass accretion. Many residential structures are located in areas subject to flooding from wave over-topping (e.g., AO and AH zones). However, very few appear to have been flooded, probably because of elevation requirements.

Region 1 counties have not inventoried all buildings that are vulnerable to wave action (i.e., in V zones); however some pertinent information is available from the National Flood Insurance Program (NFIP). These data are provided to the state and include the address of buildings insured through the NFIP, flood zones in which they are located, claims, and location of repetitive loss structures.

Coastal highways are always problematic. In Region 1, much of the problem is linked to the local geology. This has been mapped as part of DOGAMI's environmental geology series. Bedrock conditions can and do change abruptly within very short distances. This results in an inconsistent highway foundation; some sections are more susceptible to wave action than others and require continuous maintenance. There is no practical solution outside of relocation of the highway; this option is not financially feasible at this point in time. On the positive side, the State Highway Division and Region 1 counties are adept in rerouting traffic. This will continue to be part of the solution.

LANDSLIDES / DEBRIS FLOWS

Characteristics and Brief History

Landslides and debris flows always have and always will shape Oregon's landscape. Landslides become problematic, however, when people place buildings and infrastructure in harm's way. Additionally, development practices can cause or contribute to the severity of landslides.

There are several categories of landslides, based on configuration (slide mechanism), slide materials, and rate of movement. Some slides are ancient, deep-seated, and slow moving. Others move rapidly as a mass of rock, mud, and large woody debris. All can be problematic when in the vicinity of buildings and infrastructure. Fast-moving landslides, or debris flows, occur throughout Oregon, but are especially noteworthy in the Cascade and Coast Ranges.

Debris flows (mudslides, mudflows, debris avalanches) are a common type of rapidly moving landslide that generally occur during intense rainfall on previously saturated ground. They usually begin on steep hillsides as slumps or slides that liquefy, accelerate to speeds as great as 35 mph or more, and flow down slopes and channels onto gently sloping ground. Their consistency ranges from watery mud to thick, rocky, mud-like wet cement, dense enough to carry boulders, trees, and automobiles. Debris flows from different sources can combine in canyons and channels, where their destructive power is greatly increased. In general, slopes that are over 25% or have a history of landslides might signal a landslide problem.

Landslides / debris flows probably accompany every major storm system that impacts western Oregon. In recent events, particularly noteworthy landslides accompanied storms in 1964, 1982, 1966, and 1996. Two major landslide producing winter storms occurred in Oregon during November 1996. Intense rainfall on recently and past logged land as well as previously un-logged areas triggered over 9,500 landslides and debris flows that resulted directly or indirectly in eight fatalities. Highways were closed and a number of homes were lost. The fatalities and losses resulting from the 1996 landslide events brought about the passage of Oregon Senate Bill 12, which set site development standards, authorized the mapping of areas subject to rapidly moving landslides and the development of model landslide (steep slope) ordinances.

Counties with the highest percentage of reported landslides are: Lane (24%), Douglas (11%), Linn (10%), Tillamook (9%), Lincoln (8%), and Multnomah (7%).[4] Table 19 describes the history of more significant landslides and debris flows in the area.

TABLE 19. NOTABLE LANDSLIDE / DEBRIS FLOWS

DATE	INCIDENT
02/1926	Landslide closed Roosevelt Highway between Coos Bay and Coquille causing at least $25,000 in damages.
02/1961	A large section of Ecola State Park slid into the Pacific Ocean.

[4] Hofmeister, YEAR, *Slope Failures in Oregon*; and DOGAMI, 2000, Special Paper 34.

02/1996	Heavy rains and rapidly melting snow contributed to hundreds of landslides/debris flows across the state. Many occurred on clear cuts that damaged logging roads. (FEMA-1099-DR-OR)
11/1996	Heavy rain triggered mudslides in Lane and Douglas Counties. Five fatalities and several injuries in Douglas County. (FEMA-1149-DR-OR)
02/1999	Two timber workers killed in a mud and rockslide south of Florence.
01/2000	A landslide north of Florence closed Highway 101 for 3 months, resulting in major social and economic disruption to nearby communities.
12/2004	Lane, Polk, and Lincoln Counties – $12,500 in property damage
12/2007	Clatsop and Tillamook Counties - $300,000 in property damage

Source: Taylor and Hatton, 1999, *The Oregon Weather Book;* and FEMA After-Action Report, 1996 events; and interviews, Oregon Department of Transportation representatives.

Source: Hazards & Vulnerability Research Institute (2007). The Spatial Hazard Events and Losses Database for the United States, Version 5.1 [Online Database]. Columbia, SC: University of South Carolina. Available from: http://www.sheldus.org.

Probability

The probability of rapidly moving landslides occurring depends on a number of factors; these include steepness of slope, slope materials, local geology, vegetative cover, human activity, and water. There is a strong correlation between intensive winter rainstorms and the occurrence of rapidly moving landslides (debris flows). Given the correlation between precipitation / snow melt and rapidly moving landslides, it would be feasible to construct a probability curve. The installation of slope indicators or the use of more advanced measuring techniques could provide information on slower moving slides.

The Department of Forestry has mapped debris flow hazards for all of the counties in Region 1.

The probability that Region 1 will experience landslides is depicted in Table 20 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The probability scores below address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

High = One incident likely within a 10 to 35 year period.

Moderate = One incident likely within a 35 to 75 year period.

Low = One incident likely within a 75 to 100 year period.

In some cases, counties either did not rank the hazard or did not find it to be a significant consideration. These cases are noted with a dash (-) in the table below.

TABLE 20. Probability Assessment of Landslides

	Clatsop	Coos	Curry	Douglas	Lane	Lincoln	Tillamook
Probability	H	H	H	H	H	-	H

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

Vulnerability

Rain-induced landslides and debris flows can potentially occur during any winter in Region 1. Fortunately, little developed property is exposed to the hazard; the greatest impacts occur to the east-west roadways that carry traffic to and from the coast … with the potential for injuries and loss of life from rapidly moving landslide events. However, to minimize future landslide impacts to new development, hazards areas must be identified and siting standards applied.

Since 1950, at least 21 deaths have been attributed to rapidly moving landslides (i.e., debris flows). Statistically, the risk of being killed is relatively low (about .02 fatalities per 1,000 people/ year). However, the risk would be greater for that segment of the population that lives, works, or commutes through high hazard debris flow areas.

The region's vulnerability to landslides/debris flows is depicted in Table 21 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

High = More than 10% affected

Moderate = 1-10% affected

Low = Less than 1% affected

In some cases, counties either did not rank the hazard or did not find it to be a significant consideration. These cases are noted with a dash (-) in the table below.

TABLE 21. Vulnerability Assessment of Landslides

	Clatsop	Coos	Curry	Douglas	Lane	Lincoln	Tillamook
Vulnerability	M	L	L	M	M	-	H

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

TSUNAMI

Characteristics and Brief History

Tsunami waves are infrequent events, but can be extremely destructive. They may be generated by earthquakes, submarine volcanoes, or landslides, and travel hundreds of miles before striking land. Hardly discernible at sea, tsunami waves travel as fast as 500 mph across open water until, at landfall, they slow-down significantly and can reach heights up to 20 feet or more. Seward, Alaska, experienced tsunami waves as high as 25 feet during the 1964 earthquake-tsunami event.

Most tsunami waves have been described as an onrushing, rapidly rising tide, which can be seen in the few motion pictures that have captured the tsunami phenomenon. The size and behavior of tsunamis depend on a number of factors, including distance traveled, submarine topography and the shape and orientation of the coastline. Much of the damage results from water-borne debris, which can act as battering rams against on-shore development. Wave-borne fuel drums are especially hazardous because of their propensity to cause or exacerbate fires.

All Region 1 counties are susceptible to tsunami hazards. Oregon's 60 coastal communities have experienced, to various degrees, tsunamis that have originated in the oceanic regions near Russia's Kamchatka Peninsula, Japan, Chile, Hawaii, the Gulf of Alaska and northern California. Additionally, the geologic record implies that several tsunamis have been generated locally off the Oregon Coast along the Cascadia Subduction Zone. This is the region's greatest concern (see earthquake section). An anticipated M8-9 earthquake along the Cascadia Subduction Zone could generate tsunamis that would reach the Oregon coast in a very short period of time – between 15 and 30 minutes. This underscores the need to plan for such an event.

Table 22 describes some of the tsunami history of Region 1.

TABLE 22. NOTABLE TSUNAMIS

DATE	ORIGIN OF EVENT	AFFECTED COMMUNITY	DAMAGE	REMARKS
04/1868	Hawaii	Astoria		Observed
08/1868	N. Chile	Astoria		Observed
08/1872	Aleutian Is	Astoria		Observed
11/1873	N. California	Port Orford		Debris at high tide line
04/1946	Aleutian Is	Bandon		Barely perceptible
04/1946		Clatsop Spit		Water 3.7m above MLLW
04/1946		Depoe Bay		Bay drained. Water returned as a wall
04/1946		Seaside		Wall of water swept up Necanicum River
11/1952	Kamchatka	Astoria		Observed
11/1952		Bandon	Log decks broke loose	
05/1960	S. Cent. Chile	Astoria		Observed
05/1960		Seaside	Bore on Necanicum River damaged boat docks	
05/1960		Gold Beach		Observed
05/1960		Newport		Observed for about four hours
05/1960		Netarts	Some damage observed	
03/1964	Gulf of Alaska	Cannon Beach	Bridge and motel unit moved inland. $230,000 damage	
03/1964		Coos Bay	$20,000 damage	
03/1964		Depoe Bay	$5,000 damage; 4 children drowned at Beverly Beach	
03/1964		Florence	$50,000 damage	
03/1964		Gold Beach	$30,000 damage	
03/1964		Seaside	1 fatality (heart attack); Damage to city: $41,000; Private: $235,000; Four trailers, 10-12 houses, two bridges damaged	
05/1968	Japan	Newport		Observed
04/1992	N. California	Port Orford		Observed
10/1994	Japan	Coast		Tsunami warning issued, but no tsunami observed

DATE	ORIGIN OF EVENT	AFFECTED COMMUNITY	DAMAGE	REMARKS
3/2011	Japan	Coast	$6.7 million. Extensive damage to the Port of Brookings.	Tsunami warning issued, observed ocean surges. and

Source: NOAA, 1993, Tsunamis Affecting the West Coast of the United States: 1806-1992.

Source: FEMA, 2011, Federal Disaster Declaration

Probability

With respect to distant sources, Oregon has experienced 10 tsunamis in the last 144 years with only 3 causing measurable damage (Table 19). Thus, the average recurrence interval for tsunamis on the Oregon coast from distant sources would be about 15 years. However, the time interval between events has been as little as one year and as much as 73 years. The two most destructive tsunamis occurred only four years apart (1960 and 1964) and originated from two different source areas (south central Chile and the Gulf of Alaska). Since only a few tsunamis caused measurable damage, a recurrence interval for distant tsunamis does not have much meaning for this region.

Geologists predict a 10-14 percent chance that a Cascadia tsunami will be triggered by a shallow, undersea earthquake offshore Oregon in the next 50 years, causing a tsunami that will affect the Oregon coast. This forecast comes from evidence for large but infrequent earthquakes and tsunamis that have occurred at the Oregon coast every 500 years, on average.[5]

A tsunami originating from a Cascadia Subduction Zone (CSZ) event could be exceedingly destructive and thus is of greater concern than distant tsunamis. The average recurrence interval for a CSZ event is between 500 and 600 years. There have been seven CSZ events in the last 3500 years with time between individual events varying from 150 to 1000 years. It is assumed that all Cascadia tsunamis would cause extensive damage. The last CSZ event occurred approximately 300 years ago.[6]

The following probability estimates are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The probability scores below address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

High = One incident likely within a 10 to 35 year period.

Moderate = One incident likely within a 35 to 75 year period.

Low = One incident likely within a 75 to 100 year period.

TABLE 23. Probability Assessment of Tsunami

	Clatsop	Coos	Curry	Douglas	Lane	Lincoln	Tillamook
Probability	M	H	H	H	M	H	M

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores

[5] Department of Geologic and Mineral Industries. *Oregon Geology Factsheet: Tsunami Hazards in Oregon*. http://www.oregongeology.org/pubs/fs/tsunami-factsheet_onscreen.pdf.

[6] Kenji Satake et al., 1995.

Vulnerability

The Oregon coast is at risk from tsunamis that originate from local and distant sources. All communities in low-lying coastal areas in Region 1 are especially vulnerable to tsunamis because of its coastal setting and the location of many of its communities in low-lying areas. Seaside is the most vulnerable city due to its low elevation and high numbers of residents and tourist population. Although many communities have evacuation maps and evacuation plans, many casualties are expected. The built environment in the inundation zone will be especially hard hit.

In 2008, the United States Geological Survey (USGS) completed a comprehensive study of coastal cities' exposure and sensitivity to tsunami hazards in Oregon. Results indicate that the Oregon tsunami-inundation zone contains approximately 22,201 residents (four percent of the total population in the seven coastal counties), 14,857 employees (six percent of the total labor force), and 53,714 day-use visitors on average every day to coastal Oregon State Parks within the tsunami-inundation zone. The tsunami-inundation zone also contains 1,829 businesses that generate approximately $1.9 billion in annual sales volume (seven and five percent of study-area totals, respectively) and tax parcels with a combined total value of $8.2 billion (12 percent of the study-area total). Although occupancy values are not known for each facility, the tsunami-inundation zone also contains numerous dependent-population facilities (for example, adult-residential-care facilities, child-day-care facilities, and schools), public venues (for example, religious organizations and libraries), and critical facilities (for example, police stations).

Additionally, results indicate that vulnerability, described in the study by exposure (the amount of assets in tsunami-prone areas) and sensitivity (the relative percentage of assets in tsunami-prone areas) varies considerably among 26 incorporated cities in Oregon. City exposure and sensitivity to tsunami hazards is highest in the northern portion of the coast. The City of Seaside in Clatsop County has the highest exposure, the highest sensitivity, and the highest combined relative exposure and sensitivity to tsunamis. Results also indicate that the amount of city assets in tsunami-prone areas is weakly related to the amount of a community's land in this zone; the percentage of a city's assets, however, is strongly related to the percentage of its land that is in the tsunami-prone areas.[7]

Communities can engage in the following activities to prepare for tsunamis:

- **Map areas subject to tsunami inundation** – DOGAMI has mapped all Region 1 counties.
- **Establish NOAA warning system –** All counties have a warning system established.
- **Participate in NOAA's Tsunami-Ready program –** Participating communities include: Coos, Douglas, and Tillamook Counties, as well as the cities of Cannon Beach, Lincoln City, Manzanita, Nehalem, Rockaway Beach, and Wheeler.

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[7] Wood, N. 2007. *Variations in City Exposure and Sensitivity to Tsunami Hazards in Oregon.* US Geological Survey. Scientific Investigations Report 2007-5283.

The region's vulnerability to tsunamis is depicted in Table 24 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

High = More than 10% affected

Moderate = 1-10% affected

Low = Less than 1% affected

TABLE 24. Vulnerability Assessment of Tsunami

	Clatsop	Coos	Curry	Douglas	Lane	Lincoln	Tillamook
Vulnerability	H	H	H	M	H	M	H

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

VOLCANO-RELATED HAZARDS

Characteristics and Brief History

The volcanic Cascade Mountain Range is not within Region 1 counties; consequently, the risk from local volcano-associated hazards (e.g., lahars, pyroclastic flows, lava flows, etc.) is not a priority consideration. However, there is some risk from air-borne tephra (volcanic ash). This fine-grained material, blown aloft during a volcanic eruption, can travel many miles from its source. The cities of Yakima and Spokane, Washington, were inundated with ash during the May 1980, Mt. Saint Helens eruption. Air borne tephra can reduce visibility to zero, and bring street, highway, and air traffic to an abrupt halt. The material is noted for its abrasive properties and is especially damaging to machinery. It would be prudent for vulnerable communities to identify disposal areas for large quantities of tephra.

Part of Clatsop County borders the Columbia River -- which in theory makes it vulnerable to lahars or mudflows carried by the river. Although remote, such an event cannot be dismissed out of hand. A lahar or mudflow that traveled down Washington's Cowlitz River following the eruption of Mt. Saint Helens, filled the Columbia River channel overnight from its previous 40-foot depth to a mere 14 feet. This delayed ship movements in the vicinity of the Cowlitz for months.[8]

Probability

Mt. St. Helens is a probable source of air borne tephra and lahar mudflows that can reach the Columbia River. The probability of coastal counties receiving air-borne tephra is about 1 in 10,000 --- with a large portion of Curry County being even less.[9] A lahar mudflow that traveled down Washington's Cowlitz River following the 1980 eruption of Mt. Saint Helens filled the Columbia River channel overnight from its previous 40-foot depth to a mere 14 feet. This delayed ship movements for months.

The probability that Region 1 will experience volcanic activity is depicted in Table 25 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The probability scores below address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

High = One incident likely within a 10 to 35 year period.

Moderate = One incident likely within a 35 to 75 year period.

Low = One incident likely within a 75 to 100 year period.

In some cases, counties either did not rank the hazard or did not find it to be a significant consideration. These cases are noted with a dash (-) in the table below.

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[8] USGS Open File Report 95-497, 1995, pp.5-6.

[9] Sherrod, David et al, 1997.

TABLE 25. Probability Assessment of Volcano Related Hazards

	Clatsop	Coos	Curry	Douglas	Lane	Lincoln	Tillamook
Probability	L	-	L	-	-	L	M

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

Vulnerability

The region's vulnerability to volcano-related hazards is depicted in Table 26 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

High = More than 10% affected

Moderate = 1-10% affected

Low = Less than 1% affected

In some cases, counties either did not rank the hazard or did not find it to be a significant consideration. These cases are noted with a dash (-) in the table below.

TABLE 26. Vulnerability Assessment of Volcano Related Hazards

	Clatsop	Coos	Curry	Douglas	Lane	Lincoln	Tillamook
Vulnerability	H	-	H	-	-	L	M

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores.

WINDSTORMS

Characteristics and Brief History

High winds can be expected throughout Region 1. Destructive wind storms are less frequent, and their pattern is fairly well known. They form over the North Pacific during the cool months (October through March), move along the coast and swing inland in a northeasterly direction. Wind speeds vary with the storms. Gusts exceeding 100 miles per hour have been recorded at several coastal locations (Table 27), but lessen as the storm moves inland. These storms can be very destructive as documented in the now infamous Columbus Day Storm of October, 1962. Less destructive storms usually topple trees, power lines, and cause building damage. Flooding can be an additional problem. A large percentage of Oregon's annual precipitation comes from these events.[10]

[10] Taylor and Hatton, 1999, *The Oregon Weather Book*, p. 139; and FEMA-1405-DR-OR, YEAR, Reducing Windstorm Damage to Property and Electrical Utilities.

TABLE 27. SIGNIFICANT WINDSTORMS

DATE	LOCATION	DESCRIPTION	REMARKS
01/1880	Western Oregon	Very high winds. 65-80 mph near Portland	Flying debris; fallen trees
01/1921	Oregon coast / Lower Columbia	Winds 113 mph at mouth of Columbia. Gusts at Astoria, 130 mph	Widespread damage
04/1931	Western Oregon	Unofficial reports of wind speeds up to 78 mph	Widespread damage
11/1951	Most of Oregon	Winds 40-60 mph with 75-80 mph gusts	Widespread damage, especially to transmission lines
12/1951	Most of Oregon	Winds, 60-100 mph, strongest along coast	Many damaged buildings. Telephone / power lines down
12/1955	Western Oregon	Wind gusts at North Bend 90 mph	Significant damage to buildings and farms
01/1956	Western Oregon	Heavy rains, high winds, mud slides	Estimated damage: $95,000 (1956 dollars)
11/1958	Most of Oregon	Wind gusts to 75 mph at Astoria. Gusts to 131 mph at Hebo	Damage to buildings and utility lines
11/1962	Statewide	Wind speeds of 131 mph on the Oregon coast (Columbus Day Windstorm Event)	Oregon's most destructive storm. 23 fatalities. Damage at $170 million
03/1963	Coast and N.W. Oregon	100 mph gusts (unofficial)	Widespread damage
10/1967	Western and N. Oregon	Winds on Oregon Coast 100-115 mph	Significant damage to buildings, agriculture, and timber
03/1971	Most of Oregon	Notable damage in Newport	Falling trees took out power lines. Building damage
01/1986	N and Cent. Oregon Coast	75 mph winds	Damaged trees, buildings, power lines
01/1987	Oregon Coast	Wind gusts to 96 mph at Cape Blanco	Significant erosion (highways and beaches). Several injuries

Source: Taylor and Hatton, 1999, *The Oregon Weather Book*, p.151-157.

Source: Hazards & Vulnerability Research Institute (2007). The Spatial Hazard Events and Losses Database for the United States, Version 5.1 [Online Database]. Columbia, SC: University of South Carolina. Available from http://www.sheldus.org

TABLE 27. SIGNIFICANT WINDSTORMS (con't.)

DATE	LOCATION	DESCRIPTION	REMARKS
12/1987	Oregon Coast / N.W. Oregon	Winds on coast 60 mph	Saturated ground enabled winds to uproot trees
03/1988	N. and Central Coast	Wind gusts 55-75 mph	One fatality near Ecola State Park. Uprooted trees
01/1990	All of Oregon	100 mph winds in Netarts and Oceanside	One fatality. Damaged buildings. Falling trees (FEMA-853-DR-OR)
02/1990	Oregon Coast	Wind gusts of 53 mph at Netarts	Damage to docks, piers, boats
01/1991	Most of Oregon	Winds of 63 mph at Netarts. 57 at Seaside	75 foot trawler sank NW of Astoria
11/1991	Oregon Coast	Slow-moving storm. 25- foot waves off shore	Buildings, boats, damaged. Transmission lines down.
01/1992	Southwest Oregon	Wind gusts of 110 mph at Brookings	Widespread damage
01/1993	Oregon coast / N. Oregon	Tillamook wind gusts at 98 mph	Widespread damage, esp. Nehalem Valley
12/1995	Statewide	Wind gusts over 100 mph. Sea Lion Caves: 119 mph. Followed path of Columbus Day Storm (12/1962)	Four fatalities; many injuries. Widespread damage (FEMA-1107-DR-OR)

Source: Taylor and Hatton, 1999, *The Oregon Weather Book*, p.151-157.

Source: Hazards & Vulnerability Research Institute (2007). The Spatial Hazard Events and Losses Database for the United States, Version 5.1 [Online Database]. Columbia, SC: University of South Carolina. Available from http://www.sheldus.org

TABLE 27. SIGNIFICANT WINDSTORMS (con't.)

DATE	LOCATION	DESCRIPTION	REMARKS
11/1997	Western Oregon	Winds of 89 mph at Florence. 80 mph at Netarts and Newport	Severe beach erosion. Trees toppled
2/2002	SW Oregon	75-100 mph on the SW Coast (Douglas, Coos and Curry counties)	Widespread loss of electricity and damage to public utility infrastructure (FEMA-1405-DR-OR)
4/2004	Lane County		$5,000 in property damage *figure includes damages outside of Lane County
12/2004	Lane County		$6,250 in property damage *figure includes damages outside of Lane County
12/2004	Lincoln County		$6,250 in property damage *figure includes damages outside of Lincoln County
12/2004	Tillamook County		$6,250 in property damage *figure includes damages outside of Tillamook County
12/2004	Clatsop County		$6,250 in property damage *figure includes damages outside of Clatsop County
1/2006	Clatsop, Tillamook, Lincoln, Lane	Two storm events with high winds of 86 mph and 103 mph.	$244,444 and $144,444 in estimated property damage among all four coastal counties. The storm also impacted 5 other counties outside Region 1. Total damages equal $300,000 and $200,000 respectively.
2/2006	Clatsop, Tillamook, Lincoln, Lane	Wind storm event with winds measured at 77 mph	$150,000 and $91,600 in estimated property damage among all four coastal counties. The storm also impacted nine other counties outside of Region 1. Total damages equal $300,000 and $275,000
3/2006	Clatsop, Tillamook, Lincoln, Lane	Two wind storm events with winds measured at 60 mph and 75 mph	$75,000 and $211,000 in estimated property damage among all four coastal counties. The storms also impacted ten other counties outside of Region 1. Total damages equal $75,000 and $475,000

Source: Taylor and Hatton, 1999, *The Oregon Weather Book*, p.151-157.

Source: Hazards & Vulnerability Research Institute (2007). The Spatial Hazard Events and Losses Database for the United States, Version 5.1 [Online Database]. Columbia, SC: University of South Carolina. Available from http://www.sheldus.org

TABLE 27. SIGNIFICANT WINDSTORMS (con't.)

DATE	LOCATION	DESCRIPTION	REMARKS
11/2006	Coos, Curry, Douglas	Storm with winds measured at 70 mph.	Total of $10,000 in damages.
12/2006	Coos, Curry, Douglas	Storm with winds measured at 90 mph.	Total of $225,000 in estimated damages for Coos, Curry, and Douglas Counties. The storm also impacted Josephine County, leading to a total storm damage of $300,000.
12/2006	Clatsop, Tillamook	Storm with high winds	Total of $10,000 in damages.
11/2007	Clatsop, Tillamook	Storm with high winds	Total of $10,000 in damages.
12/2007	Clatsop, Tillamook	Series of powerful Pacific storms	Resulted in Presidential Disaster Declaration. $180 million in damage in the State, power outages for several days, and 5 deaths were attributed to the storm.
12/2008	Clatsop, Lane, Tillamook, Lincoln	Intense wind and rain events	Resulted in nearly $8 million in estimated property and crop damages for Clatsop, Lane, Tillamook, and Lincoln Counties.

Source: Taylor and Hatton, 1999, *The Oregon Weather Book*, p.151-157.

Source: Hazards & Vulnerability Research Institute (2007). The Spatial Hazard Events and Losses Database for the United States, Version 5.1 [Online Database]. Columbia, SC: University of South Carolina. Available from http://www.sheldus.org

Tornadoes

Most people do not associate tornadoes with the State of Oregon, and certainly not in coastal areas. Nevertheless, they have occurred in Region 1, the first of which was recorded in 1897. They are characteristically brief and small, but also damaging. The recurrence interval, based on the list compiled by Taylor and Hatton (1999, pp. 130-137), is about every nine years. In some cases, events are separated over 20 or 30 years (Table 28 below).

TABLE 28. TORNADOES RECORDED

DATE	LOCATION	REMARKS
June, 1897	Bay City	Observed, but no damage recorded
October, 1934	Clatskanie	Observed. No damage
April, 1960	Coquille	Accompanied by heavy rain. No damage
November, 1965	Rainier	Crossed Columbia River. Two buildings damaged
October, 1966	Seaside	Windows broken, telephone lines down, outdoor signs destroyed
October, 1967	Near Astoria airport	Began over ocean and moved inland. Several homes and commercial buildings damaged
December, 1973	Newport	Some roof damage
December, 1975	Tillamook	90 mph wind speed. Damage to several buildings
August, 1978	Scappoose	Manufactured home destroyed; Other damage
March, 1983	Brookings	Minor damage
November, 1984	Waldport	Damage to automobiles and roofs
February, 1994	Near Warrenton	Damage in local park
November, 2002	Curry County	$500,000.00 in property damage

Source: Taylor and Hatton, 1999, The Oregon Weather Book, pp. 130-137

Source: Hazards & Vulnerability Research Institute (2007). The Spatial Hazard Events and Losses Database for the United States, Version 5.1 [Online Database]. Columbia, SC: University of South Carolina. Available frm http://www.sheldus.org

Probability

High windstorms occur yearly. More destructive storms occur once or twice per decade. High wind events on the order of the 1962 Columbus Day storm are thought to have a 100-year recurrence interval.

The probability that Region 1 will experience windstorms is depicted in Table 29 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The probability scores below address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

High = One incident likely within a 10 to 35 year period.

Moderate = One incident likely within a 35 to 75 year period.

Low = One incident likely within a 75 to 100 year period.

TABLE 29. Probability Assessment of Windstorms

	Clatsop*	Coos	Curry	Douglas	Lane	Lincoln	Tillamook
Probability	H	H	H	H	H	H	H

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores

* Probability and vulnerability scores are for severe weather which combines both wind and winter storms.

Vulnerability

Many buildings, utilities, and transportation systems within Region 1 are vulnerable to wind damage. This is especially true in open areas, such as along the Oregon Coast, natural grasslands, or farmland. It also is true in forested areas, along tree-lined roads and electrical transmission lines, and on residential parcels --- where trees have been planted or left for aesthetic purposes. Oregon's history of wind damage underscores the need for a comprehensive wind-hazard mitigation program. The necessity of such an action is partly supported in an after-action report focusing on western Oregon's high wind event of February 7, 2002 (Hazard Mitigation Survey Team Report, FEMA-1405-DR-OR). Other historic events (e.g., 1962 Columbus Day Storm) provide additional insights.

Structures most vulnerable to high winds in Region 1 include insufficiently-anchored manufactured homes and older buildings in need of roof repair. Section 307 of the Oregon Building Code identifies high wind areas along the Oregon Coast and sets anchoring standards for manufactured homes located in those areas. It is essential that coastal counties ensure that the standards are enforced. The Oregon Department of Administrative Service's inventory of state-owned and operated buildings includes an assessment of roof conditions as well as the overall condition of the structure. Oregon Emergency Management has arranged this information by county.

Fallen trees are especially troublesome. They can block roads and rails for long periods, which can affect emergency operations. In addition, uprooted or shattered trees can down power and/or utility lines, effectively bringing local economic activity and other essential activities to a standstill. Much of the problem may be attributed to a shallow or weakened root system in saturated ground. Many roofs have been destroyed by uprooted ancient trees growing next to a house. In some situations, strategic pruning may be the answer. Prudent counties will work with utility companies in identifying problem areas and establishing a tree maintenance / removal program.

Tree-lined coastal roads and highways present a special problem. This is because much of the traveling public enjoys the beauty of forested corridors and most certainly would be concerned with any sort of tree removal program. In short, any “safety” program involving tree removal must be convincing, minimal, and involve a variety of stakeholders.

Wind-driven waves are common along the Oregon coast and are responsible for road and highway wash-outs and the erosion of beaches and headlands. These problems are addressed under Flood Hazards (i.e., Ocean flooding and wave action). Unlike Oregon’s Willamette Valley (Regions 2 and 3), there are no water-borne ferry systems in Region 1 whose operations would be affected by high winds. Bridges spanning bays or the lower Columbia River would be closed during high wind periods.

The region’s vulnerability to windstorms is depicted in Table 30 below. These scores are based on an analysis of risk conducted by county emergency program managers, usually with the assistance of a team of local public safety officials.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

High = More than 10% affected

Moderate = 1-10% affected

Low = Less than 1% affected

TABLE 30. Vulnerability Assessment of Windstorms

	Clatsop*	Coos	Curry	Douglas	Lane	Lincoln	Tillamook
Vulnerability	H	H	H	M	H	H	H

Source: Oregon Emergency Management, November 2008, County Hazard Analysis Scores

* Probability and vulnerability scores are for severe weather which combines both wind and winter storms.

REGION 1

Oregon Coast[1]

State Owned Building Inventory

[1] Region 1 includes all of Oregon's coastal counties: Clatsop, Coos, Curry, Douglas (coastal section), Lane (coastal section), Lincoln, Tillamook. The lower estuarine Columbia River is also included in Region 1 (Clatsop County).

Region 1 Oregon Coast State Owned Building Inventory

Building Name	County	Replacement Value	Contents Value	Total Bldg Value	Usage	Earthquake		Fire/WUI		Flood		Landslide		Tsunami		Windstorm		Winterstorm	
						Prob.	Vuln.	Prob.	Vuln.	Prob.	Vuln.	Prob.	Vuln.	Prob.	Vuln.	Prob.	Vuln.	Prob.	Vuln.
CMA SEAFOOD CONSUMER CTR	Clatsop	1,392,000	31,074	1,423,074	INSTRUCTION/ADMIN/RES	M	H	H	M	H	M	H	M	M	H	H	H	H	H
CMA SEAFOOD RESEARCH LAB	Clatsop	3,172,020	532,721	3,704,741	INSTRUCTION/ADMIN/RES	M	H	H	M	H	M	H	M	M	H	H	H	H	H
CAMP RILEA ARMORY	Clatsop	3,768,977	7,146	3,776,123	ARMORY	M	H	H	M	H	M	H	M	M	H	H	H	H	H
CAMP RILEA	Clatsop	2,376,160	0	2,376,160	EXCHANGE	M	H	H	M	H	M	H	M	M	H	H	H	H	H
CAMP RILEA	Clatsop	3,860,443	5,000	3,865,443	DMS/FITNESS CTR	M	H	H	M	H	M	H	M	M	H	H	H	H	H
CAMP RILEA HQ	Clatsop	1,926,223	5,000	1,931,223	BN HQ	M	H	H	M	H	M	H	M	M	H	H	H	H	H
SIMULATION CENTER	Clatsop	1,950,000	0	1,950,000	SIMULATION TRAINING CENTER	M	H	H	M	H	M	H	M	M	H	H	H	H	H
MCCALL HALL	Clatsop	3,618,180	0	3,618,180	BARRACKS	M	H	H	M	H	M	H	M	M	H	H	H	H	H
STRAUB HALL	Clatsop	2,972,673	0	2,972,673	BARRACKS	M	H	H	M	H	M	H	M	M	H	H	H	H	H
ATIYEH HALL	Clatsop	3,618,180	0	3,618,180	BARRACKS	M	H	H	M	H	M	H	M	M	H	H	H	H	H
HATFIELD HALL	Clatsop	2,972,673	0	2,972,673	BARRACKS	M	H	H	M	H	M	H	M	M	H	H	H	H	H
ANDERSON HALL	Clatsop	3,570,469	0	3,570,469	BARRACKS	M	H	H	M	H	M	H	M	M	H	H	H	H	H
WHITE HALL	Clatsop	2,972,673	0	2,972,673	BARRACKS	M	H	H	M	H	M	H	M	M	H	H	H	H	H
VEHICLE STORAGE	Clatsop	2,521,583	0	2,521,583	VEHICLE STORAGE	M	H	H	M	H	M	H	M	M	H	H	H	H	H
VEHICLE STORAGE	Clatsop	2,810,663	0	2,810,663	VEHICLE STORAGE	M	H	H	M	H	M	H	M	M	H	H	H	H	H
STORAGE BLDG-DEPOT	Clatsop	1,262,222		1,262,222	STORAGE	M	H	H	M	H	M	H	M	M	H	H	H	H	H
ADMINISTRATION/MOTOR POOL	Clatsop	2,219,161	0	2,219,161	OMS	M	H	H	M	H	M	H	M	M	H	H	H	H	H
CP RILEA/CONTROLS HUM WAREHOUSE	Clatsop	1,840,080	0	1,840,080	CHP WAREHOUSE	M	H	H	M	H	M	H	M	M	H	H	H	H	H
CP RILEA MESS HALL	Clatsop	1,591,450	0	1,591,450	DINING	M	H	H	M	H	M	H	M	M	H	H	H	H	H
TRANSIENT HOUSE	Clatsop	2,175,858	0	2,175,858	BARRACKS	M	H	H	M	H	M	H	M	M	H	H	H	H	H
NORTH COAST YCF	Clatsop	12,744,000	420,542	13,164,542	CORRECTION FACILITY	M	H	H	M	H	M	H	M	M	H	H	H	H	H
Warrenton Maint Station Building	Clatsop	758,841	379,421	1,138,262	Maintenance Station Bldg	M	H	H	M	H	M	H	M	M	H	H	H	H	H
Astoria Office D1 Bldg	Clatsop	747,325	373,662	1,120,987	Office, Administrative	M	H	H	M	H	M	H	M	M	H	H	H	H	H
COOS BAY ARMORY	Coos	3,511,049	6,664	3,517,713	ARMORY	M	H	M	M	H	H	H	L	H	H	H	H	-	-
COOS BAY SPECIALTY CREWS	Coos	1,315,956	657,978	1,973,934	OFFICE/ADMIN	M	H	M	M	H	H	H	L	H	H	H	H	-	-
SEGREGATION BUILDING	Coos	1,226,925	4,162	1,231,087	INMATE HOUSING	M	H	M	M	H	H	H	L	H	H	H	H	-	-

Source: DAS data 2005

Region 1 Oregon Coast State Owned Building Inventory

Building Name	County	Replacement Value	Contents Value	Total Bldg Value	Usage	Earthquake		Fire/WUI		Flood		Landslide		Tsunami		Windstorm		Winterstorm	
DORMITORY A	Coos	1,015,280	0	1,015,280	INMATE HOUSING	M	H	M	M	H	H	H	L	H	H	H	H	-	-
DORMITORY B	Coos	1,015,280	3,706	1,018,986	INMATE HOUSING	M	H	M	M	H	H	H	L	H	H	H	H	-	-
OIMB DINING HALL/DORM - UO	Coos	1,007,050	0	1,007,050	HOUSING	M	H	M	M	H	H	H	L	H	H	H	H	-	-
Coquille Maint Station Building	Coos	920,369	460,184	1,380,553	Maintenance Station Bldg	M	H	M	M	H	H	H	L	H	H	H	H	-	-
SSNER INTERPRETIVE CTR	Coos	1,620,972	375,950	1,996,922	PUBLIC ED/OFFICE	M	H	M	M	H	H	H	L	H	H	H	H	-	-
OIMB TERWILLIGER RESEARCH	Coos	508,288	973,131	1,481,419	Instruction, Admin, Research	M	H	M	M	H	H	H	L	H	H	H	H	-	-
Port Orford Maint Station Bldg	Curry	1,896,796	948,398	2,845,194	Maintenance Station Bldg	M	H	H	H	H	H	H	L	H	H	H	H	-	-
Reedsport Maint Station Bldg	Douglas	750,139	375,069	1,125,208	Maintenance Station Bldg	M	H	H	H	H	M	H	M	H	M	H	M	-	-
CAMP FLORENCE	Lane	1,731,264	105,704	1,836,968	SECURE BUILDING	M	H	L	L	H	H	H	M	M	H	H	H	-	-
HONEYMAN CLEAWOX DAY USE STORE	Lane	2,383,993	50,000	2,433,993	STORE	M	H	L	L	H	H	H	M	M	H	H	H	-	-
NEWPORT ARMORY	Lincoln	2,391,168	4,243	2,395,411	ARMORY	H	M	H	M	H	L	-	-	H	M	H	H	-	-
MARINE SCIENCE LAB	Lincoln	10,199,280	516,271	10,715,551	RESEARCH	H	M	H	M	H	L	-	-	H	M	H	H	-	-
MSC EDUCATION	Lincoln	1,397,000	59,185	1,456,185	LIBRARY	H	M	H	M	H	L	-	-	H	M	H	H	-	-
POTTS-GUIN LIBRARY	Lincoln	3,507,900	147,174	3,655,074	LIBRARY	H	M	H	M	H	L	-	-	H	M	H	H	-	-
MARINE REGIONAL HEADQUARTERS	Lincoln	1,120,000	750,000	1,870,000	LABORATORY/OFFICE	H	M	H	M	H	L	-	-	H	M	H	H	-	-
ROSE LODGE MAINT BLDG	Lincoln	1,366,877	550,040	1,916,917	OFFICE/ADMIN	H	M	H	M	H	L	-	-	H	M	H	H	-	-
Ona Beach MS HQ Office	Lincoln	730,536	365,268	1,095,804	Office, Administrative	H	M	H	M	H	L	-	-	H	M	H	H	-	-
ADMINISTRATION	Tillamook	1,158,500	53,599	1,212,099	ADMINISTRATION	M	H	M	H	H	H	H	H	M	H	H	H	-	-
TILLAMOOK YCF	Tillamook	4,281,300	333,496	4,614,796	CORRECTIONAL FACILITY	M	H	M	H	H	H	H	H	M	H	H	H	-	-
CAMP TILLAMOOK	Tillamook	1,913,024	329,074	2,242,098	SECURE BUILDING	M	H	M	H	H	H	H	H	M	H	H	H	-	-
TILLAMOOK OFFICE	Tillamook	4,240,000	848,549	5,088,549		M	H	M	H	H	H	H	H	M	H	H	H	-	-
Regional Totals		**118,050,800**	**9,672,411**	**127,723,211**															

Source: DAS data 2005