Section 2
Community Profile

Why Plan for Natural Hazards in Portland?

In 2000, the U.S. Congress passed the Disaster Mitigation Act of 2000. Under this Act, states, communities, and tribal governments must complete Federal Emergency Management Agency (FEMA)-approved natural hazard mitigation plans to be eligible for certain federal assistance programs such as the Hazard Mitigation Grant Program (HMGP) and the Pre-Disaster Mitigation competitive grant program. In February 2002, FEMA published the Interim Final Rule 44 CFR Part 201, which defines the requirements for natural hazard mitigation plans.[1]

While the City of Portland's climate is generally mild and it has relatively gentle topographic relief, natural hazards do pose a threat to the city's economy and its citizen's property and health. Natural disasters have caused major problems in Portland in recent history. Heavy winter rainstorms and windstorms, along with occasional severe winter storms, pose a threat to the City. Portland's location near a major subduction zone places it in danger of experiencing a major earthquake. Planning for the occurrence of these hazards will help strengthen vital components of the city's infrastructure and minimize the risk and incidence of personal injuries, fatalities, and property damage.

History of Natural Hazards in Portland

The City of Portland is directly affected by a number of natural hazards including: extreme weather events such as windstorms and severe winter storm; floods: landslides; earthquakes; and wildfires. This section presents a brief history of natural events that have significantly impacted Portland.

Severe Weather

Severe storms, including windstorms, heavy snowfall, ice storms, and heat storms occur with some frequency in the City of Portland. On October 12, 1962, the largest windstorm in recorded history hit Oregon. The infamous "Columbus Day Storm," the most powerful non-tropical storm to hit the lower-48 states, affected all of western Oregon. In terms of both human life and property, the Columbus Day Storm was by far the most costly to Oregon residents and the entire Northwest in recorded history. The storm claimed 23 lives and caused $235 million (1962 dollars) in property damage throughout the Northwest.

For more information about severe weather and its potential impacts, please see Section 10: Severe Weather.

Earthquakes

Portland is located inland to the Cascadia Subduction Zone and within a region expected to withstand severe damage from a 9.0+ subduction earthquake. Both the number of older unreinforced masonry buildings and liquefiable soils are recognized as conditions that amplify the hazard. The Portland Hills Fault Zone and the East Bank Fault Zone are potential hazardous areas for local, crustal earthquakes to occur.

Several moderate earthquakes have affected Portland in the past century. Little damage has occurred in Portland as a result, but the earthquakes have rattled nerves, and served to remind residents that their community is at risk of experiencing damaging earthquakes. The most recent earthquake to affect Portland was a 3.9 magnitude earthquake that occurred April 24, 2003, and was centered 15.8 km northwest of Portland and 42.0 km north of Canby. This quake was the largest quake to be generated by a fault under the Portland area in over 40 years, and was felt throughout the Portland area. The quake was followed by seven aftershocks and smaller-deeper tremors were detected for several weeks after.[2]

For more information about earthquakes and their potential impacts, please see Section 9: Earthquakes.

Floods

Flooding has greatly impacted Portland in the past, and has the potential to do so in the future. One of the more severe flood years on record occurred in 1996, when many rivers and creeks throughout the Willamette River watershed rose to 100-year flood levels. On Friday, February 9, 1996, the Willamette river crested 10 feet 6 inches above flood stage, just inches away from testing the plywood wall build above Portland's downtown seawall. The Columbia River crested at 11 feet 2 inches above flood stage, causing concern about the levees that protect Portland International Airport and areas north of Columbia Boulevard. Johnson Creek crested at 6 feet 5 inches above flood stage. Each year, there is about a one in 25 chance of a similar storm. A more serious storm could bring floodwaters over the downtown seawall and into the central business district.[3]

For more information about floods and their potential impacts, please see Section 7: Floods.

Landslides

Landslides are common in Portland because the area has steep slopes, abundant precipitation, and in some areas, weak soils. As many as 800 landslides accompanied the storms of the winter of 1996. Portland's two most famous landslides have occurred in the West Hills and were reactivated by construction activity. The Washington Park Landslide

was reactivated in 1895 when the city cut off the ancient landslide toe when it put in two new reservoirs. This landslide has since slowed to four centimeters per year. The Children's Museum, World Forestry Center and the Oregon Zoo also are built on a large landslide that was reactivated in 1957 by the widening of Highway 26 which also cut off the toe; this landslide is now stabilized.

For more information about landslides and their potential impacts, please see Section 8: Landslides.

Wildfires

Portland's considerable urban forest land increases its susceptibility to wildfires within the city limit. The most recent sizeable wildland fire was the Mocks Crest (or Willamette Bluffs) fire that occurred in August of 2001. A two-mile section of grass and brush was ignited along the railroad tracks paralleling the Willamette River. The fire quickly traveled up the bluff to Willamette Drive threatening structures at the University of Portland along with dozens of homes. This fire grew to a 5th alarm mobilizing all off-duty members of Portland Fire and Rescue along with mutual aid from five surrounding fire departments. Fire crews rotated through the scene for 2 _ days.

For more information about wildfires and their potential impacts, please see Section 11: Wildfire.

Geography and Environment

The City of Portland, Oregon, in Multnomah County, lies at the confluence of two major rivers, the Columbia River and the Willamette River. The Columbia River Gorge, lies to the east, providing a break in the Cascade Mountain range. Several large volcanoes surround the city, including Mount St. Helens, Mount Hood, and Mount Adams. The city lies about 70 miles east of the Pacific Coast.

Rivers and Streams

The City of Portland is located in the Willamette River Basin, which is approximately 11,460 square miles. The Willamette River Basin is the largest watershed in the state, with 13 major tributaries joining between its headwaters at Waldo Lake (south east of Eugene) and the confluence with the Columbia River at Kelley Point. Though the City of Portland only occupies 1% of the Willamette River's drainage basin, its 17 square miles are the most urbanized and heavily used of all in the basin. Approximately 60 miles of ditches, the Columbia Slough and a series of smaller sloughs throughout and surrounding the City protect Portland from flood damages.

Climate

The National Climatic Data Center has established climate zones in the US for areas that have similar temperature and precipitation characteristics. Oregon's latitude, topography, and proximity to the

Pacific Ocean give the state diversified climates. Portland is in Zone 2. The climate in Zone 2 generally consists of wet winters and dry summers. In 2001, 89% of the precipitation occurred between October and May; 11% of the annual rainfall occurred between June and September, and 4% occurred in July and August.[4] There is an average of only five days per year of measurable snow with snowfall accumulations rarely measuring more than two inches.[5] Table 2-1 describes the monthly average precipitation and temperature in Portland.

Table 2-1. Monthly Average Precipitation (inches) and Temperature (degrees Fahrenheit), Portland, Oregon

Month	Average High	Average low	Warmest on record	Coldest on record	Average dew point	Average precipitation
January	45	34	65	-2	33	5.4
February	50	36	71	-3	36	4.1
March	56	39	83	19	38	3.7
April	61	42	93	29	41	2.5
May	68	48	100	29	46	2
June	73	53	102	39	50	1.6
July	80	57	107	43	53	0.5
August	79	57	107	44	54	0.9
September	74	52	105	34	51	1.6
October	64	46	92	26	47	3.1
November	52	40	73	13	40	5.5
December	46	36	65	6	36	6.5

Source: Oregon Climate Service, 2001.

Most of the winds that come from the west are subdued by the time they reach the Portland area because of the influence of the Coast Range. The most destructive winds are those which blow from the south, parallel to the major mountain ranges.[6] Some winds blow from the east, but most often do not carry the same destructive force as those from the Pacific Ocean. Severe storms affecting Portland with snow and ice typically originate in the Gulf of Alaska or in the central Pacific Ocean. These storms are most common from October through March.[7]

While snow is relatively rare in western Oregon, the Columbia Gorge provides a low-level passage through the mountains. Cold air, which lies east of the Cascades, often moves westward through the Gorge, and funnels cold air into the Portland Area. If a wet Pacific storm happens to reach the area at the same time, larger than average snow events may result.[8] This situation may also result in ice storms.[9] Like snow storms, ice storms are characterized by cold temperatures and moisture, but subtle changes can result in varying types of ice formation, including freezing rain, sleet, and hail.[10]

Minerals and Soils

Several common natural hazards are related to soil stability and water retention. These hazards include landslides, erosion, flooding, and liquefaction resulting from an earthquake. Mineral and soil

compositions are important factors for determining whether Portland is prone to hazards such as landslides.

Soils on the west side of the Willamette River vary from clay loam with low permeability and relatively high erosion potential to gravelly loams, which are relatively well drained and moderately permeable. The flat areas along the west bank of the Willamette River are urban and highly disturbed, and many consist of unstable fill.

On the east side of the Willamette River, soils are highly variable; similar to the west side, however, they are generally urban and highly disturbed. Much of the area along the Columbia River has been filled with dredged sand, which drains very well. In undisturbed areas along the Columbia River, percolation rates are very slow. Areas south of Columbia Boulevard have soils that drain well. In the southeast areas of the City, soils vary from moderate to low permeability. In areas with well-draining soil, it is possible to manage stormwater through infiltration.

Significant Geological Factors

Most of the Pacific Northwest lies within the Cascadia Subduction Zone (Figure 2-1), where the Juan de Fuca and North American plates meet. The convergence of these tectonic plates puts most areas of western Oregon and Washington at risk for a catastrophic earthquake with a magnitude of 8.0 or higher. Portland lies in this area of risk. Another earthquake risk is the Portland Hills fault, which may be capable of generating moderately large earthquakes. As a result of the subduction zone, there are active volcanoes nearby, including Mt. St. Helens in southwest Washington, and Mt. Hood. Major eruptions of these volcanoes may cause significant ash fall in the Portland area.

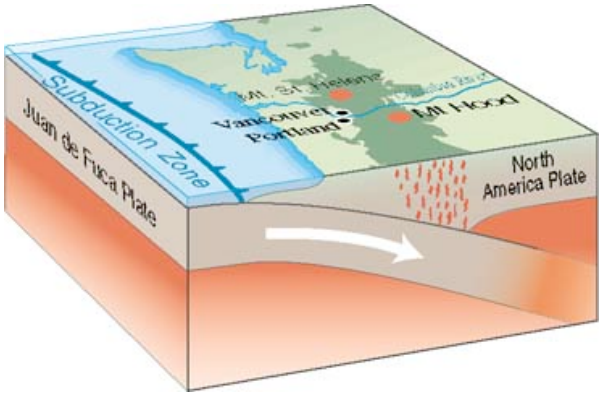

Figure 2-1 Cascadia Region Subduction Zone

Population and Demographics

Population growth in Portland has exceeded forecast expectations.[11] Between 1990 and 2000, the Portland grew nearly 21%, from 437,319 to 529,121. Table 2-2 provides population data for the Portland Metro region, including projections for 2010.

Table 2-2. Population Trends, Portland Metro area, 1950-2010

Year	Population	Percent Change
1950	619,522	
1960	728,088	18%
1970	880,675	21%
1980	1,050,367	19%
1990	1,174,291	12%
2000	1,444,219	23%
2010	*1,877,700*	*30%*

Source: Metro Regional Databook, November 2004 and 2015 Metro Regional Forecast, January 1996.

While natural hazards do not discriminate, the impacts in terms of loss and the ability to recover vary greatly among those affected.[12] According to Peggy Stahl of the FEMA Preparedness, Training and Exercise Directorate, 80% of the disaster burden falls on the public. Women, children, minorities and the poor bear a disproportionate amount of this burden.[13] Because these groups are especially at risk during disasters, it is important to identify those populations within Portland. Potential language, economic, physical, and social barriers could inhibit disaster preparedness and limit the efficacy of relief efforts during a disaster.

In Portland, 31% of households are female-headed households. There are approximately 125,561 Portland residents below the age of 20; this represents 24% of the City's total population. In 2000, 7% of Portland's population was Hispanic or Latino,[1] 6% were Asian and 7% was Black or African American. About 8% percent of Portland's families are living below the poverty level; of those, 5% are female-headed households, most with related children under the age of 18.[14]

Communication is crucially important before, during, and after a disaster event. The population must be made aware of the risk, understand how to prepare, and be able to navigate the process of recover. For this reason, language should be a major consideration for hazard planners. Table 2-3 shows the number of people who either do not speak English well or do not speak it at all.

Table 2-3. Non-English speaking population, Portland, 2000

	Number who speak another language		Number who speak English not well or not at all	
Age	Number	% of total population	Number	% of total population
5-17	17,053	3.4%	2,863	0.6%
18-64	60,688	12.2%	18,492	3.7%
65+	6,387	1.3%	2,739	0.6%
TOTAL	84,128	16.9%	24,094	4.8%

Source: U.S. Census, 2000.

[1] Includes those who identify as Hispanic or Latino plus other race(s).

Land and Development

In Portland, the largest portion of the land (about 52%) is dedicated to residential uses. About 20% is dedicated to industrial uses. This information is important for hazard planners to consider because the type of development in each land use designation reacts differently to hazard events. In industrial lands, for example, hazardous materials spills might be an issue, whereas in residential areas, planners may need to consider evacuation routes for residents or target homes for mitigation. Table 2-4 describes the land use designations in the City of Portland.

Table 2-4. Zoning, Portland, 2004

Zoning	Percent of total land
Residential	52%
Commercial	8%
Industrial	20%
Employment	3%
Open Space	18%

Source: City of Portland Bureau of Planning (Deborah Stein 10/27/04).
Note: The data is current as of October 27, 2004.

The zoning designations, however, don't necessarily represent the actual amount of development that falls into each category. In Portland, about 50% of the total developed square footage is on land that has been zoned for single family residential use and 11% is on land zoned for multi-family residential use. About 38% of Portland's developed square footage in on land zoned for commercial use. While industrial zoning represents 20% of the total land, it represents just 1% of the developed square footage.[15]

Development Regulations

Portland has adopted a number of regulations regarding development in areas subject to natural hazards. Following is a brief description of the applicable regulations.[2]

There exists a potential conflict between preserving environmental sensitive lands and "buildable" lands in the Urban Growth Boundary (UGB) inventories in the Portland Metro area. Removing environmentally sensitive lands from development infringes on the ability of the jurisdiction to maintain the required 20 years of housing capacity. The Metro Council's Resolution Number 99-2820 "encourages

[2] In November 2004, Oregon voters passed Ballot Measure 37, which requires that if a land use regulation reduces the value of land, a government entity must either pay the property owners for the reduced value or forego enforcement of the regulation. Though Measure 37 specifically excludes regulations that protect public health and safety, his measure could impact the city's ability to regulate land development to prevent loss from hazards.

all local jurisdictions in the Metro region to actively protect environmentally sensitive areas, even if they include lands that Metro is required by state law to classify as "buildable" for its UGB inventory."[16] A previous resolution related to the resolution above, 97-2562B, provided similar recommendations to local jurisdictions. The resolution indicates that:

> the protection of environmentally sensitive lands from development could result in a decline in net buildable acres in a local jurisdiction. Upon demonstration by a local jurisdiction that such protection results in an inability to meet jobs, housing and other targets established in the Urban Growth Management Functional Plan, which includes a recommendation which identifies land that would provide for the unaccommodated capacity located inside or outside the urban growth boundary and near or adjacent to the city of county, the Metro Council will grant an exception consistent with Title 8 of the Functional Plan. The exception will be granted to the extent the local jurisdiction establishes that decline in net buildable acres is the result of lands being protected from development by locally adopted and implemented regulations.[17]

The City's Comprehensive Plan currently outlines goals, policies, and actions regarding natural hazards in Portland. Policies designed to meet the State's comprehensive planning requirement, Goal 7 of the "Areas Subject to Natural Disaster and Hazards" include the provision of safe housing, regulating development in areas subject to flooding, and providing a network of emergency response routes for first responders.

Housing and Community Development

Gaining an understanding of the City's current housing stock as well as trends in community development are important in planning for natural hazards because development in Portland has increased steadily with population growth. Older housing stock can be more susceptible to damage in hazard events, especially if it was built prior to the implementation of newer code designed to reduce loss. The largest portion of Portland's housing stock (34%) was built before 1939, and could therefore be more severely impacted by earthquakes and severe weather events. Table 2-5 provides further information about housing ages in Portland.

Table 2-5. Age of housing units, Portland, April 2000

Year Built	Number	Percent
1990-March 2000	24,077	10%
1980-1989	13,630	6%
1970-1979	28,759	12%
1960-1969	27,212	11%
1950-1959	35,470	15%
1940-1949	27,352	12%
1939 or earlier	80,769	34%
TOTAL	237,269	100%

Source: US Census Bureau, 2000.

This situation can be exacerbated when vulnerable populations live in older housing stock. In Portland, 71% of homeowners who are living below the poverty line and 73% of homeowners over the age of 75 live in homes built before 1950. When these homes are impacted by disasters, these homeowners are less likely to have the physical and financial resources to respond or recover.

Employment and Industry

Portland residents' median earnings are $23,524[18]. Median earnings are $26,992 for male workers, and $20,619 for females. According to the 2000 Census, Portland had 276,081 employees. Although growth has slowed over the past few years, economists project increased job growth in all major industries in the coming years.[19] This is partly due to the fact that the Portland region has one of the more diversified economies on the West Coast.

Table 2-6 provides a breakdown of jobs and the number employed by industry type.[20] Appendix C: Risk Assessment contains further information about commercial and industrial lands that are at risk from natural hazards.

Table 2-6. Employment by industry, Portland, 2000

Industry	Number employed	Percent
Agriculture, forestry, fishing and hunting, and mining	1,100	0%
Construction	14,965	5%
Manufacturing	34,513	13%
Wholesale trade	12,768	5%
Retail trade	31,708	11%
Transportation and warehousing, and utilities	15,318	6%
Information	8,740	3%
Finance, insurance, real estate, and rental and leasing	19,033	7%
Professional, scientific, management, administrative, and waste management	33,106	12%
Educational, health, and social services	54,321	20%
Arts, entertainment, recreation, accommodation, and food services	25,993	9%
Other services	15,119	5%
Public administration	9,397	3%
Total employed population	**276,081**	**100%**

Source: US Census Bureau, 2000.
Note: The data in Table 2-6 represent how many Portland *residents* are employed in each industry. The Census does not count employees at their place of work.

The largest sector of the region's economy, manufacturing, represents production of durable goods such as electronics, metals, machinery, and lumber and woods products. The Portland metropolitan area remains the center of the region's high-tech industry; over 3,000 firms employ more than 79% of the total Oregon and Southwest Washington workforce in this sector. The largest employer in the metropolitan area, Intel, has a total of about 15,000 employees and falls into this category. Retail sales are also important. While the area ranks 25th nationally in population, it has the 24th largest retail market in the country, with retail sales exceeding $27 billion.[21]

Transportation and Commuting

Transportation in Portland includes state and county highways, arterial streets, collector streets, neighborhood routes, local streets, Tri-Met bus service, Westside Light Rail, and multiple bicycle routes. Portland's transportation network serves both residential and commercial commuters. The Tri-County Metropolitan District of Oregon (Tri-Met) provides public transportation in Portland. Tri-Met's service includes 95 bus routes and 38 miles of light rail line (called Metropolitan Area Express, or MAX). The 33-mile MAX Blue Line connects the cities of Portland, Gresham, Beaverton and Hillsboro. The

Red Line connects the Portland International Airport with downtown Portland, and the Yellow line runs north from downtown to connect North Portland. Together, the MAX lines carry about 80,000 riders each weekday. Additionally, Portland has a streetcar system that carries approximately 4,000 passengers per day in the downtown area and Northwest Portland.

Many of Portland's residents take advantage of public transit for their daily commutes. Commuters and their routes are important considerations for hazard planners; transit routes keep the economy functioning and provide important lifelines for emergency response. Additionally, if a disaster were to occur during rush hour, commuters could be seriously impacted. The largest portion of commuters leave home between 7:30 and 7:59 a.m. in the morning and require between 15 and 19 minutes to arrive at work. The majority of them drive alone; the next largest portion take the bus.[22] Table 2-7 shows the modes of transportation that commuters use in Portland.

Table 2.7. Modes of transportation for commuters, Portland, 2000

Mode of transportation	Number	Percent
Car, truck, or van	204,688	75.5%
Drove alone	172,491	63.7%
Carpooled	32,197	11.9%
Public transportation	33,410	12.3%
Bus	30,492	11.3%
Streetcar	1,195	0.4%
Subway or elevated	1,039	0.4%
Railroad	446	0.2%
Taxi	238	0.1%
Motorcycle	480	0.2%
Bicycle	4,775	1.8%
Walked	14,192	5.2%
Other	1,671	0.6%
Worked at home	11,780	4.3%
Total, all modes but driving alone	*98,505*	*36.3%*
Total	**270,996**	**100.0%**

Source: U.S. Census Bureau, 2000.

Goods travel in and out of Portland through a variety of routes. Waterborne commerce is an important driver in the regional economy. The Port of Portland owns and manages five marine terminals; in 2002, over 4,500,000 short tons of goods were shipped in from foreign ports and 11,000,000 short tons of U.S. goods left the Port of Portland.[23] Passenger and cargo rail lines traverse the city. A major north-south interstate freeway, I-5, cuts through the city. I-205 provides an alternate route around the eastern edge of the city, and I-405 provides access to downtown Portland.

Critical Facilities and Infrastructure

Critical facilities and infrastructure are those that are essential to the health and welfare of the population; these are especially important following a disaster. As defined for the Portland Risk Assessment, this category includes: schools, hospitals, fire stations, police stations, and hazardous materials sites, transportation systems, lifeline utility systems, and high-potential loss facilities.

- **Essential Facilities**. For the City of Portland, the essential facilities are police and fire stations, hospitals, City Hall, 1900 Building, the Bureau of Emergency Communications, the 911 call center, and the Justice Center.
- **Critical Facilities.** Critical facilities are those facilities that critical to the health and welfare of the population and that are especially important following a hazard. Critical facilities include essential facilities (described above), transportation systems, lifeline utility systems, high-potential loss facilities, and hazardous materials sites. As defined by the Portland Risk Assessment, this category includes: schools, hospitals, fire stations, police stations, and hazardous materials sites. Private commercial establishments although critical to the recovery of a community are also a part of this listing.
- **Infrastructure**. Critical infrastructure includes public services that have a direct impact on the quality of life. Infrastructure includes communication technology such as phone lines or Internet access, vital services such as public water supplies and sewer treatment facilities, and transportation facilities (such as airports, heliports, highways, bridges, tunnels, roadbeds, overpasses, railways, bridges, rail yards, depots; and waterways, canals, locks, seaports, ferries, harbors, dry docks, piers and regional dams).
- **Lifelines.** Lifelines include utility systems (potable water, wastewater, oil, natural gas, electric power facilities and communication systems) and transportation systems (airways, bridges, roads, tunnels and waterways). Communications facilities are also important lifelines.
- **High Potential Loss Facilities**. Facilities that would have a high loss associated with them, such as nuclear power plants, dams, and military installations are included in the high potential loss facilities category. In Portland, this would include the Hazardous Materials Sites in the Guilds Lake area and the inner city dams operated by the Portland Water Bureau.

Further information about critical and essential facilities is available in Portland's Continuity of Operations Plan.

Section Endnotes

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[3] Flood and Landslide Mitigation Work Group, Portland Bureau of Buildings. "Flood and Landslide Hazard Mitigation Plan: Based on lessons learned in February, 1996". October, 1996.
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[10] Ibid.
[11] Metro, 2015 Regional Forecast and Urban Development Patterns February 1996.
[12] Hazards Workshop *Session Summary #16, Disasters, Diversity, and Equity.* Annual Hazards Workshop, (July 12, 2000) University of Colorado, Boulder.
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[14] US Census <http://www.census.gov> 2000
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[22] US Census <http://www.census.gov> 2000
[23] Portland Development Commission, "Portland Metropolitan Region Fact Book," 2004