Section 3
Risk Assessment Summary

This Section provides information about Portland's natural hazard risk assessment. It is general in scope, providing background on the process of producing risk assessments as well as an overview of Portland's risk information. Complete risk assessment information for each of the hazards identified in this plan can be found in Appendix C.

What is a Risk Assessment?

A risk assessment is the process for identifying and evaluating the impact of natural hazards on the human-built environment, businesses, social structure and services, and the natural environment. Risk assessments provide information about the areas where the hazards may occur, the value of existing land and property in those areas, and an analysis of the potential risk to life, property, and the environment that may result from natural hazard events. Specifically, Federal Section 322 requires that the following elements are present in a risk assessment:

1) ***Hazard Identification*** identifies the geographic extent of the hazard, the intensity of the hazard, and the probability of its occurrence. Maps are frequently used to display hazard identification data. Portland identified five major hazards that consistently affect or threaten this geographic area. These hazards – floods, landslides, wildfires, extreme weather, and earthquakes – were identified through a process that utilized input from a project steering committee, subject matter experts and historical records (as well as through the City of Portland Risk Assessment).

2) ***Profiling Hazard Events*** describes the causes and characteristics of each hazard, how they have affected Portland in the past, and what part of Portland's population, infrastructure, and environment has historically been vulnerable to each specific hazard. A profile of each hazard addressed in this plan is provided in Chapter 2, Sections 7 through 11. For a full description of the history of hazard specific events, please see these sections and Appendix C.

3) ***Vulnerability Assessment/Inventorying Assets*** combines the hazard identification with an inventory of existing (or planned) property and population that would be exposed to a hazard. Critical facilities are of particular concern because they provide essential products and services that are necessary to preserve the welfare and quality of life in Portland and fulfill important public safety, emergency response, and/or disaster recovery functions.

4) ***Risk Analysis/Estimating Potential Losses*** involves estimating the damage, injuries, and financial losses likely to be sustained from hazard events in a geographic area over a given period of time. This level of analysis typically involves using mathematical models, such as HAZUS. The two measurable components of risk analysis are magnitude of the impact that may result from the hazard event and the likelihood of the hazard occurring. Describing vulnerability in terms of dollar losses provides the community and the state with a common framework in which to measure the effects of hazards on assets. Where available, the best available data was used to determine the magnitude and likelihood of future natural hazard events. For each hazard where data was available, quantitative estimates for potential losses are included in the hazard assessment.

5) ***Assessing Vulnerability/ Analyzing Development Trends*** provides a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions. This plan provides a comprehensive description of the character of City of Portland in Section 2: Community Profile. This general description includes the geography and environment, population and demographics, land use and development, housing and community development, employment and industry, transportation and commuting patterns, and historic and cultural resources. Analyzing these components of Portland can help in identifying potential issues or concerns, and can serve as a guide for incorporating the goals and ideas contained in this mitigation plan into other community development plans.

THREE PHASES OF HAZARD ASSESSMENT:

Hazard Identification → Vulnerability Assessment → Risk Analysis

HAZUS-MS Pilot Project Background

Portland's risk assessment was completed in 2001 as part of a pilot project initiated between the Federal Emergency Management Agency and the City of Portland. The project was designed to demonstrate the applicability of using Hazards U.S. Multi-Hazard (HAZUS-MH) software to address the risk assessment requirements of the Disaster Mitigation Act of 2000 (DMA 2000). The risk assessment project was conducted to evaluate priority hazards of primary concern to the community, and to estimate potential damages and losses. The risk assessment provides a foundation for the community's decision makers to evaluate mitigation measures that can help reduce the impacts of future hazard events.

Two methodologies were used to assess potential exposure and losses associated with priority hazards for this pilot project. For flood and

earthquake, specific hazard parameters (ground motion for earthquake and discharge velocity for flood) were compared to a variety of infrastructure inventory parameters (for example, first floor elevations and building types). These were modeled to determine potential impact to humans, buildings, roads, and other assets. For landslide and wildland fire, historic data were not adequate to support the estimation and modeling of future events and losses. Instead, HAZUS-MH inventory data, professional judgment, and hazard area data regarding the geographic scope of each hazard were used to estimate exposure. Over the long term, Portland will collect additional data to assist in estimating potential losses for these hazards.

The value of such a study in the City of Portland is three-fold. First, it provides a basis for mitigation decision making through a federally recognized quantitative methodology. Second, it estimates potential loss from a disaster through GIS mapping and consistent, defensible data that is accepted in applications for expedited disaster recovery reimbursement requests. Third, it provides risk information in the form of maps and statistics that appeal to planners, engineers, and program developers who might not ordinarily consider disaster management in their planning.

Risk Assessment Summary

This section provides an overview of Portland's 2001 risk assessment. The complete, hazard-specific results of the pilot project are detailed in Appendix C.

- Portland is subject to substantial natural hazard risks. Of the 1,037 "major disaster declarations" in the United States between 1972 and 2000, the State of Oregon has claimed 12, ranking it 22nd in the number of disaster declarations for any state or territory. Total aggregated losses from natural disasters in Oregon have reached into the hundreds of millions of dollars during the past decade.
- Seismic activity, heavy precipitation, weather extremes, and geography will continue to result in earthquakes, floods, and landslides. In addition, periods of long dry summers and fuel accumulation (tree, grass, and understory growth) can contribute to the potential for wildfires.
- During the winters of 1996 and 1997, the Portland area experienced floods, landslides, ice storms, and other disasters. Over $220 million was provided to Oregon under several federal relief programs for three flood and landslide disasters that occurred in 1996 and 1997.
- Portland assets equal over $59 billion, including residential and commercial structures and building content, critical facilities and infrastructure (utilities and transportation lifelines).
- Areas along the Willamette River include flood zones, landslide potential, liquefaction potential, soft soil areas and significant

development. The multiple hazard areas along the river, combined with the level of development, appear to indicate that this area may face greater risk of losses than other areas of the study region.

Earthquake Risk Summary

Over the past 100 years, 56 recorded earthquake events have caused a total of 17 deaths and $2 billion in losses. The risk from earthquakes is considered to be severe. The widespread, regional nature of the earthquake hazard means that the entire Portland population is estimated to be at risk. Risk to infrastructure varies depending on the type of construction and proximity to liquefaction zones. The following provides further detail:

- For the 100 year mean return period earthquake event, 150 – 200 major injuries or fatalities could occur and 2,000 households could require shelter. For a 500 year mean return period event, as many as 900 major injuries or fatalities could result and as many as 5,000 households could require shelter.
- Total damage to commercial and residential structures could reach over $1 billion dollars in a 100-year earthquake; in a 500-year earthquake, that number jumps to nearly $4.5 billion.
- In a 500 year earthquake event, about 13% of the total value of critical facility infrastructure (schools, hospitals, fire stations, and police stations) could be lost.
- About 115 hazardous materials sites could experience significant damage.
- In a 500 year event, major damages to transportation lifeline systems is expect. A total of 6.7 miles of key roads, 14.7 miles of railway tracks, and .2 miles of light rail are predicted to experience damage. About 2.3% of the economic value of bridges could be lost in a 500 year event. Damage would also occur during a 100 year event, but significantly less damage is expected.
- Utility lifelines are a major consideration in an earthquake event. Potable water pipelines, sewers, natural gal pipelines, and oil pipelines are all expected to receive damages in a 100 and a 500 year event.

For more information on earthquake related risks, refer to Appendix C.

Flood Risk summary

Flooding results when rain or snowmelt creates water flows that exceed the carrying capacity of river channels or other watercourses and storage facilities. Significant historic flooding has been recorded for the Willamette and Columbia River basins in 1861, 1880, 1881, 1909, 1913, 1927, 1928, 1942, 1946, 1948, 1961, 1964/65, and 1996 (Oregon OEM

2000). Statewide floods in 1996 caused five deaths, forced thousands into shelters, destroyed hundreds of homes, and caused damages in excess of $220 million. City of Portland was forced to erect makeshift barriers to prevent floodwaters from moving into the downtown area.

- The period of occurrence for floods is usually October through April; the probability of an event occurring within this time period is highly likely. Even though there can be a significant warning time (up to 3 hours for tributaries and possibly days for rivers), flooding can force the shut down of facilities for up to 30 days or more.
- In Portland, 29,900 persons live within the impacted area for a 100 year mean return period flood event.
- Commercial building class losses account for 37% of the total estimated loss for the 100 year flood event.
- The total commercial exposure for a 100 year event could be nearly $1.5 billion; the total residential exposure at risk is estimated at $2.5 billion.
- The total expected average annualized loss associated with riverine flooding for residential and commercial occupancy classes is $15.4 million.
- There are 19 hazardous materials sites at risk from a 100 year flood, and 61 at risk from a 500 year flood.
- Eighty electrical power substations are at risk from a 100 year flood.

For more information on flood related risks, refer to Appendix C.

Landslide Risk Summary

Dominant landslide-prone areas were identified based on terrain information (slope and stability factors), geologic characteristics, and degrees of water saturation. The following provides further information about the infrastructure at risk.

- There are 28,100 households at risk from the variety of landslides in the Portland area. These are debris flows in valley bottoms, steep bluffs along rivers and west hills silt soils with most of the households in the west hills silt.
- Less than one-third of these homes have income less than $20,000 per year, and almost one-quarter of the residents in this area are over 65 years of age.
- The value of the total commercial and residential structures exposed to landslides is $7.9 billion.
- Three hospitals, sixteen schools, six fire stations and nine hazardous materials sites are at risk from landslides, in addition to 71 highway and railway bridges.

- A total of 126 electric power substations are in the vicinity of possible landslides; 18.6 miles of sewer are vulnerable.

For more information on landslide related risks, refer to Appendix C.

Wildfire Risk Summary

Wildfire risk was assessed based on a number of factors, including slope, vegetation fuel types, and built environment data. As there were no historical data available, the frequency and severity of the hazard could not be reliably calculated; annualized risk was computed. However, areas of concern were identified. Using this information, risk can be estimated.

- There are two major areas of Portland that are classified in the wildland fire zone. The two dominant areas are Forest Park and Powell Butte.
- Steep slopes and winding roads add to the risk for the property owners as response could be delayed due to the terrain.
- The population exposed to this hazard would be 64,400; of these, 7,500 are over 65 years.
- Total residential and commercial structures at risk amount to nearly $8 billion.
- Infrastructure at risk from wildland fire includes 10 schools, 30 bridges and 138 electrical power substations.

For more information on landslide related risks, refer to Appendix C.

Severe Weather Risk Summary

Severe weather was not evaluated through the HAZUS-MH methodology. Historically, severe weather has had a major impact on Portland. The City of Portland is vulnerable to high winds, black ice and snow. In the 2003-4 winter season, $452,000 was awarded by FEMA to the entire county for the costs incurred by the city and county during the 19 day ice storm and cold snap.

For more information on severe weather related risks, refer to Appendix C.