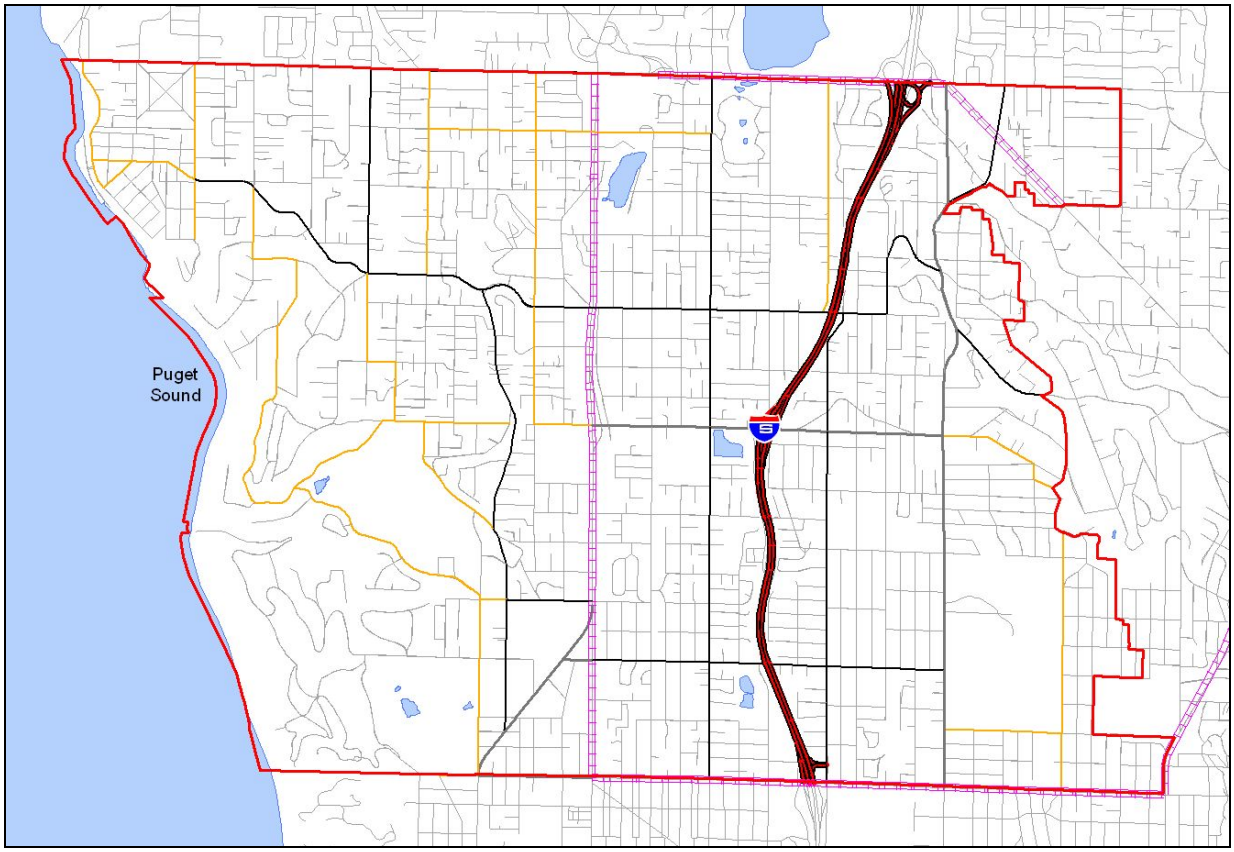
City of Shoreline
Hazard Mitigation Plan



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List of Acronyms

ATSDR	Agency for Toxic Substance and Disease Registry
BNSF	Burlington Northern Santa Fe
CERT	Community Emergency Response Team
DHS	Department of Homeland Security
DMA	Disaster Mitigation Act
DRACs	Disaster Reconstruction Assistance Centers
EERT	Employee Emergency Response Team
EHS	Extremely Hazardous Substances
EMPG	Emergency Management Performance Grant
EOC	Emergency Operations Center
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act
F	Fahrenheit
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GIS	Geographic Information System
GMA	Growth Management Act
HIVA	Hazard Inventory and Vulnerability Analysis
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HSEES	Hazardous Substances Emergency Events Surveillance
KCEM	King County Emergency Management
LEPCs	Local Emergency Planning Committees
MMI	Modified Mercalli Intensity
MPH	Miles Per Hour
NEHRP	National Earthquake Hazards Reduction Program
NIBS	
NOAA	National Oceanic and Atmospheric Administration
PGA	Peak Ground Acceleration
PSA	Public Service Announcement

RCW	Revised Code of Washington
SARA	Superfund Amendments and Reauthorization Act
SERC	State Emergency Response Commission
SMA	Shoreline Management Act
TPQ	Threshold Planning Quantity
UBC	Uniform Building Code
US	United States
USGS	United States Geological Survey
WSDOE	Washington State Department of Ecology
WAC	Washington Administrative Code
WaDNR	Washington State Department of Natural Resources
WMDEMD	Washington Military Department Emergency Management Division
WSDOH	Washington State Department of Health
WSDOT	Washington State Department of Transportation
WWII	World War II

1. Introduction

1.1. Background

The federal Disaster Mitigation Act (DMA) of 2000 (Public Law 106-390) commonly known as the 2000 Stafford Act amendments were approved by Congress on October 10, 2000. This Act requires state and local governments to develop hazard mitigation plans as a condition of federal grant assistance. Prior to 2000, federal legislation provided funding for disaster relief, recovery, and some hazard mitigation planning. The DMA improves upon the planning process to emphasize the importance of mitigation, encouraging communities to plan for disasters before they occur.

Hazard mitigation can be considered any action taken to permanently eliminate or reduce the long-term risk to human life and property from natural and human caused hazards. This is an essential element of emergency management along with preparedness, response and recovery. Disasters can produce a significant impact on communities when they occur. They can destroy or damage life, property, infrastructure, local economies and the environment.

This Hazard Mitigation Plan (HMP) helps protect the health, safety, economic and environmental interests of residents. Careful, long-term pre-disaster planning can help to reduce the impacts of natural hazards and increase a community's resilience through planning, awareness and implementation of mitigation actions. Fewer lives, homes and businesses will be lost and the disruption of a disaster event to the community will be lessened if hazard mitigation planning is utilized. Ultimately, a community that is hazard resilient is more likely to remain intact economically, structurally, socially and environmentally, even when a disaster does occur.

The basis of the HMP is the City of Shoreline Hazard Inventory and Vulnerability Analysis (HIVA) completed in 2003. Using the HIVA as a starting point, this HMP defines each hazard, assesses the risk the hazard poses to residents of Shoreline and defines the specific long-term mitigation actions that the city can take to reduce loss in the event of a hazard event.

Hazard identification is the systematic use of all available information to determine what types of and when disasters may affect a jurisdiction, how often these events can occur and the potential severity of their consequences. Vulnerability analysis refers to the process used to determine the impact these events and their collateral effects may have on the people, property, environment, economy and lands of a region.

The Federal Emergency Management Agency (FEMA) defines mitigation as "actions that reduce or eliminate the long-term risk to people and property from the effects of hazards,"(FEMA 2000). Mitigation can be structural or non-structural earthquake retrofit programs, city code that prohibits new development in floodplains or coalition building among organizations to improve their ability to educate the public about risk.

The City of Shoreline HMP will serve as a mechanism for the city to reduce the risk and impact of disaster events, allocate appropriate resources and to help set priorities and standards to ensure the safety of the public.

1.2. Purpose and Mission

The purpose of this document is to provide and expand upon information concerning significant natural hazards that have the potential to affect large areas or populations within the City of Shoreline. The HMP is intended to serve as a basis for city-level emergency management plans and programs, as well as to assist municipal jurisdictions, school districts and private businesses in the development of similar documents focused on local hazards.

This document will help to make an important first step toward a city that is resilient as possible and will cover each of the hazards affecting the City of Shoreline. The hazards include:

- Earthquakes
- Hazardous Materials
- Severe Weather
- Landslides/Sinkholes
- Flooding
- Wildland Fire
- Volcano
- Tsunami/Seiche

The City of Shoreline HMP defines each hazard, assesses the risk the hazard poses to Shoreline, provides long-term mitigation actions and implementation strategies that the city should consider to reduce loss in the event of a hazard event.

1.3. Policy Framework for Washington

Washington State Mitigation Policy identifies a commitment to hazard mitigation planning in order to reduce the impact of disasters and ensure that communities in Washington State are less vulnerable to impacts of hazards. The Washington State Legislature and the Governor have instituted a program to provide matching fund support for eligible applicants of the Hazard Mitigation Grant Program (HMGP) (WMDEMD 2003). There are also other state programs that have become available that can help aid mitigation strategies and reduce the impact of disasters.

1.4. Plan Criteria and Authority

This document provides information associated with the main disaster events affecting the City of Shoreline. This plan is designed to meet requirements of the DMA 2000 and the Washington Administrative Code (WAC 118-30-060 (1)) and is intended to be the basis for the City of Shoreline hazard mitigation planning efforts.

This plan meets the DMA 2000 hazard mitigation planning requirements. The DMA 2000 requires that for all disasters declared on or after November 1, 2004, all jurisdictions must have an adopted and FEMA approved HMP in place to be eligible for

future hazard mitigation grant funds. To support the DMA 2000 this plan includes the following:

- Hazard Identification
- Hazard Event Profile
- Vulnerability Assessment: including determining exposure, identifying assets and analyzing vulnerability
- Hazard Mitigation Goals
- Identification and Analysis of Mitigation Measures
- Monitoring, Evaluating and Updating the Plan
- Implementation through Existing Programs
- Continued Public Involvement

This document falls under the jurisdiction of the Shoreline Emergency Management Council. The council provides oversight to emergency management activities and those ordinances, resolutions, contracts, rules and regulations that are necessary for emergency management (City of Shoreline 2003).

The council consists of the following (Ord. 328 § 1, 2003; Ord. 103 § 4, 1996):

- The City Manager, or designee, who shall act as chair;
- The Emergency Management Coordinator as appointed by the city manager;
- The city Public Works Director;
- The city Police Chief;
- A representative of the Shoreline Fire Department, or successor;
- A representative of the Shoreline School District, or successor;
- A representative of the Shoreline Community College, or successor;
- A representative of the Shoreline Water District, or successor;
- A representative of the Ronald Wastewater Management District, or successor;
- A representative of the Shoreline Auxiliary Communications Service, or successor;
- And such city officials and other citizens with technical capabilities in related areas, upon appointment by the City Manager

1.5. Definitions

Critical Infrastructure: those roads and bridges, emergency response facilities, utilities like water, electricity and sewer, and other facilities critical to the health and welfare of the population that are especially important following a hazard event.

Emergency Preparedness: the steps taken to prepare for human needs during or after a disaster event. Examples of preparedness measures include having enough water and food on hand or having a plan to reconnect with family members should a disaster occur.

Exposure: an inventory of structures and systems in hazard areas.

Geographic Information System (GIS): is a computer software application that relates physical features on the earth to a database to be used for mapping and analysis. GIS analysis was used extensively in the development of this plan.

Hazard: is defined in this plan as any large-scale event, either natural or human-caused, that has the potential to cause damage to property and/or endanger human life.

Mitigation: FEMA defines mitigation as "actions that reduce or eliminate the long-term risk to people and property from the effects of hazards," (FEMA 2000). Mitigation can be structural or non-structural earthquake retrofit programs, city code that prohibits new development in floodplains or coalition building among organizations to improve their ability to educate the public about risk.

Project Planning Team: the researchers and coordinators from the Institute for Hazards Mitigation Planning and Research at the University of Washington who completed this plan.

Risk: the possibility of loss or injury from the impact of a hazard.

Vulnerability: any structures and systems in the path of a hazard that will be impacted by a hazard.

1.6. Document Overview

This plan is divided into ten sections as follows:

Section 1 – Introduction

Section 2 – Community Profile

Section 3 – Planning Process

Section 4 – Risk Assessment

Section 5 – Hazard Risk Rating

Section 6 – Capability Assessment

Section 7 – Plan Goals and Objectives

Section 8 – Mitigation and Implementation Strategies

Section 9 – Action Plan

Section 10 – Plan Maintenance

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2. Community Profile

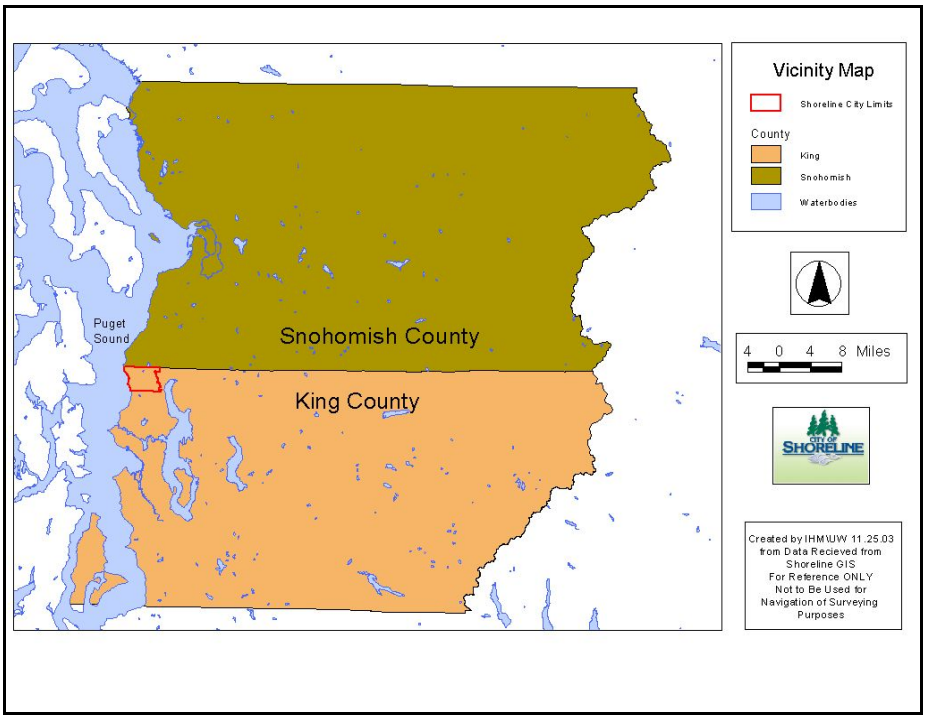
2.1. Historical Overview

Development patterns in the City of Shoreline were influenced by Seattle becoming King County's commercial center. Suburban development began after the turn of the century due to expanding transportation networks. The trans-continental railroad tracks, Seattle-Everett Interurban line and the brick-surfaced North Trunk Road made it easier to travel to and from Shoreline and spurred suburban development. During the early twentieth century, Shoreline attracted some large developments and commercial centers formed around the Interurban stops. After the end of World War II (WWII), there was tremendous demand for family housing. In the 1940's, large housing developments formed and business leaders and residents began to see Shoreline as a unified region. In 1949, the name "Shoreline" was used for the first time and described a community running from the Puget Sound shore to the Lake Washington shore and from the Seattle City line to the Snohomish County line. The City of Shoreline was incorporated on August 31, 1995 (City of Shoreline 1997).

2.2. Geographical Setting

The City of Shoreline is situated in the northwestern corner of King County along the shores of Puget Sound. Shoreline is bounded by Lake Forest Park to the east, Seattle to the south, Puget Sound to the west and Snohomish County to the north. Shoreline covers 11.74 square miles and is Washington's thirteenth most populated city with a population of about 53, 000 people. Figure 2.1 shows a general vicinity map for the City of Shoreline.

Figure 2.1: General Vicinity Map



Rivers and Streams

Shoreline is drained by a small perennial stream on the west, Boeing Creek, which flows through the steep bluffs and into Puget Sound and two other minor streams, McAleer Creek and Thornton Creek, which flow into Lake Washington.

Mountains and Volcanoes

The Cascade Range is a 1,000-mile long chain of volcanoes, which extends from northern California to southern British Columbia. The Cascade Range is located to the east of Shoreline. However, Shoreline does not lie within any basin that would drain any lahars or mudflows from the nearby volcanoes. Nonetheless it would be affected by tephra or an ash fall from either a Mount Rainier or Glacier Peak eruption.

Soils and Geology

About 14,000 years ago the Vashon Glacier was covering Shoreline with about 3,000 feet of ice. The glacier carved out a trough and when it melted the sea level rose 300 feet and filled the trough and created Puget Sound. Much of the soil in King County was left behind by the glacier. The top layer is Vashon till and can be found to depths up to 30 feet. Below Vashon till is Esperance sand and then Lawton clay. Vashon till is a stable mix of rocks, dirt, clay and sand that has the consistency of concrete. Esperance sand is a permeable mixture of sand and gravel. Lawton clay is an impermeable layer of clay, which is made up of fine sediments and large boulders (KCEM, http://www.metrokc.gov/prepare/docs/RHMPLANDSLIDES.pdf).

Climate

The City of Shoreline has the temperate climate typical of Western Washington. Summers are dry with mild temperatures, and winters are rainy with occasional snow. In Shoreline, the average temperature for January is 39.7 Fahrenheit (F) and 54.8 F for July. Average annual rainfall is 38.27 inches and average annual snowfall is 11.7 inches (City of Shoreline, http://www.cityofshoreline.com/about/facts/index.html).

2.3. Demographics

With infill growth in Shoreline will come an increasing number of potentially vulnerable people, including:

Increased percentage of older residents and residents with special needs

Increased racial, ethnic and cultural diversity

Increased percentage of residents living on fixed incomes

Why Consider Demographics in Hazard Mitigation Plans?

It is important for hazard-related plans to consider the demographics of the communities they seek to protect. Some populations experience greater risk from hazard events not because of their geographic proximity to the hazard but because of decreased resources and/or physical abilities. Elderly people, for example, may be more likely to be injured in a disaster and are also more likely to require additional assistance after a disaster. Research has shown that people living near or below the poverty line, the elderly and especially older single men, the disabled, women, children, ethnic minorities and renters have all been shown to experience, to some degree, more severe effects from disasters than the general population.

Vulnerable populations may vary from the general population in risk perception, living conditions, access to information before, during and after a hazard event, their capabilities during a hazard, and in access to resources for post-disaster recovery. Despite the fact that they often disproportionately experience the effects of a disaster, vulnerable populations are rarely accounted for in the current hazard mitigation planning process. There is a need for increased awareness of these differences.

The remainder of this section will detail the numbers of potentially vulnerable populations residing in Shoreline. The demographic information for Shoreline is based on the 2000 Census data.

Income

Impoverished people may experience greater results from disasters than members of the general population. In the United States (U.S), individual households are expected to use private resources to prepare for, respond to and recover from disasters to some extent. This expectation means that households living in poverty are automatically disadvantaged when confronted by hazards. Additionally, households living below the poverty line typically occupy the more poorly built and inadequately maintained housing of any given

community. Mobile or modular homes, for example, are more susceptible to damage in hurricanes, tornadoes and floods than other types of housing. In urban areas, households living below the poverty line often live in older houses and apartment complexes, which are more likely to be made of unreinforced masonry, a building type that is particularly susceptible to damage during earthquakes. In general, households living below the poverty line are more likely to die as a result of a disaster because they tend to live in older or poorly constructed homes located in more hazardous areas such as floodplains and they are less likely to fully recover after one (Blaikie et al. 1994).

The 2000 per capita income in Shoreline was $24,959, while the median household income was $51,658. Table 2.1 shows the comparison of income and poverty at the city, county and state level (U.S. Census Bureau 2000). About 6.9% of Shoreline residents are below the poverty line (meaning they spend more than 1/3 of income on an economy food budget). Of the 3,614 people living below poverty in Shoreline, about 6% are under the age of 18 and about 7% are 65 or older.

Table 2.1: Comparison of Income and Poverty

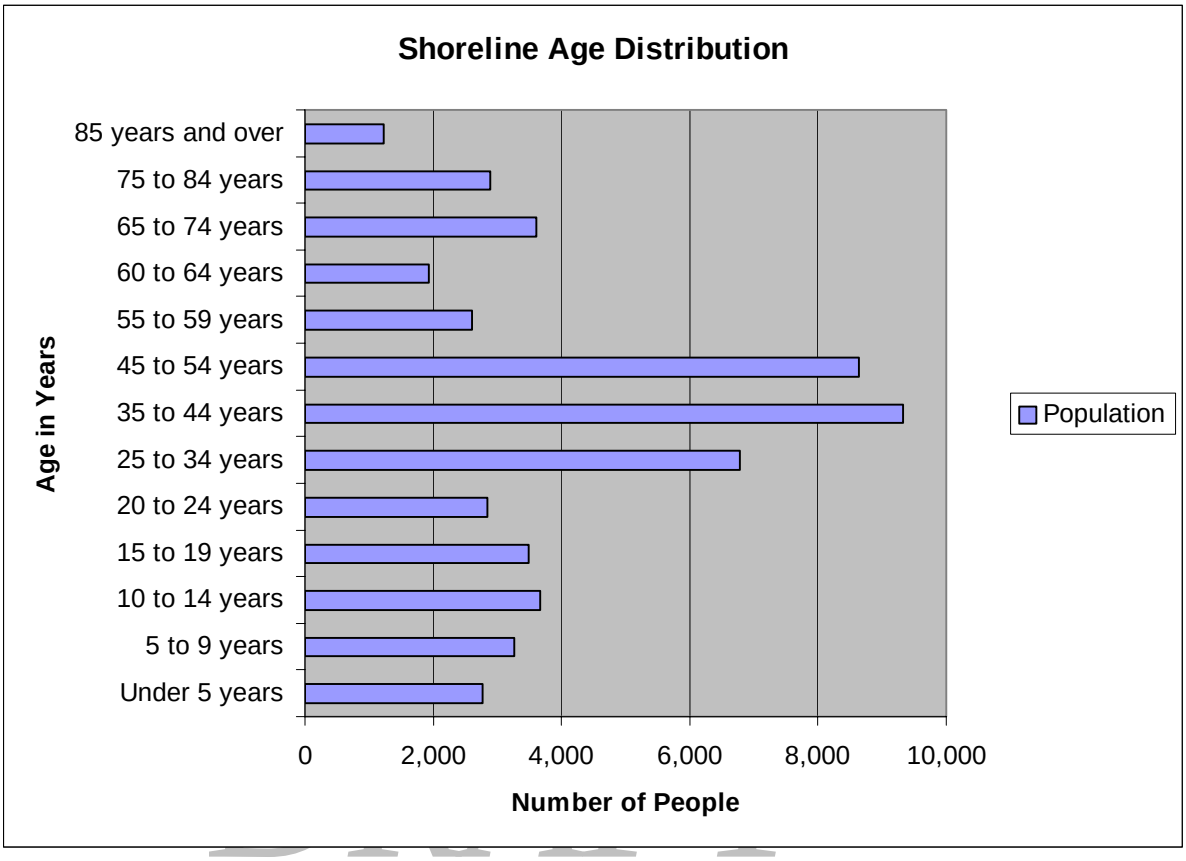
	Median Household Income	% of total population below poverty line	% of children (18 & under) below poverty line	% of elderly (65 & older) below poverty line
City of Shoreline	$51,658	6.9	6.1	7.3
King County	$53,157	8.4	9.4	7.4
Washington State	$45,776	10.6	13.2	7.5

Age Distribution

The vulnerability of elderly populations can vary quite significantly based on health, age, and economic security. However, as a group, the elderly are more apt to lack the physical and economic resources necessary for response, and are more likely to suffer health-related consequences and be slower to recover (Morrow 1999). They are more likely to be vision, hearing, and/or mobility impaired, and more likely to experience mental impairment or dementia. Furthermore, they are more likely to live in assisted-living facilities, where emergency preparedness occurs at the whim of operators (California Office of Emergency Services 1992). Certainly, the elderly require specific planning attention, an especially important consideration given the current aging of the American population.

According to 2000 US Census Bureau data, 14.5% of Shoreline's population is 65 or older. Of this 14.5%, 2,904 people or 40.8% have disabilities. Figure 2.2 shows the distribution of age in Shoreline.

Figure 2.2: City of Shoreline Age Distribution

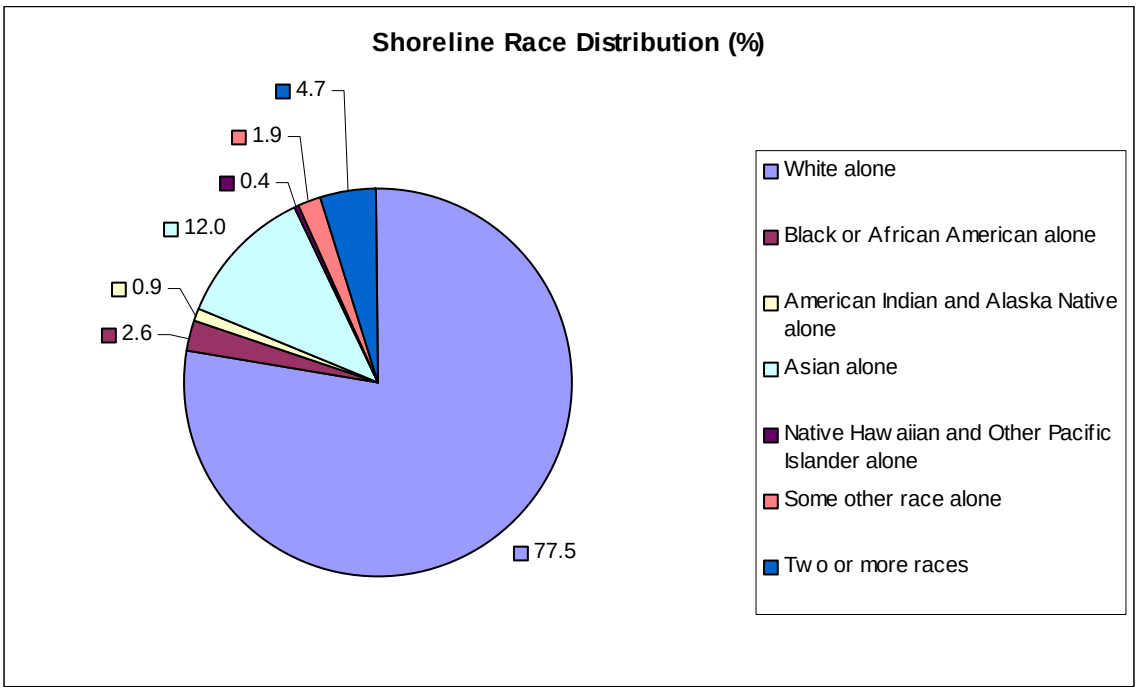


Race, Ethnicity and Language

Many researchers have focused on the increased disaster vulnerability that ethnic minorities experience in the United States. As one researcher has pointed out, "History is less likely to count minority victims in death tolls, and to minimize disasters that affect mostly minority victims as 'less disastrous' "(Steinberg 2000). Research shows that minorities are less likely to be involved in pre-disaster planning, experience higher mortality rates during an event and post-disaster recovery can be ineffective and is often characterized by cultural insensitivity. Furthermore, because higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability.

Racially, the City of Shoreline appears to be a somewhat homogenous area; about 77% of the population listed "white only" on the 2000 census form. The largest minority population is Asian, followed by Black or African American. However, these numbers do not reflect the large number of immigrants from Eastern Europe or the Latino population, who may have listed "white only". Shoreline maybe more ethnically diverse than Figure 2.3 below suggests.

Figure 2.3: Shoreline Race Distribution



In Shoreline 4,390 people, approximately 8.7% of Shoreline's residents, reported speaking English "less than 'very well' " in the 2000 Census. The largest group of languages spoken, other than English, was Asian and Pacific Island languages. Over half of those speaking Asian and Pacific Island languages reported that they speak English less than "very well." Additionally, about 23% of all households in Shoreline are "linguistically isolated," meaning that all members 14 years old and over have at least some difficulty with English (U.S. Census Bureau 2000). Table 2.2 shows linguistically isolated populations. This has important implications for emergency managers, who must get crucial information out to all members of the population in emergency events.

Table 2.2: English Use by Populations

Language	Number of People Speaking Language at Home	Number of People Speaking English less than "very well"	Number of households linguistically isolated*
Language other than English	9,646	4,390	82
% of total population	19.2	8.7	-
Spanish	1,454	566	103
% of total population	2.9	1.1	-
Other Indo-European languages	2,222	878	319
% of total population	4.4	1.7	-

Language	Number of People Speaking Language at Home	Number of People Speaking English less than "very well"	Number of households linguistically isolated*
Asian and Pacific Island languages	5,372	2,738	620
% of total population	10.7	5.5	-

*Linguistically isolated refers to household in which all members 14 years old and over have at least some difficulty with English.

Disabled Populations

Because people living with disabilities are significantly more likely to have difficulty responding to a hazard event than the general population, they have a special stake in emergency planning efforts. According to U.S. Census figures, 54 million Americans, roughly one-fifth of the U.S. population, live with a disability. These numbers are rising; furthermore, disabled populations are increasingly integrated into society (Bolin 1994). This means that a relatively large segment of the population will require assistance during the 72 hours post disaster event, the period generally reserved for self-help (Tierney et al. 1988).

Disabilities can vary greatly in severity and permanence, making these populations difficult to define and track. There is no "typical" disabled person, which can complicate disaster-planning processes that attempt to incorporate them. Furthermore, disability is likely to be compounded with other vulnerabilities, such as age, economic disadvantage and ethnicity, all of which mean that housing is more likely to be substandard. In fact, in at least one city, census data indicate that disabled populations are concentrated in older, higher-density housing that is more susceptible to earthquake damage (Tierney et al. 1988).

While the percentage of disabled in Shoreline do not differ much from those of the state as a whole, the overall numbers are significant and warrant special attention from planners and emergency managers (See Table 2.3).

Table 2.3: Shoreline Disability Status of Non-Institutionalized Population

Age	Number	Percent of Population
5-20 yrs	901	8.3
21-64 yrs	5,318	16.8
65+ yrs	2,904	40.8

2.4. Economics

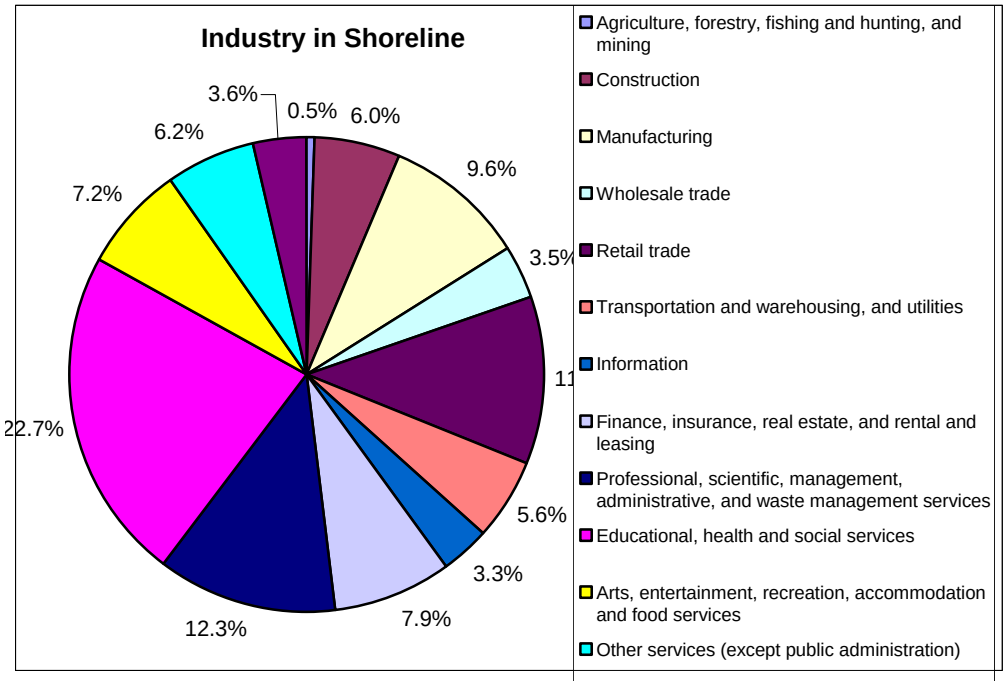
Development Trends

Development patterns in the City of Shoreline were influenced by Seattle becoming King County's commercial center. The City of Shoreline is a developed city with little vacant land. Vacant land is mostly land that cannot be developed do to land restrictions, such as steep slopes. The majority of new development in Shoreline is infill development and redevelopment projects.

Industry

The largest industry in Shoreline, at 22.7%, is educational, health and social services. Professional, scientific, management, administrative, and waste management services comes in second at 12.3% and retail trade comes in third at 11.6% (U.S. Census Bureau 2000) (See Figure 2.4).

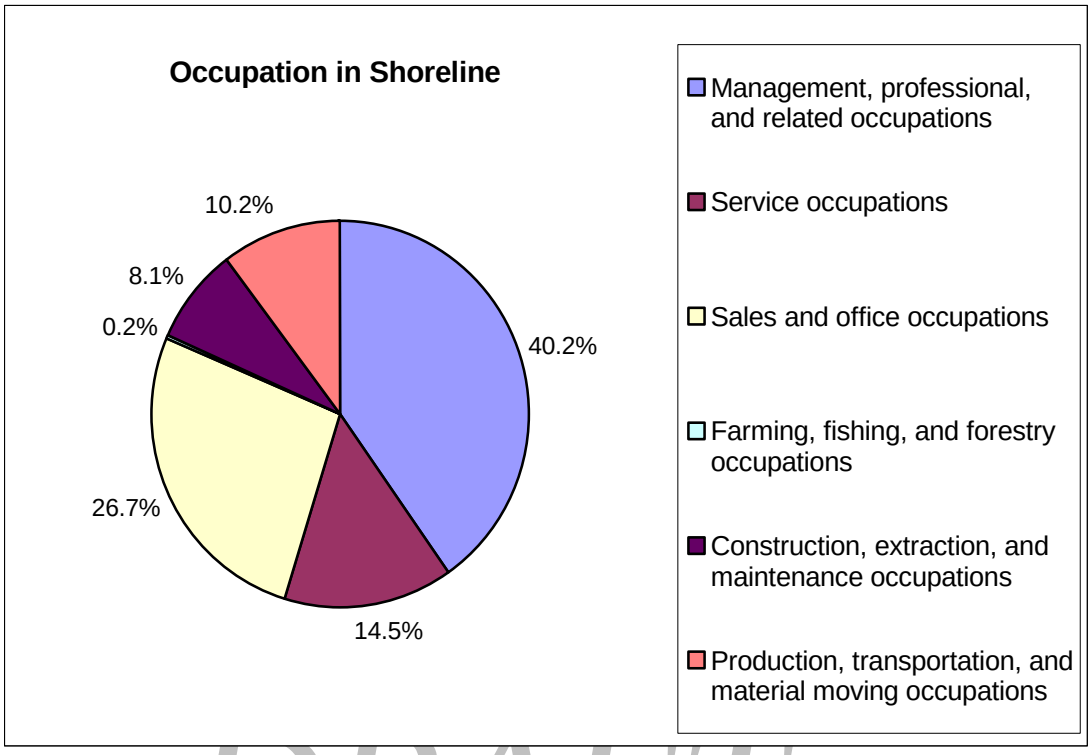
Figure 2.4: Industry in Shoreline



Occupation

In Shoreline, the top three occupations are management, professional, and related occupations (40.2%), sales and office occupations (26.7%), and service occupations (14.5%) (US Census Bureau 2000). Figure 2.5 displays the different occupations in Shoreline. The mean travel time to work is 26.9 minutes (ibid).

Figure 2.5: Occupation in Shoreline



2.5. Laws and ordinances influencing this plan

Federal

Disaster Mitigation Act (DMA 2000)

The DMA 2000 is the latest legislation to improve the hazard mitigation planning process. It reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur. It specifically addresses planning at the local level, requiring plans to be in place before Hazard Mitigation Grant Program (HMGP) funds are available to communities. This plan is designed to meet the requirements of DMA 2000, improving the City of Shoreline's eligibility for future mitigation funds.

Endangered Species Act (ESA)

ESA was enacted in 1973 with the purpose of conserving those species that are facing depletion or extinction and the ecosystems that support them. The Act sets forth a process for determining which species are threatened and endangered, and requires the conservation of the critical habitat in which those species live. It is important in hazard mitigation planning to consider habitat and species listed under the ESA.

State

Growth Management Act (GMA)

In 1990, the Washington State Legislature adopted the Growth Management Act (Chapter 36.70A Revised Code of Washington (RCW)). The Growth Management Act (GMA) mandates that local jurisdictions adopt ordinances that classify, designate, and regulate land use in order to protect critical areas. According to the code, “critical areas” include the following areas and ecosystems: (a) wetlands; (b) areas with a critical recharging effect on aquifers used for potable water; (c) fish and wildlife habitat conservation areas; (d) frequently flooded areas; and (e) geologically hazardous areas (RCW 36.70A.030).

In relation to this plan, Shoreline’s critical areas include wetland areas and potential landslide areas. The state GMA regulates development in these areas and, therefore, has the potential to affect hazard vulnerability and exposure at the local level.

Shoreline Management Act (SMA)

The Shoreline Management Act (RCW 90.58) was enacted in 1971, and is intended to manage and protect the shorelines of the state by regulating development in the shoreline area. A major goal of the act is "to prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines." Its jurisdiction includes the Pacific Ocean shoreline and the shorelines of Puget Sound, the Strait of Juan de Fuca, plus rivers, streams and lakes above a certain size. It also regulates "wetlands" associated with these shorelines.

City

Shoreline Municipal Code

Shoreline’s municipal code regulates all development throughout the city and includes code specifically dealing with many hazards.

- Geologic hazards are regulated in Shoreline municipal code 20.80 as a “critical area,” as required by the Washington State Growth Management Act.
- Fire protection code is described in chapter 15.10
- The Building and Construction Ordinance (Title 15) is particularly important to this plan as it includes all seismic and safety requirements for homes and businesses.
- The Land Use and Development Ordinance (Title 16), Subdivisions Ordinance (Title 17) and the Zoning Ordinance (Title 18) also affect this plan.

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3. Planning Process

The planning process is extremely important in any community planning process. It is crucial for the success of the plan to have the public ask questions and comment on the plan. Also, by involving the public in the planning process it increases the public's awareness of the hazards in Shoreline and informs them about the importance of hazard mitigation planning. Having public involvement in the planning process also allows for the plan to reflect the public's views and opinions. The project planning team allowed for public comment in several different phases using several different methods which are explained below.

3.1. Planning Team Formation

To facilitate the planning processes two workgroups were formed: the project planning team and the technical stakeholder committee.

The project planning team was assembled from the Institute for Hazard Mitigation Planning and Research at the University of Washington. The project team consisted of the researchers and coordinators who researched this plan and documented the planning process.

The technical stakeholder committee was comprised of group of representatives from city and jurisdictional organizations with expertise in fields ranging from public utilities to geology and emergency management. The technical stakeholder committee included members from:

Burlington Northern Santa Fe Railway

Chevron

City of Shoreline

CRISTA Ministries

Department of Social and Health Services: Fircrest

Foss Environmental

Puget Sound Energy

Seattle City Light

Shoreline Amateur Radio

Shoreline Community College

Shoreline Fire Department

Shoreline Police Department

Shoreline School District

Shoreline Water District

Washington State Department of Health: Public Health Laboratories

Washington State Department of Transportation

3.2. Public Involvement

Public involvement is critical to the success of any strategic planning process; it is particularly important for hazard mitigation plans to consider public concerns, comments, and perception of risk as factors in the creation of mitigation strategies.

Public Comment

The Shoreline Draft HMP was available on the City of Shoreline's web page, and at City Hall, the Police Station, both Police Neighborhood Centers, Shoreline Library and Richmond Beach Library. The City of Shoreline Police Chief accepted questions and public comment on the plan.

The planning project team presented the Shoreline Draft HMP at a City of Shoreline City Council Meeting (See Appendix A for an agenda). After the presentation, the planning project team listened to public comment and concern and answered questions about the plan. At the meeting the project team handed out a worksheet that allowed the public to rank the risk by hazard. The worksheet also allowed for comments and questions and suggestions for mitigation measures for the risks and hazards in Shoreline (See Appendix A for the worksheet). For those that could not attend, the council meeting was shown on Comcast Cable Services Channel 21 Wednesday through Sunday at 6 a.m., 12 noon and 8 p.m.

Public Notice

An announcement was listed in the Enterprise Newspaper that stated that the City of Shoreline was seeking public comment on the plan, where copies of the plan were available for review and where questions and comments could be received (See Appendix A). The announcement also stated that the plan would be presented at an upcoming City Council Meeting and welcomed public comment at that meeting. The Enterprise is a local newspaper that serves the South Snohomish County and North King County market.

3.3. Summary of Meetings

Planning Meeting #1—Stakeholder Meeting: November 7, 2003

The planning project team held planning Meeting #1 with the technical stakeholders (for a complete list of attendees and an agenda refer to Appendix A). First, the planning project team presented the background and planning process involved with preparing a hazard mitigation plan. The risk assessment portion of the plan had been distributed to the technical stakeholders to ensure that the information was accurate and to discover what was missing from the document. The planning project team led a discussion on the hazards located in Shoreline. GIS was used to display earthquakes hazards, landslide hazards and flooding hazards. It was determined that the FEMA mapped floodplain located in Shoreline was not accurate. The structures located in the floodplain were

located on a bluff above the stream and have never experienced any flooding. Then there was a discussion about hazardous materials, severe weather, volcanoes and tsunamis/seiches. Some of the questions the planning project team asked the stakeholders were:

- For each of the hazards what are significant past events and what was the effect on Shoreline?
- Where are vulnerable areas of concern?
- What are the critical and essential facilities and are there any concern with these facilities?
- What mitigation items have already been put in place?
- Are there any areas that could become isolated in a hazard event?
- Are there any measures that could mitigate the vulnerability in Shoreline?

The planning project team presented preliminary goals and objectives that had been developed from the risk assessment and City of Shoreline planning documents. Two worksheets were handed out. One worksheet listed the preliminary goals and objectives and asked for comments and additions and the other asked for mitigation recommendations for each of the hazards (See appendix A for the worksheets).

Planning Meeting #2—City Council Meeting: January 5th, 2004

The planning project team presented the Shoreline Draft HMP at a City of Shoreline City Council Meeting (See Appendix A for an agenda). After the presentation, the planning project team listened to public comment and concern and answered questions about the plan. At the meeting the project team handed out a worksheet that allowed the public to rank the risk by hazard. The worksheet also allowed for comments and questions and suggestions for mitigation measures for the risks and hazards in Shoreline (See Appendix A for the worksheet). For those that could not attend, the council meeting was shown on Comcast Cable Services Channel 21 Wednesday through Sunday at 6 a.m., 12 noon and 8 p.m.

Planning Meeting #3—Stakeholder Meeting: February 6, 2004

The planning project team presented the mitigation strategies to the technical stakeholders (See Appendix A for the agenda). A discussion was held about each of the mitigation strategies and the stakeholders suggested changes to the strategies as well as suggestions for additional strategies. The planning project team allowed the technical stakeholders to prioritize the mitigation strategies through a dot exercise. There were 28 mitigation strategies and each stakeholder was given 8 dots to place next to the mitigation strategies that he/she felt should be given the highest priority for implementation. The technical stakeholders were informed that they should consider the benefits and costs of

each of the strategies when prioritizing them. The results of the dot exercise were totaled and presented to the stakeholder committee (See Appendix A for the results of the dot exercise).

4. Risk Assessment

This section will describe the risks facing the City of Shoreline from each of eight hazards designated as significant. This section will also elaborate upon the hazard definition, vulnerabilities and probable event scenarios. Taken as a whole, this section assesses the risk that Shoreline is likely to experience from hazard events.

The following process was used to define risk of each hazard, which is reflected in the organization of the section:

- Identify and profile each hazard
- Determine exposure to each hazard
- Assess the vulnerability of exposed infrastructure and facilities
- Identify probability of occurrence and impact

4.1. Methodology

Assess hazards

This assessment includes the following information for each hazard:

- Geographic areas most affected by hazard
- Event frequency estimates
- Severity
- Warning time likely to be available for response

Determine exposure

Exposure was determined by overlaying hazards with an inventory of potentially vulnerable structures, facilities and systems to determine which of them would be exposed to each hazard. The City of Shoreline and King County's GIS database contains extensive coverage of infrastructure, including homes, industry, roads, bridges, oil pipelines, hazardous material storage sites, electricity and water mains.

Assess vulnerability

Vulnerability of the exposed structures and infrastructure were then assessed. Vulnerability was determined by interpreting the combination of probability of hazards in the area occurring with the amount and value of the items exposed.

Determine risk

Risk was determined by first describing a most probable case hazard scenario or impact that might affect the city. Using this scenario, the team estimated future expected losses from hazard events.

Data Sources

This information was gathered from a variety of sources. Frequency and severity indicators include past events and the expert opinions of geologists, emergency management specialists and others. To the extent possible, the hazard location was mapped using Arcview 3.2 GIS. The primary data source was the City of Shoreline and King County's GIS database, which is quite extensive, though other sources were also employed. Hazards not mentioned below employed the general data sources described above.

Earthquake

Earthquake maps involving known faults, soil types and liquefaction zones, which together define the areas most susceptible to shaking during an earthquake, were provided by the Washington State Department of Natural Resources (WaDNR). The team also used HAZUS, a GIS-based loss estimation tool developed by FEMA, to model earthquakes in the region.

Flood

A FEMA mapped floodplain was used as well as recorded flood incidents from 2003 that was collected by the City of Shoreline.

Hazardous Materials

Much of the data for this section was gathered from the Hazardous Materials Inventory, provided by the Washington State Department of Ecology (WSDOE). Additionally, health and injury information is provided by the Washington State Department of Health (WSDOH).

4.2. Presidential Declared Disasters

Presidential Declared Disasters are typically events that cause more damage than state and local governments/resources can handle without the assistance of the federal government. There is not generally a specific dollar loss threshold that must be met. A Presidential Major Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, and designed to help disaster victims, businesses and public entities (FEMA, http://www.fema.gov/library/dproc.shtm). The disasters highlighted in gray in Table 4.1 were Presidential Declared Disasters in King County that had a direct effect on Shoreline.

Table 4.1: Presidential Declared Disasters in King County

Declaration No.	Type of Disaster	Date of Disaster
185	Flood	December-64
196	Earthquake	May-65
328	Flood	February-72
492	Flood	December-75
545	Flood, Landslide	December-77
612	Flood	December-79

Declaration No.	Type of Disaster	Date of Disaster
623	Volcano	May-80
757	Flood, Landslide	January-86
784	Flood	November-86
852	Flood, Landslide, Wind	January-90
883	Flood	November-90
896	Flood	December-90
981	Wind	January-93
1079	Flood	November - December 1995
1100	Flood	January - February 1996
1159	Ice, Wind, Snow, Landslide, Flood	December 1996-February 1997
1172	Flood, Landslide	March-97
1361	Earthquake	February-01

4.3. Critical Facilities, Infrastructure and Functions

Critical and essential facilities and infrastructure are those that are critical to the health and welfare of the population. These become especially important after any hazard event occurs. Critical and essential facilities included for the City of Shoreline are as follows: police and fire stations, schools and emergency operations centers. Critical infrastructure includes the roads and bridges that provide ingress and egress and allow emergency vehicles access to those in need and the utilities that provide water, electricity and communication services to the community. Also included is Tier II facilities and the railroad, which hold or carry significant amounts of hazardous materials with a potential to impact public health and welfare in a hazard event.

This section provides the results of an exposure analysis where each critical facility and infrastructure has been evaluated to determine the hazards are likely to affect it. Figure 4.1 shows the critical and essential facilities and infrastructure in the City of Shoreline. In general, the City of Shoreline's critical infrastructure is relatively well located and is exposed to few hazards. A listing of facilities by jurisdiction, highlighting those exposed to hazards, follows below.

The following criteria were used to determine exposure:

- Earthquake: In an earthquake, all of the City of Shoreline will experience potentially damaging ground shaking. An earthquake will affect the entire city and has the potential to cause major structural and/or non-structural damage to any non-retrofitted facility and hamper its functionality. The facilities located on National Earthquake Hazards Reduction Program (NEHRP) D & E soils and high liquefaction areas are likely to sustain damages.
- Hazardous Material: There are six reported Tier II facilities located in Shoreline as well as the Washington Department of Health Lab. Any of these facilities and/or

infrastructure that either contain hazardous materials or are in close proximity to facilities that contain hazardous materials are potentially exposed to hazardous materials spills. However, the area of exposure and severity of impact is dependent on the type of chemical involved and the mode of release, such as airborne, spilled into water or spilled onto concrete. Critical facility exposure to hazardous materials would require an extensive and complex process that is beyond the scope of this project. Hazardous material exposure is therefore eliminated from this analysis.

In addition, areas adjacent to hazardous material transport routes are more likely to experience exposure. The main local routes for hazardous materials transport are Interstate 5, Aurora Avenue and the railroad located along the west shore of the city. All city government facilities are within close proximity of a transport route and should be considered exposed.

- Severe Weather: Since the entire city is susceptible to severe weather, all critical infrastructure is considered exposed to this hazard. Given that electrical utilities and roads are most often affected by severe weather, all critical infrastructure managers and operators should plan for possible power outages and difficult ingress and egress. Some critical infrastructure, such as power lines, are actually more likely to be impacted or damaged as a result of severe weather.
- Landslide/Sinkholes: Critical facilities are considered exposed to landslides if they are on or below historic landslides or potentially unstable slopes.
- Flooding: Any critical infrastructure within the 100-year floodplain is potentially exposed to flooding.
- Fire: Any critical infrastructure near high fuel areas load areas is exposed to risk from wildfires.
- Volcanic Eruption: Though volcanoes are considered in this plan, they are not likely to cause any major damage in Shoreline. However, there is a potential for the city to be affected by ash fall from an eruption at Glacier Peak or Mount Rainier. Critical facilities and infrastructure are considered exposed to volcanoes if they are with the city. However, a more in depth analysis of amount and location of ash fall would need to be completed to more accurately determined exposure. A few utilities and roads might be affected.
- Tsunami/Seiche: Critical facilities and infrastructure are considered exposed if they are located along the Puget Sound shoreline.

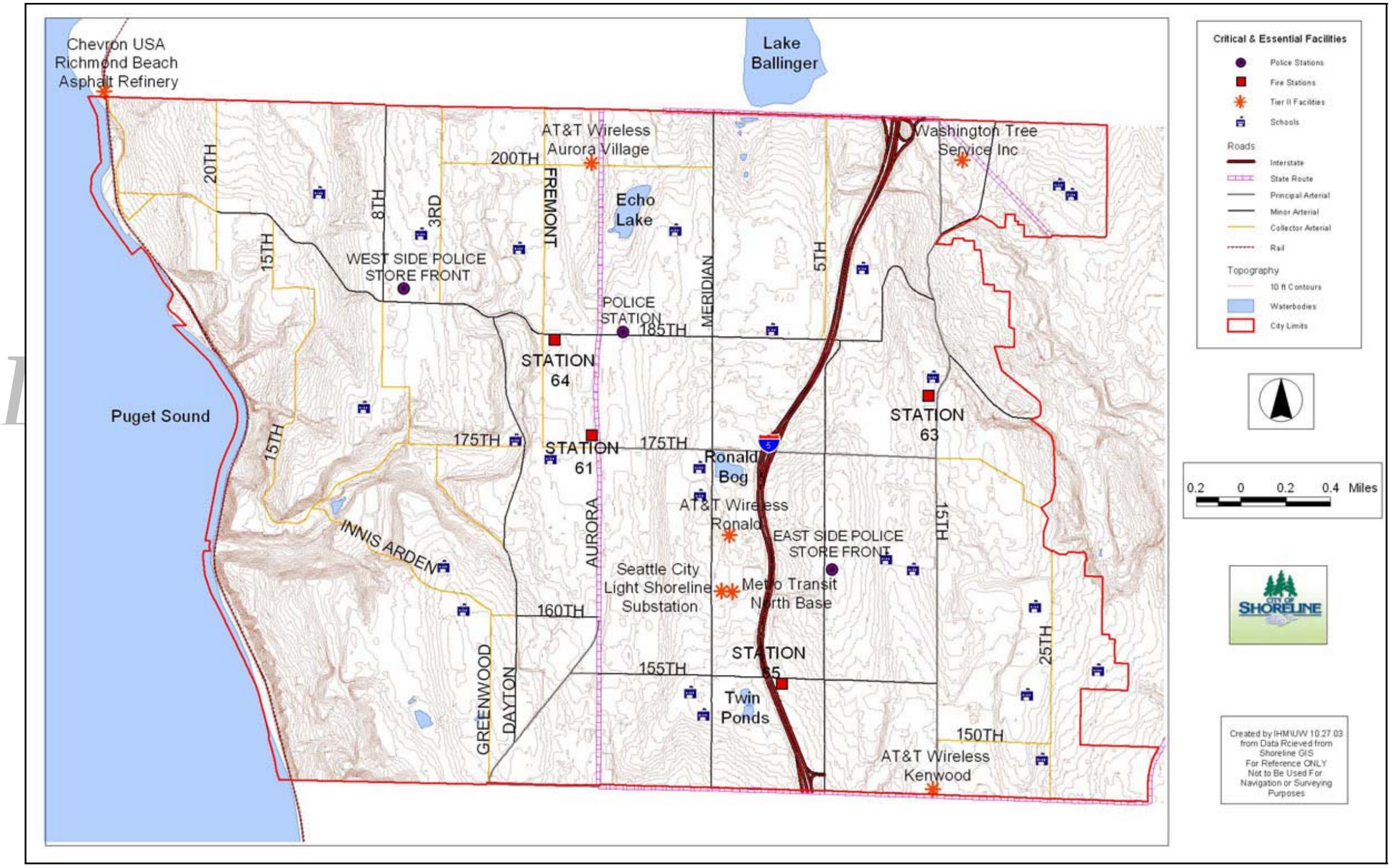
Table 4.2 describes the hazards that will significantly affect critical facilities and infrastructure based on exposure as described above.

Table 4.2: Hazard Events Affecting Critical Facilities and Infrastructure

Hazard Event	Critical Facility/Infrastructure
Earthquake	Infrastructure: Seattle Tolt Supply 3.7 & 2.0 MG Reservoir Communication Tower I-5 Bridges: 145th, 155th, 175th, 185th

Hazard Event	Critical Facility/Infrastructure
	Richmond Beach Bridge Saltwater Park Pedestrian Bridge Railroad Track Facilities: North City Elementary School St. Luke School Syre Elementary Ridgecrest Elementary Aldercrest Aldercrest Annex
Hazardous Materials	Infrastructure: Railroad Facilities: 6 Tier II Facilities Department of Health Lab
Severe Weather	All Critical Infrastructure and Facilities
Landslides/Sinkholes	None
Flooding	None
Fire	None
Volcano	None
Tsunami/Seiche	None

Figure 4.1: Critical and Essential Facilities



4.4. Earthquakes

Definitions

Earthquake: An earthquake is the shaking of the ground caused by an abrupt shift of rock along a fracture in the earth such as a fault or a contact zone between tectonic plates. Earthquakes are measured in both magnitude and intensity.

Benioff Earthquake: Sometimes called "deep earthquakes," these occur in the Pacific Northwest when the Juan de Fuca plate breaks up underneath the continental plate, approximately 30 miles beneath the earth's surface.

Crustal Earthquake: Crustal quakes occur at depths of up to 10 miles beneath the earth's surface, can create surface ruptures and are associated with fault movement within a surface plate.

Subduction Zone Earthquake: This type of earthquake occurs along two converging plates, attached to one another along their interface. When the interfaces between these two plates slips, a sudden, dramatic release of energy results, propagated along the entire fault line.

Intensity: Intensity is a measure of the effects of an earthquake. It is measured by the Mercalli scale and is expressed in Roman Numerals.

Liquefaction: Liquefaction is the complete failure of soils, occurring when soils lose shear strength and flow horizontally. It is most likely to occur in saturated fine grain sands and silts, which behave like viscous fluids when liquefaction occurs. This situation is extremely hazardous to development on the soils that liquefy, and generally results in extreme property damage and threats to life and safety.

Magnitude: Magnitude is the measure of the strength of an earthquake, and is typically measured by the Richter scale. As an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value.

Peak Ground Acceleration: Peak Ground Acceleration (PGA) is a measure of the highest amplitude of ground shaking that accompanies an earthquake, based on a percentage of the force of gravity.

Background

An earthquake is a naturally induced shaking of the ground. Earthquakes are caused by the fracture and sliding of rock within the Earth's crust. The earth's crust is divided into eight major pieces (or plates) and many minor plates. These plates are constantly moving, very slowly, over the surface of the globe. As these plates move, stresses are built up in areas where the plates come into contact with each other. Within seconds, an earthquake releases stress that has slowly accumulated within the rock, in some instances over hundreds of years. Sometimes the release occurs near the surface, and sometimes it

comes from deep within the crust (KCEM. http://www.metrokc.gov/prepare/docs/RHMPEARTHQUAKES.pdf).

The impact of any earthquake event is largely a function of ground shaking, liquefaction and distance from the source of the quake. Liquefaction generally occurs in softer, unconsolidated soils. A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics so that locations potentially subject to liquefaction and strong ground shaking may be identified. Table 4.3 provides a description of the NEHRP soil classification.

Table 4.3: NEHRP Soil Classification System

NEHRP Soil Type	Description	Mean Shear Velocity to 30 m (m/s)
A	Hard Rock	1500
B	Rock, highly consolidated soil	760-1500
C	Consolidated soil	360-760
D	Intermediate soils	180-360
E	Unconsolidated soft clays, alluvium	<180
F	Special study soils (liquefiable soils, sensitive clays, alluvium/ organic soils, soft clays > 36 m thick)	

The degree of ground shaking (or damage) caused by an earthquake is often assigned a numerical value from Roman Numeral I to XII on the Modified Mercalli Intensity (MMI) Scale. This helps assess and understand the physical affects of the earthquake. Table 4.4 provides a comparison of peak ground acceleration to the MMI scale (Nelson, Linda 2003).

Table 4.4: Mercalli Scale and Peak Ground Acceleration Comparison

MMI	Potential Damage	Est. PGA	Source
I	None	< .017	USGS
II – III	None	.017	USGS
IV	None	.014 - .039	USGS
V	Very Light	.039 - .092	USGS
VI	None to Slight USGS – Light	.02-05	Munich Re-ins
	URM – stair-step cracks	.04-.08	Goettle
	Damage to chimneys	.06 - .07	Bolt 1988
	Threshold of damage	.06 - .13	Table 3.2 Seismic Provisions
		.092 - .18	USGS
VII	Slight – Moderate USGS - Moderate	.05.-10	Munich Re-ins
	URM – Significant	.08-.16	Goettle
	cracking of parapets;	.10 - .15	Bolt
	masonry may fall	.1	Trifunac 1976

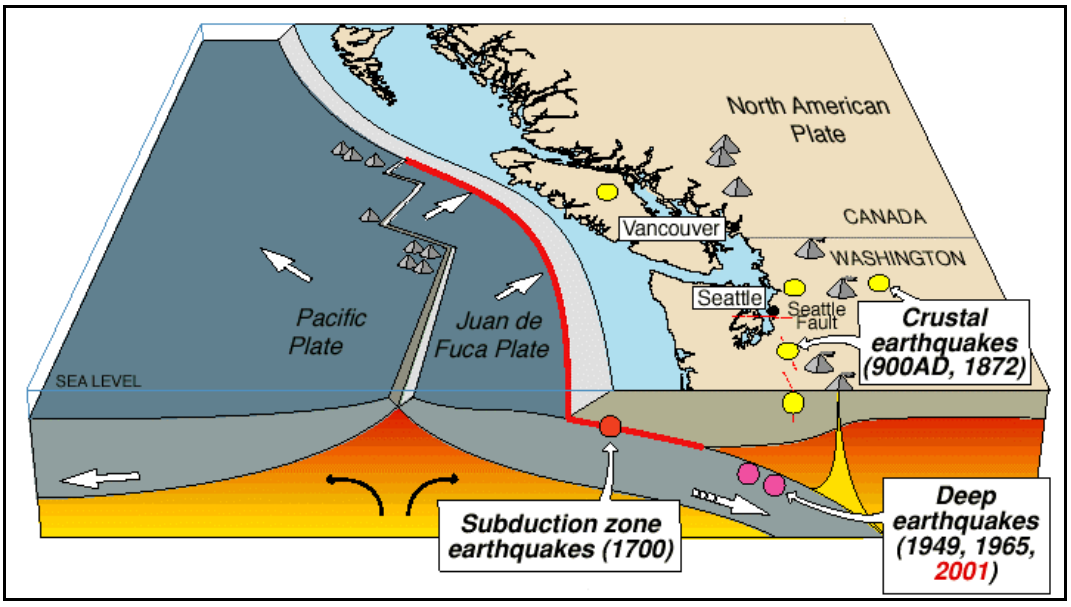
MMI	Potential Damage	Est. PGA	Source
	Threshold of structural damage	.18 - .34	USGS
VIII	Moderate – Extensive USGS – Moderate to Heavy	.10 - .20	Munich Re-ins
	URM – extensive cracking; fall of parapets and gable ends	.16 - .32	Goettle
		.25 - .30	Bolt 1988
		.13 - .26	Table 3.2 NEHRP
		.2	Trifunac 1976
		.35 - .65	USGS
IX	Extensive – Complete USGS - Heavy	.20 - .50	Munich Re-ins
	Structural collapse of some URM buildings; walls out of plane Damage to seismically designed structures	.32 - .55	Goettle
		.50 - .55	Bolt 1988
		.26 - .44	Table 3.2
		.3	Trifunac 1976
		.65 – 1.24	USGS
X	Complete Ground Failures USGS Very Heavy (X+)	.50 – 1.00	Munich Re-ins
	Structural collapse of most URM buildings Notable damage to seismically designed structures Ground Failures	.55 - .80	Goettle
		>.6	Bolt 1988
		.44 - .64	Table 3.2 bldgs w T >.5
		> 1.24	USGS
XI			
XII			

Earthquake Hazard in Shoreline

Location

In Western Washington, the primary plates of interest are the Juan De Fuca and North American plates. The Juan De Fuca plate moves northeastward with respect to the North American plate at a rate of about 4cm/yr. The boundary where these two plates converge, the Cascadia Subduction Zone, lies approximately 50 miles offshore of the west coastline and extends from the middle of Vancouver Island in British Columbia to northern California. As it collides with the North American plate, the Juan De Fuca plate slides (or subducts) beneath the continent and sinks into the earth's mantle. The collision of the Juan De Fuca and North America plates produces three types of earthquakes. These are subduction zone earthquakes, deep earthquakes and crustal earthquakes. Figure 4.2 shows the three types of earthquakes in Western Washington.

Figure 4.2: Earthquake Types in Western Washington



Subduction Zone

Subduction Zone earthquakes occur along the Cascadia subduction fault, as a direct result of the convergence of these two plates. Although no large earthquakes have occurred along the offshore Cascadia Subduction Zone since historic records began in 1790, similar subduction zones worldwide do produce "great" earthquakes – meaning a magnitude of 8 or higher. A subduction earthquake would be centered off the coast of Washington or Oregon where the plates converge and would typically have a minute or more of strong ground shaking. Usually, these types of earthquakes are immediately followed by damaging tsunamis and numerous large aftershocks.

Benioff (Deep) Zone

As the Juan de Fuca plate subducts beneath North America, it becomes denser than the surrounding mantle rocks and breaks apart under its own weight, causing Benioff zone or deep earthquakes. Beneath Puget Sound the Juan de Fuca plate reaches a depth of 40-60 km and begins to bend even more steeply downward, forming a "knee". It is at this knee where the largest Benioff zone earthquakes occur. Both the 1949 event near Olympia (southwest of Tacoma) and the 1965 event near the Seattle-Tacoma International Airport occurred at the knee.

Crustal Zone

The third source zone is the crust of the North American plate. Of the three source zones, this is the least understood. A variety of lines of evidence lead to the conclusion that the Puget Lowland area is currently shortening north-south at a rate of about 1/2 centimeter (one-fifth of an inch) per year. Where, and how, this shortening is occurring is not well understood, but at least some of it is occurring on the Seattle fault.

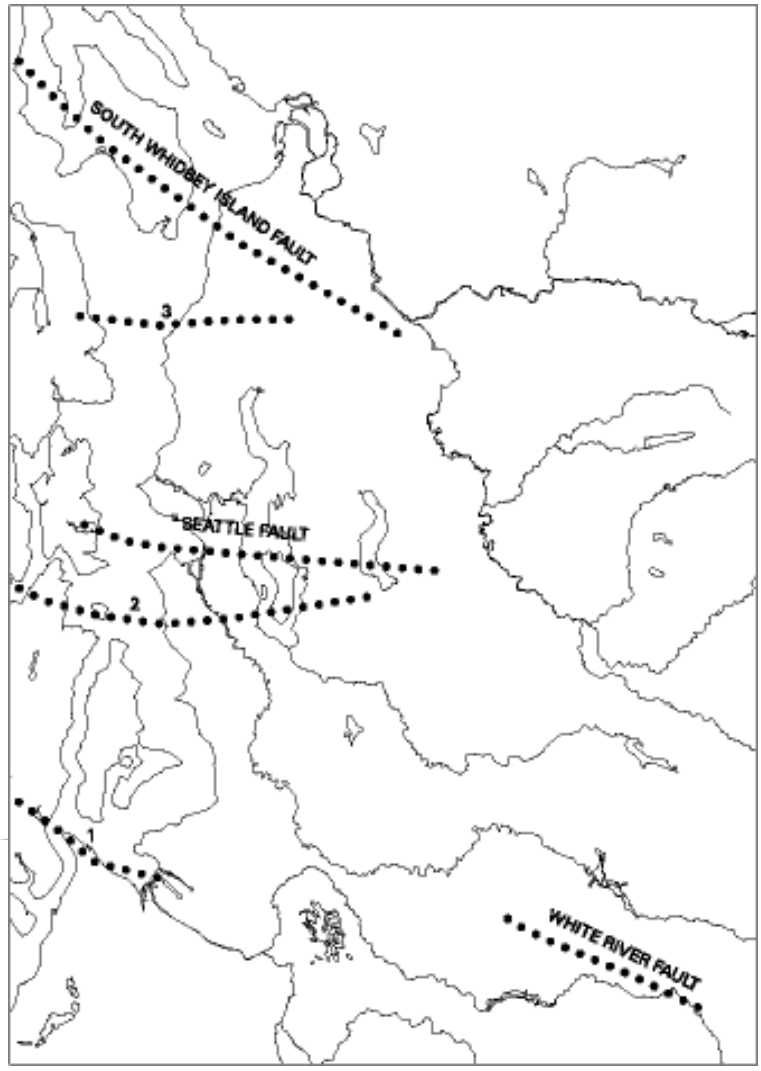
The structure of the crust in the Puget Sound area is complex, with large sedimentary rock-filled basins beneath Tacoma, Seattle and Everett. The Seattle basin is the deepest, at 8-10 kilometers. The Seattle fault forms the south margin of the Seattle basin.

Other active faults may be present in the greater Seattle area, but geologists have only documented young (in the last 14,000 years) motion on the Seattle fault. Currently the Seattle fault zone can be mapped from Dyes Inlet to Lake Washington a distance of approximately 40-kilometers. Slip rates are estimated to be approximately 0.7 to 1.1 millimeters per year (mm/year)(USGS. http://geohazards.cr.usgs.gov/pacnw/actflts/sfz.html). Historical events associated with this fault includes events that occurred at Point Robinson on January 29, 1995 with a magnitude 5.0 (Dewberry et al. 1996) and at the southwestern end of Bainbridge Island on June 23, 1997 with a magnitude of 4.9 (USGS. http://geohazards.cr.usgs.gov/pacnw/actflts/sfz.html).

How many other crustal faults pose significant earthquake hazards to the Puget Sound region is not yet known, but geologists and geophysicists are studying the South Whidbey Island fault, the Olympia fault and the Devils Mountain fault for evidence of young earthquakes.

Figure 4.3 shows the potentially active faults in the Seattle area that could affect Shoreline.

Figure 4.3: Potentially Active Faults



NEHRP Soils

The NEHRP classification system is used for this earthquake analysis and was completed for Washington State by the Department of Natural Resources. The majority of the City of Shoreline sits on NEHRP soils C as shown in Figure 4.9. In the event of an earthquake, NEHRP soils C typically sustain ground shaking well dependent on the magnitude. In Shoreline, the areas that will be most affected by ground shaking are located in NEHRP soils D and E. There are no A, B or F soils located within Shoreline.

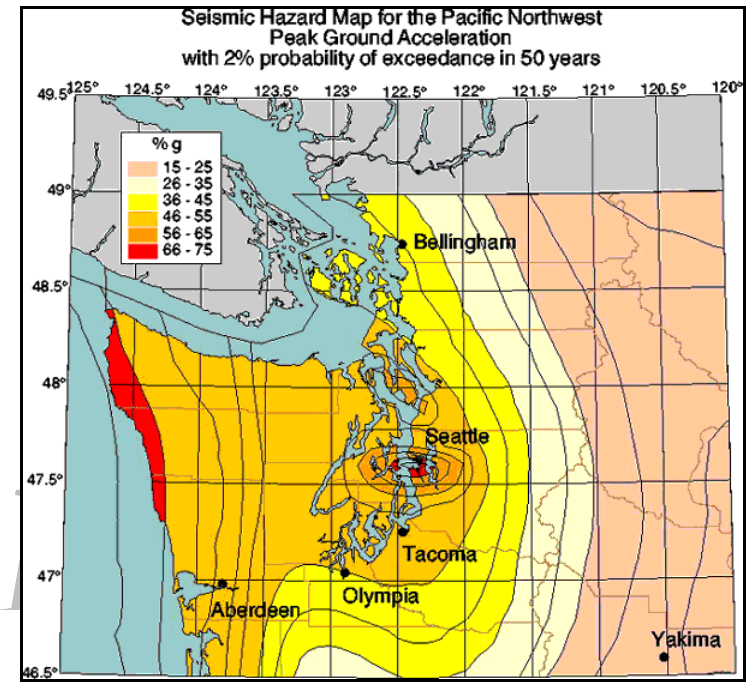
Frequency

The United States Geological Survey (USGS) has created a probabilistic map based on peak ground acceleration that takes into account new information about the Seattle fault zone. The Seattle area, including Shoreline, is in a higher risk area, with a 2% probability of exceedance in a 50 year period of seeing ground shaking at 70% of gravity. Figure 4.4

displays the expected peak horizontal ground motions for this probability (USGS. http://geohazards.cr.usgs.gov/pacnw/hazmap/index.html).

Dr. Art Frankel of USGS estimated that a Cascadia Subduction zone earthquake has a 10% to 15% probability of occurrence in 50 years, a crustal zone earthquake and a Whidbey and Seattle Fault earthquake has a 2% probability of occurrence in 50 years and a Benioff zone earthquake has an 85% probability of occurrence in 50 years.

Figure 4.4: Probabilistic Hazard Map



Severity

The City of Shoreline has the potential to be affected by a subduction, Benioff, or crustal zone earthquake, but historically has been spared the damaging effects of earthquakes. A subduction zone earthquake could produce an earthquake with a magnitude as large as an 8.5 in Shoreline. Benioff zone earthquakes as large as magnitude 7.5 are expected everywhere west of the eastern shores of Puget Sound (USGS http://wrgis.wr.usgs.gov/docs/wgmt/pacnw/lifeline/eqhazards.html). A crustal zone earthquake could produce a 6.5 magnitude earthquake affecting Shoreline.

Warning Time

There is a large amount of information that is known about possible earthquake locations, however there is no current reliable way to predict what day or month an earthquake will occur at any given location. There is current research that is being done with warning systems that use the low energy waves that precede major earthquakes (California Institute of Technology 2003). These potential warning systems give approximately 40 seconds notice that a major earthquake is about to occur. The warning time is very short, but could allow for someone to get under a desk, step away from the hazardous material they are working with or shut down a computer system.

Past Events

The February 28th, 2001 Nisqually Quake with a magnitude of 6.8 is a recent example of a Benioff zone earthquake. The Nisqually earthquake of 2001 caused several damaged chimneys in Shoreline as well as disruption to communication services for approximately 45 minutes (Dahl, Tim 2003).

The last Cascadia Subduction Zone event occurred on January 26th, 1700 and was catastrophic.

Table 4.5 is a summary of major earthquakes that have occurred in the Puget Sound Region (KCEM. http://www.metrokc.gov/prepare/docs/RHMPEARTHQUAKES.pdf).

Table 4.5: Major Earthquakes in the Puget Sound Region

Date	Location	Magnitude	Type
1872	North Cascades	7.4	Crustal Zone
1882	Olympic Area	6.0	Benioff Zone
1909	Puget Sound	6.0	Benioff Zone
1915	North Cascades	5.6	--
1918	Vancouver Island	7.0	--
1920	Puget Sound	5.5	--
1932	Central Cascades	5.2	Crustal Zone
1939	Puget Sound	5.8	Benioff Zone
1945	North Bend	5.5	Crustal Zone
1946	Puget Sound	6.3	Benioff Zone
1946	Vancouver Island	7.3	Benioff Zone
1949	Olympia	7.1	Benioff Zone
1965	Puget Sound	6.5	Benioff Zone
1981	Mt. St. Helens	5.5	Crustal Zone
1990	NW Cascades	5.0	Crustal Zone
1995	Robinson Point	5.0	Crustal Zone
1996	Duvall	5.6	--
2001	Nisqually\Puget Sound	6.8	Benioff Zone

Secondary Hazards

Secondary hazards from an earthquake event are numerous. Liquefaction in areas designated by the USGS and WaDNR as high liquefaction is a major concern. Other

significant secondary effects of an earthquake, such as landslides, wildfires and hazardous materials releases, may also affect Shoreline.

Landslides do not always occur in the first few minutes following an earthquake. It is possible that they can happen days later. There were numerous landslides during and after the 1949 and 1965 earthquakes. Many roads were closed and sections of the railroad track were swept into Puget Sound as a result of these. Steep slopes throughout the greater Seattle area are candidates for earthquake-induced failure. Shoreline is flanked on both the east and west sides by steep slopes increasing chances of susceptibility.

Brush or wildfires can be caused by downed power lines or ruptured gas lines. Shoreline has plentiful open space, which can get very dry during the summer. An earthquake during the summer may cause a fire. In addition there is a power substation located on Meridian Avenue North, which unless properly earthquake secured can cause conflagration.

Hazardous materials can be spilled from ruptured containers. In addition, traffic accidents can occur during ground shaking as well as possible train derailment from buckling tracks or landslides caused by an earthquake.

Exposure and Vulnerability

Shoreline has a large amount, approximately 82%, of residential and commercial structures that were built prior to 1972, which was when the 1970 Uniform Building Code (UBC) went into effect. This stipulated that all buildings be constructed to at least seismic risk Zone 2 Standards. Buildings in Shoreline built before 1972 can be at risk during earthquakes. These structures can be retrofitted, economically, to withstand expected ground shaking. Structures built after 1972 are in compliance with the 1970 Uniform Building Code resulting in minimizing the damage from seismic risk for these structures. In 1994, seismic risk Zone 3 standards of the UBC went into effect in Western Washington, requiring all new construction to be capable of withstanding the effects of 0.3 times the force of gravity. More recent housing stock, which is mainly infill development, is in compliance with Zone 3 standards. In July of 2004, the state will once again upgrade the building code to follow the International Building Code Standards.

Table 4.6 shows the number of residential and commercial structures in Shoreline that have been built before and after the 1970 UBC went into affect.

Table 4.6: Residential & Commercial Building Dates

Type of Structure	Built before 1972	Built during & after 1972	Total	Percentage built before 1972
Single Family	13,122	2,600	15,722	83.5
Multi-Family	58	100	158	36.7
Commercial	497	386	883	56.3

Type of Structure	Built before 1972	Built during & after 1972	Total	Percentage built before 1972
Total	13,677	3,086	16,763	81.6

The structures were further separated into categories of structures built on NEHRP D and E soils and high liquefaction areas. For maps of NEHRP Soils, liquefaction area and structures built on these areas see Figure 4.10, Figure 4.11, Figure 4.12 and Figure 4.13. A monetary value was assigned based on total taxable improvement value from the assessor's database. In addition building material was determined from the assessor's database for multi-family and commercial structures. There was no information for construction material for single family structures. Structures built of un-reinforced masonry are particularly vulnerable to ground shaking. Table 4.7, Table 4.8 and Table 4.9 specify this information.

Table 4.7: Commercial Structures in Vulnerable Soils

Commercial	NEHRP Soils D	NEHRP Soils E	High Liquefaction
Total # of Structures	55	3	3
# of Structures built before 1972	32	1	2
# of Structures built in 1972 and after	23	2	1
Total Taxable Improvements Value of Structures built before 1972	$9,347,100	N/A	N/A
Total Taxable Improvement Value of Structures built in 1972 and after	$12,356,100	N/A	N/A
Construction Material of Structures built before 1972	11 Masonry 15 Wood Frame 6 Prefab Steel	1 Masonry	2 Masonry
Construction Material of Structures built in 1972 and after	10 Masonry 12 Wood Frame	2 Masonry	1 Masonry

Table 4.8: Multi-Family Structures in Vulnerable Soils

Multi-Family	NEHRP Soils D	NEHRP Soils E	High Liquefaction
Total # of Structures	54	2	2
# of Structures built before 1972	12	1	1
# of Structures built in 1972 and after	42	1	1
Total Taxable Improvements Value of Structures built before 1972	$7,705,700	$76,400	$76,400
Total Taxable Improvement Value of Structures built in 1972 and after	$16,367,400	$1,464,400	$1,464,400
Construction Material of Structures built before 1972	12 Wood Frame	1 Wood Frame	1 Wood Frame
Construction Material of Structures built in 1972 and after	42 Wood Frame	1 Wood Frame	1 Wood Frame

Table 4.9: Single-Family Structures in Vulnerable Soils

Single Family	NEHRP Soils D	NEHRP Soils E	High Liquefaction
Total # of Structures	3,935	107	107
# of Structures built before 1972	3,297	64	64
# of Structures built in 1972 and after	638	43	43
Total Taxable Improvements Value of Structures built before 1972	$508,391,000	$12,690,900	$12,690,900
Total Taxable Improvement Value of Structures built in 1972 and after	$148,629,200	$15,255,000	$12,690,900

Single Family	NEHRP Soils D	NEHRP Soils E	High Liquefaction
Construction Material of Structures built before 1972	N/A	N/A	N/A
Construction Material of Structures built in 1972 and after	N/A	N/A	N/A

The analysis showed that there are four schools located on D soils. These schools are Syre Elementary, North City Elementary, Ridgecrest Elementary and St. Luke School. The first three schools are public and have all been retrofitted for earthquakes so they are not particularly vulnerable. St. Luke School is a private school and it is undetermined whether or not this building has been seismically upgraded. Also located on D soils are Aldercrest and Aldercrest Annex, which are owned by Shoreline School District and leased out. Aldercrest and Aldercrest Annex contain a daycare, preschool and a home school program.

There are two Tier II facilities located on D soils. These are Washington Tree Service Inc and AT&T Wireless Ronald. There are also 5 gas stations located on D soils in Shoreline.

Apart from the building stock, there are several other items that may be vulnerable.

CRISTA Ministries has schools, a senior complex, businesses, a radio tower including add-ons for repeater towers and a steam plant; there are approximately 3,000 people during the day both the young and elderly. The water tower located at CRISTA was built in 1972 and has not been retrofitted. The radio tower was built to an earthquake code, but is still a concern since there could be lost communication if there was a problem with the radio tower. Located at CRISTA are concrete high-rise apartments built in 1984 that are located on D soils. Two other buildings of concern are the gym, built in 1962, and another wood structure built in 1935. CRISTA is served by a 4 inch gas main that is also a concern during an earthquake. CRISTA is an area that could be at risk of isolation during a major earthquake.

In Shoreline, the Washington State facility, Fircrest currently houses approximately 250 people with developmental disabilities and has approximately 300 to 400 staff during the day (Melton, Kelly. 2003). A future decrease of residents and staff is planned for Fircrest. Fircrest structures are constructed of Type I and II masonry in addition to several wooden structures dating back to the 1940's. The majority of the buildings are not structurally up to current code. During an earthquake this could potentially isolate populations living at this location.

Shoreline Community College has facilities built in the 1960's and 1970's, many of which are un-reinforced masonry. The College has about 1,100 employees, 15,000 students with 8,000 full time students, 100 preschool age children at the daycare and elderly who come for services at the dental hygiene clinic and cosmetology school. The

College stores small amounts of hazardous materials. These materials are safely stored and the College has a certified small storage building.

Shoreline has a 400,000 gallon water tank located near NE 180th and 15th Avenue NE that has not been seismically retrofitted.

Interstate 5 has four bridges at N 145th Street, N 155th Street, N 175th Street and N 185th Street that were built about 1963-64 when there was no consideration given to seismic design. These bridges are listed as group 4 bridges, which means that they are multiple column pier bridges. The group 4 bridges are less vulnerable to collapse during a seismic event than the group 3 bridges. The group 3 bridges are single column pier bridges and have a higher priority for retrofit. The four I-5 bridges in Shoreline mentioned above are on the Washington State Department of Transportation (WSDOT) 05-07-biennium seismic retrofit recommendation list. However, due to lack of funding these bridges may not be retrofitted for another 8 to 10 years (Lentz, Tom. 2003). Although not mentioned in the Shoreline Hazard Inventory Vulnerability Assessment as vulnerable due to seismic design, the overpasses at N 165th Street and N 205th Street should be considered when working with the WSDOT. There is also a WSDOT pedestrian bridge at N 195th Street that should be evaluated for seismic design.

Collapse of these bridges could potentially split the city in half, isolating sections from essential services such as fire and police.

The intersection of Meridian and N 175th Street is built on pilings with soils that have the potential for liquefaction. This could cause a major problems because it is one of the through routes between the east and west sides of Shoreline. There is also a City owned bridge in Richmond Beach that is located in NEHRP E soils and does not meet the latest seismic codes. Collapse of this bridge could isolate a small population of residents. There are current plans by the City to replace this bridge.

Burlington Northern and Santa Fe (BNSF) Railway Company has railroad tracks that cross through E soils. Railway lines also pose another vulnerability for hazardous material spills during an earthquake.

The current City Hall Annex building, a converted office building, does not meet seismic codes. This is important because administrative operations are run out of the City Hall and during a disaster event it is important that this is operational.

During an earthquake the power grid can be disrupted. In Shoreline, power is provided by Seattle City Light. A concern is that if the power is lost, the Shoreline Water District currently does not have backup power generators at several pump locations. If power is lost for prolonged periods there will be a diminishment and potential loss of domestic water supply. This is a concern because the fire department is dependent on the domestic water supply to fight fires. This could pose a major problem in the event of an earthquake because fire is a secondary hazard to earthquakes and earthquakes can also cause damage to the power system which may start a fire.

Another vulnerability relating to the water system is the 60 inch Seattle Tolt pipeline that runs through Shoreline supplying potable water to several reservoirs and communities. Pipeline ruptures during an earthquake can be significant due to possible loss of water to

the community and could result in washouts and flooding problems. This pipe can only be shutdown slowly due to the size and the amount of water that travels through it.

Natural gas lines and propane tanks are also a significant vulnerability, especially those located in NEHRP D and E soils. A high-pressure natural gas line serves Richmond Beach and several properties in this area have propane tanks located on them. This area is a concern because there are NEHRP D and E soils located in Richmond Beach. Natural gas lines and propane tanks are a concern during an earthquake because if ruptured can cause conflagration.

Scenario

Using HAZUS, four probalistic earthquake event scenarios were completed. HAZUS, is a nationally applicable standardized methodology and software program that contains models for estimating potential losses from earthquakes. HAZUS was developed by FEMA under contract with the National Institute of Building Sciences (NIBS). Loss estimates produced by HAZUS are based on current scientific and engineering knowledge of the effects of earthquakes (FEMA http://www.fema.gov/hazus/hz_meth.shtm).

This is explained in the scenario section below. The four earthquake scenarios that were tested using HAZUS to predict the possible effects of earthquakes in Shoreline were:

- A Cascadia Subduction Zone Event with an 8.5 magnitude
- A 7.0 Benioff Earthquake with a magnitude of 7.0
- A Seattle Fault Earthquake with a magnitude of 6.5
- A South Whidbey Fault Earthquake with a magnitude of 6.5

The effects of each are discussed below.

Cascadia Subduction Zone Earthquake – Magnitude 8.5

A Cascadia Earthquake would produce PGA values ranging from 0.1825 to 0.1925 percent of gravity. The lower values are found in the eastern part of the city, with the higher values found in the western third of the city (See Figure 4.5).

Structures

From this event, HAZUS predicts that 46% of buildings will experience no damage, with an additional 21% experiencing slight damage. Approximately 10% of structures will experience extensive damage with an additional 4% of structures experiencing complete damage. Residential structures are least vulnerable and with industrial and government buildings are the most vulnerable.

For low level designed buildings, 71% are predicted to experience moderate to complete damage. Approximately 26% of moderately designed buildings would experience moderate to complete damage (but less than 1% would experience complete damage).

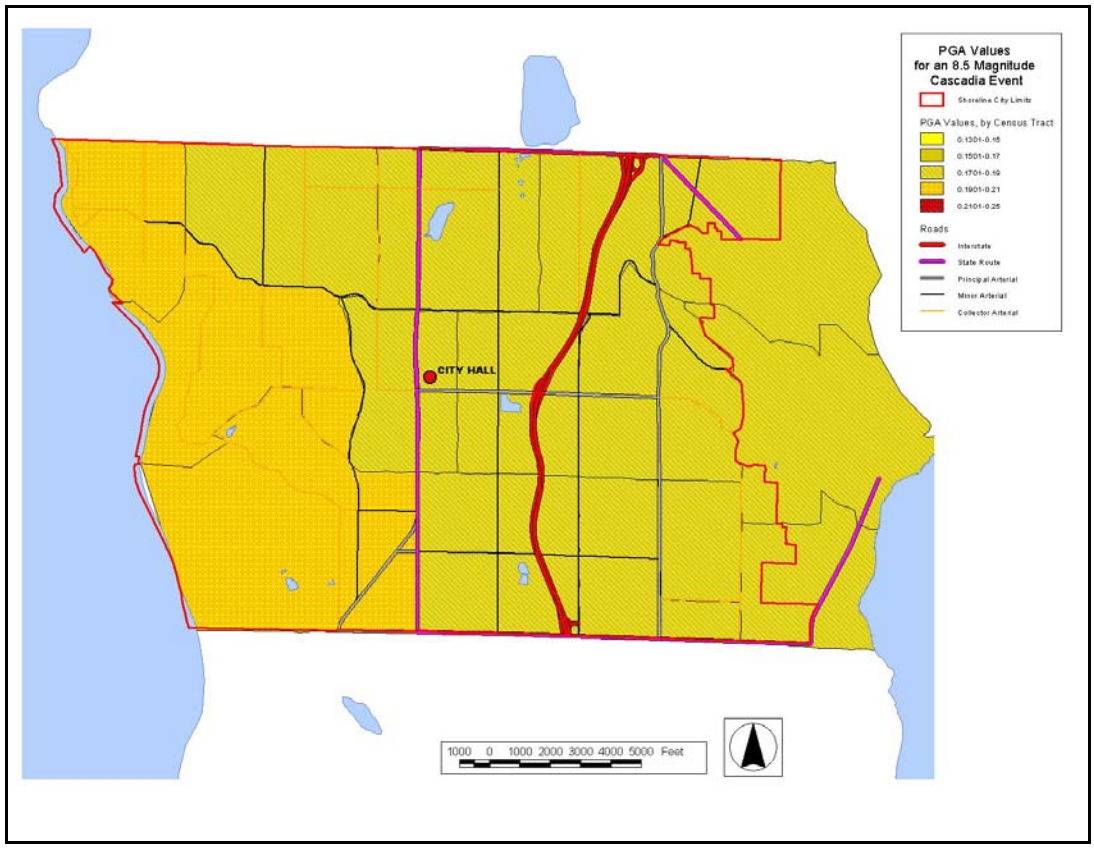
Schools

Fifty five percent of schools would experience at least slight damage in this event, with 4% experiencing complete loss. Schools would have 47% functionality following the earthquake event.

Lifelines

HAZUS shows that 67% of bridges in Shoreline would have no damage, with only 3% experiencing complete damage. There is no data available for wastewater facilities, pipelines, potable water facilities or lifelines.

Figure 4.5: Peak Ground Acceleration from Cascadia Event (in percent gravity)



Benioff Earthquake - Magnitude 7.0

A Benioff Earthquake would create PGA values from 0.1349 to 0.1830 percent of gravity. Generally the higher values are found in the southern part of the city, decreasing northward (See Figure 4.6).

Buildings

HAZUS predicts that 72% of buildings would experience no damage and 3% would experience extensive or complete damage. Residential buildings are the least vulnerable while industrial buildings are the most.

Approximately 63% of low design buildings would experience damage, with 11% experiencing extensive or possibly complete damage. Approximately 40% of moderate design level buildings would experience damage. Of those, 1% would experience extensive or complete damage.

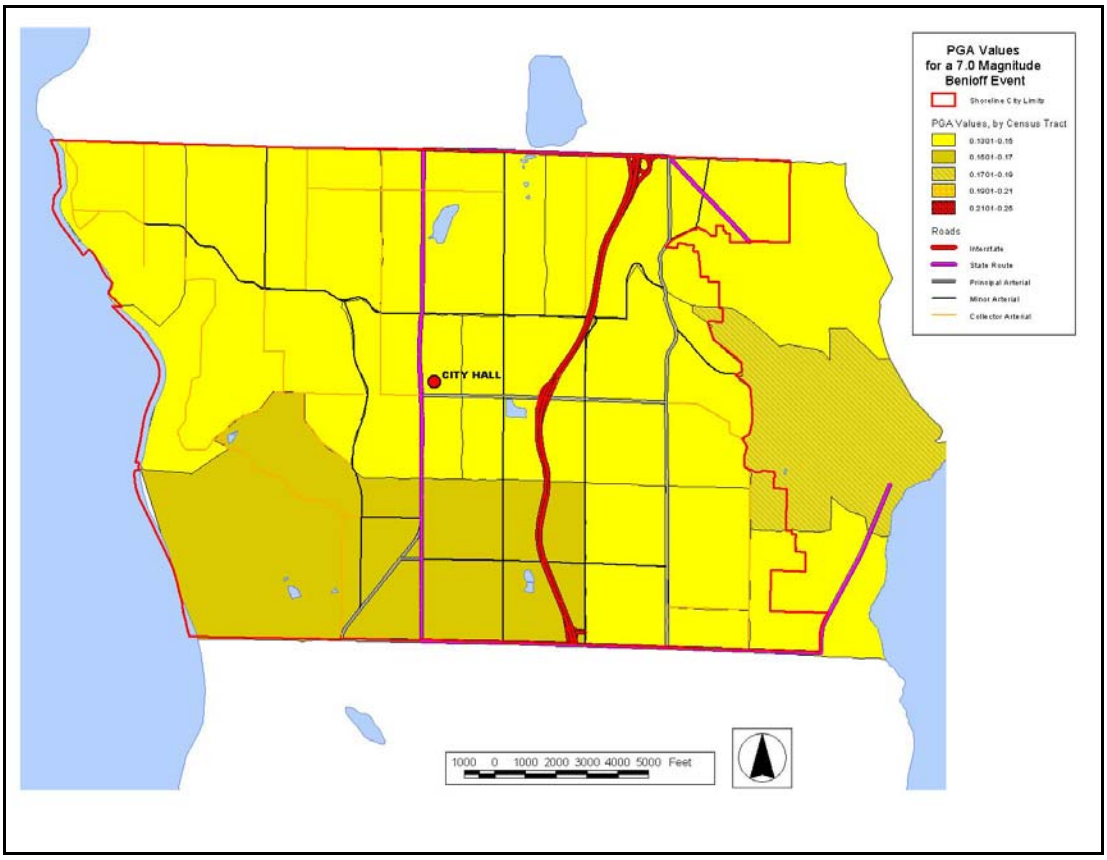
Schools

Approximately 28% of buildings would experience damage. There would be 64% functionality of these facilities following this earthquake event.

Lifelines

Eight percent of bridges would experience damage, with 5% being only slight damage.

Figure 4.6: Peak Ground Acceleration from Benioff Event (in percent gravity)



Seattle Fault Earthquake - Magnitude 6.5

A Seattle Fault earthquake would create PGA values of between 0.1421 and 0.1903 percent of gravity. These are a bit skewed as the model's high area only falls slightly in Shoreline. Generally though the higher values are south and the lower values are north as shown in Figure 4.7.

Buildings

Approximately 71% of buildings would experience no damage, with an additional 15% experiencing slight damage. Approximately 3% would experience extensive or complete damage. Residential structures are least vulnerable with industrial being most.

Approximately 65% of low designed buildings would experience damage. Approximately 10% would be extensive and 1% would be complete. Approximately 41% of moderately designed buildings would experience damage, with 2% experiencing extensive or complete damage.

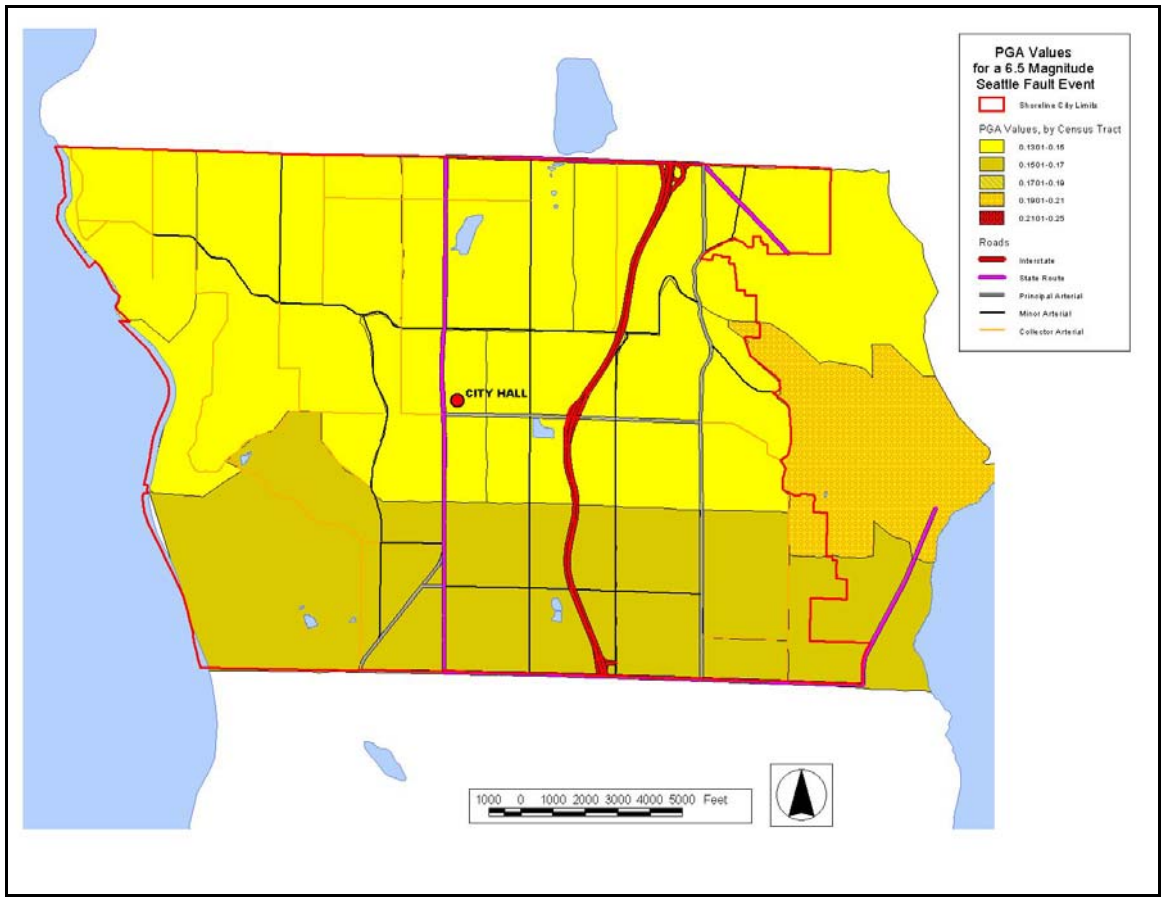
Schools

Approximately 29% of schools would be damaged, with 4% experiencing extensive or complete damage. Schools would have 62% functionality following this earthquake event.

Lifelines

Nine percent of bridges would be damaged and 3 percent would have moderate or extensive. There would be no complete damage.

Figure 4.7: Peak Ground Acceleration from Seattle Event (in percent gravity)



South Whidbey Fault Earthquake – Magnitude 6.5

A South Whidbey fault earthquake would produce PGA values between .1706- 0.2449 percent of gravity. The highest values would be in the eastern part of the city, with the lowest values in the west as shown in Figure 4.8.

Buildings

Approximately 60% of buildings would not experience any damage. Another 5% would see extensive, and a further 1% would experience complete damage. Residential buildings would experience the least amount of damage and industrial buildings would see the most.

Approximately 76% of low design buildings would be damaged. Another 16% would be extensive, and 4% would be complete. Approximately 51% of moderate designed level buildings would be damaged, 3% would have extensive damage and less than 1% would have complete damage.

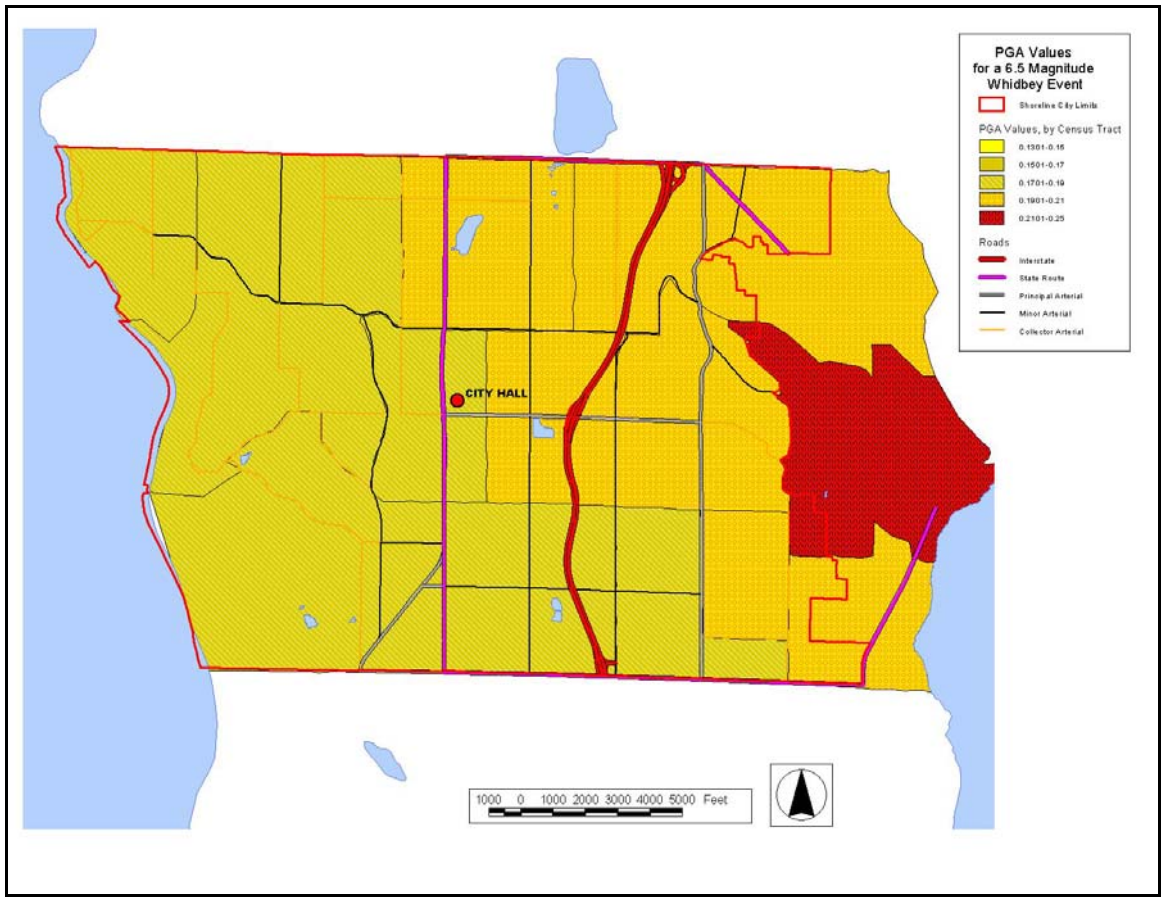
Schools

Approximately 41% of schools would be damaged. Another 6% would have extensive damage, and 1% would have complete damage. Schools would have 47% functionality following this earthquake event.

Lifelines

Fifteen percent of bridges would be damaged. Another 3% would be extensive or complete damage.

Figure 4.8: Peak Ground Acceleration from Whidbey Event (in percent gravity)



Loss Estimation

For earthquakes, the loss estimation assessed the amount of damage that would originate from an earthquake event that would produce up to a 0.2 percent of gravity. The loss estimation included damage to structures that were on located on NEHRP D and E soils, damage to bridges and number of people affected.

The percentage of damage to structures on NEHRP D and E soils was taken from FEMA's State and Local Mitigation Planning How-to-Guide (FEMA 2001). The structures were divided into precode and postcode. Precode was any structure built before 1972 and postcode was structures built in 1972 and after.

For commercial structures, the building materials were prefab steel, masonry and wood frame. It was assumed that the masonry structures were unreinforced. It was also assumed that postcode structures were of moderate design. For precode buildings constructed of prefab steel, it was estimated that there would be 5.6% damage. For postcode buildings constructed of prefab steel it was it was estimated that there would be 2.8% damage. Precode masonry structures were estimated to have 8.7% damage and for postcode masonry structures it was estimated to have 6.1% damage. For precode wood frame structures it was estimated to have 3.3% damage and postcode wood frame structures to have 1.7% damage. All of the multifamily structures in NEHRP D and E soils were wood frame construction. The postcode multi-family structures were assumed

to be of moderate seismic design level. For precode multi-family structures a 3.2% damage estimation was used. A 1.9% damage estimation was used for postcode multi-family structures. It was assumed that precode single-family structures were constructed from unreinforced masonry. For precode single-family structures a 9.4% damage estimation was used. It was assumed that post code structures were wood frame of moderate seismic design level. A 1.7% damage estimation was used for postcode single family structures.

The percent of damage estimation was then applied to the total assessed improvement value to determine a dollar value. The loss estimation for commercial structures is $1,223,326. The loss estimation for multifamily structures is $587,831. The loss estimation for single family structures is $51,767,729.

The number of people affected was calculated by multiplying the number of structures in the D and E soils, 4,156, by the average household size in Shoreline, which is 2.5 (U.S. Census 2000). This equals 10,390 people affected. This number does not account for people in the risk area who do not live there and instead work there or commute through there. Actual loss of life could vary greatly depending on the time of day that the earthquake occurs and the magnitude and epicenter location of the earthquake. It is impossible to place a dollar value on human life.

HAZUS estimates a total value of bridges in Shoreline at $237 million. HAZUS also estimated that 3% of all bridges in Shoreline would have extensive or complete damage for the South Whidbey event of magnitude 6.5. This event was used because it is the worst case of the four scenarios. The estimated bridge loss was calculated by taking 3% of $237 million, which equals $7,110,000.

In addition to the loss calculated above, there could be extensive damage to roadways, gas, water, and electric lines, and personal property of other types (cars, home interiors, etc.). Table 4.10 presents the loss estimation figures for earthquakes in Shoreline.

Table 4.10: Earthquake Loss Estimation

Type of Loss	Estimation
Commercial	$1,223,326
Multi-family	$587,831
Single Family	$51,767,729
Bridges	$7,110,000
People Affected	10,390

Figure 4.9: NEHRP Soils

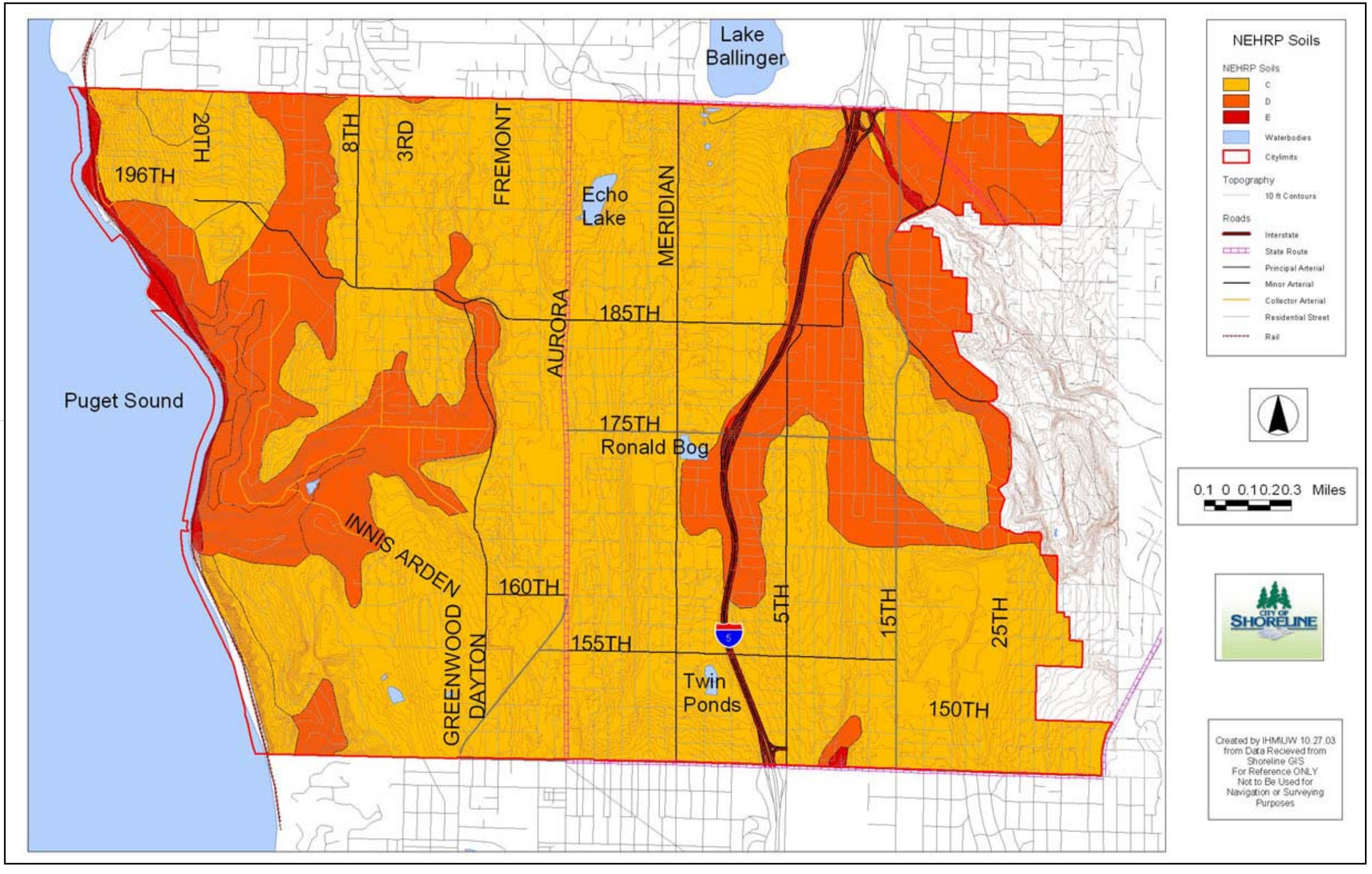


Figure 4.10: Structures in D Soils

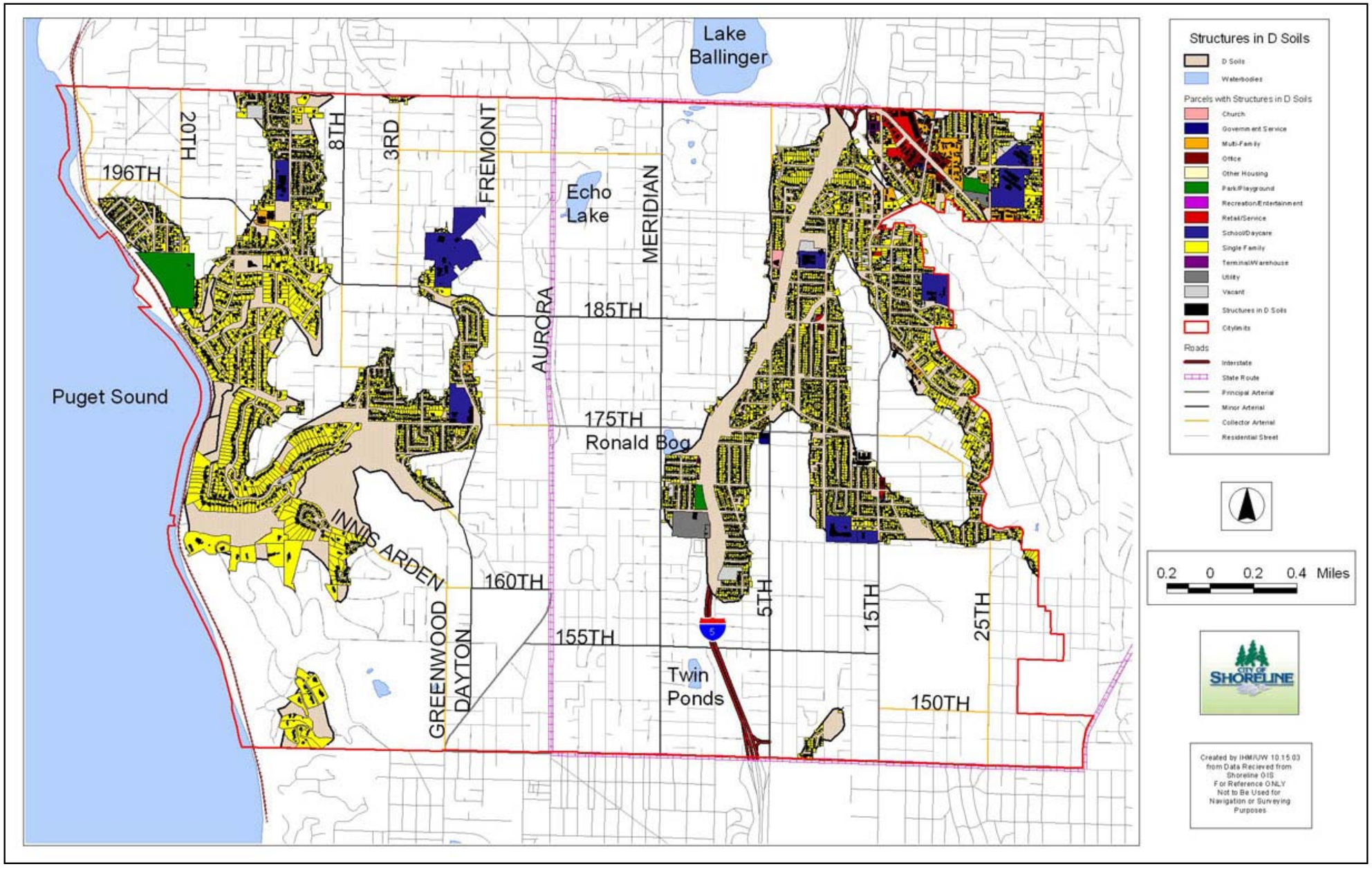


Figure 4.11: Structures in E Soils

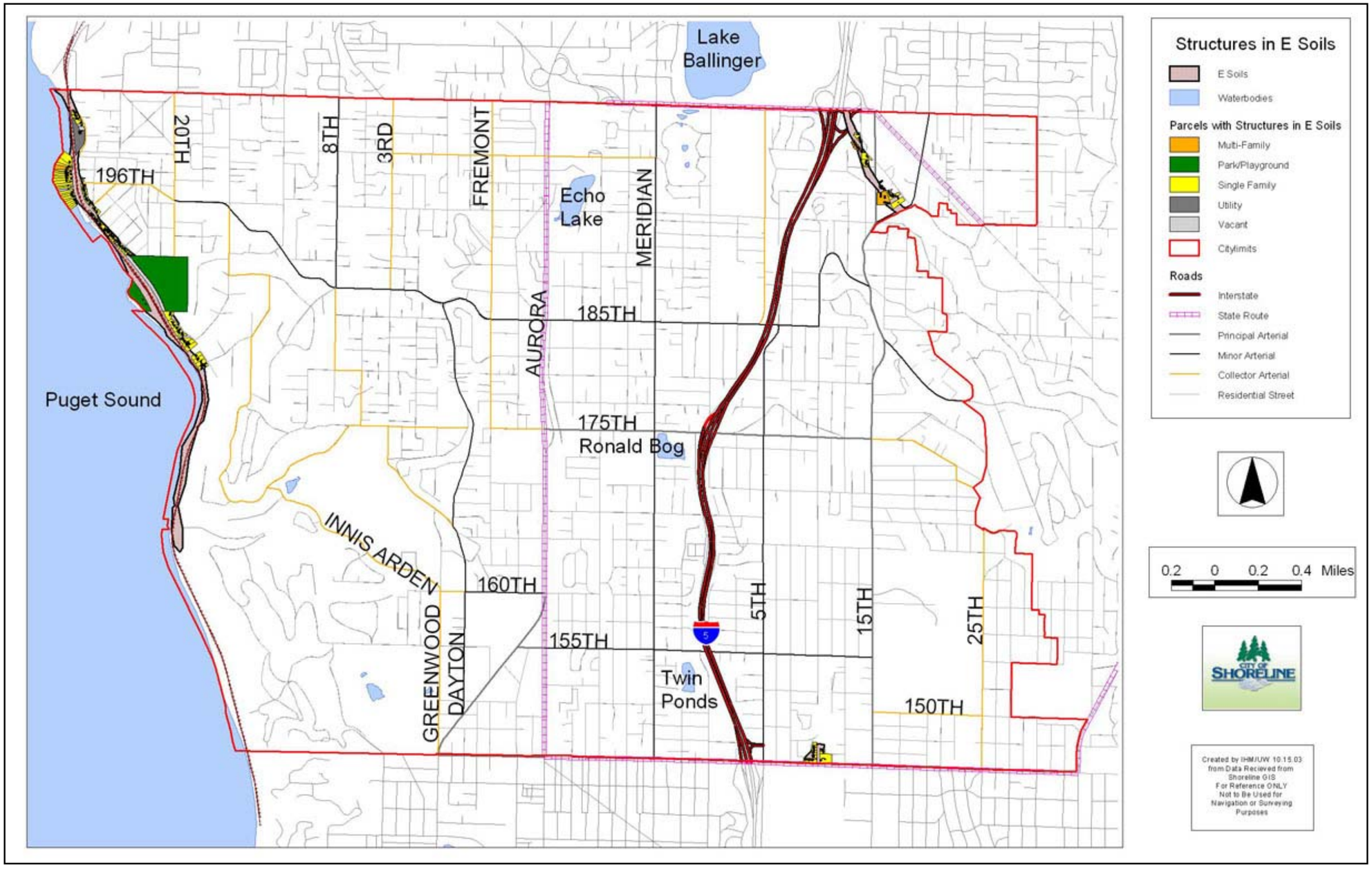


Figure 4.12: Liquefiable Soils

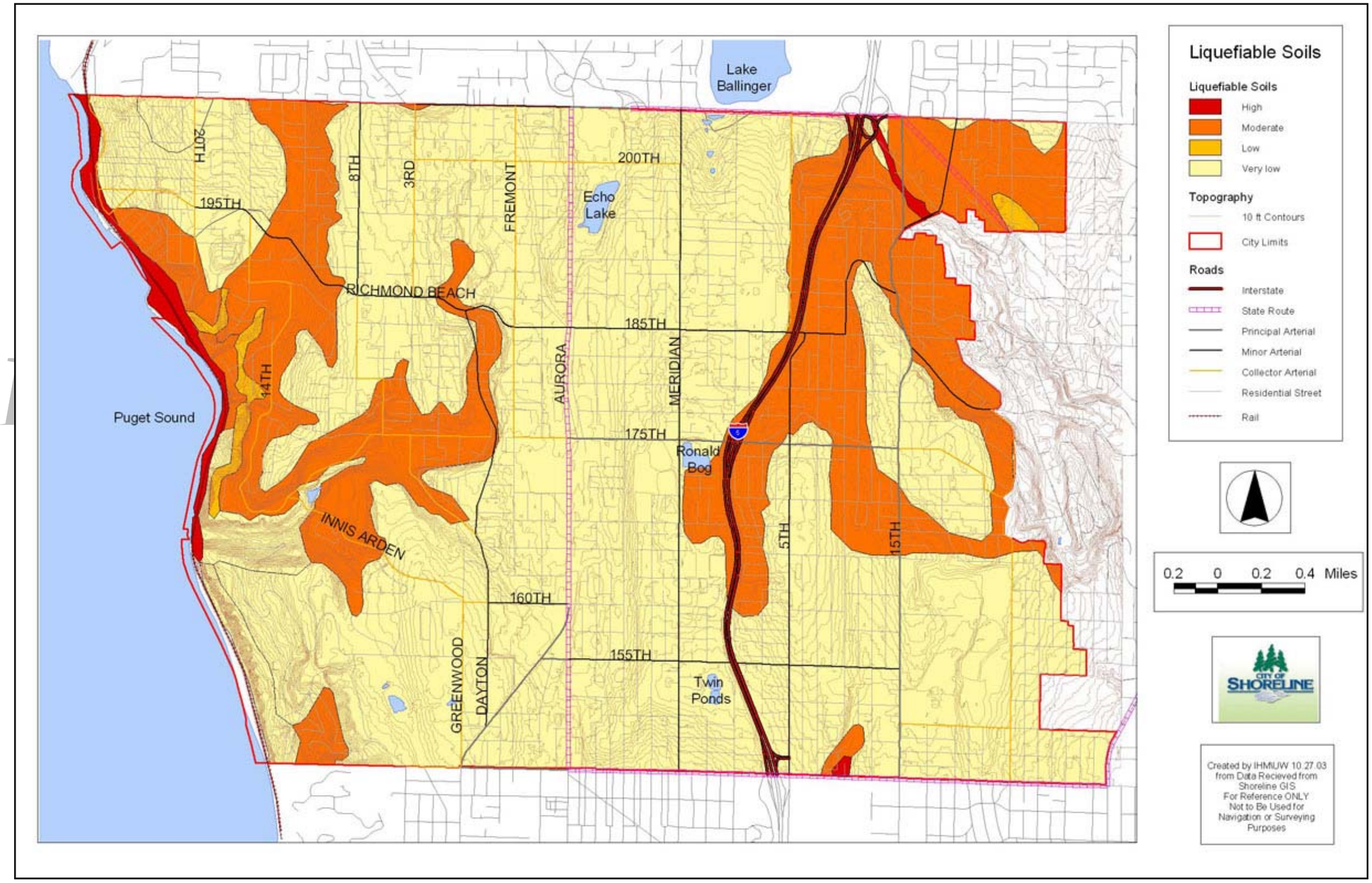
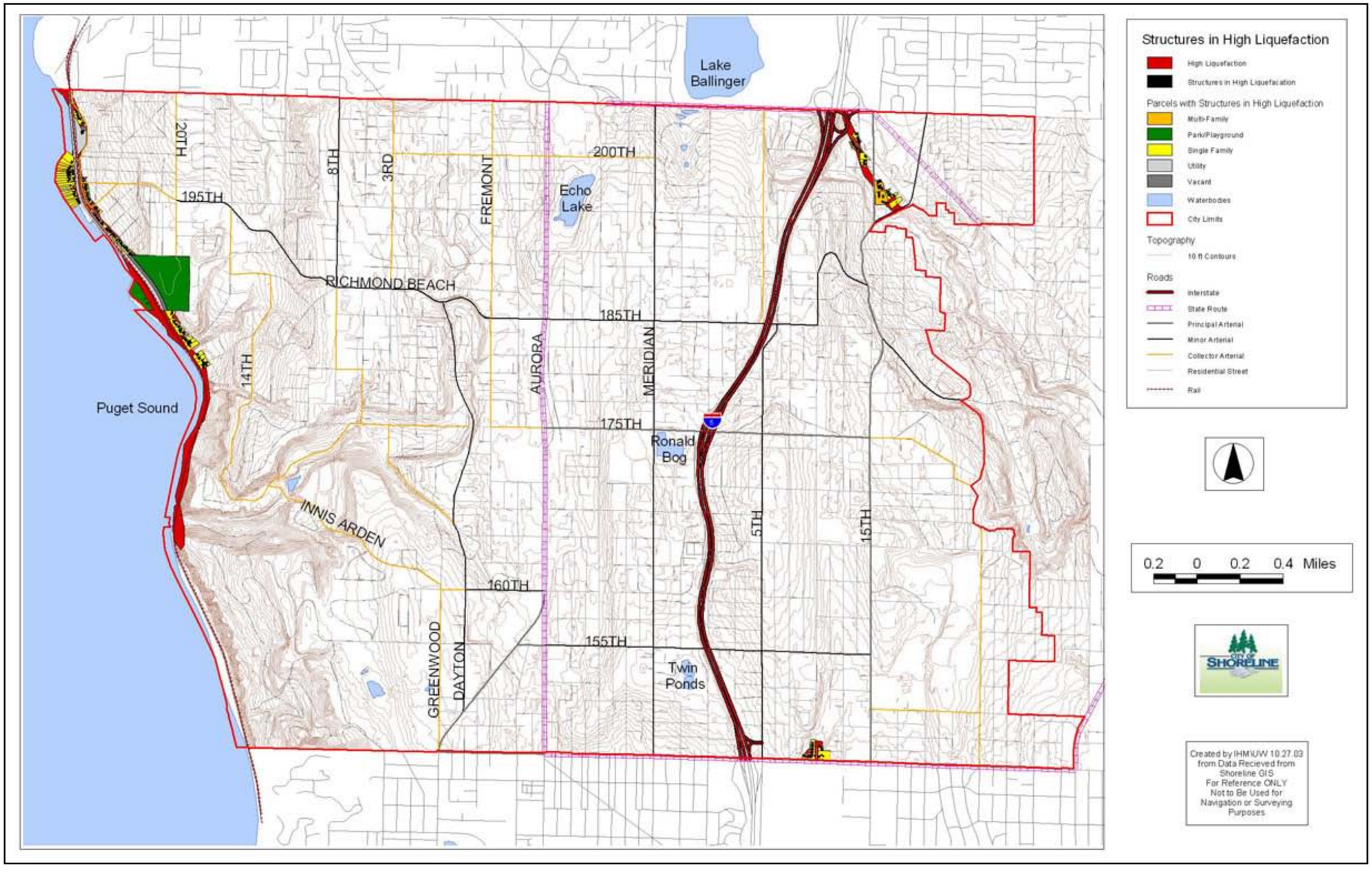


Figure 4.13: Structures in High Liquefaction



4.5. Hazardous Materials

Definitions

Extremely Hazardous Substances: A list of substances deemed extremely hazardous under Section 312 of Title III that is the same as the list of substances published in November 1985 by the Administrator in Appendix A of the "Chemical Emergency Preparedness Program Interim Guidance".

Hazardous Materials: (sometimes referred to as 'hazmat') have chemical, physical, or biological natures that threaten life, health or property when released. There are several properties or qualities that make a material hazardous, including explosivity, flammability, combustibility, corrosiveness, chemical reactivity, toxicity, and radioactivity. Hazardous materials can also exhibit qualities of a biological agent.

Tier II Reporter: Under Section 312 of Title III, facilities that store chemicals must provide specific information about the chemicals on site, at any one time, to the State Emergency Response Commission (SERC), Local Emergency Planning Committees (LEPCs), and local fire department. The threshold levels for reporting chemicals stored on site is the threshold planning quantity (TPQ) or 500 pounds at any one time, whichever is less for extremely hazardous substances (EHS); or 10,000 pounds at any one time for hazardous substances.

Background

Hazardous materials releases occur through spills, leaks, emissions of toxic vapors, or any other process that enables the material to escape its container and enter the environment. Hazardous material incidents that result in a release can cause significant damage to both humans and the environment. The impact of hazardous materials incidents depends on the quantity and physical properties of the chemical. It depends on the type of release that occurred and its proximity to population and businesses.

In 1986, Congress enacted the Emergency Planning and Community Right-to-Know Act (EPCRA) as part of the Superfund Amendments and Reauthorization Act (SARA) as a result of public concern about hazardous material and chemical accidents. This act, known as Title III, establishes requirements for federal, state, and local governments as well as for industry regarding emergency response planning and the public's right to know about hazardous chemicals in their community. The State of Washington has adopted the Federal Title III law and regulations (WAC Chapter 118-40). Title III requires that all facilities or businesses that have reportable quantities of certain chemicals must complete a Tier II Emergency and Hazardous Chemical Inventory report. Each facility does this for each type of Tier II chemical that is present. This must be given to the LEPCs, the local fire department and the Washington Department of Ecology.

Hazardous Materials in Shoreline

Location

A hazardous materials release can occur from two sources: from fixed sites (facilities that hold hazardous materials on site) and from transportation related operations. Because of the small amount of Tier II reporters and the presence of critical transportation infrastructure, Shoreline is more likely to have transportation related hazardous materials release. Besides Tier II reporters and transportation incidents, areas of concern are the Washington State Public Health Laboratories that is located on the Fircrest campus and gasoline stations. The lab has a fairly sizeable number, but in small quantities, of individual chemicals. The lab is not considered a Tier II reporter because of the small quantity of each chemical it stores. There are 10 gasoline stations located within Shoreline.

Tier II Reporters

The City of Shoreline has 6 Tier II facilities as of 2003, which are shown in Figure 4.14. Three of the facilities belonged to AT&T Wireless and reported the presence of sulfuric acid. Other facilities include a Metro Transit Bus Base which contained bus related materials such as diesel fuel and antifreeze; a Seattle City Light substation that has sulfuric acid on site; and the Washington Tree service, which has Ammonium Sulfate onsite. Chevron USA Richmond Beach Asphalt Refinery, also known as Point Wells, located in Snohomish County is also a Tier II reporter that can affect Shoreline. See Table 4.11 for a complete list of facilities.

Transportation

Three major right-of-ways traverse Shoreline and are used to transport hazardous material. These are the BNSF railroad, which is located along the western shore of the city, State Highway 99/ Aurora Avenue, which runs through the middle of the city, and Interstate 5, which is just east of Aurora Avenue. Although it is not know how much or exactly what is being transported through the area, Shoreline has a similar vulnerability as the rest of King County, which has one of the highest probabilities in the state due to the large amounts of industry and port facilities in the area. Recently there has not been any significant railroad accident in King County; however, Pierce County has recently had a railroad derailment, which spilled boric acid and diesel fuel into the Puget Sound (KCEM. http://www.metrokc.gov/prepare/docs/RHMPHazmatandRadiation.pdf).

Frequency

The probability of a hazardous material release in Shoreline is similar to that of King County. Between 1998 and 2001, King County had 352 fixed facility spills and 189 transportation related spills (WSDOH. 2002).

Severity

Hazardous material releases can be divided into three categories. These categories are based on the severity of the incident and the emergency response that is warranted by each (University of Toledo. http://safety.utoledo.edu/contplan.htm). A minor incident can be safely cleaned up and managed by one or two people. An isolated incident is one

that only affects a single area but has to be handled by more than two people. An unmanageable incident affects large areas and requires immediate response regardless of the quantity involved in the incident.

Hazardous material releases can affect both human and ecological health. The severity depends on the type and amount of chemical released and the effects range from minor to catastrophic.

Warning Time

Hazardous material releases can occur at any time without warning. Once the release has occurred the potentially affected areas will have none or little warning time depending on what chemical was released and the method by which the chemical will travel.

Past Events

The Hazardous Substances Emergency Events Surveillance (HSEES) program, sponsored by the Agency for Toxic Substance and Disease Registry (ATSDR), tracks emergency releases of non-petroleum hazardous substances. Data from 1993 through 2001 was evaluated on events that have occurred in the City of Shoreline and was provided in a report, which found four recorded events in Shoreline during the past nine years (WSDOH. 2003).

The first Shoreline HSEES event occurred in 1997 and involved a spill of diazinon with fungicide that was spilled into an open ditch from a spraying truck that had overturned. The driver of the spraying truck experienced minor contusions and was treated at a hospital emergency room and released.

In 1999, a total of three people were treated for respiratory irritation and nausea after they were exposed to a leak of chlorine gas at a swimming pool. Two were taken to an emergency room where they were treated and released. The third person sought treatment from a private doctor. Cause of the leak was unknown.

In 2000, a valve snapped on a 300 pound cylinder of trifluorobromomethane (Halon 1301) gas, allowing the entire contents to escape to the atmosphere. There were no injuries from this event, which occurred at a governmental facility loading dock.

In 2001 a bus leaked eight gallons of coolant onto a city street. There were no injuries and the spill was cleaned up.

Secondary Hazards

Hazardous material incidents can produce a variety of secondary effects. Fires resulting from hazardous materials releases are the most significant secondary hazard with potential releases caused by earthquakes.

Hazardous material incidents can have a significant effect on the environment. Releases into the environment have the potential to significantly damage soils, water quality, wildlife habitat as well as vegetation. Harm to protected areas and streams, as well as critical habitat for threatened or endangered species is likely. Processes to clean up hazardous material releases are costly and time consuming, resulting in severe

environmental and economic impacts. This would most likely occur along the protected shores of Shoreline if a hazardous materials release from a train occurred.

Exposure and Vulnerability

The most vulnerable buildings and populations are those that are located near the Tier II facilities and near the transportation corridors. The Fircrest campus is vulnerable to a release from the Washington State Public Health Laboratories. Vulnerable neighborhoods include the Richmond Beach area, which has the access road leading to Point Wells and the BNSF tracks. The shoreline in this area is also vulnerable. There are also five gas stations that are located on NEHRP D soils.

Below in Table 4.11 is a list of Tier II Reporters for Shoreline as well as the information for Point Wells.

Table 4.11: Tier Two Reporters

Facility	Address	Chemical	Days Onsite
AT&T Wireless Aurora Village	938 N 200th St Ste C Shoreline, Wa 98133-	Sulfuric Acid	365
AT&T Wireless Kenwood	14517 15th Ave Ne Shoreline, Wa 98155-	Sulfuric Acid	365
AT&T Wireless Ronald	N 167th St & Corliss Intersection N Shoreline, Wa 98133-	Sulfuric Acid	365
Metro Transit North Base	2160 N 163rd St Shoreline, Wa 98133-	Diesel Fuel #2	365
		Ethylene Glycol	365
		Gasoline	365
		Lacquer Thinner	365
		Lube Oil	365
		Transmission Fluid	365
		Waste Antifreeze	365
		Waste Oil	365
Seattle City Light Shoreline Substation	2136 N 163rd St Shoreline, Wa 98133	Sulfuric Acid	365
Washington Tree Service Inc Seattle	20057 Ballinger Rd Ne Shoreline, Wa 98155	Ammonium Sulfate	365
		Ferrous Sulfate - Heptahydrate	365
		Potassium Chloride	365

Facility	Address	Chemical	Days Onsite
		Propane	365
Chevron Usa Richmond Beach Asphalt Refinery	20555 Richmond Beach Dr Nw - Seattle, Wa 98177	Acid Dichromate	365
		Ad-Here	365
		Anti-Foam	365
		Asphalt	365
		Asphalt Emulsifier	365
		Asphalt Extender	365
		Boiler Treatment Chemical	365
		Butanol Ns 198	365
		Calcium Chloride	365
		Cationic Asphalt Emulsion	365
		Cutback Asphalt	365
		Diesel Fuel	365
		Diesel Fuel #2	365
		Elvaloy	365
		Ethylene Glycol	365
		Ferrous Sulfate	365
		Fuel Oil #6	365
		Gas Oil	365
		Gasoline	365
		Gear Compound	365
		Gel Flex Cleaner	365
		Heat Transfer Oil	365
		Hydraulic Oil	365
		Hydrochloric Acid	365
		Hydrogen Sulfide	365
		Indulin W-5	365
		Lacquer Thinner	365
		Lactol Spirits	365
		Light Cycle Oil	365
		Lubricants	365
		Marine Distillate Oil	365
		Mineral Spirits	365
		Nalclear 7768	365

Facility	Address	Chemical	Days Onsite
		Naphtha	365
		Nitrogen	365
		Oil	365
		Oxygen Scavenger	365
		Redicote E-35c	365
		Roofing Asphalt	365
		Silicon	365
		Sodium Chloride	365
		Solvent	365
		Transport Plus 2800	365
		Turbine Oil	365
		Unichem 8162w	365

Scenario

A most likely hazardous materials release would be caused by a traffic accident on Aurora Avenue or on Interstate 5. A fire would erupt sending toxic fumes into the air. Hazardous materials would drain off the road and into nearby Thornton Creek destroying the natural environment. Certain materials could be hazardous to the health of nearby residents, especially those downwind from a release.

Another scenario, which may have more damaging effects, would be from a release caused by a train derailment from an undetected landslide or track malfunction. This would have an effect on those in the Richmond Beach area, especially if a fire occurs. The natural environment would also be jeopardized as the chemicals could drain into Puget Sound, polluting the water and shoreline.

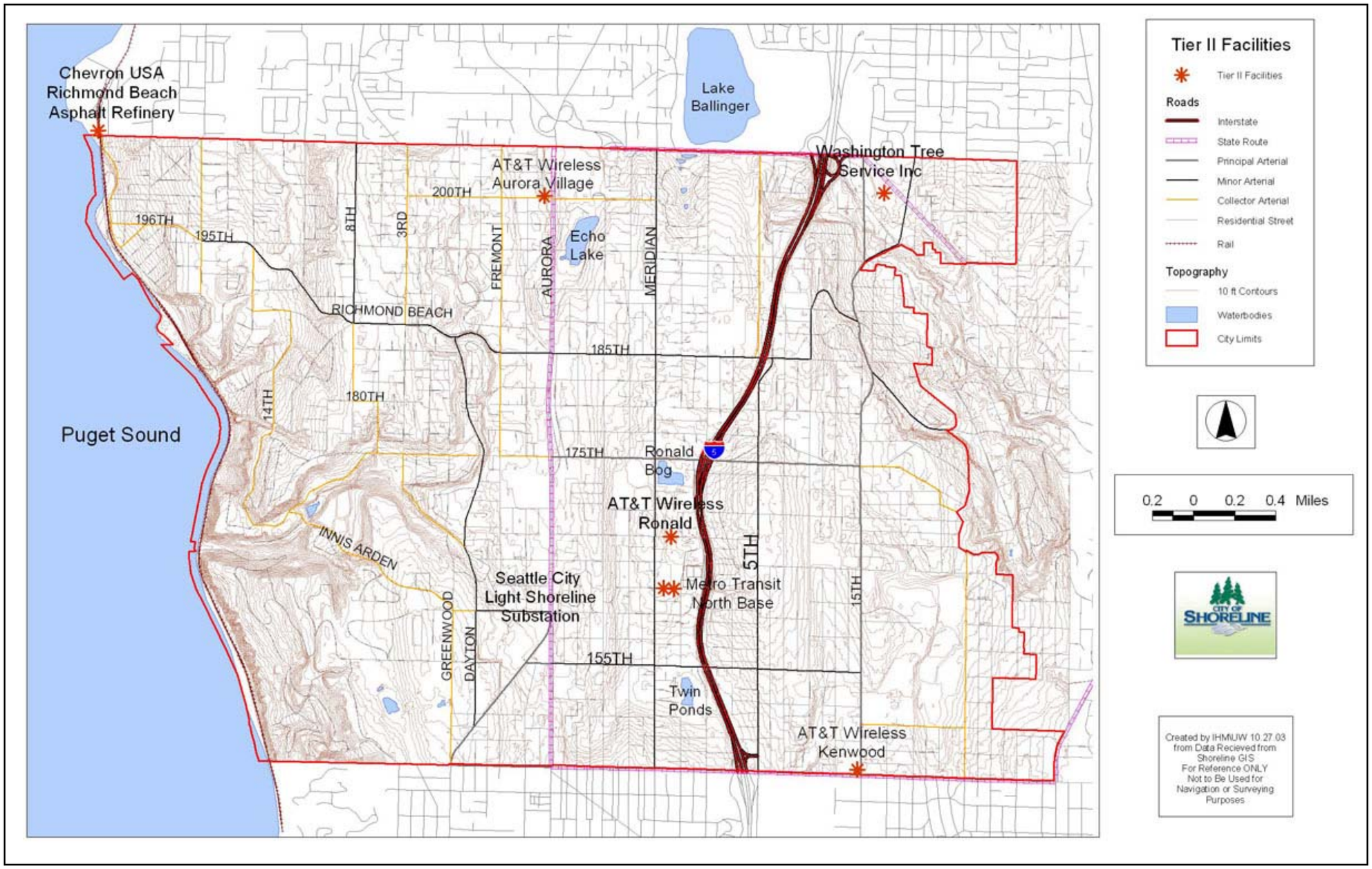
A third scenario is a release from the Tier II facility, train or truck carrying hazardous materials due to an earthquake.

Loss Estimation

Loss from exposure to hazardous materials in Shoreline is difficult to calculate without the completion of technical studies on each Tier II reporter. Shoreline has a wide array of chemicals, each of which has its own properties and effects when released. Extents of release and affected areas are also often dependent on weather conditions such as wind and rain. Some hazardous materials, when released, would result in no loss to property and very little clean up expenditure (a loss estimate very near to $0), while others would result in loss of life in surrounding neighborhoods, expensive emergency response and clean-up figures ranging from hundreds to thousands of dollars.

Given this variety, it is difficult to assess exposure to hazardous material spills with enough specificity to allow loss estimation.

Figure 4.14: Tier II Facilities



4.6. Severe Weather

Definitions

Blizzard: This is a storm with widespread snowfall accompanied by strong winds. In general, the Cascade Mountain Range acts as a barrier to cold air developing in the eastern part of the state, reducing the likelihood of snowstorms in Shoreline.

Dry Microburst: This is a severe localized wind blasting down from a thunderstorm. It covers an area less than 2.5 miles in diameter and is of short duration, usually less than 5 minutes.

Flood: When a body of water rises and overflows onto normally dry land.

Ice Storms/Freezing Rain: Ice storms occur when rain falls from warm moist upper layers of the atmosphere into a colder, drier layer near the ground. The rain freezes on contact with the cold ground and accumulates on exposed surfaces.

Lightning: An abrupt electric discharge from cloud to cloud or from cloud to earth accompanied by the emission of light.

Mud Slide: When soil, rocks and water flow quickly down slopes and canyons during or after a heavy downpour of rain.

Tornado: Tornadoes are characterized by funnel clouds of varying sizes that generate winds as fast as 500 miles per hour. They can affect an area of ¼ to ¾ of a mile, with the path varying in width and length. Tornadoes can come from lines of cumulonimbus clouds or from a single storm cloud. They are measured using the Fujita Scale ranging from F0 to F6.

Windstorms: These are storms consisting of violent winds. There are several sources of windstorms. Southwesterly winds are associated with strong storms moving onto the coast from the Pacific Ocean. Southern winds parallel to the Cascade Mountains are the strongest and most destructive winds. Windstorms tend to damage ridgelines that face into the winds.

Background

Severe weather is one of the most damaging natural hazards. Severe weather can bring heavy rain, high winds, snow and ice and lead to storm surges that flood low lying and coastal areas. Severe weather can lead to secondary effects such as landslides, flooding from streams and poor drainage, and fires, caused by either ruptured gas lines or down electrical lines or even wildfires, caused by lightening and high winds.

King County and the City of Shoreline are subject to various local storms that affect the Pacific Northwest throughout the year, such as wind, snow, ice, hail and potentially tornadoes. Although rare, tornadoes are the most violent weather phenomena known to man. Their funnel shaped clouds rotate at velocities of up to 300 mile per hour and generally affect areas up to a mile wide and seldom more than 16 miles long. Four tornadoes have been sighted in King County since 1950.

Snow storms or blizzards, which are snow storms accompanied by blowing wind or drifting snow, occur occasionally both in Washington State and King County. An ice storm can occur when rain falls out of warm moist upper layer of atmosphere into a dry layer with freezing or sub-freezing air near the ground. Rain freezes on contact with the cold ground and accumulates on exposed surfaces.

Hailstorms occur when freezing water in thunderstorm type clouds accumulate in layers around an icy core. Wind added to hail could batter crops, structures and transportation systems (KCEM. http://www.metrokc.gov/prepare/docs/RHMPSEVERESTORMS.pdf).

The most recent severe storm to affect King County occurred over a multi-day period during the end of December 1996 and beginning of January 1997. This storm shows the potential hazards that can be associated with major storms both primary weather related hazards and secondary hazards including its impacts on infrastructure. This storm, referred to in the media as the Holiday Blast, was a series of three weather systems that included severe snow and ice followed by quick melting and runoff, causing flooding and landslides.

King County and the western part of the Puget Sound region were also heavily impacted by the windstorm that struck on January 20, 1993, Inauguration Day. High winds of 67 miles per hour (mph) at Everett and 60mph at Seatac were noted and caused tremendous destruction of public and private structures, power and telephone lines, and trees; South King County was particularly hard hit. Over 280,000 of Puget Power's King County customers were without electricity; damages to Puget Power facilities were estimated around $17 million.

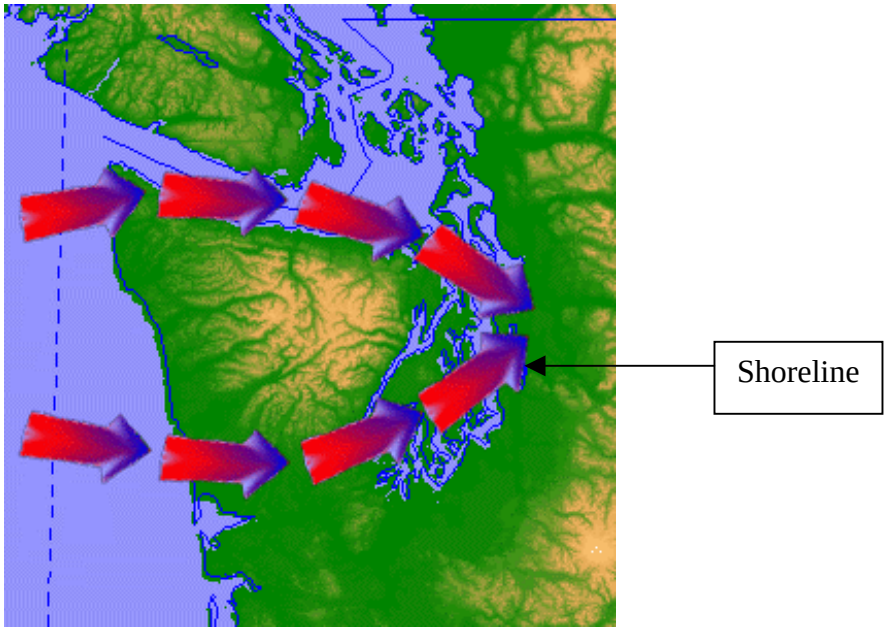
Six other major windstorms have occurred in Western Washington since 1945. The Tacoma Narrows Bridge (1940) and Hood Canal Bridge (1979) were blown down during two of these storms. However, the most severe windstorm to affect this region was the 1962 Columbus Day storm. Sustained winds over 85 mph were recorded; 46 people died and 53,000 homes were damaged throughout the region (ibid.).

Severe Weather in Shoreline

Location

Severe weather can affect all areas of Shoreline. Strong wind mainly comes from the west and southwest. The wind flows from high to low sea-level pressure through the Chehalis Gap to the south and the Strait of Juan De Fuca to the north (Nortz, Joseph et al. http://www.meteorcomm.com/docs/oceans99-wx-paper.PDF). The convergence of these two wind flows is known as the Puget Sound Convergence Zone. The convergence usually forms in an east-west line across southern Snohomish County but can go as far north as Anacortes or as far south as Federal Way, depending on where the winds collide (Pool, S. 2002). Figure 4.15 shows the air flow of the Puget Sound Convergence Zone (Geerts. B. http://www-das.uwyo.edu/~geerts/cwx/notes/chap10/oro_rain.html). Ice will more likely affect those areas at a higher elevation, such as the Highlands.

Figure 4.15: Puget Sound Convergence Zone



Frequency

The National Climatic Data Center has collected information about past severe weather events in King County since 1950. There have been a total of 91 events recorded (minus four avalanches events which are not applicable for Shoreline). The events that caused injury, loss of life or property damage are listed in further detail in Table 4.12 (NOAA http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms).

Severity

The most common problems associated with severe storms are immobility and loss of utilities. Roads may become impassable due to ice, snow, or from a secondary hazard such as a landslide. Power lines may be downed due to high winds and other services, such as water or phone, may not be able to operate without power. Strong winds have been recorded at 77 kts. in King County. Shoreline had a record-breaking day for rainfall on October 20, 2003. Sea-Tac International Airport reported 5.02 inches of rain in a 24 hour period (Brice, Pamela. 2003). This caused flooding problems for several homes as well as the closure of some sections of road. Lightning can cause severe damage and can be deadly. Two major concerns for snowfall are dangerous roadway conditions and collapse of structures due to heavy snow load on roofs. The average annual snowfall for Shoreline is 11.7 inches (City of Shoreline. http://www.cityofshoreline.com/about/facts/index.html). In addition, ice can create dangerous situations on the roadways as well as freeze pipes.

Warning Time

A meteorologist can often predict the likelihood of an onset of a severe storm. This can give several days of warning time, however, meteorologists cannot predict the exact time

of onset or the severity of the storm. Some storms may come on more quickly and have only a few hours of warning time.

Past Events

Shoreline is affected by the same severe weather than can affect King County and the Puget Sound region in general. Table 4.12 is a list of severe storms that affected King County that caused injury, loss of life or property damage between January 1st, 1950 and June 39th, 2003 (NOAA http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms). The total reported damage was $98.847 million with 21 deaths and 96 injuries.

During the 1993 Inauguration Day Wind Storm, Ronald Wastewater District was without power for several hours at all the pump stations (CHS Engineers, Inc. 2003).

The 1996-97 Holiday Blast Storm particularly affected Shoreline and the heavy rainfall from it caused a large washout/landslide within Shoreline along NW 175th Street near 6th Avenue NW that was a federally declared disaster. The 100-foot long sinkhole cost $2 million to repair (NOAA http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms).

Table 4.12: Severe Storms affecting King County

Date	Type	Magnitude	Deaths	Injuries	Property
09/28/1962	Tornado	F1	0	0	250K
12/12/1969	Tornado	F3	0	1	250K
12/22/1971	Tornado	F	0	0	25K
01/20/1993	High Wind	60-98 mph	4	31	500K
4/25/1993	Heavy Rain	N/A	0	14	100K
08/23/1993	Lightning	N/A	1	0	0
11/08/1995	Flood & Heavy Rain	N/A	1	0	0
11/28/1995	Flood & Heavy Rain	N/A	0	0	10.0M
10/15/1996	Lightning	N/A	0	0	95K
11/19/1996	Heavy Snow	N/A	1	22	0
11/30/1996	Lightning	N/A	0	1	0
12/10/1996	Lightning	N/A	0	0	4K
12/28/1996	Heavy Snow	N/A	1	0	0
12/28/1996	Heavy Snow	N/A	1	0	0
12/29/1996	Heavy Rain	N/A	0	0	31.5M
01/01/1997	Flood	N/A	1	0	20.0M
03/20/1997	Flood	N/A	0	0	1.2M
03/30/1997	High Wind	71 kts	2	4	250K
04/03/1997	Lightning	N/A	0	1	0
07/05/1997	Lightning	N/A	0	2	0
10/01/1997	High Wind	45 kts	1	0	0
10/04/1997	Lightning	N/A	0	0	5K
11/23/1998	High Wind	66 kts	0	0	6.5M
01/28/1999	High Wind	65 kts	0	0	500K
02/05/1999	High Wind	65 kts	0	0	11K

Date	Type	Magnitude	Deaths	Injuries	Property
03/01/1999	Heavy Rain	N/A	0	0	5.5M
03/02/1999	High Wind	61 kts	1	0	3.0M
07/16/1999	Lightning	N/A	0	0	130K
08/03/1999	Lightning	N/A	0	2	650K
10/27/1999	High Wind	48 kts	1	0	100K
11/11/1999	Flood	N/A	0	0	60K
11/17/1999	Heavy Rain	N/A	0	0	85K
01/10/2000	High Wind	64 kts	1	0	12K
01/14/2000	Heavy Rain	N/A	0	15	0
01/16/2000	High Wind	66 kts	1	0	2.8M
02/08/2000	Dry Microburst	0 kts	0	0	25K
12/14/2000	High Wind	77 kts	0	0	2.1M
02/15/2001	Heavy Snow	N/A	0	0	5K
02/28/2001	Mud Slide	N/A	0	0	200K
02/14/2001	Flood	N/A	0	0	40K
11/24/2001	High Wind	61 kts	1	1	20K
12/13/2001	High Wind	60 kts	0	0	800K
12/16/2001	Flood	N/A	0	0	150K
01/07/2002	Flood	N/A	0	0	200K
04/13/2002	High Wind	55 kts	0	0	8.0M
05/29/2002	Blizzard	N/A	3	1	0
12/19/2002	High Wind	56 kts	0	0	380K
12/27/2002	High Wind	52 kts	0	1	3.3M
03/31/2003	Flood	N/A	0	0	100K
TOTAL			21	96	98.847M

Secondary Hazards

The most significant secondary hazards to severe weather are floods, landslides and electrical hazards (fires) from downed power lines. Rapidly melting snow combined with heavy rain can overwhelm both natural and man-made drainage systems, causing overflow and property destruction. Landslides occur when the soil on slopes becomes oversaturated and fails.

Exposure and Vulnerabilities

All of Shoreline is vulnerable to severe weather. The Richmond Beach neighborhood is more vulnerable because of its location and limited ingress and egress points creating a possibility of isolation for residents during a severe weather event. It lies near sea level below the bluffs of the city and may be isolated during a snow or ice storm. It can also be affected by a strong storm surge. Properties located along 27th Ave NW would be most affected by a storm surge. The Highlands neighborhood is also vulnerable to isolation due to the topography and limited access points. Power systems may experience downed lines cutting power to residents. Power is lost due to severe storms about four times a year for approximately four to six hours (RH2. 2003). Trees that are overgrown or have

been blown down can create problems for the overhead power lines. The Public Works Department has done a survey and estimates that there are approximately 35,000 trees in Shoreline right of ways. Power outages could result in a disruption to the water systems. Sanitation and water systems could experience contamination or overflow problems.

Scenario

Shoreline would most likely be affected by a combination of a windstorm and snow storm. The heavy wind would knock out power, disrupting some services, such as water pump stations. Downed trees may make some roads inaccessible. Some Richmond Beach residents and residents on other streets would be isolated because the snow and ice makes the steep roads leading down to them impassable. The vast amounts of water draining would overwhelm the sewer system, causing flooding and possible washouts/sinkholes. Land on some of the steeper slopes may give way and also damage homes and block roads.

Loss Estimation

The total loss for King County over the period spanning from 1962-2003 was 98.847M. Shoreline can be affected from all the same hazards, only on a smaller scale. For the property damage loss estimation 1% of the value of past losses for King County was calculated. This value is $983,470. Shoreline's population has a population of 53,025 (Census 2000) and the whole population would be affected by severe storms. Table 4.13 presents the loss estimation figures for severe weather in Shoreline.

Table 4.13: Severe Storm Loss Estimation

Type of Loss	Estimation
Property Damage	$983,870
People Affected	53,025

4.7. Landslides & Sinkholes

Definitions

Debris Slides: Debris slides consist of unconsolidated rock or soil that have moved rapidly down slope. They occur on slopes greater than 65%.

Earthflows: Earthflows are slow to rapid down slope movements of saturated clay-rich soils. This type of landslide typically occurs on gentle to moderate slopes but can occur on steeper slopes especially after vegetation removal.

Landslide: Landslides can be described as the sliding movement of masses of loosened rock and soil down a hillside or slope. Fundamentally, slope failures occur when the strength of the soils forming the slope exceeds the pressure, such as weight or saturation, acting upon them.

Rock falls: A type of landslide that typically occurs on rock slopes greater than 40% near ridge crests, artificially cut slopes and slopes undercut by active erosion.

Rotational-Translational slides: A type of landslide characterized by the deep failure of slopes, resulting in the flow of large amounts of soil and rock. In general, they occur in cohesive masses and are usually saturated clayey soils.

Sinkhole: A collapse depression in the ground with no visible outlet. Its drainage is subterranean, its size typically measured in meters or tens of meters, and it is commonly vertical-sided or funnel-shaped.

Background

The term landslide refers to the down slope movement of masses of rock and soil. Landslides are caused by one or a combination of the following factors: change in slope gradient, increasing the load the land must bear, shocks and vibrations, change in water content, ground water movement, frost action, weathering of rocks, and removal or changing the type of vegetation covering slopes.

"By geologic standards, Seattle's landscape is very, very young. Just 14,000 years ago, the land the city sits on was still under 3,000 feet of ice, part of the Ice Age's titanic Vashon Glacier, which extended from Canada to south of Olympia. When the ice melted, sea level rose 300 feet and filled the trough the ice had carved, creating Puget Sound. The region is still witnessing the erosion and settling that has followed that tumultuous episode (Dietrich, Bill. 1997)."

The soil covering much of King County was left behind by the Vashon Glacier and is prone to slides. The top layer, Vashon till, is a stable mix of rocks, dirt, clay and sand that has the consistency of concrete and can be found to depths up to 30 feet. The next layer, Esperance sand, is a permeable mixture of sand and gravel. This sits upon an impermeable layer of clay, Lawton clay, made up of fine sediments and large boulders. It is this boundary between the clay and sand in which sliding occurs; water percolates through the sand and runs laterally on top of the denser clay. "The build up of water pressure floats the sand above the clay creating lubrication for a deep-seated slide (Carter et al. 1997)."

Landslide hazard areas occur where the land has certain characteristics, which contribute to the risk of the downhill movement of material. These characteristics include (King County.1990):

- A slope greater than 15 percent.
- Landslide activity or movement occurred during the last 10,000 years.
- Stream or wave activity, which has caused erosion, undercut a bank or cut into a bank to cause the surrounding land to be unstable.
- The presence or potential for snow avalanches.
- The presence of an alluvial fan, which indicates vulnerability to the flow of debris or sediments.

- The presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel.

Landslide Hazard in Shoreline

Location

Four types of landslides can potentially affect Shoreline. They are deep-seated, shallow, bench and large slides. Figure 4.16, Figure 4.17, Figure 4.18 and Figure 4.19 show these different kinds of slides (WSDOE. http://www.ecy.wa.gov/programs/sea/landslides/about/about.html). Puget Sound's shoreline contains many large, deep-seated dormant landslides. Shallow slides are the most common type and the most probable for Shoreline. Occasionally large catastrophic slides occur on Puget Sound. Figure 4.21 is a map of the landslide hazard areas for Shoreline and Figure 4.22 is a map of the structures located in the landslide hazard area.

Figure 4.16: Deep seated slide

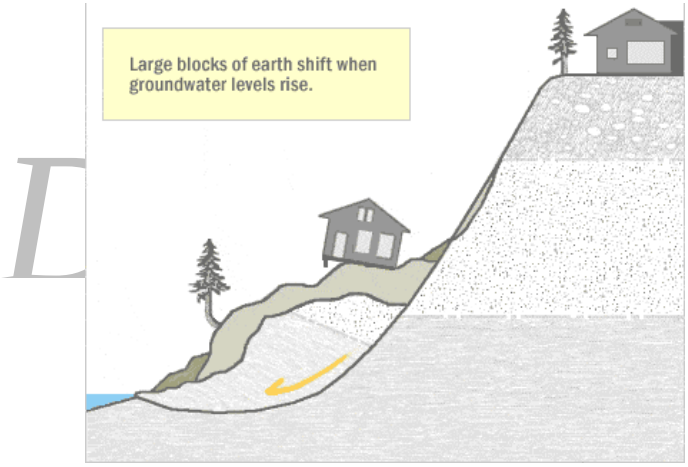


Figure 4.17: Shallow slide

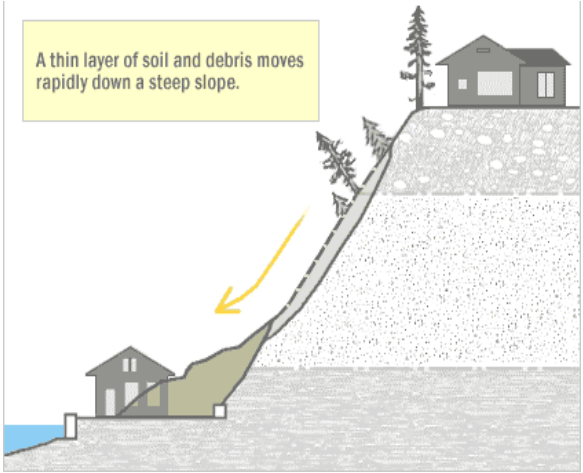


Figure 4.18: Bench slide

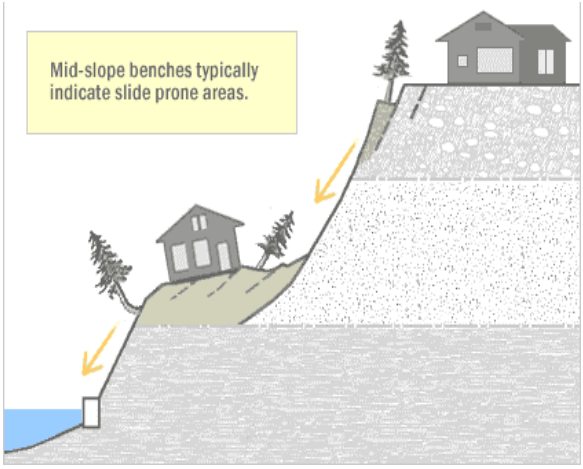
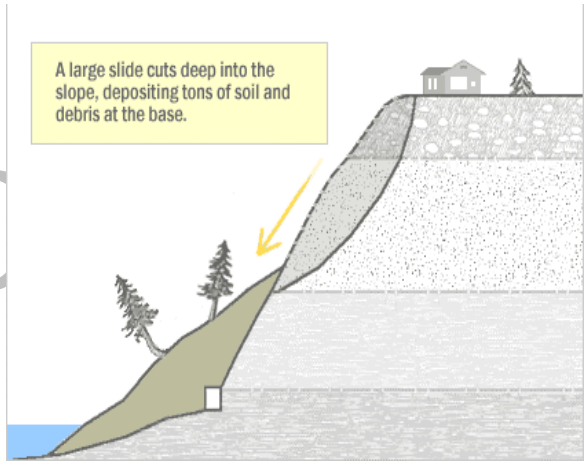


Figure 4.19: Large slides



Frequency

Landslides are often triggered by other natural hazards such as earthquakes, heavy rain, floods or wildfires. The frequency of a landslide is related to the frequency of earthquakes, heavy rain, floods, and wildfires. In the past, Shoreline has experienced two landslides which are described in further detail in the past events section. King County experienced over 100 landslides during December 1996 and January 1997 and also experienced numerous landslides in 1972 that totaled $1.8 million in damages (KCEM. http://www.metrokc.gov/prepare/docs/RHMPLANDSLIDES.pdf.)

Severity

Landslides destroy property, infrastructure, transportation systems, and can take the lives of people. Slope failures in the United States result in an average of 25 lives lost per year and an annual cost to society of about $1.5 billion (ibid).

Warning Time

Landslides can occur either very suddenly or slowly. There is no way to predict when or where a specific landslide will occur, but it is possible to determine what areas are at risk during general time periods. Assessing the geology, vegetation, and amount of predicted precipitation for a given area can help in these predictions.

Past Events

A large slide occurred in the town of Woodway, just north of the Richmond Beach neighborhood during the early morning of January 15th, 1997 (See Figure 4.20). It cut fifty feet into the property above, passed over the railroad tracks and knocked a freight train into the Sound (WSDOE. http://www.ecy.wa.gov/programs/sea/landslides/show/woodway.html).

Figure 4.20: Woodway slide: 1997

The Holiday Blast Storm of December and January 1996-97 was the cause of this massive landslide. The storm also caused a large washout/landslide within Shoreline along NW 175th Street near 6th Avenue NW that was a federally declared disaster. The 100 foot long sinkhole cost 2 million dollars to repair (NOAA. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms).

In the late 1990's a landslide near Perkin's Way and 23rd Avenue NE damaged Shoreline Water District's water main and cost the District $23,142 (RH2. 2003).

Secondary Hazards

Landslides can typically cause several different types of secondary effects. Landslides can block egress and ingress on roads. This has the potential to cause isolation for affected residents and businesses. Roadway blockages caused by landslides can also create traffic problems resulting in delays for commercial, public and private transportation. This could result in economic losses for businesses. A landslide could also block the BNSF Railroad and this could result in a release of hazardous materials or fire.

Other potential problems resulting from landslides are power and communication failures. Vegetation on slopes or slopes supporting poles can be knocked over resulting in possible losses to power and communication lines. This, in turn, creates communication and power isolation. Landslides have the potential of destabilizing the foundation of structures that may result in monetary loss for residents.

It is possible for landslides to affect environmental processes. Landslides can damage rivers or streams, potentially harming water quality, fisheries and spawning habitat.

Exposure and Vulnerability

Analysis showed that there were 657 parcels that contained structures located in the landslide hazard area. The total taxable land value for these parcels is $159,585,700; the total taxable improvements value is $243,109,700, with a total taxable value of $402,695,400. The land use of these parcels in landslide hazard areas is broken down in Table 4.14.

Table 4.14: Land Use of Parcels in Slide Hazard Areas

Land Use	Total
Apartment	4
Condominium (Residential)	4
Duplex	4
Golf Course	1
Park, Public (Zoo/Arbor)	1
Single Family (Res Use/Zone)	635
Tavern/Lounge	1
Vacant (Single-family)	7
Grand Total	**657**

Besides structures located on landslide areas, lifelines and infrastructure can be affected. Many roads cross through the landslide areas. These are listed in Table 4.15.

Table 4.15: Roads in Slide Hazard Areas

Street Name	Length in Slide Hazard Area (ft)	Street Name	Length in Slide Hazard Area (ft)
1ST AV NW	464	NW 175TH ST	3,342
2ND AV NW	601	NW 176TH ST	660
3RD AV NW	1,133	NW 177TH ST	514
6TH AV NW	782	NW 178TH PL	1,003
9TH AV NW	193	NE 179TH ST	801
9TH PL NW	412	NE 180TH ST	275
10TH AV NW	2,723	NE 182ND Pl	198
12TH AV NW	1,721	NE 185TH ST	180
13TH AV NW	2,648	NW 185TH ST	262
14TH AV NW	4,609	NW 186TH ST	438
15TH AV NE	1,309	NW 188TH ST	197
15TH AV NW	3,004	NW 190TH PL	443
16TH AV NE	556	NW 190TH ST	317

Street Name	Length in Slide Hazard Area (ft)	Street Name	Length in Slide Hazard Area (ft)
16TH AV NW	1,730	NW 191ST PL	538
17TH AV NW	321	NW 192ND PL	825
17TH PL NW	763	NW 193RD PL	555
20TH AVE NW	1,687	NW 193RD ST	317
22ND AVE NE	426	NW 198TH ST	402
22ND AVE NW	1,298	NW 199TH ST	396
23RD AVE NW	707	NW 201ST ST	340
23RD CT NE	305	NW 202ND PL	210
23RD LN NE	1,054	NW 204TH ST	350
24TH AVE NE	2,335	BEACH DR	2,714
25TH AVE NE	1,286	BOUNDARY LN	320
25TH AVE NW	317	CARLYLE HALL RD N	508
NW 163RD ST	473	CARLYLE HALL RD NW	865
NW 165TH PL	756	GREENWOOD PL N	1,098
NW 165TH ST	464	MADRONA DR	1,561
NW 166TH ST	624	MADRONA LN	592
NW 167TH ST	1,820	NW CHERRY LOOP DR	3,807
NE 168TH ST	343	NW INNIS ARDEN WY	3,126
NW 170TH ST	196	NW SPRINGDALE PL	537
NW 171ST ST	394	OLYMPIC DR	3,802
N 171ST ST	1,162	PALATINE AV N	1,405
NW 172ND ST	618	RICHMOND BEACH DR NW	2,161
N 172ND PL	245	SCENIC DR	1483
N 172ND ST	312	SPRINGDALE CT NW	795
NW 175ND CT	216	SPRING DR	1,310
NW 175TH PL	290	**Grand Total**	**78,944**

There are some cracks and signs of movement of 25th Avenue NE towards the east into Lake Forest Park.

It is also important to note that the BNSF railroad tracks cross through the landslide hazard area. Not only can a landslide disrupt service, it can cause train derailments, which can potentially lead to a secondary hazard of a hazardous materials release and fire. BNSF has had problems with slides for many years. They have installed landslide alarms that go between milepost 8 and milepost 32. The alarms consist of two strand wire fences that when triggered turn all the lights red on that section of track and this tells the trains to stop. Someone then checks to see what triggered the alarm and whether it is safe to proceed. This helps to prevent train derailments when a landslide occurs.

Scenario

A landslide may occur during or more likely a few days or weeks after a severe storm that saturates the ground. A shallow slide would occur that would damage some homes and some underground infrastructure. Some roads may be blocked.

A worse case scenario would be a large slide similar to the Woodway slide where a large mass of land slides along the developed bluffs of Shoreline, destroying homes and the

railroad tracks. If it happens unexpectedly it would also cause the derailment of a train carrying hazardous materials, which then are released into Puget Sound, polluting the surrounding environment.

Loss Estimation

The loss estimation for property damage for landslides was calculated by multiplying the assessed improvements value for parcels in the landslide hazard by 10%. The damage of 10% was chosen because in past landslide events in Shoreline there has not been much damage to structures. Most of the damage of past landslide has been toward infrastructure. The loss estimation for structures in landslide is $24,310,970.

Number of people affected was calculated by multiplying the number of structures in the hazard, 657, by the average household size in Shoreline, which is 2.5 (U.S. Census Bureau. 2000). This gives a figure of 1,643 people affected. Table 4.16 presents the loss estimation figures for severe weather in Shoreline.

Table 4.16: Landslide Loss Estimation

Type of Loss	Estimation
Property Damage	$24,310,970
People Affected	1,643

Figure 4.21: Landslide Hazard

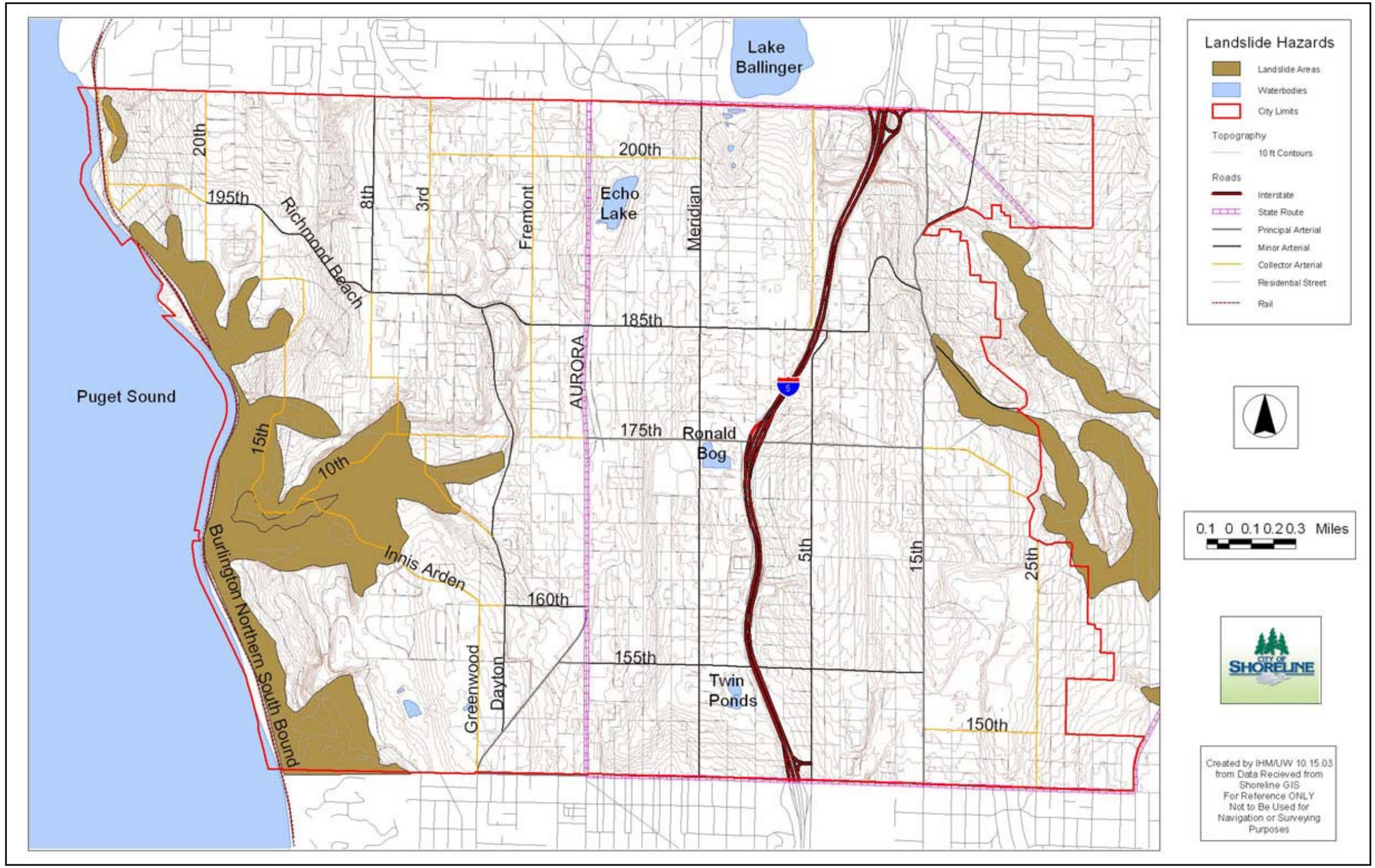
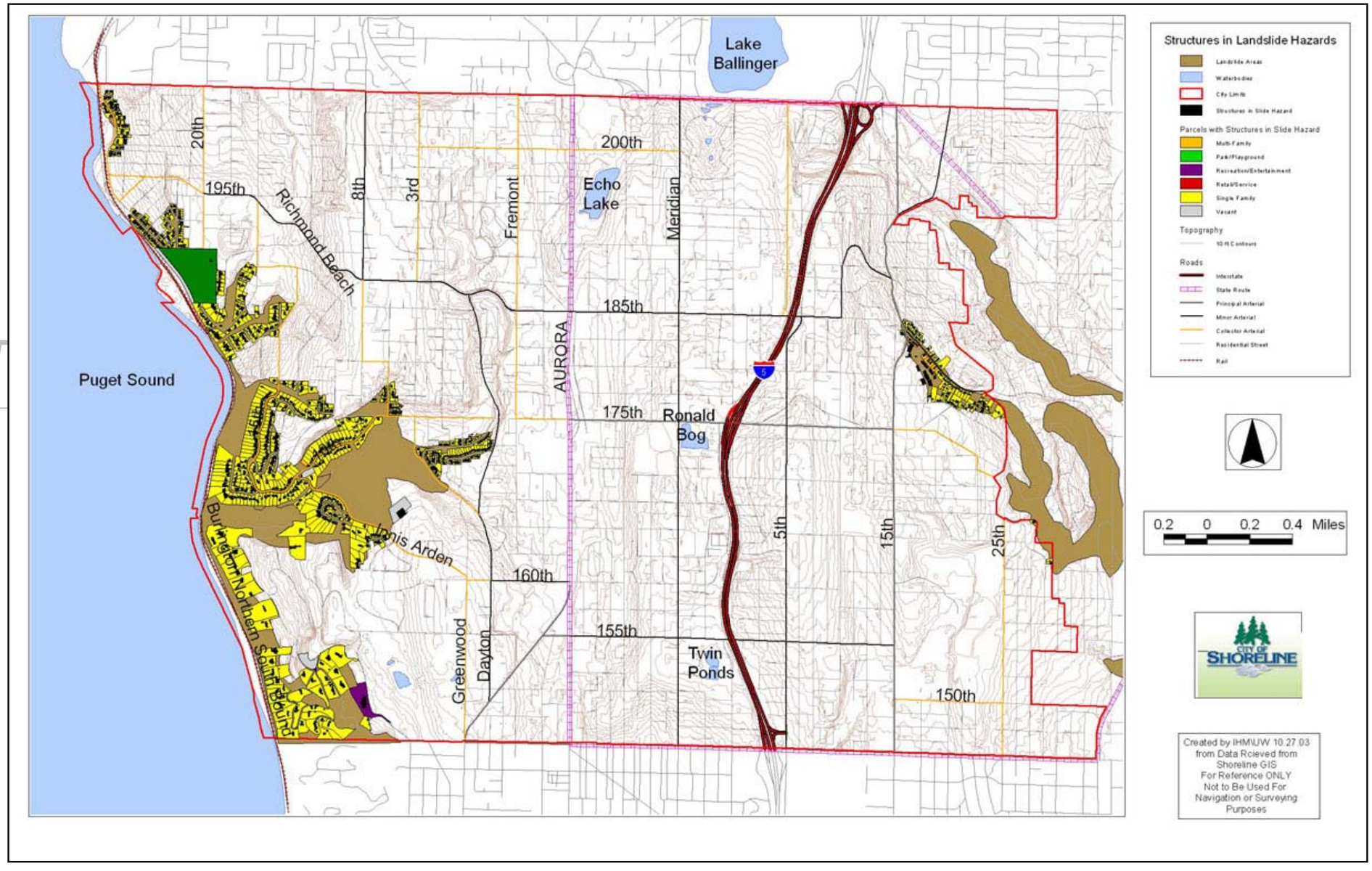


Figure 4.22: Structures in Landslide Hazard



4.8. Flooding

Definitions

Base Flood Elevation: The base flood elevation is the elevation of a 100-year flood event, or a flood, which has a 1% chance of occurring in any given year.

Flood Insurance Rate Map (FIRM): FIRMs are the official maps on which the Flood Insurance Administration has delineated areas of flood risk and risk premium zones.

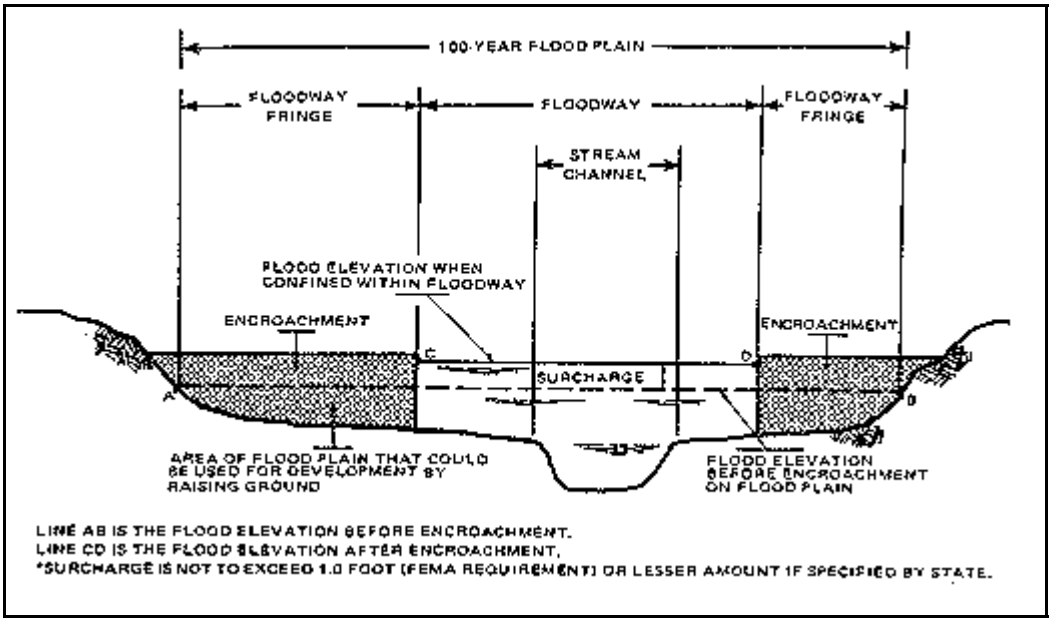
Floodplain: Floodplains are generally defined as the lands adjacent to major rivers or streams that have a 1% chance of being flooded in any given year. FEMA has mapped these areas throughout the country, and most communities in the United States regulate development within them.

Floodway: Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation more that one-foot. Generally speaking, no development is allowed in floodways, as any structures located there would block the flow of floodwaters.

Floodway Fringe: Floodway fringe areas are those lands that are in the floodplain but outside of the floodway. Some development is generally allowed in these areas with a variety of restrictions.

FEMA contracted the Army Corps of Engineers to map the floodplains, floodways, and floodway fringes. Figure 4.23 depicts the relationship among the three designations.

Figure 4.23: Floodway Schematic



Low Impact Development: Low Impact Development is a comprehensive land planning and engineering design approach with a goal of maintaining and enhancing the pre-development hydrologic regime of urban and developing watersheds. This design approach incorporates strategic planning with micro-management techniques to achieve

environmental protection while allowing for development or infrastructure rehabilitation to occur (Low Impact Development Center. http://www.lowimpactdevelopment.org/).

Zero-Rise Floodway: A 'zero-rise' floodway is an area reserved to carry the discharge of a flood without raising the base flood elevation. Some communities have chosen to implement zero-rise floodways because they provide greater flood protection than the floodway described above, which allows a one foot rise in the base flood elevation.

Background

A flood is the inundation of normally dry land resulting from the rising and overflowing of a body of water. It is a natural geologic process that shapes the landscape, provides habitat and creates rich agricultural lands. Human activities and settlements tend to use floodplains, frequently interfering with the natural processes and suffering inconvenience or catastrophe as a result. Human activities encroach upon floodplains, affecting the distribution and timing of drainage, and thereby increasing flood problems. The built environment creates localized flooding problems outside natural floodplains by altering or confining drainage channels. This increases flood potential in two ways: 1) it reduces the stream's capacity to contain flows; and 2) increases flow rates downstream.

There are basically three types of floods (KCEM. http://www.metrokc.gov/prepare/docs/RHMPFLOODS.pdf): 1) a rising flood which occurs because of heavy prolonged rain, melting snow or both (this type of flood can impact on both rural, suburban and urban areas in King County); 2) flash floods which are characterized by quick rise and fall of flood levels; and 3) wind-driven flood tides that combine wind and tides to flood coastal areas.

Flooding in Shoreline

Location

Due to its geographical location, Shoreline does not have any of the major rivers in the region that are subject to severe flooding pass through it. Shoreline is drained by one minor stream on the west, Boeing Creek, which flows through the steep bluffs and into Puget Sound and two other minor streams, McAleer Creek and Thornton Creek, which flow in Lake Washington. Boeing Creek and McAleer Creek flow through steep ravines and do not pose much of a hazard to the development above them. Thornton Creek flows through a swampy area parallel to I-5 on the west that has drainage issues and is subject to flooding. The Richmond Beach area is also subject to coastal flooding.

Frequency

Structures located on properties within the FEMA 100 year floodplain have a 1% chance in any given year to experience flooding.

Severity

The City of Shoreline has the temperate climate typical of Western Washington. Summers are dry with mild temperatures, and winters are rainy with occasional snow. Average annual rainfall is 38.27 inches and average annual snowfall is 11.7 inches (City of Shoreline. http://www.cityofshoreline.com/about/facts/index.html).

Flooding in Shoreline has mainly resulted from not enough capacity in the water system during heavy rains. This has led to flooding in roadways and several homes being flooded. The extent of the damage to the homes is undetermined at this time.

Warning Time

Flooding in Shoreline is related to heavy rains causing urban flooding so there is usually several hours of warning time. The number of hours of warning time is usually between 2 and 24 hours but depends on the extent of the flooding.

Past Events

Most of the past flooding problems are related more to poor drainage and presence of impervious soils than to development in delineated floodplains. Specifically the 3rd Avenue NW area of Richmond Highlands has had flooding problems for over 20 years and the area near Ronald Bog tends to flood every year (City of Shoreline. http://cityofshoreline.com/cityhall/projects/bog/index.cfm).

On October 20, 2003 rainfall hit an all time record high in the Shoreline area. Several homes were flooded near 3rd Avenue NW and 185th Street, a property was flooded between 10th and 11th Avenue NE at 175th, and 25th Avenue NE near Ballinger Way was closed due to flooding (Brice, Pamela. 2003). Figure 4.24 shows the flooding occuring near Ronald Bog.

Figure 4.24: Flooding near Ronald Bog

Secondary Hazards

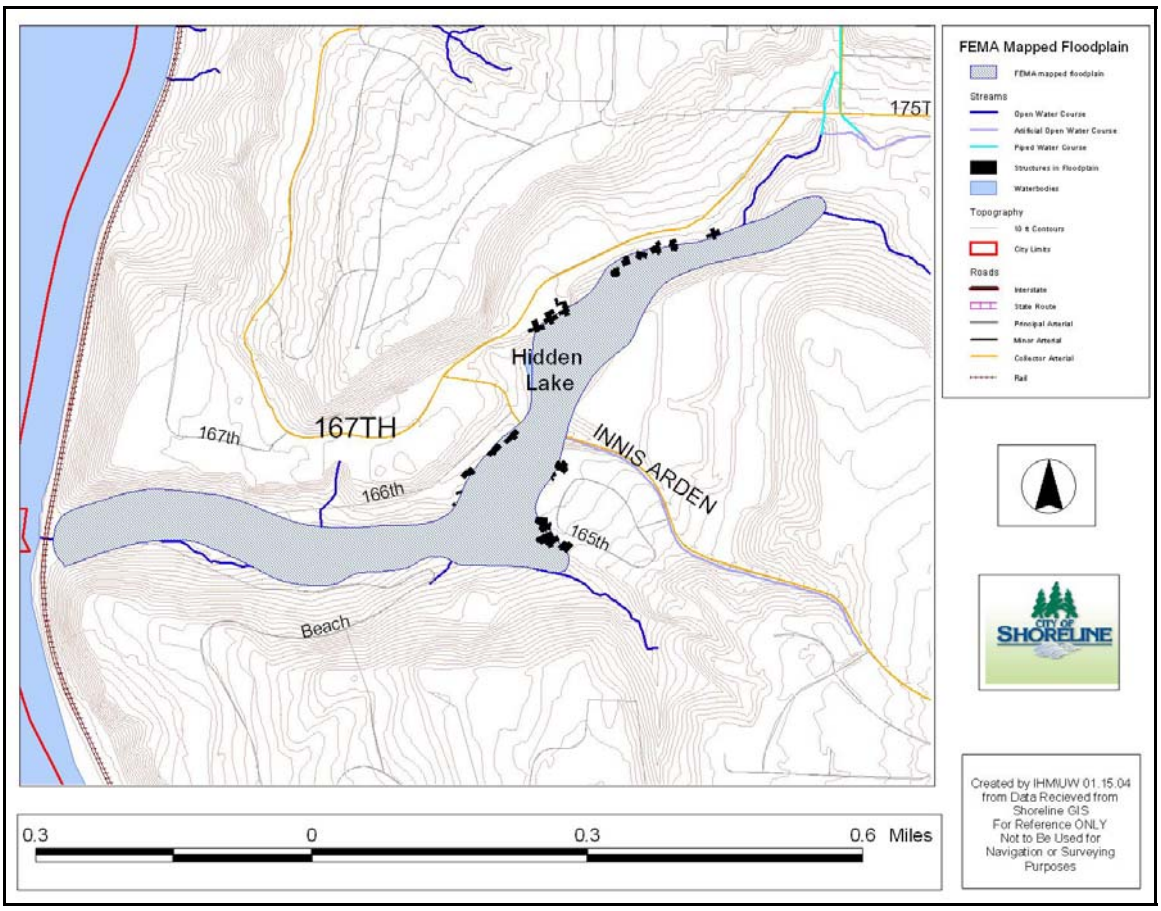
Secondary hazards include landslides, which can occur as a result of flooding when the ground is saturated. Landslide hazards are discussed in the landslide section. Additionally, chemicals or other toxic substances stored without appropriate protection may be released into floodwaters. Septic systems may cause additional water contamination.

Exposure and Vulnerability

The types of property and infrastructure that are vulnerable to flooding in Shoreline are properties along the coast and properties with poor drainage.

Analysis shows that there is one FEMA designated floodplain in Shoreline, along Boeing Creek. Figure 4.25 displays the FEMA mapped floodplain in Shoreline. This designated floodplain is not accurate since the 18 structures located within it have never been flooded and are built upon the bluff of Boeing Creek.

Figure 4.25: FEMA Mapped Floodplain



Properties along the coast may experience coastal flooding during a strong storm surge. Most vulnerable are the properties along 27th Avenue NW and the BNSF railroad tracks.

Properties that flood due to poor drainage are also vulnerable. This includes the approximately 20 properties along 3rd Avenue NW that flood during or after storms due to poor drainage. The Ronald Bog area (175th Street between Meridian Avenue and 5th Avenue NE) also has approximately 20 homes that flood constantly due to poor drainage.

Figure 4.26 shows the recorded flood incidents in Shoreline for 2003. These incidents were recorded when residents called the city to report flooding issues. The reports were then classified into four flooding categories which are public area, roadway, structure and yard/driveway. In 2003, there were a total of 182 flooding incidents that were called into

the city. There were 10 flooding incidents for public areas, 33 for roadways, 39 for structures and 100 for yards/driveways.

Figure 4.28 is a multi-hazard map showing earthquake hazards, landslide hazards, flooding hazards and hazardous materials.

Scenario

A severe storm with heavy precipitation during a generally wet cold winter that leaves the ground frozen and impervious would be a worse case scenario for flooding in Shoreline. The drainage system would go over capacity, spilling into streets, basements and low-lying areas. Damage would include flooded basements and damaged underground utilities especially in those locations of the Ronald Bog Area.

Loss Estimation

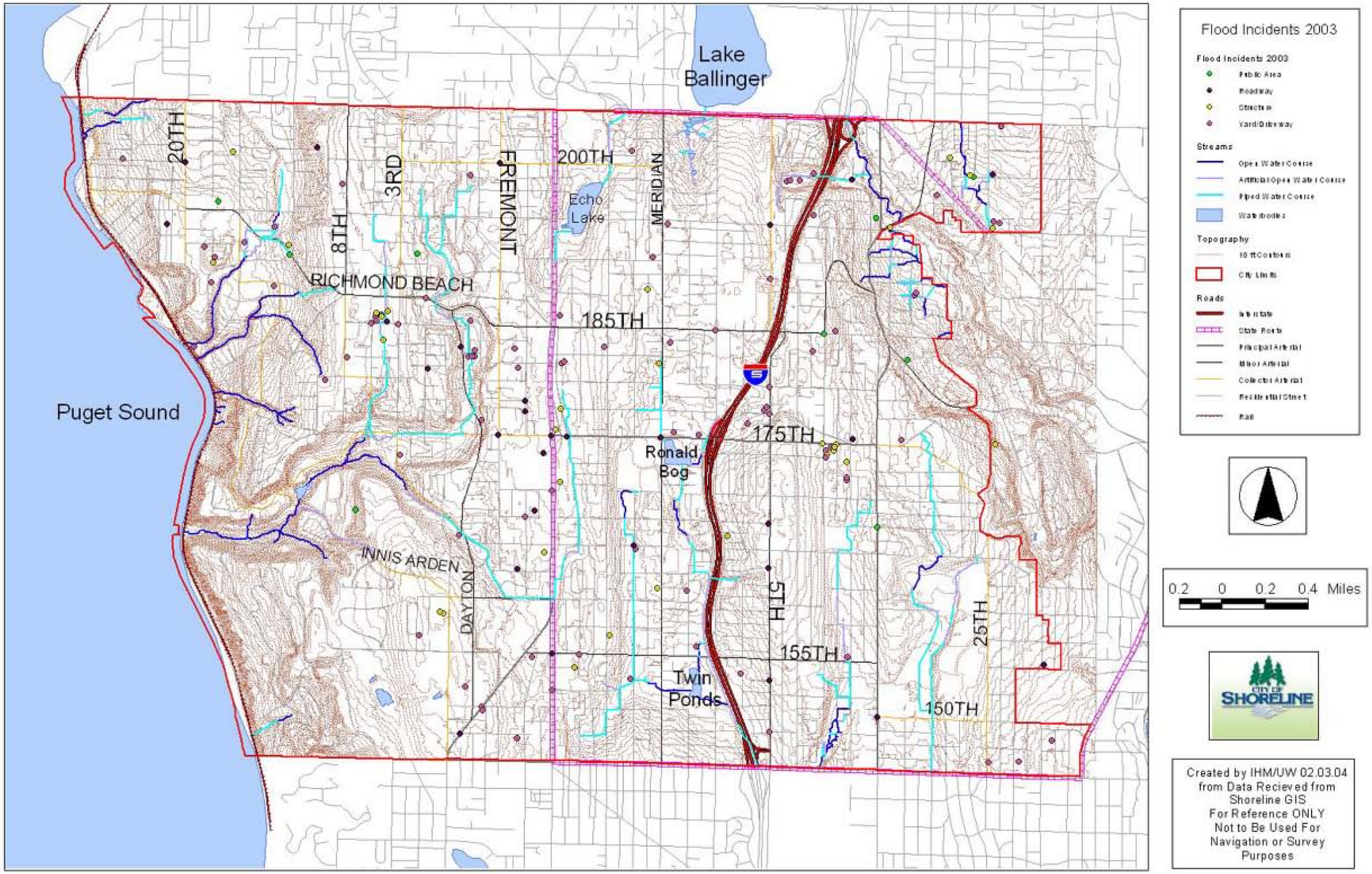
In Shoreline, the FEMA map floodplain is not accurate, however, it has been reported that there is an average of 40 homes that experience flooding each year. To calculate the structure damage for flooding, first the median value of a single-family owner occupied home in Shoreline, $205,300 (Census 200), was multiplied by 40. This gave a value of $8,212,000, which was then multiplied by an estimated loss of 15%. The 15% value was taken from the FEMA State and Local Mitigation Planning How-to-Guide (2001). It was assumed that the houses that experience flooding are 1 to 2 stories with basements and that the flood level was 1 foot. This produced a loss estimation for structures of $1,231,800. If using the previous assumptions, damage estimates for the contents of the houses could be calculated by multiplying the content value by 22.5%.

To calculate the number of people that would be affected, the average household size in Shoreline, which is 2.5 (US Census Bureau. 2000), was multiplied by 40, the average number of homes that experience flooding in Shoreline. The number of people affected by flooding is 1, 643. Table 4.17 presents the loss estimation figures for flooding in Shoreline.

Table 4.17: Flood Loss Estimation

Type of Loss	Estimation
Property Damage	$1,231,800
People Affected	100

Figure 4.26: Flood Incidents – 2003



4.9. Wildland Fire

Definitions

Intermix Area: An area susceptible to wildland or forest fires because wildland vegetation and urban or suburban development occur together (Slaughter, R. 1996).

Wildland fires: This term refers to any uncontrolled burning of grasslands, brush or woodland areas.

Background

Triggers that can cause fire are natural, such as lightning, as well as human induced. Humans can directly cause fires with careless campfires, sparks from ATVs, or inappropriate disposal of lit cigarettes. Downed electric lines during windstorms can also cause fires.

Fires are influenced by the amount and condition of fuel present, slopes, wind and temperature. Fires advance through the transmission of heat in the form of conduction, convection and radiation. During the day, fires generally travel uphill. Convection currents and radiation ahead of the fire preheat the fuels and air upslope, allowing the fire to expand rapidly. Radiation has an extreme impact when the fire enters a "chimney," or a v-shaped area on a slope, such as a drainage gully. Additionally, south and west facing slopes tend to be warmest and driest. The situation of heavy dry fuels, on a southwest facing slope with chimneys on a hot day will allow for near explosive expansion of the fire. Wind can strengthen and spread a fire, though large fires can generate their own wind. The heat rising from a large fire will create a thermal column that can rise hundreds or thousands of vertical feet. These vertical columns carry burning embers that are often picked up by prevailing winds and spread. At night, the fire will slow and travel downhill following the cooling airflow.

Fire experts attribute the generally worsening fire risk to increases in the presence of dry, hazardous fuel. Wildfires are most likely to occur between mid-May and October but can occur at any time during the year. Any particularly dry period can increase vulnerability. The probability of a fire in any one locality on any particular day depends on fuel conditions, topography, the time of year, the past and present weather conditions, and the activities (debris burning, land clearing, camping, etc.) that take place in the vicinity. Fires in general can range from isolated burns affecting a few acres or less to severe events. These large fires usually occur when groups of smaller fires merge.

With the presence of such conditions, lighting on dry fuels, recreational uses, interface development or terrorist acts can all trigger fires. The type of ignition (man-made or natural) should be discounted in evaluating the risk. If the conditions are right in a forest for a major fire, any source of ignition (whether natural or human caused) will bring about the same end results.

Fire in Shoreline

Location

Shoreline is an urbanized city but is susceptible to wildland fires that can destroy property and infrastructure. This analysis differs from most wildfire analyses in that Shoreline does not lie in an urban interface/intermix area, and does not have a specified wildfire hazard zone. Nonetheless it is a pertinent risk. The City of Shoreline is susceptible to fires as a result of the numerous steep slopes located throughout. Innis Arden, the Highlands, and Boeing Creek Canyon all have vegetated areas located on slopes. These tend to be heavily vegetated and typically dry out during the summer. Shoreline also has a utility corridor parallel to Aurora Avenue, which used to be the Interurban right of way (and is currently being converted to a bike path) that is not maintained and contains grassy/brush areas. In addition, the brush along Interstate 5 can also potentially catch fire. Richmond Beach Park, which faces south, is vulnerable to wildfires. Shoreline also has other pocket areas located on steep slopes or have high fuel loads that have not been specifically identified as of yet but can potentially cause damage.

Frequency

Richmond Beach Park, which faces south, has brush fires approximately every five years. However, urban and brush fires can occur at anytime and are more probable during dry, summer months.

Severity

Fires can burn vegetation and cause loss of life and personal property. Loss of vegetation due to fires may cause erosion and mudslides. There is strong concern for occupants in structures that may catch fire. Fires may also cause the release of hazardous materials and damage utility lines.

Warning Time

The onset of a fire can be sudden and there can be little warning time. The warning time is dependent on the extent of the fire and the speed the fire is traveling.

Past Events

In the late 1960's there was a brush fire in the Boeing Creek Canyon area. This area is very inaccessible for fire vehicles.

On July 5th, 2003 two fires burned 1.5 acres of brush between the Burlington Northern Railroad tracks and the beach at Richmond Beach Saltwater Park. The pedestrian bridge located there was threatened but the fire was put out in enough time so that there was only minimal damage to the bridge (Enterprise. 2003b).

The utility corridor parallel to Aurora Avenue caught fire on August 18, 2003 scorching a path between N 165th Street and N 160th Street. The fire damaged the exterior of two homes and twelve other property owners reported damage to backyards, outbuildings and landscaping (Enterprise. 2003a).

Secondary Hazards

Due to the presence of steep slopes, erosion after a wildfire is a risk that may potentially lead also to landslides. The protection provided by foliage and organic matter is removed, leaving the soil fully exposed to wind and water erosion.

Exposure and Vulnerability

There is any number of vulnerabilities to fires in Shoreline. These fires can spread to homes, businesses, block road and lifelines and create significant economic and environmental damage if fuel loads and vegetation are not properly maintained. Specific areas that, such as Richmond Beach Park is especially vulnerable. In addition, the Highlands neighborhood is a highly vegetated area with potential high fuel loads and limited ingress and egress for emergency vehicles. Vegetated areas in Innis Arden and south of Richmond Beach may also be an area of concern. A steep slopes and land cover map may help to determine general wildland and brush fire hazard locations in Shoreline.

Scenario

A disastrous fire could be caused by a lightening strike or more likely by human error. It would be an extremely dry hot summer and someone would discard a cigarette out the window of a car on Interstate 5 or along the bike path. It is also possible that fires can be set at Richmond Beach Park or the Highlands. Because of the dry conditions and steep slopes, the fire would spread very rapidly, especially if it is a windy day. It spreads before response teams can contain it and then moves in to neighborhoods, sparking a wave of fires that destroys or damages numerous homes.

Loss Estimation

Loss from exposure to wildland fire in Shoreline is difficult to calculate without the completion of technical studies of interface areas. Shoreline has a variety of wildland areas and depending of conditions the loss could be very different. Extents of wildland fires are also often dependent on weather conditions such as wind and dryness of vegetation. Some wildland fires, would result in no loss to property and very little clean up expenditure (a loss estimate very near to $0), while others could result in loss of life, expensive emergency response and damage figures ranging from thousands to millions of dollars.

Given this variety, it is difficult to assess exposure to wildland fires with enough specificity to allow loss estimation.

4.10. Volcano

Definitions

Ashfall: Volcanoes tend to erupt lavas so thick and charged with gases that they explode into ash rather than flow.

Debris Avalanches: Volcanoes are prone to debris and mountain rock avalanches that can approach speeds of 100 mph.

Debris Flows: Dense mixtures of water-saturated debris that move down-valley; looking and behaving much like flowing concrete. They form when loose masses of unconsolidated material are saturated, become unstable, and move down slope. The source of water varies but includes rainfall, melting snow or ice, and glacial outburst floods.

Lahars: Lahars are rapidly flowing mixtures of water and rock debris that originate from volcanoes. While lahars are most commonly associated with eruptions, heavy rains, debris accumulation, and even earthquakes may also trigger them. They may also be termed debris or mud flows.

Lateral blasts: These are explosive events in which energy is directed horizontally instead of vertically from a volcano. They are gas charged, hot mixtures of rock, gas and ash that are expelled at speeds up to 650 mph.

Lava Flows: Lava flows are normally the least hazardous threat posed by volcanoes. Cascades volcanoes are normally associated with slow moving andesite or dacite lava.

Pyroclastic Flows and Surges: Pyroclastic flows are avalanches of hot (570-1470° F), ash, rock fragments and gas that move at high speeds down the sides of a volcano during explosive eruptions or when the edge of a thick, viscous, lava flow or dome breaks apart or collapses. Speeds range from 20 to more than 200 miles per hour.

Stratovolcano: The volcanoes in the Cascade Range surrounding Shoreline are all stratovolcanoes. They are typically steep-sided, symmetrical cones of large dimension built of alternating layers of lava flows, volcanic ash, cinders, blocks, and bombs and may rise as much as 8000 feet above their bases (USGS. http://vulcan.wr.usgs.gov/Glossary/StratoVolcano/description_composite_volcano.html).

Tephra: The ash and the large volcanic projectiles that erupt from a volcano into the atmosphere are called tephra. The largest fragments 2½ inches) fall back to the ground fairly near the vents, as close as a few feet and as far as 6 mi. The smallest rock fragments (ash) are composed of rock, minerals, and glass that are less than 1/8 inch in diameter. Tephra plume characteristics are affected by wind speed, particle size, and precipitation.

Volcanic Gases: All active volcanoes emit gases. These gases may include steam, carbon dioxide, sulfur dioxide, hydrogen sulfide, hydrogen, and fluorine.

Background

A volcano is a vent in the Earth from which molten rock (magma) and gas erupts. There are a wide variety of hazards related to volcanoes and volcanic eruptions. With volcanic eruptions, the hazards are distinguished by the different ways in which volcanic materials and other debris flow from the volcano. The molten rock that erupts from the volcano (lava) forms a hill or mountain around the vent. The lava may flow out as a viscous liquid, or it may explode from the vent as solid or liquid particles.

Volcanic Hazards in Shoreline

Location

The Cascade Range is a 1,000 mile long chain of volcanoes, which extends from northern California to southern British Columbia. Shoreline does not lie within any basin that would drain any lahars or mudflows from the nearby volcanoes. Nonetheless it would be affected by tephra or an ash fall from either a Mount Rainier or Glacier Peak eruption.

Frequency

Volcanoes in the Cascades erupt at a rate of 1 or 2 eruptions every 200 years. Many of these volcanoes have erupted in the recent past and will erupt again in the foreseeable future. Eruptions in the Cascades have occurred at an average rate of 1-2 per century during the last 4,000 years. The USGS classifies Glacier Peak, Mount Adams, Mount Baker, Mount Hood, Mount St. Helens and Mount Rainier as being potentially active Washington state volcanoes. Mount Saint Helens is by far the most active volcano in the Cascades, with four major explosive eruptions in the last 515 years.

Severity

A one-inch deep layer of ash weighs an average of ten pounds per square foot causing danger of structural collapse. Ash is harsh, acidic, gritty, and smelly. Ash may also carry a high static charge for up to two days after being ejected from a volcano. An ash cloud combines with rain, sulfur dioxide in the cloud combines with water to form diluted sulfuric acid that may cause minor, but painful burns to the skin, eyes, nose, and throat.

Warning Time

Constant monitoring of all active volcanoes means that there will be more than adequate time for evacuation before an event. Since 1980, the volcano has settled into a pattern of intermittent, moderate and generally nonexplosive activity, and the severity of tephra, explosions, and lava flows have diminished. All episodes, except for one very small event in 1984, have been successfully predicted several days to 3 weeks in advance. However, scientists remain uncertain as to whether the current cycle of explosivity has ended with the 1980 explosion. The possibility of further large-scale events continues for the foreseeable future (Tilling et al. 1990).

Past Events

The most famous of past eruptions for Mount Saint Helens occurred May 18, 1980. In this eruption, the elevation of Mount Saint Helens dropped dramatically from 9,677 feet to 8,364 feet; 23 square miles of volcanic material buried the North Fork of the Toutle River to an average depth of 150 miles. A total of 57 human fatalities resulted from the blast (Brantley et al. 1997). The following table (Table 4.18) summarizes the eruptions in the area:

Table 4.18: Past Eruptions in Puget Sound Area

Volcano	Number of Eruptions	Type of Eruptions
Mount	3 in the last 10,000 years, most recent between	Andesite lava

Volcano	Number of Eruptions	Type of Eruptions
Adams	1,000 and 2,000 years ago	
Mount Baker	5 eruptions in past 10,000 years; mudflows have been more common (8 in same time period)	Pyroclastic flows, mudflows, ashfall in 1843.
Glacier Peak	8 eruptions in last 13,000 years	Pyroclastic flows and lahars
Mount Rainier	14 eruptions in last 9000 years; also 4 large mudflows	Pyroclastic flows and lahars
Mount St Helens	19 eruptions in last 13,000 years	Pyroclastic flows, mudflows, lava, and ashfall

Secondary Hazards

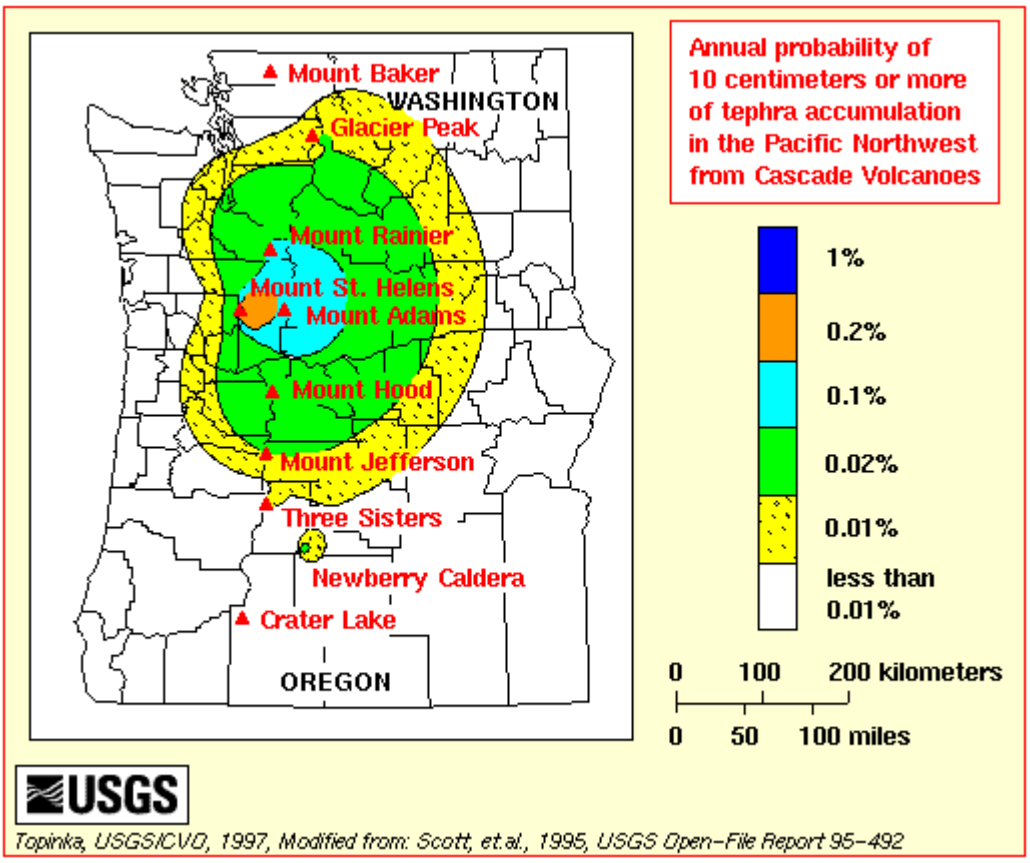
In Shoreline, the most likely secondary hazards associated with volcanic eruptions are disruption of traffic and loss of services.

Exposure and Vulnerability

Shoreline has low vulnerability to volcanic hazards. Tephras can potentially cause the most damage. Ash only ½ inch thick can impede the movement of most vehicles and disrupt transportation, communication, and utility systems. Tephra may cause eye and respiratory problems, particularly for those with existing medical conditions. Ash may also clog ventilation systems and other machinery. It is easily carried by winds and air currents remaining a hazard to machinery and transportation long after the eruption. When tephras are is mixed with rain it becomes a much greater nuisance because wet ash is much heavier, more difficult to remove, and can even cause structures to collapse. Heavy ashfall can drift into roadways, railways, and runways where it becomes slippery and dangerous. Wet ash may also cause electrical shorts. Power lines can be destroyed and roofs may collapse from the ashfall loads. Ash fall also decreases visibility and may cause psychological stress and panic. Figure 4.27 below depicts the probability of ash accumulation from a Cascade volcano. As is evident, there is little likelihood of major accumulation, but some should be expected. An ash fall may cause secondary hazards such as fire or flooding. The weight of ash may cause structural collapse.

Vulnerable populations are the elderly, children, and those with weakened immune and respiratory systems. Gases from volcanic eruptions are usually too diluted to constitute danger to a person in normal health, the combination of acidic gas and ash may cause lung problems. Extremely heavy ash can clog breathing passages and cause death.

Figure 4.27: Probability of Tephra Accumulation from Cascade Volcanoes



Scenario

Glacier Peak or Mount Rainier would erupt with little warning time with a large explosion, sending ash miles into the air, dispersing and then falling in all directions. Although the mudflows would not affect Shoreline, except economically, it would be affected by the ash fall. The tephra would blanket the city, possibly putting stress on power lines and roofs. A heavy rainstorm could occur, creating a heavy clay from the ashfall. Traffic accidents, reduction in production by business, stressed power lines and residential roofs collapse may occur. The wet ash would also clog storm drains, causing the secondary hazard of flooding.

The dry tephra would also cause respiratory problems for the elderly and infirm people living in the city, particularity affecting those residing at the CRISTA Ministries Facility and at elderly and retirement centers.

Loss Estimation

Loss from exposure to volcanoes in Shoreline is difficult to calculate because the loss is related to tephra distribution. Extents of affected areas are also often dependent on weather conditions such as wind and rain. The damage from tephra could range from no loss to property and very little clean up expenditure (a loss estimate very near to $0) to

potential in loss of life and expensive emergency response and clean-up figures ranging from hundreds to thousands of dollars.

Given this variety, it is difficult to assess exposure volcanoes with enough specificity to allow loss estimation.

4.11. Tsunami/Seiche

Definitions

Seiche: A seiche is a standing wave in an enclosed or partly enclosed body of water and normally caused by earthquake activity and can affect harbors, bays, lakes, rivers and canals.

Tsunami: Tsunamis are sea waves usually caused by displacement of the ocean floor and are typically generated by seismic or volcanic activity or by underwater landslides.

Background

A tsunami consists of a series of high-energy waves that radiate outward like pond ripples from the area in which the generating event occurred. The sequence of tsunami waves arrives at the shore over an extended period. The first wave will be followed by others a few minutes or a few hours later with the following waves generally increasing in size over time. Tsunamis are commonly 60 or more miles from crest to crest and travel at remarkable speeds, often more than 600 miles per hour in the open ocean. They can traverse the entire Pacific Ocean in 20 to 25 hours. These are extremely destructive to life and property. The tsunami caused by the 1883 eruption of Krakatau, caused more than 30,000 fatalities, and the 1886 tsunami on the Sunriku coast of Japan killed about 26,000 people.

Typical signs of a tsunami hazard are earthquakes and/or a sudden and unexpected rise or fall in coastal water. The large waves are often preceded by coastal flooding and a quick recession of the water. Tsunamis are difficult to detect in the open ocean; with waves only one or two feet high. The tsunami's size and speed, as well as the coastal area's form and depth are factors that affect the impact of a tsunami; wave heights of fifty feet are not uncommon. In general, scientists believe it requires an earthquake of at least a magnitude 7 to produce a tsunami.

Seiches are usually earthquake-induced but typically do not occur close to the epicenter of an earthquake, but hundreds of miles away. This is due to the fact that earthquake shock waves close to the epicenter consist of high-frequency vibrations, while those at much greater distances are of lower frequency, which can enhance the rhythmic movement in a body of water. The biggest seiches develop when the period of the ground shaking matches the frequency of oscillation of the waterbody.

Tsunami/Seiche Hazard in Shoreline

Location

Tsunamis affecting Washington State may be induced by an earthquake of local origin, or they may be caused by earthquakes at a considerable distance, such as from Alaska or

Japan. Shoreline does not have any major lakes within its area, but a severe quake could create seiches in the small ponds such as Ronald Bog and Echo Lake that could potentially cause damage.

Frequency

The frequency of a tsunami or seiche is related to the frequency of earthquakes and landslides that can produce a tsunami or seiche. There is a low probability of a tsunami or seiche occurring in Shoreline.

Severity

It is unlikely that a tsunami or seiche generated by a distant or Cascadia subduction earthquake would result in much damage in Shoreline. One computer model suggests that a tsunami generated by such an earthquake with a magnitude of 8.5 would only be 0.2 to 0.4 meters in height when it reached the Seattle/Shoreline area. This results from the shielding of the Olympic Peninsula and the Puget Sound islands. However, Puget Sound is vulnerable to tsunamis generated by local crustal earthquakes (such as along the Seattle fault or South Whidbey Island fault) or by submarine landslides triggered by earthquake shaking. This type of tsunami could impact Shoreline. The low-lying areas along the Puget Sound coastline could suffer damage.

Warning Time

Warning vulnerable areas would be nearly impossible due to the close proximity to the origin of the tsunami. The first wave would probably hit coastline areas within minutes.

Past Events

There is no historic record of tsunamis affecting Shoreline or Puget Sound. However, geologic evidence of tsunamis has been found at Cultus Bay on Whidbey Islands and at West Point in Seattle. Researchers believe these tsunamis are evidence of earthquake activity along the Seattle fault.

The area around Shoreline has been affected by seiches, most recently caused by a November 3rd, 2002 when a 7.9 magnitude quake in Alaska shook houseboats loose from their moorings in Lake Union. No damage was reported in Shoreline for this event.

Exposure and Vulnerability

Properties located along Puget Sound may be vulnerable to tsunamis. There are 33 parcels that could be affected and are located on 27th Avenue NW. Properties directly adjacent to ponds or the small lakes in Shoreline may be potentially affected by a seiche caused by a local or distant quake. Echo Lake has development surrounding it, as does Ronald Bog on its south side. Since actual buildings are located a several feet above the lake, the most affected structures would be the piers on Echo Lake and any boats moored to them.

Scenario

The worst-case scenario for a tsunami and seiche would be as a secondary effect of a powerful local earthquake on the Seattle fault or South Whidbey fault zones centered in

Puget Sound. This would send a tsunami rushing towards Shoreline with little or no warning time, damaging buildings and property located along the low lying coast in the Richmond Beach area. The tsunami itself would damage the closest buildings and the floods from the storm surge would damage other buildings. The seiche from this quake would also damage the small piers located on Echo Lake and some of the boats docked on them causing property losses for households. The seiche could possibly flood some basements of the buildings located near the lake, and the basements of buildings near Ronald Bog.

Loss Estimation

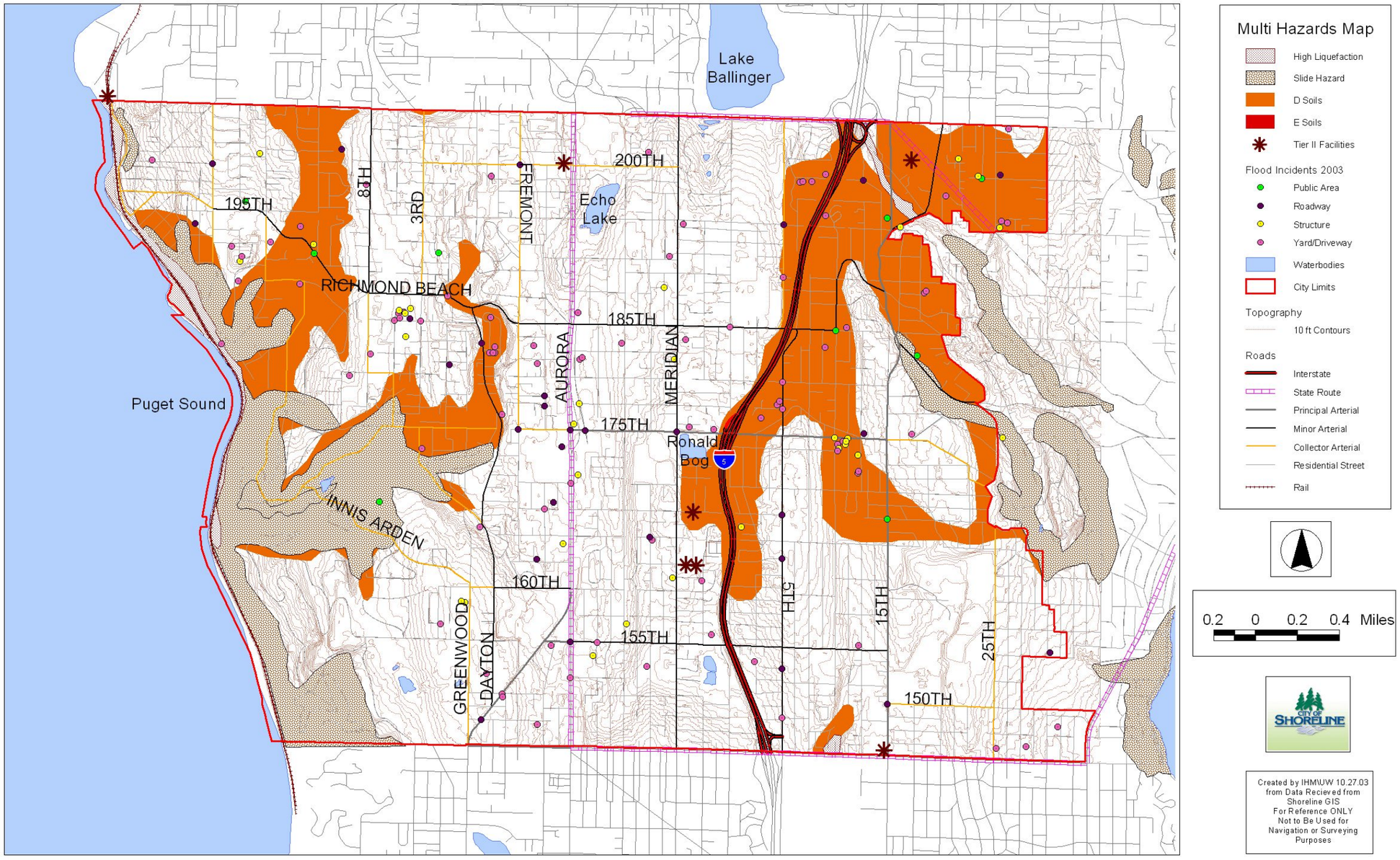
To calculate the property damage loss estimation for tsunami/seiche, the assessed improvement value, $8,889,000, was multiplied by 13%. The 13% damage estimation value was taken from the FEMA State and Local Mitigation Planning How-to-Guide (FEMA 2001). It was assumed that the houses that would be exposed to a tsunami/seiche are 2 stories with no basements and that the flood level would be 2 feet. This gave a value of $1,155,570. If using the previous assumptions, damage estimates for the contents of the houses could be calculated by multiplying the content value by 19.5%.

To calculate the number of people affected, the number of structures on 27th Avenue NW, 32, was multiplied by the average household size in Shoreline, which is 2.5 (Census 2000). This gives a figure of 80 people affected. Table 4.19 presents the loss estimation figures for tsunami/seiche in Shoreline.

Table 4.19: Tsunami/Seiche Loss Estimation

Type of Loss	Estimation
Property Damage	$1,155,570
People Affected	80

Figure 4.28: Composite Map of Earthquake, Landslides, Flooding, & Hazardous Materials Hazards



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5. Hazard Risk Rating

A risk rating has been completed for each of the major hazards described in this plan. For the purposes of this plan, the risk rating is a function of two factors. The first factor describes the probability that a hazard event will occur. The second factor describes the impact of the event. This is typically considered both in number of people affected and amount of dollar loss caused by the hazard event. Estimates of risk for the City of Shoreline were based on the methodology that the City used in preparing their HIVA. This fulfills the Washington Administrative Code (WAC 118-30-060(1)) requirement.

5.1. Probability of Occurrence

The probability of occurrence of a hazard event provides an estimation of how often the event occurs. This is generally based on the past hazard events that have occurred in the area and the forecast of the event occurring in the future. This is done by assigning a probability factor, which is based on yearly values of occurrence. The numerical value assigned to each category will be used to determine the risk rating of each hazard (See Table 5.1). These are allotted as follows:

High - Hazard event is likely to occur within 5 years (Numerical value **3**)

Medium – Hazard event is likely to occur within 50 years (Numerical value **2**)

Low – Hazard event in not likely to occur within 50 years (Numerical value **1**)

Table 5.1: Probability of Hazards

Hazard Event	Probability	Numerical Value
Earthquake	Medium	2
Hazardous Materials	High	3
Severe Weather	High	3
Landslides/Sinkholes	Medium	2
Flooding	Medium	2
Fire	High	3
Volcano	Low	1
Tsunami/Seiche	Low	1

5.2. Impact

The impact of each hazard was divided into two categories, impact to people and impact in dollar loss (See Table 5.2 and Table 5.3). These two categories were also assigned weighted values. Impact to people was given a weighted factor of 3 and impact of dollar losses was given a weighted factor of 2. For impact to people the categories were broken down as follows:

High - Hazard event seriously affects **greater than 100 people** (Numerical value **3**)

Medium – Hazard event seriously affects **26-100 people** (Numerical value **2**)

Low – Hazard event seriously affects **0-25 people** (Numerical value **1**)

Table 5.2: Impact to People from Hazards

Hazard Event	Impact	Numerical Value	Multiplied by weighted value of 3
Earthquake	High	3	9
Hazardous Materials	Medium	2	6
Severe Weather	Medium	2	6
Landslides/Sinkholes	Medium	2	6
Flooding	Medium	2	6
Fire	Low	1	3
Volcano	High	3	9
Tsunami/Seiche	Medium	2	6

For the impact in dollar loss, it was estimated what the dollar loss would be from a major event of each hazard. For impact in dollar loss, the categories were broken down as follows:

High - Hazard event causing damages **over $10 million** (Numerical value **3**)

Medium – Hazard event causing damages **between $1 and $10 million** (Numerical value **2**)

Low – Hazard event causing damages **less than $1 million** (Numerical value **1)**

Table 5.3: Impact in Dollar Losses for Hazards

Hazard Event	Impact	Numerical Value	Multiplied by weighted value of 2
Earthquake	High	3	6
Hazardous Materials	Low	1	2
Severe Weather	Low	1	2
Landslides/Sinkholes	Medium	2	4
Flooding	Medium	2	4
Fire	Low	1	2
Volcano	Medium	2	4
Tsunami/Seiche	Low	1	2

5.3. Risk Rating

The risk rating for each hazard was determined by multiplying the assigned numerical value for probability to the weighted numerical value of impact to people added to the weighted numerical value of dollar losses (See Table 5.4). The following equation expresses the risk rating calculation:

Risk Rating = Probability * Impact (people +dollar losses)

Table 5.4: Risk Rating

Hazard Event	Probability	Impact	Total (Probability *Impact)
Earthquake	2	9+6=15	30
Hazardous Materials	3	6+2=8	24
Severe Weather	3	6+2=8	24
Landslides/Sinkholes	2	6+4=10	20
Flooding	2	6+4=10	20
Fire	3	3+2=5	15
Volcano	1	9+4=13	13
Tsunami/Seiche	1	6+2=8	8

The risk ratings were developed to help focus the mitigation strategies to areas that warrant greatest attention. The hazards were given an overall risk rating which ranked them in relation to one another.

The highest risk ratings such as earthquakes, hazardous materials and severe weather warrant major mitigation program with attention to preparedness, response and recovery until the mitigation program has been implemented.

The medium risk ratings such as flooding, landslides/sinkholes and fire warrant modest program effort.

The low risk ratings such as volcano and tsunami/seiche warrant no special mitigation effort although inexpensive or all hazards preparedness, response and recovery measures may be warranted.

6. Capability Assessment

A capability assessment addresses a community's current capacity to address risks from potential hazard events. The City of Shoreline currently has in place several capabilities to reduce the risk associated with hazard events. This includes public outreach, planning, training, communication and several others. Below, a description is provided of Shoreline's general capabilities that apply to all of the eight hazard events. In addition, Table 6.1 presents capabilities that apply specifically to each hazard.

Public Outreach

The City of Shoreline has a page on its city website relating emergency preparedness. This is located at http://www.cityofshoreline.com/cityhall/projects/emergency/index.cfm. Periodically the Police Department publishes an article in the community paper regarding health and safety issues.

Training

Community Emergency Response Team (CERT) classes and Employee Emergency Response Team (EERT) classes are available.

Planning

An Emergency Operations Plan was created in June 2003 for the City of Shoreline. It provides a document that city officials and employees can use in a disaster to determine what the chain of command is, where people should go, and what they should do. The plan requires that each Shoreline City Department provide personnel to staff the Emergency Operations Center (EOC) if necessary. The plan also designates the location of the EOC's. The primary location is the Shoreline Fire Department Headquarter Training and Support Facility and the secondary location is the Shoreline Police Station.

The City of Shoreline has an activated Emergency Management Council, which was established in 1996 by Municipal Code 2.50. The Council provides oversight to emergency management activities and those ordinances, resolutions, contracts, rules and regulations that are necessary for emergency management (City of Shoreline. 2003).

The Shoreline Water District has a section in their comprehensive plan that discusses emergency operations as well as an appendix that is the Shoreline Water District Emergency Response Program. The District has two emergency interties with the City of Mountlake Terrace that could be used if the main supply station is out of service (Shoreline Water District. 2001).

The Shoreline Water District, Ronald Wastewater District and the Fire Department are currently working on hazard mitigation plans using the Mitigation 2020 model in coordination with King County. When completed these plans will be appendices to the King County Hazard Mitigation Plan

The Transportation and Parks Department Master Plans are currently being updated as well as Shoreline's Comprehensive Plan.

The Shoreline Water District has a section in their comprehensive plan that discusses emergency operations as well as an appendix that is the Shoreline Water District Emergency Response Program (ibid).

Communication

The City of Shoreline can request that King County activate the Emergency Alert System, which immediately interrupts television and radio broadcast to warn of an emergency situation and provide necessary instructions.

The City of Shoreline website and Government Access Channel 21 will provide information in emergency situations. This method of providing information is limited by staff time and the availability of electricity and cable.

The City of Shoreline can send official vehicles to make announcements via a public address system. This method would most likely be used for evacuations.

Support following a presidential declaration

There is considerable support for risk reduction measures following a federal disaster declaration. Often these programs and their implications are not taken advantage of before permanent repairs are made. Some of the more significant ones include:

- The Hazard Mitigation Grant Program (HMGP) offers assistance for a wide range of mitigation projects following a presidential declaration. Eligibility is restricted to projects that have gone through a comprehensive hazard mitigation planning process.
- Minimal Repair Program often funds risk reduction such as the anchoring of mobile homes.
- The Small Business Administration will fund eligible mitigation measure to qualified owners of damaged homes.
- Outreach is available through Disaster Reconstruction Assistance Centers (DRACs), Recovery Information Centers or Hazard Mitigation Teams.
- Benefit/Cost Mitigation support is available from FEMA on infrastructure repair. To break the damage-rebuild-damage cycle FEMA Region 10 is encouraging communities to:
    - Institute mitigation betterments taking advantage of multi-hazard, multiobjective approaches whenever possible
    - Strengthen existing infrastructure and facilities to more effectively withstand the next disaster
    - Ensure that communities address natural hazards through comprehensive planning

Following a federal disaster declaration, FEMA can support cost effective mitigation on infrastructure and have published a manual on the subject.

Table 6.1: Shoreline Capabilities Matrix

Hazard	Planning	Codes	Other
Earthquake	In the Shoreline Capital Improvement Plan 2004 to 2009, there is a plan for the Richmond Beach Overcrossing. This involves designing and constructing a concrete bridge to replace the existing, deteriorating timber structure over the Burlington Northern Railroad at Richmond Beach Drive NW and approximately NW 196th St. This bridge provides sole access to 35 homes on 27th Avenue NW.	Shoreline's Municipal Code, Chapter 15.05, Building and Construction Code, adopted as Ordinance 17 in 1995 uses the King County Building Code, which is Title 16 of the King County Code. Of particular interest is 16.06 of KCC, Disaster damage UBC and 16.04.05047 relating to foundation construction.	The Washington State Department of Natural Resources has updated and improved the NEHRP soils map for the state. This improved map identifies the seismic hazard areas in Shoreline.
Hazardous Materials	An Area Contingency Plan was developed by the State Department of Ecology in cooperation with Federal, State and Local agencies. The purpose of the plan is "to provide orderly implementation of response actions to protect the people and natural resources of the states of Washington, Oregon, and Idaho from the impacts of oil or hazardous substances spills". The plan accounts for potential problems from vessels, offshore facilities, onshore facilities or other sources. The Environmental Protection Agency has responsibility for all spills in inland waters. The United States Coast Guard has responsibility for all spills in coastal waters (KCEM. http://www.metrokc.gov/prepare/	Shoreline has a Hazardous Materials Management Plan under the Shoreline Municipal Code chapter 15.10.210 Section 8001.3.2 amended. Section 8001.3.2 has adopted the Uniform Fire Code, 1994 Edition, as published by the International Fire Code Institute. [Ord. 84 § 8.10, 1996] The Emergency Operation Plan cites that Washington Administrative Code (WAC) 296-62-3112 requires that the Incident Command System be used in responses to hazardous materials incidents (City of Shoreline. 2003).	There are currently sixteen hazardous materials response teams in King County. Eight of these are public fire jurisdictions and the Boeing Company operates eight. Private response contractors working with the Environmental Protection Agency and a unit of the Washington State Department of Ecology supplement the hazardous materials teams in King County (KCEM. http://www.metrokc.gov/prepare/docs/RHMP HazmatandRadiation.pdf). Burlington Northern/Santa Fe inspects its tracks frequently

Hazard	Planning	Codes	Other
	docs/RHMPHazmatandRadiation.pdf).		inspects its tracks frequently and has track and landslide sensors to prevent derailment. Foss Environmental Inc is contracted by Shoreline to aide in the event of a hazardous materials release.
Severe Storms	Snow routes are designated by Shoreline. These roads are cleared first to assure that navigable routes exist throughout the city.	Shoreline Municipal Code, Chapter 15.05, Building and Construction Code (Ordinance 17, 1995) refers to the King County Building Code, Title 16 of the King County Code, see especially: 6.04.5046 Roof design - Snow loads. Section 1605.4 of the Uniform Building Code is not adopted and the following is substituted: Snow loads (UBC 1605.4). The "Snow Load Analysis for Washington" Second Edition (1995), published by the Structural Engineers Association of Washington shall be used in determining snow load. Minimum Snow Load shall be 25 pounds per square feet. (Ord. 14111 § 60, 2001: Ord. 12560 § 50, 1996).	Fircrest, CRISTA Ministries, Department of Health Lab, Point Wells, Ronald Wastewater District and the Police Department all have back up generators.
Landslides and Sinkholes	As part of the Growth Management Act, the city is mandated to address steep slopes as a critical area.	Landslide Hazards are dealt with the Shoreline Municipal Code Chapter 20.80, critical areas. See particularly Subchapter 2 (20.80.210- 20.80.250, SMC) Geological Hazard Areas.	Burlington Northern/Santa Fe inspects its tracks frequently and has track and landslide sensors to prevent derailment.

Hazard	Planning	Codes	Other
		Hazard Areas.	
Flooding	Shoreline has Capital Improvement Projects planned or underway seeking to address flooding issues. These typically involve improving the drainage infrastructure. One project is Third Avenue NW Drainage Improvements, which are drainage improvements along Third Avenue NW that will reduce flooding for more than 20 homes in the area. Another project is the 5th Avenue NE Street Improvements Project (175th St TO 185th St). This project will design and construct a 36 foot two lane street with bike lanes, sidewalks, landscaping, illumination, and drainage that eliminates City flows to the private Pump 25 pond and reduces Ronald Bog flooding. Drainage improvements on NE 180th Street may be included. The city also has a project for Ronald Bog Drainage improvements. The Ronald Bog Preferred Solutions were adopted by City Council in 2001. These are a	Shoreline Municipal Code Chapter 16.12 Flood Damage Prevention (ordinance 115, 1997). Shoreline's Municipal code, Chapter 20.80 critical areas deals with development in Floodplains. Particularly important is Subchapter 5, Flood Hazard Areas (20.80.360-20.80.410 SMC).	

Hazard	Planning	Codes	Other
	Ballfield/detention facility at Cromwell Park, an open stream channel south of Ronald Bog along Corliss Avenue N, watercourse improvements north of 167th Street along Corliss Place, stormwater conveyance line along Serpentine Avenue, and improvement to Pump Station #25 (2nd Place and 178th Street). Short-term improvements were completed in 2003. The City of Shoreline is in the process of developing a Surface Water Master Plan that will evaluate and recommend solutions for flooding problems and drainage issues throughout the City. The City of Shoreline Public Works Department is currently in the process of creating a Surface Water Management Plan, which is proposed to be completed in June of 2004.		
Fire	In the Shoreline Capital Improvement Plan 2004 to 2009 there is a plan for the Interurban Trail Development. This is a 3.25 mile trail project that includes construction of a pedestrian, bicycle trail including a small parking lot and trail head from North 145th to North 205th Streets primarily along the Seattle City Light power transmission right of	Shoreline Municipal Code Chapter 15.10 is the Fire Code Shoreline Municipal Code 20.30.750, Declaration of Public Nuisance, enforcement says: Code violations detrimental to the public health, safety and environment are hereby declared public nuisances. All conditions determined to be	Fire Department outreach training to the public.

Hazard	Planning	Codes	Other
	City Light power transmission right of way. This will help keep a hazard area maintained which will reduce the potential for fire.	public nuisances shall be subject to and enforced pursuant to the provisions of this subchapter except where specifically excluded. Nuisance vegetation is listed as a public nuisance and all conditions defined as public nuisances shall be subject to abatement under this subchapter. (Ord. 251 § 2(E), 2000; Ord. 238 Ch. III § 10(d), 2000).	
Volcano	Currently nothing in place	Shoreline Municipal Code, Chapter 15.05, Building and Construction Code (Ordinance 17, 1995) This refers to the King County Building Code, Title 16 of the King County Code, see especially: 16.04.5046 Roof design - Snow loads. Section 1605.4 of the Uniform Building Code is not adopted and the following is substituted: snow loads (UBC 1605.4). The "Snow Load Analysis for Washington" Second Edition (1995), published by the Structural Engineers Association of Washington shall be used in determining snow load. Minimum Snow Load shall be 25 pounds per square feet. (Ord. 14111 § 60, 2001: Ord. 12560 § 50, 1996). Buildings codes relating to roof capacities for snow can also be considered a	Since all Northwest volcanoes are in a regular seismic zone, tremors are monitored by the USGS and the University of Washington Seismology Lab.

Hazard	Planning	Codes	Other
		capability for ash falls.	
Tsunami	Currently nothing in place	Currently nothing in place	

6.1. Bibliography

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7. Plan Goals and Objectives

This section defines the general outcomes that can be expected as a result of successful implementation of this plan. Plan goals are broad statements describing the principles that guide the actions suggested in this document. The plan goals below were developed based on the outcome of Planning Meeting #1, the Risk Assessment and the goals and objectives defined in the City of Shoreline Comprehensive Plan, the Shoreline City Council Strategic Plan, the City of Shoreline Operations Plan, the City of Shoreline Emergency Support Functions and the City of Shoreline Information Technology Strategic Plan.

Plan objectives are more targeted statements that define strategies and implementation steps to attain the goals. Specific mitigation actions will be defined in Section 8, and will describe how the goals and objectives outlined here should be implemented. The specific strategies that meet each objective are listed here to enable cross-referencing between sections 7 and 8.

The goals in this plan were designed to support those defined in City of Shoreline Comprehensive Plan, the Shoreline City Council Strategic Plan, the City of Shoreline Operations Plan, the City of Shoreline Emergency Support Functions and the City of Shoreline Information Technology Strategic Plan.

This section demonstrates how the hazard mitigation goals support many of the comprehensive and strategic plan goals and the interconnectedness of these separate planning efforts.

7.1. Goals and Objectives

Goal 1: Protect public health, welfare, and public safety

There is no more important goal for this hazard mitigation plan than to protect the people who live in Shoreline, their homes, their businesses and the infrastructure that serves them. Since individuals must undertake many forms of mitigation in their homes, it is crucial that the general public be made aware of the findings in the risk assessment in this document. Increasing public knowledge of potential hazards can save lives and property.

Objective 1.1: Increase public awareness of hazards

Mitigation strategies that achieve this objective:
M-2, M-8, M-22

Related Goals and Objectives:

Strategic Plan Goal 1—Effective Community Relations and Communications:
Better informed residents about how the City operates, what projects the City is working

on, pros and cons of City issues and how they can take part in the City's decision-making process

Strategic Plan Goal 2—Effective Community Relations and Communications: Provide residents and businesses accurate and timely information in a way that is convenient to them.

Emergency Operations Plan Mission: To minimize loss of life; protect property and natural resources; and restore the proper operation of the City in the event of a major natural or technological disaster.

Emergency Support Function #4—Emergency Public Information: Provide dissemination of prompt, accurate emergency information to the public and the media during emergency and disaster situations.

Information Technology Strategic Plan—Objective #10: Improve City stakeholder access to useful information and key business data to facilitate decision-making and improved citizen communications through the use of user-friendly web applications via the City's website.

Objective 1.2: Encourage involvement of community in risk reduction programs

Mitigation strategies that achieve this objective:
M-6, M-13, M-23

Related Goals and Objectives:

Comprehensive Plan Goal 9—Other Goals: Continue to welcome citizen involvement in community planning decisions.

Strategic Plan Goal 2—Community Alliances and Partnerships: Promote successful partnerships in the community by bringing partners together to develop and implement shared goals.

Strategic Plan Goal 4—Community Alliances and Partnerships: Strengthen and celebrate relationships among private and public sector organizations.

Emergency Operations Plan Mission: To minimize loss of life; protect property and natural resources; and restore the proper operation of the City in the event of a major natural or technological disaster.

Goal 2: Minimize losses to existing and future properties

It is important to implement mitigation measures that will minimize the loss to existing properties as well as mitigate the development that is going to happen in the future. Programs and initiatives can be critical in successfully mitigating against hazards.

Objective 2.1: Support programs and initiatives to reduce risk to property and the surrounding environment

Mitigation strategies that achieve this objective:
M-10, M-25, M-27, M-28

Related Goals and Objectives:

Strategic Plan Goal 1—Healthy, Vibrant Neighborhoods: Provide safe, secure and attractive neighborhoods for residents, motorists and pedestrians.

Strategic Plan Goal 3—Healthy, Vibrant Neighborhoods: Provide and maintain excellent public utilities and infrastructure for each neighborhood.

Emergency Operations Plan Mission: To minimize loss of life; protect property and natural resources; and restore the proper operation of the City in the event of a major natural or technological disaster.

Objective 2.2: Support programs and initiatives to reduce risk in residential, commercial, and governmental structures, especially those prone to hazards

Mitigation strategies that achieve this objective:
M-5, M-9, M-11, M-14

Related Goals and Objectives:

Strategic Plan Goal 1—Healthy, Vibrant Neighborhoods: Provide safe, secure and attractive neighborhoods for residents, motorists and pedestrians.

Strategic Plan Goal 3—Healthy, Vibrant Neighborhoods: Provide and maintain excellent public utilities and infrastructure for each neighborhood.

Emergency Operations Plan Mission: To minimize loss of life; protect property and natural resources; and restore the proper operation of the City in the event of a major natural or technological disaster.

Objective 2.3: Support upgrades to critical infrastructure and facilities

Mitigation strategies that achieve this objective:
M-4, M-7

Related Goals and Objectives:

Comprehensive Plan Goal 7—Public safety, Capital Facilities, Utilities, and Parks: Assure public services, facilities, and utilities as our community grows.

Strategic Plan Goal 3—Healthy, Vibrant Neighborhoods: Provide and maintain excellent public utilities and infrastructure for each neighborhood.

Emergency Operations Plan Mission: To minimize loss of life; protect property and natural resources; and restore the proper operation of the City in the event of a major natural or technological disaster.

Goal 3: Encourage coordination and communication amongst public and private organization

When there is coordination and communication amongst public and private organizations on emergency preparedness, response, recovery and mitigation measures it will allow these groups to work efficiently together to ensure risks and impacts from a disaster event are reduced.

Objective 3.1: Encourage organizations, businesses, and local governmental agencies within community and region to develop partnerships

Mitigation strategies that achieve this objective:
M-15, M-16, M-18, M-19, M-20

Related Goals and Objectives:

Strategic Plan Goal 2—Community Alliances and Partnerships: Promote successful partnerships in the community by bringing partners together to develop and implement shared goals.

Strategic Plan Goal 4—Community Alliances and Partnerships: Strengthen and celebrate relationships among private and public sector organizations.

Emergency Operations Plan Mission: To minimize loss of life; protect property and natural resources; and restore the proper operation of the City in the event of a major natural or technological disaster.

Objective 3.2: Promote consistencies in communication, plans and policies to facilitate coordination between all involved groups

Mitigation strategies that achieve this objective:
M-1

Related Goals and Objectives:

Strategic Plan Goal 2—Community Alliances and Partnerships: Promote successful partnerships in the community by bringing partners together to develop and implement shared goals.

Strategic Plan Goal 4—Community Alliances and Partnerships: Strengthen and celebrate relationships among private and public sector organizations.

Emergency Support Function #3—Community and Warning: Organize, establish and maintain the communications capabilities necessary to meet the operation requirements for response to disasters and emergencies and provide guidance regarding the dissemination of warning information.

Emergency Operations Plan Mission: To minimize loss of life; protect property and natural resources; and restore the proper operation of the City in the event of a major natural or technological disaster.

Goal 4: Ensure continuity of critical facilities and corresponding operations of local government

During and after a disaster it is important the critical facilities and corresponding operations of local government are properly functioning so that the City can adequately respond to the event.

Objective 4.1: Support redundancy of critical government functions

Mitigation strategies that achieve this objective:
M-12, M-21

Related Goals and Objectives:

Information Technology Strategic Plan—Objective #16: Ensure that the City can successfully recover its information systems and critical business operations in the aftermath of a disastrous event.

Emergency Operations Plan Mission: To minimize loss of life; protect property and natural resources; and restore the proper operation of the City in the event of a major natural or technological disaster.

Objective 4.2: Promote use of new technology in critical operations

Mitigation strategies that achieve this objective:
M-3, M-24, M-26

Related Goals and Objectives:

Comprehensive Plan Goal 2—Land Use: Promote development, which is aesthetic and compatible with the surrounding built and natural environments.

Information Technology Strategic Plan—Objective #4: Enhance the City's capability to manage and report on infrastructure components such as roads, storm sewers, park land, and wetlands (surface water inventories).

Emergency Operations Plan Mission: To minimize loss of life; protect property and natural resources; and restore the proper operation of the City in the event of a major natural or technological disaster.

Goal 5: Protect and promote environmental quality

Healthy natural systems are important to this plan for several reasons. First, when ecosystems are healthy, they can provide protection from natural hazards. Second, natural systems can also be damaged through disasters. Toxic materials releases and sediment loading from landslides or flooding can damage the ecosystems that are important to the quality of life for Shoreline residents.

Objective 5.1: Encourage low impact development

Mitigation strategies that achieve this objective:
M-17

Related Goals and Objectives:

Comprehensive Plan Goal 2—Land Use: Promote development, which is aesthetic and compatible with the surrounding built and natural environments.

Comprehensive Plan Goal 5—Natural Environments/Shoreline: Preserve and enhance natural environment for wildlife habitat, natural systems, and community enjoyment.

Emergency Operations Plan Mission: To minimize loss of life; protect property and natural resources; and restore the proper operation of the City in the event of a major natural or technological disaster.

8. Mitigation and Implementation Strategies

This section describes an action plan to reduce risk and loss from future hazard events in the City of Shoreline. The specific projects are listed in the pages that follow. Mitigation strategies were defined and prioritized primarily through a formalized workshop process with stakeholder committee members. The team devised a dot exercise to allow the stakeholders to prioritize the mitigation strategies (See Appendix A). The results were summed and the mitigation strategies were ranked according to the results. Some of the mitigation strategies received the same scores or a score of 0. The team then prioritized the tied mitigation strategies and those receiving a score of 0 by determining which mitigation strategies were most important for the life and safety of Shoreline residents. The planning team verified the results of this process through interviews with knowledgeable local officials and technicians. The mitigation strategies are listed below in order of priority.

Though the strategies here have been ranked through the process described above, a benefit to cost analysis will be completed as part of the project development process, using Federal Emergency Management Agency (FEMA) approved Benefit Cost Methods. (See Appendix B for more information about these methods).

It is also important to note that some of the mitigation strategies suggested below are more accurately defined as response and recovery actions rather than pure mitigation. These items convey recommendations that support the goals and objectives of this plan and are crucial to the life safety of Shoreline residents. These recovery and response items are designated as such in the strategies below. At this time, alternative strategies that would be purely mitigation cannot be recommended because they are not cost beneficial. Mitigation grant funds may not be available for response or recovery items, but they are, nonetheless, important to achieving the overall objectives of this plan.

Definitions

Associated Hazards: Each mitigation strategy is related to one or more of the hazards that could affect Shoreline.

Funding Source: This offers suggestions on potential financial resources for implementing the mitigation strategy. This includes funding from government agencies as well as various different types of grants.

Implementation Cost: This is the approximate amount that the strategy will cost to implement.

Implementation Strategy: Each mitigation strategy includes ideas to implement and accomplish the specific project.

Lead Agency: This is the agency or agencies that will organize resources, find appropriate funding or oversee project implementation, monitoring and evaluation.

Problem/Opportunity: This describes either a problem or possible opportunity to reduce risk.

Related Goal and Objective: Each mitigation strategy is related to a Goal and Objective listed in Section 7.

Timeline: This estimates the amount of time it will take to begin implementation of each strategy. Under timeline there are three categories, short term, long term and ongoing.

- Short Term: the mitigation strategy will be implemented in years 1 to 2.
- Long Term: the mitigation strategy will be implemented in years 3 to 5.
- Ongoing: the mitigation strategy will be implemented in years 1 to 5 and will continue into the future indefinitely.

M-1: Create a full time position in the City of Shoreline for an Emergency Management Coordinator.

Problem/Opportunity: An Emergency Management Coordinator would coordinate mitigation strategies created in this plan.

Implementation Strategy: Employ an Emergency Management Coordinator to administer mitigation actions throughout the City of Shoreline. Some strategies the coordinator would work with include:

- Coordinate the monitoring, maintenance and updating of the Shoreline Hazard Mitigation Plan.
- Develop and coordinate the City's emergency management and emergency preparedness programs.
- Plan, oversee and provide training in all aspects and phases of emergency management.
- Coordinate annual updates of the City's Comprehensive Emergency Plan.
- Organize partnerships among business, industry and local government.
- Initiate public awareness and education campaigns for all hazards.
- The coordinator would implement mitigation strategies M-2, M-3, M-4, M-5, M-6, M-8, M-9, M-11, M-12, M-13, M-14, M-15, M-16, M-18, M-19, M-20, M-21, M-22 and M-23.

Lead Agency: City Manager's Office

Funding Source: Shoreline Operating Budget

Implementation Cost: $75,000

Timeline: Short Term

Associated Hazards: All Hazards

Related Goal and Objective: Goal 3, Objective 3.2

M-2: Create a community wide comprehensive education program to educate the public about hazards and hazard mitigation.

Problem/Opportunity: One of the most important elements to mitigation is awareness. Residents are often unaware of the risk of hazards and what actions to take during a disaster event. Public awareness programs can provide information about mitigation measures for different hazards as well as preparedness, response and recovery measures after a disaster event. During and after a hazard event, emergency responders may be either overwhelmed with emergency calls or unable to access some residents. This means that it is important that individual households are prepared for an event and have the ability to support themselves for a period of time while emergency responders deal with more immediate and life-threatening situations.

Implementation Strategy: The education program should be an ongoing program that is devoted to increasing the public's awareness of what hazards affect Shoreline and what can be done to mitigate these hazards and their effects. Following a disaster event, there should be extra efforts to provide the public with information about disaster preparedness and mitigation measures. Generally, the public is very receptive to this type of information at this time. The Emergency Management Coordinator outlined in M-1 could implement this strategy. Some of the measures that should be taken to educate the public are:

- Evaluate success of current public education efforts.
- Develop and index a mitigation/preparedness packet for the public and for the media for each type of hazard affecting Shoreline.
- Draft a campaign strategy to effectively distribute information about hazards and hazard mitigation.
- Create a link on the city's web page that is specifically devoted to providing current information about hazards and hazard mitigation. This would include static information about existing hazards and up-to-date information on disaster events affecting Shoreline. For example, there could be information about what to do during an earthquake as well as information about a specific flood event currently occurring in Shoreline.
- Maintain sufficient fund balance earmarked for advertising and public service announcements (PSA).
- Develop and implement workshops and training programs that address specific issues related to the hazards affecting Shoreline. An example would be providing a workshop on how to non-structurally retrofit buildings in order to minimize loss from an earthquake.

Lead Agency: Police Department

Funding Source: Shoreline Operating Budget, Emergency Management Performance Grant (EMPG), Hazards Mitigation Grant Program (HGMP), Pre-Disaster Mitigation Program

Implementation Cost: The initial cost would be about $50, 000 and would include the material assembly, printing and distribution. The continuing cost would be about $20,000 per year and would include development and implementation of workshops and training programs. Included in this cost would be mitigation strategies M-22, M-8, M-23, M-13, M-14 and portions of M-9 and M-5.

Timeline: Ongoing

Associated Hazards: All Hazards

Related Goal and Objective: Goal 1, Objective 1.1

M-3: Create and maintain a partnership with utility providers to ensure that the utility infrastructure serving Shoreline is retrofitted or built to standards that make them less vulnerable in a hazard event including critical infrastructure protection.

Problem/Opportunity: Utility infrastructure in Shoreline may be at risk to failure during or after an event. There are methods of retrofitting or building to a certain standard that will reduce the risk of failure.

Implementation Strategy: The Emergency Management Coordinator outlined in M-1 could implement this strategy.

- Develop a contact at each of the utility providers in Shoreline so that the city can stay updated about what is being done to reduce risk.
- Jointly analyze high-risk areas and develop mitigation strategies that address the risk. Initial focus should be given to infrastructure in NEHRP E soils.
- Maintain contact and work with utility providers to ensure that the utility infrastructure is retrofitted or built to standards that make them less vulnerable in a hazard event.

Lead Agency: Public Works

Funding Source: Shoreline Operating Budget

Implementation Cost: No significant additional cost for Shoreline

Timeline: Ongoing

Associated Hazards: All Hazards

Related Goal and Objective: Goal 4, Objective 4.2

M-4: Create and maintain a partnership with Washington State Department of Transportation (WSDOT) to ensure that the I-5 overpasses located in Shoreline are retrofitted to current seismic standards within a reasonable time frame.

Problem/Opportunity: Interstate 5 has four bridges at N 145th Street, N 155th Street, N 175th Street and N 185th Street that were built about 1963-64 when there was no consideration given to seismic design. The four I-5 bridges in Shoreline mentioned above are on the Washington State Department of Transportation (WSDOT) 05-07-biennium seismic retrofit recommendation list. However, due to lack of funding these bridges may not be retrofitted for another 8 to 10 years. Although not mentioned in the Shoreline Hazard Inventory Vulnerability Assessment as vulnerable due to seismic design, the overpasses at N 165th Street and N 205th Street should be considered when working with the WSDOT. There is also a WSDOT pedestrian bridge at N 195th Street that should be evaluated for seismic design.

Collapse of these bridges could potentially split the city in half, isolating sections from essential services such as fire and police.

Implementation Strategy: The Emergency Management Coordinator outlined in M-1 could implement this strategy.

- Develop a contact at WSDOT so that the city can stay updated about when the overpasses will be retrofitted and any delays that might occur.
- Maintain contact and work with WSDOT to ensure that the I-5 overpasses in Shoreline are retrofitted to current seismic standards within a reasonable time frame.

Lead Agency: City Manager's Office

Funding Source: Shoreline Operating Budget

Implementation Cost: No significant additional cost for Shoreline

Timeline: Long Term

Associated Hazards: Earthquakes

Related Goal and Objective: Goal 2, Objective 2.3

M-5: Implement non-structural retrofitting in city facilities and provide incentives for non-structural retrofitting for privately owned structures throughout the city.

Problem/Opportunity: Most injury and business loss is due to non-structural damage such as toppling shelves and hazardous material spills. These are largely preventable through relatively simple, non-structural measures.

Implementation Strategy: Incentives could be monetary or non-monetary. Non-monetary incentives could include providing information and\or training about how to implement non-structural retrofitting. The Emergency Management Coordinator outlined in M-1 could implement this strategy.

- Coordinate assessments of non-structural hazards for city facilities.
- Prioritize the order by which city facilities should be non-structurally retrofitted.

- Implement non-structural retrofitting in city facilities using the prioritization list.
- Provide education and training about non-structural hazards and non-structural retrofitting for critical facilities, schools, health care facilities, residences and businesses. Initial focus should be given to facilities on NEHRP D and E Soils.
- Apply for grants that could provide funding for non-structural retrofitting.

Lead Agency: Public Works Department

Funding Source: Shoreline Operating Budget

Implementation Cost: For non-structural assessment and non-structural retrofitting of city facilities the cost would be about $25,000. The education and training component is included in the cost of M-2.

Timeline: Ongoing

Associated Hazards: Earthquakes

Related Goal and Objective: Goal 2, Objective 2.2

M-6: Identify critical community facilities and infrastructure that are without back up power generators.

Problem/Opportunity: Hazard events frequently cause power outages and create disruptions to the operation of important community facilities. In some cases, power outages can be life threatening for those who are on life support or otherwise require electricity for basic life functions. It is especially important that facilities designated as emergency shelters have back up power generators. Back up power generators supply the needed electricity to maintain operations until the power supply is restored.

Implementation Strategy: The Emergency Management Coordinator outlined in M-1 could implement this strategy.

- Identify the critical community facilities and infrastructure within the city that currently do not have back up power capacity.
- Provide incentives for facilities and infrastructure without backup power so that they acquire a source of back up power sufficient to maintain necessary operations. Examples of incentives are:
- Providing information on the importance of a back up power source.
- Work with utility providers as a possible funding source.

Lead Agency: Police Department

Funding Source: Shoreline Operating Budget

Implementation Cost: No significant additional cost to Shoreline

Timeline: Short Term

Associated Hazards: All Hazards

Related Goal and Objective: Goal 1, Objective 1.2

M-7: Identify and assess critical and essential city infrastructure and facilities.

Problem/Opportunity: Throughout the City of Shoreline there are critical and essential city infrastructure and facilities that must be functioning during and immediately after a disaster. These include transportation infrastructure such as retaining walls and bridges and facilities such as shelters and critical city facilities. In order to assure that these are functioning during or after a disaster, they must be identified and assessed to determine if any new infrastructure or facilities are needed or if mitigation can reduce the risk from disasters.

Implementation Strategy:

- Identify critical and essential city infrastructure and facilities.
- Analyze critical and essential city infrastructure and facilities and determine problem areas.
- Prioritize critical and essential city infrastructure and facilities that need mitigation.

Lead Agency: Public Works

Funding Source: Shoreline Operating Budget

Implementation Cost: No significant additional cost for Shoreline

Timeline: Ongoing

Associated Hazards: All Hazards

Related Goal and Objective: Goal 2, Objective 2.3

M-8: Assure that the public is informed of the necessity of maintaining a 3 day supply of food and water, along with basic first aid and medical supplies.

Problem/Opportunity: During and after a hazard event, emergency responders may be either overwhelmed with emergency calls or unable to access some residents. It is important that individual households are prepared for a period of self-sufficiency while responders deal with more immediate and life-threatening situations. Assuring that the public is informed of the necessity of maintaining a 3 day supply is a preparedness measure that must be implemented until mitigation measures can be implemented that appropriately address the issue of isolation.

Implementation Strategy: Educate the public about the necessity of maintaining a 3-day supply for emergencies. The Emergency Management Coordinator outlined in M-1

could implement this strategy. Some important elements of maintaining a 3-day supply are:

- A three-gallon supply of water per person stored in sealed, unbreakable containers.
- A supply of non-perishable packaged or canned food and a non-electric can opener.
- A first aid kit and prescription medications.
- A battery-powered radio, flashlight and plenty of extra batteries.
- To implement this program refer to M-2, which describes the methodology of how to distribute information community wide.

Lead Agency: Police Department

Funding Source: Shoreline Operating Budget, Emergency Management Performance Grant (EMPG)

Implementation Cost: Included in M-2

Timeline: Ongoing

Associated Hazards: All Hazards

Related Goal and Objective: Goal 1, Objective 1.1

M-9: Provide incentives for voluntary structural retrofitting of older structures on vulnerable soils.

Problem/Opportunity: It is estimated that there are 3,759 structures built on NEHRP D soils and 57 structures built on NEHRP E soils built before 1972 that are at risk to being jolted off of their foundation during an earthquake. Existing homes can be anchored to their foundations for a cost between $1,000 and $5,000 depending on whether the basements or crawl spaces are unfinished and who conducts work. For example, in Seattle, homeowners have voluntarily retrofitted over 1,000 homes.

Implementation Strategy: Incentives could be monetary or non-monetary. Non-monetary incentives could include providing information and\or training about how to implement structural retrofitting of older structures. The Emergency Management Coordinator outlined in M-1 could implement this strategy.

- Evaluate and record the construction material of the structures on NEHRP D and E soils built before 1972. Initial focus should be given to structures on E soils built before 1972.
- Provide information and training about structural retrofitting for property owners with structures located on NEHRP D and E soils. Initial focus should be given to structures on E soils built before 1972.

- Apply for grants that could provide funding for structural retrofitting of older structures on vulnerable soils.
- It is possible that some structures cannot be retrofitted due to construction material and type. The owners of these structures should be provided with information about the risk resulting from potential earthquakes.

Lead Agency: Planning and Development Services Department, Public Works

Funding Source: Department of Homeland Security (DHS)/FEMA funding for cost-effective projects, Shoreline Operating Budget

Implementation Cost: The City should apply for a grant that would allow for retrofitting. The amount needed would be about $250,000. This would allow for about $5,000 for each of the 57 structures located on NEHRP E Soils built before 1972. The education and training component is included in M-2.

Timeline: Long Term

Associated Hazards: Earthquake

Related Goal and Objective: Goal 2, Objective 2.2

M-10: Improve\expand storm water drainage, dams, detention and retention system capabilities.

Problem/Opportunity: Flooding in Shoreline is related to inadequate capacity in the water system and the large amount of impervious surfaces. During and after heavy rains there has been flooding of roadways, yards and driveways and several structures.

Implementation Strategy:

- Analyze reports of flooding from past years and determine problem areas.
- Determine if drainage, dams, detention and retention system capabilities are adequate in these areas.
- Prioritize areas that need the drainage, dams, detention and retention system capabilities expanded.
- Begin expanding the drainage, dams, detention and retention system capabilities in the order of prioritization.
    - Refer to M-17 for low impact development measures that can be taken to address this problem.

Lead Agency: Public Works Department

Funding Source: Shoreline Capital Improvement Budget, Hazards Mitigation Grant Program (HGMP), Pre-Disaster Mitigation Program

Implementation Cost: No significant additional cost for the analysis. Expansion costs cannot be determined until the analysis is completed.

Timeline: Long Term

Associated Hazards: Flooding

Related Goal and Objective: Goal 2, Objective 2.1

M-11: Identify critical city facilities and infrastructure and acquire back up power generators for those currently without.

Problem/Opportunity: Hazard events frequently cause power outages and create disruptions to the operation of important city facilities. In some cases, power outages can cause city operations to be unable to function as necessary. Back up power generators supply the needed electricity to maintain operations until the power supply is restored.

Implementation Strategy: The Emergency Management Coordinator outlined in M-1 could implement this strategy.

- Identify critical city facilities that currently do not have back up power capacity.
- Prioritize the list of critical city facilities that do not have back up power capacity by which facilities are most important in maintaining the critical functions of Shoreline.
- Acquire a source of back up power sufficient to maintain necessary operations for these city facilities using the prioritization list.

Lead Agency: Public Works Department

Funding Source: Shoreline Operating Budget

Implementation Cost: For the assessment, there is no significant additional cost for Shoreline. There is no way to determine the cost for acquisition of back up generators until it is determined how many facilities need back up power generators.

Timeline: Short Term

Associated Hazards: All Hazards

Related Goal and Objective: Goal 2, Objective 2.3

M-12: Identify critical government functions and establish backup operations for these functions.

Problem/Opportunity: During and immediately after a disaster it is important that critical government functions continue to operate. It is important that there is backup operations so that if a function is disrupted it can be preformed at an alterative location or through an alternative department.

Implementation Strategy: The Emergency Management Coordinator outlined in M-1 could implement this strategy.

- Identify critical government functions and services and assess where backup operations are needed.
- Conduct exercises that test functionality during extended periods of isolation.
- Develop contingency plans for essential and critical services such as:
    - Temporary relocation
    - Out-of-area mutual aid
    - Offsite storage of critical work files
    - Offsite capabilities for critical information technology (IT) systems
    - Employee/family preparedness
    - Emergency communications and transportation systems
    - Emergency supplies that may be needed after a disaster

Lead Agency: City Manager's Office

Funding Source: Shoreline Operating Budget

Implementation Cost: No significant additional cost to Shoreline

Timeline: Long Term

Associated Hazards: All Hazards

Related Goal and Objective: Goal 4, Objective 4.1

M-13: Educate homeowners, developers and business owners about how to reduce impacts of urban flooding.

Problem/Opportunity: In Shoreline, the large amount of impervious surfaces prevents natural absorption of rainwater and increases urban flooding. Urban flooding is the main flooding concern in Shoreline and homeowners, developers and business owners can take measures to reduce this problem.

Implementation Strategy: Provide education for homeowners, developers, and business owners about specific measures that can be taken to reduce urban flooding. The Emergency Management Coordinator outlined in M-1 could implement this strategy.

Some measures to reduce impacts of urban flooding are:

- Adopt-A-Storm-Drain: By adopting nearby storm drains and cleaning them out when they become covered with debris, private homeowners, developers and business owners can reduce urban flooding. By clearing the storm drain, it will allow the storm drains to collect water at full capacity.
- Low Impact Development: Low impact development has the potential to alleviate the adverse impacts of urban flooding. Two examples of low impact development are:

- Depression Gardening: When possible, homeowners should use the lowest point on their property for planting a garden. The garden will absorb water and stay green while reducing surface water flow.
- Rain Barrels: By using rain barrels, homeowners can collect rain from their roof. Rain barrels keep the ground from becoming oversaturated as a result of heavy rains and create a free water source for use around the yard during summer months.
- For other examples of low impact development refer to M-17.

To implement this program refer to M-2, which describes the methodology of how to distribute information community wide.

Lead Agency: Public Works Department

Funding Source: Shoreline Operating Budget

Implementation Cost: Included in M-2

Timeline: Ongoing

Associated Hazards: Flooding

Related Goal and Objective: Goal 1, Objective 1.2

M-14: Provide incentives for non-structural retrofitting of hazardous materials containment throughout the city.

Problem/Opportunity: The greatest damage from an earthquake may be to non-structural building elements such as hazardous materials containment. Retrofitting of non-structural elements is a simple, inexpensive method to help prevent hazardous material damages during an earthquake. An example would be securing propane tanks or other fuel containers to a wall or to the ground.

Implementation Strategy: Incentives could be monetary or non-monetary. Non-monetary incentives could include providing information and\or training about how to implement non-structural retrofitting of hazardous materials containment. The Emergency Management Coordinator outlined in M-1 could implement this strategy.

- Provide education and training about non-structural hazards and non-structural retrofitting for facilities containing hazardous materials. Initial focus should be given to facilities on NEHRP D and E Soils.
- Apply for grants that could provide funding for non-structural retrofitting of hazardous materials containment.

Lead Agency: Public Works Department

Funding Source: Shoreline Operating Budget, Hazards Mitigation Grant Program (HGMP), Pre-Disaster Mitigation Program

Implementation Cost: Included in M-2.

Timeline: Ongoing

Associated Hazards: Earthquakes, Hazardous Materials

Related Goal and Objective: Goal 2, Objective 2.2

M-15: Create and maintain a partnership between City of Shoreline Emergency Services and Washington State Public Health Laboratories so there is coordination during and immediately after a disaster.

Problem/Opportunity: The Washington State Public Health Laboratories is located on the Fircrest campus. The lab has a fairly sizeable number, but in small quantities, of individual chemicals. During a disaster, especially earthquake, chemicals may be accidentally released and can cause harm to the surrounding population and environment.

Implementation Strategy: The Emergency Management Coordinator outlined in M-1 could implement this strategy.

- Develop a contact person for the City of Shoreline as well as the Washington State Public Health Laboratories so that there is an ongoing dialog between the two agencies.
- Work together on emergency preparedness, response, recovery and mitigation measures so that in the event of a disaster the City of Shoreline Emergency Services and the Washington State Public Health Laboratories can work efficiently together to ensure impacts from the event are reduced.

Lead Agency: Police Department

Funding Source: Shoreline Operating Budget

Implementation Cost: No significant additional cost for Shoreline

Timeline: Ongoing

Associated Hazards: Earthquakes and Hazardous Materials

Related Goal and Objective: Goal 3, Objective 3.1

M-16: Create and maintain partnerships with educational and care facilities.

Problem/Opportunity: Within the City of Shoreline there are several educational and care facilities that are both publicly and privately operated. By creating a partnership between the City of Shoreline and these facilities there can be coordination in implementing mitigation measures that can reduce the risk to the community.

Implementation Strategy: The Emergency Management Coordinator outlined in M-1 could implement this strategy.

- Identify the educational and care facilities within the City of Shoreline.

- Develop a contact person for the City of Shoreline and from these facilities so that there is an ongoing dialog.
- Work together on emergency preparedness, response, recovery and mitigation measures so that in the event of a disaster the City of Shoreline and these facilities can work efficiently together to ensure that impacts from the event are reduced.

Lead Agency: Police Department

Funding Source: Shoreline Operating Budget

Implementation Cost: No significant additional cost for Shoreline

Timeline: Ongoing

Associated Hazards: All Hazards

Related Goal and Objective: Goal 3, Objective 3.1

M-17: Institute low impact development regulations for new developments as well as re-development projects.

Problem/Opportunity: Impervious surfaces, such as sidewalks, driveways, or foundations do not allow water to filter through the ground but instead water drains quickly into storm water management systems. This situation increases the risk of flooding and adds sediment and toxins to runoff. Low impact development has the potential to alleviate these adverse impacts through the creation of appropriately placed green space, landscaping, grading, streetscapes, roads and parking lots. Low impact development can achieve multifunctional objects and help to reduce storm water impacts, and provide and maintain the beneficial hydrologic functions of a natural drainage system.

Implementation Strategy: Develop city regulations and guidelines that implement low impact development objectives to:

- Minimize impacts to the extent practicable by reducing imperviousness, conserving natural resources and ecosystems, maintaining natural drainage courses, reducing the use of pipes and minimizing clearing/grading.
- Recreate detention and retention storage so that water is dispersed and evenly distributed throughout a site. This can be done with the use of open swales, gentler slopes, depressions, storage rain gardens (bio-retention), water use (rain barrels) and others.
- Strategically route water flows to maintain predevelopment travel times.
- Provide effective public education and socioeconomic incentives to ensure property owners use effective pollution prevention measures and maintain water management measures.

Lead Agency: Planning & Development Services Department

Funding Source: Shoreline Operating Budget**,** Shoreline Capital Improvement Budget

Implementation Cost: No significant additional cost to Shoreline.

Timeline: Ongoing

Associated Hazards: Flooding

Related Goal and Objective: Goal 5, Objective 5.1

M-18: Create and maintain a partnership between the City of Shoreline and the Shoreline Fire Department so that there is coordination in implementing mitigation measures as well as coordination during and immediately after a disaster.

Problem/Opportunity: The Shoreline Fire Department is a special district serving the City of Shoreline. The Shoreline Fire Department is a valuable resource and may be able help implement mitigation measures dealing with wildland fire. The Fire Department also takes part in emergency preparedness, response and recovery. Coordination with the City of Shoreline can ensure impacts from a disaster event are reduced.

Implementation Strategy: The Emergency Management Coordinator outlined in M-1 could implement this strategy.

- Develop a contact person for the City of Shoreline as well as the Shoreline Fire Department so that there is an ongoing dialog between the two agencies.
- Work together on emergency preparedness, response, recovery and mitigation measures so that in the event of a disaster the City of Shoreline and the Shoreline Fire Department can work efficiently together to ensure that impacts from the event are reduced.

Lead Agency: Police Department

Funding Source: Shoreline Operating Budget

Implementation Cost: No significant additional cost for Shoreline

Timeline: Ongoing

Associated Hazards: All Hazards

Related Goal and Objective: Goal 3, Objective 3.1

M-19: Create and maintain a partnership between the City of Shoreline and the Shoreline School District so that there is coordination in implementing mitigation measures as well as coordination during and immediately after a disaster.

Problem/Opportunity: The Shoreline School District is a special district serving the City of Shoreline. By creating a partnership between the City of Shoreline and the Shoreline School District there can be coordination in implementing mitigation measures

that can reduce the risk to School District employees as well as the children who attend the schools. Also, School District Buildings are a valuable resource for disaster shelters and in the past have been utilized as shelters. Creating this partnership can help to reduce the impacts from a disaster event.

Implementation Strategy: The Emergency Management Coordinator outlined in M-1 could implement this strategy.

- Develop a contact person for the City of Shoreline as well as the Shoreline School District so that there is an ongoing dialog between the two agencies.
- Work together on emergency preparedness, response, recovery and mitigation measures so that in the event of a disaster the City of Shoreline and the Shoreline School District can work efficiently together to ensure that impacts from the event are reduced.

Lead Agency: Police Department

Funding Source: Shoreline Operating Budget

Implementation Cost: No significant additional cost for Shoreline

Timeline: Ongoing

Associated Hazards: All Hazards

Related Goal and Objective: Goal 3, Objective 3.1

M-20: Create and maintain a partnership with Snohomish County.

Problem/Opportunity: Snohomish County borders the City of Shoreline to the north. It is important to create and maintain a partnership with Snohomish County so that there is coordination in implementing mitigation measures as well as response, recovery and preparedness. This partnership is especially important because the City of Shoreline provides emergency services to Point Wells, which is located in Snohomish County.

Implementation Strategy: The Emergency Management Coordinator outlined in M-1 could implement this strategy.

- Develop a contact person for the City of Shoreline and Snohomish County so that there is an ongoing dialog.
- Work together on emergency preparedness, response, recovery and mitigation measures so that in the event of a disaster the City of Shoreline and Snohomish County can work efficiently together to ensure that impacts from the event are reduced.

Lead Agency: Police Department

Funding Source: Shoreline Operating Budget

Implementation Cost: No significant additional cost for Shoreline

Timeline: Ongoing

Associated Hazards: All Hazards

Related Goal and Objective: Goal 3, Objective 3.1

M-21: Reassess the City of Shoreline evacuation and primary response routes.

Problem/Opportunity: The Emergency Operations Plan identifies evacuation and primary response routes. Some of the same roads are used and may cause problems in the event of a disaster. An analysis of other potential routes is needed to ensure that traffic congestion does not impede response efforts during or after a disaster. Additional work may need to be done to roads so that they can serve as an evacuation or primary response route. The Emergency Management Coordinator outlined in M-1 could implement this strategy.

Implementation Strategy:

- Reassess the City of Shoreline evacuation and primary response routes.
- Develop new routes where necessary.

Lead Agency: Police Department

Funding Source: Shoreline Operating Budget

Implementation Cost: No significant additional cost for Shoreline

Timeline: Short Term

Associated Hazards: All Hazards

Related Goal and Objective: Goal 4, Objective 4.1

M-22: Educate business owners about potential hazards and hazard mitigation.

Problem/Opportunity: Businesses are more than a collection of buildings and inventories. They act as suppliers, customers and have products making up a larger independent business environment. Planning ahead for disasters and developing strong partnerships have enabled businesses to recover from disasters.

Implementation Strategy: Develop a business education program to educate business owners about potential hazards and hazard mitigation. The Emergency Management Coordinator outlined in M-1 could implement this strategy. Some measures that should be taken are:

- Secure Chamber of Commerce and business associations' support and elicit active involvement and leadership from the organizations in hazard mitigation planning.
- Research potential business participants and build a database/mailing list.

- Develop a direct mail/publicity campaign to get businesses' attention.
- Tie information dispersal to business license issuance (new and renewal).
- Distribute guides to businesses and/or post on the city's website.
- Educate businesses about forming partnerships so that businesses can maintain operations after a disaster event.
- Assist and educate businesses about creating resumption plans for after a disaster event.

Lead Agency: Police Department

Funding Source: Shoreline Operating Budget

Implementation Cost: Included in M-2

Timeline: Ongoing

Associated Hazards: All Hazards

Related Goal and Objective: Goal 1, Objective 1.1

M-23: Educate private homeowners about how to implement measures to reduce impacts of wildland fires.

Problem/Opportunity: Wildland fire is a hazard that puts structures in the wildland urban interface areas at risk. The city can educate homeowners in the interface areas about what specific steps can be taken to reduce the risk to their homes from wildland fire.

Implementation Strategy: Educate private homeowners in the interface areas about measures to reduce risk from wildland fire that are outlined in programs such as Firewise. The Emergency Management Coordinator outlined in M-1 could implement this strategy. Some of these measures are:

- Survivable Space: Homeowners can reduce the amount of fuel around a structure that is burnable. The survivable space area around the structure can include gravel pathways, healthy lawns and driveways.
- Landscaping: To reduce risk, homeowners can plant species that are acclimated to Northwest Washington and plants that have high moisture content in their leaves. Maintaining a healthy landscape can also reduce risk from wildland fire. Some things that can be done are adequately spacing and pruning plants, removing dead leaves and litter and providing the landscape with sufficient moisture.
- Roofing Materials: The choice of roofing material in interface areas is important in reducing risk from Wildland fire. Some roofing materials such as asphalt or

tile are recommended to reduce risk. It is also recommended that wooden shingles and shakes be treated with fire retardant.

To implement this program refer to M-2, which describes the methodology of how to distribute information community wide.

Lead Agency: Planning & Development Services Department

Funding Source: Shoreline Operating Budget

Implementation Cost: Included in M-2

Timeline: Ongoing

Associated Hazards: Wildland Fire

Related Goal and Objective: Goal 1, Objective 1.2

M-24: Utilize the most current data and technology to develop a work program to regulate development and re-development on NEHRP E soils.

Problem/Opportunity: NEHRP E soils are susceptible to ground shaking and liquefaction. Structures and infrastructure located on E soils are vulnerable during an earthquake. Regulation of these structures can reduce the risk and loss to the community.

Implementation Strategy:

- Require evaluations for new and redevelopment construction on sites that are located on NEHRP E Soils.
- Based on evaluation, require implementation of successful earthquake mitigation technologies.

Lead Agency: Planning and Development Services

Funding Source: Shoreline Operating Budget

Implementation Cost: No significant additional cost for Shoreline

Timeline: Ongoing

Associated Hazards: Earthquakes

Related Goal and Objective: Goal 4, Objective 4.2

M-25: Target code enforcement for abatement of nuisance vegetation on both City right-of-ways and public property.

Problem/Opportunity: Shoreline Municipal Code 20.30.750 allows for the abatement of nuisance vegetation. Nuisance vegetation includes any trees, plants, shrubs, vegetation or parts thereof that interfere with sidewalks, streets, poles, wires, pipes, fixtures or any other part of any public utility situated in the street as well as shrubs, brush, vines, trees

or other vegetation growing or which has grown and died, and organic debris, which constitutes a fire hazard.

In Shoreline, the power lines are above ground and one of the most common reasons for power supply disruptions is trees and other vegetation damaging the lines. Also, high fuel loads are an ignition source for wildland fires. Enforcement of the code would reduce the amount of damage to the power lines as well as the potential for wildland fires.

Implementation Strategy:

- Evaluate the effectiveness of the current code and ensure that there are no conflicts with other regulation.
- Create a work plan that ensures proper code enforcement of abatement of nuisance vegetation.
- Evaluate vegetation management plans for city properties and ensure that the plans adequately keep vegetation clear of power lines and remove vegetation that constitutes a fire hazard.
- Produce an educational pamphlet to give to residents. This would include information about why maintaining vegetation around power lines is important and what vegetation constitutes a fire hazard. It would also include a recommended tree planting guide for areas near power lines.
- Partner with utility provider to ensure that transmission corridors are maintained.

Lead Agency: Public Works Department, Planning & Development Services Department

Funding Source: Shoreline Operating Budget

Implementation Cost: No significant additional cost to Shoreline

Timeline: Ongoing

Associated Hazards: Severe Storms, Wildland Fire

Related Goal and Objective: Goal 2, Objective 2.1

M-26: Utilize Geographic Information Systems (GIS) in decision-making processes.

Problem/Opportunity: GIS offers a quick and comprehensive tool to identify problems and opportunities.

Implementation Strategy: Utilize GIS software to aid in reducing risk from hazard. This would include educating decision makers about how hazards can be analyzed using GIS. Some of the functions GIS can be used for include:

- Determination of areas of high risk, exposure, coding, retrofitting, and education priorities.

- Planning for road network and utility network expansions.
- Evaluating the risk to existing and new developments.
- Update and maintain data so that there is consistency and data coordination among all city departments.

Lead Agency: Finance Department

Funding Source: Shoreline Operating Budget

Implementation Cost: There is no significant additional cost to Shoreline unless additional software is needed. The cost of the additional software cannot be determined at this time.

Timeline: Ongoing

Associated Hazards: All Hazards

Related Goal and Objective: Goal 4, Objective 4.2

M-27: Utilize the most current data and technology when regulating landslide areas.

Problem/Opportunity: Landslide hazard areas create risk for the structures, roads and utilities located within these areas. Regulations can help to decrease the risks of landslides by requiring the use of the most current data and technology.

Implementation Strategy:

- Require geotechnical evaluations for new construction sites that are located on landslide hazard areas.
- Based on geotechnical evaluations require implementation of successful landslide mitigation technologies.

Lead Agency: Planning & Development Services Department

Funding Source: Shoreline Operating Budget, Private Developers

Implementation Cost: No significant additional cost to Shoreline, Private developer would pay through permitting process

Timeline: Ongoing

Associated Hazards: Landslides

Related Goal and Objective: Goal 2, Objective 2.1

M-28: Remove the Robinson Water Tower.

Problem/Opportunity: In November of 2000, the Shoreline Building Official declared the Robinson Water Tower, located at intersection of NW 195th and 3rd Ave NW, to be a hazardous structure. In the event of an earthquake or a severe storm, the tower could collapse potentially harming people or infrastructure.

Implementation Strategy:

- Demolish the Robinson Water Tower

Lead Agency: Planning & Development Services Department

Funding Source: Shoreline Operating Budget

Implementation Cost: Approximately $17,000

Timeline: Short Term

Associated Hazards: Earthquake, Severe Weather

Related Goal and Objective: Goal 2, Objective 2.1

9. Action Plan

This section outlines the implementation agenda that the Emergency Management Council should follow for the five years following adoption of this plan. More information about each of the items listed can be found in Section 8.

The items are displayed on Table 9.1 in the order of their priority for implementation. They have been ranked for implementation based on input from the Stakeholder Committee and other participants; however, a benefit to cost analysis will be completed as part of the project development process, using FEMA approved benefit cost methods. See Appendix B for more information about these methods. The Emergency Management Council should consider the following an action plan for the first 5-year planning cycle.

Each mitigation strategy is assigned a timeline. This estimates the amount of time it will take to begin implementation of each strategy. Under timeline there are three categories, short term, long term and ongoing. Short Term means that the mitigation strategy will be implemented in years 1 to 2 and is either crucial to the life safety of Shoreline residents, or relatively easy to implement because funding has already been secured or is readily available. Long Term means that mitigation strategy will be implemented in years 3 to 5. Long term mitigation measures will take more effort to implement and funding has not been secured or is not readily available. Ongoing means that the mitigation strategy will be implemented in years 1 to 5 and will continue into the future indefinitely. Ongoing mitigation measures should be implemented early in the planning cycle, but will be on-going projects once implementation has occurred.

Each mitigation strategy is related to a plan goal and objective. After implementation plan goals should be used to assess how well each of the mitigation strategies is accomplishing its intended goal and objective.

Table 9.1: City of Shoreline Action Plan

Mitigation Strategy		Associated Hazards								Timeline	Lead Agency	Funding	Implementation Strategies (Section 8)	Plan Goals Addressed				
		Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche					Goal 1: Protect public health, welfare, and public safety	Goal 2: Minimize losses to existing and future properties	Goal 3: Encourage coordination and communication amongst public and private organization	Goal 4: Ensure continuity of critical facilities and corresponding operations of local government	Goal 5: Protect and promote environmental quality
M-1	Create a full time position in the City of Shoreline for an Emergency Management Coordinator.	x	x	x	x	x	x	x	x	Short Term	City Manager's Office	Shoreline Operating Budget	p.			x		
M-2	Create a community wide comprehensive education program to educate the public about hazards and hazard mitigation.	x	x	x	x	x	x	x	x	Ongoing	Police Department	Shoreline Operating Budget, EMPG, HGMP, Pre-Disaster Mitigation Program	p.	x				
M-3	Create and maintain a partnership with utility providers to ensure that the utility infrastructure serving Shoreline is retrofitted or built to standards that make them less vulnerable in a hazard event including critical infrastructure protection.	x	x	x	x	x	x	x	x	Ongoing	Public Works	Shoreline Operating Budget	p.				x	
M-4	Create and maintain a partnership with Washington State Department of Transportation (WSDOT) to ensure that the I-5 overpasses located in Shoreline are retrofitted to current seismic standards within a reasonable time frame.	x								Long Term	City Manager's Office	Shoreline Operating Budget	p.		x			
M-5	Implement non-structural retrofitting in city facilities and provide incentives for non-structural retrofitting for privately owned structures throughout the city.	x								Ongoing	Public Works Department	Shoreline Operating Budget	p.		x			
M-6	Identify critical community facilities and infrastructure that are without back up power generators.	x	x	x	x	x	x	x	x	Short Term	Police Department	Shoreline Operating Budget	p.	x				
M-7	Identify and assess critical and essential city infrastructure and facilities	x	x	x	x	x	x	x	x	Ongoing	Public Works	Shoreline Operating Budget	p.		x			

Mitigation Strategy		Associated Hazards								Timeline	Lead Agency	Funding	Implementation Strategies (Section 8)	Plan Goals Addressed				
		Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche					Goal 1: Protect public health, welfare, and public safety	Goal 2: Minimize losses to existing and future properties	Goal 3: Encourage coordination and communication amongst public and private organization	Goal 4: Ensure continuity of critical facilities and corresponding operations of local government	Goal 5: Protect and promote environmental quality
	infrastructure and facilities.																	
M-8	Assure that the public is informed of the necessity of maintaining a 3-day supply of food and water, along with basic first aid and medical supplies.	x	x	x	x	x	x	x	x	Ongoing	Police Department	Shoreline Operating Budget, EMPG	p.	x				
M-9	Provide incentives for voluntary structural retrofitting of older structures on vulnerable soils.	x								Long Term	Planning & Development Services, Public Works	DHS/FEMA, Shoreline Operating Budget	p.		x			
M-10	Improve\expand storm water drainage, dams, detention and retention system capabilities.					x				Long Term	Public Works	Shoreline Capital Improvement Budget, HGMP, Pre-Disaster Mitigation Program	p.		x			
M-11	Identify critical city facilities and infrastructure and acquire back up power generators for those currently without.	x	x	x	x	x	x	x	x	Short Term	Public Works	Shoreline Operating Budget	p.		x			
M-12	Identify critical government functions and establish backup operations for these functions.	x	x	x	x	x	x	x	x	Long Term	City Manager's Office	Shoreline Operating Budget	p.				x	
M-13	Educate homeowners, developers and business owners about how to reduce impacts of urban flooding.					x				Ongoing	Public Works Department	Shoreline Operating Budget	p.	x				
M-14	Provide incentives for non-structural retrofitting of hazardous materials containment throughout the city.	x	x							Ongoing	Public Works Department	Shoreline Operating Budget, HGMP, Pre-Disaster Mitigation Program	p.		x			

Mitigation Strategy		Associated Hazards								Timeline	Lead Agency	Funding	Implementation Strategies (Section 8)	Plan Goals Addressed				
		Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche					Goal 1: Protect public health, welfare, and public safety	Goal 2: Minimize losses to existing and future properties	Goal 3: Encourage coordination and communication amongst public and private organization	Goal 4: Ensure continuity of critical facilities and corresponding operations of local government	Goal 5: Protect and promote environmental quality
M-15	Create and maintain a partnership between City of Shoreline Emergency Services and Washington State Public Health Laboratories so there is coordination during and immediately after a disaster.	x	x							Ongoing	Police Department	Shoreline Operating Budget	p.			x		
M-16	Create and maintain partnerships with educational and care facilities.	x	x	x	x	x	x	x	x	Ongoing	Police Department	Shoreline Operating Budget	p.			x		
M-17	Institute low impact development regulations for new developments as well as re-development projects.					x				Ongoing	Planning & Development Services	Shoreline Operating Budget, Shoreline Capital Improvement Budget	p.					x
M-18	Create and maintain a partnership between the City of Shoreline and the Shoreline Fire Department so there is coordination in implementing mitigation measures as well as coordination during and immediately after a disaster.	x	x	x	x	x	x	x	x	Ongoing	Police Department	Shoreline Operating Budget	p.			x		
M-19	Create and maintain a partnership between the City of Shoreline and the Shoreline School District so there is coordination in implementing mitigation measures as well as coordination during and immediately after a disaster.	x	x	x	x	x	x	x	x	Ongoing	Police Department	Shoreline Operating Budget	p.			x		
M-20	Create and maintain a partnership with Snohomish County.	x	x	x	x	x	x	x	x	Ongoing	Police Department	Shoreline Operating Budget	p.			x		
M-21	Reassess the City of Shoreline evacuation and primary response routes.	x	x	x	x	x	x	x	x	Short Term	Police Department	Shoreline Operating Budget	p.				x	

Mitigation Strategy		Associated Hazards								Timeline	Lead Agency	Funding	Implementation Strategies (Section 8)	Plan Goals Addressed				
		Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche					Goal 1: Protect public health, welfare, and public safety	Goal 2: Minimize losses to existing and future properties	Goal 3: Encourage coordination and communication amongst public and private organization	Goal 4: Ensure continuity of critical facilities and corresponding operations of local government	Goal 5: Protect and promote environmental quality
M-22	Educate business owners about potential hazards and hazard mitigation.	x	x	x	x	x	x	x	x	Ongoing	Police Department	Shoreline Operating Budget	p.	x				
M-23	Educate private homeowners about how to implement measures to reduce impacts of wildland fires.						x			Ongoing	Planning & Development Services	Shoreline Operating Budget	p.	x				
M-24	Utilize the most current data and technology to develop a work program to regulate development and re-development on NEHRP E soils.	x								Ongoing	Planning & Development Services	Shoreline Operating Budget	p.				x	
M-25	Target code enforcement of abatement of nuisance vegetation on both City right-of-ways and public property.			x			x			Ongoing	Public Works, Planning & Development Services	Shoreline Operating Budget	p.		x			
M-26	Utilize Geographic Information Systems (GIS) in decision-making processes.	x	x	x	x	x	x	x	x	Ongoing	Finance Department	Shoreline Operating Budget	p.				x	
M-27	Utilize the most current data and technology when regulating landslide areas.				x					Ongoing	Planning & Development Services	Shoreline Operating Budget, Private Developers	p.		x			
M-28	Remove the Robinson Water Tower.	x		x									p.					

10. Plan Maintenance

This section details the process that the City of Shoreline will undertake to assure that the goals, objectives, and action items described in this document will remain relevant. The first section, "Monitoring, Evaluating, and Updating the Plan," describes the system established to monitor the plan, as well as how, when and by whom the plan will be evaluated. The next section, "Implementation Through Existing Programs," describes how current city programs can be used to further the All Hazard Mitigation Plan goals. The final section describes how continued public involvement will be assured as the plan is monitored and updated.

10.1. Monitoring, Evaluating and Updating the Plan

Emergency Management Council

The Shoreline Emergency Management Council was established in 1996 by Municipal Code 2.50. The council provides oversight to emergency management activities and those ordinances, resolutions, contracts, rules and regulations that are necessary for emergency management (City of Shoreline Emergency Operations Plan, June 2003). This is the group responsible for monitoring the plan. The chair of this committee and the Emergency Management Coordinator outlined in M-1 will be responsible for overseeing the monitoring, evaluating and updating of the Shoreline Hazard Mitigation Plan.

The council consists of the following (Ord. 328 § 1, 2003; Ord. 103 § 4, 1996):

- The city manager, or designee, who shall act as chair;
- The emergency management coordinator as appointed by the city manager;
- The city public works director;
- The city police chief;
- A representative of the Shoreline Fire Department, or successor;
- A representative of the Shoreline School District, or successor;
- A representative of the Shoreline Community College, or successor;
- A representative of the Shoreline Water District, or successor;
- A representative of the Ronald Wastewater Management District, or successor;
- A representative of the Shoreline Auxiliary Communications Service, or successor;
- And such city officials and other citizens with technical capabilities in related areas, upon appointment by the city manager

Schedule

To assure that the All Hazard Mitigation Plan continues to provide an appropriate path for risk reduction in Shoreline, it is necessary to regularly monitor, evaluate and update it. The Shoreline Emergency Management Council will convene a yearly meeting devoted to reviewing and updating the All Hazard Mitigation Plan.

The council will be responsible for:

- Regularly reviewing each goal and objective to determine its relevance to the changing situation in Shoreline.
- Monitoring and evaluating the mitigation strategies in this plan to assure that the document reflects current hazard analyses, development trends, code changes and risk analyses and perceptions.
- Assuring the appropriate implementation of the 5-year action plan, described below. The council will hear progress reports from the parties responsible for the various implementation actions to monitor progress.
- Creating future action plans and mitigation strategies. These should be carefully assessed and prioritized using the benefit-cost analysis methodology that FEMA has developed. More information about this is provided in Appendix B.
- Assuring a continuing role for public comment and involvement as the mitigation plan evolves.
- Reassessing the plan in light of any major hazard event occurrence such as an earthquake or major flood, for example. The council will convene within 15 days of any major event to review all applicable data and to consider the risk assessment, plan goals, objectives, and action items given the effects of the hazard event. Applicable hazard-dependent action items, in Section 9, should be implemented at that time.
- Review the hazard mitigation plan in connection to other plans, such as capital improvement project plans, comprehensive plan and emergency operations plan updates.

After each meeting, the Emergency Management Council will have 3 months to update and make any necessary changes to the plan before submitting it to the state hazard mitigation officer for review.

10.2. Criteria for Evaluation

The Emergency Management Council will be responsible for evaluating the plan. One of the first tasks of the council will be to determine the criteria to be used for evaluation of the plan. Included among these criteria should be:

- Do the goals and objectives continue to address expected conditions in Shoreline?

- Is the risk assessment still appropriate, or has the nature or magnitude of the hazard and/or vulnerability changed over time?
- Are current resources appropriate for implementing this plan?
- Have lead agencies participated as originally proposed?
- Have outcomes been adequate?
- What problems have occurred in the implementation process?
- Have member of the public been adequately involved in the process? Are their comments being heard?

10.3. Implementation Through Existing Programs

The City of Shoreline currently utilizes several mechanisms to guide development, including the following:

Comprehensive land use planning as required by the Washington State Growth Management Act

Capital improvement planning

Building codes

Each of these mechanisms can also be utilized to meet the goals of the Hazard Mitigation Plan. After the city officially adopts the Hazard Mitigation Plan, mitigation strategies will be implemented into these existing processes, plans and codes.

After adoption of the Hazard Mitigation Plan, the city will assure that they address hazard risk in their comprehensive plans and land use regulations. The city planning department will conduct periodic reviews of the city comprehensive plan, land use policies and analyze any plan amendments.

The city building department is responsible for administering the building codes in Shoreline. After the adoption of the Hazard Mitigation Plan, they will work with the state building code office to make sure that Shoreline adopts and enforces the minimum standards established in the new state building code. This is intended to assure that life/safety criteria are met for new construction.

Various city departments develop capital improvement programs and review them regularly. The capital improvement program is another avenue that can help fulfill the goals in Shoreline's Hazard Mitigation Plan. The Emergency Management Council will work with city departments to identify capital improvement projects that are consistent with the Hazard Mitigation Plan goals and integrate them as appropriate.

Within six months of the formal adoption of the Hazard Mitigation Plan, the policies listed above will be incorporated into the process of existing program and planning mechanisms.

10.4. Continued Public Involvement

To facilitate the goal of continued public involvement in the planning process, Shoreline Emergency Management Council will assure that the following steps are taken:

- Copies of the plan will be catalogued and kept on hand at all of the public libraries, police and fire stations and at appropriate agencies throughout Shoreline. Contained in the plan is the address and phone number of the City of Shoreline employee responsible for keeping track of public comments on the plan.
- The plan will be available on the city's website, and will contain an email address and phone number the public can use for submitting comments and concerns about the plan.
- A public meeting will be held annually to provide the public with a forum for expressing concerns, opinions, and ideas. The council will set meeting schedules and dates and use city resources to publicize and host this meeting. A public meeting will also be held within 4 months after a disaster event to ensure that the public can express concerns, opinions and ideas over the disaster event.

Appendix A

Planning Process

This appendix describes the source of all information in this plan that came from people, whether through meetings, forms, or individual personal or telephone contact. The project team held two stakeholder committee meetings with representatives from throughout the city, met separately with representatives from each of the districts serving Shoreline, gathered information from the public at large, held meetings with experts in several major hazard areas, and contacted many individuals in city, county, and state organizations while completing this plan. Each of these is described below.

Stakeholder Committee

The stakeholder committee is comprised of group of representatives from city and jurisdictional organizations with expertise in fields ranging from public utilities to geology to emergency management. While each member was invited to participate in each meeting, attendance was variable. Those who were unable to attend were often contacted by telephone for input.

Committee Members:

Bob Phelps, Shoreline Amateur Radio

Dana Wheelock, Seattle City Light

Mark Wesolowski, Puget Sound Energy

Mike Wilkinson, NRC: Foss Environmental

Mike Harrison, Seattle City Light

Al Nelson, Burlington Northern Santa Fe Railway: Police

LaDonna Smith, City of Shoreline

Kelly Melton, Department of Social and Health Services: Fircrest

Dick Deal, Shoreline Parks Department

Lisa Dustin, Shoreline Parks Department

Tom Lentz, Washington State Department of Transportation

Bridget Smith, City of Shoreline

Scott Keeny, Shoreline Fire Department

Mark Maynard, Crista Ministries

Bud Taylor, Washington State Department of Health: Public Health Laboratories

Brian Wuellnor, Chevron

Randy Stegmeier, Shoreline Community College

Steve LaCruix, Washington State Department of Health: Public Health Laboratories

Paul Haines, City of Shoreline: Public Works Department

Paul Plumis, Shoreline School District

Bob Olander, City of Shoreline: City Managers Office

R. D'Alessandro, Shoreline Water District

Marcus Kragness, Shoreline Fire Department

Ron Mehlert, Shoreline Fire Department

Debbie Tarry, City of Shoreline

Clement Rusk, Shoreline Police Department

Tim Dahl, Shoreline Fire Department

Leona Obstler, Shoreline Police Department

Tim Stewart, City of Shoreline: Planning and Development Services

Joyce Nichols, City of Shoreline: Communications and Intergovernmental Relations

Jay Clark, City of Shoreline: GIS

Michelle Bennett, Shoreline Police Department

Denise Turner, Shoreline Police Department

Michael Derrick, Ronald Wastewater District

Bob Crozier, City of Shoreline

Julie Modrzejewski, City of Shoreline

Kirk Peterson, City of Shoreline

Planning Meeting #1—Stakeholder Committee Meeting: November 7, 2003

Agenda

CITY OF SHORELINE
HAZARD MITIGATION PLAN
Planning Workshop 1 - November 7th, 2003

AGENDA

Risk Assessment and Goal Development

8:30 am -	Introduction - Background & Planning Process
8:40 – 10:00 am	Discussion (GIS Display) – Earthquake, Landslides, Severe Flooding, Fire
10:00- 10:10 am	Break
10:10 – 10:50 am	Discussion – Hazardous Materials, Severe Weather, Volcano, Tsunami/Seiche
10:50 – 11:30 am	Goal and Objective Development

Worksheets

Preliminary Goals and Objectives

GOAL 1: Protect public health, welfare, and public safety

OBJECTIVE 1a: Increase public awareness of hazards

OBJECTIVE 1b: Encourage involvement of community in risk reduction programs

Comments/Additions:

GOAL 2: Minimize losses to existing and future properties

OBJECTIVE 2a: Support programs and initiatives to reduce risk in residential and commercial structures, especially those prone to hazards

OBJECTIVE 2b: Support upgrades to critical transportation infrastructure

OBJECTIVE 2c: Enact and enforce regulatory measures that ensures reduction of risk to property and the surrounding environment

Comments/Additions:

GOAL 3: Encourage coordination and communication amongst public and private organization

OBJECTIVE 3a: Incorporate hazard mitigation into activities of other organizations

OBJECTIVE 3b: Encourage organizations, businesses, and local governmental agencies within community and region to develop partnerships

OBJECTIVE 3c: Promote consistencies in communication, plans and policies to facilitate coordination between all involved groups

Comments/Additions:

GOAL 4: Ensure continuity of critical facilities and corresponding operations of local government

OBJECTIVE 4a: Support redundancy of critical government functions

OBJECTIVE 4b: Promote use of new technology in critical operations

Comments/Additions:

Mitigation Recommendations

Please write down any mitigation recommendations that you feel are important. If possible, please include recommendation and lead agency.

Please provide the following information:

Name: _____

Agency: _____

Phone: _____

Email: _____

EARTHQUAKE

LANDSLIDES

FLOODING

WILDLAND AND URBAN FIRE

HAZARDOUS MATERIALS

SEVERE WEATHER

VOLCANO

TSUNAMI/SEICHE

GENERAL MITIGATION RECOMMENDATIONS

Planning Meeting #2—City Council Meeting: January 5th, 2004

Agenda

AGENDA

SHORELINE CITY COUNCIL
SPECIAL MEETING
Monday, January 5, 2004

Shoreline Conference Center

6:30 p.m. Mt. Rainier Room

1. CALL TO ORDER

Swearing In Ceremony administered by Judge Richard Eadie

Position #2 Rich Gustafson

Position #3 Paul Grace

Position #4 Maggie Fimia

Position #6 Robert Ransom

2. FLAG SALUTE / ROLL CALL

   (a) Election of Mayor and Deputy Mayor

3. REPORT OF CITY MANAGER

4. COUNCIL REPORTS

5. PUBLIC COMMENT

This is an opportunity for the public to address the Council on any subject which is not of a quasi-judicial nature or specifically scheduled for today's agenda (see items below). The public may comment for up to two minutes. However, Item 5 will be limited to a maximum period of twenty minutes. A maximum of three persons will be permitted to speak to each side of any one topic. The public may also comment for two minutes on action items after the staff report has been presented. In all cases, speakers are asked to come to the front of the room to have your comments recorded. Please state clearly your name and address.

6. WORKSHOP ITEMS

(a) Review of options for the Robinson Water Tower located at the intersection of NW 195th Street and 3rd Avenue NE

20 min.

(b) Draft Hazard Mitigation Plan

30 min.

Link to Draft Hazard Mitigation Plan

(c) Adoption of new Specialty Business Licensing Regulations and repeal of Ordinance No. 34

15 min.

7. CONTINUED PUBLIC COMMENT

Public comment is limited to three minutes per person.

8. ADJOURNMENT

The Council meeting is wheelchair accessible. Any person requiring a disability accommodation should contact the City Clerk's Office at 546-8919 in advance for more information. For TTY service, call 546-0457. For up-to-date information on future agendas, call 546-2190 or see the web page at www.cityofshoreline.com. Council meetings are shown on Comcast Cable Services Channel 21 Wednesday through Sunday at 6 a.m., 12 noon and 8 p.m.

Council Meeting Date: **Agenda Item: 6(b)**

CITY COUNCIL AGENDA ITEM

CITY OF SHORELINE, WASHINGTON

AGENDA TITLE:	Draft Hazard Mitigation Plan
DEPARTMENT:	Police Department
PRESENTED BY:	Denise Turner, Chief of Police

PROBLEM/ISSUE STATEMENT:

With the passing of the federal Public Law 106-390, the Disaster Mitigation Act of 2000 (DMA2K), a new hazard mitigation-planning requirement has been enacted. On October 1, 2002, the interim final regulations of the DMA2K were updated and published addressing the planning requirements for local government and requiring jurisdictions to have an adopted and FEMA approved Hazard Mitigation Plan by November 1, 2004, in order to be eligible for future hazard mitigation grant funds.

In late November, staff provided the Council with a draft of the Hazard Mitigation Plan. In addition, staff began community outreach to facilitate public input. In order for the plan to be approved by FEMA, a key element of the plan requires community involvement. Staff is seeking Council and public input on the draft plan and will incorporate comments and concerns in the final plan, which is targeted for Council approval July 2004.

BACKGROUND

As part of the City's Emergency Operations Plan, which the Council adopted on May 27, 2003, City staff contracted with the University of Washington Institute for Hazard Mitigation to assist in preparing the City's Hazard Mitigation Plan.

The goal of the City of Shoreline Hazard Mitigation Plan is to identify and recommend projects and programs that when implemented, would eliminate, minimize, or otherwise mitigate the vulnerability of the people, property, environmental resources, and economic vitality of the community to the impacts of future disasters. These identified projects and programs are termed "mitigation initiatives" and constitute the principal component of the plan. The fundamental purpose of the plan is to guide, coordinate, and facilitate the efforts of the agencies, organizations, and individuals participating as they seek funding, authority, or other resources necessary for implementation of mitigation initiatives.

An important step in securing approval of the plan by FEMA is to have community involvement. Staff has conducted outreach to residents to seek their input on the draft plan. At the Council's January 5th Workshop Meeting, the Council and the public will have an opportunity to meet with representatives from the University of Washington

Institute for Hazard Mitigation, who will provide a brief presentation of the plan, focusing on methodology, the City's three primary hazards, and potential mitigation strategies. In addition, prior to this meeting, staff ensured that the plan was made available to the public for review on the City's web site, at city hall, the two police storefronts, and at the City's two public libraries. Local governments are required to have their hazard mitigation plans approved and adopted by November 1, 2004; therefore, staff will return to Council for plan approval by July 2004.

FINANCIAL IMPACT:

To prepare the Hazard Mitigation Plan, the City contracted with the University of Washington Institute for Hazard Mitigation. The scope of work includes developing all elements of the plan, coordinating efforts with City stakeholders and key agencies, and submitting the plan to the State/FEMA. The contract is budgeted for $30,000. To assist in funding the project, the City applied to the State of Washington for a Pre-Disaster Mitigation Competitive Program (PDMC) grant. Currently, the State has recommended approval to FEMA for a total of $37,500.

Once the Council adopts the plan, which is targeted for July 2004, the City will be eligible for FEMA assistance following a disaster. Likewise, the City will be eligible for future hazard mitigation grant funds.

RECOMMENDATION

No action is required. At this time, staff seeks both Council and public comment on the draft Hazard Mitigation Plan.

ATTACHMENTS

City of Shoreline Draft Hazard Mitigation Plan

Approved By: City Manager City Attorney N/A

Risk Ranking by Hazard Worksheet

Below are the hazards that have been determined to potentially impact Shoreline. These were determined through analysis done by the technical stakeholder group and the UW Institute for Hazards Mitigation.

DIRECTIONS: Please rank the risk from each hazard as high, medium, low or no opinion by writing the appropriate statement in the box next to the corresponding hazard.

High: The risk is significant enough to warrant **major program effort** to prepare for, respond to, recover from and mitigate against this hazard. This hazard should be a major focus of the City's emergency management training and exercise program.

Medium: The risk is significant enough to warrant **modest program effort** to prepare for, respond to, recover from and mitigate against this hazard. This hazard should be included in the City's emergency management training and exercise program.

Low: The risk is such as to warrant **no special effort** to prepare for, respond to, recover from or mitigate against this hazard. This hazard need not be specifically addressed in the City's emergency management training and exercise program except as generally dealt with during hazard awareness training.

No Opinion: A ranking of no opinion means that you do not have an opinion about the impact of the hazard on Shoreline.

RETURN DATE: Please return by **January 9, 2003 at 5:00 PM** to the following address:

Heidi Costello
City Manager's Office
Shoreline City Hall
17544 Midvale Ave. N Suite 300
Shoreline, WA 98133-4921

Name:

_____

Organization:

_____

Phone #/Email Address:

_____

Hazard Event	Ranking
Earthquake	
Hazardous Materials	
Landslides/Sinkholes	
Severe Weather	
Flooding	
Fire	

Hazard Event	Ranking
Volcano	
Tsunami/Seiche	

Comments/Questions:

Please provide risk reduction measures for the hazards affecting Shoreline:

Planning Meeting #3—Stakeholder Committee Meeting: February 6, 2004

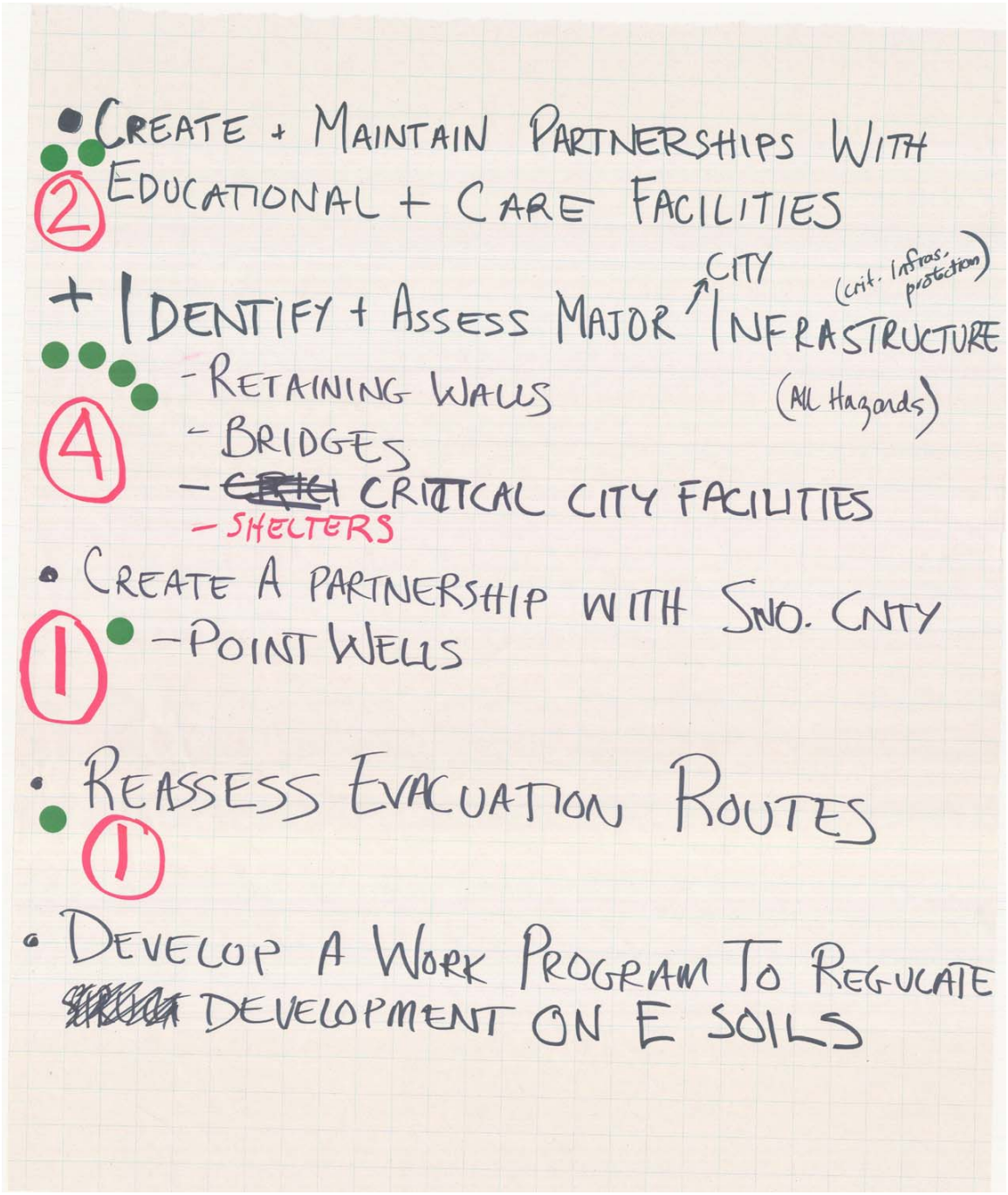
Agenda

CITY OF SHORELINE
HAZARD MITIGATION PLAN
Planning Workshop 3 - February 6, 2003
8:30 to 10:00 am

AGENDA

8:30 – 8:40am	Introduction
8:40 – 9:40 am	Discussion – Mitigation Strategies and Implementation
9:40 – 10:00 am	Mitigation Strategy Prioritization

Dot Exercise Results



Hazard Mitigation Strategies

Strategy	Lead Agency	Cost	Timeline
(7) Create a full time position in the City of Shoreline for an Emergency Management Coordinator	CMO	$75,000	Short Term
(7) Create a community wide comprehensive education program to educate the public about hazards and hazard mitigation*	Police	$50,000	Ongoing
Educate business owners about potential hazards and hazard mitigation	Police	*	Ongoing
(4) Assure that the public is informed of the necessity of maintaining a 3-day supply of food and water, along with basic first aid and medical supplies	Police	*	Ongoing
Educate private homeowners about how to implement measures to reduce impacts of wildland fires	PDS	*	Ongoing
2 Educate homeowners, developers and business owners about how to reduce impacts of urban flooding	PW	*	Ongoing
2 Provide incentives for non-structural retrofitting of hazardous materials containment in throughout the city	PW	*	Ongoing
3 Provide incentives for voluntary structural retrofitting of older structures on vulnerable soils	PDS	$250,000*	Long Term
4 Implement non-structural retrofitting in city facilities and provide incentives for non-structural retrofitting for privately owned structures throughout the city	PW	$25,000*	

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Hazard Mitigation Strategies

	Strategy	Lead Agency	Cost	Timeline
4	Identify critical community facilities and infrastructure that are without back up power generators ●●●●	Police		Short Term
3	Identify critical city facilities and infrastructure and acquire back up power generators for those currently without ●●●	PW		Short Term
2	Identify critical government functions and establish redundancy for these functions ●●	CMO		Long Term
	Target code enforcement of abatement of nuisance vegetation on both City right-of-ways and public property	PW, PDS		Ongoing
	Utilize the most current data and technology when regulating landslide areas	PDS		Ongoing
4	Work with Washington State Department of Transportation (WSDOT) to ensure that the I-5 overpasses located in Shoreline are retrofitted to current seismic standards within a reasonable timeframe ●●●●	PW		Long Term
6	Work with utility providers to ensure that the utility infrastructure serving Shoreline is retrofitted or built to standards that make them less vulnerable in a hazard event ●●●●●●	PDS		Ongoing
2	Create a partnership between City of Shoreline Emergency Services and Washington State Public Health Laboratories so there is coordination during and immediately after a disaster ●●	Police		Ongoing

Hazard Mitigation Strategies

Strategy	Lead Agency	Cost	Timeline
Utilize Geographic Information Systems (GIS) in decision-making processes	Police		Ongoing
Institute low impact development (LID) regulations for new developments as well as redevelopment projects ● (1)	PDS		Ongoing
Improve/expand storm water drainage, detention and retention system capabilities ●● ● (3)	PW		Long Term
Remove the Robinson Water Tower	PDS	$17,000	Short Term
Create a partnership between the City of Shoreline and the Shoreline Fire Department so there is coordination in implementing mitigation measures as well as coordination during and immediately after a disaster ● (1)	Police		Ongoing
Create a partnership between the City of Shoreline and the Shoreline School District so there is coordination in implementing mitigation measures as well as coordination during and immediately after a disaster ● (1)	Police		Ongoing

3

Key Informant Interviews

The following is a list of key informants contacted individually in the process of creating Shoreline's Hazard Mitigation Plan:

- Tim Dahl, Shoreline Fire Department
- M. Bennett, Shoreline Police Department
- Clem Rusk, Shoreline Police Department
- Bob Phelps, Shoreline A.C.S.
- Bridgette Wilson, City of Shoreline Planning and Development Services
- Robert Love, Fircrest
- Kelly Melton, Fircrest
- Mike Scott, Fircrest
- Stu Turner, Shoreline Water District
- Kris Kuluham, Shoreline Water District
- Dick D'Alessandro, Shoreline Water District
- Michael Derrick, Ronald Wastewater District
- Diane Pottinger, CH2 Engineers
- Paul Haines, Shoreline Public Works Department
- Mark Wesolowski, Puget Sound Energy
- Tom Lentz, Washington State Department of Transportation

City of Shoreline Website

The City of Shoreline Website (http://www.cityofshoreline.com/) posted information on the Hazard Mitigation Planning Process and requesting public comment.

Shoreline Seeks Comment on Draft Hazard Mitigation Plan

To comply with Federal Emergency Management Agency (FEMA) requirements, the City of Shoreline is developing a Hazard Mitigation Plan.

Shoreline Seeks Comments on Draft Hazard Mitigation Plan

To be eligible for Federal Emergency Management Agency (FEMA) help following a disaster, FEMA requires that cities complete a Hazard Mitigation Plan. A Hazard Mitigation Plan identifies potential hazards in a community and outlines plans to reduce the risks of those hazards.

The City of Shoreline hired the University of Washington Institute for Hazard Mitigation to help prepare the plan. Stakeholders and agency partners attended a half-day session in November to review the draft plan and now the City is seeking public comments.

The City's draft Hazard Mitigation Plan is available for review at City Hall, the Police

Station, both Police Neighborhood Centers, Shoreline Library and Richmond Beach Library, or by downloading the pdf version below.

The Shoreline City Council will be discussing the draft plan at its Jan. 5 meeting at which time public comments will be welcome. You can also mail comments to Police Chief Denise Turner, Shoreline City Hall, 17544 Midvale Ave. N., Shoreline, WA 98133 or email Heidi Costello at hcostello@ci.shoreline.wa.us.
Once the plan is finalized, it will go to the City Council for approval in summer 2004.

File Attachments: Draft Hazard Mitigation Plan

Announcement in the Enterprise Newspaper: Friday December 5, 2003

CITY SOURCE

City seeks comment on hazard mitigation plan

To be eligible for Federal Emergency Management Agency (FEMA) help following a disaster, FEMA requires that cities complete a Hazard Mitigation Plan. A Hazard Mitigation Plan identifies potential hazards in a community and outlines plans to reduce the risks of those hazards.

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The City's draft Hazard Mitigation Plan is available for review at City Hall, the Police Station, both Police Neighborhood Centers, Shoreline Library and Richmond Beach Library. It is also available on the City's Web site at www.cityofshoreline.com.

The Shoreline City Council will be discussing the draft plan at its Jan. 5 meeting at which time public comments will be welcome. You can also send comments to: Police Chief Denise Turner, Shoreline City Hall, 17544 Midvale Ave. N., Shoreline, WA 98133.

Once the plan is finalized, it will go to the City Council for review and approval next summer.

Christmas Ships come to Saltwater Park in Shoreline

Don't miss this annual tradition at Richmond Beach Saltwater Park on Tuesday, Dec. 9, 7:15 – 8:50 p.m.

The Christmas Ship will be brilliantly decked out with shimmering lights followed by a fleet of Argosy vessels, private yachts, sailboats and other small craft, combining to create the world's largest holiday flotilla.

Aboard the Christmas Ship, harmonious voices from the Northwest's finest choirs serenade the beach gathering while Syre and Einstein Middle School students offer "on-the-beach" vocal performances.

For more information, contact Shoreline Parks, Recreation and Cultural Services at (206) 546-5041.

CITY OF SHORELINE

For information on all City services, call the Customer Response Team at 546-1700

SHL

ENTERPRISE Friday, December 5, 2003 News

Appendix B

Benefit Cost Analysis

Benefit-cost analysis is an important mechanism used among local, state and federal governments in evaluating hazard mitigation projects. It is a critical part of the hazard mitigation planning process for project development. As part of mitigation project development, strategies in this City of Shoreline Hazard Mitigation Plan should be assessed using a FEMA/DHS approved benefit cost method. This should be done for all projects including ones not intended to be funded by FEMA/DHS grants.

This appendix briefly describes the importance of the benefit-cost analysis and how it should be used in relation to hazard mitigation projects in Shoreline. This is not meant to be a comprehensive description of a benefit-cost analysis.

Purpose

Hazard Mitigation projects can help reduce the cost of disaster events by lessening the loss of life and damage to property. The intention of these projects is to strengthen and improve buildings and infrastructure to ensure the creation of a resilient and sustainable community and withstand the harmful impacts of future disaster events. The purpose of a benefit-cost analysis is to determine whether undertaking projects now will result in minimizing or avoiding damages from future hazard events. Determining the cost-effectiveness of action items will provide project developers with additional knowledge so that if necessary, alternative, more cost-effective projects can be developed to accomplish the plan goals.

Benefit Cost Analysis for Mitigation Projects

A benefit-cost analysis is used in hazard mitigation to determine if the benefits of life and property protected through implementation of mitigation strategies outweigh the cost. In other words, this establishes if the benefits of reducing or avoiding future damages as a result of a disaster event exceeds the cost of implementing the strategy. A benefit-cost analysis shows a project's collective effect.

Benefits calculated for hazard mitigation projects are based on the frequency and severity of a disaster event and are determined probabilistically. They are considered to be the value of avoided future damages that are anticipated as a result of the mitigation strategy being implemented. Costs are considered to be the amount needed to implement the mitigation strategy.

The benefits and costs are translated into monetary values. To incorporate the future value of benefits, a net present value calculation is completed using an appropriate discount rate. A benefit cost ratio (B/C Ratio) is used to compare the benefits that a project produces against the cost of project implementation. If this ratio is greater than 1 this indicates the project benefits will exceed the costs. A project must have a B/C ratio greater than 1 in order to be implemented.

Benefit-cost analysis can be difficult but is important to conduct for each mitigation strategy. Project development that fulfills several objectives of the Hazard Mitigation

Plan should be considered and encouraged. This can help to minimize costs and effectively accomplish goals and objectives of this plan.