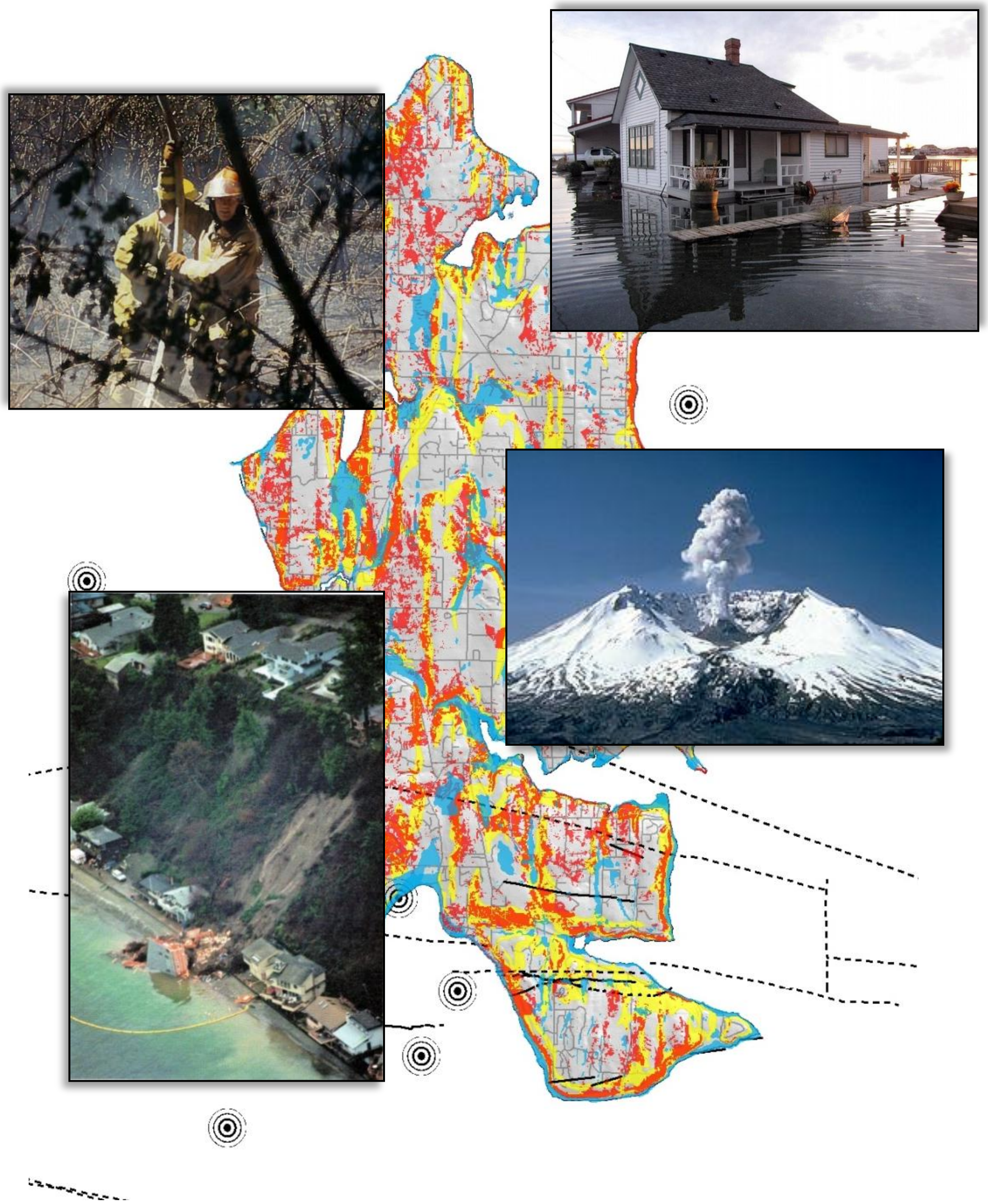
Bainbridge Island Hazard Identification and Vulnerability Assessment



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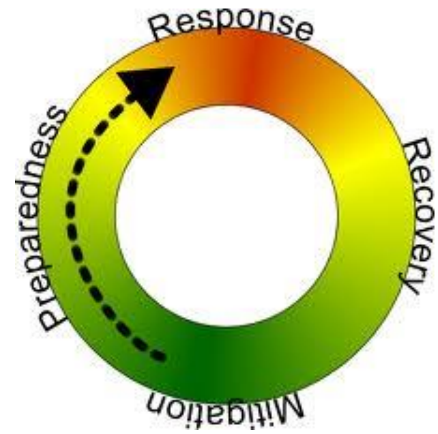
Contents

I. Introduction

Overview

Conducting a Hazard Identification and Vulnerability Assessment (HIVA) is the initial step supporting the emergency management process of hazard preparedness, response, recovery, and mitigation. Hazard identification refers to the systematic use of all available information to determine which types of hazards might affect a community, along with their driving forces and typical effects. Vulnerability assessment refers to the estimation of scale and severity these hazards may have on the people, property, environment, and economy of a community. The Disaster Mitigation Act (DMA) of 2000 states: “natural disasters, including earthquakes, tsunamis, tornadoes, hurricanes, flooding, and wildfires, pose great danger to human life and to property throughout the United States; greater emphasis needs to be placed on identifying and assessing the risks to States and local governments (including Indian tribes) from natural disasters.” The Washington Administrative Code (WAC 118-30-060) requires each political subdivision to base its Comprehensive Emergency Management Plan (CEMP) and Hazard Mitigation Plan (HMP) on a hazard analysis. This document refers to and compliments the 2008 Kitsap County HIVA, while narrowing the scope to Bainbridge Island specifically. Where appropriate, efforts were made to maintain a structure and terminology consistent with the current Kitsap HIVA, CEMP, and HMP.



Use and Limitations

It should be noted that this assessment constitutes a “snapshot in time” for planning purposes and should not be consider comprehensive and absolute. The hazard and vulnerability maps were developed from existing data sources, not from field surveys. There is no guarantee of accuracy; the user of these maps assumes responsibility for determining the suitability for their intended use in planning purposes.

The purpose of this document is to:

(1) Identify hazards, natural and technological, with the potential to threaten the people, property, environment, and economy of Bainbridge Island.

(2) Estimate the risk or likelihood of a hazard’s occurrence based on historic and other factors.

(3) Evaluate the Islands vulnerability to each hazard and estimate the potential severity of loss.

Hazard: a source of danger

Risk: chance of loss or injury

Vulnerability: susceptibility to attack or damage

Natural Hazards

Severe Storms - Flooding - Landslides - Earthquakes - Drought - Wildfire - Tsunami - Volcano

Technological Hazards (Human-origin)

Energy Emergency – Hazardous Materials (HazMat) - Transportation Mass Casualty - Search & Rescue - Terrorism/Civil Disorder - Epidemic

Risk and Severity Matrix

Hazards vary in their frequently of occurrence and the damage they can incur. Because of this, we've separated and ranked each according to risk and severity. Risk is determined by the historic frequency or their likelihood to occur in the near future. Consistent with the Kitsap CEMP, we used a 25 year span to measure probability. Events that can be expected annually or are likely to occur every 25 years are considered high risk. Events that have a moderate likelihood of occurring within a 25 year span are considered moderate risk, while those expected beyond 25 years are considered low risk. Severity was determined somewhat subjectively based on the scale of people, property, environment, and economy vulnerable to loss or damage from each hazardous event.

Risk and Severity Categories

High Risk **Low Severity**	**High Risk** **Moderate Severity**	**High Risk** **High Severity**
Moderate Risk **Low Severity**	**Moderate Risk** **Moderate Severity**	**Moderate Risk** **High Severity**
Low Risk **Low Severity**	**Low Risk** **Moderate Severity**	**Low Risk** **High Severity**

Risk Severity Matrix of Hazards

Energy Emergency	**Severe Storms**	**Earthquake**
Drought	**Flooding, Landslide,** **HazMat**	**Wildfire,** **Terrorism/Civil Disorder**
Search and Rescue	**Tsunami, Volcano,** **Transportation Mass Casualty**	**Radiological, Epidemic**

II. Bainbridge Island Profile

Location and Background of Assessment Area

Bainbridge Island is located at 47°39′ N 122°32′ W in northwestern Washington State (Figure 1). The City-Island is centrally located in the Puget Lowlands, east of the Kitsap Peninsula and west of the City of Seattle. The island is approximately 3.5 miles wide by 10.5 miles long and has an area of 28 mi^2 (17,778 acres). Elevations on the island range from sea level to just over 400 feet. The Island has an irregular coastline of approximately 45 miles and an extensive network of rivers, streams, and creeks that drain into 12 distinct watersheds.

The earliest known inhabitants of Bainbridge Island were coastal-dwelling members of the Suquamish Tribe, whose ancestors have resided in Central Puget Sound for approximately 10,000 years. The Suquamish depended on salmon, cod and other bottom fish, clams and other shellfish, berries, roots, ducks and other waterfowl, and deer and other land game to provide food for family use, ceremonial feasts, and for trade. Many present-day Suquamish live on the Port Madison Indian Reservation to the northwest of Bainbridge Island.

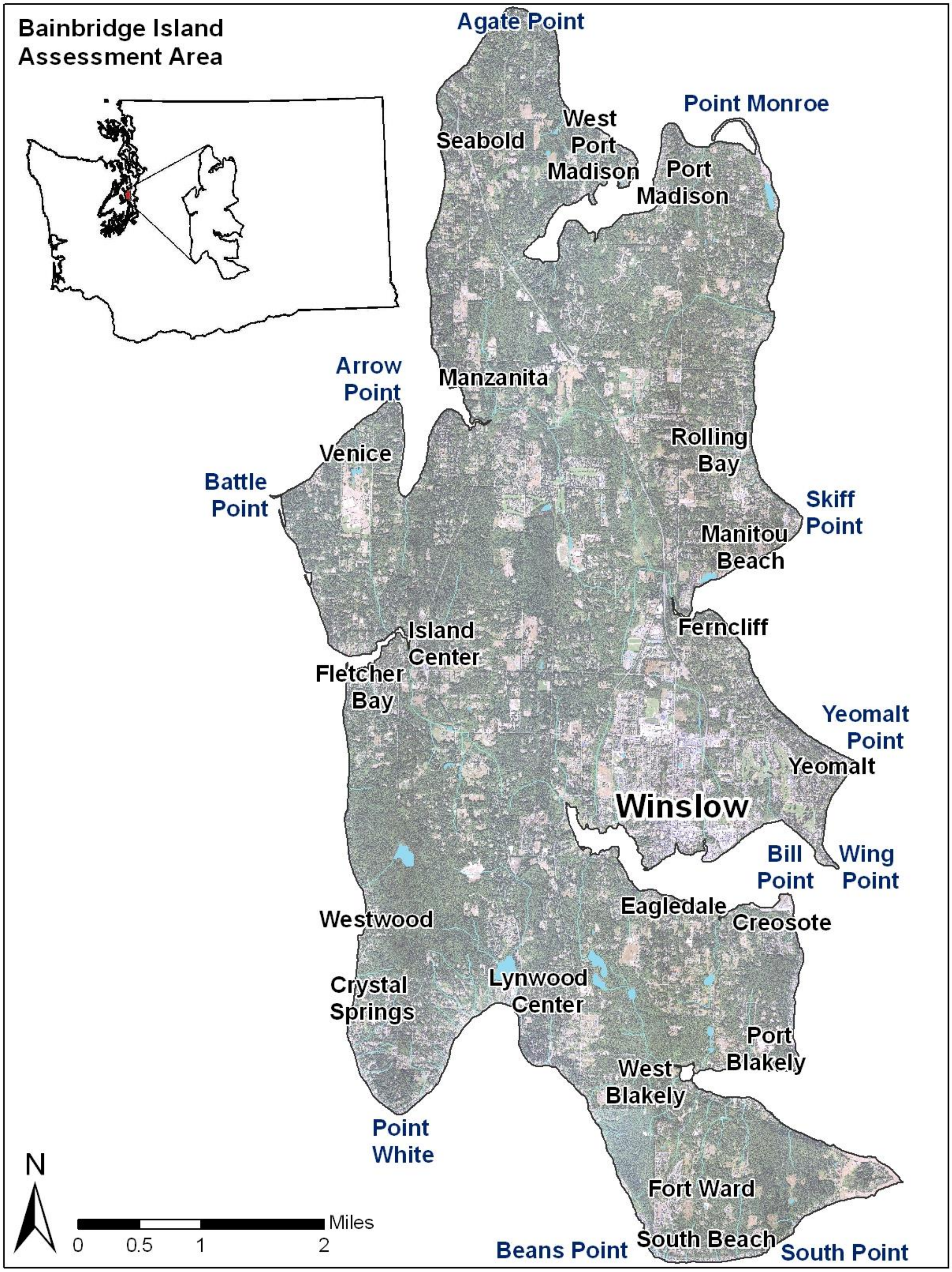
European exploration and settlement began in 1792, when George Vancouver led the British ships H.M.S. Discovery and Chatham into Puget Sound. While surveying parts of Puget Sound, Vancouver anchored off Restoration Point at the southern end of Bainbridge Island and traded with the Suquamish. The Vancouver expedition failed to identify Agate Pass and mapped the Island as a peninsula.

In 1841, the U.S. Exploring Expedition led by Charles Wilkes spent two months mapping Puget Sound in anticipation of U.S. sovereignty in the Region. It was during this expedition that Agate Passage was identified and the newly “discovered” Bainbridge Island was named after Commodore William Bainbridge, commander of the frigate U.S.S. Constitution in the War of 1812. Reports of the Wilkes survey attracted early settlers, many of whom trapped or cut trees to supply the “world’s largest sawmill” at Port Blakely and the bustling Hall Brothers’ Shipyard. Bainbridge Island has a strong Japanese and Filipino cultural history. They worked as farmers and helped make Bainbridge Island famous for strawberries.

Today, most of the strawberry fields are gone and Bainbridge Island is predominantly composed of residential neighborhoods. However, residents support preserving open space and keeping control over development, both residential and commercial. In a 2008 survey of community values, residents responded that they are committed to preserving the Island's sense of community and its green spaces, including agricultural land, forests, parks, and trails.

The city center was incorporated as the City of Winslow in 1947 and the unincorporated areas of the Island were annexed to create the City of Bainbridge Island (COBI) in 1991. Established neighborhoods on the Island include: Creosote, Crystal Springs, Eagledale, Lyndale, Island Center, Ferncliff, Fletcher Bay, Seabold, Port Madison, South Beach, West Port Madison, Manzanita, Venice, Fort Ward, Manitou Beach, Port Blakely, West Blakely, Westwood, Yeomalt, and Rolling Bay (Figure 1). Throughout this document, “the Island” refers to Bainbridge Island.

Figure 1: Bainbridge Island Hazard Identification and Vulnerability Assessment Area.



Demographics

The 2010 U.S. Census Bureau population estimate for Bainbridge Island was 23,025 with a density of about 834 persons per mi^2 (Figure 2). This represents a 13% increase from the 2000 estimate of 20,308 (Figure 3). The Island had a 22% increase in population between 1990 (pop. 15,846) and 2000. Population is distributed fairly evenly across the Island, with the highest density and growth in the Winslow area (Figures 2-3). There are 10,584 housing units (2010) with an 81% home ownership rate (2005-2009). From 2005-2009, Bainbridge Island had an estimated 8,903 households with an average size of 2.5 people. The median owner-occupied home value is approximately $600,000. The 2005-2009 median monthly housing costs for mortgaged owners was $2,582, non-mortgaged owners $704, and renters $1,179. The 2005-2009 estimated median income of households on Bainbridge Island was $91,280 with 5.6% of the population in poverty.

The 2010 ethnicity estimate for Bainbridge Island was distributed as 91% white, 3.2% Asian, 0.5% American Indian or Alaska Native, 0.4% Black or African, and 0.2% Native Hawaiian and Other Pacific Islander. From 2005-2009, 97.8 percent of people 25 years and over had at least graduated from high school and 64.6 percent had a bachelor's degree or higher. The leading industries on Bainbridge Island for the employed population 16 years and older include professional, scientific, and management; administrative and waste management services; educational services; health care; and social assistance.

Residential land uses occupy the largest percentage (73%) of developed land and covers 38% of all land on the Island (about 7,000 total units). Single-family homes account for 84% of residential units, while 16% are multi-family units in condominiums and apartment buildings of various sizes. The most densely developed areas are in Winslow and along the shoreline of the Island (Figure). The Winslow area is developed at about 2.5 units per acre. Agriculture is still an important land-use presence on the Island and there are a number of small-scale farms ranging from strawberry and raspberry farms to a goat dairy, tree farms, and organic vegetable farms. A few large tracts of second-growth timber remain on the Island; in 2006, there were approximately 620 acres classified as timberlands by the Kitsap County Tax Assessor.

Figure 2: Bainbridge Island population density estimate in 2010, by census block (U.S. Census data).

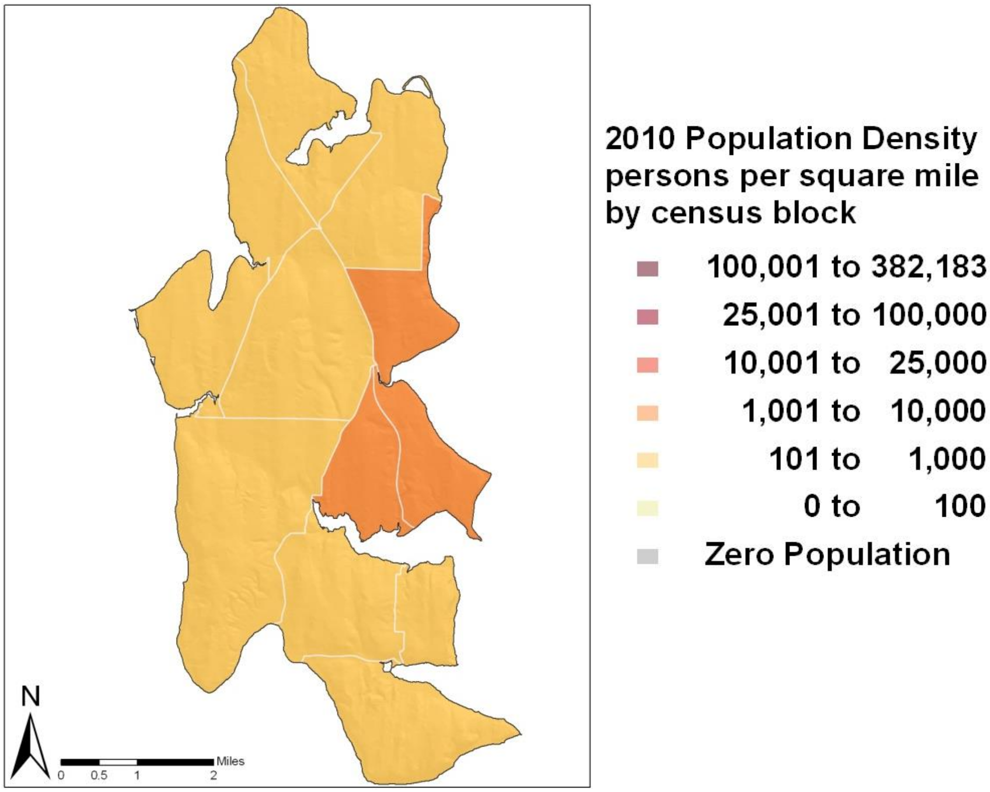
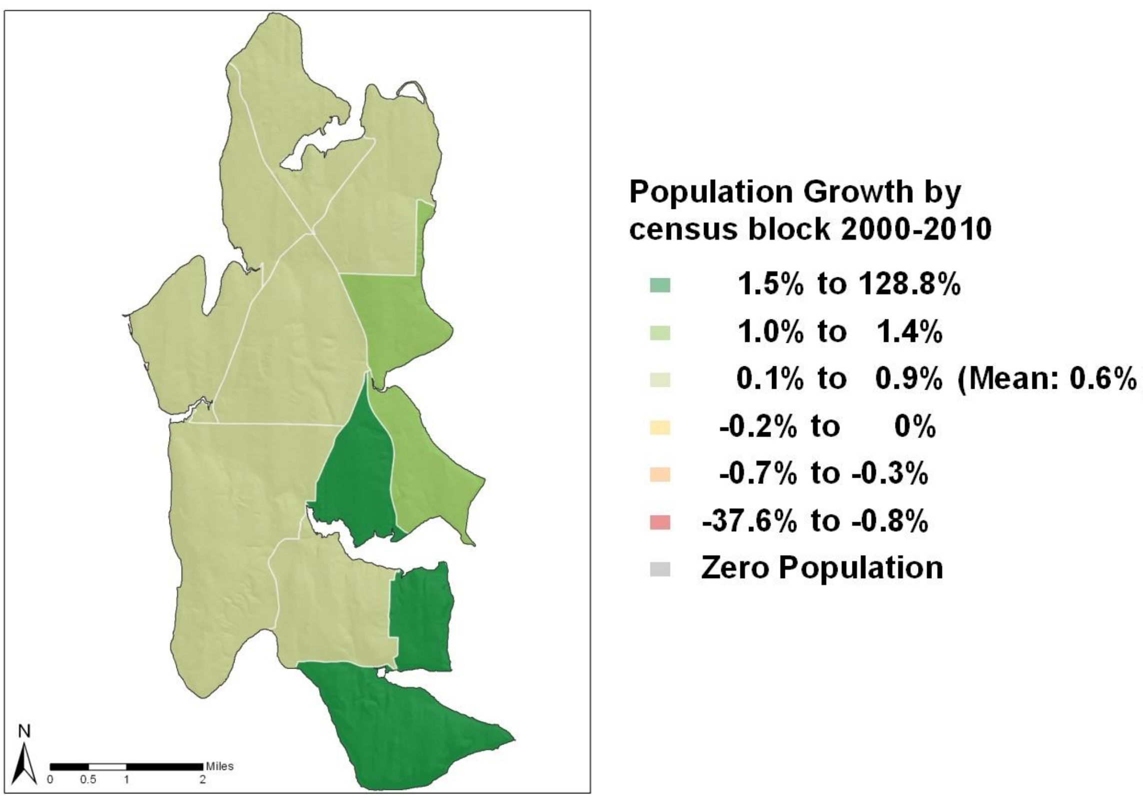


Figure 3: Bainbridge Island average annual estimated population growth 2000-2010 (U.S. Census data).



Transportation

The Island serves as a transportation route connecting the State Route 305 corridor from the Kitsap Peninsula to downtown Seattle and the Interstate 5 and 90 corridors (Figure 4). SR 305 provides an important north-south connection for intra- and inter-Island travel and is supported by the City roadway system that connects residential areas to each other, the highway, and retail and employment areas. The City's roadway system consists of approximately 119 miles of paved roads, and another 20 miles of unpaved roads.

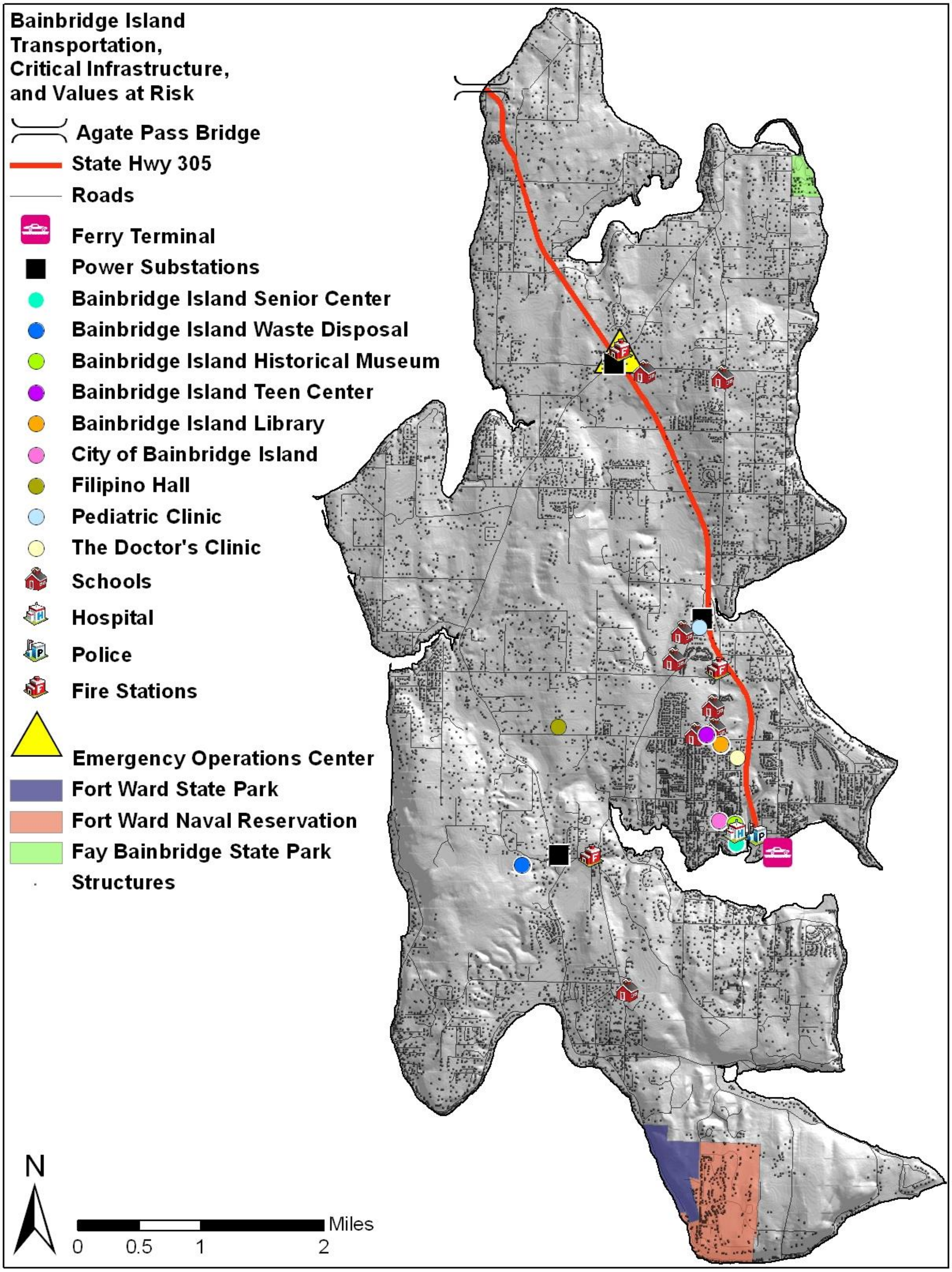
The Seattle/Bainbridge Island ferry is the state's most heavily travelled ferry run, providing about 90 crossings per week between Eagle Harbor in Winslow and Coleman Dock (Pier 51) in Seattle. Two jumbo Mark II Class auto/passenger ferries, the M/V Tacoma and M/V Wenatchee, serve the 8.6 mile route with a 35-minute crossing time, traveling at a speed of 28 knots. Each vessel has maximum capacity for 2,500 passengers, 218 vehicles, and 60 commercial vehicles.

The Agate Pass Bridge connects State Route 305 from Bainbridge Island to the Kitsap Peninsula and was built in 1950 to replace car ferry service that dated from the 1920's. The bridge spans 1,229 feet, reaching 75 feet above the water with a 300 foot channel clearance between piers.
There are no airport facilities on Bainbridge Island and the nearest airport is the Bremerton National Airport in Bremerton.

Critical Infrastructure and Values at Risk

An essential part of hazard planning is identifying the people, places, and things in need of protection. Hazard mitigation efforts typically focus on protecting homes, critical infrastructure, and places of value. Critical infrastructure can include, but is not limited to: fire response, police hospitals, utilities, schools, roads, etc. In addition, every community has sites of social, environmental, or historic value that require priority during protection planning. These can include, but are not limited to: community centers, environmentally sensitive areas, parks, historic sites, etc. Island structures, critical infrastructure, and select values at risk are shown in Figure 4. Emergency centers are listed in Appendix D. Historic sites and community centers are listed in Appendix E.

Figure 4: Bainbridge Island Transportation and Critical Infrastructure.



Environment

Geology

Bainbridge Island was initially shaped as the 3,000 foot-thick Vashon Glacier carved out Puget Sound at the end of the last Ice Age, 13,000 to 15,000 years ago (Figure 5). The island lies within a broad region in the fore-arc of the Cascade volcanic arc that extends from south of Olympia, WA to north of Campbell River, BC. To the east are the Cascades; west are the Olympic Mountains. Soils on the island (Figure 6) are typical of Puget Sound in that dense, compacted, glacial till is present at a rather shallow depth with an underlying hardpan. This glacial till is made up of clay, silt, sand, and gravel, and overlay bedrock in varying thickness across the Island. There is sedimentary bedrock exposed on the southern part of the island, where soils in some areas are moderately well to poorly drained.

Figure 5: Bainbridge Island Geology (DNR data).

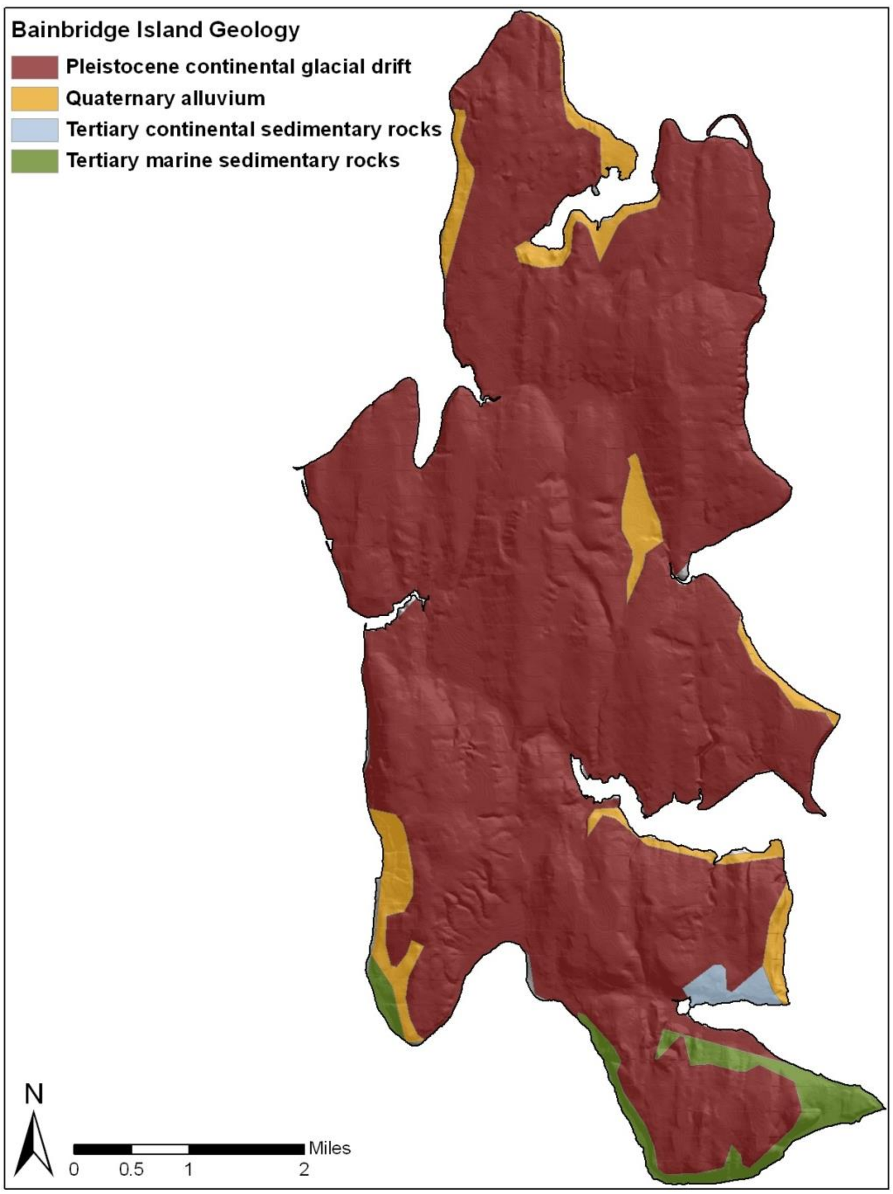
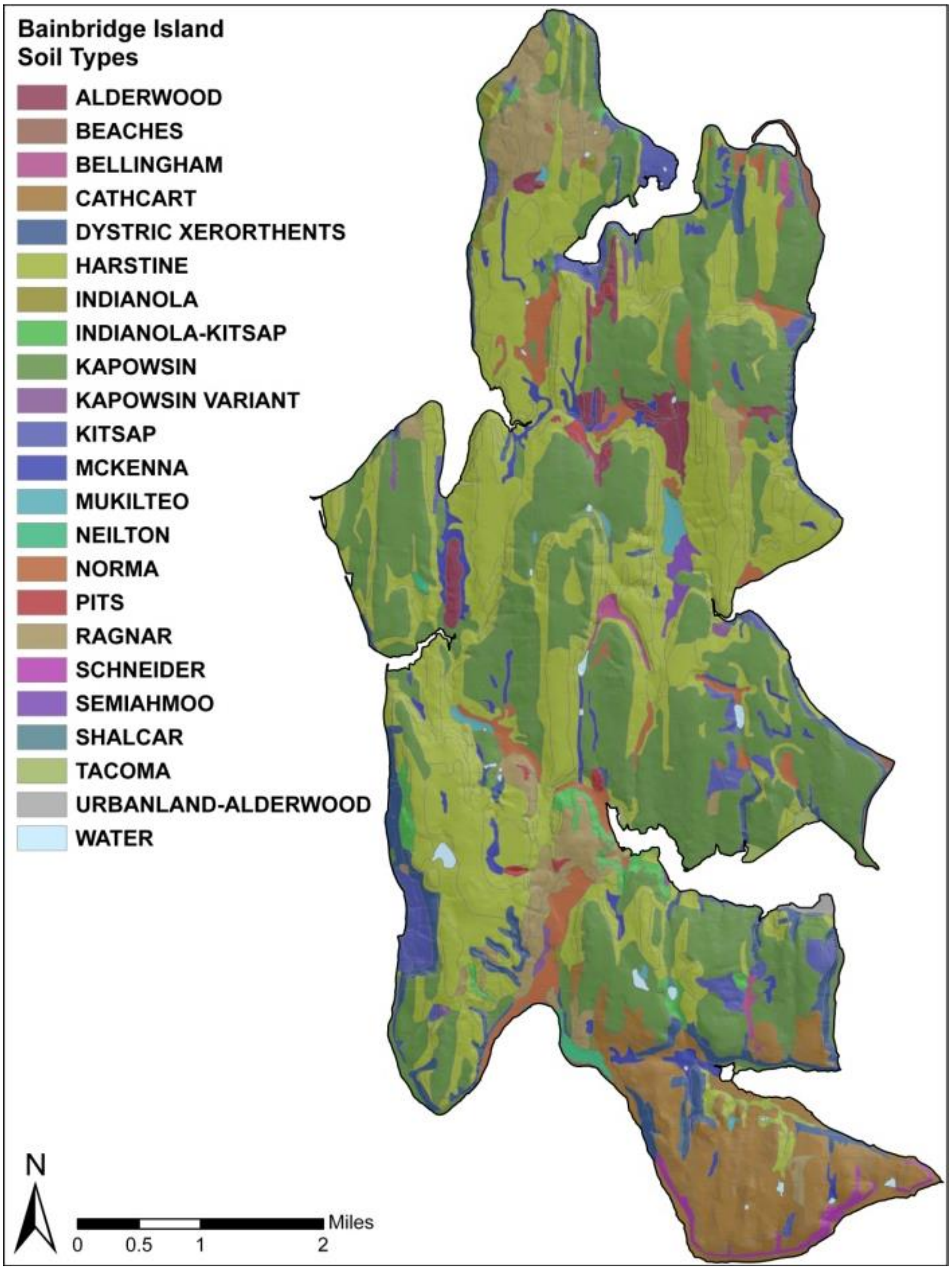


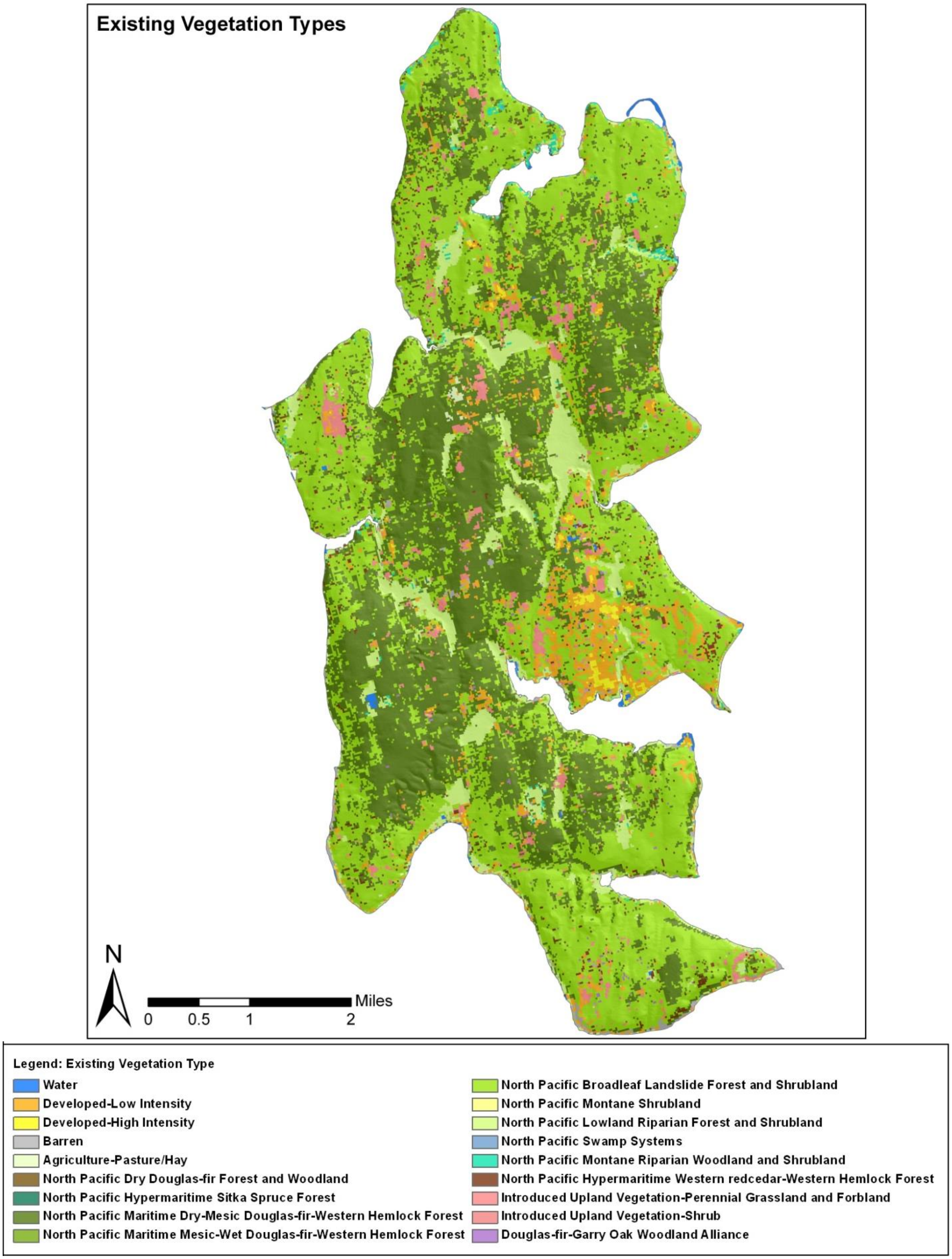
Figure 6: Bainbridge Island soil types (DNR data).



Vegetation

Characteristic of the temperate maritime climate of the Puget Sound region, vegetation tends to grow lush and dense (Figure 7). Outside of human development, second- and third-growth forest covers most of the island. Common tree species are: Douglas fir, western hemlock, western redcedar, bigleaf maple, and alder. Undergrowth is dominated by dense salmonberry, huckleberry, sword fern, salal, Oregon grape and English ivy. Open areas, unless grazed or mowed, are often filled with two exotic species of blackberry or slide alder.

Figure 7: Bainbridge Island Existing Vegetation Types.



Wildlife

A diversity of wildlife can be found on Bainbridge Island. The abundance of shoreline, tidelands, tidal inlets, and coastal forests are the major component of the Island's wildlife habitat. Oysters, clams, geoducks, and crabs are found on the tidelands while many species of shorebirds and waterfowl live along the shoreline or use the area as a stop-over point during migration. The forests and understory provide habitat for deer, coyotes, a variety of small mammals, and dozens of bird species. Pastures and meadows support openland wildlife, such as pheasant, quail, and rabbits, while riparian and wetland areas provide cover for many species of fish, birds, mammals, and amphibians. Salmon presence has been verified in Springridge, Hidden Cove, Manzanita and Murden Cove.

Species on Bainbridge Island that are classified as threatened, endangered, sensitive, or in need of monitoring as identified by the Washington Department of Fish and Wildlife (DFW) include the Bald Eagle, the Great Blue Heron, and the Pileated Woodpecker. Although no longer listed State and Federal threatened classification, Bald Eagles are still protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. They are found along the shores of saltwater and freshwater lakes and streams, and nest in predominantly coniferous forests. The Great Blue Heron is listed for state priority habitat status due to its threatened breeding areas. They are typically found at low elevations near all types of fresh and saltwater wetlands, streams, and shorelines, and they usually nest in colonies in the tallest conifers or deciduous trees available. The Pileated Woodpecker is a state candidate for threatened status that usually nests within cavities in snags or live trees. Considered "uncommon" by local birders, they are generally found in mature forests. They may persist in younger forest stands if large diameter trees are retained along with significant numbers of snags and fallen trees. Other priority habitat species sighted by citizens, but not officially documented by the DFW include osprey, river otter, and harlequin ducks.

Climate

The climate on Bainbridge Island is generally characterized as Maritime with mild, wet winters (40-50˚ F average daytime temperatures) and warm, dry summers (70-80˚ F average daytime temperatures). Temperatures will occasionally drop low enough for snow to develop during the winter months, although typically without significant accumulation.

Average annual rainfall varies between 40 to 45 inches, and its distribution is influenced by the prevailing wind patterns. Most precipitation occurs in the autumn and winter; like much of western Washington, the summer months experience an average of less than 2" rain per month (Figures 8-9).

Prevailing winds from the west and southwest are strongly affected by the Olympic Mountains (Figures 10-11). A meteorological phenomenon known as the Puget Sound Convergence Zone (PSCZ) occurs when the atmosphere is unstable and a low-level, large-scale air flow splits around the Olympic Mountains and then converges over Puget Sound (Figure 11). This event occurs several dozen times a year in the winter, spring and early summer; creating cloudy and rainy conditions in the Puget Sound Basin when it's clear elsewhere. A PSC event can erupt into heavy rain and/or snow, gusty erratic winds, cold temperatures, and even thunder and lightning. Stormy episodes usually last two to four hours, but an entire PSCZ event can last two or three days. The most intense PSCZ events occur in the spring and early summer.

Figure 8: Climograph for Bremerton, WA ~5 mi. SW of Bainbridge Island (WRCC data).

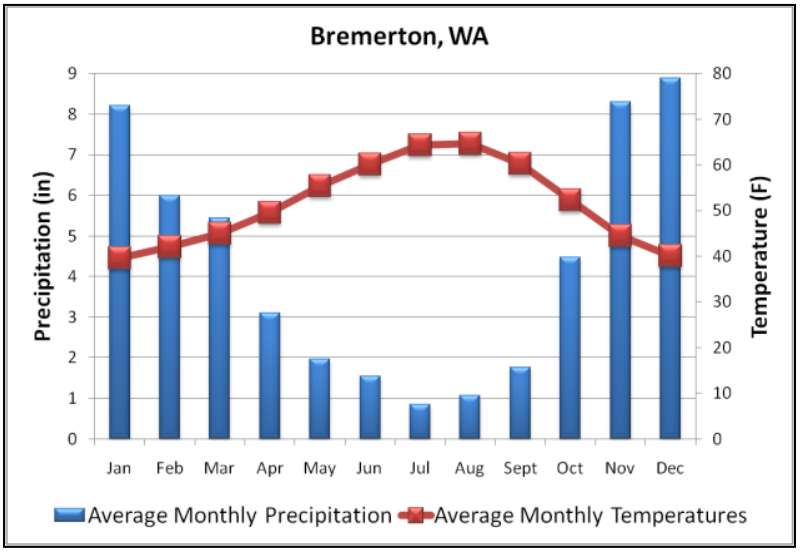


Figure 9: Bainbridge Island average annual precipitation distribution (OSU-PRISM data).

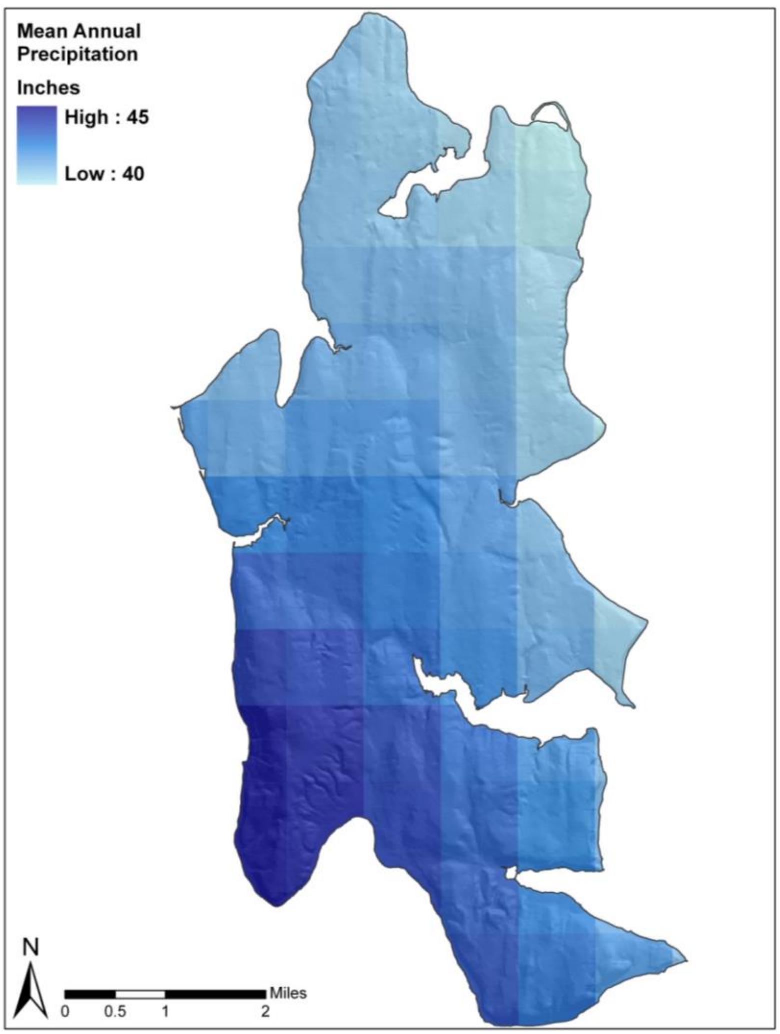


Figure 10: Windrose displaying predominant wind direction at Seattle-Tacoma Airport, ~15 miles southeast of Bainbridge Island (WRCC graph).

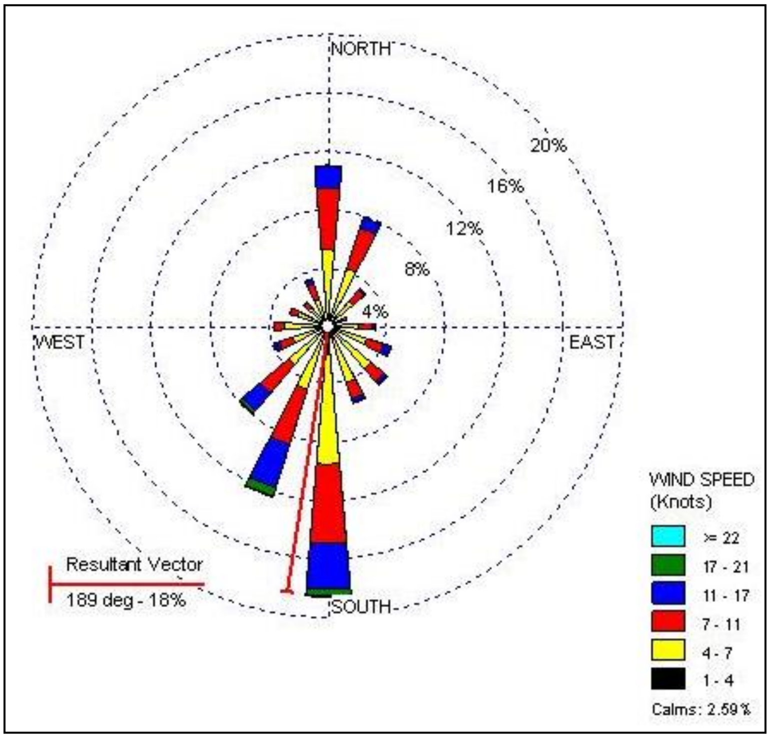
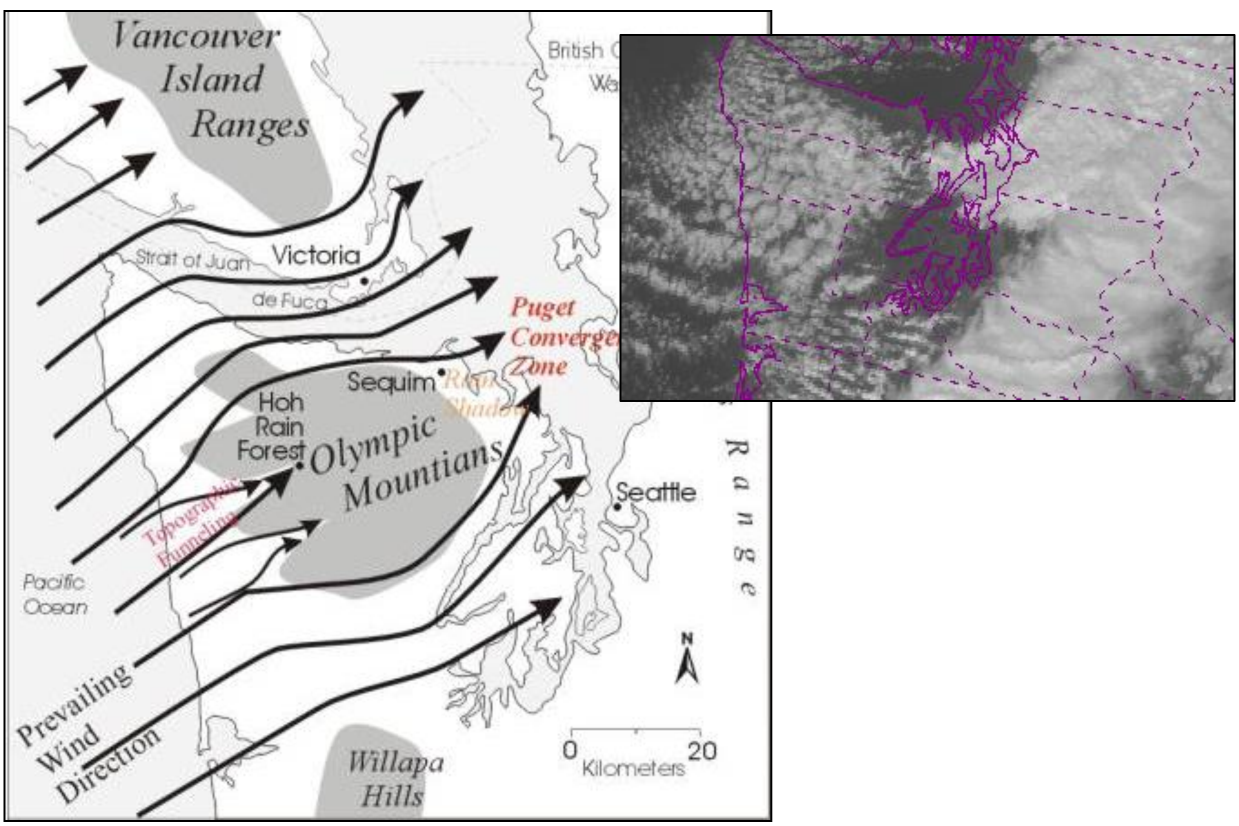


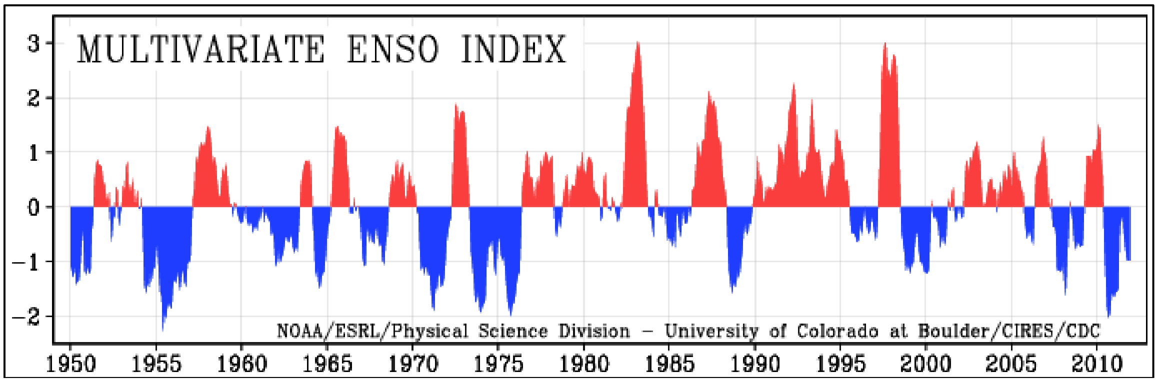
Figure 11: Olympic Mountains and their influence on prevailing winds creating the Puget Sound Convergence Zone (PSCZ).



Climate Cycles

Climate and precipitation in the Puget Sound region are strongly affected by the El Niño Southern Oscillation (ENSO), and the Pacific Decadal Oscillation (PDO) cycles. ENSO variations in sea surface temperatures are more commonly known as El Niño (the warm phase of ENSO) or La Niña (the cool phase of ENSO) (Figure 12). La Niña years are associated with higher than average precipitation while El Niño years are associated with lower precipitation.

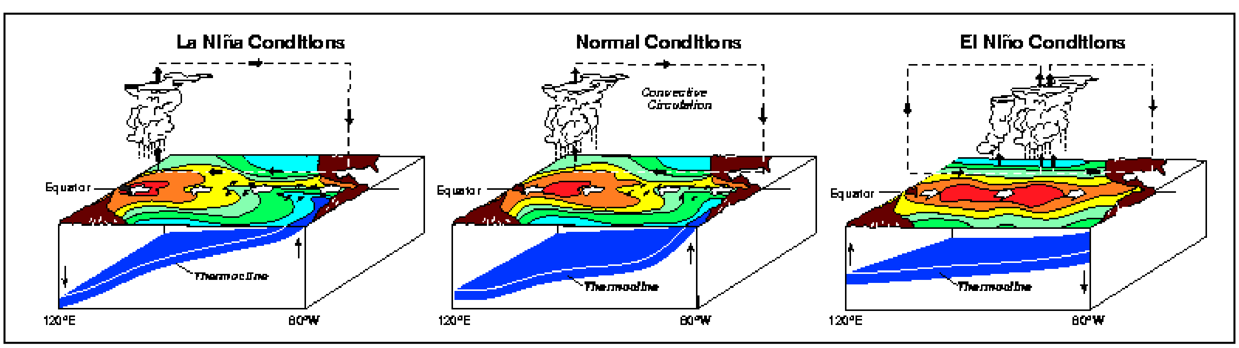
Figure 12: El Niño Southern Oscillation (ENSO) cycles of warm and cool sea surface periods expressed as the annual degrees above or below the long-term average from 1950 through 2011. (NOAA)



During an El Niño year, there is a warming of the Pacific Ocean between South America and the Date Line, centered directly on the Equator, and typically extending several degrees of latitude to either side of the equator. The warming is expressed as a departure from long-term average ocean temperatures, which are generally cool in the region, due to upwelling. El Niño is thus associated with a slackening, or even cessation, of the cold upwelling conditions which typically prevail in that area.

La Niña is essentially the opposite of El Niño. La Nina exists when cooler than usual ocean temperatures occur on the equator between South America and the Date Line. Stronger than usual trade winds accompany La Niña, and these winds from the east push the ocean water away from the equator in each hemisphere due to the rotation of the earth. Cold water from the deep rises to replace the warm surface water which has moved away from the equator. The cool water acts as an impediment to the formation of clouds and tropical thunderstorms in the overlying air. This suppression of rain-producing clouds leads to dry conditions on the equator in the Pacific Ocean from the Date Line east to South America but create wetter than normal conditions further up the pacific (Figure 13).

Figure 13: Cross-section of ocean temperatures and wind flow during La Nina, Normal, and El Nino years.



The PDO is a twenty- to thirty-year cycle in between warm and cool sea-surface temperatures and wind patterns over the Pacific Ocean (Figure 14). Warm-cycle PDO years bring the PNW warmer temperatures and less snow, while cold-cycle years bring colder temperatures and increased snow. Cool phase PDO years are associated with increased precipitation, while La Nina years combined with a cool phase PDO will bring the greatest precipitation events. Flooding is less likely and drought more likely, during warm phase ENSO (El Niño) and PDO (Figure 15).

Figure 14: Pacific Decadal Oscillation (PDO) cycles from 1900 through 2011.

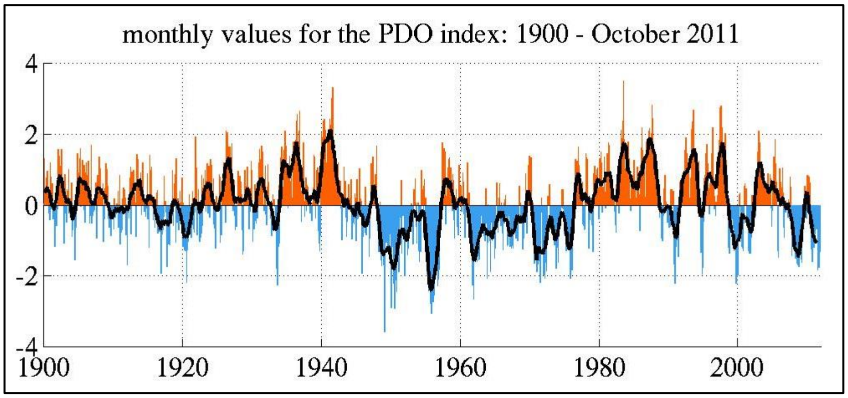
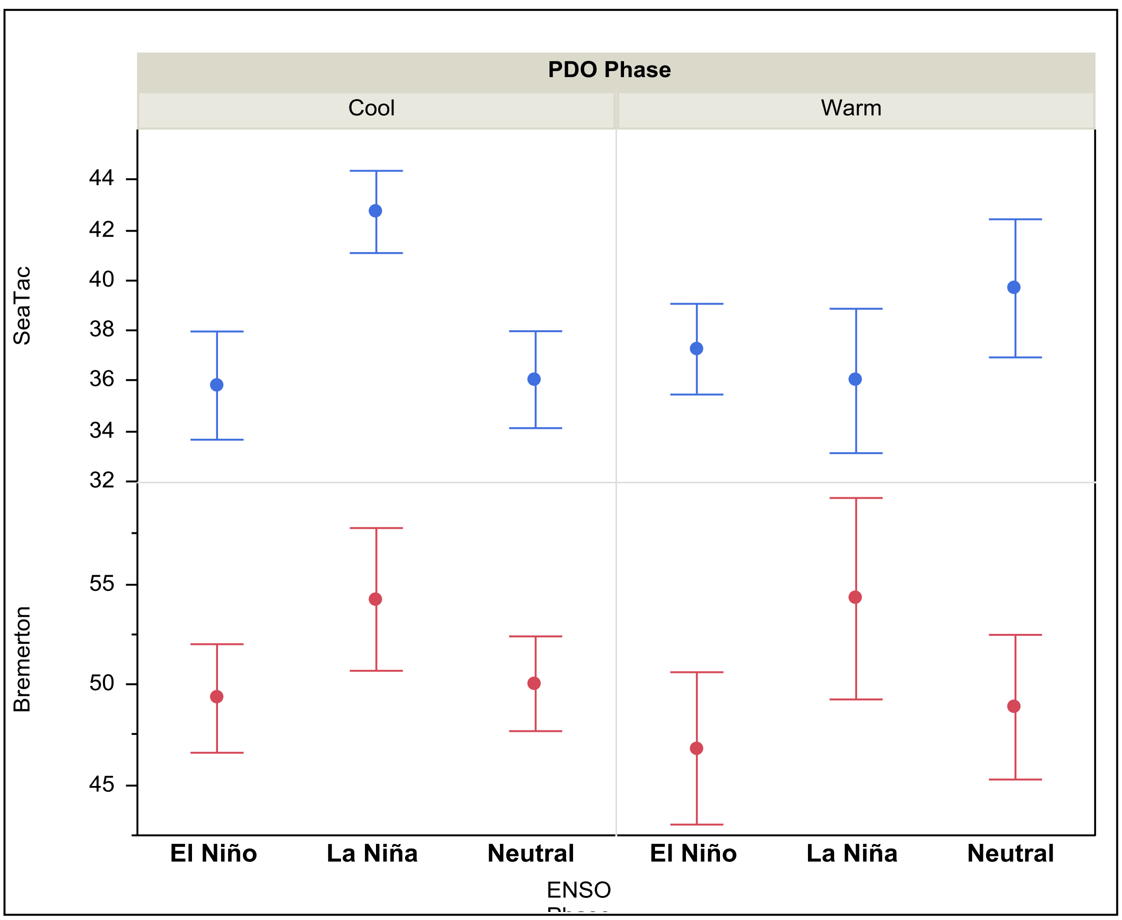


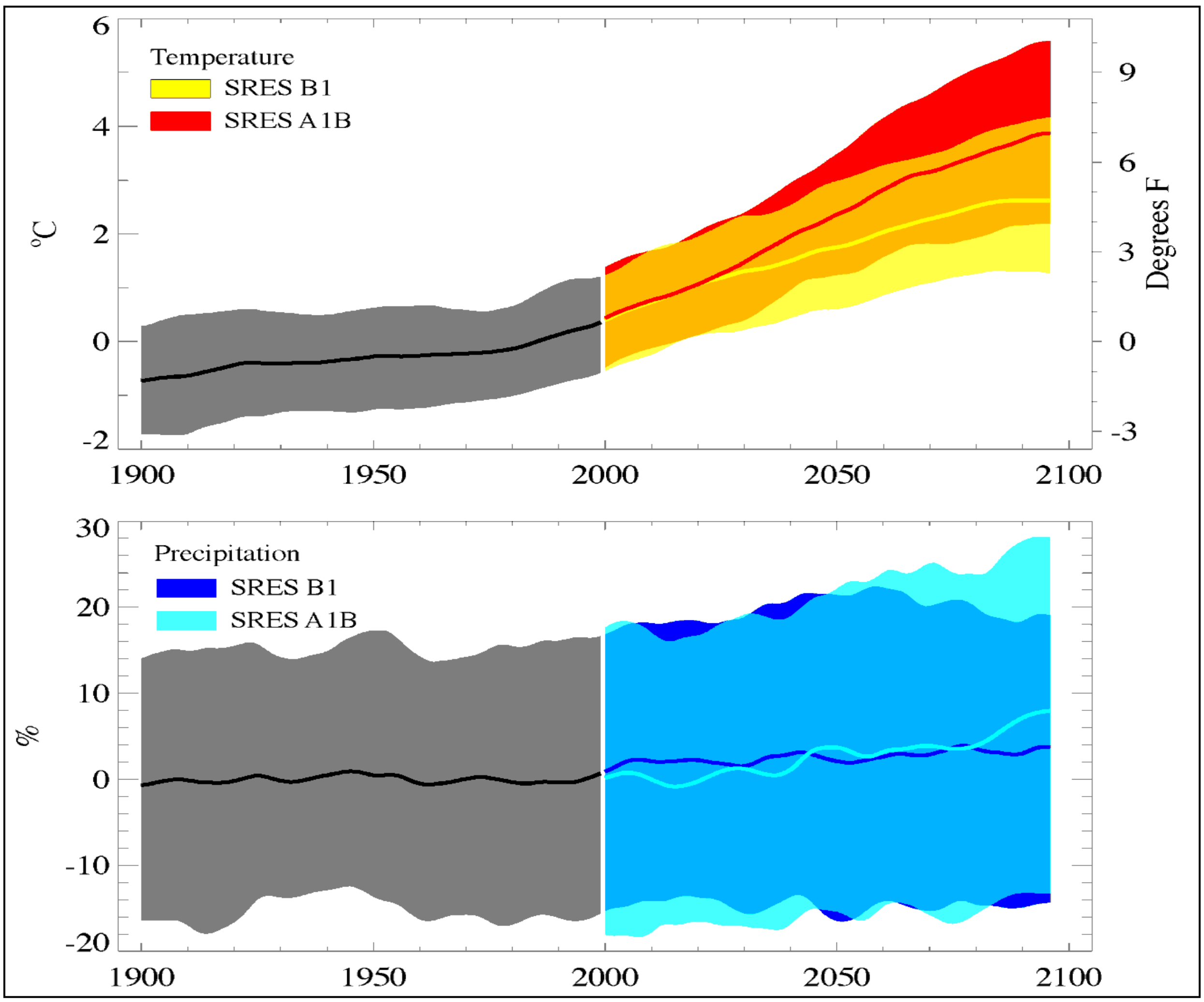
Figure 15: Average annual inches of precipitation near Bainbridge Island during each combination of ENSO and PDO cycle.



Climate Change

An increasing amount of climate research in recent years has indicated that we are experiencing a significant change in global climate due primarily to the anthropogenic release of greenhouse gasses into the atmosphere. While there is great uncertainty as to the ultimate long-term climatic response, the University of Washington Climate Impacts Group has conducted extensive research to support their climate change projections (Figure 16). Temperature is projected to increase overall with more extreme and prolonged summer highs, increasing the risk of droughts. Precipitation is also projected to increase overall with greater winter precipitation, increasing the risk of floods. There is also the potential that an increase in atmospheric energy from the higher temperatures could drive more extreme storm events.

Figure 16: Projected temperature and precipitation increases for the Pacific Northwest Region as modeled by the UW Climate Impacts Group. SRES B1 reflects significant greenhouse gas mitigation by the mid 21st century (low emissions scenario). SRES A1B reflects significant greenhouse gas mitigation by the end of the 21st Century (medium emissions scenario). Shaded ranges are 5th percentile and 95th percentile.



III. Natural Hazards

Severe Storms

Description

A severe storm is an atmospheric disturbance that results in one or more of the following phenomena: strong winds and large hail, thunderstorms, tornados, rain, snow, or other mixed precipitation. The most common storms that visit the Island involve wind, rain, snow, and ice. There is a remote possibility of a small tornado touching down on the Island because of the rotation of winds in a Puget Sound Convergence event, as happened in Kent, WA in Dec. 1969.

Effects

Severe storms can destroy property, disrupt traffic, cause power outages, and lead to loss of life. Severe storms are often a catalyst for other hazards. Strong winds can blow down trees and powerlines, and mobilize projectiles increasing the risk of injury. Intense rain can cause flooding and landslides, while lightning storms are capable of igniting wildfires. Snowstorms can impede traffic, cause accidents, and cause injury or death through cold related exposure.

History

Figure 17: 40 mph winds during a March, 2010 storm cause a Douglas fir falls on powerlines along Miller Road near Tolo Road. (Bainbridge Island Review)

Despite the moderate marine climate, severe storms are the most frequently occurring hazard on the Island. The greatest wind storm to ever hit the area was the extratropical cyclone "Columbus Day" storm of 1962, which had estimated peak wind speeds of 145-179 mph. More recently, the Inauguration Day storm of 1993 brought severe winds reaching over 90 mph in downtown Seattle. Other storms that have severely impacted Kitsap County have occurred in: 2006, 1986, 1985, 1980, 1979, 1973, and 1971. The most severe snowstorms that have occurred in Kitsap County were: 1996, 1990, 1985, 1971, 1969, 1961, 1951, 1950 and 1949. While storms can hit anytime, the most severe storms have historically occur during the autumn and winter months from October through February. Recently, a Christmas storm with wind gusts up to 50 mph knocked out power to a portion of the Island on Dec. 25, 2011.

The El Niño Southern Oscillation (ENSO), and the Pacific Decadal Oscillation (PDO) cycles can influence the type of storm systems expected in a given year. La Niña years are associated with higher than average precipitation and La Niña years combined with a cool phase PDO will bring the greatest precipitation events. (See Climate Cycles in section II)

Storm tracks can bring different types of weather to the Island depending on direction of origin. Snowstorms are frequently the result of northerly storm fronts. Systems coming from the west to northwest can bring brief, but intense precipitation with thunderstorms. Weather systems from the south to southwest, known as the “pineapple express,” can bring warm humid air from the tropics and tend to cause persistent rain. These weather systems can also push the freezing level up to 8,000 ft creating flood conditions from snowmelt and rain-on-snow events. At its most extreme, the pineapple express system becomes what’s known as an “atmospheric river” and can lead to large scale precipitation and flooding (Figure 19).

Figure 18: Winds exceeding 100 mph resulted in the failure of the western section of the Hood Canal Bride on Feb. 13, 1979 (Peninsula Daily News).

Figure 19: Climate system where a warm and moist airstream known as an “Atmospheric River” hits the Pacific Northwest.

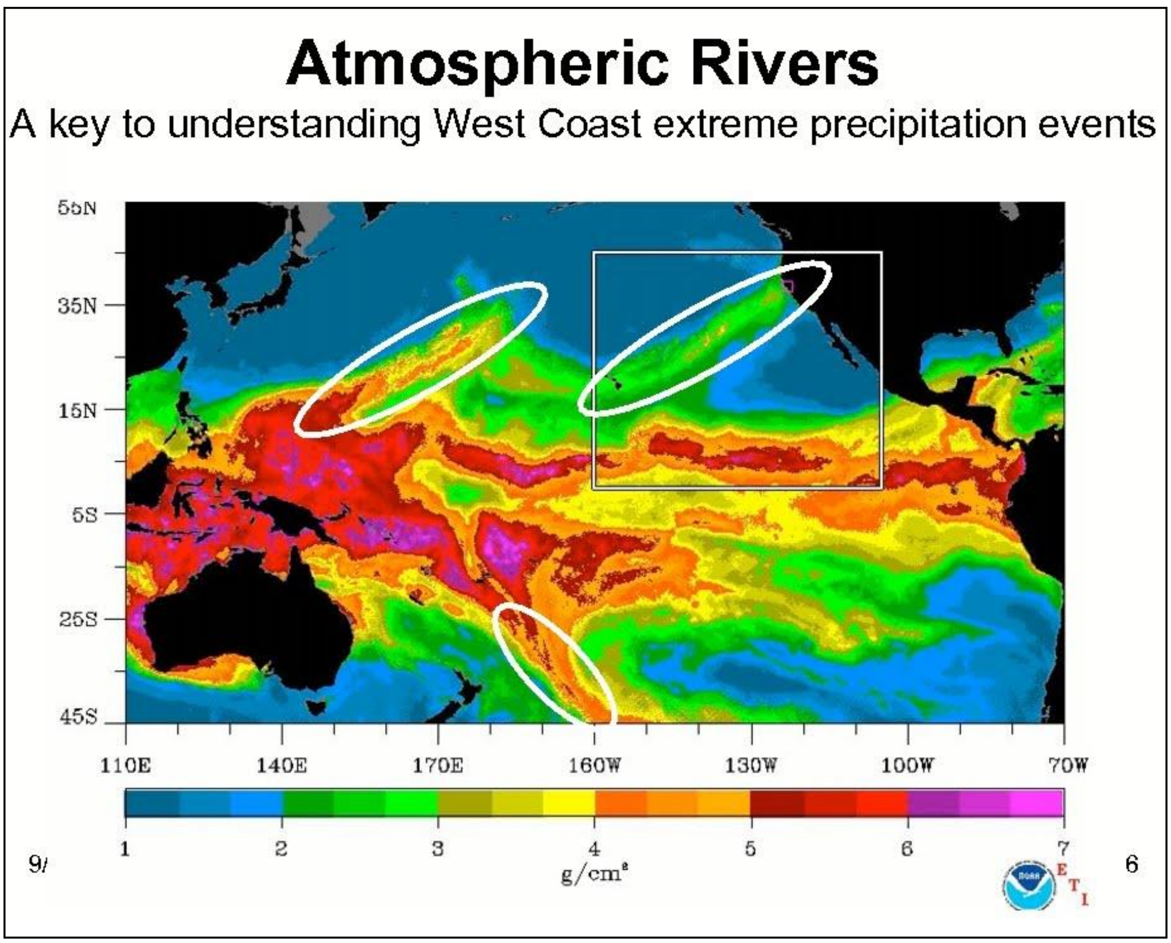
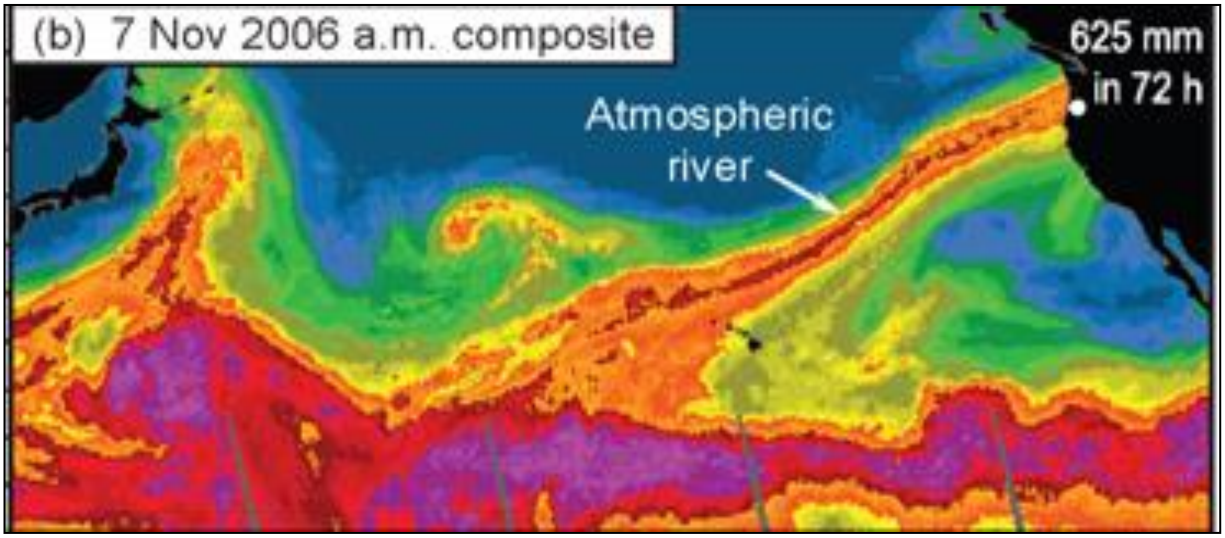


Figure 20: The floods of Nov 2006 were generated by a large atmospheric river.



A recent modeling study on a worst-case severe winter storm impacting California, driven by a series of heavy atmospheric rivers, suggested that such an event could readily flood thousands of square miles, result in thousands of landslides, disrupt lifelines throughout the state for days or weeks, and cost on the order of $725 billion, an economic value more than three times that estimated for a major earthquake.

Vulnerability

Power loss is the Island's most common vulnerability to severe storms. There is also a risk of people suffering from cold exposure during power outages or if stranded in the event of traffic closure. The Bainbridge Island Senior Community Center serves as the Island's only designated warming station for storm related power outages (Figure 4). The Center now has a 45 kilowatt generator and 500-gallon capacity propane tank, which can provide power for up to a week.

Blowdown of trees and power lines during powerful windstorms is another source of vulnerability for the Island. Many Island structures are proximal to potential hazard trees.

The National Weather Service (NWS) Climate Prediction Center (CPC) provides 3-7 and 8-14 day climate hazard outlooks to assist in preparing for severe storms
http://www.cpc.ncep.noaa.gov/products/predictions/threats/threats_ie.php

Flooding

Description

A flood is an inundation of dry land with water. Types of floods in Washington State are primarily river, surface water, flash, and tidal. Flooding on Bainbridge Island is typically brief and associated with intense precipitation events.

Effects

Floods may result in the loss of life, damage to property and critical infrastructure, damage to the environment, and economic loss. The swift currents of swollen rivers, streams, and drainages can increase the risk of people being swept away and suffering injury or drowning. Saturation of the soil can compromise structural foundations and increase the risk of landslides. Structures built near wetlands, in flood plains, or low lying coastal areas are at the highest risk.

History

Some past flooding events occurred in Nov. 1990, Dec. 1994, Feb. 1996, Mar. 1997, July 2002, Oct. 2003, Nov. 2006, and Dec. 2007. According to an article in the Kitsap Sun, flooding on Dec. 3, 2007 caused a power outage which led Safeway to close, while residents flocked to a minimart at Island Center looking for essentials like milk, bread and beer. The High School Road, Wing Point, and Tolo Road areas were the hardest-hit during that storm. Sand bags were available at Bainbridge Island Fire Station 22 on Bucklin Hill while road closures on the island included: Country Club Road, Toe Jam to Upper Farms, and Manitou Beach at Murden Cove.

Figure 21: Flooding along High School Road in Bainbridge Island (King 5 news).

Photo posted on November 23, 2011 at 8:26 AM: Heavy rains overwhelmed drains along High School Road in Bainbridge Island providing unplanned delays for commuters. Local resident dons boots and searches for the storm drain below two feet of water. Status as of 8:15 am - storm drain cleared. (Photo credit King 5 news)

Figure 22: High tides flood yards, driveways, and the street on the Bainbridge Island Sandspit (Kitsap Sun).

Vulnerability

The absence of snow packed mountains or large river drainages limits the potential for a destructive flood on the Island. Roads and large areas of impermeable surface (parking lots, etc.) are the most likely to suffer from flash flooding during precipitation events. High School Road is an area that has experienced repeated flood vulnerability. Homes on the northern sand spit and other coastal areas that currently experience tidal flooding could have a greater flood risk in the future (Figure 22). Projections state that Puget Sound sea levels could rise above 1980-99 levels up to 6 inches by 2050 and 13 inches by 2010. If sea levels raise in accordance with climate change projections, it would result in coastal inundation (Figure 23). Inland areas that are determined most likely to suffer from flooding are shown in Figure 24. The flood prone areas are comprised of existing wetlands and FEMA's Flood Insurance Rate Map (FIRM) of the Islands 100-year floodplain; the area of the community with a 1% chance of flooding in any given year.

Figure 23: Projected sea level rise in Puget Sound relative to 1980-99. Range is highest/lowest estimate.

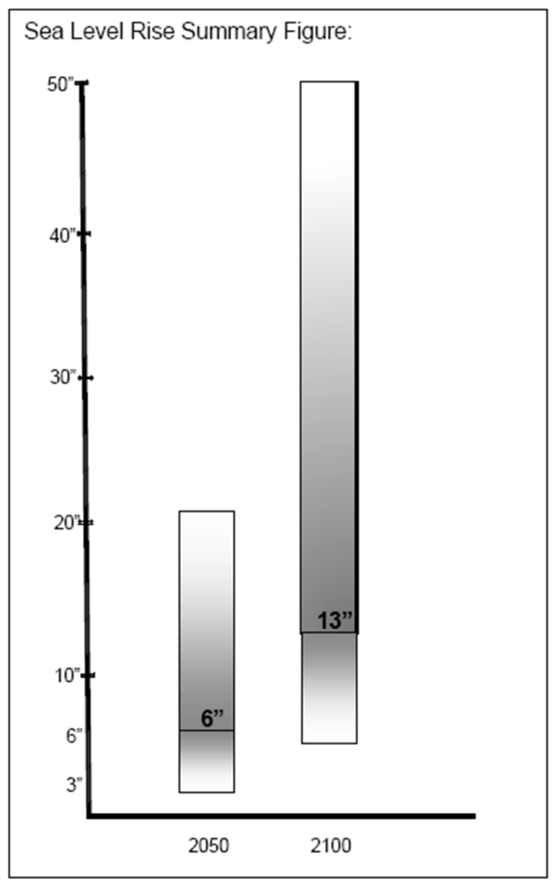
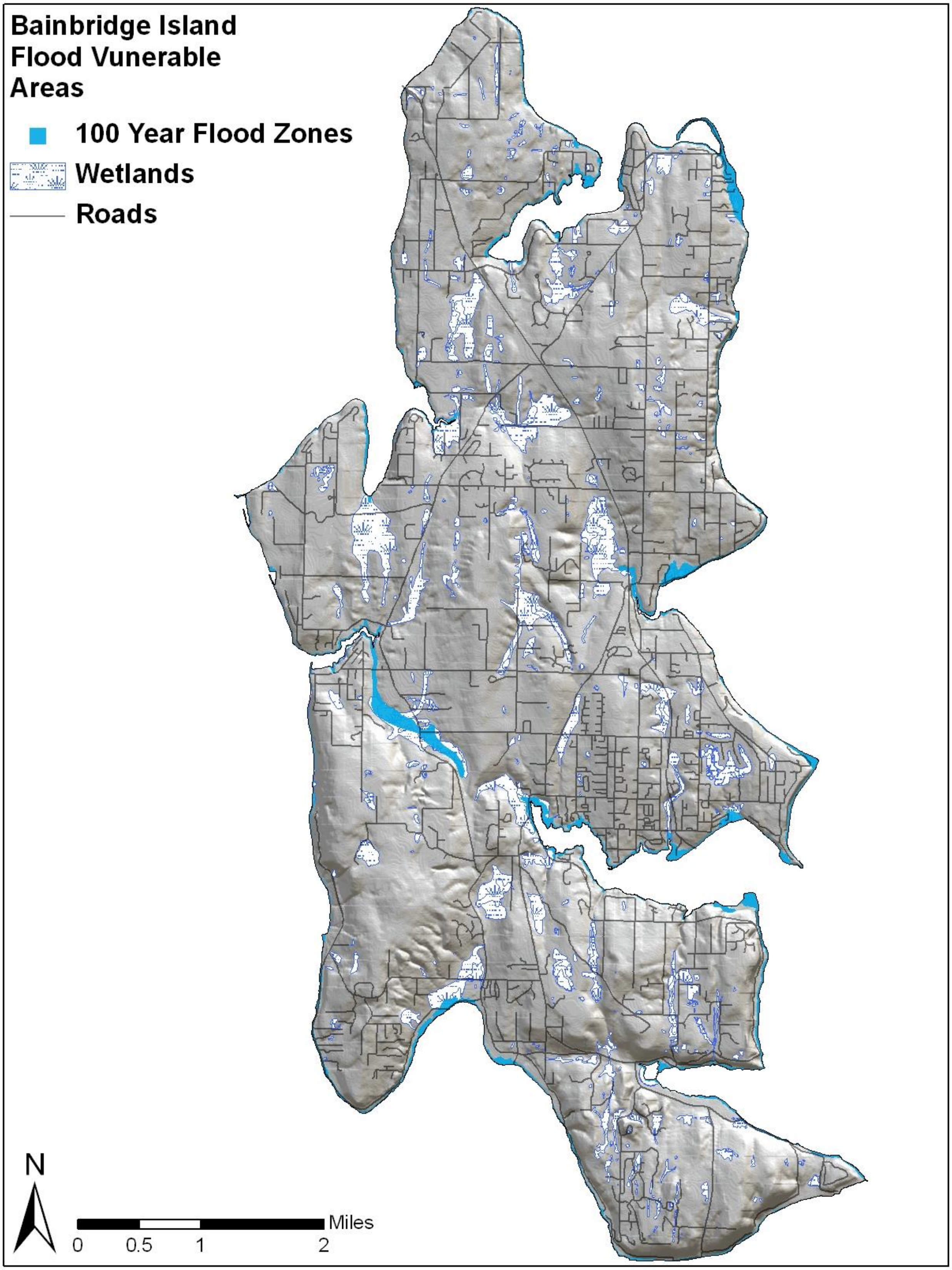


Figure 24: Areas on Bainbridge Island vulnerable to floods base on FEMA flood 100-year flood map and existing wetlands.



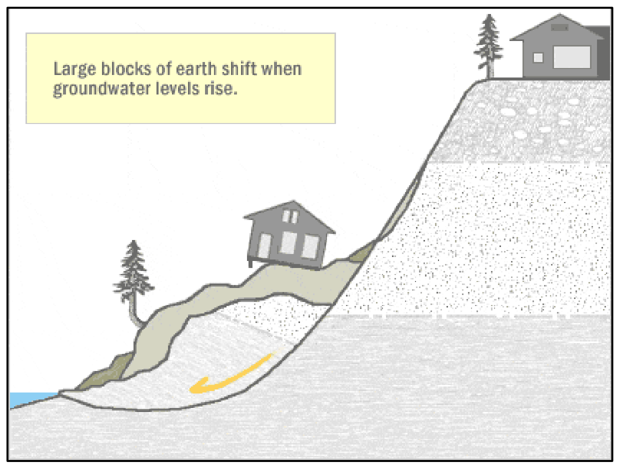
Landslides

Description

The term landslide refers to the movement of rock, soil and debris down a slope or hillside. While gravity is the primary cause, there are typically other contributing factors including: underlying geology, soil composition, percent grade, moisture, land development and zoning practices, and seismic activity. Landslides often occur in conjunction with other natural disasters such as heavy rain-storms, earthquakes, volcanoes, wildfires, and floods.
Less dramatic than landslides, erosion refers to the gradual movement of rock and soil through wind and water action. Erosion can range from windblown soil loss to waves eroding coastal cliffs. Persistent erosion can lead to weakened infrastructure, gullies, sediment drifts, and landslides.

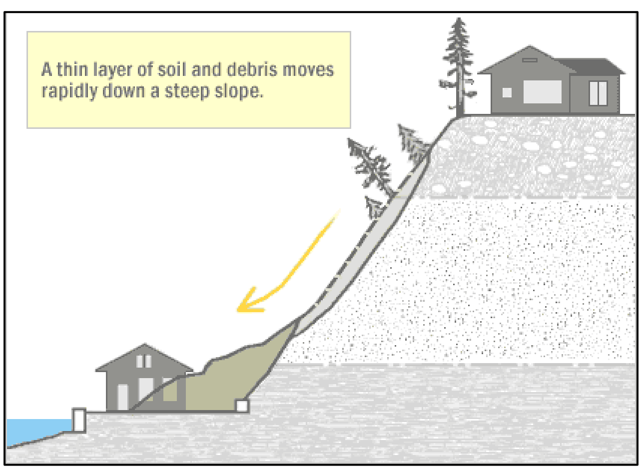
Landslides are complex and can range widely in size and rate of travel. While there are a variety of landslide types, the Washington State Department of Ecology (ECY) focuses on three types of landslides that are of concern in the Puget Sound region; deep-seated landslide, shallow slide, and a bench slide. WA ECY also focuses on scale with large slides naturally being of the greatest concern Figures (25-28).

Figure 25: Cross-sectional representation of a deep-seated landslide.



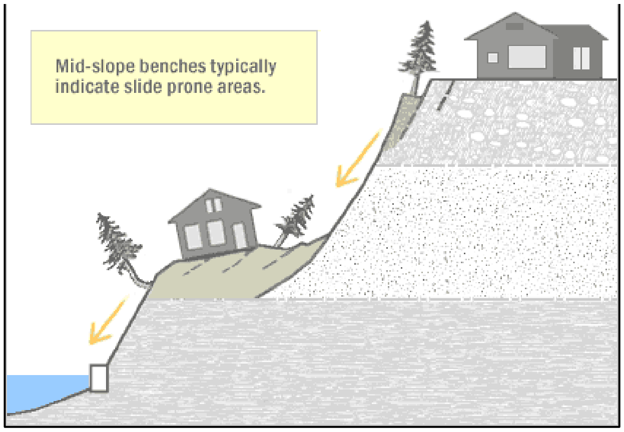
Typically large, **deep-seated landslides** range in size from less than an acre to several acres that can extend over a mile of shoreline. The larger ones often consist of several smaller blocks that may move independently. These slides tend to rotate the earth and rock backward as gravity pulls the mass of the slide downward. These often occur at the site of ancient landslides that reactivate every few years or decades due to particularly wet conditions (Figure 25).

Figure 26:Cross-sectional representation of a shallow slide.



The **shallow slide** typically occurs during prolonged periods of heavy rainfall. They involve a relatively thin layer (less than five feet) of wet soil and vegetation, but can be extremely dangerous, as mud and debris travel fast and with destructive force.

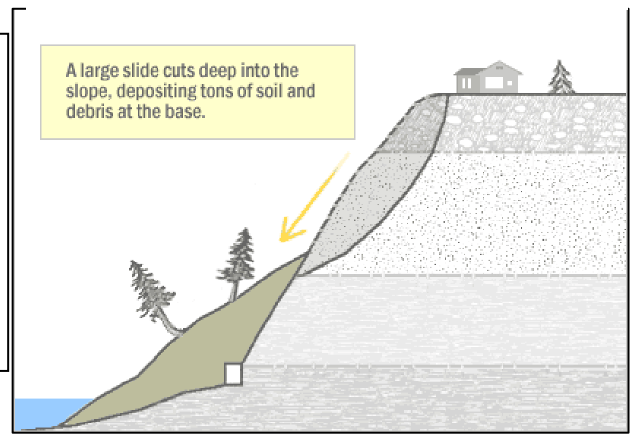
Figure 27: Cross-sectional representation of a mid-slope bench.



Bench slides occur at mid-slope benches. Relatively level mid-slope benches on an otherwise steep slope may indicate past slope movement and are often a vulnerable setting for a variety of landslide types.

Figure 28: Cross-sectional representation of a large slide.

Large slides can cut 50 or more feet into the upland and involve tens of thousands of tons of earth. These slides are relatively rare in Puget Sound, but they have a high severity potential. Were a large slide to occur along a bluff lined with homes or above a beach community built at the base of the slope, the consequences could be catastrophic



Effects

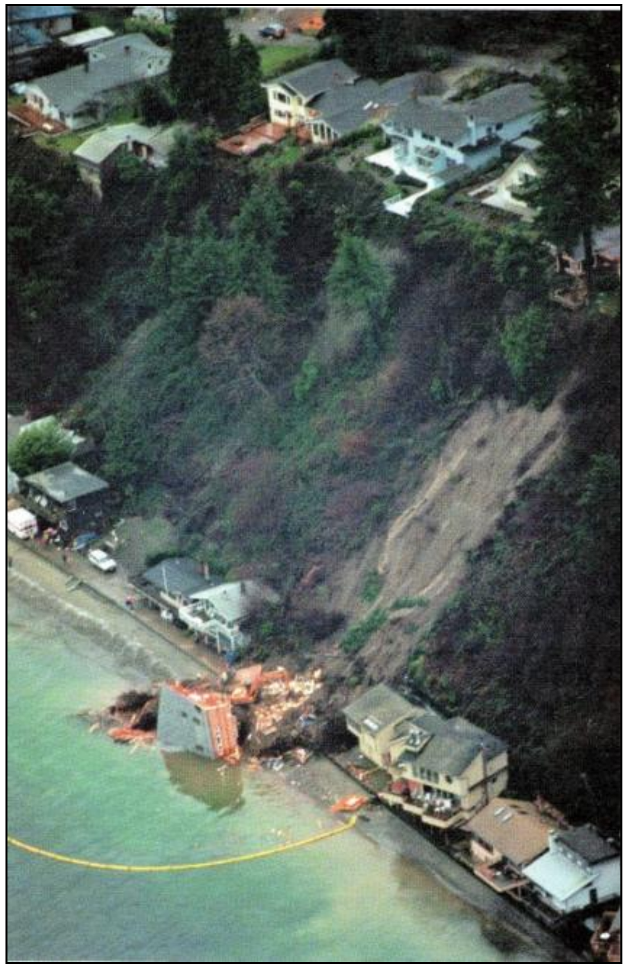
Landslides can take lives, destroy homes, businesses, and public buildings, interrupt transportation, undermine bridges, derail train cars, cover marine habitat, and damage utilities. Severe slides may impact shipping and travel routes to the extent that economic loss results, particularly for tourism and recreational businesses.

History

Landslides are a common occurrence in many areas of Puget Sound including Bainbridge Island, due to the relatively young regional geology and prevalence of unconsolidated glacial fill. Prolonged or high-intensity rain events are the most common cause of significant landslides in our region. A winter storm in 1996 led to the destruction of millions of dollars in both public and private property. In January 1997, over 2,000 tons of rock, trees, and soil slid down the Rolling Bay bluffs, crushing a home within three seconds and killing a family of four inside (Figure 29). Separate landslides in April, 1996, and in March 1997 also destroyed other homes at Rolling Bay. Earthquakes historically have also caused large-scale landslides in the region. The earthquakes of 1949, 1965, and the Nisqually earthquake of 2001 produced numerous landslides throughout the Puget Sound basin.

Vulnerability

Figure 29: Landslide in Rolling Bay occurred after a hundred-year rainstorm in Dec, 1996 (Seattle Times).



FEMA lists Washington as one of seven states especially vulnerable to severe land stability problems. One of the best predictors of future landslides is past landslides, because they tend to reoccur in the same places. However, they can also occur in new places. There are certain indicators of areas that are significantly more prone to landslides or soil erosion (Table 1). Earthquakes combined with heavy precipitation may increase risk for those areas previously thought to be on stable ground. Exceeding 3-day and 15-day precipitation thresholds can also be an indicator of increased landslide hazard (Figure 30). Kitsap Co developed a soil stability GIS layer based on the DNR and NRCS 1980 Soil Survey for Kitsap County and the soil stability classification from the 1979 "Quaternary Geology and Stratigraphy of Kitsap County" thesis work by Jerald Deeter. The map in Figure 31 shows unstable areas and existing structures.

Higher resolution soil stability maps are also available through the Department of Ecology (ECY) http://www.ecy.wa.gov/programs/sea/femaweb/kitsap.htm

Table 1: Common characteristics of landslide hazard

Characteristics of landslide hazard areas include:
1. A slope greater than 15 percent
2. Landslide activity or movement in the last 10,000 years
3. Steam or wave action with erosion or bank undercutting
4. The presence or potential for snow avalanches
5. The presence of an alluvial fan that indicates vulnerability to the flow of debris or sediments
6. The presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel

Figure 30: 113-day and 15-day cumulative precipitation threshold for increased landslide hazard. Current conditions graphs are available online from the USGS. http://landslides.usgs.gov/monitoring/seattle/rtd/plot.php

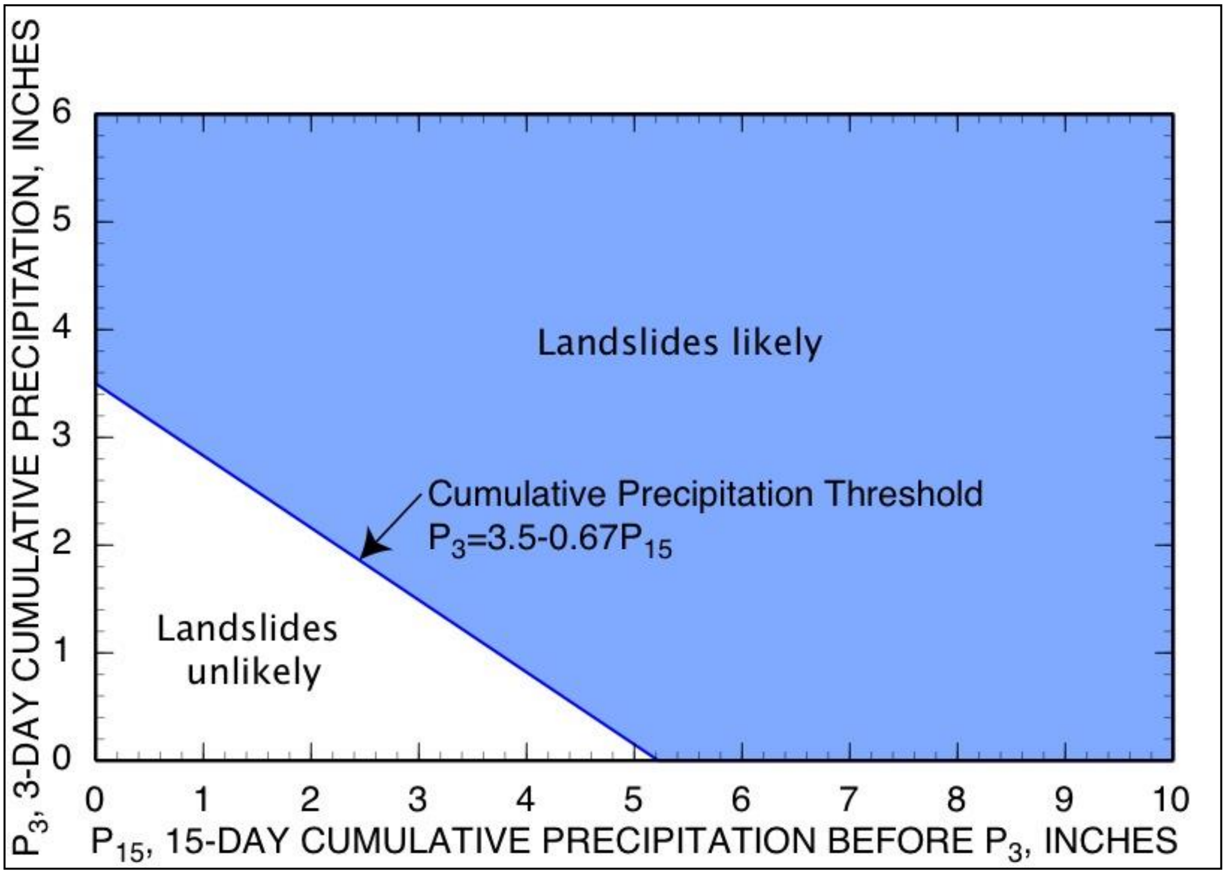
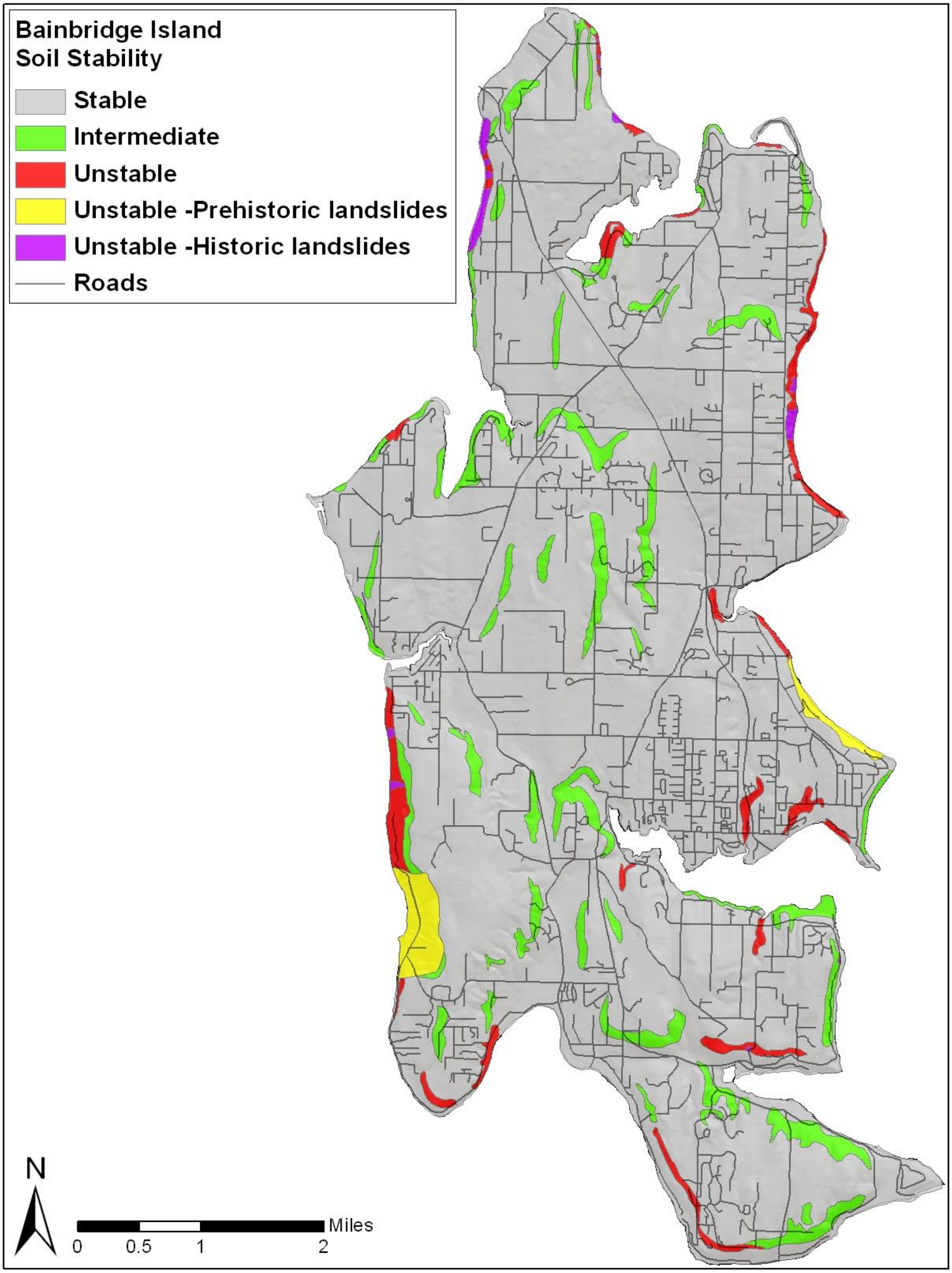


Figure 31: Bainbridge Island Soil Stability based on hydric soils and underlying geology (DNR data).



Drought

Description

A drought is an extended period of unusually dry weather that can damage crops and/or cause water supply shortages. In our region, drought can be caused by weather patterns that produce persistent, upper-level high-pressure systems along the West Coast with warm, dry air that results in lower-than-normal levels of precipitation.

The National Oceanic and Atmospheric Administration (NOAA) defines drought as less than 60% normal precipitation over a prolonged period of time. Washington State is unique in having a statutory definition of drought. According to state law (Revised Code of Washington Chapter 43.83B.400), an area is in a drought condition when:

- The water supply for the area is below 75 percent of normal.
- Water uses and users in the area will likely incur undue hardships because of the water shortage.

The severity of a drought is measured by the Palmer Drought Severity Index (Table 3). The index incorporates temperature, precipitation, evaporation and transpiration, runoff and soil moisture when designating the degree of drought within a range of 4 (very wet) to –4 (extremely dry).

Table 2: Palmer Drought Severity Index Classifications

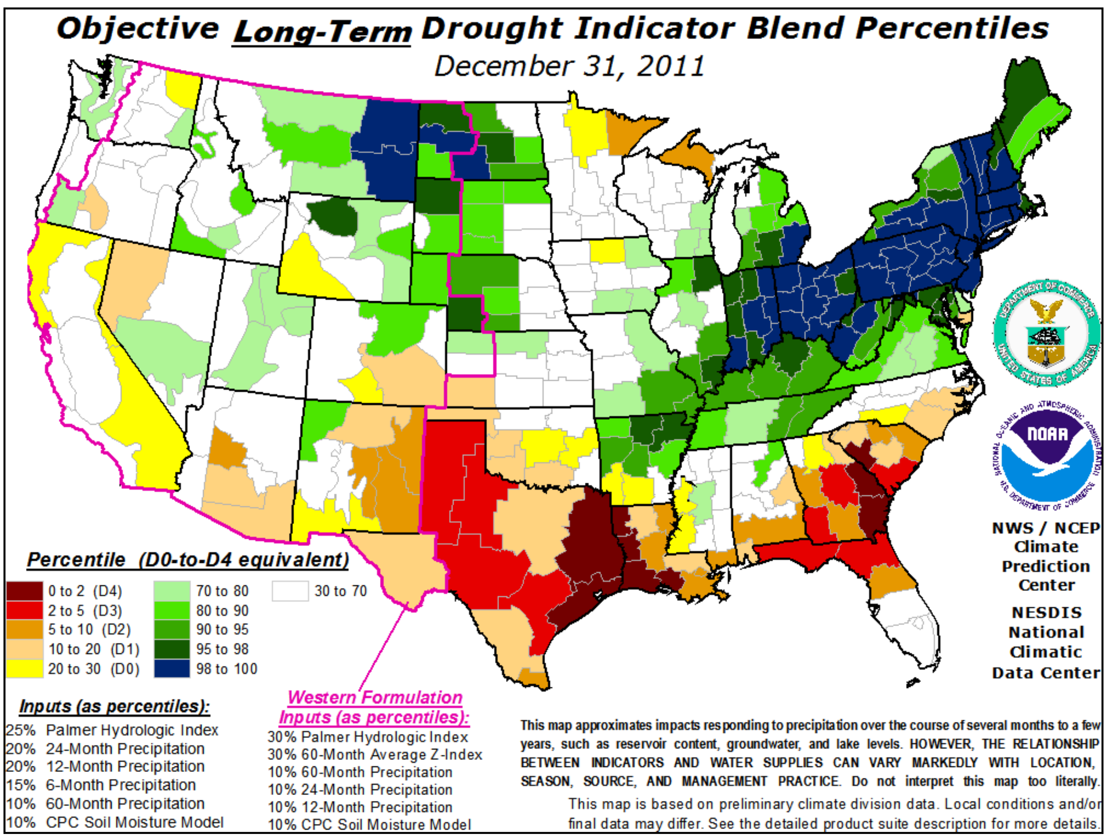
Palmer Drought Severity Index Classifications	
3.0 to 3.99	Very Wet
2.0 to 2.99	Moderately Wet
1.0 to1.99	Slightly Wet
0.5 to 0.99	Incipient Wet Spell
0.49 to -0.49	Near Normal
-0.5 to 0.99	Incipient Dry Spell
-1.0 to –1.99	Mild Drought
-2.0 to –2.99	Moderate Drought
-3.0 to –3.99	Severe Drought
-4.0 or less	Extreme Drought

Climate forecasters also use a set notation for identifying drought conditions (Table 4). The drought index classifications and dryness categories are used to inform the Climate Prediction Center’s drought monitoring forecasts (Figure 32).

Table 3: Dryness Categories for Climate Prediction Center drought forecasts

Dryness Categories	
D0	Abnormally Dry ... used for areas showing dryness but not yet in drought, or for areas recovering from drought.
Drought Intensity Categories	
D1	Moderate Drought
D2	Severe Drought
D3	Extreme Drought
D4	Exceptional Drought
Drought or Dryness Types	
S	Short-Term, typically <6 months (e.g. agricultural, grasslands)
L	Long-Term, typically >6 months (e.g. hydrology, ecology)

Figure 32: Long-term drought indicator map available from NOAA Climate Prediction Center (droughtmonitor.unl.edu).



Effects

While droughts can be damaging to the environment and economy, by itself, loss of life and property are less likely. Droughts can lead to water shortages, stressed wildlife, vegetation damage, and increased fire risk. Low stream flows can lead to high temperatures, oxygen depletion, disease and lack of spawning areas for fish. Lost agricultural crops could adversely affect the local economy.

History

Though not as frequent as the region east of the Cascade Mountains, severe droughts periodically hit the Puget Sound region. Moderate droughts or drought-like conditions commonly occur during the late summer months on Bainbridge Island. Based on the 100-year history of drought in Washington, the state as a whole can expect severe or extreme drought conditions at least every five years. The droughts of 1977 and 2001 were the worst and second worst in state history. The El Niño Southern Oscillation (ENSO) events that occur in the Pacific Ocean affect Washington's winter weather and play a role in whether the region experiences a drought. In El Niño years, winters tend to be drier and springtime temperatures tend to be warmer, the result is lower springtime snowpack and resulting lower stream flow during spring and summer in snowmelt driven rivers. These factors make drought more likely, during El Niño years.

Climate change projections indicate that droughts in our region will increase in frequency, intensity, and duration. All climate change scenarios evaluated by the Climate Impacts Group (CIG) project a warmer PNW climate in the 21st century. Climate models project an average rate of warming of approximately 0.5^{o} F per decade through the 2050s (range: 0.2-1.0^{o} F per decade). For comparison, the observed rate of 20th century PNW warming was approximately 0.2^{o} F per decade while the observed rate of warming for the second half of the 20th century was approximately 0.4^{o} F per decade (Figures 33-34). See Climate Cycles in Section II.

The Washington State Legislature gave the Department of Ecology (ECY) permanent drought relief authority in 1989, enabling them to issue orders declaring drought emergencies. Washington was the first Northwest state to make a drought declaration when Governor Gary Locke authorized the Department of Ecology to declare a statewide drought emergency on March 14, 2001, after several months of record low precipitation. The drought emergency formally expired on December 31, 2001, after two months of above-average precipitation. Notable regional droughts are listed in Table 5 below.

Figure 33: Historic Precipitation Pattern as recorded ~ 11 miles east of Bainbridge Island geographical center. (http://climate.washington.edu/trendanalysis)

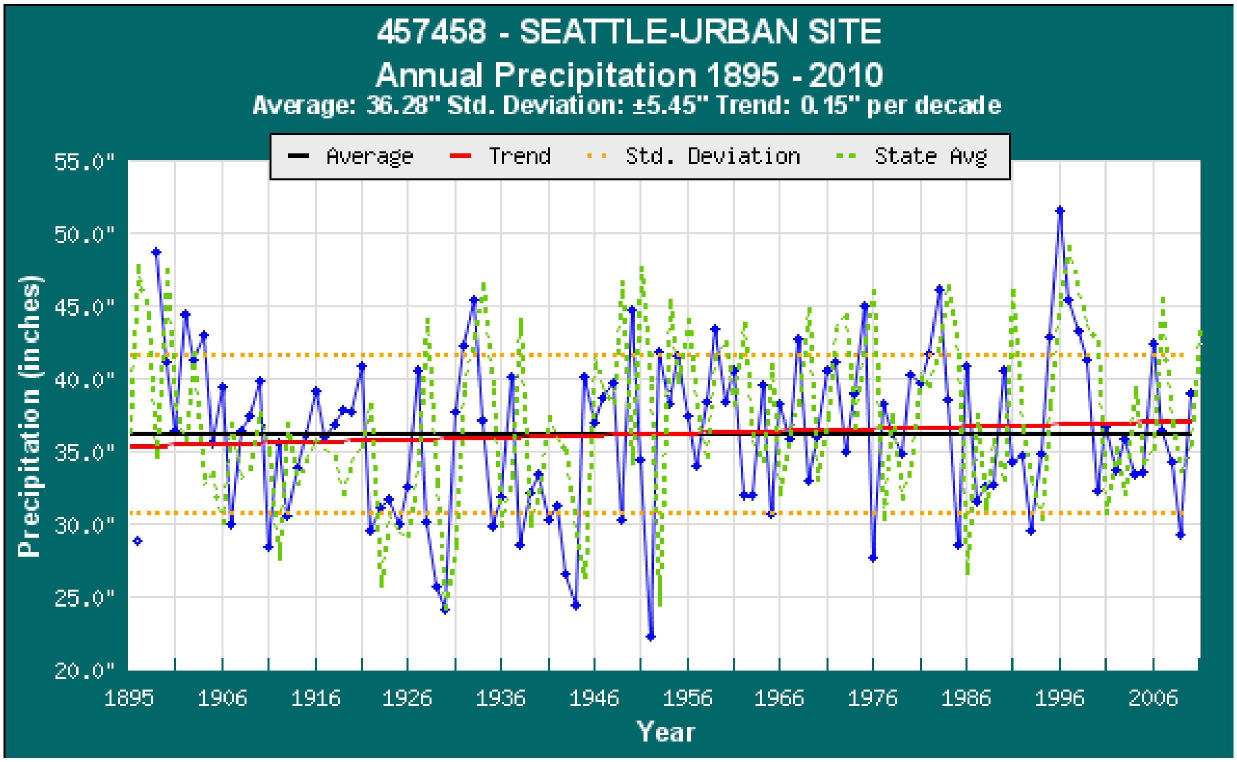


Figure 34: Historic mean temperature Pattern as recorded ~ 11 miles east of Bainbridge Island geographical center. (http://climate.washington.edu/trendanalysis)

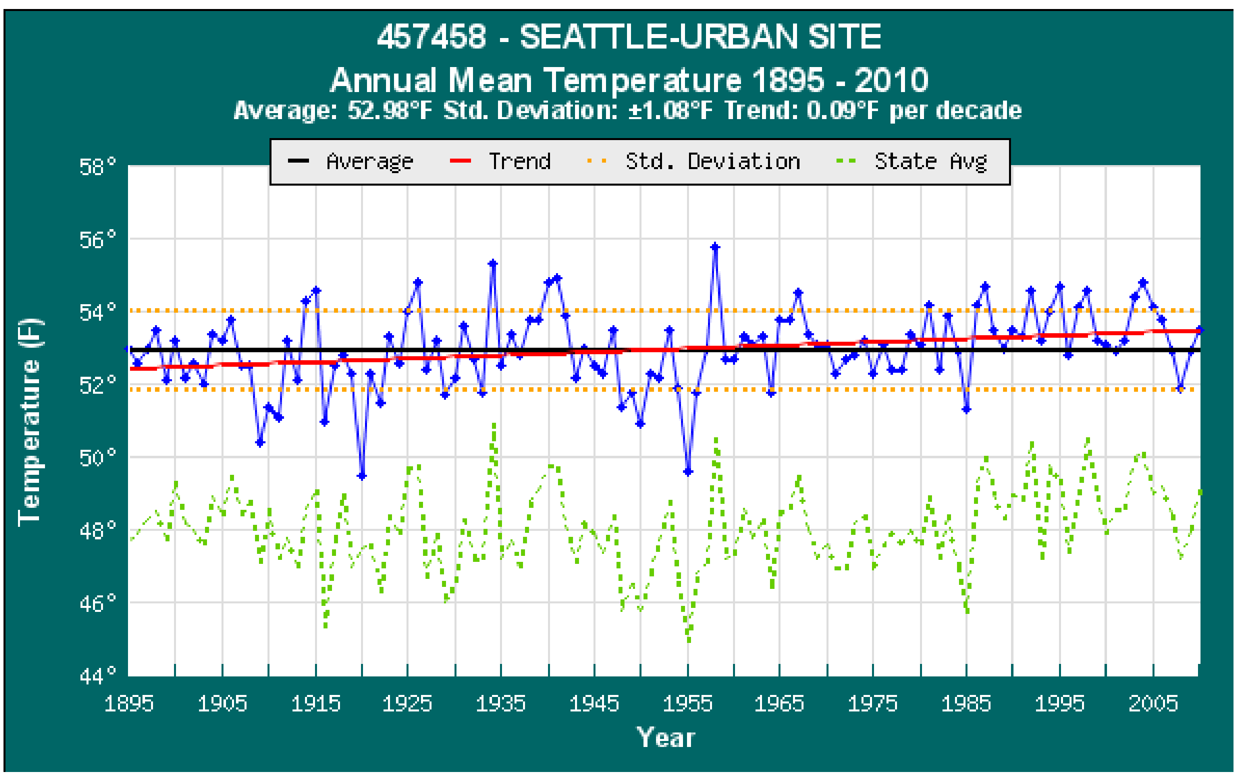


Table 4: Dryness Categories

Date	Occurrence
July-August 1902	No measurable rainfall in Western Washington.
August 1919	Drought and hot weather occurred in Western Washington.
July-August 1921	Drought in all agricultural sections.
June-August 1922	The statewide precipitation averaged .10 inches.
March-August 1924	Lack of soil moisture retarded germination of spring wheat.
July 1925	Drought occurred in Washington.
July 21-August 25, 1926	Little or no rainfall was reported.
June 1928-March 1929	Most stations averaged less than 20 percent of normal rainfall for August and September and less than 60 percent for nine months.
July-August 1930	Drought affected the entire state. Most weather stations averaged 10 percent or less of normal precipitation.
April 1934-March 1937	The longest drought in the region's history – the driest periods were April-August 1934, September-December 1935, and July-January 1936-1937.
May-September 1938	Driest growing season in Western Washington.
1944	Water Shortages in Spokane.
1952	Every month was below normal precipitation except June. The hardest hit areas were Puget Sound and the central Cascades.
January-May 1964	Drought covered the southwestern part of the state. Precipitation was less than 40 percent of normal.
Spring, 1966	The entire state was dry.
June-August 1967	Drought occurred in Washington.
January-August 1973	Dry in the Cascades.
October 1976-September 1977	Worst drought in Pacific Northwest history. Crop yields were below normal and stream flows averaged between 30% and 70% of normal. Higher than normal temperatures resulted in algae growth and fish kills.
1997	Drought conditions throughout WA state.
January – March 2001	The second driest winter on record in 106 years. Stream flows approached the low levels reached during the 1976-77 drought.
2005	Less severe than the previously listed droughts.

Vulnerability

The Island has limited water storage capacity. Water supplies are predominantly groundwater and wholly dependent upon rainfall for recharge. Gazzam Lake is the only lake of significant size and surface drainage on the Island mostly occurs via small spring-fed streams that discharge into Puget Sound. Many of the smaller streams become dry in the summer months. Prolonged drought conditions could have a limiting effect on ground water supplies and could lead to increased saltwater intrusion. Residents with shallow private wells and without supplemental storage capabilities could be most affected by drought. Due to the states reliance on hydroelectric energy, drought conditions could also lead to power shortages or increased rates. Agricultural operations have the greatest economic susceptibility to droughts. Drought conditions can also increase the risk of wildfires on the Island. Wildfire hazard can be further compounded in extreme cases where the firefighting capabilities of fire agencies are limited by water shortages.

The USDA provides online drought monitoring services NRCS provides online Water Supply Forecasting Services: (www.wcc.nrcs.usda.gov/wsf)

Wildfire

Description

Wildfires are fires caused by nature or humans that result in the uncontrolled destruction of forests, brush, field crops, grasslands, and real and personal property. People are responsible for most wildfires on state lands; major causes include arson, recreational fires that get out of control, smoker's carelessness, debris burning, fireworks and children playing with fire. The major cause of fires on federally protected lands is lightning.

Effects

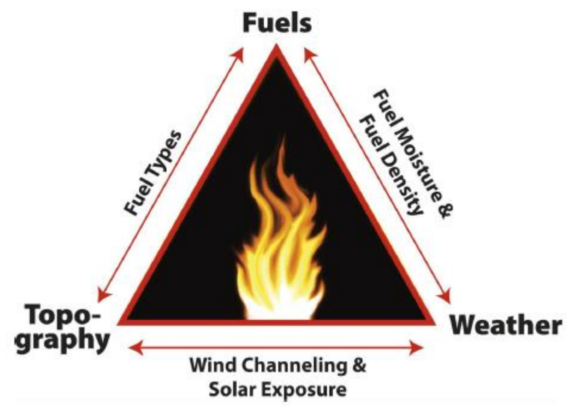


Figure 35: The wildfire behavior triangle (graphic by Ron Kaufman, WWU).

Wildfires are a natural and often beneficial ecological disturbance process, influencing species composition and vegetative structure across a landscape. They can also be a severe hazard, posing a threat to life, property, and natural and cultural resources. This can be especially true when they occur where development mixes with wildlands: the area that firefighters call the Wildland-Urban interface (WUI). In addition, the secondary effects of wildfires on lives, livelihoods, and infrastructure –including erosion, landslides, introduction of invasive species, and changes in water quality – can sometimes be more disastrous than the fire itself. Wildfire behavior is driven by the interaction of a few factors: weather, vegetation type, or "fuels", and topography. The wildfire triangle (Figure 20) is a simple graphic used in wildland firefighter training courses to illustrate how the environment affects fire behavior. Each point of the triangle represents one of the three main factors that drive wildfire behavior. The sides represent the interplay between the factors that are seen on the ground as they affect wildfire behavior. The potential for wildfires to become severe depends on these factors. For example, drier and warmer weather combined with dense fuel loads and steeper slopes will cause more hazardous fire behavior than light fuels on flat ground.

History

Wildfire is an age-old element of the forest and prairies of Bainbridge Island, and fires of varying severity have occurred both historically and in recent times. Although fire history is difficult to trace back more than 350 years, wide-spread stands of Douglas-fir (a fire-dependent forest type), tree-stand age classes, fire-scarred trees, and charcoal layers suggest that major fires burned in Kitsap County 450,480, 540, and 670 years ago. Medium-sized, less intense fires occur on a several decade scale, and small fires of a few acres or less occur every year on Bainbridge Island (Figures 36-37 and Table 5).

Figure 36: Number of natural vegetation fires on Bainbridge Island, 1989-2009 (BIFD data)

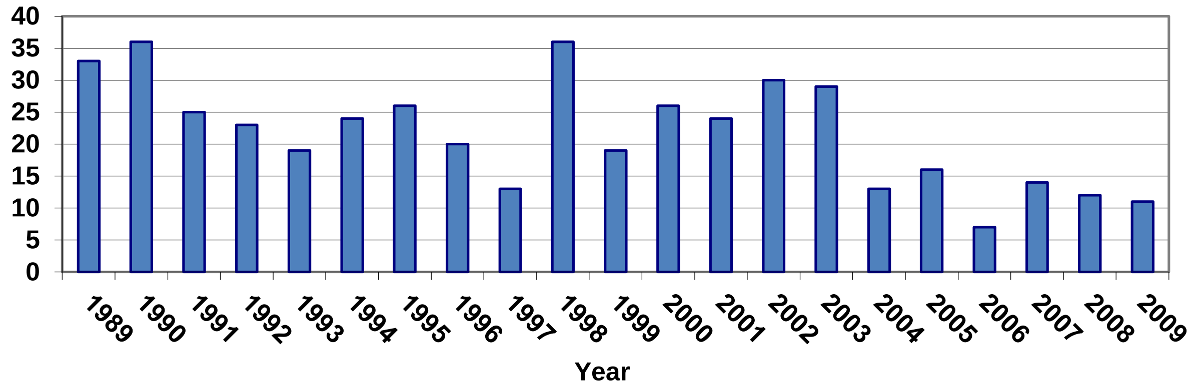


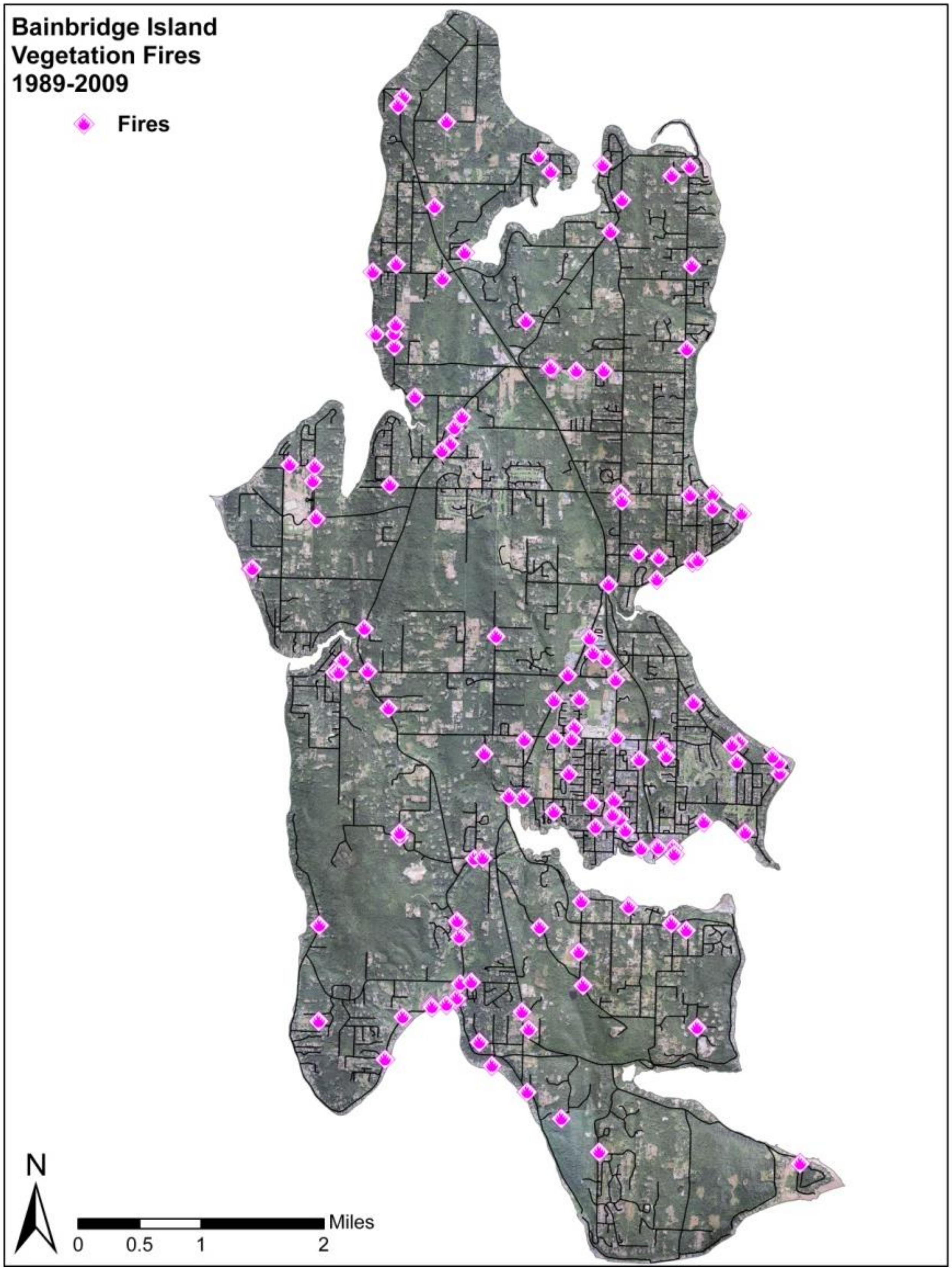
Table 5: Recent fire history (1989-2009) on Bainbridge Island (BIFD data).

Year	# of incidents	Year	# of incidents	Year	# of incidents
2009	11	2002	30	1995	26
2008	12	2001	23	1994	24
2007	14	2000	26	1993	19
2006	7	1999	19	1992	23
2005	16	1998	36	1991	25
2004	13	1997	13	1990	36
2003	28	1996	20	1989	33

Vulnerability

Though Bainbridge Island has not experienced a major wildfire in recent years, the risk is still present - each year, about 10-30 small wildfires occur across the Island. The potential for a major wildfire disaster is very high due to the combination of having seasonally dry climate and high vegetative fuel loads – all it would take is an ignition under the right weather conditions. The risk wildfire poses to human life is increased by the growing number of homes located within the Bainbridge Island WUI. Many residents of the Island may be unaware of the concept of defensible space or unaware that the concept is directly applicable to their lands, adding to the potential for severe WUI incidents in the near future. Should we face a major wildfire it is possible that the Island could become a major disaster zone with heavy property losses and potential loss of human life.

Figure 37: Bainbridge Island vegetation fires, 1989-2009 (BIFD data).



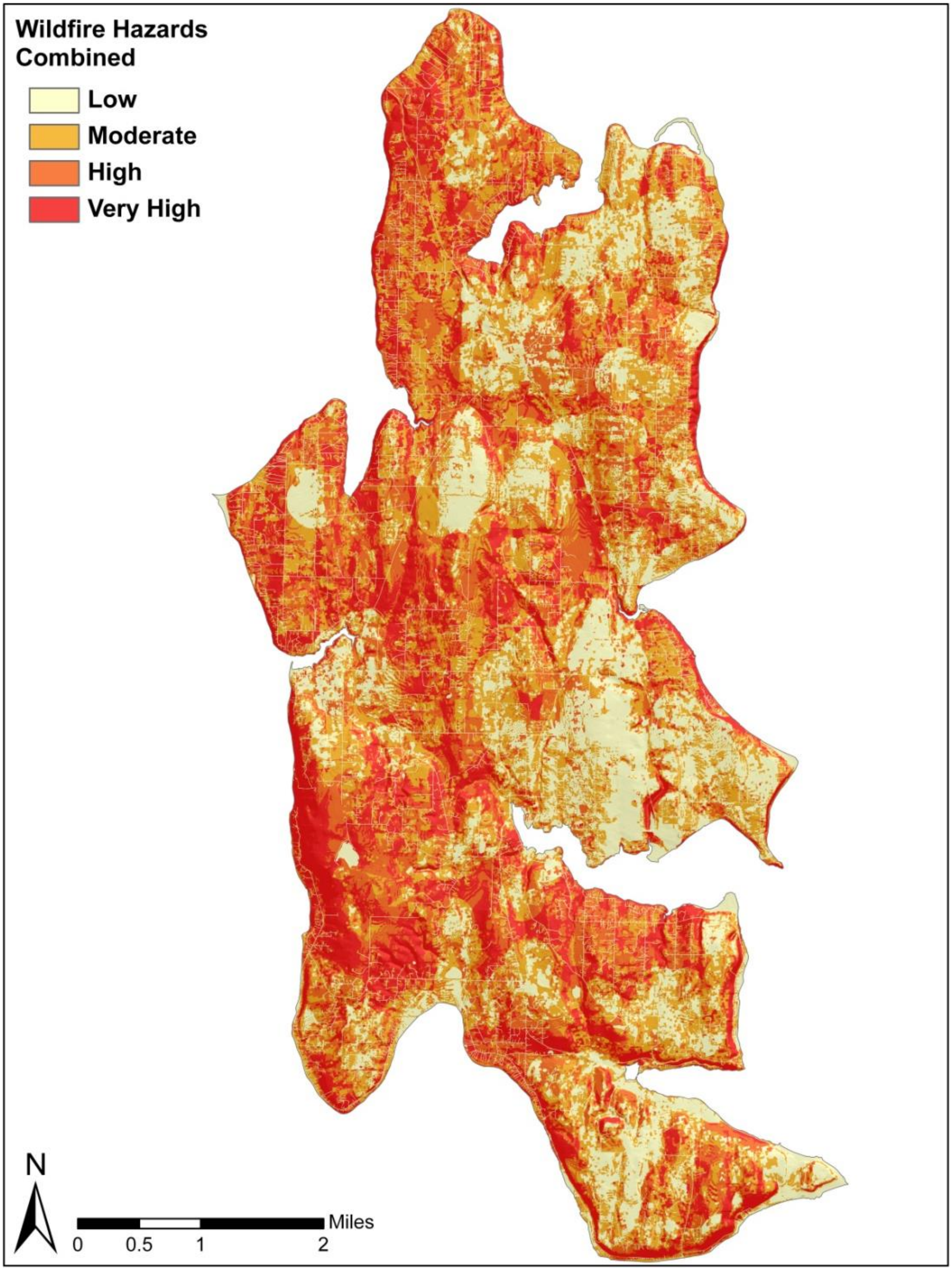
Large fires in western Washington typically occur on steep south-facing slopes, and often result from a combination of circumstances including a source of ignition in areas of dry, heavy fuels, an extended period of drought, and dry east winds. Wildfires here usually occur during the dry summer months of July, August, and early September, but they can occur anytime between April and October given the right conditions. Fire hazard increases in the late summer and early fall when hot, dry east winds occur more frequently and the area has experienced the low point of the annual precipitation cycle. While Bainbridge Island rarely has low enough fuel moisture for major fires, small fires occur frequently.

An overall wildfire map was created for the 2010 Bainbridge Island Community Wildfire Protection Plan for the purpose of identifying those areas with the greatest wildfire hazard (Figure 38). The hazard map was produced through a weighted combination of factors that contribute to wildfire risk and hazard (Table 6).

Table 6: Hazard assessment criteria and ratings.

Category	Item	Points	Point Category	Hazard Rating	Percent of Overall Rating
Spatial Hazard	Fuels	0 5 10 20 25	Non Burnable Light Medium Heavy Slash (None Present)	None Low Moderate High Very High	50%
	Slope	1 4 7 10 15	<10% 10-20% 21-30% 31-40% >40%	Minimal Low Moderate High Very High	25%
	Aspect	0 2 3 5	N E W S	Low Moderate High Very High	8.3%
Protection Hazard	Hydrants	0 5	Hydrant within 1000' Hydrant ≥ 1000' away	Low High	8.3%
Ignition Risk	Past Vegetation Fires*	1 2 4 5	0 fires / square mile** >0-5.4 fires / square mile >5.4-14 fires / square mile >14 fires / square mile	Low Moderate High Very High	8.3%
	Maximum Possible:	60			100%

Figure 38: Overall *Wildfire Hazard* levels for Bainbridge Island

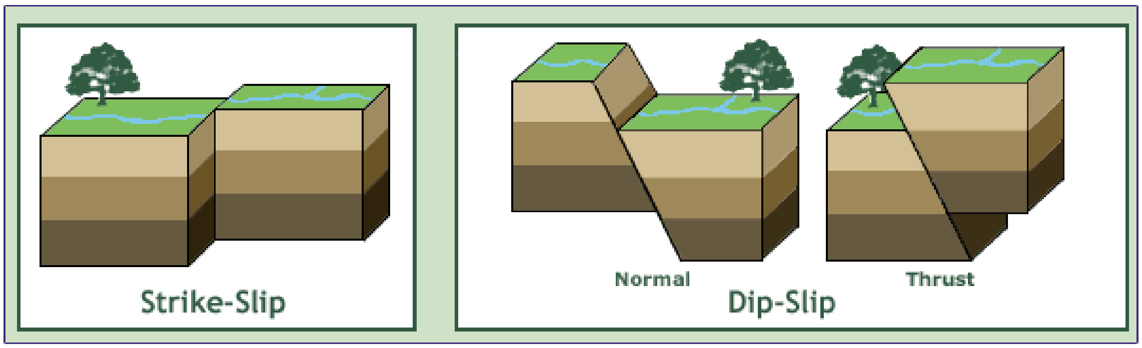


Earthquakes

Description

Earthquakes are the result of a sudden release of energy in the Earth's crust that creates seismic waves. Most earthquakes occur due to sudden shifts along faults, or fractures within the earth's crust. Strike-slip faults are vertical (or nearly vertical) fractures where the blocks have mostly moved horizontally. Dip-slip faults are inclined fractures where the blocks have mostly shifted vertically. Oblique-slip faults have significant components of both slip styles (Figure 39).

Figure 39: A cross-sectional representation of a strike-slip and a dip-slip fault movement.



Earthquakes are measured by magnitude; a logarithmic measure of earthquake size. This means that at the same distance from the earthquake, the shaking will be 10 times as large during magnitude 5.0 earthquakes as it is during magnitude 4.0 earthquakes. The total amount of energy released by the earthquake, however, goes up by a factor of 32 (Figure 41). Intensity scales like the Modified Mercalli Scale are based on observations of the strength of shaking Figure 40).

Figure 40: A graphical representation of the Richter scale.

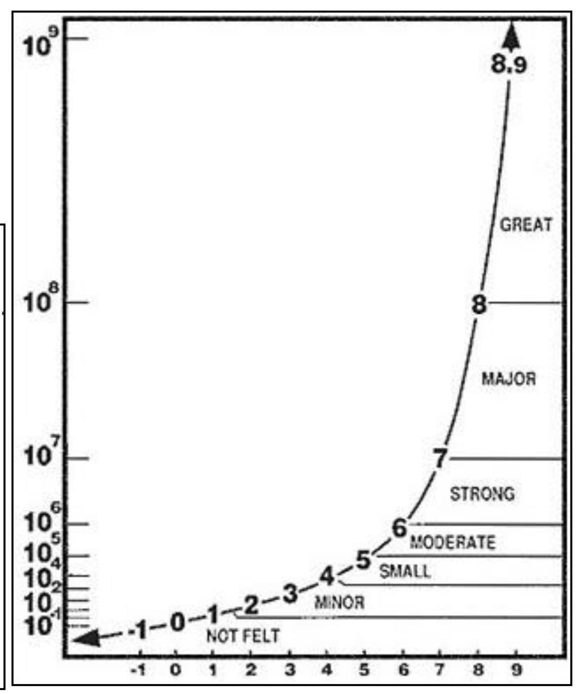


Figure 41: The Modified Mercalli Scale for measuring earthquake magnitude.

Modified Mercalli Scale

I.	Not felt.
II.	Felt by persons at rest, on upper floors, or favorably placed.
III.	Felt indoors. Vibration like passing of light trucks.
IV.	Vibration like passing of heavy trucks.
V.	Felt outdoors. Small unstable objects displaced or upset.
VI.	Felt by all. Furniture moved. Weak plaster/masonry cracks.
VII.	Difficult to stand. Damage to masonry and chimneys.
VIII.	Partial collapse of masonry. Frame houses moved.
IX.	Masonry seriously damaged or destroyed.
X.	Many buildings and bridges destroyed.
XI.	Rails bent greatly. Pipelines severely damaged.
XII.	Damage nearly total.

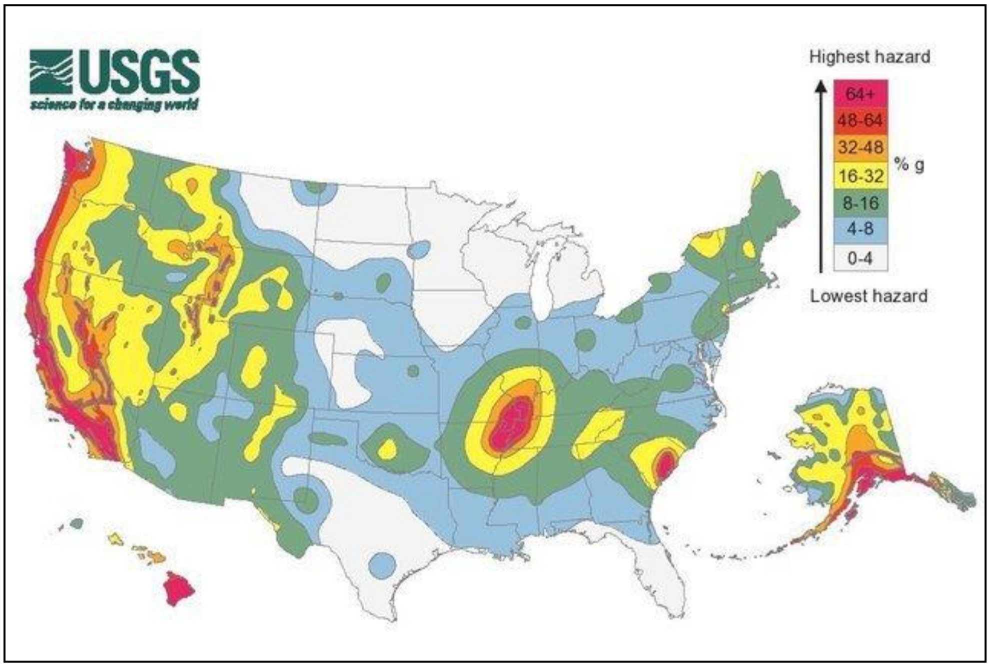
There are three technically distinct types of earthquakes: Interplate or Benioff zone earthquakes, Subduction zone, and Shallow Crustal earthquakes. Each has the potential to generate powerful damaging motion in the greater Puget Sound area.

- **Interplate, or Benioff Zone** Events occur at depths of 15 to 60 miles from the subducting Juan de Fuca plate. These earthquakes are caused by mineral changes as the plate goes to deeper depths and is exposed to increased temperature and pressure. The mineral changes cause the plate to shrink and become more dense. Stresses build up which pull the plate apart. Examples of this type of damaging event include the Olympia earthquake in 1949, 1965 Seattle/Tacoma earthquake, 1999 Satsop earthquake, and the 2001 Nisqually earthquake. Depending on location, shaking could be felt for anywhere between 15-40 seconds.
- **Subduction Zone** events occur along the interface between tectonic plates. The energy generated from the collision of the Juan de Fuca, Pacific, and North American plates is considerable. These great magnitude events can reach 8.0 to 9.0 on the Richter scale.
- **Shallow Crustal** earthquake events occur within 20 miles of the earth's surface. These are fairly common events with typical magnitudes of up to 5.5, though there is some evidence that a number of shallow events have exceeded this level.

Effects

The movement caused by the shifting of the earth's crust often creates very small shaking, but occasionally large earthquakes produce very strong and violent ground shaking. This intense shaking can damage buildings and structures and lead to landslides, tsunamis, and/or soil liquefaction. Earthquakes can present complex challenges in extremes cases because they can result in the failure of numerous lifelines at once. Power, water, and gas lines can become ruptured and lead to an energy emergency. Earthquakes can cause significant failure of structures such as bridges, roads, and highway systems that are not quickly or easily replaced. This can make restoration of critical infrastructure more difficult.

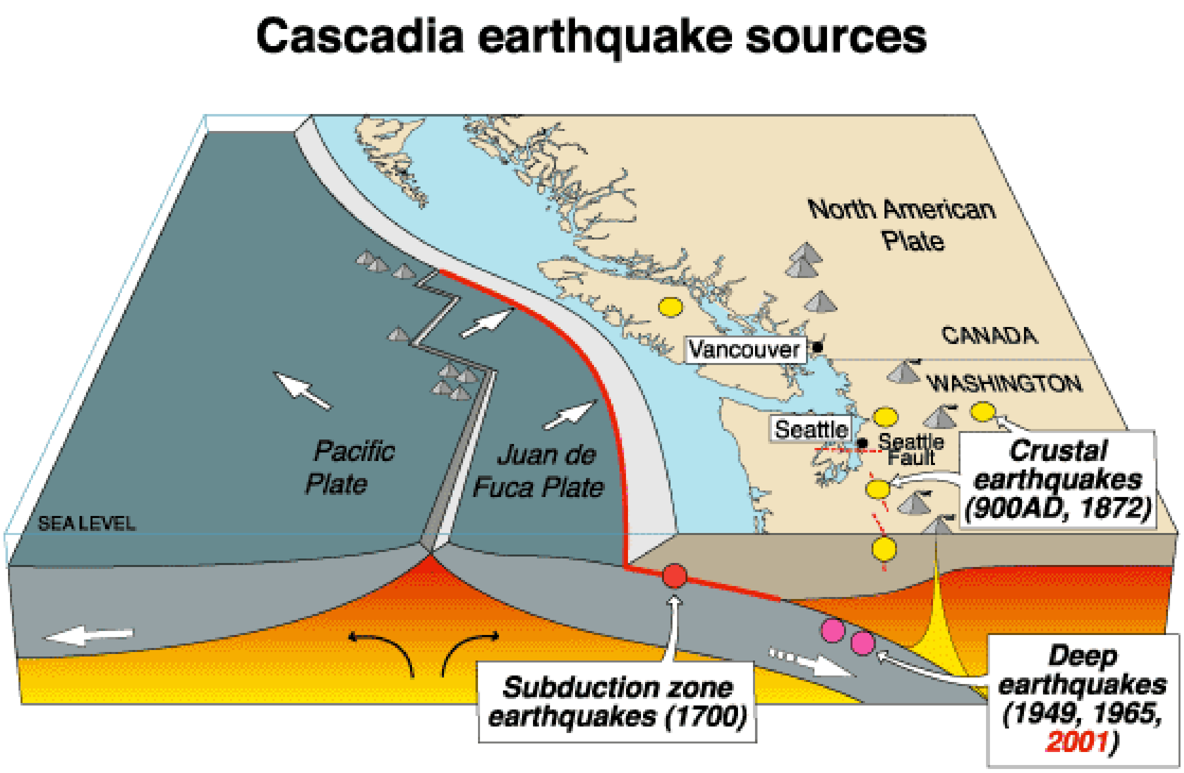
Figure 42: USGS National Seismic Hazard Map.



History

Nationally, the Puget Sound Basin is a high earthquake hazard zone. Bainbridge Island lies near the Cascadia Subduction Zone (CSZ) which is a convergent boundary of the North American and Juan de Fuca tectonic plates. It stretches from northern Vancouver Island to northern California (Figure 42). It is a very long sloping fault that separates the Juan de Fuca and North America plates. Because of the subduction process, the region is vulnerable to earthquakes originating from all three sources: Interplate or Benioff Zone, Subduction Zone, and Shallow Crustal earthquake (Figure 42). There are seven active faults in the Puget Lowland capable of generating damaging earthquakes (Figure 43).

Figure 43: Cascadia Subduction Zone (CSZ) with examples of where Interplate, Subduction Zone, and Shallow Crustal earthquakes occur, their maximum size, and their typical recurrence period. (USGS image)



Source	Affected area	Max. Size	Recurrence
Subduction Zone	W.WA, OR, CA	M 9	500-600 yr
Deep Juan de Fuca plate	W.WA, OR,	M 7+	30-50 yr
Crustal faults	WA, OR, CA	M 7+	Hundreds of yr?

These faults include: two Seattle faults, the Tacoma fault, two Darrington-Devils Mountain fault, the Utsalady Point fault, and two Whidbey Island faults. The northern Seattle fault crosses the southern portion of Bainbridge Island (Figure below). Washington has more than 1,000 earthquakes per year. In terms of economic impact, Washington ranks second in the nation after California among states susceptible to economic loss caused by earthquakes, according to a FEMA study. A dozen or more of these earthquakes are of high enough magnitude that people can feel ground shaking. The most destructive outcome of an earthquake is the damage and loss of life that can result due to such an event. Large earthquakes in 1946 (magnitude 5.8), 1949 (magnitude 7.1), and 1965 (magnitude 6.5) killed 15 people and caused more than $200 million (1984 dollars) in damage throughout several counties in Washington.

The Seattle-Tacoma Earthquake of April 29, 1965 measured a magnitude of 6.5, a depth of 40 miles, and centered about 10 miles north of Tacoma. This earthquake caused an estimated $12.5 million (1965 dollars) worth of damage and killed seven people. Most damage in Seattle was concentrated in areas of filled ground, including Pioneer Square and the Seattle Waterfront, of which both contain older masonry built buildings. Nearly every waterfront building experienced damage during this event. Extensive chimney damage occurred in West Seattle. Low-lying and filled areas along the Duwamish River and its mouth settled causing severe damage at Harbor Island and slumping along Admiral Way in Seattle. Buildings with unreinforced brick-bearing walls with sand-lime mortar were damaged most severely in this event. However, wood frame dwellings, such as residential homes, feared excellent in this quake with most damaged confined in cracks in plaster or to failure of unreinforced brick chimneys near the roofline.

The Olympia earthquake of April 13, 1949 measured a magnitude of 7.1 and centered about eight miles north-northeast of Olympia. Property damage in the Seattle, Tacoma, and Olympia area was estimated at $25 million (1949 dollars). Eight people were killed with many more injured because of this earthquake.

The Nisqually Earthquake of February 28, 2001 measured a magnitude of 6.8 and centered under Anderson Island about 11 miles northeast of Olympia. The depth of this earthquake was calculated at 36.7 miles. The area of most intense ground shaking occurred along the densely populated Interstate 5 corridor region and not directly around the epicenter of the earthquake. This was due to the amplification of energy waves from the earthquake on the softer river valley sediments common to this area. The six counties most severely damaged by the earthquake – King, Kitsap, Lewis, Mason, Pierce, and Thurston – were declared federal disaster areas (Federal Disaster #1361) one day after the event. Eventually, 24 counties received disaster declarations for Stafford Act assistance.

Figure 44: Bainbridge Island Regional Earthquakes 1971 – present, displayed by location and magnitude with fault lines.

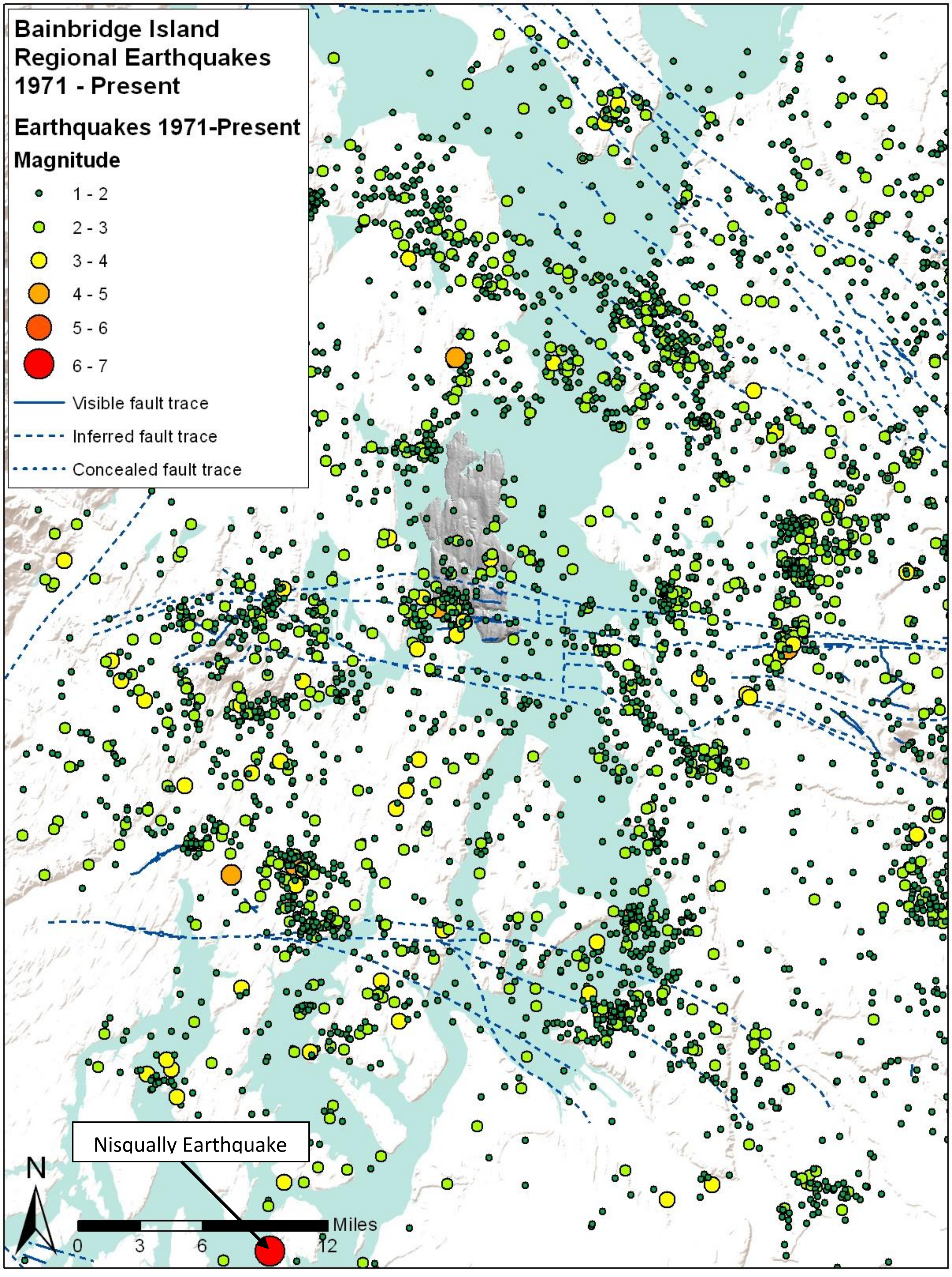


Figure 45: Bainbridge Island Regional Earthquakes 1971 – present, displayed by location and magnitude with fault lines.

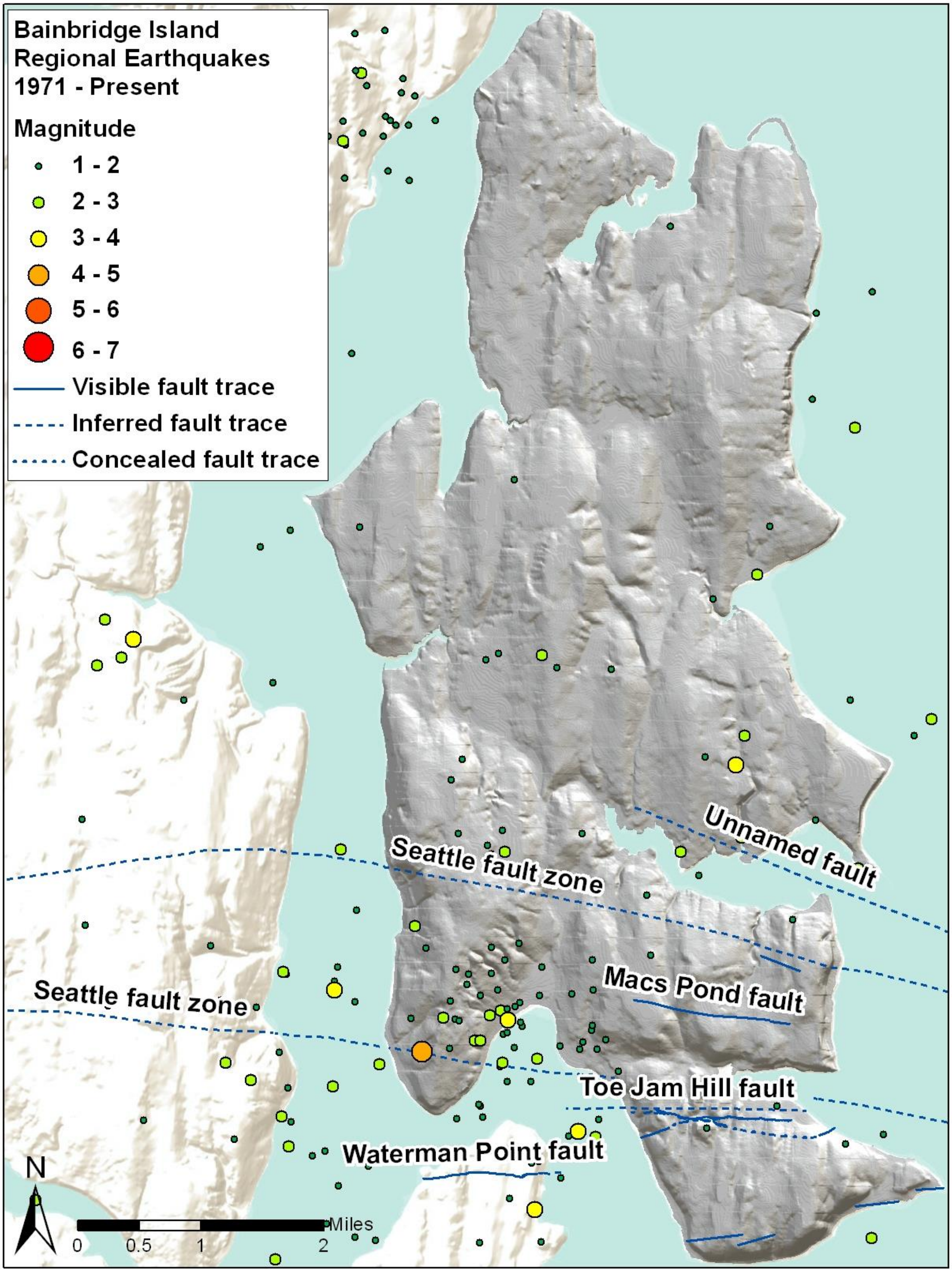
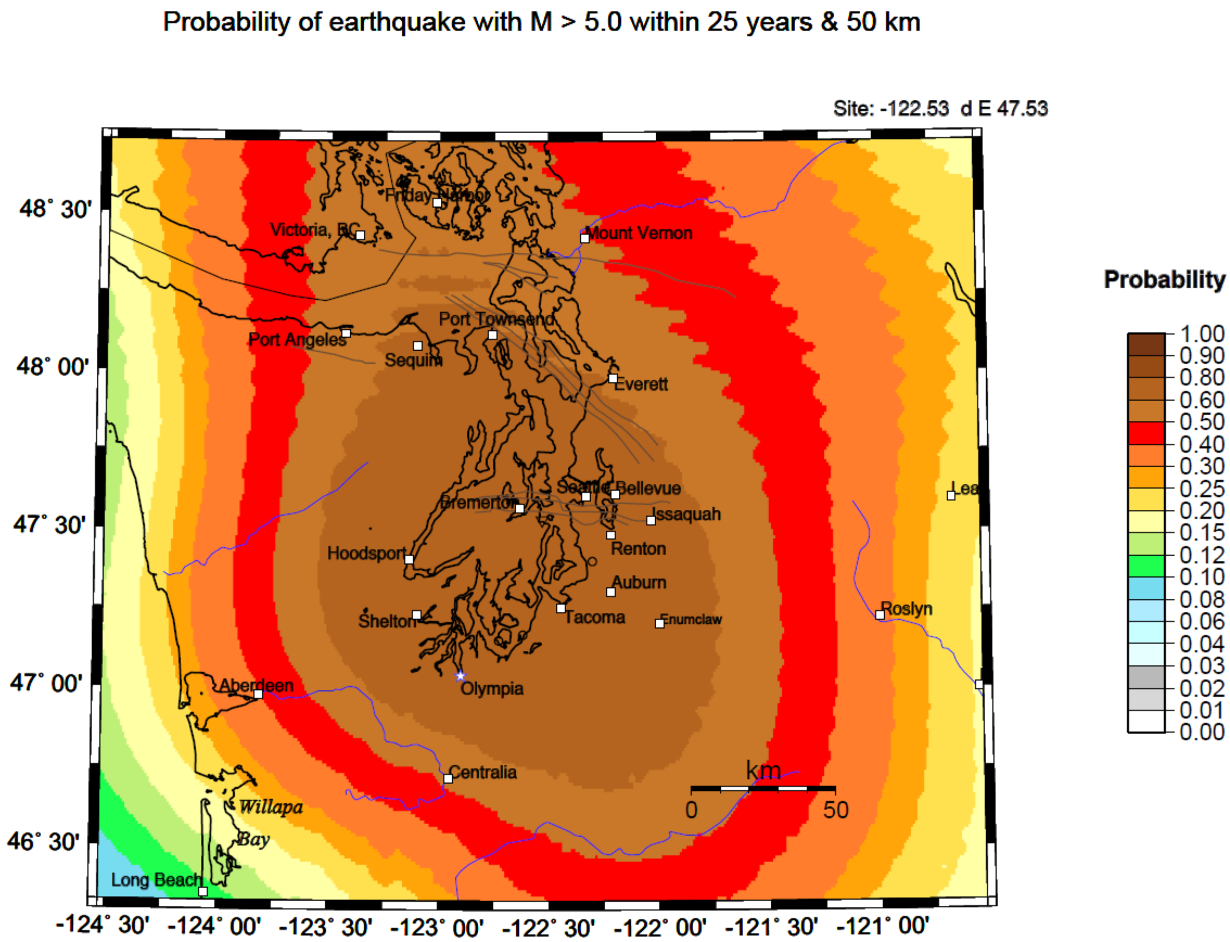


Figure 46: Probability of an earthquake with a magnitude greater than occurring within a 25 year span of Jan1, 2012 and within 50 km of Bainbridge Island (USGS).



Vulnerability

Geologic evidence documents prehistoric magnitude 8 to 9.5 earthquakes along the outer coast, and events of magnitude 7 or greater along the shallow crustal faults located within the urban areas of Puget Sound. There is a high risk or probability of a major earthquake affecting Bainbridge Island and the severity could be devastating (Figure 45). While the part of Washington State east of the Cascades has historically been subject to shallow, though infrequent, smaller earthquakes up to a magnitude of 6.0., the western part of the state is vulnerable to the following earthquake risks:

● A magnitude of 7.5 event of 40 or more kilometers in depth.
● A magnitude of 6.5 event at a shallow depth in the vicinity of Mt. St. Helens.
● A magnitude of 7.5 event at a shallow depth anywhere in western Washington of uncertain probability.
● Subduction-plate earthquakes can reach magnitudes greater than 8.0.

The largest estimated magnitude to occur in our region is 8.0, which would be catastrophic in nature, while earthquakes of lesser magnitude or further from the Island would cause less damage and displacement. Depending on the damage and injuries caused by an earthquake, severe economic loss might occur.

Were a major earthquake to strike in the Puget Sound basin, it could result in injuries, deaths, and hundreds of thousands of dollars in property damage.

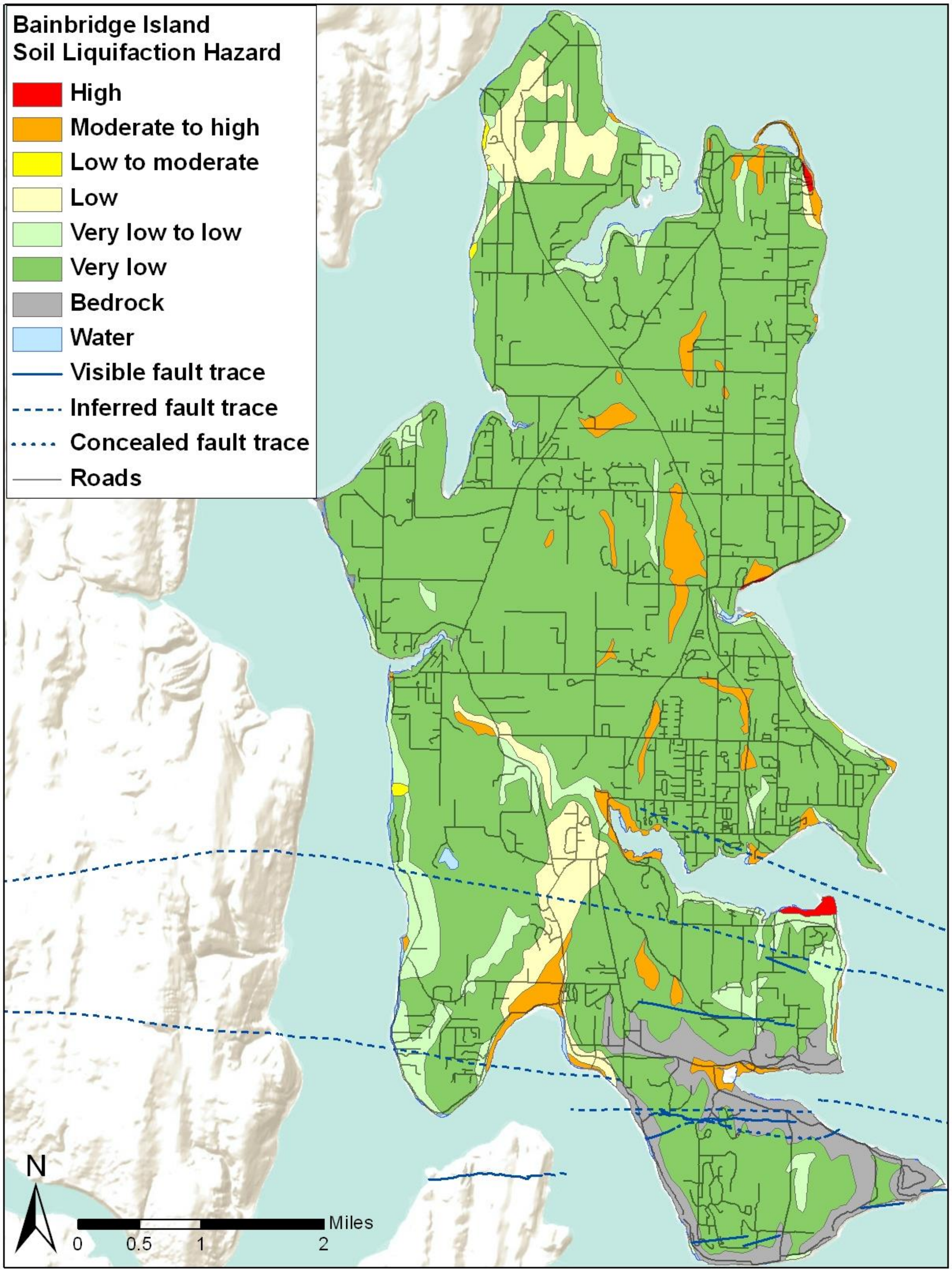
A severe earthquake could cause:

- Massive power outages from failed transformers and downed electrical lines.
- Major damage to water utilities through ruptured mains and possible failure of water towers.
- Ruptured gas lines, which would create conditions for large fires and explosions.
- Indefinite loss of public communication facilities (i.e., radio, television, and telephone systems) through damaged infrastructure or loss of power.
- Exceedance of response capacity of emergency personel (medical, fire, police, search and rescue, etc.)

In the event of a catastrophic earthquake, major road damage would be likely, limiting rescue and essential services. Emergency food and shelter would be needed for potentially thousands of persons forced from their homes or isolated by damaged roads and bridges. The Island could become isolated if there were significant damage to Agate Pass Bridge or ferry services. Since a catastrophic earthquake would likely affect more communities than Bainbridge Island, immediate assistance from sources outside the Island would be unlikely.

Bainbridge Island lies within United Building Code (UBC) Seismic Risk Zone 3, requiring that buildings be engineered to withstand earthquakes measuring 7.5 in magnitude. Older buildings, especially those constructed of non-reinforced masonry, or buildings not built to code could be severely damaged or completely leveled. Newer structures, built to recent building codes, would probably sustain less damage but are still susceptible to earthquakes of a magnitude greater than 8.0 or soil liquefaction events. Soil liquefaction occurs when shaking causes water-saturated granular material (such as sand) temporarily loses its strength and transform from a solid to a liquid. Soil liquefaction may cause rigid structures, like buildings and bridges, to tilt or sink into the liquefied deposits. There would likely be an overall greater damage or loss of infrastructure in areas where soil liquefaction occurs. While most of the Island has low soil liquefaction hazard, some neighborhoods and areas lie in zones of moderate to high hazard as determined by the DNR slope stability dataset (Figure 47).

Figure 47: Bainbridge Island Soil Liquifaction Hazard.



Tsunami

Description

A tsunami is a series of long waves generated by sudden displacements of a large volume of water. They are typically generated by underwater earthquakes, although they can also be caused by landslides, underwater volcanic activity, or meteor impacts. Tsunami waves can travel at speeds averaging 450 to 600 miles per hour across the open ocean, and often reach speeds of 30 mph during the run-up. They can reach unusual heights of over 100 feet high; however waves that are 10 to 20 feet high can still be very destructive. A tsunami becomes a hazard as it nears the coastline; the shallow water causes its waves to slow and compress, and its height to increase greatly. Tsunamis rarely resemble their usual icon, a towering wave with a breaking crest. They more resemble a series of quickly rising tides as they come onshore, and they withdraw with currents much like those of a river. Swift currents—which can readily reach 40 mph—commonly cause much of the damage from tsunamis.

Figure 48: Tsunami surging over a breakwater during the March 2011 Japan event.

Seiches are a series of standing waves (sloshing) in an enclosed or partially enclosed body of water that are normally caused by earthquake activity, and can affect harbors, bays, lakes, rivers, and canals.

Tsunamis and seiches that could affect Bainbridge Island can be generated by distant earthquakes along the Pacific Rim, local earthquakes, or large landslides into or underneath the surface of Puget Sound. Tsunamis generated by off-coast subduction zone earthquakes are unlikely to significantly impact the Island because of the shielding effect of the landmasses and coastlines of Puget Sound; a massive 8.5 Mm Cascadia subduction zone earthquake would generate a wave that would be only about 2 feet high by the time it reached the Bainbridge Island area. Of most concern are tsunamis generated by major landslides or local earthquakes, particularly those that are generated by the Seattle Fault or other nearby surface faults. Of course, the amount of inundation for any type of tsunami or Sound-based seiche would depend on when it occurred in the tide cycle; during high tide the effects would likely be considerably worse.

Effects

Tsunamis and high waves can cause flooding, property, and loss of life in affected areas. The impacts from the March 3, 2011 Honshu, Japan tsunami—a country arguably more prepared for such events than the United States—demonstrated the massive scale of destruction and loss of life that can occur from this hazard. Tsunamis from local earthquakes or landslides typically strike quickly with little time for evacuation, increasing the hazard. Ships moored at piers and in harbors often are swamped and sunk or are left battered and stranded high on the shore. Breakwaters and piers collapse, sometimes because of scouring actions that sweep away their foundation material, and sometimes because of the sheer impact of the waves. Buildings within the run-up zone are often destroyed and/or swept off their foundations, particularly those oriented with walls perpendicular to the wave direction. Debris from these impacts that move with the current can increase the overall damage considerably.

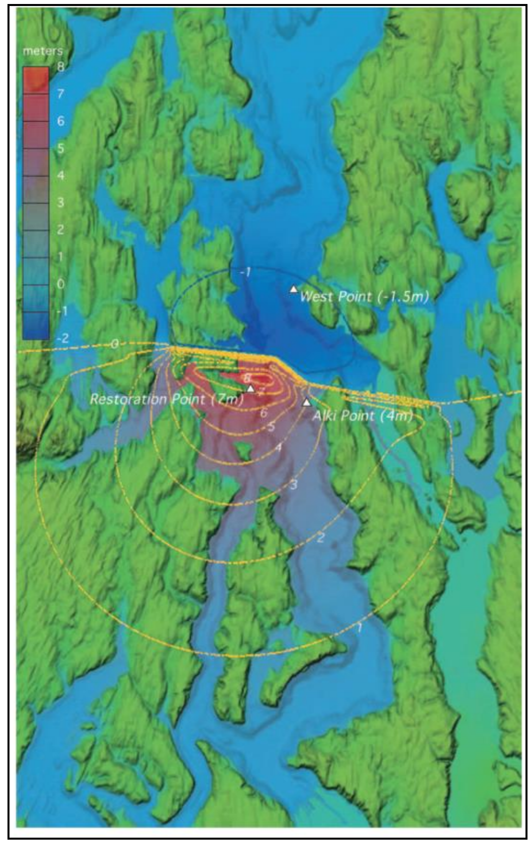
History

Approximately 1000-1100 years before present, a large earthquake (~7.3 Mm)/tsunami event occurred on the Seattle Fault, leading to an uplift of about 15-20 feet on the southern end of Bainbridge Island and subsidence of about 3 feet on the rest of the Island. The resulting maximum tsunami wave was probably between 6 and 8 feet and would have reached the shores within minutes (Figure 48).

While such major events are rare, the West Coast experiences a damaging tsunami every 18 years on average. Within Puget Sound, a landslide is the most likely tsunami/seiche triggering event (Figure 49). An earthquake-induced landslide in 1949 at Salmon Beach in the Tacoma Narrows generated a 6 to 8 foot tsunami that hit Gig Harbor. It moved both directions within the Narrows, probably reaching portions of south Kitsap County.

Figure 50: Tacoma landslide that generated a tsunami at Gig Harbor in 1949.

Figure 49: Illustration of land uplift/subsidence during a ~7.3 Mm dip-slip earthquake along the Seattle Fault. Units are change in elevation in meters



Other records of tsunami/seiches impacting or recorded in central Puget Sound include 1891 (earthquake near Port Angeles), 1894 (submarine landslide in Commencement Bay), 1949 (Olympia earthquake, Salmon Beach landslide), 1964 (Alaska earthquake), 1965 (Puget Sound earthquake), and 2002 (Denali earthquake).

Vulnerability

Although possible impacts and inundation areas have been modeled for several coastal areas of Washington, including Elliot Bay, Bainbridge Island has not yet been specifically assessed for possible inundation areas based on credible scenarios. Low lying coastal areas are clearly vulnerable, especially those positioned across the water from large unstable slopes or embankments. For comparison, NOAA modeling of a 7.3 Mm quake on the Seattle Fault (considered a worst-case scenario) suggested a tsunami wave could reach almost 20 feet above mean sea level in Elliot Bay, submerging the entirety of Harbor Island as well as many areas along the coastline. Modeled current velocities exceeded 40 mph in places, and nowhere within the possible inundation area were velocities lower than a speed at which it would be difficult to stand (Figure 51).

Figure 51: Illustrative model of the wave pattern and wave height of energy disbursement in a Seattle Fault earthquake.

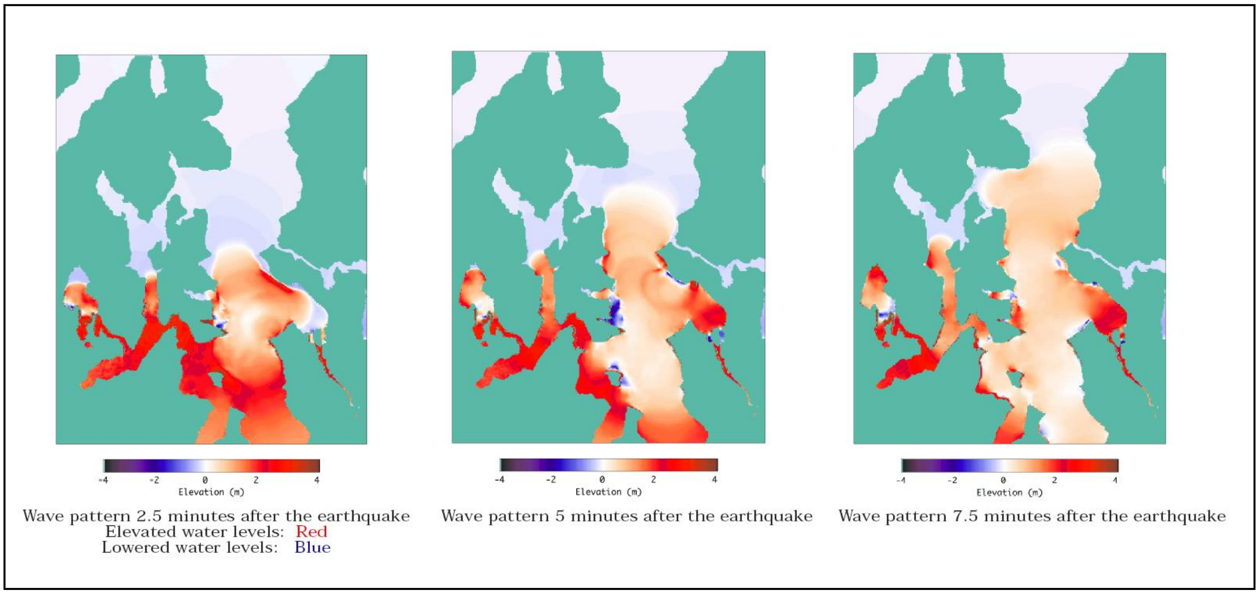


Figure 52: Debris and damage from the Mar. 2011 Japan Tsunami.

The most likely scenario for a major quake on the Seattle Fault is considered to be in the range of 6.5-6.7 Mm. A tsunami from an event of this magnitude had not been modeled at the time of this report. It is possible that such an event would easily inundate the shorelines of Bainbridge Island by 3 to 6 feet, possibly even as much as 12 feet. Harbor resonance in the narrow passages around the Island could increase wave height considerably, though the extent to which it would in this scenario is unknown.

Because much of the development of the shoreline of the Island outside of Winslow is private residences, which would be unlikely to withstand waves at the upper end of this range, debris would be a major secondary hazard, both during the event as well as well after its end. During the event, it would be a contributor to further destruction and loss of life. After the event, it would hinder search and rescue operations, utility restoration, infrastructure repair, and so on. Further, heavy equipment would be required to remove debris, and locations must be designated for its disposal. For comparison, the

3/11 Japan tsunami generated so much debris that it was estimated at “normal rates” of debris disposal, it would take about a century to properly and safely dispose of it all.

Finally, hazardous materials could pose a risk to residents, emergency personnel, and cleanup personnel. For example, sediments at the Superfund site at Eagle Harbor would likely be resuspended and redistributed, increasing the presence of hazardous materials in the waters and shorelines nearby for the short term. While not an immediate threat to life, it could pose a long term health risk to people exposed to those higher levels. In addition, several HazMat materials locations exist in and around Sinclair Inlet, and failures of containment could lead to a “backwash” of those materials onto the Island’s shores by strong outgoing currents.

Two Tsunamis hazard maps were generated for this assessment. The first one displays areas of stable and unstable shoreline surrounding Bainbridge Island as determined by the WA DNR data (Figure 52). There is notation of those areas where steep slopes are next to areas of deep water, as those areas across from unstable slopes combined with “steep and deep” geography have highest risk for a landslide generated Tsunami. The most obvious hazard area on this map is in the southeast, across from Crystal Springs and Point White. The Illahee Park area on Kitsap Peninsula has steep unstable slopes above deep water, placing the shoreline homes along Crystal Springs Drive at risk. There is also increased hazard condition for Point Monroe in the northeast quadrant of the Island.

The second map delineates the 4 and 6-meter shoreline contours as extracted from a Digital Elevation Dataset (DEM), as an indication of the areas that could potentially be inundated with Tsunami waves of those heights (Figure 53). Some of the hazard areas where the contour lines reach furthest into the Island are: Blakely Harbor, Eagle Harbor, the Point Monroe sandspit, Manzanita Bay, Fletcher Bay, and Lynwood Center. While those areas are in susceptible elevation zones, the harbors are likely to absorb some of the wave energy. Many of the coastal homes on the outer ring of the Island lay in relatively more vulnerable places, such as Crystal Springs, South Beach, Pleasant Beach, Yeomalt Point, Rockaway Beach, Rolling Bay, and Point Monroe.

Figure 53: Potential landslide generated Tsunami hazard zones based on slope stability, slope steepness, and water depth.

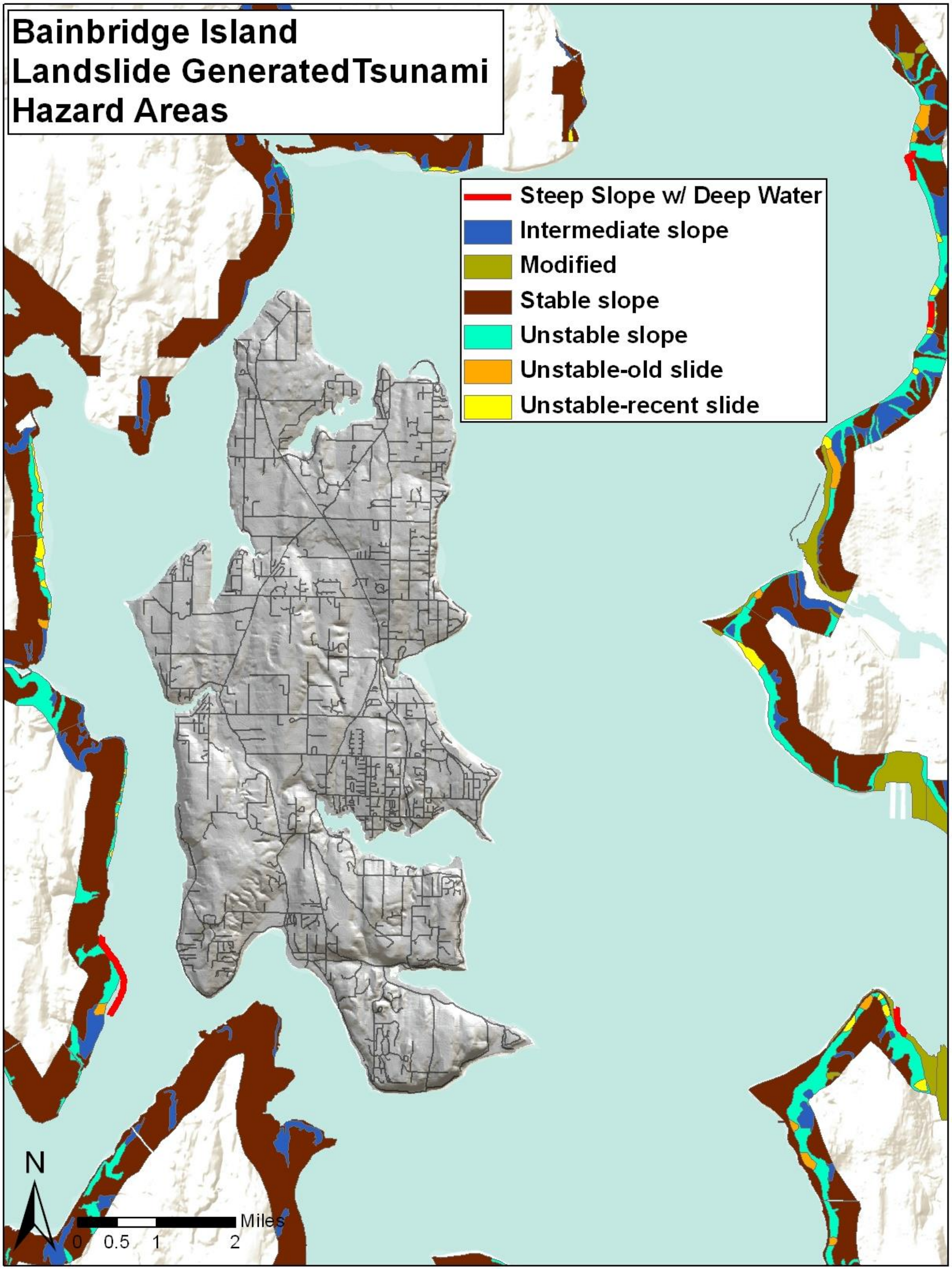
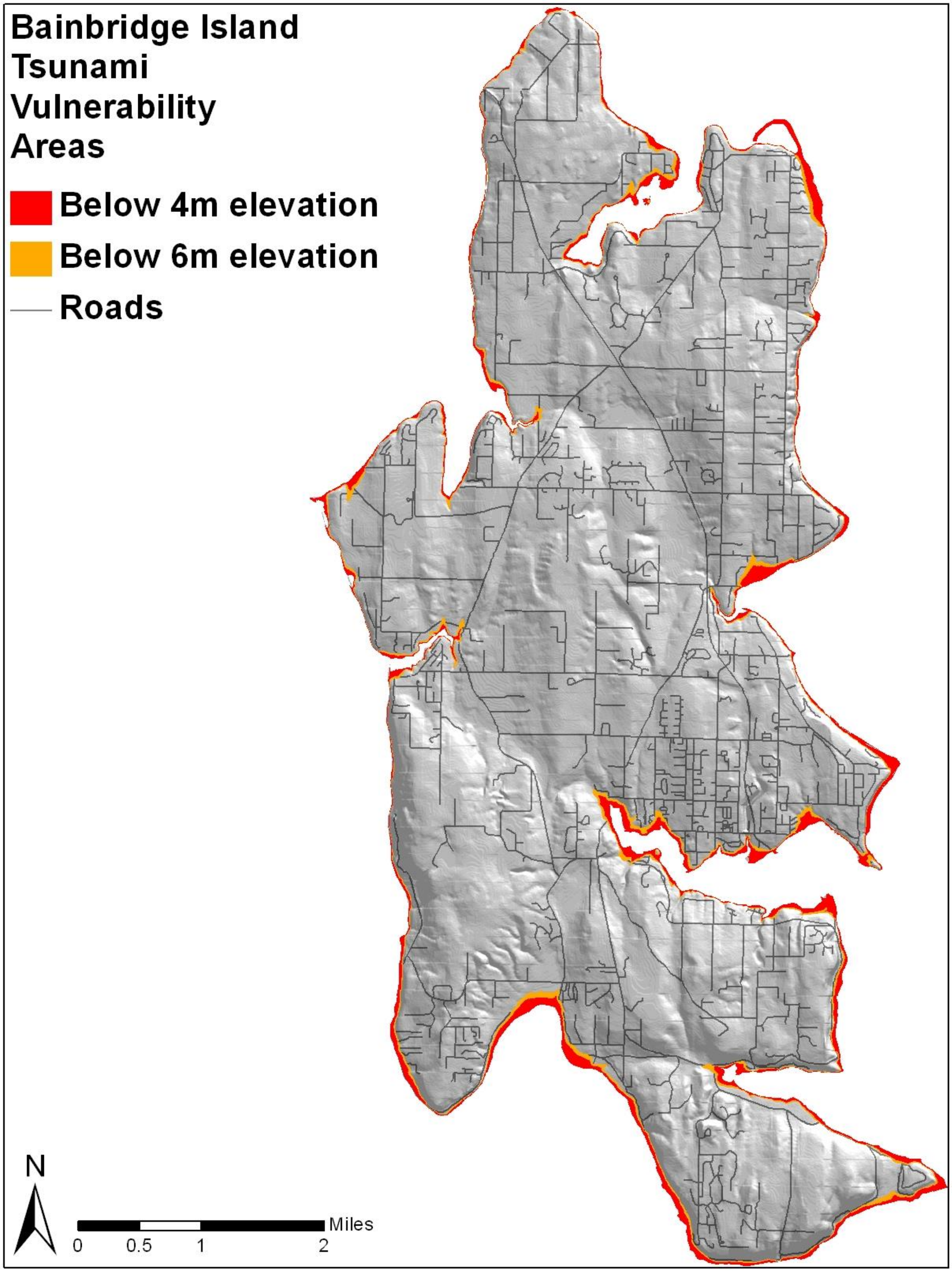


Figure 54: Bainbridge Island Tsunami Vulnerability Areas based on possible inundation from 4 and 6 meter wave heights.



Volcano

Description

A volcano is a vent in the earth's crust through which magma, rock fragments, gases, and ash are ejected from the earth's interior. Eruptive episodes are likely to be accompanied by seismic activity as magma works its way to the surface. Volcanic eruptions can be accompanied by other natural hazards, including earthquakes, mudflows and flash floods, rock falls and landslides, acid rain, fire, and (under special conditions) tsunamis.

Effects

Volcanic eruptions can produce debris flows and avalanches, pyroclastic flows and surges, floods, lava flows and domes, ashfalls and gases, and lateral blasts. Areas in the path of lava flows are the most at risk. While less hazardous than lava, ashfall affects a much greater area. Andesitic and dacitic volcanoes tend to emit lava so thick and charged with gases that they explode into ash rather than flow. Ash and its associated gases are usually too diluted to constitute danger to a normal person but they may cause lung damage to the very young, very old or infirm, or those already suffering from respiratory problems. Extremely heavy ash can clog breathing passages and cause death.

Volcanic Terms

Lava – Molten rock that pours or oozes onto earth's surface.

Pyroclastic flow – Hot avalanches of lava fragments and volcanic gas.

Tephra – Explosive eruptions of fragments of rock blasted high in the air (ash is small fragments).

Lahar – Fast-moving slurries of mud, rock, and water that look and behave like concrete.

Acid rain could result when the sulphur dioxide in the ash cloud combines with rain. Acid rain may cause minor, but painful burns to skin, eyes, and mucous membranes (nose, throat, etc.) as well as affect water supplies, strip and burn foliage, strip paint, corrode machinery, and dissolve fabric.

Heavy ashfall can blot out light and could create a sudden heavy demand for electric light and air conditioning, which could further lead to a partial or full power failure.

Ash clogs water courses and machinery of all kinds and causes electrical short circuits. It drifts onto roadways, railways and runways, where it is slippery. Its weight may cause structural collapse. Because it is easily carried by winds and air currents, it remains a hazard to machinery and transportation for months after the eruption. Any significant ashfall would cause damage to the unprotected moving parts of any machinery, especially motor vehicles. Damage would also occur to electrical equipment due to short circuits. Clean up of ash would tend to be long term since ash must eventually be absorbed by the earth.

Volcanic earthquakes, often centered within or beneath the volcano, are usually one of three kinds: pre-eruption earthquakes caused by explosions or steam or underground magma movements, eruption earthquakes caused by explosions and collapse of walls inside the volcano, or post-eruption earthquakes caused by magma retreat and interior structural collapse. Although volcanic earthquakes are strong near the volcano, they are generally confined there. There are some exceptions, as with the "St. Helens Fault Zone", where a tectonic fault (earth's crustal structure) is closely associated with the volcano. Tremors may cause large rockfalls, snow avalanches, landslides, and building collapse. Since all northwest volcanoes are in a regular seismic zone, tremors should be evaluated for their volcanic potential by qualified geophysicists or seismologists.

History

Cascadia is home to numerous active volcanoes that form as a part of the subduction process. There are five active volcanoes in Washington: Glacier Peak, Mount Baker, Mount Rainier, Mount Adams, and Mount St. Helens (Figure). Volcanic eruptions in the Cascades are infrequent, but may be violent. Mount St. Helens has been the most frequently active volcano in the Cascade Range during the past four thousand years, producing many lahars and a wide variety of eruptive activity. The most recent large eruption on May 18, 1980, caused heavy ash to blanket much of Eastern Washington. Subsequent eruptions on May 25 and June 12 similarly affected Western Washington, although to a lesser degree. Mount St. Helens more recently ended an eruption that extended from October 2004 to early 2008. It resulted in gas and steam explosions from inside the crater along with extensive lava dome building. Glacier Peak has experienced four eruptive periods during the past four thousand years. About thirteen thousand years ago a powerful series of eruptions from this volcano deposited volcanic ash as far away as Wyoming.

Mount Baker last erupted in the mid-1800s for the first time in several thousand years. Volcanic activity at steam vents in Sherman Crater, near the volcano's summit, increased in 1975 and to this day is still strong; but there is no evidence that an eruption is imminent.

Mount Adams has produced few eruptions during the past several thousand years. The most recent activity for this volcano occurred with a series of small eruptions about a thousand years ago.
Mount Rainier has produced numerous eruptions and lahars in the past four thousand years. Rainier is also capped by more glacial ice than all other Cascade volcanoes combined. Hot, acidic volcanic gases and water making it especially prone to landslides and lahars have weakened parts of the steep slopes of Rainier.

Vulnerability

Mount Rainier is the volcano nearest to Bainbridge Island and the one which poses the greatest hazard. The greater hazard a volcanic eruption poses to Bainbridge Island is through ashfall. This is expected to vary from non-existent to light due to prevailing wind patterns that would tend to blow ash and gasses away from the Island. There is still risk of ashfall, depending on wind direction at the time of eruption and the amount and type of tephra ejected (Figure 54). It is unlikely that magma or lahar flows from a Mount Rainier eruption would reach the Island based on USGS modeling of lava and Lahar (volcanic mudflow) flows in such an event (Figure 55).

Figure 55: Visual display of annual probability of 10 centimeters or more of tephra accumulation from a major Cascade volcano in Washington and/or Oregon with Cascade Volcanoes. (WA HIVA)

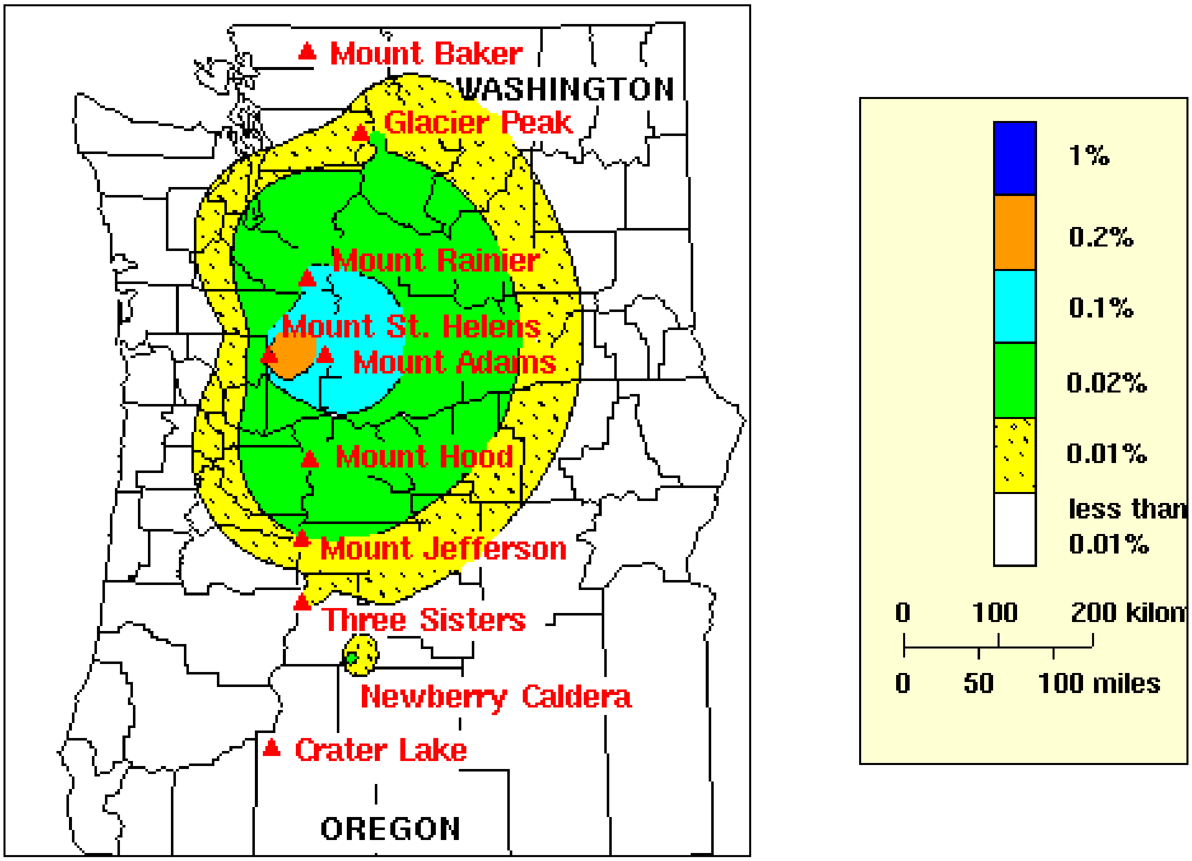
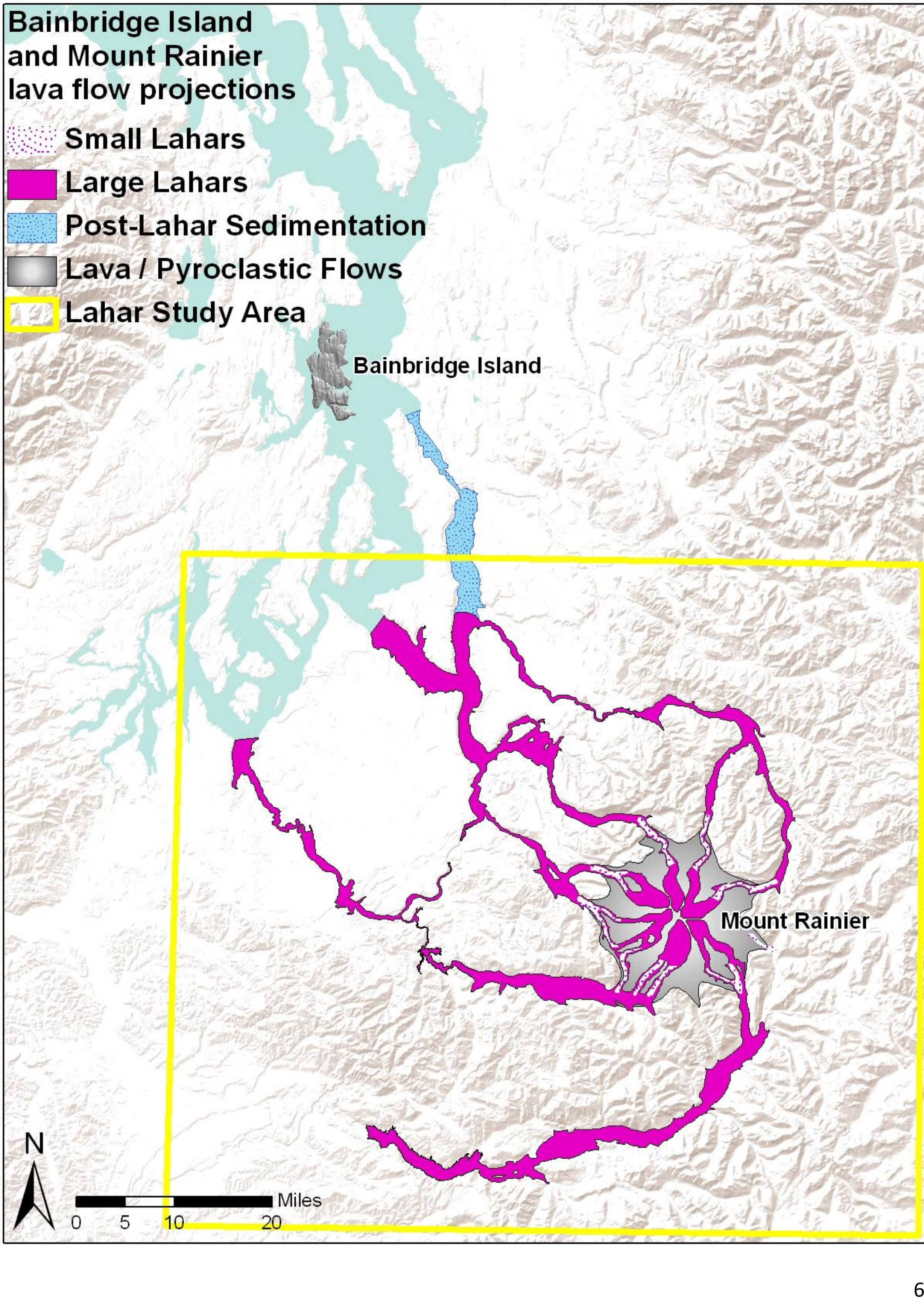


Figure 56: Bainbridge Island in relation to projected lava and Lahar flows in the event of Mt. Rainier eruption.



Natural Hazards Combined

In order to better identify those areas that are vulnerable to multiple hazards, we combined the water, wildfire, and geo hazard layers into a three color transparency overlay to distinguish the hazard classes and a grey-scale overlay to show more clearly areas of overlap between different classes (Figures 57-58). The water hazard layer is a combination of the FEMA 100-year flood layer, the wetlands layer, and the sub 6-meter elevation zone that is potentially vulnerable to Tsunami inundation (Figures 24 and 54). The wildfire layer is the high hazard area from the combined wildfire hazard map (Figure 38). The geo hazard layer was developed by WA DNR as a combination of steep and unstable slopes from the slope stability layer (Figure 31), and areas of high erodiblility that have steep slopes combined with groundwater. Fault lines were also overlaid to indicate where earthquakes are most likely to originate, although a large earthquake would likely affect the Island as a whole. Storms, Volcanic Ash, and Drought would all affect the Island similarly across the landscape.

Figure 57: Bainbridge Island with grouped water, wildfire, and geo hazard overlays and fault lines (DNR, BIFD, and FEMA data)

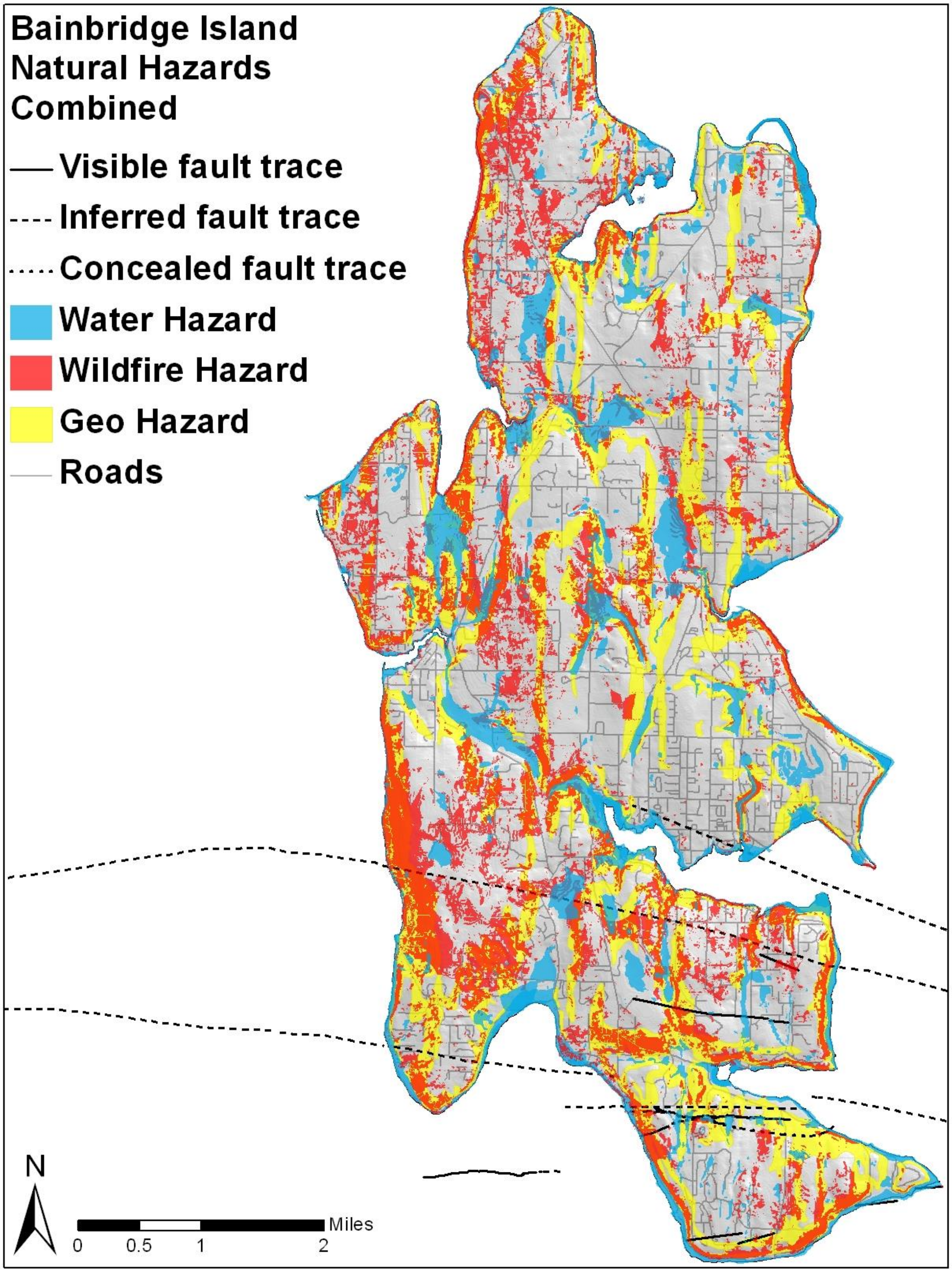
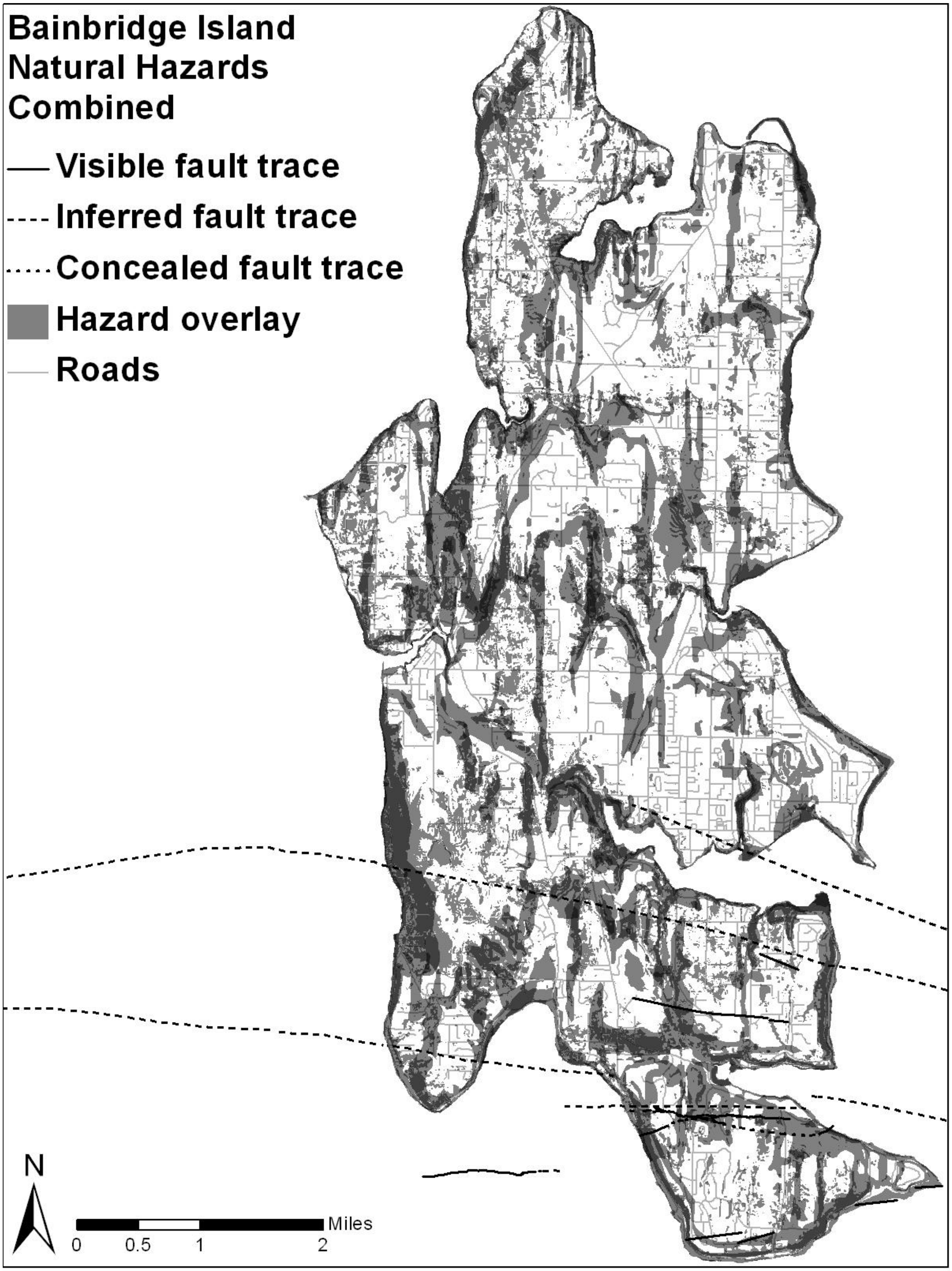


Figure 58: Bainbridge Island with water, wildfire, and geo hazard overlays combined and fault lines (DNR, BIFD, and FEMA data)



IV. Technological Hazards

Energy Emergency

Description

Energy emergencies can include fuel shortages in the form of gasoline, heating fuel and electricity. Oil embargos, terrorism and economic turmoil can help to create these shortages. Severe storms or other natural disasters may disrupt power, creating electrical interruption and shortages.

Effects

Human suffering and economic loss are the most common effect of an energy emergency. Lives could be lost in circumstances where powered medical support is needed.

History

The most common type of energy incident is a power outage and Bainbridge Island typically has about 300 power outages per year. The last major example of an ice storm was the December 1996 storm, which left some people in the rural areas of the county without power for several days. The last major windstorm which impacted our area occurred in December 2006, which left many people in the rural areas of the county without power for several days, in some cases, in excess of one week.
The gasoline shortages from 1973-1974, and in 1979, created long lines at gas stations for both commercial and private vehicles.

Major electricity producers on the West Coast created an energy emergency in the fall of 2000 through market manipulation that artificially inflated the kilowatt/hour cost. This was highly detrimental to the financial well being of power distributors, individual homeowners, business owners, and especially to industries that relied on large quantities of cheap power.

Vulnerability

Hospitals and people who require powered medical equipment would be highly vulnerable to an energy emergency. The loss of power during periods of cold weather could lead to cold related casualties. The Bainbridge Island Senior Community Center serves as the Island's only designated warming station for storm related power outages. The Center has a 45 kilowatt generator and 500-gallon capacity propane tank, which can provide power for up to a week.

Hazardous Sites/ Materials

Description

A hazardous material (HAZMAT) refers to any liquid, solid, gas or sludge, including any materials, substance, product, commodity or waste, regardless of quantity, that exhibits any of the characteristics or criteria of hazardous waste described in WAC 173-303-090 and WAC 173-303-100, including waste oil and petroleum products. Incidents involve the unintentional or intentional release of hazardous materials, which because of their physical, biological, or chemical makeup, pose a threat to the life, health, environment, or property around them. Hazardous materials may also be released as a secondary result of a natural disaster like earthquakes or floods. Some of the hazardous materials that have been identified by Kitsap Co as potential risks are fuel spills, chemical release, sewage spill, mercury spill, methamphetamine labs, bulk road waste, and radiological release.

Effects

The release of toxic agents into the atmosphere and environment can harm the population, animals, food supplies and cause property damage. Building private homes, schools and public facilities on abandoned landfills or at Superfund sites could be devastating to building occupants, causing unsafe working or living conditions.

History

Bainbridge Island has one Superfund site at Eagle Harbor. The site is a shallow embayment on the east side of Bainbridge. Uses of Eagle Harbor include extensive recreational boat moorage, repair of Washington State Ferries, and ferry transport of cars and passengers to and from Seattle. The former Wyckoff Company wood treating facility is located on the south shore at the mouth of the harbor. Wood treating operations at the Wyckoff Facility began in 1905 and continued until 1988 through several changes of ownership. Pressure treatment with creosote was the primary method of wood preservation, although pentachlorophenol also came into use. Preservative chemicals were delivered to the facility by barge and ship and stored in tanks on the property. Spills, leaks, and drippage entered the ground directly or through unlined sumps. Wastewater was discharged into Eagle Harbor for many years, and the practice of storing treated pilings and timber in the water continued until the late 1940's. A shipyard operated on the north shore of Eagle Harbor from 1902 to 1961. Associated sandblasting, waste storage, and disposal led to metal contamination, predominantly mercury, throughout Eagle Harbor. Eagle Harbor supports several fish resources.

Vulnerability

Because there is limited industry or storage of hazardous materials on the Island, the primary risk comes from transport of those substances across the Island. The corridor including the Agate Pass Bridge, SR 305, and the ferry terminal is the area most likely to have a HAZMAT event.

Radiological Incidents

Description

A radiological incident involves the release and potential exposure of radioactive material that can lead to significant consequences to people, the environment or the facility.

Effects

Radioactivity is highly detrimental to all biological forms, causing death or often resulting in sickness or cancer. Radioactive contamination is persistent and capable of entering and cycling through the food chain. Radiological incidents can have an adverse affect on the psyche, creating a state of panic.

History

There have been no radiological releases affecting local jurisdictions in Washington State, either from any nuclear power generating system or nuclear weapon.

Vulnerability

Nuclear facilities exist in the Puget Sound area. The Puget Sound Naval Shipyard and Naval Submarine Base Bangor are both located in Kitsap County. Puget Sound Naval Shipyard decommissions nuclear submarines, recycles gray water, and stores, until shipped, spent fuel rods from the nuclear submarines. It is also the home of modern nuclear aircraft carriers and submarines. Navy Base Kitsap Bangor is home to numerous nuclear power submarines some of which are designed to carry nuclear weapons. While there is always a remote possibility of a radiological event at a Naval facility, the safeguards and safety record of Navy personnel and systems make this a small vulnerability. The threat of radioactive “dirty bombs” used in terrorism activities is a possibility.

Search and Rescue

Description

Anyone who becomes lost is a potential search and rescue emergency.

Effects

Injury or death may occur if people are lost for a prolonged period of time. Small children and the elderly are the most likely to wander off and the most susceptible to injury or exposure.

History

Kitsap County has been conducting Search and Rescue operations since 1971 and continues to train and coordinate resources with surrounding counties. The Bainbridge Island Police, Kitsap County Sheriff's office, and the Kitsap County Department of Emergency Management coordinate all Search and Rescue operations on Bainbridge Island.

Vulnerability

Bainbridge Island has limited recreational areas to attract hunters, hikers, fishermen, etc., that may find themselves lost or in trouble. However, due to the presence of heavily forested areas and recreational areas, Bainbridge Island is vulnerable for missing/lost individuals. The limited size of the Island reduces the risk of a victim being lost for an extended period.

Terrorism and Civil Disorders

Description

Terrorism has been defined by the Federal Bureau of Investigation as "the unlawful use of force or violence against persons or property to intimidate or coerce a government, the civilian population, or any segment of it in furtherance of political or social objectives." Typically the objective of terrorism is not destruction or death but rather the psychological impact to the targeted population and the influence of public opinion. The desired goal is often disruption to public services, economies, and social patterns or creating a feeling of insecurity.

Terrorism can be categorized as either international or domestic. International terrorism originates from groups based outside the U.S. and may be perpetrated against U.S. interests abroad or within the territorial boundaries of the U.S.A. The September 11, 2001 attacks, Al Qaeda, and sympathizer groups would be an example of international terrorism. Acts of domestic terrorism are conceived of and carried out by U.S. citizens within the U.S. borders. The Oklahoma City bombing would be an example of domestic terrorism while other cases could include bullying and school related violence such as the Virginia Tech and Columbine events, or workplace violence such as the "going postal" syndrome.

History

While no major terrorist activities have occurred on Bainbridge Island, the events of 9/11 have increased the threat nationwide and accelerated terrorism mitigation efforts. Regionally, convicted terrorist Ahmed Ressam was arrested in Port Angeles on Dec 14, 1999 for attempting to smuggle explosives into the U.S. with the intent of bombing the Los Angeles International Airport. While school related terrorism garners less attention, it occurs more often and can cause a disproportionately large emotional impact on its community. As stated on the Kitsap Co. Sheriffs website: "*Throughout the United States each year over 200,000 violent crimes occur on school property and 150,000 students stay home because they are sick of violence and afraid they might be stabbed, shot or beaten. Each day in the U.S. 60 teachers are assaulted and 160 threatened. It is estimated that between 100,000 and 135,000 guns are brought to school each day.*"

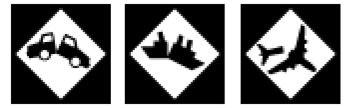
Vulnerability

Table 7: The Department of Homeland Security (DHS) vulnerability factors for terrorist risk assessment.

1. Level of visibility
2. Criticality of target site to jurisdiction
3. Impact outside of the Jurisdiction
4. Public access to the target
5. Potential target threat of hazard
6. Potential target site population capacity
7. Potential for collateral mass casualties

Overall vulnerability on the Island is moderate with the ferry terminal being the most likely target for terrorist activity based on the DHS risk assessment criteria (Table 7). According to a 2006 RAND report on Maritime Terrorism, their "findings suggest that onboard bombings present the greatest combination of threat and vulnerability among the specific types of assaults that were considered." The most likely threat in this case is the use of a human placed Improvised Explosive Device (IED) or a Vehicle Born Improvised Explosive Device (VBIED). Although the economic and social demographics of Bainbridge Island lower the overall risk for school or workplace related violence, shooter incidents in public and private situations are always possible (e.g., King County Metro Bus, 1998; Tacoma Mall, 2005). All public facilities (particularly government buildings such as schools or public offices) should have a shooter incident plan created for such an eventuality.

Transportation Mass Casualty Event



Description

Use of road, air, and maritime systems and supporting transportation vehicles create the opportunity for accidents, emergencies, and disasters. Transportation hazards may be natural or human caused. Emergency incidents occur when the response capabilities of the Island's EMS are exceeded.

Any collisions or pile-up along the SR 305 corridor or main city streets would constitute a Highway Accident. A Marine Accident could involve the Washington State Ferry System or other private and commercial seagoing vessels. An Aviation Accident would involve any in-air collision or collision from the air to the ground.

Effects

The effects of a major disaster involving the highway system would depend on the location of the accident. As is the case with most emergencies, rural areas will be impacted more than urban areas. Local fire and law forces could quickly be overtaxed. All fire districts have contracted assistance, in the form of mutual aid, available to them; thus the problem of emergency forces being overtaxed by a highway accident should only be temporary. The emergency medical force is another area that could be temporarily overextended, as emergency transportation will probably be lacking initially. Consequently, on-scene personnel may have to set up a triage system and/or rely on aid cars for emergency transportation until enough ambulances can respond. In addition, clinics and hospitals are generally not staffed for handling a large number of emergency cases at one time.

History

Over the years there have been several major accidents in Kitsap County, many times caused by heavy fog, freezing rain, wind or ice forming on bridges and overpasses. These types of accidents happen every year. Occasionally tanker trucks, chemical trucks, busses or other vehicles, which could have led to a major accident, are involved. Some of these have closed down the highways for portions of a day; however, none has caused large long term evacuation or closure of the highways for long periods of time.

Vulnerability

Bainbridge Island is moderately susceptible to a transportation mass casualty event due to the Island's position in the SR 305 transportation corridor and the funneling of traffic at the Agate Pass Bridge and the ferry terminal. Incidents involving trucks or other large vehicles can potentially lead to secondary hazards such as fires or hazmat spills.

While the ferry system does present a potential for an emergency situation, the outstanding safety features of the vessels, the effective control of Puget Sound marine vehicular traffic by the U.S. Coast Guard's Vessel Traffic System (VTS), and the Ferry System's excellent safety record all minimize the potential for an accident. Incidents affecting the Ferry and/or its passengers are much more likely to be caused by humans (e.g., terrorism).

Because Bainbridge Island lies in the flight path of Seattle Tacoma National Airport and the Bremerton National Airport in Bremerton, there is always the potential of an airline accident occurring over the Island. Any area within a major flight pattern has the potential for a mid-air collision or an incident arising from an equipment malfunction or pilot error. An Aviation Accident could be represented by the crash of a single aircraft involving a large number of passengers (e.g., Alaska Airlines Flight 261, 2000), a mid-air collision (e.g., as nearly happened with Air Force 2 near Boeing Field in 1984), an accident involving ground structures (residential area, industrial complex, etc.), or any combination of the above)

Epidemic

Description

An epidemic refers to the outbreak and rapid spread of a disease in a community affecting a significant number of people or animals in a relatively short period of time.

This assessment identifies animal and human epidemics diseases as well as zoonotic diseases that can infect both animals and humans. A zoonotic disease agent typically has a nonhuman vertebrate as its host, while possessing the capability to infect humans. A zoonotic disease can have serious socio-economic impacts when transmitted widely within human populations, or when transmitted consistently between human and animal populations. Globally, many of the recent emerging and re-emerging infections have involved zoonotic disease agents. Lyme disease and West Nile virus are zoonotic and were only more recently transferred to human populations while rabies is an example of a zoonotic disease that has been with us for centuries.

Emerging infections are increasing for a variety of reasons including:

- Globalization of the economy is causing increased world travel and human contact.
- Land-use changes such as: deforestation, urbanization, leading to increased human/animal contact.
- Ecological changes such as: agricultural shifts, dam construction, climate change causing species migration and changes in interaction.

Animal Epidemics

Examples:

- influenza zoonotic disease
- rabies zoonotic disease
- Bovine Spongiform Encephalopathy (BSE), also known as "Mad Cow Disease," is a transmittable, slowly progressive, and ultimately fatal neurological disorder found in adult cattle. The primary source of transmission is the feeding of sheep and cow remains to livestock. Infected hormones taken from the pituitary glands of slaughtered cows are another possible vector of transmission when injected in live cows to improve breeding. The discovery of an infected cow typically leads to the destruction of the herd.
- Foot and Mouth Disease (FMD) is a highly contagious viral disease of cattle and swine, as well as sheep, goats, deer, and other cloven-hoofed animals. Although rarely transmissible to humans, FMD is devastating to livestock and has critical economic consequences with potentially severe losses in the production and marketing of meat and milk. The disease is difficult to control, and has occurred in over 60 percent of the world.
- Lyme disease zoonotic disease
- West Nile virus zoonotic disease

Animal epidemics are often the result of poor animal husbandry. The popularity of exotic pets, such as potbellied pigs or unusual rodents, is a new threat to disease control in the animal population in the county. Potbellied pigs can become infected with many diseases that could infect not only other potbellied pigs but also agricultural swine and, in some cases, humans. A 2003 monkeypox outbreak in the Midwestern United States was traced to rodents imported from Ghana and destined for the pet trade. The rodents spread the virus to a number of susceptible non-African species with which they were co-housed, including prairie dogs. Direct or indirect contact with the infected prairie dogs resulted in forty-seven confirmed and probable human monkeypox cases.

Animal epidemics can cause: economic loss due to either the direct death of livestock and/or the necessity for euthanasia due to exposure; the need for disposal of the carcasses before they become a secondary health hazard; loss of primary food supplies, such as the possible loss of meat and/or dairy products and animal byproducts such as wool; and the loss of recreation such as has happened in Washington State with the death of a majority of the coastal razor clam population.

History

While there has been historic evidence of rabies and psittacosis in Kitsap County, as well as a few other diseases, these have not occurred in epidemic proportions. Rabies was considered a major problem in the early part of this century, appearing in epidemic proportions, in Washington and throughout the United States. Today, only one to four human rabies deaths occur each year in the United States. There are still more than 50,000 human rabies deaths world-wide per year, mostly in developing countries. Bats are the only documented reservoir for rabies in Washington State, with over 20 captured bats testing positive in 2007. Approximately 10% of tested bats are carriers of the disease according to Health Department reports. While there have been incidents where animals and people have been bitten without provocation or have had bats in their sleeping areas without knowing that they were bitten, bats generally do not attack people. In other parts of the country, various other species, such as raccoons, coyotes, and skunks, are known rabies carriers. There have been no cases of rabies in the Bainbridge Island pet population in the recent past.

Vulnerability

There are a number of vectors by which animal epidemics could get established on the Island.

- Animals with exotic diseases imported, legally or illegally, from other parts of the state, country or world.
- Infected animals straying across the border from neighboring states or British Columbia.
- Migrating birds can carry avian diseases on their annual migration routes between Alaska and Canada to the north and Mexico or South America to the south.
- Contaminated garbage tossed overboard from a ship in area waters can be eaten by animals.

Washington Administrative Codes (WAC 246-101-101 and WAC 246-101-405) detail public health responsibilities of veterinarians. All veterinarians are required to report certain conditions to their local health district and/or the Washington Department of Health.

Pets brought into Bainbridge Island from outside of Washington, by new or current residents, are a significant potential disease vector. Dogs, cats and ferrets are required to have a current rabies certificate to legally bring their pets into the State, but pet owners are often unaware of this requirement. There is limited control over companion animals entering the Island from outside the state and the lack of entrance stations to enforce the certification regulations leaves the Island open to the importation of diseased animals from other parts of the country. All other non-pet animals are required to have a certificate of health upon entering Washington.

Human Epidemics

Examples:

- West Nile Virus
- E. coli
- Cryptosporidium or other water-borne pathogens
- Lyme Disease
- Hantavirus Pulmonary Syndrome (HPS)
- Acquired immune deficiency syndrome (AIDS)
- Measles
- Hepatitis B
- Tuberculosis (TB)
- The standard seasonal flu

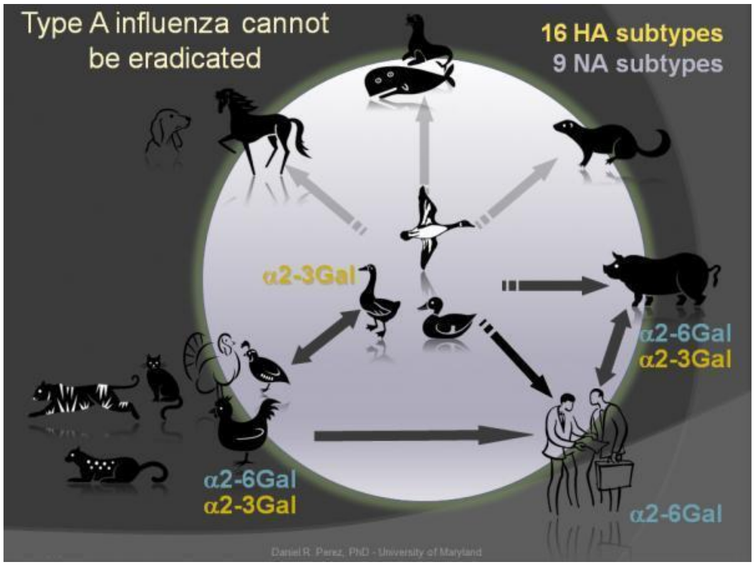
Effects

The impacts could include loss of life, short or long term debilitation, economic hardship for the individuals or their families, lost work time, loss of productivity, strain on current public health and medical resources.

Vulnerability

While the effects of disease on the population have been minor, the potential continues to exist for a large epidemic to be brought in by persons, animals, or materials from elsewhere (e.g., most varieties of influenza).

The potential for an epidemic would increase dramatically in the event of a major disaster, such as an earthquake. In such a case, disease may reach a larger population due to the absence or breakdown of normal intervening factors.



Appendix A: Acronyms

CEMP…………..Comprehensive Emergency Management Plan
CIG……………….Climate Impacts Group
COBI…………….City of Bainbridge Island
CSZ ....Cascadia Subduction Zone
DFW……………..Department of Fish and Wildlife
DHS ....Department of Homeland Security
DMA…………….Disaster Mitigation Act (2000)
DNR ....Department of Natural Resources
DOT ....Department of Transportation
ECY………………Department of Ecology
EMD ....Emergency Management Division
ENSO…………….El Nino Southern Oscillation
EPA ....Environmental Protection Agency
FBI..................Federal Bureau of Investigation
FEMA ....Federal Emergency Management Agency
FIRM…………….Flood Insurance Rate Map
GIS ....Geographic Information System
HazMat……….Hazardous Materials
HIVA ....Hazard Identification and Vulnerability Assessment
HMP…………….Hazard Mitigation Plan
NDCD ....National Climatic Data Center
NEPA ....National Environmental Policy Act
NFIP ....National Flood Insurance Program
NOAA ....National Oceanic and Atmospheric Administration
NDMC ....Nation Drought Mitigation Center
NRCS…………….Natural Resource Conservation Service
NTHMP ....National Tsunami Hazard Mitigation Program
NVEWS ....National Volcano Early Warning System
NWAC ....Northwest Weather and Avalanche Center
NWCG ....National Wildfire Coordinating Group
NWS ....National Weather Service
PDO………………Pacific Decadal Oscillation
PNSN ....Pacific Northwest Seismic Network
PSCZ…………….Puget Sound Convergence Zone
RCW ....Revised Code of Washington
UBC………………Uniform Building Code
USGS .............U.S. Geological Survey
WAC ....Washington Administrative Code

Appendix B: Glossary

Acceleration - The rate of change of velocity with respect to time. Acceleration due to gravity at the earth's surface is 9.8 meters per second squared. That means that every second that something falls toward the surface of earth its velocity increases by 9.8 meters per second.

Asset - Any manmade or natural feature that has value, including, but not limited to people; buildings; infrastructure like bridges, roads, and sewer and water systems; lifelines like electricity and communication resources; or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks.

Base Flood - Flood that has a 1 percent probability of being equaled or exceeded in any given year. Also known as the 100-year flood.

Base Flood Elevation (BFE) - Elevation of the base flood in relation to a specified datum, such as the National Geodetic Vertical Datum of 1929. The Base Flood Elevation is used as the standard for the National Flood Insurance Program.

Bedrock - The solid rock that underlies loose material, such as soil, sand, clay, or gravel.

Building - A structure that is walled and roofed, principally above ground and permanently affixed to a site. The term includes a manufactured home on a permanent foundation on which the wheels and axles carry no weight.

Coastal High Hazard Area - Area, usually along an open coast, bay, or inlet, that is subject to inundation by storm surge and, in some instances, wave action caused by storms or seismic sources.

Coastal Zones - The area along the shore where the ocean meets the land as the surface of the land rises above the ocean. This land/water interface includes barrier islands, estuaries, beaches, coastal wetlands, and land areas having direct drainage to the ocean.

Contour - A line of equal ground elevation on a topographic (contour) map.

Critical Facility – Facilities that are critical to the health and welfare of the population and that are especially important following hazard events. Critical facilities include, but are not limited to, shelters, police and fire stations, and hospitals.

Duration - How long a hazard event lasts.

Earthquake - A sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of earth's tectonic plates.

Erosion - Wearing away of the land surface by detachment and movement of soil and rock fragments, during a flood or storm or over a period of years, through the action of wind, water, or other geologic processes.

Essential Facility - Elements that are important to ensure a full recovery of a community or state following a hazard event. These would include: government functions, major employers, banks, schools, and certain commercial establishments, such as grocery stores, hardware stores, and gas stations.

Fault - A fracture in the continuity of a rock formation caused by a shifting or dislodging of the earth's crust, in which adjacent surfaces are differentially displaced parallel to the plane of fracture.

Federal Emergency Management Agency (FEMA) - Independent agency created in 1978 to provide a single point of accountability for all Federal activities related to disaster mitigation and emergency preparedness, response and recovery.

Flood - A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waters, (2) the unusual and rapid accumulation or runoff of surface waters from any source, or (3) mudflows or the sudden collapse of shoreline land.

Flood Insurance Rate Map (FIRM) - Map of a community, prepared by the Federal Emergency Management Agency, which shows both the special flood hazard areas and the risk premium zones applicable to the community.

Geographic Area Impacted - The physical area in which the effects of the hazard are experienced.

Geographic Information Systems (GIS) - A computer software application that relates physical features on the earth to a database to be used for mapping and analysis.

Hazard - A source of potential danger or adverse condition. Hazards in this howto series will include naturally occurring events such as floods, earthquakes, tornadoes, tsunami, coastal storms, landslides, and wildfires that strike populated areas. A natural event is a hazard when it has the potential to harm people or property.

Hazard Event - A specific occurrence of a particular type of hazard.

Hazard Identification - The process of identifying hazards that threaten an area.

Hazard Mitigation - Sustained actions taken to reduce or eliminate long-term risk from hazards and their effects.

Hydrology - The science of dealing with the waters of the earth. A flood discharge is developed by a hydrologic study.

Infrastructure - Refers to the public services of a community that have a direct impact on the quality of life. Infrastructure includes communication technology such as phone lines or Internet access, vital services such as public water supplies and sewer treatment facilities, and includes an area's transportation system such as airports, heliports; highways, bridges, tunnels, roadbeds, overpasses, railways, bridges, rail yards, depots; and waterways, canals, locks, seaports, ferries, harbors, drydocks, piers and regional dams.

Landslide - Downward movement of a slope and materials under the force of gravity.

Liquefaction - The phenomenon that occurs when ground shaking causes loose soils to lose strength and act like viscous fluid. Liquefaction causes two types of ground failure: lateral spread and loss of bearing strength.

Mitigation Plan - A systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards typically present in the state and includes a description of actions to minimize future vulnerability to hazards.

National Flood Insurance Program (NFIP) - Federal program created by Congress in 1968 that makes flood insurance available in communities that enact minimum floodplain management regulations in 44 CFR §60.3.

National Weather Service (NWS) - Prepares and issues flood, severe weather, and coastal storm warnings and can provide technical assistance to Federal and state entities in preparing weather and flood warning plans.

Probability - A statistical measure of the likelihood that a hazard event will occur.

Richter Scale - A numerical scale of earthquake magnitude devised by seismologist C.F. Richter in 1935.

Risk - The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate or low likelihood of sustaining damage above a particular threshold due to a specific type of hazard event. It also can be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Tectonic Plate - Torsionally rigid, thin segments of the earth's lithosphere that may be assumed to move horizontally and adjoin other plates. It is the friction between plate boundaries that cause seismic activity.

Tsunami - Great sea wave produced by submarine earth movement or volcanic eruption.

Vulnerability - Describes how exposed or susceptible to damage an asset is. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. Like indirect damages, the vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power – if an electric substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Often, indirect effects can be much more widespread and damaging than direct ones.

Wildfire - An uncontrolled fire spreading through vegetative fuels, exposing and possibly consuming structures.

Zone - A geographical area shown on a Flood Insurance Rate Map (FIRM) that reflects the severity or type of flooding in the area.

Appendix C: Major Disaster, Emergency, and Fire Management Assistance Declarations in WA State

		Major Disaster Declarations	
Year	Date	Incident Description	Disaster Number
2011	25-Mar	Severe Winter Storm, Flooding, Landslides, and Mudslides	1963
2009	2-Mar	Severe Winter Storm and Record and Near Record Snow	1825
2009	30-Jan	Severe Winter Storm, Landslides, Mudslides, and Flooding	1817
2007	8-Dec	Severe Storms, Flooding, Landslides, and Mudslides	1734
2007	14-Feb	Severe Winter Storm, Landslides, and Mudslides	1682
2006	12-Dec	Severe Storms, Flooding, Landslides, and Mudslides	1671
2006	17-May	Severe Storms, Flooding, Tidal Surge, Landslides, and Mudslides	1641
2003	7-Nov	Severe Storms and Flooding	1499
2001	1-Mar	Earthquake	1361
1998	16-Oct	Landslide In The City Of Kelso	1255
1998	5-Oct	Flooding	1252
1997	21-Jul	Snowmelt/Flooding	1182
1997	2-Apr	Severe Storms/Flooding/Landslides/Mudslides	1172
1997	17-Jan	Severe Winter Storms/Flooding	1159
1997	7-Jan	Ice and Snow Storms	1152
1996	9-Feb	Severe Storms/Flooding	1100
1996	3-Jan	Storms/High Winds/Floods	1079
1994	2-Aug	El Nino Effects (The Salmon Industry)	1037
1993	4-Mar	Severe Storm, High Winds	981
1991	13-Nov	Fires	922
1991	8-Mar	High Tides, Severe Storm	896
1990	26-Nov	Flooding, Severe Storm	883
1990	18-Jan	Flooding, Severe Storm	852
1989	14-Apr	Heavy Rains, Flooding, Mudslides	822
1986	15-Dec	SEVERE STORMS, FLOODING	784
1986	26-Jul	SEVERE STORMS, FLOODING	769
1986	19-Mar	Heavy Rains, Flooding, Landslides	762
1986	15-Feb	SEVERE STORMS, FLOODING	757
1983	27-Jan	SEVERE STORMS, HIGH TIDES, FLOODING	676
1980	21-May	VOLCANIC ERUPTION, MT. ST. HELENS	623
1979	31-Dec	STORMS, HIGH TIDES, MUDSLIDES, FLOODING	612
1977	10-Dec	SEVERE STORMS,MUDSLIDES, FLOODING	545
1975	13-Dec	SEVERE STORMS, FLOODING	492
1974	25-Jan	SEVERE STORMS, SNOWMELT, FLOODING	414
1972	10-Jun	SEVERE STORMS, FLOODING	334
1972	24-Mar	Heavy Rains, Flooding	328

1972	1-Feb	SEVERE STORMS, FLOODING	322
1971	9-Feb	Heavy Rains, Melting Snow, Flooding	300
1965	11-May	Earthquake	196
1964	29-Dec	Heavy Rains & Flooding	185
1963	2-Mar	FLOODS	146
1962	20-Oct	SEVERE STORMS	137
1957	6-Mar	FLOODS	70
1956	25-Feb	FLOOD	50
		Emergency Declarations	
Year	Date	Incident Description	Disaster Number
2005	7-Sep	Hurricane Katrina Evacuation	3227
1982	19-Aug	Threat of Flooding at Spirit Lake	3086
1979	12-Mar	Flooding	3070
1977	31-Mar	Drought	3037
		Fire Management Assistance Declarations	
Year	Date	Incident	Disaster Number
2011	8-Sep	Monastery Fire Complex	2966
2010	27-Aug	Slide Creek Fire	2854
2010	19-Jul	Cowiche Mills Fire	2848
2009	22-Aug	Dry Creek Fire Complex	2827
2009	22-Aug	Oden Road Fire	2826
2009	29-Jul	Union Valley Fire	2823
2008	11-Jul	Badger Mountain Fire Complex	2784
2008	11-Jul	Spokane Valley Fire	2783
2007	21-Sep	Broughton Fire	2731
2007	16-Jul	Tunk Grade Fire	2714
2007	8-Jul	Easy Street Fire	2711
2006	11-Sep	Flick Creek Fire	2674
2006	22-Aug	Columbia Fire Complex	2668
2006	8-Aug	Valley Mill Fire	2663
2005	7-Aug	School Fire	2575
2005	1-Aug	Dirty Face Fire	2572
2004	12-Aug	Mud Lake Fire	2546
2004	11-Aug	Fischer Fire	2543
2004	30-Jul	Elk Heights Fire	2538
2004	30-Jul	Deep Harbor Fire	2537
2004	6-Jul	Beebe Fire	2527
2003	6-Sep	Needle Fire	2498
2003	16-Jul	Okanogan City Fire	2481
2003	12-Jul	Middle Fork Fire	2477

Appendix D: Emergency Contacts

Contact	Phone #
Bainbridge Island Fire Department Station 21 (Main Headquarters) 8895 Madison Avenue NE, Bainbridge Island, WA 98110	(206) 842-7686
WA DNR - Report a Forest Fire	1-800-562-6010
Washington Department of Natural Resources South Puget Sound Region 950 Farman Avenue N, Enumclaw, WA 98022	(360) 825-1631
Law Enforcement	911
Police Department 625 Winslow Way East, Bainbridge Island, WA 98110	(206) 842-5211
Washington State Patrol 4811 Werner Road, Bremerton, WA 98312	(360) 478-4646
Fire and EMS	911
Virginia Mason Clinic 380 Winslow Way E., Bainbridge Island, WA 98110	(206) 842-5632
The Doctors Clinic 945 Hildebrand Lane Northeast Bainbridge Island, WA 98110	(206) 855-7700
Bainbridge Pediatrics 9431 Coppertop Loop, Suite A Bainbridge Island, WA 98110	(206) 780-5437
Bainbridge Island Ambulance Association 12985 Phelps Rd. NE Bainbridge Island, WA 98110	(206) 842-2676
Bainbridge Island Utilities	
Puget Sound Energy 10885 NE 4th Street, P.O. Box 97034 Bellevue WA 98009-9734	(888) 225-5773

City of Bainbridge Island Water 280 Madison Ave North Bainbridge Island, WA 98110	(206) 780-8603 or 842-1212
South Bainbridge Water 4573 Point White Dr NE Bainbridge Island, WA 98110	(206) 842-4299
Island Utilities 625 Winslow Way E, Bainbridge Isle, WA 98110	(206) 319-2656
Meadowmeer Water P.O. Box 10483, Bainbridge Island, WA. 98110	(206) 780-2958
There are over 100 independent water companies on Bainbridge Island. For information, contact Christy or Debbie at the COBI offices.	(206) 780-8603

Appendix E: National Register of Historic Places and Community Facilities

Historic Places	**Address**	**Listed**	**Area of Significance**
Agate Pass Bridge	WA 305 over Agate Pass	1995	Transportation
Bainbridge Island Filipino Community Hall	7566 NE High School Rd.	1995	Events
Fort Ward Historic District	South of Winslow	1978	Architecture/Engineering
U.S. Naval Radio Communications Station	0.5 mi N of Beans Point	1996	Communications/Military
Community Facilities			
Virginia Mason Winslow Clinic	380 Winslow Way E		Medical
Bainbridge Island Teen Center	9332 NE High School RD		Youth Center
Bainbridge Island Senior Center	370 Brien Drive		Senior Center
Bainbridge Island Library	1270 Madison Ave N		Public Library
Bainbridge Island Historical Museum	215 Ericksen Ave NE		History
City of Bainbridge Island	280 Madison Ave N		City Government
Bainbridge Island Waste Disposal Facility	7215 NE Vincent Rd		Public Service
Ferry Terminal	Winslow Ferry landing		Transportation

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Washington State DNR: fortress.wa.gov/dnr/app1/dataweb/dmmatrix.html

Washington State ECY: www.ecy.wa.gov/services/gis/data/data.htm

Washington State DOT: www.wsdot.wa.gov/mapsdata/geodatacatalog/

Geospatial Clearinghouse: wa-node.gis.washington.edu/geoportal/

USGS Seamless Server: seamless.usgs.gov/website/seamless/viewer.htm