Tulalip Reservation
Hazard Mitigation Plan

Tulalip eservation
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List of Acronyms

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

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

1. Introduction

1.1. Background

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

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

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

Information from the **2004 Snohomish County Hazard Inventory and Vulnerability Analysis** (HIVA) that is relevant to the Tulalip Reservation was used to develop this HMP. Using the HIVA as a starting point, this HMP defines each hazard, assesses the risk the hazard poses to residents of the Tulalip Reservation and defines the specific long- and short-term mitigation actions that the Tulalip Tribes can take to reduce loss in the event of a disaster.

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

The Federal Emergency Management Agency (FEMA) defines mitigation as "actions that reduce or eliminate the long-term risk to people and property from the effects of hazards"[1]. Mitigation can be structural or non-structural earthquake retrofit programs, Tribal ordinances that prohibit new development in floodplains, or coalition building among organizations to improve their ability to educate the public about risk.

[1] FEMA 2000

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

1.2. Purpose and Mission

The purpose of this document is to provide and expand upon information concerning significant natural hazards that have the potential to affect large areas or populations within the Tulalip Reservation. The HMP is intended to serve as a basis for Tribal-level emergency management plans and programs, as well as to assist other Tribal agencies, local special districts (such as school and fire districts), and private businesses in the development of similar documents focused on local hazards.

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

- Earthquakes
- Flooding
- Landslides
- Severe Weather
- Tsunami/Seiche
- Wildland Fire

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

1.3. Policy Framework for Washington

Washington State Mitigation Policy identifies a commitment to hazard mitigation planning in order to reduce the impact of disasters and ensure that communities in Washington State are less vulnerable to the impacts of hazards. The Washington State Legislature and the Governor have instituted a program to provide matching fund support for eligible applicants of the Hazard Mitigation Grant Program (HMGP).[2] There are also other state programs that have become available that can help aid mitigation strategies and reduce the impact of disasters. The Tulalip Hazard Mitigation Plan is being developed as a Local Hazard Mitigation Plan.

1.4. Plan Criteria and Authority

This document provides information associated with the main disaster events affecting the Tulalip Tribes. This plan is designed to meet requirements of the DMA 2000 for

[2] WMDEMD 2003

local mitigation plans [44CFR201.6] and is intended to be the basis for the Tulalip Tribes hazard mitigation planning efforts.

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

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

This document falls under the jurisdiction of the Tulalip Tribes Board of Directors. The Board of Directors provides oversight to emergency management activities and those ordinances, resolutions, contracts, rules and regulations that are necessary for emergency management.[3]

The Tulalip Tribes Board of Directors consists of seven Board members. The Chairman of the Board of Directors will provide necessary input and supervision to the General Manager of the Tulalip Tribes, who will act as the Emergency Management Director in the event of an emergency, to carry out the duties of the position. The General Manager/Emergency Management Director will also create an Office of Emergency Management. The OEM shall be a division of the Tulalip Tribes Administration Department and work collaboratively with the Tulalip Police Department. The OEM shall maintain a full time position for an Emergency Management Coordinator. The Emergency Management Coordinator shall have the responsibility of implementing the Tulalip Tribes Hazard Mitigation Plan. The Tulalip Tribes Hazard Mitigation Plan will be a living document and primary duties of the Emergency Management Coordinator will include creating and maintaining partnerships with private, public and business sectors to assist with the continuous and ongoing monitoring, evaluating and updating of the Tulalip Tribes Hazard Mitigation Plan.

The Tulalip Tribes Board of Directors and/or the Emergency Management Director may direct any department, program or operation and use their authorities and resources in response to an emergency or disaster situation. This authority shall include and not be limited to the following entities:

[3] The Tulalip Tribes Basic Emergency Management Plan 2003

- The Chairperson of the Tulalip Tribes, whom shall act as chair;
- The Emergency Management Director
- The Tulalip Tribes Chief of Police
- The Emergency Management Coordinator
- A representative of the Tulalip Fire Department, or successor;
- A representative of the Tulalip School District, or successor;
- A representative of the Tulalip Utilities District, or successor,
- A representative of the Tulalip Finance Department, or successor;
- A representative of the Tulalip Logging/Forestry
- And such Tribal officials and other citizens with technical capabilities in related areas, upon appointment by the General Manager.

1.5. Document Overview

This plan is divided into eleven sections as follows:

Section 1 – Introduction

Section 2 – Community Profile

Section 3 – Planning Process

Section 4 – Risk Assessment

Section 5 – Hazard Risk Rating

Section 6 – Capability Assessment

Section 7 – Plan Goals and Objectives

Section 8 – Mitigation and Implementation Strategies

Section 9 – Action Plan

Section 10 – Plan Maintenance

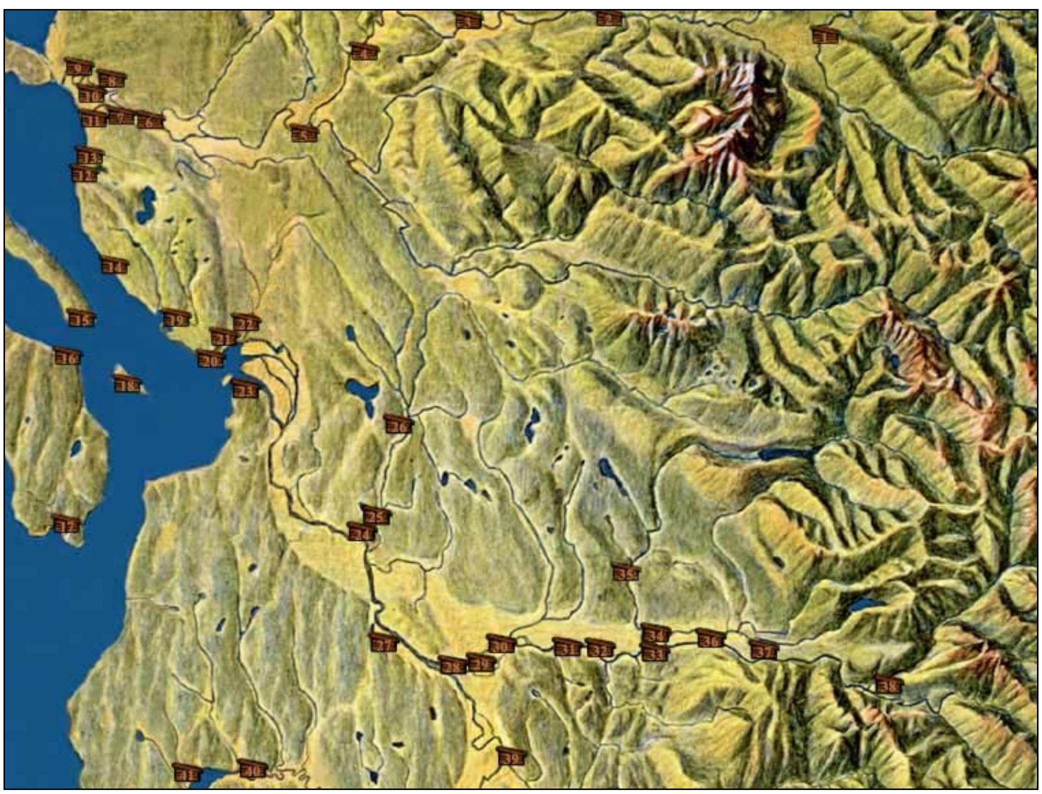
Section 11 – References and Appendices

2. Community Profile

2.1. Tulalip Reservation History

Current scientific data indicate that Native Americans arrived from Siberia via the Bering Sea land bridge about 12,000 years ago, during the end of the last Ice Age. Natives in the region share a similar cultural heritage based on a life focused on the bays and rivers of Puget Sound. The many tribal groups in the area shared a common language, known as Salish, or by native speakers as Lushootseed or Whulshootsheed, which evolved into many dialects. Some of the major tribes in the area of the present Tulalip Reservation include the Kikiallus, Stillaguamish and Snohomish Tribes. The area was home to at least 40 villages in 1800, including at least 5 on the present site of the Tulalip Reservation. Figure 2-1 shows the villages located in the Snohomish County area in 1800. Villages numbered, 34, 39, 20, 21, and 22 are located on the present site of the Tulalip Reservation. For more detailed information on the local villages, and the map, please see "The Coast Salish Villages of Puget Sound" (http://coastsalishmap.org/start_page.htm), prepared by Tom Dailey.

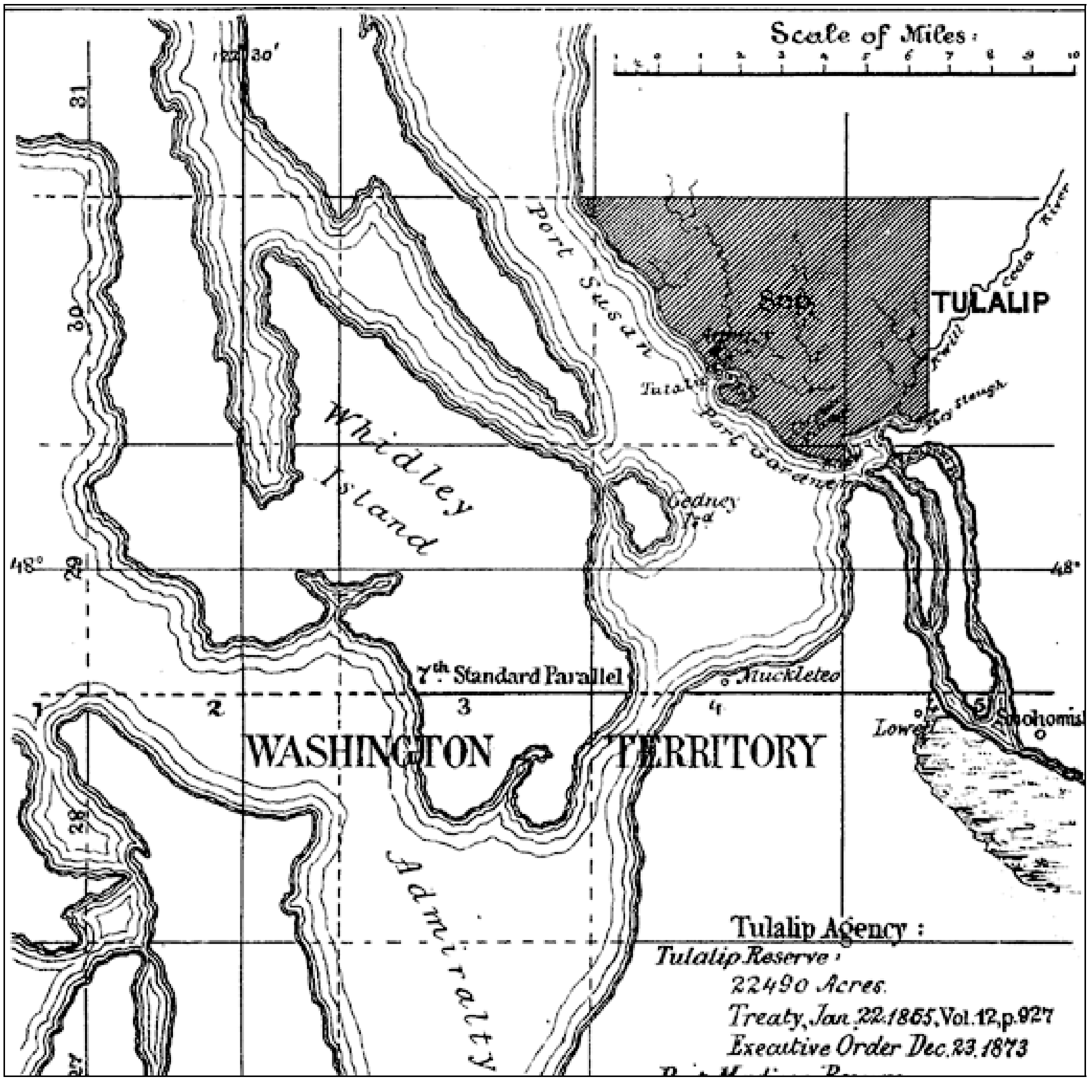
Figure 2-1: Villages in the Snohomish County Area, circa 1800



Increasing pressure from European-American settlers exacerbated the problems faced by a native population already decimated by diseases such as smallpox and tuberculosis, which culminated in the signing of treaties in 1854 and 1855 that ceded much of native territory to the United States.

The Tulalip Reservation was established by the Point Elliott Treaty of January 22, 1855 and enlarged by Executive Order of December 23, 1873. It was established to provide a permanent home for the Snohomish, Snoqualmie, Skykomish, Skagit, Suiattle, Samish and Stillaguamish Tribes and allied bands living in the region. Figure 2-2 shows the Tulalip Reservation in 1879.[4] Catholic Missionaries moved into the area, and soon established a missionary school and church.

Figure 2-2: Tulalip Reservation, 1879[5]



The natives on the Reservation did not adapt to agriculture too readily, as the federal government had hoped, and many either returned to a sustenance lifestyle based on fishing and gathering, or just moved off the Reservation to find employment to support their families. The allotment of land to tribal members and families began in 1883 and ended in 1909.[6] The modern Tulalip Tribal government was organized under the Indian

[4] University of Washington Digital Collection, scanned from 1879 U.S. Office of Indian Affairs Annual Report, http://content.lib.washington.edu/aipnw/maps.html
[5] ibid.
[6] http://www.goia.wa.gov/tribalinfo/tulalip.html

Reorganization Act of 1934. Tulalip's Constitution and Bylaws were approved January 24, 1936 and a Charter ratified October 3, 1936. The governing body is the seven member Board of Directors. The Tulalip tribal government is responsible for administering lands, leasing, loans, education, social services, health, land use planning, environmental protection, police, criminal and civil courts enrollment, water resources and roads, hunting and fishing and recreation. Presently, the Tribe has incorporated a tribal municipality, Quil Ceda Village, to provide city services and infrastructure to help facilitate development of a major business park along the I-5 corridor that includes shopping malls and retail chains, including Home Depot. The tribe has also developed its own businesses, including two new casinos, a bingo facility and two liquor stores. These actions have resulted in increased revenue for the Tribe, which has led in turn to the development and expansion of tribal government services and facilities, such as the Tulalip Health Clinic.

2.2. Geographic Setting

The Tulalip Reservation is located in Snohomish County about 35 miles from downtown Seattle, Washington, and just north of Everett, Washington. It encompasses a land area of about 22,000 acres or about 35 square miles. It is located north of the mouth of the Snohomish River, and along Possession Sound. Major development is located along Tulalip Bay, home to Native Americans for thousands of years, and along Interstate 5, which serves as its eastern border. The City of Marysville is adjacent to the reservation across I-5. Figure 2-3 shows the general location of the Tulalip Reservation in relationship to Seattle and the Puget Sound region. Figure 2-4 shows the Tulalip Reservation.

Lakes, Rivers and Streams

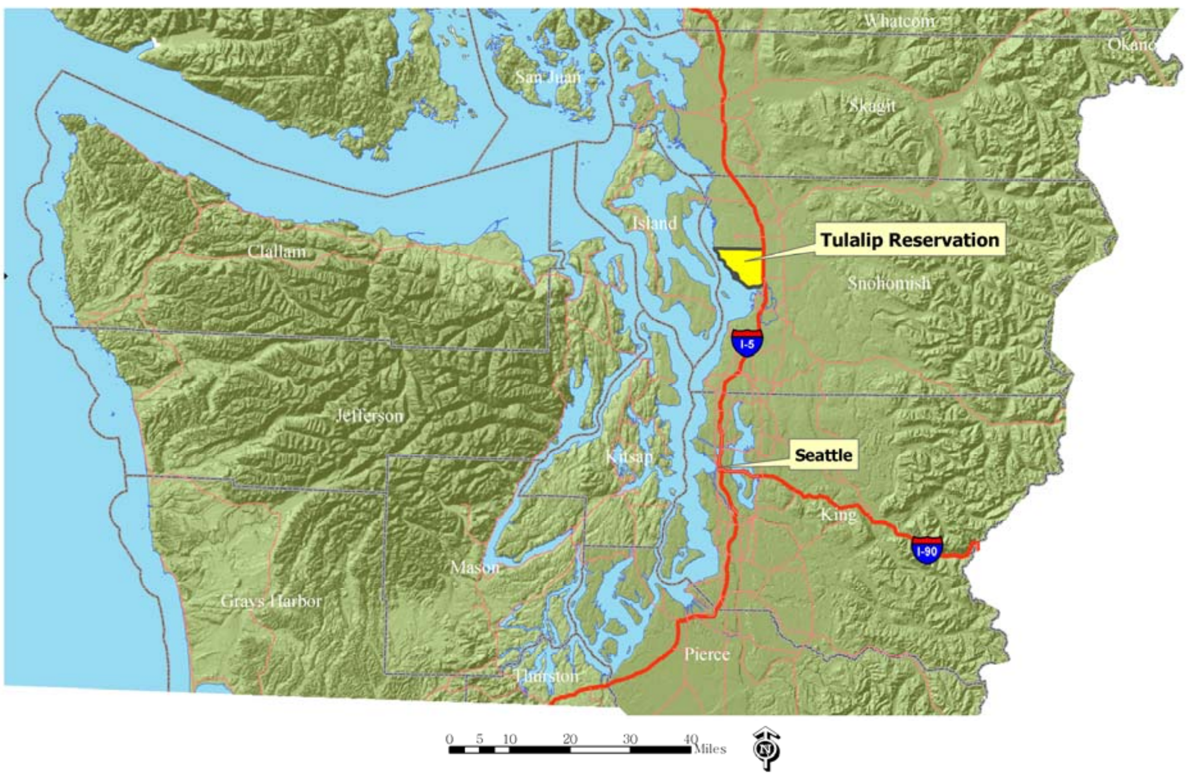
The Snohomish River's delta forms the southern boundary of the Reservation along Steamboat Slough. The Snohomish River (average annual discharge of 3,945 cubic feet per second) is a major producer of several species of salmon, including steelhead. Development is limited in this area due to the debris and sediment load of the Snohomish River. The river deposits debris and sediment along the mouth of the river and into Possession Sound adjacent to the Reservation's coast and routinely damages docks and bulkheads, as well as flood low-lying areas such as Priest Point. The Reservation is located in two sub-basins, the Tulalip and Quil Ceda basins, although a very small portion in the northwest is drained by the Stillaguamish coastal basin. The Tulalip sub-basin, located in the western 2/3's of the reservation, is drained by Tulalip Creek and Battle (Mission) Creek. The Quil Ceda sub-basin, in the low eastern part of the reservation, is drained by Sturgeon and Quil Ceda Creeks. Quil Ceda Creek, which is currently suffering from the effects of pollution and urban waste run-off, is the largest stream on the Reservation, and was once the location of large runs of salmon.

The reservation also contains a few ponds and lakes, notably, Weallup Lake, Ross Lake, John Sam Lake, Mary Shelton Lake, Lake Agnes, and Fryberg Lake. There is also a fish hatchery located on Upper Tulalip Creek Pond, which is formed by a dam.

Hills and Mountains

The western 2/3s of the Reservation is comprised of three generally parallel, rolling ridges from 400 to 600 feet high drained by Tulalip and Battle Creeks. These ridges are the southern end of what is known as the Tulalip Plateau, an elongated mound surrounded by the waters of Port Susan to the west and the low-lying and flat Marysville Trough to the east. This plateau ends abruptly as steep sea cliffs which drop as much as 300 feet at the coast.

Figure 2-3: Context Map of Tulalip Reservation



Soils and Geology

About 14,000 years ago the Vashon Glacier was covering the Tulalip Reservation with about 3,000 feet of ice. The glacier carved out a trough and when it melted the sea level rose 300 feet and filled the trough in creating Puget Sound. The top layer is *Vashon till* and can be found to depths up to 30 feet. Below Vashon till is *Esperance sand* and then *Lawton clay*. Vashon till is a stable mix of rocks, dirt, clay and sand that has the consistency of concrete. Esperance sand is a permeable mixture of sand and gravel. Lawton clay is an impermeable layer of clay, which is made up of fine sediments and large boulders.[7] See Figure 2-5 for a cross section of the soils that make up the coastal geology of the Tulalip Reservation.

[7] KCEM, http://www.metrokc.gov/prepare/docs/RHMPLANDSLIDES.pdf

Figure 2-4: The Tulalip Reservation

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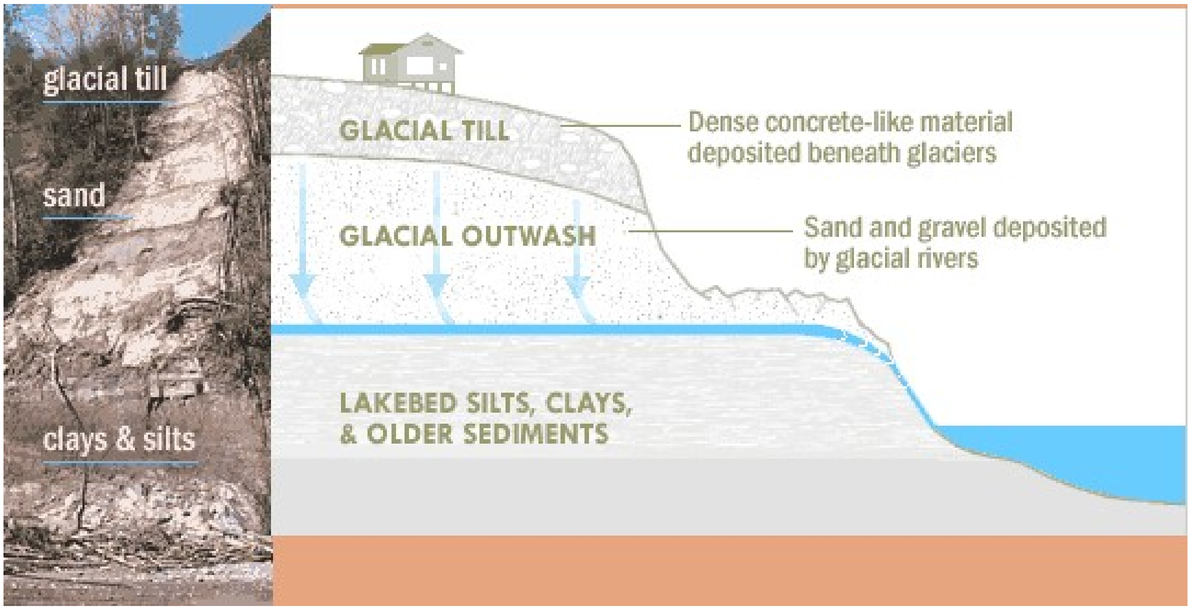
Figure 2-5 Soil Characteristics of the Tulalip Reservation[8]



Climate

The Tulalip Tribes of Tulalip Reservation has the temperate climate typical of the Puget Sound coastal lowlands. Summers are dry with mild temperatures, and winters are rainy with occasional snow. On the Tulalip Reservation, the average temperature for January is 38° F and 63° F for July. Summer highs can be in the high 90s, while winter lows can reach 0°. Average annual rainfall is 35 inches. Winds vary in direction, but are predominantly southerly and westerly. Winter winds average 25 mph with gusts up to 50 mph not uncommon. Air inversions and periods of stagnation occur for short periods during the winter, resulting in regional burn bans and other pollution control measures. Fog may occur in low lying areas such as Tulalip Bay and the Snohomish River delta due to the proximity to Puget Sound.

2.3. Land Use and Future Development Trends

The Tulalip Reservation has a unique land ownership and land use system compared to other jurisdictions in Washington State. This is because the Tulalip Reservation is not a State jurisdiction at all; rather it is a sovereign nation within Washington State and held in Trust for its native inhabitants, namely Tulalip Tribes members, by the United States Federal government. Nonetheless, Federal policy and relations between Native Americans and non-native Americans, has led to about 11,400 acres or 48% of the land area being alienated or owned by non-natives. This land is referred to as Fee Land. With

[8] Puget Sound Landslides http://www.ecy.wa.gov/programs/sea/landslides/about/geology.html

greater economic independence in recent years, the Tribe has been buying back alienated land.

The Treaty of Point Elliot or Muckl-te-oh of 1855 established the Reservation, to be reserved "for exclusive use[9]" by all the native inhabitants of the region. Article 3 defines the location and eventual use of the Reservation:

There is also reserved from out the lands hereby ceded the amount of thirty-six sections, or one township of land, on the northeastern shore of Port Gardner, and north of the mouth of Snohomish River, including Tulalip Bay and the before-mentioned Kwilt-seh-da Creek [Quil Ceda Creek]*, for the purpose of establishing thereon an agricultural and industrial school, as hereinafter mentioned and agreed, and with a view of ultimately drawing thereto and settling thereon all the Indians living west of the Cascade Mountains in said Territory. Provided, however, That the President may establish the central agency and general reservation at such other point as he may deem for the benefit of the Indians.*[10]

From 1883 to 1909, land was allocated to tribal members and family with the purpose of assimilating their land into the greater County. Tribe members were free to sell their land to non-tribal members, and thus began the alienation process. Figure 2-6 shows the allotment of lands from 1883 to 1909. Note the reserved land along Tulalip Bay and some of the family names on Tribal allotments, many of which are familiar today.

Presently, in 2004, 11,392 acres are Fee land and 12,442 acres are Trust Lands. Of the 294 parcels held in trust, 180 are tribally owned and 114 are tribal members. Furthermore, 47 parcels are Pending Trusts and 16 are Fee Simple. Figure 2-7 shows the current land ownership of the Reservation. Please note the tribally owned parcel at Camano Head. This was the site of a landslide that killed many Tribal members' ancestors in the 1830's while clamming. It caused a small tidal wave, a tsunami, that then swept across Possession Sound and destroyed a village at Hat Island.

Zoning and Future Land Use

Figure 2-8 shows the current zoning of the land of the Tulalip Reservation. Figure 2-9 shows the proposed future land use of the Tulalip Reservation. Note that Tribal Trust lands located along the steep landslide-prone bluffs are now designated as *Conservation.*

[9] Point Elliot Treaty 1855 http://www.nwifc.wa.gov/tribes/treaties/tpointell.asp
[10] ibid.

Figure 2-6: Original Allocation of 1883

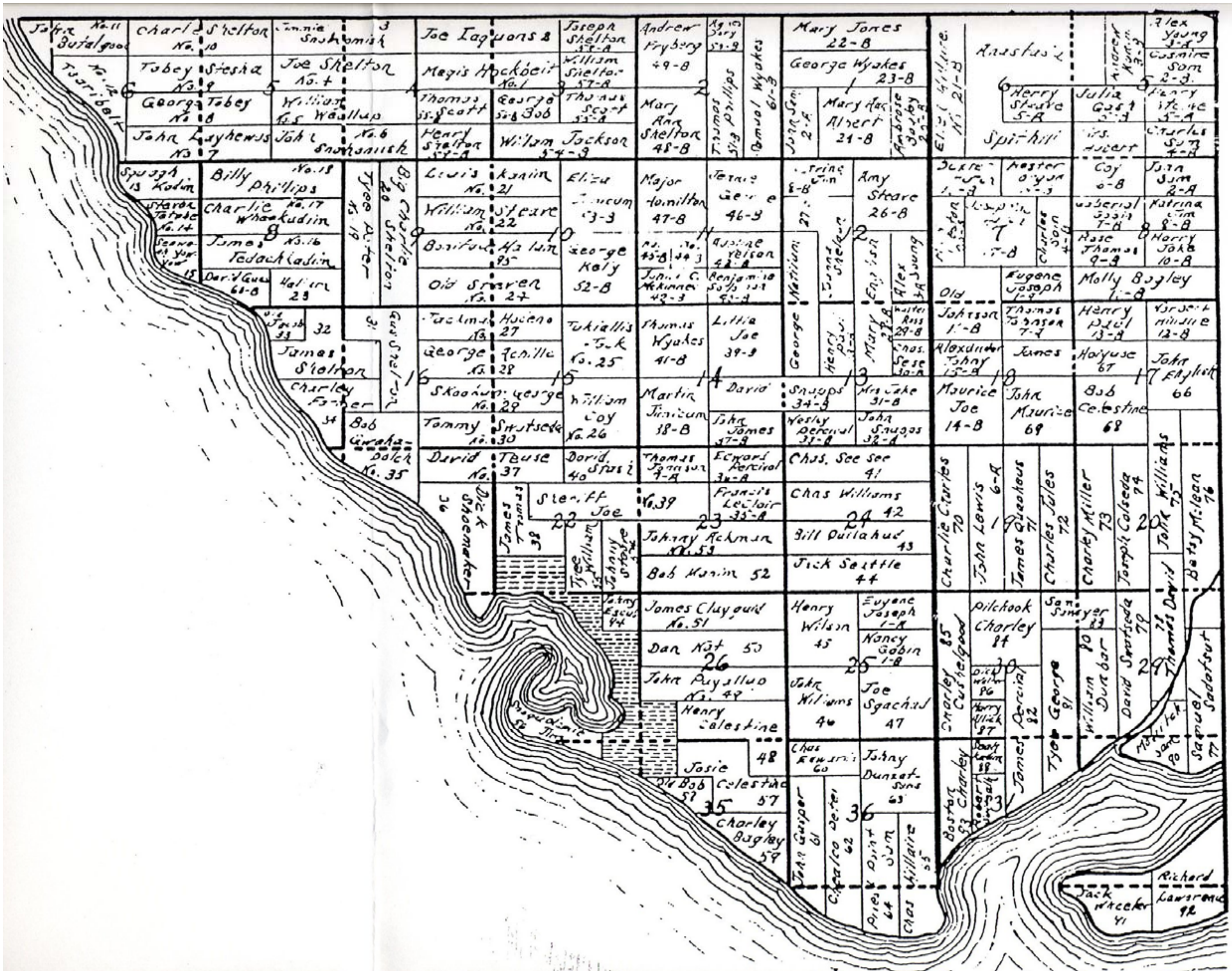


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Figure 2-7: 2004 Land Ownership

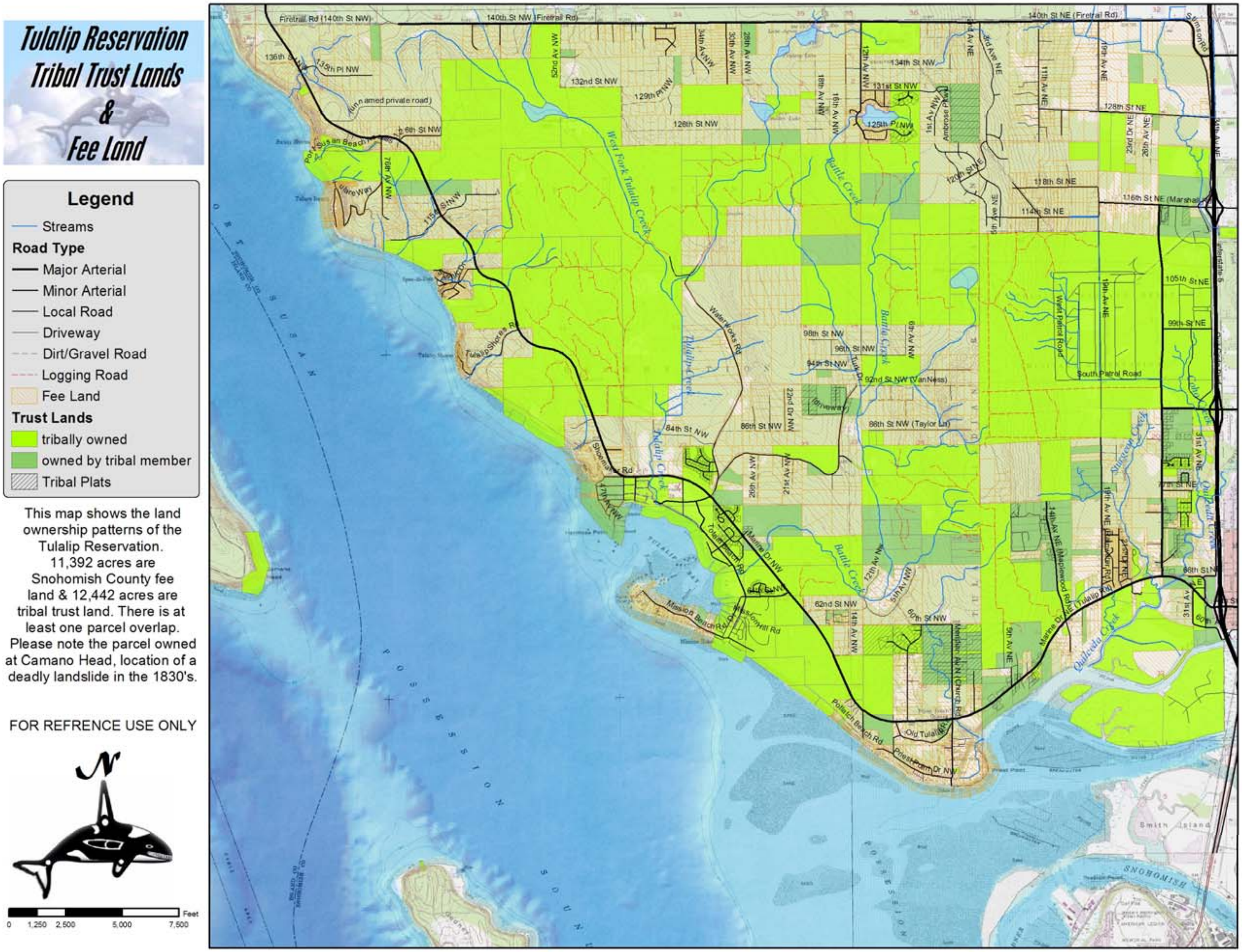

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Figure 2-8: 2004 Tulalip Reservation Zoning

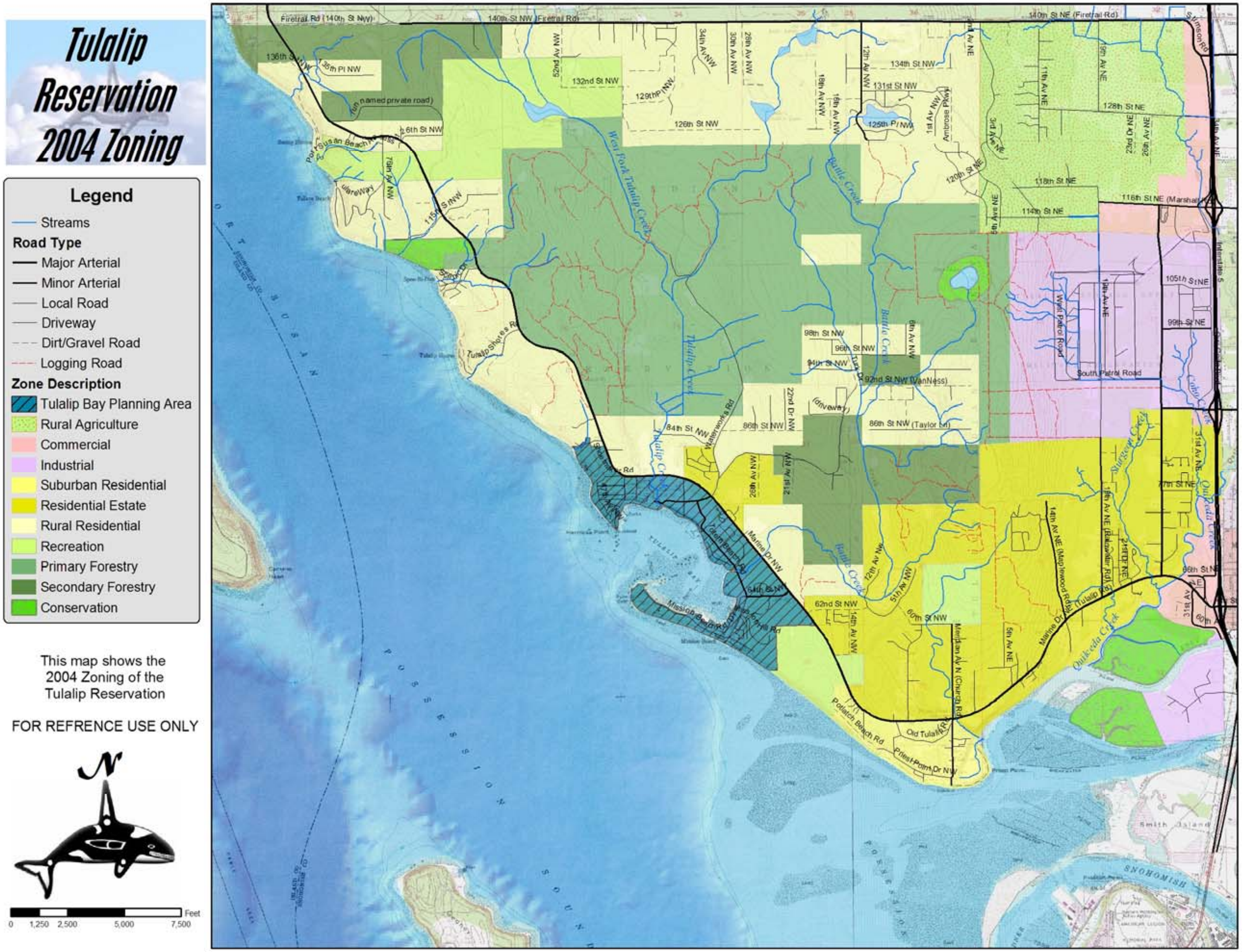

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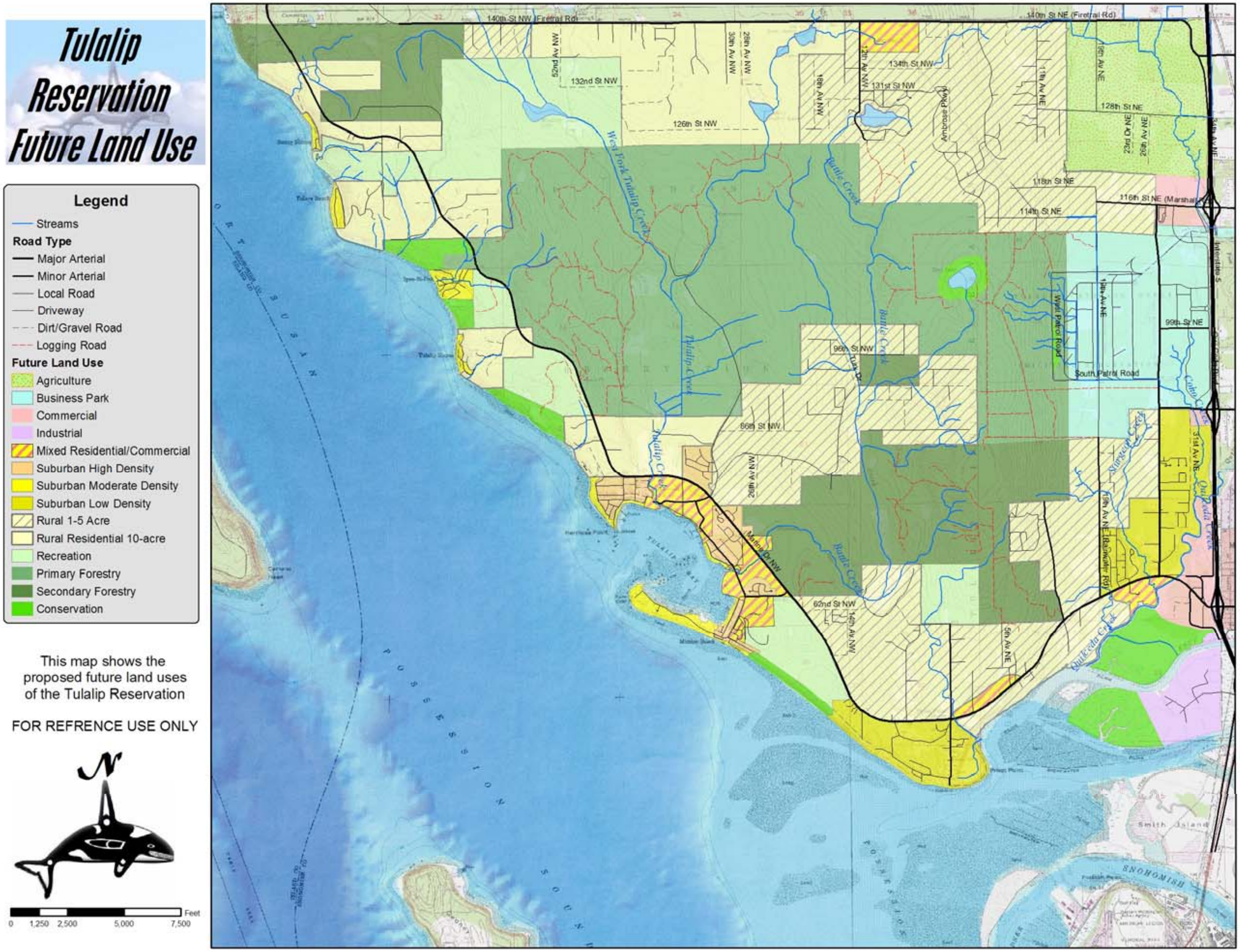
Figure 2-9: Tulalip Reservation Future Land Use



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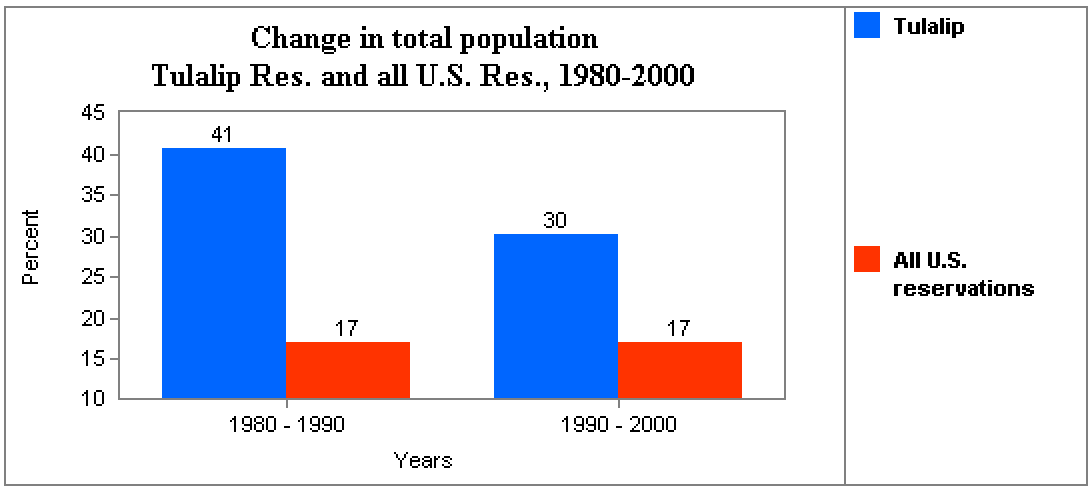
2.4. Demographics

This section will discuss the population characteristics of the Tulalip Reservation, and will also discuss why demographics are important to hazard mitigation planning, especially in terms of vulnerable populations. In general this section will discuss population characteristics of the Reservation as a whole and the Native American population in particular.

Tulalip Reservation General Population Characteristics[11]

The U.S. Census Bureau reported that 9,246 people of all races lived on the Tulalip Reservation in 2000, compared to 7,103 in 1990, and 5,046 in 1980. The population on the Tulalip Reservation increased by 30.2 percent from 1990 to 2000. Compared to other reservations across the United States, the Tulalip Reservation has experienced some of the highest growth. From 1990 to 2000, reservations in the United States grew about 17%. See Figure 2-10.

Figure 2-10: Tulalip's Growth Compared to All U.S. Reservations



The Tulalip Reservation is the home of the Tulalip Indians, a tribe formed under the Indian Reorganization Act of 1934. Native Americans, including tribe members, make up about 22% of the population. Whites make up the largest ethnic group, with 72.1%. During the last century, much of the Tribe's land was sold off to non-tribal interests, and thus the reason the Reservation has a large non-Native American population. Of those who reported being of mixed descent, 25% listed American Indian and almost 75% White as one of their ethnic groups. As of 2002, The Tulalip Tribes had 2,359 members living on reservation.

The Tulalip Reservation has 3,314 households, averaging 2.79 persons per household. Average family size is 3.17 persons. For Native Americans, the average household size is 3.38 persons, while average family size is 3.62 persons. In 2000 the Tulalip Reservation

[11] Office of Financial Management 2000 Census Community Profiles http://www.ofm.wa.gov/census2000/profiles/reservation/280534290.pdf

had 3,638 housing units, 91.1% of which are occupied. Of all occupied housing on the Reservation, 82.1% of housing is owner occupied, while 17.9% is renter occupied. Native Americans occupy 590 housing units, 47.8% by owners and 52.2% by renters.

Why Consider Demographics in Hazard Mitigation Plans?

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

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

The remainder of this section will detail the numbers of potentially vulnerable populations residing in Tulalip Reservation. Particular focus will be on the Tulalip Tribal members living on the Reservation. The general demographic information can be quite misleading in regards to the real social and economic situation faced by those living on the Reservation. The majority White population, who are generally in middle and upper incomes groups, hide the reality of the poverty, lack of education, and overall vulnerability of the Native American population. The demographic information for the Tulalip Reservation is based on the 2000 United States Census data and from information supplied by the State of Washington Office of Financial Management (OFM).[12]

Income

Impoverished people are more adversely impacted from disasters than members of the general population. In the United States, individual households are expected to use private resources to prepare for, respond to, and recover from disasters to some extent. This expectation means that households living in poverty are automatically disadvantaged when confronting hazards. Additionally, the poor typically occupy the more poorly built and inadequately maintained housing of any given community. Mobile or modular homes, for example, are more susceptible to damage in hurricanes, tornadoes and floods than other types of housing. In urban areas, the poor often live in older houses and apartment complexes, which are more likely to be made of unreinforced masonry, a building type that is particularly susceptible to damage during earthquakes.

[12] http://www.ofm.wa.gov/localdata/whit.htm

The 2000 per capita income on the Tulalip Reservation was $19,858, while the median household income was $47,453. The incomes for Native Americans were significantly lower. Native American per capita income was $10,282, while median household income was $20,911. Table 2-1 shows the comparison of income and poverty for the Native American population, the Reservation and Washington State. About 10% of Tulalip Reservation residents are below the poverty line (meaning they spend more than 1/3 of income on an economy food budget). Among Native Americans it is 25.4%. Among the population under 18 in Tulalip Reservation, 13.2% are below the poverty line, while amongst the Native population it is 21.5%. Among those 65 and older, 6.3% fall below the poverty line. For the 65 and older Native population, 41.5% fall below the poverty line.

Table 2-1: Population under the Poverty Line

	Median Household Income	Percent of total population below poverty line	Percent of children (18 & under) below poverty line	Percent of elderly (65 & older) below poverty line
Native American Population	**$33,214**	**25.4**	**21.5**	**41.5**
Tulalip Reservation	$47,453	10.1	13.2	6.3
Washington State	$45,776	10.6	13.2	7.5

Age Distribution

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

According to 2000 US Census Bureau data, 10.3% or 953 of Tulalip Reservation's population is 65 or older. This is less than the state average of 11.2%. Of this 350, or 36.3% of elderly persons, have disabilities of some kind. For Native Americans, only 3.8% of the population is 65 or older, but 64.6% have a disability. Figure 2-11 shows the distribution of age in Tulalip Reservation as a whole, while Figure 2-12 shows the age distribution of Tulalip Tribal members living on the Reservation in 2002.

Figure 2-11: Tulalip Reservation Age Distribution

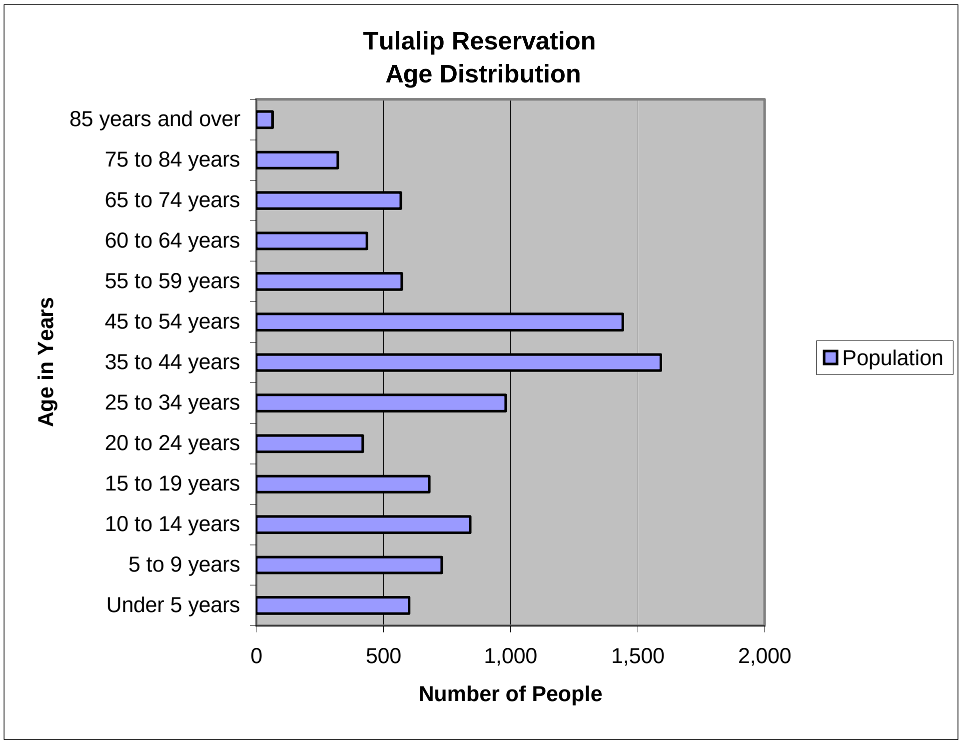
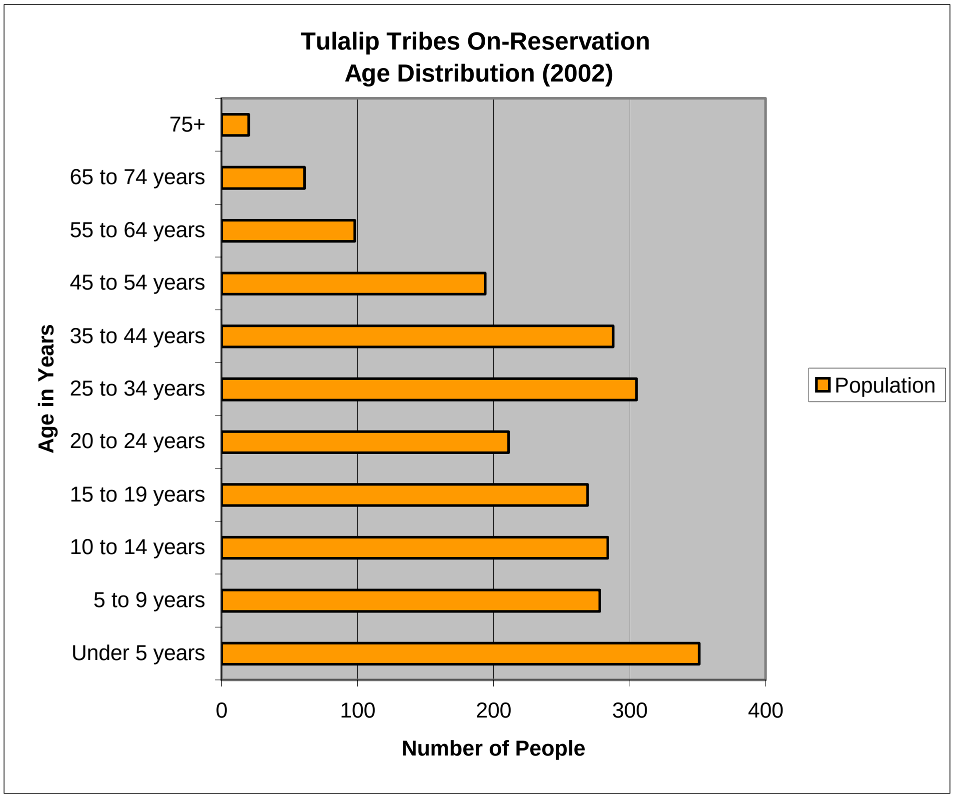


Figure 2-12: Tulalip Tribal Population Age Distribution

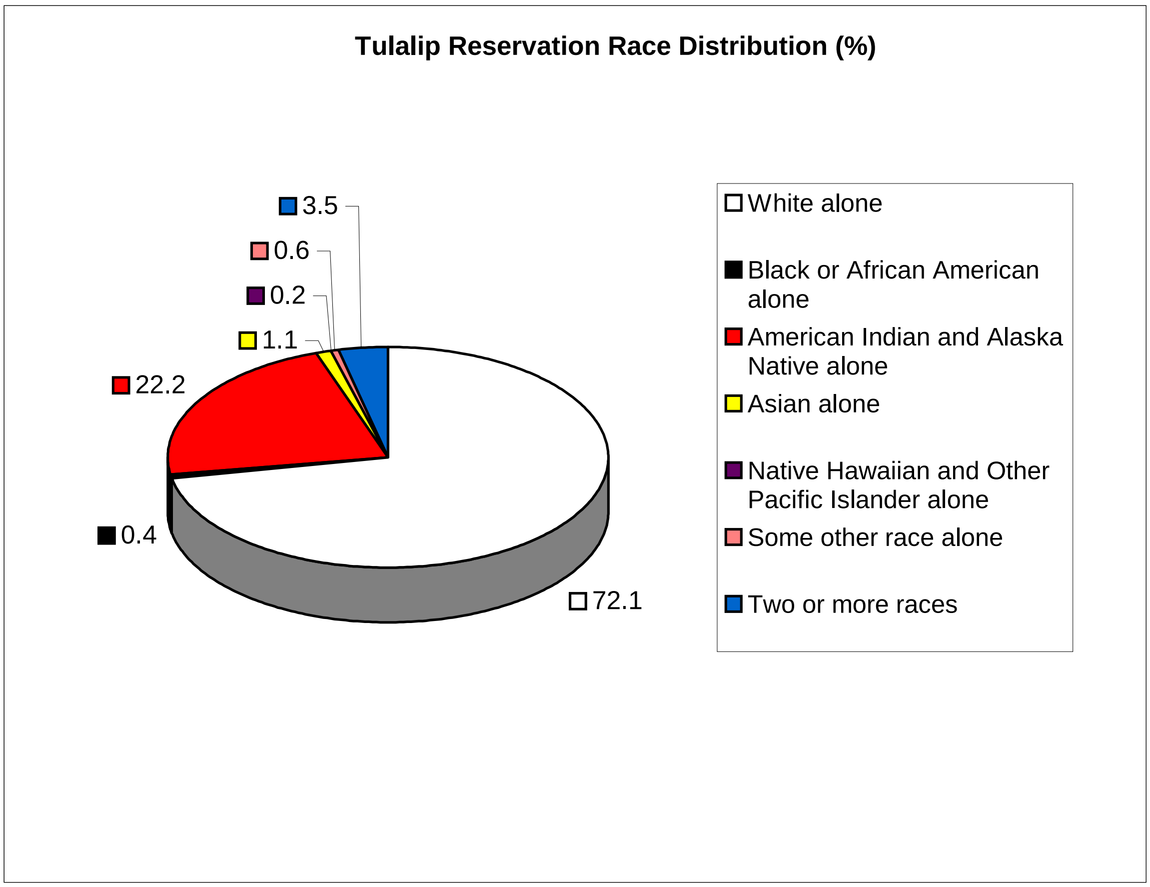


Race, Ethnicity and Language

Many researchers have focused on the increased disaster vulnerability that ethnic minorities experience in the United States. As one researcher has pointed out, "History is less likely to count minority victims in death tolls, and to minimize disasters that affect mostly minority victims as 'less disastrous' ".[13] Research shows that minorities are less likely to be involved in pre-disaster planning, experience higher mortality rates during an event, and post-disaster recovery can be ineffective and is often characterized by cultural insensitivity. Furthermore, because higher proportions of ethnic minorities live below the poverty line than the majority white population, poverty can compound vulnerability.

Racially, Tulalip Reservation is a generally homogenous area, with Native American tribal members and Whites being the largest ethnic groups. The next largest race is Asian, who number about 103 on the reservation. Figure 2-13 shows the racial distribution of Tulalip Reservation.

Figure 2-13: Tulalip Reservation Race Distribution



Tulalip Reservation has a 4% foreign-born population. Approximately 1.8% or 152 of Tulalip Reservation's residents reported speaking English "less than 'very well' " in the 2000 Census.

[13] Steinberg 2000

The Native-American inhabitants are extremely vulnerable to the effects of hazards. Most Tribal members are poorer than their white counterparts who live on the Reservation, and are more likely to be less educated. Until recently many Native Americans did have access to, or did not know how to access basic services, such as health care and schooling. Furthermore 2.4% of Native-American housing lacks complete plumbing facilities, 2.5% lack complete kitchen facilities and 10.8% do not have telephone service. Mitigation efforts should be focused on making Tribal members much more aware of natural hazards, and how to prepare and respond to them.

Disabled Populations

Because the disabled are significantly more likely to have difficulty responding to a hazard event than the general population, people living with disabilities have a special stake in emergency planning efforts. According to U.S. Census figures, 54 million American, roughly one-fifth of the U.S. population, live with a disability. These numbers are rising; furthermore, disabled populations are increasingly integrated into society.[14] This means that a relatively large segment of the population will require assistance during the 72 hours post-event, the period generally reserved for self-help.[15]

Disabilities can vary greatly in severity and permanence, making populations difficult to define and track. There is no "typical" disabled person, which can complicate disaster-planning processes that attempt to incorporate them. Furthermore, disability is likely to be compounded with other vulnerabilities, such as age, economic disadvantage and ethnicity, all of which mean that housing is more likely to be substandard. In fact, in at least one city, census data indicates that disabled populations are concentrated in older, higher-density housing that is more susceptible to earthquake damage.[16]

The Tulalip Reservation has generally the same percentage as the state of young people who are disabled, while a slightly higher percentage of adults 21-64 years old. The Reservation has a lower percentage of elderly who are disabled. For Native Americans, once again, the percentages are much higher (see Table 2-2).

Table 2-2: Disability Status of Non-Institutionalized Population

Age	Number on Tulalip Reservation	Percent of Age Group, Reservation	**Percent of Age Group, Native Americans**	Percent of Age Group, State
5-20 yrs	171	7.2	**10**	7.7
21-64 yrs	1,105	20.9	**24.2**	17.8
65+ yrs	350	36.3	**64.6**	42.8

[14] Bolin 1994
[15] Tierney et al. 1988
[16] Tierney et al. 1988

2.5. Economy

Development Trends

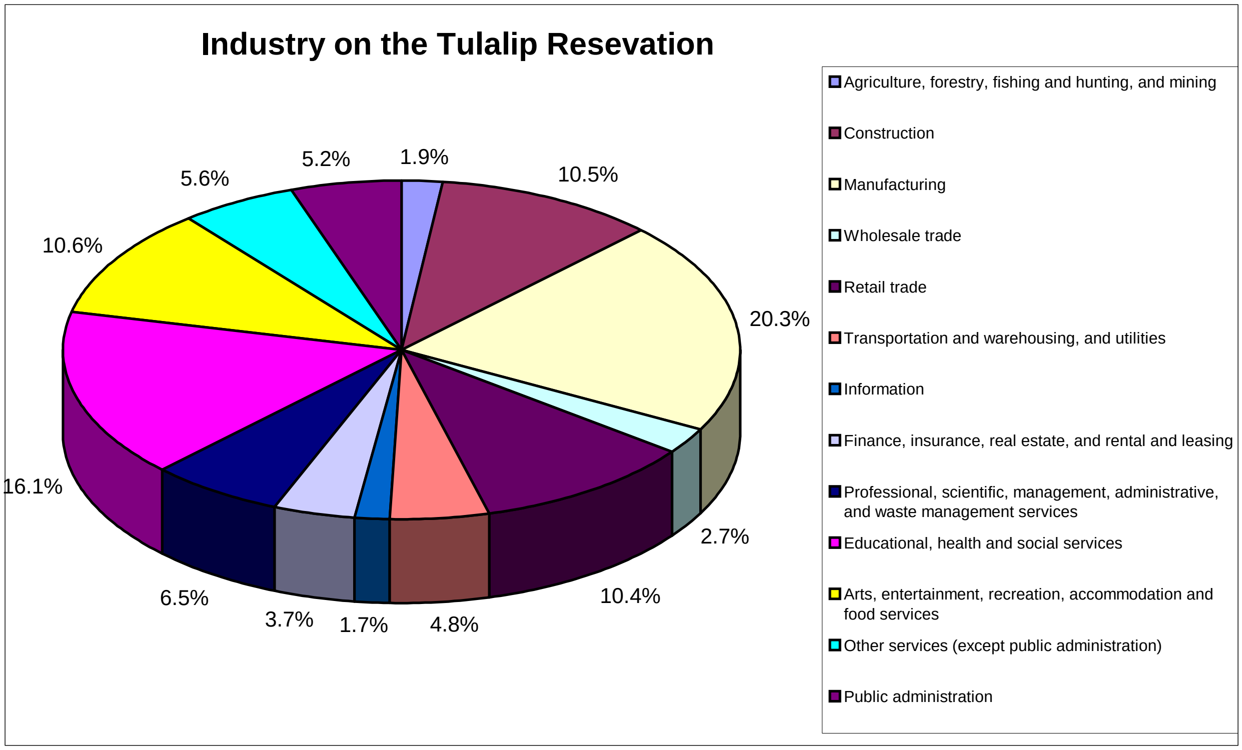
The 2000 Census reported that the Tulalip Reservation had 4,156 residents over the age of 16 who were employed, about 60% of the population. This is similar to the state average, with 61.4% of the population employed. Since the census has been taken, the Reservation has seen great increases in employment, due largely to the increase in local government, new retail operations along I-5 (such as Wal-Mart and Home Depot), and the new Tulalip Casino. Nonetheless much of this employment is low wage service-based jobs that do not offer much in terms of career advancement or economic independence. Unemployment continues to be a major problem among the Native American population. Unemployment statistics compiled by the Bureau of Indian Affairs found that in 2001, 26% of Tulalip Tribal membership living on-reservation were unemployed.

Industry

In 2000, the largest majority of residents were employed in the manufacturing industry. Other industries residents were employed in were Educational, Health and Social Service (16.1%), Arts, Entertainment, Recreation, Accommodation and Food Services, with 10.6% of the working population, Construction (10.5%), and Retail Trades, with 10.4%.[17] The Tulalip Tribes is the single largest employer on the Reservation, and the third largest in Snohomish County, with approximately 1,200 jobs. For Native Americans, the leading industry for employment was Arts, Entertainment, Recreation, Accommodation and Food Services, with 38.3%, and Public Administration, with 12%. Figure 2-14 shows the employment by industry for all Tulalip residents.

[17] U.S. Census Bureau 2000

Figure 2-14: Industry in Tulalip Reservation by Percentage of Jobs



Occupation

The Tulalip Reservation's residents are employed in a diverse field of occupations. For the residents of the Tulalip Reservation, the top three occupations are Management, Professional, and Related Occupations (25.8%), Sales and Office Occupations (23.4%), and Production, Transportation, and Material Moving Occupations (17.2%).[18] The mean travel time to work is 30.3 minutes. Although fishing accounts for only 1.9% of the employment and is listed as an occupation of 1.8% of residents, it is a very important industry for many Tribal members, many of whom rely on the food for sustenance and supplemental income. Figure 2-16 shows the occupations of Tulalip's Native American population in 2000. More than 40% are employed in service-based jobs.

Figure 2-15 shows percentages for occupations of residents on the Tulalip Reservation. Although fishing accounts for only 1.9% of the employment and is listed as an occupation of 1.8% of residents, it is a very important industry for many Tribal members, many of whom rely on the food for sustenance and supplemental income. Figure 2-16 shows the occupations of Tulalip's Native American population in 2000. More than 40% are employed in service-based jobs.

[18] U.S. Census Bureau 2000

Figure 2-15: Occupation in Tulalip Reservation

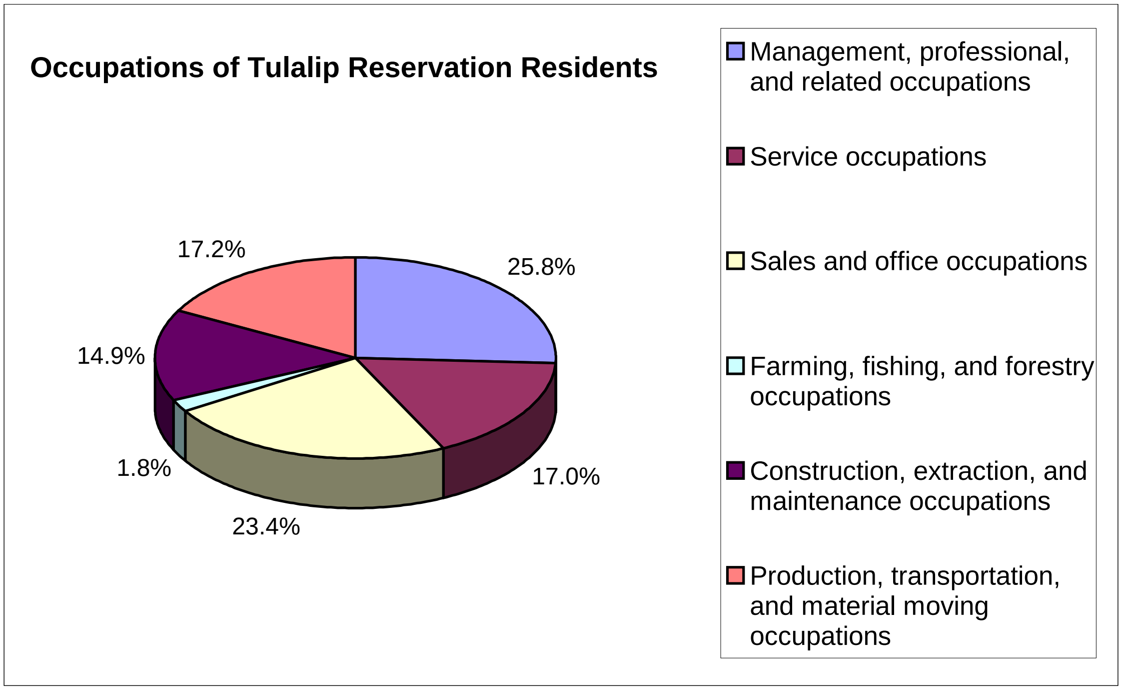
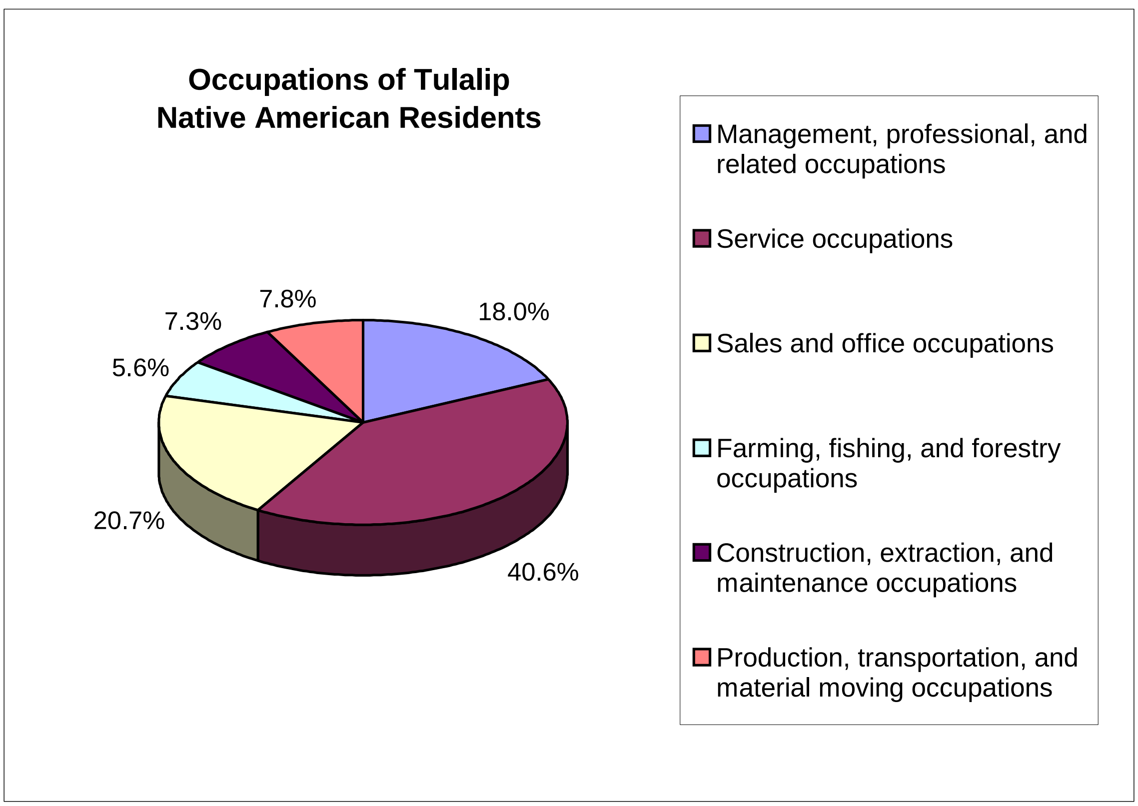


Figure 2-16: Occupation of Tulalip Native Americans



2.6. Laws and Ordinances Influencing this Plan

Federal

Disaster Mitigation Act (DMA 2000)

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

Tribal

The Tulalip Tribes Comprehensive Plan 1994

The Tulalip Comprehensive Plan 1994 is the framework to guide all development throughout the Reservation and includes goals and objectives specifically dealing with many hazards; Chapter 6 deals with sensitive lands.

Tulalip Zoning Ordinance, Ordinance No. 80

The Tulalip Zoning Ordinance implements the goals and objectives of the Comprehensive Plan. Section 23 deals specifically with environmentally sensitive lands.

Tulalip Tribes Police Services Strategic Plan

The Tulalip Tribes Police Services Strategic Plan is a document that was created for the purpose of establishing clear and well guided values, goals and objectives that steer the Tulalip Tribes Police Services toward a common mission. The mission statement of the Tulalip Tribes Police Services in partnership with the Tulalip Office of Neighborhoods is to reduce crime, improve community relations, and improve community livability and quality of life issues through the creation of partnerships between neighborhoods and community resources.

Tulalip Tribes Basic Emergency Management Plan

Emergency management is a system that through organized analysis, planning, decision making and assigning of resources will help prevent, prepare for, respond to and recover from the effects of all-hazards within the Tulalip Reservation. The Tulalip Tribes Basic Emergency Management Plan is the roadmap that sets the stage for the Tulalip Tribes response in the event of a disaster or emergency situation.

3. Planning Process

The planning process is an extremely important aspect in the development of a hazard mitigation plan. It is crucial for the success of the plan to have the public ask questions and comment on the plan. Also, by involving the public in the planning process, it increases the public's awareness of the hazards on the Tulalip Reservation and informs them about the importance of hazard mitigation planning. Having public involvement in the planning process also allows for the plan to reflect the public's views and opinions.

FEMA requires that all Local Mitigation Plans shall include
"Documentation of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved." **[44CFR201.69(c)(1)]**

Development of the Tulalip Hazard Mitigation Plan has been an ongoing process that began in January of 2001. This section will detail the planning process used for the development of the Tulalip Hazard Mitigation Plan as it has evolved over the past three years.

3.1. Steering Committee

This section is a composite list of the individuals that were identified as the steering committee. The steering committee was formed to provide leadership and direction, set goals and objectives and assist in the overall preparation of the Tulalip Hazard Mitigation Plan.

Chief J Goss, Tulalip Tribes Police Department

Byron Larson, Executive Director of Health and Social Services

Todd Ayling, Tulalip Bay Fire Department

Tulalip Casino, Lee Topash

Lynda Holland, Director of the Tulalip Office of Neighborhoods

3.2. Stakeholder Group Members

This section is the final list of all the agencies and community groups located on the Reservation who participated in the planning process and were members of the Stakeholders Group. Each group was shown a PowerPoint presentation to introduce the basic concepts of hazard mitigation and to allow for more informed input for the purpose of incorporating agency and community feedback. Each group was asked a list of questions to solicit input as well as asked to complete a risk ranking survey.

The questions posed to each group were as follows:

- For each of the hazards that could affect the Reservation, what were significant past events that you recall and what were their effects on the Tulalip Reservation? Hazards include flooding, landslides, earthquakes, tsunamis or severe weather.

- Where are vulnerable areas of concern? These include roads, properties, and infrastructure that have been or potentially could be, damaged from a natural hazard, such as flooding, landslides, earthquakes, tsunamis or severe weather.
- Are there any areas (streets, neighborhoods) that could become isolated in a hazard event?
- What are the critical and essential facilities on the Reservation and do you have any concerns with these facilities in terms of vulnerability to natural hazards? Critical and essential facilities include schools, medical centers, police and fire stations, historic or cultural buildings, or buildings that are essential to the local economy, such as the Casino.
- What mitigation items have already been put in place? Mitigation items are projects, such as retrofitting older buildings to withstand earthquakes, or planning efforts, such as polices that discourage building on steep slopes.
- Are there any measures (mitigation projects) that could mitigate the vulnerability on the Tulalip Reservation?

The risk rating survey results can be found in Section 5.4. The Tulalip agencies and community groups that participated are shown in Table 3-1 and Table 3-2.

Table 3-1: Participating Tulalip Departments and Agencies

Tulalip Departments and Agencies	
Administration	Garden Project
A. R. M. Employment	Governmental Affairs
Auto Maintenance	Grants & Self Governance
Beda?chelh	Ground/Building Maintenance
Bingo	Hatchery
Boys & Girls Club	Health Clinic / Pharmacy
Business Park	Heritage School
Cablevision	Human Resources
Casino	Leasing/Real Estate
Community Development	Legal/Reservation Attorney
Community Resources	Montessori School
Community Services	Natural Resources
Construction Development	Police Department
Compliance	Public Health & Safety Network
Cultural Resources	Quil Ceda Village

Tulalip Departments and Agencies	
Custodial Maintenance	Quil Ceda Liquor Store/Smoke Shop
Daycare	Recreation
Dental Clinic	See-Yaht-Sub/Communications
Dock Security/Marina	Tulalip Employment Rights Office(TERO)
ECEAP	Transitional House
Education	Tribal Court
Elders/Senior Services	Tribal Gaming
Employment	Tulalip Data Services
Enrollment	Tulalip Liquor Store/Smoke Shop
Family & Youth Services	Utilities
Finance	Veterans
Fire Dept	Water Quality Laboratory
Fisheries	Work First
Forestry	Youth Hope House
	Youth Prevention

Table 3-2: Participating Tulalip Communities

Tulalip Communities
Silver Village
Turk Road Association
Kath Ann Estates
Quilceda I
Hermosa Beach
Battlecreek Apartment Blockwatch
Totem Beach Loop Road Blockwatch
Marysville West Housing Development
John Sam Lake North
John Sam Lake South

3.3. Public Involvement

Public involvement is critical to the success of any strategic planning process. It is particularly important for hazard mitigation plans to consider public concerns, comments, and perception of risk as factors in the creation of mitigation strategies. As documented in sections 3.2 and 3.4, effort was made to include the public during the planning process.

3.4. Plan Preparation

This section documents how the plan was developed and who was involved in the effort. Dates shown are the occurrence of key events and meetings relating to the plan and planning process.

January, 2002

In January 2002, representatives from each agency of the Tulalip Tribes were invited to discuss the creation of the Tulalip Tribes Hazard Mitigation Plan. In attendance were representatives from the Tulalip Tribes Police Services, Tulalip Bay Fire Department, Tulalip Health Services, Tulalip Social Services, Tulalip Utilities, Tulalip Casino and Tulalip Office of Neighborhoods. Discussion in this meeting led to the creation of a steering committee. Chief J Goss was chosen to chair this committee.

January, 2002

A second meeting was held by the steering committee and it was decided that each agency would create a report outlining its roles and responsibilities in an emergency. A key list of contact people within the Tribe and the agencies was established.

February, 2002

A compilation of the reports gathered from each agency within the Tribe was used to create a skeletal format for the Tulalip Tribes Emergency Response Plan.

January, 2003

The first draft of the Tulalip Tribes Emergency Response Plan was completed.

February, 2004

February 03, 2004, the Tulalip Office of Neighborhoods was created to help address crime prevention, community emergency response and mitigation at the neighborhood level as well as reservation wide.

March, 2004

In March 2004, representatives of the local tribes in the Snohomish County area (the Tulalip Tribes, the Stillaguamish, and the Sauk-Suiattle) were invited to the Snohomish County Department of Emergency Management's (DEM) office at Paine Field in Everett, Washington for a presentation of the DEM's 2004 Hazard Identification and Vulnerability Analysis (HIVA). This document was to be the basis of the risk assessment used for the County's Hazard Mitigation Plan. The purpose of this meeting was to inform the tribal representatives of the County's efforts in hazard mitigation planning and to also inform them of the potential hazards they could experience in their jurisdictions. Glenn

Coil, a graduate student at the University of Washington's Department of Urban Design and Planning, who helped prepare the HIVA for the UW's Institute for Hazards Mitigation and Planning, conducted the presentation and led the discussion about tribal efforts in hazard mitigation planning. From this meeting, it was decided that the Tulalip Tribes would contract with Glenn Coil to assist in the preparation of a hazard mitigation plan for the Tulalip Reservation. The risk assessment and an expanded list of representatives from the different agencies and community groups having a stake in the planning process were also drafted.

May 20th, 2004

An invitation was sent to agencies and community representatives on the reservation for a meeting on this date to discuss the progress of the risk assessment. Glenn Coil gave an update on the risk assessment. During this meeting, a discussion was conducted about finalizing the list of representatives from the community and agencies as the Stakeholder Group. There was also discussion of expanding on the Steering Committee to coordinate the plan preparation to ensure that the whole community had an opportunity to offer input into the planning process. Preliminary goals and strategies were also discussed and the need that they are concurrent with state goals and strategies was stressed.

June 10th, 2004

A neighborhood meeting was held to discuss the creation of neighborhood blockwatch, emergency preparedness and hazard mitigation. This meeting was attended by thirty-five households in the development. Blockwatch captains were identified and agreed to continue to receive educational materials regarding crime prevention, emergency preparedness and hazard mitigation. These individuals committed to actively participating in ongoing community meetings to contribute crucial input to the overall planning process.

July 28th, 2004

A community meeting was held on this date to discuss the Tulalip Hazard Mitigation Plan's progress and to allow community members and representatives to ask questions about the plan. During this meeting there was a lively debate about the DMA 2000, the Tribe's and State's requirements for the plans, and about the types of projects that are eligible for funding. Brainstorming during this meeting helped develop an outline of potential projects the Tulalip Tribes would like to pursue in its plan. At this time it was decided that better efforts at involving the community were still needed.

September 3rd, 2004

A meeting was held on this date to discuss the progress of the hazard mitigation plan and set a deadline for the draft review and adoption of final document.

1) At this meeting, it was decided two methods were to be used to involve the community better: Schedule an open meeting at a set time each week so that members of the community could come by and ask questions and offer feedback on the plan.

2) Effort would be made to interview all key representatives and community members in the Stakeholder group who were not able to attend previous meetings.

Notification of this would be through the community newspaper, via e-mail and phone calls, and via word-of-mouth between community members.

October 1st, 2004

On this date, the Tulalip Tribes posted a government-wide email to all Tulalip Tribes employees to solicit community input for the purpose of incorporation into the Tulalip Hazard Mitigation Plan. A copy of the solicitation was also prepared for the Tulalip See-Yaht-Sub newspaper and Cable Channel 10 with the Tulalip Tribes Cablevision.

October 4th and October 5th, 2004

Scheduled individual and group interviews were held throughout these two days with governmental department heads to assure that every attempt was made to solicit public comment on the Tulalip Hazard Mitigation Plan. Departments that participated in these interviews can be found in Section 3.2.

October 22nd, 2004

A final meeting was held to conclude public comment on the Tulalip Hazard Mitigation Plan. It was decided in this meeting that the plan would be considered complete and submitted to the Tulalip Board of Directors for final review, approval and adoption.

October 29th, 2004

The final draft of the Tulalip Hazard Mitigation Plan was submitted to the Tulalip Board of Directors for review, approval and adoption. Resolution #04-XXXX was voted on and approved with a 7 for 0 against vote to adopt the Tulalip Hazard Mitigation Plan.

4. Risk Assessment

The first step in preparing a risk assessment for the Tulalip Reservation is to identify which natural hazards affect the Reservation. The 2004 Snohomish County HIVA analyzed 8 natural hazards to see if they affected the County. These were:

- Avalanches
- Earthquakes
- Floods
- Landslides/Mass Movements
- Severe Weather
- Tsunamis/Seiches
- Volcanoes
- Wildfires

Further analysis was done to identify which of these hazards specifically affect the Tulalip Reservation. The study was conducted by analyzing data and maps used for the HIVA, and by interviewing Tribal and County officials. The hazards that could potentially affect the Reservation are:

- Earthquakes
- Floods
- Landslides/Mass Movements
- Severe Weather
- Tsunamis/Seiches
- Wildfires

Avalanches and volcanic eruptions were excluded from the hazards studied. The Tulalip Reservation is located along the coast, and does not have steep rugged mountains or snow cover to experience avalanches. The Tulalip Reservation is west of a volcano, Glacier Peak, but is not considered a risk to the Reservation due to river drainage courses and prevailing winds. Most ash and smoke (tephra) would blow east, particularly with the strong winds of the Convergence Zone. Lava and mudflows (lahars) would not flow through any rivers that pass through the Reservation.

The next 6 sections will profile, in detail, each of the hazards mentioned above, and will answer the question of "how bad could each hazard be?" Maps will be shown detailing the location where the hazard may affect the Reservation. A discussion of past occurrences will be made. The profile will also discuss the frequency of the hazard occurring, how severe it could be, and the amount of warning time the community has to prepare for, or evacuate from, the hazard event.

Included in each hazard profile will be an inventory of the assets, such as buildings, infrastructure, and people that could be affected by each of the hazard events. Each section will conclude with a loss estimation that will determine, in monetary terms, how much the Reservation could be affected by a hazard event.

The results of this risk assessment will be summarized and ranked according to severity and will be discussed in Section 5.

4.1. Methodology

This section will explain in greater detail the methodology used to create this risk assessment and document data sources.

Assess Hazard

This assessment includes the following information for each hazard:

Past events

Geographic areas most affected by hazard

Event frequency estimates

Severity

Warning time likely for response

Determine Exposure

The chief method used to determine exposure was the use of Geographic Information Systems (GIS) digitized map data. Exposure was determined by overlaying hazards with an inventory of potentially vulnerable structures, facilities, and systems.

Assess Vulnerability

Vulnerability of the exposed structures and infrastructure were then assessed. Vulnerability was determined by interpreting the probability of occurrence of each event and then assessing the structures and infrastructure that were exposed.

Data Sources

This information was gathered from a variety of sources. Frequency and severity indicators include past events and the expert opinions of geologists, emergency management specialists and others. To the extent possible, the hazard location was mapped using ArcGIS 8.3. The primary data source was the Tulalip Tribe's GIS database, though other sources were used, such as Snohomish County's GIS data and USGS topographical maps. Hazards not mentioned below employed the general data sources described above.

Earthquake

Earthquake hazard maps and data, including the NEHRP and Liquefaction Risk soils data, was supplied by the Washington Department of Natural Resources. Other source information was supplied by the United States Geological Survey (USGS).

Flood

Flood data, including Flood Insurance Rate Maps (FIRMS) and National Flood Insurance Program (NFIP) data, was provided by FEMA.

Wildland Fire

Wildland Fire data, such as historic fire starts, was provided by the Washington Department of Natural Resources.

4.2. Presidential Declared Disasters

Presidential Declared Disasters are typically events that cause more damage than state and local governments/resources can handle without the assistance of the federal government. There is not generally a specific dollar loss threshold that must be met. A Presidential Major Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, and designed to help disaster victims, businesses, and public entities.[19]

Historically, Snohomish County has had 17 Presidential Declared Disasters with the frequency increasing over the past ten year and are listed in Table 4-1. It is not known at this time how much damage the Tulalip Reservation received from these disasters, nor how much financial assistance was given to members and residents of the Reservation. For future events, it is essential that the Tulalip Tribes apply directly for disaster assistance rather than through Snohomish County. Not only will a better assessment be made of damages, but more financial assistance is possible.

Table 4-1: Presidential Declared Disasters

Disaster	Type of Event	Date
137	Flood, Wind	October-62
185	Flood	December-64
196	Earthquake	May-65
492	Flood	December-75
545	Flood, Landslide	December-77
612	Flood	December-79
623	Volcano	May-80
784	Flood	November-86
883	Flood	November-90
896	Flood	December-90
981	Wind	January-93
1079	Flood	Nov-Dec 1995
1100	Flood	Jan-Feb 1996
1159	Ice, Wind, Snow, Landslide, Flood	Dec 1996-Feb 1997
1172	Flood, Landslide	March-97
1361	Earthquake	February-01

[19] FEMA, http://www.fema.gov/library/dproc.shtm

Disaster	Type of Event	Date
1499	Severe Storm, Flooding	November-03

4.3. Critical Facilities and Infrastructure

Critical and essential facilities and infrastructure are those that are critical to the health and welfare of the population. These become especially important after any hazard event occurs.

Critical facilities included for the Tulalip Reservation Hazard Mitigation Plan are as follows: police and fire stations, schools, and tribal buildings. Essential facilities include buildings and businesses that are essential to the community's economy and/or safety after an event. These include the Tulalip Casino, Wal-Mart, Home Depot and other businesses that supply essential goods such as food and equipment.

Critical infrastructure includes the roads and bridges that provide ingress and egress and allow emergency vehicles access to those in need and the utilities that provide water, electricity and communication services to the community. Also included are Tier II facilities and railroads, which hold or carry significant amounts of hazardous materials with a potential to impact public health and welfare in a hazard event.

Critical and essential facilities and infrastructure were identified through GIS analysis, and from interviews with Tribal officials.

This section provides the results of an exposure analysis where critical Tribal facilities and infrastructure have been evaluated to determine the hazards that are likely to affect them. Figure 4-1 shows the critical and essential facilities and infrastructure on the Tulalip Reservation.

The following criteria were used to determine exposure, and, if applicable, a discussion is made of which facilities and infrastructure are particularly vulnerable:

- Earthquake: In an earthquake, all of the Reservation's critical facilities will experience potentially damaging ground shaking. An earthquake has the potential to cause major structural and/or non-structural damage to any non-retrofitted facility and hamper its functionality. Older buildings, such as St. Anne Catholic Church at Tulalip Bay, are especially vulnerable. The facilities located on National Earthquake Hazards Reduction Program (NEHRP) D, E, and F class soils, and Moderate and High Liquefaction areas, are likely to sustain the heaviest damages.
- Flooding: Any critical or essential facility that is near the coast or directly along a stream or has been identified as being vulnerable to flooding. Facilities located directly along Tulalip Bay, such as the Marina, and structures located near Quil Ceda Creek are vulnerable. The Tulalip Salmon Hatchery is extremely vulnerable to flooding.
- Landslides: Critical facilities are considered exposed to landslides if they are on or below historic landslides or potentially unstable slopes. No facilities have been identified.

- Severe Weather: Since the entire Reservation is susceptible to severe weather, all critical facilities and infrastructure is considered exposed to this hazard. Given that electrical utilities and roads are most often affected by severe weather, all critical infrastructure managers and operators should plan for possible power outages and difficult ingress and egress. Some critical infrastructure, such as power lines, are actually more likely to be impacted or damaged as a result of severe weather.
- Tsunami/Seiche: Critical facilities and infrastructure are considered exposed if they are located along the Puget Sound shoreline and were determined based on a 70-foot inundation zone. This includes most Tribal facilities, and especially vulnerable are the Tribal Center, the Elder Housing Complex and the Marina.
- Wildland Fire: Any critical infrastructure near high fuel areas load areas is exposed to risk from wildfires. No Tribal facilities have been identified as being vulnerable to wildfires.

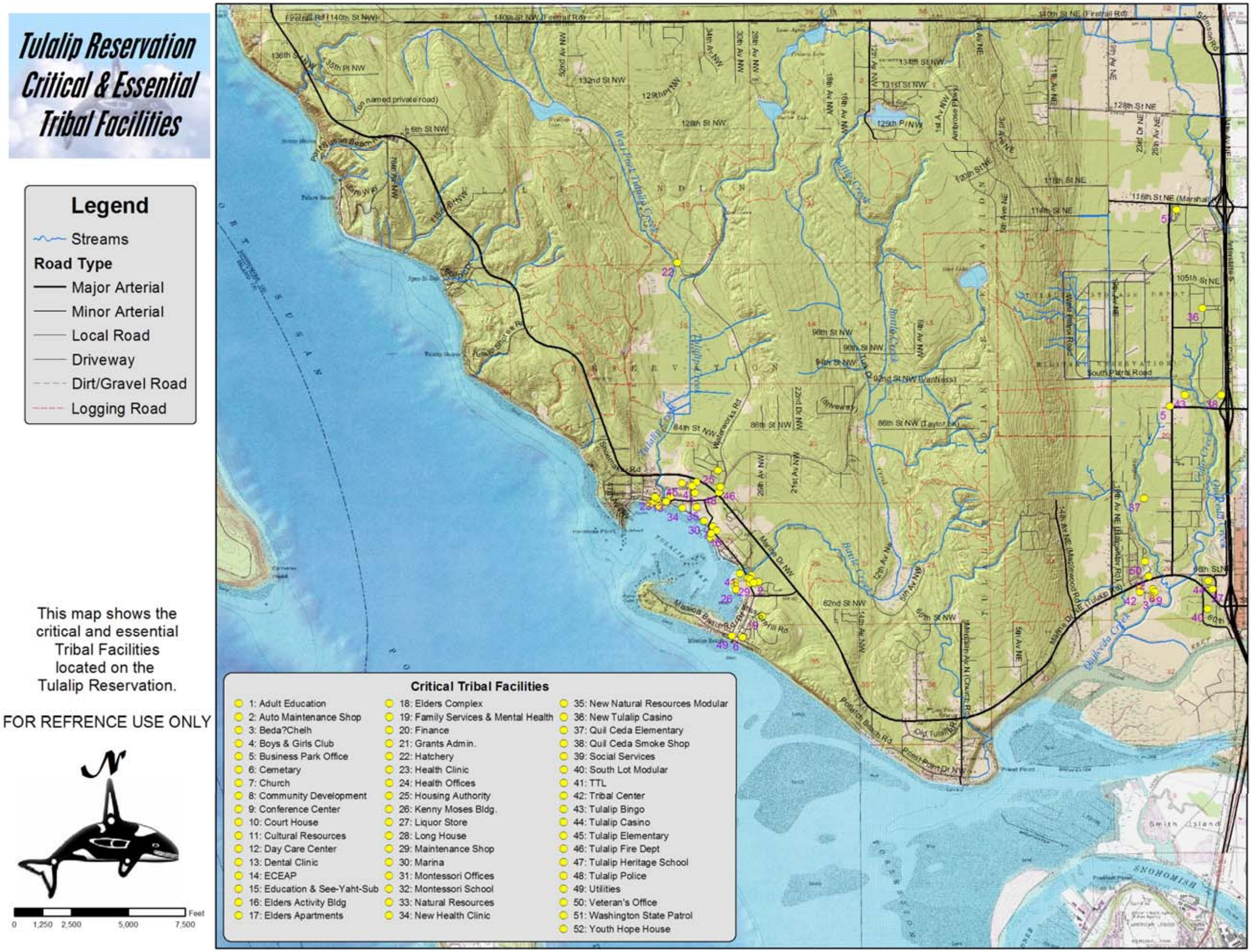
Table 4-2 below is a list of all tribal facilities. All can be considered critical and essential.

Table 4-2: Critical and Essential Tribal Facilities

Place Name	BldgNum	Address
A Frame	6729 B	6729 TOTEM BEACH RD BLDG B
Administration / Tribal Center	6700	6700 TOTEM BEACH RD
Barbeque Shelter		6700 TOTEM BEACH RD
Beda?Chelh (new Location @ Old Dental Clinic)	7631	7631 41ST AVE NW
Beda?Chelh (new location @ Old Health Clinic Offices)		
Beda?Chelh (new location @ Old Health Clinic)	7627	7627 41ST AVE NW
Beda?Chelh (old location)	6221	6221 23RD AVE NE
Bingo	2911	2911 QUIL CEDA WAY
Boys & Girls Club	7707	7707 36TH AV NW
Canoe Storage		6700 TOTEM BEACH RD
Casino (new)	10200	10200 QUIL CEDA BLVD
Casino (old)	6410	6410 33RD AV NE
Casino Facilities Building	10200	10200 QUIL CEDA BLVD
Community Development / Construction	6319	6319 23rd AV NE
Community Development Conference Center	6319	6319 23RD AV NE
Construction Storage Garage #1	6319	6319 23RD AV NE
Construction Storage Garage #2	6319	6319 23RD AV NE
Court House (old)	6729 D	6729 TOTEM BEACH RD
Cultural Resources	6410	6410 23RD AV NE
Day Care	2322	2322 MARINE DR
Dispatch Office (@ Marina)		
ECEAP	6729 E	6729 TOTEM BEACH RD BLDG E
Education	7707	7707 36TH AV NW
Education / Classrooms	7707	7707 36TH AV NW
Elders Activity Building	7308	7308 TOTEM BEACH RD
Elders Complex	7300	7300 TOTEM BEACH RD
Family Services / Home Recovery	2821	2821 MISSION HILL RD
Family Services	2821 B	2821 MISSION HILL RD BLDG B

Family Services	2825	2825 MISSION HILL RD
Finance	6729 A	6729 TOTEM BEACH RD BLDG A
Fire Station	7812	7812 WATERWORKS RD
Fisheries	7615 D	7615 TOTEM BEACH RD BLDG D
Grants / Self Governance	7615 E	7615 TOTEM BEACH RD BLDG E
Hatchery	10610	10610 WATERWORKS RD
Health Clinic (New)	7520	7520 TOTEM BEACH RD
Heritage School	7707	7707 36TH AV NW
Homeless Shelter / Social Services	2817	2817 MISSION HILL RD
Housing Authority	3107	3107 REUBEN SHELTON DR
Kenny Moses Bldg	6700 D	6700 TOTEM BEACH RD
Kubota Treatment Plant	8814	8814 27TH AV NE
Legal Office (Mike Taylor)	6700 A	6700 TOTEM BEACH RD BLDG A
Long House	6700 C	6700 TOTEM BEACH RD
Long House Shelter		6700 TOTEM BEACH RD
Maintenance	6729 G	6729 TOTEM BEACH RD BLDG G
Maintenance Shop	6729 F	6729 TOTEM BEACH RD BLDG F
Marina	7411	7411 TULALIP BAY DR
Marina Security	7411	7411 TULALIP BAY DR
Montessori School	4032	4032 76TH PL NW
Natural Resources (new)	3829	3829 TOTEM BEACH RD
Natural Resources (old)	7615 A	7615 TOTEM BEACH RD BLDG A
Natural Resources (old)	7615 B	7615 TOTEM BEACH RD BLDG B
Natural Resources (old)	7615 C	7615 TOTEM BEACH RD BLDG C
Police Station	7720	7720 WATERWORKS RD
Pre-School		
QCV Maintenance Shop (@ Boeing Site near TERO)		
Quil Ceda Village / Business Park	8802	8802 27TH AV NE
Quil Ceda Village / Governmental Affairs	8802	8802 27TH AV NE
Quil Ceda Village Smoke Shop	8825	8825 QUIL CEDA BLVD SUITE F
South Lot Building	6103	6103 31ST AV NE
TERO	11224	11224 34TH AV NE
Tulalip Data Services	6416	6416 23RD AV NE
Tulalip Data Services / Computer Lab	6412	6412 23RD AV NE
Tulalip Liquor Store / Cablevision	6326	6326 33RD AV NE
Utilities	3015	3015 MISSION BEACH RD
Utilities Shed	3015	3015 MISSION BEACH RD
Veteran's Office	2331	2331 OLD TULALIP RD
Veteran's Storage	2331	2331 OLD TULALIP RD
Work First	6729 C	6729 TOTEM BEACH RD BLDG C
Youth Center	6700 B	6700 TOTEM BEACH RD

Figure 4-1: Tulalip Reservation Critical Facilities



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Hazardous Materials

Although not a natural hazard, hazardous materials can cause widespread damage to people, property, and the environment. Hazardous materials can be released by a hazard event, such as an earthquake, flood, or even by severe weather (for instance, a truck accident during an icy winter storm). Hazardous material spills may be the most deadly and dangerous secondary effect of natural hazards. That is why it is essential to identify all potential locations where hazardous materials may be spilled and what locations store hazardous materials on-site.

Initial review of Tier II facilities in Snohomish County (facilities and businesses that reported they contain hazardous materials) found the Tulalip Reservation did not have any. However, after discussions with Tribal officials, it was found that the Reservation had 4 major locations where hazardous materials are stored or sold:

- Home Depot
- Wal-Mart
- Suburban Propane
- Donna's Truck Stop at the intersection of 116th and Interstate 5. This is the largest truck stop along the I-5 corridor located between Seattle and the Canadian border and routinely houses dozens of trucks containing hazardous materials. Any hazardous material spill could drain into the Quil Ceda Creek watershed.

In addition, Interstate 5, the main thoroughfare between Canada and Mexico, makes up the eastern border of the Tulalip Reservation. Thousands of trucks containing hazardous materials travel this road along and through the Reservation every day, many of which stop at the Truck stop mentioned above.

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4.4. Earthquakes

Definitions

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

Crustal Earthquake: Crustal quakes occur at a depth of 5 to 10 miles beneath the earth's surface and are associated with fault movement within a surface plate.

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

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

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

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

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

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

General Background

The Puget Sound region is seismically active, with hundreds of earthquakes occurring each year. Most of these earthquakes are so small only sensitive instruments can detect them. However, at least 20 damaging earthquakes have occurred in Western Washington during the past 125 years. Large quakes in 1946, 1949, 1965 and 2001 killed 16 people and caused more than $3.59 billion (2004 dollars) in property damage. In fact, recent seismic studies have increased concern among the scientific and engineering communities regarding both magnitude and frequency of damaging earthquakes in the Pacific Northwest.

More than 90% of all Pacific Northwest earthquakes occur along the crustal plate boundary between the Juan de Fuca plate and the North American plate. Seismicity catalogs are the fundamental tool used to determine where, how often, and how big earthquakes are likely to be. However, because of the short time (from a geological perspective) that written records have been kept and the relative infrequency (from a human perspective) of such events, seismicity statistics are necessarily based on historically short catalogs.

The results from examining the historical record, monitoring seismic and geodetic changes, and study of the geologic record are combined to characterize seismic sources. This data is used to identify seismic source zones, the regions of the earth's crust where earthquakes occur. Although there are large uncertainties associated with source characterization (we have not yet figured out how to place instruments in the crust at the depths where earthquakes are generated), the Pacific Northwest has been studied extensively in recent years and some valuable new insights have been developed as a result of this attention. It is now generally agreed that three source zones exist for Puget Sound quakes: a shallow (crustal) zone; the Cascadia Subduction zone; and a deep or intraplate ("Benioff") zone.

Estimating the expected ground motion at a given distance from an earthquake of a certain magnitude is the second element of earthquake hazard assessment. The parameters that must be identified in order to estimate ground motions at any location are: earthquake magnitude, type of faulting, distance of the site from the epicenter, and local site conditions (hard rock, soft rock, stiff soil, soft soil, etc). Hazard values calculated for rock/stiff soil (the most common classifications) are lower than hazard values calculated for unconsolidated or soft soil sites typically found along river valleys. The type of faulting is important because high angle reverse thrust displacements (most common in Puget Sound shallow fault zones) are far more damaging than, for example, strike-slip faults.

The third element of earthquake hazard assessment, the actual calculation of expected ground motion values, involves determining the annual probability that certain ground motion accelerations will be exceeded, then summing over the time period of interest. The most commonly mapped ground motion parameters are the horizontal and vertical peak ground accelerations (PGA) for a given site classification (soil or rock type). Maps of PGA values now form the basis of seismic zone maps that are included in building codes, including the U.S. Uniform Building Code (UBC). Building codes that include seismic provisions specify the horizontal force due to lateral acceleration that a building should be able to withstand during an earthquake. PGA values are directly related to these lateral forces that could damage "short period structures" (i.e. single-family dwellings, the most common structures in the county). Maps of longer period spectral response components may also need to be developed to determine the lateral forces that damage larger structures with longer natural periods (apartment buildings, factories, high-rises, bridges).

Earthquakes are caused by the fracture and sliding of rock within the Earth's crust. The Earth's crust is divided into eight major pieces (or plates) and many minor plates. These plates are constantly moving, very slowly, over the surface of the globe. As these plates move, stresses are built up in areas where the plates come into contact with each other. Within seconds, an earthquake releases stress that has slowly accumulated within the rock, in some instances over hundreds of years. Sometimes the release occurs near the surface, and sometimes it comes from deep within the crust.[20]

The impact of any earthquake event is largely a function of ground shaking, liquefaction and distance from the source of the quake. Liquefaction results generally in softer, unconsolidated soils. A program called the National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics so that locations potentially subject to liquefaction may be identified. Table 4-3 provides a description of the NEHRP soil classification.

Table 4-3: NEHRP Soil Classification System

NEHRP Soil Type	Description	Mean Shear Velocity to 30 m (m/s)
A	Hard Rock	1500
B	Firm to Hard Rock	760-1500
C	Dense soil, soft rock	360-760
D	Stiff Soil	180-360
E	Soft clays	<180
F	Special study soils (liquefiable soils, sensitive clays, organic soils, soft clays > 36 m thick)	

The degree of ground shaking (or damage) caused by an earthquake is often assigned a numerical value from Roman Numeral I to XII on the Modified Mercalli (MM) Scale and is referred to as intensity. This helps to assess and understand the physical affects of the earthquake. Table 4-4 provides a comparison of peak ground acceleration to the MM intensity scale.[21]

Table 4-4: Mercalli Scale and Peak Ground Acceleration Comparison

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

[20] http://www.metrokc.gov/prepare/hiva/earthquakes.htm
[21] Cascadia Region Earthquake Workgroup, Professor Anthony Qamar, University of Washington

*MMI	**Potential Damage	Est. PGA	Source
	masonry may fall	.1	Trifunac 1976
	Threshold of structural damage	.18 - .34	USGS
VIII	Moderate – Extensive USGS – Moderate to Heavy	.10 - .20	Munich Re-ins
	URM – extensive cracking; fall of parapets and gable ends	.16 - .32	Goettle
		.25 - .30	Bolt 1988
		.13 - .26	Table 3.2 NEHRP
		.2	Trifunac 1976
		.35 - .65	USGS
IX	Extensive – Complete USGS - Heavy	.20 - .50	Munich Re-ins
	Structural collapse of some URM buildings; walls out of plane Damage to seismically designed structures	.32 - .55	Goettle
		.50 - .55	Bolt 1988
		.26 - .44	Table 3.2
		.3	Trifunac 1976
		.65 – 1.24	USGS
X	Complete Ground Failures USGS Very Heavy (X+)	.50 – 1.00	Munich Re-ins
	Structural collapse of most URM buildings	.55 - .80	Goettle
		>.6	Bolt 1988
		.44 - .64	Table 3.2 bldgs w T >.5
	Notable damage to seismically designed structure Ground Failures	> 1.24	USGS

Hazard Profile

Earthquakes were profiled for The Tulalip Reservation by using two methodologies: using GIS data to determine the location of earthquakes, and particularly the NEHRP soils that can exaggerate the effects of an earthquake, and by using Hazus-MH, which was used to model the potential severity of different types of earthquakes, and how the Reservations' assets could be affected. The sections below will profile, in detail, the earthquake hazard as it affects the Tulalip Reservation.

Past Events

There have been several earthquakes in the past that have affected the Puget Sound Region and more specifically the Tulalip Reservation. The actual effect of these earthquakes on the Tulalip Reservation has been less severe that in other areas within the region, but nonetheless significant damage has occurred to the older and dilapidated structures occupied by tribal members. Table 4-5 is a summary of large earthquakes that have occurred in the Puget Sound Region.[22]

Table 4-5: Large Earthquakes in the Puget Sound Region

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

1872, 75 miles northeast of Everett: This shallow earthquake had a magnitude of approximately 7.4 on the Richter scale. This was approximately 75 miles northeast of Everett near Mount Baker and just east of the Cascade crest (largest recorded earthquake in Washington). No record of any fatalities in Snohomish County.

1949, Nisqually Delta Area north of Olympia: This earthquake had a magnitude of 7.1 on the Richter scale. The Snohomish County zone that experienced the most intense effects extended along the South Stillaguamish River valley from Granite Falls to Arlington, and along the Snohomish and Skykomish River Valleys from Everett to Snohomish and Monroe. Within this area the effects included fallen chimneys and building cornices; cracked plaster; broken water and gas mains; damaged docks, bridges,

[22] Hazard Identification and Vulnerability Analysis, King County Office of Emergency Management. September 1998

and water storage tanks; cracked ground and pavement; and landslides, mudflows and debris slides.

1996, Duvall: This earthquake had a magnitude of 5.6 on the Richter scale. Near the epicenter, merchandise fell off of shelves and at least one resident reported a cracked chimney. In Snohomish County, 16,000 residents were reportedly without power for several hours as a result of breakers tripping in four substations. Monroe experienced damage buildings. There was, however, no report of physical damage to electrical power facilities.[23]

2001, Nisqually Delta Area North of Olympia: This earthquake had a magnitude 6.8 on the Richter scale. Snohomish County had damages that were between $2 million and $3 million for public and private sector combined. There were minor casualties and 13 minor injuries. A few older unreinforced masonry structures suffered significant damage, but there were no building collapses in the county. The greatest shaking and highest percentage of damaged structures were in the main stem river valleys and the cities or towns built along the rivers: Darrington, Sultan, Monroe and Snohomish. The Tulalip Tribes also experienced significant damage to its structures and housing. Although exact figures are not known, it is estimated that at least 80% of Tribal housing experienced damage from the quake.

Location

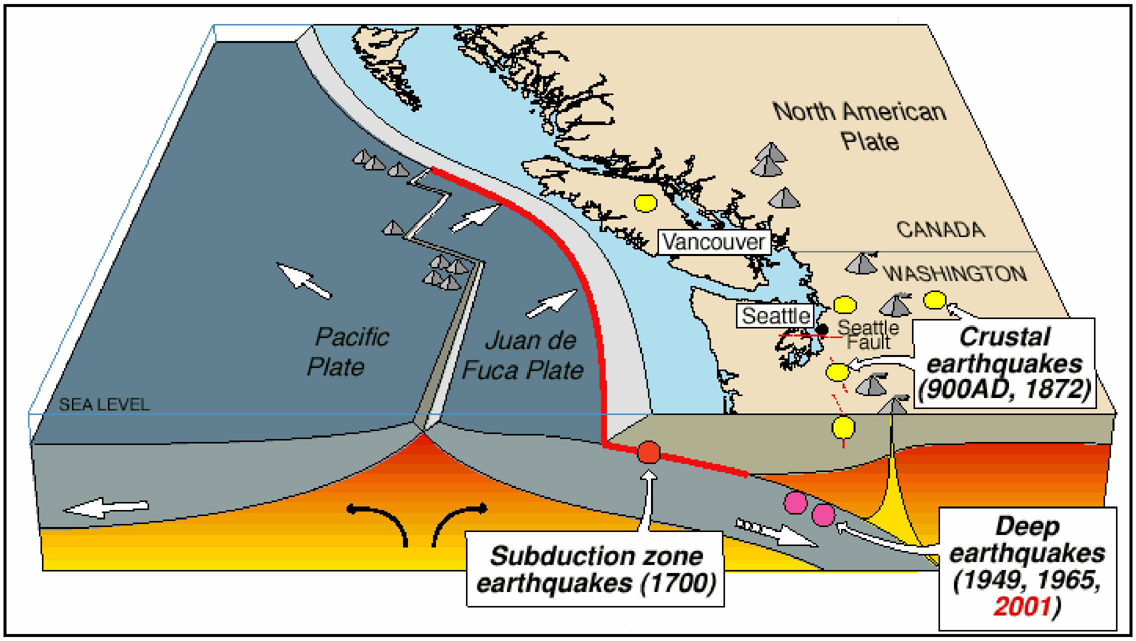
The Tulalip Reservation is located in one of the most earthquake prone regions of the United States. This section will detail the different types of earthquakes that can affect the Reservation. There will also be a discussion of the soil make-up of the Reservation to identify areas of highest concern. Structures located on softer soils are more vulnerable to the shaking caused by earthquakes.

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

The three source zones that exist for Puget Sound quakes are a shallow (crustal) zone; the Cascadia Subduction zone; and a deep or intraplate ("Benioff") zone. These are shown in Figure 4-2.

[23] http://www.eqe.com/publications/duvall/duvall1.pdf

Figure 4-2: Earthquake Types in Western Washington



Cascadia Subduction Zone

Subduction Zone earthquakes occur along the Cascadia subduction fault, as a direct result of the convergence of these two plates. These are the world's greatest earthquakes and are observed at subduction zone boundaries. A subduction earthquake would be centered off the coast of Washington or Oregon where the plates converge and would typically have a minute or more of strong ground shaking. These magnitude 8 to 9.5 Richter scale thrust-type subduction earthquakes occur from time to time as two converging plates slide past one another. There are no reports of such earthquakes in the Cascadia Subduction Zone off the Oregon/Washington coast since the first written records of permanent occupation by Europeans in 1833 when the Hudson Bay Trading Company post was established at Fort Nisqually. However, paleoseismic evidence suggests that there may have been as many as five of these devastating energy releases in the past 2000 years, with a very irregular recurrence interval of 150 to 1100 years. Written tsunami records from Japan, correlated with studies of partially submerged forests in coastal Washington and Oregon, give a probable date for the most recent of these huge quakes as January 26, 1700.

Since the installation in 1969 of a multi-station seismograph network in Washington, there has been no evidence of even small subduction-type earthquakes in the Cascadia region, indicating the plates are locked. However, parts of subduction zones in Japan and Chile also appear to have had very low levels of seismicity prior to experiencing great earthquakes. Therefore the seismic quiescence observed historically along coastal region of Washington and Oregon does not refute the possibility that an earthquake having a magnitude of greater than 8 could occur there. Recent shallow geodetic strain measurements near Seattle indicate that significant compressional strain is accumulating parallel to the direction of convergence between the Juan de Fuca and North America plates, as would be expected prior to a great thrust earthquake off the coast of Oregon, Washington and British Columbia. Usually, these types of earthquakes are immediately followed by damaging tsunamis and numerous large aftershocks.

Benioff (Deep) Zone

Western Washington is most likely to experience intraplate or "deep" earthquakes of magnitude 6 to 7.4 on the Richter scale. This occurs within the subducting Juan de Fuca plate at depths of 50 -70 km. As the Juan de Fuca plate subducts beneath North America, it becomes denser than the surrounding mantle rocks and breaks apart under its own weight, causing Benioff zone earthquakes. The Juan de Fuca plate begins to bend even more steeply downward, forming a "knee". It is at this knee where the largest Benioff zone earthquakes occur.

The largest of these events recorded in modern times were the 7.1 magnitude Olympia earthquake in 1949 and the 6.8 magnitude Nisqually earthquake in 2001. Strong shaking during the Olympia earthquake lasted about 20 seconds. For the Nisqually quake, duration of shaking in Snohomish County varied from about 30 seconds to "more than 2 minutes" up-river from Sultan. Since 1870, there have been seven deep earthquakes in the Puget Sound basin with measured or estimated magnitudes of 6.0 or larger. The epicenters of all of these events have been located within about 80 kilometers of each other between Olympia and just north of Tacoma. Scientists estimate the recurrence interval for this type of quake to be 30 - 40 years for magnitude 6.5, and 50 - 70 years for magnitude 7.0. Because of their depth, intraplate earthquakes are least likely to produce significant aftershocks.

Crustal Zone

The third source zone is the crust of the North American plate. These are known as shallow earthquakes. Of the three source zones, this is the least understood. A variety of lines of evidence lead to the conclusion that the Puget Lowland area is currently shortening north-south at a rate of about ½ cm (one-fifth of an inch) per year. Shallow earthquakes of magnitude up to 7 or more on the Richter scale can happen anywhere in the Puget Sound region. Such earthquakes have the potential to cause greater loss of life and property on the Tulalip Reservation than any other kind of disaster. Fortunately, great crustal quakes do not seem to happen very often: perhaps no more than once every 1000 years.

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

In addition to the 1872 Mount Baker earthquake, seismologists have found evidence that a devastating crustal quake occurred on a fault near Seattle approximately 1100 years ago. Several known major fault zones cross Whidbey Island and run east to southeast into Snohomish County. Seismologists have recently identified a near-surface fault zone in the northeast corner of Snohomish County near the Town of Darrington. This fault, the Darrington Seismic Zone Devil's Mountain Fault - North Whidbey Fault complex, is estimated to be capable of generating at least a 6-7 magnitude crustal earthquake on the Richter scale. The Duvall Fault near Lake Margaret on the King - Snohomish County border has produced two (magnitude 5.2 and 5.6) earthquakes in the past 70 years (1932 and 1996).

Crustal earthquakes are the least predictable of Puget Sound's seismic threats, and also are the most likely to be followed by significant aftershocks. Following a great crustal earthquake of magnitude 7.0 or more, one of the greatest dangers to human life is that buildings or other structures damaged in the initial shock but still in use and believed safe could collapse in a strong aftershock.

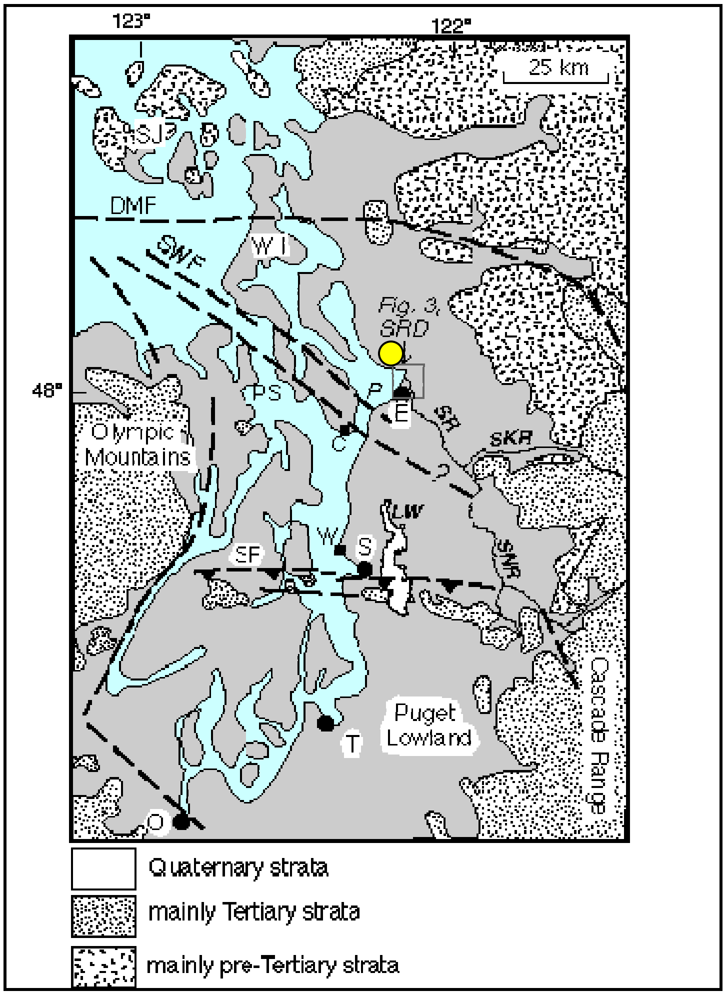
How many other crustal faults pose significant earthquake hazards to the Puget Sound region is not yet known, but geologists and geophysicists are studying the South Whidbey Island fault and the Olympia fault for evidence of recent earthquakes. In addition, a potential Everett fault has been identified and is currently being researched. Recently, there has been a study of earthquake activity in the Snohomish River Delta region. In particular, the scientists have found two crustal events from around 900-950 AD and 1450-1620 AD.[24] The study took soil samples from the delta and found evidence of liquefaction through upward thrusts of sand and woody debris.[25]

Furthermore, The Tulalip Reservation is located in a basin of softer soils, known as the Everett Basin, which can intensify the effect of an earthquake. The Reservation is also located between the two recently identified crustal faults mentioned above known as the Devil's Mountain Fault and the South Whidbey Fault. Figure 4-3 shows these faults, labeled DMF and SWF, and the location of the Reservation with a yellow dot.

[24] http://depts.washington.edu/presence/records/makenice.cgi?ID=121

[25] Bourgeois, Joanne and Johnson, Samuel Y. "Geologic evidence of earthquakes at the Snohomish delta, Washington, in the past 1200 years, " Geological Society of America, 2001, GSA Bulletin Vol.113, p. 482-494

Figure 4-3: Faults near Tulalip Reservation



National Earthquake Hazard Reduction Program (NEHRP)

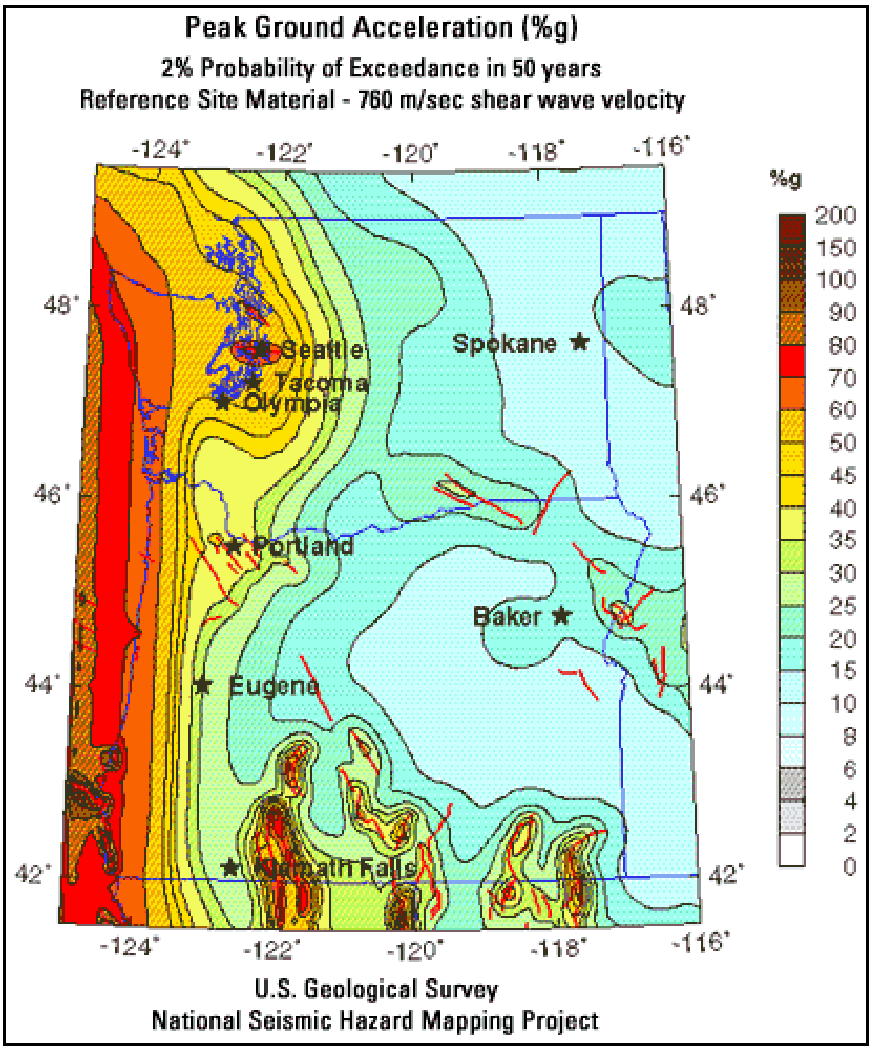
In addition to understanding the different types of earthquakes that can affect the Tulalip Reservation, it is also crucial to have knowledge of the soil make-up of the Reservation. This will narrow down what areas of the Reservation will be more impacted by an earthquake event. The NEHRP classification system is used to accomplish this. In the event of an earthquake, NEHRP soils B and C typically can sustain ground shaking dependent on the magnitude. The areas that will be most affected by ground shaking are located in NEHRP soils D, E and F. In general these areas will also be most susceptible to liquefaction, a secondary effect of an earthquake where soils lose their shear strength and flow horizontally. The NEHRP Soils Classifications and Liquefaction Risk for the Tulalip Reservation are shown in Figure 4-5 and Figure 4-6.

Frequency

The USGS has created a probabilistic hazard map based on peak ground acceleration that takes into account new information on several fault zones. The Puget Sound area, including the Tulalip Reservation, is in a higher risk area, with a 2% probability of exceedance in a 50-year period of seeing ground shaking at 70% of gravity from a Subduction Zone event. Figure 4-4 displays the expected peak horizontal ground motions for this probability.[26]

Dr. Art Frankel of the USGS estimated that a Cascadia Subduction zone earthquake has a 10% to 15% probability of occurrence in 50 years. A crustal zone earthquake in general has a recurrence interval of about 500 to 600 years. A Benioff zone earthquake has an 85% probability of occurrence in 50 years indicating a greater likelihood of occurring than all other types of earthquake events. Its recurrence interval is approximately 30 to 50 years. The South Whidbey and Seattle faults have a 2% probability of occurrence in 50 years. The Devil's Mountain Fault - North Whidbey Fault complex does not yet have enough information to determine the probability of occurrence of this event. In general, it's difficult to estimate the probability of occurrence of these crustal earthquake events.

Figure 4-4: Probabilistic Hazard Map



[26] http://wrgis.wr.usgs.gov/docs/wgmt/pacnw/lifeline/eqhazards.html

Severity

As noted earlier the Tulalip Reservation has the potential to be affected by a subduction, Benioff, or crustal zone earthquake. A subduction zone earthquake could produce an earthquake with a magnitude as large as an 8.5 on the Reservation. Benioff zone earthquakes as large as magnitude 7.1 are expected everywhere west of the eastern shores of Puget Sound.[27] A crustal zone earthquake could produce a 7.1 magnitude earthquake affecting the Reservation. Table 4-6 provides a description of the expected severity of the earthquakes.

Table 4-6: Severity of Tulalip Reservation Earthquakes

Type of Earthquake	Expected Magnitude
Cascadia Subduction Zone	9.0 for approximately 4 minutes with aftershocks
Benioff	7.1 with no aftershocks
Crustal - North Whidbey, Devil's Peak Complex South Whidbey Possible Everett Fault	7.1 with some aftershocks

Warning Time

Although, there is a large amount of information that is known about possible earthquake locations, there is no current reliable way to predict what day or month an earthquake will occur at any given location. There is current research that is being conducted with warning systems that use the low energy waves that precede major earthquakes.[28] These potential warning systems give approximately 40 seconds notice that a major earthquake is about to occur. The warning time is very short but it could allow for someone to get under a desk, step away from the hazardous material they are working with or shut down a computer system.

Secondary Hazards

There are several secondary effects of earthquakes. Earthquakes can cause large and sometimes disastrous landslides and mudslides, including debris flows from volcanoes (lahars) not directly associated with eruptions. River valley and coastal hydraulic-fill sediment areas are also vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction occurs when water-saturated sands, silts or gravelly soils are shaken so violently that the individual grains lose contact with one another and "float" freely in the water, turning the ground into a pudding-like liquid. Building and road foundations lose load-bearing strength and may actually sink quicksand-like into

[27] http://wrgis.wr.usgs.gov/docs/wgmt/pacnw/lifeline/eqhazards.html
[28] California Institute of Technology, Caltech 336, "System gets the jump on quakes"

what was previously solid ground. Lastly, unless properly secured, hazardous materials releases can cause significant damage to the surrounding environment and people.

Tsunamis and seiches are also a major secondary hazard caused by earthquakes. These can be caused directly by the earthquake, or by an earthquake-induced landslide into Puget Sound or other bodies of water.

Exposure Inventory

This section will detail the Tulalip Reservation's inventory of people, property, and infrastructure exposed to earthquakes. To put it succinctly, all of its assets are exposed to the different kinds of earthquakes that can occur in the Puget Sound area. Nonetheless, a more detailed inventory can be made of the assets located in highly vulnerable soils, such as NEHRP D, E and F classified soils and in liquefaction risk areas. 2003 Snohomish County Assessor's data and the Tulalip Tribe's GIS database of critical and essential tribal facilities were used to identify property listed in this inventory.

As mentioned, all property is exposed to earthquakes. For the whole Reservation:

- There are **4845** parcels in total that are exposed to earthquakes
- The total assessed market value of these parcels is **$693,397,750**
- The total market land value is **$409,465,400**
- The total market improvement value is **$283,932,350**

Population

For the Tulalip Reservation, the whole population is considered exposed to earthquakes. This number in 2000 was 9,246 persons. Estimates were not made for populations living within each NEHRP and/or Liquefaction Class.

Property on NEHRP D soils

This section will detail the property that is located on NEHRP D soils.

There are **2,904** parcels located on NEHRP D soils, about **60%** of all parcels.

- These parcels have a total market value (land + improvements) of **$396,870,950**
    - These parcels account for **57%** of all the value of the Tulalip Reservation's parcels
- Total market land value of parcels is **$228,229,000**
- These parcels make up **56%** of the market land value of all parcels on the Reservation
- Total market improvement value is **$168,641,950**
- These parcels make up **59%** of the market improvement value of all parcels on the Reservation

Table 4-7: Parcels on NEHRP D Soils

Tulalip Parcels on NEHRP D Soils	
Land Use Code and Description	Number of Parcels
001 Reference Account	1
111 Single Family Residence - Detached	1515
113 Manufactured Home (Leased Site)	95
114 Manufactured Home (Owned Site)	302
121 Two Family Residence (Duplex)	2
123 Four Family Residence (Four Plex)	1
143 Single Family Residence Condominium	6
160 Hotel / Motel 1 - 99 Units	2
183 Non Residential Structure	52
184 Septic System	2
185 Well	1
186 Septic & Well	13
189 Other Residential	2
198 Vacation Cabins	3
343 Electrical Machinery, Equipment & Supplies	1
349 Other Fabricated Metal Products NEC	1
351 Engineering, Lab & Scientific Research	8
451 Freeways	2
459 Other Highway & Street Right-of-Way NEC	3
481 Electric Utility	1
483 Water Utilities & Irrigation & Storage	3
484 Sewage Disposal	1
489 Other Utilities NEC	4
511 Motor Vehicles & Automotive Equipment	1
519 Other Wholesale Trade, NEC	1
539 Other Retail Trade NEC	2
541 Groceries (With or Without Meat)	1
551 Motor Vehicles	2
553 Gasoline Service Stations	2
581 Eating Places (Restaurants)	3
582 Drinking Places (Alcoholic Beverages)	1
598 Fuel & Ice	1
624 Funeral & Crematory Services (Inc. Cemetery	1
639 Other Business Services NEC	1
641 Automobile Repair & Services	1
672 Protective Functions & Related Activities	1
681 Nursery, Primary & Secondary School	2
691 Religious Activities (Churches Synagogue	3
692 Welfare & Charitable Services	1
711 Cultural Activities (Inc. Libraries)	1
749 Other Recreation NEC	1
830 Open Space Agriculture RCW 84.34	25
880 DF Timber Acres Only RCW 84.33	17
881 DF Timber Acres / Imp/Unimp Ac With Bldg	3
910 Undeveloped (Vacant) Land	727

Tulalip Parcels on NEHRP D Soils	
915 Common Areas	3
940 Open Space General RCW 84.34	4
950 Open Space Timber RCW 84.34	4
No data	74
Grand Total	**2904**

Property on NEHRP E soils

This section will detail the property that is located on NEHRP E soils.

There are **266** parcels located on NEHRP E soils, about **5%** of all parcels.

- These parcels have a total market value (land + improvements) of **$36,280,000**
    - These parcels account for **5%** of all the value of the Tulalip Reservation's parcels
- Total market land value of parcels is **$21,995,300**
- These parcels make up **5%** of the market land value of all parcels on the Reservation
- Total market improvement value is **$14,284,700**
- These parcels make up **5%** of the market improvement value of all parcels on the Reservation

Table 4-8: Parcels on NEHRP E Soils

Tulalip Parcels on NEHRP E Soils	
Land Use Code and Description	Number of Parcels
111 Single Family Residence - Detached	120
113 Manufactured Home (Leased Site)	1
114 Manufactured Home (Owned Site)	8
122 Three Family Residence (Tri Plex)	1
182 Houseboat	1
183 Non Residential Structure	20
198 Vacation Cabins	1
241 Logging Camps & Logging Contractors	2
344 Transportation Equipment	1
662 Special Construction Trade Services	1
711 Cultural Activities (Inc. Libraries)	1
880 DF Timber Acres Only RCW 84.33	2
910 Undeveloped (Vacant) Land	95
915 Common Areas	4
939 Other Water Areas, NEC	1
No data	7
Grand Total	**266**

Property on NEHRP F soils

This section will detail the property that is located on NEHRP F soils.

There are **19** parcels located on NEHRP F soils, about **0.02%** of all parcels.

- These parcels have a total market value (land + improvements) of **$672,600**
  - These parcels account for **0.1%** of all the value of the Tulalip Reservation's parcels
- Total market land value of parcels is **$618,600**
- These parcels make up **0.15%** of the market land value of all parcels on the Reservation
- Total market improvement value is **$54,000**
- These parcels make up **0.02%** of the market improvement value of all parcels on the Reservation

Table 4-9: Parcels on NEHRP F Soils

Tulalip Parcels on NEHRP F Soils	
Land Use Code and Description	Number of Parcels
111 Single Family Residence - Detached	1
910 Undeveloped (Vacant) Land	6
939 Other Water Areas, NEC	10
No data	2
Grand Total	**19**

Vulnerability

Older structures, such as housing, are vulnerable to earthquakes. Homes located on, above or below steep slopes are vulnerable due to the secondary hazards associated with earthquakes, such as landslides.

Most vulnerable are the older critical and historic Tribal structures that were not built to current earthquake standards and have already experienced earthquakes. This includes many structures located in Tulalip Bay, such as St. Anne's Church and the Tribal Center.

Loss Estimation

FEMA has developed a detailed methodology to estimate damages from earthquakes based on the strength and location of an earthquake and also the characteristics of Tulalip structures, such as year built, foundation and building materials, such as wood-frame, tilt-up or steel frame. Unfortunately at this time it is not possible to conduct a detailed inventory of all structures on the Tulalip Reservation to come up with an accurate loss estimate. For this estimate, general values were used. The values used in this loss estimation are a hypothetical estimate of all *potential* damage. Its purpose is to come up with a value that can be used to compare with other hazards, in order to prioritize and focus mitigation efforts. Loss estimate accounted for all structures on Tulalip Reservation.

Assumptions:

- PGA value used for this estimate is 0.4%.
- The estimated damage to wood frame structures (which most Tulalip buildings are, built pre-code, is 16.7% of improvement value
- FEMA suggests that damage to content value be estimated as ½ of the damage to improvements, or 8.35%

Loss estimation:

- Estimated loss to earthquake-prone structures is **$47,416,702**
- Estimated loss to contents is **$23,708,351**

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Figure 4-5: Tulalip NEHRP Classification

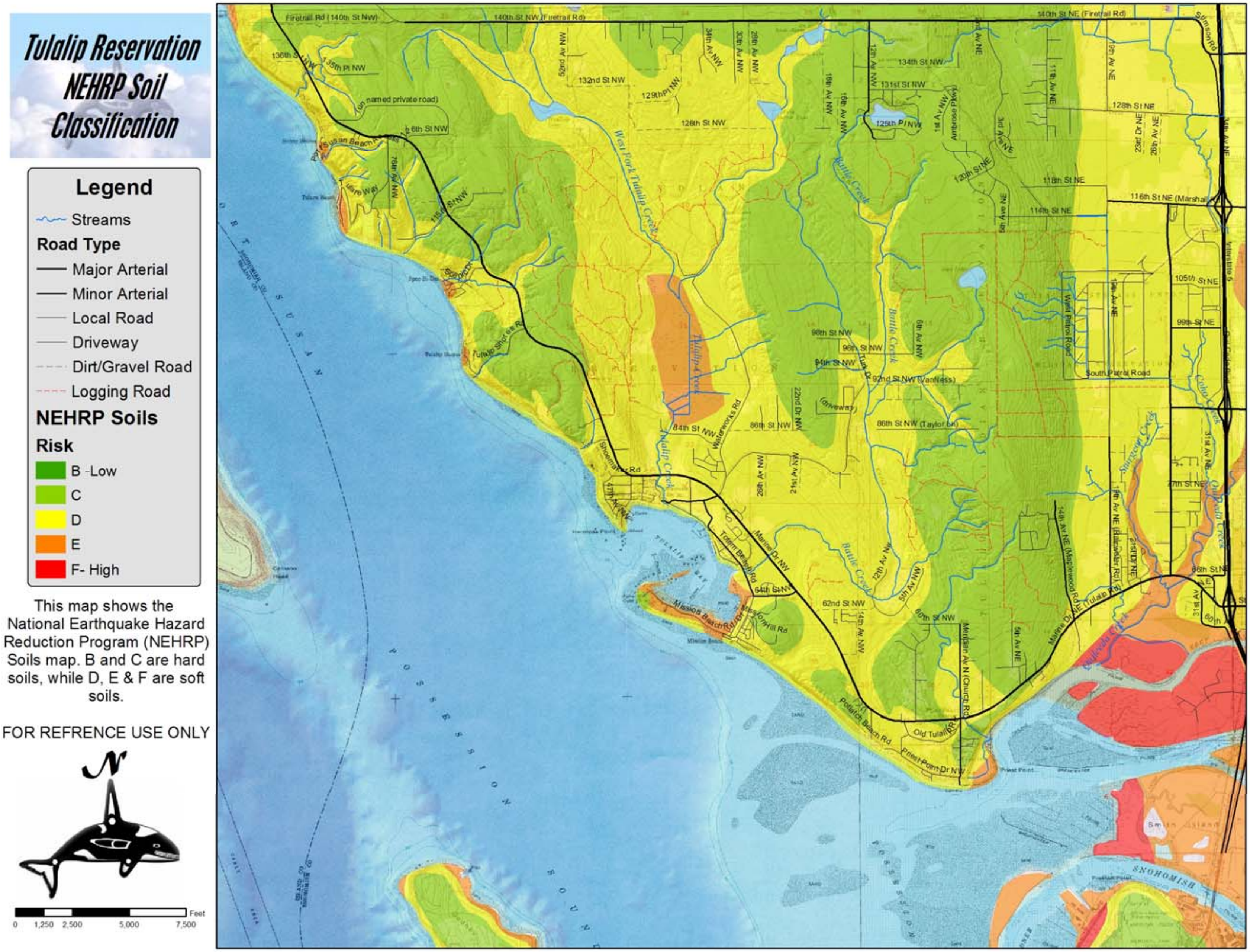

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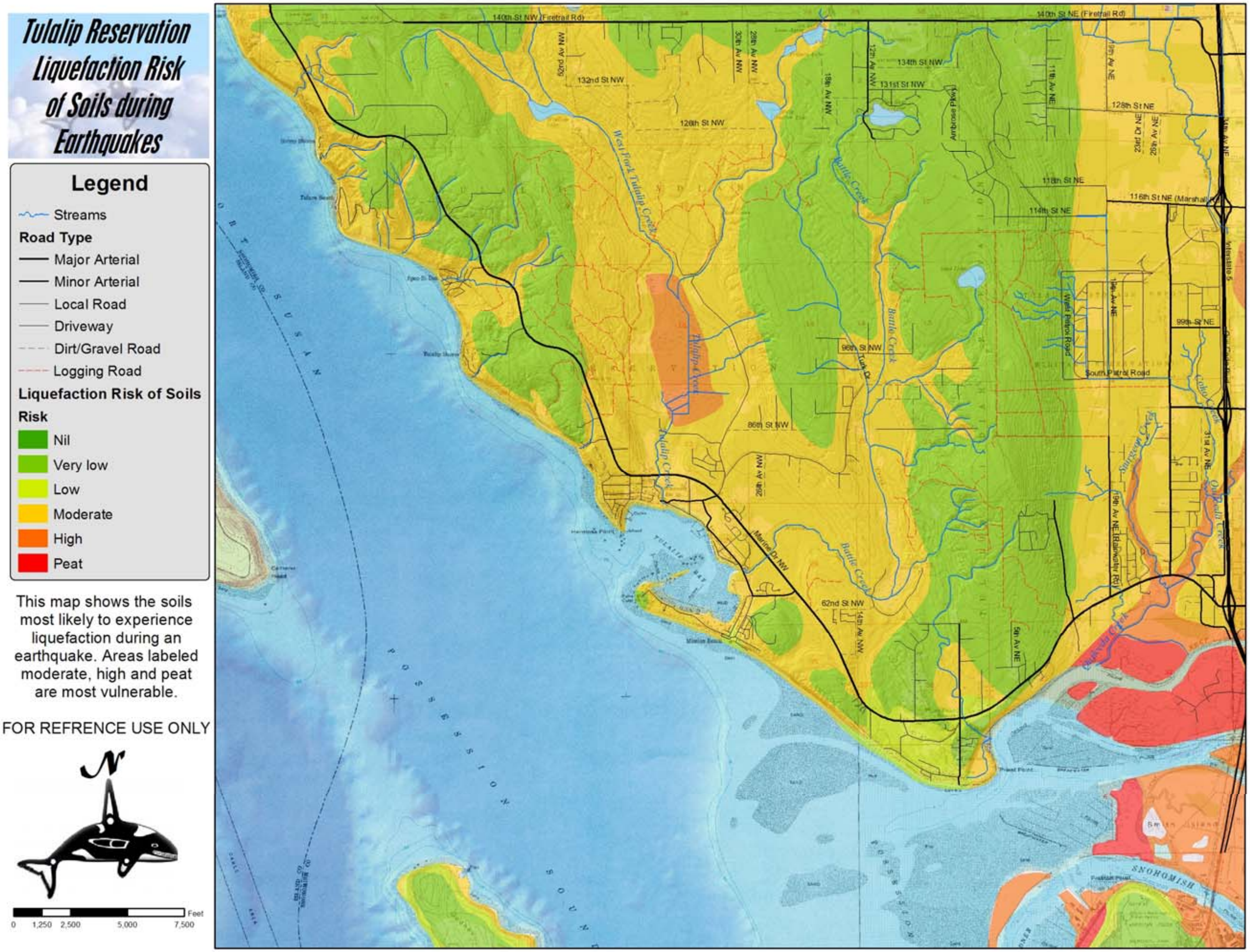
Figure 4-6: Tulalip Soil Liquefaction Risk



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4.5. Flood

Definitions

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

Basin: A basin is the area within which all surface water- whether from rainfall, snowmelt, springs or other sources- flows to a single water body or watercourse. The boundary of a river basin is defined by natural topography, such as hills, mountains and ridges. Basins are also referred to as **Watersheds** or **Drainage Basins**.

Cubic Feet per Second (cfs): Discharge or river flow is commonly measured in cfs. One cubic foot is about 7.5 gallons of liquid.

Flood Insurance Rate Map (FIRM): FIRMs are the official maps on which the Federal Emergency Management Agency (FEMA) has delineated the Special Flood Hazard Area (SFHA).

Floodplain: Floodplains are the land area along the sides of rivers that becomes inundated with water during a flood. Floodplain can be defined in different ways, but is commonly defined as the area that is also called the 100 year floodplain. The term 100 year flood is misleading. It is not the flood that will occur once every 100 years. Rather, it is the flood that has a 1% chance of being equaled or exceeded each year. Thus, the 100 year flood could occur more than once in a relatively short period of time. Because this term is misleading, FEMA has properly defined it as the 1% annual chance flood. This 1% annual chance flood is now the standard used by most Federal and State agencies and by the National Flood Insurance Program.[29]

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

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

Flood Zone Designations: These are the different flood hazard zones FEMA uses for FIRMs. These designations may be found on the flood hazard maps for Whitman County's communities.

Zone A: An area inundated by 100-year flooding, for which no Base Flood Elevations (BFEs) have been determined.

Zone AE: An area inundated by 100-year flooding, but for which BFEs have been determined.

Zone ANI: An area that is located within a community or county that is not mapped on any published FIRM.

[29] Definition from: FEMA, http://www.fema.gov/fhm/fq_gen23.shtm

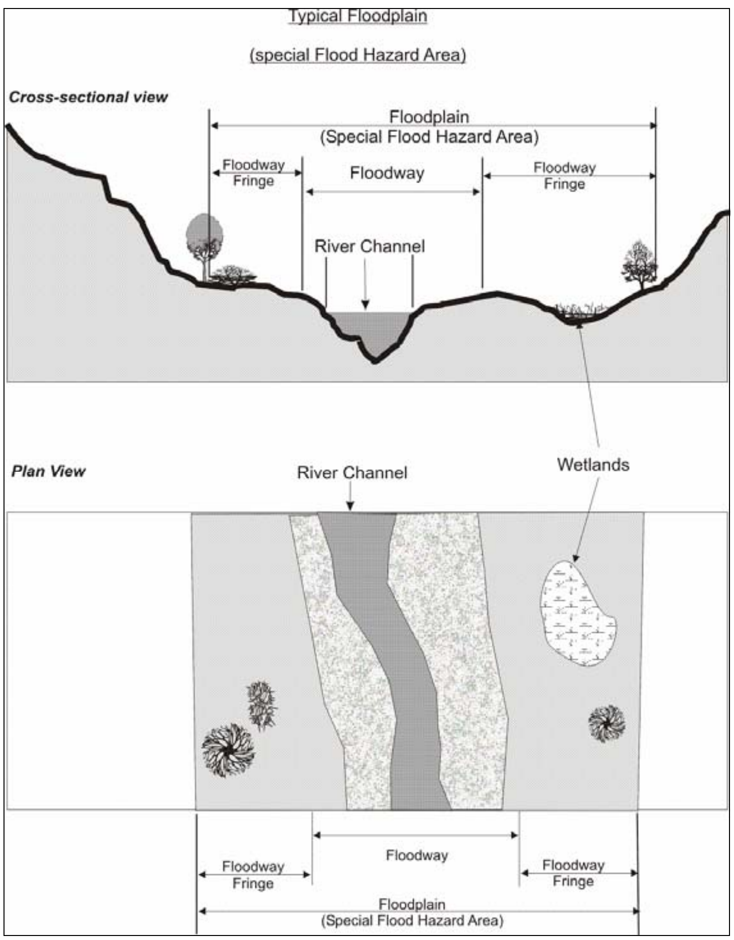
Zone X500: An area inundated by 500-year flooding; an area inundated by 100-year flooding with average depths of less than 1 foot or with drainage areas less than 1 square mile; or an area protected by levees from the 100-year flooding.

National Flood Insurance Program[30]: In 1968, Congress created the National Flood Insurance Program (NFIP) in response to the rising cost of taxpayer funded disaster relief for flood victims and the increasing amount of damage caused by floods.

The Mitigation Division is a section of the Federal Emergency Management Agency (FEMA) manages the NFIP, and oversees the floodplain management and mapping components of the Program. Nearly 20,000 communities across the United States and its territories participate in the NFIP by adopting and enforcing floodplain management ordinances to reduce future flood damage. In exchange, the NFIP makes federally backed flood insurance available to homeowners, renters, and business owners in these communities.

FEMA contracted the Army Corps of Engineers to map the floodplains, floodways, and floodway fringes. Figure 4-7 depicts the relationship among the three designations.

Figure 4-7: Floodway Schematic



30 Definition from FEMA: http://www.fema.gov/nfip/whonfip.shtm

Pre and Post FIRM rates[31]: Category of rates published in the National Flood Insurance Program Manual, applying to buildings located in a community qualifying for the regular flood program. Post-FIRM rates are used on building construction that started after December 31, 1974, or after the community's initial Flood Insurance Rate Map was published, whichever is later. These rates are lower than pre-FIRM rates.

Repetitive Loss Properties[32]: Any NFIP-insured property that, since 1978 and regardless of any change(s) of ownership during that period, has experienced:

a) Four or more paid flood losses in excess of $1000.00; or
b) Two paid flood losses in excess of $1000.00 within any 10-year period since 1978 or
c) Three or more paid losses that equal or exceed the current value of the insured property.

Special Flood Hazard Area: The base floodplain delineated on a Flood Insurance Rate Map. The SFHA is mapped as a Zone A in riverine situations and zone V in coastal situations. The SFHA may or may not encompass all of a community's flood problems.

Stream Bank Erosion[33]: Stream bank erosion is common along rivers, streams and drains where banks have been eroded, sloughed or undercut. However, it is important to remember that a stream is a dynamic and constantly changing system. It is natural for a stream to want to meander, so not all eroding banks are "bad" and in need of repair.

Generally, stream bank erosion becomes a problem where development has limited the meandering nature of streams, where streams have been channelized, or where stream bank structures (like bridges, culverts, etc.) are located in places where they can actually cause damage to downstream areas. Stabilizing these areas can help protect watercourses from continued sedimentation, damage to adjacent land uses, control unwanted meander, and improvement of habitat for fish and wildlife.

Subbasin: A subbasin is a tributary basin of a larger basin or watershed.

Water Resource Inventory Area (WRIA): WRIAs were formalized under WAC 173-500-040 and authorized under the Water Resources Act of 1971, RCW 90.54. Ecology was given the responsibility for the development and management of these administrative and planning boundaries. These boundaries represent the administrative under pinning of this agency's business activities. The original WRIA boundary agreements and judgments were reached jointly by Washington's natural resource agencies (Ecology, Natural Resources, Fish and Wildlife) in 1970.

Wild and Scenic River: A federal designation that is intended to protect the natural character of rivers and their habitat without adversely affecting surrounding property.

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

[31] Definition from: http://insurance.cch.com/rupps/post-firm-rates.htm
[32] Definition from FEMA: http://www.fema.gov/nfip/replps.shtm
[33] Definition from: http://washtenawcd.org/az/streambankeros.php

General Background

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

Hazard Profile

The Tulalip Reservation does not experience the exposure to or severity of flooding typically found in the region and Snohomish County in particular. The Reservation is located along the Port Susan/Possession Sound coast and at the mouth of the Snohomish River, but nonetheless is less exposed because it is located on hills above areas subject to major flooding. The Reservation is drained by some small creeks that can overflow, occasionally causing minor flooding. The Reservation can also experience coastal flooding from storm surges during severe weather. The sections below will profile in detail the exposure and vulnerability the Tulalip Reservation faces in regards to flooding.

Past Events

The Tulalip Reservation does not have a well-documented history of flooding. This is due primarily to the fact that the Reservation is drained by small coastal creeks and does not have any significant development adjacent to the creeks. The Upper Tulalip Creek Pond, used by the Tulalip Salmon Hatchery and protected by a 70 year old dam, overtopped during the New Year's Day Storm of 1997. Tens of thousands of Coho rearing in the pond were carried over the dam and Totem Beach Road, into the stones and brush below. It is estimated that 400,000 fish were lost.[34] In 2000, the Tulalip Reservation saw significant street flooding caused by blocked drainages on Totem Beach Road, Quil Ceda Boulevard and Marine Drive near 31st Ave. Firetrail Road saw flooding in 3 locations: the overtopping of Cummings Lake and two washouts caused by small creeks that cross under the road. Properties located along Priest Point are known to experience 2-3 feet of flooding caused by the overflow of the Snohomish River and/or a strong storm surge, although exact dates of flooding are not known. These locations are shown in Figure 4-8.

Location

There are three types of flooding that could affect the Tulalip Reservation: riverine flooding, tidal flooding and flash/surface flooding. The Tulalip Reservation was excluded

[34] Tulalip Tribes Assess Coho Damage from Winter Flood
http://www.tulalip.nsn.us/htmldocs/nr061697.htm

for study (Zone ANI) during the creation of FEMA Flood Insurance Rate Maps (FIRM), so 100- and 500- year floodplains are not defined.

Riverine Flooding

Most residents of the Tulalip Reservation are familiar with the annual conditions responsible for the potential of riverine flooding. "Flood season" begins in mid-November and continues to mid-February. In general, the first element leading to a potential flood is a heavy, fresh snow in the mountains. If a weather front with warm winds, usually from the southwest, and heavy rainfall follows the snow before it has a chance to settle and solidify, a flood potential exists. It is rare for rain to cause flooding without the other elements being present. High tides may be responsible for holding up the normal discharge of river runoff into Puget Sound, while low tides facilitate the discharge from the Snohomish River system. The Reservation is least exposed to this type of flooding, as it is generally located above the floodplain of the Snohomish River. There are some exceptions though. The marshy delta islands located near Ebey Slough and Steamboat Slough known as Big Flats can flood, as well as some of the marshy wetlands near the mouth of Quil Ceda Creek. Priest Point can be affected by riverine flooding too. Heavy floods on the Snohomish River carry large amounts of silt and debris, such as logs. The discharging flood can deposit this debris and silt along Priest Point, damaging bulkheads and property adjacent to the river mouth. Floods on Priest Point can reach depths of 2-3 feet.

Tidal Flooding

The potential for flooding in low-lying coastal areas exists when favorable atmospheric conditions (i.e. very low pressure) occur simultaneously with periods of unusually high tides. No significant damage has been experienced on the Reservation in the recent past due to tidal flooding. Storm surges, also known as storm tides, can affect a number of beachfront areas within the Tulalip Reservation. Generally, storm surges are caused by an increase in the usual tide level by a combination of low atmospheric pressure and onshore winds. During a storm surge tides may run from two to four feet above the predicted tide level. Storm surges can usually be predicted up to 12 hours before occurrence; however, only an approximate height can be predicted because of the large number of variables. The effects of a storm surge generally range from saltwater inundation to the battering of beachhead property by water driven debris. The beachfront areas on the Reservation include Priest Point, Mission Beach and the Tulalip Bay area, and the small coastal settlements of Tulalip Shores, Spee-Bi-Dah, Tulare Beach, and Sunny Shores. Property most often damaged by storm surge includes beachfront homes and businesses, bulkheads, marinas, docks and ferry terminals.

Flash Flooding and Surface Flooding

Several factors contribute to flash flooding. The two key elements are rainfall intensity and duration. Topography, soil conditions, urbanization and groundcover also play an important role. Flash floods occur within a few minutes to a few hours of excessive rainfall, a dam or levee failure, or a sudden release of water held by an ice or log jam. They can roll boulders, tear out trees, destroy buildings and bridges, and scour out new stream channels. Most flood deaths are due to flash floods.

Flash flooding can occur on the small creeks located on the Reservation if the conditions are right. These creeks include Tulalip Creek, Mission Creek and the Quil Ceda River. Unnamed creeks feeding Weallup Lake and Lake Agnes are known to overflow and sometimes washout Firetrail Road. The dam overtopping of Upper Tulalip Creek Lake in 1997 can be described as a flash flood because the rain was so rapid and heavy that the lake, dam and river could not accommodate the flow of water. In addition, localized surface or "urban" flooding occurred countywide during the "Holiday Blast" storm of December 1996 to January 1997 as a result of drainage systems that were incapable of carrying exceptional volumes of snowmelt and heavy rain runoff. There are numerous locations on the Reservation where urban flooding occurs, which are shown in Figure 4-8. As more of the Reservation's natural watershed is converted to human habitation and transportation systems, the urban flooding potential will continue to grow.

Frequency

The frequency of flooding on the Tulalip Reservation is similar to Snohomish County. Minor flooding can be experienced at least every year, especially during the fall and winter, while damaging flooding is experienced at least every 5 years.

Severity

Flooding on the Tulalip Reservation is not known to be as severe as that in Snohomish County in general. Roads can be blocked by blocked culverts or even washed-out. Homes located on low-lying areas along the coast, such as Tulare Beach and Priest Point, can be damaged by storm surge and/or flooding from the Snohomish River. During past events, 5 homes have made claims for damage from flooding. These claims totaled $37,000 for damage to buildings and $12,000 for damage to contents of buildings. Damage to the Tulalip Salmon Hatchery can be severe though. In 1997, 400,000 fish were lost, which translated into millions of dollars in lost revenue from fishing.

Warning Time

Flooding on the Snohomish River can be predicted days in advance, as it usually takes days for the highest flood stages to be reached. The Tulalip Reservation is located at the mouth of the river, so would be last to experience flooding from the river. Storm surges are harder to predict. Severe weather can be predicted hours to days in advance, while high tides can be predicted years in advance. Nonetheless because of its location at the northern edge of the Convergence Zone, unpredictable winds and severe weather is possible that can cause a massive storm surge, damaging low-lying waterfront properties.

Secondary Hazards

The major secondary hazards caused by flooding are landslides and erosion. Severe weather and flooding can saturate the soil, making it more susceptible to landslides. Flash flooding can cause erosion along streams, while storm surges can cause coastal erosion. Debris from flooding, such as logs, can also cause damage.

Exposure Inventory

The Tulalip Reservation's main vulnerability to flooding is to properties located along the coast and the along mouth of the Snohomish River. For this exposure inventory, all properties located adjacent to the shore were inventoried. GIS was used to determine exposed properties. Please note that a detailed inventory was not done. Some parcels, whose property lines extend to the shore, may not necessarily have structures located along the shore. Until further, more detailed analysis is done, this is the best available information regarding flood prone properties on the Tulalip Reservation. Snohomish County Assessor's data (2003) was used for land use information. Findings include:

There are **785** parcels exposed to flooding, **16%** of all parcels located on the Reservation

These parcels have a total market value (land + improvements) of **$154,571,100**

This is **22%** of all the value of all parcels on the Tulalip Reservation

Total market land value of parcels is **$109,748,000**

These parcels' market land value make up **27%** of all the land value on the Reservation

Total market improvement value is **$44,823,100**

These parcels contain **16%** all improvement values on the Reservation.

Figure 2-1 shows the land use of parcels exposed to flooding. The vast majority of parcels are single family residences. At least 128 parcels are undeveloped, and thus have potential for new structures.

Table 4-10: Flood-prone Parcels

Tulalip Reservation Flood-prone Parcels	
Land Use Code and Description	Number of Parcels
111 Single Family Residence - Detached	562
112 Common Wall Single Family Residence	4
113 Manufactured Home (Leased Site)	3
114 Manufactured Home (Owned Site)	7
122 Three Family Residence (Tri Plex)	1
182 Houseboat	1
183 Non Residential Structure	8
198 Vacation Cabins	2
241 Logging Camps & Logging Contractors	1
344 Transportation Equipment	1
459 Other Highway & Street Right-of-Way NEC	1
662 Special Construction Trade Services	1
818 Farms - General (No Predominant Activity	1
910 Undeveloped (Vacant) Land	128
915 Common Areas	4
934 Oceans & Seas	1
939 Other Water Areas, NEC	9
940 Open Space General RCW 84.34	1
No Data	49
Grand Total	**785**

Of the parcels listed above, about 55 parcels are Tribal Trust Lands, most of which are large undeveloped land holdings. None of the Tribe's critical facilities or structures are exposed to flooding.

Population

Population exposed to flooding was estimated by multiplying the number of residential parcels found in Table 4-10 by the average household size on the Tulalip Reservation, which is 2.79.[35]

The estimated exposed population to flooding is 1,613 persons[36]

17% of the Tulalip Reservation's population is exposed to flooding

Vulnerability

This section will discuss areas and properties most vulnerable to flooding.

Properties located along the shore, especially low lying areas, are most vulnerable to coastal flooding. These include residential properties along Tulalip Bay, Tulare Beach and Priest Point. Due to low elevations, homes located along Tulare Beach and Priest Point are most vulnerable.

The Tulalip Salmon Hatchery is vulnerable to flooding. Any losses at the hatchery can have a negative impact on the fishing industry for the Tulalip Tribes and other fishermen.

Vulnerable roads include Firetrail Road, which has seen past washouts, and other main arterials whose drainages can get clogged. These roads include Quil Ceda Boulevard, Totem Beach Road and the intersection of 31st Ave and Marine Drive.

National Flood Insurance Policies and Claims

The National Flood Insurance Program (NFIP) is administered by the Federal Emergency Management Agency (FEMA) and is intended to provide insurance to flood-prone properties. The Tulalip Tribes does not participate in the program, but Snohomish County does, and thus the Tulalip Reservation is covered. NFIP policies and claims serve as a good indicator of flood-prone properties and locations. Most people who take out a flood insurance policy have experienced flooding in the past. The Tulalip Reservation has 23 NFIP policies, which are shown in Figure 4-9. During past flood events, 5 policyholders filed claims for flood damage. These are also shown in Figure 4-9.

Loss Estimation

Flood loss estimates are based on damage curves developed by FEMA. These numbers do not represent the total estimated value a flood may cost, but rather a hypothetical estimate of all *potential* damage. Its purpose is to come up with a value that can be used to compare with other hazards, in order to prioritize and focus mitigation efforts.

Assumptions:

Flooding can reach depths of 3 feet

[35] U.S. Census Bureau, Census 2000

[36] 578 residences*2.79 average household size

Exposed structures are assumed to be 1 story, no basement structures. Analysis of assessor's data found that 66% of structures exposed are 1 story, while 73% of structures have no improved basements

Building damage estimates for these assumptions are 27% of improvement value

Building content damage (damage to TVs, furnaces, furniture) estimates are 40.5% of ½ of the improvement value

Loss estimate:

Estimated loss to flood-prone structures is **$12,102,237**

Estimated loss to contents is **$9,076,678**

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Figure 4-8: Known Flood Hazard Locations

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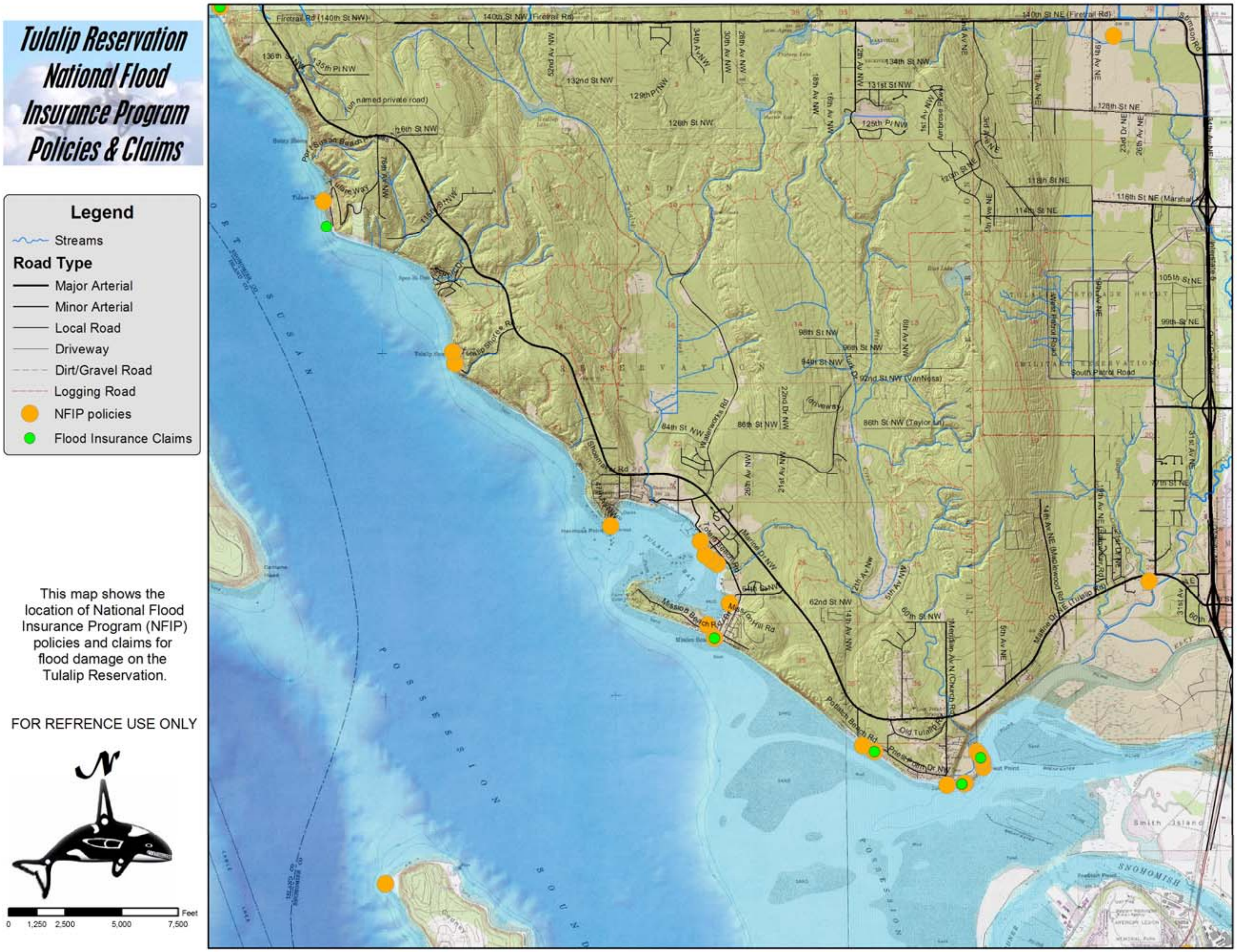
Figure 4-9: NFIP Policies and Claims



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4.6. Landslides

Definitions

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

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

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

Mass movements: [37] A collective term for landslides, mudflows, debris flows, sinkholes and lahars.

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

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

Sinkholes:[38] A collapse depression in the ground with no visible outlet. Its drainage is subterranean, its size typically measured in meters or tens of meters, and it is commonly vertical-sided or funnel-shaped.

Steep Slope: Different communities and agencies define it differently, depending on what it is being applied to, but generally a steep slope is a slope in which the percent slope equals or exceeds 25%. For this study, steep slope is defined as slopes greater than 33%.

General Background

Land sliding (or more properly, mass movement, which includes the mudslides and debris flows more typical of the greater Puget Sound area) is caused by a combination of geological and climatological conditions. This includes steep topography, as well as the encroaching influence of urbanization. The geological conditions of western Washington are primarily a legacy of repeated glacial episodes of advance and retreat during the past 2 million years. The cool, rainy Pacific Northwest climate ensures that soil moisture levels remain high throughout most of the year, and in fact are often at or near saturation during the wetter winter months. The region's topography reflects glacial carving, as well as the differential erosion of weaker sediments in the 13,000 years since the last ice disappeared. One of the most active erosive processes during this period has been mass wasting. This is the action of landslides and mudslides. Finally, and probably of greatest

[37] Snohomish HIVA
[38] ibid.

significance, the vulnerable natural setting is being steadily invaded by human residential, agricultural, commercial and industrial development and the infrastructure that supports it.

A landslide is a mass of rock, earth or debris moving down a slope. Landslides may be minor or very large, and can move at slow to very high speeds. They can be initiated by storms, earthquakes, fires, volcanic eruptions, and by human modification of the land.

Mudslides or mudflows (or debris flows) are rivers of rock, earth, organic matter and other soil materials saturated with water. They develop in the soil overlying bedrock on sloping surfaces when water rapidly accumulates in the ground, such as during heavy rainfall or rapid snowmelt. Water pressure in the pore spaces of the material increases to the point that the internal strength of the soil is drastically weakened. The soil's reduced resistance can then easily be overcome by gravity, changing the earth into a flowing river of mud or "slurry."

A debris flow or mudflow can move rapidly down slopes or through channels, and can strike with little or no warning at avalanche speeds. The slurry can travel miles from its source, growing as it descends, picking up trees, boulders, cars, and anything else in its path. Although these slides behave as fluids, they pack many times the hydraulic force of water due to the mass of material included in them. Locally, they can be some of the most destructive events in nature.

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

Landslides are caused by one or a combination of the following factors: change in slope gradient, which increases the load the land must bear, shocks and vibrations, change in water content, ground water movement, frost action, weathering of rocks, and removal or changing the type of vegetation covering slopes.

In general, landslide hazard areas occur where the land has certain characteristics, which contribute to the risk of the downhill movement of material. These characteristics include:

- A slope greater than 15 percent.
- Landslide activity or movement occurred during the last 10,000 years.
- Stream or wave activity, which has caused erosion, undercut a bank or cut into a bank to cause the surrounding land to be unstable.
- The presence or potential for snow avalanches.
- The presence of an alluvial fan, which indicates vulnerability to the flow of debris or sediments.
- The presence of impermeable soils, such as silt or clay, which are mixed with granular soils such as sand and gravel. [39]

[39] http://www.metrokc.gov/prepare/hiva/landslide.htm

Hazard Profile

Past Events

There is little recorded information for Snohomish County regarding landslides, and even less is known about landslides on the Tulalip Reservation. Although Snohomish County's records are less than complete, during the "Holiday Blast" winter storm of 1996-97, more than half of the county's $60-70M in reported damages occurred as a result of landslides, mudslides and debris flows. Drainage systems and catchment basins could not handle the volume of runoff, focusing the water's energy against vulnerable slopes and manmade structures. In some cases, saturated soils simply became overloaded with the weight of snow and rainwater and collapsed. Private homeowners, particularly in those areas where the natural drainage has been paved, diverted or otherwise modified by man, reported significant damage. This storm was the first well-documented event with landslides.

Another large slide occurred in the town of Woodway, Snohomish County, just north of the City of Shoreline, King County, during the early morning of January 15th, 1997. It cut fifty feet into the property above, passed over the railroad tracks and knocked a freight train into the Sound.[40] Figure 4-10 provides a picture of the Woodway slide. The steep coastal bluffs where this occurred are similar to the Tulalip's steep coastal bluffs and serve as a good indicator of what a major landslide on the Reservation may look like.

Figure 4-10: 1997 Woodway Slide

Location

A recent study of historic landslides in Seattle commissioned by Seattle Public Utilities has identified four types of landslides in the region:[41]

- **High Bluff Peeloff** - block falls of soil from high bluffs (primarily along the near-vertical cliffs of Puget Sound).

[40] http://www.ecy.wa.gov/programs/sea/landslides/show/woodway.html
[41] Shannon and Wilson, January, 2000

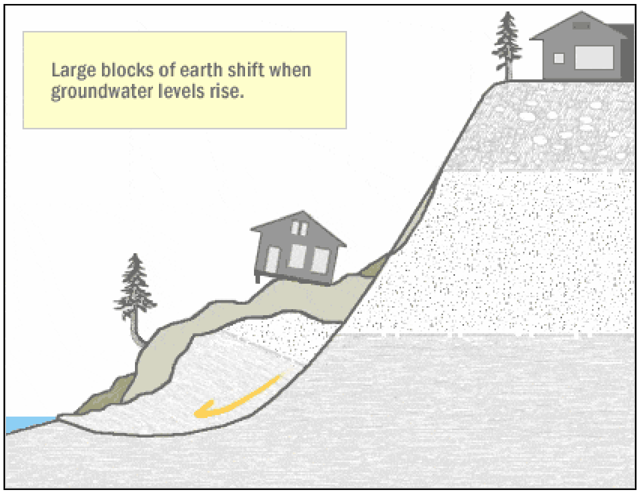
- **Groundwater Blowout** - catastrophic groundwater soil bursts caused by the buildup of groundwater pressures along the contact of pervious/impervious soil units.
- **Deep-Seated Landslides** - deep, rotational or translational sliding and slumping caused by groundwater pressures within a hillside.
- **Shallow Colluvial (Skin) Slides**—shallow rapid sliding of the outer surface of a hillside slope sometimes also resulting in a debris flow.

The most common type of slide in the Puget Sound area to be the shallow colluvial slide, occurring particularly in response to intense, short-duration storms. The largest and most destructive are deep-seated slides, although they are less common than other types. The preponderance of landslides occur in January after the water table has risen during the wetter months of November and December. In addition to the coastal bluffs, land sliding is most prevalent around the slopes of the Puget Sound's steep, linear hills. Water is involved in nearly all cases; and, consistent with other studies in the region; human influence was identified in more than 80% of the reported slides.

In addition, the recognition of ancient dormant mass movement sites is important in the identification of those areas most susceptible to flows and slide because they can be reactivated by earthquakes or by exceptionally wet weather. Also, because they consist of broken materials and frequently involve disruption of ground water flow, these dormant sites are more vulnerable to construction-triggered sliding than adjacent undisturbed material.

The diagrams below show different kinds of slides that can occur in the Puget Sound Region (Figure 4-11, Figure 4-12, Figure 4-13, and Figure 4-14).[42] Puget Sound's shoreline contains many large, deep-seated dormant landslides. Shallow slides are the most common type and the most probable for Snohomish County. Occasionally large catastrophic slides occur on Puget Sound. Additionally, Figure 4-15 shows the steep slope hazard areas on the Tulalip Reservation.

Figure 4-11: Deep Seated Slide



[42] http://www.ecy.wa.gov/programs/sea/landslides/about/about.html

Figure 4-12: Shallow Slide

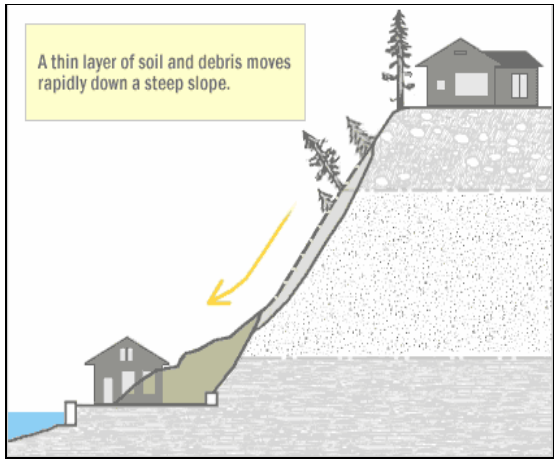


Figure 4-13: Bench Slide

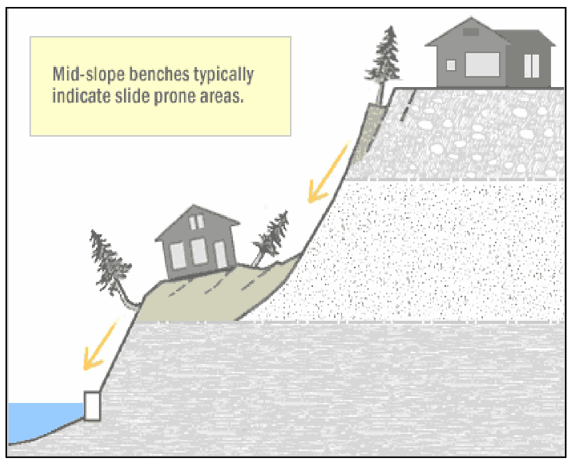
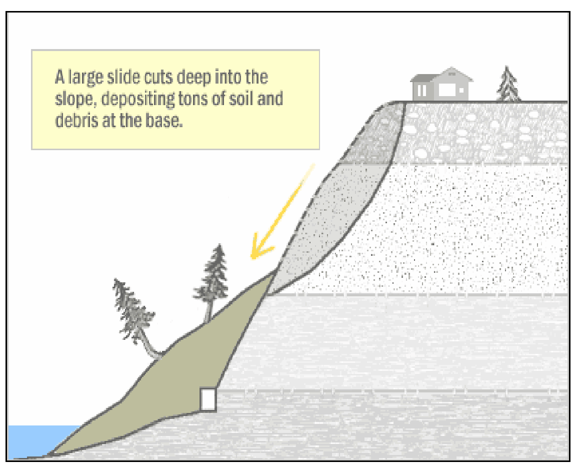


Figure 4-14: Large Slides



Frequency

Landslides are often triggered by other natural hazards such as earthquakes, heavy rain, floods or wildfires. The frequency of a landslide is related to the frequency of earthquakes, heavy rain, floods, and wildfires. On the Tulalip Reservation, landslides typically occur during and after major storms. Recent events occurred during the Holiday Blast storm of 1996-7. Flows and slides are commonly categorized by the form of initial ground failure, but they may travel in a variety of forms along their paths. The velocity of movement may range from a slow creep of centimeters per year to many meters per second, depending on slope angle, material and water content.

Severity

Landslides destroy property, infrastructure, transportation systems, and can take the lives of people. Slope failures in the United States result in an average of 25 lives lost per year and an annual cost to society of about $1.5 billion. [43]

The 1996 Holiday Blast storm caused about $30-35 million in damage throughout Snohomish County due to landslides, mudslides and debris flows. This was about half of all damage caused by the storm. The landslides caused by the storm also caused tens of millions of dollars of damage to road infrastructure. The actual amount of damage that occurred on the Tulalip Reservation is not known, but there were road washouts caused by landslides on Tulare Beach Road and on the steep narrow cliff side private road that leads to Sunny Shores.

Warning Time

Mass movements can occur either very suddenly or slowly. There are methods used to monitor mass movements with that can provide an idea of type of movement and amount of time prior to failure. It is also possible to determine what areas are at risk during general time periods. Assessing the geology, vegetation, and amount of predicted precipitation for a given area can help in these predictions.

Secondary Hazards

Landslides can typically cause several different types of secondary effects. Several landslides have blocked egress and ingress on roads. This has the potential to cause isolation for affected residents and businesses. Roadway blockages caused by landslides can also create traffic problems resulting in delays for commercial, public and private transportation. This could result in economic losses for businesses.

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

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

The major natural secondary hazards caused by landslides, especially landslides along the coast or along the large lakes, are tsunamis/seiches. When a landslide falls into the water, such as Puget Sound, it creates a sloshing effect that generates a tidal wave or tsunami

[43] http://www.metrokc.gov/prepare/hiva/landslide.htm

that can cause as much or even more damage than the landslide itself. One of the most famous of these was the landslide that occurred on Camano Head in the early 1800s. It killed about a hundred people, mostly women and children, and sent a tsunami southeast towards Hat Island, which destroyed a village and killed many people there. Such a similar event could affect the Tulalip Reservation, particularly Tulalip Bay.

Exposure

The Tulalip Zoning Ordinance (Ordinance number 80) defines bluffs and steep slopes as Environmentally Sensitive Lands, where development should be regulated. These steep slopes are defined as

- Slopes over 15% or otherwise subject to slope instability, potential landslide or significant erosion[44]

Furthermore, Snohomish County Code defines landslide hazard areas as "areas potentially subject to mass earth movement based on a combination of geologic, topographic, and hydrologic factors, with a vertical height of 10-feet or more. These include the following:

- Areas of historic landslides as evidenced by landslide deposits, avalanche tracks, and areas susceptible to basal undercutting by streams, rivers or waves;
- Areas with slopes steeper than 15 percent which intersect geologic contacts with a relatively permeable sediment overlying a relatively impermeable sediment or bedrock, and which contain springs or ground water seeps;
- Areas located in a canyon or an active alluvial fan, susceptible to inundation by debris flows or catastrophic flooding." [45]

For this study, a slope map generated from a 10-meter resolution digital elevation model (DEM) was used to identify areas exposed to landslides. This is shown on Figure 4-15. The slope map shows slope areas of 15%. A detailed map is not currently available at this time that shows potential landslide areas[46]. The slope map is used as a proxy to identify potential exposure areas until a better map can be produced. The Washington State Department of Natural Resources is currently in the process of creating a Landslide Hazard Zonation database that should used in the future to identify landslide hazard areas.

Exposure Inventory

The Tulalip Reservation's main areas of exposure and vulnerability to landslides are to the homes located along the high, steep bluffs along Port Susan and Possession Sound. Using GIS, 2003 Snohomish County Assessor's parcel data was overlain onto the steep slope locations in order to inventory the amount and value of structures and properties exposed to landslides. Although this may not be as accurate as carrying out a detailed

[44] Tulalip Zoning Ordinance 23.2
[45] Snohomish County Code 30.91L.040
[46] The Washington State Dept. of Ecology has mapping from the 1970s that shows landslides hazards for the coastal areas of the State. See http://www.ecy.wa.gov/programs/sea/landslides/maps/maps.html

assessment, it does serve as a good starting point to determine the Tulalip's exposure and vulnerability to landslides. Findings include:

- There are **619** parcels exposed to landslides, about **13%** of all parcels located on the Reservation
- These parcels have a total market value (land + improvements) of **$111,127,400**
  - These parcels account for **16%** of all the value of the Tulalip Reservation's parcels
- Total market land value of parcels is **$70,042,600**
- These landslide-prone parcels make up **17%** of the market land value of all parcels on the Reservation
- Total market improvement value is **$41,084,800**
- These landslide-prone parcels make up **14%** of the market improvement value of all parcels on the Reservation

Table 4-11 shows the land use of parcels exposed to flooding. The vast majority are single-family residences and other housing. Undeveloped parcels also frequent, with 152.

Table 4-11: Landslide-prone Parcels

Tulalip Reservation Landslide-prone Parcels	
Land use Code and Description	Number of Parcels
111 Single Family Residence - Detached	360
112 Common Wall Single Family Residence	4
113 Manufactured Home (Leased Site)	5
114 Manufactured Home (Owned Site)	13
115 Manufactured Home (Mobile Home Park)	29
150 Mobile Home Park 1 - 99 Units	1
183 Non Residential Structure	7
186 Septic & Well	1
198 Vacation Cabins	3
459 Other Highway & Street Right-of-Way NEC	2
483 Water Utilities & Irrigation & Storage	1
624 Funeral & Cemetery Services	1
910 Undeveloped (Vacant) Land	152
915 Common Areas	5
934 Oceans & Seas	1
940 Open Space General RCW 84.34	1
950 Open Space Timber RCW 84.34	2
No data	31
Grand Total	**588**

Population

Population exposed to landslides was estimated by multiplying the number of residential parcels found in Table 4-11 (412 parcels) by the average household size on the Tulalip reservation, which is 2.79.[47]

The estimated population exposed to landslides is **1,149**

This amounts to about **12%** of the population living on the Tulalip Reservation exposed to landslides

Vulnerability

This section will discuss areas and property most vulnerable to landslides.

Homes located along the bluffs on Potlatch Beach Road and Priest Point Drive are vulnerable to landslides.

The communities of Tulalip Shores, Tulare Beach, and Sunny Shores are extremely vulnerable to landslides. All three communities, but especially Tulare Beach and Sunny Shores, can become isolated by landslides blocking or washing out roads. These roads are Tulare Way, Port Susan Beach Road and Tulalip Shores Road. Much of Sunny Shore is located on a steep, winding private road that sees frequent landslides. Many homes here are perched on precariously steep slopes and are extremely vulnerable to landslides.

Loss Estimation

Currently there are no standards in place to estimate losses from landslides. Large landslides occur infrequently and tend to be very localized, damaging only one or a few homes. Nonetheless the damages can be quite high, and many homes are frequently condemned after experiencing a landslide. The values used in this loss estimation are a hypothetical estimate of all *potential* damage. Its purpose is to come up with a value that can be used to compare with other hazards, in order to prioritize and focus mitigation efforts.

Assumptions:

Damage to improvements of a parcel (that is, the building) is estimated to be 55%

Content loss is 10% of ½ of the improvement value. Landslides typically destroy the structural integrity of the building, leading to condemnation, but hardly ever destroy the contents (clothes, televisions etc.) or injure people

Loss estimate:

Estimated loss to landslide-prone structures is **$422,596,640**

Estimated loss to contents is **$2,054,240**

[47] U.S. Census Bureau, Census 2000

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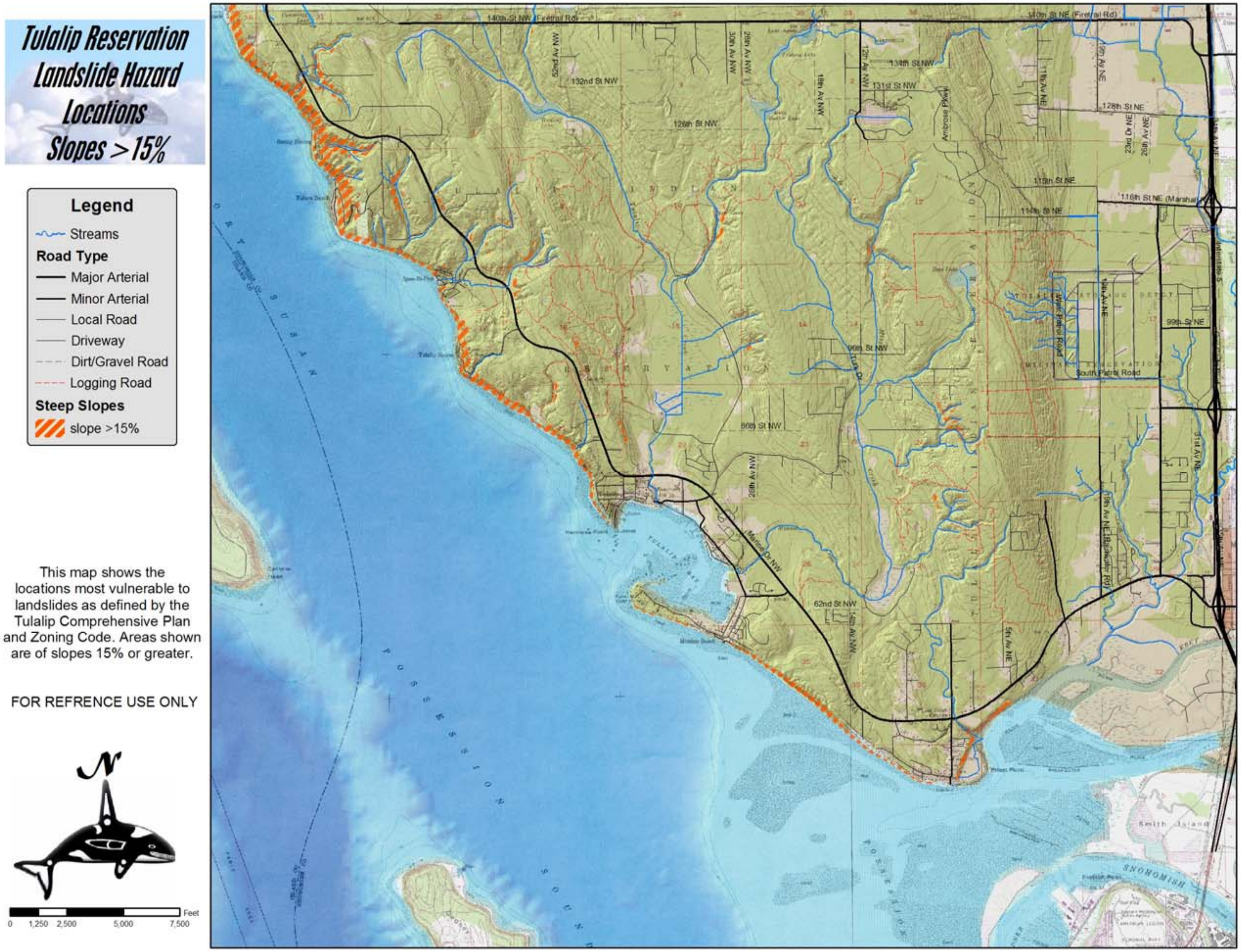
Figure 4-15: Landslide Hazard Location



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4.7. Severe Weather

Definitions

Blizzard: A storm with considerable falling and/or blowing snow combined with sustained winds or frequent gusts of 35 mph or greater that frequently reduces visibility to less than one-quarter mile. Blizzards typically are confined to the Columbia River Gorge and Northwest Washington near the Fraser River Valley of British Columbia.

Freezing Rain: This is the result of rain occurring when the temperature is below the freezing point. When this occurs the rain will freeze on impact and will result in a layer of glaze ice over everything it touches. Although the layer of glaze is generally quite thin it can measure up to one inch in depth. In a severe ice storm an evergreen tree measuring 20 meters high and 10 meters wide can be burdened with up to six tons of ice, creating a serious threat to power and telephone lines and transportation routes.

Severe Local Storms: These include what are termed “microscale” atmospheric systems: tornadoes, thunderstorms, windstorms, ice storms and snowstorms. Typically, major impacts from a severe storm are to transportation and loss of utilities. The major characteristic all of these events have in common is that their effects are usually limited in scope. Although one of these storms may cause a great deal of destruction and even death, its impact is generally confined to a small area.

Snowstorms: These are caused by a war between air of different temperatures and densities. This resultant low pressure system can cover thousands of square miles with snow. Snowstorms affecting Whitman County form along the mid-Pacific polar front and head south. Heavy snow in western Washington is generally confined to the mountains with heavy accumulation in the lowlands uncommon. Eastern Washington can expect snow during much of the winter.

Thunderstorms: This is the most common of severe weather systems. These are typically 25 kilometers in diameter and last 30 minutes from birth to growth through maturity to decay. Thunderstorms are underrated hazards. Lightning, which occurs with all thunderstorms, is a serious threat to human life nationwide. Heavy rains dumped in a small area over a very short time can lead to flash flooding. Strong winds, hail and tornadoes are also dangers associated with thunderstorms.

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

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

General Background

The location of the State of Washington on the windward coast in mid-latitudes is such that climatic elements combine to produce a predominantly marine-type climate west of the Cascade Mountains, while east of the Cascades; the climate possesses both continental and marine characteristics.

The state's climate is impacted by two significant factors:

- Mountain ranges: The Olympic Mountains and the Cascade Mountains affect rainfall. The first major release of rain occurs along the west slopes of the Olympics, and the second is along the west slopes of the Cascade Range. Additionally, the Cascades are a topographic and climatic barrier. Air warms and dries as it descends along the eastern slopes of the Cascades, resulting in near desert conditions in the lowest section of the Columbia Basin in eastern Washington. Another lifting of the air occurs as it flows eastward from the lowest elevations of the Columbia Basin toward the Rocky Mountains. This results in a gradual increase in precipitation in the higher elevations along the northern and eastern borders of the state.
- Location and intensity of semi-permanent high and low-pressure areas over the North Pacific Ocean: During the summer and fall, circulation of air around a high-pressure area over the North Pacific brings a prevailing westerly and northwesterly flow of comparatively dry, cool and stable air into the Pacific Northwest. As the air moves inland, it becomes warmer and drier, resulting in a dry season. In the winter and spring, the high pressure resides further south while low pressure prevails in the Northeast Pacific. Circulation of air around both pressure centers brings a prevailing southwesterly and westerly flow of mild, moist air into the Pacific Northwest. Condensation occurs as the air moves inland over the cooler land and rises along the windward slopes of the mountains. This results in a wet season beginning in late October or November, reaching a peak in winter, and gradually decreasing by late spring.

In interior valleys, measurable rainfall occurs on 150 days each year and on 190 days in the mountains and along the coast. Thunderstorms over the lower elevations occur up to 10 days each year and over the mountains up to 15 days.

During the wet season, rainfall is usually of light to moderate intensity and continuous over a period of time, rather than heavy downpours for brief periods; heavier intensities occur along the windward slopes of the mountains.

The strongest winds are generally from the south or southwest and occur during the fall and winter. In interior valleys, wind velocities reach 40 to 50 mph each winter, and 75 to 90 mph a few times every 50 years. The highest summer and lowest winter temperatures generally occur during periods of easterly winds.

The climate east of the Cascade Mountains has characteristics of both continental and marine climates. Summers are warmer, winters are colder, and precipitation is less than in western Washington. Extremes in both summer and winter temperatures generally occur when air from the continent influences the inland basin.

In the driest areas, rainfall occurs about 70 days each year in the lowland and about 120 days in the higher elevations near the eastern border and along the eastern slopes of the Cascades. Annual precipitation ranges from seven to nine inches near the confluence of the Snake and Columbia Rivers in the Tri-Cities area, 15 to 30 inches along the eastern border and 75 to 90 inches near the summit of the Cascade Mountains. During July and August, four to eight weeks can pass with only a few scattered showers. Thunderstorms, most as isolated cells, occur on one to three days each month from April through September. A few damaging hailstorms are reported each summer.

During the coldest months, freezing drizzle occasionally occurs, as does a Chinook wind that produces a rapid rise in temperature. Chinook (a Native American word meaning "snow-eater") winds are warm, moist wind patterns originating in the Pacific Ocean during the winter that cool, and then rapidly warm as they pass over the western and eastern slopes of the Cascades and Rockies. On the Columbia Plateau they can cause drastic and rapid increases in temperature, which can also cause rapid snow melt and contribute to flooding. Whitman County averages about 38 inches of snow every year.

During most of the year, the prevailing wind is from the southwest or west. The frequency of northeasterly winds is greatest in the fall and winter. Wind velocities ranging from four to 12 mph can be expected 60 to 70 percent of the time; 13 to 24 mph, 15 to 24 percent of the time; and 25 mph or higher, one to two percent of the time. The highest wind velocities are from the southwest or west and are frequently associated with rapidly moving weather systems. Extreme wind velocities can be expected to reach 50 mph at least once in two years; 60 to 70 mph once in 50 years; and 80 mph once in 100 years.

Hazard Profile

The Tulalip Reservation will typically experience the types of severe weather found in Puget Sound: heavy rains, windstorms, and occasionally snow and ice storms. A tornado may even be possible. The Reservation is also located at northern edge of the Puget Sound Convergence Zone. This Convergence Zone is the area where the jet stream converges again after splitting around the Olympic Mountains. When these streams converge, air rises, causing precipitation and high winds. This area is generally just north of Seattle and south of the northern border Reservation. This narrow area and areas east of it can experience even more extreme weather than found in areas just north and south of this zone.

Past Events

Probably because of their relatively small size and short life cycle, severe local storms have not been well documented in Snohomish County and the Tulalip Reservation. The following events stand out as examples that damaging natural events need not be countywide in scale:

Tornadoes:

- 1970 - Marysville

- 1971 - Lake Roesinger
- January 2, 1997 - Granite Falls
- June 8, 1997 – Darrington
- September 1, 1998 - Monroe
- May 31, 1997 – Lake Stevens
- July 6, 1997 – Snohomish
- December 8, 1997 – Snohomish
- April 22, 2000 – Stanwood

Windstorms:

- October 12, 1962 – The Columbus Day Wind Storm: The top weather event in Washington during the 20th Century, according to the National Weather Service, Seattle Forecast Office. This storm is the greatest windstorm to hit the Northwest since weather record keeping began in the 19th century, and is called the "mother of all wind storms". All windstorms in the Northwest are compared to this one. The Columbus Day Storm was the strongest widespread non-tropical windstorm to strike the continental U.S. during the 20th century, affecting an area from northern California to British Columbia. The storm claimed seven lives in Washington State; 46 died throughout the impacted region. One million homes lost power. More than 50,000 homes were damaged. Total property damage in the region was estimated at $235 million (1962 dollars). The storm blew down 15 billion board feet of timber worth $750 million (1962 dollars); this is more than three times the timber blown down by the May 1980 eruption of Mount St. Helens, and enough wood to replace every home in the state.
- November 1981 - Record high winds
- January 20, 1993 – The Inauguration Day Wind Storm: Federal Disaster #981. Stafford Act disaster assistance provided – $24.2 million. Hurricane force winds swept King, Lewis, Mason, Pierce, Snohomish, Thurston and Wahkiakum counties. This storm claimed five lives. More than 870,000 million homes and businesses lost power. Fifty-two single-family homes, mobile homes, and apartment units were destroyed, and 249 incurred major damage, many from falling trees and limbs. More than 580 businesses were damaged. Total damage in western Washington estimated at $130 million. Winds in Puget Sound area gusted to 70 mph. A gust at Cape Disappointment on the Washington Coast reached 98 mph. This storm caused two deaths. Damage estimated at $250 million. The Interstate 90 – Lake Washington floating bridge between Seattle and Mercer Island sank during this storm event.
- December 1995 - California Express Windstorm

- January – March 1999 – La Niña Winter Windstorms

Snowstorms:

- January 13, 1950 – The January 1950 Blizzard: One of the top 10 weather events in Washington during the 20th Century, according to the National Weather Service, Seattle Forecast Office. On this date, 21.4 inches of snow fell in Seattle, the second greatest 24-hour snowfall recorded. The snowfall was accompanied by 25-40 mph winds. The storm claimed 13 lives in the Puget Sound area. January had 18 days with high temperatures of 32 degrees or lower. The winter of 1949-50 was the coldest winter on record in Seattle, with an average temperature of 34.4 degrees.
- November 1961
- January 1969
- January 1971
- January 1980
- December 1990 – Severe Storm: Federal Disaster #896. Stafford Act disaster assistance provided – $5.1 million. Floods, snow, and high winds affected the counties of Island, Jefferson, King, Kitsap, Lewis, Pierce, San Juan, Skagit, Snohomish, and Whatcom.
- January 1991
- December 1996-January 1997 "Holiday Blast" Storm: Federal Disaster #1159. Stafford Act disaster assistance provided – $83 million. Small Business Administration loans approved – $31.7 million. Saturated ground combined with snow, freezing rain, rain and rapid warming and high winds within a five-day period produced flooding and landslides. Impacted counties – Adams, Asotin, Benton, Chelan, Clallam, Clark, Columbia, Cowlitz, Douglas, Ferry, Franklin, Garfield, Grant, Grays Harbor, Island, Jefferson, King, Kitsap, Kittitas, Klickitat, Lewis, Lincoln, Mason, Okanogan, Pacific, Pend Oreille, Pierce, San Juan, Skagit, Skamania, Snohomish, Spokane, Stevens, Thurston, Walla Walla, Whatcom, and Yakima. Twenty-four deaths; $140 million (est.) in insured losses; 250,000 people lost power.
- Winter 2000: In addition to the events reported above, Tulalip officials also report that the Reservation experienced a serious snow/ice storm in 2000. This storm knocked down numerous power lines and left black ice on many of the roads, especially the hilly ones. It was reported that as many as 100 car accidents occurred due to the icy conditions this storm brought.

Severe Flooding

- For past events of flooding refer to Section 3.8.

Location

Severe weather can affect whole regions; thus the whole of the Tulalip Reservation can experience severe weather. A single storm may affect a vast area of land and all of the population within it. Because storms often significantly affect utility and transportation systems, power and telephone outages are a frequent result of storms and ingress and egress may be limited. Consequently, the more isolated areas of the Reservation may experience greater effects from storms. Severe local storms significantly impact driving conditions on roads, and downed power lines can cause isolation. They can also hinder police, fire, and medical responses to urgent calls.

Frequency

History shows Snohomish County and the Tulalip Reservation will encounter an average of one major snowstorm every ten years. The frequency of a major snowstorm is variable and is not predictable on a seasonal basis. 1996 was the most recent major snowstorm. Ice storms also occur infrequently, but probably have a higher degree of probability. Windstorms also occur infrequently, but can usually be predicted more accurately than other local storms. The Tulalip Reservation can expect to experience at least one windstorm each year. A windstorm during January of 1993 resulted in a Presidential Disaster Declaration and disaster assistance of approximately four million dollars for public agencies in Snohomish County.

The National Climatic Data Center has collected information about past severe weather events in Snohomish County since 1950. There have been a total of 31 events recorded.

The probability of severe weather occurring on the Tulalip Reservation is very likely during any season depending on localized pressure differences and larger air mass movements aloft. Table 4-12 shows frequency of severe storms for Snohomish County.

Table 4-12: Frequency of Severe Storms

Snohomish County Frequency of Severe Storms	
Type	Recurrence/Year (>100% - At least 1 occurrence per year)
High Winds	175%
Winter Storms	57.5%
Tornado	10%
Coastal Flooding	7.5%

Severity

The effects upon Tulalip Reservation of a strong thunderstorm, tornado, windstorm or ice storm are likely to be similar: fallen trees, downed power lines and interruption of transportation lifelines, damaged homes and public buildings. Fatalities are uncommon in western Washington, but they can occur.

A tornado is the smallest and potentially most dangerous of local storms. A tornado is formed by the turbulent mixing of layers of air with contrasting temperature, moisture, density and wind flow. This mixing accounts for most of the tornadoes occurring in April, May and June, when cold, dry air moving into the Puget Sound region from the north or northwest meets warm, moister air moving up from the south. If a major tornado struck a populated area in Snohomish County, damage could be widespread. Businesses could be forced to close for an extended period or permanently, fatalities could be high, many people could be homeless for an extended period, and routine services such as telephone or power could be disrupted. In the case of extremely high winds some buildings may be damaged or destroyed. Due to the (often) short warning period, livestock are commonly the victims of a tornado or windstorm.

The effects of an ice storm or snowstorm are downed power lines and trees and a large increase in traffic accidents. These storms can cause death by exposure, heart failure due to shoveling or other strenuous activity, traffic accidents (over 85% of ice storm deaths are caused by traffic accidents), and carbon monoxide poisoning. These storms also have the potential to cause large losses among livestock. Livestock losses are caused primarily by dehydration rather than cold or suffocation.

Although windstorms are not a frequent problem on the Tulalip Reservation, they have been known to cause substantial damage. The predicted wind speed given in wind warnings issued by the National Weather Service is for a one minute average; gusts may be 25% - 30% higher. Under most conditions the county's highest winds come from the southwest, although they have been known to blow from the south or east. The highest recorded wind gust in the Everett area was more than 81 miles per hour.

The most common problems associated with severe storms are immobility and loss of utilities. Roads may become impassable due to ice, snow, or from a secondary hazard such as a landslide. Power lines may be downed due to high winds and other services, such as water or phone, may not be able to operate without power. Strong winds have been recorded at 77 knots in King County. Sea-Tac International Airport reported 5.02 inches of rain in a 24- hour period. This caused flooding problems for several homes as well as the closure of some sections of road. Lightning can cause severe damage and can be deadly. Two major concerns for snowfall are dangerous roadway conditions and collapse of structures due to heavy snow load on roofs. In addition, ice can create dangerous situations on the roadways as well as freeze pipes.

Warning Time

A meteorologist can often predict the likelihood of an onset of a severe storm. This can give several days of warning time, however, meteorologists cannot predict the exact time of onset or the severity of the storm. Some storms may come on more quickly and have only a few hours of warning time.

Secondary Hazards

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

Exposure Inventory

All people, property and infrastructure are potentially exposed to severe weather. For this exposure and loss estimation, 2003 Snohomish County Assessor's data is used to determine exposure inventory.

As mentioned, all property is exposed to severe weather. For the whole Reservation:

- There are **4845** parcels in total that are exposed to earthquakes
- The total assessed market value of these parcels is **$693,397,750**
- The total market land value is **$409,465,400**
- The total market improvement value is **$283,932,350**

Vulnerability

Marine Drive is most vulnerable to severe weather. It is that main road on the Reservation and critical for emergency responders to use. It is also prone to downed trees and black ice, which cause numerous accidents.

Also vulnerable are the many homes located on narrow, dirt paved and usually one-laned roads, some of which pass through steep slopes known to experience landslides or wash-outs. This isolation can prevent ingress or egress, and may prevent emergency responders to access some homes.

Loss Estimation

Currently there are no standards in place to estimate losses from severe weather. Severe weather has the potential to affect all people, property and infrastructure, but in most cases, it is infrastructure, such as power lines, that suffer the most damage from severe weather, such as high winds and ice. The values used in this loss estimation are a hypothetical estimate of all *potential* damage. Its purpose is to come up with a value that can be used to compare with other hazards, in order to prioritize and focus mitigation efforts.

Assumptions:

Damage to improvements of a parcel (that is, the building) is estimated to be 5%

Content loss is 10% of ½ of the improvement value. Loss estimate:

Estimated loss to landslide-prone structures is **$14,196,618**

Estimated loss to contents is **$7,098,309**

4.8. Tsunami/Seiche

Definitions

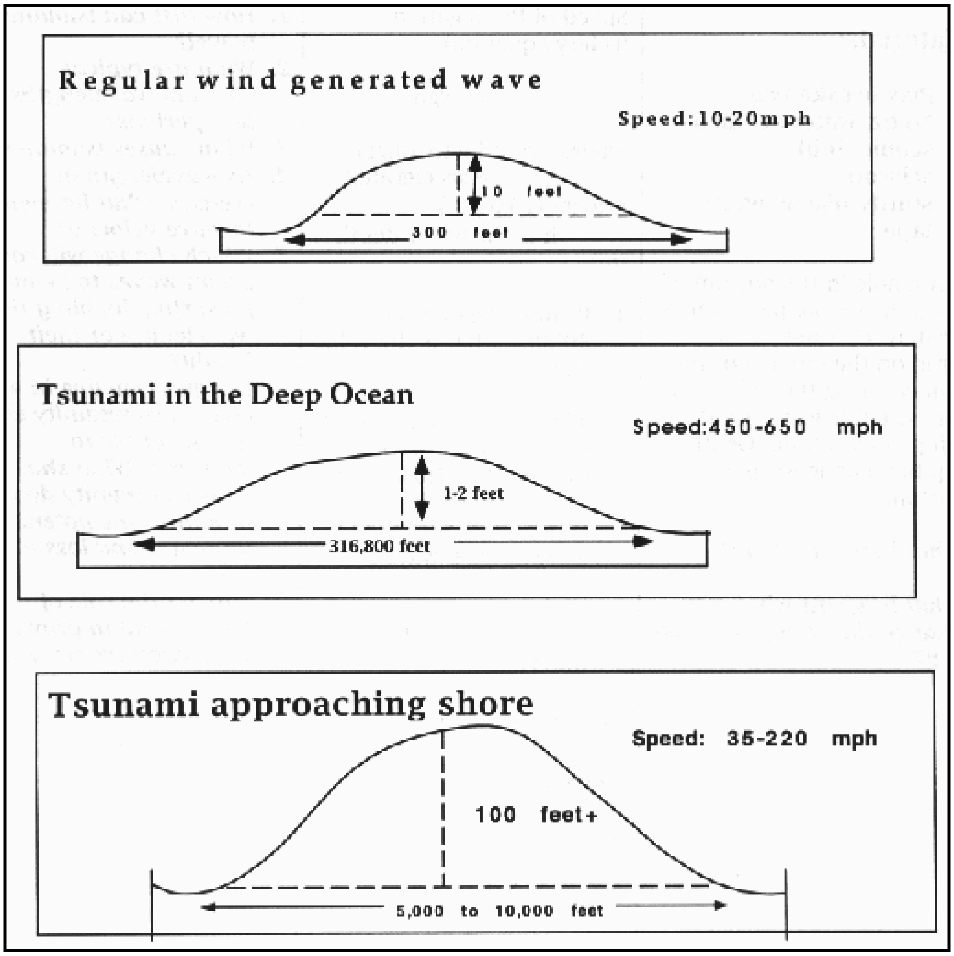
Seiche: A seiche is a standing wave in an enclosed or partly enclosed body of water and normally caused by earthquake activity and can affect harbors, bays, lakes, rivers and canals. These events usually don't occur in proximity to the epicenter of a quake, but possibly hundreds of miles away due to the fact that the shock waves a distance away is of a lower frequency.

Tsunami: Tsunamis are sea waves usually caused by displacement of the ocean floor and are typically generated by seismic or volcanic activity or by underwater landslides. They are a series of traveling ocean waves of extremely long wavelength and are generally associated with earthquakes.

General Background

A tsunami consists of a series of high-energy waves that radiate outward like pond ripples from the area in which the generating event occurred. The sequence of tsunami waves arrives at the shore over an extended period. The first wave will be followed by others a few minutes or a few hours later with the following waves generally increasing in size over time. Tsunamis are commonly 60 or more miles from crest to crest and travel at remarkable speeds, often more than 600 miles per hour in the open ocean. Figure 4-16 shows the size and speed of tsunamis. They can traverse the entire Pacific Ocean in 20 to 25 hours. These are extremely destructive to life and property. The tsunami caused by the 1883 eruption of Krakatau, in Indonesia, caused more than 30,000 fatalities, and the 1886 tsunami on the Sunriku coast of Japan killed about 26,000 people.

Figure 4-16: Size and Speed of Tsunami Waves



Hazard Profile

Past Events

Within Puget Sound, no written records exist of damaging waves. However, verbal accounts among the Snohomish Tribe reported by Colin Tweddell in 1953 describe a great landslide induced wave caused by the collapse of Camano Head at the south end of Camano Island around the 1820's-1830's. The slide itself is said to have buried a small village, and the resulting tsunami drowned "…men and women, and some of the children…" who may have been clamming on Hat (Gedney) Island, two miles to the south. Bathymetry between Camano Head and Hat Island could have contributed to the size and destructive power of the wave.[48] The Tulalip Tribes consider this event a very tragic moment in their history and accordingly consider tsunami a major hazard.

Geologic evidence of tsunamis has been found at Cultus Bay on Whidbey Island and at West Point in Seattle. There was also a past event on Possession Beach on Whidbey Island that caused sloughing and a tsunami. Researchers believe these tsunami deposits

[48] Harold Mofjeld, 2001

are evidence of earthquake activity along the Seattle Fault or other shallow crustal Puget Sound faults.

Puget Sound has experienced seiches in historical times. In 1891, an earthquake near Port Angeles caused an eight-foot seiche in Lake Washington. Seiches generated by the 1949 Queen Charlotte Islands earthquake were reported on Lake Union and Lake Washington. The 1964 Alaska earthquake created seiches on 14 inland bodies of water in Washington, including Lake Union where several pleasure craft, houseboats and floats sustained minor damage.

Location

Tsunamis affecting Washington State may be induced by geologic events of local origin, or earthquakes at a considerable distance may cause them, such as from Alaska or South America. Typical signs of a tsunami hazard are earthquakes and/or sudden and unexpected rise or fall in coastal water. Coastal flooding and a quick recession of the water often precede the large waves. Tsunamis are difficult to detect in the open ocean with waves less than a 3 feet high. The tsunami's size and speed, as well as the coastal area's form and depth are factors that affect the impact of a tsunami.

For the Tulalip Reservation, a tsunami is most likely to be caused by a local earthquake or by a landslide, either along the bluffs, or below the water surface. A Seventy-foot tsunami was used as the worst-case event that could affect the Tulalip Reservation. This was for the worst-case scenario event, such as a magnitude 9.1 Whidbey earthquake or a very large landslide. In most cases though, a tsunami or seiche would be between 3-10 feet in height. This tsunami would affect low lying areas and communities on the Reservation, such as the Quil Ceda Creek basin, Priest Point, Mission Beach, Tulalip Bay, Tulalip Shores, Spee-Bi-Dah, Tulare Beach, and Sunny Shores. The heaviest damage would be seen in those areas directly across open water, such as Mission Beach. During an earthquake, seiches could also occur in the Reservation's lakes and ponds.

Frequency

Great earthquakes in the North Pacific or along the Pacific coast of South America that generate tsunamis that sweep through the entire Pacific basin occur at a rate of about six every 100 years. Local earthquakes and landslides that generate tsunamis occur more frequently, although a specific rate of occurrence has not been calculated by scientists.

Severity

Tsunamis are a threat to life and property to anyone living near the ocean. From 1895 to 1995, 454 tsunamis were recorded in the Pacific Basin. Ninety-four of these tsunamis killed over 51,000 coastal residents during the past century. Recent tsunamis have struck Nicaragua, Indonesia, and Japan, killing several thousand people. Property damage due to these waves was nearly one billion dollars. Historically, tsunamis originating in the northern Pacific and along the west coast of South America have caused more damage on the west coast of the United States than tsunamis originating in Japan and the Southwest Pacific. For example, the 1960 Chile Earthquake generated a Pacific-wide tsunami that caused widespread death and destruction in Chile, Hawaii, Japan and other areas in the Pacific. In contrast, the tsunami generated by the 1883 eruption of Krakatau Volcano in

Indonesia caused more than 30,000 fatalities and the 1886 tsunami on the Sunriku coast of Japan killed about 26,000 people, but neither of these events were destructive outside their immediate locales.

Closer to the Northwest, a tsunami hit the Washington coast after the great 1964 Alaska earthquake; in places wave heights reached 15 feet. No deaths were reported in Washington but it caused $115,000 in damage. This same tsunami killed 11 people and caused $7.4 million damage in Crescent Tulalip Tribes, California. Scientific studies indicate that local tsunamis generated off the northern California, Oregon and Washington coast could reach Washington shores within 3 to 30 minutes after the earthquake is felt.

Landslide induced tsunamis could cause destruction and injuries due to lack of warning time. A tsunami or seiche generated by a landslide in Puget Sound could reach the shore in seconds. A similar type of tsunami was responsible for the major loss of life experienced from the Camano Head landslide.

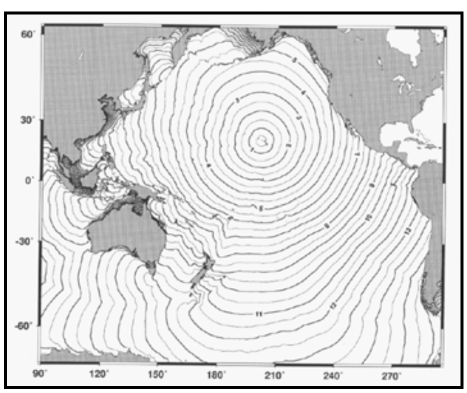
Warning Time

Typical signs of a tsunami hazard are earthquakes and/or a sudden and unexpected rise or fall in coastal water. The large waves are often preceded by coastal flooding and followed by a quick recession of the water. Tsunamis are difficult to detect in the open ocean, with waves only one or two feet high. The tsunami's size and speed, as well as the coastal area's form and depth are factors that affect the impact of a tsunami; wave heights of fifty feet are not uncommon. In general, scientists believe it requires an earthquake of at least a magnitude 7 to produce a tsunami. See Figure 4-17 for estimated arrival times for a Pacific based tsunami.

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

A tsunami or seiche generated in Puget Sound may only have minutes to seconds to evacuate.

Figure 4-17: Image Showing Arrival Times of Pacific Based Tsunami



Secondary Hazards

Aside from the tremendous hydraulic force of the tsunami waves themselves, floating debris carried by a tsunami can endanger human lives and batter inland structures. 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. Railroad yards and oil tanks situated near the waterfront are particularly vulnerable. Oil fires frequently result and are spread by the waves.

Port facilities, naval facilities, fishing fleets, and public utilities are frequently the backbone of the economy of the affected areas, and these are the very resources that generally receive the most severe damage. Until debris can be cleared, wharves and piers rebuilt, utilities restored, and the fishing fleets reconstituted, communities may find themselves without fuel, food, and employment. Wherever water transport is a vital means of supply, disruption of coastal systems caused by tsunamis can have far-reaching economic effects.

Seiches create a “sloshing” effect on bodies of water and liquids in containers. This primary effect can cause damage to moored boats, piers and facilities close to the water. Secondary problems, including landslides and floods, are related to accelerated water movements and elevated water levels. Damage to the Tulalip Bay Marina could have a serious effect on the Tulalip Tribe’s economy.

Exposure Inventory

An inventory was taken of all structures, population and critical and essential tribal facilities that are potentially exposed to the effects of a tsunami. Although past events indicate that a tsunami or seiche typically reach maximum heights of 10 feet, a 70 foot inundation zone was shown as a worst case scenario. Even if a tsunami or seiche does not reach this elevation, this area stills serve as a critical location for evacuation and other planning purposes. Findings include:

- There are **2296** parcels exposed to tsunami/seiche, about **47%** of all parcels located on the Reservation
- These parcels have a total market value (land + improvements) of **$359,590,250**
    - These parcels account for **52%** of all the value of the Tulalip Reservation’s parcels
- Total market land value of parcels is **$227,226,900**
- These landslide-prone parcels make up **55%** of the market land value of all parcels on the Reservation
- Total market improvement value is **$132,363,350**
- These landslide-prone parcels make up **47%** of the market improvement value of all parcels on the Reservation

Major Roads, such as Marine Drive and Interstate 5 (I-5) could be affected.

All critical and essential facilities listed above would be affected.

Table 4-13 shows the land use of parcels exposed to a tsunami/seiche. Most property affected would be residential buildings and undeveloped parcels.

Table 4-13: Parcels Exposed to Tsunamis/Seiches

Tulalip Reservation Parcels Exposed to Tsunami/Seiche	
Land Use Code and Description	Number of Parcels
111 Single Family Residence - Detached	1403
112 Common Wall Single Family Residence	4
113 Manufactured Home (Leased Site)	48
114 Manufactured Home (Owned Site)	78
115 Manufactured Home (Mobile Home Park)	29
122 Three Family Residence (Tri Plex)	1
150 Mobile Home Park 1 - 99 Units	1
160 Hotel / Motel 1 - 99 Units	2
182 Houseboat	1
183 Non Residential Structure	49
184 Septic System	1
186 Septic & Well	1
198 Vacation Cabins	4
241 Logging Camps & Logging Contractors	2
343 Electrical Machinery, Equipment & Supplies	1
344 Transportation Equipment	1
349 Other Fabricated Metal Products NEC	1
351 Engineering, Lab & Scientific Research I	10
451 Freeways	2
459 Other Highway & Street Right-of-Way NEC	2
481 Electric Utility	1
484 Sewage Disposal	1
511 Motor Vehicles & Automotive Equipment	1
519 Other Wholesale Trade, NEC	1
539 Other Retail Trade NEC	2
551 Motor Vehicles	1
553 Gasoline Service Stations	2
581 Eating Places (Restaurants)	3
582 Drinking Places (Alcoholic Beverages)	1
639 Other Business Services NEC	1
641 Automobile Repair & Services	1
662 Special Construction Trade Services	1
681 Nursery, Primary & Secondary School	2
691 Religious Activities (Churches Synagogue	1
711 Cultural Activities (Inc. Libraries)	2
818 Farms - General (No Predominant Activity	1
830 Open Space Agriculture RCW 84.34	8
880 DF Timber Acres Only RCW 84.33	2
910 Undeveloped (Vacant) Land	516

Tulalip Reservation Parcels Exposed to Tsunami/Seiche	
915 Common Areas	7
939 Other Water Areas, NEC	11
940 Open Space General RCW 84.34	1
No Data	88
Grand Total	**2208**

Population

Population exposed to tsunami/seiche was estimated by multiplying the number of residential parcels found in Table 4-13 (1,567 parcels) by the average household size on the Tulalip reservation, which is 2.79.[49]

The estimated population exposed to tsunami/seiche is **4,372**

This amounts to about **47%** of the population living on the Tulalip Reservation exposed to tsunami/seiche

Vulnerability

The main vulnerability to tsunamis are areas, structures and people who live or work along low-lying areas along the coast. These include properties along Priest Point, Mission Beach, Tulalip Bay, Tulalip Shores, Spi-Bee-Dah, Tulare Beach, and Sunny Shores.

Many of the Tulalip Tribe's critical facilities, such as the health clinic, marina, tribal center and elder housing are located along Tulalip Bay, and are extremely vulnerable. Structures located along the I-5 corridor and Quil Ceda Creek basin may experience some flooding, but are less vulnerable.

Loss Estimation

Currently there are no standards in place to estimate losses from tsunamis. For this estimate, structures and people exposed were used. The values used in this loss estimation are a hypothetical estimate of all *potential* damage. Its purpose is to come up with a value that can be used to compare with other hazards, in order to prioritize and focus mitigation efforts.

Assumptions:

Damage to improvements of a parcel (that is, the building) is estimated to be 50%

Content loss is 50% of ½ of the improvement value.

Loss estimate:

Estimated loss to landslide-prone structures is **$66,181,675**

Estimated loss to contents is **$33,090,837**

[49] U.S. Census Bureau, Census 2000

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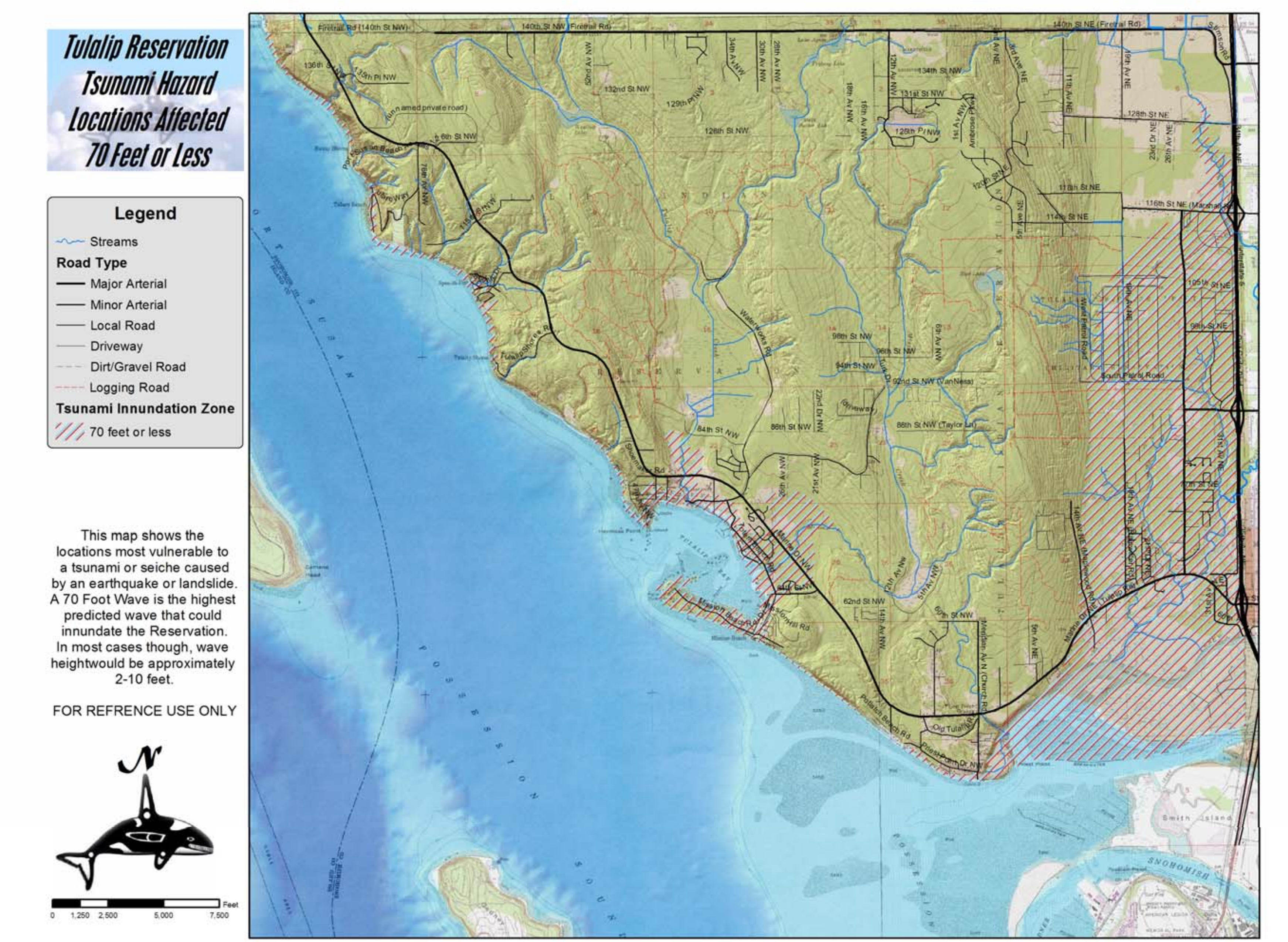
Table 4-14: Areas Potentially affected by a Tsunami



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4.9. Wildland Fire

Definitions

Forest Fire: Forest fires are the uncontrolled destruction of forested lands caused by natural or human-initiated events. Wildfires occur primarily in undeveloped areas; these natural lands contain dense vegetation such as forest, grasslands or agricultural croplands. Because of their distance from firefighting resources and manpower, these fires can be difficult to contain and can cause a great deal of destruction.

Conflagration: A conflagration is a fire, which grows beyond its original source area to engulf adjoining regions. Wind, extremely dry or hazardous weather conditions, excessive fuel buildup and explosions are usually the elements behind a wildfire conflagration.

Firestorm: This term describes a fire that expands to cover a large area, often more than a square mile. A firestorm usually occurs when many individual fires grow together to make one huge conflagration. The involved area becomes so hot that all combustible materials ignite, even if they are not exposed to direct flame. Temperatures may exceed 1000° Celsius as the fire creates its own local weather: superheated air and hot gases of combustion rise upward over the fire zone, drawing surface winds in from all sides, often at velocities approaching fifty miles per hour. Although firestorms seldom spread because of the inward direction of the winds, once started there is no known way of stopping them. Within the area of the fire, lethal concentrations of carbon monoxide are present; combined with the intense heat this hazard poses a serious life threat to responding fire forces. In exceptionally large events, the rising column of heated air and combustion gases carries enough soot and particulate matter into the upper atmosphere to cause cloud nucleation, creating a locally intense thunderstorm and the hazard of lightning strikes.

Interface Area: An area susceptible to wildland or forest fires because wildland vegetation and urban or suburban development occur together. An example would be the smaller urban areas and dispersed rural housing in the forested area of Snohomish County. Whenever the majority of a parcel lies within the established wildland urban interface/interface area, the entire parcel shall be included in the area.

General Background

Wildland fires are fires caused by nature or humans that result in the uncontrolled destruction of forests, brush, field crops, grasslands, and real and personal property in non-urban areas.

The wildland fire season in Washington usually begins in early July and typically culminates in late September with a moisture event; however, wildland fires have occurred in every month of the year. Drought, depth of snow pack, and local weather conditions can expand the length of the fire season. The early and late shoulders of the fire season usually are associated with human-caused fires, with the peak period of July, August and early September related to thunderstorms and lightning strikes.

Short-term loss caused by a wildland fire can include the destruction of timber, wildlife habitat, scenic vistas, and watersheds; vulnerability to flooding increases due to the destruction of watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and destruction of cultural and economic resources and community infrastructure.

The Washington Department of Natural Resources protects 2.5 million acres of state-owned land and 10 million acres of land in private ownership through legislative directive (Revised Code of Washington 76.04).

People start most wildland fires; major causes include arson, recreational fires that get out of control, smoker's carelessness, debris burning, and children playing with fire. From 1992 to 2001, on average, people caused more than 500 wildland fires each year on state-owned or protected lands; this compares to 135 fires caused by lightning strikes. wildland fires started by lightning burn more state-protected acreage than any other cause, an average of 10,866 acres annually; human caused fires burn an average of 4,404 state-protected acres each year.

Wildland fires usually are extinguished while less than one acre; they can spread to more than 100,000 acres and may require thousands of firefighters and several months to extinguish. A number of federal, state, county, city, and private agencies and private timber companies provide fire protection and firefighting services in Washington.

Factors that Influence Wildland Fire

A fire needs three elements in the right combination to start and grow – a heat source, fuel, and oxygen. How a fire behaves primarily depends on the characteristics of available fuel, weather conditions, and terrain.

Fuel:

Lighter fuels such as grasses, leaves, and needles quickly expel moisture and burn rapidly, while heavier fuels such as tree branches, logs and trunks take longer to warm and ignite.

Snags and hazard trees – those that are diseased, dying, or dead – are larger west of the Cascades, but more prolific east of the Cascades. In 2002, about 1.8 million acres of the state's 21 million acres of forestland contained trees killed or defoliated by forest insects and diseases.

Weather:

West of the Cascades, strong, dry east winds in late summer and early fall produce extreme fire conditions. East wind events can persist up to 48 hours with wind speed reaching 60 miles per hour; these winds generally reach peak velocities during the night and early morning hours. These strong winds can be even stronger in the convergence one, where the Tulalip Reservation is located.

Terrain:

Topography of a region or a local area influences the amount and moisture of fuel; the impact of weather conditions such as temperature and wind speed and direction; any potential barriers to fire spread, such as highways and lakes; and elevation and slope of land forms (i.e., fire spreads more easily as it moves uphill than downhill).

Peak burning period of a fire generally is between 1 p.m. and 6 p.m., with local factors (generally described above) greatly influencing this. Wildland fires can take on a life of their own when there is plenty of heat and fuel. They can create their own winds and weather, generating hurricane force winds of up to 120 miles per hour. Fires also can heat fuels in their path, making fuels easier to ignite and burn.

Fire Seasons:

Western Washington's fire season typically is shorter than Eastern Washington's for a number of reasons:

The western half of the state receives more rainfall. The Cascade Range tends to squeeze most of the rain from weather systems before they pass into the eastern half of the state.

The west has spring seasons that are wetter and cooler than the east. Much of the precipitation received in the east is snow that falls during winter months. Heavier snow packs keep fuels moist longer, while lighter snow packs allow fuels to dry out earlier in the year.

Hazard Profile

Past Events

Since 1970, the earliest year for which Department of Natural Resource (DNR) records are available, there have been 37 wildfires recorded on the Tulalip Reservation. These fires were all small, and it is not known at this time whether these fires caused any damage to property or infrastructure. Detailed information on fires on the Reservation before 1970 is not available at this time. The reservation first began to be heavily logged in the 1850's, and Tulalip Bay was home to several sawmills. Heavy unmanaged logging led to conditions where wildfires were extremely common, especially after the turn of the 20th century. The Reservation was clear-cut by the Bureau of Indian Affairs in many locations, with debris left over that could easily catch, especially during the dry, warm summer months. Firetrail Road owes it name and creation to this period of wildfires, as well as the numerous fire roads found on the Reservation.

Location

Using the map of past events as an indicator, most wildfires could occur in the heavily forested areas and undeveloped lands near the bluffs in the northwest part of the Reservation. Many wildfires also have occurred in the undeveloped and heavily forested lands of the interior, particular in the hilly areas east of Marine Drive. See Figure 4-18.

Frequency

Past events indicate that the Tulalip Reservation can expect at least one wildfire every year. These will small in size, and most likely will cause no or minor damage. Nonetheless the potential does exist for significant damage to structures and natural resources, such as timber, located in areas more susceptible fires, such as undeveloped timberlands and steep slopes.

Severity

As mentioned above, past events indicate that wildfires would not be severe on the Tulalip Reservation. The Reservation is small in size, and thus a fire can be identified quickly. Secondly, the Reservation receives a large amount of rainfall, reducing the risk to dryness, which is an essential contribution of fires. In a worst-case scenario, a wildfire spread by heavy winds may damage residential structures and developments, particularly those located in the dense, heavily forested areas of the interior.

Warning Time

After a wildfire is detected, it would only take minutes to at worst, hours to respond to a fire. Unless accompanied by very heavy winds, perhaps contributed by the weather conditions created in the Convergence Zone, sufficient time should be available to protect property and/or evacuate.

Secondary Hazards

Wildland fires can generate a range of secondary effects, which in some cases may cause more widespread and prolonged damage than the fire itself. Fires can cause direct economic losses in the reduction of harvestable timber. Wildland fires destroy transmission lines and contribute to flooding. Landslides can be a significant secondary hazard of wildfires. Wildfires strip slopes of vegetation, exposing them to greater amounts of rain and run-off. This in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildfire.

In addition to landslides, the following secondary effects are possible. Rehabilitation efforts after a fire occurs can reduce but cannot eliminate them:

Damaged Fisheries: Critical trout fisheries throughout the west and salmon and steelhead fisheries in the Pacific Northwest can suffer from increased water temperatures, sedimentation, and changes in water quality and chemistry.

Soil Erosion: The protective covering provided by foliage and dead organic matter is removed, leaving the soil fully exposed to wind and water erosion. Accelerated soil erosion occurs, causing landslides and threatening aquatic habitats.

Spread of Invasive Plant Species: Non-native woody plant species frequently invade burned areas. When weeds become established, they can dominate the plant cover over broad landscapes, and become difficult and costly to control.

Disease and Insect Infestations: Unless diseased or insect-infested trees are swiftly removed, infestations and disease can spread to healthy forests and private lands. Timely active management actions are needed to remove diseased or infested trees.

Destroyed Endangered Species Habitat: Catastrophic fires can have devastating consequences for endangered species. For instance, the Biscuit Fire in Oregon has destroyed 125,000 to 150,000 acres of spotted owl habitat.

Soil Sterilization: Topsoil exposed to extreme heat can become water repellant, and soil nutrients may be lost. It can take decades or even centuries for ecosystems to recover from a fire. Some fires burn so hot that they can sterilize the soil.

Exposure Inventory

Without a detailed analysis of forest conditions and structures located on the Reservation, it is difficult to determine how much of the Tulalip Reservation's inventory is exposed to wildfires. Past events have shown that most fires occur in uninhabited areas. Furthermore, many of the lands where these wildfires occurred are Tribal Trust lands, and are used primarily for forestry or are maintained as Conservation lands. In order to come up with a general inventory to be used for planning purposes and the Loss Estimation, parcels were inventoried that had a past wildfire occurrence. Furthermore, parcels within a 500 foot buffer from the location of a past event were also selected. This should serve as a general indicator of the inventory exposed to wildfires Reservation-wide.

- There are **198** parcels exposed to wildfires, about **5%** of all parcels located on the Reservation
- These parcels have a total market value (land + improvements) of **$53,805,600**
  - These parcels account for **8%** of all the value of the Tulalip Reservation's parcels
- Total market land value of parcels is **$35,491,100**
- These parcels make up **9%** of the market land value of all parcels on the Reservation
- Total market improvement value is **$18,156,500**
- These parcels make up **6%** of the market improvement value of all parcels on the Reservation

Table 4-15 show the land use of parcels identified as exposed for the Exposure Inventory. Most parcels are single family and other housing. These include newer higher density developments within the interior of the Reservation. The other major land uses include forest land, open spaces and undeveloped/vacant land.

Table 4-15: Parcels Exposed to Wildfires

Tulalip Reservation of Wildfire-prone Parcels	
Land Use Code and Description	Number of Parcels
111 Single Family Residence - Detached	80
113 Manufactured Home (Leased Site)	6
114 Manufactured Home (Owned Site)	24
122 Three Family Residence (Tri Plex)	1
183 Non Residential Structure	6
184 Septic System	1
351 Engineering, Lab & Scientific Research I	1
749 Other Recreation NEC	2
880 DF Timber Acres Only RCW 84.33	4
881 DF Timber Acres / Imp/Unimp Ac With Bldg	1

Tulalip Reservation of Wildfire-prone Parcels	
889 DF Timber Acres / Imp/Unimp Ac No Bldg	1
910 Undeveloped (Vacant) Land	62
915 Common Areas	1
950 Open Space Timber RCW 84.34	4
No data	4
Grand Total	198

Population

Population exposed to wildfire was estimated by multiplying the number of residential parcels found in Table 4-15 (111 parcels) by the average household size on the Tulalip Reservation, which is 2.79.

- The estimated population exposed to wildfires is 310 persons
- About 3% of the Tulalip Reservation's population is exposed to wildfires

Vulnerability

The potential for large forest fires on the Tulalip Reservation is normally small. Improved fire spotting techniques, better equipment, and trained personnel are major factors, as are the Reservation's wet climate and normally low fire fuel conditions.

Nonetheless isolated homes and developments located in heavily forested and undeveloped areas, as well as the infrastructure to support them, are vulnerable. Homes that do no have adequate buffers around their property separating structures from the forest are also vulnerable.

Loss Estimation

Wildfire loss estimates were based largely on the effects past wildfire events have had in the Puget Sound area. FEMA has developed a detailed methodology to estimate potential losses, but that is not presently available with the resources used to prepare this Hazard Mitigation Plan. Rather an estimate was based on projected damages that do not represent the total estimated value a wildfire may cost, but rather a hypothetical estimate of all *potential* damage. Its purpose is to come up with a value that can be used to compare with other hazards in order to prioritize and focus mitigation efforts.

Assumptions:

Wildfires will cause 10% damage to improvements, and 5% damage to contents (which is estimated as ½ of improvement value)

Wildfires will cause 10% damage to land

Loss estimate:

Estimated losses to structures is **$1,815,650**

Estimated losses to contents is **$453,913**

Estimated loss to land is **$3,549,110**

Figure 4-18: Location of Wildfires 1970-2001

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5. Hazard Risk Rating

A risk rating has been completed for each of the major hazards described in this plan, and was based on the exposure inventory and loss estimation. For the purposes of this plan, the risk rating is a function of two factors. The first factor describes the probability that a hazard event will occur. The second factor describes the impact of the event. This is typically considered both in number of people affected and amount of dollar loss caused by the hazard event.

As mentioned in Section 3, Tribal officials and community members were asked to fill out a hazard risk ranking sheet, so that they could offer insight into what they perceive as the natural hazards the Tulalip Reservation are most vulnerable to. This is shown in Section 5.4.

5.1. Probability of Occurrence

The probability of occurrence of a hazard event provides an estimation of how often the event occurs. This is generally based on the past hazard events that have occurred in the area and the forecast of the event occurring in the future. This is done by assigning a probability factor, which is based on yearly values of occurrence. The numerical value assigned to each category will be used to determine the risk rating of each hazard (See Table 5-1). These are allotted as follows:

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

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

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

Table 5-1: Probability of Hazards

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

5.2. Impact

The impact of each hazard was divided into two categories, impact to people and impact in dollar loss (See Table 5-2 and Table 5-3). These two categories were also assigned weighted values. Impact to people was given a weighted factor of 3 and impact of dollar losses was given a weighted factor of 2. For impact to people the categories were broken down as follows:

High - Hazard event seriously affects **greater than 1000 people** (Numerical value **3**)

Medium – Hazard event seriously affects **260-1000 people** (Numerical value **2**)

Low – Hazard event seriously affects **0-250 people** (Numerical value **1**)

Table 5-2: Impact to People from Hazards

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

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

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

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

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

Table 5-3: Impact in Dollar Losses for Hazards

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

5.3. Risk Rating

The risk rating for each hazard was determined by multiplying the assigned numerical value for probability to the weighted numerical value of impact to people added to the weighted numerical value of dollar losses (See Table 5-4). The following equation expresses the risk rating calculation:

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

Table 5-4: Risk Rating

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

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

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

The medium risk ratings such as flooding, landslides and wildfire warrant modest program effort.

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

5.4. Community Risk Rating

As mentioned above, a risk ranking by hazard worksheet was given out to tribal officials and community members so that they could rank their perception of what natural hazards the Reservation are most vulnerable to. The definition of each ranking is shown below. Table 5-5 shows the results of the survey. Tribal officials and community members perceived the Reservation to be most vulnerable to Severe Weather and Earthquakes.

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

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

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

Table 5-5: Community Risk Ranking

Community Risk Rating				
	Number of Responses			
hazard event	High (3 points)	Medium (2 Points)	Low (1 point)	**Risk Rating**
Severe Weather	17	10	0	**71**
Earthquake	15	12	1	**70**
Wildland Fire	9	11	8	**57**
Landslides	6	15	8	**56**
Flooding	7	10	10	**51**
Tsunami/Seiche	5	6	15	**42**
Volcano	1	8	17	**34**

6. Capability Assessment

A capability assessment addresses a community's current capacity to address risks from potential hazard events. The Tulalip Tribes currently has in place several capabilities to reduce the risk associated with hazard events. This includes public outreach, training, planning, communication and support following a declaration.. Below, a description is provided of Tulalip's general capabilities that apply to all of the six hazard events profiled.

Public Outreach

The Tulalip Tribes has created an Office of Neighborhoods that specifically addresses emergency preparedness in its program. The Tulalip Office of Neighborhoods regularly runs public announcements on Cable 10 television, articles in the See-Yaht-Sub newspaper and conducts community meetings addressing emergency preparedness. The Tulalip Office of Neighborhoods is located at 6729 Totem Beach Road, Building D, Tulalip WA, 98271.

Training

The Tulalip Tribes are in the process of working collaboratively with the Snohomish County Department of Emergency Management to provide Community Emergency Response Team (CERT) classes and Employee Emergency Response Team (EERT) classes.

Planning

An Emergency Operations Plan was created in June 2003 for the Tulalip Tribes. It provides a document that Tribal officials and employees can use in a disaster to determine what the chain of command is, where people should go, and what they should do. The plan requires that each Tulalip Tribes Department provide personnel to staff the Emergency Operations Center (EOC) if necessary. The plan also designates the location of the EOC. The document defines the primary location to be the Tulalip Administration Building with a secondary location to be located at the Tulalip Police Station.

The Tulalip Board of Directors provides oversight to emergency management activities and those ordinances, resolutions, contracts, rules and regulations that are necessary for emergency management

The 1994 Tulalip Tribes Comprehensive Plan discusses Sensitive Lands in Chapter 6, and stresses the needs for higher regulatory standards within said lands. Chapter 13 discusses the goals and objectives that will protect and maintain sensitive lands and limit development. Appended to the Tulalip Comprehensive Plan is the Tulalip Tribes Interim Sensitive Lands Development Policy.

The Tulalip Zoning Ordinance, Ordinance No. 80, Section 23 regulates development in environmentally sensitive lands. These regulations include buffers around streams and wetlands to protect the environment and prevent damage to property. Steep slopes are also regulated. Section 25.2 discusses regulations in regards to hydraulic projects.

Communication

The Tulalip Tribes has equipped the police station with both analog and digital phone systems, is in the process of upgrading alternate phone systems to include satellite, and have developed a list of known current ham radio operators in the immediate area to further assist with communications in the event of an emergency.

The Tulalip Tribes Cable Access Channel 10 will provide information in emergency situations. This method of providing information is limited by staff time and the availability of electricity and cable.

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

Support following a Presidential Declaration

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

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

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

7. Plan Goals and Objectives

This section defines the general outcomes that can be expected as a result of successful implementation of this plan. Plan goals are broad statements describing the principles that guide the actions suggested in this document. The plan goals below were developed based on the outcome of numerous planning meetings, the Risk Assessment and the goals and objectives defined in the Tulalip Tribes Comprehensive Plan, the Tulalip Police Services Strategic Plan and the Tulalip Tribes Emergency Management Plan.

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

The goals in this plan were designed to support those defined in The Tulalip Tribes Comprehensive Plan, the Tulalip Tribes Police Services Strategic Plan, and the Tulalip Tribes Emergency Management Plan.

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

7.1. Goals and Objectives

Goal 1: Protect public health, welfare and public safety

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

Objective 1.1: Increase public awareness of hazards

Mitigation strategies that achieve this objective: M-1, M-2, M-3, M-4, M-6

Related Goals and Objectives:

Tulalip Tribes Police Services Strategic Plan

Section 3.2: Improve public education opportunities in the areas of crime prevention, emergency preparedness and problem solving.

Section 3.2.1: Enhance the use of the media to educate and provide information to the public concerning crime prevention and problem solving resources available to them.

Section 4.1: In partnership with the community and Tulalip government, develop and prioritize the safety and welfare of our people.

Section 4.2: In partnership with our community continually evaluate our performance and improve as necessary.

Tulalip Tribes Basic Emergency Management Plan

Mission Statement: To coordinate all emergency management activities to protect the people, property, economy and environment of the Tulalip Tribes**.**

Section 4a: Provides the following: A basis for incorporating all individuals and organizations with disaster responsibilities into the emergency program.

Objective 1.2: Encourage involvement of community in risk reduction programs

Mitigation strategies that achieve this objective: M-1, M-2, M-3, M-4, M-6

Related Goals and Objectives:

The Tulalip Tribes Comprehensive Plan

Chapter 13, Section B, Goal 1**:** To develop a Comprehensive Plan through extensive community involvement providing for the preservation and maintenance of the essential Tribal Character of the land area and resources; Objective, Carry out the Comprehensive Plan public involvement process to maximize community involvement and responsibility for input and refinement of the Plan Goals and Objectives

Tulalip Tribes Police Services Strategic Plan

Section 3.0.1: To Empower the Community.

Section 3.1.0: Promote a more involved, responsible, community by building stronger community partnerships.

Section 3.1.10: Increase community and neighborhood involvement in Tulalip Office of Neighborhoods.

Tulalip Tribes Basic Emergency Management Plan

Section 4a: A basis for incorporating all individuals and organizations with disaster responsibilities into the emergency program.

Goal 2: Minimize losses to existing and future properties

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

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

Mitigation strategies that achieve this objective: M-1, M-2, M-3, M-4, M-6

Related Goals and Objectives:

The Tulalip Tribes Comprehensive Plan

Chapter 13, Section A, 3.b: Adopt, maintain, and update as necessary, in addition to the Comprehensive Plan, appropriate zoning ordinances that will assist in achieving the above goals and objectives

Tulalip Tribes Police Services Strategic Plan

Section 4.7.2: Strengthen emergency preparedness through cooperation with Snohomish County Department of Emergency Management. Assist in developing emergency plans for the county and participate in training exercises.

Tulalip Tribes Basic Emergency Management Plan

Section 4c: Develop a comprehensive framework for local disaster mitigation, preparedness, response, and recovery operations.

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

Mitigation strategies that achieve this objective: M-1, M-2, M-3, M-4, M-6

The Tulalip Tribes Comprehensive Plan

Chapter 13, Section E, Goal 1: To develop and adopt appropriate ordinances for the management and implementation of the Tulalip Comprehensive Plan

The Tulalip Tribes Police Services Strategic Plan

Section 4.7.2: Strengthen emergency preparedness through cooperation with Snohomish County Department of Emergency Management. Assist in developing emergency plans for the county and participate in training exercises

Tulalip Tribes Basic Emergency Management Plan

Mission: Develop a comprehensive framework for local disaster mitigation, preparedness, response, and recovery operations.

Objective 2.3: Support upgrades to critical infrastructure and facilities

Mitigation strategies that achieve this objective:
M-3, M-4, M-5, M-7,

Related Goals and Objectives:

The Tulalip Tribes Comprehensive Plan

Chapter 13, Section F, Goal 2: Encourage local and regional public transportation systems which contribute to the relief of traffic congestion, promote energy conservation and enhance mobility for the community.

Chapter 13, Section G, Goal 1: To implement the recommended improvements as described for each utility in Chapter 10 (Utilities).

Tulalip Tribes Basic Emergency Management Plan

Section 3c: To develop a comprehensive framework for local disaster mitigation, preparedness, response, and recovery operations.

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

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

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

Mitigation strategies that achieve this objective: M-1, M-2, M-3, M-4, M-6

Related Goals and Objectives:

The Tulalip Tribes Comprehensive Plan

Chapter 13, Section B: Comprehensive Plan Process, Objective, Carry out the Comprehensive Plan public involvement process to maximize community involvement and responsibility for input and refinement of the Plan Goals.

Tulalip Tribes Police Services Strategic Plan

Section 3.0.1: Promote a more involved, responsible, community by building stronger community partnerships.

Section 2.1.5: Enhance training related to leadership, problem, solving, safety and crime prevention, and developing community partnerships for all employees.

Tulalip Tribes Basic Emergency Management Plan

Section 3a: Provide a basis for incorporating all individuals and organizations with disaster responsibilities into the emergency program.

Section 5: This shares general emergency management planning concepts with neighboring jurisdictions.

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

Mitigation strategies that achieve this objective: M-1

Related Goals and Objectives:

Tulalip Tribes Police Services Strategic Plan

Section 2.4: Improve internal communication to enhance the accurate and timely exchange of information.

Section 2.4.1: Improve employee effectiveness in meetings, committees and written communications.

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

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

Objective 4.1: Support redundancy of critical government functions

Mitigation strategies that achieve this objective: M-1, M-5

Related Goals and Objectives:

The Tulalip Tribes Comprehensive Plan

Chapter 13**,** Section A, Goal 1: To preserve the ability of the Tribal government (and the capability of the Reservation) to provide a permanent homeland on-Reservation for Tulalip Tribal members.

Tulalip Tribes Police Services Strategic Plan

Section 4.3: Ensure our organizational structure that most effectively supports the mission, goals and objectives of the Tulalip Office of Neighborhoods.

Section 4.3.2: Identify and eliminate programs that are ineffective and adversely affect our ability to maintain adequate front line staffing

Section 4.7.3: Enhance the ability of the Tulalip Police Services and others to respond to crisis situations, especially involving multiple agencies.

Tulalip Tribes Basic Emergency Management Plan

To establish the Tulalip Tribes Basic Emergency Management functions and responsibilities of agencies, commissions, boards and councils. This plan is intended as a comprehensive framework for mitigation, preparedness, response, and recovery activities.

Objective 4.2: Promote use of new technology in critical operations

Mitigation strategies that achieve this objective: M-11

Related Goals and Objectives:

Tulalip Tribes Police Services Strategic Plan

Section 2.1.9: Increase the use of video technology in training for front-line personnel.

Section 3.3.3: Develop an online Internet program for the public to access community resources information.

Goal 5: Protect and promote environmental quality

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

Objective 5.1: Encourage low impact development

Mitigation strategies that achieve this objective: M-9

Related Goals and Objectives:

The Tulalip Tribes Comprehensive Plan

Chapter 13, Section G, Goal 1b: Develop and adopt a revised land clearing, grading and drainage policy, building code, road standards, land locked relief and community services, and infrastructure improvement plans.

Chapter 13, Section H, Goal 1: To encourage infilling of existing residential areas where services and site suitability allow

Chapter 13, Section H, Goal 1: To develop multiple unit, institutional and clustered housing to provide the lowest possible housing cost for groups and individuals unable to afford or manage care of a single family house

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8. Mitigation and Implementation Strategies

This section describes an action plan to reduce risk and loss from future hazard events in the Tulalip Tribes. The specific projects are listed in the pages that follow. Mitigation strategies were defined and prioritized primarily through discussions with stakeholder committee members. The mitigation strategies are listed below in order of priority.

Though the strategies here have been ranked through the process described above, a detailed benefit to cost analysis should be completed as part of the project development process, using Federal Emergency Management Agency (FEMA) approved Benefit Cost Methods. A brief, informal benefit-cost analysis was conducted for each strategy and it was decided that all projects were feasible, but further analysis should be done as new strategies and projects are proposed. (See Appendix C for more information about these methods).

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

Definitions

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

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

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

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

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

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

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

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

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

M-1: Create a full time position in the Tulalip Tribes for an Emergency Management Coordinator.

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

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

- Coordinate the monitoring, maintenance and updating of the Tulalip Hazard Mitigation Plan.
- Develop and coordinate the Tulalip Tribe's emergency management and emergency preparedness programs.
- Plan, oversee and provide training in all aspects and phases of emergency management.
- Coordinate annual updates of the Tulalip Tribe's Comprehensive Emergency Plan.
- Organize partnerships among business, industry and local government.
- Initiate public awareness and education campaigns for all hazards.
- The coordinator would implement mitigation strategies M-2, M-3, M-4, M-5, M-6, M-7, M-8, M-9,

Lead Agency: Tulalip Board of Directors

Funding Source: Tulalip Operating Budget

Implementation Cost: $58,700

Timeline: Short Term

Associated Hazards: All Hazards

Related Goal and Objective: All Goals and Objectives in Section 7

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

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

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

- Evaluate success of current public education efforts.
- Develop and index a mitigation/preparedness packet for the public and for the media for each type of hazard affecting Tulalip.
- Draft a campaign strategy to effectively distribute information about hazards and hazard mitigation.
- Create a link on the Tulalip Tribes web page that is specifically devoted to providing current information about hazards and hazard mitigation. This would include static information about existing hazards and up-to-date information on disaster events affecting Tulalip. For example, there could be information about what to do during an earthquake.
- Develop and implement workshops and training programs that address specific issues related to the hazards affecting Tulalip. An example would be providing a workshop on how to non-structurally retrofit buildings in order to minimize loss from an earthquake.

Lead Agency: Tulalip Police Services Office of Neighborhoods

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

Implementation Cost: The initial cost would be about $50, 000 and would include the material assembly, printing and distribution. The continuing cost would be about $20,000 per year and would include development and implementation of workshops and training programs. Included in this cost would be mitigation strategies M-2, M-3, M-4, M-6

Timeline: Ongoing

Associated Hazards: All Hazards

Related Goal and Objective: Goal 1, Objective 1.1

<u>M-3:</u> Create and maintain partnerships with all entities that impact the Tulalip Tribes to ensure that critical facilities and infrastructure are retrofitted or built to standards that make them less vulnerable in a hazard event.

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

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

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

Lead Agency: Tulalip Office of Emergency Management

Funding Source: Tulalip Operating Budget

Implementation Cost: No significant additional cost for Tulalip

Timeline: Ongoing

Associated Hazards: All Hazards

Related Goal and Objective: Goal 1, Objective 1.2

<u>M-4:</u> Create and maintain partnerships with all entities that impact the Tulalip Tribes to implement non-structural retrofitting in Tribal households, facilities and businesses.

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

Implementation Strategy: Provide information and\or training about how to implement non-structural retrofitting. The Emergency Management Coordinator outlined in M-1 could implement this strategy.

- Coordinate assessments of non-structural hazards for Tribal facilities.
- Prioritize the order by which Tribal facilities should be non-structurally retrofitted.
- Provide education and training about non-structural hazards and non-structural retrofitting for critical facilities, schools, health care facilities, residences and businesses. Initial focus should be given to facilities on NEHRP D and E Soils.
- Apply for grants that could provide funding for non-structural retrofitting.

Lead Agency: Tulalip Utilities Department

Funding Source: Tulalip Operating Budget

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

Timeline: Ongoing

Associated Hazards: Earthquakes

Related Goal and Objective: Goal 2, Objective 2.2

M-5: Identify critical community facilities and infrastructure that are without back up power generators.

Problem/Opportunity: Hazard events frequently cause power outages and create disruptions to the operation of important community facilities. In past cases, the Tulalip Tribe's operations have been disrupted or unable to function as necessary. It is especially important that facilities designated as emergency shelters have back up power generators. Back up power generators supply the needed resources to maintain operations until the power supply is restored.

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

- Identify critical Tulalip Tribes facilities that currently do not have back up power capacity.
- Prioritize the list of critical Tulalip Tribes facilities that do not have back up power capacity by which facilities are most important in maintaining the critical functions of Tulalip.
- Acquire a source of back up power sufficient to maintain necessary operations for these Tulalip Tribes facilities using the prioritization list.
- Provide information on the importance of a back up power source
- Work with utility providers as a possible funding source.

Lead Agency: Tulalip Utilities Department

Funding Source: Tulalip Operating Budget

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

Timeline: Short Term

Associated Hazards: All Hazards

Related Goal and Objective: Goal 2, Objective 2.3

M-6: Assure that the public is informed of the necessity of maintaining a 3-day supply of food and water, along with basic first aid and medical supplies.

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

Implementation Strategy: Educate the public about the necessity of maintaining a 3-day supply for emergencies. The Emergency Management Coordinator outlined in M-1 could implement this strategy. Some important elements of maintaining a 3-day supply are:

- A three-gallon supply of water per person stored in sealed, unbreakable containers.
- A supply of non-perishable packaged or canned food and a non-electric can opener.
- A first aid kit and prescription medications.
- A battery-powered radio, flashlight and plenty of extra batteries.
- To implement this program refer to M-2 and M-8, which describes the methodology of how to distribute information community wide.

Lead Agency: Tulalip Police Department Office of Neighborhoods

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

Implementation Cost: Included in M-2 an M-8

Timeline: Ongoing

Associated Hazards: All Hazards

Related Goal and Objective: Goal 4, Objective 4.2

<u>M-7:</u> Improve\expand storm water drainage, dams, detention and retention system capabilities.

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

Implementation Strategy:

- Analyze reports of flooding from past years and determine problem areas.
- Determine if drainage, dams, detention and retention system capabilities are adequate in these areas.
- Prioritize areas that need the drainage, dams, detention and retention system capabilities expanded.
- Begin expanding the drainage, dams, detention and retention system capabilities in the order of prioritization.

Lead Agency: Public Works Department

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

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

Timeline: Long Term

Associated Hazards: Flooding

Related Goal and Objective: Goal 2, Objective 2.3

<u>M-8:</u> Promote use of new technology in hazard mitigation and emergency preparedness

Problem/Opportunity: One of the most important elements to mitigation and emergency preparedness is awareness. The general public, as well as critical operations personnel, are often unaware of the risk of hazards and what actions to take during a disaster event. Public awareness programs can provide information about mitigation measures for different hazards as well as preparedness, response and recovery measures after a disaster event. The use of current technologies can help with the distribution of crucial information in a more organized and expeditious manner.

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

- Develop a partnership with the Tulalip Data Services for the purpose of distributing crucial information on a Tulalip Tribes Website.
- Develop and promote the use of the Internet and video technologies for providing training opportunities to the community, as well as, critical operations personnel.

Lead Agency: Tulalip Data Services

Funding Source: Tulalip Operating Budget

Implementation Cost: There is no significant additional cost for Tulalip.

Timeline: Short Term

Associated Hazards: All Hazards

Related Goal and Objective: Goal 4, Objective 4.2

M-9: Institute low impact development regulations for new developments as well as re-development projects.

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

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

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

Lead Agency: Planning & Development Services Department

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

Implementation Cost: No significant additional cost to Tulalip.

Timeline: Ongoing

Associated Hazards: Flooding

Related Goal and Objective: Goal 5, Objective 5.1

M-10: Assess the Tulalip Tribes evacuation and primary response routes.

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

Implementation Strategy:

- Reassess the Tulalip Tribes evacuation and primary response routes.
- Develop new routes where necessary.

Lead Agency: Tulalip Police Department

Funding Source: Tulalip Operating Budget

Implementation Cost: No significant additional cost for Tulalip

Timeline: Short Term

Associated Hazards: All Hazards

Related Goal and Objective: Goal 4, Objective 4.1

M-11: Utilize Geographic Information Systems (GIS) in decision-making processes.

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

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

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

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

Lead Agency: Planning & Development Services Department

Funding Source: Tulalip Operating Budget

Implementation Cost: The additional cost for the printer, software, GPS equipment and training would be $40,000.

Timeline: Ongoing

Associated Hazards: All Hazards

Related Goal and Objective: Goal 4, Objective 4.2

9. Action Plan

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

The items are displayed on Table 9-1 in the order of their priority for implementation. They have been ranked for implementation based on input from the Steering Committee, the Stakeholder Committee and other participants and include a benefit-cost analysis as part of the project development process using FEMA approved benefit-cost methods. See Appendix C for more information about these methods. The Tulalip Tribes should consider the following an action plan for the first 5-year planning cycle.

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

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

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Table 9-1: The Tulalip Tribes Action Plan

Mitigation Strategy		Associated Hazards								Timeline	Lead Agency	Funding	Implementation Strategies (Section 8)	Plan Goals Addressed				
		Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche					Goal 1: Protect public health, welfare, and public safety	Goal 2: Minimize losses to existing and future properties	Goal 3: Encourage coordination and communication amongst public and private organization	Goal 4: Ensure continuity of critical facilities and corresponding operations of local government	Goal 5: Protect and promote environmental quality
M-1	Create a full time position in the Tulalip Tribes for an Emergency Management Coordinator.	x	x	x	x	x	x	x	x	Short Term	Tulalip Tribes Board of Directors	Tulalip Operating Budget	p. 8-2			x		
M-2	Create a community wide comprehensive education program to educate the public, private and business sectors about hazards and hazard mitigation.	x	x	x	x	x	x	x	x	Ongoing	Police Department	Tulalip Operating Budget, EMPG, HGMP, Pre-Disaster Mitigation Program	p. 8-2	x				
M-3	Create and maintain partnerships with all entities that impact the Tulalip Tribes to ensure that critical facilities and infrastructure are retrofitted or built to standards that make them less vulnerable in a hazard event.	x	x	x	x	x	x	x	x	Ongoing	Tulalip OEM	Tulalip Operating Budget	p. 8-4				x	
M-4	Create and maintain partnerships with all entities that impact the Tulalip Tribes to implement non-structural retrofitting in Tribal households, facilities and businesses.	x								Long Term	Tulalip Tribes Utilities	Tulalip Operating Budget	p. 8-4		x			
M-5	Identify critical community facilities and infrastructure that are without back up power generators.	x		x						Ongoing	Public Works Department	Tulalip Operating Budget	p. 8-5		x			

	Mitigation Strategy	Associated Hazards								Timeline	Lead Agency	Funding	Implementation Strategies (Section 8)	Plan Goals Addressed				
		Earthquakes	Hazardous Materials	Severe Weather	Landslides & Sinkholes	Flooding	Wildland Fire	Volcano	Tsunami/Seiche					Goal 1: Protect public health, welfare, and public safety	Goal 2: Minimize losses to existing and future properties	Goal 3: Encourage coordination and communication amongst public and private organization	Goal 4: Ensure continuity of critical facilities and corresponding operations of local government	Goal 5: Protect and promote environmental quality
M-6	Assure that the public is informed of the necessity of maintaining a 3-day supply of food and water, along with basic first aid and medical supplies.	x	x	x	x	x	x	x	x	Short Term	Police Department	Tulalip Operating Budget	p. 8-6	x				
M-7	Improve\expand storm water drainage, dams, detention and retention system capabilities.	x	x	x	x	x	x	x	x	Ongoing	Public Works	Tulalip Operating Budget	p. 8-7		x			
M-8	Promote use of new technology in hazard mitigation and emergency preparedness	x	x	x	x	x	x	x	x	Ongoing	TDS	Tulalip Operating Budget, EMPG	p. 8-7	x				
M-9	Institute low impact development regulations for new developments as well as re-development projects.	x			x	x	x	x		Long Term	Planning & Development Services	DHS/FEMA, Tulalip Operating Budget	p. 8-8		x			
M-10	Assess the Tulalip Tribes evacuation and primary response routes.	x	x	x	x	x	x	x	x	Long Term	Police Department	Tulalip Capital Improvement Budget, HGMP, Pre-Disaster Mitigation Program	p. 8-9		x			
M-11	Utilize Geographic Information Systems (GIS) in decision-making processes.	x	x	x	x	x	x	x	x	Short Term	Planning & Development Services	Tulalip Operating Budget	p. 8-9		x			

10. Plan Maintenance

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

10.1. Monitoring, Evaluating and Updating the Plan

Authority

The Tulalip Tribes Board of Directors was established in 1936 under the Indian Reorganization Act of 1934. The Tulalip Tribes Board of Directors provides oversight to emergency management activities and those ordinances, resolutions, contracts, rules and regulations that are necessary for emergency management.

The Tulalip Tribes Board of Directors consists of seven Board members. The Chairman of the Board of Directors will provide necessary input and supervision to the General Manager of the Tulalip Tribes, who will act as the Emergency Management Director in the event of an emergency, to carry out the duties of the position. The General Manager/Emergency Management Director will also create an Office of Emergency Management. The OEM shall be a division of the Tulalip Tribes Administration Department and work collaboratively with the Tulalip Police Department. The OEM shall maintain a full time position for an Emergency Management Coordinator. The Emergency Management Coordinator shall have the responsibility of implementing the Tulalip Tribes Hazard Mitigation Plan. The Tulalip Tribes Hazard Mitigation Plan will be a living document and primary duties of the Emergency Management Coordinator will include creating and maintaining partnerships with private, public and business sectors to assist with the continuous and ongoing monitoring, evaluating and updating of the Tulalip Tribes Hazard Mitigation Plan.

The Tulalip Tribes Board of Directors and/or the Emergency Management Director may direct any department, program or operation and use their authorities and resources in response to an emergency or disaster situation. This authority shall include and not be limited to the following entities:

- The Chairperson of the Tulalip Tribes, whom shall act as chair;
- The Emergency Management Director
- The Tulalip Tribes Chief of Police
- The Emergency Management Coordinator

- A representative of the Tulalip Fire Department, or successor;
- A representative of the Tulalip School District, or successor;
- A representative of the Tulalip Utilities District, or successor,
- A representative of the Tulalip Finance Department, or successor;
- A representative of the Tulalip Logging/Forestry
- And such Tulalip Tribes officials and other citizens with technical capabilities in related areas, upon appointment by the General Manager.

Schedule

To assure that the Hazard Mitigation Plan continues to provide an appropriate path for risk reduction in Tulalip, it is necessary to regularly monitor, evaluate and update it. The Tulalip Emergency Management Coordinator will convene a yearly meeting devoted to reviewing and updating the Hazard Mitigation Plan. In addition to a yearly meeting, the Emergency Management Council will update the Tulalip Hazard Mitigation Plan every five years and resubmit the plan to Washington State and FEMA for approval.

The Emergency Management Coordinator will be responsible for:

Regularly reviewing each goal and objective to determine its relevance to the changing situation in Tulalip.

Monitoring and evaluating the mitigation strategies in this plan to assure that the document reflects current hazard analyses, development trends, ordinance changes and risk analyses and perceptions.

Assuring the appropriate implementation of the 5-year action plan. The Steering Committee will hear progress reports from the parties responsible for the various implementation actions to monitor progress.

Creating future action plans and mitigation strategies. These should be carefully assessed and prioritized using the benefit-cost analysis methodology that FEMA has developed. More information about this is provided in Appendix B.

Assuring a continuing role for public comment and involvement as the mitigation plan evolves.

Reassessing the plan in light of any major hazard event occurrence such as an earthquake or major flood, for example. The council will convene within 15 days of any major event to review all applicable data and to consider the risk assessment, plan goals, objectives, and action items given the effects of the hazard event. Applicable hazard-dependent action items, in Section 9, should be implemented at that time.

Review the hazard mitigation plan in connection to other plans, such as capital improvement project plans, comprehensive plan, and emergency operations plan updates.

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

10.2. Criteria for Evaluation

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

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

Is the risk assessment still appropriate, or has the nature or magnitude of the hazard and/or vulnerability changed over time?

Are current resources appropriate for implementing this plan?

Have lead agencies participated as originally proposed?

Have outcomes been adequate?

What problems have occurred in the implementation process?

Have member of the public been adequately involved in the process? Are their comments being heard?

10.3. Implementation through Existing Programs

The Tulalip Tribes currently utilizes several mechanisms to guide development, including the following:

- Comprehensive land use planning
- Capital improvement planning
- Tulalip Zoning Ordinances

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

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

The Emergency Management Coordinator will work with Tribal departments to identify capital improvement projects that are consistent with the Hazard Mitigation Plan goals and integrate them as appropriate.

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

10.4. Continued Public Involvement

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

Copies of the plan will be catalogued and kept on hand at all of the public buildings, police and fire stations and at appropriate agencies throughout Tulalip. Upon completion of mitigation M-1, contact information for the Emergency Management Coordinator will be included with the dissemination of the Tulalip Hazard Mitigation Plan.

The plan will be available on the Tulalip Tribes website, and will contain an email address and phone number for the public's use for submitting comments and concerns about the plan.

A public meeting will be held annually to provide the public with a forum for expressing concerns, opinions, and ideas. The Coordinator will set meeting schedules and dates and use Tribal resources to publicize and host this meeting. A public meeting will also be held within 4 months after a disaster event to ensure that the public can express concerns, opinions and ideas over the disaster event.

11. References

This section lists all references used in preparation of this plan that were not cited specifically as footnotes.

Blaikie, Piers, Terry Cannon, Ian Davis, and Ben Wisner. 1994. At Risk: Natural Hazards, People's Vulnerability, and Disasters.

Bolin, Robert. 1994. Post Disaster Sheltering and Housing, Disasters, Collective Behavior, and Social Organization.

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Washington Military Department Emergency Management Division. (WMDEMD). 2003. A Mitigation Workbook for Local Jurisdictions. 44 CFR Section 201.6 Planning Requirements. March 2003.

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Appendix A: Planning Process

Planning Process

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

Stakeholder Committee

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

Committee Members:

Linda Jones, General Manager for the Tulalip Tribes

Chief J A Goss, Tulalip Police Department

Mike Alva, Tulalip Tribes Community Development Housing Program Manager

Terri Grinaker, Tulalip Tribes Forestry

Debra Muir, Deputy Director of Tulalip Office of Neighborhoods

Lori Wright, Community Development Land Use Planner

Amanda Hunter, Project Coordinator/Licensing Administrator

Richard Young

Sgt John Harvey, Tulalip Tribes Police Department

Robert Myers, Tulalip Tribes Fish and Wildlife Enforcement

Todd Ayling, Tulalip Bay Fire Department

Byron Larson, Executive Director of Health & Social Services

Key Informant Interviews

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

Tom Gobin Jr, Tulalip Utilities

Dale Jones, Recreation

Niki Cleary

Mike Dunn

Deborah Parker

Dr. Yvonne Ryans

Linda Hill

Diane Gordon

Stan Anderson

Debra Foster

Roni Arbuckle

Appendix B: Risk Ranking by Hazard Worksheet

Risk Ranking by Hazard Worksheet

Below are the hazards that have been determined to potentially impact the Tulalip Reservation. These hazards were identified from community input and review of the 2004 Snohomish County HIVA and the Tulalip Risk Assessment (found in Section 4 of this document.)

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

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

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

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

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

RETURN DATE: Please return by **October 8th, 2004 at 4:30 PM** to the following address:

Lynda Harvey or Debra Muir
Tulalip Office of Neighborhoods
6729 Totem Beach Road Bldg D
Tulalip, WA 98271

Name: ______________________________

Organization: ______________________________

Phone #/Email Address: ______________________________

Hazard Event	Ranking
Earthquake	
Landslides/Sinkholes	

Hazard Event	Ranking
Severe Weather	
Flooding	
Wildland Fire	
Volcano	
Tsunami/Seiche	

Appendix C: Benefit-Cost Analysis

Benefit Cost Analysis

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

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

Purpose

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

Benefit Cost Analysis for Mitigation Projects

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

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

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

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

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

Appendix D: Public Notices

The Tulalip Tribes Website

The Tulalip Tribes Website (www.TulalipTribes.org) posted information on the Hazard Mitigation Planning Process and requesting public comment.

Tulalip Seeks Comment on Draft Hazard Mitigation Plan

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

Tulalip Seeks Comments on Draft Hazard Mitigation Plan

To be eligible for Federal Emergency Management Agency (FEMA) help following a disaster, FEMA requires that cities complete a Hazard Mitigation Plan. A Hazard Mitigation Plan identifies potential hazards in a community and outlines plans to reduce the risks of those hazards.
The Tulalip Tribes contracted with an intern from the University of Washington's Department of Urban Design and Planning to help prepare the plan. Stakeholders and agency partners attended a half-day session in November to review the draft plan and now the Tulalip Tribes is seeking public comments.
The Tulalip Tribe's draft Hazard Mitigation Plan is available for review at the Tulalip Tribes Office of Neighborhoods and the Tulalip Police Station.

360-651-4361

Tulalip Office of Neighborhoods
In Partnership with
The Tulalip Police Department
The Tulalip Housing Authority
6729 Totem Beach Road
Tulalip, WA 98271

360-651-4608

Community Potluck Block Watch Meeting

Please join us for a block watch meeting in your neighborhood

Friday, April 30, 2004 @ 6:00pm

Location

Norris Residence
6923-22nd Drive NE
Tulalip, WA. 98271
360-651-9943

Everyone in the neighborhood is invited to attend the block watch meeting to discuss concerns you may have about your neighborhood.
We will brain storm ways to help you have a positive impact on reducing neighborhood crime, help reduce fear of crime and enhancing the quality of life in your neighborhood.
You have two community officers and their names are Corporal Carlos Echevarria and Officer Yamah Hood and both will be in attendance at the meeting.
Look forward to seeing everyone at the meeting !!!
Any questions call The Tulalip Office Of Neighborhoods at 360-651-4361

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360-651-4361

Tulalip Office of Neighborhoods
In Partnership with
The Tulalip Police Department
The Tulalip Housing Authority
6729 Totem Beach Road
Tulalip, WA 98271

360-651-4608

Community Block Watch Meeting

Please join us for a block watch meeting in your neighborhood

Thursday, June 10, 2004 @ 5:30pm

Location

Norris Residence
6923-22nd Drive NE
Tulalip, WA. 98271
360-651-9943

Everyone in the neighborhood is invited to attend the block watch meeting to discuss concerns you may have about your neighborhood.
We will brain storm ways to help you have a positive impact on reducing neighborhood crime, help reduce fear of crime and enhancing the quality of life in your neighborhood.
You have two community officers and their names are Corporal Carlos Echevarria and Officer Yamah Hood and both will be in attendance at the meeting.
Look forward to seeing everyone at the next meeting !!!
Any questions call Debra Muir at The Tulalip Office Of Neighborhoods at 360-651-4361

This article was placed in the October 20th edition of the Tulalip See-Yaht-Sub.

Hazard Mitigation Plan available for public review

Contact Debra Muir, 360-651-4361,reprinted from the Tulalip Office of Neighborhoods Newsletter, Number 1, Vol. 1, Sept. 30, 2004.

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

The Tulalip Tribes hired the University of Washington Institute for Hazard Management to help prepare the plan. Individual entities within the Tulalip Tribes attended sessions during he 2002, 2003, and 2004 years to review the draft plan and now the Tulalip Tribes is seeking public comment.

The Tulalip Tribes Hazard Mitigation Plan 2004 is available for public review and comment by all residents of the Tulalip Reservation at the Tulalip Office of Neighborhoods (TOON) at 6729 Totem Beach Road, Bldg. D (old Tulalip Court House).

Questions, comments, or concerns please call Lynda Harvey at 360-651-4351 or Debra Muir at 360-651-4361.

Appendix E: Resolution Adopting Hazard Mitigation Plan