Squaxin Island Tribe
2024 Hazard Mitigation Plan Update and Community Wildfire Protection Plan

South view of the Squaxin Museum, Library, and Research Center in Kamilche

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Hazard Mitigation Plan and Community Wildfire Protection Plan
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ACKNOWLEDGMENTS

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Thank you to the dedication and assistance of the planning team who provided insight and information throughout this process!

EXECUTIVE SUMMARY

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The Disaster Mitigation Act (DMA; Public Law 106-390) is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program and requirements for the national post-disaster hazard mitigation grant program were established.

In recognition of tribal sovereignty and the government-to-government relationship that currently exists between FEMA and Indian Tribal governments, FEMA amended 44 CFR 201 at 72 Fed. Reg. 61720 on October 31, 2007, and provided further amendments on September 16, 2009, amending 74 Fed. Reg. 47471 to consolidate and clarify the requirements for Indian Tribal governments. These amendments established protocol for Tribal Hazard Mitigation Plans to be separate from State and Local Mitigation Plans. It also finalized several editions of the Mitigation Planning and Review Guidelines. It is under those guidelines which this Tribal Hazard Mitigation Plan was developed. At the time the previous Hazard Mitigation Plan was developed, Tribal standards were based to a great extent on those requirements of a State-level plan as there was no other guidance in place specific to tribes. To the greatest extent possible, information from the 2019 plan has been incorporated into this document.

For consistency, 44 CFR 201.2 defines *Indian Tribal Government* as any Federally recognized governing body of an Indian or Alaska Native tribe, band, nation, pueblo, village, or community that the Secretary of Interior acknowledges to exist as an Indian Tribe under the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. 479a.

The DMA encourages tribes, states, and local authorities to work together on pre-disaster planning, and it promotes sustainability as a strategy for disaster resistance. “Sustainable hazard mitigation” includes the sound management of natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context. The enhanced planning network called for by the DMA helps local governments articulate accurate needs for mitigation, resulting in faster allocation of funding and more cost-effective risk reduction projects.

Embracing this initiative as a foundation for proactive planning, the Squaxin Island Tribe has developed its 2024 Hazard Mitigation Plan (HMP) update in an effort to reduce loss of life and property resulting from disasters. While it is impossible to predict exactly when and where disasters will occur, or the extent to which they will impact the Tribe, with careful planning and collaboration among the relevant parties, it is possible to minimize losses that can occur from disasters. This has been and will continue to be the driving force behind this plan’s development. Utilizing the three primary characteristics of mitigation efforts to retreat, accommodate, or protect, the Tribe will develop techniques and practices that will contribute to the environment by developing non-regret actions which create multiple positive outcomes.

For planning purposes, *Hazard Mitigation* is defined as *long-term actions taken to reduce or alleviate the loss of life, personal injury, and property damage that can result from a disaster.* It involves strategies such as planning, policy changes, programs, projects, and other activities that can mitigate the impacts of hazards on the Squaxin Island Reservation (SIR). It recognizes that the responsibility for hazard mitigation

lies with many, including private property owners; business and industry; and Tribal, local, state, and federal governments.

Many elements went into making this Tribal Hazard Mitigation Plan a success. The Tribe's Emergency Management Department was instrumental in providing ideas, concepts, historical data and information, discussions, and support needed to develop this plan. Development of the update was completed in coordination with the Planning Team members and the Tribe's consultant, Bridgeview Consulting, LLC.

PLAN DEVELOPMENT METHODOLOGY

Development of the hazard mitigation plan included five phases:

- Phase 1—Organize and review
- Phase 2—Risk assessment
- Phase 3—Engage the public
- Phase 4—Assemble the plan
- Phase 5—Plan adoption

Phase 1—Organize and Review

Under this phase, the Hazard Mitigation Planning Team (hereinafter Planning Team) was assembled to oversee the development of the plan update. The Planning Team consisted of Tribal staff and Tribal citizens, other stakeholders in the planning area, and a consultant who provided technical support to the Planning Team. Coordination with other tribal, county, state, and federal agencies involved in hazard mitigation occurred from the onset of this plan's development through its completion. A multi-media public involvement strategy which centered on a hazard preparedness questionnaire/survey was developed during Phase 1, as well as identification of public presentations at various events which were scheduled to occur during the plan's development. Phase 1 included a comprehensive review of the Tribe's previous Hazard Mitigation Plan (2018), Washington State's Enhanced Hazard Mitigation Plan (2018 and 2023), and a comprehensive review of existing programs within the planning area that may support or enhance hazard mitigation actions. A key function of the Planning Team was to review and update existing goals as appropriate, and to develop measurable objectives for the 2024 update.

For future planning purposes, the Hazard Mitigation Planning Team adopted June 30, 2023 as the end date for incidents, information, and data incorporated in this plan. Future planning efforts shall commence with incidents and information beginning July 1, 2023 forward.

Phase 2—Risk Assessment

Risk assessment is the process of measuring the potential loss of life, personal injury, economic injury, and property damage resulting from natural hazards. This process assesses the vulnerability of people, buildings, cultural resources, and infrastructure to natural hazards. It focuses on the following parameters:

- Hazard identification and profiling
- Identification of Cultural resources

- The impact of hazards on physical, cultural, social and economic assets
- Vulnerability identification
- Estimates of the cost of damage or costs that can be avoided through mitigation.

The risk assessment for this hazard mitigation plan meets the requirements outlined in Chapter 44 of the Code of Federal Regulations (44 CFR). Phase 2 occurred simultaneously with Phase 1, with the two efforts using information generated by one another to generate valid data, supported by sound analysis.

Phase 3—Engage the Public

Specific to tribal plans, 44 CFR 201.7 states that tribal governments may define who they feel constitute "public" within the planning realm, as many tribal citizens have difficulty or apprehension about how to honor traditional beliefs and cultural attributes while still fully participating in the mitigation planning process.

Under this phase, a public involvement strategy was developed by the Planning Team that maximized the capabilities of the Tribe, while still maintaining their cultural beliefs and responsibilities to the Elements. The Planning Team provided information necessary for inclusion within the document. One of the first steps taken was the development of a contact list which included individuals whose input was needed to complete this plan to its fullest capacity. Additionally, the strategy also included: Tribal Council updates; public outreach to review the hazards of concern and draft plan; distribution of the draft plan to Planning Team members; utilization of a hazard mitigation survey; use of the Tribe's existing website dedicated to the plan, and social media releases throughout various stages in the process. Public engagement also included information from Grays Harbor and Mason Counties, the counties in which the Squaxin Island Tribe (SIT) own and maintain properties. The Tribe also owns land in Lewis and Thurston Counties, but at present, the land is vacant, and no buildings exist. Throughout the course of this project, numerous meetings were held, in addition to briefings provided to various stakeholders involved in this effort. This strategy was deemed by the Hazard Mitigation Planning Team as a key function in the success of this planning effort.

Phase 4—Assemble the Plan

The Planning Team assembled key information from Phases 1 and 2 into a document to meet the DMA requirements. Under 44 CFR 201.7, a Tribal Hazard Mitigation Plan must include the following:

- A description of the planning process
- Risk assessment
- Mitigation Strategy
  - Goals
  - Review of alternatives
  - Prioritized "action plan"
- Plan Maintenance section
- Documentation of Adoption

Phase 5—Plan Adoption and Maintenance

The Project Manager for this plan was tasked with briefing the Tribal Council on the plan prior to its adoption. The Tribe elected to adopt the plan prior to submission to FEMA for review. Said adoption occurred on xxx. A copy of the Adoption Resolution is included in Chapter 13.

This document, as written, includes a plan implementation and maintenance section that details the formal process for ensuring that the plan remains an active and relevant document. The plan maintenance process includes a schedule for monitoring and evaluating the plan's progress annually and producing a plan revision every five years. This process seeks to keep a planning team in place that meets the criteria of the original Hazard Mitigation Plan to perform its annual review. This phase includes strategies for continued public involvement and incorporation of the recommendations of this plan into other planning mechanisms of the Tribe, such as comprehensive plans, capital improvement plans, application of building codes, development design guidelines, and emergency management response plans, among others.

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CHAPTER 1.
GENERAL INFORMATION

1.1 PURPOSE AND AUTHORITY

The federal Disaster Mitigation Act (DMA) emphasizes the importance of planning for disasters before they occur by requiring tribes, states, and local governments to develop hazard mitigation plans as a condition for federal grant assistance. The DMA (Public Law 106-390; approved by Congress October 10, 2000), amended the Stafford Disaster Relief and Emergency Assistance Act by repealing its previous mitigation planning provisions and replacing them with a new set of requirements that emphasize the need to closely coordinate mitigation planning and implementation.

Hazard Mitigation Plan Requirements for Indian Tribal Governments

Requirements for Indian tribal governments were consolidated and clarified when the U.S. Federal Emergency Management Agency (FEMA) amended Title 44 of the Code of Federal Regulations (44 CFR; Section 201) on October 31, 2007 (72 Fed. Reg. 61720) and again on September 16, 2009 (74 Fed. Reg. 47471). These amendments were made in recognition of the status of tribal sovereignty and the government-to-government relationship between FEMA and Indian Tribal governments. They established a protocol for Tribal hazard mitigation plans to be separate from state and local mitigation plans. Tribal hazard mitigation plan requirements differ from local hazard mitigation plan requirements and are more like the requirements for a state-level type plan. This Hazard Mitigation Plan (HMP) for the SIT (hereinafter may be referenced as Tribe) was developed under those guidelines. The federal statutes define *Indian Tribal Government* as "any Federally recognized governing body of an Indian or Alaska Native tribe, band, nation, pueblo, village, or community that the Secretary of Interior acknowledges to exist as an Indian Tribe under the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. 479(a)" (44 CFR 201.2).

1.1.1 The Squaxin Island Tribe's Response to DMA

Underlying Principles of the DMA

The intent behind hazard mitigation is to reduce or alleviate loss of life, personal injury, property, and environmental damage that can result from a disaster through long- and short-term strategies. It involves planning, policy changes, programs, projects, and other activities that can mitigate the impacts of hazards. The responsibility for hazard mitigation lies with many, including private property owners; business, industry, and tribal, local, state, and federal government. The DMA encourages tribes, states, and local authorities to work together on pre-disaster planning, promoting sustainability for disaster resistance. *Sustainable hazard mitigation* includes the sound management of cultural and natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context. The enhanced planning network called for by the DMA helps tribes and governments articulate accurate needs for mitigation, resulting in faster allocation of funding, and more cost-effective risk reduction projects.

In an effort to support the underlying principles of the DMA, the Squaxin Island Tribe (SIT) developed their first Hazard Mitigation Plan as a stand-alone plan, followed by an update in 2019. This document serves

as the update to the 2019 plan, demonstrating the Tribe's continued efforts to ensure the safety of their Tribal members, staff, and visitors to the Reservation and surrounding lands, while also continuing to be good stewards to the environment by practicing sound and sensible mitigation efforts.

This 2024 plan has been developed in accordance with requirements of the DMA, including criteria addressing the planning process, risk assessment, mitigation strategy, plan maintenance, and the adoption process. To the greatest extent possible, data from the previous plan has been incorporated into this document; however, as planning requirements, guidance, and data have changed, there are new additions to this document which were previously not addressed. Likewise, some materials from the previous plan were considered no longer relevant, accurate, or applicable, and were therefore removed. Throughout this document, reflection to the previous plan is made when data was incorporated. The previous plan was utilized as a starting point and was fully reviewed during this update process by all Hazard Mitigation Planning Team Members.

1.1.2 Progress Report of 2019 Hazard Mitigation Plan

Since the 2019 Hazard Mitigation Plan (HMP) was approved, the Tribe has completed many initiatives identified throughout this document in an attempt to serve the population and increase economic growth throughout the planning area. Chapter 12 identifies the current status of the strategies contained in the previous plan. The 2019 plan maintenance strategy identified an annual meeting with all planning team members as its method of tracking project completion and identification of hazard impact. Such meetings did not occur due to staffing levels and workloads, as well as COVID response and operations. The Tribe, however, does feel that such strategy remains effective as it relates to them, and has developed a similar process for their use as discussed in Plan Maintenance portion of this document. The Tribe's Emergency Manager will continue to work with the Tribal Council in the continued quest to reduce the risk and vulnerability to the Squaxin Peoples.

In addition to implementation of some of the 2019 mitigation strategies, the SIT has developed a number of different efforts which have enhanced the Tribe's ability to support mitigation-friendly infrastructure development. During development of these various planning efforts, data from the previous Hazard Mitigation Plan were integrated to the greatest extent possible, with the HMP data serving as a starting point. A detailed list of the various efforts which support mitigation is contained within the Capability Matrix (Chapter 4).

Integrating mitigation efforts into the daily practices has become commonplace to a large extent. A number of Tribal departments/divisions daily practices support mitigation. These entities, as well as others, have continued to incorporate mitigation activities into various day-to-day functions. A few examples of those efforts include:

- Land use development projects emphasizing smart planning by utilizing the risk data to assist in selecting site locations for development purposes, restricting develop on the Reservation that are within high hazard areas;
- Regularly purchasing land in the area of the Reservation with the intent of maintaining its natural habitat to create space which reduces the negative impact of flooding;

- Utilizing building materials and construction standards based on recommended codes and their ability to reduce risk;
- Implementing program management for timber stewardship and harvest, freshwater and ocean fisheries, wildlife and cultural resource protection, and air and water quality monitoring.
- Overall assessment of the communities' usage of new construction to determine if multiple purposes exist, which, when fully operational, can be used for multiple purposes (e.g., a shelter or community resilience center which can also serve as a gym); and
- During planning stages, projected development includes prioritizing mitigation efforts based on impact (positive and negative), such as the project's proximity to the 100- and 500-year floodplain, landslide risk, wildfire risk, and assessing the impact of climate change, among others.

The updated version of the hazard mitigation action plan is a key element of this plan. For the purpose of this document, mitigation action items are defined as: *activities designed to reduce or eliminate the long-term losses resulting from the impacts of natural hazards of concern*. It is through the implementation of the action plan that the SIT can strive to become disaster-resilient through sustainable hazard mitigation.

Although one of the driving influences for preparing this plan was grant funding eligibility, that is not the focus of this plan. It was important to the SIT that it examine initiatives that would work through all phases of emergency management and that contribute to, rather than remove from, the environment. It was significant to the Tribal Citizens that the mitigation efforts include mainstreaming adaptive, 'no-regrets' strategies which improved their abilities to live with the hazards of concern, while not adversely impacting their beliefs and culture. They have adopted a philosophy of *accommodate, retreat, or protect* when developing their mitigation strategies. As such, some of the initiatives outlined in this plan are not grant-eligible, and grant eligibility was not the focus of the selection. Rather, the focus was on the initiatives' effectiveness in achieving the goals of the plan, and whether or not they are within the Tribe's capabilities. Detailed descriptions for these actions can be found in Chapter 12.

1.1.3 Funding Sources

Once the Hazard Mitigation Plan is approved by FEMA, the Tribe will be eligible for funding under the Stafford Act. FEMA grant programs provide various funding opportunities to support mitigation planning and projects to reduce potential disaster damages. It is the intent of the Tribe to pursue grant opportunities in the future to assist in mitigating the Tribe's hazards of concern. Some of those current grant opportunities available which support mitigation efforts are delineated in Table 1-1. Additional funding sources are identified within the Strategy section of this document.

TABLE 1-1
GRANT OPPORTUNITIES AND RELATIONSHIP TO HAZARD MITIGATION

Program	Enabling Legislation	Funding Authorization	Hazard Mitigation Plan Requirement	
			Grantee	Sub-Grantee
Public Assistance, Categories A-B (e.g., debris removal, emergency protective measures)	Stafford Act	Presidential Disaster Declaration	☑	☑
Public Assistance, Categories C-G (e.g., repair of damaged infrastructure, publicly owned buildings)	Stafford Act	Presidential Disaster Declaration	☑	☑
Individual Assistance (IA)	Stafford Act	Presidential Disaster Declaration	☑	☑
Fire Management Assistance Grants	Stafford Act	Fire Management Assistance Declaration	☑	□
Hazard Mitigation Grant Program (HMGP) Planning and Project Grant	Stafford Act	Presidential Disaster Declaration	☑	☑
Building Resilient Infrastructure and Communities (BRIC) (previously Pre-Disaster Mitigation (PDM) Planning Grant)	Stafford Act	Annual Appropriation	☑	☑
Drought Mitigation Program	State	Annual Appropriation	□	□
Flood Mitigation Assistance (FMA)	National Flood Insurance Act	Annual Appropriation	☑	☑
Severe Repetitive Loss (SRL)	National Flood Insurance Act	Annual Appropriation	☑	□
Repetitive Flood Claims (RFC)	National Flood Insurance Act	Annual Appropriation	☑	□
Tribal Homeland Security	Dept. of Homeland Security	Annual Appropriation	☑	□

☑ = Tribal Hazard Mitigation Plan Required
□ = No Tribal Hazard Mitigation Plan Required

1.2 IMPLEMENTATION AND ASSURANCES

Full implementation of the recommendations of this plan will require time and resources. This plan reflects an adaptive management approach in that specific recommendations and plan review protocols are provided to evaluate changes in vulnerability and action plan prioritization after the plan is adopted. The true measure of the plan's success will be its ability to adapt to the ever-changing climate of hazard mitigation. Funding resources are always evolving, as are programmatic changes based on new mandates. The SIT has a long-standing tradition of proactive response to issues that may impact its members. The Tribe is forward-thinking and strives whenever possible to improve the lives of its members, and the residents living in the planning area. This tradition is reflected in the development of this plan, as it is not an easy task to accomplish. The Tribal Council will assume responsibility for adopting the

recommendations of this plan and committing Tribal resources towards its implementation. The framework established by this plan will help identify a strategy that maximizes the potential for implementation based on available and potential resources. It commits the Tribe to pursue initiatives when the benefits of a project exceed its costs, and adequate resources are available. Most important, the Tribe developed this plan with community input. These techniques will set the stage for successful implementation of the recommendations in this plan.

As established within the Code of Federal Regulations, the Tribal Council will continue to comply with all applicable federal statutes and regulations in effect, including those periods during which the Tribe receives grant funding to ensure grant contract compliance, and scheduled project quarterly and closeouts reports as identified and required within each specific grant. This would include 2 CFR 200 and 3002. To ensure compliance, the SIT, whenever necessary, will reflect new or revised federal statutes or regulations, or any material changes in Tribal policy or operation. It is understood that the Tribe will submit those amendments for review and approval in coordination with FEMA Region X. The Tribe, through assigned project managers and grant coordinators, will work with the granting authority to ensure all necessary reports and documentation as required by specific grants are completed in compliance with the established regulations.

This plan is intended to cover all properties owned and operated by the SIT, no matter their location. This includes all fee and trust lands. These areas are inclusively referred to as the tribal planning area. The SIT's owned land mass includes not only the Reservation itself, but also properties (including private residences and business ventures), which are owned by non-tribal members, falling within the Tribe's boundaries. For planning purposes, those structures were not included in this planning effort.

Information contained in this plan is not absolute in terms of its accuracy regarding quantity, quality, or location. It shall only be used as a source for generalized information, and it is not a substitute for site-specific information where such information is required by tribal, local, state, or federal government laws or ordinance.

1.3 WHO WILL BENEFIT FROM THIS PLAN?

All tribal citizens and businesses of the SIT are the ultimate beneficiaries of this hazard mitigation plan. The plan reduces risk for those who live in, work in, and visit the planning area. It provides a viable planning framework for all foreseeable natural hazards. Participation in development of the plan by Tribal Hazard Mitigation Planning Team Members (and outside stakeholders as requested by the Tribe) helped ensure that outcomes will be mutually beneficial. The plan's goals and recommendations can lay groundwork for the development and implementation of local mitigation activities and partnerships.

1.4 HOW TO USE THIS PLAN

This hazard mitigation plan is organized into five primary parts, each of which includes elements required under federal guidelines to attain plan approval:

- Part 1— Introduction
- Part 2— The Planning Process

- Part 3— Community Profile
- Part 4— Risk Assessment
- Part 5—Mitigation Strategy.

The following appendices provided at the end of the plan include information or explanations to support the main content of the plan:

- Appendix A—A glossary of acronyms and definitions.
- Appendix B—A sample template for progress reports to be completed as this plan is implemented.

1.5 CHANGES BETWEEN THE 2019 AND 2024 PLAN UPDATE

Significant differences exist between the 2019 Hazard Mitigation Plan and the 2024 Plan. The plan has been expanded to meet all planning requirements identified within 44 CFR 201.7. All materials identified in the previous plan have been incorporated and updated as appropriate. This document is also intended to meet the mitigation plan requirements for the 2017 Tribal Declarations Pilot Guidance.

The plan itself is a comprehensive update of all data and includes best available science which has been enhanced since completion of the previous plan. New studies, reports, and scientific data have been reviewed, and all risk data has been updated to the greatest extent possible with that new data (discussed in detail in the profiles).

Hazards previously identified in the 2019 plan were reviewed and carried over as determined appropriate by the Hazard Mitigation Planning Team. Some of the weather events were re-grouped into a "Severe Weather" chapter. Non-natural hazards were not addressed in this update, with the exception of hazardous materials sites which were queried to identify proximity to tribal properties and included as appropriate .

Based on the risk assessment, all maps, charts, graphics, and associated data have been updated to reflect current findings. Specific methodology for how each assessment was completed is included in Chapter 5.

A different method was utilized for the risk ranking of the hazards of concern, discussed in Chapter 11. The approach utilized is simplistic in nature and will make future updates less difficult. Social Vulnerability is also addressed in greater detail in this plan, as well as information concerning programs and efforts in place to help address issues associated with social vulnerability.

Structure data was modified to include only tribal structures and infrastructure, adding new structures and land mass acquired by the Tribe since completion of the last plan. This will more accurately reflect the actual losses which the Tribe can potentially experience as a result of hazard impact. It is understood that this list will be continually updated to include additional structures and land mass as it is acquired.

Census data was updated with the most current data available; however, there are limitations with respect to US Census data, as only very limited information was available specific to the Tribe. Such are indicated.

The Capabilities Assessment was enhanced to include a clearer perspective as to the capabilities of the Tribe, while also demonstrating areas on which focus must be given with respect to deficiencies which exist. In many instances, those deficiencies were identified as potential action items/strategies within Chapter 12. The previous goals and objectives were reviewed and updated during the September 22, 2023 Kick-Off Meeting.

Specific strategies and action items identified previously have been discussed in detail in Chapter 12. Those strategies carried over to the 2024 plan are identified, and new strategies and action items are identified. Specific focus was placed on new construction. The methodology used for prioritization of strategies has also been modified, complying with FEMA's requirements. Additional items which reflect differences between the previous and current plan update are referenced throughout the plan itself where appropriate and significant.

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CHAPTER 2.
PLANNING PROCESS

2.1 PLANNING RESOURCE ORGANIZATION

The process followed to develop the SIT's Hazard Mitigation Plan Update had the following primary objectives, which are discussed in detail in the following sections:

- Secure funding
- Define the planning area
- Establish a Planning Team
- Coordinate with other agencies
- Review existing programs
- Engage the public (as defined by the Tribe)

2.1.1 Funding of the 2023 Hazard Mitigation Plan

This planning effort was funded with allocation of Tribal funds. The Tribe did contemplate applying for a FEMA BRIC grant to fund the project, but with the change in Emergency Managers, there was little time to pursue such effort; however, it will consider such grants for future updates. The Tribe is considered an impoverished community. This document constitutes a Stand-Alone Tribal Hazard Mitigation Plan for the Squaxin Island Tribe (SIT). Written concurrent with this effort is the Tribe's Threat Hazard Identification and Risk Assessment.

2.1.2 Formation of the Tribal Hazard Mitigation Planning Team

Hazard mitigation planning enhances collaboration and support among diverse parties whose interests can be affected by hazard losses. A Tribal Hazard Mitigation Planning Team (hereinafter may be referred to as Planning Team) made up of various Tribal staff and citizens, as well as outside stakeholders was formed to help provide information and input into the plan development. The members of this team included key Tribal department heads, staff, planners, Tribal citizens, and supporting community enterprises which provide support and services to the . Other stakeholders from within the planning area were also identified by Tribal Staff to provide relevant information. All participants aided the plan update in ways that matched their time availability and subject matter expertise. The SIT retained Bridgeview Consulting, LLC., to assist with development and implementation of the plan. The Bridgeview Consulting Project Manager, Beverly O'Dea, assumed the role of the lead planner, reporting directly to the Tribe's Emergency Manager/Project Manager, Kelly Guy. Table 2-1 lists the members of the team.

2.1.3 Roster of Participants and their Contributions

Though many participants represent multiple sectors, only their primary sector or contribution to the planning effort are shown. The Planning Team agreed to meet as needed throughout the course of the

plan's development. These meetings occurred in various formats, including via conference calls, webinar meetings, in person, and one-on-one discussions. The Planning Team addressed a set of objectives based on the work plan established for the plan. Various members met beginning June 1, 2023 to begin assimilating required data, with the official Kick-Off meeting occurring September 22, 2023. Meetings continued through the plan's completion, with members soliciting subject matter expertise from team members as needed depending on the issue being addressed. Meeting topics included Identification of Hazards of Concern and Impact, Goals and Objectives, Strategy Development and Update, general information gathering, Land Use Development Trends, Presentation of the Risk Findings, and Final Plan Review and Comment.

TABLE 2-1
PLANNING MEMBERSHIP

Name	Position	Planning Task
Kelly Guy	Emergency Manager (serving as Project Manager for this THMP effort);	Assisted with all tasks associated with the HMP development, including pre-award consultant solicitation; served as project manager, coordinating the capture of information as needed, working with all tribal departments. Ms. Guy also conducted regular briefings to council and others on the scope and project and conduct public outreach during the planning process. Ms. Guy conducted plan review during drafting stages, as well as during final review prior to the plan going public. Ms. Guy also assisted with the development of critical asset list; provided GIS data for parcel data and boundary information. Presented final plan to Council for adoption.
Marvin Campbell Erika Thale	Tribal Executive and Tribal Director of Operations	Attended meetings, provided general information and guidance for the plan development, reviewed risk assessment data and draft plan; assisted with plan adoption.
Tribal Emergency Management Homeland Security Committee Members	All Department Directors	Attended meetings and provided general information and guidance for plan development; provided information on Casino and Tribal Enterprises; assisted with distribution of information; provided historical impact and loss data (as available); reviewed and commented on risk assessment and draft plan.
Savanna Fenton	Island Enterprises, Inc.	
Joshua Crooke	Little Creek Casino & Resort	
Michael Schumaker (left SIT prior to plan completion)	Little Creek Casino & Resort	
Leila Whitener	Community Member	
Patrick Whitener	Community Member	

TABLE 2-1
PLANNING MEMBERSHIP

Name	Position	Planning Task
Greg Rudolph	Fire Chief (via MOU), Mason County Fire District #4	Assisted with data collection and public outreach; provided risk data and assisted with identifying gaps which increase the risk to the SIT; conducted review of the risk assessment data, and the draft plan review.
Theresa Henderson	Communications Manager, Information Technology Department	Assisted with public outreach; provided website development and maintenance; distributed materials via website and social media.
Karen Holms Judy Hartley David Burnett	Financial Coordinator, SIT Finance Department CFO, Little Creek Casino & Resort CEO Island Enterprises, Inc.	Provided information on critical assets and structure data; provided information on parcel data and various information included in the plan; attended Council briefing/adoption.
Penni Restivo	Planning and Community Development Director (Includes planning, building inspections, zoning, etc.)	Provided general information on the SIT, including historical information on hazards, information on the tribal land use, and land management information. Also provided information on tribal capabilities and the current existing plans in place; reviewed draft plan once completed. Conducted review of risk assessment findings and draft plan prior to submission to Council for adoption.
Natural Resources Dept. Candace Penn Erica Marbet	. Climate Change Ecologist Water Resources Biologist	Provided general information on the natural resources of the SIT; provided flood information and data; provided information on on-going climate change study and potential impact information; meeting attendance; review of hazard data; review of draft plan.
Beverly O'Dea,	Bridgeview Consulting, LLC	Project Manager and Lead Planner

2.1.4 Coordination with Other Agencies

Opportunities for involvement in the planning process must be provided to neighboring communities, local and regional agencies involved in hazard mitigation, agencies with authority to regulate development, businesses, academia, and other private and nonprofit interests (44 CFR, Section 201.7(b)). This task was accomplished by the Planning Team as follows:

- **Planning Team Involvement**—Tribal department and various agency representatives were invited to participate on the Planning Team.
- **Agency Notification and/or Use of Information**—The following agencies were notified of the planning effort, provided relevant data, invited to participate in the plan development process, or were kept apprised of plan development milestones. These notifications took place via email, personal contact, or telephonic contact:

  - FEMA Region X – various personnel
  - Grays Harbor and Mason County Emergency Management Divisions, as well as other Departments within Grays Harbor and Mason Counties with which the SIT have MOUs
  - Washington State Department of Natural Resources (various divisions)
  - Washington State Department of Ecology (various divisions)

- **Utility Lifeline Systems** – Various utility agencies such as Hood Canal Communications, PUD 3, etc., were invited to participate in the process, and attended some of the planning meetings. These entities are some of the primary service providers for communications and internet. PUD-3 had recently completed their Annex Template to the Mason County HMP, and information provided during that process was utilized as appropriate for the SIT's update.. Water and wastewater are provided by SIT, and individuals from those departments were involved in the update process, including providing critical facility information.
- **Pre-Adoption Review**— Various agencies and departments were provided an opportunity to review and comment on this plan, primarily through the Tribe's website, which was utilized for the hazard mitigation plan update. E-mails were distributed containing information concerning draft review, as well as a link to download the plan if desired.
- **Newsletters/Social Media —**In addition to the above, the Tribe distributes regular social media/newsletters, which announced plan development and milestones. The effort directed Tribal citizens to the newly developed website, the on-line survey, and completed risk maps.
- **Press Release –** The Tribe distributed a press release which announced the planning effort, and provided the address to the *Hazard Mitigation Survey*, asking citizens to complete the document. The Press Release was distributed through the various social media sites and posted on the Tribe's website. Information concerning the HMP process and survey were included.
- **Flyers –** The Tribe distributed flyers announcing the planning process, as well as inviting tribal members to take the survey. Flyers were distributed in various ways, including through handouts at community events.

Some of the various stakeholders and their respective areas of participation are identified in Table 2-2. This list is not all-inclusive, but does demonstrate the various topics and agencies utilized/contacted.

TABLE 2-2
STAKEHOLDERS AND AREAS OF PARTICIPATION

Stakeholders		Data and Information Provided
US Forest Service	Dan Isaak	NorWest Stream Temperature projections
FEMA Region X	Ted Perkins	Flood hazard information

TABLE 2-2 STAKEHOLDERS AND AREAS OF PARTICIPATION		
Stakeholders		**Data and Information Provided**
	Josha Crowley, PE Starr II – Region 10 Service Center Marshall Rivers FEMA Risk Analyst	Risk Report (Mason and Grays Harbor Counties) FEMA Risk Report Data and Depth Grid Data (Sea Level Rise) Floodplain Specialist
WA DNR		Landslide Data Earthquake Data Wildfire Data
WA DOE	Diane Fowler, Community Right to Know Coordinator Jerry Franklin	Reporting Hazmat sites in Mason County. RiskMap Coordinator Climate Change and Drought Data
USGS		Earthquake Data
Mason County	Tammi Wright, EM Coordinator, Project Manager for County's HMP (2023) Chief KC Whitehouse	Mason County EM, provided hazard information, conducted plan review and meeting attendance. Information on historic wildfires in the area.
Grays Harbor County	Nick Falley, EM Program Manager and Project Manager for County's HMP Update (2023-2024)	Grays Harbor EM received notice of the planning process, and provided information concerning their hazards of concern with respect to properties the SIT maintains within GH. The County was invited to attend meetings and review the risk assessment and plan once completed.

2.1.5 Review of Existing Information

Chapter 4 of this plan provides a detailed overview of existing information, laws, and ordinances in effect within the planning area that can affect hazard mitigation initiatives. As a whole, hazard mitigation

planning must include review and incorporation, if appropriate, of existing plans, studies, reports, and technical information (44 CFR, Section 201.7(c)(1)(iii)), such as those identified below, many of which can affect mitigation within the planning area:

- 2019 SIT Hazard Mitigation Plan
- Grays Harbor 2018 HMP, as well as risk data for 2023 plan
- Mason County 2018 and 2023 HMP
- WRIA 14 Watershed Restoration Plan
- Grays Harbor County RiskMap Report (2017), FIS Study (2020)
- Mason County NFIP data, FIS Study (2019)
- State of Washington Enhanced Multi-Hazard Mitigation Plan (2018, 2023)
- Washington Department of Ecology Hazardous Materials Annual Report for Mason and Grays Harbor Counties
- Various papers and studies concerning the impacts of climate change
- Interpretive Map Series: Earthquake Hazard Maps, and Seismic Risk Assessment for Washington

An assessment of all Tribe's regulatory, technical, and financial capabilities to implement hazard mitigation initiatives is presented in Chapter 4. Many of these relevant plans, studies and regulations are cited in the capability assessment.

2.1.6 Public Involvement

Broad public participation in the planning process helps ensure that diverse points of view about the planning area's needs are considered and addressed. The public must have opportunities to comment on disaster mitigation plans during the drafting stages and prior to plan approval (44 CFR Section 201.7(b), 201.7(c)(1)(i) and 201.7(c)(1)(ii)).

Public Defined

For this planning effort, "public" is defined as tribal citizens, tribal employees, the contractor, and some members of surrounding jurisdictions. As a remote Tribe, involvement from the general public was limited. While surrounding jurisdictions and governmental agencies had some involvement in the planning effort, the Planning Team was primarily limited to Tribal government, Tribal citizens, Tribal employees, and Tribal contractors. Part of the reason for this decision was to preserve information concerning the Tribe's cultural resources.

The Planning Team developed a comprehensive public involvement strategy using existing council (and other) meetings, Tribal websites, various social media platforms, email distribution lists, newsletters, and utilized existing meetings to gain input on the process.

The Tribe developed a webpage on their website to post announcements and draft plan materials, as well as notices and survey links. During existing meetings, Planning Team Members discussed the planning effort and directed interested parties to the website to gain better insight of the on-going endeavors, and to solicit input. Planning Team Members also identified non-tribal stakeholders who possessed relevant information, which were queried for specific data for inclusion in the plan update. The Tribe's Project Manager for this update also conducted one-on-one interviews to capture relevant information as appropriate, and to disseminate information which was captured during the plan's development.

Public Outreach Strategy

The strategy for involving the public in this plan emphasized the following elements:

- Include Tribal citizens and staff on the Planning Team. Including staff allowed involvement from individuals who are not Tribal, but have relevant knowledge of the Tribe gained through their employment. The Tribe's Project Manager facilitated the exchange of information throughout this effort with various Planning Team Members.
- Use a questionnaire/survey to determine general perceptions of risk and support for hazard mitigation and to solicit direction on alternatives. The questionnaire was available to anyone wishing to respond via the website, as well as hard copies being made available if requested. The Tribe also posted a news release at various locations around the Reservation, seeking response and input.
- Utilize the Tribe's Information Technology Department to assist with the distribution of mitigation-related information and efforts on the Tribe's newsletter, website, and various social media sources. The IT Department utilized Squaxinisland.org as one method of distribution, which has over 5,000 visitors per month reviewing the site.
- Utilize existing distribution lists to disseminate and capture relevant information. These lists historically have reached both tribal and non-tribal citizens living on the Reservation.
- Identify and involve planning area stakeholders (non-tribal).

Planning Team Input

The majority of all of the members of the Planning Team live or work in the planning area. The make-up of the Planning Team proved to be integral in the success of this planning effort, as a representative from many tribal departments were represented. This helped to add a historical perspective to this team that was valuable in identifying direction for the plan development process, as well as providing departmental and programmatic efforts ongoing, which directly influence mitigation efforts.

Survey

A Hazard Mitigation Survey was developed by the Planning Team Members. The survey was designed to help identify vulnerable areas; to gauge household preparedness, and to identify the level of knowledge of tools and techniques that assist in reducing risk and loss from hazards. The answers helped guide the Planning Team in selecting goals, objectives, and mitigation strategies. The survey was disseminated throughout the planning area by multiple means, including hard-copy distribution and web-based. A link to the web-based version of the survey was made available on the Tribe's website, and well as distributed

in email utilizing existing distribution lists. These lists included tribal members, employees, and community members.

Survey Results.

While the survey was advertised and distributed in multiple ways, only 11 responses were received to the survey. However, in reviewing the data, it does still help support the data developed in this HMP with respect to the risk ranking, while also providing information with respect to potential outreach efforts. Review of the data indicates the following:

- The majority of the respondents either live or work on the reservation, or make use of the services provided by the Tribe.
- Only 30 percent of respondents have previously been impacted by a natural disaster. Of those impacted, 60 percent have been impacted by a severe weather event, 60 percent have been impacted by an earthquake, and 30 percent have been impacted by a flood.
- 73 percent have been impacted by 1-3 disaster events, with 1 individual impacted by five or more disasters; 55 percent of respondents indicate that the disasters have occurred while they were not living or working in the tribal planning area, with 40 percent of respondents indicating that the incident impacted their ability to get to work, with 1 person indicating the incident impacted their ability to utilize their residence.
- All of the respondents indicate that they are familiar with the hazards of concern that have the potential to impact them, with none living in the flood or landslide hazard area.
- Most of the respondents living on the reservation perform mitigation actions regularly to remove fire danger from around their homes, including clearing and removing brush, downed tree limbs, or other vegetation which increases fire danger. Some had also installed screens over vents to prevent embers from getting into the attack.
- When queried, 67 percent of respondents indicate that they are somewhat prepared with respect to self-preparedness, while 15 percent indicate they are adequately prepared; 6 percent indicate they are well prepared, and 2 percent indicate they are very well prepared.
- Preparedness efforts include 80 percent of responders receiving first aid/CPR training; 38 percent have developed a fire escape plan and established a family meeting place or out-of-area phone contact. 63 percent of respondents have medical supplies, including medications, food, and water.
- When questioned about the hazards of greatest concern, climate change, severe weather, wildfire and earthquake are the hazards of greatest concern. These rankings very closely resemble the results of the planning team with respect to the hazards of greatest concern.
- The Internet (88 percent), and Tribal Newsletter (75 percent) are the selected means of obtaining hazard information, followed by tribal meetings (62 percent). These were the avenues utilized by the planning team to disseminate information during the development of the hazard mitigation plan.
- The majority of respondents - 50 percent - ranged in age from 51 to 60.

Meetings and Website

At the beginning of the plan development process, information was added to the Tribe's website to inform and keep the public advised on plan development milestones and to solicit relevant input. Tribal-wide distribution lists were utilized. Discussions during Tribal Council meetings also occurred to provide status updates, solicit information, and advised of the various project milestones, including during the adoption phase. The Emergency Management Homeland Security Committee, which includes the Tribal Executive, department directors, tribal citizens, and external stakeholders attended meetings, which are regularly scheduled meetings. The planning process also included presentation at the Annual General Body meeting, which was attended by Tribal Council members, department directors and tribal members.

The Tribe's website address was publicized in all releases, mailings, flyers, questionnaires, and public meetings. Information on the plan development process, the Planning Team, the questionnaire, and phased drafts of the plan were made available to the public on the site. The Tribe intends to keep their website active after the plan's completion to keep the public informed about successful mitigation projects and future plan updates.

2.1.7 Plan Development Milestones

Various planning team meetings and public outreach efforts occurred beginning September 2023 with the planning team conducting regular information-gathering sessions throughout the process. What follows is a sampling of the strategy employed by the Planning Team, with specific milestones identified.

- Large public gatherings were somewhat limited, with reliance placed on existing meetings proving to be valuable for information exchange, including the Tribe's General Body Meeting occurring in January 2024. Presented information included risk findings (maps, storyboards, etc.), preparedness information, information on developing family plans, and home and vehicle preparedness kit information.
- General Body Meeting - At that meeting, various risk maps were presented, as well as general information on the history of disasters, and ways to mitigate impacts. The survey link was also distributed via flyers developed, as well as computers staged for individuals to take the survey during the preparedness classes. The Tribe also conducted public outreach events via the internet and web throughout the process. The use of existing meetings included department meetings, regularly scheduled Council meetings, the Emergency Management Homeland Security Committee meeting, and various other meetings. Such events allowed attendees to examine information and still have direct conversations with project staff, as each outreach effort provided direct contact information. Information generated from the risk assessment was shared with attendees via the Tribe's website, with notices distributed in several different ways, making use of existing capabilities and resources.
- The hazard profiles and results of the risk assessment were presented at the Annual General Body Meeting in January 2024, as well as being published on the Tribe's website. All efforts provided the opportunity for public engagement and questions concerning the risk information. Availability of the risk assessment data was also addressed at various outreach efforts, as well as

via an email distribution announcing the availability of data utilizing existing distribution lists for staff and tribal members. Maps and data were also printed and posted for review and comment.

- In addition to the physical posting of maps and data, notebooks containing the risk data were also developed and made available for anyone wishing to review hard copies, or for those not having access to computers. Contact information for planning team members were included to allow for discussions. Contact information included department contact, phone numbers, and email addresses.
- During outreach efforts, citizens were encouraged to complete the on-line survey if they had not yet done so, and each was given an opportunity to provide written comments to the Planning Team.
- All comments received throughout the process were reviewed and vetted through the Planning Team Members, and data incorporated as appropriate.
- The initial draft plan was briefed to Tribal Council in May 2024, with a summary of the plan and risk ranking data provided.
- The final Draft Plan was distributed to the Planning Team in June 2024. After comments and information gathered during the internal review process were incorporated, the draft of the plan was made available for public review and comment. An email distribution was made to all tribal staff and tribal members (the defined public) that the plan was available for public review and comment both in hard copy and via posting on the web.
- The draft plan remained available for review and comment for xxx days, until it was forwarded to FEMA. All comments received were reviewed and included as appropriate.
- Copies of the plan were made available via the Tribe's Mitigation webpage. Notice of its availability was provided through multiple sources, including website postings, social media, and various email distribution lists.
- The final public meeting was held on June xxx, 2024, during which time the plan was again presented to the Tribal Council, and at which time the Council approved and adopted the plan prior to submission to FEMA.
- The plan was officially approved by FEMA on xxxxx, beginning the five-year life cycle of the plan prior to next update.

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CHAPTER 3.
SQUAXIN ISLAND TRIBE PROFILE

3.1 HISTORY AND GOVERNMENT

The Squaxin Island Tribe (SIT) is a self-governing Treaty Tribe. The Tribe is a signatory to the 1854 Medicine Creek Treaty. Tribal governance combines sovereign powers as well as U.S. Congressional acts related to treaties, statutes, and public law. Squaxin Island is one of the first 30 Federally recognized Tribes to enter a Compact of Self-Governance with the United States in both the Departments of the Interior and Health and Human Services.

The Squaxin Island Tribe are descendants of the First Peoples people who lived along the shores and watersheds of the seven southernmost inlets of Puget Sound for many thousands of years. The Squaxin Island Culture is still very much connected to both the marine and terrestrial environments of its traditional territories.

The Squaxin Island Indian Reservation is in southeastern Mason County, Washington. The treaty-designated reservation, Squaxin Island, is approximately 2.2 square miles of uninhabited forested land, surrounded by the bays and inlets of southern Puget Sound. Because the Island lacks fresh water, the Tribe has built its community on roughly 26 acres at Kamilche, Washington purchased and placed into trust. The Tribe also owns six acres across Pickering Passage from Squaxin Island and a plot of 36 acres on Harstine Island, across Peale Passage. In addition, the Tribe manages roughly five hundred acres of Puget Sound tidelands. The total land area including off-reservation trust lands is 1,715.46 acres.

This Plan covers all lands owned and operated by the SIT, whether fee or trust. The planning area is inclusive of the territory within the present boundaries of the SIT as established, and to such other lands without such boundaries as may hereafter be added under any law of the United States, except as otherwise provided by law. Tribal-owned land mass is not contiguous, with non-tribal members owning properties and businesses which abut tribal lands. Those lands are not specifically analyzed for hazard impact in this process.

3.2 LOCATION AND GEOGRAPHY

The SIT is located primarily in Mason County, with additional land mass in Grays Harbor, Thurston, and Lewis Counties. There are no incorporated cities on the Reservation.

In December 2021, Squaxin Island Tribe came to an agreement with Port Blakely Companies, a family-owned timber company, to reacquire 1,000 acres of the tribe's ancestral land. Two miles of waterfront and 125 acres of tidelands on Little Skookum Inlet in Mason County were returned to the tribe, free of charge. The return of the shoreline restored the tribe’s direct access to Puget Sound, and some of the most productive shellfish beds in the region. In a separate transaction, the tribe purchased 875 acres of upland forest. The so-called Kamilche property was acquired by Port Blakely following the signing of the

1854 Medicine Creek Treaty 167 years prior. At present, the tribe has no plans to develop the property. The land will be used for nature conservation and ceremonial purposes.

Overall, the Squaxin Tribe owns 26.13 acres (105,700 m^2) in Kamilche, two parcels of off-reservation trust land near Kamilche, as well as a plot of 6.03 acres (24,400 m^2) across Pickering Passage from Squaxin Island and a plot of 35.93 acres (145,400 m^2) on Harstine Island, across Peale Passage. The total land area including off-reservation trust lands is 6.942 km^2 (2.68 sq mi, or 1,715.46 acres).

Adjacent lands to the reservation are managed by Mason, Grays Harbor, Lewis, and Thurston Counties, Washington State Department of Natural Resources, the Olympic National Forest, and the Olympic National Park, as well as some private residential and commercial lands.

3.2.1 Usual and Accustomed Fishing Areas

Tribes with usual and accustomed fishing areas within WRIA 14 include the Skokomish and Squaxin Island Tribes. These tribes hold reserved fishing rights in WRIA 14 under their treaties with the federal government (Treaty of Point No Point, Treaty of Medicine Creek).

The Tribes claim Treaty-reserved water rights in WRIA 14 under federal law that are necessary to support healthy salmon populations; to support and maintain hunting, fishing and cultural resource harvesting rights; and to meet all homeland purposes reserved by the Treaties. These rights have not been confirmed and quantified through an adjudication in federal or state court. Reserved water rights are necessary to fulfill the promises and purpose of the Treaties. Federal Indian water rights retain a senior priority date over all other federal and state water rights holders and state instream flow rules. Although federal Indian water rights in WRIA 14 have yet to be adjudicated, any Treaty-reserved water rights are senior to all other rights and have not been fully accounted for by the State of Washington in the way in which the State determines water availability and over appropriation and adopts instream flow rules.[1]

3.2.2 Watershed Overview

The Reservation falls within Water Resource Inventory Area (WRIA) 14. WRIA 14 has both unincorporated urban growth areas and incorporated urban growth areas, totaling approximately 4 percent of the watershed. The Squaxin Island Tribe's Reservation and Off-Reservation trust land occupies approximately 2,162 acres of WRIA 14.

The University of Washington Climate Impact Group has developed numerous downscaled global climate models to forecast streamflow and precipitation changes in the Puget Sound, including WRIA 14. General

[1] Washington State Department of Ecology. Watershed Restoration and Enhance Plan: WRIA 14. (March, 2022). Publication: 22-11-016. Accessed 15 Sept. 2023. Available online at: https://ecology.wa.gov/Water-Shorelines/Water-supply/Streamflow-restoration/Streamflow-restoration-planning

trends such as increased stream temperatures, earlier streamflow timing, increased winter flooding, and lower summer minimum flows are expected.[2]

3.3 CLIMATE

The Squaxin Reservation lies on the southeast side of the Olympic Coastal Range, which influences prevailing wind and precipitation patterns. The area's climate can be characterized as moderate-maritime, influenced by the Pacific Ocean, yet sheltered by the Olympic Mountains. Temperatures range from a high of 77° F. in July to 33° F. in January. The average daily temperature in the area is 51° F. The area receives an average of 66 inches of precipitation annually, with average monthly rainfalls ranging from a low in July of 0.9 inches, to a high of 10.4 inches in January.

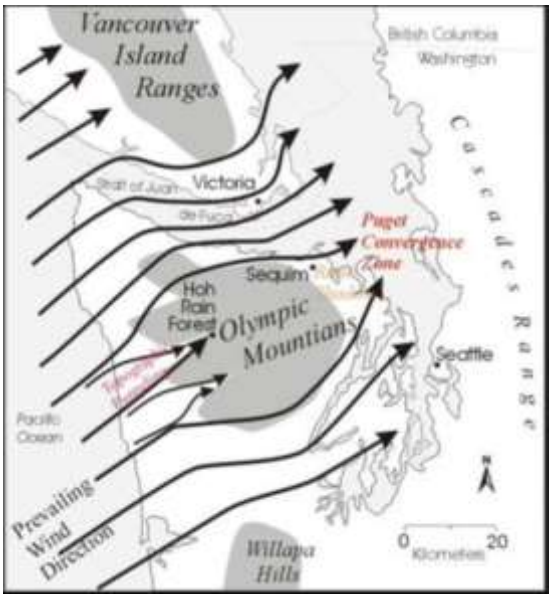

Figure 3-1 Prevailing Wind Directions

Based on data from USA Facts (2022), temperatures within Mason County have increased 0.2 degrees from May 1900 to April 2022 (see Figure 3-2). The 12-month total precipitation increased 9.9 inches from May 1900 to April 2022. From May 1900 to April 2022, the average 12-month total precipitation was 88.6 inches. The wettest 12-month average was November 1996-Octobr 1997, with a total of 132.5 inches. The driest 12-month average was December 1928-November 1929, with only 49.5 inches (see Figure 3-3). April 2022 had 9 inches of precipitation, which is 4 inches wetter than average when compared to all Aprils since 1985.[3]

As climate change progresses, monitoring climate and maintaining regular weather records and data will become increasingly important to track local changes. The Tribe has identified this as a potential strategy for the 2024 update.

[2] Ibid.

[3] Climate in Mason County, Washington | USAFacts

Figure 3-2 12-Month Average Temperatures 1900-2022

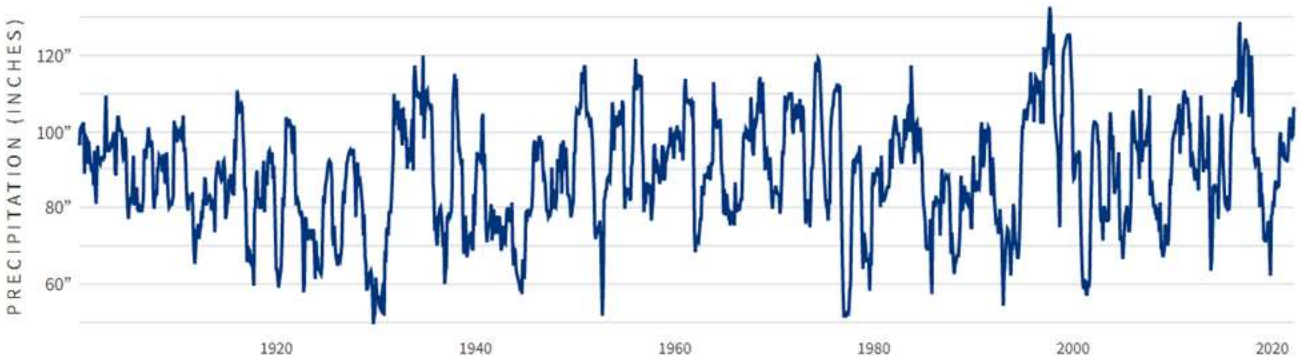

Figure 3-3 12-Month Precipitation Totals 1900-2022

3.4 DEMOGRAPHICS, DEVELOPMENT AND REGULATION

Knowledge of the composition of the population and how it has changed in the past and how it may change in the future is needed for making informed decisions about the future. Information about population is a critical part of planning because it directly relates to land needs such as housing, industry, stores, public facilities and services, and transportation. Population changes are useful socio-economic indicators. A growing population generally indicates a growing economy, while a decreasing population signifies economic decline.

3.4.1 Tribal Enrollment

Based on Census Data[4] for the Squaxin Island Tribe (SIT), there are approximately 382 individuals living on the Reservation (both tribal and non-tribal); however, SIT data identifies a Tribal population count of 426

[4] Census Data. Accessed 18 Sept. 2023. Available at: My Tribal Area (census.gov)

individuals living on-reservation. Enrollment data identifies a tribal population as of January 2023 in excess of 1,120 enrolled members. The SIT do anticipate a continued increase in population, with more tribal citizens returning to the area once new areas have been developed, and there is increased housing available.

For planning purposes, the sum of 141 housing units, and 3 people per household was utilized to identify potential population impact based on tribal data.

3.4.2 Age Distribution

In general, as a group, the elderly (65 and over) are more apt to lack the physical and economic resources necessary for response to hazard events 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. Elderly residents living in their own homes may have more difficulty evacuating their homes and could be stranded in dangerous situations. This population group is more likely to need special medical attention, which may not be readily available during natural disasters due to isolation caused by the event. Specific planning attention for the elderly is an important consideration given the current aging of the American population.

Children under 5 are also particularly vulnerable to disaster events because of their young age and dependence on others for basic necessities. Very young children may additionally be vulnerable to injury or sickness; this vulnerability can be worsened during a natural disaster because they may not understand the measures that need to be taken to protect themselves from hazards.

According to Census data (2020), the median age distribution on the Reservation is 26 years. Based on Census data, approximately 42 residents are over 65, with 58 children 5 years of age or under. There are 33 children aged 5-9 years.

3.4.3 Income

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 means that households living in poverty are automatically disadvantaged when confronting hazards. Additionally, the poor typically occupy more poorly built and inadequately maintained housing. Mobile or modular homes, for example, are more susceptible to damage in earthquakes 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 un-reinforced masonry, a building type that is particularly susceptible to damage during earthquakes. Furthermore, residents below the poverty level are less likely to have insurance to compensate for losses incurred from natural disasters. This means that residents below the poverty level have a great deal to lose during an event and are the least prepared to deal with potential losses. Personal household economics significantly impact people's decisions on evacuation: those who cannot afford gas for their cars will likely decide not to evacuate.

Median household income is $48,750. Approximately 17.5 percent of the Tribal Members living on the Reservation fall below the poverty line (2020 Census). Based on Tribal data (2023), unemployment rate

is approximately 30 percent. It is estimated that 344 individuals living on the Reservation have health insurance coverage, while 38 do not.

3.4.4 Disabled Populations

The 2020 U.S. Census Bureau estimated 54 million (non-institutionalized) Americans with disabilities in the U.S. This equates to about one-in-five persons. People with disabilities are more likely to have difficulty responding to a hazard event than the general population. Knowing that local government is the first level of response to assist individuals, coordination of efforts to meet the access and functional needs of individuals with disabilities is paramount to life safety efforts. In this respect, it is important for emergency managers to distinguish the differences between *functional* and *medical* needs to allow them to plan accordingly for incidents which require evacuations and sheltering needs. Pre-determining the percentage of population impacted with a disability will provide emergency management personnel and first responders the information necessary to pre-plan by having individuals available who can provide those services necessary to meet the requirements of those with access and functional needs.

The 2020 Census identifies a total of 57 individuals living on the reservation with a disability, broken down by age as follows: four (4) under the age of 18 years; 38 between the ages of 18-64, and 15 65 years of age and over.

3.4.5 Economy

Prior to COVID-19, the Tribal government and its economic enterprises constituted the largest employer in Mason County with over 1,250 employees. As of the end of 2022, the SIT had a total of 291 employees, 10 of which served as department directors, with 12 tribal members serving in managerial positions (SIT 2022 Annual Report).[5]

Service industry occupations were the highest sector of employment, followed by management, business, science and arts. Sales and office occupations and natural resources, construction and maintenance occupations were the remaining primary sectors.

Traditional SIT economic activities are centered on the productive land the SIT people inhabited. Fishing, shellfish harvesting, and the lumber industry remain the most prominent sources of income. Throughout the years, focus has shifted due to external influences (lack of federal funding to support expansion), but today, the SIT people are committed to a value-added model of resource management.

Tribal governments have the authority to operate tribal-owned businesses, which in turn generate revenues for governmental services, provide jobs and develop natural resources. This model also allows entrepreneurial Tribal members to work together to benefit from economies of scale and to have access to capital resources that they may not otherwise have had access.

Economic/Commercial/Businesses owned and operated by the SIT include:

[5] SIT FY 2022 Annual Report. Accessed 7 Aug. 2023. Available online at: FY22 Government Annual Reports – Squaxin Island Tribe

- Little Creek Casino and Resort
- Salish Cliffs Golf Club
- Island Enterprises Inc.
- Kamilche Trading Post
- Skookum Tabacco Factor
- Steamboat Trading Post
- Clam Fresh LLC
- Elevation

Washington State Employment Security Department, in conjunction with the federal Bureau of Labor Statistics annually compiles a list of distressed areas within Washington state by averaging the employment and unemployment numbers for the prior three years. Distressed areas are counties where the three-year unemployment rate is at least 20 percent higher than the statewide average. At present both Grays Harbor and Mason Counties, the counties in which the Reservation is located, are considered distressed areas (see Figure 3-4).[6]

The Tribe feels that the percentage of unemployed on the Reservation is much higher than indicated within the general areas of the surrounding counties, with the Tribe estimating an unemployment rate of approximately 30 percent of tribal members. The Tribe does qualify as a small, impoverished community based on FY2023 Federal standards.

[6] Washington State Employment Security Department – Distressed Areas List (2021). Accessed 29 Sept. 2022. Available online at: ESDWAGOV - Distressed areas list

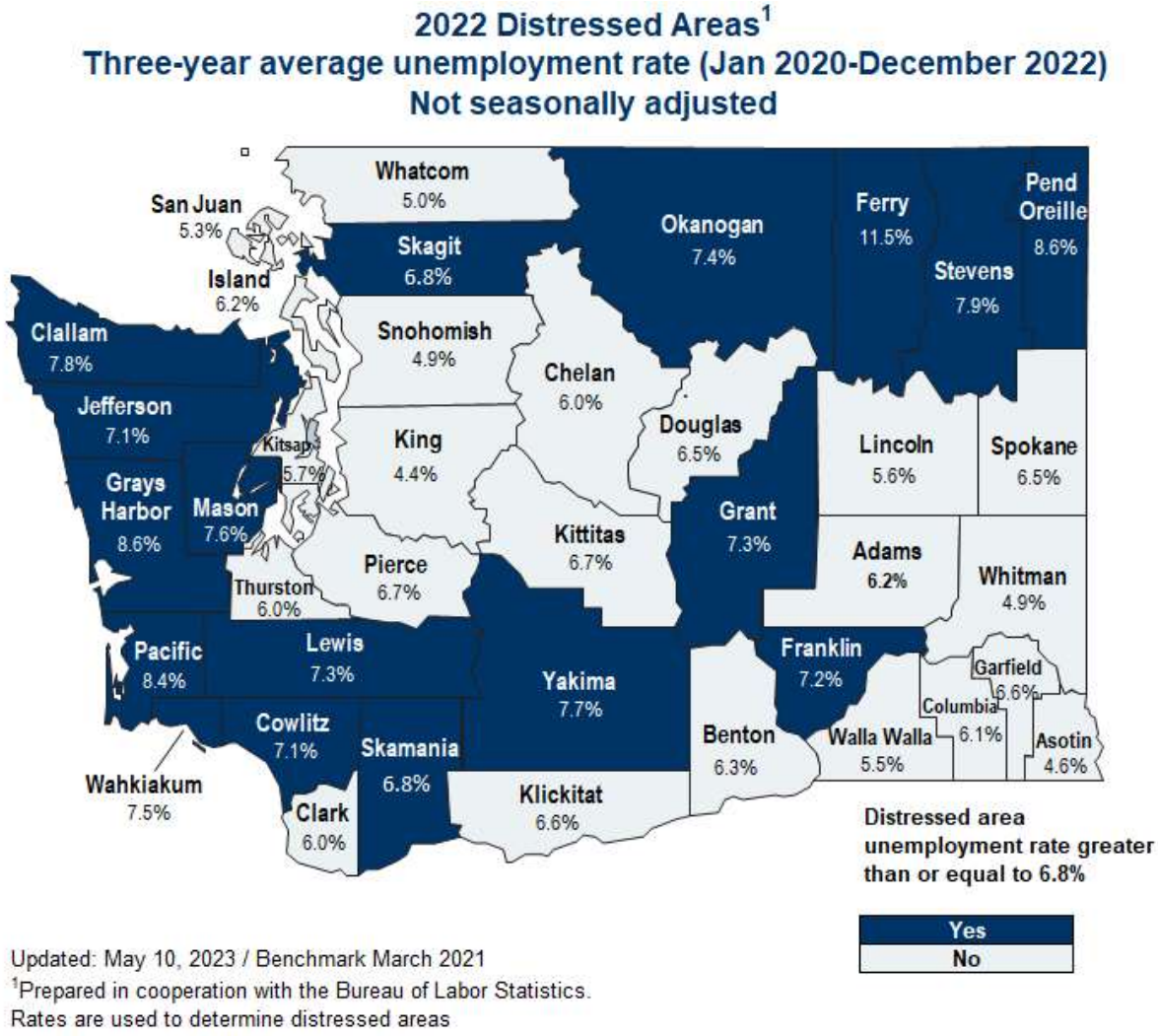

Figure 3-4 Washington State 2022 Distressed Areas and Unemployment Rates

3.5 MAJOR PAST HAZARD EVENTS

Presidential disaster declarations are typically issued for hazard events that cause more damage than tribal governments can handle without assistance from the federal government, although no specific dollar loss threshold has been established for these declarations. A presidential disaster declaration puts federal recovery programs into motion to help disaster victims, businesses, tribal and public entities. In some instances, grant funding from disaster declarations are also matched by state programs and funds, for which the Tribe may be eligible.

Emergency declarations are more limited in scope and without the long-term federal recovery programs of a presidential major disaster declaration. Generally, federal assistance and funding are provided to meet a specific emergency need or to help prevent a major disaster from occurring.

Fire Management Assistance declarations (44 CFR 204.21) are ones for which FEMA approves declarations for fire management assistance when a fire constitutes a major disaster, based on the following criteria:

- Threat to lives and improved property, including threats to critical facilities and critical watershed areas
- Availability of state and local firefighting resources
- High fire danger conditions, as indicated by nationally accepted indices such as the National Fire Danger Ratings System
- Potential major economic impact.

Table 3-1 identifies all Federal Disaster Declarations which have occurred on the SIT since 1957 for which presidential disaster declarations were issued, or in the case of fire, where the fire management was issued. A total of 29 federally declared disasters have occurred.[7] In addition, the SIT has also issued its own disaster declarations when situations have justified such actions. Those declarations are referenced within the hazard profiles as the information is available.

Unfortunately, many natural hazard events do not trigger or rise to the level of a federal disaster declaration, but nonetheless have significant impacts on their communities. These events are also important to consider in establishing recurrence intervals for hazards of concern. Limited dollar loss data is available to identify impact to the SIT for many events. The SIT has identified the capture of such loss data as a strategy for future planning efforts, as well as to support grant opportunities.

TABLE 3-1
DISASTER DECLARATIONS FOR HAZARD EVENTS SQUAXIN ISLAND TRIBE (1953-2022)

Disaster Number	Programs Declared		Declaration Date	Incident		Incident Date	Comments / Dollar Losses
	IA	PA		Type	Title		(If available)
4650*	N	Y	March 29, 2022	Severe Winter Storm	Severe Winter Storms, Straight-Line Winds, Flooding	12/26/ 2021 – 1/15/ 2022	Pending
4593	N	Y	April 8, 2021	Severe Winter Storm	Severe Winter Storms, Straight-line Winds, Flooding	12/29/ 2020 - 1/16/ 2021	~$5.4 million statewide
4539	N	Y	April 23, 2020	Severe Storm	Severe Storms, Flooding, Landslides and Mudslides	1/20 – 2/10/ 2020	Pending

[7] Incidents include one for Hurricane Katrina, which had no direct impact on the State, but we were identified as receiving victims impacted by Hurricane Katrina. COVID includes two disaster events.

TABLE 3-1
DISASTER DECLARATIONS FOR HAZARD EVENTS SQUAXIN ISLAND TRIBE (1953-2022)

Disaster Number	Programs Declared		Declaration Date	Incident		Incident Date	Comments / Dollar Losses
	IA	PA		Type	Title		(If available)
4481* / 3427	Y	Y (PA-B)	March 22, 2020	Pandemic	COVID-19	1/20/ 2020 – 5/11/23	May 2023
4418	N	Y	March 4, 2019	Severe Winter Storm	Severe Winter Storms, Straight-Line Winds, Flooding	12/10 – 12/24/ 2018	~$12.7 million statewide
4253	N	Y	2/2/2016	Flood	Severe Winter Storm, Straight-Line Winds, Flooding, Landslides, Mudslides	12/1/ to 12/14/ 2015	~$10.3 million statewide
4249	N	Y	1/15/2016	Severe Storm	Severe Storms, Straight-Line Winds, Flooding, Landslides, Mudslides	11/12/ to 11/21/ 2015	
4056	N	Y	3/5/2012	Severe Storm	Severe Winter Storm, Flooding, Landslides, Mudslides	1/14/ to 1/23/ 2012	$30.55 million statewide
1825	N	Y	3/2/2009	Severe Storm	Severe Winter Storm And Record And Near Record Snow	12/12/2008 to 1/5/ 2009	
1817	N	Y	1/30/2009	Flood	Severe Winter Storm, Landslides, Mudslides, Flooding	1/6/ to 1/16/ 2009	
1734	Y	Y	12/8/2007	Severe Storm	Severe Storms, Flooding, Landslides, Mudslides	12/1 to 12/17/ 2007	
1682	N	Y	2/14/2007	Severe Storm	Severe Winter Storm, Landslides, Mudslides	12/14 to 12/15/ 2006	
1641	N	Y	5/17/2006	Severe Storm	Severe Storms, Flooding, Tidal Surge, Landslides, Mudslides	1/27 to 2/4/ 2006	
3227	N	N	9/8/2005	Coastal Storm	Hurricane Katrina		No direct impact in WA State.
1499	Y	Y	11/7/2003	Severe Storm	Severe Storms and Flooding	10/15 to 10/23/ 2003	Disaster also included Drought for some counties in state.

TABLE 3-1
DISASTER DECLARATIONS FOR HAZARD EVENTS SQUAXIN ISLAND TRIBE (1953-2022)

Disaster Number	Programs Declared		Declaration Date	Incident		Incident Date	Comments / Dollar Losses
	IA	PA		Type	Title		(If available)
1361	Y	Y	3/1/2001	Earthquake	Earthquake	2/28/ to 3/16/ 2001	
1172	Y	Y	4/2/1997	Flood	Heavy Rains, Snow Melt, Flooding, Land- and Mud-slides	3/18/ to 3/28/ 1997	
1159	Y	Y	1/17/1997	Severe Storm	Severe Winter Storms, Land- & Mud- slides, Flooding	12/26/1996 to 2/10/ 1997	
1079	Y	Y	1/3/1996	Severe Storm	Severe Storms, High Wind, Flooding	11/7 to 12/18/ 1995	
981	N	Y	3/4/1993	Severe Storm	Severe Storms and High Wind	1/20 to 1/21/ 1993	
883	Y	Y	11/26/1990	Flood	Severe Storms and Flooding	11/9 to 12/20/ 1990	
623	Y	Y	5/21/1980	Volcano	Volcanic Eruption, Mt. St. Helens	5/21/ 1980	
612	Y	N	12/31/1979	Flood	Storms, High Tides, Mudslides, Flooding	12/31/ 1979	
492	Y	Y	12/13/1975	Flood	Severe Storms & Flooding	12/13/ 1975	
414	Y	Y	1/25/1974	Flood	Severe Storms, Snowmelt, Flooding	1/25/ 1974	
196	Y	Y	5/11/1965	Earthquake	Earthquake	5/11/ 1965	
185	Y	Y	12/29/1964	Flood	Heavy Rains and Flooding	12/29/ 1964	

*Tribal direct disaster declaration
Loss data identified within hazard profiles if available
Shaded gray disasters occurred since completion of the 2018 Update (Approved by FEMA 2019)

The most common disasters to occur are severe storms and flooding. Those hazards are further broken down by month, year, recurrence intervals (not based on order of magnitude), probability of occurrence, and FEMA ranking as illustrated in Table 3-2. These are based on FEMA event typing. For these generalized purposes, recurrence intervals are determined by the number of events divided by the number of years to obtain an average. In some instances, recurrence intervals based on magnitude are

contained within the hazard profiles. The recurrence intervals are not based on the order of magnitude (e.g., a 100-year storm), but rather on the fact that the event occurred, no matter what the magnitude. The Percent Probability of Occurrence is calculated by the dividing the number of events by years, and then multiplying that sum by 100 to create the percent probability of an event occurring in any given year.

TABLE 3-2
STORM DISASTER HISTORY BY MONTH, RECURRENCE, AND PROBABILITY OF OCCURRENCE (1953-2022)

Hazard Type	Jan	Feb	Mar	Ap	May	June	July	Aug	Sept	Oct	Nov	Dec	Total	Years of Occurrence	FEMA Rank	Recurrence / Years (No Order of Magnitude)	Probability/ (Percent risk that an event may occur)
Flood	2	1	1	2	0	0	0	0	0	0	1	3	**10**	64, 74, 75, 79, 90, 97, 09, 16, 20, 22	2	6.5	15.38
Severe Storm	3	1	4	1	1	0	0	0	0	0	1	1	**12**	93, 96, 97, 03, 06, 07 (x2), 09, 12, 16, 19, 21	1	5.4	18.46
TOTAL	**5**	**2**	**5**	**3**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**4**	**22**				

Based on FEMA designation and dates.

3.6 LAND USE AND FUTURE DEVELOPMENT TRENDS

As a Sovereign Nation, decisions on land use are governed by tribal government, who maintain legislative and policy-making authority. The Tribe has adopted the most recent edition of the International Building Codes. Facilities Planning within Planning and Community Development provides Housing Code Enforcement.

The SIT does have planning and zoning regulations which govern the areas of development for lands on the reservation or on tribal-owned lands. In general, land use categories are divided into four zones: Forested Lands, Commercial, Residential, and Wilderness.

Homeownership consists of individual (fee and trust), BIA, and HUD housing (including rentals) located on the Reservation. As of FY 2022, Squaxin Housing managed 77 rentals, 10 additional rental units, four RV sites, and 12 Tiny Homes located within Kamilche Valley. The Tribe estimates that there are approximately 141 housing restructures owned throughout the area by Tribal Members. For planning purposes, only

emergency housing owned by the Tribe are considered within the residential structure count identified within the risk assessment. In some instances, those may be multi-dwelling units (e.g. duplex or triplex), but is counted as one structure.

Much of the owned tribal lands are considered culturally sacred; however, there are specific areas which are particularly more significant, such as areas designated for archaeological preservation. The Tribe's cultural resource program oversees the ancestral and sacred sites and landscapes in cooperation with federal, state, and local land management agencies, private developers, and landowners.

With respect to additional future development, the Squaxin Island Tribe plans to continue targeting sustainable development where suitable infrastructure can be guaranteed and where reasonable precautions can be taken to protect the sites from the adverse conditions of natural disasters while protecting the natural environment from damage. For new construction, the following underlying principles form the foundation for the Tribe's land use goals and policies.

- Create complete and integrated communities (or neighborhoods) containing housing, shops, work places, campsites, parks, and civic facilities essential to the daily life of the Tribe while keeping cultural resources and cultural heritage intact.
- Encourage development of tribal centers that combine housing, commercial, office park and public uses in designated mixed-use areas, while preserving the locations of culturally sensitive areas.
- Ensure that the Tribe maintains well-defined edges, such as agricultural and forest greenbelts, wildlife corridors and urban separators, which are permanently protected from development.
- Ensure that planning and development are pedestrian-oriented and designed to enhance the human scale, creating a greater sense of community and place that enhances the livability of the Reservation, while promoting its hopes for expansion.
- Respect the integrity and character of existing natural topography, vegetation and landscape features when locating roads and other development.
- Promote development that supports natural drainage and infiltration for new subdivisions, multifamily development, and commercial development in a manner which is economically sound and environmentally feasible.

Structure Development Since Completion of Last Plan

Since completion of the last plan, minimal new development has occurred, although there has been some remodeling and updating of existing structures. The Tribe has also built 12 tiny homes to assist with housing shortages on the Reservation in the Kimalchie area.

Those new structures completed since the last mitigation plan was adopted have resulted in no negative impact, and do not increase the vulnerability to the hazards of concern, other than by the mere increase in the number of structures owned by the SIT.

Since completion of the last plan, the following development efforts have occurred or been completed:

- WWTP Expansion started in FY 2022 with anticipated completion in 2023-2024.

- Storm water system rehabilitation occurred to improve the existing systems in place;
- The Tribe updated SCADA system to the wastewater treatment plant to ensure appropriate safety measures are in place with respect to cyber security and operational capacity;
- Tribal Center and Casino water storage tanks were cleaned and refurbished to higher code standards;
- Emergency Generators were acquired for wells one and two, the main lift station, the Community Kitchen, and the Administration Building to ensure continued operations during periods of power outages. This would include continuity of government operations with respect to the administration building, and continued safety for tribal citizens with respect to the functionality of the Community Kitchen, which serves as a shelter and feeding location on the Reservation.
- Wastewater lift, pumps and various components were renovated and upgraded to enable daily manual operations.

All of the structures completed since the last plan provide critical services for the Tribe and have had no negative hazard impact resulting from their construction.

Community water, roads and other (public) utilities have also been developed within the area but are not under the ownership of the SIT. The Tribe does offer support when such construction occurs and helps to utilize every possible means to ensure that new development or remodel does not have an adverse impact on the hazards of concern.

Permitting and Enforcement

The SIT does require permitting for construction occurring on the Reservation or on Tribal lands pursuant to SIT Tribal Code. This may include a public hearing identifying and discussing the project, as well as the development of an Environmental Impact Statement assessing environmentally sensitive areas when necessary. The SIT also fully complies with existing permitting and code requirements in place at the local level for tribal structures remodeled or built off of the Reservation on lands not yet in trust.

Structures built on the Reservation or trust lands are inspected to ensure compliance with all established building, plumbing, electrical (etc.) codes in place, which are regularly updated to maintain compliance. Appropriate building setbacks and restrictions in high-hazard areas are enforced.

The SIT Facilities Planning with the Planning and Community Development Department are responsible for inspection and code enforcement of all regulations and may utilize additional departments and agents to assist in enforcement. Building Inspectors are also utilized to perform regulatory and enforcement functions, including compliance inspections.

At present, all new buildings are required to be built to existing International Building Code (IBC) standards. The SIT has always utilized the most stringent codes in place at the time of construction when any construction or remodeling has occurred. Once complete, this 2024 update to the Hazard Mitigation Plan, along with existing development regulations, will be utilized to support land use development in the future by providing vital information on the risk associated with natural hazards in the planning area, and

support development in such a way as to reduce the impact of the hazards on the Tribal citizens and visitors to the planning area.

The Tribe will continue to incorporate by reference the Hazard Mitigation Plan in any future comprehensive or land use plans as completed. This will assure that all future trends in development can be established with the benefits of the information on risk and vulnerability to natural hazards identified in this plan, as well as continue to protect the natural environment.

Future Development

Future development during the life cycle of this plan includes housing, governmental structures (including essential facilities), and economic expansion. The following are under review for future development or structural improvements (these areas have been included within the current risk assessment):

- Residential structures, including single family and multi-unit complexes;
- Government administrative facilities;
- Community Center, Health and Wellness Structures, Social Service Buildings; and
- Gas/Fueling Station.

Examples of the positive and low-impact activities undertaken by the Tribe are discussed throughout the document, but include, among other efforts, acquisition of properties for open space, including the removal of structures from those properties, relocation of portions of the reservation which include previously flooded buildings, and forest practices which will enhance the economic industry for the SIT while also sustaining those areas for future generations. Additional projects are further discussed in Chapter 13.

3.6.2 Critical Facilities and Infrastructure

Critical facilities and infrastructure are those that are essential to the health and welfare of the population. These become especially important after a hazard event. Critical facilities typically include police and fire stations, schools, shelters, and emergency operations centers, among others. Critical infrastructure can include 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. As defined for this Hazard Mitigation Plan, critical facilities are focused on tribal-owned facilities, and include, but are not limited to the following:

Figure 3-5 The first Indian Shaker Church a Mud Bay, Eld Inlet, Washington State, circa 1892

- Police stations, fire stations, vehicle and equipment storage facilities, communication centers and towers, and emergency operations centers needed for disaster response before, during, and after hazard events.

- Public and private utilities, facilities, and infrastructure vital to maintaining or restoring normal services to areas damaged by hazard events.

- Hospitals, including large medical facilities, which provide critical medical services.

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, and/or water-reactive materials (e.g., hazmat facilities).

- Public gathering places that could be used as evacuation or feeding centers during large-scale disasters.

- Governmental facilities central to governance and quality of life along with response and recovery actions taken as a result of a hazard event.

Applying the above definition, the Planning Team developed a detailed list of those structures meeting the identified definition, which was utilized as the primary source of risk assessment during this process. Structures identified for analysis include:

- Tribal owned facilities such as department, agency, council facilities, casino, hotel, fish hatchery, and administrative offices that provide essential services or are primary to the economy or the culture of the Squaxin Island Tribe or its Peoples.
- Emergency response facilities needed for disaster response and recovery, including, but not limited to: public safety buildings; emergency services buildings; emergency operations centers; emergency supply storage facilities; public works facilities; low income, emergency shelter(s), and tribally owned residential structures.
- Tribal medical and health clinics or facilities used during both emergency response, or in the normal course of business.
- Tribal facilities that may be used to house or shelter disaster victims, schools, day cares, gymnasiums, churches, senior or community centers, or facilities that have large kitchen areas to provide emergency feeding services.
- Tribal owned utilities and infrastructure vital to maintaining or restoring normal services to the areas damaged by the disaster such as power lines, roads, public works facilities, communication hubs, water, and wastewater facilities, etc.
- Community gathering places, including culturally significant areas, parks, community centers, gymnasiums, and meeting halls.
- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic, and/or water-reactive materials (e.g., hazmat sites).
- Cultural sites or facilities that are vitally important to maintaining the Tribe's cultural history, language, and traditions, such as burial grounds, archaeological sites, and artifact storage facilities.

The critical facilities identified for this plan update incorporate ~119 structures, including culturally significant structures, emergency residences (owned by SIT Housing), and governmental structures, among others. The Tribe does own land mass and some structures which are located outside of the study region of the SIT (e.g., Grays Harbor County maintains the Northwest Indian Treatment Center on a 2.5 acre parcel in Elma, which also maintains ceremonial areas and a healing garden; Thurston County maintains culturally significant areas and trees, among other items; and Lewis County maintains culturally significant areas, including clam beds, etc.).

Due to the historic land use on the Reservation, residential structures were not included in this assessment as there is a mix of tribal and non-tribal residential structures scattered throughout the tribal planning area, as well as non-tribal commercial/business structures. Many of the residential structures in the area also serve as seasonal homes or rentals, so determining impact to individuals is difficult. For planning purposes, the Planning Team estimates approximately 141 residential structures scattered throughout the area, with ~3 persons per household.

The critical facilities list of structures is not provided within this document and is considered confidential in nature. The Tribe will continue to rely on the Mason County Hazard Mitigation Plans to identify critical or essential facilities which are not owned or managed by the SIT which are at risk to the hazards of concern.

For emergency management planning purposes, building structure values considered in this plan which are owned and operated by the SIT total approximately $180 million. Content value for planning purposes is estimated to be $57 million. These figures do not include potential revenues generated by the commercial or business structures, or inventory. Table 3-3 illustrate the critical facilities for the SIT.

TABLE 3-3
CRITICAL FACILITIES

Critical Facility Type	Count	Building Values (Structure and Content Combined)
Agricultural	5	$2,994,224.00
Commercial (includes docks)	17	$115,815,909.00
Cultural	10	$7,784,965.00
Environmental and Hazardous Materials	3	$115,563.00
Government/Administration	13	$28,033,423.00
Industrial	7	$19,516,581.00
Medical	8	$12,571,392.00
Power	1	$825,789.00
Protective	12	$5,020,292.00

TABLE 3-3 CRITICAL FACILITIES		
Critical Facility Type	**Count**	**Building Values (Structure and Content Combined)**
Residential (SIT Owned) (Emergency Units, such as the Tiny Homes)	24	$5,607,810
Schools (Daycare, Head Start)	2	$8,408,640
Shelters, Gym, Gathering Structures	2	$9,895,507
Transportation	2	$881,604
Water	4	$3,044,865
Wastewater	9	$15,504,266
Totals	**119**	**$236,020,830.00**

3.6.3 Age and Type of Building Stock

The year of construction is significant in determining the potential impact from various hazards due to construction standards in place at the time. Structures built pre-1975 historically have maintained lower building standards than current codes in place. Moderate code are those structures built after 1975. New construction is built to higher standards. The Tribe has limited data with respect to the year built for many of the structures owned.

Review of structure data identifies the following:

- One structure was built in the 1920s, which serves as the industrial location of Salish Seafood. That structure is also of steel construction.
- Two structures were built in the late 1950's, and include the tribal gas station/convenience store, and a culturally significant structure. Both of those structures are of wood construction.
- Two structures were built in 1960, one of which serves as a rental dwelling, and one a church. Both are constructed of wood materials.
- The legal department is housed in a 1970 wood structure.
- All of the identified medical facilities were built post 1996, with the newest constructed in 2000, 2007, 2009, 2014, and 2019. The Fitness Center was completed since completion of the last plan.
- The existing Emergency Operations Center and Public Safety Office was built in 1993, of wood construction. One small structure (previously an expresso hut) which is identified as a potential site for distribution during an emergency, was built in 2018. The Senior Center Building, which serves as a shelter location, appears newer, with a commercial grade kitchen. Two additional shelter locations are of newer construction and to higher standards, built in 1998 and

2000/2009 (remodel). The year of construction for the fire pump house and Kamilche Fire Station is unknown.

- Two school/learning centers are newer, built in 2004 and 2005, of wood construction.
- Of the residential structures owned by the SIT included in the assessment for which age is known range from 1998-2021, with 12 Tiny Homes build since completion of the last plan between the years 2020-2021. The age of construction for the Elders' housing is unknown.

Construction Materials

- The majority of structures (>50) are wood framed.
- The water system is concrete; one additional structure is also concrete (storage facility);
- Ten buildings are of steel construction, including one of the Tribe's largest economic hubs, the Casino and Hotel.
- The water towers and wastewater treatment plants are constructed of heavy, non-combustible materials.
- There are a limited number of modular buildings in place, which have taken the place of structures previously damaged by flood or severe weather events and serve as both residential structures and office space.

3.6.4 Transportation and Bridges

US Highway 101 (US101) traverses through the middle of the Reservation. It is a major trucking transport route to the coastal communities north on Highway 101 and Highway 3. These serve the planning area as main access and evacuation route. State Route 108 and Highway 8 are also major routes into the area, although Highway 8 is frequently flooded. These routes make up the major transportation network of the Squaxin Island Tribe.

There are also miles of forestry roads which provide access to remote forestlands, river ecosystems, and shorelines of the Reservation. These roads are primarily narrow, gravel roads used for logging activities. Most are closed to general public access. If conditions are good after an event, these roads may provide alternative evacuation routes. However, these roads are primarily dirt roads through heavily wooded areas that are susceptible to erosion, washouts, and fallen trees that could block access.

3.6.5 Hazardous Materials

Hazardous materials can be released for many reasons, including as a potential terrorist target, human error, or the structural integrity being compromised by a natural hazard event, such as an earthquake, tsunami, flood, or landslide (among others). Release of hazardous materials could cause significant damage to the environment and people. Figure 3-6 identifies the location of potential hazmat sites on and around the Reservation based on Washington State Department of Ecology's annual report (2023).

The planning area has two tribal-owned hazardous material sites (gas stations) on the Reservation. There is also the Squaxin Island Propane Transfer Station, which maintains approximately 2,000 gallons of

propane in a single tank. Propane also fuels the wastewater treatment facilities' backup generators. The Tribe also owns and operates a marijuana grow and sale facility, which maintains waste products and chemicals requiring special handling and disposal. Rail lines traveling through Squaxin Island Reservation are utilized to transport ammunition for the Department of Defense facilities in Bremerton, WA, twice annually. Natural Gas is provided to areas of the Reservation by Cascade Natural Gas, with the pipeline traveling throughout the Reservation.

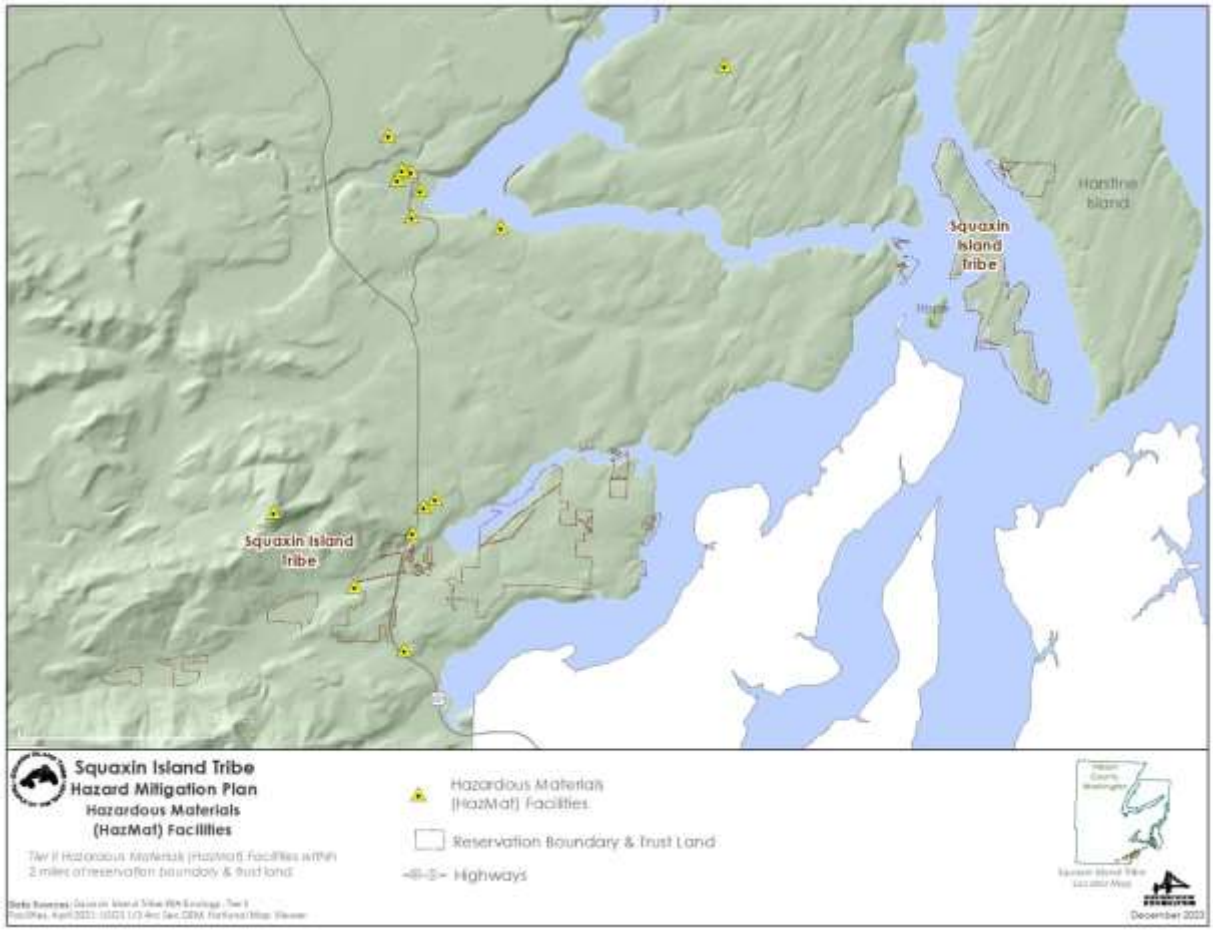

Figure 3-6 Hazardous Materials Facilities (WA DOE, 2023)

3.7 CLIMATE CHANGE

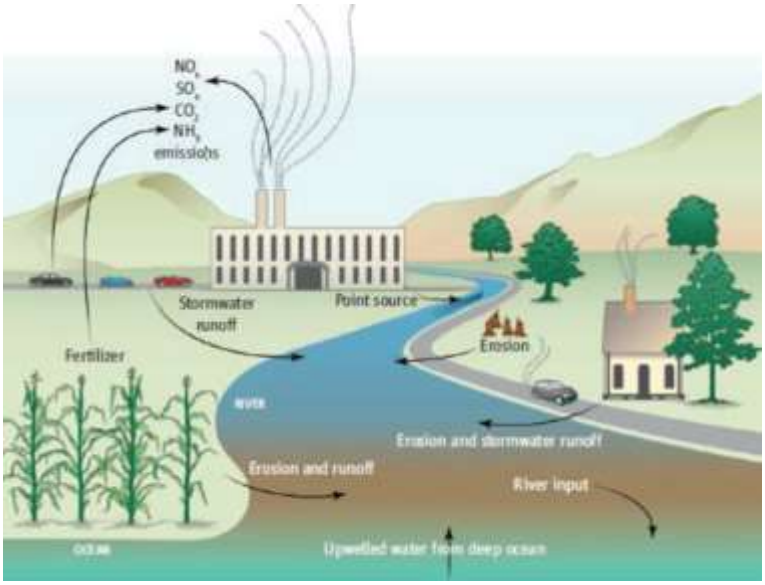

Figure 3-7 Climate Change Contributors

Climate, consisting of patterns of temperature, precipitation, humidity, wind and seasons, plays a fundamental role in shaping natural ecosystems and the human economies and cultures that depend on them. Climate change is a long-term shift in global or regional climate patterns. Often climate change refers specifically to the rise in global temperatures from the mid-20th century to present.

The warming trend and its related impacts are caused by increasing concentrations of carbon dioxide and other greenhouse gases in the earth's atmosphere. Greenhouse gases are gases that trap heat in the atmosphere, resulting in a warming effect. Carbon dioxide is the most commonly known greenhouse gas; however, methane, nitrous oxide and fluorinated gases also contribute to warming. Emissions of these gases come from a variety of sources, such as the combustion of fossil fuels, agricultural production, and changes in land use (see Figure 3-7).

Climate change will affect the people, property, economy, and ecosystems of the SIT in a variety of ways. Some impacts will have negative consequences for the planning area and others may present opportunities. The most important effect for the development of this plan is that climate change will have a measurable impact on the occurrence and severity of natural hazards.

3.7.1 How Does Climate Change Affect Hazard Mitigation?

An essential aspect of hazard mitigation is predicting the likelihood of hazard events in a planning area. Typically, predictions are based on statistical projections from records of past events. This approach assumes that the likelihood of hazard events remains essentially unchanged over time. Thus, averages based on the past frequencies of, for example, floods are used to estimate future frequencies: if a river has flooded an average of once every five years for the past 100 years, then it can be expected to continue to flood an average of once every five years.

For hazards that are affected by climate conditions, the assumption that future behavior will be equivalent to past behavior is not valid if climate conditions are changing. As flooding is generally associated with precipitation frequency and quantity, for example, the frequency of flooding will not remain constant if broad precipitation patterns change over time. The risks of avalanche, landslide, severe weather, severe winter weather, and wildfire are all affected by climate patterns as well.

For this reason, an understanding of climate change is pertinent to efforts to mitigate natural hazards. At present, the SIT has been unable to conduct a comprehensive assessment of climate impact due to cost and staffing levels, but have been able to engage in some assessments with respect to sea level rise and

its impact. With the completion of this plan, the Tribe will continue eligibility for various grant programs, and may elect to pursue funding which will help develop an assessment to determine potential impacts. As such, for this 2024 HMP update, the planning team elected to incorporate the impact of climate change on the specific hazards of concern within each hazard's profile, enabling a clearer understanding of the potential impacts of climate change on the hazards of concern in a generalized manner.

Information about how climate patterns are changing provides insight on the reliability of future hazard projections used in mitigation analysis. Table 3-4 identifies the relationship between climate change risk and its influence on the various hazards of concern within the planning region.

TABLE 3-4
RELATIONSHIP BETWEEN CLIMATE CHANGE AND IDENTIFIED HAZARDS

	Hazards of Concern	Coastal Erosion	Drought	Earthquake	Flood	Landslide	Severe Weather			Wildfire	Tsunami	Volcano*
							Cold	Heat	Winter storms			
CLIMATE RISKS	Increased temperatures	X	P		X	X	X	X	X	P		
	Changes in hydrology	X	P	X	P	P			X	X	X	
	Increased wildfires		X		X	X				P		
	Increase in ocean temperatures and changes in ocean chemistry	P			X				P			
	Increased drought		P									
	Increased coastal erosion	P									X	
	Changes in habitat	X	X		X	X				X		
	Increase in invasive species and pests		X		X	X		X		P		
	Decrease in natural vegetation	X	X		P	P	X		X	P		
	Loss of Wetland ecosystems and services	X	P		P	X				X		
	Increased frequency of extreme precipitation events and flooding				P	P			X			
	Increased Landslides	X	X		X	P			X	X		

"P" identifies the primary relationship between the risk and the identified hazard.
"X" identifies a secondary relationship.

Based on review and analysis of the data, while climate change is not a separate hazard profile, it is appropriate to rank climate change as a hazard based on the following: the probability for impact from climate change throughout the area is likely. While there are still many uncertainties associated with climate change, indicators of impact already exist. The area has previously experienced drought conditions multiple times, almost annually, with the Small Business Administration issuing Economic Injury Disaster Loans throughout the planning area on several occasions. During the summer of 2017, the state experienced one of its driest summers on record. With the anticipated increase in temperatures as a result of climate change such that occurred in June 2021, drought situations will only intensify, including increased water temperatures. During 2022, historic low water levels closed most fishing in several streams of the Olympic Peninsula.[8]

The impact of climate change on earthquake, while relatively unknown, could be exacerbated as a result of increased liquefaction due to increased flooding issues. Anticipated sea level rise would impact the coastal areas of the Tribe , increasing storm surge which exacerbates landslide and erosion incidents (where applicable), as well as increasing the potential for flooding in areas which customarily experienced no or limited flooding. Historical hydrologic patterns of weather events would become increasingly inaccurate, thereby increasing potential vulnerability due to uncertainty for water supplies, flood management, and ecological functions. Increased temperatures would also impact snow levels, decreasing water supplies in the various watersheds, even those outside of the planning area. Higher temperatures anticipated with climate change would increase vulnerability of the population due to excessive heat. Based on the potential impact, the Planning Team determined the CPRI score to be 2.80, with overall vulnerability determined to be a high level.

[8] National Park Service. News Release, 2022. Accessed 19 Sept. 2023. Available online at: Emergency Closure of Recreational Fishing in Most Rivers and Streams of Olympic National Park to Begin on October 6 - Olympic National Park (U.S. National Park Service) (nps.gov)

CHAPTER 4.
CAPABILITY ASSESSMENT

The Planning Team performed an inventory and analysis of existing authorities and capabilities called a "capability assessment." A capability assessment creates an inventory of the Tribe's mission, regulations, programs, and policies in place, and evaluates the capacity to carry them out. Table 4-1 summarizes the legal and regulatory capabilities of the Tribe. Table 4-2 summarizes the administrative and technical capability. Table 4-3 summarizes fiscal capability. Table 4-4 identifies mitigation efforts which are on-going in the planning area. This information illustrates an integration of on-going tribal planning efforts, including FEMA programs and initiatives, among others.

TABLE 4-1
LEGAL AND REGULATORY CAPABILITY

	Tribal Authority or Program in Place	Other Jurisdictional Plan or Program in Place	State Mandated	Comments
Codes, Ordinances & Requirements				
Building Code IBC Standards	Y		Y	The SIT utilizes and has regularly adopted the most current building code standards in place. (Title 11 – Chapter 11.16)
Floodplain Ordinance	Y			The Tribe is NOT part of the NFIP, but flood maps were developed in 2019. The SIT does have land use development regulations in place.
Stormwater Management	Y	Y	Y	Title 11.16.040 #10 of the SIT Tribal Code addresses Stormwater Management
SIT Various Land Use Development Codes, Utility Codes and Building Codes	Y			Various permitting and regulations for the Reservation, including Title 11 – Buildings and Utilities. Note: As of this 2024 update, the Tribe is in the process of reviewing and revising this section of the SIT Codes.

TABLE 4-1
LEGAL AND REGULATORY CAPABILITY

	Tribal Authority or Program in Place	Other Jurisdictional Plan or Program in Place	State Mandated	Comments
Growth Management	Y			The Tribe has established areas for development which has been updated as new land mass is acquired. While the Tribe is not required to address growth management in the same manner as applicable counties and cities in the state of Washington, it has developed smart land use decisions which are a benefit to both the environment and the residents of the SIT.
Tribal Health and Safety	Y	Y	Y	Health and Safety as it relates to public health of tribal citizens is addressed by Tribal Wellness, who administers programs and provide direct medical services. The SIT also works with surrounding communities, and State Dept. of Health to provide various types of health campaigns.
Climate Change Adaptation	Y			The Tribe is engaged in various climate change issues. At present, the Tribe is in the process of a Climate Change Study; however, the results of that study will not be completed during the development phase of this plan. As data is available, it will be incorporated herein. The Tribe has had a practice of purchasing surrounding lands, many of which are frequently flooded or impact the natural and cultural resources of the Tribe. Much of the lands have remained in their natural environment, embracing climate change adaptation practices as climate change continues to impact and exacerbate hazard prone areas as a result of, among other causes, increased precipitation, and severe storm events.

TABLE 4-1
LEGAL AND REGULATORY CAPABILITY

	Tribal Authority or Program in Place	Other Jurisdictional Plan or Program in Place	State Mandated	Comments
SIT Title 7: Natural Resource and Cultural Resource Management	Y			Used by the SIT Natural Resources to manage SIT forests, finfish, shellfish, hunting, and wildlife habitat, and mineral lands.
Environmental Protection	Y			Tribal programs as well as EPA regulated programs. SIT Brownfield Program identifies various Brownfield Sites for cleanup and restoration on or near Tribal lands.
SIT Forest Practices Act and Regulations	Y			Adopted by Resolution 04-56 and amended by Resolution 05-74. SIT under Title 7.36 of Squaxin Island Tribal Code was given authority to establish, administer and enforce management guidelines to ensure the commercial forest lands of the reservation would be managed consistent with sound policies of natural resource protection.
Planning Documents				
Improvement Plan	Y			Improvement plans via the Business Committee and Natural Resources exist for developed areas, and several undeveloped parcels.
Floodplain or Basin Plans or Activities	Y			The Tribe is heavily engaged in planning efforts to reduce flood damage and protect aquatic species in the watersheds throughout the area, undertaking various studies and conducting analyses, which, when completed, will be integrated and utilized to enhance the various programs in place to help mitigate the hazards of concern. As of 9/25/23, the Tribe has several studies on-going, which remain confidential in nature.

TABLE 4-1
LEGAL AND REGULATORY CAPABILITY

	Tribal Authority or Program in Place	Other Jurisdictional Plan or Program in Place	State Mandated	Comments
Capital Improvement Plan	Y			The Tribe maintains a CIP to identify and prioritize future development and enhancement of existing structures. Content of that plan remain protected and are not readily available for public disclosure.
Habitat Conservation or Clean-Up Plans	Y			Wildlife trafficking is growing at an alarming rate worldwide and threatens an increasing variety of terrestrial, freshwater, and marine species. A high demand exists for some of the species that occur within the SIT including, but not limited to bald eagles, black bear gall bladders, and elk and deer velvet antlers. The SIT also maintains climate change plans, air/water quality monitoring, shoreline protection plans, among others. The Tribe also has enforcement officers who maintain the authority for enforcement of all established civil and criminal codes.
Community Wildfire Protection Plan	Y	N	N	With the completion of this HMP, the Tribe will have a CWPP, as the wildfire chapter is written to incorporate CWPP requirements. The Tribe does participate in planning initiatives with surrounding communities to ensure forest health and works with the fire suppression organizations as needed (FD#4).
Response/Recovery Planning				
Comprehensive Emergency Management Plan / Emergency Operations Plan	Y			The Tribe does have a CEMP as well as various other EOPs. That plan has been updated within the last two years, but new and additional annexes are continually being developed, which will integrate into the plan as appropriate.

TABLE 4-1
LEGAL AND REGULATORY CAPABILITY

	Tribal Authority or Program in Place	Other Jurisdictional Plan or Program in Place	State Mandated	Comments
Post-Disaster Recovery Plan	N			The Tribe has various plans in place to address disaster impact and post disaster recovery, but a final version has not been assimilated.
Continuity of Operations Plan	Y			The Tribe is currently in the process of updating its COOP, with some departments having completed their annex to the COOP during this 2024 update.
Administration, Boards, and Commission				
Mitigation Planning Committee	Y			A Hazard Mitigation Committee was established to develop this plan. Those members will remain on the committee during the lifecycle of this plan and will conduct the annual reviews as identified in the plan maintenance section while in office.
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems, chipping, etc.)	Y			Several programs are in place to reduce impact from the hazards of concern, including various environmental and climate change programs. During times when tree trimming is necessary, the firewood is provided to Tribal Elders. For many of these elders, the wood stove or fireplace is their primary source of heat, particularly if there is a power outage, or during times of excessive cold due to the age of the residential structures and lack of updated insulation.

TABLE 4-1
LEGAL AND REGULATORY CAPABILITY

	Tribal Authority or Program in Place	Other Jurisdictional Plan or Program in Place	State Mandated	Comments
Mutual Aid Agreements / Memorandums of Understanding and various Service Agreements/Contracts	Y		N	The Tribe has MOUs with various entities from which it receives and provides various services. These include Mason County Fire District 4, law enforcement being cross commissioned with Mason County Sheriff's Office, contracts with the Nisqually Tribal Jail and Mason County Juvenile Detention Center.
Planning Committee	Y	N	N	The SIT does have a Planning Commission which serves to monitor, update and maintain the land use development practices on the Reservation.

TABLE 4-2
ADMINISTRATIVE AND TECHNICAL CAPABILITY

Staff/Personnel Resources	Available?	Department/Agency/Position
Planners or engineers with knowledge of land development and land management practices	Yes	Natural Resources, Cultural Resources, Planning & Community Development and Contracted Services
Professionals trained in building or infrastructure construction practices (building officials, fire inspectors, etc.)	Yes	Natural Resources, Planning & Community Development, Public Safety & Justice
Engineers or inspectors specializing in construction practices?	Yes	Planning & Community Development, Natural Resources, and Contracted Services
Planners or engineers with an understanding of natural hazards	Yes	Natural Resources, Planning & Community Development, Cultural Resources, Emergency Management, and Contracted Services as needed.
Staff with training in benefit/cost analysis	Yes	Finance and Grant personnel have performed BCAs.
Surveyors	Yes	Contracted Service Agreement.

TABLE 4-2 ADMINISTRATIVE AND TECHNICAL CAPABILITY		
Personnel skilled or trained in GIS applications	Yes	GIS professional on staff, as well as contracted.
Personnel skilled or trained in Hazus use	No	Contracted services.
Scientist familiar with natural hazards in local area	Yes	Various, including hydrologist, biologists, etc.
Emergency Manager	Yes	Designated Emergency Manager
Grant writers	Yes	On staff
Warning Systems/Services	Yes	Code Red Early Warning Systems.
Hazard data and information available to public	Yes	Risk assessment maps are available for viewing in person and on the Tribe's website; the Tribe also provides hazardous weather updates and response, including tree removal as necessary and 24/7 de-icing of tribal roads and parking lots during inclement weather.

TABLE 4-3 FISCAL CAPABILITIES	
Financial Resources	**Accessible or Eligible to Use?**
1. Community Development Block Grants	Yes
2. Capital Improvements Project Funding	Yes
3. Authority to Levy Taxes for Specific Purposes	Yes
4. User Fees for Water, Sewer, Gas or Electric Service	Yes
5. Impact Fees for Buyers or Developers of New Development/Homes	Yes
6. State-Sponsored Grant Programs	Yes
7. Bureau of Indian Affairs Sponsored Grant	Yes
8. Indian Health Services Grant	Yes
9. U.S. Dept. of Agriculture, Rural Development Agency	Yes
10. U.S. Environmental Protection Agency	Yes
11. U.S. Fire Administration	Yes
12. Tribal Homeland Security Grants	Yes
13. Stafford Act Grants	Yes
14. Healthy Forest Restoration Act	Yes

TABLE 4-4
ON-GOING MITIGATION EFFORTS

Mitigation Effort	Available? Yes/No	Department/Agency/Position
Hazardous Vegetation Abatement Program	Y	Through various partnerships with the State Forest Service, Fire, and Tribal maintenance programs
Fire Safe Councils or Fire Wise Community	N	
Chipper program	Y	
Defensible space inspections program	Y	The SIT is actively engaged in forest management practices, including through Natural Resources and working with Mason County Fire District #4.
Creek, stream, culvert, or storm drain maintenance or cleaning program	Y	Actively involved as needed.
Stream restoration program	Y	Various on-going efforts as well as several completed efforts.
Erosion or sediment control program	Y	Actively involved in various restoration projects throughout the area in support of erosion and sediment control efforts, particularly as they impact finfish and shellfish habitat and spawning areas
Other		

4.1 EXISTING REGULATIONS

Some pertinent federal laws are described below, as well as initiatives and programs which support mitigation planning efforts, integrating various programs in place. It should be noted that the Squaxin Island Tribe is a sovereign nation, and as such is not required to adhere to any local or state planning regulations; however, in an effort to be a good steward and neighbor, the SIT does strive to plan in consideration of state and local requirements. The Tribe must comply with applicable federal regulations for construction and maintenance of facilities, such as those administered by HUD and EPA, as well as other federal agencies. This places a significant burden upon the Tribe as it is doubly impacted in their efforts when attempting to implement land use authority and other regulatory statutes. The Tribe does assert that application of such regulations during its land use development has reduced the impact and vulnerability from the hazards of concern.

4.1.1 Federal

Disaster Mitigation Act (DMA)

The DMA is the current federal legislation addressing hazard mitigation planning. It 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 funds are available to communities. This plan is designed to meet the requirements of DMA, improving eligibility for future hazard mitigation funds.

Since a pre-requisite of FEMA funding is the existence of approved tribal, local, and state plans, the three programs that are most integrated to the hazard mitigation plans are: the Building Resilient Infrastructure and Communities (BRIC) grant program; the Hazard Mitigation Grant Program (HMGP); and the Flood Mitigation Assistance (FMA) grant program.

In addition, FEMA has developed several programs which support the identification of risk, vulnerabilities, and impact, including identification of disadvantaged communities. A few of these programs which were utilized for this update include the following:

- FEMA's Risk Map program which works in conjunction with federal, tribal, local, and state agencies to provide reports and information which will lead to better floodplain management through development of maps and education with respect to the hazards of concern. While initially focusing on floodplain management, FEMA's Risk Map reports expanded to provide additional information on the natural hazards of concern.
- Helping to identify the social vulnerability and potential negative effects on communities caused by external stresses on human health (e.g., natural or human-caused disasters, disease outbreaks, etc.) the Center for Disease Control and Prevention (CDC) (and others) developed the Social Vulnerability Index which uses 16 U.S. census variables to help local officials identify communities that may need support before, during, or after disasters. [9]
- The Grant Equity Threshold Tool provides important information regarding community populations in Climate & Economic Justice Screening Tool (CEJST) Disadvantaged communities, FEMA's Community Disaster Resilience Zones (CDRZs) and FEMA's Community Resilience Challenges Index (CRCI) communities. It also provides grant applicants with benefitting area shapefiles that can be submitted with grant application. This tool can help grant applicants demonstrate how their potential benefitting area supports the Justice40 Initiative by focusing efforts on disadvantaged communities and Tribal Lands.[10]
- In addition, FEMA's Resilience Analysis and Planning Tool (RAPT) assists in providing up-to-date community level information and data that can be utilized to support updates to the hazards of concern and help identify potential vulnerabilities.[11]

National Landslide Preparedness Act

On January 5, 2021, the National Landslide Preparedness Act (P.L. 116-323) was signed into law authorizing a national landslide hazards reduction program and a 3D elevation program within the USGS. This broadened the already existing Landslide Hazards Program under the Natural Hazards Mission Area, and the 3D Elevation Program under the National Geospatial Program and required additional coordination with other federal agencies.

[9] SVI Tool: https://www.atsdr.cdc.gov/placeandhealth/svi/index.html
[10] CEJST Tool: https://screeningtool.geoplatform.gov/
[11] RAPT: https://www.fema.gov/emergency-managers/practitioners/resilience-analysis-and-planning-tool

Clean Water Act

The federal Clean Water Act (CWA) employs regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff. These tools are employed to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's surface waters so that they can support "the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water."

The Tribe has treatment authority as a State under the Clean Water Act. The Tribe's Natural Resources Department actively monitors the streams and rivers of the SIT.

The evolution of CWA programs over the last decade has included a shift from a program-by-program, source-by-source, pollutant-by-pollutant approach to more holistic watershed-based strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring impaired ones. A full array of issues are addressed, not just those subject to CWA regulatory authority. Involvement of stakeholder groups in the development and implementation of strategies for achieving and maintaining water quality and other environmental goals is a hallmark of this approach. The EPA recognizes that Indian Tribes face serious human health and environmental problems and are working with the Indian Tribes to protect the health and environment of waters in Indian Country.

Presidential Disaster Declarations

Presidentially declared disasters are disaster events that cause more damage than state, tribe or local governments/resources can handle without federal assistance. 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. A Presidential Emergency Declaration can also be declared, but assistance is limited to specific emergency needs. Tribal entities have the option of seeking a direct Presidential Declaration and are not required to join See Sandy Recovery and Improvement Act of 2013 for additional information.

Non-FEMA Disaster Declarations

Unique to tribes is the fact that disaster declarations can also be granted by other federal agencies other than FEMA, such as the Department of Housing and Urban Development and the Bureau of Indian Affairs. In such cases, similar to a Presidentially declared event, funds are designated to help the tribes recover from the impact of disaster events, and customarily carry a match requirement. Those funds are limited to specific needs and are limited in nature.

4.1.2 State-Level Planning Initiatives

The SIT must comply with all applicable Federal regulations, which many times are much more stringent than those regulations which state or local jurisdictions must address, placing a much heavier burden on the Tribe as they continue to grow and develop tribal lands. As a sovereign nation, they are not subject to state or local requirements; however, in the spirit of being a good neighbor and in partnership with the surrounding jurisdictions, the Tribe does consider its local communities in all of its planning initiatives. Some planning initiatives which the SIT are undertaking also coincide with the following state and local planning initiatives:

- International and Washington State Building Code
- Washington State Enhanced Hazard Mitigation Plan
- Mason and Grays Harbor Counties' Hazard Mitigation Plans
- Climate Change Adaptation Planning (on-going)

4.1.3 General Public Safety Information

Emergency Management:

The SIT does have a designated Emergency Manager; however, duties for emergency management planning are shared throughout several departments. The various departments have taken proactive steps to enhance the Tribe's capabilities with respect to emergency response and recovery efforts for both pre-and post-disaster efforts as discussed throughout this plan.

While many of these activities have been grant funded through various federal programs, policy development to enhance resilience of the Tribe has been funded through other Tribal funds, demonstrating the Tribe's commitment to developing a robust and applicable *all hazards* emergency management program. The development of this 2024 HMP update was funded by Tribal General Funds. During the life cycle of this plan, the Tribe will continue to seek funds to assist in the development of various response plans, including potentially a Comprehensive Emergency Management Plan, completion of the Continuity of Operation's Plan, Threat Hazard Identification and Risk Assessment (THIRA) and a Recovery Plan, which will further enhance the Tribe's resiliency to disasters.

National Incident Management System (NIMS):

The SIT has adopted the National Incident Management System (NIMS) as its operating structure for emergency events.

Schools, Community Centers, and Shelters:

The Tribe does maintain Childcare/Head Start facilities. The Gym/Community Centers/Community Kitchen serve as gathering places for Tribal citizens and could be utilized as emergency shelters or resilience centers as needed to provide services to both tribal members and other citizens in the area should a disaster or significant event occur. This would be particularly true with respect to the Little Creek Casino and Resort, which also has kitchen facilities as well as sheltering facilities. With potential isolation occurring should a major roadway providing ingress and egress fail, these facilities would be an important resource for the SIT to utilize.

Disaster Declaration Policy:

The Tribe does have an established Disaster Declaration Policy which allows it to request disaster assistance directly to FEMA (and others). The Tribe does have the capacity to administer its own grant and recovery program and would be able to establish an Administrative Plan to administer and track any such grants it receives as a result of any disaster. The SIT has previously gone directly to FEMA for disaster declarations. Completion of this mitigation plan is a necessary step in meeting the requirements for that effort, and once approved, the Tribe will continue to be in a position to do so.

Hazardous Materials Response:

There are no personnel trained for a significant Hazmat response, and the Tribe does not have the capacity in this regard. The Tribe relies on local fire agencies, WSP, and WA DOE for hazmat response and cleanup.

Law Enforcement and Gaming Enforcement:

The Tribe does have its own law enforcement officers, which are cross-commissioned with Mason County Sheriff's Department for enforcement of Tribal Criminal Code and gaming/hunting enforcement. The Tribe does not have a jail facility, but partners with the Nisqually Tribe for jail space, as well as Mason County Juvenile Detention.

Tribal Court:

There is a Court facility housing a Court of General Jurisdiction. The Tribe has criminal, civil, domestic violence, probate, and youth operations.

Fire Services / Medical/ Ambulance / Hospital / Social Services:

The SIT contracts with Mason County Fire District #4 for Fire and Emergency Medical Transport Services, providing Basic Life Support. There is no hospital on the Reservation. Travel time to the nearest hospitals takes approximately 20 minutes each way.

The Tribe does provide medical services and has established health care centers located in various locations throughout the planning area. Significant social services are provided by the SIT to its citizens, including a senior lunch program, various counseling programs, and emergency housing programs.

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CHAPTER 5.
HAZARD IDENTIFICATION AND RISK ASSESSMENT METHODOLOGY

5.1 OVERIEW

The DMA requires measuring potential losses to critical facilities and property resulting from natural hazards. A hazard is an act or phenomenon that has the potential to produce harm or other undesirable consequences to a person or thing. Natural hazards can exist with or without the presence of people and land development. However, hazards can be exacerbated by societal behavior and practice, such as building in a floodplain, along a sea cliff, or on an earthquake fault. Natural disasters are inevitable, but the impacts of natural hazards can, at a minimum, be mitigated or, in some instances, prevented entirely.

The goal of the risk assessment is to determine which hazards present the greatest risk and what areas are the most vulnerable to hazards. The Tribe is exposed to many natural and other hazards. The risk assessment and vulnerability analysis helps identify where mitigation measures could reduce loss of life or damage to property in the planning region. Each hazard-specific risk assessment provides risk-based information to assist the Tribe in determining priorities for implementing mitigation measures.

It should be noted that due to the availability of data and information to appropriately profile the hazards of concern, in many instances, county-level data is the only data available as datasets do not identify information at a more local level. As such, in the case of the Squaxin Island Tribe, Mason County data is utilized.

The methodology utilized for this risk assessment differs from the methodology utilized for the 2019 plan. The current method is more streamlined, and easier to maintain for future updates. It also allows for a more simplistic methodology for adding new or additional hazards of concern.

The risk assessment approach used for this plan entailed using geographic information system (GIS), Hazus hazard-modeling software (as appropriate), and hazard-impact data to develop vulnerability models for people, structures and critical facilities, and evaluating those vulnerabilities in relation to hazard profiles that model where hazards exist. This approach is dependent on the detail and accuracy of the data used. In all instances, this assessment used Best Available Science and data to ensure the highest level of accuracy possible.

This risk assessment is broken down into three phases, as follows:

> The first phase, hazard identification, involves the identification of the geographic extent of a hazard, its intensity, and its probability of occurrence (discussed below). This level of assessment typically involves producing a map. The outputs from this phase can be used for land use planning, management, and development of regulatory authority; public awareness and education; identifying areas which require further study; and identifying properties or structures appropriate for mitigation efforts, such as acquisition or relocation.

The second phase, the vulnerability assessment, combines the information from the hazard identification with an inventory of the existing (or planned) property and population exposed to the hazard. It then attempts to predict how different types of property and population groups will be impacted or affected by the hazard of concern. This step assists in justifying changes to building codes or regulatory authority, property acquisition programs, such as those available through various granting opportunities; developing or modifying policies concerning critical or essential facilities, and public awareness and education.

The third phase, the risk analysis, involves estimating the damage, injuries, and costs likely to be incurred in the geographic area of concern over a period of time. Risk has two measurable components:

1. The magnitude of the harm that may result, defined through the vulnerability assessment; and
2. The likelihood or probability of harm occurring.

Utilizing those three phases of assessment, information was developed which identifies the hazards that affect the planning area, the likely location of natural hazard impact, the severity of the impact, previous occurrences, and the probability of future hazard events. That data, once complete, is utilized to complete the Risk Ranking process described in Chapter 12, which applies to all of the data captured.

The following is provided as the foundation for the standardized risk terminology utilized in this effort:

- Hazard: Natural, human caused or technological source or cause of harm or damage, demonstrated as actual (deterministic/historical events) or potential (probabilistic) events.
- Risk: The potential for an unwanted outcome resulting from a hazard event, as determined by its likelihood and associated consequences. For this plan, when possible, risk includes potential future losses based on probability, severity and vulnerability, expressed in dollar losses. In some instances, dollar losses are based on actual demonstrated impact, such as through the use of the Hazus model. In other cases, losses are demonstrated through exposure analysis due to the inability to determine the extent to which a structure is impacted.
- Extent and Location: The area of potential or demonstrated impact within the area in which the analysis is being conducted. In some instances, the area of impact is within a geographically defined area, such as a floodplain. In other instances, such as for severe weather, there is no established geographic boundary associated with the hazard, as it can impact the entire area.
- Severity/Magnitude: The extent or magnitude on which a hazard is ranked, demonstrated in various means, e.g., Richter Scale.
- Vulnerability: The degree of damage, e.g., building damage or the number of people injured.
- Probability of Occurrence and Return Intervals: These terms are used as a synonym for likelihood, or the estimation of the potential of an incident to occur.

5.2 HAZARD IDENTIFICATION AND PROFILES

For this plan, a full range of natural hazards that could impact the planning area was considered. The process incorporated review of state and local hazard planning documents, as well as information on the frequency, magnitude and costs associated with hazards that have impacted or could impact the planning area. Anecdotal information regarding natural hazards and the perceived vulnerability of the planning area's assets to them was also used. The Planning Team reviewed the hazards of concern addressed in the last plan as a starting point. In review of that list, for this 2024 update, the Planning Team felt Volcano should be removed for this update as Volcano was felt to be of limited potential impact. While ash may accumulate, there was minimal impact during the eruption of Mount Saint Helens, and therefore, it will be removed from this update. As indicated in the 2019 plan, no tsunami impact information is available, and impact is felt to be minimal. Therefore, the Planning Team felt that it would best to again review this as a possible hazard during the next update should data become available which indicates potential impact. While the actual Tribal Reservation on the Squaxin Island may be impacted by wave activity, at present, there are no structures on the island, and the island has no fresh water sources. The Island's cultural significance is identified at potential risk, as are the shellfish beds; however, no dollar losses can be associated with that. Also reviewed was the landslide hazard. The Tribal lands have never been impacted by a landslide, and based on review of the 2019 data, there are no slopes which are 40 percent or greater, which would indicate a landslide hazard. The planning team did review data from historic slides and proximity to those as well. Based on that information, the planning team determined that the landslide hazard is minimal, with impact occurring primarily to roadways in the tribal planning area which would impact ingress and egress, but those roadways are not owned by the Tribe. Table 5-1 illustrates the analysis conducted in reaching this determination.

Table 5-1
Critical Facilities in Proximity to Historic Landslide or Unstable Slope Zones

Hazard Zone	Government Function	Communications	Medical	Hazardous Materials	Protective Services	Power	Other	Water	Wastewater	Total
Within Historic Landslide or Unstable Slope	0	0	0	0	0	0	0	6	0	**6**
Within 500 ft. of Historic Landslide or Unstable Slope	0	0	0	0	6	0	0	22	0	**28**
Within 1,000 ft. of Historic Landslide or Unstable Slope	1	0	0	0	5	2	0	16	2	**26**

The remaining list of hazards was felt to be consistent with the previous plan, with slight modifications to expand Severe Weather and to include discussion on Climate Change within each profile. Based on the review, the Planning Team, at its kick-off meeting, identified the following natural hazards that this plan addresses as the hazards of concern:

- Climate Change (not as a separate hazard, but incorporated into other hazards of concern)
- Drought
- Earthquake
- Flood
- Severe Weather
- Wildfire

Based on the full spectrum of hazards addressed, it is the intent of the Tribe to use this risk assessment in lieu of preparing a separate hazard identification and vulnerability assessment for other planning efforts which may require the same data and information.

The hazard profiles describe the risks associated with identified hazards of concern. Each chapter describes the hazard, the planning area's vulnerabilities, and, when possible, probable event scenarios. The following steps were used to define the risk of each hazard:

Identify and profile the following information for each hazard:

- General overview and description of hazard;
- Identification of previous occurrences;
- Geographic areas most affected by the hazard;
- Event frequency estimates;
- Severity estimates;
- Warning time likely to be available for response;
- Risk and vulnerability assessment, which includes identification of impact on people, property, economy, and the environment.

5.3 RISK ASSESSMENT PROCESS AND TOOLS

The hazard profiles and risk assessments describe the risks associated with each identified hazard of concern. Each chapter describes the hazard, the planning area's vulnerabilities, and probable event scenarios. Chapter 111 summarizes all analysis through completion of the Calculated Priority Risk Index (CPRI) for hazard ranking. This method of profiling the hazards is modified slightly from the previous plan edition, with data reorganized for ease in review and continued update, simplifying the process.

Once the profiles were completed, the following steps were used to define the risk vulnerability of each hazard:

- Determine exposure to each hazard—Exposure was determined by overlaying hazard maps with an inventory of structures, facilities, and systems to determine which of them would be exposed to each hazard.
- Assess the vulnerability of exposed facilities—Vulnerability of exposed structures and infrastructure was determined by interpreting the probability of occurrence of each event and assessing structures, facilities, and systems that are exposed to each hazard. Tools such as GIS and Hazus (discussed below) were used in this assessment.
- Where specific quantitative assessments could not be completed, vulnerability was measured in general, qualitative term, summarizing the potential impact based on past occurrences, spatial extent, and subjective damage and casualty potential. Those items were categorized utilizing the criteria established in the CPRI (see below).
- The final step in the process was to assign a significance level determined by review of the results of vulnerability based on the CPRI schedule, assigning an ordinal assessment based on the following classifications:
    - □ Extremely Low—The occurrence and potential cost of damage to life and property is very minimal to nonexistent.
    - □ Low—Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
    - □ Medium—Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
    - □ High—Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have occurred in the past.
    - □ Extremely High—Very widespread with catastrophic impact.

5.3.1 Calculated Priority Risk Index Scoring Criteria

For the 2023 update, the Planning Team utilized a Calculated Priority Risk Index Score for each hazard of concern, addressing impact primarily at the reservation level. In some cases, this may include areas off the reservation, but vulnerabilities are focused on tribal-owned structures. Vulnerabilities are described in terms of critical facilities, structures, population, economic values, and functionality of government which can be affected by the hazard event as identified in the below tables. Hazard impact areas describe the geographic extent a hazard can impact the tribe and are uniquely defined on a hazard-by-hazard basis. Mapping of the hazards, where spatial differences exist, allows for hazard analysis by geographic location. Some hazards can have varying levels of risk based on location. Other hazards cover larger geographic areas and affect the area uniformly. Therefore, a system must be established which addresses all elements (people, property, economy, continuity of government) in order to rate each hazard consistently. The use of the Calculated Priority Risk Index allows such application, based on established criteria of application to determine the risk factor. For identification purposes, the six criteria on which the CPRI is based are

probability, magnitude, geographic extent and location, warning time/speed of onset, and duration of the event. Those elements are further defined as follows:

Probability

Probability of a hazard event occurring in the future was assessed based on hazard frequency over a 100-year period (where available). Hazard frequency was based on the number of times the hazard event occurred divided by the period of record. If the hazard lacked a definitive historical record, the probability was assessed qualitatively based on regional history and other contributing factors. Probability of occurrence was assigned a 40% weighting factor, and was broken down as follows:

Rating	Likelihood	Frequency of Occurrence
1	Unlikely	Less than 1% probability in the next 100 years.
2	Possible	Between 1% and 10% probability in the next year, or at least one chance in the next 100 years.
3	Likely	Between 10% and 100% probability in next year, or at least one chance in the next 10 years.
4	Highly Likely	Greater than 1 event per year (frequency greater than 1).

Magnitude

The magnitude of potential hazard events was evaluated for each hazard. Magnitude is a measure of the strength of a hazard event and is usually determined using technical measures specific to the hazard. Magnitude was calculated for each hazard where property damage data was available and was assigned a 25% weighting factor. Magnitude calculation was determined using the following: *Property Damage / Number of Incidents) / $ of Building Stock Exposure = Magnitude.* In some cases, the Hazus model provided specific people/dollar impact data. For other hazards, a GIS exposure analysis was conducted. Magnitude was broken down as follows:

Rating	Magnitude	Percentage of People and Property Affected
1	Negligible	Less than 5% Very minor impact to people, property, economy, and continuity of government at 90%.
2	Limited	6% to 24% Injuries or illnesses minor in nature, with only slight property damage and minimal loss associated with economic impact; continuity of government only slightly impacted, with 80% functionality.
3	Critical	25% to 49% Injuries result in some permanent disability; 25-49% of population impacted; moderate property damage ; moderate impact to economy, with loss of revenue and facility impact; government at 50% operational capacity with service disruption more than one week, but less than a month.
4	Catastrophic	More than 50% Injuries and illness resulting in permanent disability and death to more than 50% of the population; severe property damage greater than 50%; economy significantly

Rating	Magnitude	Percentage of People and Property Affected
		impacted as a result of loss of buildings, content, inventory; government significantly impacted; limited services provided, with disruption anticipated to last beyond one month.

Extent and Location

The measure of the percentage of the people and property within the planning area impacted by the event, and the extent (degree) to which they are impacted. Extent and location were assigned a weighting factor of 20%, and broken down as follows:

Rating	Magnitude	Percentage of People and Property Affected
1	Negligible	Less than 10% Few if any injuries or illness. Minor quality of life lost with little or no property damage. Brief interruption of essential facilities and services for less than four hours.
2	Limited	10% to 24% Minor injuries and illness. Minor, short term property damage that does not threaten structural stability. Shutdown of essential facilities and services for 4 to 24 hours.
3	Critical	25% to 49% Serious injury and illness. Major or long-term property damage, that threatens structural stability. Shutdown of essential facilities and services for 24 to 72 hours.
4	Catastrophic	More than 50% Multiple deaths Property destroyed or damaged beyond repair Complete shutdown of essential facilities and services for 3 days or more.

Warning Time/Speed of Onset

The rate at which a hazard occurs, or the time provided in advance of a situation occurring (e.g., notice of a cold front approaching or a potential hurricane, etc.) provides the time necessary to prepare for such an event. Sudden-impact hazards with no advanced warning are of greater concern. Warning Time/Speed of onset was assigned a 10% weighting factor, and broken down as follows:

Rating	Probable amount of warning time
1	More than 24 hours warning time.
2	12-24 hours warning time.
3	5-12 hours warning time.
4	Minimal or no warning time.

Duration

The time span associated with an event was also considered, the concept being the longer an event occurs, the greater the threat or potential for injuries and damages. Duration was assigned a weighting factor of 5%, and was broken down as follows:

Rating	Duration of Event
1	6-24 hours
2	More than 24 hours
3	Less than 1 week
4	More than 1 week

Chapter 13 summarizes the analysis conducted by way of completion of the Calculated Priority Risk Index (CPRI) for hazard ranking.

5.3.2 Hazus and GIS Applications

Earthquake and Flood Modeling Overview

In 1997, FEMA developed the standardized Hazards U.S., or Hazus model to estimate losses caused by earthquakes and identify areas that face the highest risk and potential for loss. Hazus was later expanded into a multi-hazard methodology, with new models for estimating potential losses from hurricanes, floods, and tsunami (although still limited in nature).

Hazus is a GIS-based software program used to support risk assessments, mitigation planning, and emergency planning and response. It provides a wide range of inventory data, such as demographics, building stock, critical facility, transportation and utility lifeline, and multiple models to estimate potential losses from natural disasters. The program maps and displays hazard data and the results of damage and economic loss estimates for buildings and infrastructure. Its advantages include the following:

- Provides a consistent methodology for assessing risk across geographic and political entities.
- Provides a way to save data so that it can readily be updated as population, inventory, and other factors change and as mitigation planning efforts evolve.
- Facilitates the review of mitigation plans because it helps to ensure that FEMA methodologies are incorporated.
- Supports grant applications by calculating benefits using FEMA definitions and terminology.
- Produces hazard data and loss estimates that can be used in communication with local stakeholders.
- Is administered by the tribal or local government and can be used to manage and update a hazard mitigation plan throughout its implementation.

Levels of Detail for Evaluation

HAZUS provides default data for inventory, vulnerability, and hazards; this default data can be supplemented with local data to provide a more refined analysis. The model can carry out three levels of analysis, depending on the format and level of detail of information about the planning area:

- **Level 1**—All of the information needed to produce an estimate of losses is included in the software's default data. This data is derived from national databases and describes in general terms the characteristic parameters of the planning area.
- **Level 2**—More accurate estimates of losses require more detailed information about the planning area. To produce Level 2 estimates of losses, detailed information is required about local geology, hydrology, hydraulics and building inventory, as well as data about utilities and critical facilities. This information is needed in a GIS format.
- **Level 3**—This level of analysis generates the most accurate estimate of losses. It requires detailed engineering and geotechnical information to customize it for the planning area.

Building Inventory

The SIT utilized this effort to develop a new critical facilities layer which was utilized to identify potential loss data to include exposure and vulnerability to the critical infrastructure identified during this process. GIS building data utilizing detailed structure information for tribal facilities was utilized in GIS. Building information was developed using best available Tribal data, including building address points, aerial imagery, and Tribal staff resources. Building and content replacement values were estimated using values from various sources, including valuation by Tribe staff and insurance coverage data, which identified replacement values, years built, construction type, etc. In some instances, estimations were made where missing data existed. In some instances, where content value was missing, the value was based on one-half of building value, which is an acceptable practice for these planning purposes.

Hazus Application for This Plan

The following methods were used to assess specific hazards for this plan:

- **Flood**— Analysis was based on current FEMA regulatory 100- and 500-year flood hazard data, to include a proprietary study completed by FEMA for the SIT.
- **Earthquake**— Earthquake shake maps prepared by the U.S. Geological Survey (USGS) were used for the analysis of this hazard. A modified version of the National Earthquake Hazard Reduction Program (NEHRP) soils inventory was used. One scenario event was modeled:
  - The scenario event utilized was the Cascadia M9.0 Earthquake.

GIS Application

For severe weather and wildfire, historical data is not adequate to model future losses as no specific damage functions have been developed. However, GIS is able to map hazard areas and calculate exposure if geographic information is available with respect to the location of the hazard and inventory data. Areas and inventory susceptible to some of the hazards of concern were mapped and exposure was evaluated. For other hazards, a qualitative analysis was conducted using the best available data and professional judgment. Locally relevant information was gathered from a variety of sources. Frequency and severity indicators include past events and the expert opinions of geologists, tribal staff, emergency management personnel and others. The primary data source was Tribal staff, including various GIS data sets, augmented with county, state, and federal datasets.

Additional data sources for specific hazards were as follows:

Drought—The risk assessment methodologies used for this plan focus on damage to structures. Because drought does not impact structures, the risk assessment for drought was more limited and qualitative than the assessment for the other hazards of concern, and discussed within the severe weather hazard with only a brief overview. The potential impact from drought also references fish loss associated with the negative impact of climate change on water levels, and sedimentation issues resulting from drought situations, as well as its economic losses due to timber growth and harvesting, and increased wildfire danger.

Landslide—Historic landslide hazard data was used to assess exposure to landslides using Washington State Department of Natural Resources Landslide Susceptibility data. This data depicts landslide susceptibility at a 10-meter resolution across the state of Washington. Utilizing elevation data and WA DNR identified slope susceptibility at anything greater than 40 percent slope, 1000' buffers were used to identify any potential critical facilities falling within these potential landslide hazard areas. It should be noted that *this data is for mitigation planning purposes only, and should not be considered for life safety matters.* No landslide hazard analysis was conducted for development of this plan as such far exceeds the level of knowledge to conduct such an assessment, which requires geologists, among others. Rather only reprojection of existing data completed by WA DNR and the USGS. Additional landslide data is available at: http://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/landslides

Severe Weather—Severe weather data was downloaded from various sources, including the Natural Resources Conservation Service and the National Climatic Data Center, PRISM, Tornado Project, and other sources as referenced. A lack of data separating severe weather damage from flooding, windstorms, and landslide damage prevented a detailed analysis for exposure and vulnerability, as well as the fact that there are no generally accepted damage functions for the hazard. For planning purposes, it is assumed that the entire planning area is exposed to some extent to severe weather. Certain areas are more exposed due to geographic location and local weather patterns, as well as the response capabilities of local first responders.

Wildfire— There is currently no validated damage function available to support wildfire mitigation planning because no such damage functions have been generated. Instead, loss estimates were developed by identifying the number of structures exposed to the various LANDFIRE Fire Regime (1-5) datasets. Information on wildfire analysis was captured from various sources, including Washington State Department of Natural Resources, Wildfire Protection data, US Forest Service data, LAND FIRE data, and Wildland Urban Interface Zone data, among other sources as available for the tribal planning area.

5.3.3 Probability of Occurrence and Return Intervals

Natural hazard events with relatively long return periods, such as a 100-year flood or a 500-year earthquake, are often thought to be very unlikely. In reality, the probability that such events occur over the next 30 or 50 years is relatively high.

Natural hazard events with very long return periods, such as 100 or 500 or 1,000 years, have significant probabilities of occurring during the lifetime of a building:

- Hazard events with return periods of 100 years have probabilities of occurring in the next 30 or 50 years of about 26 percent and about 40 percent, respectively.
- Hazard events with return periods of 500 years have about a 6 percent and about a 10 percent chance of occurring over the next 30 or 50 years, respectively.
- Hazard events with return periods of 1,000 years have about a 3 percent chance and about a 5 percent chance of occurring over the next 30 or 50 years, respectively.

For life safety considerations, even natural hazard events with return periods of more than 1,000 years are often deemed significant if the consequences of the event happening are very severe (extremely high damage and/or substantial loss of life). For example, the seismic design requirements for new construction are based on the level of ground shaking with a return period of 2,475 years (2 percent probability in 50 years). Providing life safety for this level of ground shaking is deemed necessary for seismic design of new buildings to minimize life safety risk. Of course, a hazard event with a relatively long return period may occur tomorrow, next year, or within a few years. Return periods of 100 years, 500 years or 1,000 years mean that such events have a 1 percent, a 0.2 percent or a 0.1 percent chance of occurring in any given year.

5.4 LIMITATIONS

Loss estimates, exposure assessments and hazard-specific vulnerability evaluations rely on the best available data and methodologies. Uncertainties are inherent in any loss estimation methodology and arise in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from the following:

- Approximations and simplifications necessary to conduct a study;
- Incomplete or outdated inventory, demographic or economic parameter data;
- The unique nature, geographic extent and severity of each hazard;
- Mitigation measures already employed; and
- The amount of advance notice residents have to prepare for a specific hazard event.

These factors can affect loss estimates by a factor of two or more. Therefore, potential exposure and loss estimates are approximate. *The results do not predict precise results and should be used only to understand relative risk for planning purposes; not life-safety measures.*

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CHAPTER 6.
DROUGHT

6.1 GENERAL BACKGROUND

DEFINITIONS

Drought—The cumulative impacts of several dry years on water users and agricultural producers. It can include deficiencies in surface and subsurface water supplies and cause impacts to health, well-being, and quality of life.

Hydrological Drought—Deficiencies in surface and subsurface water supplies.

Socioeconomic Drought—Drought impacts on health, well-being, and quality of life.

Droughts originate from a deficiency of precipitation resulting from an unusual weather pattern. If the weather pattern lasts a short time (a few weeks or a couple of months), the drought is considered short-term. If the weather pattern becomes entrenched and the precipitation deficits last for several months or years, the drought is considered to be long-term. It is possible for a region to experience a long-term circulation pattern that produces drought, and to have short-term changes in this long-term pattern that result in short-term wet spells. Likewise, it is possible for a long-term wet circulation pattern to be interrupted by short-term weather spells that result in short-term drought.

Drought is a prolonged period of dryness severe enough to reduce soil moisture, water, and snow levels below the minimum necessary for sustaining plant, animal, and economic systems. Droughts are a natural part of the climate cycle. For this plan, the SIT have elected to use Washington's statutory definition of drought (RCW Chapter 43.83B.400), which is based on both of the following conditions occurring:

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

6.2 HAZARD PROFILE

6.2.1 Extent and Location

Drought can have a widespread impact on the environment and the economy, depending upon its severity, although it typically does not result in loss of life or damage to property, as do other natural disasters. The National Drought Mitigation Center uses three categories to describe likely drought impacts:

- Agricultural—Drought threatens crops that rely on natural precipitation, while also increasing the potential for infestation.
- Water supply—Drought threatens supplies of water for irrigated crops, for communities and for fish and salmon and other species of wildlife.
- Fire hazard—Drought increases the threat of wildfires from dry conditions in forest and rangelands.

In Washington, where hydroelectric power plants generate nearly three-quarters of the electricity produced, drought also threatens the supply of electricity. Unlike most disasters, droughts normally occur slowly but last a long time. Drought conditions occur every few years in Washington.

On average, the nationwide annual impacts of drought are greater than the impacts of any other natural hazard. They occur primarily in the agriculture, transportation, recreation and tourism, forestry, and energy sectors. Social and environmental impacts are also significant, although it is difficult to put a precise cost on these impacts.

Drought affects groundwater sources, but generally not as quickly as surface water supplies, although groundwater supplies generally take longer to recover. Reduced precipitation during a drought means that groundwater supplies are not replenished at a normal rate. This can lead to a reduction in groundwater levels and problems such as reduced pumping capacity or wells going dry. Shallow wells are more susceptible than deep wells. About 16,000 drinking water systems in Washington get water from the ground; these systems serve about 5.2 million people. Reduced replenishment of groundwater affects streams. Much of the flow in streams comes from groundwater, especially during the summer when there is less precipitation and after snowmelt ends. Reduced groundwater levels mean that even less water will enter streams when steam flows are lowest. Reduced water levels in wells also means that the wells are subject to saltwater intrusion.

Much of the area depends on well water, which currently supplies a large portion of SIT and Mason County residents with their drinking water. The Tribe maintains two water towers, as well as a water system. There is also an irrigation system and pump house on the golf course. Drought conditions within the planning area increase pressure on local aquifers, with increased pumping potentially resulting in saltwater intrusion into freshwater aquifers. This, in turn, could cause restrictions on economic growth and development.

A drought directly or indirectly impacts all people in affected areas. A drought can result in farmers or other types of agriculture not being able to plant crops or the failure of planted crops. This results in loss of work for farm or agricultural workers and those in related food processing jobs. Other water- or electricity-dependent industries are commonly forced to shut down all or a portion of their facilities, resulting in further layoffs. A drought can also harm recreational companies that use water (e.g., fishing, swimming pools, water parks, and river rafting companies) as well as landscape and nursery businesses because people will not invest in new plants if water is not available to sustain them. With much of Washington's energy coming from hydroelectric plants, a drought means less inexpensive electricity coming from dams and probably higher electric bills. All people would pay more for water if utilities increase their rates. This has become an issue within Washington State as a whole previously, when a lack of snowpack has decreased hydroelectric generating capacity, and raised the electric prices, impacting residents.

6.2.2 Previous Occurrences

The Tribe has never been declared in a federal disaster declaration related to drought. While the County has never received a direct disaster declaration for a drought, the County has received several declarations issued by the U.S. Secretary of Agriculture for drought incidents. For those declared incidents, there have

been several rounds of Small Business Administration (SBA) loans issued to support impacted businesses and farms. SBA makes Economic Injury Disaster Loans available when the U.S. Secretary of Agriculture designates an agricultural disaster. Those incidents have occurred (to some degree) annually since completion of the 2019 HMP. Occurring during 2022, historic low water levels also closed most fishing in several streams of the Olympic Peninsula.[12]

Figure 6-1 identifies the streamflow in the planning area as of September 2023.[13] Figure 6-2 identifies historical drought conditions during the period 2015 through 2022 in Mason County. In the past century, Washington has experienced a number of drought episodes, including several that lasted for more than a single season. Table 6-1 identifies drought occurrences within the State of Washington.

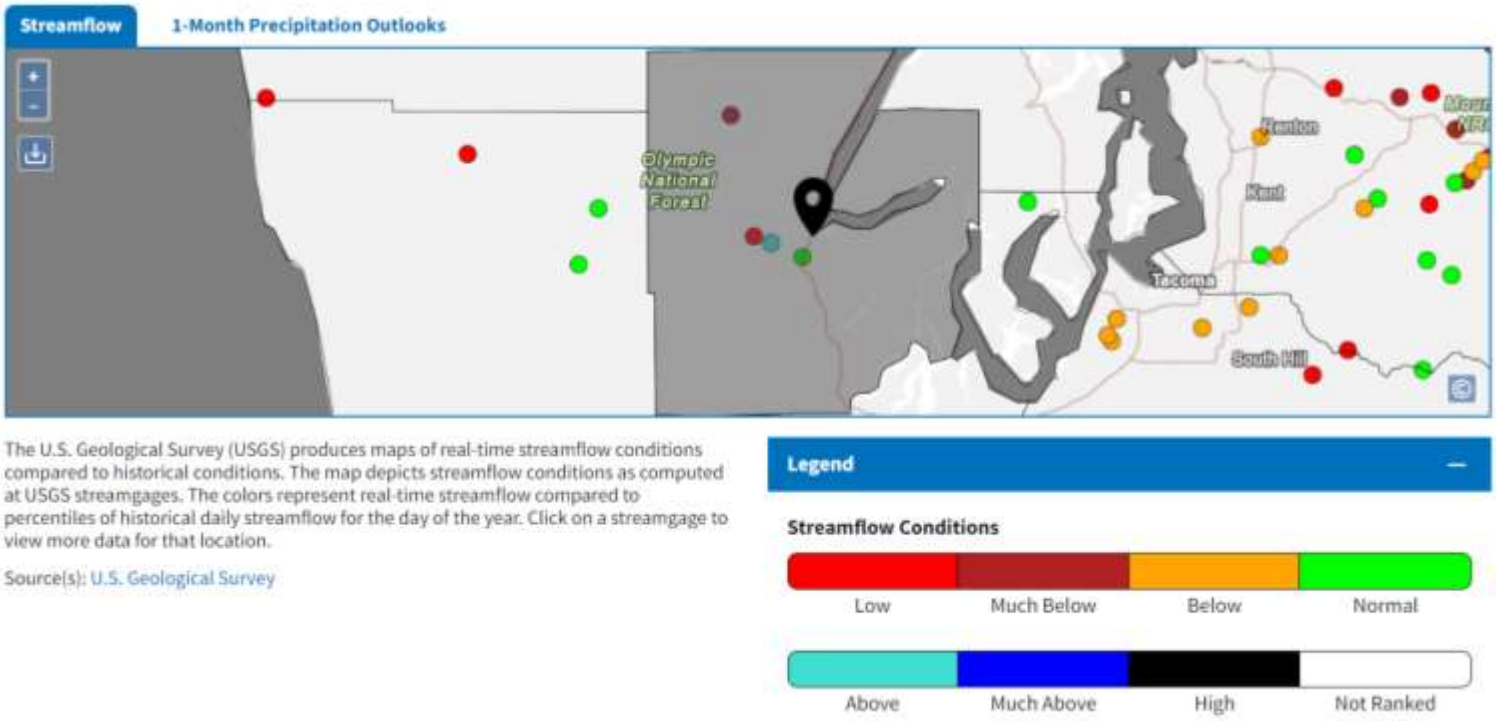


Figure 6-1 Streamflow in Mason County September 2023

[12] National Park Service. News Release, 2022. Accessed 19 Sept. 2023. Available online at: Emergency Closure of Recreational Fishing in Most Rivers and Streams of Olympic National Park to Begin on October 6 - Olympic National Park (U.S. National Park Service) (nps.gov)

[13] NOAA Drought.gov. Accessed 19 Sept 2023. Available online at: Mason County Conditions | Drought.gov

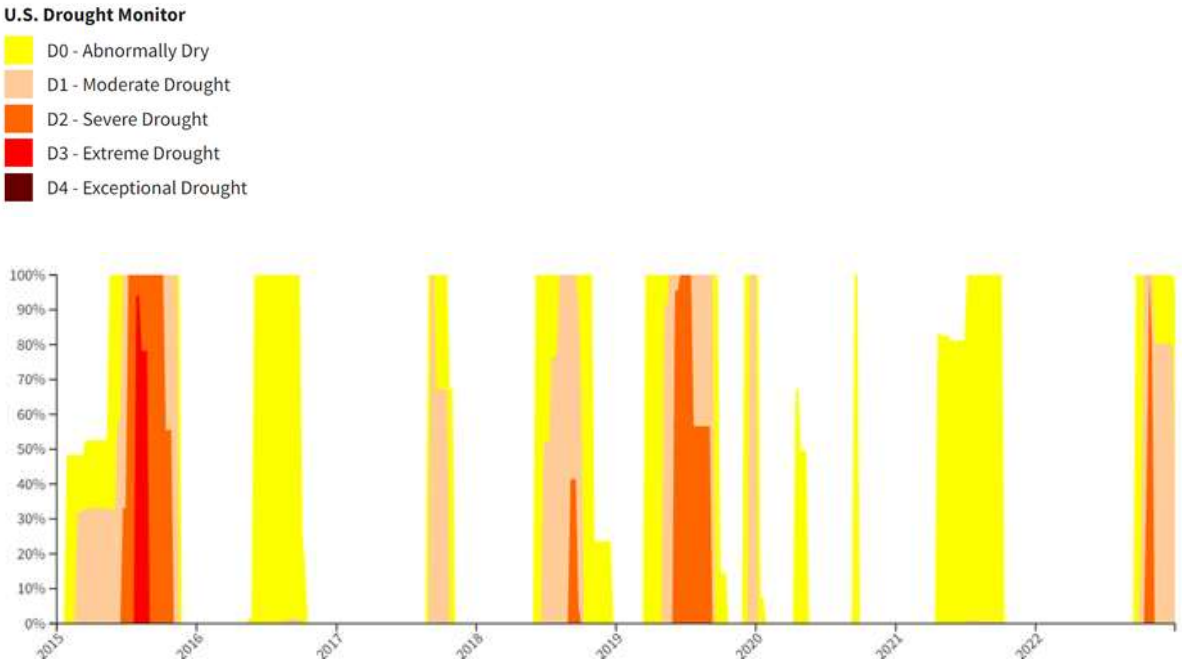


Figure 6-2 Historical Drought Conditions in Mason County 2015-2022

Source: The U.S. Drought Monitor (2015–present) depicts the location and intensity of drought across the country. Every Thursday, authors from NOAA, USDA, and the National Drought Mitigation Center produce a new map based on their assessments of the best available data and input from local observers. The map uses five categories: Abnormally Dry (D0), showing areas that may be going into or are coming out of drought, and four levels of drought (D1–D4).

TABLE 6-1
DROUGHT OCCURRENCES

July-August 1902	No measurable rainfall in Western Washington
August 1919	Drought and hot weather occurred in Western Washington
July – August 1921	Drought in all agricultural sections.
June-August 1922	The statewide precipitation averaged 0.10 inches.
March – August 1924	Lack of soil moisture retarded germination of spring wheat.
July 1925	Drought occurred in Washington
July 21-August 25, 1926	Little or no rainfall was reported.
June 1928-March 1929	Most stations averaged less than 20 percent of normal rainfall for August and September and less than 60 percent for nine months.
July – August 1930	Drought affected the entire state. Most weather stations averaged 10 percent or less of normal precipitation.
April 1934-March 1937	The longest drought in the region's history – the driest periods were April-August 1934, September-December 1935, and July-January 1936-1937.

TABLE 6-1
DROUGHT OCCURRENCES

May – September 1938	Driest growing season in Western Washington.
1952	Every month was below normal precipitation except June. The hardest hit areas were Puget Sound and the central Cascades.
January – May 1964	Drought covered the southwestern part of the state. Precipitation was less than 40 percent of normal.
Spring 1966	Drought throughout Washington
June – August 1967	Drought throughout Washington
January – August 1973	Dry in the Cascades.
October 1976 – September 1977	Worst drought in Pacific Northwest history. Below normal precipitation in Olympia, Seattle, and Yakima. Crop yields were below normal and ski resorts closed for much of the 1976-77 season.
2001 Governor Declared Drought	Governor declared statewide Stage 2 drought in response to severe dry spell.
June – September 2003	Federal disaster number 1499 assigned to 15 counties. The original disaster was for flooding but several jurisdictions were included because of previous drought conditions.
March 10, 2005 Governor Declared Drought	Precipitation levels was below or much below the average from November through February, with extremely warm fall and winter months, adversely affecting the state's mountain snow pack. A warm mid-January removed much of the remaining snow pack, with March projections at 66 percent of normal, indicating that Washington might be facing a drought as bad as, or worse, than the 1977 drought. Late March rains filled reservoirs to about 95 percent. State legislature approved $12 million supplemental budget that provided funds to buy water, improve wells, and implement other emergency water supply projects. Wildfires numbers was about 75 percent of previous five years, but acreage burned was three times greater.

TABLE 6-1 DROUGHT OCCURRENCES	
2015	2015 was the year of the "snowpack drought." Washington State had normal or near-normal precipitation over the 2014-2015 winter season. However, October through March the average statewide temperature was 40.5 degrees Fahrenheit, 4.7 degrees above the 20th century long-term average and ranking as the warmest October through March on record. Washington experienced record low snowpack because mountain precipitation that normally fell as snow instead fell as rain. The snowpack deficit then was compounded as precipitation began to lag behind normal levels in early spring and into the summer. With record spring and summer temperatures, and little to no precipitation over many parts of the state, the snowpack drought morphed into a traditional precipitation drought, causing injury to crops and aquatic species. Many rivers and streams experienced record low flows.
2019 Governor Declared Drought	On May 20, 2019, Governor Jay Inslee issued an emergency drought declaration in 24 watersheds statewide. According to the Washington State Department of Ecology, very dry conditions over several months and a diminished snowpack impacted streamflow, which were identified to be well below normal conditions across most of the state.[14] Watersheds west of the Cascades crest, which are more rain dependent than rivers on the east side, flowed at much below normal levels. Some rivers set record daily lows for historic May flows. Statewide, at the time the declaration was ordered, only four (4) percent of rivers were flowing at levels above normal. While stream flows were strong in the southeast corner of the state, 27 out of 62 watersheds were declared for drought as of May 20, 2019.
2020	Several months in a row of below-average precipitation brought drought to the Pacific Northwest in spring 2020, with only the northwestern corner of Washington, around Seattle, free of any kind of drought or abnormal dryness. As the region's dry summer approached, the winter and spring precipitation deficits pose a threat to livestock operators, farmers, and fish, and heighten the risk of wildfires. In this event, while precipitation falling as snow was initially at normal levels, the higher-than-average temperatures caused rapid snow melt, with runoff coming earlier in the year causing high rates of soil moisture evaporation.
2021 Dept. of Ecology issued Emergency Drought Declaration	The spring of 2021 was the second driest on record, and then an unprecedented late-June heatwave smashed temperature records across the state. In response, Washington State Department of Ecology issued an emergency drought declaration in July 2021 covering 96 percent of the state. Only Seattle, Everett, and Tacoma – cities with ample water storage – escaped the designation.

[14] Source: https://waterwatch.usgs.gov/?m=real&r=wa

TABLE 6-1 DROUGHT OCCURRENCES	
2022	Historically low water levels in several areas closed most recreational fishing on most streams of the Olympic Peninsula.

6.2.3 Severity

Droughts impact individuals (farm owners, tenants, and farm laborers), the agricultural industry, and other agriculture-related sectors. Lack of snowpack has forced ski resorts into bankruptcy. There is increased danger of forest and wildland fires. Millions of board feet of timber have been lost. Loss of forests and trees increases erosion, causing serious damage to aquatic life, irrigation, and power development by heavy silting of streams, reservoirs, and rivers.

The severity of a drought depends on the degree of moisture deficiency, the duration, and the size and location of the affected area. The longer the duration of the drought and the larger the area impacted, the more severe the potential impacts. Droughts are not usually associated with direct impacts on people or property, but they can have significant impacts on agriculture, wildlife, and fishing, which can impact people indirectly. When measuring the severity of droughts, analysts typically look at economic impacts.

The National Oceanic and Atmospheric Administration (NOAA) has developed several indices to measure drought impacts and severity to map their extent and locations.

- The ***Palmer Crop Moisture Index*** measures short-term drought on a weekly scale and is used to quantify drought's impacts on agriculture during the growing season.

- The ***Palmer Z Index*** measures short-term drought on a monthly scale. Figure 5-3 shows this index for September 2023.

- The hydrological impacts of drought (e.g., reservoir levels, groundwater levels, etc.) take longer to develop and it takes longer to recover from them. The ***Palmer Hydrological Drought Index***, another long-term index, was developed to quantify hydrological effects. This index responds more slowly to changing conditions than the Palmer Drought Index.

- While the Palmer indices consider precipitation, evapotranspiration and runoff, the ***Standardized Precipitation Index*** considers only precipitation. In this index, a value of zero indicates the median precipitation amount; the index is negative for drought and positive for wet conditions. The Standardized Precipitation Index is computed for time scales ranging from one month to 24 months.

- The ***Palmer Drought Index*** measures the duration and intensity of long-term drought-inducing circulation patterns. Long-term drought is cumulative, so the intensity of drought during a given month is dependent on the current weather patterns plus the cumulative patterns of previous months. Weather patterns can change quickly from a long-term drought pattern to a long-term wet pattern, and this index can respond fairly rapidly.

These indices change very frequently. The data contained in this profile frequently changes, and is meant to provide only a brief overview. Reviewers wishing additional or more current data should check NOAA's website at [Historical Palmer Drought Indices | National Centers for Environmental Information (NCEI) (noaa.gov)]

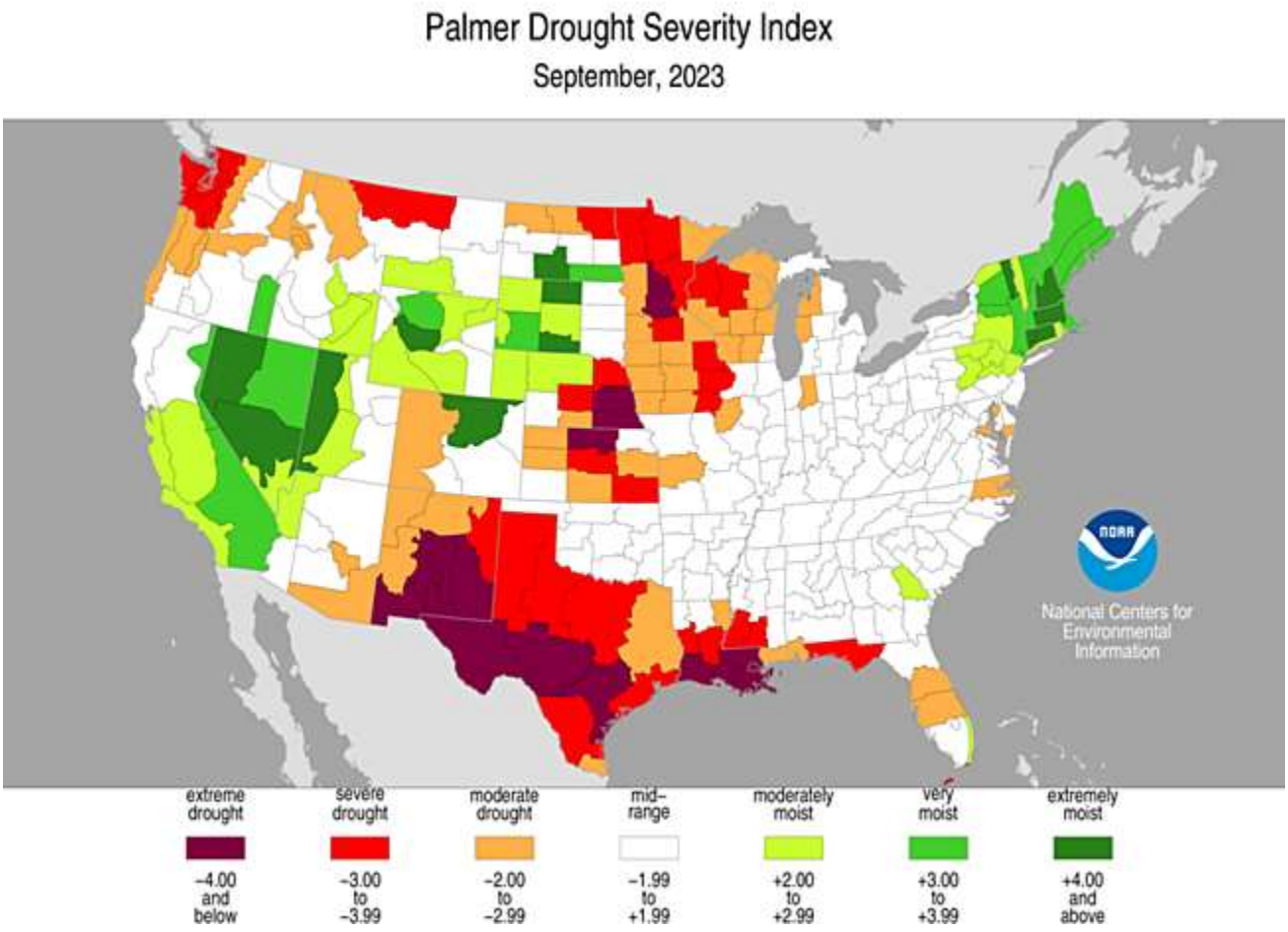


Figure 6-3 Palmer Z Index Short-Term Drought Conditions (September 2023)

6.2.4 Frequency

Empirical studies conducted over the past century have shown that meteorological drought is never the result of a single cause. It is the result of many causes, often synergistic in nature; these include global weather patterns that produce persistent, upper-level high-pressure systems along the West Coast with warm, dry air resulting in less precipitation.

In temperate regions, including Washington, long-range forecasts of drought have limited reliability. In the tropics, empirical relationships have been demonstrated between precipitation and El Niño events, but few such relationships have been demonstrated above 30º north latitude. Meteorologists do not believe that reliable forecasts are attainable at this time a season or more in advance for temperate regions.

A great deal of research has been conducted in recent years on the role of interacting systems in explaining regional and even global patterns of climatic variability. These patterns tend to recur periodically with enough frequency and with similar characteristics over a sufficient length of time that they offer opportunities to improve the ability for long-range climate prediction. However, too many variables exist in determining the frequency with which a drought will occur.

While reliable forecasts of drought are not attainable for temperate regions of the world more than a season in advance, based on review of the State's 2023 HMP, the probability of a chance of a drought-related disaster declaration each year in the state is 24% (State HMP, 2023 p. 30). With changing climatic conditions, the State's 2018 Hazard Mitigation Plan indicates that the "state may likely experience one or two major drought events," impacting 75 percent of the State area with approximately 2 million of the State's population exposed to severe drought conditions (HMP, 2023).

Based on the State's 2018 HMP, Mason County has a low exposure rate to drought (WA EMD HMP, 2018).[15] The Central area of the state is the region most at-risk, with the most frequent droughts occurring "primarily in Eastern Washington" (WA EMD HMP, 2023).

6.3 VULNERABILITY ASSESSMENT

6.3.1 Overview

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to the ability to produce goods and provide services. Drought can affect a wide range of economic, environmental, and social activities. The vulnerability of an activity associated with the effects of drought usually depends on its water demand, how the demand is met, and what water supplies are available to meet the demand.

All people, property and environments in the planning area could be exposed to some degree to the impacts of moderate to extreme drought. Areas densely wooded, especially areas in parks throughout the County which host campers, increase the exposure to forest fires. Additional exposure comes in the form of economic impact should a prolonged drought occur that would impact fishing, recreation, agriculture, and timber harvesting—primary sources of income in the planning area. Prolonged drought would also decrease capacity within the watersheds, thereby reducing fish runs and spawning areas.

Warning Time

A drought is not a sudden-onset hazard. Droughts are climatic patterns that occur over long periods, providing for some advance notice. In many instances, annual situations of low water levels are identified

[15] At the time of this 2024 update, the 2018 Washington State Enhanced Hazard Mitigation Plan was under FEMA review, but had not yet been approved. Once approved, the 2023 HMP was incorporated as appropriate, but in some instances, similar analysis from the previous plans was not available. Thus, the previous versions are utilized as cited.

months in advance (e.g., snowpack at lower levels are identified during winter months), allowing for advanced planning for water conservation.

Meteorological drought is the result of many causes, including global weather patterns that produce persistent, upper-level high-pressure systems along the West Coast resulting in less precipitation. Only general warning can take place, due to the numerous variables that scientists have not pieced together well enough to make accurate and precise predictions. It is often difficult to recognize a drought before being in the middle of it. Droughts do not occur spontaneously; they evolve over time as certain conditions are met.

Scientists do not know how to predict drought more than a month in advance for most locations. Predicting drought depends on the ability to forecast precipitation and temperature. Weather anomalies may last from several months to several decades. How long they last depend on interactions between the atmosphere and the oceans, soil moisture and land surface processes, topography, internal dynamics, and the accumulated influence of weather systems on the global scale. In temperate regions such as Washington, long-range forecasts of drought have limited reliability. Meteorologists do not believe that reliable forecasts are attainable at this time a season or more in advance for temperate regions.

6.3.2 Impact on Life, Health, and Safety

Wildfires are often associated with drought. A prolonged lack of precipitation dries out vegetation, which becomes increasingly susceptible to ignition as the duration of the drought extends. This increases the risk to the health and safety of all of the residents within the planning area, especially those in wildland-urban interface areas. Smoke and particles embedded within the smoke are of significant concern for the elderly and very young, especially those with breathing problems. The Tribe does own and maintains two water towers. As such, the Tribe does have the ability to minimize impacts on residents and water consumers within the tribal planning area to some degree should several consecutive dry years occur through water rationing and the installation of air purification systems.

6.3.3 Impact on Property

No structures will be directly affected by drought conditions, though some may become vulnerable to wildfires, which are more likely following years of drought. Droughts can also have significant impacts on landscapes, which could cause a financial burden to property owners. However, these impacts are not considered critical in planning for impacts from the drought hazard.

6.3.4 Impact on Critical Facilities and Infrastructure

Critical facilities will continue to be operational during a drought unless impacted by fire. Critical facility elements such as landscaping may not be maintained due to limited resources, but the risk to the planning area's critical facilities inventory will be largely aesthetic. For example, when water conservation measures are in place, landscaped areas will not be watered and may die. These aesthetic impacts are not considered significant. The Tribe does maintain fish pens, which are considered critical infrastructure. The state hatcheries provide to the SIT its Coho parr which are reared in the pens. Impact to the parr as a result of a drought situation could be minimized to some degree through proactive measures of ensuring

temperatures remain accurate within the state's hatcheries, but low water levels in the streambeds into which the juveniles are released cannot be as easily controlled. Other areas may need to be identified into which the juveniles can be released. Negative impact to the parr would be experienced for several years due to the life cycle of the parr.

6.3.5 Impact on Economy

Economic impact from a drought is associated with different aspects, including potential loss of agri- and aqua-cultural production. The Tribe's economy relies heavily on aquaculture. The planning area and surrounding Mason County have a high agricultural dependency on Christmas trees and short rotation woody crops, ranking fourth statewide. Drought situations such as those that have previously occurred statewide have impacted the fishing industry, including shellfish. Combined, the impact from a drought situation on these areas of agri- and aqua-cultural markets for economic sustainability could be high, if not by direct impact via a tribal business, than potentially by employment for tribal members and lost wages for those who work in the various economic sectors.

Additional economic impact stems from the potential loss of critical infrastructure due to fire damage and impacts on industries that depend on water for their business, such as fishing industries, potentially golf courses, and water-based recreational activities.

Problems of domestic and municipal water supplies have historically been corrected by building another reservoir, a larger pipeline, new well, or some other facility. With drought conditions increasing pressure on aquifers and increased pumping, which can result in saltwater intrusion into freshwater aquifers, resultant reductions or restrictions on economic growth and development could occur. Given potential political issues, a drought situation, if prolonged, could restrict building within specific areas due to lack of supporting infrastructure, thereby impacting the tax base and economy of the entire region by limiting growth. In addition, impact to or the lack of hydroelectric generating capacity associated with drought conditions as a result of reduced precipitation levels could raise electric prices throughout the region.

6.3.6 Impact on Environment

Environmental losses from drought are associated with aquatic life, plants, animals, wildlife habitat, air and water quality, forest fires, landscape quality, biodiversity, and soil erosion. Some effects are short term and conditions quickly return to normal after the drought. Other effects linger or even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation, but many species will eventually recover from this effect. Degraded landscape quality, including soil erosion, may lead to a more permanent loss of biological productivity. Lifecycles for fish spawning in the area would have environmental impacts years into the future.

Public awareness and concern for environmental quality has led to greater attention to these effects. Drought conditions within the planning area could increase the demand for water supplies. Water shortages would have an adverse impact on the environment, relied upon by the planning partnership, causing social and political conflicts. If such conditions persisted for several years, the economy of the tribal planning area could experience setbacks, especially in water dependent industries.

6.3.7 Impact from Climate Change

The impact from climate change on drought will be significant. With historic records demonstrating increased temperature rise, the results will only further exacerbate drought stations. Ocean acidification has also been noted. Drought also plays a significant role in the wildfire system, fire behavior, ignitions, fire management, and vegetation fuels. Hot dry spells create the highest fire risk. Increased temperatures may intensify wildfire danger by warming and drying out vegetation. Climate change will further change the use of water available for fish spawning and rearing due to increased temperature. The SIT harvest a significant amount of Coho and since Coho stay in the creeks/rivers for a year, low summer water, particularly when temperatures rise, negatively impact the parr and other juvenile fish. The SIT is also attempting to restore cutthroat to the area, which is a native species that depends on summer water flows. Climate Change will also impact the availability of water levels for agricultural growers with respect to their crops. With decreased precipitation in the form of snow, water levels will fall, creating water shortages for use by consumers as drinking water, irrigation and watering of livestock, and firefighters to control and fight fires.

6.4 FUTURE DEVELOPMENT TRENDS

The Squaxin Island Tribe has a relatively low amount of land available for future construction. With the anticipated increase in population, the rezoning of land from agricultural to residential would have the propensity to increase water demands, as well as increase demands on other infrastructure, and increase the potential for wildfires. The Tribe (and Mason County) have established comprehensive plans that include policies directing land use and dealing with issues of water supply and the protection of water resources, as well as fire regulations. These plans provide the capability to protect future development from the impacts of drought. If deficiencies in this respect are identified, mitigation measures to increase the capability to deal with future trends in development can be identified both by the Tribe and the County in an effort to continue to be good stewards of the land.

The planning area continues to move forward in developing policies directing land use and dealing with zoning, density and permitting for any new development. This will provide the capability to protect future development from the impacts of drought.

6.5 ISSUES

An extreme drought could impact the region with little warning. Combinations of low precipitation and unusually high temperatures could occur over several consecutive years, especially in response to climate change. Intensified by such conditions, extreme wildfires could break out throughout the area, increasing the need for water. Surrounding communities, also in drought conditions, could increase their demand for water, causing social and political conflicts. Low water tables could increase issues of life, safety, and health, while also impacting the economy both for loss of potential agricultural income, but also with respect to decreased ability to construct new housing due to lack of ability to provide water. If such conditions persisted for several years, the economy of the region could experience setbacks, especially in water dependent industries.

The planning team has identified the following drought-related issues:

- The need for alternative water sources should a prolonged drought occur;
- Use of groundwater recharge to stabilize the groundwater supply;
- The probability of increased drought frequencies and durations due to climate change;
- The promotion of active water conservation even during non-drought periods;
- The potential impact on businesses in the area;
- The potential impact on the livelihood of those employed in industries that could be impacted by drought, such as agriculture, fishing, forestry, and tourism.

6.6 RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from Drought throughout the area is highly likely. The area has previously experienced drought conditions. As of this 2024 update, the State has experienced some of its driest summers on record, as well as setting high-temperature records. With anticipated increase in temperatures as a result of climate change expected to continue, drought situations will only intensify. With the planning area's dependence on aqua- and agri-culture, there is a significant potential economic loss in the region. In addition, higher temperatures anticipated with climate change would increase vulnerability of the population due to excessive heat, while also potentially impacting power supplies at the hydro-dams in the area. With a higher number of tribal elders and an aged population of more socially vulnerable individuals than that of the remaining state, as well as older residential structures that may not have air conditioning or air purification systems in place, this would increase the potential vulnerability, although exact figures cannot be determined. Based on the potential impact, the Planning Team determined the CPRI score to be 2.0, with overall vulnerability determined to be a low level.

CHAPTER 7.
EARTHQUAKE

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden dislocation of the crust or by a volcanic eruption. Its epicenter is the point on the earth's surface directly above the hypocenter of an earthquake. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth. Earthquakes many times occur along a fault, which is a fracture in the earth's crust.

DEFINITIONS

Earthquake—The shaking of the ground caused by an abrupt shift of rock along a fracture in the earth or a contact zone between tectonic plates.

Epicenter—The point on the earth's surface directly above the hypocenter of an earthquake. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth.

Fault—A fracture in the earth's crust along which two blocks of the crust have slipped with respect to each other.

Focal Depth—The depth from the earth's surface to the hypocenter.

Hypocenter—The region underground where an earthquake's energy originates

Liquefaction— Loosely packed, water-logged sediments losing their strength in response to strong shaking, causing major damage during earthquakes.

7.1 GENERAL BACKGROUND

Most destructive quakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called "seismic waves" are generated. These waves travel outward from the source of the earthquake at varying speeds.

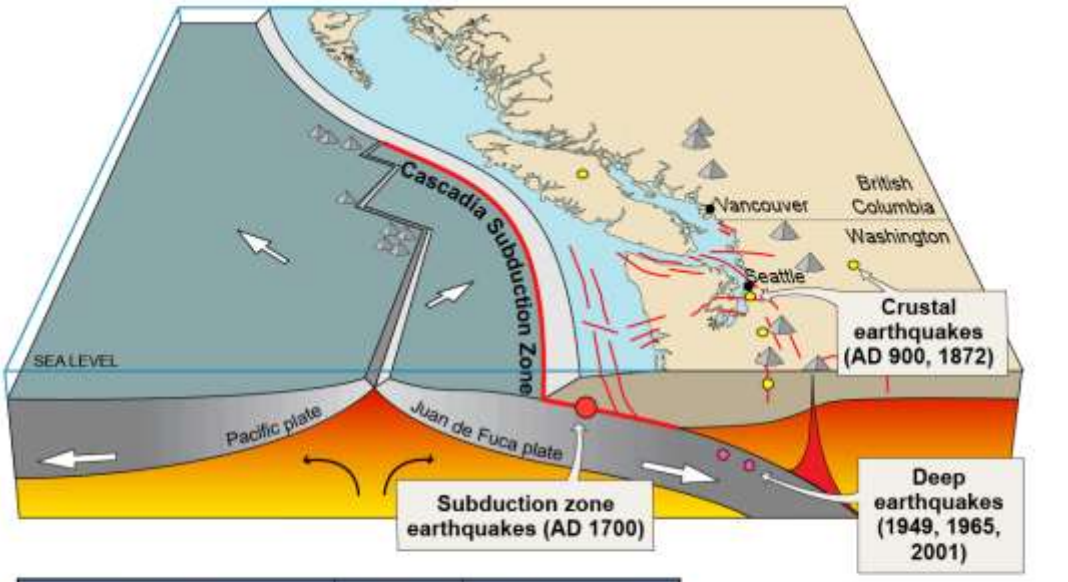
Earthquakes tend to reoccur along faults, which are zones of weakness in the crust. Even if a fault zone has recently experienced an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake could still occur.

Geologists classify faults by their relative hazards. Active faults, which represent the highest hazard, are those that have ruptured to the ground surface during the Holocene period (about the last 11,000 years). Potentially active faults are those that displaced layers of rock from the Quaternary period (the last 1,800,000 years). Determining if a fault is "active" or "potentially active" depends on geologic evidence, which may not be available for every fault.

Faults are more likely to have earthquakes on them if they have more rapid rates of movement, have had recent earthquakes along them, experience greater total displacements, and are aligned so that movement can relieve accumulating tectonic stresses. A direct relationship exists between a fault's length and location and its ability to generate damaging ground motion at a given site. In some areas, smaller, local faults produce lower magnitude quakes, but ground shaking can be strong, and damage can be significant as a result of the fault's proximity to the area. In contrast, large regional faults can generate great magnitudes but, because of their distance and depth, may result in only moderate shaking in the area.

It is generally agreed that three source zones exist for Pacific Northwest quakes: a shallow (crustal) zone; the Cascadia Subduction Zone; and a deep, intraplate "Benioff" zone. These are shown in Figure 7-1. More

than 90 percent of Pacific Northwest earthquakes occur along the boundary between the Juan de Fuca plate and the North American plate.



Source	Max. Size	Recurrence
Subduction zone	M 9+	200–600 years
Deep Juan de Fuca plate	M 7+	30–50 years
Crustal faults	M 7+	Hundreds of years?

*figure modified from USGS Cascadia earthquake graphics at http://geomaps.wr.usgs.gov/pacnw/pacnweq/index.html

Figure 7-1 Earthquake Types in the Pacific Northwest and Recurrence Intervals

An earthquake will generally produce the strongest ground motions near the epicenter (the point on the ground above where the earthquake initiated) with the intensity of ground motions diminishing with increasing distance from the epicenter. The intensity of ground shaking at a given site depends on four main factors:

- Earthquake magnitude
- Earthquake epicenter
- Earthquake depth
- Soil or rock conditions at the site, which may amplify or de-amplify earthquake ground motions.

For any given earthquake, there will be contours of varying intensity of ground shaking with distance from the epicenter. The intensity will generally decrease with distance from the epicenter, and often in an irregular pattern, not simply in concentric circles. The irregularity is caused by soil conditions, the complexity of earthquake fault rupture patterns, and directionality in the dispersion of earthquake energy.

7.2 EARTHQUAKE CLASSIFICATIONS

Earthquakes are typically classified in one of two ways: By the amount of energy released, measured as *magnitude* (size or power based on the Richter Scale); or by the impact on people and structures, measured as *intensity* (based on the Mercalli Scale). Magnitude is related to the amount of seismic energy released at the hypocenter of an earthquake. It is determined by the amplitude of the earthquake waves recorded on instruments. Magnitude is represented by a single, instrumentally determined value for each earthquake event. Intensity indicates how the earthquake is felt at various distances from the earthquake epicenter.

Table 7-1 presents a classification of earthquakes according to their magnitude.

TABLE 7-1
EARTHQUAKE MAGNITUDE CLASSES

Magnitude Class	Magnitude Range (M = magnitude)
Great	M > 8
Major	7 <= M < 7.9
Strong	6 <= M < 6.9
Moderate	5 <= M < 5.9
Light	4 <= M < 4.9
Minor	3 <= M < 3.9
Micro	M < 3

Estimates of moment magnitude roughly match the local magnitude scale (ML) commonly called the Richter scale. One advantage of the moment magnitude scale is that, unlike other magnitude scales, it does not saturate at the upper end. That is, there is no value beyond which all large earthquakes have about the same magnitude. For this reason, moment magnitude is now the most often used estimate of large earthquake magnitudes.

Intensity

There are many measures of the severity or intensity of earthquake ground motions. The Modified Mercalli Intensity scale (MMI) was widely used beginning in the early 1900s. MMI is a descriptive, qualitative scale that relates severity of ground motions to the types of damage experienced. MMI values range from I to XII (USGS, 1989). Table 7-2 compares the moment magnitude scale to the modified Mercalli intensity scale.

TABLE 7-2
EARTHQUAKE MAGNITUDE AND INTENSITY

Magnitude (Mw)	Intensity (Modified Mercalli)	Description
1.0—3.0	I	I. Not felt except by a very few under especially favorable conditions
3.0—3.9	II—III	II. Felt only by a few persons at rest, especially on upper floors of buildings. III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it is an earthquake. Standing cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
4.0—4.9	IV—V	IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like a heavy truck striking building. Standing cars rocked noticeably.
5.0—5.9	VI—VII	VI. Felt by all; many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. VII. Damage negligible in buildings of good design and construction; slight in well-built ordinary structures; considerable in poorly built or badly designed structures. Some chimneys broken.
6.0—6.9	VII—IX	VIII. Damage slight in specially designed structures; considerable damage in ordinary buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
7.0 and higher	VIII and higher	X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly. XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

More accurate, quantitative measures of the intensity of ground shaking have largely replaced the MMI and are used in this mitigation plan. These scales use terms that can be physically measured with seismometers, such as the acceleration, velocity, or displacement (movement) of the ground. The intensity may also be measured as a function of the frequency of earthquake waves propagating through the earth. In the same way that sound waves contain a mix of low-, moderate- and high-frequency sound waves, earthquake waves contain ground motions of various frequencies. The behavior of buildings and other structures depends substantially on the vibration frequencies of the building or structure versus the frequency of earthquake waves. Earthquake ground motions also include both horizontal and vertical components.

Ground Motion

Earthquake hazard assessment is also based on expected ground motion. This involves determining the probability that certain ground motion accelerations will be exceeded over a time period of interest. A common physical measure of the intensity of earthquake ground shaking, and the one used in this mitigation plan, is peak ground acceleration (PGA). PGA is a measure of the intensity of shaking relative to the acceleration of gravity (g). For example, an acceleration of 1.0 g PGA is an extremely strong ground motion, which does occur near the epicenter of large earthquakes. With a vertical acceleration of 1.0 g, objects are thrown into the air. With a horizontal acceleration of 1.0 g, objects accelerate sideways at the same rate as if they had been dropped from the ceiling. A PGA equal to 10% g means that the ground acceleration is 10 percent that of gravity. Figure 7-2 illustrates the USGS's analysis identifying earthquake hazard areas/levels nationwide. Figure 7-3 illustrates the PGA that Washington State can expect (most current available showing PGA as of 2024 update).[16]

Damage levels experienced in an earthquake vary with the intensity of ground shaking and with the seismic capacity of structures. The following generalized observations provide qualitative statements about the likely extent of damage for earthquakes with various levels of ground shaking (PGA) at a given site:

- Ground motions of only 1% g or 2% g are widely felt by people; hanging plants and lamps swing strongly, but damage levels, if any, are usually very low.
- Ground motions below about 10% g usually cause only slight damage.
- Ground motions between about 10% g and 30% g may cause minor to moderate damage in well-designed buildings, with higher levels of damage in more vulnerable buildings. At this level of ground shaking, some poorly built buildings may be subject to collapse.
- Ground motions above about 30% g may cause significant damage in well-designed buildings and very high levels of damage (including collapse) in poorly designed buildings.
- Ground motions above about 50% g may cause significant damage in most buildings, even those designed to resist seismic forces.

[16] USGS. Accessed 19 Sept. 2023. Available at: https://earthquake.usgs.gov/earthquakes/search/

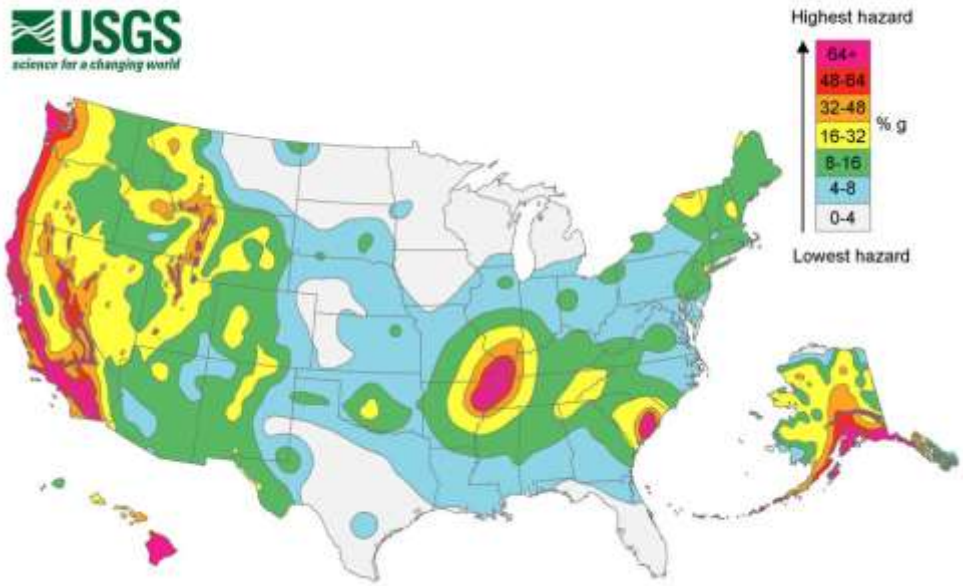


Figure 7-2 USGS Ranked Earthquake Hazard Areas Nationwide (2022)

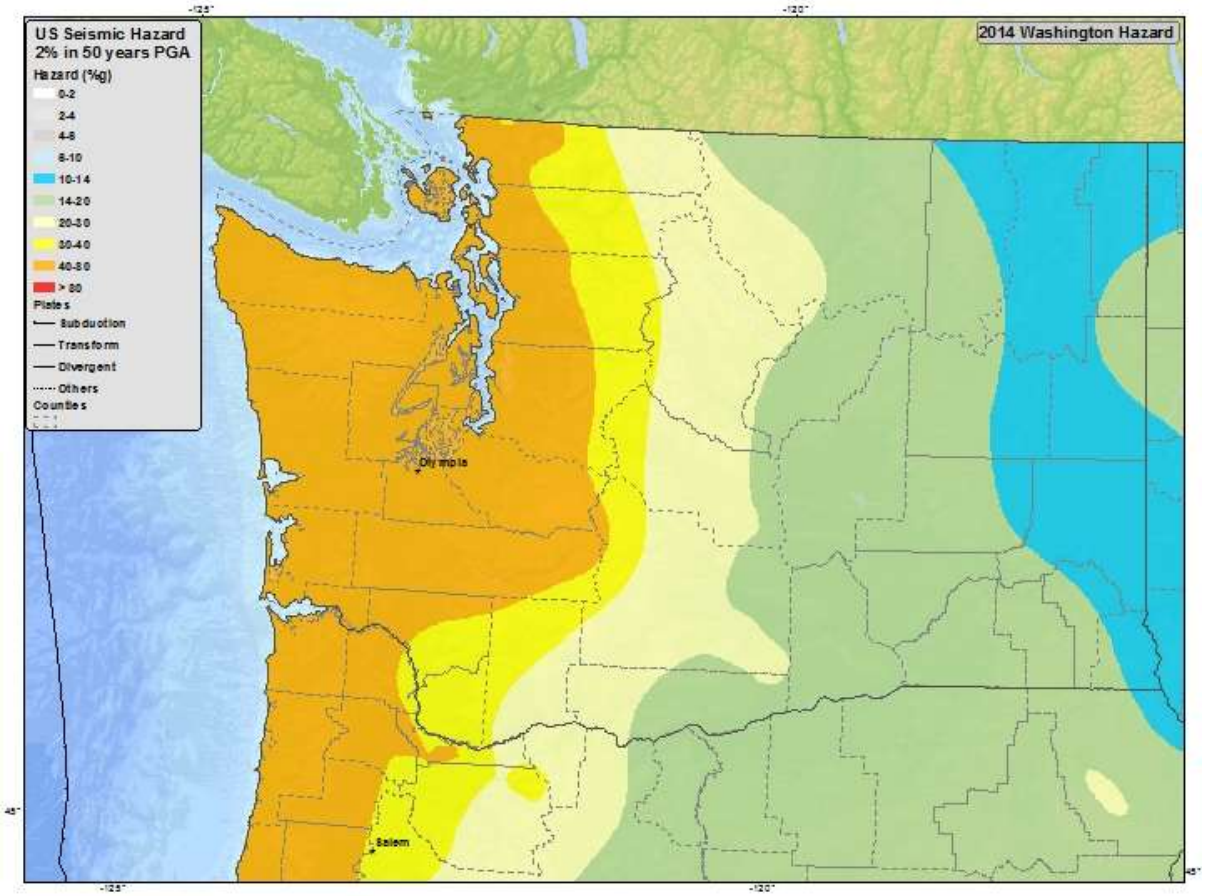


Figure 7-3 USGS PGA for Washington State (2014)

PGA is the basis of seismic design categories that are included in building codes such as the International Building Code (see Figure 7-4).[17] 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" (e.g. single-family dwellings). Longer period response components determine the lateral forces that damage larger structures with longer natural periods (apartment buildings, factories, high-rises, bridges). The amount of earthquake damage and the size of the geographic area affected generally increase with earthquake magnitude:

- Earthquakes below M5 are not likely to cause significant damage, even near the epicenter.
- Earthquakes between about M5 and M6 are likely to cause moderate damage near the epicenter.
- Earthquakes of about M6.5 or greater (e.g., the 2001 Nisqually earthquake in Washington) can cause major damage, with damage usually concentrated fairly near the epicenter.
- Larger earthquakes of M7+ cause damage over increasingly wider geographic areas with the potential for very high levels of damage near the epicenter.
- Great earthquakes with M8+ can cause major damage over wide geographic areas.
- A M9 mega-quake on the Cascadia Subduction Zone could affect the entire Pacific Northwest from British Columbia, through Washington and Oregon, and as far south as Northern California, with the highest levels of damage nearest the coast.

Table 7-3 identifies damage potential and perceived shaking by PGA factors, compared to the Mercalli scale.

[17] Source: fema_hazard_maps_western-map_graphic.jpg

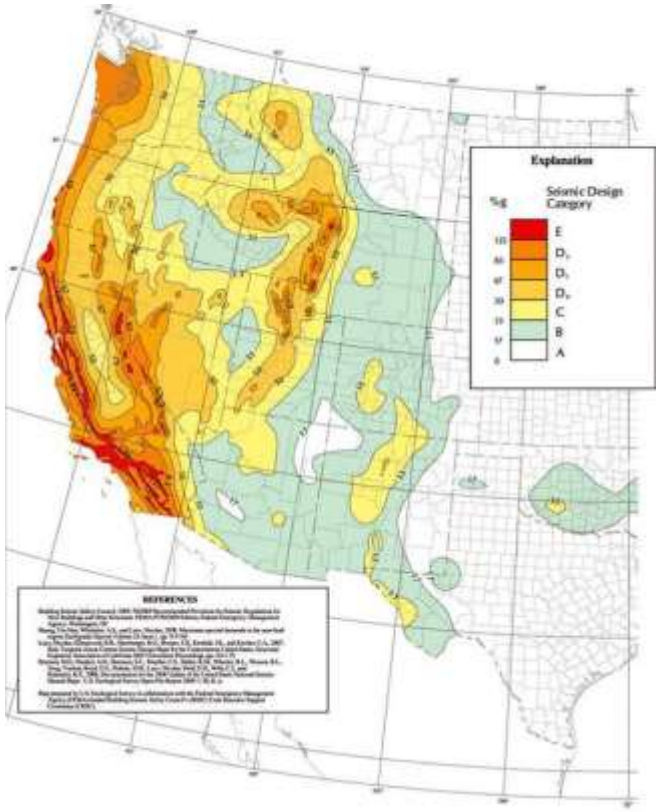


Figure 7-4 USGS Seismic Design Category (2020)

TABLE 7-3
COMPARISON OF MERCALLI SCALE AND PEAK GROUND ACCELERATION

Modified Mercalli Scale	Perceived Shaking	Potential Structure Damage		Estimated PGA[a] (%g)
		Resistant Buildings	Vulnerable Buildings	
I	Not Felt	None	None	<0.17%
II-III	Weak	None	None	0.17%—1.4%
IV	Light	None	None	1.4%—3.9%
V	Moderate	Very Light	Light	3.9%—9.2%
VI	Strong	Light	Moderate	9.2%—18%
VII	Very Strong	Moderate	Moderate/Heavy	18%—34%
VIII	Severe	Moderate/Heavy	Heavy	34%—65%
IX	Violent	Heavy	Very Heavy	65%—124%
X—XII	Extreme	Very Heavy	Very Heavy	>124%

a. PGA measured in percent of g, where g is the acceleration of gravity
Sources: USGS, 2008; USGS, 2010

7.3 EFFECT OF SOIL TYPES

Liquefaction is a secondary effect of an earthquake in which soils lose their shear strength and flow or behave as liquid, thereby damaging structures that derive their support from the soil. Liquefaction generally occurs in soft, unconsolidated sedimentary soils. The National Earthquake Hazard Reduction Program (NEHRP) creates maps based on soil characteristics to identify areas subject to liquefaction. NEHRP Soils B and C typically can sustain ground shaking without much effect, dependent on the earthquake magnitude. Areas that are commonly most affected by ground shaking and susceptible to liquefaction have NEHRP Soils D, E and F. Table 7-4 identifies the number and types of tribal-owned structures within each soil classification. Figure 7-5 illustrates the areas in which the soil classifications are situated (inclusive of all lands within the Reservation boundary, regardless of ownership), as well as the fault lines traveling through the area.

TABLE 7-4
SIT CRITICAL FACILITIES / INFRASTRUCTURE IN NEHRP SOIL CLASSIFICATIONS

NEHRP Soil Type	Description	Government Function	Hazardous Materials	Medical / Health Care	Protective Services	Residential	Schools	Shelter	Commercial	Industrial	Transportation	Cultural	Agricultural/Environmental	Power	Water	Wastewater	Total
A	Hard Rock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
B	Firm to Hard Rock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
C	Dense Soil/Soft Rock	6	0	4	7	20	1	1	4	3	0	8	25	0	2	6	**64**
D	Stiff Soil	5	0	3	2	1	0	1	5	4	0	1	2	0	2	1	**28**
E	Soft Clays	1	1	1	3	3	1	0	9	0	2	1	0	1	0	2	**25**
F	Special Study Soils (liquefiable soils, sensitive clays, organic soils, soft clays >36 m thick)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Water	Water	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	**1**

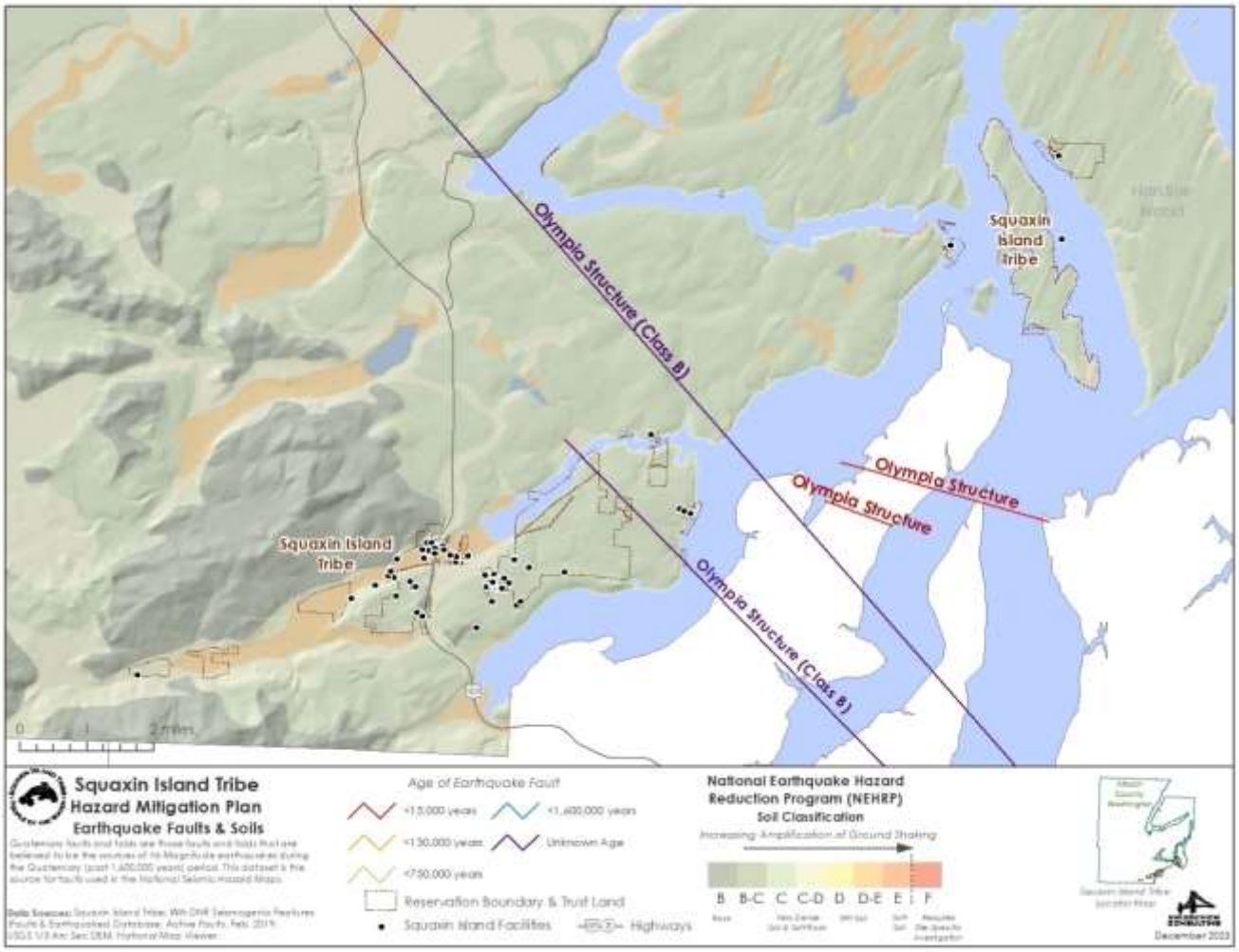


Figure 7-5 NEHRP Soil Classifications Impacting the SIT

7.3.1 Fault Classification

The U.S. Geologic Survey defines four fault classes based on evidence of tectonic movement associated with large-magnitude earthquakes during the Quaternary period, which is the period from about 1.6 million years ago to the present:

- Class A—Geologic evidence demonstrates the existence of a Quaternary fault of tectonic origin, whether the fault is exposed by mapping or inferred from liquefaction or other deformational features.

- Class B—Geologic evidence demonstrates the existence of Quaternary deformation, but either (1) the fault might not extend deep enough to be a potential source of significant earthquakes, or (2) the currently available geologic evidence is too strong to confidently assign the feature to Class C but not strong enough to assign it to Class A.

- Class C—Geologic evidence is insufficient to demonstrate (1) the existence of tectonic faulting, or (2) Quaternary slip or deformation associated with the feature.

- Class D—Geologic evidence demonstrates that the feature is not a tectonic fault or feature; this category includes features such as joints, landslides, erosional or fluvial scarps, or other landforms resembling fault scarps but of demonstrable non-tectonic origin.

7.4 HAZARD PROFILE

Seismic-related hazards include ground motion from shallow (less than 20 miles deep) or deep faults; liquefaction and differential settling of soil in areas with saturated sand, silt, or gravel; and tsunamis that result from seismic activities. Earthquakes also can cause damage by triggering landslides or bluff failure. The Puget Sound region is entirely within Seismic Risk Zone 3, requiring that buildings be designed to withstand major earthquakes measuring 7.5 in magnitude. It is anticipated, however, that earthquakes caused from subduction plate stress can reach a magnitude greater than 8.0.

High-magnitude earthquakes are possible in planning area when the Juan de Fuca slips beneath the North American plates. Deep zone or Benioff zone quakes have occurred within the Juan de Fuca plate (1949, 1965, and 2001) and can be expected in the future.

7.4.1 Extent and Location

Washington State as a whole is one of the most seismically active states in United States. Figure 7-6 depicts the faults known or suspected to be active within the state. Figure 7-7 illustrates the shaking hazard of those fault. Figure 7-8 illustrates the fault lines in proximity to the SIT.

There are a number of faults running near or through Squaxin Island and Mason County, including the Saddle Mountain East Fault, Frigid Creek Fault, and Canyon Creek Fault, which are located north and west of Hoodsport near the Olympic National Forest (USGS, 2015a). The Saddle Mountain fault was first recognized in the early 1970's. Drowned trees and trench excavations demonstrate that the fault produced a MW 6.5-7.0 earthquake 1,000-1,300 years ago, likely occurring with the MW 7.5 Seattle fault earthquake 1,100 years ago.

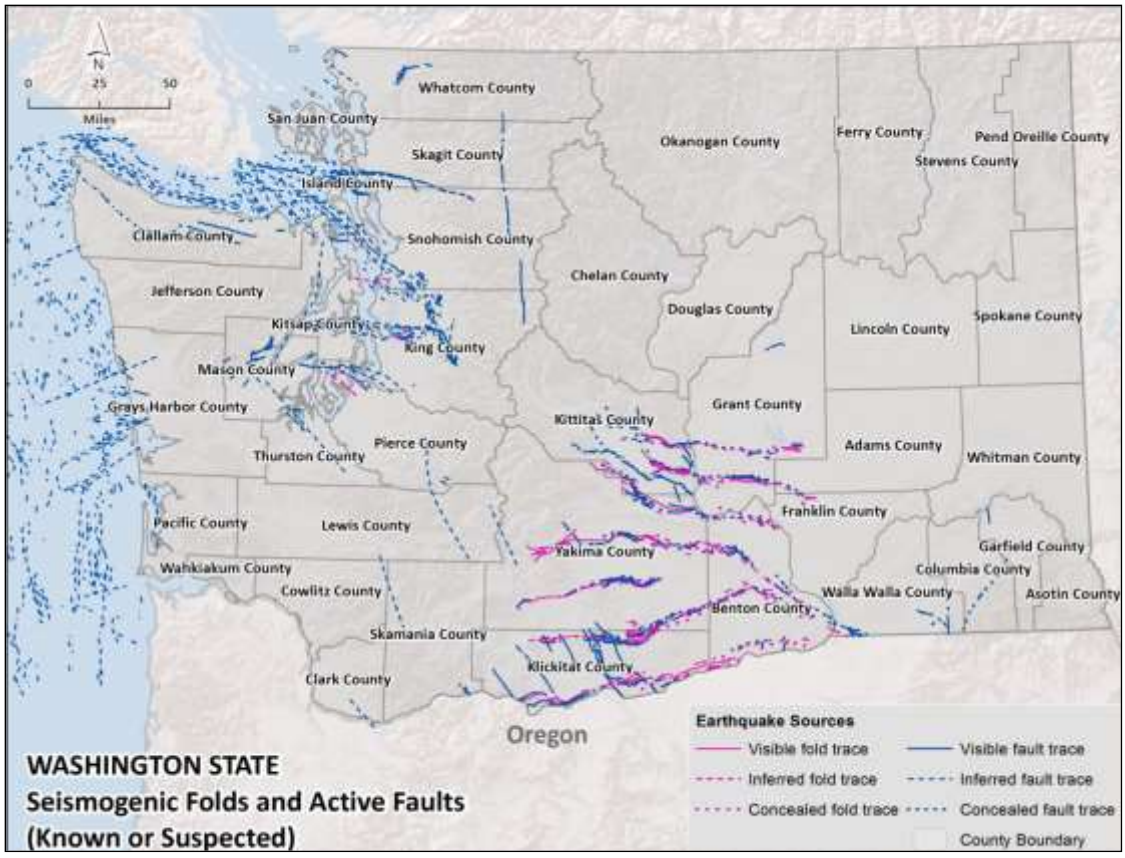


Figure 7-6 Washington State Seismogenic Folds and Active Faults

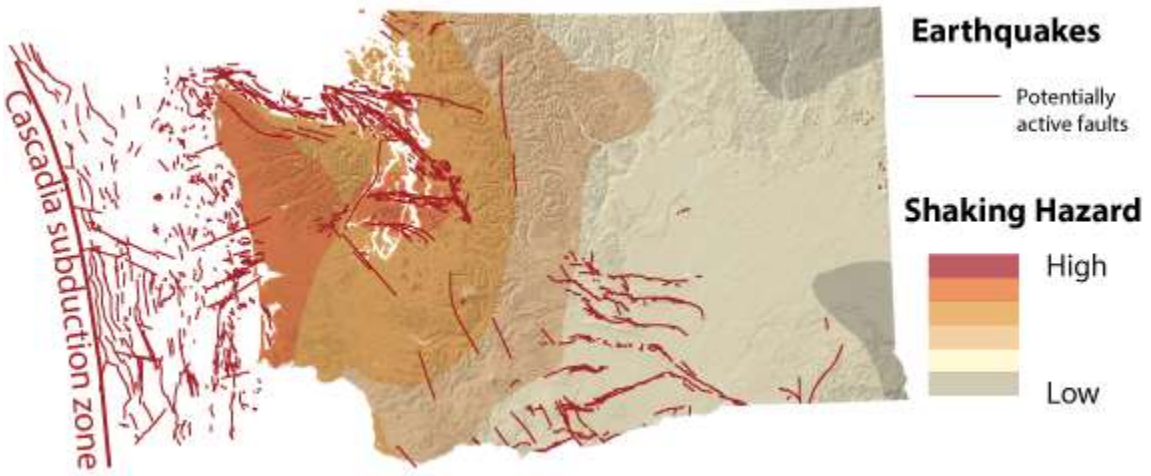


Figure 7-7 Washington State Earthquakes and Faults with Shaking Hazard

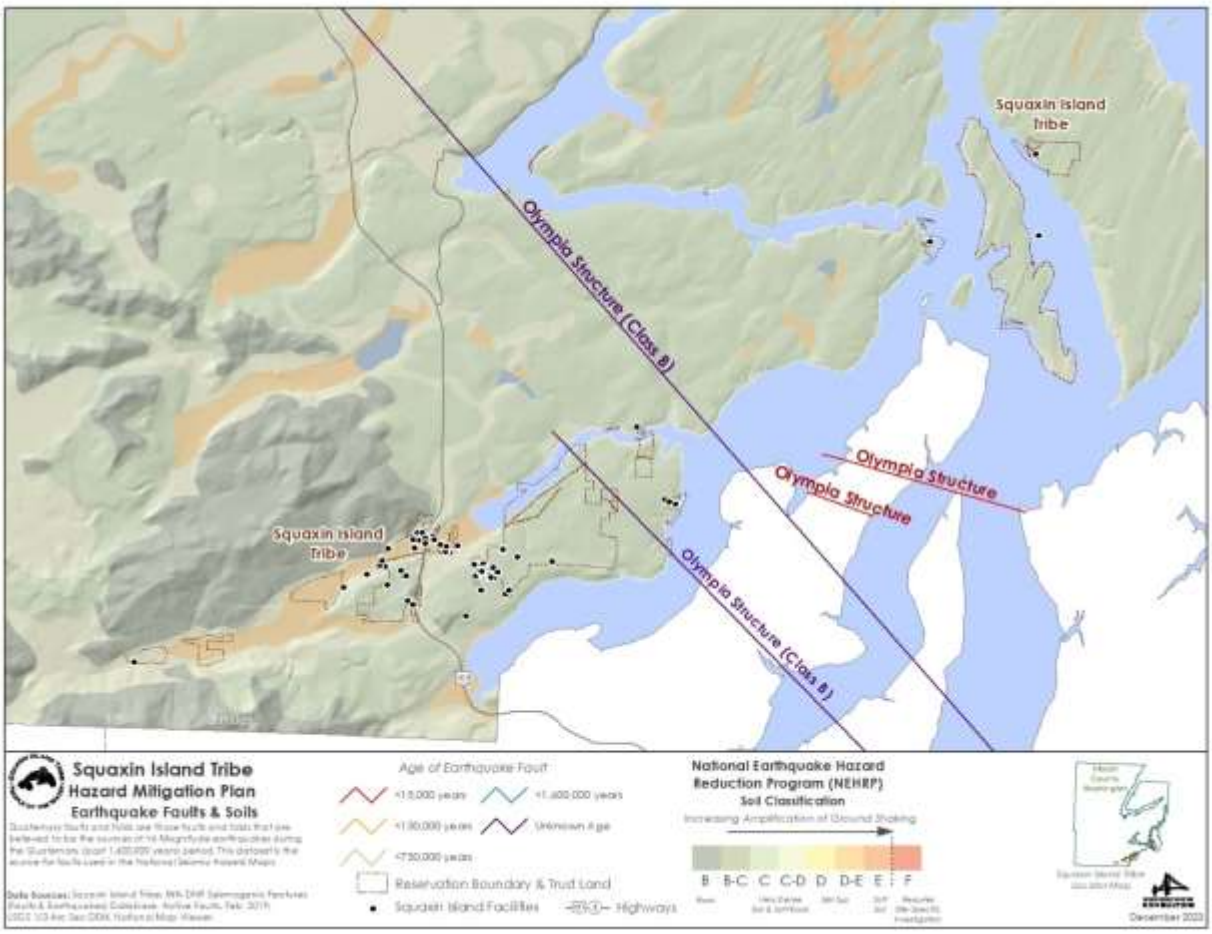


Figure 7-8 Faults on and around SIT

A quake from the Cascadia Subduction Zone would significantly impact the Tribe, both by ground shaking because of the age of the structures, and also by a Tsunami impacting culturally significant areas along the coastline, and by impact to major roadways in other areas of the planning region directly impacted by tsunami waves.

Ground shaking from earthquakes on shallow faults typically lasts from 20 to 60 seconds and are localized to the source. In addition to the direct impact of injured and structure damage, due to limited roadways in the area, should an earthquake occur on any of the existing faults in the surrounding communities, there would be impact to the SIT with respect to supply chain issues and evacuation, among others.

Additional Information

- ✓ Additional information on local faults is available from Washington State Department of Natural Resources Scenario catalogue, available online at: https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/earthquakes-and-faults#what-are-faults-and-earthquakes?.9
- ✓ Additional data and illustrative maps can be obtained at U.S. Quaternary Faults (arcgis.com) (USGS 2022).

- ✓ Additional information on the Earthquake Hazard Program is available at: Earthquake Hazards Program | U.S. Geological Survey (usgs.gov)

Hazard Mapping

Identifying the extent and location of an earthquake is not as simple as it is for other hazards such as flood, landslide, or wildfire. The impact of an earthquake is largely a function of the following factors:

- Ground shaking (ground motion accelerations)
- Liquefaction (soil instability)
- Distance from the source (both horizontally and vertically).

Mapping which shows the impacts of these components was utilized to assess the risk of earthquakes within the planning area. While the impacts from each of these components can build upon each other during an earthquake event, the mapping looks at each component individually. The mapping used in this assessment is described below.

ShakeMaps

A shake map is a representation of ground shaking produced by an earthquake (Peak Ground Acceleration). The information it presents is different from the earthquake magnitude and epicenter that are released after an earthquake because shake maps focus on the ground shaking resulting from the earthquake, rather than the parameters describing the earthquake source. An earthquake has only one magnitude and one epicenter, but it produces a range of ground shaking at sites throughout the region, depending on the distance from the earthquake, the rock and soil conditions at sites, and variations in the propagation of seismic waves from the earthquake due to complexities in the structure of the earth's crust. A shake map shows the extent and variation of ground shaking in a region immediately following significant earthquakes.

Ground motion and intensity maps are derived from peak ground motion recorded on seismic sensors, with interpolation where data are lacking and site-specific corrections. Color-coded intensity maps are derived from empirical relations between peak ground motions and Modified Mercalli intensity. Two types of shake map are typically generated from the data:

- A probabilistic seismic hazard map shows the hazard from earthquakes that geologists and seismologists agree could occur. The maps are expressed in terms of probability of exceeding a certain ground motion, such as the 10 percent probability of exceedance in 50 years. This level of ground shaking has been used for designing buildings in high seismic areas.

- Earthquake scenario maps describe the expected ground motions and effects of hypothetical large earthquakes for a region. Maps of these scenarios can be used to support all phases of emergency management.

For this plan development, the Cascadia M9.0 Earthquake Scenario completed by FEMA's RiskMAP was utilized to illustrate potential impact as it remains the most current (discussed in detail below).

Liquefaction Maps

Soil liquefaction maps are useful tools to assess potential damage from earthquakes. When the ground liquefies, sandy or silty materials saturated with water behave like a liquid, causing pipes to leak, roads and airport runways to buckle, and building foundations to be damaged. In general, areas with NEHRP Soils D, E and F are susceptible to liquefaction (see Table 7-4 for identification of number of structures in each soils type). If there is a dry soil crust, excess water will sometimes come to the surface through cracks in the confining layer, bringing liquefied sand with it and creating sand boils. Figure 7-9 illustrates liquefaction susceptibility in the surrounding areas where tribal structures are located.

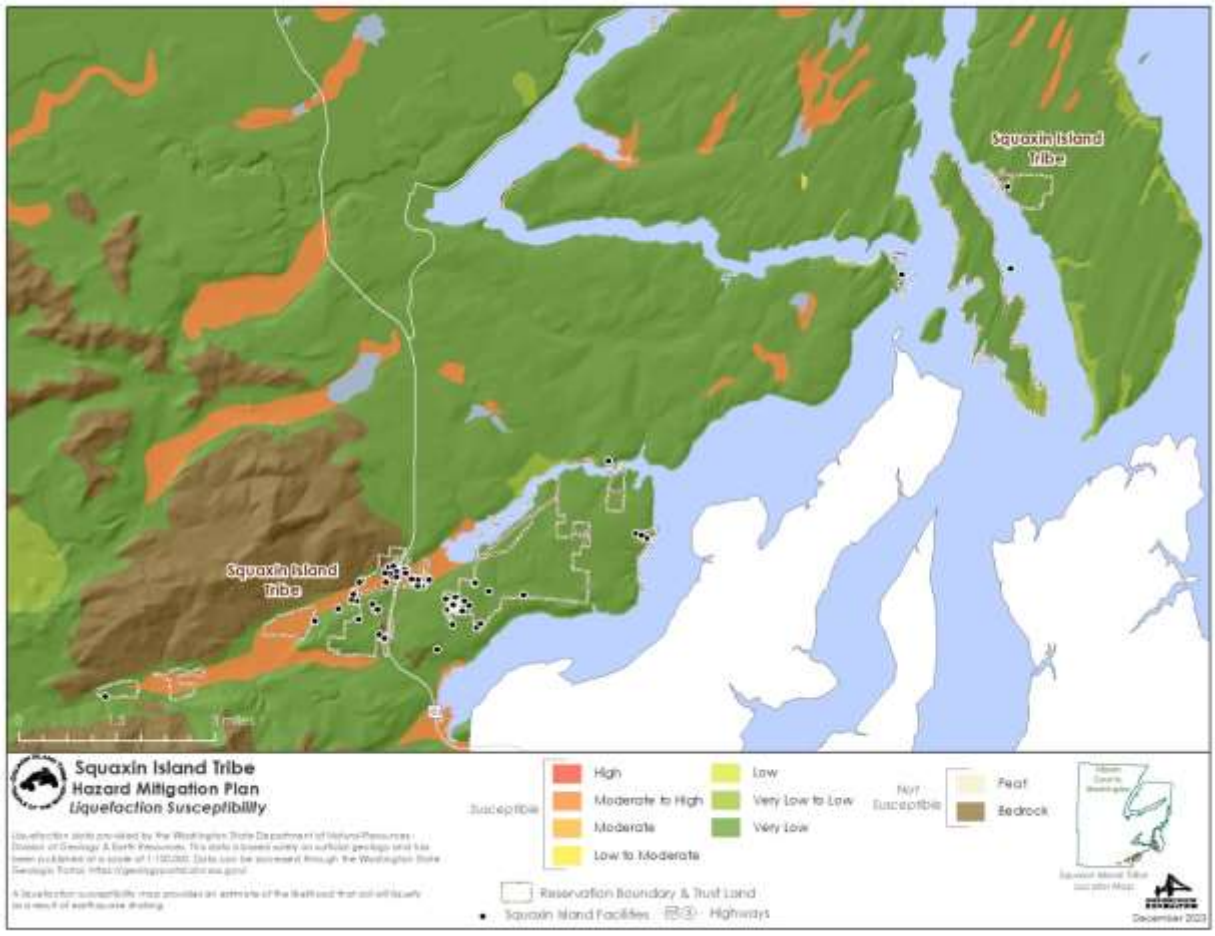


Figure 7-9 Liquefaction Susceptibility Zones Within Reservation Boundary and Tribal Lands

7.4.2 Previous Occurrences

The Squaxin Island Tribe (and Mason County) as a whole is subject to Modified Mercalli Intensity VII or IX from several sources: the Canyon River-Price Lake fault zone (Walsh and Logan, 2007; Barnett and others, 2012), which generated earthquakes about 1,000, 1,800, and 3,500 years ago; the Seattle and Tacoma faults, which generated large earthquakes about 1,000 years ago (Nelson and others, 2003; Sherrod and others, 2004); and the Cascadia subduction zone, which generated large magnitude earthquakes as recently as a few hundred years ago.

For the SIT, the largest earthquake threat would likely be from a Cascadia Subduction Zone earthquake. Abundant physical evidence for an earthquake in AD 1700 includes evidence for abrupt tectonic subsidence along the Copalis River and subsequent drowning of a spruce and cedar forest. This event is presumed to be ~M9 and is the largest earthquake in Grays Harbor County (neighboring county in which the SIT own structures) in the historic or paleoseismic record. The evidence for this earthquake is documented in Atwater and others (2005) and Goldfinger and others (2012). The fault runs from California to British Columbia and has an average recurrence interval of approximately 500 years for earthquakes of ~M9. Researchers predict a 10 to 14 percent chance that another could occur in the next 50 years, making it the most active fault that can affect Mason County.[18]

Table 7-5 lists past seismic events that have affected the areas in and around Mason County. Those which directly impacted Mason County are highlighted. Earthquakes can occur daily within Washington State. For up-to-date information on earthquakes occurring worldwide, reviewers can obtain current data by visiting Earthquakes | U.S. Geological Survey (usgs.gov). Figure 7-10 further identifies previous earthquakes and the energy released from them.

The most recent significant earthquake to occur in the planning region is the Nisqually earthquake. The Nisqually earthquake occurred February 2, 2001, with the epicenter about 11 miles northeast of the City of Olympia. It was a deep magnitude 6.8 event and due to extensive damage in several counties, was declared Federal Disaster #1361. No major earthquakes have occurred in the County since completion of the 2019 plan. Mason County has received two disaster declarations as a result of earthquake damage – the Nisqually Earthquake, which occurred on February 28, 2001, and the May 11, 1965 earthquake. The Tribe itself has never received a direct disaster declaration for earthquake.

TABLE 7-5
HISTORICAL EARTHQUAKES IMPACTING THE PLANNING AREA

Year	Magnitude	Epicenter	Type
2/28/2001 (DR 1361)	6.8	Olympia (Nisqually)	Benioff
6/10/2001	5.0	Matlock	Benioff
7/3/1999	5.8	8.0 km N of Satsop	Benioff
6/23/1997	4.7	Bremerton	Shallow Crustal
5/3/1996	5.5	Duvall	Shallow Crustal
1/29/1995	5.1	Seattle-Tacoma	Shallow Crustal
2/14/1981	5.5	Mt. St. Helens (Ash)	Crustal
9/9/76	4.5	Union	Benioff Zone (28 miles deep)
5/11/1965 (DR 196)	6.6	18.3 KM N of Tacoma	Benioff

[18] PNSN, 2022

TABLE 7-5
HISTORICAL EARTHQUAKES IMPACTING THE PLANNING AREA

Year	Magnitude	Epicenter	Type
4/29/1965	6.5	12 miles North of Tacoma	Benioff
1/13/1949	7.0	12.3 KM ENE of Olympia	Benioff
6/23/1946	7.3	Strait of Georgia	Benioff
2/14/1946	6.3	Puget Sound	Benioff
4/1945	5.7	Northbend (8 miles south/southeast)	Unknown
1939	5.8	Puget Sound – Near Vashon Island	Unknown
1932	5.3	Central Cascades	Unknown
1/23/1920	5.5	Puget Sound	Unknown
12/6/1918	7.0	Vancouver Island	Unknown
8/18/1915	5.6	North Cascades	Unknown
1/11/1909	6.0	Puget Sound	Unknown
4/30/1882	5.8	Olympia area	Unknown
12/15/1872	6.8	Pacific Coast	Unknown

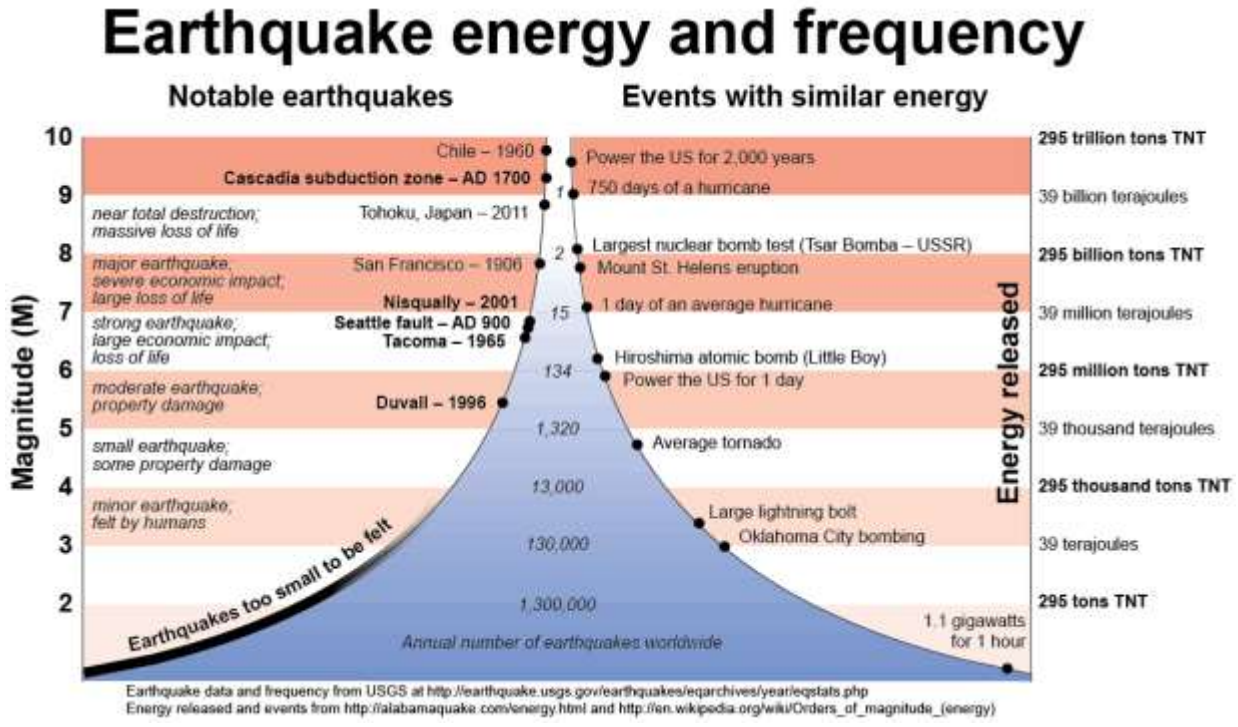


Figure 7-10 Earthquake Energy and Frequency

7.4.3 Severity

Earthquakes can last from a few seconds to over five minutes; they may also occur as a series of tremors over several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties generally result from falling objects and debris, because the shocks shake, damage, or demolish buildings and other structures. Disruption of communications, electrical power supplies and gas, sewer and water lines should be expected. Earthquakes may trigger fires, dam failures, landslides, or releases of hazardous material, compounding their disastrous effects.

Small, local faults produce lower magnitude quakes, but ground shaking can be strong, and damage can be significant in areas close to the fault. In contrast, large regional faults can generate earthquakes of great magnitudes but, because of their distance and depth, they may result in only moderate shaking in an area.

USGS ground motion maps based on current information about fault zones show the PGA that has a certain probability (2 or 10 percent) of being exceeded in a 50-year period. The PGA is measured in %g. Figure 7-11 shows the PGA with a 2 percent exceedance chance in 50 years in Washington.

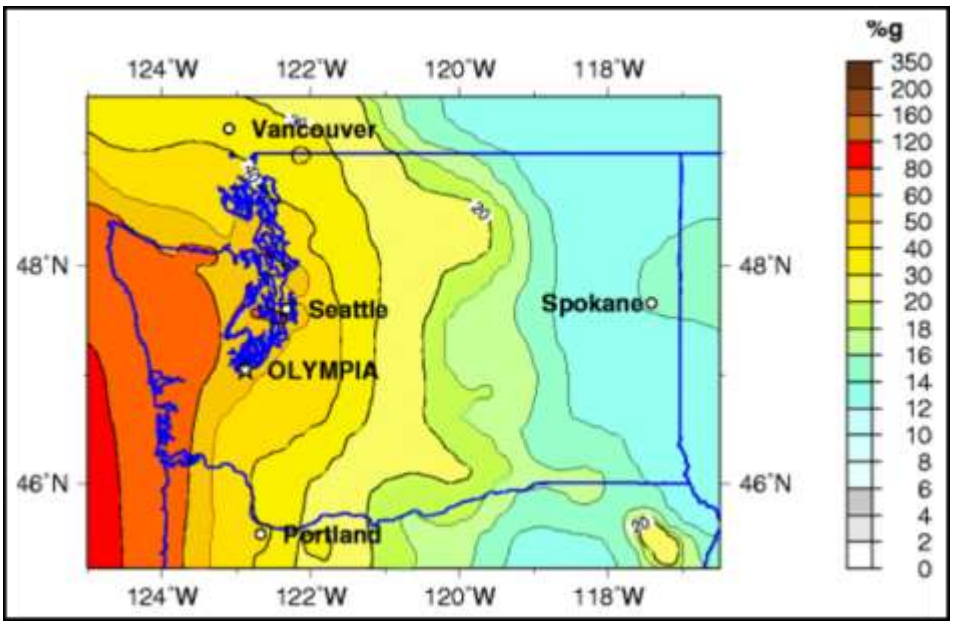


Figure 7-11 PGA with 2-Percent Probability of Exceedance in 50 Years, Northwest Region

A Cascadia Subduction Zone earthquake is felt to be the largest earthquake threat to the state as a whole. Abundant physical evidence for the 1700 earthquake includes evidence for abrupt tectonic subsidence, as well as producing both near- and far-tsunamis. This event was estimated to be about M9 and is one of the largest earthquakes in historic or paleoseismic record. This fault has an average recurrence interval of approximately 500 years for earthquakes of approximately M9.

Effects of such a major earthquake in the region could be catastrophic, providing the worst-case disaster. Potentially thousands of residents could be killed, and a multitude of others left injured and homeless. Figure 7-12 illustrates the potential peak ground velocities for such an event (Frankel, 2018).

Although recorded damage sustained to date by the Squaxin Island Tribe and within Mason County has been relatively minor and has been restricted to some incidence of cracked foundations, walls and chimneys, and damage to private wells, depending on the time of day and time of year, a catastrophic earthquake could cause hundreds of injuries, deaths, and hundreds of thousands of dollars in property damage.

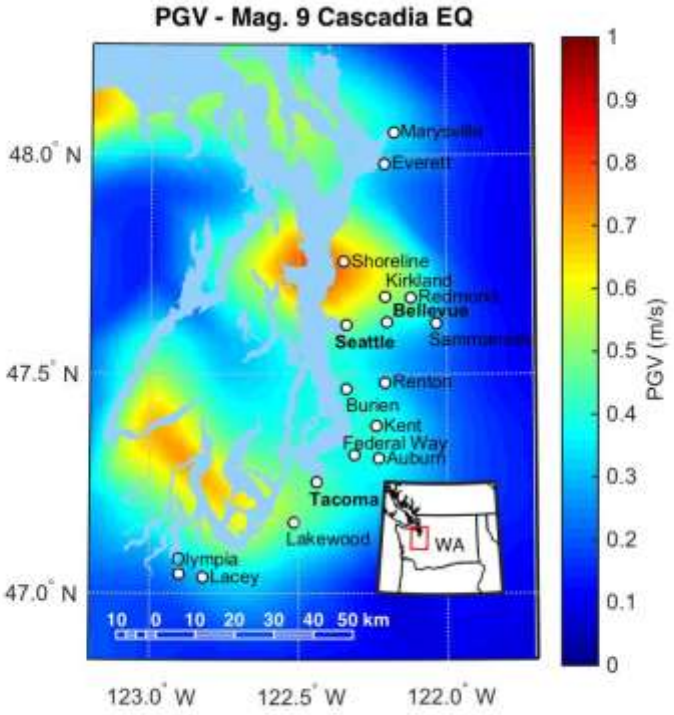


Figure 7-12 Estimated Peak Ground Velocities - M9.0 Cascadia Subduction Zone Earthquake

7.4.4 Frequency

Scientists continually work on methods to more accurately determine when an earthquake will occur, determining the probability of an earthquake in a given period of time, or other probability distribution in which the probability of an event depends on the time since the last event. However, earthquakes happen at random time intervals, with few scientifically-well tested early warning signs to indicate when one is likely to occur. Determining the probability of future earthquakes in Washington is challenging, because of their infrequency, and the lack of sufficient recorded data to enable a reliable recurrence interval. Such time-dependent models produce results broadly viewed.

- Current estimates of the likelihood of another potentially damaging intraplate earthquake during a 50-year time window with the Puget Sound region put the probability at 84 percent, with somewhat lower probabilities as one goes southward (Earthquake Hazard Program, 2012).

- Scientists currently estimate that a Magnitude-9 earthquake in the Cascadia Subduction Zone occurs about once every 500 years. The last one was in 1700. Paleoseismic investigations have identified 41 Cascadia Subduction Zone interface earthquakes over the past 10,000 years, which corresponds to one earthquake about every 250 years. About half were M9.0 or greater earthquakes that represented full rupture of the fault zone from Northern California to British Columbia. The other half were M8+ earthquakes that ruptured only the southern portion of the subduction zone.

- The 300+ years since the last major Cascadia Subduction Zone earthquake is longer than the average of about 250 years for M8 or greater and shorter than some of the intervals between M9.0 earthquakes.

- Scientists currently estimate the frequency of deep earthquakes similar to the 1965 Magnitude-6.5 Seattle-Tacoma event and the 2001 Magnitude-6.8 Nisqually event as about once every 35 years. The USGS estimates an 84-percent chance of a Magnitude-6.5 or greater deep earthquake over the next 50 years.

- Scientists estimate the approximate recurrence rate of a Magnitude-6.5 or greater earthquake anywhere on a shallow fault in the Puget Sound basin to be once in about 350 years. There have been four earthquakes of less than Magnitude 5 in the past 20 years.

- Earthquakes on the Seattle Faults have a 2-percent probability of occurrence in 50 years. A Benioff zone earthquake has an 85 percent probability of occurrence in 50 years, making it the most likely of the three types.

7.5 VULNERABILITY ASSESSMENT

7.5.1 Overview

Several faults within the planning region have the potential to cause direct impact. The area also is vulnerable to impact from an event outside the planning area, although the intensity of ground motions diminishes with increasing distance from the epicenter. As a result, the entire population of the planning area is exposed to both direct and indirect impacts from earthquakes. The degree of direct impact (and exposure) is dependent on factors including the soil type on which homes are constructed, the proximity to fault location, the type of materials used to construct residences and facilities, etc. Indirect impacts are associated with elements such as the inability to evacuate the area as a result of earthquakes occurring in other regions of the state as well as impact on commodity flow for goods and services into the area, many of which are serviced only by one roadway in or out. Impact from other parts of the state could require shipment of supplies via a barge.

The following are also general areas of vulnerability to be considered:

- Landslides associated with an earthquake occurring along Highway 101
- Impact on State Route 3, which connects to Highway 101
- Hazardous materials incidents may occur as the result of damage to oil refineries, chemical plants, rail lines and major petroleum pipelines. These do not have to be in the immediate

vicinity to cause impact, particularly with respect to environmental concerns and the Coho net pen, and the large shellfish/fishing industries on which the Tribe and its members rely.
- Levees and salt-water dikes may be damaged.
- Large hydroelectric dams may be damaged or possibly fail.
- The arrival of outside resources to assist with debris removal, repair of critical facilities, and sheltering of victims may be delayed due to severe damage in adjacent areas with larger populations and needs.
- The overall economy of the area and possibly the region could be affected.
- Large areas lying within the floodplains are susceptible to liquefaction.

Warning Time

There is currently no reliable way to predict the day or month that an earthquake will occur at any given location. Newly developed warning systems that use the low energy waves that precede major earthquakes give approximately 40 seconds notice that a major earthquake is about to occur. The warning time is very short, but it could allow someone to get under a desk, step away from a hazardous material they are working with, or shut down equipment.

7.5.2 Impact on Life, Health, and Safety

The entire population of the planning area is exposed to direct and indirect impacts from earthquakes. This would include residents, visitors, and employees of the Tribe. This would also include individuals seeking services or referrals for health and other services which the SIT provides.

The most vulnerable populations to a disaster incident such as this are the young and the elderly, and others who are socially vulnerable. Linguistically isolated populations and those living below poverty level are also more susceptible. Based on 2020 Census data, approximately 42 residents are over 65, with 58 children 5 years of age or under. There are 33 children aged 5-9 years. This does not include additional family members which may be visiting Tribal Members or living within multi-generational houses.

Also for consideration would be the number of tourists traveling to the Reservation's Casino and Hotel Resort, which includes an entertainment venue, its Golf Club, its RV park, and cultural events. It is estimated that this number could easily exceed well over 4,000 guests daily during peak seasons that would be vulnerable.

The need for increased rescue efforts and/or to provide assistance to such a large population base could tax the first-responder resources in the area during an event. At present, the Tribe does not have its own fire and EMS services, relying on Mason County Fire District #4 to provide mutual aid for fire and medical services. The Tribe has identified this as a potential mitigation item to assist in the expansion of these services.

Although many injuries may not be life-threatening, people will require medical attention and, in many cases, hospitalization. Potential life-threatening injuries and fatalities are expected; these are likely to be at an increased level if an earthquake happens during the afternoon or early evening. The lack of first responders within a reasonable distance is a significant factor when considering the travel time required, daily population at the Tribal offices, on the Reservation, and for services provided by the Tribe, as well

as individuals staying at the hotel and vacation rentals in the area, or traveling to and from other areas of the Olympic Peninsula and Hood Canal areas. It is anticipated that due to the distance to the more populated area, the Tribe will be significantly impacted with respect to any type of assistance, with the more populated areas receiving services first.

Additionally, the degree of exposure is also dependent on many factors, including the soil type on which structures are built, quality of construction, their proximity to fault location, etc. Whether impacted directly or indirectly, the entire population will have to deal with the consequences of earthquakes to some degree. Business interruption could keep people from working, road closures would undoubtedly isolate populations on the reservation, and loss of functions of utilities could impact populations that suffered no direct damage from an event itself.

It should be noted that there are significant variables that exist in the data which is used to populate the inputs necessary to reach definitive conclusions identified within this document, including the type of structure, year built, remodeling, engineered assessments, etc. All of these factors play a significant role in determining potential impact, and therefore any outputs are considered to have a high rate of error unless better, more accurate (engineered) building specific data is utilized. Such efforts far exceed the scope of this project, and as such, outputs gained during this process should be considered for planning purposes only, and in no manner should be considered for life-safety measures.

7.5.3 Impact on Property

All structures owned by the Tribe are at some risk to impact from earthquake. The current plan includes ~119 critical facilities analyzed during this assessment, with a potential of an additional 150 residential structures for which the Tribe does not have data to accurately include in this assessment. Total critical facilities' value is approximately $180 million dollars (structure only). There is an additional $57 million in content value. Due to the area of impact and the proximity to a fault or epicenter location, all structures could be impacted. This update did not review the general building stock due to ownership, focusing only on tribal owned critical assets due to limitations in structure data. The Tribe has identified this as a mitigation strategy to enhance future risk assessment which more accurately reflects all structures.

Review of soils data identified indicate that many of the structures in the area fall within the "very low" soils liquefaction areas. This does not mean that buildings could not be impacted; however, the type of soil helps more readily support structures, if they are built to appropriate standards, and within the various zoning regulations.

During FEMA's 2017 RiskMap project, various scenarios (Shake maps) were developed and utilized to illustrate the potential impact on Mason County as a whole, including the Squaxin Island Reservation. Figure 7-13 and Figure 7-14 illustrate the probable impact on the planning area. Review of the outputs from FEMA's HAZUS runs illustrate that based on a Cascadia M9.0 event, over 25 percent of the buildings in the region will be at least moderately damaged.

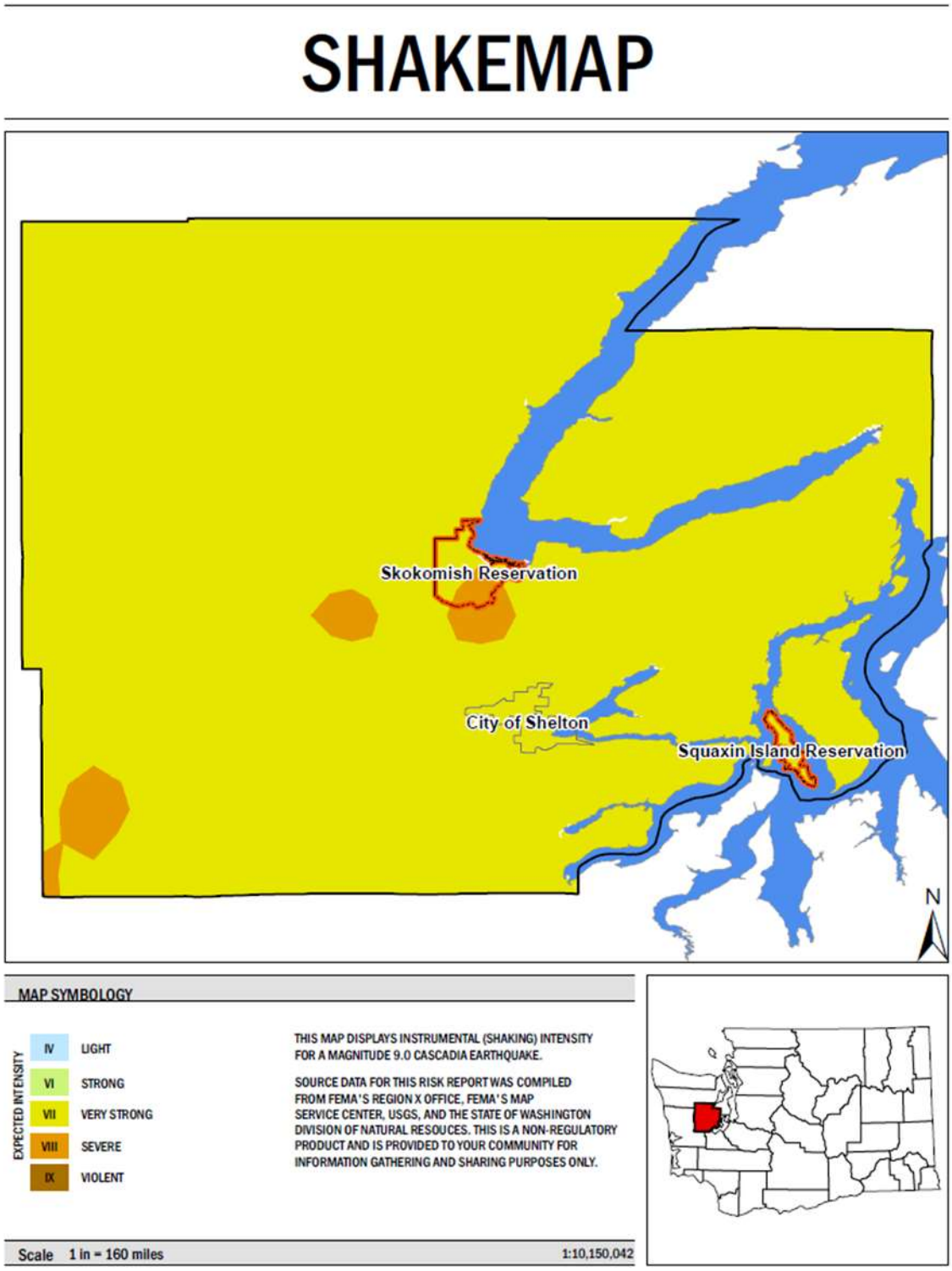


Figure 7-13 Shaking Intensity for a M9.0 Cascadia Earthquake (FEMA, 2017)

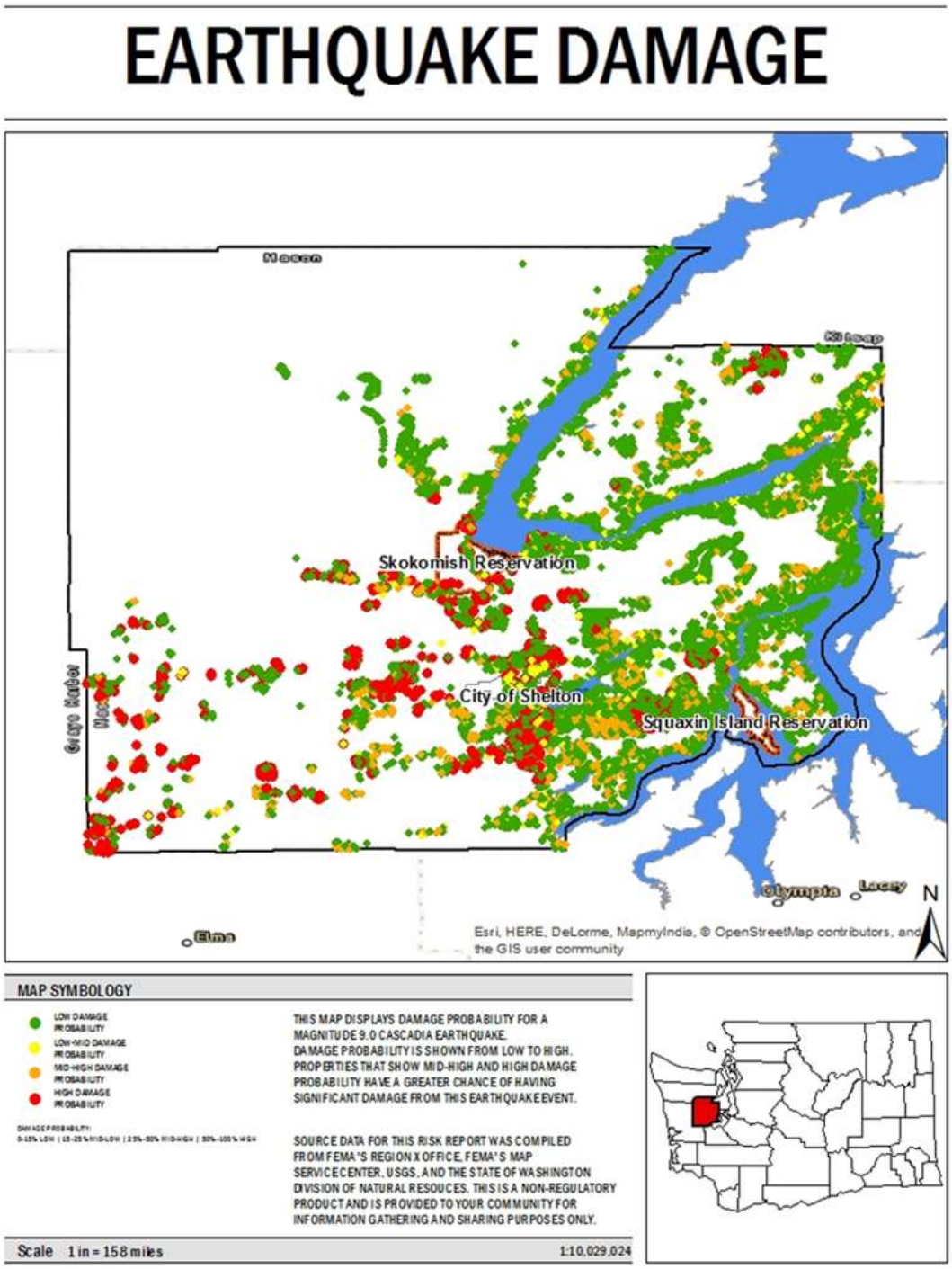


Figure 7-14 Probability of Potential Damages for M9.0 Cascadia Event (FEMA, 2017)

Building Age

Chapter 3, Section 3.6.3 identifies the age of structures owned by the SIT which were included in this update. While older structures have an increased impact potential, for the SIT, several of the post-1975 structures have been damaged by severe storms and flooding events, so the buildings may not perform as well during an earthquake and may be impacted to some degree.

The SIT has adopted the International Building Codes and continues to adopt its successors on a regular basis. As such, it is assumed that buildings in the planning area constructed after those dates of adoption are built to the highest standards. When federal funding is utilized for any construction, the Tribe in actuality must adhere to more stringent guidelines than the state regulations require based on stipulations imposed to receive federal funding.

In some cases, the SIT purchased structures not built by the Tribe. In such instances, those structures must adhere to the existing building codes in place at the time of construction. Within the State of Washington, the State adopted the UBC as its state building code in 1974, so it is assumed that buildings in the planning area built after 1974 were built in conformance with UBC seismic standards and have less vulnerability. It should be noted, however, that issues such as code enforcement and code compliance could impact this assumption. Construction material is also important when determining the potential risk to a structure. However, for planning purposes, establishing this line of demarcation can be an effective tool for estimating vulnerability. In 1994, seismic risk Zone 3 standards of the UBC went into effect in Washington, requiring all new construction to be capable of withstanding the effects of 0.3 g. More recent structures are in compliance with Zone 3 standards. In July 2004, the state again upgraded the building code to follow International Building Code Standards. While the "zones" are still referenced, they are, in large part, no longer used in the capacity they once were as there can be different zones within political subdivisions, making it difficult to apply. For instance, within Washington, there are both Seismic Zones 2B and 3. Table 7-6 provides a timeline of building code standards.

TABLE 7-6
TIMELINE OF BUILDING CODE STANDARDS

Time Period	Code Significance for Identified Time Period
Pre-1974	No standardized earthquake requirements in building codes. Washington State law did not require the issuance of any building permits, or require actual building officials
1975-2003	UBC seismic construction standards were adopted in Washington.
1994-2003	Seismic Risk Zone 3 was established within the Uniform Building Code in 1994, requiring higher standards.
2004-Present	Washington State upgrades its building codes to follow the International Building Code Standard. As upgrades occur, the State continues to adopt said standards.

7.5.4 Impact on Critical Facilities and Infrastructure

Similar to the impact to property, all critical facilities are exposed to the earthquake hazard. The degree of impact from an earthquake is largely determined based on proximity, magnitude, and ground motion causing liquefaction. Based on the distribution of structures owned by the SIT within the planning area, it can be determined that impact will be similar. As identified, FEMA's 2017 RiskMAP Report indicated that over 25 percent of the buildings in the region will be at least moderately damaged. This would include critical facilities and infrastructure. Table 7-7 identifies impact to critical facilities based on liquefaction susceptibility zones.

Review of the identified critical facilities and infrastructure information captured during this process provides information which would apply with respect to application of building codes and age of the critical facilities and infrastructure, particularly when considering the ability of structures to withstand ground shaking. Section 3.6.3 discusses the age of the structures, as well as the applicable building code standards.

TABLE 7-7
CRITICAL FACILITIES AND INFRASTRUCTURE WITHIN LIQUEFACTION SUSCEPTIBILITY ZONES

Liquefaction Susceptibility Zones	Government	Medical/Health	Protective Services	Hazardous Materials	Schools	Shelter	Industrial	Commercial	Power	Water	Wastewater	Residential	Agricultural/ Environmental /	Cultural	Transportation	Total
High	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Moderate to High	1	1	3	1	1	0	0	9	1	0	2	3	0	1	2	**25 (E)**
Moderate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Low to Moderate	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	**4 (D)**
Low	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Very Low to Low	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Very Low	11	7	9	0	1	2	7	6	0	4	7	21	5	8	0	**88 (C/ D)**
Not Susceptible to Liquefaction																
Bedrock	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**1**
Peat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Water	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**1**

Earthquakes may trigger fires, dam failures, landslides, or releases of hazardous material. Hazardous materials releases can occur during an earthquake from both fixed facilities or transportation-related incidents, leaking into the surrounding area or an adjacent waterway, having a disastrous effect on the

environment. At present, there is a large propane facility on the reservation, which could be significantly impacted.

Earthquakes can also cause disruption to communications, electrical power, wastewater and potable water services and supplies. Such disruptions should be expected. In the event of a major earthquake, areas lying within the floodplain or along coastlines are susceptible to liquefaction.

Culvert and bridge failure on roads and major thoroughfares in the area are also vulnerable to potential impact and failure. While not all owned by the SIT, there are many roadways and bridges throughout the planning area which would be at risk.

A Magnitude 7+ earthquakes can potentially trigger slope failures as well. The potential for landslide-induced roadway and bridge closures are of concern, in addition to the steep and/or unstable slopes in various locations susceptible to landslides.

The Tribe has previously experienced isolation as a result of County roadways being impacted by flood events. While flood-related impact has lasted for only a few days (unless it was a significant flood), that may not be the case during an earthquake, particularly a widespread earthquake such as anticipated with a Cascadia event, or as experienced with the Nisqually Earthquake in 2001. In the case of an earthquake, given the rural locations, it may take significantly longer for the state, county, and local municipalities to be able to make repairs, allowing for traffic flow. Closure of major arterials would also require increased evacuation periods, in some instances by several hours, if passage is even possible. With a potential ensuing tsunami as a result of an earthquake (whether a near or distant tsunami), residents and tourists along the coastline would attempt to flee inland. If roadways were impacted, evacuation and emergency response would be significantly hindered, as would the ability for communities to quickly recover.

While new structures and roadways are built to current code standards, they could nonetheless be impacted. Many of the roadways in the area have been funded through Tribal grant programs and are part of the National Tribal Transportation Facility Inventory. The Tribe does work in unison with the federal, state and local municipal road maintenance personnel to maintain roadways in good repair.

7.5.5 Impact on Economy

Economic losses sustained as a result of an earthquake include damage to buildings, including the cost of structural and non-structural damage, damage to contents, and loss of inventory, loss of wages, and loss of income. Structure value for the SIT for its critical facilities only is approximately $180 million, with an additional estimated content value of $57 million. This is not inclusive of additional, non-critical structures owned by the SIT.

The SIT does have several significantly large businesses which currently employ hundreds of personnel, both tribal and non-tribal. Prior to COVID 19, the SIT was the largest employer within Mason County.

Economic impact would also include loss to the various business ventures owned and operated by individual tribal members. The value of economic loss cannot be identified in this assessment due, in part, to the confidentiality of some of the information; however, economic losses are anticipated to rise to millions of dollars per month, particularly when the Little Creek Casino Hotel and Resort, the

entertainment/concert venues, and Tribe's golf course, and its shellfish/fish industries are factored into estimations.

In addition, loss of goods and services may hamper recovery efforts, and even preclude residents from rebuilding within the area, causing further impact. No specific loss data is available with respect to the Tribe's loss of inventory, wages, income, and revenue.

7.5.6 Impact on Environment

Earthquake-induced landslides up or down-stream of rivers, streams or coastlines can significantly impact habitat on the SIT. It is also possible for streams to be rerouted after an earthquake. This can change water quality, possibly damaging habitat and feeding areas. The tribe maintains a Coho net pen in the vicinity of the reservation, which could be severely impacted. There is also a possibility of streams fed by groundwater drying up because of changes in underlying geology.

There also exists the impact from hazardous materials impacting the environment, including the coastlines, estuaries, and watersheds, among others. The Tribe does have a fueling station, both commercial and for tribal vehicles, which could be impacted. There is also a storage of chemicals utilized for various purposes by the Tribe (e.g., chemicals utilized for facilities maintenance or construction, the Golf Course, etc.). Several of the residential structures (both tribal and non-tribal) maintain propane tanks which could rupture and release chemicals, as well as the 2,000 gallon propane tank which sits on the Reservation. Wastewater treatment facilities which maintain significant supplies of chemicals for treatment as well as the wastewater itself, if ruptured, could devastate the surrounding environment.

7.5.7 Impact from Climate Change

The impacts of global climate change on earthquake probability are unknown. Some scientists say that melting glaciers could induce tectonic activity. As ice melts and water runs off, tremendous amounts of weight are shifted on the earth's crust. As newly freed crust returns to its original, pre-glacier shape, it could cause seismic plates to slip and stimulate volcanic activity, according to research into prehistoric earthquakes and volcanic activity. Sea level rise is not anticipated to impact the earthquake hazard, as the normal tidal flows mimic a similar increase.

Secondary impacts of earthquakes could be magnified by climate change. Soils saturated by repetitive storms could experience liquefaction or an increased propensity for slides during seismic activity due to the increased saturation. Dams storing increased volumes of water due to changes in the hydrograph could fail during seismic events. There are currently no models available to estimate these impacts.

7.6 FUTURE DEVELOPMENT TRENDS

The SIT does utilize the International Building Code as established within the areas of construction. Such requires structures to be built at a level which supports soil types and earthquake hazards (ground shaking). Presently, as existing buildings are renovated, provisions are in place which require reconstruction at higher standards. The Tribe regularly reviews and updates its land use code to maintain compliance with various regulatory agencies, including federal requirements for new construction.

Construction which has occurred since completion of the last plan includes higher standards.

The Tribe does not feel that the development which has occurred since the last plan has increased their vulnerability beyond the mere fact that new structures have been acquired, which increases the overall valuation of structures owned.

7.7 ISSUES

While the planning area has a high probability of an earthquake event occurring within its boundaries, an earthquake does not necessarily have to occur in the planning area to have a significant impact as such an event would disrupt transportation to and from the region as a whole, including evacuation, as well as impacting commodity flow. As such, any seismic activity of 6.0 or greater on faults in or near the planning area would have significant impact. Warning systems, if such were in place, could give approximately 40 seconds notice that a major earthquake is about to occur. While this would not provide adequate time for preparation, it would provide limited time to turn off machinery or seek cover, at the least. Earthquakes of M6 or higher would lead to massive structural failure of property on NEHRP C, D, E, and F soils. Bridges, levees, and revetments built on these poor soils would likely fail, representing a loss of critical infrastructure. These events could cause secondary hazards, including landslides and mudslides that would further damage structures. River valley hydraulic-fill sediment areas are also vulnerable to slope failure, often as a result of loss of cohesion in clay-rich soils. Soil liquefaction would occur in water-saturated sands, silts, or gravelly soils such as those that exist along the coastline, riverbeds, and riverbanks.

Earthquakes can cause large and sometimes disastrous landslides and mudslides. Bluff areas along the coastline such as those that border the SIT Reservation are extremely susceptible. River valleys are 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, bridge, and road foundations lose load-bearing strength and may sink into what was previously solid ground. Such has previously occurred in areas of both Grays Harbor and Mason Counties. Unless properly secured, hazardous materials can be released, causing significant damage to the environment and people. Earthen dams and levees are highly susceptible to seismic events and the impacts of their eventual failures can be considered secondary risks for earthquakes. Earthquakes at sea can generate destructive tsunamis.

7.8 IMPACT AND RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from an Earthquake throughout the area is highly likely. A Cascadia-type event, such as that utilized as the scenario modeled for this update, has a high probability of occurring within the region. Likewise, all structures owned and operated by the SIT would be impacted to some degree, with newer structures theoretically sustaining less damage as a result of more stringent building codes in place. The Tribe lacks redundant water supply systems, which is something that has previously been identified as a mitigation strategy.

When considering the ranking of this hazard, the Planning Team also considered additional factors given the widespread impact a Cascadia event would have on western Washington. Items considered include:

- A Cascadia-type earthquake could generate a large amount of damage within the general planning area in which the reservation is situated. Municipalities within the surrounding counties (Grays Harbor, Thurston, and Mason Counties) have a large number of older structures, particularly in the downtown hub areas. In this respect, the Planning Team considered not only Tribal-owned structures, but also structures which are residences for Tribal citizens; those which provide services to Tribal citizens (e.g., hospitals, medical offices, etc.); or on which Tribal businesses rely (e.g., supply-chain). Collapse or damage to the structures could divert emergency response personnel away from the Reservation or tribal structures.
- Further consideration was given with respect to the distance between the Reservation and surrounding towns, and the response capabilities both by the tribe itself, or through services provided by through mutual aid and other local service providers (e.g., fire districts).
- While the Tribe maintains law enforcement, it is of limited size, particularly when considering the potential number of individuals needing assistance or medical care. Given the potential inaccessibility of roadways which have previously been impassible in areas (such as resulted with the Nisqually Earthquake), or impact to the I-5 corridor, the potential for law enforcement response from one area to other areas may be impacted. Such would also be the case for fire response, ambulance transport, or medical services.
- With the potential of a Cascadia event generating a tsunami wave at 43 feet in height (or higher) within the surrounding area of Grays Harbor County, evacuation from the reservation and surrounding beach areas such as those on Hood Canal or in Grays Harbor would significantly increase traffic on both major and local roadways. Depending on the area, in some cases, tsunami waves are anticipated to make shore within 20 minutes in Grays Harbor County based on WA DNR's analysis (WA DNR, 2022). Evacuation from surrounding counties would impact evacuation from Mason County. This was experienced as a result of the Nisqually earthquake as well.
- With the large number of estimated tourists visiting the area, this could put roadways at a standstill. Should a Cascadia event occur during a summertime month when a high number of tourists are in the area, resources, and supplies (including medical) throughout the entire region would be significantly taxed in addition to roadway congestion.
- During a significant event, potential injuries could lead to mass-casualty events throughout the region, wholly taxing capabilities.

Based on the potential impact, the Planning Team determined the CPRI score to be 3.85, with overall vulnerability determined to be a high level.

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CHAPTER 8.
FLOOD

Floods are one of the most common natural hazards in the U.S. They can develop slowly over a period of days or develop quickly, with disastrous effects that can be local (impacting a neighborhood or community) or regional (affecting entire river basins, coastlines and multiple counties or states) (FEMA, 2010). Most communities in the U.S. have experienced some kind of flooding, after spring rains, heavy thunderstorms, coastal storms, or winter snow thaws. Floods are one of the most frequent and costly natural hazards in terms of human hardship and economic loss, particularly to communities that lie within flood-prone areas or floodplains of a major water source.

DEFINITIONS

Flood—The inundation of normally dry land resulting from the rising and overflowing of a body of water.

Floodplain—The land area along the sides of a river that becomes inundated with water during a flood.

100-Year Floodplain—The area flooded by a flood that has a 1-percent chance of being equaled or exceeded each year. This is a statistical average only; a 100-year flood can occur more than once in a short period of time. The 1-percent annual chance flood is the standard used by most federal and state agencies.

Floodway—The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

8.1 GENERAL BACKGROUND

Flooding is a general and temporary condition of partial or complete inundation on normally dry land from the following:

- Riverine flooding, including overflow from a river channel, flash floods, alluvial fan floods, dam-break floods and ice jam floods;
- Local drainage or high groundwater levels;
- Fluctuating lake levels;
- Coastal flooding;
- Coastal erosion;
- Unusual and rapid accumulation or runoff of surface waters from any source;
- Mudflows (or mudslides);
- Collapse or subsidence of land along the shore of a lake or similar body of water that result in a flood, caused by erosion, waves or currents of water exceeding anticipated levels (Floodsmart.gov, 2012);
- Dam failure (no dams within the immediate area of the SIT)
- Sea level rise;
- King/High Tides; and
- Climate Change.

8.1.1 Flooding Types

Many floods fall into one of three categories: riverine, coastal, or shallow (which may include urban flooding, areas with gentle slopes and no defined channels with an average depth limited to 3.0 feet or less, or flat areas along riverbanks which may covered for days after a flood event, etc.). Other types of floods include alluvial fan floods, dam failure floods, ice/debris jam floods, and floods associated with local drainage or high groundwater. On the SIT, the primary types of flooding to occur include coastal, including King Tides, and riverine, although others have also occurred.

Riverine

Riverine floods are the most common flood type. They occur along a channel and include overbank and flash flooding. Channels are defined ground features that carry water through and out of a watershed. They may be called rivers, creeks, streams, or ditches. When a channel receives too much water, the excess water flows over its banks and inundates low-lying areas.

Flash Floods

A flash flood is a rapid, extreme flow of high water into a normally dry area, or a rapid water level rise in a stream or creek above a predetermined flood level, beginning within six hours of the causative event (e.g., intense rainfall, dam failure, ice jam). The time may vary in different areas. Ongoing flooding can intensify to flash flooding in cases where intense rainfall results in a rapid surge of rising floodwaters (NWS, 2009).

Coastal Flooding

Coastal flooding is the flooding of normally dry, low-lying coastal land, primarily caused by severe weather events along the coast, estuaries, and adjoining rivers. These flood events are some of the more frequent, costly, and deadly hazards that can impact coastal communities. Factors causing coastal flooding include:

- Storm surges, which are rises in water level above the regular astronomical tide caused by a severe storm's wind, waves, and low atmospheric pressure. Storm surges are extremely dangerous, because they are capable of flooding large coastal areas.
- Large waves, whether driven by local winds or swell from distant storms, raise average coastal water levels and individual waves roll up over land.
- High tide levels are caused by normal variations in the astronomical tide cycle (discussed below).
- Other larger scale regional and ocean scale variations are caused by seasonal heating and cooling and ocean dynamics.

Coastal floods are extremely dangerous, and the combination of tides, storm surge, and waves can cause severe damage. Coastal flooding is different from river flooding, which is generally caused by severe precipitation. Depending on the storm event, in the upper reaches of some tidal rivers, flooding from storm surge may be followed by river flooding from rain in the upland watersheds. This increases the flood severity. Within the National Flood Insurance Flood Maps, coastal flood zones identify special flood hazard areas (SFHA) which are subject to waves with heights of between 1.5 and 3 feet during a 1-percent annual chance storm (100-year event).

Tidal Flooding

Spring tides, the highest tides during any month, occur with each full and new moon. When these coincide with a northerly wind piling water, tidal flooding can occur. The tides can also enhance flooding in delta areas when rivers or creeks are at or near flood stage. Such flooding is also a threat to low-lying areas of the Reservation. Tidal impact is of most concern in delta areas when rivers are at flood stage and high tide

exacerbates the situation. Concerns about tidal flooding are anticipated to increase due to the impacts of global climate change and sea level rise.

8.1.2 Measuring Floods and Floodplains

A floodplain is the area adjacent to a river, creek or lake that becomes inundated during a flood. Floodplains may be broad, as when a river crosses an extensive flat landscape, or narrow, as when a river is confined in a canyon. Connections between a river and its floodplain are most apparent during and after major flood events. These areas form a complex physical and biological system that not only supports a variety of natural resources, but also provides natural flood and erosion control. When a river is separated from its floodplain with levees and other flood control facilities, natural, built-in benefits can be lost, altered, or significantly reduced.

In the case of riverine or flash flooding, once a river reaches flood stage, the flood extent or severity categories used by the NWS include minor flooding, moderate flooding, and major flooding. Each category has a definition based on property damage and public threat (NWS, 2011):

- Minor Flooding—Minimal or no property damage, but possibly some public threat or inconvenience.
- Moderate Flooding—Some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations are necessary.
- Major Flooding—Extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.

8.1.3 Flood Insurance Rate Maps

According to FEMA, flood hazard areas are defined as areas that are shown to be inundated by a flood of a given magnitude on a map (see Figure 8-1). These areas are determined using statistical analyses of records of river flow, storm tides, and rainfall; information obtained through consultation with the community; floodplain topographic surveys; and hydrologic and hydraulic analyses. Three primary areas make up the flood hazard area: the floodplains, floodways, and floodway fringes. Figure 8-2 depicts the relationship among the various designations, collectively referred to as the special flood hazard area. Figure 8-3 identifies the coastal flood zones.

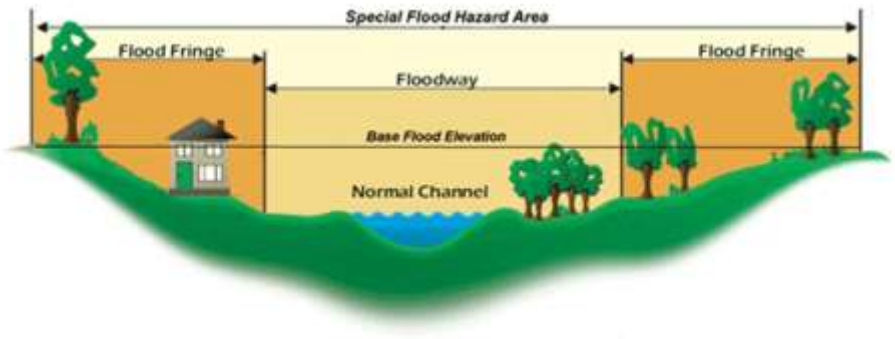


Figure 8-1 Flood Hazard Area Referred to as a Floodplain

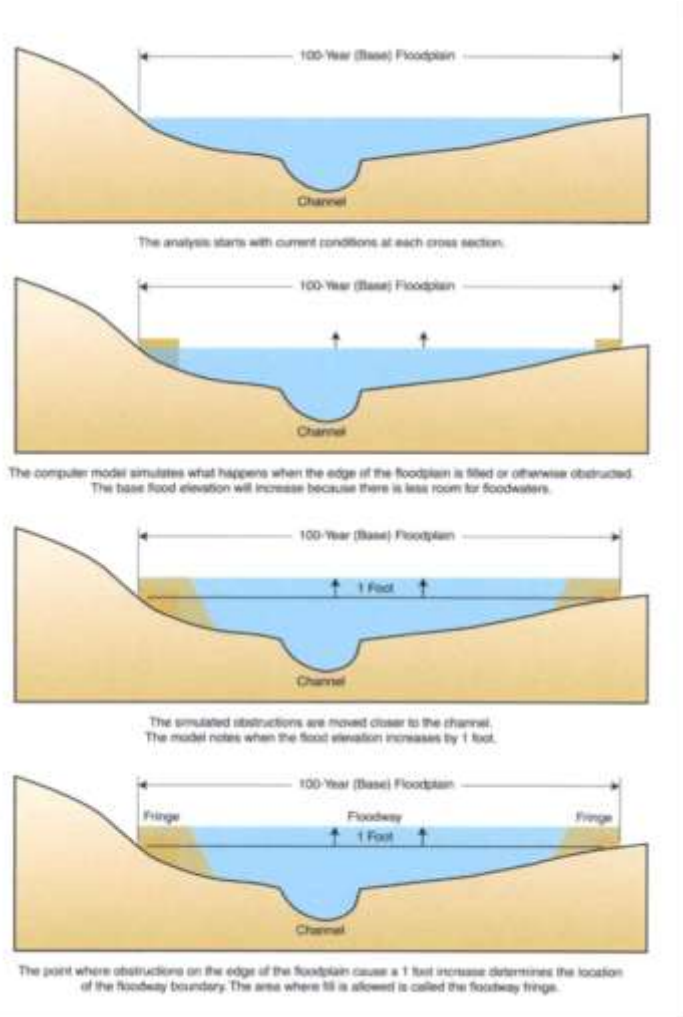


Figure 8-2 Special Flood Hazard Area

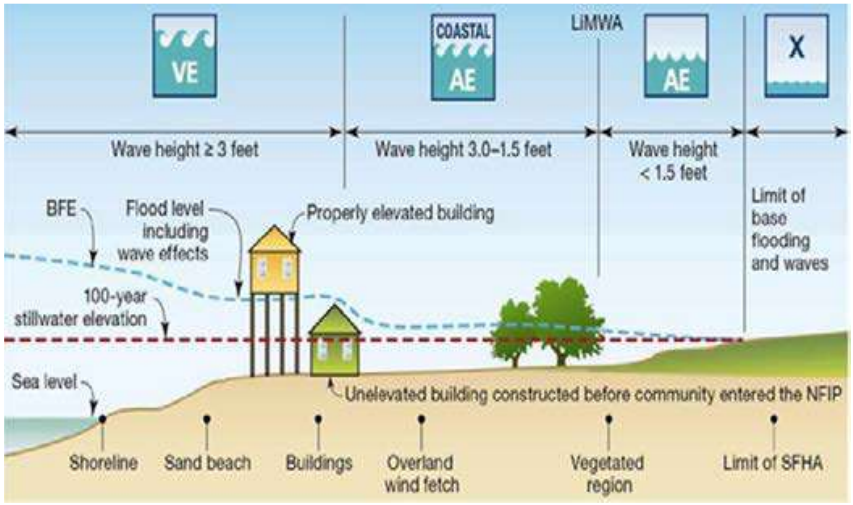


Figure 8-3 Coastal Zones Graphic

Flood hazard areas are delineated on FEMA's Flood Insurance Rate Maps (FIRM), which are official maps of a community on which the Federal Insurance and Mitigation Administration has indicated both the special flood hazard areas (SFHA) and the risk premium zones applicable to the community. These maps identify the geographic areas or zones that FEMA has defined according to varying levels of flood risk, and include: special flood hazard areas; the location of a specific property in relation to the special flood hazard area; the base (100-year) flood elevation at a specific site; the magnitude of a flood hazard in a specific area; and undeveloped coastal barriers where flood insurance is not available. The maps also locate regulatory floodways and floodplain boundaries—the 100-year and 500-year floodplain boundaries (FEMA (various years). Table 8-1 identifies the various rate map zones.

TABLE 8-1
FLOOD INSURANCE RATE MAP ZONES

Moderate to Low Risk Areas: Areas of moderate or minimal hazard are studied based upon the principal source of flood in the area. However, buildings in these zones could be flooded by severe, concentrated rainfall coupled with inadequate local drainage systems. Local stormwater drainage systems are not normally considered in a community's flood insurance study. The failure of a local drainage system can create areas of high flood risk within these zones. Flood insurance is available in participating communities but is not required by regulation in these zones. Nearly 25-percent of all flood claims filed are for structures located within these zones.

Zone	Description
B and X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floodplain area with a 0.2% (or 1 in 500 chance) annual chance of flooding. B Zones are also used to designate base floodplains of lesser hazards, such as areas protected by levees from 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than one (1) square mile.
C and X (unshaded)	Area of minimal flood hazard usually depicted on FIRMs as above the 500-year flood level. Zone C may have ponding and local drainage problems that do not warrant a detailed study or designation as base floodplain. Zone X is the area determined to be outside the 500-year flood and protected by levee from 100-year flood.

TABLE 8-1
FLOOD INSURANCE RATE MAP ZONES

High Risk Areas: Special Flood Hazard Areas represent the area subject to inundation by 1-percent-annual chance flood. Structures located within the SFHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage. Federal floodplain management regulations and mandatory flood insurance purchase requirements apply to participating communities in these zones.

Zone	Description
A	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas, no depths or base flood elevations are shown within these zones.
AE	The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones.
A1-30 (old map format)	These are known as numbered A Zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format). Older maps still utilize this numbered system, but newer FEMA products no longer use the "numbered" A Zones. (Zone AE is used on new and revised maps in place of Zones A1–A30.)
AH	Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
AO	River or stream flood hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
AR	Areas with a temporarily increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam). Mandatory flood insurance purchase requirements will apply, but rates will not exceed the rates for unnumbered A zones if the structure is built or restored in compliance with Zone AR floodplain management regulations.
A99	Areas with a 1% annual chance of flooding that will be protected by a Federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.

High Risk – Coastal High Hazard Areas (CHHA): These represent the area subject to inundation by 1-percent-annual chance flood, extending from offshore to the inland limit of a primary front al dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources. Structures located within the CHHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage. Federal floodplain management regulations and mandatory purchase requirements apply in the following zones.

Zone	Description
V	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. No base flood elevations are shown within these zones.
VE, V1-30	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year

TABLE 8-1 FLOOD INSURANCE RATE MAP ZONES	
	mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
Undetermined Risk Areas	
Zone	**Description**
D	Areas with possible but undetermined flood hazard. No flood hazard analysis has been conducted. Flood insurance rates are commensurate with the uncertainty of the flood risk.

The frequency and severity of flooding are measured using a discharge probability, which is a statistical tool used to define the probability that a certain river discharge (flow) level will be equaled or exceeded within a given year. Flood studies use historical records to determine the probability of occurrence for the different discharge levels.

The extent of flooding associated with a 1-percent annual probability of occurrence (the base flood or 100-year flood) is used as the regulatory boundary by many agencies. Also referred to as the special flood hazard area, this boundary is a convenient tool for assessing vulnerability and risk in flood-prone communities. Many communities have maps that show the extent and likely depth of flooding for the base flood. Corresponding water-surface elevations describe the elevation of water that will result from a given discharge level, which Is one of the most important factors used in estimating flood damage.

A structure located within a 1 percent (100-year) floodplain has a 26 percent chance of suffering flood damage during the term of a 30-year mortgage. The 100-year flood is a regulatory standard used by federal agencies and most states to administer floodplain management programs. The 1 percent (100-year) annual chance flood is used by the NFIP as the basis for insurance requirements nationwide. FIRMs also depict 500-year flood designations, which is a boundary of the flood that has a 0.2-percent chance of being equaled or exceeded in any given year. It is important to recognize, however, that flood events and flood risk are not limited to the NFIP delineated flood hazard areas. Table 8-2 illustrates the estimated probability of flood events as utilized by the NFIP.

TABLE 8-2 ESTIMATED PROBABILITY OF FLOOD EVENT	
EVENT	**ANNUAL CHANCE OF OCCURRENCE**
10-year flood	10%
25-year flood	4%
50-year flood	2%
100-year flood	1%
500-year flood	0.2%

8.1.4 National Flood Insurance Program (NFIP)

The NFIP is a federal program enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for state and community floodplain management regulations that reduce future flood damage. The U.S. Congress established the NFIP with the passage of the National Flood Insurance Act of 1968 (FEMA's 2002 *National Flood Insurance Program (NFIP): Program Description*). There are three components to the NFIP: flood insurance, floodplain management, and flood hazard mapping. Nearly 20,000 communities across the U.S. 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. Community participation in the NFIP is voluntary.

For most participating communities, FEMA has prepared a detailed Flood Insurance Study. The study presents water surface elevations for floods of various magnitudes, including the 1-percent annual chance flood and the 0.2-percent annual chance flood (the 500-year flood). Base flood elevations and the boundaries of the 100- and 500-year floodplains are shown on Flood Insurance Rate Maps (FIRMs), which are the principle tool for identifying the extent and location of the flood hazard. FIRMs are the most detailed and consistent data source available, and for many communities they represent the minimum area of oversight under their floodplain management program.

NFIP participants must regulate development in floodplain areas in accordance with NFIP criteria. Before issuing a permit to build in a floodplain, participating jurisdictions must ensure that three criteria are met:

- New buildings and those undergoing substantial improvements must, at a minimum, be elevated to protect against damage by the 100-year flood.
- New floodplain development must not aggravate existing flood problems or increase damage to other properties.
- New floodplain development must exercise a reasonable and prudent effort to reduce its adverse impacts on threatened salmonid species.

NFIP Status and Severe Loss/Repetitive Loss Properties

The SIT is not a member of the NFIP. They are assigned Community Number 530325, with the latest map panel developed on June 20, 2019. The Tribe does have regulatory authority within its land use planning which regulates development to IBC standards. FEMA has developed flood maps as part of the Mason County Flood Insurance Study; however the SIT has not adopted those maps. The identified flood hazard areas have been used to project the floodplain areas in this plan. The Tribe has no previous claim history under the NFIP.[19] The SIT has no current NFIP policies in place as of September 2023.

[19] FEMA Flood Insurance Data and Analytics. Accessed 20 Sept. 2023. Available online at: Flood Insurance Data and Analytics | The National Flood Insurance Program | FloodSmart | NFIPServices.

Repetitive Flood Claims

Residential or non-residential (commercial) properties that have received one or more NFIP insurance payments are identified as repetitive flood properties under the NFIP. Such properties are eligible for funding to help mitigate the impacts of flooding through various FEMA programs, subject to meeting certain criteria and maintaining a Repetitive Loss Strategy. Repetitive flood claims provide funding to reduce or eliminate the long-term risk of flood damage to structures insured under the NFIP that have had one or more claim payments for flood damages.

A Repetitive Loss Strategy must identify the specific actions taken to reduce the number of repetitive loss properties, which must include severe repetitive loss properties, and specify how the Tribe intends to reduce the number of such repetitive loss properties. In addition, the hazard mitigation plan must describe the strategy it will take to reduce the number of these properties, including the development of Tribal hazard mitigation plan.

In preparation of this plan, the Planning Team did review Washington State's 2018, 2023 Hazard Mitigation Plan, which does contain a Repetitive Loss Strategy.[20] While a sovereign nation and not required to adhere to state policies and procedures, the SIT, as appropriate, will continue to work with the state in its endeavor to reduce impact from flooding within the tribal planning area. At the SIT's election, this may include seeking opportunities for mitigation funds under the various Stafford Act Grant Programs.

- The Tribe has no repetitive flood claims under FEMA.

Tribal Repetitive Loss Strategy:

The SIT will continue to address repetitive loss properties by ensuring that new construction is built to the highest building code standards required, and also continue to view the mitigation plan for identified areas of risk. As was previously done, the Tribe will continue to mitigate structures within the floodplain, including, if feasible, to move (or rebuild) structures out of the floodplain or to take other such corrective actions as appropriate.

The Planning Team will use the five-year updates of this Hazard Mitigation Plan as an opportunity to evaluate hazard management laws, regulations, and policies, and work with the Tribe's legal and planning departments to create the most effective and efficient regulatory authority when necessary to do so in an effort to continue to mitigate flood issues on the properties owned by the SIT.

Severe Repetitive Loss Program

The severe repetitive loss program is authorized by Section 1361A of the National Flood Insurance Act (42 U.S.C. 4102a), with the goal of reducing flood damages to residential properties that have experienced *severe* repetitive losses under flood insurance coverage and that will result in the greatest savings to the

[20] Washington State's 2018 Enhanced HMP remained the most current plan in place as of the majority of this update, with the State's new plan under review and adopted late 2023, after the majority of the risk assessment was completed.

NFIP in the shortest period of time. A severe repetitive loss property is a residential property that is covered under an NFIP flood insurance policy and:

- a) That has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or
- b) For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.

For both (a) and (b) above, at least two of the referenced claims must have occurred within any 10-year period and must be greater than 10 days apart.

- The SIT has no severe repetitive loss properties.

The Community Rating System

The Community Rating System (CRS) is a voluntary program within the NFIP that encourages floodplain management activities that exceed the minimum NFIP requirements. Flood insurance premiums are discounted to reflect the reduced flood risk resulting from community actions.

- The SIT is not a CRS Community.

8.2 HAZARD PROFILE

8.2.1 Extent and Location

Flooding is the most common hazard occurring in the tribal planning area based on review of the disaster history, particularly when combined with the severe storm events which also many times include flooding. Annual occurrences many times do not always rise to the level of a disaster declaration. Flooding is most often due to riverine or shallow/urban flooding. Portions of the tribal planning area are subject to coastal flooding, particularly during King Tides.

The severity of flood damage is dependent upon ground elevation, the surrounding topography, peak flow volumes, surface flow velocities, tides, driving winds, and the storm surge impacting the drainage of the various river bodies traveling through the planning area. Review of FEMA's 2019 FIS identifies the Squaxin Island Tribe as having limited area within Zone A which may cause impact, as well as potential impact from AE Zone. None of the tribal structures assessed in this 2024 update fall in proximity to the 500-year flood area (Zone X).

FEMA Flood Maps

FEMA performed a new flood study for Mason County that resulted in the creation of new flood maps in March 2017, and adopted by the County thereafter, with an effective date of June 2019 (FEMA FIS). The SIT has not adopted the maps. The County's project also updated flood modeling along the Mason County coastline, as well as multiple riverine and lake analyses throughout the county. That study also included the Squaxin Island Reservation and lands. Due to the impact to major roadways within the planning area,

it is significant to show potential impact countywide at this level, particularly as they relate to the various watersheds which have the potential to exacerbate flooding in areas of the SIT.

In addition to FIRMs, FEMA also developed the flood risk assessment products used in their Risk Report, which supports much of the flood data utilized throughout this HMP update. Mason County's 100- and 500-year flood areas are illustrated in Figure 8-4. It should be noted that only a very small area, or 0.3863 square miles of land fall within the 500-year flood hazard area based on FEMA's FIRMs. None of the area in the 500-year floodplain encompass tribal lands. Figure 8-4 illustrates the flood hazard area for all of Mason County, including the SIT. Figure 8-5 illustrates the flood hazard area in the City of Elma (Grays Harbor County), which is where the SIT's Northwest Indian Treatment Center and one of the Tribe's green houses are located. Those structures, located on East Young Street, fall outside of the City's flood hazard area. FEMA's 2020 NFIP maps were utilized for the Grays Harbor area assessment.

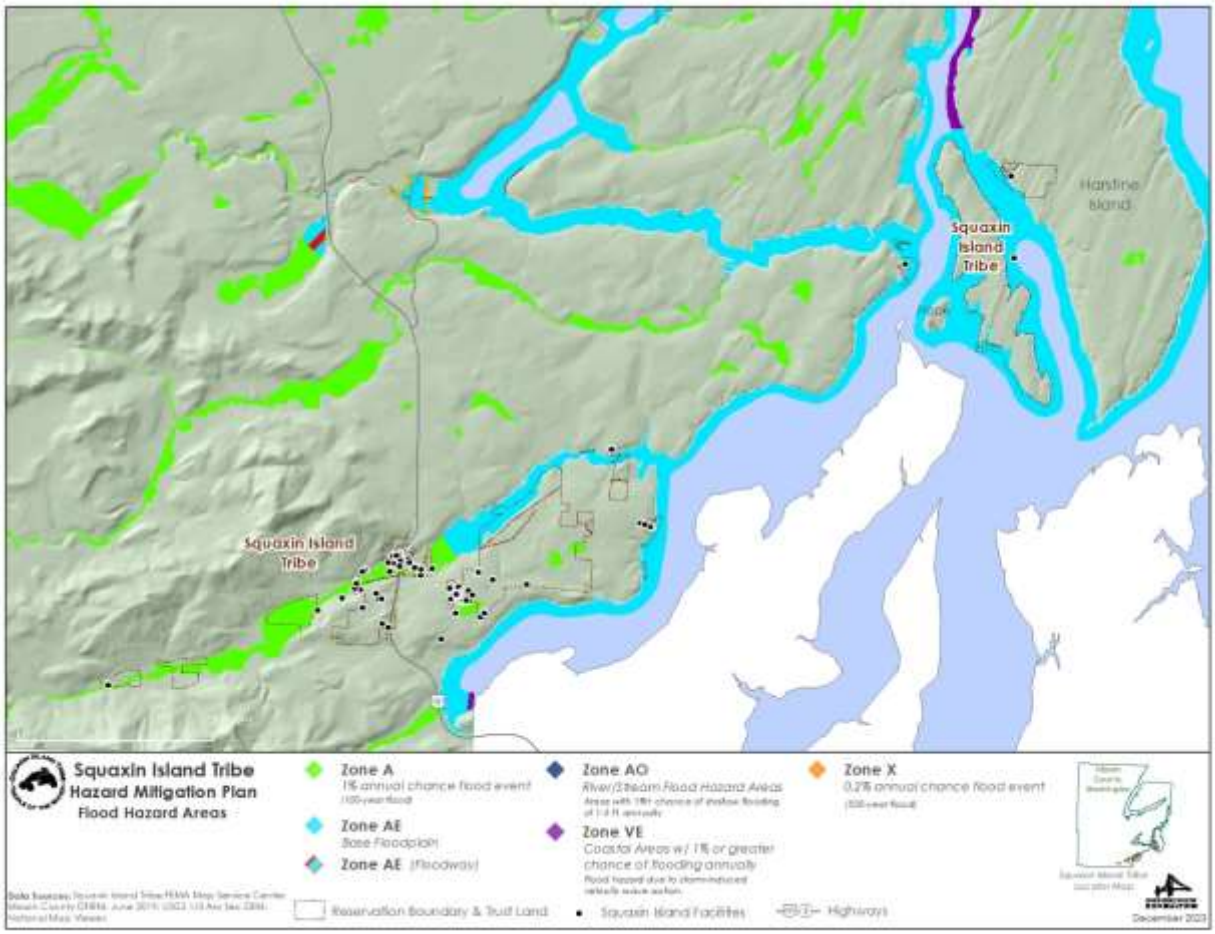


Figure 8-4 Squaxin Island Tribe and Mason County 100- and 500-Year Flood Hazard Areas[21]

[21] FEMA Flood Insurance Study (2019). Available at: FEMA Flood Map Service Center | Search All Products

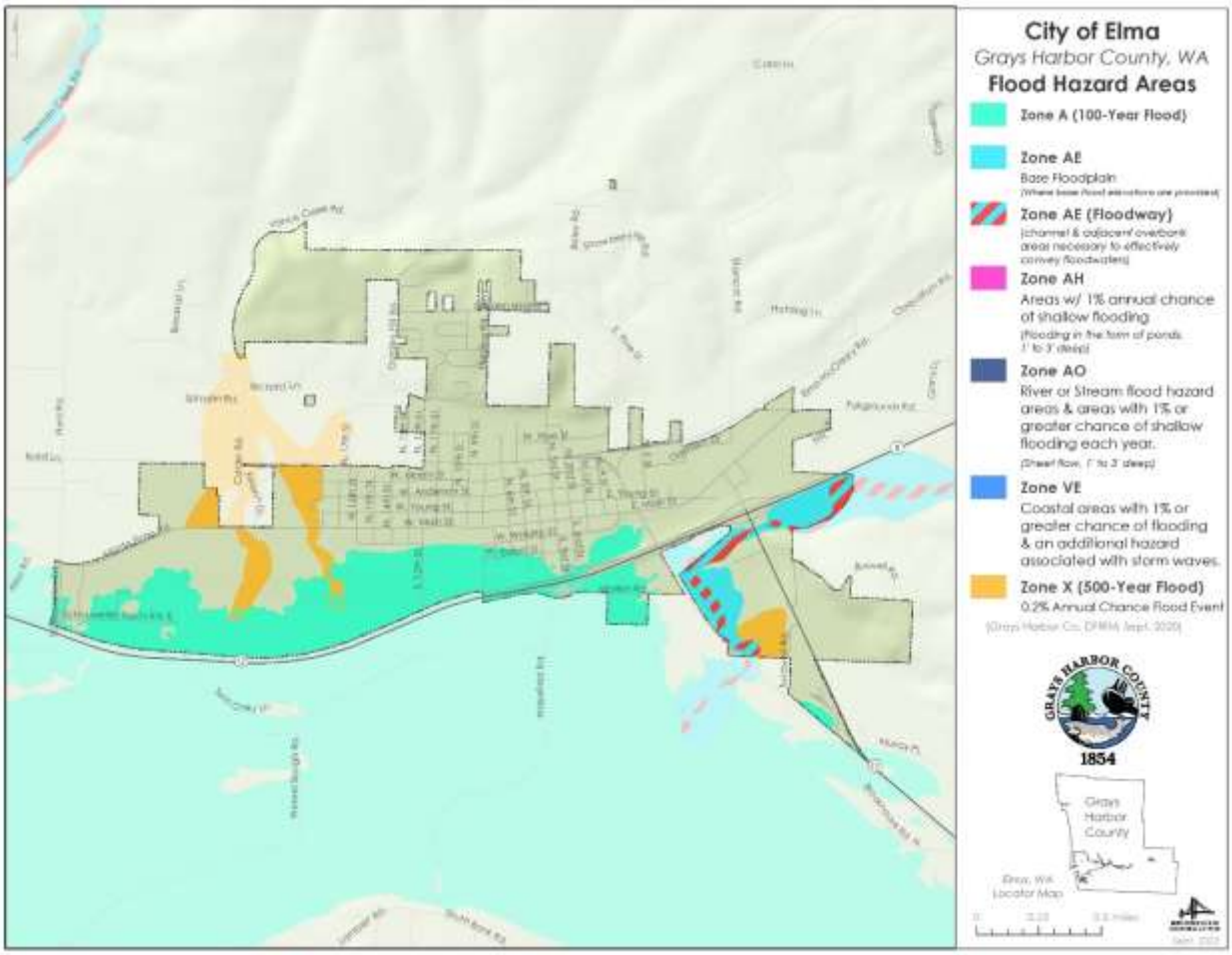


Figure 8-5 City of Elma (Grays Harbor County) 100- and 500-year Flood Hazard Areas

8.2.2 Previous Occurrences

Major floods in the planning area have resulted from intense rainstorms customarily between October and April. In addition to events discussed above, Table 8-3 highlights some of the historical flood events occurring in the area. It should be noted that due to the disaster typing which occurs at the FEMA level, there are other types of events which also include flooding, but due to the typing, those are not referenced within this chapter. Specific examples of this include Severe Weather events which include flooding as a hazard of impact. Viewers should also review the Severe Weather hazard profile for additional information.

TABLE 8-3
FLOOD EVENTS IMPACTING PLANNING AREA 1956-2022

Disaster Number	Declaration Date	Disaster Type	Incident Type	Title	Incident Begin Date	Incident End Date	PA Dollars Obligated or Losses (State)
4539	4/23/2020	DR	Flood / Severe Storm	Severe Storm, Flooding, Landslides, and Mudslides	1/20/2020	2/10/2020	$10.6M statewide
Several days of heavy rain on January 20, 2020 resulted in widespread flooding of roadways, homes, and property. On April 23, 2020, a Federal disaster aid was made available to the State of Washington to supplement state, tribal, and local recovery efforts in Mason County and other areas affected by the flooding.							
4253	2/2/2016	DR	Flood	Severe Winter Storm, Straight-Line Winds, Flooding, Landslides, and Tornado	12/1/2015	12/14/2015	$3,166,346
Several days of heavy rain in December 2015 resulted in widespread flooding of roadways, homes, and property. On February 2, 2016, Federal disaster aid was made available to the State of Washington to supplement state, tribal, and local recovery efforts in Mason County and other areas affected by the flooding.							
1817	1/30/2009	DR	Flood	Severe Winter Storm, Landslides, Mudslides, & Flooding	1/6/2009	1/16/2009	$750,000 (County)
January 2009- Washington State was hit with severe winter storms that brought heavy rains and warmer temperatures, resulting in snow melting causing flooding, land- and mudslides. While ~12 county roads were impacted by flooding, as well as three homes being destroyed and an additional 12 more being affected, the Tribe experienced no damage or losses. Costs for damages at the County level due to flooding were estimated at $750,000.							
1172	4/2/1997	DR	Flood	Heavy Rains, Snow Melt, Flooding, Land Slides	3/18/1997	3/28/1997	$50,889,413
A week of torrential rain in late March 1997 created flooding and landslides in multiple places in Washington State. In Mason County, multiple roads were closed and five homes were posted for evacuation.							
883	11/26/1990	DR	Flood	Severe Storms & Flooding	11/9/1990	12/20/1990	$2.9 million
Two individuals died as a result of this incident statewide. Over the Thanksgiving weekend, between 8 and 15 inches of rain fell. County road damage, including replacement costs for a bridge over Mission Creek, totaled $260,000. Several homes were extensively damaged in the Skokomish Valley and two homes were uninhabitable. Twenty-five people were evacuated from the Skokomish Valley. Highways and roads were closed. Residents lost power. On November 26, 1990, Federal disaster aid was made available. Mason County received $754,238 of HMGP funds for the East Bourgault Road area property acquisition project.							
612	12/31/1979	DR	Flood	Storms, High Tides, Mudslides & Flooding	12/31/1979	12/31/1979	
Heavy rains and snowmelt caused floods, mudslides, and road washouts. Twenty-eight Skokomish Valley residents were evacuated. Damage to county roads was estimated at $375,000 to $515,000 and damage to other property was estimated at $160,000.							

TABLE 8-3
FLOOD EVENTS IMPACTING PLANNING AREA 1956-2022

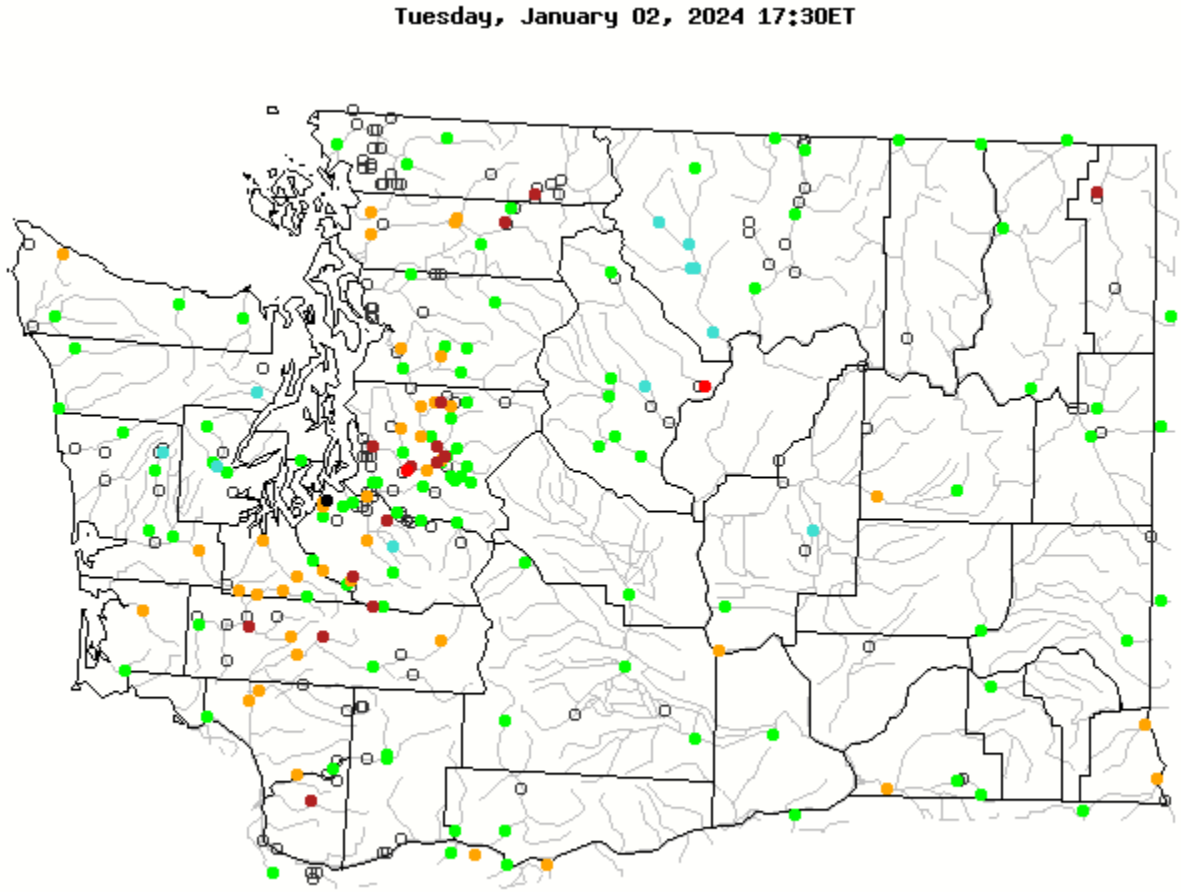
492	12/13/1975	DR	Flood	Severe Storms & Flooding	12/13/1975	12/13/1975	
Damage to county roads totaled ~ $185,000. Flooding in Skokomish Valley damaged a number of levees. Numerous residences had water damage. Several persons were evacuated from their homes by boat. The total estimate of damage to private and farm land was $300,000.							
414	1/25/1974	DR	Flood	Severe Storms, Snowmelt & Flooding	1/25/1974	1/25/1974	Unknown
Impacts included roadway closures resulting from flooding and landslides in the area.							
185	12/29/1964	DR	Flood	Heavy Rains & Flooding	12/29/1964	12/29/1964	
In December 1964, snow and heavy rains caused slides and run-off knocking two houses 12 feet off of their foundations, covering half of Hwy 21 above Alderbrook. One house was unoccupied. The other residents were not injured. Slides and running water closed the Purdy Cut-Off Road. Snow accumulation amounted to 20 inches in Union and Hoodsport areas, 19 inches at Lilliwaup, 16 inches at Dayton, 20 inches in the Matlock area, and 36 inches at the upper end of Lake Cushman. Shelton, Kamilche, and Mary M. Knight schools were closed for 1 day. Falling branches and the weight of the snow caused numerous power outages. Numerous reports were received of roofs of barns, sheds, carports, and garages collapsing under the weight of the snow. Snow (4 ½ feet deep) closed logging operations at Camps Grisdale and Govey. Dairymen in the Skokomish Valley couldn't operate milking machines or water cattle due to power outages. At the height of the storm only 150 of the 1600 PUD customers had electricity. Cost of the storm damage was estimated between $25,000 and $30,000.							

8.2.3 Severity

The severity of a flood depends not only on the amount of water that accumulates in a period of time, but also on the land's ability to manage this water. One element is the size of rivers and streams that have the potential to impact an area; but an equally important factor is the land's absorbency. When it rains, soil acts as a sponge. When the land is saturated or frozen, infiltration into the ground slows and any more water that accumulates must flow as runoff (Harris, 2001).

The principal factors affecting flood damage are flood depth and velocity. The deeper and faster flood flows become, the more damage they can cause. Shallow flooding with high velocities can cause as much damage as deep flooding with slow velocity. This is especially true when a channel migrates over a broad floodplain, redirecting high velocity flows and transporting debris and sediment. Flood severity is often evaluated by examining peak discharges. The USGS maintains limited stream gage data which is available real-time for viewing. Figure 8-6 illustrates the gages providing data statewide, including several for Mason County.[22] Readers may elect to obtain data on stream gages directly from the USGS at: https://waterdata.usgs.gov/wa/nwis/rt.

[22] USGS Stream Gages. Accessed 2 Jan 2024. Available online at: https://waterdata.usgs.gov/wa/nwis/rt.



Explanation

- High
- > 90th percentile
- 76th - 90th percentile
- 25th - 75th percentile
- 10th - 24th percentile
- < 10th percentile
- Low
- Not ranked

The colored dots on this map depict streamflow conditions as a percentile, which is computed from the period of record for the current day of the year. Only stations with at least 30 years of record are used.
The **gray circles** indicate other stations that were not ranked in percentiles either because they have fewer than 30 years of record or because they report parameters other than streamflow. Some stations, for example, measure stage only.

Figure 8-6 USGS Stream Flow Data for January 2, 2024

Floods that result from rainfall on frozen ground in the winter, or rainfall associated with a warm, regional frontal system that rapidly melts snow at low and intermediate altitudes (rain-on-snow), can be the most severe. Both of these situations quickly introduce large quantities of water into the stream channel system, easily overloading its capacity. On small drainages, the most severe floods are usually a result of rainfall on frozen ground but moderate quantities of warm rainfall on a snowpack, especially for one or more days, can also result in rapid runoff and flooding in streams and small rivers. Although

meteorological conditions favorable for short-duration warm rainfall are common, conditions for long-duration warm rainfall are relatively rare. Occasionally, however, the polar front becomes situated along a line from Hawaii through Oregon and Washington causing warm, moist, unstable air to move into the region. Most winter floods develop under these conditions.

8.2.4 Frequency

Floods are commonly described as having a 10-, 50-, 100-, and 500-year recurrence interval, meaning that floods of these magnitudes have (respectively) a 10-, 2-, 1-, or 0.2-percent chance of occurring in any given year. These measurements reflect statistical averages only; it is possible for two or more rare floods (with a 100-year or higher recurrence interval) to occur within a short time period. Assigning recurrence intervals to historical floods on different rivers can help indicate the intensity of a storm over a large area.

As indicated, the SIT is subject to flooding (of some degree) annually. The frequency of flooding is caused by the unique geologic and physical environment of the SIT. While the minor floods occur primarily along only certain areas of the Tribal owned lands, the impacts outside of the Tribal Planning Area can be significant, flooding buildings, homes, and impacting evacuation routes. Although many of these events are minor, these smaller events tend to limit access to areas, causing isolation and sometimes disrupting services, including wells and wastewater systems.

Major floods resulting in severe impacts, including evacuation of people from residences in low-lying areas, and the inundation of major access roads has historically occurred every 6.5 years in Mason County, and every 4.6 years in the Grays Harbor area. Severe storms that also include flooding occur approximately every 5-6 years. The planning area has sustained 14 (Grays Harbor County) and 10 (Mason County) declared *Flood* incidents during the period 1953-2022, not inclusive of *Severe Storm/Weather* incidents which also include an element of flood. There are an additional 12 Severe Storm incidents (each County) that include some level of flooding.

Flood events have continued to increase over the decades, with the majority of the declared incidents impacting the Reservation being flood or flood related (e.g., sever weather events which include a flood component). As impact has grown in frequency and in size, flood management efforts have been accelerated by the SIT to help reduce the impact of flooding, in many cases returning land to open spaces to allow for water accumulation with limited impact. In many cases, these actions were funded or developed by the SIT.

8.3 VULNERABILITY ASSESSMENT

To understand risk, a community must evaluate what assets are exposed or vulnerable in the identified hazard area. For this planning purpose, the flood hazard areas identified include the 1-percent (100-year) and 0.2 % (500-year) floodplains. These events are generally those considered by planners and evaluated under federal programs such as the NFIP. The following text evaluates and estimates the potential impact of flooding on Tribal assets.

8.3.1 Overview

All types of flooding can cause widespread damage throughout rural and urban areas, including but not limited to: water-related damage to the interior and exterior of buildings; destruction of electrical and other expensive and difficult-to-replace equipment; injury and loss of life; proliferation of disease vectors; disruption of utilities, including water, sewer, electricity, communications networks and facilities; loss of agricultural crops and livestock; placement of stress on emergency response and healthcare facilities and personnel; loss of productivity; loss of continuity of government, and displacement of persons from homes and places of employment.

Warning Time

Due to the sequential pattern of meteorological conditions needed to cause flooding, it is unusual for a flood to occur without some warning. Warning times for floods can be between 24 and 48 hours. Flash flooding can be less predictable, but potential hazard areas can be warned in advance of potential flash flooding danger. Tidal inundation due to high tides has considerable advanced notice.

The potential warning time a community has to respond to a flooding threat is a function of the time between the first measurable rainfall and the first occurrence of flooding. The time it takes to recognize a flooding threat reduces the potential warning time to the time that a community has to take actions to protect lives and property. Another element that characterizes a community's flood threat is the length of time floodwaters remain above flood stage. Flood threat systems in the planning area consist of a network of precipitation gauges throughout the watersheds and stream gauges at strategic locations that constantly monitor and report stream levels, some of which are funded by the SIT. This information is fed into a U.S. Geological Survey forecasting program, which assesses the flood threat based on the amount of flow in the stream (measured in cubic feet per second). In addition to this program, data and flood warning information is provided by the National Weather Service (NWS). All of this information is analyzed to evaluate the flood threat and possible evacuation needs.

The NWS issues watches and warnings when forecasts indicate rivers may approach bank-full levels. When a watch is issued, the public should prepare for the possibility of a flood. When a warning is issued, the public is advised to stay tuned to a local radio station for further information and be prepared to take quick action if needed. A warning means a flood is imminent, generally within 12 hours, or is occurring. Local media broadcast NWS warnings.

8.3.2 Impact on Life, Health, and Safety

The impact of flooding on life, health, and safety is dependent upon several factors, including the severity of the event and whether or not adequate warning time is provided to residents. The SIT has not experienced the loss of life as a result of highwater levels on the Reservation or tribally owned lands.

Exposure to life, health, and safety customarily represents the population living or working in or near floodplain areas that could be impacted should a flood event occur. Currently, there is limited area of identified tribal parcels or residential structures which fall within the 100-year flood zone, and none within the 500-year flood zone.

A portion of the Tribal lands and the Reservation are coastal, which would increase life safety concerns for those individuals visiting or working in those areas. At present, there are no residential structures that exist along the coastal boundaries of the Tribe.

While none of the residential structures assessed during this update fall within the 100-year flood zone, flooding can nonetheless occur in areas outside of the identified flood zone. Exposure also cannot be limited to only those who reside or work in a defined hazard zone, but rather, everyone who may be affected by the effects of a hazard event (e.g., people are at risk while traveling in flooded areas, or when their access to emergency services is compromised during an event). That degree of impact will vary and is not measurable with any specificity. Other factors to consider would be the impact of a flood event associated with King Tides, or the impact of King Tides themselves, such as those which occurred in December 2022. King Tides do have the potential to elevate groundwater around subsurface structures such as septic tanks, drain fields, and wells, which potentially could impact the ability to utilize some of the residential structures.

Many tribal members work in other areas of the County which could be exposed to flooding. The Tribe also has various health and social service programs in other counties which provide services to tribal members and employees. One such area in which the Tribe owns structures providing those services is the City of Elma, within Grays Harbor County. Grays Harbor County does have a significant number of flood zones which are regularly impacted, as are a high number of roadways providing ingress and egress to the area and are regularly impacted by flooding, severe weather, and landslide events. While a numeric value cannot be placed on the number of individuals seeking services, those individuals traveling to or visiting those areas could be at risk.

Of significant consideration and concern to the SIT is the number of tourists and guests utilizing the various local tourist destinations who can be impacted during periods of flooding. Tourism is a very large economic base for the SIT, with millions of people annually visiting the areas (based on Olympic National Park estimations and Tribal commerce data). Within the planning region as a whole, many tourists travel through the area at all times of the year to enjoy the Casino Resort and Golf Course, among other ventures in which the Tribe is engaged. All of these individuals are exposed to the flood hazard as a result of inundation, flooding, and potential isolation during flood events, even those more minor in nature.

Of the population exposed, the most vulnerable include the socially vulnerable. This includes those economically disadvantaged, and the populations under 5 years of age, or over the age of 65. Economically disadvantaged populations are more vulnerable because they are likely to evaluate their risk and make decisions to evacuate based on the net economic impact on their family. The population over the age of 65 is also more vulnerable because they are more likely to seek or need medical attention which may not be available due to isolation during a flood event and they may have more difficulty evacuating. Chapter 3 discusses in detail the vulnerable population living on the Reservation, but such does not account for the transitory population also disadvantaged that may be in the area when a flood event occurs.

The number of injuries and casualties resulting from flooding is generally limited based on advance weather forecasting, blockades, and warnings. Therefore, injuries and deaths generally are not anticipated, but can occur. Ongoing mitigation efforts should help to avoid the most likely cause of injury, which results from persons trying to cross flooded roadways or channels during a flood, or not evacuating

when floodwaters rise. With roadways being impacted due to floodwaters overtopping them, including by King Tides, or landslides occurring which close transportation routes, there potentially could be a significant number of individuals impacted, including isolation caused by restricted ingress and egress.

8.3.3 Impact on Property

Review of the flood hazard areas indicates that there is one structure owned by the Tribe which falls within the 100-year floodplain situated on land; the Tribe's Coho Net Pen is situated in the water, in falls within the AE Zone. None of the residential properties included in this assessment fall within the 100-year flood zone. No structures fall within or are near the 500-year flood zone (or VE Flood Zone).

The Squaxin Island Reservation (the Island) would also be impacted by King Tides or during storm events with wind-drive waves causing flooding; however, at present, there are no structures on the Island, and there are no utilities which would allow for permanent housing in its current state. The Island does, however, hold significant cultural value to the SIT.

While the Tribe has limited area in the flood zones, the Tribe has nonetheless initiated removal and/or restoration of some tribal lands which were previously impacted from floods. Such activities have been extremely important to the Tribe in protecting its lands and the environment. The Tribe is also in the initial phases of looking to develop other vacant land for various purposes. As this potential development moves forward, data and information from this plan will help identify appropriate areas for development to ensure any flood risks are taken into consideration.

8.3.4 Impact on Critical Facilities and Infrastructure

As indicated, approximately 119 facilities were identified for this plan update which are considered critical in nature. Several of those structures fall outside of Mason County and the Reservation Boundary. Review of analysis which included FEMA's FIRM maps for Mason County identified one structure – the Bridge leading to the Golf Course, to fall within the A-Zone. Its value is approximately $715,000. The Tribe's Coho Pen is situated within the water and falls within the AE Zone. Its value is $2million. Review of Grays Harbor data with respect to the City of Elma where the Tribe maintains medical treatment centers and a greenhouse on East Young Street illustrates that those structures are also out of the flood zones.

In addition, the majority of all roadways both on the reservation and leading to the reservation could be inundated to different depths, in some cases causing isolation. Such has been the case many times historically in the tribal planning area.

8.3.5 Impact on Economy

Impact on the economy related to a flood event would include loss of property, inventory, equipment, and loss of business revenue for the Tribe and those individual tribal members which operate businesses. In the case of the SIT, over the course of the lifecycle of this plan, with the continued expansion of the Tribe, the SIT will also be establishing different types of businesses. Flooding would have the potential to

impact revenue generated by the Tribe, particularly if roadways leading into the tribal planning area as a whole were impacted.

Flooding has the potential to impact all industrial sectors. Depending on the duration between the onset of the event and recovery, businesses within the area may not be able to sustain the economic loss of their business being disrupted for an extended period of time. In addition to the Tribe's economic loss, Tribal citizens would also be impacted due to loss of income.

8.3.6 Impact on Environment

Flooding is a natural event, and floodplains provide many natural and beneficial functions. Nonetheless, with human development factored in, flooding can impact the environment in negative ways. Because they border water bodies, floodplains have historically been popular sites to establish settlements. Human activities tend to concentrate in floodplains for a number of reasons: water is readily available; land is fertile and suitable for agriculture, farming, or forestry; transportation by water is easily accessible; and land is flatter and easier to develop. But human activity in floodplains frequently interferes with the natural function of floodplains. It can affect the distribution and timing of drainage, thereby increasing flood problems. Human development can create local flooding problems by altering or confining drainage channels. This increases flood potential in two ways: it reduces the stream's capacity to contain flows, and it increases flow rates or velocities downstream during all stages of a flood event. Pollution from roads, such as oil, and hazardous materials can wash into rivers and streams. During floods, these can settle onto normally dry soils, polluting them for agricultural uses. Human development such as bridge abutments and levees, logjams from timber harvesting, culvert development, and construction of roadways all can increase stream bank erosion, causing rivers and streams to migrate into non-natural courses. Flooding has significant impact on migrating fish due to the chemicals or pollutants which can wash into rivers and streams, killing the fish and their food supplies. The SIT does have a Coho pen in which they rear and release millions of fish annually. The Tribe and private industries also have significant shellfish rearing areas which could also sustain negative impact.

Floodplains can support ecosystems that are rich in quantity and diversity of plant and animal species. A floodplain can contain 100 or even 1000 times as many species as a river. Wetting of the floodplain soil releases an immediate surge of nutrients: those left over from the last flood, and those that result from the rapid decomposition of organic matter that has accumulated since then. Microscopic organisms thrive and larger species enter a rapid breeding cycle. Opportunistic feeders (particularly birds) move in to take advantage. The production of nutrients peak and fall away quickly; however, the surge of new growth endures for some time. This makes floodplains particularly valuable for agriculture. Species growing in floodplains are markedly different from those that grow outside floodplains. For instance, riparian trees (trees that grow in floodplains) tend to be very tolerant of root disturbance and very quick growing compared to non-riparian trees.

8.3.7 Impact from Climate Change

Global climate change is expected to result in warmer and wetter winters and are projected to increase flooding frequency in most Western Washington river basins. Future floods are expected to exceed the

capacity and protective abilities of many existing flood protection facilities, threatening lives, property, major transportation corridors, communities, and regional economic centers.

Changes in Hydrology

Use of historical hydrologic data has long been the standard of practice for designing and operating water supply and flood protection projects. For example, historical data are used for flood forecasting models and to forecast snowmelt runoff for water supply. This method of forecasting assumes that the climate of the future will be similar to that of the period of historical record. However, the hydrologic record cannot be used to predict changes in frequency and severity of extreme climate events such as floods. Going forward, model calibration or statistical relation development must happen more frequently, new forecast-based tools must be developed, and a standard of practice that explicitly considers climate change must be adopted. Climate change in many areas is already impacting water resources, and resource managers have observed the following:

- Historical hydrologic patterns can no longer be solely relied upon to forecast the water future.
- Precipitation and runoff patterns are changing, increasing the uncertainty for water supply and quality, flood management and ecosystem functions.
- Extreme climatic events will become more frequent, necessitating improvement in flood protection, drought preparedness, and emergency response.

The amount of snow is critical for water supply and environmental needs, but so is the timing of snowmelt runoff into rivers and streams. Rising snowlines caused by climate change will allow more mountain areas to contribute to peak storm runoff. High frequency flood events (e.g. 10-year floods) in particular will likely increase with a changing climate. Along with reductions in the amount of the snowpack and accelerated snowmelt, scientists project greater storm intensity, resulting in more direct runoff and flooding. Changes in watershed vegetation and soil moisture conditions will likewise change runoff and recharge patterns. As stream flows and velocities change, erosion patterns will also change, altering channel shapes and depths, increased sedimentation will occur, and affecting habitat and water quality. With potential increases in the frequency and intensity of wildfires due to climate change, there is potential for more floods following fire, which increase sediment loads and water quality impacts.

As hydrology changes, what is currently considered a 100-year flood may strike more often, leaving many communities at greater risk. Planners will need to factor a new level of safety into the design, operation, and regulation of flood protection facilities such as dams, bypass channels and levees, as well as the design of local wastewater treatment facilities and storm drains.

Sea Level Rise

Sea level and temperature are interrelated (U.S. EPA, 2016). Warmer temperatures result in the melting of glaciers and ice sheets. This melting means that less water is stored on land and, thus, there is a greater volume of water in the oceans. Water also expands as it warms, and the heat content of the world's oceans has been increasing over the last several decades. The impacts of sea level rise could include the

following: increased coastal community flooding, coastal erosion and landslides, seawater well intrusion, acidification of waters, and lost wetlands and estuaries.

8.4 FUTURE DEVELOPMENT TRENDS

Development has affected the natural features of the land over time as the area has been developed from a wilderness to the present day. Along with development came land alternations that have been a factor in increasing the magnitude and frequency of floods in the area. Encroachment on floodplains by structures and fill material reduces carrying capacity and increases flood heights and velocities.

The local municipalities in the area are subject to the provisions of the Washington State Growth Management Act (GMA) which regulate identified critical areas, but until those lands directly impacted can be returned to their normal condition, flooding will continue.

The SIT has established land use regulations, including a flood ordinance. The Tribe is prepared to address flooding issues through various mitigation activities, including its restoration projects, and building outside of the floodplain when new construction occurs. In some cases, when development may occur in the floodplain, it is regulated such that the degree of risk and vulnerability is reduced through building standards and performance measures as the Tribe deems appropriate, thereby decreasing the level vulnerability.

8.5 ISSUES

Some portions of the SIT lands have the potential to be impacted from a flood event, generally in response to a succession of winter rainstorms, increased snow melt beginning in July, and high tides, which can occur at any time. Storm patterns of warm, moist air are normal events, usually occurring between October and April. All of these events can cause some level of flooding in the area, which can occur at any time.

A worst-case scenario for a flood event would be a series of storms that result in high accumulations of runoff surface water within a relatively short time period, especially when occurring simultaneous with a high-tide event which would impact the various rivers' ability to discharge. These types of events have occurred in the planning area, specifically causing issues with roadways and impacting travel. High in-channel flows would cause watercourses to scour, possibly washing out roads or impacting bridges, creating more isolation or evacuation problems. In the case of multi-basin flooding, repairs could not be made quickly enough to restore critical facilities and infrastructure. While human activities influence the impact of flooding events, human activities can also interface effectively with a floodplain as long as steps are taken to mitigate the activities' adverse impacts on floodplain functions.

8.6 IMPACT AND RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from Flood throughout the area is highly likely. The area can experience several flood events annually, albeit not to the level of a disaster declaration. FEMA has identified the flood hazard as the

second most significant hazard to occur (behind severe weather) based on impact within the planning area.

While structural damage will vary due to flood depths and existing floodplain management regulations, existing structures to date have been minimally impacted. With climate change and continued growth and expansion of the Tribe, flooding impact may become more regular. This may be particularly true as both Mason and Grays Harbor Counties as a whole have grown both in population and structure count. With new construction comes a greater amount of impervious surfaces and infrastructure that could increase the potential for impact to the tribal planning area.

Roadways leading to the tribal areas are also regularly impacted. With individuals traveling through the area, this has the potential to impact the SIT with respect to individuals trapped in the area until floodwaters recede, or until landslides have been cleared. Emergency response (medical, police and fire) may also be impacted as a result of water inundating roadways, making travel or evacuation impossible for extended periods of time.

This has impacted the Tribe with respect to its economy and commerce, both at the tribal level, but also individually for tribal members who own businesses which operate in the area. Health care services provided by the Tribe have also been impacted by roadway closure both with respect to patients seeking services, and also employees unable to get to or leave those facilities.

There also exists the potential hazmat impact with respect to fueling stations or other hazardous material sites, as well as the railcars traveling through the area. Rail lines travel through Grays Harbor and Mason Counties daily, with Elma and Shelton serving as primary lines carrying propane, automobiles, agricultural products, as well as military and other US Government loads from Naval Base Kitsap and Bangor Submarine Base. Grays Harbor has experienced previous issues with rail incidents (derailment), but no reports are associated with Mason County. Should a flooding event occur which impacts the rail lines, hazardous materials could spill, combining with floodwaters and cause environmental issues.

Flood events have the potential to negatively impact fish and other wildlife habitats, including the Coho pen, which is situated in the AE Zone of FEMA's NFIP maps. Such impact can be long-lasting as a result of impact on spawning cycles. Of additional consideration are the Tribe's restoration projects. Flood events can cause saltwater inundation, contaminating soils while also potentially causing well water intrusion. The Tribe does maintain its own water storage facility which is supplied by well water. Fortunately, the Tribe has never been impacted in this respect.

Based on the potential impact, the Planning Team determined the CPRI score to be 2.45 with overall vulnerability determined to be a medium level.

CHAPTER 9.
SEVERE WEATHER

Severe weather refers to any dangerous meteorological phenomena with the potential to cause damage, serious social disruption, or loss of human life. It includes thunderstorms, downbursts, wind, tornadoes, waterspouts, and snowstorms. Severe weather differs from extreme weather, which refers to unusual weather events at the extremes of the historical distribution.

General severe weather covers wide geographic areas; localized severe weather affects more limited geographic areas. The severe weather event that most typically impacts the planning area is a damaging windstorm, which causes storm surges exacerbating coastal erosion. Flooding and erosion associated with severe weather are discussed in their respective hazard chapters. Snow historically does not accumulate in great amounts in the area, although even small amounts can impact the area through traffic-related issues and safety for citizens walking in areas of snow accumulation or ice. Excessive heat and cold, while they have occurred, are rare and the SIT has never received a disaster declaration for either type of event.

DEFINITIONS

Freezing Rain—The result of rain occurring when the temperature is below the freezing point. The rain freezes on impact, resulting in a layer of glaze ice up to an inch thick. In a severe ice storm, an evergreen tree 60 feet high and 30 feet wide can be burdened with up to six tons of ice, creating a threat to power and telephone lines and transportation routes.

Hail Storm—Any thunderstorm which produces hail that reaches the ground is known as a hailstorm. Hail has a diameter of 0.20 inches or more. Hail is composed of transparent ice or alternating layers of transparent and translucent ice at least 0.04 inches thick. Although the diameter of hail is varied, in the United States, the average observation of damaging hail is between 1 inch and golf ball-sized 1.75 inches. Stones larger than 0.75 inches are usually large enough to cause damage.

Thunderstorm—A storm featuring heavy rains, strong winds, thunder and lightning, typically about 15 miles in diameter and lasting about 30 minutes. Hail and tornadoes are also dangers associated with thunderstorms. Lightning is a serious threat to human life. Heavy rains over a small area in a short time can lead to flash flooding.

Tornado— Most tornadoes have wind speeds less than 110 miles per hour are about 250 feet across, and travel a few miles before dissipating. The most extreme tornadoes can attain wind speeds of more than 300 miles per hour, stretch more than two miles across, and stay on the ground for dozens of miles They are measured using the Enhanced Fujita Scale, ranging from EF0 to EF5.

Windstorm—A storm featuring violent winds. Southwesterly winds are associated with strong storms moving onto the coast from the Pacific Ocean. Southern winds parallel to the coastal mountains are the strongest and most destructive winds. Windstorms tend to damage ridgelines that face into the winds.

Winter Storm—A storm having significant snowfall, ice, and/or freezing rain; the quantity of precipitation varies by elevation.

9.1.1 Semi-Permanent High- and Low-Pressure Areas Over the North Pacific Ocean

During summer and fall, the 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 is further south, and low pressure prevails in the northeast Pacific. Circulation of air around both pressure centers bring 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 October, reaching a peak in winter, and gradually decreasing by late spring.

Summers in the planning area are typically cool and relatively dry while winters are mild, wet, and generally cloudy. Measurable rainfall occurs on 150 days each year in interior valleys and on 190 days in the mountains and along the coast.

Thunderstorms occur up to 10 days each year over the lower elevations and up to 15 days over the mountains. Damaging hailstorms are rare in western Washington. During July and August, the driest months, two to four weeks can pass with only a few showers; however, in December and January, the wettest months, precipitation is frequently recorded on 25 days or more each month. Snowfall is light in the lower elevations and heavier in the mountains. During the wet season, rainfall is usually of light to moderate intensity and continuous over a long period rather than occurring in heavy downpours for brief periods; heavier intensities occur along the windward slopes of the mountains.

9.1.2 Atmospheric Phenomenon

Atmospheric rivers (see Figure 9-1) are relatively long, narrow regions in the atmosphere – like rivers in the sky – that transport most of the water vapor outside of the tropics. These columns of vapor move with the weather, carrying an amount of water vapor roughly equivalent to the average flow of water at the mouth of the Mississippi River. When the atmospheric rivers make landfall, they often release this water vapor in the form of rain or snow. Those that contain the largest amounts of water vapor, and the strongest winds can create extreme rainfall and floods, often by stalling over watersheds vulnerable to flooding. These events can disrupt travel, induce mudslides, and cause catastrophic damage to life and property. A well-known example is the "Pineapple Express," a strong atmospheric river that is capable of bringing moisture from the tropics near Hawaii over to the U.S. West Coast. [23]

El Niño-Southern Oscillation (ENSO) cycle is a scientific term that describes the fluctuations in temperature between the ocean and atmosphere in the east-central Equatorial Pacific. ENSO is one of the most important climate phenomena on Earth due to its ability to change the global atmospheric circulation, which in turn, influences temperature and precipitation across the globe. Though ENSO is a single climate phenomenon, it has three states, or phases, it can be in. The two opposite phases, "El Niño" and "La Niña," require certain changes in both the ocean and the atmosphere because ENSO is a coupled climate phenomenon. "Neutral" is in the middle of the continuum.

- La Nina (translated from Spanish as "little girl") is a natural ocean-atmospheric phenomenon marked by cooler-than-average sea surface temperatures across the central and eastern Pacific Ocean near the equator. La Nina typically brings above-average precipitation and colder-than-average temperatures along the northern tier of the U.S., along with below-average precipitation and above-average temperatures across the South.
- An El Nino (translated from Spanish as "little boy") is marked by warmer-than-average sea surface temperatures in the region. Typical El Niño effects are likely to develop over North America during the upcoming winter season. Those include warmer-than-average temperatures over western and central Canada, and over the western and northern United States. Wetter-than-average conditions are likely over portions of the U.S. Gulf Coast and Florida, while drier-than-average

[23] NOAA. What are atmospheric rivers? Accessed 18 Sept 2022. Available online at: https://www.noaa.gov/stories/what-are-atmospheric-rivers

conditions can be expected in the Ohio Valley and the Pacific Northwest. The presence of El Niño can significantly influence weather patterns, ocean conditions, and marine fisheries across large portions of the globe for an extended period of time.

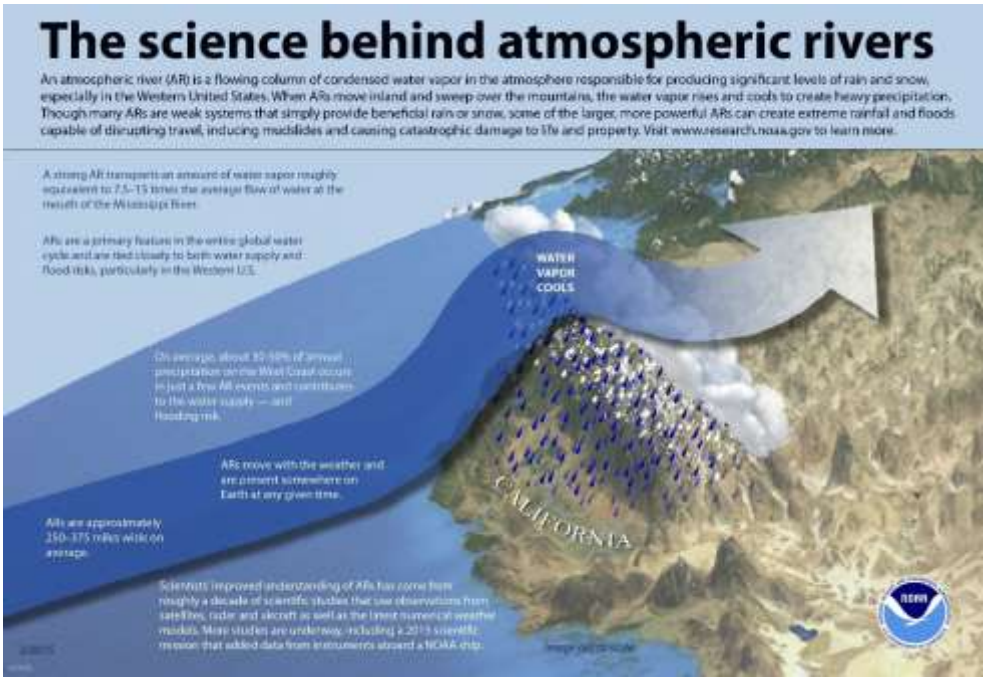


Figure 9-1 Atmospheric Rivers

9.1.3 Thunderstorms

A thunderstorm is a rain event that includes thunder and lightning. A thunderstorm is classified as "severe" when it contains one or more of the following: hail with a diameter of three-quarter inch or greater, winds gusting in excess of 50 knots (57.5 mph), or tornado. Thunderstorms have three stages (see Figure 9-2):

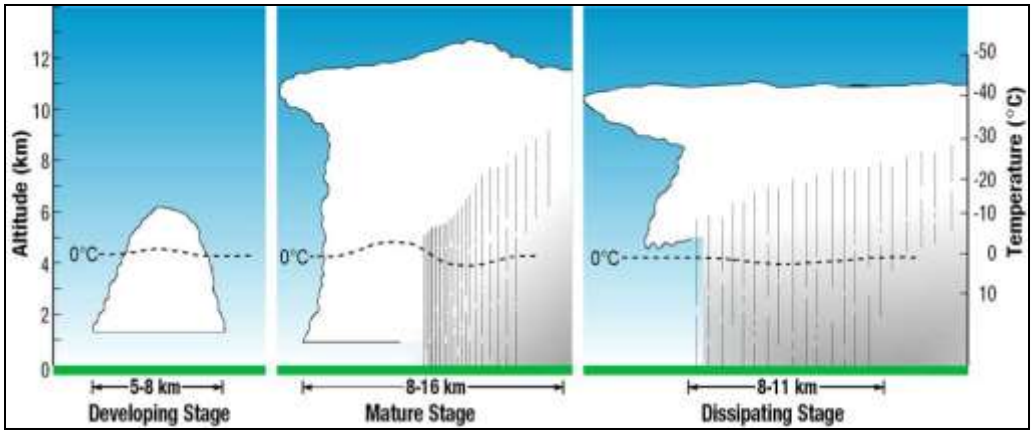


Figure 9-2 The Thunderstorm Life Cycle

Three factors cause thunderstorms: moisture, rising unstable air (air that keeps rising once disturbed), and a lifting mechanism to provide the disturbance. The sun heats the surface of the earth, which warms the air above it. If this warm surface air is forced to rise (hills or mountains can cause rising motion, as can the interaction of warm air and cold air or wet air and dry air) it will continue to rise as long as it weighs less and stays warmer than the air around it. As the air rises, it transfers heat from the earth surface to the upper atmosphere (the process of convection). The water vapor it contains begins to cool and it condenses into a cloud. The cloud eventually grows upward into areas where the temperature is below freezing. Some of the water vapor turns to ice and some of it turns into water droplets. Both have electrical charges. Ice particles usually have positive charges, and rain droplets usually have negative charges. When the charges build up enough, they are discharged in a bolt of lightning, which causes the sound heard as thunder. There are four types of thunderstorms:

- **Single-Cell Thunderstorms—**Single-cell thunderstorms usually last 20 to 30 minutes. A true single-cell storm is rare, because the gust front of one cell often triggers the growth of another. Most single-cell storms are not usually severe, but a single-cell storm can produce a brief severe weather event. When this happens, it is called a pulse severe storm.

- **Multi-Cell Cluster Storm—**A multi-cell cluster is the most common type of thunderstorm. The multi-cell cluster consists of a group of cells, moving as one unit, with each cell in a different phase of the thunderstorm life cycle. Mature cells are usually found at the center of the cluster and dissipating cells at the downwind edge. Multi-cell cluster storms can produce moderate-size hail, flash floods and weak tornadoes. Each cell in a multi-cell cluster lasts only about 20 minutes; the multi-cell cluster itself may persist for several hours. This type of storm is usually more intense than a single cell storm.

- **Multi-Cell Squall Line—**A multi-cell line storm, or squall line, is a long line of storms with a continuous well-developed gust front at the leading edge. The storms can be solid, or have gaps and breaks in the line. Squall lines can produce hail up to golf-ball size, heavy rainfall, and weak tornadoes, but they are best known as the producers of strong downdrafts. Occasionally, a strong downburst will accelerate a portion of the squall line ahead of the rest of the line. This produces what is called a bow echo. Bow echoes can develop with isolated cells as well as squall lines. Bow echoes are easily detected on radar but are difficult to observe visually.

- **Super-Cell Storm—**A super-cell is a highly organized thunderstorm that poses a high threat to life and property. It is similar to a single-cell storm in that it has one main updraft, but the updraft is extremely strong, reaching speeds of 150 to 175 miles per hour. Super-cells are rare. The main characteristic that sets them apart from other thunderstorms is the presence of rotation. The rotating updraft of a super-cell (called a mesocyclone when visible on radar) helps the super-cell to produce extreme weather events, such as giant hail (more than 2 inches in diameter), strong downbursts of 80 miles an hour or more, and strong to violent tornadoes.

In 2022, Washington ranked 40th nationwide in deaths associated with lightning strikes, having five deaths during the time period 1959-2013. No deaths in Washington have been experienced since 2013 as a result of lightning strikes. Figure 9-3 illustrates the ranking nationwide. Figure 9-4 illustrates the lightning fatalities based on the type of activity at the time of strike.[24]

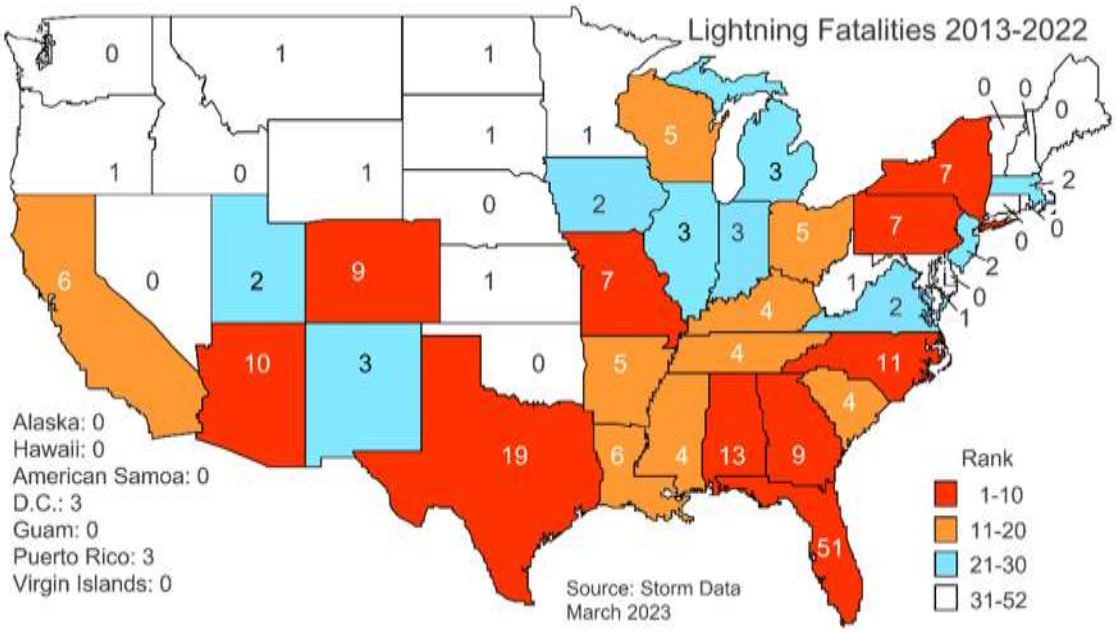


Figure 9-3 Lightning Fatalities by State 2013-2022

[24] Lightning Safety Council (2023). Accessed 26 Sept. 2023. Available online at: A Detailed Analysis Of Lightning Deaths in the United States From 2006 through 2022.pdf (lightningsafetycouncil.org)

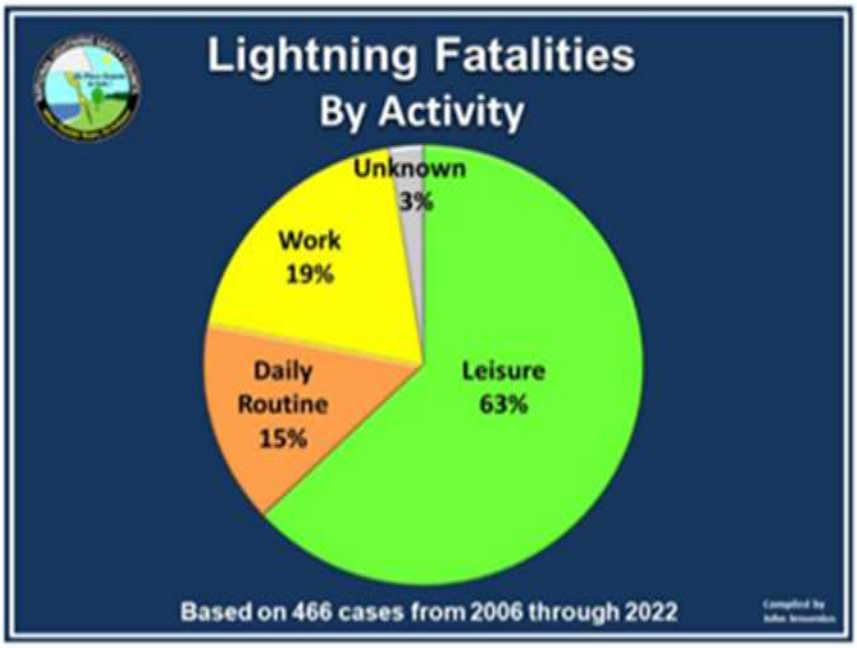


Figure 9-4 Lightning Fatalities by Activity

9.1.4 Damaging Winds

Damaging winds are classified as those exceeding 60 mph, although winds at 55 mph can cause structural damage. Damage from such winds accounts for half of all severe weather reports in the lower 48 states and is more common than damage from tornadoes. Wind speeds can reach up to 100 mph and can produce a damage path extending for hundreds of miles. There are seven types of damaging winds:

- **Straight-line winds —**Any thunderstorm wind that is not associated with rotation; this term is used mainly to differentiate from tornado winds. Most thunderstorms produce some straight-line winds as a result of outflow generated by the thunderstorm downdraft.

- **Downdrafts —**A small-scale column of air that rapidly sinks toward the ground.

- **Downbursts—**A strong downdraft with horizontal dimensions larger than 2.5 miles resulting in an outward burst or damaging winds on or near the ground. Downburst winds may begin as a microburst and spread out over a wider area, sometimes producing damage similar to a strong tornado. Although usually associated with thunderstorms, downbursts can occur with showers too weak to produce thunder.

- **Microbursts—**A small concentrated downburst that produces an outward burst of damaging winds at the surface. Microbursts are generally less than 2.5 miles across and short-lived, lasting only 5 to 10 minutes, with maximum wind speeds up to 168 mph. There are two kinds of microbursts: wet and dry. A wet microburst is accompanied by heavy precipitation at the surface. Dry microbursts, common in places like the high plains and the intermountain west, occur with little or no precipitation reaching the ground.

- **Gust front—**A gust front is the leading edge of rain-cooled air that clashes with warmer thunderstorm inflow. Gust fronts are characterized by a wind shift, temperature drop, and gusty winds out ahead of a thunderstorm. Sometimes the winds push up air above them, forming a shelf cloud or detached roll cloud.

- **Derecho—**A derecho is a widespread thunderstorm wind caused when new thunderstorms form along the leading edge of an outflow boundary (the boundary formed by horizontal spreading of thunderstorm-cooled air). The word "derecho" is of Spanish origin and means "straight ahead." Thunderstorms feed on the boundary and continue to reproduce. Derechos typically occur in summer when complexes of thunderstorms form over plains, producing heavy rain and severe wind. The damaging winds can last a long time and cover a large area.

- **Bow Echo—**A bow echo is a linear wind front bent outward in a bow shape. Damaging straight-line winds often occur near the center of a bow echo. Bow echoes can be 200 miles long, last for several hours, and produce extensive wind damage at the ground.

There are four main types of windstorm tracks that impact the Pacific Northwest as identified in Figure 9-5. These four tracks are distinguished by two basic windstorm patterns that have emerged in the Puget Sound Region: the South Wind Event and the East Wind Event. South wind events are generally large-scale events that affect large portions of Western Washington and possibly Western Oregon.

In contrast, easterly wind events are more limited. High pressure on the east side of the Cascade Mountain Range creates airflow over the peaks and passes, and through the funneling effect of the valleys, the wind increases dramatically in speed. As it descends into these valleys and then exits into the lowlands, the wind can pick up enough speed to damage buildings, rip down power lines, and destroy fences. Once it leaves the proximity of the Cascade foothills, the wind tends to die down rapidly.

SIT has properties impacted by wind at varying degrees as a result of properties within both Grays Harbor and Mason Counties. For Mason County, the entire county is in an 85-mph wind zone. Within this zone there are four (4) zones of exposure, three (3) of which are identified in Mason County and that are utilized to guide structure development (2006 International Building Code). The exposure zones further identify areas that are at higher risk from impacts of high winds. The closer development is to open waters and on top of steep cliffs, the higher the design criteria that is required through building code. Grays Harbor County's Wind Zones Map is featured in Figure 9-6.[25]

For each wind direction considered, an exposure category that adequately reflects the characteristics of ground surface irregularities is determined for the site at which the building or structure is to be constructed. Also taken into account is the variations in ground surface roughness that arise from natural topography and vegetation as well as from constructed features. Based on the International Building Code, the zones are further broken down into surface roughness categories and are defined as follows:

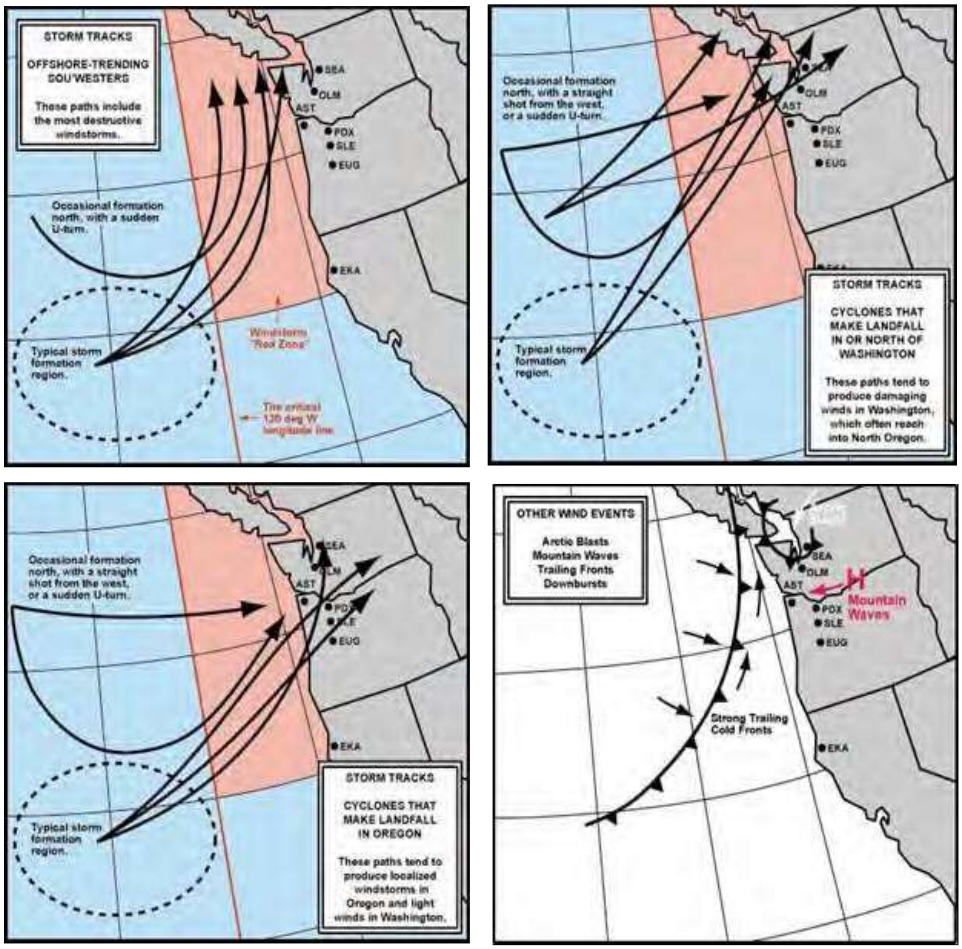
[25] Grays Harbor County Wind Zones. Accessed 27 Oct. 2023. Available online at: http://www.co.grays-harbor.wa.us/docs/16ClimateGeographicDesignCriteria.pdf

- Surface Roughness B. Urban and suburban areas, wooded areas or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger.

- Surface Roughness C. Open terrain with scattered obstructions having heights generally less than 30 feet (9144 mm). This category includes flat open country, grasslands, and all water surfaces in hurricane-prone regions.

- Surface Roughness D. Flat, unobstructed areas, and water surfaces outside hurricane-prone regions. This category includes smooth mud flats, salt flats and unbroken ice.

For the SIT, the strongest winds are generally from the south or southwest and occur during fall and winter, although can occur at any time of the year. Wind velocities regularly reach 40 to 50 mph each winter, with 75 to 100 mph occurring a few times annually. Winds have been recorded at and above 100 mph during the storm season, which normally occurs October through May. The highest summer and lowest winter temperatures generally occur during periods of easterly winds.



Source: Oregon Climate Service, 2015

Figure 9-5 Windstorm Tracks Impacting the Pacific Northwest

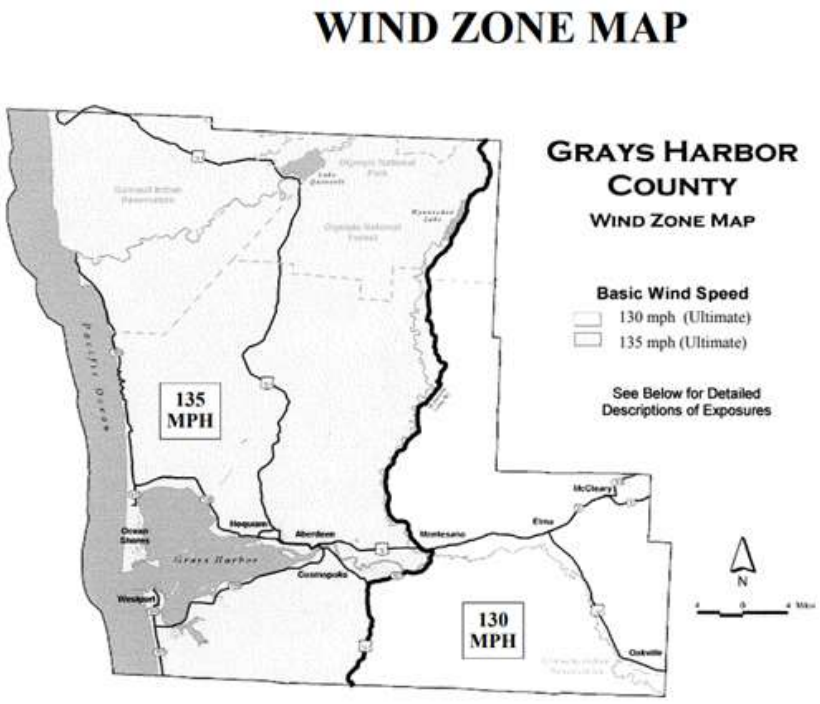


Figure 9-6 Grays Harbor County Wind Zones

9.1.5 Hail Storms

Hail occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into ice. Recent studies suggest that super-cooled water may accumulate on frozen particles near the back side of a storm as they are pushed forward across and above the updraft by the prevailing winds near the top of the storm. Eventually, the hailstones encounter downdraft air and fall to the ground.

Hailstones grow two ways: by wet growth or dry growth. In wet growth, a tiny piece of ice is in an area where the air temperature is below freezing, but not super cold. When the tiny piece of ice collides with a super-cooled drop, the water does not freeze on the ice immediately. Instead, liquid water spreads across tumbling hailstones and slowly freezes. Since the process is slow, air bubbles can escape, resulting in a layer of clear ice. Dry growth hailstones grow when the air temperature is well below freezing and the water droplet freezes immediately as it collides with the ice particle. The air bubbles are “frozen” in place, leaving cloudy ice.

9.1.6 Ice and Snow Storms

The National Weather Service defines an ice storm as a storm that results in the accumulation of at least 0.25 inches of ice on exposed surfaces. Ice storms occur when rain falls from a warm, moist, layer of atmosphere into a below freezing, drier layer near the ground. The rain freezes on contact with the cold ground and exposed surfaces, causing damage to trees, utility wires, and structures (see Figure 9-7).

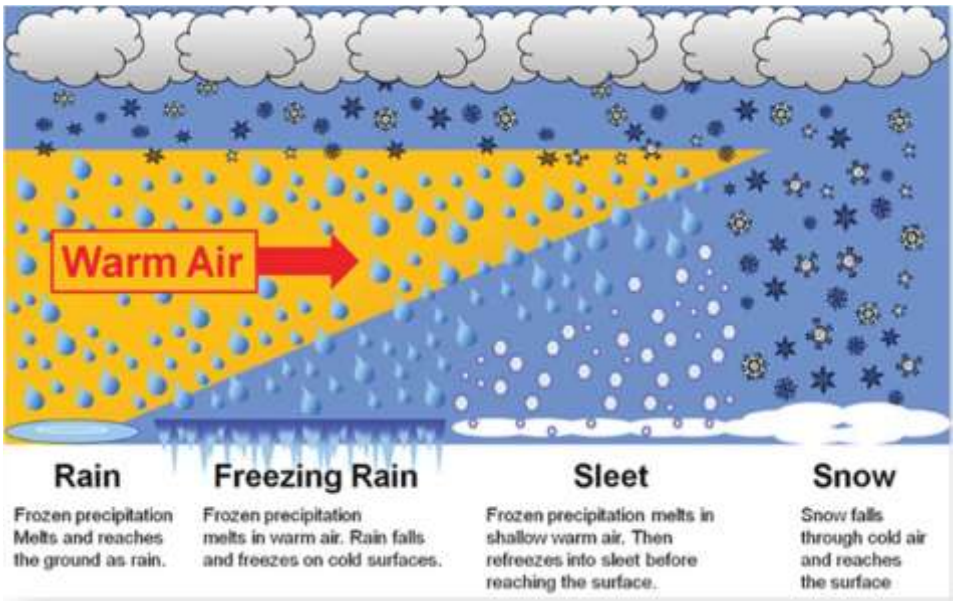


Figure 9-7 Types of Precipitation

Precipitation falls as snow when air temperature remains below freezing throughout the atmosphere. In many climates, precipitation that forms in wintertime clouds starts out as snow because the top layer of the storm is usually cold enough to create snowflakes. Snowflakes are just collections of ice crystals that cling to each other as they fall toward the ground. Precipitation continues to fall as snow when the temperature remains at or below 0 degrees Celsius from the cloud base to the ground. The following are used to define snow events:

- Snow Flurries. Light snow falling for short durations. No accumulation or light dusting is all that is expected.
- Snow Showers. Snow falling at varying intensities for brief periods of time. Some accumulation is possible.
- Snow Squalls. Brief, intense snow showers accompanied by strong, gusty winds. Accumulation may be significant. Snow squalls are best known in the Great Lakes Region.
- Blowing Snow. Wind-driven snow that reduces visibility and causes significant drifting. Blowing snow may be snow that is falling and/or loose snow on the ground picked up by the wind.
- Blizzards. Winds over 35mph with snow and blowing snow, reducing visibility to ¼ mile or less for at least 3 hours.

Depending on the type of snow falling (dry flakes versus heavy, wet flakes), the weight can exceed 10 pounds per square foot, which is significant when accumulations fall onto trees, electrical lines, or older structures built to lower snow-load capacities.

Significant snowfall does not customarily occur within the low-lying areas in the SIT with any regularity; however, areas in higher elevations can and have experienced a greater amount of snow. When

significant events occur, this has impacted the surrounding rivers with increased snowmelt flowing in the rivers when temperatures rise. Snow accumulations on trees, which are abundant on the SIT, can be damaged by the snow itself due to weight accumulations, but particularly when snow-ladened trees are exposed to high winds, which are many times associated with snowstorms.

Snowfall in the surrounding municipalities also impacts the SIT with respect to power outages (with the weight of the snow impacting power lines), increased motor vehicle accidents, and (limited) supply-chain issues. Travel restrictions also impact the economy of the Tribe, particularly for the tourism industries.

9.1.7 Extreme Temperatures

Extreme temperature includes both heat and cold events, which can have a significant impact on human health, commercial/agricultural businesses, and primary and secondary effects on infrastructure (e.g., burst pipes, power failure). Definitions of extreme "cold" or "heat" vary across different areas of the country based on what the population is accustomed to within the region (CDC, 2014).

Extreme Cold

Extreme cold events occur when temperatures drop below normal in an area. In regions relatively unaccustomed to winter weather, near freezing temperatures are considered "extreme cold." Extreme cold is often associated with severe winter storms and winds, which exacerbate the effects of cold temperatures by quickly depleting body heat, making it feel colder than temperatures indicate (wind chill). Figure 9-8 demonstrates the value of wind chill based on the ambient temperature and wind speed.

Exposure to cold temperatures, whether indoors or outside, can lead to serious or life-threatening health problems such as hypothermia, cold stress, frostbite or freezing of the exposed extremities such as fingers, toes, nose, and ear lobes. Hypothermia occurs when the core body temperature is <95ºF. If individuals exposed to excessive cold are unable to generate enough heat (e.g., through shivering) to maintain a normal core body temperature of 98.6ºF, their organs (e.g., brain, heart, or kidneys) can malfunction. Extreme cold also can cause emergencies in susceptible populations, such as those without shelter, those who are stranded, or those who live in a home that is poorly insulated or without heat. Infants and the elderly are particularly at risk, but anyone can be affected.

Extremely cold temperatures often accompany a winter storm, so individuals may have to cope with power failures and icy roads. Although staying indoors as much as possible can help reduce the risk of car crashes and falls on the ice, individuals may also face indoor hazards. Many homes will be too cold—either due to a power failure or because the heating system is not adequate for the weather. The use of space heaters and fireplaces to keep warm increases the risk of household fires and carbon monoxide poisoning.

During cold months, carbon monoxide may be high in some areas because the colder weather makes it difficult for car emission control systems to operate effectively. Carbon monoxide levels are typically higher during cold weather because the cold temperatures make combustion less complete and cause inversions that trap pollutants close to the ground (USEPA, 2009).

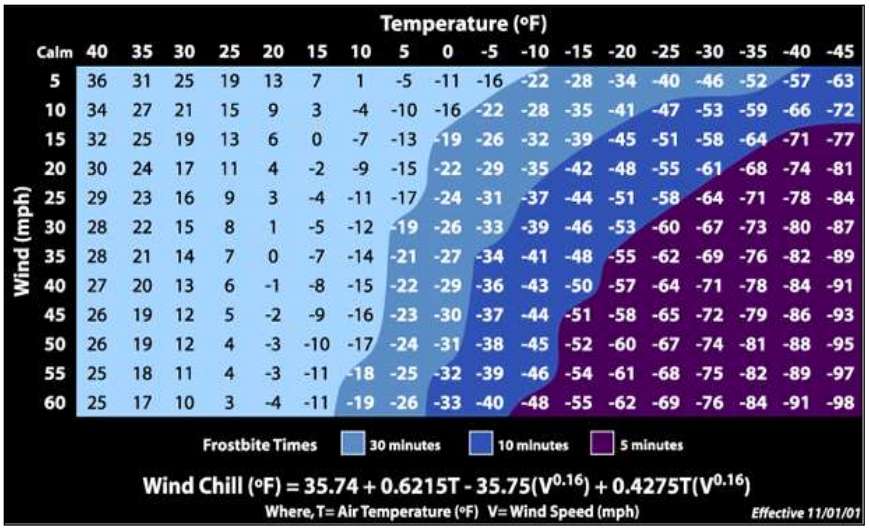


Figure 9-8 NWS Wind Chill Index

Extreme Heat

Temperatures 10 degrees or more above the average high temperature for the region lasting for days or weeks are defined as extreme heat (FEMA, 2022; CDC, 2017). An extended period of extreme heat of three or more consecutive days is typically called a heat wave and is often accompanied by high humidity. There is no universal definition of a heat wave because the term is relative to the usual weather in an area. The term heat wave is applied both to routine weather variations and to extraordinary spells of heat which may occur only once a century (Meehl and Tebaldi, 2004). A basic definition of a heat wave implies that it is an extended period of unusually high atmosphere-related heat stress, which causes temporary modifications in lifestyle and which may have adverse health consequences for the affected population (Robinson, 2000). Figure 9-9 identifies some of those consequences and associated temperatures. [26]

Certain populations are at greater risk during extreme heat events. These populations include the elderly age 65 and older, infants and young children under five years of age (see Figure 9-10), pregnant woman, the homeless or poor, the overweight, and people with mental illnesses, disabilities, and chronic diseases.

Depending on severity, duration, and location, extreme heat events can create or provoke secondary hazards, which include droughts, wildfires, water shortages and power outages, among other issues. This could result in a broad and far-reaching set of impacts throughout a local area or entire region. Impacts could include significant loss of life and illness; economic costs in transportation; agriculture; production; energy and infrastructure; and losses of ecosystems, wildlife habitats, and water resources (Adams, Date Unknown; Meehl and Tebaldi, 2004; CDC, various dates).

[26] NCDC, 2000

Relative Humidity (%) \ Temperature (°F)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Category	Heat Index	Health Hazards
Extreme Danger	130 °F – Higher	Heat Stroke / Sunstroke is likely with continued exposure.
Danger	105 °F – 129 °F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.
Extreme Caution	90 °F – 105 °F	Sunstroke, muscle cramps, and/or heat exhaustions possible with prolonged exposure and/or physical activity.
Caution	80 °F – 90 °F	Fatigue possible with prolonged exposure and/or physical activity.

Figure 9-9 Heat Stress Index

Wind-Chill Factor Chart (in Fahrenheit)

Wind Speed in mph

Air Temperature \ Wind Speed in mph	Calm	5	10	15	20	25	30	35	40
40	40	36	34	32	30	29	28	28	27
30	30	25	21	19	17	16	15	14	13
20	20	13	9	6	4	3	1	0	-1
10	10	1	-4	-7	-9	-11	-12	-14	-15
0	0	-11	-16	-19	-22	-24	-26	-27	-29
-10	-10	-22	-28	-32	-35	-37	-39	-41	-43

Comfortable for out door play | Caution | Danger

Heat Index Chart (in Fahrenheit %)

Relative Humidity (Percent)

Air Temperature (F) \ Relative Humidity (Percent)	40	45	50	55	60	65	70	75	80	85	90	95	100
80	80	80	81	81	82	82	83	84	84	85	86	86	87
84	83	84	85	86	88	89	90	92	94	96	98	100	103
90	91	93	95	97	100	103	105	109	113	117	122	127	132
94	97	100	103	106	110	114	119	124	129	135			
100	109	114	118	124	129	130							
104	119	124	131	137									

Figure 9-10 Heat and Wind Chill Index for Children

Weather Fatalities

Figure 9-11 identifies the number of weather fatalities nationwide based on 10- and 30-year averages.[27] Extreme heat is the number one weather-related cause of death in the U.S. over the 30-year average, followed by flood. On average, more than 1,500 people die each year from excessive heat. No Tribal Member of the SIT has been killed due to a severe weather event.

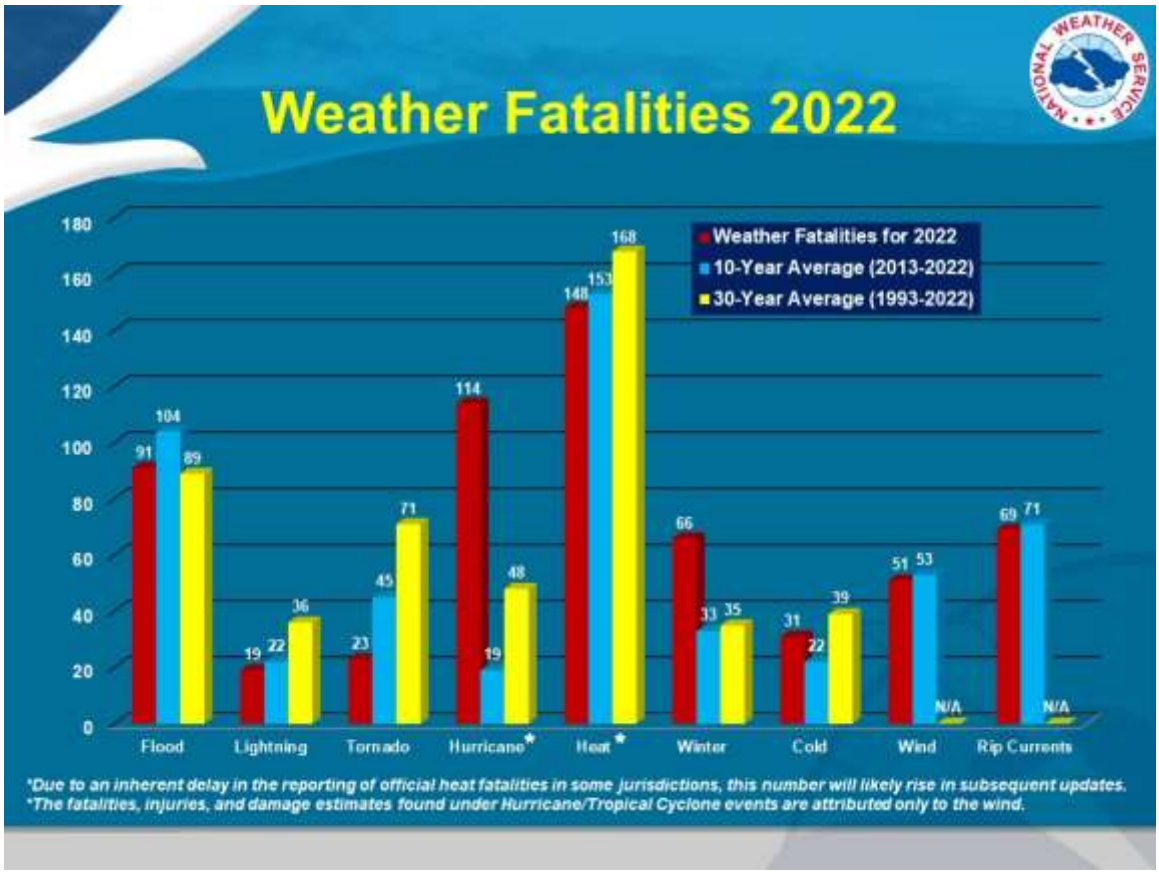


Figure 9-11 Average Number of Weather-Related Fatalities in the U.S.

9.2 HAZARD PROFILE

9.2.1 Extent and Location

The entire planning area is susceptible to the impacts of severe weather. Severe weather events customarily occur during the months of October to May, although they have occurred year-round. The County as a whole, including SIT, has been impacted by strong winds, rain, snow, or other precipitation, and often are accompanied by thunder or lightening (Mason County, 2023). Considerable snowfall does not customarily occur throughout the region, although snowfall does occur to some extent annually. The

[27] NOAA, 2020. Accessed 6 Feb 2024. Available online at https://www.weather.gov/hazstat/

year 2022 did have a severe winter weather event (heavy snow) which resulted in one fatality occurring statewide as a result of the event (vehicle accident), but that fatality did not occur on the Reservation.

Communities in low-lying areas next to coastlines, rivers, streams, or lakes are more susceptible to flooding as a result of storm surge. Wind events are damaging throughout the planning area. Winds coming off of the Pacific Ocean can have a significant impact on the planning region as a result of both the wind and associated storm surge and increased precipitation. For the planning region as a whole, wind events are one of the most common weather-related incidents to occur, often times leaving the area without power, although customarily not for long extended periods. Due to the geologic makeup of the area, winds can be accelerated in small areas. Wind damage has also been significant with respect to the trees on the SIT, particularly in the forested areas, where large groups of trees have been impacted.

Severe storms and storm surges also cause flooding and channel migration, which can cause floodwaters to travel inland for many miles along waterways. Such has been a regular occurrence within the planning area, particularly as it relates to the Skokomish flooding areas within the planning region, causing damage along major roadways, impacting ingress and egress to the Reservation, or impacting residential structures. Access is sometimes unpredictable as roads are vulnerable to damage from severe storms, flooding, and landslide/erosion, which is regularly experienced along the coastline area, and along State Route 106 and US Route 101, which have been closed previously for several days as a result of the 1996 severe storm/flooding incident (see Figure 9-12).

Figure 9-12 U.S. Route 101 North of Shelton - December 3, 2007 Severe Storm Event

While the Reservation itself does not experience large quantities of snow in the lower elevations, the Olympic Mountains, which feeds into the watershed in the area, does. The snow melt associated with the area has caused flooding events during otherwise dry conditions.

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, 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 also commonly the victims of a tornado or windstorm.

9.2.2 Previous Occurrences

Types of severe weather occurring on the SIT can vary but impact the tribe at least once annually. The most common types of severe storms experienced can include thunderstorms, hailstorms, heavy precipitation, straight line winds, and damaging downburst winds. Less frequent severe weather phenomena include heavy snowstorms and ice storms.

Since 1956, 12 severe weather events (including FEMA's severe winter, severe wind, and severe storm-typing) have been declared in Mason County. In addition, Mason County experienced one tornado (F-1) in October 2019; Grays Harbor County experienced two tornado events as recently as March 2019 and October 2020, with damages limited to trees (see Figure 9-13). Chapter 3, Section 3.5 identifies all disaster events occurring since 1953. Table 3-2 identifies severe weather events by month, FEMA ranking, recurrence intervals, and probability factors.

Table 9-1 describes several of the more significant severe weather events impacting the area. In addition to the federally declared events identified, the area also sustains impact from other events which do not rise to the level of a declaration but have significant impact on the area.

As indicated, downed trees and windstorms continue to be the leading cause of power outages throughout the planning area, as well as road closures. All areas of the SIT are regularly impacted both as a result of the winds themselves, or as a result of power outages and road closures in other areas of the county causing impact. The Tribe has buried power lines on the Reservation, reducing direct impact; however, when power outages do occur, they are customarily a bigger issue than a local issue, particularly in light of the buried lines. On average, outside of the significant windstorm events which can cause outages for a week or more, when more minor events occur, they typically last for less than one day.

Approximately nine facilities on the Reservation are equipped with generators, but not all. Seven support government buildings, with one each at the Casino and Event Center. The Tribe does have some portable generators, which can be relocated as needed, but additional or permanent generators are needed. Residential structures are not equipped with generators when built. The Tribe does have generators at each pump station for the wastewater system.

Winds in general are a regular occurrence, and have impacted every home, business, power line, and shoreline within the tribal planning area.

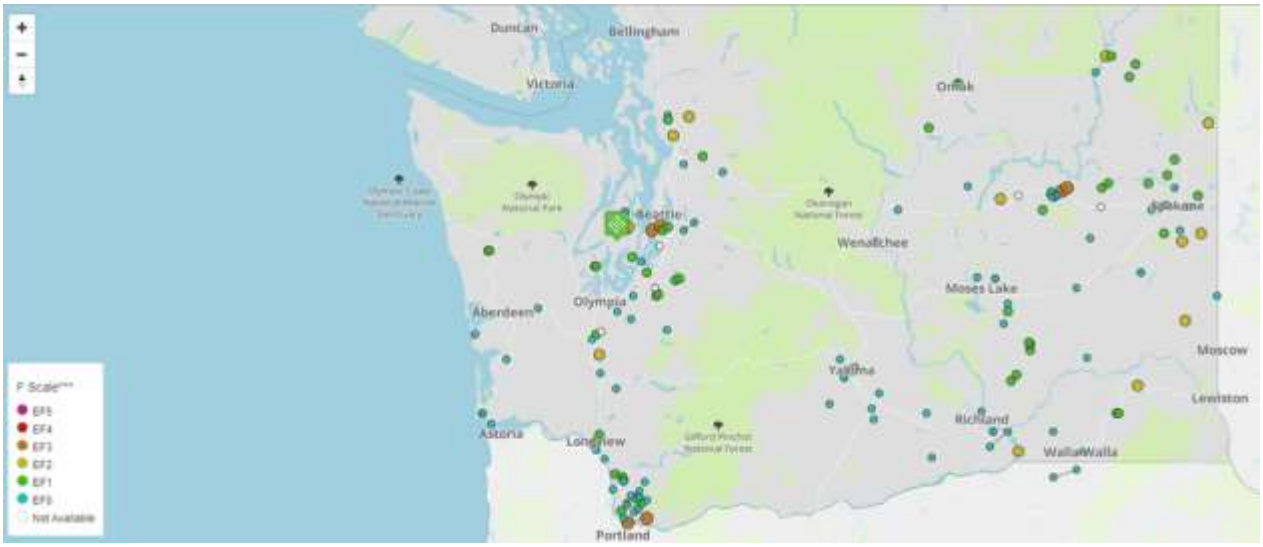


Figure 9-13 Tornado History in Washington 1950-2022

TABLE 9-1
SAMPLING OF SEVERE WEATHER EVENTS IMPACTING PLANNING AREA SINCE 1960

Date	Type	Deaths or Injuries	Property Damage
October 1962 Disaster 137	Windstorm	7 in Washington; 46 – combined all state's impacted	$235 million in property damage; 15 billion board feet of timber valued at $750 million
Description: *Most powerful non-tropical storm to impact lower 48 states. Impact felt in Washington, Oregon and California. Damaged over 50,000 buildings throughout regions impacted. Power in some areas out for 3+ weeks. Wind speeds ranged from 88 mph in Tacoma to 160 mph in Naselle, WA. There was extensive damage with power and telephone outages throughout the region.*			
December 1964	Severe winter storm event	Unknown	Unknown
Description: *Cold wave, heavy snowfall and heavy rain.*			
December 1979 Disaster 612	Severe winter storm with heavy rains	Unknown	Unknown
Description: *Strong winds destroyed the Hood Canal Bridge, thereby isolating the Olympic Peninsula from the Kitsap Peninsula and roads leading to Tacoma and Seattle.*			
November 1995 DR 1079	Flooding, severe storm, thunderstorm	Unknown	Unknown
Description: *Heavy rains lead to flooding throughout the region.*			
Dec. 1996 – Jan. 1997 Disaster 1159	Severe winter storm, snow, freezing rain; high winds; landslides.	24 deaths statewide	Stafford Act assistance $83 million; SBA $31.7 million; total losses $140 million statewide

TABLE 9-1
SAMPLING OF SEVERE WEATHER EVENTS IMPACTING PLANNING AREA SINCE 1960

Date	Type	Deaths or Injuries	Property Damage
Description: *Saturated ground combined with snow, freezing rain, rain, rapid warming and high winds within a five-day period produced flooding and landslides. 37 counties were impacted with large power outages throughout the impacted counties.*			
January 2006 Disaster 1641	Severe winter storm, flood, landslide, mudslide, tidal surge	Unknown	Unknown
Description: *Heavy rains, including tidal surge.*			
December 2006 Disaster 1682 (Jefferson County not declared)	Windstorm	15 deaths statewide	+$50 million statewide
Description: *The most powerful windstorm since the Inauguration Day Storm of 1993 slammed into Washington State with 90 MPH winds on the Coast, gusts up to 70 MPH in the Puget Sound basin, and peak winds well over 100 MPH along the Cascade Crest. Up to 1.5 million residents were without power for up to 11 days.*			
December 2007 Disaster 1734	Severe winter storm, snow, heavy rains, landslides, winds, tidal surge	Unknown	
Description: *Severe winter storm, including snow fall and heavy rains; winds ranged from 102 mph to 146 mph. Winds lasted 36 hours in some areas. Increased wave heights in some areas 44 to 48 feet offshore. After snowfall, near record temperatures and moist tropical air led to record rainfall, with reports indicating 100-year flood event.*			
January 2009 Disaster 1817	Severe Winter Storm, Landslides, Mudslides and Flooding	Unknown	$10 million statewide in Individual Assistance
Description: *Strong warm and very wet Pacific weather system brought high amounts of rainfall to Washington during 6-8 January 2009. Snow levels rose from low levels to between 6,000 and 8,000 feet, with strong westerly winds enhancing precipitation amounts in the mountains. Conditions from a mid-December through early January region-wide cold snap and associated heavy snow helped set the stage for flooding. This event produced avalanches in the mountains, caused more than 1,500 slides across the state, and resulted in structural damage to buildings from added snow load. All counties of Western Washington lowlands received 3-8 inches of rain. The National Weather Service issued flood warnings for 49 points across the state. Quillayute saw 2.88 inches on January 7, breaking the 2.39-inch record for the date set in 1983.*			
March 2009 Disaster 1825	Severe winter storm and record and near record snow	Unknown	PA program only available >$26 million for impacted communities, no IA.
Description: *A severe winter storm with near-record snow blanketed the area. The incident period ran from December 12, 2008-January 5, 2009. (March 2009 declaration.)*			
January 2016 Disaster 4249	Severe winter storm, straight-line winds, flooding, landslides and mudslides	Unknown	PA only >$25 million.
Description: *Severe winter storm, including record and near record snowfall and heavy rains and winds during the period November 12-21, 2015. (Declared January 2016)*			
December 2018 Disaster 4418	Severe winter storm, straight-line winds, flooding, landslides and mudslides	Unknown	PA program only available for >$12.6, no IA.
Description: *Severe winter storm, including record and near record snowfall and heavy rains and winds during the period December 12-24, 2018. (Declared March 2019.)*			

TABLE 9-1
SAMPLING OF SEVERE WEATHER EVENTS IMPACTING PLANNING AREA SINCE 1960

Date	Type	Deaths or Injuries	Property Damage
December 2020 Disaster 4593	Severe winter storm, straight-line winds, flooding, landslides and mudslides	Unknown	PA program only available >$6.2, no IA.
Description: *Severe winter storm, including record and near record snowfall and heavy rains and winds. Incident period was December 29, 2020-January 16, 2021. (Declared April 2021.)*			
December 2021 Disaster 4650	Severe winter storm, straight-line winds, flooding, landslides and mudslides	Unknown	PA program only available, no IA.
Description: *Severe winter storm, including record and near record snowfall and heavy rains and winds. Incident period was December 26, 2021-January 15, 2022. (Declared March 2022.)*			

9.2.3 Severity

The most common problems associated with severe storms are immobility and loss of utilities. Roads become impassable due to flooding, downed trees, ice or snow, or a landslide, increasing the potential for injuries or death. Mason County has experienced one death associated with a severe weather event where a landslide struck a residence, killing the occupant; however, that fatality did not occur on the reservation, nor include a tribal member. Downed trees in the area do have the potential to impact ingress and egress to certain areas, and the Tribe does assist County and State personnel to help clear debris from the roadways as necessary after a weather event.

While the Tribe does have buried power lines on the Reservation, the lines are above-ground in the surrounding area. As such, power lines may be downed due to high winds in other areas of the county, impacting services such as water or phone which may not be able to operate without power. Lightning can cause severe damage and injury, although no such injuries have been reported within the tribal planning area. Physical damage to homes and facilities caused by wind do occur, although unless it is a significant windstorm, the impact is usually limited in nature. Only a few of the Tribal owned critical facilities have backup power generators. In addition, no residential structures in the area maintain generators, leaving the elderly and young citizens, and those citizens with disabilities more vulnerable to the impacts of power outages.

The strongest winds are generally from the south or southwest and occur during fall and winter, although severe windstorms are associated with summertime storms. In interior-facing valleys, wind velocities regularly reach 40 to 50 mph each winter, 75 to 90 mph a few times every, with some storms bringing winds in excess of 100 mph at least on an annual basis. The highest summer and lowest winter temperatures generally occur during periods of easterly winds.

Due to the limited amount of snow customarily received in the region, even a small accumulation of ice or snow on the roadways can, and has, caused havoc on transportation systems due to terrain, the level of experience of drivers to maneuver in snow and ice conditions. Snow melts in the mountains during

spring and summer months can cause flooding on the rivers in the planning area. Such events occur (almost) annually, and while more of a nuisance than a declared event, it does impact ingress and egress in areas of the reservation.

Severe weather events can impact routine services throughout the planning area on which Tribal members rely. Businesses could be forced to close for an extended period, impacting the availability of commodities. As a result of the heavily forested areas, debris accumulations would be high, causing additional difficulties with access along major arterials, further impacting logistical support and commodities. The Tribe currently does not have its own refuse company but relies on contracted services with LeMay. The Tribe also has limited capability with respect to tree (or general debris) removal equipment and has identified this as a strategy in this plan to ensure a greater capacity for management of such events. The Tribe has also identified a Debris Management Plan as a planning effort strategy, potentially to occur during the life cycle of this plan.

The extent (severity or magnitude) of extreme cold temperatures is generally measured through the wind chill temperature index. Wind Chill Temperature is the temperature that people and animals feel when outside and it is based on the rate of heat loss from exposed skin by the effects of wind and cold. As the wind increases, the body is cooled at a faster rate causing the skin's temperature to drop (NWS, 2009).

In 2001, the NWS implemented a new wind chill temperature index designed to more accurately calculate how cold air feels on human skin. Figure 9-8 (above) illustrates the new wind chill temperature index.[28] The Index includes a frostbite indicator, showing points where temperature, wind speed and exposure time will produce frostbite to humans. The chart shows three shaded areas of frostbite danger. Each shaded area shows how long a person can be exposed before frostbite develops (NWS, 2009).

The extent of extreme temperatures is generally measured through the heat index (shown above). Created by the NWS, the Heat Index accurately measures apparent temperature of the air as it increases with the relative humidity. The Heat Index can be used to determine what effects the temperature and humidity can have on the population (NCDC, 2000).

9.2.4 Frequency

The severe weather events are often related to high winds and associated other winter storm-type events such as heavy rains and landslides, and occasionally snow. Severe storms (which include flooding) are the first-most declared event for the planning area in Mason County, and the second-most declared event for Grays Harbor. The SIT experiences some form of a severe storm annually, although in most cases, such events do not always rise to the level of a declared disaster. While snow events do occur, they customarily are not significant, nor last for extended periods of time. For declared-level events, this equates to one declared incident every 5.4 years, with a probability of occurrence per year of 18.46 percent. Severe storms or weather events are the hazard which has impacted the SIT most frequently since 1953, followed by Flood events. FEMA ranks Severe Storms as the hazard of highest priority in Mason County.

The National Weather Service reports that Washington state averages 2.5 tornadoes per year, which ranks in the bottom ten states. However, the planning area has had a tornado as recently as 2019,

[28] NWS, 2008

although there was no impact to the Tribe. Washington State Department of Ecology has estimated frequency intervals for wind speed as follows:

WIND SPEEDS EXCEED	FREQUENCY
55 MPH	Annually
76 MPH	~ 5 years
83 MPH	~10 years
92 MPH	~25 years
100 MPH	~50 years
108 MPH	~100 years

9.3 VULNERABILITY ASSESSMENT

9.3.1 Overview

Severe weather incidents can and regularly do occur throughout the entire planning area. Similar events impact areas within the planning region differently, even though they are part of the same system. While in some instances some type of advanced warning is possible, as a result of climatic differences, topographic and relative distance to the coastline, the same system can be much more severe in certain areas than others. Therefore, preparedness plays a significant contributor in the resilience of the citizens to withstand such events.

Warning Time

Meteorologists can often predict the likelihood of some severe storms. In some cases, this can give several days of warning time. However, meteorologists cannot predict the exact time of onset or severity of the storm, and the rapid changes which can also occur significantly increasing the impact of a weather event.

9.3.2 Impact on Life, Health, and Safety

The entire planning area is susceptible to severe weather events. Both populations in higher elevations or those along the coastline with no wind buffers are more susceptible to wind damage and black-out conditions, particularly in areas with large tree stands, or with above ground power lines. Populations in low-lying areas are customarily more at risk for possible flooding and landslides associated with the flooding as a result of heavy rains. Increased levels of precipitation in the form of snow also vary by area, with higher elevations being more susceptible to increased accumulations. During snow events, the Tribe becomes impacted due to school closures and employees who are unable to come to work due to the accumulation of snow on roadways, particularly in those areas with hills or steeper terrain. Resultant secondary impacts from power outages during cold weather events, when combined with the high population of elderly residents significantly impacts response capabilities and the risk factor associated

with such weather incidents. Within the densely wooded areas, increased fire danger during extreme heat conditions increases the likelihood of fire, which increases risk to human life.

Particularly vulnerable populations are the elderly and very young, low income, linguistically isolated populations, people with life-threatening illnesses, and residents living in areas that are isolated from major roads. According to Census data (2020), the median age distribution on the Reservation is 26 years. Based on Census data, approximately 42 residents are over 65, with 58 children 5 years of age or under. There are 33 children aged 5-9 years. Extreme temperature variations, either heat or cold, are of significant concern for both the elderly and the young, increasing vulnerability of those populations. Likewise, falling trees and debris could cause injury or death to citizens and visitors to the reservation.

The National Severe Storms Laboratory states that of injuries related to ice and snow:[29]

- About 70% occur in automobiles.
- About 25% are people caught out in the storm.
- Majority are males over 40 years old.

- Of injuries related to exposure to cold:
  - 50% are people over 60 years old.
  - Over 75% are males.
  - About 20% occur in the home.

Due to the somewhat limited roadways for ingress and egress via primary transportation routes, even minor incidents have the potential to impact the ability to travel throughout the area. Such issues are of concern as a result of the potentially limited access for evacuation purposes by first responder if vital Advanced Life Support is required, as well as for general evacuation purposes during a period where power is out, and individuals attempt to leave the area. The Tribe does have a very robust tourism industry, particularly with the Salish Golf Course and the Little Creek Casino Resort. It is estimated that over 4,000 people visit those establishments daily. Those numbers significantly impact the potential number of people at risk.

In addition, portions of the planning area are dependent on well water, which must be pumped and a wastewater system which also utilize pumps. During power outages, many residents may lack drinking water or sewer services. When combined with flooding, which commonly occurs during a severe weather event, the likelihood of such ramifications increases.

9.3.3 Impact on Property

Loss estimations for severe weather hazards are not based on modeling utilizing damage functions, as no such functions have been generated. For planning purposes, all properties and buildings within the planning area are considered to be exposed to the severe weather hazard, but structures in poor condition or in particularly vulnerable locations (exposed open areas, low-lying coastal areas, or areas along hilltops or bluffs) may be at risk for the most damage.

[29] http://www.nssl.noaa.gov/education/svrwx101/winter/

The SIT, like most of western Washington, is vulnerable to high winds because of the climatic conditions and prevalence of 100 ft to 150 ft tall conifer trees. High winds weaken standing trees and structures weighted with snow or ice. Western Hemlock trees have shallow root systems with top heavy crowns and occur naturally on the reservation. They are also the predominant species used for reforestation after timber harvest. Western hemlock are particularly vulnerable to falling when soils are saturated from heavy rainfall. Sustained high winds and gusts cause tress to sway significantly; repetitive swaying can weaken a tree's roothold in the saturated soils and force it to topple.

The frequency and degree of damage will depend on specific locations and severity of the weather pattern impacting the region. It is improbable to determine the exact number of structures susceptible to a weather event, and therefore emergency managers and public officials should establish a maximum threshold, or worst-case scenario, of susceptible structures.

9.3.4 Impact on Critical Facilities and Infrastructure

It should be assumed that all critical facilities are vulnerable to some degree, with older structures built pre-code being more susceptible to impact from a severe weather event. As many of the severe weather events include multiple hazards, information such as that identifying facilities exposed to flooding (see Flood profile) are also likely exposed to severe weather. Additionally, facilities on higher ground may also be exposed to wind damage or damage from falling trees. The most common problems associated with severe weather are loss of utilities. Downed power lines can cause blackouts, leaving large areas isolated. Historically the outages have not lasted extremely long, but there have been events where power has been out for several days.

In addition, power, phone, internet, water, and sewer systems may also not function properly during severe weather events. Cell towers may be damaged; landlines may be impacted via flood or landslide event. Power outages may impact wells and sewer systems; areas of the planning area do operate on wells and septic or wastewater systems. The Tribe maintains two water storage towers and a water filtration system which distributes water to the existing portions of the Reservation. The existing water and wastewater systems on the Reservation could be impacted by severe weather events through inundation from ground water seepage, as well as through power outages impacting lift stations or pumphouses. A power outage may impact the Tribe's ability to provide services on the existing Reservation, but as part of the future development, the Tribe anticipates installing generators to ensure more consistency as new structures and services come on line.

Roads may become impassable due to ice or snow or from secondary hazards such as landslides which occur off the Reservation, such as has previously occurred on several instances. The planning area as a whole experiences major road closures very frequently, which would impact the SIT. Incapacity and loss of roads are the primary transportation failures, most of which are associated with secondary hazards. Landslides that block roads are caused by heavy prolonged rains. High winds can cause significant damage to trees and power lines, with obstructing debris blocking roads, incapacitating transportation, isolating population, and disrupting ingress and egress. Snowstorms can impact the transportation system, impacting not only commodity flow, but also the availability of public safety services into impacted areas.

Of particular concern are roads providing access to isolated areas and to the elderly, or areas where there is only one primary access route.

Severe windstorms, downed trees, and ice can create serious impacts on power and above-ground communication lines, whether on the reservation or outside due to transmission service impact. Freezing of power and communication lines can cause them to break, disrupting both electricity and communications not only for households, but also public safety dispatching. Loss of electricity and phone connection would result in isolation because some residents will be unable to call for assistance, with cell phone operability weak in certain areas of the planning area.

9.3.5 Impact on Economy

All severe weather events have the potential to impact the functional operations of government, as well as maintaining continuity of government. The SIT and tribal members own businesses reliant on tourists. Employees that currently live off the reservation have, on several occasions, not been able to report for duty at the Reservation due to impassable roadways. Prolonged obstruction of major routes due to severe weather can not only disrupt employees' ability to get to work, but also the shipment of goods and other commerce, both on and off the reservation. For the SIT, the fishing/shellfish industry is significant, and delays in shipments could be costly. Likewise, the Little Creek Casino Resort is also an economic hub for the entire planning region, providing an economic value via jobs (direct, induced, and indirect), local employees' personal income, and in the re-spending and local consumption in the area, including taxes on goods and services. With an average daily visitor count to the Casino/Resort at over 4,000 per day, impact would be significant. There is also the potential economic loss should a scheduled event at the Event Center be impacted, which can accommodate an additional 1,800 individuals.

9.3.6 Impact on Environment

The environment is highly exposed to severe weather events. Natural habitats such as streams and trees are exposed to the elements during a severe storm and risk major damage and destruction. Prolonged rains can saturate soils and lead to slope failure. Flooding events caused by severe weather or snowmelt can produce river channel migration or damage riparian habitat, also impacting spawning grounds and fish populations for many years. The Tribe does maintain an active fish hatchery via the Coho net pen, which could also be potentially impacted by various severe weather events. Storm surges can erode riverbanks and redistribute sediment loads. Extreme heat can raise temperatures of rivers, impacting oxygen levels in the water, threatening aquatic life.

9.3.7 Impact from Climate Change

Climate change presents a challenge for risk management associated with severe weather. The frequency of severe weather events has increased steadily over the last century. The number of weather-related disasters during the 1990s was four times that of the 1950s, and cost 14 times as much in economic losses. Historical data shows that the probability for severe weather events increases in a warmer climate.

The last several years (with particular attention to 2021 and statewide records) have seen record temperatures, with meteorologists predicting continued increase. This increase in average surface

temperatures can also lead to more intense heat waves that can be exacerbated in urbanized areas by what is known as urban heat island effect. Additionally, the changing hydrograph caused by climate change could have a significant impact on the intensity, duration, and frequency of storm events. All of these impacts could have significant economic consequences.

With the increase in average ambient temperatures, since the 1980s, unusually cold temperatures have become less common in the contiguous 48 states. This trend is expected to continue, and the frequency of winter cold spells will likely decrease. As ambient temperatures increase, more water evaporates from land and water sources. The timing, frequency, duration, and type of precipitation events will be affected by these changes. In general, more precipitation will fall as rain rather than snow. Climate change is also expected to increase sea levels. When coupled with strong storm surges encroaching inland as a result of the sea level rise, greater areas impacted will further reduce natural habitats, as well as land mass for expansion.

9.4 FUTURE DEVELOPMENT TRENDS

All future development will be affected by severe storms. The ability to withstand impacts lies in sound land use practices and consistent enforcement of codes and regulations for new construction. The Tribe does have land use regulations in place and does adhere to strict implementation of the International Building Codes as well as additional land use authority as established within the various jurisdictions in which non-trust properties are situated. These codes are equipped to deal with the impacts of severe weather incidents by identifying construction standards which address wind speed, roof load capacity, elevation, and setback restrictions, among others.

While under the Growth Management Act, public power utilities are required by law to supply safe, cost effective and equitable service to everyone in the service area requesting service, most lines in the area are above-ground until they actual cross onto reservation boundaries, causing them to be more susceptible to high winds or other severe weather hazards. However, growth management is also a constraint, which could possibly lead to increased outages or even potential shortages, as while most new developments expect access to electricity, they do not want to be in close proximity to substations. The political difficulty in sighting these substations makes it difficult for the utility to keep up with regional growth. The Tribe does not generate its own power, although some facilities do have generators for emergency use. As such, the Tribe must rely on public infrastructure to provide this to them.

Land use policies currently in place, when coupled with informative risk data such as that established within this mitigation plan will also address the severe weather hazard. In addition to the local land use authority, the SIT must also address Federal land use requirements for any projects funded with federal dollars. That, when coupled with the land use tools currently in place, the SIT will be well-equipped to deal with future growth and the associated impacts of severe weather.

Since completion of the last plan, the Tribe has conducted mitigation activities that have reduced the Impact of the severe weather hazard, particularly when wind and flooding is a component of the severe weather event. Newly completed structures are outside of the flood zone and built to meet both current seismic and wind standards.

9.5 ISSUES

Important issues associated with a severe weather event in the planning area include the following:

- Older building stock in the planning area are built to low code standards or none at all. These structures could be highly vulnerable to severe weather events such as windstorms. While some structures owned by the SIT are newer (post-1975), and built to higher code standards, tribal citizens living throughout the planning area could be impacted as a result of the lower building code standards in their residential structures.
- Redundancy of power supply must be evaluated and increased planning-region wide in order to understand the vulnerabilities more fully in this area. As the local PUDs replace power lines, consideration should be given to placing the lines underground to make them less vulnerable.
- The capacity for backup power generation should be enhanced, especially in areas of potential isolation due to impact on major thoroughfares or evacuation routes, or structures which ensure continuity of government.
- Isolated population centers could exist if roadways are impacted.
- Climate change will increase the frequency and magnitude of winter flooding or storm surges, thus exacerbating severe winter events.

9.6 IMPACT AND RESULTS

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from a severe weather event throughout the area is highly likely, but the impact is more limited when removing resulting flood events from the severe weather category.

The entire area experiences some severe storm or weather event annually. FEMA has identified Severe Storm/Weather as the number one hazard impacting the area. When severe weather events occur, the storms do have the ability to impact the area, posing a danger to life and property, as well as causing economic losses to both the SIT and its tribal members. While snow and ice do occur, impact and duration are somewhat limited, reducing life safety dangers as advanced warning many times allow residents to take precautionary measures (extra food, not driving, etc.).

Wind is a very significant factor, which can cause power outages, as well as impacting transportation for both citizens and goods/supply chain. While the local PUD/utilities maintain excellent records for low incidents of long-term power outages, the possibility does exist. The clearing of roadways and debris management is also an issue of concern, with limited capabilities to administer debris management beyond a limited scale. Historically, severe weather events that occur are of a relatively short duration, with more localized impacts, and thankfully, power outages have not been for extended periods of time, but shorter in duration and is something to which Tribal Members have become accustomed to deal with when it occurs. However, it does impact the ability to carry out normal functions, including governmental operations. There are also health-related issues if power outages last beyond a day. While the Tribe does not experience extremely cold or hot temperatures with any great frequency, it does occur. There are some portable generators, and fixed generators in enough buildings that could be utilized for cooling or

heating facilities. There is also concern of a power outage impacting the fish/shellfish industries, as well as the Casino Resort and Event facilities. Based on the potential impact, the Planning Team determined the CPRI score to be 3.50, with overall vulnerability determined to be a high level.

CHAPTER 10.
WILDFIRE HAZARD
COMMUNITY WILDFIRE PROTECTION PLAN

A wildfire is any uncontrolled burning occurring on undeveloped land that requires fire suppression. A wildland fire's main fuel source is natural vegetation. Often referred to as forest or rangeland fires, these fires occur in national forests and parks, private timberland, and on public and private rangeland. A wildland fire can become an interface fire if it encroaches on developed areas.

Wildfires can be ignited by lightning or by human activity such as smoking, campfires, equipment use, and arson. The wildfire season in Washington usually begins in April, picks up in early July, and generally ends in late September; however, wildfires have occurred every month of the year. Drought, snowpack, and local weather conditions can expand the length of the fire season.

People start most wildfires; major causes include arson, recreational fires that get out of control, smoker carelessness, debris burning, and children playing with fire. Wildfires started by lightning burn more state-protected acreage than any other cause. Fires during the early and late shoulders of the fire season usually are associated with human-caused fires; fires during the peak period of July, August and September often are related to thunderstorms and lightning strikes.

DEFINITIONS

Conflagration—A fire that 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—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 into one. The involved area becomes so hot that all combustible materials ignite, even if they are not exposed to direct flame. Temperatures may exceed 1000°C. Superheated air and hot gases of combustion rise over the fire zone, drawing surface winds in from all sides, often at velocities approaching 50 miles per hour. Within the area of the fire, lethal concentrations of carbon monoxide are present; combined with the intense heat, this poses a serious life threat to responding fire forces. In very 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 wildfires and where wildland vegetation and urban or suburban development occur together.

Wildfire—Fires that result in uncontrolled destruction of forests, brush, field crops, grasslands, and real and personal property in non-urban areas. Due to their distance from firefighting resources, they can be difficult to contain and can cause a great deal of destruction.

10.1 COMMUNITY WILDFIRE PROTECTION PLAN

10.1.1 Purpose

In response to several significant fires occurring throughout the United States from 1995 to 2000, in 2009, Congress passed the Federal Land Assistance, Management, and Enhancement Act (FLAME Act), which directed the U.S. Department of Agriculture (USDA) and the Department of Interior (DOI) to develop a national cohesive wildland fire management strategy.

In furtherance of that strategy, in a 2012 USFS Technical Report NRS-89, it was recommended that a Community Wildfire Protection Plan (CWPP) should fit into the larger picture of planning for natural disasters as a best practice. As such, it was recommended that a CWPP should be incorporated within the Natural Hazards Mitigation Plan.

Benefits illustrated in the report include the use of "a variety of data already collected" for the HMP process, making it "easier to link the CWPP to other planning efforts."[30] With this in mind, this Wildfire Chapter contained in the Squaxin Island Tribe's 2024 Hazard Mitigation Plan is intended to serve as the Squaxin Island Tribe's Community Wildfire Protection Plan, covering all lands owned and managed by the SIT.

In short, a CWPP identifies communities at risk, prioritizes fuel treatments, and recommends ways to reduce structural ignitability by developing risk-reducing strategies at the Tribal level based on capabilities.

10.1.2 History

Community Wildfire Protection Plans have been in place since shortly after the Healthy Forests Restoration Act (HFRA) was signed into law in 2009. HFRA legislation included incentives for the United States Forest Service (USFS) and the Bureau of Land Management (BLM) to give consideration to local community priorities when developing forest management and hazardous fuels reduction projects.

The National Cohesive Wildland Fire Management Strategy is a collaborative process to seek national, all-lands solutions to wildland fire management issues.[31] The Cohesive Strategy focuses on three key areas:

1. Restore and Maintain Landscapes,
2. Fire Adapted Communities; and
3. Response to Fire.

The Cohesive Strategy has a long list of goals and performance measures establishing a common understanding among all entities interacting in the wildland-urban interface. The Cohesive Strategy required that all wildland fire protection entities assist in the development and implementation of Community Wildfire Protection Plans and comparable land resource management plans to create fire-adaptive communities.

In 2023, the Wildland Fire Leadership Council presented an Addendum to the strategy to identify critical emphasis areas and challenges which were not previously identified or addressed in the 2014 National Cohesive Wildland Fire Management Strategy framework to now include:[32]

1. Climate change
2. Workforce capacity, health, and well-being
3. Community resilience (preparation, response and recovery)
4. Diversity, equity, inclusion, and environmental justice.

[30] USFS. (2012). Accessed 5 January 2024. Available on-line at: Best management practices for creating a community wildfire protection plan (usda.gov)

[31] U.S. Forest Service. Accessed 5 January 2024. Available online at: The National Cohesive Wildland Fire Management Strategy and Risk Analysis – Phase III Report (forestsandrangelands.gov)

[32] U.S. Forest Service. Accessed 5 January 2024. National Cohesive Wildland Fire Management Strategy Addendum Update (forestsandrangelands.gov) (2023 Update)

Community Wildfire Protection Plans (CWPPs) are the primary tool that communities use to prioritize wildfire risk reduction and resilience. They can bring together multiple sources of information, activities, and interests into one document, while focusing the reduction activities at the local, community level.

What are the benefits of developing a CWPP?

- Reducing the direct and indirect social, economic, and environmental costs of wildfire
- Coordinating wildfire risk reduction with other community values & priorities
- Bringing together diverse interests to tackle local wildfire challenges and opportunities
- Identifying potential resources and funding for mitigation activities
- Increasing community awareness and engagement in risk reduction

There are three minimum requirements for a CWPP according to HFRA:

1. Show collaboration between tribal, local, and state agencies, in consultation with federal agencies and other interested parties;
2. Identify and prioritize fuel treatments to reduce hazardous fuel areas; and
3. Recommend strategies to reduce the ignitibility of structures.

CWPPs are not legally binding documents; however, given changing climate conditions and national budgets, they can be an effective local tool to help communities plan for unknowns with respect to wildfire, while increasing wildfire resilience through established mitigation strategies that provide long-term benefits.

10.1.3 Scope

The planning area boundary was established to include all of the properties owned by the SIT distributed through the wide-spread areas of the wildland-urban interface within Mason County, as the pre-defined tribal planning area boundaries in the Natural Hazard Mitigation Plan to which this document is a component.

Similar to the HMP development process, a CWPP also utilizes a collaborative process involving various organizations and agencies described in Chapter 2 of this document. The planning process included five steps:

1. Collection of Data about the extent and periodicity of hazards
2. Observations and Estimations about risks, structures and infrastructure to risk areas, access, and potential treatments.
3. Mapping or identification of data relevant to pre-disaster mitigation control and treatments, structures, resource values, infrastructure, risk assessments, and related data.
4. Facilitation of Public Involvement utilizing a public survey, news release, public meeting, public review of draft documents, and acknowledgement of the final plan by the signatory representatives.
5. Final Drafting of the report compiling the first four steps into one final document.

10.2 GENERAL BACKGROUND

Wildland-Urban Interface Areas

The wildland urban-interface (WUI) is the area where development meets wildland areas. This can mean structures built in or near natural forests, or areas next to active timber and rangelands. The federal definition of a WUI community is an area where development densities are at least three residential, business, or public building structures per acre. For less developed areas, the wildland-intermix community has development densities of at least one structure per 40 acres.

In 2001, Congress mandated the establishment of a Federal Register which identifies all urban wildland interface communities within the vicinity of Federal lands, including Indian trust and restricted lands that are at high-risk from wildfire. The list includes information provided from States and Tribes and is intended to identify those communities considered at risk.

Review of the Federal Registry lists in excess of 10 communities within Mason County at high-risk within the vicinity of Federal lands, including Shelton, which is the largest city in proximity to the SIT, and in the area in which reservation lands are situated.[33] The SIT reservation itself is not identified in the Federal Registry.

Review of Washington State Department of Natural Resource's data concerning Wildland Urban Interface areas, the area in and around the Squaxin Reservation and tribal lands do have areas that fall within the Wildfire Urban Interface zones (see Figure 10-1).[34]

When identifying areas of fire concern, in addition to the Federal Register, the Washington Department of Natural Resources and its federal partners, the U.S. Forest Service, also determine communities at risk based on fire behavior potential, fire protection capability, and risk to social, cultural and community resources. These risk factors include areas with fire history, the type and density of vegetative fuels, extreme weather conditions, topography, number and density of structures and their distance from fuels, location of municipal watersheds, and likely loss of housing or business.

Based on these criteria, FEMA's National Risk Index identifies the wildfire risk for the Squaxin Island Tribe as being very low.[35] Review of the U.S. Forest Service analysis identified in Figure 10-2 indicates a wildfire hazard class of low and very low.

While such determination is made, wildfires can occur whenever the right conditions exist. Within Mason County, there has been an increased number of large wildfires occurring annually for the last several years. This, when combined with climate change and the demonstrated increase in higher-than-normal temperatures during summer months has increased fire danger.

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[33] https://www.federalregister.gov/documents/2001/01/04/01-52/urban-wildland-interface-communities-within-the-vicinity-of-federal-lands-that-are-at-high-risk-from

[34] Washington State Department of Natural Resources Wildland Urban Interface. Accessed 21 November 2023. Available online at: WA State's Wildland Urban Interface (WUI) (arcgis.com)

[35] FEMA National Risk Index. Accessed 4 Jan 2024. Available online at: Map | National Risk Index (fema.gov)

The Tribe's current fire protection services are provided through a service contract with South Mason Fire (FD#4). There is one fire station on the Reservation, but is unmanned due to low staffing, and the lack of adequate living quarters at the station. At present, low staffing at Fire District #4 allows only two calls for service at the same time, unless a larger fire exists elsewhere which requires all personnel.

The Tribe has significant concern over the wildfire danger as it exists and is utilizing this opportunity to identify mitigation strategies which have the potential to reduce that risk. This may, potentially include not only fuel reduction strategies, but also exploring the potential to erect a fire station on Tribal lands, thereby increasing their capabilities where currently a gap exists.

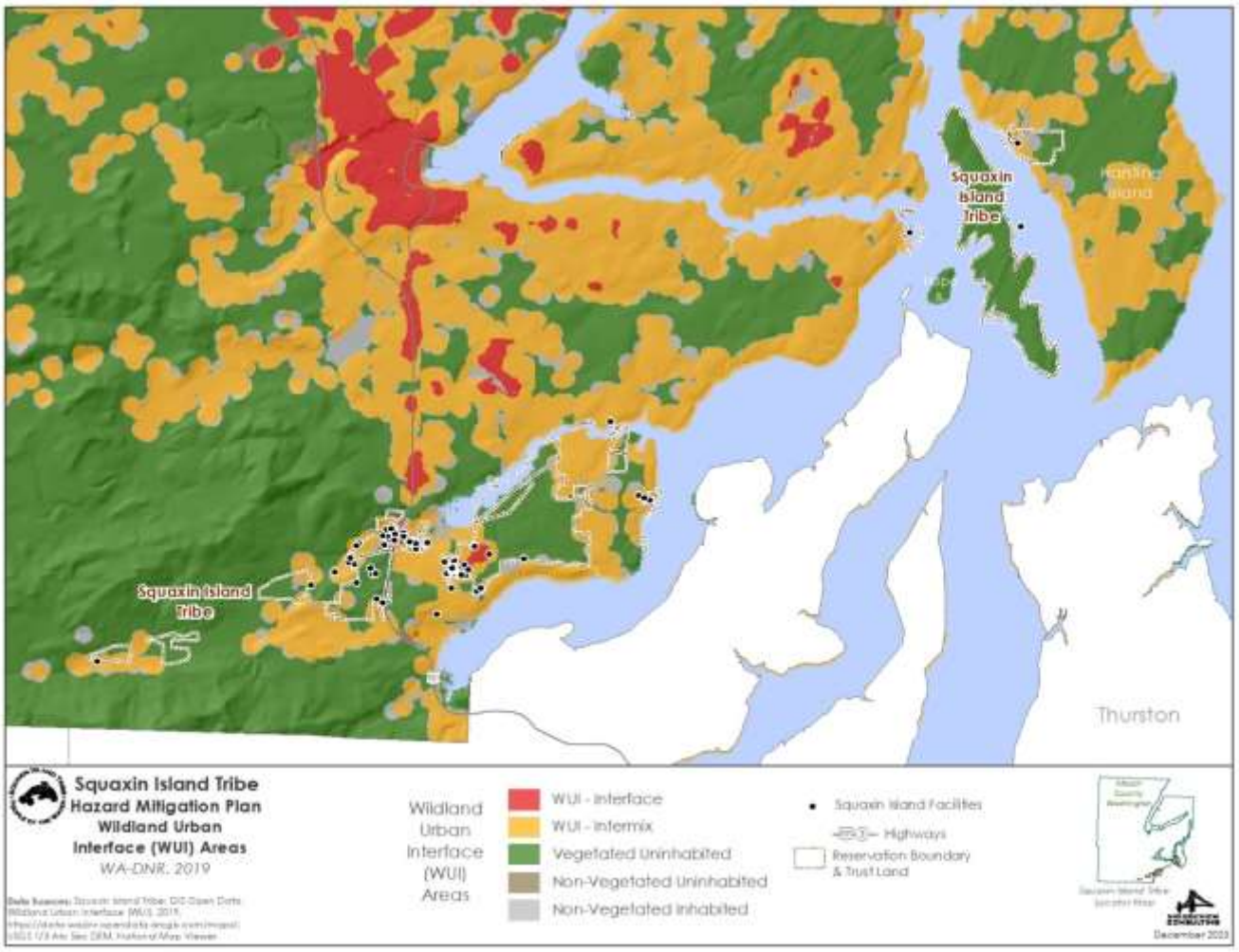

Figure 10-1 WUI Area (WA DNR, 2019)

Figure 10-2 Wildfire Hazard Potential

10.2.2 Identifying Wildfire Risk

Risk to communities is generally determined by the number, size and types of wildfires that have historically affected an area; topography; fuel and weather; suppression capability of local and regional resources; where and what types of structures are in the WUI; and what types of pre-fire mitigation activities have been completed. Identifying areas most at risk to fire or predicting the course a fire will take requires precise science. The following data sets are most useful in assessing risk in the area:

- **Topography (slope and aspect) and Vegetation (fire fuels)**—These are two of the most important factors driving wildfire behavior.

- **Weather**—Regional and microclimate variations can strongly influence wildfire behavior. Because of unique geographic features, weather can vary from one neighborhood to another, leading to very different wildfire behavior.

- **Critical Facilities/Asset Location**—A spatial inventory of assets—including homes, roads, fire stations, and natural and cultural resources that need protection—in relation to wildfire hazard helps prioritize protection and mitigation efforts.

10.3 WILDFIRE BEHAVIOR

The wildfire triangle (see Figure 10-3; DeSisto et al., 2009) is a simple graphic used in wildland firefighter training courses to illustrate how the environment affects fire behavior. Each point of the triangle represents one of three main factors that drive wildfire behavior: weather, vegetation type (which firefighters refer to as "fuels"), and topography. The sides represent the interplay between the factors. For example, drier and warmer weather combined with dense fuel loads (e.g., logging slash) and steeper slopes will cause more hazardous fire behavior than light fuels (e.g., short grass fields) on flat ground.

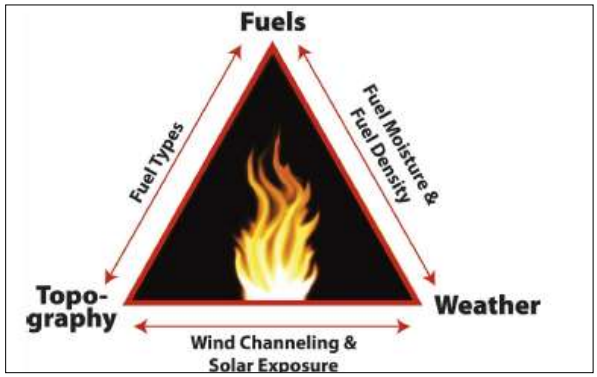

Figure 10-3 Wildfire Behavior Triangle

The following are key factors affecting wildfire behavior:

- **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 but less prolific west of the Cascades than east of the Cascades.

- **Weather**— Relevant weather conditions include temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount and duration, and the stability of the atmosphere. Of particular importance for wildfire activity are wind and thunderstorms:

  - Strong, dry winds produce extreme fire conditions. Such winds generally reach peak velocities during the night and early morning hours. East wind events can persist up to 48 hours, with wind speed reaching 60 miles per hour. Being a coastal community, the County experiences significant winds on a fairly regular basis during all times of the year.

  - The thunderstorm season typically begins in June with wet storms and turns dry with little or no precipitation reaching the ground as the season progresses into July and August.

- **Topography—**Topography includes slope, elevation and aspect. The topography of a region influences the amount and moisture of fuel; the impact of weather conditions such as temperature and wind; potential barriers to fire spread, such as highways and lakes; and elevation and slope of land forms (fire spreads more easily uphill than downhill).

- **Time of Day**—A fire's peak burning period generally is between 1 p.m. and 6 p.m.

- **Forest Practices—**In densely forested areas, stands of mixed conifer and hardwood stands that have experienced thinning or clear-cut provide an opportunity for rapidly spreading, high-intensity fires that are sustained until a break in fuel is encountered.

Fires can be categorized by their fuel types as follows:

- **Smoldering**—Involves the slow combustion of surface fuels without generating flame, spreading slowly and steadily. Smoldering fires can linger for days or weeks after flaring has ceased, resulting in potential large quantities of fuel consumed. They heat the duff and mineral layers, affecting the roots, seeds, and plant stems in the ground. These are most common in peat bogs, but are not exclusive to that vegetation.

- **Crawling**—Surface fires that consume low-lying grass, forest litter and debris.

- **Ladder**—Fires that consume material between low-level vegetation or forest floor debris and tree canopies, such as small trees, low branches, vines, and invasive plants.

- **Crown**—Fires that consume low-level surface fuels, transition to ladder fuels, and also consume suspended materials at the canopy level. These fires can spread rapidly through the top of a forest canopy, burning entire trees, and can be extremely dangerous (sometimes referred to as a "Firestorm").

Wildfires may spread by jumping or spotting, as burning materials are carried by wind or firestorm conditions. Burning materials can also jump over roadways, rivers, or even firebreaks and start distant fires. Updraft caused by large wildfire events draws air from surrounding area, and these self-generated winds can also lead to the phenomenon known as a firestorm.

10.4 WILDFIRE IMPACT

Short-term loss caused by a wildfire can include the destruction of timber, wildlife habitat, scenic vistas, and watersheds. Long-term effects include smaller timber harvests, reduced access to affected recreational areas, and destruction of cultural and economic resources and community infrastructure. Vulnerability to flooding increases due to the destruction of watersheds. The potential for significant damage to life and property exists in WUI areas, where development is adjacent to densely vegetated areas (DeSisto et al., 2009).

Forestlands in the planning area are susceptible to disturbances such as logging slash accumulation, forest debris due to weather damage, and periods of drought and high temperature. Forest debris from western red cedar, western hemlock, and Sitka spruce can be especially problematic and at risk to wildfires when

slash is accumulated on the forest floor, because such debris resists deterioration. When ignited, these fuels can be explosive and serve as ladder fuels carrying fire from the surface to the canopy.

10.4.1 Secondary Effects

Wildfires 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 and indirect economic losses in reduced tourism. Wildfires cause the contamination of reservoirs, destroy transmission lines and, as indicated, contribute to flooding. They strip slopes of vegetation, exposing them to greater amounts of runoff. This in turn can weaken soils and cause failures on slopes. Major landslides can occur several years after a wildfire. Most wildfires burn hot and for long durations that can bake soils, especially those high in clay content, thus increasing the imperviousness of the ground. This increases the runoff generated by storm events, thereby increasing the chance of flooding.

10.5 HAZARD PROFILE

10.5.1 Extent and Location

The SIT has never received a direct disaster declaration from FEMA as a result of a wildfire. Mason County has received one wildfire disaster declaration for a fire event – the McEwan Fire (FM-5468-WA), which occurred July 2023 near Shelton. As a result of the McEwan Fire, there were a number of tribal members which were displaced, but did not sustain loss of property. Given its rural land use complexity and its proximity to the various large park systems (both federal and state), the entire region is susceptible to impact from wildfire, either as a direct result, or as a secondary result from health or economic impact.

10.5.2 Previous Occurrences

Wildfires have been a common occurrence throughout Washington as a whole for thousands of years. Evidence from tree rings or fire-scarred trees indicates cycles of prehistoric fires burned in many locations in both Eastern and Western Washington. Natural fire occurrences are directly related, but not proportional, to lightning incidence levels. It is rare for a summer to pass without at least one period of lightning activity. Lightning incidence is greatest during July and August, though storms capable of igniting fires have occurred from early spring to mid-October. Lightning storms generally track across the planning area in a southwest to northeast direction. At a national level, lightning starts over 4,000 house fires each year, which can ignite wildland fires through ember ignition and as a result of proximity to wildland areas. Lightning-caused fires cause over 10 times more acreage damage than human-caused fires, requiring great resource allocation.

Within Washington, lightning storms are typically followed by light to moderate amounts of precipitation. The rainfall may extinguish the fires, while high fuel moisture inhibits spread. However, prolonged periods of warm, dry weather, especially in combination with east winds, often reveal numerous latent “sleepers.” While most lightning fires are less than a quarter acre in size, occasional large fires during dry periods

account for most of the burned acreage. Review of Washington State Department of Natural Resources (DNR) data, the primary ignition sources statewide for fires are human caused or lightning strikes.

Squaxin Island Tribe does not have the resources to establish their own fire department, but rather has entered into a service contract with South Mason Fire. As such, the Tribe has limited data on the history of wildfires occurring within the tribal planning area.

According to Mason County's Hazard Mitigation Plan (2022), during the time period 2009-2021, Mason County as a whole had 850 wildfires occurring throughout the County, burning a total of ~5,600 acres. Since completion of the County's HMP, the County sustained one additional disaster declaration for the McEwan Fire, which occurred in July 2023, and burned in excess of 250 acres near the town of Shelton. In addition, on May 13, 2023, a large brush fire was reported off Kamilche Point Road in Mason County Fire District 4. The Kamilche Point Fire burned 41 acres of slash and some heavy timber and required assistance from two DNR helicopters, which dropped water over the heavy timber while a dozer and hand crews worked to place a fire line around the fire edge.

When averaged, that equates to ~71 fires per year occurring in the county and surrounding area. That figure does not reflect the recurrence interval for fires, but rather an average calculation as to the number of wildland fires which have historically occurred within the planning area during the periods reflected. For the period 2017-2023, those numbers also reflect mutual aid response provided to surrounding areas and are indicative of the increase in fire response calls and the need for mutual aid.

Table 10-1 identifies some of the wildfires occurring within Mason County (or the surrounding areas) which have burned 5 acres or more. Table 10-2 identifies some additional fires by year, with 2021 being the last full year available as of this update. Additional historic events are identified in Table 10-3.

TABLE 10-1
MASON COUNTY HISTORIC FIRE EVENTS 5 ACRES OR GREATER

Date	Name	Acres Burned
7/7/2004	Island Shore Fire	10.4
4/25/2006	Razor Fire	5.6
7/24/06	Bear Gulch	1,050
8/29/2006	South Loop Fire	15
9/2/2006	Dewatto 2 Fire	61
9/7/2006	Pipeline 2 Fire	5
7/12/2007	Shelton Valley Rd. Fire	13
7/1/2007	Martin Road Fire	15

TABLE 10-1
MASON COUNTY HISTORIC FIRE EVENTS 5 ACRES OR GREATER

Date	Name	Acres Burned
9/7/2008	East Cushman	10
8/2/2009	Eels Hill Road	13.2
8/25/2009	Vance Creek	16.3
8/15/2010	Richert Road	84.4
8/17/2011	Eells Hill	51.20
9/11/2012	School	10.4
9/12/2012	Carney Lake	5
9/26/2012	Powerline	9.3
10/4/2012	Powerline 2	229
8/10/2014	Mill 5	21
8/11/2014	Haven Lake	185
9/6/2014	Boyer Road	11
11/16/2014	WC 131	37
6/22/2015	Kamilche	5
7/31/2015	Deckerville	107
8/27/2015	Sunnyside	58
5/27/2016	Lynch Pit	7.1
8/13/18	Maple Fire (USFS Fire)	3,300
9/21/22	High Steel Fire	26
5/13/23	Kamilche Point Road	41
7/4/23	McEwan Fire	>250

TABLE 10-2
TOTAL NUMBER WILDFIRE EVENTS 2009-2021

Year	Total Number of Wildland Fires	Total Acres Burned
2009	26	42.90
2010	17	91.31
2011	26	55.52
2012	42	262.94
2013	18	4.44
2014	33	261.77
2015	54	183.65
2016	53	25.8
2017*	40	15.51
2018*	76	170.09
2019*	150	207.8
2020*	161	484.24
2021*	154	199.98
Total	850	2,006

*Includes some incidents of fire response from the various Fire Districts within Mason County to areas outside of the county via mutual aid. 2021 was the last full year available as of this update.

TABLE 10-3
ADDITIONAL HISTORIC WILDFIRE INCIDENTS

8/1985	One of the largest fires in area history began with an illegal campfire caused the Beaver Fire just north of Staircase. Approximately 400 firefighters and 3 water-dumping helicopters fought the blaze. Smoke from the fire drifted at least 140 miles and over the Cascade Mountains creating a haze as far away as Wenatchee in Eastern Washington. Twenty backcountry hikers were evacuated from the Flapjacks Lakes area and another forty people in the area were taken out by park rangers supported by packhorses. The blaze charred over 1,000 acres and thousands of trees – some 200 to 300 years old – were destroyed. Only three minor injuries were reported among firefighters. The cost to fight the fire was over $500,000.

TABLE 10-3 ADDITIONAL HISTORIC WILDFIRE INCIDENTS	
9/1995	A blaze consumed 25 acres of logged land on Harstine Island and involved almost 150 firefighters and suppression support personnel costing $135,000 to fight. Cause of fire was from a hunter's cigarette. The following day 36 acres of reforested land burned at Morrow Lake, an area south of Lake Nahwatzel. East winds pushed flames in the opposite direction from homes along the shore. The cost of fighting the fire was $65,000. A total of 200 firefighters were involved in the two battles.
5/1997	The Lake Limerick fire, pushed by strong southwest winds, burned 594 acres, including 100 acres of wetlands, between Lake Limerick and Emerald Lake. The fire burned Christmas trees, slash, young replanted trees, wetland areas, and second growth Douglas fir trees. The cost of fighting the fire was approximately $94,000. Firefighters from districts in Mason, Kitsap and Pierce Counties assisted the effort along with 70 Cedar Creek Correctional Center inmates. ~112 people from DNR and Cedar Creek completed the firelines. At the same time a second blaze consumed about 8 acres off Eagle Point Road.
7/2006	A wildfire burned from July to December, blackening a total of 1,085 acres on steep terrain in the Bear Gulch area, threatening the Lake Cushman community. Cost of fighting the fire was approximately $1.8 million. US Forest Service Rd. was closed for about 1 year to prevent injuries from rock and debris slides. This road is the major access to the popular Staircase area and several summer homes located on the west side of Lake Cushman.
7/2023	The McEwan Fire started as a large brush fire burning near Shelton in Mason County, threatening hundreds of homes and power infrastructure. The fire resulted in residents in the area having to evacuate, with several shelters opening to support evacuees.

10.5.3 Severity

In 2021, Washington state recorded the hottest and driest year on record. In addition to the heat wave in June, which recorded triple-digit temperatures throughout Washington, state officials noted that the intense heat throughout July and August often made wildfires harder to manage. Officials anticipated that as the state is likely to encounter more of the extreme weather experienced in 2021, future wildfires would in turn be more frequent and more destructive. Despite severe heat and drought-like conditions, the 2021 wildfire season was in fact not as devastating with human and property loss as prior years.

Potential losses from wildfire include human life, structures and other improvements, and natural resources. Smoke and air pollution from wildfires can be a health hazard, especially for sensitive populations such as children, the elderly and those with respiratory and cardiovascular diseases. The Tribe has previously issued health warnings to members. Wildfire may also threaten the health and safety of those fighting the fires. Wildfire can lead to ancillary impacts such as landslides in steep ravine areas and flooding due to the impacts of silt in local watersheds. The destruction of forestlands can have a significant impact on salmon rearing for generations.

Extreme fires, when they occur, are characterized by more intense heat and preheating of surrounding fuels, stronger flame runs, potential tree crowning, increased likelihood of significant spot fires, and fire-

induced weather (e.g., strong winds, lightning cells). Extreme fire behavior is significantly more difficult to combat and suppress, and can drastically increase the threat to homes and communities. Several factors contribute to the severity of a fire, most of which are utilized when completing a Community Wildfire Protection Plan (CWPP), and developing a component-based hazard ranking.

Due to years of fire suppression, logging, and other human activities, the forests and rangelands have changed. Areas that historically experienced frequent, low-severity wildfires now burn with much greater intensity due to the build-up of understory brush and trees. At times, this equates to fires which are larger and more severe, killing the trees and vegetation at all levels. The combination of steep slopes, canyons, open rangeland, and fuel type have a history and potential for fast moving and fast spreading wildfires.

The planning area is vulnerable to wind-driven fires, whose embers could ignite grasses and weeds, and cause spot fires in more populated areas. Typical summer conditions could prove to be problematic due to a fire moving uphill from a structure fire on a lower slope, or from a wildland fire pushing upslope through the trees on a windy day, endangering multiple homes simultaneously in a very short period of time. Residents would have very short notice of an approaching fire.

Review of U.S. Forest Service data indicates that while the Reservation has a low probability of fires impacting its lands (U.S. Forest Service 2024), the populated areas have, on average, a 20 percent greater level of risk to homes than other tribal areas (and counties) in the state.[36]

Figure 10-4 Wildfire Risk to Homes

[36] U.S. Forest Service. (2022). Accessed 1 Jan 2024. Wildfire Risk to Communities.

Certain types of vegetations, or fuels respond differently in fire situations, with some more easily ignitable, and others which burn more quickly than others. Historically, grasses burn more quickly, and spread fires to shrubs and timber. The existing LANDFIRE Vegetation Type is identified in Figure 10-5. This represents a simple categorization of the associated vegetation types. The variation of vegetation types directly influences fire.

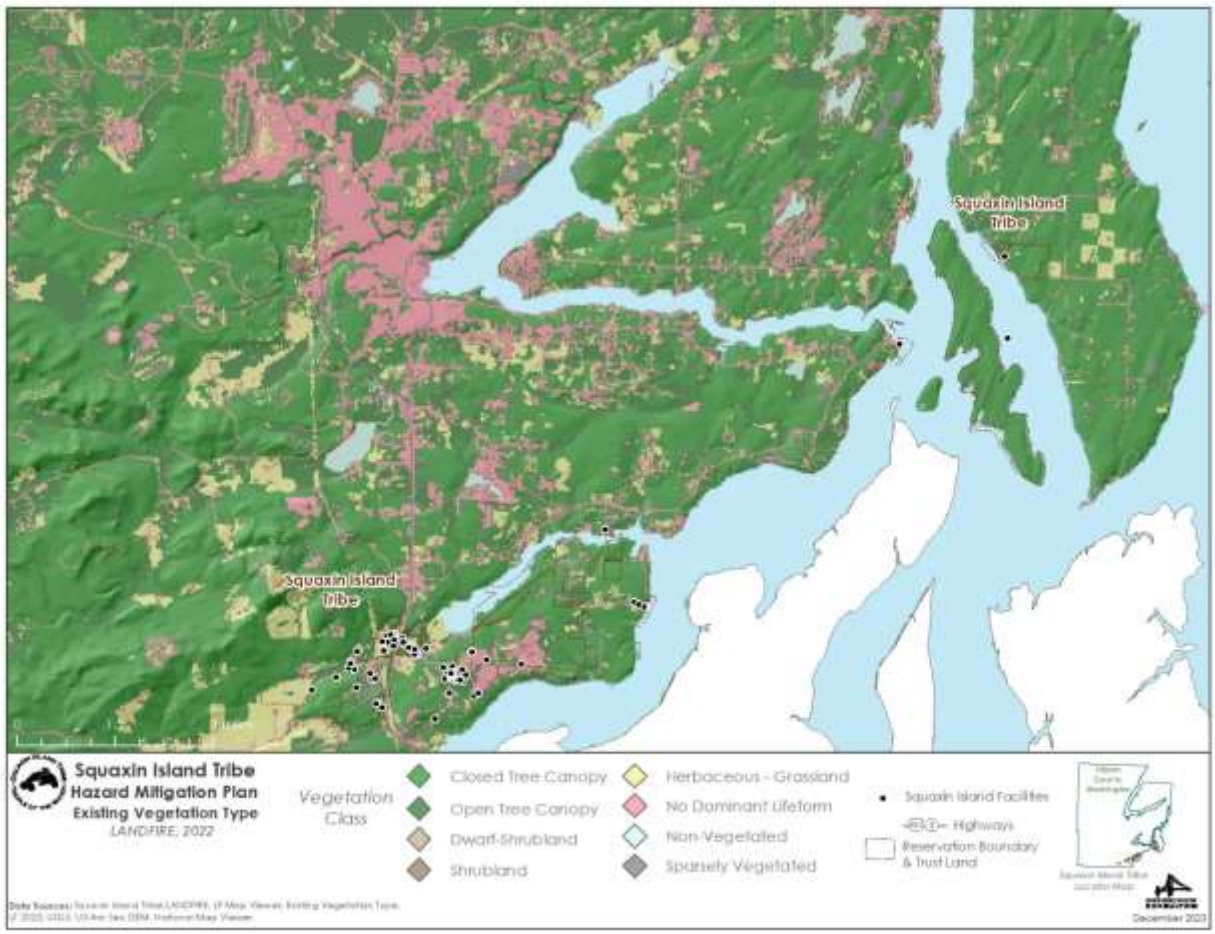

Figure 10-5 Vegetation Type

10.5.4 Frequency

As previously indicated, none of Washington State's most significant wildfires have occurred in Mason County, although smaller fires have occurred in the region annually. Fires historically burn on a regular cycle, recycling carbon and nutrients stored in the ecosystem, and strongly affecting species within the ecosystem. The burning cycle in western Washington is approximately every 100 to 150 years.

Historically, drought patterns are related to large-scale climate patterns in the Pacific and Atlantic oceans. The El Niño–Southern Oscillation varies on a 5- to 7-year cycle, the Pacific Decadal Oscillation varies on a 20- to 30-year cycle, and the Atlantic Multidecadal Oscillation varies on a 65- to 80-year cycle. As these

large-scale ocean climate patterns vary in relation to each other, drought conditions in the U.S. shift from region to region. El Niño years bring drier conditions to the Pacific Northwest and more fires.

Historic Fire Regime and Mean Fire Return Intervals

Many ecosystems are adapted to historical patterns of fire. These patterns, called "fire regimes," include temporal attributes (e.g., frequency and seasonality), spatial attributes (e.g., size and spatial complexity), and magnitude attributes (e.g., intensity and severity), each of which have ranges of natural variability. A fire regime refers to the frequency and intensity of natural fires occurring in various ecosystem types. Alterations of historical fire regimes and vegetation dynamics have occurred in many landscapes in the U.S., including the SIT and Mason County through the combined influence of land management practices, fire exclusion, insect and disease outbreaks, climate change, and the invasion of non-native plant species. Anthropogenic influences on wildfire occurrence have been witnessed through arson, incidental ignition from industry (e.g., logging, railroad, sporting activities), and other factors. Likewise, wildfire abatement practices have reduced the spread of wildfires after ignition. This has reduced the risk to both the ecosystem and the urban populations living in or near forestlands, such as portions of Mason County.

The LANDFIRE Project produces maps of simulated historical fire regimes and vegetation conditions using the LANDSUM landscape succession and disturbance dynamics model (see LANDFIRE at LANDFIRE Program: Home for additional information). The LANDFIRE Project also produces maps of vegetation and measurements of vegetation departure from simulated historical reference conditions, although in some instances, the data is older in nature. These maps have been used to support fire and landscape management planning outlined in the goals of the National Fire Plan, Federal Wildland Fire Management Policy, and the Healthy Forests Restoration Act.

The simulated historical Mean Fire Return Interval (MFRI) data layer quantifies the average number of years between fires under the presumed historical fire regime as illustrated in Figure 10-6. It should be noted that not all fire regime groups are present within the planning area (or County). While the historical fire regimes and the other data sets are not a predictive model and should not be utilized for life safety measures (such as pre-event evacuation planning), information presented can be used for reference and planning purposes but should be limited in nature as the variables existing with respect to predictive wildfire planning continually change. The Tribe has identified this as a deficiency within the existing data given the length of time since a vegetation study has been completed countywide on which more reliable planning and mitigation efforts can be based. This deficiency will also serve as the basis for a mitigation strategy to seek grant funding to complete a more detailed vegetation analysis on tribal properties.

Applying the LANDFIRE data, Figure 10-7 illustrates the MFRI for portions of Mason County and the SIT. Since completion of the last plan in 2018, LANDFIRE has modified its Fire Regime Groups to reflect the following:

- I-A Percent replacement fire less than 66.7%, fire return interval 0-5 years
- I-B Percent replacement fire less than 66.7%, fire return interval 6-15 years
- I-C Percent replacement fire less than 66.7%, fire return interval 16-35 years
- II-A Percent replacement fire greater than 66.7%, fire return interval 0-5 years
- II-B Percent replacement fire greater than 66.7%, fire return interval 6-15 years
- II-C Percent replacement fire greater than 66.7%, fire return interval 16-35 years

- III-A Percent replacement fire less than 80%, fire return interval 36-100 years
- III-B Percent replacement fire less than 66.7%, fire return interval 101-200 years
- IV-A Percent replacement fire greater than 80%, fire return interval 36-100 years
- IV-B Percent replacement fire greater than 66.7%, fire return interval 101-200 years
- V-A Any severity, fire return interval 201-500 years
- V-B Any severity, fire return interval 501 or more year

Further defining the LANDFIRE analysis:

- Replacement severity is defined as greater than 75 percent average top-kill within a typical fire perimeter for a given vegetation type.
- Low severity is defined as less than 25 percent average top-kill within a typical fire perimeter for a given vegetation type.
- Mixed severity is defined as between 25 and 75 percent average top-kill within a typical fire perimeter for a given vegetation type.

Large wildfires have historically been infrequent in the coastal regions of the Pacific Northwest. While ~850 fires have occurred in the planning area since 2009, due to firefighting efforts, many have been contained with limited impact on acreage burned. The Mean Fire Return Interval (MFRI) layer quantifies the average period between fires under the presumed historical fire regime. MFRI is intended to describe one component of historical fire regime characteristics. Review of the Mean Fire Return Interval illustrates that the majority of the Tribal Planning Area has a return interval of between 36 and >500 years in certain areas, with the majority of the area falling into Regime Groups III-A or III-B, as well as Groups V-A and V-B.

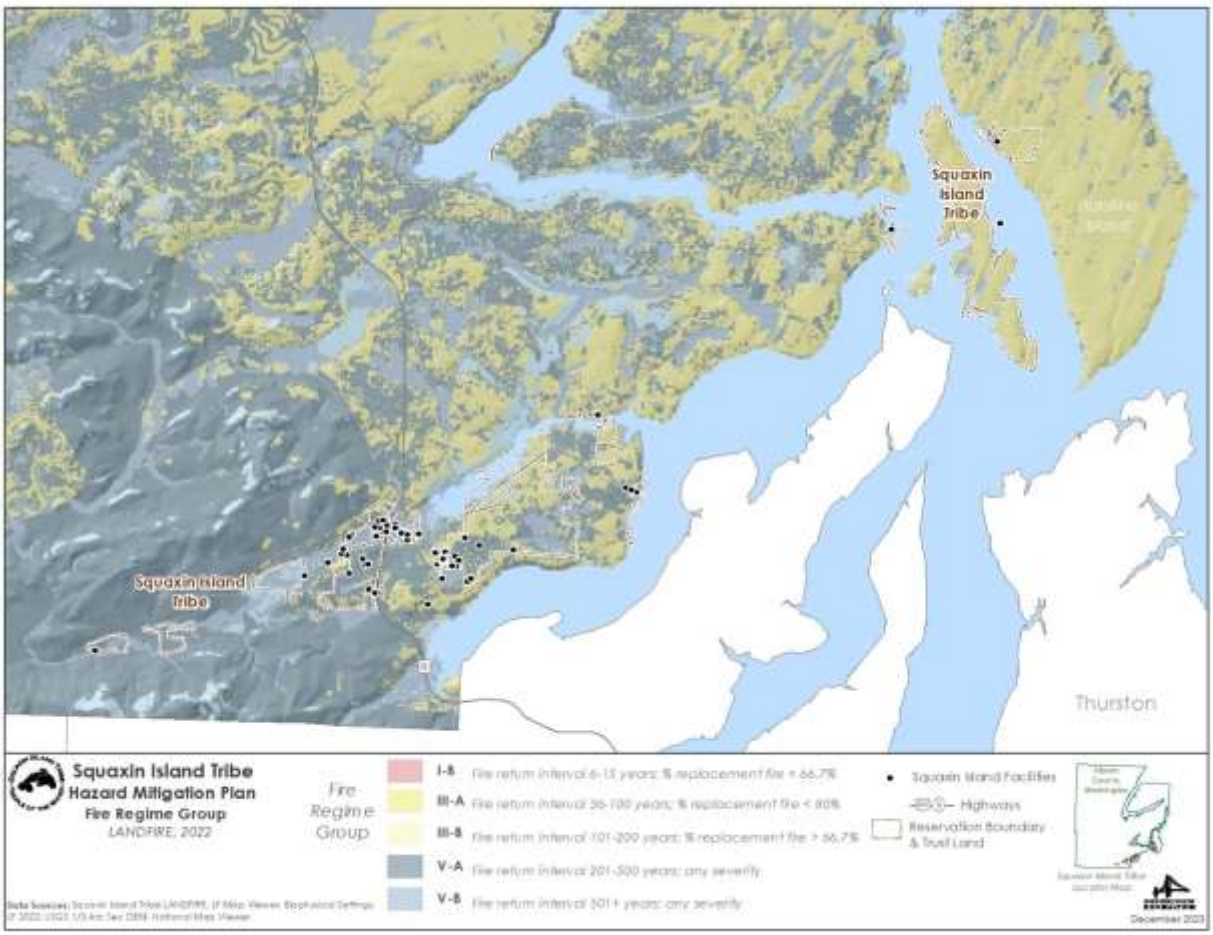

Figure 10-6 LANDFIRE Fire Regimes in Mason County

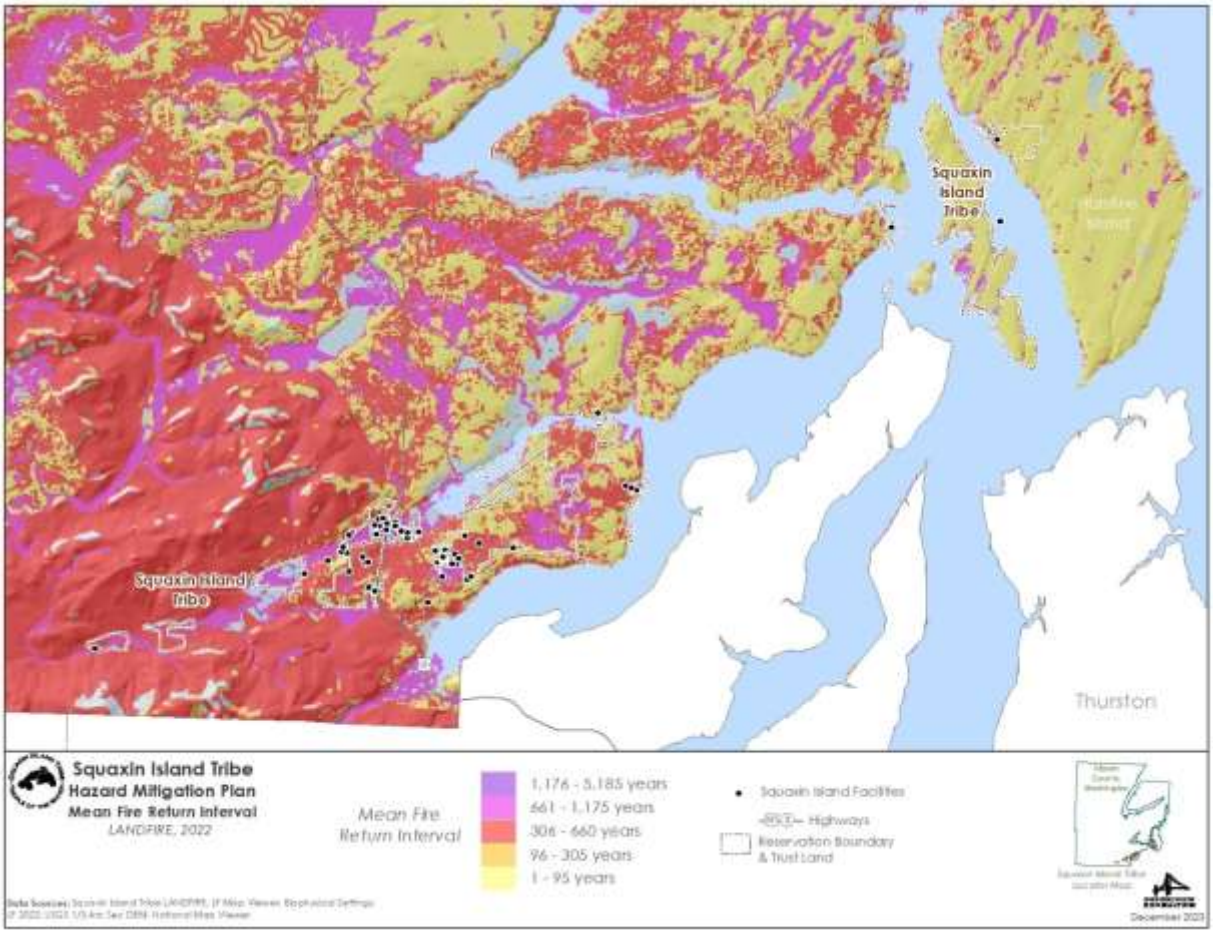

Figure 10-7 Mean Fire Return Interval

10.6 VULNERABILITY ASSESSMENT

10.6.1 Overview

Structures, above-ground infrastructure, critical facilities and natural environments are all vulnerable to the wildfire hazard (see Figure 10-8). Understanding the relationship between weather, potential fire activity, and geographical features enhances the ability to prepare for the potential of wildfire events. This knowledge, when paired with emergency planning and appropriate mitigation measures, creates a safer environment.

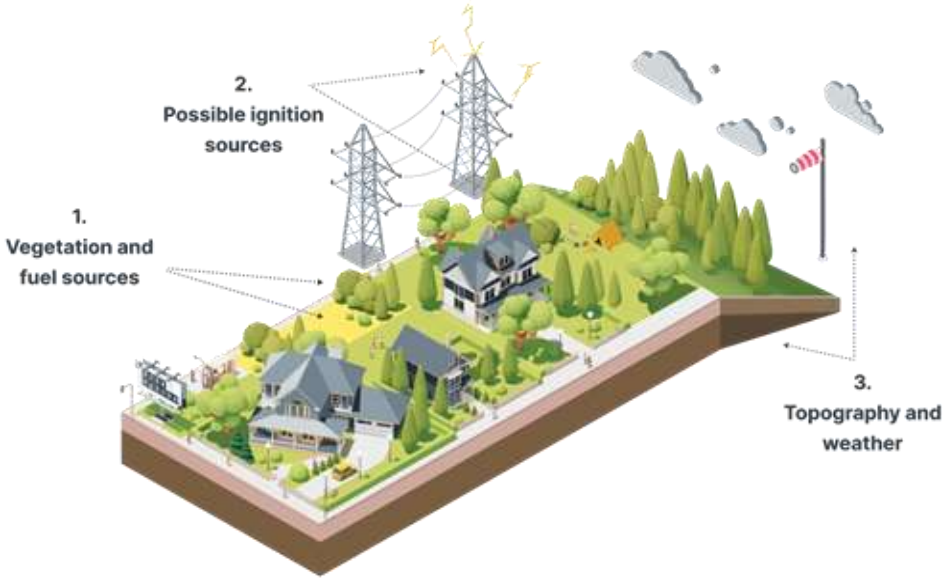

Figure 10-8 Potential Wildfire Factors

Wildfire studies can analyze weather data to assist firefighters in understanding the relationship between weather patterns and potential fire behavior. Fire forecasting examines similarities between historical fire weather and existing weather and climate values. These studies have determined that for areas such as Mason County, any combination of two of the following factors can create more intense and potentially destructive fire behavior, known as extreme fire behavior:

- Sustained winds from the east
- Relative humidity less than 40 percent
- Temperature greater than 72º Fahrenheit
- Periods without precipitation greater than 14 days in duration
- 1,000-hour fuel moisture less than 17 percent.

If a fire breaks out and spreads rapidly, residents may need to evacuate within a short timeframe. A fire's peak burning period generally is between 1 p.m. and 6 p.m. In normal situations, fire alerting would commence quickly, helping to reduce the risk. However, in more remote locations of the planning area, or in areas where cell phone services are sporadic, warning time and calls for assistance may be reduced.

Warning Time

Wildfires are often caused by humans, intentionally or accidentally. There is no way to predict when one might break out. Since fireworks often cause brush fires, extra diligence is warranted around the Fourth

of July when the use of fireworks is highest. Dry seasons and droughts are factors that greatly increase fire likelihood. Dry lightning may trigger wildfires. Severe weather can be predicted, so special attention can be paid during weather events that may include lightning. Reliable National Weather Service lightning warnings are available on average 24 to 48 hours prior to a significant electrical storm.

10.6.2 Impact on Life Health & Safety

Exposure to wildfire is dependent upon many factors. The maps used in the analysis show areas of relative importance in determining fire risk, though they do not provide sufficient data for a statistical estimation of exposed population.

While there are no recorded fatalities from wildfire in the planning area, a statistical number of the population vulnerable to impact from fire is impossible to determine with any accuracy, due to the high number of variables that impact fire scenarios. The population at risk must also take into consideration tourists given the Tribe's Little Creek Casino Resort, including its gaming center, hotel, convention center and golf course, as well as the planning area's proximity to the parklands and other Washington high-tourist destinations. With its relatively high tourism rate, especially during summer months, there is an increase in the population vulnerability to fire. Given the increase in tourism during the summer months, when fire danger is at its greatest, increased consideration must be taken into account for fire response.

Smoke generated by wildfire consists of visible and invisible emissions that contain particulate matter (soot, tar, water vapor, and minerals), gases (carbon monoxide, carbon dioxide, nitrogen oxides), and toxics (formaldehyde, benzene). Emissions from wildfires depend on the type of fuel, the moisture content of the fuel, the efficiency (or temperature) of combustion, and the weather. Public health impacts associated with wildfire include difficulty in breathing, odor, and reduction in visibility.

Smoke and air pollution from wildfires can be a severe health hazard, especially for sensitive populations, including children, the elderly and those with respiratory and cardiovascular diseases, or other disabilities. Social vulnerabilities also tell us that those living below the poverty line are also less likely to evacuate, due to both the inability to acquire lodging in other places due to the expense, but also because they are less likely to be able to replace possessions lost or destroyed, and are therefore fearful of evacuating and not protecting their belongings.

Mason County in general has a high population of retirees and individuals over 65, further increasing the potential impact on the fire hazard. According to Census data (2020) for the SIT, the median age distribution on the Reservation is 26 years. Based on Census data, approximately 42 residents are over 65, with 58 children 5 years of age or under. There are 33 children aged 5-9 years. The 2020 Census also identifies a total of 57 individuals living on the reservation with a disability, broken down by age as follows: four (4) under the age of 18 years; 38 between the ages of 18-64, and 15 65 years of age and over. Approximately 17.5 percent of the Tribal Members living on the Reservation fall below the poverty line (2020 Census). Based on Tribal data (2023), the unemployment rate for tribal members is approximately 30 percent – much higher than the state average.

Wildfire also threatens the health and safety of those fighting fires. First responders are exposed to the dangers from the initial incident and after-effects from smoke inhalation and heat stroke.

10.6.3 Impact on Property

Property damage from wildfires can be severe and can significantly alter entire communities. The potential exposure of the structures should a fire occur is high, depending on the area, with the unincorporated county and the City of Shelton all having some degree of exposure to wildfire hazards. Some of the area fire districts that may provide response are also volunteer, increasing the response times. For additional consideration, the planning team also reviewed the condition of the current structures, their close proximity to one another, potential climate change impacts, and the potential exposure to the structures on the Reservation and Tribal Lands should a fire occur. Density and the age of building stock in the area are contributing factors in assessing property vulnerability to wildfire. Many of the buildings in the planning area are of significant age, with many being constructed with wood frames and shingle roofs. Most do not have sprinkler systems.

Exposure to property in the context of wildfire is the intersection of wildfire likelihood and intensity with communities. Communities can be directly exposed to wildfire from adjacent wildland vegetation, or indirectly exposed to wildfire from embers and home-to-home ignition. Communities that are not exposed are not likely to be subjected to wildfire from either direct or indirect sources.

Figure 10-9 identifies the potential wildfire exposure risk based on FEMA's Wildfire Risk to Communities analysis.[37] Based on review of the data, exposure to a wildland fire in and around the Squaxin Island Tribe is very high.

[37] Wildfire Risk to Communities

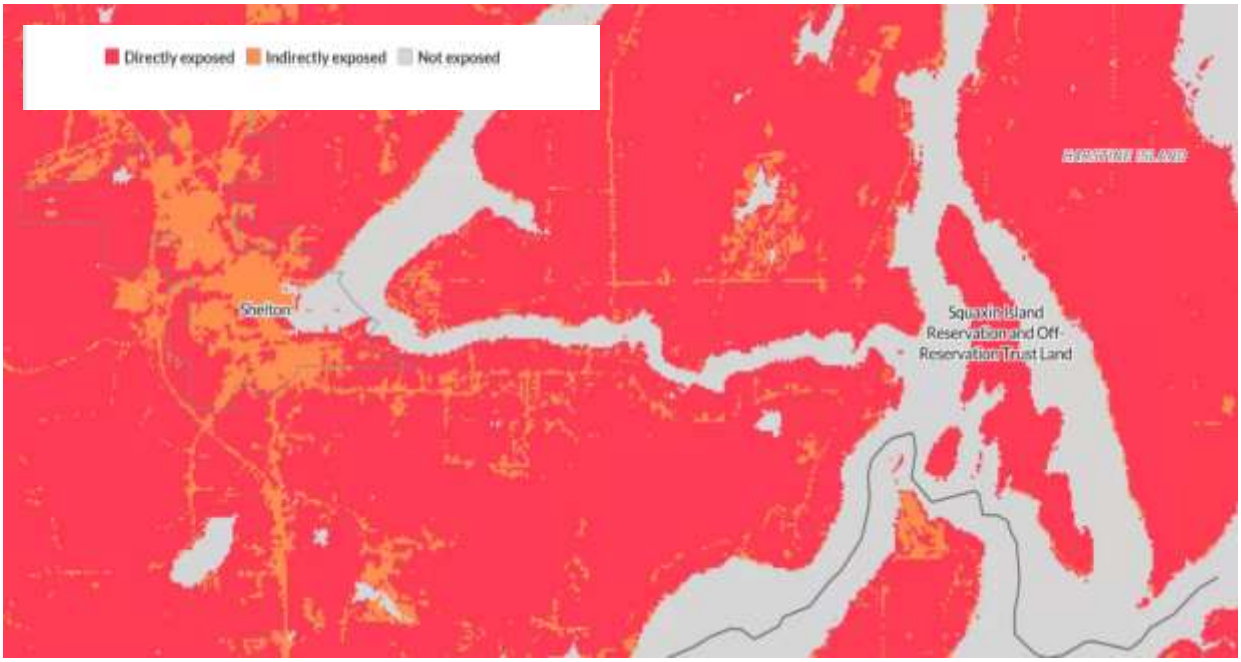

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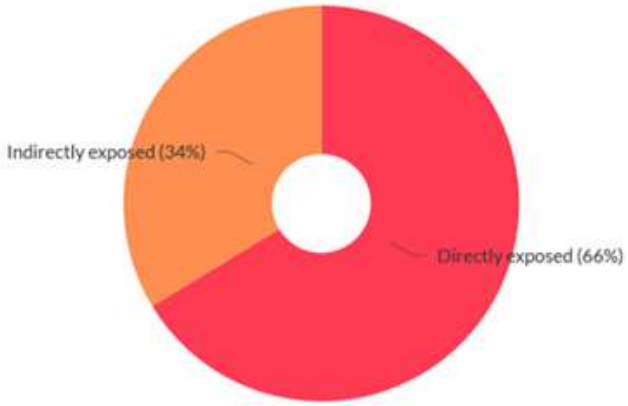
Figure 10-9 Wildfire Exposure



10.6.4 Impact on Critical Facilities and Infrastructure

Critical facilities of wood frame construction are especially vulnerable during wildfire events. In the event of wildfire, there would likely be little damage to most infrastructure. Most roads and railroads would be without damage except in the worst scenarios. Fueling stations could be significantly impacted, as could other structures maintaining hazardous materials. During a wildfire event, hazardous material storage containers could rupture due to excessive heat and act as fuel for the fire, causing rapid spreading and escalating the fire to unmanageable levels. In addition, the materials could leak into surrounding areas, saturating soils and seeping into surface waters, having a disastrous effect on the environment. Power lines are also significantly at risk from wildfire because most poles are made of wood and susceptible to burning. Fires can create conditions that block or prevent access and can isolate residents and emergency service providers. Wildfire in the planning area within Mason County could also impact wood-structured bridges, peers, and docks, which are utilized to moor watercraft, launch search and rescue vessels, dam safety inspections, shellfish harvesting, fishing vessels, or other private boats associated with tourism.

Table 10-4 identifies critical facilities owned and operated by the SIT which are potentially exposed to the wildfire hazard within the various mean fire return intervals and hazard zone types. Table 10-5 identifies the critical facilities within the various fire regime groups.

TABLE 10-4
CRITICAL FACILITIES WITHIN THE LANDFIRE - MEAN FIRE RETURN INTERVAL HAZARD ZONES

Structure Type Exposed	YEARS												Zone Type				
	6-10	16-20	26-30	36-40	71-80	91-100	101-125	151-200	201-300	301-500	501-1000	>1,000	Water	Snow/Ice	Barren	Sparsely Vegetated	Indeterminate Return Interval
Agricultural	0	0	0	0	**2**	0	0	0	0	**1**	0	0	**1**	0	0	0	0
Commercial	0	0	0	0	**1**	0	0	0	0	**4**	**5**	0	0	0	0	0	4
Cultural	0	0	0	0	**2**	0	0	0	0	**1**	**6**	0	0	0	0	0	0
Environmental	0	0	0	0	**1**	0	0	0	0	**1**	0	0	0	0	0	0	0
Government	0	0	0	0	**2**	0	0	0	0	**6**	**1**	0	0	0	0	0	1
Hazmat	0	0	0	0	0	0	0	0	0	**1**	0	0	0	0	0	0	0
Industrial	0	0	0	0	**4**	0	0	0	0	**2**	0	0	0	0	0	0	1
Medical	0	0	0	0	0	0	0	0	0	**2**	**3**	0	0	0	0	0	0
Power	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Protective	0	0	0	0	**2**	0	0	0	0	**2**	5	0	0	0	0	0	3
Residential	0	0	0	0	**1**	0	0	0	0	**20**	3	0	0	0	0	0	0
Schools	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Shelter	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Transportation	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Wastewater	0	0	0	0	**4**	0	0	0	0	**3**	1	0	0	0	0	0	1
Water	0	0	0	0	0	0	0	0	0	**2**	2	0	0	0	0	0	0
TOTAL	**0**	**0**	**0**	**0**	**19**	**0**	**0**	**0**	**0**	**45**	**32**	**0**	**1**	**0**	**0**	**0**	**11**

TABLE 10-5
CRITICAL FACILITIES WITHIN THE LANDFIRE - FIRE REGIME GROUP HAZARD ZONES

Structure Type Exposed	Regime I-A	Regime I-B	Regime II-A	Regime II-B	Regime III-A	Regime III-B	Regime IV-A	Regime IV-B	Regime V-A	Regime V-B	Indeterminate Fire Regime Characteristics	Water
Agricultural	0	0	0	0	**2**	0	0	0	**1**	0	0	**1**
Commercial	0	0	0	0	**1**	0	0	0	**4**	5	**4**	0
Cultural	0	0	0	0	**2**	0	0	0	**1**	6	0	0
Environmental	0	0	0	0	**1**	0	0	0	**1**	0	0	0
Government	0	0	0	0	**2**	0	0	0	**6**	1	**1**	0
Hazmat	0	0	0	0	0	0	0	0	**1**	0	0	0
Industrial	0	0	0	0	**4**	0	0	0	**2**	0	**1**	0
Medical	0	0	0	0	0	0	0	0	**2**	3	0	0
Power	0	0	0	0	0	0	0	0	0	0	**1**	0
Protective	0	0	0	0	**2**	0	0	0	**2**	**5**	**3**	0
Residential	0	0	0	0	**1**	0	0	0	**20**	**3**	0	0
Schools	0	0	0	0	0	0	0	0	0	**2**	0	0
Shelter	0	0	0	0	0	0	0	0	0	**2**	0	0
Transportation	0	0	0	0	0	0	0	0	0	**2**	0	0
Wastewater	0	0	0	0	**4**	0	0	0	**3**	**1**	**1**	0
Water	0	0	0	0	0	0	0	0	**2**	**2**	0	0
TOTAL	**0**	**0**	**0**	**0**	**19**	**0**	**0**	**0**	**45**	**32**	**11**	**1**

10.6.5 Impact on Economy

Wildfire impact on the economy can be far reaching, ranging from damage to transportation routes to non-use of park facilities and campsites impacting tourism, to loss of structures influencing tax base and lost revenue. The economy of the Tribe is largely dependent on governmental operations/functions, entertainment/tourism (casino, hotel, fishing excursions) and other businesses conducted by tribal members. Fire within the tribal planning area could also impact timber harvesting, as well as other agricultural businesses. The Casino Resort, Golf Course and other businesses owned and operated by the Tribe, as well as Taylor Shellfish, a major employer within the county distributing shellfish nationwide, could also be impacted by both primary and secondary impacts to wildfire. Impact to the economic hubs of the Tribe would also impact the income of tribal members due to lost wages, further negatively influencing a socially vulnerable area. Disruption of major thoroughfares in the area could impact distribution of goods. Secondary hazards associated with wildfire, such as environmental impact, or increased landslides and flooding potential, would further impact the economy.

10.6.6 Impact on Environment

Fire is a natural and critical ecosystem process in most terrestrial ecosystems, dictating in part the types, structure, and spatial extent of native vegetation. However, wildfires can cause severe environmental impacts:

- Damaged Fisheries—Critical fisheries can suffer from increased water temperatures, sedimentation, and changes in water quality.
- Damaged Timber and Forestland – The timber industry would suffer tremendous loss due to a wildfire. Some areas may remain barren for years, depending on the heat associated with the fire, and the scarring of the land on which the timber and other vegetation has grown. The Tribe has an active forest management program, including harvesting of timber. Tribal members also rely heavily on certain types of vegetation for cultural beliefs, as well as for economic benefits by the sale of items.
- 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.
- 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.

10.6.7 Impacts from Climate Change

Fire in western ecosystems is determined by climate variability, local topography, and human intervention. Climate change has the potential to affect multiple elements of the wildfire system: fire behavior, ignitions, fire management, and vegetation fuels. Hot dry spells create the highest fire risk. Increased temperatures may intensify wildfire danger by warming and drying out vegetation. When climate alters fuel loads and fuel moisture, forest susceptibility to wildfires changes. Climate change also may increase winds that spread fires. Faster fires are harder to contain, and thus are more likely to expand into residential neighborhoods.

Historically, drought patterns in the West are related to large-scale climate patterns in the Pacific and Atlantic oceans. The El Niño–Southern Oscillation in the Pacific varies on a 5- to 7-year cycle, the Pacific Decadal Oscillation varies on a 20- to 30-year cycle, and the Atlantic Multidecadal Oscillation varies on a 65- to 80-year cycle. As these large-scale ocean climate patterns vary in relation to each other, drought conditions in the U.S. shift from region to region. El Niño years bring drier conditions to the Pacific Northwest and more fires.

Climate scenarios project summer temperature increases between 2ºC and 5°C and precipitation decreases of up to 15 percent. Such conditions would exacerbate summer drought and further promote high-elevation wildfires, releasing stores of carbon and further contributing to the buildup of greenhouse gases. Forest response to increased atmospheric carbon dioxide—the so-called "fertilization effect"—could also contribute to more tree growth and, thus, more fuel for fires, but the effects of carbon dioxide on mature forests are still largely unknown. High carbon dioxide levels should enhance tree recovery after fire and young forest regrowth, as long as sufficient nutrients and soil moisture are available, although the latter is in question for many parts of the western United States because of climate change.

10.7 FUTURE DEVELOPMENT TRENDS

The increase in residential development in interface areas has resulted in greater wildfire risk. Fire has historically been a natural wildland element that can sweep through vegetation adjacent to combustible homes or structures. New residents in remote locations are often surprised to learn that in moving away from urban areas, they have left behind readily available fire services providing structural protection. Rural locations may be more difficult to access or simply take more time for fire protection services to get there. Many are serviced by volunteer firefighters.

The Tribe is optimistic that increased population growth will continue to occur in the area, as more tribal members return home. However, they are also aware that as areas become more urbanized, the potential exists that the fire risk may increase as urbanization tends to alter the natural fire regime, and the growth will expand the urbanized areas into undeveloped wildland areas. The Tribe feels that this expansion of the wildland-urban interface can be managed through, among other things, strong land use and building codes, while also providing education and outreach to citizens to help define the areas where hazards are of concern.

A growing body of research suggests that "the only effective home protection treatment is treatment in, on, and around the house (see Figure 10-10); homeowners must be responsible for protecting that property" (Nowicki 2001, p. 1:3). U.S. Forest Service research scientist, Jack Cohen has stated that "home ignitions are not likely unless flames and firebrand ignitions occur within 40 meters [131 feet] of the structure; the WUI fire loss problem primarily depends on the home and its immediate site."

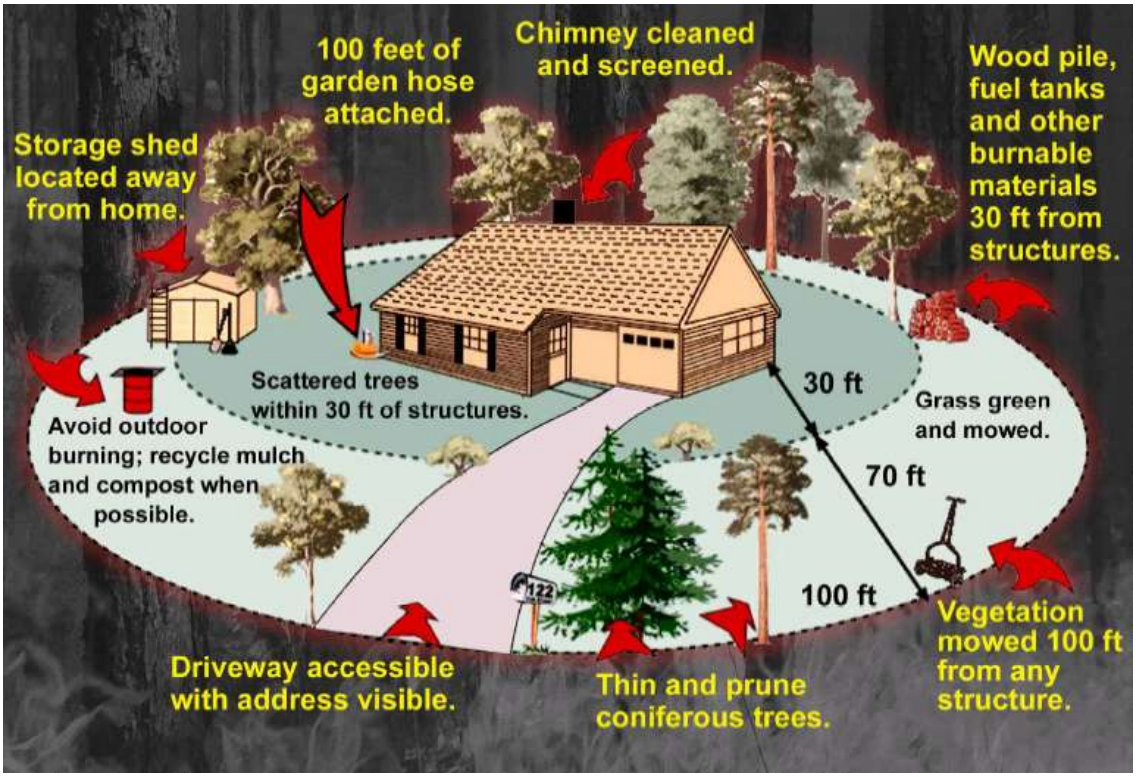


Figure 10-10 Measures to Protect Homes from Wildfire

Within the wildfire communities, there are various programs that support growth and development trends, while still protecting individuals within the community. Programs such as FireWise or Ready Set Go! are but a few of those examples.

Firewise Communities USA™

The NFPA's Firewise USA program encourages local solutions for safety by involving homeowners in taking individual responsibility for preparing their homes from the risk of wildfire. Firewise is a key component of Fire Adapted Communities – a collaborative approach that connects all those who play a role in wildfire education, planning and action with comprehensive resources to help reduce risk. Currently, the Tribe is not a recognized Firewise Community.[38] There are three Firewise Communities currently within Mason County: Lake Cushman in Hooodsport (entrance into Firewise Program 12/30/2006), Thunder Ridge Firewise Group (entrance into Firewise Program 1/14/2020), and Harstene Pointe (entrance into Firewise Program 12/30/2005), both in Shelton. Working with Tribal Natural Resources, Tribal foresters, and Mason County Fire District #4, the Tribe will investigate the possibility of becoming a Firewise Community over the lifecycle of this plan and has identified this as a strategy.

[38] http://www.firewise.org/usa-recognition-program/state-listing-of-partcipants.aspx

Ready, Set, Go!

The Ready, Set, Go! (RSG) Program seeks to empower fire departments to engage the residents they serve in wildland fire community risk reduction. The RSG! Program provides tools and resources for fire departments to use as they help residents gain an understanding of their wildland fire risk and actions individuals can take to reduce that risk.

10.8 ISSUES

The major issues for wildfire on the SIT and in Mason County are the following:

- Public education and outreach to people living in or near the fire hazard zones should include information about and assistance with mitigation activities such as defensible space, and advance identification of evacuation routes and safe zones.
- Wildfires could cause landslides as a secondary natural hazard.
- Climate change will affect the wildfire hazard.
- Future growth into interface areas should continue to be managed.
- Vegetation management activities should include enhancement through expansion of target areas as well as additional resources.
- Building code standards need to be enhanced, including items such as residential sprinkler requirements and prohibitive combustible roof standards.
- Increased fire department water supply is needed in high-risk wildfire areas.
- Recruiting and retaining firefighters trained in wildland fire response should be a priority.

A worst-case scenario would include an active fire season throughout the American west, spreading resources thin. Firefighting teams would be exhausted or unavailable. Many federal assets would be responding to other fires that started earlier in the season. While local fire districts would be extremely useful in the urban interface areas, they have limited wildfire capabilities or experience, and they would have a difficult time responding to the ignition zones. Even though the existence and spread of the fire is known, it may not be possible to respond to it adequately, so an initially manageable fire can become out of control before resources are dispatched.

To further complicate the problem, heavy rains could follow, causing flooding and landslides and releasing tons of sediment into rivers, permanently changing floodplains and damaging sensitive habitat and riparian areas. Such a fire followed by rain could release millions of cubic yards of sediment into streams for years, creating new floodplains and changing existing ones. With the forests removed from the watershed, stream flows could easily double. Flood that could be expected every 50 years may occur

every couple of years. With the streambeds unable to carry the increased discharge because of increased sediment, the floodplains and the flood elevations would increase.

10.9 MITIGATION STRATEGIES:

Specific mitigation projects are identified in Chapter 12 of the HMP. The following strategies should be accomplished to work towards helping to reduce major loss due to fire.

1. Enhance fire prevention education and enforcement programs.
    a. Since humans often trigger urban fires and wildfires, this could significantly reduce the threat of fire.
2. Continue development of enhanced wildfire detection systems (such as infrared cameras or wireless sensor networks in areas of concern) and emergency communications capabilities.
    a. The importance of immediate reporting of any fire events must be impressed on residents and users of forested lands.
3. Expand upon existing warning systems such as CodeRED, AlertSense, and the Emergency Alert System to quickly alert local residents in case of fire.
4. Detail primary and secondary escape routes with an evacuation plan for major transportation corridors.
    a. Land use planning criteria could ensure that adequate escape routes are provided for new areas of development in forested areas.
5. Obtain and maintain certifications and qualifications for fire department personnel.
    a. Ensure that firefighters are trained in basic wildfire behavior, basic fire weather, and that company officers and chief level officers are trained in the wildland command and strike team leader level.
6. Implement fire-safe development planning and appropriate wildfire mitigation strategies for the Tribe as a whole, as well as individual property owners, including:
    a. Requiring the use of fire-resistant roofing materials
    b. Requiring the maintenance of defensible “clear zones” around residential structures
    c. Requiring ingress, egress and turnaround provisions for emergency response units
    d. Requiring the adequate water supply to support fire response
    e. Developing local ordinances (including enforcement) to control hazardous practices (trash burning, campfires, etc.)
    f. Ensuring home addresses are clearly visible

10.10 IMPACT AND RESULTS

Due to its close proximity to densely wooded areas, fire danger is of significant concern to the SIT. With increased popularity of tourists to the Olympic National Park, Hood Canal area, and tribal-owned tourist destinations, there is an increase in concern for fire danger.

For the purposes of ranking the Wildfire hazard, it is determined that potential impact to Tribal population due to fire is medium to high. This is due to the proximity of forested lands and timber industry on which the Tribe relies, albeit forest management practices have been very successful for the SIT in reducing risk.

Based on review and analysis of the data, the Planning Team has determined that the probability for impact from Wildfire throughout the area is likely, but the impact is more limited with respect to geographic extent. The area experiences some level of wildfire almost annually, but the acreage burned has, thankfully, been more limited in nature throughout the planning area due in large part to response activities. The Tribe experienced one wildfire on tribal lands in 2023 – the Kamilche fire, which burned 41 acres. In addition, the McEwen fire also displaced several tribal members due to the smoke.

There is the potential for isolation should a significant wildfire occur in certain areas, as well as the potential impact from smoke and the elderly population of citizens living on the Reservation. As the tribe continues to build and develop, it will take fire danger into consideration utilizing best practice construction standards and materials, to include landscaping and by establishing barriers around the proximity of the new facilities. This may also include air filtration systems in the new structures to assist with smoke issues for the elderly. As growth continues, the SIT also feels that it may be prudent to look at establishing additional tribal fire departments in different locations throughout the planning area.

As with many hazards, the initial source does not have to occur in the immediate area, as embers can travel great distances with prevailing winds. Construction into the wildfire hazard areas undoubtedly will continue to expand, thereby increasing the risk of fires. Implementation of mitigation strategies which help reduce wildfire risk, such as set-backs, landscaping regulations, appropriately sized roadways for fire apparatus, and mandatory sprinkler systems (among others), could potentially help reduce the number of structures at risk. Based on the potential impact, the Planning Team determined the CPRI score to be 2.60, with overall vulnerability determined to be a medium level.

CHAPTER 11.
HAZARD RANKING

The risk ranking process conducted by Planning Team members assessed the probability of each hazard's occurrence, as well as its likely impact on the people, property, and economy of the planning area. Also of significant concern to the Tribe is the impact of these hazards on the environment, which factor was also taken into consideration during this plan update.

For some hazards, estimates of risk were generated with data from Hazus, using methodologies promoted by FEMA. For other hazards, citizens, and Planning Team members (who have an extensive historic perspective and knowledge base concerning the impact of hazards on the Tribe) provided invaluable information during this process. That information had a significant impact on the risk ranking process.

In ranking the hazards, the Planning Team completed a Calculated Priority Risk Index worksheet for each hazard (Figure 11-1). The Index examines the various criteria for each hazard (probability, magnitude/severity, geographic extent and location, warning time, and duration) as discussed in Chapter 5, defines a risk index for each criterion according at four levels (1-4), and then applies a weighting factor.

The result is a score that has been used to rank the hazards for the Tribe. Table 11-1 presents the results of the Calculated Priority Risk Index (CPRI) scoring for the hazards of concern. Once the hazard ranking was completed, the Planning Team also assigned an ordinal scale to identify the level of significance based on the CPRI score and rank, assigning a low-to-high rating of concern or significance. Those ratings are categorized into the following levels, with Table 11-2 presenting the overall results:

- □ Extremely Low—The occurrence and potential cost of damage to life and property is very minimal to nonexistent.
- □ Low—Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
- □ Medium—Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- □ High—Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have occurred in the past.
- □ Extremely High—Very widespread with catastrophic impact.

CPRI Category	Degree of Risk			Assigned Weighting Factor
	Impact/ Level ID	Description	Impact Factor	
Probability	Unlikely	• Rare with no documented history of occurrences or events. • Annual probability of less than 1% (~100 years or more).	1	40%
	Possible	• Infrequent occurrences; at least one documented or anecdotal historic event. • Annual probability that is between 1% and 10% (~10 years or more).	2	
	Likely	• Frequent occurrences with at least two or more documented historic events. • Annual probability that is between 10% and 90% (~10 years or less).	3	
	Highly Likely	• Common events with a well-documented history of occurrence. • Annual probability of occurring. (1% chance or 100% Annually).	4	
Magnitude/ Severity	Negligible	• People – Injuries and illnesses are treatable with first aid; minimal hospital impact; no deaths. Negligible impact to quality of life. • Property – Less than 5% of critical facilities and infrastructure impacted and only for a short duration (less than 24-36 hours such as for a snow event); no loss of facilities, with only very minor damage/clean-up. • Economy – Negligible economic impact. • Continuity of government operating at 90% of normal operations with only slight modifications due to diversion of normal work for short-term response activity. Disruption lasts no more than 24-36 hours. • Special Purpose Districts: No Functional Downtime.	1	25%
	Limited	• People – Injuries or illness predominantly minor in nature and do not result in permanent disability; some increased calls for service at hospitals; no deaths; 14% or less of the population impacted. Moderate impact to quality of life. • Property – Slight property damage -greater than 5% and less than 25% of critical and non-critical facilities and infrastructure. • Economy – Impact associated with loss property tax base limited; impact results primarily from lost revenue/tax base from businesses shut down during duration of event and short-term cleanup; increased calls for emergency services result in increased wages. • Continuity of government impacted slightly; 80% of normal operations; most essential services being provided. Disruption lasts >36 hours, but <1 week. • Special Purpose Districts: Functional downtime 179 days or less.	2	
	Critical	• People – Injuries or illness results in some permanent disability or significant injury; hospital calls for service increased significantly; no deaths. 25% to 49% of the population impacted. • Property – Moderate property damages (greater than 25% and less than 50% of critical and non-critical facilities and infrastructure). • Economy - Moderate impact as a result of critical and non-critical facilities and infrastructure impact, loss of revenue associated with tax base, lost income. • Continuity of government ~50% operational capacity; limited delivery of essential services. Services interrupted for more than 1 week, but <1 month. • Special Purpose Districts: Functional downtime 180-364 days.	3	
	Catastrophic	• People - Injuries or illnesses result in permanent disability and death to a significant amount of the population exposed to a hazard. >50% of the population impacted. • Property – Severe property damage >50% of critical facilities and non-critical facilities and infrastructure impacted. • Economy – Significant impact - loss of buildings /content, inventory, lost revenue, lost income. • Continuity of government significantly impacted; limited services provided (life safety and mandated measures only). Services disrupted for > than 1 month. • Special Purpose Districts: Functional Downtime 365 days or more.	4	
Geographic Extent and Location	Limited	Less than 10% of area impacted.	1	20%
	Moderate	10%-24% of area impacted.	2	
	Significant	25%-49% of area impacted.	3	
	Extensive	50% or more of area impacted.	4	
Warning Time / Speed of Onset	<6 hours	Self-explanatory.	4	10%
	6 to 12 hours	Self-explanatory.	3	
	12 to 24 hours	Self-explanatory.	2	
	> 24 hours	Self-explanatory.	1	
Duration	< 6 hours	Self-explanatory.	1	5%
	< 24 hours	Self-explanatory.	2	
	<1 week	Self-explanatory.	3	
	>1 week	Self-explanatory.	4	

Figure 11-1 Calculated Priority Risk Index

TABLE 11-1
CALCULATED PRIORITY RANKING SCORES

Hazard	Probability	Magnitude and/or Severity	Geographic Extent and Location	Warning Time	Duration	Calculated Priority Risk Index Score
Climate Change	4	2	2	1	4	2.80
Drought	2	2	2	1	4	2.00
Earthquake	4	4	4	4	1	3.85
Flood	3	2	2	2	3	2.45
Severe Weather	4	3	4	2	3	3.50
Wildfire	3	2	2	4	2	2.60

The Calculated Priority Risk Index scoring method has a range from 0 to 4. “0” being the least hazardous and “4” being the most hazardous situation.

TABLE 11-2
HAZARD RANKING

Hazard in Ranked Order	Rank	CPRI Score	Level of Concern and Significance
Earthquake	1	3.85	High
Severe Weather	2	3.50	High
Climate Change	3	2.80	High
Wildfire	4	2.60	High
Flood	5	2.45	Medium
Drought	6	2.00	Medium-Low

CHAPTER 12.
MITIGATION STRATEGY

The development of a mitigation strategy allows the community to create a vision for preventing future disasters. This is accomplished by establishing a common set of mitigation goals and objectives, a common method to prioritize actions, and evaluation of the success of such actions.

Once identified, the goals and objectives establish an overall mitigation strategy by which the Tribe will enhance resiliency of the planning area. When combined with the Risk Assessment data developed during this plan update, the Planning Team identified a set of mitigation action items (sometimes referred to as initiatives or strategies) which, when implemented, will help reduce the impact of the hazards on the Tribe.

12.1 GOALS AND OBJECTIVES

Hazard mitigation plans must identify goals and objectives for reducing long-term vulnerabilities to identified hazards (44 CFR Section 201.7I(3)(i)). In identifying the goals, the Planning Team reviewed the goals from the previous 2017 Hazard Mitigation Plan. During the September 2023 Kick Off Meeting, the Planning Team determined that the two sets of goals (primary and parallel) were not necessary and elected to combine the two sets of goals. It also reviewed and updated the objectives. The 2024 Goals and Objectives are as follows:

1. Reduce natural hazard-related injury and loss of life.
2. Reduce property damage.
3. Promote a sustainable economy.
4. Maintain, enhance, and restore the natural environment's capacity to absorb and reduce the impacts of natural hazard events.
5. Increase public awareness and ability to respond to disasters.

TABLE 12-1
2024 OBJECTIVES

Objective Number	Objective Statement	Goals for which it can be applied
O-1	Acquire, retrofit, or relocate structures in high hazard areas where safety to life, preservation of vital ecosystems, or provision of services cannot be assured, thereby reducing the adverse impacts of disasters.	1, 2, 3, 5
O-2	Encourage open space uses in hazardous areas or ensure that if building occurs in these high-risk areas that it is done in such a way as to minimize risk and reduce adverse impacts.	1, 2, 4, 5

TABLE 12-1
2024 OBJECTIVES

Objective Number	Objective Statement	Goals for which it can be applied
O-3	Utilize the best available data and science to continually improve the understanding of the location and potential impacts of natural hazards.	1, 2, 3, 5
O-4	Consider the impacts of natural hazards in all planning mechanisms that address current and future land uses on the Reservation.	1, 2, 4, 5
O-5	Educate the reservation residents on the risk exposure to natural hazards and ways to increase the member's capability to prepare, respond, recover, and mitigate the impacts of these events.	1, 2, 4, 5
O-6	Increase resilience and the continuity of operations of identified critical facilities within the Reservation.	1, 2, 3, 4, 5
O-7	Establish a partnership among all levels Tribal departments, surrounding tribes, governments, adjoining communities, and the business community to improve and implement methods to protect property.	1, 2, 4, 5
O-8	Seek mitigation projects that provide the highest degree of natural-hazard protection at the least cost.	1, 3, 5

12.2 MITIGATION ACTION ITEM IDENTIFICATION AND ANALYSIS

FEMA defines mitigation initiatives as sustained measures, which if enacted, will reduce or eliminate the long-term risk from hazards. Whether by preparing citizens for disasters, training responders, or structural infrastructure protection, the actions ultimately should help protect our citizens, and enhance social and economic recovery during such times when disasters do strike.

FEMA identifies four categories of actions that constitute natural hazard mitigation, which become the core competencies for developing an effective mitigation program. Those categories, divided further into hard or soft mitigation initiatives, include:

1) Local planning and regulations (soft mitigation);
2) Education and awareness programs (soft mitigation);
3) Structural or infrastructure projects (hard mitigation); and
4) Natural systems protection (hard mitigation).

These competencies allow organizations to assess mitigation efforts, and where lacking, develop processes, programs, rules, regulations, and standards on which to enhance resilience when considering the hazards of concern, and their potential impact on a community.

New to this planning effort was the use of FEMA's 2013 *Catalog of Mitigation Ideas,* which was presented to the Planning Team and served as the beginning point in the development of the Tribe's 2024 initiatives.

The FEMA document includes a broad range of alternatives for consideration in the planning area, in compliance with 44 CFR (Section 201.7.c.3.ii). Many of the action items or initiatives can be applied to both existing structures and new construction, as identified below. The catalog provides a baseline of mitigation initiatives that are backed by a planning process, are consistent with the planning partners' goals and objectives, and are within the capabilities of the Tribe to implement.

Also new for this 2024 update, the Planning Team developed strategies/action items that are categorized and assessed in several ways:

- By what the alternative would impact – new or existing structures, to include efforts which:
  - Manipulate/mitigate a hazard
  - Reduce exposure to a hazard
  - Reduce vulnerability to a hazard
- By who would have responsibility for implementation:
  - Individuals
  - Businesses
  - Government (Tribal, County, Local, State and/or Federal)
- By the timeline associated with completion of the project, based on the following parameters:
  - Short Term = to be completed in 1 to 5 years
  - Long Term = to be completed in greater than 5 years
  - Ongoing = currently being funded and implemented under existing programs.
- By the type of mitigation activity involved (most of which also coincide with CRS activities):
  - **Prevention –** Government, administrative or regulatory actions that influence the way land and buildings are developed to reduce hazard losses. This includes planning and zoning, floodplain laws, capital improvement programs, open space preservation, and stormwater management regulations.
  - **Public Information and Education –** Public information campaigns or activities which inform citizens and elected officials about hazards and ways to mitigate them – a public education or awareness campaign, including efforts such as: real estate disclosure, hazard information centers, and school-age and adult education, all of which bring awareness of the hazards of concern.
  - **Structural Projects** —Efforts taken to secure against acts of terrorism, manmade, or natural disasters. Types of projects include levees, reservoirs, channel improvements, or barricades which stop vehicles from approaching structures to protect.
  - **Property Protection** – Actions taken that protect the properties. Types of efforts include: structural retrofit, property acquisition, elevation, relocation, insurance, storm shutters, shatter-resistant glass, sediment and erosion control, stream corridor restoration, etc.

Protection can be at the individual homeowner level, or a service provided by police, fire, emergency management, or other public safety entities.

- **Emergency Services / Response** —Actions that protect people and property during and immediately after a hazard event. Includes warning systems, emergency response services, and the protection of essential facilities (e.g., sandbagging).
- **Natural Resource Protection** – Wetlands and floodplain protection, natural and beneficial uses of the floodplain, and best management practices. These include actions that preserve or restore the functions of natural systems. Includes sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- **Recovery** —Actions that involve the construction or re-construction of structures in such a way as to reduce the impact of a hazard, or that assist in rebuilding or re-establishing a community after a disaster incident. It also includes advance planning to address recovery efforts which will take place after a disaster. Efforts are focused on re-establishing the planning region in such a way as to enhance resiliency and reduce impacts to future incidents. Recovery differs from response, which occurs during, or immediately after an incident. Recovery views long-range, sustainable efforts.

- By the Community Lifeline[39] they support:
  - **Safety and Security** – Law Enforcement/Security, Fire Services, Search and Rescue, Government Service, Community Safety
  - **Food, Hydration, Shelter** – Food, Hydration, Shelter, Agriculture
  - **Health and Medical** – Medical Care, Public Health, Patient Movement, Medical Supply Chain, Fatality Management
  - **Energy** – Power Grid, Fuel
  - **Communications** – Infrastructure, Responder Communications, Alerts Warnings and Messages, Finance, 911 and Dispatch
  - **Transportation** – Highway/Roadway/Motor Vehicle, Mass Transit, Railway, Aviation, Maritime
  - **Hazardous Materials** – Facilities, HAZMAT, Pollutants, Contaminants
  - **Water Systems** – Potable Water Infrastructure, Wastewater Management

[39] FEMA created Community Lifelines to reframe incident information, understand and communicate incident impacts using plain language, and promote unity of effort across the whole community to prioritize efforts to stabilize the lifelines during incident response. While lifelines were developed to support response planning and operations, the concept can be applied across the entire preparedness cycle. Efforts to protect lifelines, prevent and mitigate potential impacts to them, and building back stronger and smarter during recovery will drive overall resilience of the nation.

During development of these strategies, the initial starting point was review of the previous action items. As this current plan update is of a new format and organizational structure, the Planning Team elected to use this opportunity to modify the structure of the action items previously identified to eliminate those which are no longer relevant, combine the strategies as appropriate, and to reword existing strategies to make them more viable. The method for developing strategies in the previous plan was overly cumbersome and exhaustive as in many instances, the same strategy was identified for each hazard (e.g., public outreach). Those projects which remain valid have been included within Table 12-2 and referenced as having been previously identified. The status of the previous action items are also summarized, providing detail as to what has been accomplished occurring since completion of the 2018 HMP. Those which are new strategies have no status update section.

In addition to the referenced *Catalog*, many of the hazard mitigation initiatives recommended in this plan were selected from among examples presented from other studies, planning, or strategic documents – integrating various planning efforts already in existence to the extent possible.

TABLE 12-2
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Previous Plan: Yes=Y No=N (new strategy for 2024 update); Modified=M; Carried Forward=CF, Completed=C, Removed=R	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Lead Agency (listed first) and others potentially involved	Estimated Cost (High – H / Medium - M / Low - L	Sources of Funding	Timeline	Community Lifeline Addressed	Initiative Type: Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources
1—Develop necessary action plans and need's assessments addressing hazards of concern. This may include a Comprehensive Emergency Management Plan (CEMP), Evacuation Plans, Debris Management Plan, Damage Assessment Plan, Continuity of Operations Plan (COOP), Communications Plan, Community Wildfire Protection Plan, (CWPP), Threat Hazard Identification and Risk Assessment (THIRA), a process for identifying cultural and historical data gathering, and grants management.									
Y Several combined and modified, CF	New and existing	All Hazards	3, 4, 5, 6, 7, 8	Emergency Management (EM)	High	General Fund, FEMA BRIC, HMGP funds, EMPG funds, BIA funds,	Short-term	Safety and Security, Communica-tions, Hazmat	All

TABLE 12-2
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Previous Plan: Yes=Y No=N (new strategy for 2024 update); Modified=M; Carried Forward=CF, Completed=C, Removed=R	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Lead Agency (listed first) and others potentially involved	Estimated Cost (High – H / Medium - M / Low - L	Sources of Funding	Timeline	Community Lifeline Addressed	Initiative Type: Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources
2024 Status: The Tribe has made some progress with respect to plan development, including a draft of the CEMP, COOP, and with adoption of this plan, the CWPP. Since completion of the last plan, the Tribe has written and received a grant for development of a THIRA, which will be completed during 2024-2025. The Tribe has also developed broader-focused communications plans to include alert and warning, as well as the Tribal radio system.									
2—Adopt the *SIT Hazard Mitigation Plan* as an element of any land use comprehensive plan or updating of ordinances and regulations that the Tribe is creating to ensure linkage between the documents. Utilizing information in HMP and in conjunction with on-going public outreach, continue to present information on the hazards of concern to the community.									
Y CF	New and existing	All Hazards	All	Planning	Low	General Fund	Short-term	Safety & Security	Emergency Services, Property Protection, Prevention, Recovery, Public Info, Structural Projects
2024 Status: The Tribe proactively develops land use (and other) regulations to address issues and concerns. The Tribe does have Code Enforcement through its Planning Department, which enforces the regulations in place. Since completion of the last plan, the Tribe has updated various codes to ensure the most current building standards are in place.									
3—Map the Tribal hazard areas using the best available data and generate map-based product that will actively support hazard mitigation and land-use decision-making within the Reservation, including for identification and construction of evacuation routes and sites, and for identification of critical structures and infrastructure.									
N	New and existing	Flood	1, 2, 3, 4, 5	GIS	Medium	FEMA Risk Map program, LIDAR data	Short-term	Safety & Security	Emergency Services, Prevention, Structural Projects

TABLE 12-2
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Previous Plan: Yes=Y No=N (new strategy for 2024 update); Modified=M; Carried Forward=CF, Completed=C, Removed=R	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Lead Agency (listed first) and others potentially involved	Estimated Cost (High – H / Medium - M / Low - L	Sources of Funding	Timeline	Community Lifeline Addressed	Initiative Type: Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources
4—Consider developing regulatory authority to address land use development. This may include an ordinance to become compliant and a member in good standing under the National Flood Insurance program (NFIP) if the Tribe elects to do so, as well ad land use considerations to address wildfire and climate change impacts.									
Y M CF	New and Existing	Flood	1, 2, 3, 4, 5, 7, 8	Planning & Community Development	Low	General Fund	Short-term,	Safety & Security	Protection, Prevention, Structural Project
2024 Status: The Tribe continues to explore the potential of joining the NFIP. At present, new flood maps have been developed for Mason County, which does include SIT; however, the Tribe has not adopted those maps as of this 2024 update.									
5—Explore the need for relocation of the Squaxin Island Tribe Consolidated Community Water System (p. 133 old plan)									
Y	New and Existing	Flood, Severe Weather	1, 2, 3, 4, 5, 6, 8	Planning & Community Development, Utilities Dept.	Medium	Stormwater Utility	Short-term	Food, Hydration, Shelter; Water Systems	Property Protection, Prevention
2024 Status: No action has been taken since completion of the last plan; however, the Tribe feels this is still an appropriate strategy and will carry it forward.									
6—Consider building setback/spacing requirement, landscaping, building codes, ignition-resistant construction materials, sprinkler systems, fuels reduction, and land use development regulations for all new construction and significantly improved structures for redevelopment in areas deemed susceptible to wildfire exposure, which will help reduce the impacts from wildfire.									

TABLE 12-2
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Previous Plan: Yes=Y No=N (new strategy for 2024 update); Modified=M; Carried Forward=CF, Completed=C, Removed=R	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Lead Agency (listed first) and others potentially involved	Estimated Cost (High – H / Medium - M / Low - L	Sources of Funding	Timeline	Community Lifeline Addressed	Initiative Type: Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources
Y M CF	New	Wildfire	All	Planning & Community Development	Medium	General Fund, Safer (or other wildfire) Grants	Long-term	Safety & Security, Energy, Transpor-tation, HazMat	Emergency Services, Property Protection, Prevention, Projects, Public Info., Natural Resources
2024 Status: Since completion of the last plan, the Tribe has continued its regular practice of removing damaged or diseased trees which have been impacted by other weather events in an effort to reduce fuels available to spread wildfire. With this 2024 HMP update, the tribe is expanding the Wildfire chapter to create a CWPP, making the tribe eligible for additional wildfire grants.									
7— Seek grant funding to complete storm water study to determine not only the need for flood control measures (e.g., dike, levy, etc.), but also to hold stormwater for longer periods of time for use during summer months. This will also include seeking grant funding to help develop/construct the identified measure.									
Y M CF	New and Existing	Flood, Severe Weather, Climate Change	All	Planning & Community Development, Natural Resources	Medium	BRIC, HMGP, DOE	Short-term	Food, Hydration, Shelter; Water Systems	Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources
2024 Status: The Tribe has determined that an additional stormwater retention pond would be beneficial for use during summer months to help with irrigation. The Tribe will continue to explore the need for potential flood control measures, while also seeking appropriate funding to help facilitate the development of a stormwater retention pond, as they feel that with climate change impacts, the retainage of stormwater will help curtail water shortages.									

TABLE 12-2
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Previous Plan: Yes=Y No=N (new strategy for 2024 update); Modified=M; Carried Forward=CF, Completed=C, Removed=R	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Lead Agency (listed first) and others potentially involved	Estimated Cost (High – H / Medium - M / Low - L	Sources of Funding	Timeline	Community Lifeline Addressed	Initiative Type: Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources
8—Consider enhanced building codes and structural retrofit projects that would harden new and existing structures from potential impacts hazards of concern.									
Y M CF	New and existing	All	1, 2, 3, 4, 5, 6, 8	Planning & Community Development and Tribal Council	High	General Fund	Short-term	Safety & Security, Communi-cations, Transpor-tation, HazMat, Water Systems	Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Natural Resources
2024 Status: Since completion of the 2018 plan, all new structures or structures which have been significantly remodeled have included the most stringent building codes in place. As the Tribe continues to develop building code data in the future within its land use authority, this will continue to be an element which is included in all future construction and retrofits.									
9—Construct and/or enhance where feasible, the Tribe's ongoing flood-mitigation efforts such as levees and drainage system maintenance programs to reduce or minimize the impacts from flooding within the Reservation.									
Y M CF	New and existing	Flood, Severe Weather	1, 2, 3, 4, 5, 6, 8	Planning & Community Development	High	Land Use Permitting Fees, Grant Funds, General Funds, BIA	Short-term,	Safety & Security, Water Systems	Property Protection, Prevention, Recovery, Structural Projects, Natural Resources
2024 Status: Since completion of the last plan, the Tribe has maintained the tribal-owned drainage systems, but has not constructed any new systems. The Tribe feels developing a program to address new levees or drainage systems is still relevant, and therefore this strategy is carried forward.									

TABLE 12-2
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Previous Plan: Yes=Y No=N (new strategy for 2024 update); Modified=M; Carried Forward=CF, Completed=C, Removed=R	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Lead Agency (listed first) and others potentially involved	Estimated Cost (High – H / Medium - M / Low - L	Sources of Funding	Timeline	Community Lifeline Addressed	Initiative Type: Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources
10—Develop a public outreach strategy and training efforts that maximizes the Tribe's capabilities through its ongoing emergency management (and other) programs that provide multiple messages that support all phases of emergency management, including, for example, the maintenance of a 14-day supply of food and water, evacuation planning, CERT training, Ham Radio Operators, ICS Training to insure NIMS compliance, or perhaps establish a Storm-Ready program, etc.									
Y M	New and Existing	All Hazards	3, 5, 6, 7	Emergency Management	Medium	Tribal General fund, FEMA HMGP	Short-Term	All	Emergency Services, Prevention, Public Info.
2024 Status: This continues to be a monthly topic within the EM group, as well as with weekly messaging tribal-wide. The various elements identified have been developed in conjunction with all departments and South Mason Fire and Rescue. During the annual preparedness fair, this will also be a focus area to ensure consistency in the dissemination of information.									
11—Conduct vulnerability assessments of water and wastewater utilities for exposure to all identified hazards of concern. This effort may include engineers and various subject matter experts. Once identified, replace vulnerable systems.									
Y CF	Existing	All Hazards	1, 2, 3, 4, 6, 7, 8	Planning & Community Development	High	FEMA Hazard Mitigation Grant funding	Short-term	Food, Hydration, Shelter; Water Systems	Emergency Services, Property Protection, Structural Projects
2024 Status: With completion of this 2024 HMP, information from the risk assessment will help identify areas of concern with respect to the water and wastewater utilities. Further studies with engineers and various subject matter experts may still be required. As such, the Tribe has carried forward this initiative.									
12—Review utility designs and standards for safety and competence under natural and human caused disasters, utilizing information from this Hazard Mitigation Plan for the natural hazards of concern.									

TABLE 12-2
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Previous Plan: Yes=Y No=N (new strategy for 2024 update); Modified=M; Carried Forward=CF, Completed=C, Removed=R	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Lead Agency (listed first) and others potentially involved	Estimated Cost (High – H / Medium - M / Low - L	Sources of Funding	Timeline	Community Lifeline Addressed	Initiative Type: Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources
N	New and Existing	All hazards	1, 2, 3, 4, 6, 7	EM	Low	General Fund, Land Use Permit Fees, Grants, BIA	Short-Term,	Safety & Security, Communi-cations, Energy, HazMat, Water Systems	Emergency Services, Property Protection, Prevention, Recovery
2024 Status: With completion of this 2024 update, the Tribe will utilize information from the risk assessment in determining its course forward with respect to this strategy.									
13—Develop a Reservation-wide comprehensive education program to educate the Tribal members about the hazards of concern on the Reservation, about mitigation opportunities, and about emergency management opportunities to become engaged and increase resilience of the Tribe during an emergency incident.									
Y	New and existing	All	2, 3, 5, 7	Emergency Management	Low	General Fund, Grant funds when available	Short-term, ongoing	All	Emergency Services, Prevention, Recovery, Public Info.
2024 Status: In conjunction with the completion of this HMP update, several outreach efforts were conducted to assist with distribution of information concerning the hazards of concern, as well as mitigation efforts to help reduce the impact of the hazards. The Tribe will also maintain the risk map portion of the planning process on its website, updating the maps as new data becomes available.									
14—Develop a protocol and system for capturing data for structure location (e.g., GIS) and damage occurring on the Reservation, including flood depths, dollar losses for all hazards impacting the Reservation, and the duration of impact from the event. This data should then be used to update the Tribe's Hazard Mitigation Plan.									

TABLE 12-2
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Previous Plan: Yes=Y No=N (new strategy for 2024 update); Modified=M; Carried Forward=CF, Completed=C, Removed=R	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Lead Agency (listed first) and others potentially involved	Estimated Cost (High – H / Medium - M / Low - L	Sources of Funding	Timeline	Community Lifeline Addressed	Initiative Type: Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources
N	New and existing	All	All	Emergency Management, Planning & Community Development, GIS	Low	General Fund, FEMA grant programs	Short-term,	Safety & Security, Energy, Communi-cations, Transpor-tation, HazMat, Water Systems	Emergency Services, Public Info., Recovery
2024 Status: During the 2024 development of this HMP, the Tribe did develop a critical facilities list in the GIS format. The Tribe will continue to keep that data updated on a regular basis to help ensure the critical facilities information remains current. With that in place, the Tribe will also be able to more easily capture impact data by critical facility, as well as maintaining historic impact records as identified in the plan maintenance section, to capture the relevant information more timely.									
15—Relocate public facilities that have been repeatedly impacted by other hazards to areas outside of the hazard area through acquisition projects funded by BRIC and HMGP.									
Y M CF	Existing	Flood, SW	1, 2, 3, 4, 6, 7, 8	Planning & Community Development, Executive Director/ Tribal Government	High	General Fund, BRIC & HMGP Grants, HUD, BIA	Long-Term	All	Emergency Services, Property Protection, Prevention, Recovery, Structural Projects
2024 Status: With completion of this 2024 HMP, the Tribe will again be eligible to seek grant funding under the various Stafford Act programs to facilitate potential mitigation efforts to relocate or improve impacted facilities. Two new projects identified through this effort include an upgrade to one of the tribal kitchens used as a shelter, as well as seeking grant funding for generators at the tribal gas station to allow for fueling during times when power outages occur.									

TABLE 12-2
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Previous Plan: Yes=Y No=N (new strategy for 2024 update); Modified=M; Carried Forward=CF, Completed=C, Removed=R	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Lead Agency (listed first) and others potentially involved	Estimated Cost (High – H / Medium - M / Low - L	Sources of Funding	Timeline	Community Lifeline Addressed	Initiative Type: Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources
16—Conduct hazardous tree/branch removal for vegetation close to existing structures or critical infrastructure to help reduce fire danger.									
N	Existing	Severe Weather, Wildfire	5, 6, 7, 8	Planning & Community Development	Low	General Fund, Land Use Permit Fees, BRIC and HMGP Grants, HUD, BIA	Long-Term	Energy	Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Natural Resources
17—Seek out and plan for alternative energy sources (for example, solar systems) to support development and resilience throughout the Reservation. This should also include the purchase of generators for existing structures until a new or redundant system can be established to ensure continuity of operations.									
N	New	All	All	Planning & Community Development, Natural Resources	High	General Fund, Land Use Permit Fees, BRIC & HMGP, BIA and HUD Grants	Long-Term	Energy, Communi-cations, Water Systems	Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources

TABLE 12-2
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Previous Plan: Yes=Y No=N (new strategy for 2024 update); Modified=M; Carried Forward=CF, Completed=C, Removed=R	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Lead Agency (listed first) and others potentially involved	Estimated Cost (High – H / Medium - M / Low - L	Sources of Funding	Timeline	Community Lifeline Addressed	Initiative Type: Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources
18-Explore the potential of a public safety program on the SIT through various granting opportunities. This includes: funding to construct a new law enforcement/court structure/emergency management structure; staffing of a fire department on the Reservation with appropriately trained fire professionals, EMTs, and/or Paramedics; and obtaining portable medical devices for staging at various locations throughout the SIT. This should also include emergency response equipment necessary to be fully operational and independent due to the required self-reliance of the tribe, including heavy construction equipment, search and rescue equipment, and four-wheel vehicles (e.g., gators or brush fire vehicles) to assist with evacuation for anyone injured from remote areas.									
N	New and Existing	All	All	Tribal Council, Police, EM	High	USDA Fire Grants, HLS	Long-term	All	Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources
19 - Expand the existing public safety facilities (police, courts, fire station on reservation) to include alternative power sources, such as solar power, to enable the structure to be utilized during power outages associated with several of the hazards of concern. This may include expansion of the structure to be utilized as a resilience center.									
N	New	All	1, 3, 4, 6, 7	Police and (Contracted) Fire Chiefs	High	US Dept. of Commerce, USDA, BIA	Long-term	Safety & Security	Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources

TABLE 12-2
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Previous Plan: Yes=Y No=N (new strategy for 2024 update); Modified=M; Carried Forward=CF, Completed=C, Removed=R	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Lead Agency (listed first) and others potentially involved	Estimated Cost (High – H / Medium - M / Low - L	Sources of Funding	Timeline	Community Lifeline Addressed	Initiative Type: Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources
20 - Seek out and apply for grant funding to enhance or update cybersecurity software, computers, networking, communications equipment, and equipment necessary to ensure interoperability on the SIT. This may include software, computer equipment, radio communications, dispatching services, inter-departmental communications, and expanding the alert and warning systems to include both siren and text alerts, to enhance response and recovery efforts. Once a new system is in place, develop necessary communications plans, which, when implemented, will help notify residents and staff of impending harm (e.g., storm surge, high tides, tsunamis, flooding, etc.).									
N	New	All	All	EM IT	High	BRIC, US Dept. of Commerce, BIA	Long-term	Communi-cations, Safety & Security; Health & Medical; Transpor-tation	Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources
21 - Continue working with the County and WA-DOT to stabilize areas repeatedly impacted by landslides to ensure continued ingress and egress in the area.									
N	New	All	3, 7	Executive Director, Tribal Council	High	US Dept. of Commerce, USDA, BIA	Long-term	Transpor-tation	Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources

TABLE 12-2
HAZARD MITIGATION ACTION PLAN MATRIX

Action Identified in Previous Plan: Yes=Y No=N (new strategy for 2024 update); Modified=M; Carried Forward=CF, Completed=C, Removed=R	Applies to New or Existing Assets	Hazards Mitigated	Objectives Met	Lead Agency (listed first) and others potentially involved	Estimated Cost (High – H / Medium - M / Low - L	Sources of Funding	Timeline	Community Lifeline Addressed	Initiative Type: Emergency Services, Property Protection, Prevention, Recovery, Structural Projects, Public Info., Natural Resources
22 - Seek out granting funding which will allow for the continued study of the impacts of climate change on the SIT, as well as potential mitigation efforts which will help reduce those impacts. This may include maintaining weather records and data to help identify the changing climate and its impact on the SIT. As available, apply for grants to fund efforts which will help reduce the impact of climate change on the SIT, its People, and the environment.									
N	All	All	1, 2, 3, 4, 6, 7, 8	Natural Resources	High	EPA, USDA, BIA	Long-term	Food, Hydration, Shelter, Energy, Water Systems	Emergency Services, Property Protection, Prevention, Recovery, Natural Resources
23 – Seek out grant funding to construct a new health/medical clinic on the SIT.									
N	New	All	All	Health	H	IHS, BRIC, HMPG	Long-term	Health and Medical	Prevention, Recovery
24 – Seek out grant funding to enhance existing Community Kitchen, which serves as main shelter on Reservation.									
N	Existing	All	All	EM	H	BRIC, HMPG	Long-term	Food, Hydration and Shelter	Prevention, Recovery
25 – Seek out grant funding to enhance existing gas station to include, among other possibilities, alternate power source to ensure availability of gas pumping capabilities during power outages.									
N	Existing	All	All	Public Safety (EM, Police, Fire – contracted)	H	BRIC, HMPG	Long-term	Safety & Security	Prevention, Recovery

12.3 BENEFIT/COST REVIEW

Once established, the action plan must then be prioritized according to some form of a benefit/cost analysis of the proposed projects and their associated costs. The benefits of proposed projects were

weighed against estimated costs as part of the project prioritization process. The benefit/cost analysis was not of the detailed variety required by FEMA for project grant eligibility under the Hazard Mitigation Grant Program (HMGP) and Building Resilient Infrastructure and Communities (BRIC) grant program. A less formal approach was used because some projects may not be implemented for up to 10 years, and associated costs and benefits could change dramatically in that time. Therefore, a review of the apparent benefits versus the apparent cost of each project was performed. Parameters were established for assigning subjective ratings (high, medium, and low) to the costs and benefits of these projects.

Cost ratings were defined as follows:

- **High**—Existing funding will not cover the cost of the project; implementation would require new revenue through an alternative source (for example, bonds or grants).
- **Medium**—The project could be implemented with existing funding but would require a re-apportionment of the budget or a budget amendment, or the cost of the project would have to be spread over multiple years. If partial funding is available, or the project is a joint project with other agencies, *Partial* is also identified as an option.
- **Low**—The project could be funded under the existing budget. The project is part of or can be part of an ongoing existing program.

Benefit ratings were defined as follows:

- **High—**Project will provide an immediate reduction of risk exposure for life and property.
- **Medium—**Project will have a long-term impact on the reduction of risk exposure for life and property, or project will provide an immediate reduction in the risk exposure for property.
- **Low—**Long-term benefits of the project are difficult to quantify in the short term.

Using this approach, projects with positive benefit versus cost ratios (such as high over high, high over medium, medium over low, etc.) are considered cost-beneficial and are prioritized accordingly.

For many of the strategies identified in this action plan, the Tribe may seek financial assistance under the HMGP or BRIC programs, both of which require detailed benefit/cost analyses. These analyses will be performed on projects at the time of application using the FEMA benefit-cost model. For projects not seeking financial assistance from grant programs that require detailed analysis, the Tribe reserves the right to define “benefits” according to parameters that meet the goals and objectives of this plan.

12.4 ACTION PLAN PRIORITIZATION

Table 12-3 lists the priority of each initiative, using the same parameters used in selecting the initiatives. A qualitative benefit-cost review was performed for each of these initiatives. The priorities are defined as follows:

- **High Priority**—A project that meets multiple objectives (i.e., multiple hazards), has benefits that exceed cost, has funding secured or is an ongoing project and meets eligibility

requirements for the HMGP or PDM grant program. High priority projects can be completed in the short term (1 to 5 years).

- **Medium Priority**—A project that meets goals and objectives, that has benefits that exceed costs, and for which funding has not been secured but that is grant eligible under HMGP, PDM or other grant programs. Project can be completed in the short term, once funding is secured. Medium priority projects will become high priority projects once funding is secured.
- **Low Priority**—A project that will mitigate the risk of a hazard, that has benefits that do not exceed the costs or are difficult to quantify, for which funding has not been secured, that is not eligible for HMGP or PDM grant funding, and for which the time line for completion is long term (1 to 10 years). Low priority projects may be eligible for other sources of grant funding from other programs.

TABLE 12-3
ACTION PLAN PRIORITIZATION

	No. of Objectives Met	Benefits	Costs	Benefits Equal or Exceed Costs (Y or N)	Grant-Eligible (Y or N)	Can Be Funded Under Existing Programs or Budgets (Y or N)	Priority
1	6	High	High	Yes	Yes	Yes	High
2	8	High	Low	Yes	Yes	Yes	High
3	5	High	Medium	Yes	Yes	Yes	High
4	7	High	Low	Yes	No	Yes	High
5	7	High	Medium	Yes	No	Yes	High
6	8	High	Medium	Yes	No	Yes	High
7	8	High	Medium	Yes	No	No	Medium
8	7	High	High	Yes	No	Yes	High
9	7	High	High	Yes	Yes	No	High
10	4	High	Medium	Yes	No	Yes	High
11	7	High	High	Yes	No	Yes	High
12	6	High	Low	Yes	No	Yes	High
13	4	High	Low	Yes	Yes	Yes	High
14	8	High	Low	Yes	Yes	No	Medium
15	7	High	High	Yes	Yes	Yes	High
16	4	High	Low	Yes	Yes	Yes	High
17	8	High	High	Yes	Yes	No	High
18	8	High	High	Yes	Yes	No	High
19	5	High	High	Yes	Yes	No	High

TABLE 12-3
ACTION PLAN PRIORITIZATION

	No. of Objectives Met	Benefits	Costs	Benefits Equal or Exceed Costs (Y or N)	Grant-Eligible (Y or N)	Can Be Funded Under Existing Programs or Budgets (Y or N)	Priority
20	8	High	High	Yes	Yes	No	High
21	2	High	High	Yes	Yes	No	High
22	7	High	High	Yes	Yes	Partial	High
23	8	High	High	Yes	Yes	No	High
24	8	High	High	Yes	Yes	No	High
25	8	High	High	Yes	Yes	No	High

12.5 ADDITIONAL HAZARD MITIGATION PROJECTS AND EFFORTS

In addition to the above project status, the Tribe has also completed other mitigation-related efforts, including land use development trends which have reduced the impacts of various hazards of concern. Those projects include, but are not limited to:

- Wetland projects, which reduce impact from flooding.
- Fish Habitat Restoration Project.
- Establish and enforce a burn-bans on Tribal owned lands, reducing the risk of wildfire.
- For those projects off of the Reservation or on non-trust lands, establish a system whereby the Tribe's building ordinances are applied to ensure the highest level of integrity for construction.
- The Tribe also continues to work in partnership with a number of different agencies and organizations for various projects since completion of the Tribe's 2018 HMP, including with FEMA and state agencies. Additional mitigation efforts (from FY2022 Annual Report):
- Dangerous Tree Removal that brought safety to the water tower area and needed firewood to Elders.
- Hazardous Weather response: Deicing 24/7 of tribal roads and parking lots during inclement weather conditions.

Natural Resources Department[40]

The Natural Resources Department is involved in environmental monitoring, protection, and restoration in marine, freshwater, and terrestrial environments. Projects include a wide range of activities from stormwater monitoring, plant and animal population studies and climate change analysis to full scale river restoration projects and debris removal. Staff use traditional ecological knowledge and insights from

[40] Natural Resources – Squaxin Island Tribe

Tribal citizens to influence their work to ensure availability of traditional use materials and native foods for current and future generations.

The SIT participates in natural resources enhancement and protection programs with the Northwest Indian Fisheries Commission, the Puget Sound Water Quality Authority, the Washington State Department of Fish & Wildlife, and other groups and agencies to ensure that today's decisions provide for a healthy future. Its Mission: To maintain a leadership role in perpetuating natural resources including water quality, fish, shellfish, wildlife, timber and plants, while promoting, preserving, protecting and restoring habitat. Mother Earth and her resources are the cultural foundation for the people of Squaxin Island. The Natural Resources department works to sustain and enhance those tribal resources.

Policy Partnerships

The Tribe participates in several policy organizations aimed at protecting natural resources within the planning area, such as with FEMA, Environmental Protection Agency (EPA), U.S. Army Corps of Engineers (USACE), Climate Change, and other studies. By collaborating with various stakeholders, the Tribe is able to increase support for projects restoring and preserving resources important to the Tribe.

Protection

In addition to restoring and acquiring parcels for conservation, the Tribe also works to protect properties outside of Tribal control by ensuring existing regulations are properly implemented and enforced. This involves collaboration and occasionally confrontation with a variety of local, state, and federal rule-makers and enforcers. Fish and wildlife know no jurisdictional boundaries; therefore, it is critical to protect the environment on and off Tribal land.

Conservation

Habitat restoration is critical to maintaining and enhancing cultural opportunities for Tribal citizens; however, projects on private land are often limited and have no guarantee of longevity. Thus, the Tribe has continued to focus on land acquisition as a means of habitat conservation. Benefits of an acquisition strategy for conservation include:

- Ensuring protection from development in perpetuity;
- Allows for larger scale restoration projects that would not otherwise be practical on occupied land (e.g., bank armoring removal, floodplain reconnection); and
- Provides exclusive access to Tribal citizens to exercise their cultural practices.

12.6 MITIGATION MEASURES AND PROJECT CLOSEOUT

Mitigation measures and project closeouts are the responsibility of the department identified in the actual strategy or identified by grant application, as well as the grant management personnel. The Planning Team shall share information regarding projects as they are implemented and completed.

The Tribe has limited staff. Initiation and submission of projects utilizing federal or state grant funds falls under the Tribe's Financial Office for monitoring, as well as the respective Department which the funds benefit,

and Tribal Council for approval of grant submissions and acceptance. Squaxin Island Tribe's policy further assures that:

- The applying department has the legal authority to apply for assistance and the capability to ensure proper planning, management, and completion of the project, including funds sufficient to pay any matching share of the project.
- Authorized representatives of the funding agency will be granted access to and the right to examine all records related to the award.
- Federal and federally originating state grant funded projects will comply with all federal regulations, inclusive of personnel administration, non-discrimination and civil rights, labor standards, environmental standards, historic preservation, animal welfare, lobbying and political activities, drug-free workplace, maintenance of effort, and financial standards including audit and non-supplanting of funds.

In addition to the above:

- The SIT'S policy includes a process assuring departmental review, financial (budget) approval, and approval by resolution of the Tribal Council.
- Projects utilizing tribal funds are authorized through tribal authorization processes, which is similar to the Tribe's Grant Development and Review Policy and assures departmental review, financial (budget) approval, and approval by resolution of the Tribal Council.
- Those projects specific to the HMP mitigation strategies, including those incorporating the Community Wildfire Protection Plan will be reviewed annually by the Planning Team and Emergency Management Director, among others.

CHAPTER 13.
IMPLEMENTATION AND MAINTENANCE

13.1 PLAN ADOPTION

A hazard mitigation plan must document that it has been formally adopted by the governing body of the jurisdiction requesting federal approval of the plan (44 CFR Section 201.7(c)(5)). DMA compliance and its benefits cannot be achieved until the plan is adopted. This plan was adopted by the Tribal Council on xxx, 2024. A copy of the resolution is provided in Figure 13-1.

Figure 13-1 Resolution Adopting Hazard Mitigation Plan

13.2 PLAN MAINTENANCE STRATEGY

A hazard mitigation plan must present a plan maintenance process that includes the following (44 CFR Section 201.7(c)(4)):

- A section describing the method and schedule for monitoring, evaluating, and updating the mitigation plan over a 5-year cycle; a system for monitoring implementation of mitigation measures and project closeouts.
- A system for reviewing progress on achieving goals, as well as specific activities and projects identified in the mitigation plan.
- A process by which Tribal governments incorporate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate.
- A discussion on how the community will continue public participation in the plan maintenance process.

This chapter details the formal process that will ensure that the Hazard Mitigation Plan remains an active and relevant document and that the SIT maintain its eligibility for applicable funding sources. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing an updated plan every five years. This chapter also describes how public participation will be integrated throughout the plan maintenance and implementation process. It also explains how the mitigation strategies outlined in this Plan will be incorporated into existing planning mechanisms and programs, such as comprehensive land-use planning processes, capital improvement planning, and building code enforcement and implementation. The Plan's format allows sections to be reviewed and updated when new data become available, resulting in a plan that will remain current and relevant.

13.2.1 Plan Implementation

The effectiveness of the hazard mitigation plan depends on its implementation and incorporation of its action items into existing local plans, policies, and programs. Together, the action items in the Plan provide a framework for activities that the SIT can implement over the next five years. The Planning Team has established goals and objectives and has prioritized mitigation actions that will be implemented through existing plans, policies, and programs. Implementation of the long-term and short-term objectives/goals will be dependent on securing funding for each of the strategies identified in the plan. The Tribe will actively pursue a variety of funding opportunities identified in the various plans and prioritized by the various departments and programs under the direction of the SIT Council.

The Emergency Manager will have lead responsibility for overseeing the Plan implementation and maintenance strategy. Plan implementation and evaluation will be a shared responsibility among all departments and agencies identified as lead agencies in the mitigation action plan.

The implementation of all short-term mitigation actions will primarily be monitored by the Emergency Manager, or their designee, on an ongoing basis until implementation is complete, unless identified

otherwise. Long-term actions being actively implemented will be monitored on an ongoing basis, or at least annually as needed. Long-term actions planned for the future will be reviewed during plan updates every five years.

The system for reviewing progress on achieving goals, objectives, and specific actions included in the mitigation strategy will be based on a progress report of all objectives and actions. This progress report will be reviewed annually by the SIT. As described in the previous section, progress on mitigation actions will be described in an annual report to the SIT Council and in the five-year update of the Hazard Mitigation Plan.

Project Tracking

In addition to the work products described in approved work plans for projects funded by FEMA's Building Resilient Infrastructure and Communities (BRIC) Program (previously Pre-Disaster Mitigation Grants), the Hazard Mitigation Grant Program, or other grant programs, quarterly or semi-annual (depending on reporting requirements of funding agencies) performance reports that identify accomplishments toward completing the work plan commitments, a discussion of the work performed for all work plan components, a discussion of any existing or potential problem areas that could affect project completion, budget status, and planned activities for the subsequent quarter (and/or annual and/biannual basis depending on the funding agency requirements and Tribal regulations) will be submitted to the funding agency by the assigned Project Manager and/or Grant Coordinator. The agency-specific final grant closeout documents will also be prepared by the appropriate tribal personnel at the conclusion of the performance period and submitted to the funding agency.

13.2.2 Planning Team

The existing Planning Team oversaw the development of the HMP and made recommendations on key elements of the plan, including the maintenance strategy. The principal role of the Planning Team in this plan maintenance strategy will be to review the annual progress report and provide input on possible enhancements to be considered at the next update. Future plan updates will be overseen by a Planning Team similar to the one that participated in this plan development process. As such, keeping an interim Planning Team intact will provide a head-start on the next plan. It will be the Planning Team's role to review the progress report in an effort to identify issues needing to be addressed by future plan updates.

13.2.3 Annual Progress Report

The minimum task of the ongoing annual Planning Team meeting will be the evaluation of the progress of its individual action plan during a 12-month performance period. This review will include the following:

- Summary of any hazard events and the impact these events had on the planning area;
- Review of mitigation success stories;
- Review of continuing public involvement;
- Brief discussion about why targeted strategies were not completed;

- Re-evaluation of the action plan to determine if the timeline for identified projects needs to be amended (such as changing a long-term project to a short-term one because of new funding);
- Recommendations for new projects;
- Changes in or potential for new funding options (grant opportunities);
- Impact of any other planning programs or initiatives that involve hazard mitigation.

The Planning Team has created a template for preparing a progress report (see Appendix B). The Planning Team will prepare a formal annual report on the progress of the plan that will be presented to Tribal Council during the reporting period.

Annual progress reporting is not a requirement specified under 44 CFR. However, it may enhance opportunities for funding. While failure to implement this component of the plan maintenance strategy will not jeopardize compliance under the DMA, it may jeopardize the opportunity to leverage funding opportunities with other agencies.

13.2.4 Plan Update

CFR 201.7 requires that tribal hazard mitigation plans be reviewed, revised if appropriate, and resubmitted for approval in order to remain eligible for benefits under the DMA (44 CFR, Section 201.7(d)(3)). The SIT intends to update the hazard mitigation plan on a 5-year cycle from the date of plan approval. This cycle may be accelerated to less than five years based on the following triggers:

- A Presidential Disaster Declaration that impacts the planning area;
- A hazard event that causes loss of life; or
- New data becomes available which significantly changes the findings of the risk assessment.

It will not be the intent of future updates to develop a completely new hazard mitigation plan for the planning area. The update will, at a minimum, include the following elements:

- The update process will be convened through a Planning Team.
- The hazard risk assessment will be reviewed and, if necessary, updated using best available information and technologies.
- The action plan will be reviewed and revised to account for any initiatives completed, dropped, or changed and to account for changes in the risk assessment or new policies identified under other planning mechanisms (such as the comprehensive plan).
- The draft update will be sent to appropriate agencies and organizations for comment.
- The public will be given an opportunity to comment on the update prior to adoption.
- Tribal Council will adopt the updated plan.

13.2.5 Continuing Public Involvement

The public will continue to be apprised of the plan's progress through the Tribe's website and by providing copies of annual progress reports at various public outreach meetings, including the SIT Annual General Meeting. Copies of the plan will be shared with the various Tribal departments and tribal citizens as requested. Upon initiation of future update processes, a new public involvement strategy will be initiated based on guidance from a new Planning Team. This strategy will be based on the needs and capabilities of the Tribe at the time of the update. At a minimum, this strategy will include the use of social media tools, the Tribe's website, and also potentially utilizing media outlets within the planning area.

13.2.6 Incorporation into Other Planning Mechanisms

The information on hazard, risk, vulnerability, and mitigation contained in this plan is based on the best science and technology available at the time this plan was prepared. The SIT, through its various on-going capital improvement projects has planned for the impact of natural hazards. The plan development process provided the opportunity to review and expand on policies in these planning mechanisms. The SIT has done extensive planning and assessment with respect to climate change, threat and hazard assessments, forest management planning, and appropriate land use zoning as it relates to the relocation of vulnerable areas of the reservation. Various policies have been regularly updated and are complementary documents that work together to achieve the goal of reducing risk exposure.

The Tribe will create a linkage between the hazard mitigation plan and future land use plans by identifying a mitigation initiative as such and giving that initiative a high priority. Other planning processes and programs to be coordinated with the recommendations of the hazard mitigation plan may include the following:

- FEMA Flood Insurance Studies
- FEMA's Risk Map Program Studies and Reports
- FEMA's RAPT data and information
- Emergency response plans
- Capital improvement programs
- Tribal codes
- Community design guidelines
- Restoration plans
- Water-efficient landscape design guidelines
- Stormwater management programs
- Vegetation Studies
- Transportation Plans
- Climate Adaptation Plans
- Social Vulnerability Index Utilization and Implementation Tool (SUIT)

Some action items do not need to be implemented through regulation. Instead, these items can be implemented through the creation of new educational programs, continued interagency coordination, mutual aid agreements, or improved public participation. As information becomes available from other planning mechanisms that can enhance this plan, that information will be incorporated via the update process.

REFERENCES

Ahrens, James. 2013. Lightning Fires and Lightning Strikes. National Fire Protection Association Fire Analysis and Research Division. Accessed at: https://www.nfpa.org/News-and-Research/Data-research-and-tools/US-Fire-Problem/Lightning-Fires-and-Lightning-Strikes

American Geosciences Institute. 2020. How much do landslides cost the U.S. in terms of monetary losses? Accessed online 21 July 2022. Available at: https://www.americangeosciences.org/critical-issues/faq/how-much-do-landslides-cost-terms-monetary-losses

Climate Impacts Group. 2022. Climate Impacts Group website. Accessed online at http://cses.washington.edu/cig/res/res.shtml

Federal Emergency Management Agency (FEMA). The Disaster Process & Disaster Aid Programs. Federal Emergency Management Agency Website Accessed 13 July 2023 at https://www.fema.gov/pdf/rrr/dec_proc.pdf

Federal Emergency Management Agency (FEMA). National Flood Insurance Program, Community Rating System; CRS Coordinator's Manual.

Frankle, A., E. Wirth; N. Marafi, J. Vidale, W. Stephenson. Bulletin of the Seismological Society of America. (2018) 108 (5A):2347-2369. Accessed online 11 July 2022, Available at: https://pubs.geoscienceworld.org/ssa/bssa/article-abstract/108/5A/2347/544772/Broadband-Synthetic-Seismograms-for-Magnitude-9?redirectedFrom=fulltext

Headwater Economics. 2018. "The Full Community Costs of Wildfire". Accessed online at: https://headwaterseconomics.org/wp-content/uploads/full-wildfire-costs-report.pdf

International Strategy for Disaster Reduction. (2008). "Disaster Risk Reduction Strategies and Risk Management Practices: Critical Elements for Adaptation to Climate Change."

Ludwin, Ruth, 2006, Historic earthquake catalog for Cascadia--1793-1929: Pacific Northwest Seismic Network.online at http://www.pnsn.org/NEWS/PRESS_RELEASES/CASCAT2006.html

Meehl, G., and Tebaldi, C. 2004. More Intense, More Frequent, and Longer Lasting Heat Waves in the 21st Century. Accessed online at: https://science.sciencemag.org/content/305/5686/994/tab-pdf

Miller, I.M., Morgan, H., Mauger, G., Newton, T., Weldon, R., Schmidt, D., Welch, M., Grossman, E. 2018. Projected Sea Level Rise for Washington State – A 2018 Assessment. (Updated 07/2019.)

National Weather Service (NWS). Wind Chill Chart. Accessed online at: https://www.weather.gov/safety/cold-faqs

NOAA National Centers for Environmental Information. Accessed various times. Available online at: National Centers for Environmental Information (NCEI) (noaa.gov)

NOAA. National Climatic Data Center website. Accessed various dates, 2022. Storm Events Database - Search Page | National Centers for Environmental Information (noaa.gov)

OTA (Congressional Office of Technology Assessment). 1993. Preparing for an Uncertain Climate, Vol. I. OTA–O–567. U.S. Government Printing Office, Washington, D.C.

Pacific Northwest Seismic Network (PNSN). 2022. Cascadia Historic Earthquake Catalog, 1793-1929 Covering Washington, Oregon, and Southern British Columbia. Accessed online at http://assets.pnsn.org/CASCAT2006/Index_152_216.html

Sherrod, D. R., Mastin, L. G., Scott, W. E., and Schilling, S. P., 1997, Volcano hazards at Newberry Volcano, Oregon: U.S. Geological Survey Open-File Report 97-513, 14 p., 1 plate, scale 1:100,000, Accessed online on December 9, 2019 at: https://pubs.usgs.gov/of/1997/0513/

Tilling, Robert, I. et.al. 1990. Eruptions of Mount St. Helens: Past, Present, and Future, U.S. Geological Survey Special Interest Publication.

U.S. Army Corps of Engineers, Seattle District. (2021). Technical Assistance Response for the January Coastal Storm Event of 2021.

U.S. Environmental Protection Agency (EPA). 2006. Excessive Heat Events Guidebook. EPA 430-B-06-005. Available online at http://www.epa.gov/heatisld/about/pdf/EHEguide_final.pdf

U.S. Environmental Protection Agency (EPA). 2023. Climate Change Indicators in the United States. U.S. Environmental Protection Agency, Washington, DC, USA. Available online at: Climate Change Indicators in the United States | US EPA

U.S. Environmental Protection Agency (EPA). 2011. Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act, EPA Response to Public Comments. U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency (EPA). 2022. Climate Change Facts: Answers to Common Questions. U.S. EPA Website. Accessed at: https://www.epa.gov/climate-research

U.S. Geological Survey (USGS). 1989. The Severity of an Earthquake. U.S. Government Printing Office: 1989-288-913. Accessed online at: http://pubs.usgs.gov/gip/earthq4/severity_text.html

U.S. Geological Survey (USGS). An Atlas of ShakeMaps for Selected Global Earthquakes. U.S. Geological Survey Open-File Report. Prepared by Allen, T.I., Wald, D.J., Hotovec, A.J., Lin, K., Earle, P.S. and Marano, K.D.

U.S. Geological Survey (USGS). 2022. USGS Fault Database, accessed online at https://earthquake.usgs.gov/hazards/qfaults/ or U.S. Quaternary Faults (arcgis.com)

U.S. Geological Survey (USGS). 2022. The Modified Mercalli Intensity Scale. USGS website accessed online https://www.usgs.gov/programs/earthquake-hazards/modified-mercalli-intensity-scale?qt-science_center_objects=0#qt-science_center_objects

U.S. Geological Survey (USGS). 2022. *Landslides 101*. 2020. Accessed 21 July 2022. Available online https://www.usgs.gov/natural-hazards/landslide-hazards/science/landslides-101?qt-science_center_objects=0#qt-science_center_objects

U.S. Global Change Research Program (USGCRP). 2009. Global Climate Change Impacts in the United States. Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson (eds.). United States Global Change Research Program. Cambridge University Press, New York, NY, USA.

Vaisala, 2022 Annual Report. Accessed 27 Oct 2023. Available online at: 2022 Annual Lightning Report (vaisala.com)

Washington State Enhanced Hazard Mitigation Plan. (Various editions 2013, 2018, 2023). Accessed various times. Available online at: https://mil.wa.gov/enhanced-hazard-mitigation-plan

Western States Seismic Policy Council. 1964 Alaska Tsunami. Accessed 18 Aug 2022. Available online at: 1964 Alaska Tsunami - Western States Seismic Policy Council (wsspc.org)

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APPENDIX A.
ACRONYMS AND DEFINITIONS

APPENDIX A.
ACRONYMS AND DEFINITIONS

ACRONYMS

CFR—Code of Federal Regulations

cfs—cubic feet per second

CPRI – Calculated Priority Risk Index

CIP—Capital Improvement Plan

CRS—Community Rating System

DFIRM—Digital Flood Insurance Rate Maps

DHS—Department of Homeland Security

DMA —Disaster Mitigation Act

EAP—Emergency Action Plan

EPA—U.S. Environmental Protection Agency

ESA—Endangered Species Act

FEMA—Federal Emergency Management Agency

FERC—Federal Energy Regulatory Commission

FIRM—Flood Insurance Rate Map

FIS—Flood Insurance Study

GIS—Geographic Information System

HAZUS-MH—Hazards, United States-Multi Hazard

HMGP—Hazard Mitigation Grant Program

IBC—International Building Code

IRC—International Residential Code

MM—Modified Mercalli Scale

NEHRP—National Earthquake Hazards Reduction Program

NFIP—National Flood Insurance Program

NOAA—National Oceanic and Atmospheric Administration

NWS—National Weather Service

PDM—Pre-Disaster Mitigation Grant Program

PDI—Palmer Drought Index

PGA—Peak Ground Acceleration

PHDI—Palmer Hydrological Drought Index

SFHA—Special Flood Hazard Area

SHELDUS—Special Hazard Events and Losses Database for the US

SPI—Standardized Precipitation Index

USGS—U.S. Geological Survey

DEFINITIONS

100-Year Flood: The term "100-year flood" can be misleading. The 100-year flood does not necessarily occur once every 100 years. Rather, it is the flood that has a 1 percent chance of being equaled or exceeded in any given year. Thus, the 100-year flood could occur more than once in a relatively short period of time. The Federal Emergency Management Agency (FEMA) defines it as the 1 percent annual chance flood, which is now the standard definition used by most agencies and by the National Flood Insurance Program (NFIP).

Acre-Foot: An acre-foot is the amount of water it takes to cover 1 acre to a depth of 1 foot. This measure is used to describe the quantity of storage in a water reservoir. An acre-foot is a unit of volume. One acre foot equals 7,758 barrels; 325,829 gallons; or 43,560 cubic feet. An average household of four will use approximately 1 acre-foot of water per year.

Asset: An asset is any man-made or natural feature that has value, including, but not limited to, people; buildings; infrastructure, such as bridges, roads, sewers, and water systems; lifelines, such as electricity and communication resources; and environmental, cultural, or recreational features such as parks, wetlands, and landmarks.

Base Flood: The flood having a 1% chance of being equaled or exceeded in any given year, also known as the "100-year" or "1% chance" flood. The base flood is a statistical concept used to ensure that all properties subject to the National Flood Insurance Program (NFIP) are protected to the same degree against flooding.

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" and "drainage basins."

Benefit: A benefit is a net project outcome and is usually defined in monetary terms. Benefits may include direct and indirect effects. For the purposes of benefit-cost analysis of proposed mitigation measures, benefits are limited to specific, measurable, risk reduction factors, including reduction in expected property losses (buildings, contents, and functions) and protection of human life.

Benefit/Cost Analysis: A benefit/cost analysis is a systematic, quantitative method of comparing projected benefits to projected costs of a project or policy. It is used as a measure of cost effectiveness.

Building: A building is defined as a structure that is walled and roofed, principally aboveground, and permanently fixed to a site. The term includes manufactured homes on permanent foundations on which the wheels and axles carry no weight.

Calculated Priority Risk Index: The calculated priority risk index (CPRI) is the method utilized for the ranking of hazards. It is a calculation to sort the risks from highest to lowest by multiplying the scoring columns.

Capability Assessment: A capability assessment provides a description and analysis of a community's current capacity to address threats associated with hazards. The assessment includes two components: an inventory of an agency's mission, programs, and policies, and an analysis of its capacity to carry them out. A capability assessment is an integral part of the planning process in which a community's actions to reduce losses are identified, reviewed, and analyzed, and the framework for implementation is identified. The following capabilities were reviewed under this assessment:

- Legal and regulatory capability
- Administrative and technical capability
- Fiscal capability

Community Rating System (CRS): The CRS is a voluntary program under the NFIP that rewards participating communities (provides incentives) for exceeding the minimum requirements of the NFIP and completing activities that reduce flood hazard risk by providing flood insurance premium discounts.

Critical Area: An area defined by state or local regulations as deserving special protection because of unique natural features or its value as habitat for a wide range of species of flora and fauna. A sensitive/critical area is usually subject to more restrictive development regulations.

Critical Facility: Facilities and infrastructure that are critical to the health and welfare of the population. These become especially important after any hazard event occurs. For the purposes of this plan, critical facilities include:

- Structures or facilities that produce, use, or store highly volatile, flammable, explosive, toxic and/or water reactive materials;
- Hospitals, nursing homes, and housing likely to contain occupants who may not be sufficiently mobile to avoid death or injury during a hazard event.
- Police stations, fire stations, vehicle and equipment storage facilities, and emergency operations centers that are needed for disaster response before, during, and after hazard events, and
- Public and private utilities, facilities and infrastructure that are vital to maintaining or restoring normal services to areas damaged by hazard events.
- Government facilities.

For the purposes of this planning effort, the Planning Team elected to define all structures on the reservation, including culturally significant areas, as critical facilities due to the impact the loss of one structure would have on the Tribe.

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

Dam: Any artificial barrier or controlling mechanism that can or does impound 10 acre-feet or more of water.

Dam Failure: Dam failure refers to a partial or complete breach in a dam (or levee) that impacts its integrity. Dam failures occur for a number of reasons, such as flash flooding, inadequate spillway size, mechanical failure of valves or other equipment, freezing and thawing cycles, earthquakes, and intentional destruction.

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

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

Debris Slide: Debris slides consist of unconsolidated rock or soil that has moved rapidly down slope. They occur on slopes greater than 65 percent.

Disaster Mitigation Act of 2000 (DMA); The DMA is Public Law 106-390 and is the latest federal legislation enacted to encourage and promote proactive, pre-disaster planning as a condition of receiving financial assistance under the Robert T. Stafford Act. The DMA emphasizes planning for disasters before they occur. Under the DMA, a pre-disaster hazard mitigation program, and new requirements for the national post-disaster hazard mitigation grant program (HMGP) were established.

Drainage 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. Drainage basins are also referred to as **watersheds** or **basins**.

Drought: Drought is a period of time without substantial rainfall or snowfall from one year to the next. Drought can also be defined as the cumulative impacts of several dry years or a deficiency of precipitation over an extended period of time, which in turn results in water shortages for some activity, group, or environmental function. A hydrological drought is caused by deficiencies in surface and subsurface water supplies. A socioeconomic drought impacts the health, well-being, and quality of life or starts to have an adverse impact on a region. Drought is a normal, recurrent feature of climate and occurs almost everywhere.

Earthquake: An earthquake is defined as a sudden slip on a fault, volcanic or magmatic activity, and sudden stress changes in the earth that result in ground shaking and radiated seismic energy. Earthquakes can last from a few seconds to over 5 minutes, and have been known to occur as a series of tremors over a period of several days. The actual movement of the ground in an earthquake is seldom the direct cause of injury or death. Casualties may result from falling objects and debris as shocks shake, damage, or demolish buildings and other structures.

Exposure: Exposure is defined as the number and dollar value of assets considered to be at risk during the occurrence of a specific hazard.

Extent: The extent is the size of an area affected by a hazard.

Fire Behavior: Fire behavior refers to the physical characteristics of a fire and is a function of the interaction between the fuel characteristics (such as type of vegetation and structures that could burn), topography, and weather. Variables that affect fire behavior include the rate of spread, intensity, fuel consumption, and fire type (such as underbrush versus crown fire).

Fire Frequency: Fire frequency is the broad measure of the rate of fire occurrence in a particular area. An estimate of the areas most likely to burn is based on past fire history or fire rotation in the area, fuel conditions, weather, ignition sources (such as human or lightning), fire suppression response, and other factors.

Flash Flood: A flash flood occurs with little or no warning when water levels rise at an extremely fast rate

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).

Flood Insurance Study: A report published by the Federal Insurance and Mitigation Administration for a community in conjunction with the community's Flood Insurance rate Map. The study contains such background data as the base flood discharges and water surface elevations that were used to prepare the FIRM. In most cases, a community FIRM with detailed mapping will have a corresponding flood insurance study.

Floodplain: Any land area susceptible to being inundated by flood waters from any source. A flood insurance rate map identifies most, but not necessarily all, of a community's floodplain as the Special Flood Hazard Area (SFHA).

Floodway: Floodways are areas within a floodplain that are reserved for the purpose of conveying flood discharge without increasing the base flood elevation more than 1 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 located in the floodplain but outside of the floodway. Some development is generally allowed in these areas, with a variety of restrictions. On maps that have identified and delineated a floodway, this would be the area beyond the floodway boundary that can be subject to different regulations.

Fog: Fog refers to a cloud (or condensed water droplets) near the ground. Fog forms when air close to the ground can no longer hold all the moisture it contains. Fog occurs either when air is cooled to its dew point or the amount of moisture in the air increases. Heavy fog is particularly hazardous because it can restrict surface visibility. Severe fog incidents can close roads, cause vehicle accidents, cause airport delays, and impair the effectiveness of emergency response. Financial losses associated with transportation delays caused by fog have not been calculated in the United States but are known to be substantial.

Freeboard: Freeboard is the margin of safety added to the base flood elevation.

Frequency: For the purposes of this plan, frequency refers to how often a hazard of specific magnitude, duration, and/or extent is expected to occur on average. Statistically, a hazard with a 100-year frequency

is expected to occur about once every 100 years on average and has a 1 percent chance of occurring any given year. Frequency reliability varies depending on the type of hazard considered.

Fujita Scale of Tornado Intensity: Tornado wind speeds are sometimes estimated on the basis of wind speed and damage sustained using the Fujita Scale. The scale rates the intensity or severity of tornado events using numeric values from F0 to F5 based on tornado wind speed and damage. An F0 tornado (wind speed less than 73 miles per hour (mph)) indicates minimal damage (such as broken tree limbs), and an F5 tornado (wind speeds of 261 to 318 mph) indicates severe damage.

Goal: A goal is a general guideline that explains what is to be achieved. Goals are usually broad-based, long-term, policy-type statements and represent global visions. Goals help define the benefits that a plan is trying to achieve. The success of a hazard mitigation plan is measured by the degree to which its goals have been met (that is, by the actual benefits in terms of actual hazard mitigation).

Geographic Information System (GIS): GIS is a computer software application that relates data regarding physical and other features on the earth to a database for mapping and analysis.

Hazard: A hazard is a source of potential danger or adverse condition that could harm people and/or cause property damage.

Hazard Mitigation Grant Program (HMGP): Authorized under Section 202 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the HMGP is administered by FEMA and provides grants to states, tribes, and local governments to implement hazard mitigation actions after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to disasters and to enable mitigation activities to be implemented as a community recovers from a disaster

Hazards U.S. Multi-Hazard (HAZUS-MH) Loss Estimation Program: HAZUS-MH is a GIS-based program used to support the development of risk assessments as required under the DMA. The HAZUS-MH software program assesses risk in a quantitative manner to estimate damages and losses associated with natural hazards. HAZUS-MH is FEMA's nationally applicable, standardized methodology and software program and contains modules for estimating potential losses from earthquakes, floods, and wind hazards. HAZUS-MH has also been used to assess vulnerability (exposure) for other hazards.

Hydraulics: Hydraulics is the branch of science or engineering that addresses fluids (especially water) in motion in rivers or canals, works and machinery for conducting or raising water, the use of water as a prime mover, and other fluid-related areas.

Hydrology: Hydrology is the analysis of waters of the earth. For example, a flood discharge estimate is developed by conducting a hydrologic study.

Intensity: For the purposes of this plan, intensity refers to the measure of the effects of a hazard.

Inventory: The assets identified in a study region comprise an inventory. Inventories include assets that could be lost when a disaster occurs and community resources are at risk. Assets include people, buildings, transportation, and other valued community resources.

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.

Lightning: Lightning is an electrical discharge resulting from the buildup of positive and negative charges within a thunderstorm. When the buildup becomes strong enough, lightning appears as a "bolt," usually within or between clouds and the ground. A bolt of lightning instantaneously reaches temperatures approaching 50,000ºF. The rapid heating and cooling of air near lightning causes thunder. Lightning is a major threat during thunderstorms. In the United States, 75 to 100 Americans are struck and killed by lightning each year (see http://www.fema.gov/hazard/thunderstorms/thunder.shtm).

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.

Local Government: Any county, municipality, city, town, township, public authority, school district, special district, intrastate district, council of governments (regardless of whether the council of governments is incorporated as a nonprofit corporation under State law), regional or interstate government entity, or agency or instrumentality of a local government; any Indian tribe or authorized tribal organization, or Alaska Native village or organization; and any rural community, unincorporated town or village, or other public entity.

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.

Mass movement: A collective term for landslides, mudflows, debris flows, sinkholes, and lahars.

Mitigation: A preventive action that can be taken in advance of an event that will reduce or eliminate the risk to life or property.

Mitigation Actions: Mitigation actions are specific actions to achieve goals and objectives that minimize the effects from a disaster and reduce the loss of life and property.

Objective: For the purposes of this plan, an objective is defined as a short-term aim that, when combined with other objectives, forms a strategy or course of action to meet a goal. Unlike goals, objectives are specific and measurable.

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.

Preparedness: Preparedness refers to actions that strengthen the capability of government, citizens, and communities to respond to disasters.

Presidential Disaster Declaration: These declarations are typically made for events that cause more damage than state and local governments and resources can handle without federal government assistance. Generally, no specific dollar loss threshold has been established for such declarations. A Presidential Disaster Declaration puts into motion long-term federal recovery programs, some of which are matched by state programs, designed to help disaster victims, businesses, and public entities.

Probability of Occurrence: The probability of occurrence is a statistical measure or estimate of the likelihood that a hazard will occur. This probability is generally based on past hazard events in the area and a forecast of events that could occur in the future. A probability factor based on yearly values of occurrence is used to estimate probability of occurrence.

Repetitive Loss Property: Any NFIP-insured property that, since 1978 and regardless of any changes of ownership during that period, has experienced:

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

Return Period (or Mean Return Period): This term refers to the average period of time in years between occurrences of a particular hazard (equal to the inverse of the annual frequency of occurrence).

Riverine: Of or produced by a river. Riverine floodplains have readily identifiable channels. Floodway maps can only be prepared for riverine floodplains.

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

Risk Assessment: Risk assessment is the process of measuring potential loss of life, personal injury, economic injury, and property damage resulting from hazards. This process assesses the vulnerability of people, buildings, and infrastructure to hazards and focuses on (1) hazard identification; (2) impacts of hazards on physical, social, and economic assets; (3) vulnerability identification; and (4) estimates of the cost of damage or costs that could be avoided through mitigation.

Risk Ranking: This ranking serves two purposes, first to describe the probability that a hazard will occur, and second to describe the impact a hazard will have on people, property, and the economy. Risk estimates are based on the methodology for each hazard as identified within this plan.

Robert T. Stafford Act: The Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 100-107, was signed into law on November 23, 1988. This law amended the Disaster Relief Act of 1974, Public Law 93-288. The Stafford Act is the statutory authority for most federal disaster response activities, especially as they pertain to FEMA and its programs.

Sinkhole: A collapse depression in the ground with no visible outlet. Its drainage is subterranean. It is commonly vertical-sided or funnel-shaped.

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

Stakeholder: Business leaders, civic groups, academia, non-profit organizations, major employers, managers of critical facilities, farmers, developers, special purpose districts, and others whose actions could impact hazard mitigation.

Stream Bank Erosion: 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.

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%.

Sustainable Hazard Mitigation: This concept includes the sound management of natural resources, local economic and social resiliency, and the recognition that hazards and mitigation must be understood in the largest possible social and economic context.

Thunderstorm: A thunderstorm is a storm with lightning and thunder produced by cumulonimbus clouds. Thunderstorms usually produce gusty winds, heavy rains, and sometimes hail. Thunderstorms are usually short in duration (seldom more than 2 hours). Heavy rains associated with thunderstorms can lead to flash flooding during the wet or dry seasons.

Tornado: A tornado is a violently rotating column of air extending between and in contact with a cloud and the surface of the earth. Tornadoes are often (but not always) visible as funnel clouds. On a local scale, tornadoes are the most intense of all atmospheric circulations, and winds can reach destructive speeds of more than 300 mph. A tornado's vortex is typically a few hundred meters in diameter, and damage paths can be up to 1 mile wide and 50 miles long.

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

Watershed: A watershed is an area that drains downgradient from areas of higher land to areas of lower land to the lowest point, a common drainage basin.

Wildfire: These terms refer to any uncontrolled fire occurring on undeveloped land that requires fire suppression. The potential for wildfire is influenced by three factors: the presence of fuel, topography, and air mass. Fuel can include living and dead vegetation on the ground, along the surface as brush and small trees, and in the air such as tree canopies. Topography includes both slope and elevation. Air mass includes temperature, relative humidity, wind speed and direction, cloud cover, precipitation amount, duration, and the stability of the atmosphere at the time of the fire. Wildfires can be ignited by lightning and, most frequently, by human activity including smoking, campfires, equipment use, and arson.

Windstorm: Windstorms are generally short-duration events involving straight-line winds or gusts exceeding 50 mph. These gusts can produce winds of sufficient strength to cause property damage. Windstorms are especially dangerous in areas with significant tree stands, exposed property, poorly constructed buildings, mobile homes (manufactured housing units), major infrastructure, and aboveground utility lines. A windstorm can topple trees and power lines; cause damage to residential, commercial, critical facilities; and leave tons of debris in its wake.

Zoning Ordinance: The zoning ordinance designates allowable land use and intensities for a local jurisdiction. Zoning ordinances consist of two components: a zoning text and a zoning map.

APPENDIX B.
EXAMPLE PROGRESS REPORT

APPENDIX B.
SAMPLE PROGRESS REPORT

The Squaxin Island Tribe
Hazard Mitigation Plan
Annual Progress Report

Reporting Period: *(Insert reporting period)*

Background: The Squaxin Island Tribe (SIT) developed a hazard mitigation plan to reduce risk from all hazards by identifying resources, information, and strategies for risk reduction. The federal Disaster Mitigation Act of 2000 requires state and local governments to develop hazard mitigation plans as a condition for federal disaster grant assistance. To prepare the plan, the Tribe organized resources, assessed risks from natural hazards, developed planning goals and objectives, reviewed mitigation alternatives, and developed an action plan to address probable impacts from natural hazards. By completing this process, the Tribe maintained compliance with the Disaster Mitigation Act, achieving eligibility for mitigation grant funding opportunities afforded under the Robert T. Stafford Act. The plan can be viewed on-line at:

INSERT LINK

Summary Overview of the Plan's Progress: The performance period for the Hazard Mitigation Plan became effective on ____, 2024, with the final approval of the plan by FEMA. The initial performance period for this plan will be 5 years, with an anticipated update to the plan to occur before _____, 2029. As of this reporting period, the performance period for this plan is considered to be __% complete. The Hazard Mitigation Plan has targeted __ hazard mitigation initiatives to be pursued during the 5-year performance period. As of the reporting period, the following overall progress can be reported:

- __ out of __ initiatives (__%) reported ongoing action toward completion.
- __ out of __ initiatives (__%) were reported as being complete.
- __ out of __ initiatives (___%) reported no action taken.

Purpose: The purpose of this report is to provide an annual update on the implementation of the action plan identified in the Tribe's Hazard Mitigation Plan. The objective is to ensure that there is a continuing and responsive planning process that will keep the Hazard Mitigation Plan dynamic and responsive to the needs and capabilities of the SIT. This report discusses the following:

- Natural hazard events that have occurred within the last year
- Changes in risk exposure within the planning area
- Mitigation success stories
- Review of the action plan

- Changes in capabilities that could impact plan implementation
- Recommendations for changes/enhancement.

The Hazard Mitigation Plan Planning Team: The Hazard Mitigation Plan Planning Team, made up of stakeholders within the planning area, reviewed and approved this progress report at its annual meeting held on _____, 20___. It was determined through the plan's development process that a Planning Team would remain in service to oversee maintenance of the plan. At a minimum, the Planning Team will provide technical review and oversight on the development of the annual progress report. It is anticipated that there will be turnover in the membership annually, which will be documented in the progress reports. For this reporting period, the Planning Team membership is as indicated in Table 1.

TABLE 1.
PLANNING TEAM MEMBERS

Name	Title	Jurisdiction/Agency

Natural Hazard Events within the Planning Area: During the reporting period, there were __ natural hazard events in the planning area that had a measurable impact on people or property. A summary of these events is as follows:

- _____
- _____

Changes in Risk Exposure in the Planning Area: *(Insert brief overview of any natural hazard event in the planning area that changed the probability of occurrence or ranking of risk for the hazards addressed in the hazard mitigation plan)*

Mitigation Success Stories: *(Insert brief overview of mitigation accomplishments during the reporting period)*

Review of the Action Plan: Table 2 reviews the action plan, reporting the status of each initiative. Reviewers of this report should refer to the Hazard Mitigation Plan for more detailed descriptions of each initiative and the prioritization process.

Address the following in the "status" column of the following table:

- *Was any element of the initiative carried out during the reporting period?*
- *If no action was completed, why?*
- *Is the timeline for implementation for the initiative still appropriate?*
- *If the initiative was completed, does it need to be changed or removed from the action plan?*

TABLE 2.
ACTION PLAN MATRIX

Action Taken? (Yes or No)	Timeline	Priority	Status	Status (X, O,✓)
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				
Initiative #__—_____[description]				

TABLE 2. ACTION PLAN MATRIX				
Action Taken? (Yes or No)	Timeline	Priority	Status	Status (X, O,✓)
Completion status legend: ✓= Project Completed O = Action ongoing toward completion X = No progress at this time				

Changes That May Impact Implementation of the Plan: *(Insert brief overview of any significant changes in the planning area that would have a profound impact on the implementation of the plan. Specify any changes in technical, regulatory, and financial capabilities identified during the plan's development)*

Recommendations for Changes or Enhancements: Based on the review of this report by the Hazard Mitigation Plan Planning Team, the following recommendations will be noted for future updates or revisions to the plan:

- _____
- _____
- _____
- _____
- _____
- _____

Public review notice: *The contents of this report are considered to be public knowledge and have been prepared for total public disclosure. Copies of the report have been provided to the Tribe's governing board and to local media outlets and the report is posted on the Tribe's Hazard Mitigation Plan website. Any questions or comments regarding the contents of this report should be directed to:*

Insert Contact Info Here