



# Swinomish Climate Change Initiative Climate Adaptation Action Plan



## Swinomish Indian Tribal Community

Office of Planning  
and Community  
Development

La Conner, WA 98257

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# Swinomish Climate Change Initiative

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## Climate Adaptation Action Plan

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[http://www.swinomish-nsn.gov/climate\\_change/climate\\_main.html](http://www.swinomish-nsn.gov/climate_change/climate_main.html)

# Forward

By

M. Brian Cladoosby

Chairman, Swinomish Indian Senate

In 2007 I was pleased to sign a landmark Proclamation passed by the Swinomish Indian Senate declaring action to study the impacts of climate change on the lands, resources, and community of the Swinomish Indian Reservation. A year later in 2008, the Swinomish Climate Change Initiative, our first, was officially launched. The following year, in 2009, we released our first report describing the broad array of projected impacts expected to bring significant changes to our ancestral homeland. Now in 2010, we reach the culmination of two years of intensive study with the release of our Climate Adaptation Action Plan, a document that will help lay a course for our community in meeting a daunting series of challenges in years ahead.

We at Swinomish often take pride in being a community of “firsts.” However, despite our diligent hard work to this point, we do not find this is a time to celebrate. On the contrary, what we have achieved is only the first step in what we expect to be a long and demanding journey into an uncertain future, a future that all signs indicate may be much different than what we know today. While Swinomish may have been hailed for leadership on these issues, we must also face the sobering truth that we are all too far behind already in our efforts to determine how best to meet this uncertain future. We know now that the changes we study today began decades ago, and that we may already be one or two generations into these changes; yet we are only now beginning to understand these changes well enough to understand what must be done and to understand the true depth and extent of impacts to our community and way of life.

Overwhelming as the challenges before us may at times seem, our community and culture have also proven their ability to endure and survive many times before. Indeed, it is the enduring heart, spirit, and strength of our community in facing previous challenges that shows us the promise of the future. If adaptation is to be our future, we at Swinomish have already proved ourselves equal to the challenge. In the spirit and knowledge of our long history, I urge those within our community to embrace this challenge, and to meet it with every confidence of success. That is the true essence of Swinomish.





# 1 Executive Summary

In the fall of 2008 the Swinomish Indian Tribal Community started work on a landmark two-year Climate Change Initiative to study the impacts of climate change on the resources, assets, and community of the Swinomish Indian Reservation and to develop recommendations on actions to adapt to projected impacts. This followed issuance of a Proclamation by the Tribal Senate in 2007 directing action to study and assess climate change impacts on the Reservation. Under the guidance and coordination of the Swinomish Office of Planning & Community Development, the first year of the project was devoted to assessment of projected impacts, as presented in an Impact Assessment Technical Report issued in the fall of 2009. The second year of the project was focused on evaluation of strategies and options for recommended actions to counter identified impacts, which resulted in preparation and release of this report. The ultimate goal of the project was to help ensure an enduring and climate-resilient community that can meet the challenges of anticipated impacts in the years to come. The information in this report, therefore, completes the Tribe's first critical assessment of climate change issues and actions, as a basis for the next steps in what is expected to be an ongoing effort to address a daunting array of complex issues.

The Tribe was assisted during the two years of this project by the University of Washington Climate Impacts Group as science advisors, who provided expert assistance with analysis and interpretation of climate data and models. Given a mix of inter-jurisdictional issues involved, the Tribe also solicited the assistance of a strategy advisory group comprised of representatives of Skagit County, the Town of LaConner, and the Shelter Bay Community. In addition, project staff worked with a tribal community interest group, led by a communications/outreach facilitator, to communicate information on particular significant potential impacts to tribal traditions and practices, and to solicit feedback on concerns and issues. Working with these partners and groups, project staff evaluated a broad range of potential strategy options for targeting to various climate impacts and developed a comprehensive list of recommendations for actions to address specified impacts.

## Strategy Evaluation

In determining appropriate adaptation strategies, project staff worked with participants to survey a wide range of potential strategy options and develop a process for evaluation and prioritization of targeted strategies. To address projected impacts identified in the Technical Report such as inundation of shoreline areas and resources, wildfire risk, and health impacts from higher temperatures, the project team assembled a comprehensive adaptation strategy toolbox. Types of options in the toolbox included non-regulatory tools such as buffers and incentives, regulatory controls such as shoreline restrictions and setbacks, options to allow shoreward migration of beaches and habitat, practical engineering techniques such as bank protection or raising/hardening structures where desired or appropriate, and improved risk prevention planning. To establish a rational process for evaluating strategy options, the team worked with project advisors to develop a set of evaluation objectives against which to do initial screening of options. The basic set of evaluation objectives included:

- **Comprehensiveness:** Does the proposed strategy address the range of anticipated impacts and risk for the affected asset/resource, or is it limited in application?
- **Long-term sustainability:** Does the proposed strategy promote a sustainable long-term solution, rather than a short-term "band-aid" fix?
- **Dynamic/adaptive approach:** Does application of the proposed strategy allow for responding to changing facts and circumstances, or is it rigid and inflexible?

- **Fiscal impact and feasibility:** What is the degree of fiscal impact of the proposed strategy based on estimated financial requirements, commitments, and terms?
- **Non-regulatory approaches:** To what extent does the proposed strategy encourage the use of non-regulatory approaches, such as cooperative, programmatic, or incentive measures?
- **Community goals:** Does the proposed strategy align with desires and needs of the Reservation community as expressed through Tribal planning documents and other sources?

Once evaluation objectives were established, potential adaptation tools were screened and targeted to specific projected climate change impacts; the resulting correlation of potential tools and impacts were then assembled in a matrix into which additional considerations were factored, including:

- Existing governmental authority and capacity for implementation of given strategies;
- The level and/or type of authority or capacity needed for implementation;
- Internal and external partners needed for implementation; and
- Approximate timeframe anticipated for potential implementation, as stated in increments of 1 to 3 years, 3 to 10 years, and greater than 10 years.

This completed strategy evaluation matrix formed the basis for identification and prioritization of major action recommendations.

## Action Recommendations

Based on the above mentioned evaluation matrix, an exhaustive list of targeted impacts and strategies was assessed to identify priority issues and preferred options. The primary methodology used for prioritizing impacts was based on a correlation of vulnerability and risk for the given impacts, following from impact assessment performed as discussed in the previous Technical Report. While strategy options were scoped and targeted for all identified impacts, for the purposes of this report the prioritization was applied to narrow the list of impacts and actions to those deemed to be most significant, as a means of focusing discussion and subsequent decisions on implementation. In addition, the list of major impacts and associated actions were reorganized under four basic categories that reflect the orientation and organization of community life on the Swinomish Indian Reservation; these four categories are Coastal Resources, Upland Resources, Physical Health, and Community Infrastructure and Services. A fifth overarching category, Cultural Traditions and Community Health, has threads to all categories, given the ties and significant of cultural and community health to a great number of the issues, and as such is the subject of special focus.

After exhaustive analysis and assessment as described above, the major potential impacts and associated types of recommended actions can be summarized as follows (see Chapter 8 for additional discussion):

### Coastal Resources:

- **Impact:** Inundation from sea level rise and storm surge; includes impacts on shoreline areas, structures, habitat, and natural resources within those areas.  
**Actions:** Shoreline controls (risk zones, setbacks, rolling easements, restrictions); physical controls (bulkhead removal for shoreward migration, armoring for shoreline protection, raising/hardening structures, raising/extending dikes); habitat enhancement (fill removal, sediment input); land acquisition.
- **Impact:** Decreased habitat viability due to changing water quality parameters.  
**Actions:** Aquaculture operations.

**Upland Resources:**

- **Impact:** Increased wildfire risk.  
**Actions:** Adopt/maintain Firewise standards/buffers; enhanced training/support for wildfire response; improve forest management policies/practices.

**Physical Health:**

- **Impact:** Heat related illness.  
**Actions:** Education/emergency preparation (cooling center)/weather warnings; housing design/retrofit for improved cooling efficiency.
- **Impact:** Increased risk of respiratory disease.  
**Actions:** Improved monitoring/reporting; maintain/strengthen health services.
- **Impact:** Toxic seafood contamination.  
**Actions:** Strengthen traditional roles for food safety; aquaculture operations.

**Community Infrastructure & Services:**

- **Impact:** Inundation of low-lying roads and bridge approaches.  
**Actions:** Build/raise dikes; raise road level; relocated route; abandon route.
- **Impact:** Road closure from storm/tidal surge event and/or wildfire.  
**Actions:** Alternate route plans; restrict road construction in risk zones.
- **Impact:** Reduced potable water supplies due to decreased sources.  
**Actions:** Water management plan for droughts; incentives/disincentives for water usage; wastewater treatment of grey water; water-efficient appliances/fixtures; voluntary/mandated water restrictions; water conservation/education; additional water storage.
- **Impact:** Contamination of drinking water supplies from flooding.  
**Actions:** Stockpile/maintain emergency water supplies; identify/protect vulnerable facilities; well testing/disinfection program; increase stormwater management capacity.
- **Impact:** Service disruption of communication and energy systems.  
**Actions:** Develop alternate energy and communications systems.

**Implementation**

Making an Action Plan useful relies on effective implementation. Project participants identified a number of issues considered important for successful implementation or pertinent to specific proposed strategies or actions, including key principles for implementation of adaptation actions as follow:

- **Flexibility in approaches:** Because of the number and complexity of many climate change issues, there may be few common solutions to the same basic impacts as they affect different areas; adaptive response may be required for changing circumstances.
- **Public education/outreach:** Communication, information, and training on identified issues are vital to building support within the community for action.

- **Relevancy:** Relating to facts, current issues, and real world situations will help to make issues and actions more relevant to the local community.
- **Political realities:** Address political constraints and institutional barriers realistically. Issues of organizational capacity and mainstreaming adaptation actions must be addressed.
- **Incremental approach:** Phasing and scaling of actions may help to cope with issues such as governmental inertia and challenging funding requirements.
- **Regional approach/partnerships:** Some issues are larger than individual jurisdictions; cooperative efforts may be useful or necessary to promote effectiveness or to increase capacity for response.

Finally, several implementation project concepts have been formulated based on review of priority issues and actions in each of the major categories described above. These potential project concepts address a representational cross-section of the more critical issues identified, and they range from relatively inexpensive planning activities to more costly and technically complex adaptation projects, as follows:

- Coastal protection implementation;
- Coastal resource research;
- Dike maintenance authority and program;
- Regional access preservation and coordination;
- Wildfire risk management and mitigation; and
- Local emergency planning.

## 2 Key Terms

**Adaptation (climate change):** Actions to respond to and/or counter the effects of climate change; relocation and armoring are examples of adaptation actions.

**Adaptive capacity:** The ability of a system to accommodate or respond to changes in climate with minimum disruption or cost.

**Armoring:** Shoreline erosion control practices using hardened structures intended to stabilize the shore; examples include bulkheads, revetments, concrete walls, and rip-rap. Armoring inhibits natural processes, leading to conflict between protection of built structures and protection of the environment.

**CIG:** Climate Impacts Group of the University of Washington Center for Science in the Earth System.

**Climate Change:** Changes in the Earth's physical systems that occur over long time periods (decades, centuries, or even millions of years) rather than over shorter periods such as for annual or seasonal changes; climate change may include changes in natural cycles of variability such as seasonal, annual, multi-year, and/or multi-decade patterns of variability. As used in the Tribal project, climate change refers to those changes resulting from increase in greenhouse gas concentrations and changes in aerosol emissions that are deemed to be caused by human activities. Examples of global effects of climate change include increase in average atmospheric and sea temperatures, general melting and decrease in snow and ice, increased drought conditions, and rising sea levels.

**Estuary/estuarine:** An estuary is a body of water formed where freshwater from rivers and streams flows into the ocean, mixing with the seawater. Estuaries and the lands surrounding them are places of transition from land to sea, and from freshwater to saltwater. Although influenced by the tides, estuaries are protected from the full force of ocean waves, winds, and storms by the reefs, barrier islands, or fingers of land, mud, or sand that surround them. *The entire Puget Sound is an estuary*, made up of a series of underwater valleys and ridges fed by more than 10,000 streams and rivers. The average depth is 450 feet. Puget Sound is surrounded by an array of beaches, bluffs, deltas, mudflats and wetlands teeming with plants, fish, birds and wildlife. (EPA National Estuary Program)

**GIS:** Geographic Information System, a means of location, mapping, and analysis of spatial data, such as for natural, environmental, and built features.

**Greenhouse gas (GHG):** Gases that trap heat within the Earth's atmosphere by absorbing and emitting infrared radiation; such gases include carbon dioxide, methane, nitrous oxide, ozone, and water vapor.

**Indigenous Knowledge, Native Science, Traditional Knowledge, Traditional Ecological Knowledge:** The terms are used interchangeably to refer to holistic, evolving practices and beliefs passed down through generations about the relationships of living beings to their environment.

**Inundation risk zone:** Zone in which an increased risk of inundation has been identified, based on a given set of parameters derived from analysis of scientific models and data. For the Swinomish Climate Change Initiative, two risk zones were established, one for sea level rise and one for storm/tidal surge. As described in the Impact Assessment Technical Report, these zones were derived by shifting the line of MLLW and MHHW upward 5 feet to reflect the range of risk of projected sea level rise and by an additional 3 feet to reflect the range of risk of storm/tidal surge, based on analysis of prevalent inundation models and projections.

**IPCC:** Intergovernmental Panel on Climate Change.

**Mean Higher High Water (MHHW):** The average elevation of all higher high tides calculated over a complete tidal cycle of 18.6 years.<sup>1</sup>

**Mean High Tide (MHT):** The average elevation of all high tides, including spring tides and neap tides, calculated over a complete tidal cycle of 18.6 years.

**Mean Lower Low Water (MLLW):** The average elevation of all lower low tides calculated over a complete tidal cycle of 18.6 years.

**Mitigation (climate change):** Actions to reduce the causes of climate change; emission reduction and energy efficiency programs are examples of mitigation actions.

**Rolling easement:** A special type of easement placed along the shoreline that allows shoreward migration of tidal areas while also allowing certain types of use and activity on the uplands; as the sea advances, the easement automatically moves or "rolls" landward. Because shoreline stabilization structures are not used, sediment transport remains undisturbed and wetlands and other important tidal habitat can migrate naturally.

**Sector:** Any policy area, planning discipline, management focus, resource, human system, or natural system that may be a subject of study.

**Sequestration:** The storage of carbon dioxide in a given material through biological or physical processes.

**SUA:** Swinomish Utility Authority, the entity responsible for management of Swinomish water distribution and sewage collection systems.

**Surge:** An offshore rise of water associated with a low pressure weather system, caused by high winds pushing the surface of the water.

**Sustainability:** The ability of a system to meet its needs on a continuing basis without harm to the environment and without compromising the ability of systems to do so in the future. In tribal traditions, the concept of "seven generation sustainability" is the idea that decisions should be considered for their impact on the seventh generation to come.

**Vulnerability (climate change):** Measurement of the level of impact on a system from the effects of climate change; vulnerability is an assessment of the consequences of climate changes, as a function of the sensitivity of a system to climate changes and the adaptive capacity of the system to respond to such changes.

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<sup>1</sup>Some locations have diurnal tides, or one high tide and one low tide per day. Most locations are characterized by semi-diurnal tides, in which the tide cycles through a high and low twice each day, with one of the two high tides being higher than the other and one of the two low tides being lower than the other. These more extreme tides are used to measure MHHW and MLLW. (NOAA)

### 3 Introduction and Background

This report is a beginning. While one phase of work on climate change issues is concluding with issuance of this report, the challenges and tasks for the Tribe, as outlined herein, remain largely ahead. The Tribe is only just beginning to engage in the many discussions that will need to occur internally and externally on the spectrum of issues at hand, and the work required toward the next steps is likewise only beginning. Many competing priorities must be considered, and difficult questions of organizational capacity and funding will have to be answered. In addition, solutions to issues critical to Reservation services and mobility will require coordination with other local jurisdictions. Most importantly, the Tribe must come to terms with potential challenges threatening traditions that have continued for centuries.

With this understanding as a backdrop, this Climate Adaptation Action Plan presents the first comprehensive assessment of strategies and options to address a daunting array of climate change issues as described in the Impact Assessment Technical Report (Technical Report) released in the fall of 2009.<sup>2</sup> In presenting this Action Plan, the discussion will key on the following:

- Review of the impacts and process of assessment leading to this report;
- The particular significance of these issues to a tribal way of life going back generations;
- The process and methodologies for evaluating strategy options to address impacts;
- Major priority issues and key recommendations; and
- Critical considerations for implementation of recommendations.

#### 3.1 Reservation Overview and Setting

The Swinomish Indian Reservation is located on the southeastern peninsula of Fidalgo Island, west of the Swinomish Channel and adjacent to low-lying mainland areas of western Skagit County, in western Washington (Figures 3-1 and 3-2). The Reservation encompasses approximately 7,450 upland acres and approximately 2,900 acres of tidelands for a total of 10,350 acres. Roughly 4,700 acres are forested uplands with interspersed rural development and surrounding urban development. Approximately 7,675 acres are held by the Tribe or Tribal members, with the remaining 2,675 acres held in private non-tribal ownership (Figure 3-3). Tribal headquarters are located in the historic Swinomish Village in the southeast portion of the peninsula, across the channel from the Town of LaConner. Tribal enterprises, including a casino, gas station, and RV park, are located on the north end of the Reservation, adjacent to SR20, a state highway crossing the Reservation. There are upwards of 1,300 homes on the Reservation, and total Reservation population is estimated at somewhat over 3,000 (approximately 2,600 as of 2000 census).



Figure 3-1. Aerial view of Swinomish Indian Reservation vicinity, with Swinomish Village and Town of LaConner, foreground (photo courtesy of Swinomish Tribal Archives).

<sup>2</sup> [http://www.swinomish-nsn.gov/climate\\_change/project/reports.html](http://www.swinomish-nsn.gov/climate_change/project/reports.html)

Established in 1855 by the Treaty of Point Elliott, the Swinomish Indian Reservation brought together several Coast Salish groups who shared a culture centered on fishing, and a ceremonial calendar revolving around cedar longhouses. Before the influence of European settlers, Coast Salish cultures derived their wealth from abundant natural resources and extensive trade relationships that stretched well beyond the Puget Sound region. While salmon was a primary staple, Coast Salish people also harvested a wide variety of flora and fauna from the land, sea, and rivers, including a rich selection of shellfish species. Permanent villages consisted of longhouses that sheltered large extended families. The village provided a social support network during times of crisis and was used in celebrations and ceremonies that were an integral part of culture, health, governance, and the maintenance of kinship allegiances and exchange relationships important to the intensive harvesting required to accumulate the necessary foods and goods exchanged (Gunther and Haeblerlin 1930, Roberts 1975, Suttles and Lane 1990).

With the formation of the Reservation and accompanying restrictions on traditional cultural practices by non-Indian laws and policies, tribal members faced decades of declining health, education, and community assets, along with increasing poverty, illness, drug abuse, and racism (Roberts 1975). Although the past 20 years have brought positive changes in economic and social conditions for the Tribe, many problems remain, including low graduation rates, high unemployment, lower income levels, and high rates of violence and drug abuse.



Figure 3-2. Location of Swinomish Indian Reservation.



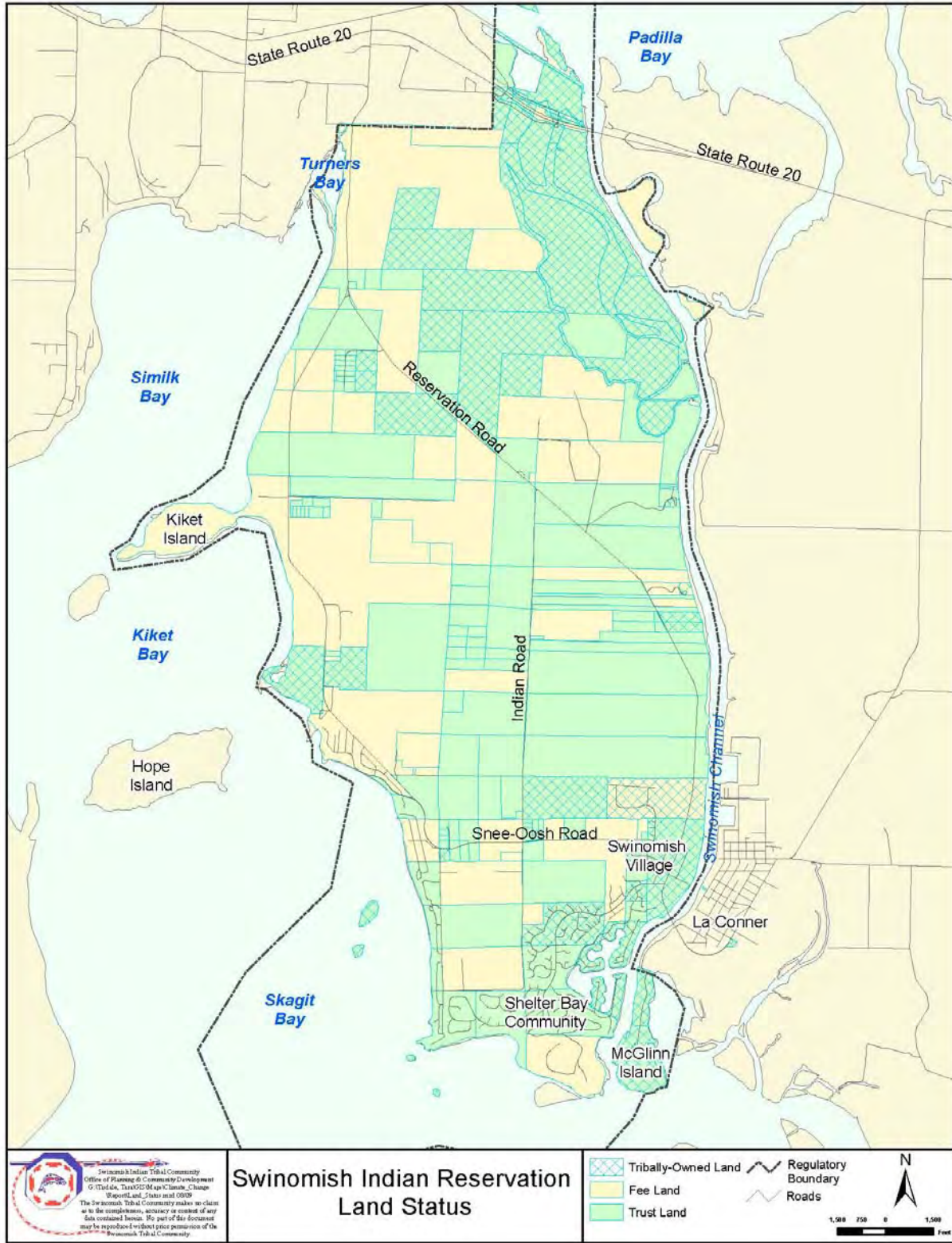


Figure 3-3. Land Status of Swinomish Indian Reservation.

Approximately a quarter of the employed Swinomish workforce still remains below the poverty line, which the Indian Health Service estimates is twice the poverty rate of the general U.S. population.<sup>3</sup> The average health of Native Americans is measurably worse than the US population as a whole (Indian Health Service 2000, US Commission on Civil Rights 2003), with morbidity and mortality rates often many times higher than the U.S. average.<sup>4</sup> With judicial recognition of the Tribe's Treaty fishing rights in 1975, prospects for tribal members began to improve as they reasserted rights to harvest their customary fishing grounds that provide culturally important food staples, one of which is shellfish (clams, crabs, oysters, shrimp, mussels). Traditional foods such as salmon and shellfish are "cultural keystone" aquatic species to the Tribe; much more than a food source, these foods are a vital contribution to the cultural, spiritual, and social life of tribal members (Garibaldi and Turner 2004). Shellfish can be harvested year-round, providing a stable, high protein food source. Individual beaches are treasured for their shellfish populations and are maintained to avoid over-harvest. Loss of a traditional food is directly related to loss of morale, and cultural health and well-being (Arquette et al. 2002; Kuhnlein and Receveur 1996).

Recent years have seen additional improvements within the Swinomish Tribe and Swinomish Indian Reservation. These include development of community facilities for health and other services, programs to meet the social needs of the community, new housing in the Swinomish Village for tribal members, and new commercial enterprises on the north end of the Reservation. While these improvements have made it possible for the Tribe to begin reversing decades of social and economic decline, unemployment rates still often exceed 30% and seldom drop below 20%. Throughout these years and continuing through the present, however, the Tribe still strongly embraces its resource-based traditions and practices; as detailed in the Technical Report, and as further addressed in this report, these traditions are expected to be increasingly threatened by climate change impacts, as are many other aspects of Reservation life.

## 3.2 Origins of the Swinomish Climate Change Initiative

A number of local events in recent years have highlighted the potential for future climate-related issues, some of which occurred prior to undertaking this project and some which have occurred since. While it may be difficult to point to any single event as an affirmation of changes taking place, given inherent uncertainties of scientific models and projections, such events are nevertheless indicative of the types of projected climate changes, and taken as a whole they provide useful reference points for possible correlation to projected changes. Recent events include:

- A storm surge in February, 2006, that pushed tidal levels several feet above normal along shoreline areas of the Reservation and Town of La Conner (and other areas of Puget Sound);
- A strong winter storm in November, 2006, that downed trees and power lines across the Reservation, isolating the Reservation community for three days and prompting plans for evacuation of residents to the local Tribal gymnasium;
- Extreme heat in July, 2009, when temperatures soared above 100 degrees, including in areas of Puget Sound that are normally moderated by cooler marine air; and
- An extreme high tide in January, 2010, that rose almost two feet above the projected high tide, caused by a low-pressure system off the west Pacific coast (in the absence of any storm activity).

<sup>3</sup> Nationally the poverty rate for US population is 12.3 percent (DeNavas-Walt et al. 2007), while the Native American poverty rate is 26.6 percent (Webster, Jr. et al. 2007).

<sup>4</sup> According to the Indian Health Service's *Facts on Indian Health Disparities* (2007), "American Indians and Alaska Natives die at higher rates than other Americans from tuberculosis (500 percent higher), alcoholism (550 percent higher), diabetes (200 percent higher), unintentional injuries (150 percent higher), homicide (100 percent higher) and suicide (60 percent higher)."

The earlier events in particular stirred the Tribe's initial interest and efforts in examining climate change issues. These events heightened awareness of potential climate impacts in general as well as the lack of preparedness within the community, and they helped provide a catalyst for action to determine responses to climate impacts. Additionally, a climate change report issued in late 2006 by the State of Washington identified the lower Skagit River area as one of two areas within the state at high risk for sea level rise.<sup>5</sup> In recognition of these emerging issues, the Swinomish Indian Senate issued a Proclamation<sup>6</sup> in October of 2007 directing action to assess potential climate change challenges and develop appropriate responses. Following this Proclamation, the Tribe sought and was awarded a grant through the U.S. Department of Health & Human Services, Administration for Native Americans (ANA), to support a major new \$400,000 Climate Change Initiative, which was funded 80% by ANA and 20% by the Tribe.

### 3.3 Project Summary

While acknowledging the importance of action to mitigate the causes of climate change, the Tribe consciously directed the approach for this project toward adaptation actions to counter the anticipated effects of climate change on the Reservation community, given the geographic characteristics and coastal location of the Reservation that makes it particularly vulnerable to potential impacts. The project was structured over two years, beginning in late 2008, with the first year devoted to detailed assessment and analysis of climate change impacts. The Swinomish Office of Planning & Community Development provided the core staff team to manage and carry out project activities. To assist with complex analysis of myriad scientific issues, the Tribe enlisted the support of the University of Washington Climate Impacts Group (CIG), a premiere regional climate research entity. Anticipating issues for residents in low-lying areas of the Reservation as well as critical issues reaching off-Reservation, a Strategy Advisory Group was formed consisting of representatives from Skagit County, the Town of LaConner, and the Shelter Bay Community (a 900-unit residential development on leased tribal land). In addition, a community outreach effort was begun through formation of a tribal outreach group, assisted by a Communications Facilitator retained by the Tribe. The aggregate intent and ultimate goal of the project was to help ensure an enduring and climate-resilient community that can meet the challenges of anticipated impacts in the years to come.

The primary tasks for the first year's work consisted of: 1) scoping and technical assessment of potential impacts, based on analysis of numerous scientific models and data; 2) mapping of "risk zones" and inventory of assets and resources within those zones; 3) a vulnerability assessment of the Reservation community and resources, based on the identified impacts; 4) a risk analysis of potential impacts, based on the completed vulnerability assessment; and 5) preliminary scoping of potential strategy and policy issues. A key document guiding the methodologies used in this series of assessments was a CIG/King County guidebook, **Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments**. Project staff drew upon many tools and approaches presented in this guidebook, while modifying some processes and methodologies to suit particular project needs and objectives. The culmination of these tasks was the issuance of the Technical Report in the fall of 2009.

During the second year of the project, the staff team continued working with CIG, the advisory group, and community group, as well as key staff in various disciplines, to assess potential strategy options for targeting to identified impacts. Tasks for this strategy assessment included: 1) identification of applicable adaptation goals; 2) evaluation of a wide range of potential strategy options in multiple categories for application to given impacts; 3) development of proposed recommendations for adaptation strategies

<sup>5</sup> Washington Department of Ecology (2006) Impacts of climate change on Washington's economy: A preliminary assessment of risks and opportunities. Publication No. 07-01-010

<sup>6</sup> See Appendix 1 for full text of Proclamation

across the spectrum of impacts; and 4) consideration of policy issues for implementation, such as coordination, timing, and funding. This report represents the final product based on these tasks. A complete and more detailed case study summary is contained in Appendix 3.

For the benefit of the reader, we should note differences in organization of information between the Technical Report and this report. In the Technical Report, the approach to assessment and organization of information was primarily divided between Human Systems and Natural Systems. In this Action Plan, for the purposes of discussing strategies and recommendations, the information has been organized (and impacts resorted) under four basic categories that reflect the orientation and organization of community life on the Swinomish Indian Reservation; these four categories are Coastal Resources, Upland Resources, Physical Health, and Community Infrastructure and Services. A fifth overarching category, Cultural Traditions and Community Health, had threads to all categories, given the ties and significant of cultural and community health to a great number of the issues, and as such has been given special focus in Chapter 4.

As stated above, this two-year project is just the start of work by the Tribe to address climate change issues, and the Tribe continues to look for additional resources to support this important work. This effort is expected to continue in various phases well into the future, expanding discussions with internal tribal departments and disciplines, tribal leaders, community members, neighboring jurisdictions, and funding agencies. The results of these efforts are not likely to be seen by the present generation, but it is up to the present generation to begin this work.

## 4 Cultural Traditions and Community Health

Climate change is expected to impact the Swinomish Indian Reservation in many ways, as well as potentially many members of the Reservation community, both tribal and non-tribal. Addressing these impacts is important to the long-term integrity and health of the community. Also as noted in the Technical Report, a number of the projected impacts are expected to affect long-standing traditions of tribal members, including shellfish harvesting, salmon fishing, hunting, gathering of native plants, and use of cedar and other species. Tribal members continue to maintain historical connections to the natural resources, land, and waters of their ancestral homeland, connections that go back generations and are deeply embedded in the cultural foundations of tribal life and community.

Given the potential threats to a way of life that has been at the core of tribal culture for countless generations, the significance of these issues and long traditions merits special focus. This chapter describes the connection between these tribal traditions and issues of community resilience and cultural sovereignty that are vital to preparing for significant changes, issues based on a foundation of *community wellness* that encompasses more than the physical health actions listed in this report. Wellness, as described herein, includes community cohesion, food security, ceremonial use, knowledge transmission, and self determination. The adaptive responses described in this report are intended to be dynamic, and they are consistent with local traditions, while drawing from and contributing to neighboring tribes, regional compacts, and international bodies.

### 4.1 Context of Climate Change Issues for Indigenous People

#### A. Climate change issues transcend artificial boundaries, local interests, and economics

Indigenous people throughout the world have been meeting for over a decade to share their experiences of climate change and to press forward an action plan to address the impacts. Impacts to small island nations and to arctic areas were among the first to be observed. One of the first international sessions to focus on climate change was the 2008 United Nations Permanent Forum on Indigenous Issues (UNPFII). The Inuit Circumpolar Council, observing the rapid changes at high latitudes, hosted the Indigenous Peoples' Global Summit on Climate Change in 2009, which prepared recommendations to take to the 2009 Conference of Parties (COP 15) United Nations Framework Convention on Climate Change at Copenhagen, Denmark. COP 15 did not achieve a binding agreement on long-term action, so the effort continues at the international level to address impacts to indigenous peoples through forums such as the annual COP meetings. As expressed at the Indigenous Peoples' Global Summit, common climate change themes of indigenous people are<sup>7</sup>:

- Indigenous peoples are disproportionately impacted by climate change, layering new challenges on top of existing problems. Conversely, resources available to many native communities to address climate change impacts are disproportionately scarce. They are also impacted by unintended consequences of some mitigation measures.

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<sup>7</sup> Galloway McLean, K; Ramos-Castillo, A; Gross, T; Johnston, S; Vierros, M; Noa, R (2009). Report of the Indigenous Peoples' Global Summit on Climate Change: 20-24 April 2009, Anchorage, Alaska. United Nations University – Traditional Knowledge Initiative, Darwin, Australia.

- There is a need for Free and Prior Informed Consent (FPIC) for indigenous peoples in adaptation or mitigation actions and for formal participation in international bodies.
- Indigenous knowledge can help shape strategies to address climate change, yet such knowledge must also be protected from misappropriation and misuse.
- Developed countries generally have contributed most to greenhouse gas emissions and should pay that ecological debt to share in the burden that falls disproportionately on native communities in addressing climate change impacts.

There are also efforts underway at the national, regional, and local levels to foster action on climate change. The National Congress of American Indians has developed a set of federal priorities focusing on energy, including: 1) tribal set-asides of no less than 5% of allowances that are provided to states to support programs in renewable energy, energy efficiency, domestic adaptation, and natural resources adaptation, among others; 2) flexible use of such funds for tribal capacity to develop plans, collaborate, and administer related programs; 3) substantive inclusion of tribes and Alaska Native Villages in programs for energy efficiency, adaptation, green jobs, tribal traditional practices, and other international programs; and 4) overcoming underlying obstacles to renewable energy deployment on tribal lands.

Regionally, the Coast Salish Gathering is a periodic meeting of Western Washington tribes and British Columbia First Nations dedicated to “protect the environment and natural resources of the Salish Sea for the sustainability of the Coast Salish peoples.” Climate change actions have been developed by the tribal leadership and are expected to be released later in 2010. Agenda items at the 2010 climate change gathering included shared impacts to natural resources, the importance of *indigenous knowledge*, and impacts on tribal rights. Additionally, the Affiliated Tribes of Northwest Indians (ATNI) has adopted several resolutions related to climate change and sustainable energy production. During the 2008 Winter Conference, ATNI adopted Resolution #08-30, “Support for the Northwest Indigenous Alliance Initiative on Community Wellness and Climate Change.” The resolution calls for raising awareness and educating tribal youth about climate change impacts and paths for adaptation. The Swinomish Tribe became a natural partner through its Climate Change Initiative and establishment of a tribal community interest group.

Many Alaskan native communities are already struggling with the impacts of climate change. In some areas of the Alaskan interior, melting permafrost has contributed to increased slumping of hillsides and siltation of streams providing vital water supplies for communities; in other areas, such melting has cracked foundations for treatment plants and other community facilities, requiring expensive repairs. Along the Alaska coast, protective barrier islands are disappearing with the melting of pack ice that formerly protected such areas, allowing the sea to invade inland, erode community lands, and contaminate drinking water supplies; elsewhere, unstable and melting ice packs are making it more difficult to mount hunting parties for traditional food sources such as seals, walrus, and whales. Such changes are creating significant disruptions to traditional ways of life in these communities.

In the lower continent, tribes such as Swinomish, Tulalip, Quinault, Umatilla, and others have begun assessing issues in their respective locations, responding in part to local climate and storm surge events, disappearing species, and other changes. As noted previously in the Technical Report, a Washington Department of Ecology report issued in 2006 stated that the lower Skagit River area, near the Swinomish Reservation, is one of two areas in the state expected to be most at risk from sea level rise. Accordingly, the Swinomish Climate Change Initiative sets the stage for a continuous focus on adaptation. Shelly Vendiola, communications and outreach facilitator for the Swinomish Climate Change Initiative, reported to the 2009 Anchorage Indigenous People’s Global summit that “The Swinomish tribe are fishing peoples and are experiencing climate change impacts on cultural and natural resources. The Salish Sea has lost

95% of the Chinook salmon since 1995. We need to keep raising awareness about climate change and strengthen our connection with the local tribal communities to figure out what we are going to do to prepare." This adaptation report points the way toward multiple adaptation actions which will be guided by ongoing community responses.

## B. Finding Solutions in Indigenous Knowledge

Indigenous knowledge offers valuable insights and tools to respond to challenges such as climate change and to find solutions. The Swinomish Senate has adopted several goals aimed at protecting and preserving the traditional culture, including intergenerational sharing of local indigenous knowledge, teaching the Lushootseed language, and establishing a cultural center. While acknowledging the value of indigenous knowledge, there needs to be recognition of the need and ways to protect sensitive knowledge.

### What is Indigenous Knowledge?

Indigenous Knowledge encompasses Indigenous Peoples' knowledge of and beliefs in the web of life that includes humans and the environment (Berkes 1999). This knowledge is "cumulative and long-term, dynamic, historical, local, holistic, embedded, and moral and spiritual" (Menziez and Butler 2006). For example, Skokomish leader Bruce Miller (Subiyay, 1944-2005<sup>8</sup>) stated the following about the importance of traditional medicinal plants and forest ecology:

*"The medicines that we gather can't exist under commercial forest tree planting. With just the hemlock and the evergreens, you don't have the proper mosses, soil and mixtures to [nurture] the princess pine and the plantains and all the other things that we use for our medicine because they can only grow when there's an indigenous mixture of trees."*

Subiyay also spoke of the ancient story of the Tree People. This story tells how the trees have much to teach us about their diversity and symbiotic nature. Under the forest floor there is an intricate and vast system of roots and fungi that keeps the forest strong. The story captures an important teaching for building alliances, communal strength, diversity and roles each member has in the web of the whole community. Together we are stronger.

*"Trees were to develop the most powerful method of teaching, and the teaching doesn't utilize language, or words, because it's teaching by example, which is the strongest form of teaching that can be established. Animals teach their young ones by example. Things that teach by example have the unique absence of lying. Language gives us the ability to become liars and develop false sets of values. Trees were placed on earth as an example of what true harmony and contribution is to the world. Their example was that they existed side by side from the beginning of time with no criticism of one another."*<sup>9</sup>

It is vital that such teachings are not lost or forgotten. These teachings are indigenous science and are crucial to the survival of future generations to offer guidance and instruction in how one should live and thrive in what has become a very complex world, to avoid a "life out of balance."

Knowledge systems are in a continual state of change and Indigenous Knowledge is no exception. Indigenous Knowledge is the result of everyday human interaction with the local environment, and just as the ecosystems shift and alter, so does the resultant knowledge gained from consistent interaction with that ecosystem (Berkes 1999; Menziez 2006).

<sup>8</sup> <http://coastsalishweaving.com/2007/01/seattle-times-blanket-brings-sacred-change/#more-25>

<sup>9</sup> May 2000, Eco-Trust - Salmon Nation, Skokomish leader Subiyay (Gerald Bruce Miller)

Not only is natural ecological change dynamic, but so too are human actions, such as social or regulatory changes (Butler 2006). For instance, if federal statutes were adopted that restricted fishing in certain waters, fishers' knowledge of the area would not be updated as new changes arise since the fishermen would have less interaction with the changing locale. Yet it does not follow that if interaction with specific local environments has changed or stopped, all associated Indigenous Knowledge is lost. As long as the knowledge continues to be passed on, historical information exists.

Indigenous Knowledge is context specific and "place-based." Indigenous Knowledge can only be considered in relation to the specific locale and culture that formulated it (Ellen and Harris 2000; Menzies and Butler 2006). In order to formulate Indigenous Knowledge, physical immersion in the local landscape is required on a day-to-day basis; only thus can the cultural transmissions from generation to generation be understood (Pálsson 2000). All of the intricately woven connections that exist between humans and the natural environment are tied to a particular place.

### Challenges of "place"

"Swinomish" means "people by the water," and the Swinomish Reservation is surrounded by water. The Swinomish Indian Tribal Community is a political successor to several treaty-time bands and groups, including aboriginal Swinomish, Kikiallus, aboriginal Samish, and Lower Skagit. The traditional places used by the people ranged across a large area and changed with the seasons as culturally significant resources were gathered. If the range of native species were to change in response to climate impacts, this may create new challenges in pursuing traditional practices.

## C. Community-based response must be grounded in knowledge, action, and organization

As with the international efforts described above, organizational responses are emerging at the regional and local level. For the Swinomish Climate Change Initiative, community-based response evolved into creation of the Climate Change Education and Awareness Group (CCEAG), facilitated by Shelly Vendiola, who was retained as the project's communications and outreach facilitator. CCEAG was established to assist with communication of complex issues to the community and gathering of input on tribal perspectives toward climate change issues. This work entails establishment of an *honorable engagement* process for the Swinomish community by raising awareness of climate impacts on the tribal community, and it opens a pathway for community input to inform and guide policy and decisions about how the tribe will adapt and prepare to deal with the impacts of climate change.

### Honorable Community Engagement Strategy

The tribal community-interest group currently serves the tribe's Climate Change Initiative with select tribal members who represent each of the respective families within the tribal community and who are linked to various tribal committees, groups and sectors of the community such as Youth Recreation, Prevention, Education, Cultural Groups, Social Services, Health, Elders, Education, Social Groups, Law Enforcement, Fisheries, and tribal leadership. Each CCEAG member is encouraged to provide insights as to how the Climate Change Initiative intersects with their tribal practices, program or sector. The intention is to create a pathway for community members to engage in one or more aspects of the Initiative. For example, Public Health is one sector that would be impacted by increases in greenhouse gases, industrial pollutants, hotter temperatures, and longer growing seasons. This could lead to an increase in respiratory disease such as higher asthma rates, and heat related illness such as heat stroke and cardiac arrest. Sea level rise would cause flooding and disturb cultural and natural resources such as shellfish habitat.



CCEAG has met regularly and has participated in community-wide events to raise awareness about climate change and share information about future efforts for community education and empowerment. The group conducted a series of community meetings and interviews to bring people together to talk about changes they have seen, as well as hopes and concerns. Fact sheets and tribal newsletter articles were developed based on project reports and activities to communicate and summarize the general impacts to the Swinomish Reservation residents and surrounding areas. CCEAG members have also actively participated in many other activities, including:

- Alliance building and grassroots mobilizing with local Eco-Fair & Annual Shred Day, Swinomish Earth Enhancement Day, Skagit Beat the Heat, and Tribal Canoe Journey;
- Partnerships with institutions and organizations such as for video storytelling of climate change perspectives, proposals for museum exhibits, publications through Evergreen State College-Northwest Institute for Applied Research, La Conner Middle School class presentations, Puget Sound Energy “It’s Cool Campaign,” the Northern Cascade Institute Climate Challenge Program, and the Potlatch Fund.
- Communications to inform, educate, raise awareness, recognize, and promote, including Swinomish Kee-Yoks tribal newsletter, Northwest Indian Fisheries Commission News, Skagit Valley Herald, KSVR Skagit Talks radio, Facebook, and KANU Native News.

Some outcomes pursued by CCEAG include the following; while progress was made, full implementation may take longer, as assisted by “mainstreaming” into ongoing tribal programs:

- Public awareness about climate change impacts to the Swinomish community—cultural and natural resources, marine life, forests, and surrounding communities.
- Community and youth voice in action planning for adapting to changes.
- Youth engaged in creating public education materials, sustainable community projects and use of technology to create reports, digital stories, films, or other media.
- Opportunities for students to receive education on environmental planning specific to climate change adaptation.
- Collaboration and coordination with tribal community and departments to address climate impacts (flooding, fires, diseases, public safety, forests, plants, marine life, etc.).
- Collaboration and strengthened relationships between Swinomish and neighboring communities in Skagit County.
- Opportunity to influence policy with regard to climate change impacts, adaptation and mitigation.



CCEAG members and project staff

Front row, left to right:  
Shelly Vendiola, Communications/  
Outreach Facilitator; Janie Beasley;  
Laura Kasayuli; Caroline Edwards;  
Diane Vendiola.

Back row, left to right:  
Tara Tisdale, Associate Planner; Brian  
Wilbur, Tribal Senator; Ed Knight,  
Project Coordinator; Kevin Paul,  
Tribal Senator

CCEAG members encourage tribal members to practice “small sacrifices” that, taken together, are meaningful and helpful in making a difference for climate change. They are consistent with traditional ethics of respecting Mother Earth. For example, CCEAG member Laura Kasayuli brings items that her daughter Ashley makes to sell during community-wide events. She explained that Ashley is creating what is known as “up-cycle” crafts, a form of art created from used clothes, linens, etc., that transforms an old used item into something new.

During a retreat CCEAG members were asked, “What is the value of CCEAG to the Swinomish community?” In summary, they found is that there is a dire need to continue to:

- Raise awareness within our community;
- Keep the community updated on the facts;
- Seek out intertribal opportunities for raising awareness and partnerships; and
- Strengthen the relationships between youth and elders to share cultural teachings.

CCEAG seeks to recapture the values and wisdom of the elders and promote understanding of our deep connection to this place. They see a need to connect youth to indigenous and western science opportunities so they become well informed and can participate meaningfully and appropriately in the decision-making process. CCEAG seeks to continue to keep the youth encouraged and to invite them help document how things have changed over time.

### **Community Perceptions on Climate Change**

In addition to the above activities, the Outreach Facilitator held pilot interviews with a small number of Tribal members to collect their perspectives on climate change and to field test the interview instrument for broader use in the Tribal community. In-depth interviews of Tribal members provide deeper insights into the understanding, observations, and views on climate change issues within the Tribal community, and hence are a valuable tool in understanding what issues are important to Tribal members and how best to communicate complex climate change issues with the community. Care was taken in conducting such interviews to protect the privacy of individuals and information provided, as needed or desired, to allow for a free flow of information in a manner that respects the trust of the interview subject. A copy of the survey questions is provided in the Appendices; questions were designed to query interview subjects about their general knowledge of climate change, perceived impacts on Reservation community and resources, changes they have observed, and how the Tribe should address competing issues and priorities. A sampling of some of the responses relevant to issues in this report is given below:

#### ***Climate change could severely impact the community ...***

*“Our wealth comes from the salmon and it comes from the resources from the waters, and those continue to decline, we’re going to be unable to pursue a livelihood in that way...Our biological cycles are attuned to the life cycles of the salmon, and when we have to force ourselves to adapt to other patterns, it’s generally going to have a severe impact on our well-being, our mental, or social or psychological well-being. And it creates stresses that contribute to the weakening of the Swinomish tribal community as we know it today.”*

*“The berries and the medicine that come from them--medicine that we’ve used over the generations-- they’re disappearing. The natural medicines are going...Once those disappear, then the people that know how to use them and know what they’re used for, those people disappear too... that’s not being passed down.”*

*“Our water is probably my main concern in the environment—[the] water around our reservation, our tidelands, our drinking water, our water coming out of the river. All of this, which has always sustained us for generations, could be wiped out in a matter of two generations and never come back.”*

**... On the other hand, there are community strengths that can build resilience**

*“We’ve always been good at adaptation. You look at the 500 years that the western civilizations have been here... And the tribes are probably one of the best adapters of being able to survive right along next to the western cultures.”*

*“What makes is most healthy and strong is the education that’s been passed down from our tribal elders from generation to generation... If we took the seed that was planted by our grandfathers, for our great-great-grandchildren, then we’re going to be able to leave some type of legacy here that yes, we are a culture that won’t vanish.”*

**Traditional and indigenous knowledge holds the answers...**

*“Change the focus of our education in the public schools, and...our tribal community...start pushing our children into the sciences of environmental protection – biology, fishery science, all the science that has to deal with the natural resources, even climate... then it allows us to remain in touch with those traditional laws that we’ve had here for thousands of years... It encourages our young people to go to the older people and to be reminded of what they knew, and what they grew up with, and what laws pertain to what. Even though some of the things may be lost...I don’t think that they ever go extinct...they will re-emerge...as we begin to take care of our homeland.”*

This phase of outreach work within the Tribal community has only just begun, and further outreach work such as this within the community is expected to continue well beyond the duration of this project, given the enduring nature of climate change impacts. Initial summaries of the pilot interviews are contained in the Appendices.

## **4.2 Cultural setting of Swinomish**

Important information about the Swinomish culture is recognized in an ongoing health study that includes neighboring Coast Salish tribes. This study is holistic, including spiritual and community factors as well as physical health. The first phase is reported in Table 4-1 below.<sup>10</sup> Results of the health study will help guide the climate change adaptation effort. Future phases will identify specific actions.

The first phase sets the stage by clarifying what is meant by “community health.” The study identified five indicators of community health as listed in the following table. Quotes from Coast Salish tribal members about the connections between natural resources and health provide explanatory illustrations.

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<sup>10</sup> White Paper: “Key Indicators of Tribal Human Health in Relation to the Salish Sea” Prepared in fulfillment to Swinomish Action Agenda Goal 4, Objective 1 for EPA grant #PSP438 in coordination with the Puget Sound Partnership.

### Community Health in Native Communities

In many Native American communities, Swinomish included, health is defined on a community level, consisting of inseparable strands of human health, ecological health, and cultural health woven together, all equally important. Within this definition, many of the dimensions of good health as defined by the Swinomish are difficult to quantify, such as participation in spiritual ceremonies, intergenerational education opportunities, and traditional harvesting practices, yet they may be negatively impacted or even destroyed when resources are scarce or disappear. (Arquette et al. 2002, Harris and Harper 1997, 2000, 2001, Wolfley 1998)

**Table 4-1. Suggested Top 5 Tribal Health Factors and Associated Health Indicators**  
(Salish Sea natural resources, including seafood, seaweeds, shells, etc.)

<b>Five Health Factors</b>	<b>Fifteen Health Indicators with Definitions for each</b>
<b>Community Cohesion</b>	<i>Participation &amp; cooperation</i> – the community depends on each other; strong support network (e.g., everyone supports the maintenance, harvest and distribution of resources)
	<i>Roles</i> (e.g., harvest, prepare, preserve natural resources) – each member of the community has a role that is respected
	<i>Familiarity</i> – food roles are known and trusted; therefore, it is assumed food is “safe”
<b>Food Security</b>	<i>Availability</i> – natural resources are abundant and healthy
	<i>Access</i> – all resource use areas (i.e., Usual and Accustomed areas) are allowed to be harvested with an emphasis on local resources for subsistence consumers.
	<i>Sharing</i> – ensuring that everyone in the community receives natural resources from the Salish Sea, esp. Elders
<b>Ceremonial Use</b>	<i>Gatherings &amp; ceremonies</i> – particular community assemblies that require natural resources from the Salish Sea
	<i>Giving thanks</i> – thanking Nature/ the Spirit for providing the natural resources when harvesting and preparing them; done with prayers and thoughtful intentions
	<i>Feeding the Spirit</i> – using natural resources from the Salish Sea to satisfy a spiritual “hunger” (e.g., consuming traditional foods)
<b>Knowledge Transmission</b>	<i>The Teachings</i> – knowledge, values and beliefs about tribal health in connection with the Salish Sea
	<i>Elders</i> – the knowledge keepers; they have and are able to pass on the knowledge
	<i>Youth</i> – the future; they receive and respect the knowledge
<b>Self Determination</b>	<i>Healing</i> — ability to choose life-style desired for what is considered “good health” (e.g., traditional medicines, language programs)
	<i>Development</i> —community enrichment opportunities directed by and for the community
	<i>Restoration</i> — environmental or habitat restoration projects that are community driven

**Community cohesion** means to actively participate in one or more roles within your community network. Two of the main duties in regards to natural resources are harvesting and preparation, which are imbued with thoughtful significance and intention. Particular methods have been honed over countless generations. Community members each have a role in the process and each role carries with it an identity and the pride of being a needed part of the entire process. For example, the cooks' role is looked upon with reverence equal to that of the harvesters' role. These roles are often learned and passed down through the generations such that some may be known as the best salmon cooks while others may be known as expert clam diggers or hunters. Community members know each other's roles, and who taught them the roles. That familiarity instills trust that the food handlers have performed their jobs accordingly and the food is "healthy" and "safe" to consume. As one tribal community member explained, "...*there is an importance that you know where it [a natural resource] is caught and you know that it is part of our community and it's been part of our history for that long period of time if it's caught by local community members.*"

**Food security** depends on 1) availability of natural resources (i.e., that there are sufficient stocks to be harvested), 2) access (i.e., that harvesters are allowed access to those stocks) and 3) sharing. Particularly for elders, who have passed on their food harvest and preparation knowledge but can no longer harvest or cook for themselves, they rely heavily on the food sharing networks. Food security is defined by the United States Department of Agriculture (2007) as "...access by all members at all times to enough food for an active, healthy life. Food security includes at a minimum (1) the ready availability of nutritionally adequate and safe foods, and (2) assured ability to acquire acceptable foods in socially acceptable ways." Shellfish are a high protein, low fat, nutrient rich food source (Dong 2001) that comprises a large portion of the Swinomish traditional diet. Shellfish (crab, shrimp and clams) are in the top five types of seafood eaten at Swinomish, second only to salmon, and clams provide a stable food source. A saying shared by many Coast Salish tribes is "when the tide is out, the table is set."

The natural resources of the Salish Sea are also a significant part of the subsistence economy—part of a long history of Native peoples supplementing economic income with subsistence foods to ensure food security. Subsistence relies on functioning kinship or community relationships sustained by internal support networks and honored and reinforced through ceremonies and gatherings (Usher et al. 2003). Often repeated in Coast Salish communities, one young fisher stated, "*Yes, I always believe in sharing my catch because it's always been taught to me to do this and I always try and give mostly to elders, the ones that can't get out on the water and get their own.*"

**Ceremonial use** is more than the ceremonies and gatherings themselves. It also means the importance of giving thanks to the spirits of the natural resources when harvesting and preparing them, and the necessity to feed the spirit of oneself by consuming natural resource foods or feeding the spirit of a relative who has passed away by offering natural resources. Ceremonies, also referred to as gatherings, involve natural resources such as salmon, duck and clams and are viewed as an important part of the food-sharing network. Ceremonies provide the environment in which healing can take place (as health is both a physical and spiritual state (Garrett 1999)). Community members look forward to ceremonies for the natural resources and the company as well as the spiritual significance. Ceremonies are the best way to reinforce ties with other community members and members of other tribal communities, and are especially important to elders, many of whom only have access to natural resources at these events throughout the year.

When asked about the importance of having natural resources at gatherings and ceremonies, the majority of interviewees said that the *events would be changed or impossible without natural resources such as seafood*. For example, the First Salmon ceremony occurs at the beginning of the fishing season. The ceremony thanks the marine natural resources for returning and allowing the people to harvest them, and also asks for protection and guidance for the fishers to safely obtain plentiful catches. The proper way to

harvest and prepare a natural resource is to pray and give thanks to the Spirit for offering itself to the community. In this way, the natural resource is empowered with the prayers, which in turn nourishes both the body and the soul.

The **Knowledge transmission** health indicator encompasses the teachings how to gather, prepare, preserve, distribute, and employ natural resources, passed down from the elders to the youth. One example of knowledge transmission that also ties in all of the aforementioned key health indicators of community cohesion, ceremonies, and food security is the role of food preparation as recounted by a Coast Salish community member:

*“I fostered two teenagers... They were getting into a little bit of trouble. They wore the backwards baseball hats that read ‘Native Pride,’ you know, ‘I’m Indian, I’m Indian.’ I said, ‘Well, you really want to show your people how to be Indian, here I’ll show you.’ I just happened to be filleting fish; I had a lot of fish. And we filleted them and I made them help me...I said, ‘...this is how you want to be Indian is you provide food for your people. It’s not standing on the corner with a Native pride hat acting tough. That’s not Indian.’ The effect on them was just passing that on...the importance, and emphasizes that we have to gather these foods; we have to provide these foods in the wintertime when we’re putting food on the table for the smokehouse.”*

**Self determination** is a key health indicator that incorporates healing, restoration, and development, all enacted by and at a community/ local level. Self determination means the freedom to decide how to create and sustain “good health.” This final health indicator is unique in that, unlike the four previous indicators, asserting self-determination was not necessary until externally imposed trauma occurred. “Externally imposed trauma is defined as ‘events that overwhelm a community’s capacities to function in stable and generative ways’ (Korn 2002). Community trauma results from externally imposed habitat destruction, economic dislocation, food security interruption, social order disruption, and physical relocation. Educational colonization, religious conversion, natural resource piracy, distortion of decision-making, and externally imposed priority-making are all together and individually factors that can give rise to community trauma” (Korn and Dyer 2008). Forced assimilation through boarding schools and government laws outlawing Native people from practicing their traditional ways are examples of trauma that negatively impact self-determination (c.f., Adams 1995, Collins 1997, Hoxie 1984).

Self-determination is the ability to exercise sovereign rights. The first component, healing, is the availability of and access to traditional medicines, language programs and other culturally integral community health. Development, the second component, is the ability for a community to determine and enact their own, chosen community and economic enrichment activities in their homelands (this includes both reservation areas and traditional fishing, hunting, and gathering areas). The third component of self-determination is restoration, the ability for a community to determine and enact their own chosen environmental or habitat restoration programs. A germane example of this third component is the current dam removal and river restoration project occurring on the Elwha River.

The remaining two steps in this health study are to summarize the tribal knowledge base of threats to and status of the Salish Sea and develop criteria and priorities for actions that address the threats and tradeoffs to tribal human health. Once the tribal knowledge base of the threats to and status of the Salish Sea has been established, a closer look at threats specifically from climate change may be undertaken, and priorities altered based on potential findings.

## 4.3 Cultural Resilience: New Term, Old Meaning

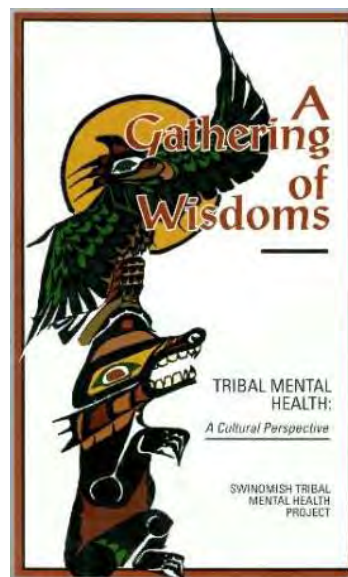
### What is cultural resilience and why is it important?

“Cultural resilience is a relatively new term, but it is a concept that predates the so called ‘discovery’ of our people,” wrote Iris HeavyRunner (Blackfeet), when she was coordinator of a tribal college faculty development project at the University of Minnesota. “The elders teach us that our children are gifts from the Creator and it is the family, community, school, and tribe's responsibility to nurture, protect, and guide them. We have long recognized how important it is for children to have people in their lives who nurture their spirit, stand by them, encourage and support them. This traditional process is what contemporary researchers, educators, and social service providers are now calling fostering resilience. Thus, resilience is not new to our people; it is a concept that has been taught for centuries. The word is new; the meaning is old.”<sup>11</sup>

### Community wellness and circles of support

Resilience is important because certain impacts of climate change may lead to *grief* and *despair*, e.g. from decline of shellfish, salmon, land animals such as elk, the loss of traditional gathering and hunting places, and impacts to traditional plants. Resilience also is key to a five-phase model of wrap-around services to help native youth succeed in education.<sup>12</sup> CCEAG seeks to integrate such a model into its youth leadership work tied to climate change.

The book *A Gathering of Wisdoms*, produced by the Swinomish Tribal Behavioral Health Program (second edition) speaks to the importance of supporting tribal mental health and community wellness; it describes how to develop a behavioral health program in a tribal setting. It provides guidance that could be a resource for addressing community health issues of grief and despair and in building resilience.



(cover art: Alex Paul, Jr.)

### Indigenous Plants and Healing Garden

The new Swinomish branch of Northwest Indian College is the site of an emerging landscape of indigenous plants, including one or more healing gardens. Elders and community volunteers are preparing the site and gathering plants, including a restored (or enhanced) wetland. This project was not conceived specifically as a climate change response. Nevertheless, it can strengthen community wellness and resilience to climate change impacts because it will be a repository of indigenous plants and a place for teaching and healing. It could also be a way to share information with the Tulalip ecosystem project that is inventorying native plants and plant communities.

<sup>11</sup> HeavyRunner, I., & Morris, J.B. (1997). Traditional native culture and resilience. *Research and Practice*, 5(1). (Available from the Center for Applied Research and Educational Improvement, College of Education and Human Development, University of Minnesota, MN).

<sup>12</sup> Gillory, Justin. Generational Resilience, Strategies for Reproducing Success in Native College Students

## 4.4 Tribal Traditions and Effective Adaptation Planning

This chapter describes ongoing work to communicate climate change issues and to recruit people to join in adaptation measures. It describes the importance of tribal traditions and the challenges of developing effective adaptation measures that respond to those traditions. It also discusses the need to have an ethical response that respects and preserves the sensitive nature of traditional knowledge and specifies ongoing work to connect elders with youth for intergenerational sharing of spiritual and other traditional environmental knowledge. Specific actions that will help ensure the connection between tribal traditions and effective adaptation planning are outlined below.

### A. Integrate indigenous knowledge into ongoing planning and programs

There are a number of efforts underway regionally that are exploring ways to incorporate indigenous knowledge into planning efforts to address climate change issues, and these vary considerably in their approach. A selection of such efforts includes the following:

- The Tulalip Tribes are pursuing a codification approach to institutionalizing traditional knowledge by creating an ethical construct that functions as an indirect representation of more sensitive knowledge concepts, in the interest of respecting and protecting such core knowledge.
- Creation of tribal review boards as a vehicle for formal screening and approval of traditional knowledge and sources. This would allow for and create a pathway for application of traditional knowledge, while providing a direct means of protecting such knowledge from misappropriation and misuse.
- Application of the community health indicators referenced in this chapter as a tool for measuring success and effectiveness of implemented programs and actions. This could be done both at the outset of proposed implementation and as part of ongoing monitoring of actions.

### B. Explore treaty implications of adaptation planning

Because climate change can jeopardize the exercise of treaty-protected rights and thus impact tribal sovereignty, a range of actions needs to be explored to address such possibility. For example, “in-lieu” claims can assert the precedent of hydropower impacts on fisheries to help support efforts to replace impacted resources. Likewise, agreements for cooperative, defensive, or info-sharing purposes can be negotiated. Such a strategy might be useful, for example, to bolster the joint efforts of local tribes to preserve or enhance impacted resources.

During a Climate Change Summit of the Coast Salish Gathering in the spring of 2010, participants discussed many aspects of treaty resources and climate change impacts. A recurring focus of discussion concerned the subject of “first foods,” meaning traditional or cultural foods that tribes have used for centuries. Participants heard about and discussed impacts already affecting the collection and use of first foods, as well as emerging strategies and programs to address these issues. Following the Summit, a position paper was developed to summarize an adaptation path that includes a closer look at first foods and treaty rights<sup>13</sup>, as presented in the Appendices.

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<sup>13</sup> Jamie Donatuto, Ph.D. and Catherine A. O’Neill, J.D. Protecting First Foods in the Face of Climate Change, Summary and Call to Action, Coast Salish Gathering Climate Change Summit, July 2010.



As presented at the Coast Salish Climate Change Summit,<sup>14</sup> a pertinent tribal case study and approach that addresses both incorporation of traditional knowledge and the treaty implications of climate change is that developed by the Confederated Tribes of Umatilla. Eric Quaempts, Natural Resources Director, created the Umatilla's approach to first foods after many interviews with tribal members. Their management program assigns natural resource management branches to the appropriate food. Quaempts noted the order of food to the table and its importance. Water is the first food to the table and the most important; Water Resources and Fisheries are responsible for the water. The Cultural Resources Program is responsible for all the first foods such as salmon, deer, roots, and berries, along with the other natural resource departments that manage specific foods. The reciprocity of first foods is that they are managed to return to the people. It is a food-associated culture. It means tribal members have:

- Access to them, as provided by their treaty rights;
- The teaching of first foods and learning about them;
- Harvest and how and when to do that;
- The preparation, that is passed on;
- Consumption;
- Celebration, sharing, and caring.

### **Food takes care of the people and the people take care of the food: Umatilla Case Study<sup>14</sup>**

Teara Farrow Ferman, Cultural Resources Protection Program Manager for the Umatilla, states: "We manage our foods to have the foods into the future and preserve our culture." Historically, the men harvested and presented the salmon and the deer. The women collected and presented the roots and berries. Today, because climate change is already affecting the availability of foods, some Umatilla tribal members teach their sons *and* daughters to collect both foods. "We don't know what foods will be available [to tribal members] in the future or who they will marry," said Farrow. "We want them to be able to identify these foods and know how to prepare them. It's central to who we are." Farrow emphasized the importance of collecting oral histories and archeological data and archiving the information. "What this information has shown us is that we have adapted to changes in our environment; where we once used dip nets we now have to use gill nets but this hasn't changed the importance of the food," said Farrow. "The community still values the First foods order even though species have changed." If physical and ecological processes change, however, our foods will change. Umatilla tribal members are already seeing roots and berries become less available in areas they traditionally gather from so they are having to look beyond those areas, further away. If climate change continues to have an effect, we may have to go back to our old ways of trade, trading food resources with family members of other tribes.

<sup>14</sup> <http://blogs.nwifc.org/climatechangesummit/tag/confederated-tribes-of-the-umatilla/>

## 5 Summary of Potential Impacts

As presented in the Technical Report, a detailed sector-by-sector analysis of impacts was performed to identify specific impact types, extent, approximate timeframes, and probability. This chapter provides a synopsis of the impacts discussed in greater detail in the Technical Report. The principle areas and resources within the Swinomish Indian Reservation vulnerable to climate change impacts are shorelines, beaches, low-lying terrain, and forests, along with the assets within those areas. Impacts to some of these vulnerable areas are potentially high within 20-50 years, increasing through the end of the century and beyond.<sup>15</sup> Other areas and resources may have moderate impacts during this timeframe. Significant among these potential impacts are the following:

- Over 1,100 acres of Swinomish Reservation lands, or approximately 15% of Reservation uplands, are potentially at risk of inundation from increasing sea level rise, including the only agricultural lands within the Reservation, the Tribe's primary economic development lands, and sensitive shoreline areas.
- Approximately 160 residential structures are potentially at risk of inundation from sea level rise and/or tidal surge, with a total estimated value of over \$83 million.
- Approximately 18 non-residential or commercial structures are potentially at risk of inundation from sea level rise and/or tidal surge, with a total estimated value of almost \$19 million.
- Approximately 2,218 acres of uplands and over 1,500 properties are in a high risk zone for potential wildfire based on projected increase in temperatures; total value of structures and properties within this zone is estimated to be more than \$518 million. Most other areas within the Reservation are at least at moderate risk of wildfire.
- Vital transportation links and access routes to the Reservation are at risk of inundation, with the potential to isolate the Reservation from the mainland during increasingly high tidal events.
- Traditional beach seining sites and significant shellfish beds along the west shore of the Reservation, areas of traditional tribal harvest, are at risk of permanent inundation and potential loss, as are estuaries and salmon-rearing areas.
- The Reservation population as a whole, particularly those who are ill or elderly, are potentially at risk of a variety of heat-related illnesses during isolated or extended high heat episodes as average temperatures increase, and tribal members in particular may be at risk of increased incidence of respiratory ailments such as asthma from potential increase in synergistic impacts of pollutants.
- Sensitive cultural sites within low-lying areas may face permanent inundation, and traditional native species may be lost as they are forced to migrate or adapt to hotter, drier climatic conditions.

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<sup>15</sup> As discussed in the Technical Report, models and scenarios examined, as well as assessments of impacts, generally rely upon projections through 2100; most analyses agree, however, that climate change and associated impacts are expected to continue for some period of centuries or longer. See Technical Report and Appendix 2 for more complete discussion of projected impacts.

The risk of inundation of shorelines and low-lying areas is expected to increase over the long term with gradual sea level rise and projections of more frequent and intense storm/tidal surges. Global projections of sea level rise indicate a range from lower estimates of 18-59 cm (~1-1/2 to 2 feet) by the end of the century (IPCC, 2007) to higher estimates of up to 55-125 cm (~2 to 4+ feet) within the same timeframe (Rahmstorf, 2007; Pacific Institute, 2009). Regional estimates of sea level rise depend on the local effects of wind patterns, atmospheric pressure, and vertical land movement caused by tectonic activity. Considering these local conditions, Mote et al. (2008) estimates regional sea level rise for the Puget Sound to span from very low estimates of 16 cm (6") to very high estimates of 128 cm (50"). Structures, roads, utilities, and other assets within nearshore or low-lying areas will be increasingly impacted by sea level rise and tidal surge events to the extent that adaptation measures will not be available or able to forestall, protect against, or prevent such impacts.

Based on projections of potential sea level rise and tidal surge, risk zones were mapped for the Reservation (Figure 5-1). For the purpose of risk analysis, projected inundation zones were derived by adding an increase of up to 5 feet above current Mean Higher High Water (MHHW) for sea level rise (upper range of surveyed scenarios) and an additional 3 feet beyond that for storm/tidal surge. An inventory of properties and improvements within these risk zones identified almost 200 properties potentially at risk, including residential structures and non-residential facilities (Tables 5-1 and 5-2). Any revenues generated from leasing or other commercial activity on these properties would also be at risk of loss. Estuaries, eel grass habitat for forage fish, and low-lying agricultural and shellfish areas could ultimately be lost entirely, and primary economic development land could be significantly impacted. Certain impacts also carry potentially significant secondary consequences as well, such as inundated access routes causing isolation of the Reservation from the mainland, or inundation of low-lying development zones affecting or preventing implementation of critical economic development projects. Such secondary consequences have the potential to extend impacts to the entire Reservation population and stress the ability of Tribal and other governmental entities to respond.

Structures and Lots Within Inundation Risk Zones										
Subarea:	Swin. Village / Shelter Bay		Economic Zone / Agricultural		Snee-Oosh / Kiket Island		Similk Bay / Turner's Bay		Total All Areas	
Sea Level Rise	#	Approx. Value*	#	Approx. Value*	#	Approx. Value*	#	Approx. Value*	#	Approx. Value*
Residential	16	\$12,259,500	4	\$1,088,100	9	\$4,024,400	0	\$0	29	\$17,372,000
Non-Residential	4	\$1,720,760	2	\$670,000	2	\$794,700	0	\$0	8	\$3,185,460
Buildable Lots	1	\$308,800	0	\$0	9	\$3,050,000	3	\$1,044,500	13	\$4,403,300
<b>Subtotal</b>	<b>21</b>	<b>\$14,289,060</b>	<b>6</b>	<b>\$1,758,100</b>	<b>20</b>	<b>\$7,869,100</b>	<b>3</b>	<b>\$1,044,500</b>	<b>50</b>	<b>\$24,960,760</b>
<b>Tidal Surge</b>										
Residential	121	\$63,282,900	1	\$192,200	7	\$2,228,300	2	\$308,800	131	\$66,012,200
Non-Residential	4	\$1,124,000	5	\$14,146,300	1	\$253,200	0	\$0	10	\$15,523,500
Buildable Lots	3	\$525,000	0	\$0	1	\$172,400	0	\$0	4	\$697,400
<b>Subtotal</b>	<b>128</b>	<b>\$64,931,900</b>	<b>6</b>	<b>\$14,338,500</b>	<b>9</b>	<b>\$2,653,900</b>	<b>2</b>	<b>\$308,800</b>	<b>145</b>	<b>\$82,233,100</b>
<b>Total Risk Zones</b>										
Residential	137	\$75,542,400	5	\$1,280,300	16	\$6,252,700	2	\$308,800	160	\$83,384,200
Non-Residential	8	\$2,844,760	7	\$14,816,300	3	\$1,047,900	0	\$0	18	\$18,708,960
Buildable Lots	4	\$833,800	0	\$0	10	\$3,222,400	3	\$1,044,500	17	\$5,100,700
<b>TOTAL</b>	<b>149</b>	<b>\$79,220,960</b>	<b>12</b>	<b>\$16,096,600</b>	<b>29</b>	<b>\$10,523,000</b>	<b>5</b>	<b>\$1,353,300</b>	<b>195</b>	<b>\$107,193,860</b>

\*Values based on Assessor's records of market value for fee properties, and Swinomish Tribal data for certain trust properties.

Table 5-1. Structures and Lots within Inundation Risk Zones.

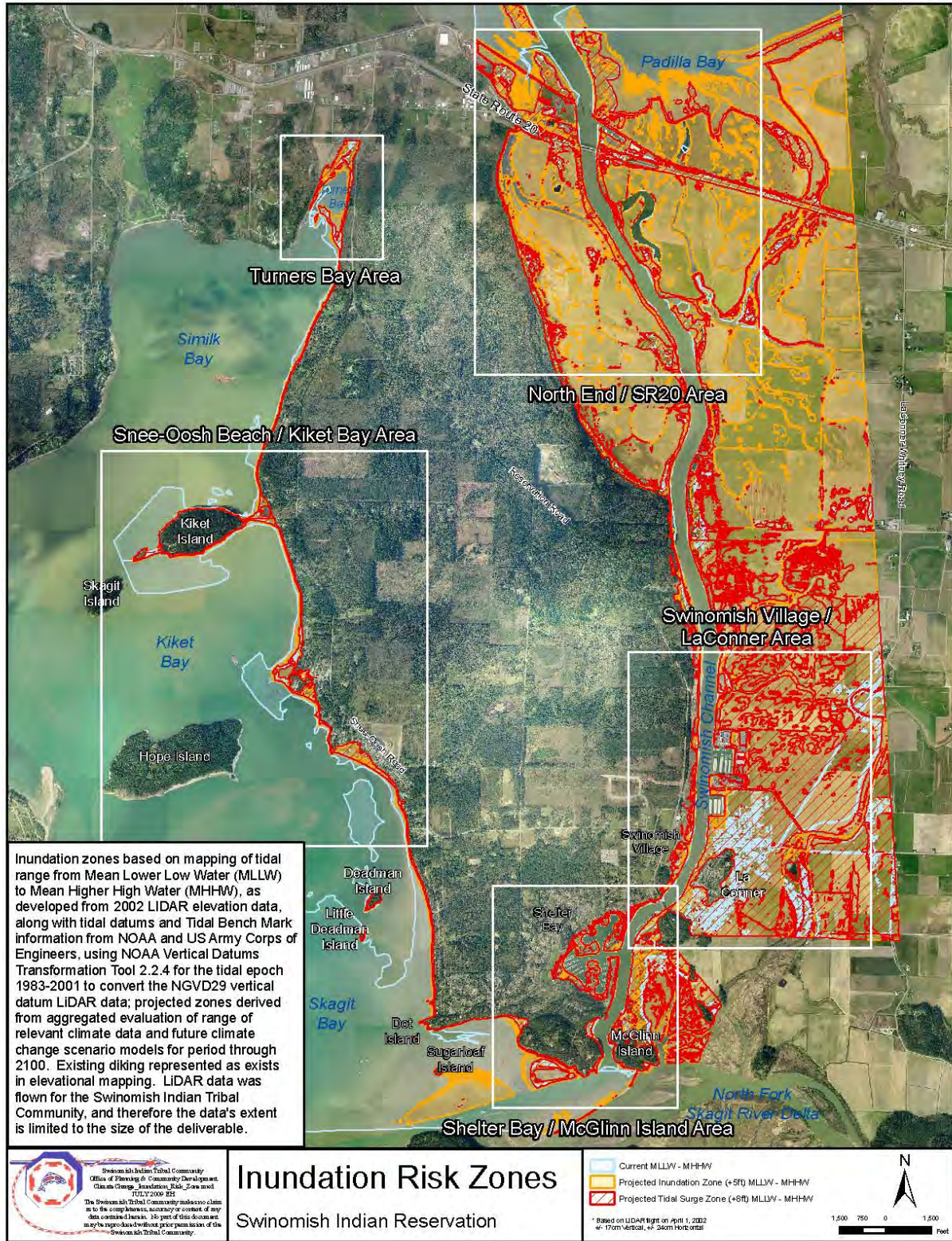


Figure 5-1. Inundation Risk Zones for Swinomish Indian Reservation vicinity.

<b>Non-Residential Facilities Within Inundation Risk Zones</b>		
<b>Sea Level Rise:</b>	<b>Location</b>	<b>Approx. Value</b>
Fish Plant	Swinomish Village	\$1,675,000
SITC Boat repair facility	McGlenn Island	\$45,760
Smoke shop	North end commercial zone	\$670,000
Hope Island Inn	Snee-Oosh Beach (west shore)	\$783,800
Community pump station	Snee-Oosh Beach (west shore)	\$10,900
<b>Total</b>		<b>\$3,182,460</b>
<b>Tidal Surge:</b>	<b>Location</b>	<b>Approx. Value</b>
Skagit River System Coop.	Swinomish Village	\$284,000
SITC Planning Department	Swinomish Village	\$575,000
SITC Waste Oil Facility	Swinomish Village	\$15,000
Latitude Marine	McGlenn Island	\$250,000
SITC Casino/Bingo	North end economic zone	\$9,412,000
SITC Gas Station	North end economic zone	\$2,000,000
SITC RV Park	North end economic zone	\$584,300
SITC Water Treatment Plant	North end economic zone	\$2,100,000
SITC Gaming Office	North end economic zone	\$50,000
Fire District 13 station	Snee-Oosh Beach (west shore)	\$253,200
<b>Total</b>		<b>\$15,523,500</b>

Table 5-2. Non-Residential Facilities within Inundation Risk Zones

Forested areas and resources are projected to experience different but equally significant impacts. Annual mean temperature is projected to increase in the northwest by up to 3-4°F by 2040 and perhaps as much as 7-8°F by the end of the century (DOE 2006, CIG 2009). Gradually increasing average and summer temperatures will decrease moisture content in soils and vegetation and increase the potential for devastating wildfire throughout forested areas of the Reservation, but with potentially greatest impact in the urban/forest interface. The urban/forest interface was evaluated using analysis of GIS and aerial photo data, correlating developed areas of varying densities to forested areas of given density. Forested areas cover the majority of Reservation uplands, while developed areas primarily lie within southeast, south, and west shore areas, although some scattered pockets of homes and homesites exist in interior uplands. Where denser developed and forested areas intersect, a wildfire risk zone was identified, as augmented by a 200-foot buffer around identified developed areas (Figure 5-2). While the entire Reservation is deemed to potentially be at risk of wildfire due to extent of forestation, the identified urban/forest interface zones were considered to be at greatest risk, and for the purpose of risk evaluation and response strategy implementation, were designated as primary wildfire risk zones. Tables 5-3 and 5-4 summarize residential and non-residential properties inventoried and identified within the primary wildfire risk zones.

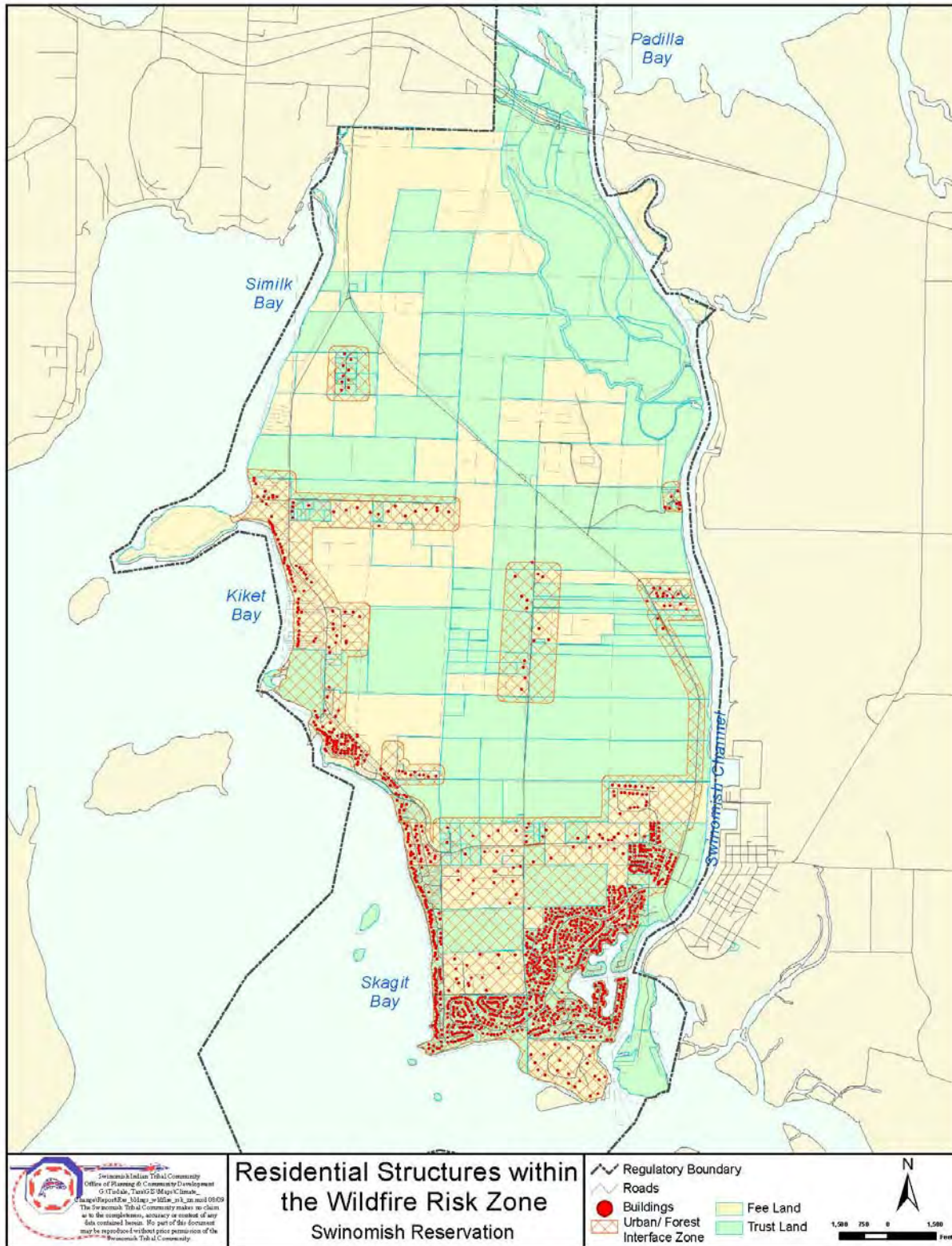


Figure 5-2. Structures within Wildfire Risk Zone.

<b>PROPERTY WITHIN WILDFIRE RISK ZONES (Urban/Forest Interface)</b>			
<b>Property Type</b>	<b>Number</b>	<b>Acres</b>	<b>Approx. Value</b>
Residential	1,368	1,995	\$ 493,688,000
Non-Residential	9	143	\$ 4,806,000
Buildable Lots	183	80	\$ 19,918,000
<b>TOTAL</b>	<b>1,560</b>	<b>2,218</b>	<b>\$ 518,412,000</b>

Table 5-3. Property within Wildfire Risk Zone.

<b>Non-Residential Facilities Within Wildfire Risk Zone</b>		
<b>Facility</b>	<b>Location</b>	<b>Approx. Value</b>
Swinomish Longhouse	Swinomish Village	\$250,000
Fire District 13 station (new)	Snee-Oosh Rd., west of Village	\$320,000
LaConner Neighborhood Church	Snee-Oosh Rd., west of Village	\$251,000
Shelter Bay Community buildings	Shelter Bay	\$750,000
Thousand Trails Campground	Lone Tree Point	\$1,444,000
Northwest Indian College	Tallawhalt	\$550,000
Shaker Church (new)	Tallawhalt	\$300,000
Swinomish Utility water tanks	Indian Rd.	\$600,000
Cycle Barn	Mill Rd. Lane	\$341,000
<b>TOTAL</b>		<b>\$4,806,000</b>

Table 5-4. Non-Residential Facilities within Wildfire Risk Zone.

Other impacts on forest resources include increasing drought stress with rising temperatures, and an associated proliferation of drought-tolerant species such as fir and decline in drought-susceptible species such as western red cedar, possibly accompanied by a shift in understory species and ground vegetation. Additionally, higher temperatures are projected to create a more suitable environment for the spread of forest pests and diseases, such as bark beetles and various fungi that would previously have been suppressed by colder winters.

Additional significant or notable impacts include effects on public health, marine resources, and cultural resources. Increasing temperatures are projected to impact human health in numerous ways; heat stress will have a variety of impacts on the general population, as already seen in some parts of the globe, and rising temperatures will create a more suitable environment for pathogens and their vectors that is not normally prevalent in a colder regime. Likewise, rising ocean acidity and shifts in tidal zones will put additional stress on near-shore marine resources such as shellfish and viable habitats. Cultural resources may be impacted both positively and negatively by tidal inundation. Gradual sea level rise will increasingly submerge nearshore or low-lying buried artifacts and sites, both protecting them and making investigation more difficult, while strong storm surges may uncover some sites or artifacts, rendering them vulnerable to weathering and tampering. Cultural use areas may be impacted by either inundation in near-shore or low-lying areas or by wildfire in forested areas, rendering them unusable in either case for some extended period of time.

## **6 Adaptation Goals**

Planning for adaptation must necessarily follow and be guided by community goals. For the purposes of this project, the project team was guided by existing goals as contained in documents approved and developed by the Tribal Senate. The primary guiding document is the Swinomish Comprehensive Plan, which addresses goals for all major functions and activities within the Reservation. It is also a key document into which climate adaptation planning will be incorporated as the Comprehensive Plan is updated. Other guiding goals for this project were drawn from the annual statement of Senate Goals, as updated yearly by the Tribal Senate. Table 6-1 below provides a summary of relevant goals extracted from these documents, organized according to the major categories of impacts.

Goals relevant to identified issues were extracted from these documents and correlated to given impacts; once correlated, the identified and extracted goals were then applied in evaluation of potential strategies, as presented in both the evaluation tables in Chapter 8 and in the associated narrative. Some goals apply to many impact sectors. For example, the Senate’s goal of “substantially increasing Tribal employment” can be incorporated into many of the adaptation measures proposed in this document. Goals and objectives are expected to change as community review proceeds and as more is learned about ongoing climate change impacts.



**TABLE 6-1. ADAPTATION PREPAREDNESS GOALS  
(derived from Swinomish Comprehensive Plan and Tribal Senate goals)**

Sector/Element	Potential Impacts	Risk (est.)	Applicable Goals (Comprehensive Plan goals in italics)
<b>COASTAL RESOURCES</b>			
Shorelines/marine habitat (estuaries, eel grass beds, beaches, etc.)	Increasing inundation from gradual sea level rise, flooding from storm surges, bluff erosion	High	<ol style="list-style-type: none"> <li>1. <i>Every attempt shall be made to preserve the aesthetic value and natural systems of the beaches</i></li> <li>2. <i>Shoreline regulatory and management programs should identify and protect vital ecosystems and be conducive to implementing enhancement proposals.</i></li> </ol>
Shoreline development (residential, commercial)	Inundation, damage to structures from sea level rise, storm surge	High	<ol style="list-style-type: none"> <li>1. Balance, cultural, economic, and environmental goals.</li> <li>2. Protect human life.</li> <li>3. <i>Shoreline regulatory and management programs should identify and protect vital ecosystems and be conducive to implementing enhancement proposals.</i></li> </ol>
Economic development in shoreline area	Inundation, damage to structures from sea level rise, storm surge	High	<ol style="list-style-type: none"> <li>1. Balance, cultural, economic, and environmental goals.</li> <li>2. <i>Protect economic investments, opportunities, and revenues.</i></li> <li>3. <i>Substantially increase Tribal employment and skill development opportunities</i></li> </ol>
Shellfish beds	Loss of harvest sites and opportunities due to impacts to shellfish populations and habitat	High	<ol style="list-style-type: none"> <li>1. <i>Fishery and shellfish resources of the Reservation should be restored and enhanced, maintaining the traditional livelihood based upon these resources.</i></li> <li>2. Seek off-reservation sites for shellfish harvest/cultivation</li> <li>3. <i>Preserve ability to fully exercise treaty rights and cultural practices and to improve physical and spiritual health.</i></li> <li>4. <i>Reestablish natural diversity in harvestable clam populations.</i></li> </ol>
Beach seining/ Fin fish	Loss of beach seining sites and opportunities, loss of fish habitat	High	<ol style="list-style-type: none"> <li>1. <i>Fishery and shellfish resources of the Reservation should be restored and enhanced, maintaining the traditional livelihood based upon these resources.</i></li> <li>2. <i>Preserve ability to fully exercise treaty rights and cultural practices and to improve physical and spiritual health.</i></li> </ol>
Waterfowl/shorebirds	Loss of forage areas and opportunities due to impacts on food sources	Medium-High	<ol style="list-style-type: none"> <li>1. <i>Biotic productivity and species diversity within the coastal zone should be maintained and enhanced</i></li> </ol>
Recreation/gathering places	Inundation of beaches from sea level rise, storm surge	High	<ol style="list-style-type: none"> <li>1. <i>Every attempt shall be made to preserve the aesthetic value and natural systems of the beaches</i></li> </ol>
Archeological sites/ artifacts	Increasing inundation of archeological sites from gradual sea level rise	High	<ol style="list-style-type: none"> <li>1. Enhance tribal capacity to protect sites and human remains.</li> <li>2. Increase compliance with laws among neighboring entities.</li> </ol>
Burial sites, human remains	Disturbance/exposure from severe storm events	Medium-High	<ol style="list-style-type: none"> <li>3. <i>Designated or established sites of cultural value should be protected, maintained and enhanced.</i></li> </ol>

Sector/Element	Potential Impacts	Risk (est.)	Applicable Goals (Comprehensive Plan goals in italics)
<b>UPLAND RESOURCES</b>			
Forest resources, upland habitat	Wildfire risk	High	<ol style="list-style-type: none"> <li>1. Sustained yield forestry and ground cover management programs and controls should be developed on a Reservation-wide basis.</li> <li>2. Develop an old growth forest ecosystem that includes mature stands of cedar and other indigenous plants and trees.</li> <li>3. Maintain and expand diversity of forest lands, wildlife habitat, and wetlands.</li> </ol>
	Heat stress, degraded habitat viability	High	<ol style="list-style-type: none"> <li>1. Natural habitat should be protected to the greatest extent possible from development and other interferences.</li> </ol>
	Species loss/migration	Medium-High	<ol style="list-style-type: none"> <li>1. Protect and enhance natural habitat values.</li> <li>2. The multiple use concept of forest management should be encouraged and used in appropriate areas.</li> </ol>
	Increased pest/disease infestations	Medium-High	<ol style="list-style-type: none"> <li>1. Forestry practices shall discourage the use of herbicides and/or other potential contaminants unless substances can be demonstrated harmless to the resource.</li> </ol>
Upland wetlands	Decline/degradation from reduced flow/input	Medium-High	<ol style="list-style-type: none"> <li>1. Habitat, water quality and stream flow of the Reservation's wetlands should be maintained.</li> </ol>
Upland freshwater	Declining consistency/volume	Medium-High	<ol style="list-style-type: none"> <li>1. The quantity and quality of surface and ground water supplies should be maintained for long-term natural, physical, and human uses.</li> </ol>
Groundwater	Increasing salinization	Medium-High	<ol style="list-style-type: none"> <li>1. The quantity and quality of surface and ground water supplies should be maintained for long-term natural, physical, and human uses.</li> </ol>
Agriculture	Eventual inundation & salinization Decreased value for current farm use.	Medium-High	<ol style="list-style-type: none"> <li>1. Prime agricultural lands should be protected and preserved as a non-renewable food production resource to benefit present and future generations.</li> <li>2. Whenever possible, buffers between agricultural and potentially conflicting uses should be established.</li> <li>3. Forestry and agricultural areas should be preserved and protected from incompatible land uses.</li> </ol>
Upland development (residential, commercial)	Wildfire risk, urban/forest interface zone	High	<ol style="list-style-type: none"> <li>1. Forestry and agricultural areas should be preserved and protected from incompatible land uses.</li> <li>2. Development which significantly impacts productive resource areas should be prohibited or be designed to mitigate or compensate for such impacts.</li> <li>3. Balance, cultural, economic, and environmental goals.</li> <li>4. Protect human life.</li> <li>5. Protect economic investments, opportunities, and revenues.</li> <li>6. Reduce damage from wildfire.</li> <li>7. Restore habitat in abandoned areas</li> </ol>

Sector/Element	Potential Impacts	Risk (est.)	Applicable Goals (Comprehensive Plan goals in italics)
<b>COMMUNITY INFRASTRUCTURE &amp; SERVICES</b>			
Water	Lower summer river flow, increased demand, reduced supply	Medium	<ol style="list-style-type: none"> <li>1. Implement MOU requirement of 10% water use reduction.</li> <li>2. Maintain adequate water supply</li> <li>3. Increase reliability and quality of water supply</li> <li>4. <i>Development in the groundwater recharge area should be restricted and a buffer established between any such recharge area and urban development.</i></li> <li>5. <i>Reservation groundwater aquifer should be investigated for designation as a sole source aquifer and managed to preserve long-term quantity and quality. Withdrawn water should be recycled back to the groundwater to the greatest extent possible</i></li> </ol>
	Contamination from inundation, flooding	Medium	<ol style="list-style-type: none"> <li>1. Maintain safe water supply</li> <li>2. Increase safety of water supply</li> </ol>
Wastewater treatment facilities	Disabled treatment capacity, water pollution from inundation	Low-Medium	<ol style="list-style-type: none"> <li>1. Ensure adequate, secure, long-term availability of wastewater treatment.</li> </ol>
Communications	Service disruption from severe storm events	Medium-High	<ol style="list-style-type: none"> <li>1. Maintain capability and reliability of communications system.</li> <li>2. Develop alternate or emergency capability for communications to prevent disruption in the event of outage.</li> </ol>
Energy/Power	Service disruption from severe storm events	Medium-High	<ol style="list-style-type: none"> <li>1. Develop alternate or emergency power sources to supplement existing sources and minimize disruption in the event of outage.</li> <li>2. Decrease dependence on power grid.</li> <li>3. Minimize power demand from cooling.</li> </ol>
	Increased energy demand	Medium	
Waste Disposal	Spread of waste from containers during flooding	Medium	<ol style="list-style-type: none"> <li>1. Secure hazardous waste from exposure to flooding.</li> <li>2. Locate collection and transfer facilities shall away from at-risk areas.</li> </ol>
Police/Fire/Emergency response, repair crews	Increased demand for assistance during storm events, outages, flooding, fire	Medium-High	<ol style="list-style-type: none"> <li>1. Build tribal capacity to respond to emergencies.</li> <li>2. <i>Substantially increase Tribal employment.</i></li> </ol>
Stormwater Control	Inundation/backup of drainage lines and discharge points from higher tides, storm surges	Medium	<ol style="list-style-type: none"> <li>1. Increase capacity of stormwater system.</li> <li>2. <i>Surface water runoff and drainage facilities should be designed and utilized in a manner that protects against the destruction of private property, the disruption of natural drainage ways and the degradation of water quality.</i></li> </ol>
	Damage to discharge outfalls from bank erosion	Medium-High	
Marine facilities	Flooded dock facilities, impaired fishing activities	High	<ol style="list-style-type: none"> <li>1. <i>Protect ability to exercise treaty rights and to provide economic development.</i></li> <li>2. Provide for upgrade of marine facilities in long-range planning.</li> </ol>
Roads & Bridges	Inundation of access routes, travel disruption, isolation from mainland	High	<ol style="list-style-type: none"> <li>1. <i>A transportation network should be provided that will adequately satisfy the requirements for everyday access, tourism, and emergency vehicle access and evacuation in a safe and effective manner.</i></li> <li>2. <i>Road and utility construction should be prohibited from areas subject to excessive erosion and/or accretion.</i></li> </ol>

Sector/Element	Potential Impacts	Risk (est.)	Applicable Goals (Comprehensive Plan goals in italics)
	Flood damage from storm/tidal surge, heat damage	Medium	<ol style="list-style-type: none"> <li>1. <i>Road and utility construction should be prohibited from areas subject to excessive erosion and/or accretion.</i></li> <li>2. Provide for an effective ongoing program of maintenance and inspection of vital transportation facilities.</li> </ol>
	Erosion of bridge footings from higher tides/storm surges	Medium	
	Fatigue of bridge joints from higher temps	Medium	
<b>PHYSICAL HEALTH</b>			
Heat-related illness	Heat exhaustion/stroke from higher summer temperatures (elders, children, ailing, homeless most at risk)	Medium-High	<ol style="list-style-type: none"> <li>1. Improve and enhance the quality of health services within the Reservation.</li> <li>2. Promote outreach and educational programs on critical health issues.</li> </ol>
Respiratory disease	Increasing incidence of asthma, allergen-related problems	Medium-High	
Disease vectors	New/increased disease vectors, related outbreaks	Medium	
Pollution-related illness	Increased illness from environmental pollutants, exacerbated by weather/climate	Medium-High	
Food-related illness	Shellfish poisoning, consumption of toxin-laden seafood	Medium	<ol style="list-style-type: none"> <li>1. Preserve ability to exercise treaty rights, cultural practices, improve physical health.</li> <li>2. <i>Construct more appropriate human health risk assessment for toxics in cultural keystone foods.</i></li> <li>3. <i>Promotion of shellfish aquaculture on Tribal tidelands should be encouraged, emphasizing subsistence harvest practices.</i></li> </ol>
Hazardous Sites	Inundation/ flooding, spread of contaminants	Medium-High	<ol style="list-style-type: none"> <li>1. <i>Reduce hazards to public health and environment from disposal of solid waste and toxic or hazardous substances.</i></li> </ol>
Air Quality	Increasing stagnation, noxious elements due to higher average temperatures	Medium	<ol style="list-style-type: none"> <li>1. <i>Develop standards to attain excellent air quality on the Reservation.</i></li> <li>2. Communicate issues of air quality to Reservation residents.</li> </ol>

## 7 A Climate Change Adaptation Strategy Toolbox

### 7.1 Potential Adaptation Options

A necessary first task in beginning assessment of potential strategies is scoping the range of possible options. After surveying a variety of resources and discussing the possibilities with the Strategy Advisory Group, a broad array of potential strategies was identified. These strategies were sorted and grouped into appropriate categories as listed below, which will later serve to help correlate them to various levels and types of organizational functions for response. The range of potential strategies will be further revised and expanded as work continues on evaluation and application of adaptation options and solutions.

#### a. Incentives/programmatic/non-regulatory:

- Land acquisition
- Open space buffers
- “Local Impact Districts” to fund adaptation (or flood/wildfire control districts)
- Incentives for relocation/avoidance
- Incentives for emerging technologies to benefit adaptation
- Penalties for high-risk activities (disincentive)
- “Distressed community” assistance/grants/loans
- Volunteer/community action groups on climate issues

#### b. Regulatory/code controls:

- Zoning restrictions, setback requirements, rolling setbacks
- Tightened building code standards in risk zones
- Low-impact development standards
- Climate impact screening in development review
- Climate impact screening in environmental review (critical/sensitive areas)
- Streamlined permitting for adaptation activities
- Risk response/management plans and requirements (risk zones)
- Disclosure requirements for real estate transactions

#### c. Practical/Engineering solutions:

- Loss-prevention design, engineering standards (new construction)
- Retrofitting/Armoring in place (existing structures)
- Fortification (seawalls, diking, etc.)
- Preventive maintenance (e.g., culverts, storm system, repainting, replanting)
- Relocation (horizontally, vertically)
- Replacement (alternate locations)
- Abandonment

**d. Risk prevention planning:**

- Amend Hazard Mitigation/Emergency Management plans to address climate issues
- Amend/revise resource plans to address climate impact issues (utilities, natural resources, etc.)
- Amend/revise Comprehensive Plan for climate change issues
- Implement climate and risk assessment planning across disciplines (transportation planning, capital facilities, forest management planning, open space, etc.)
- Identify/establish clearinghouse for climate change data/information

**e. Emergency preparedness:**

- Emergency planning for extreme weather events (flood, heat, fire, drought, storm)
- Provision/stockpiling of emergency shelters and supplies
- Enhancement and training of emergency response teams
- Community education/outreach on emergency planning
- Citizen action plans
- Event exercises (tabletop and live simulations)

**f. Other:**

- Litigation (where only option available, or option of last resort?)
- Legislation (currently focused on mitigation rather than adaptation)

## 7.2 Strategy Evaluation Objectives

Another early task in developing a potential strategy framework was to identify a set of basic objectives to help guide further evaluation and application of potential strategy options for identified impacts. Based on a series of discussions with the Strategy Advisory Group on the scope of identified impacts, the scope of perceived strategy issues and ramifications, and a wide range of potential strategy options available, a set of proposed evaluation objectives was distilled as described below:

- **Comprehensiveness:** Does the proposed strategy address the range of anticipated impacts and risk for the affected asset/resource, or is it limited in application?
- **Long-term sustainability:** Does the proposed strategy promote a sustainable long-term solution, rather than a short-term “band-aid” fix?
- **Dynamic/adaptive approach:** Does application of the proposed strategy allow for responding to changing facts and circumstances, or is it rigid and inflexible?
- **Fiscal impact and feasibility:** What is the degree of fiscal impact of the proposed strategy based on estimated financial requirements, commitments, and terms?
- **Non-regulatory approaches:** To what extent does the proposed strategy encourage the use of non-regulatory approaches, such as cooperative, programmatic, or incentive measures?
- **Community goals:** Does the proposed strategy align with desires and needs of the Reservation community as expressed through Tribal planning documents and other sources?

The above evaluation objectives were applied to help determine useful and appropriate options for specified climate change impacts, and they were also used as a guide in helping to prioritize multiple strategies. This threshold level of screening was combined with consideration of other key issues and factors to develop primary recommendations for the final Action Plan, as discussed and presented in Chapter 8.

### **7.3 Preliminary Evaluation of Strategies**

With a potential list of adaptation options and a set of basic evaluation objectives in hand, these elements provided the basis for building a framework in which to begin evaluating options for various given impacts. This task involved screening the various strategy options against the long list of identified climate change impacts and the evaluation criteria, in addition to other factors, to assist in determining suitability and applicability. In the course of performing this screening and evaluation, additional strategy options emerged that were specific to given impacts, as driven by the issues and adaptation needs for the give impact. This level of analysis formed the basis for developing a matrix of impacts and options as a tool for more complete evaluation, as presented in Chapter 8. With the impacts and options as the backbone of the evaluation matrix, it was then possible to apply a range of other evaluation factors as discussed in Chapter 8. It is also anticipated that potential strategies identified thus far are not necessarily the only options that may prove to be useful or necessary, and that evaluation of options will continue concurrent with ongoing monitoring of impacts and determination of next steps toward implementation of strategies.

Deciding which strategies to pursue, and how, will involve a mixture of regulatory and non-regulatory approaches. Identifying and pursuing appropriate non-regulatory actions, where feasible and sufficient, may be preferable in some circumstances, e.g., where regulatory measures are difficult to apply or enforce. However, regulatory options may be necessary in some instances, such as applying new requirements or restrictions in risk zones to reduce risks to people and property, or where non-regulatory actions have failed or otherwise been ineffective. If properly targeted and drafted, regulatory measures to reduce the impacts of climate change impacts such as sea level rise can be positive tools that help reduce the risk of damage to the community. In the case of permanent inundation from sea level rise, impacts will be slow and incremental, and taking the time to work with the community in developing and applying solutions will be mutually beneficial. In the context of dealing with sea level rise and other climate change impacts as environmental issues, regulatory measures and tools also fall squarely within the sovereign rights and responsibilities of the Tribe to protect the Reservation environment.

## 8 Action Recommendations and Priorities

Having identified projected climate change impacts, risks, adaptation goals, and potential strategies, this chapter discusses specific adaptation options and strategies targeted to specific impacts. While recommendations are presented in summary format for all impacts identified, recommendations discussed in detail in this chapter are those addressing impacts deemed to be highest priority or the most significant, i.e., those deemed to present the greatest threats or most critical challenges for the Tribe and the Reservation community. Again, discussion is organized under the four major categories as previously presented. Accompanying the discussion of strategies in each major category are tables detailing the specific adaptation strategies identified as potentially applicable to given impacts. These tables note a number of key considerations against which strategies were screened, which include the following:

- The evaluation objectives met by given strategies (as discussed in Chapter 7);
- Existing governmental authority and capacity for potential implementation of given strategies;
- The level and/or type of authority or capacity needed for implementation;
- Internal and external partners needed for implementation; and
- Approximate timeframe anticipated for potential implementation, as stated in increments of 1 to 3 years, 3 to 10 years, and greater than 10 years.

While attempts have been made to be comprehensive in review of potential strategies, proper implementation of climate adaptation strategies will require adaptive responses to dynamic situations. As with projected impacts, the expectation is that new or alternate strategies will continue to emerge or that approaches to existing strategies may change in response to changing data or circumstances. This flexibility is vital to successful response. In that context, these recommendations are, once again, only a starting point.

To aid policy makers in determining next steps for implementing recommended strategies, potential priorities for various strategies were identified as a guide for future planning. The methodology used to determine these potential priorities was drawn from the CIG/King County guidebook, **Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments**. Building upon previous determinations of vulnerability and risk as presented in Tables 7-1A and 7-1B of the Technical Report, these two factors can be used together to inform and guide the process of prioritizing planning areas, as illustrated below:

### ***PLANNING AREAS WITH SYSTEMS THAT ARE...***

	Low Vulnerability	High Vulnerability
High Risk	<i>May be priority planning areas</i>	<i>Should be priority planning areas</i>
Low Risk	<i>Are unlikely to be priority planning areas</i>	<i>May be priority planning areas</i>

Source: Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments

Applying the above methodology, assessments of vulnerability and risk were correlated as presented in Table 8-0, as a basis for determining potential priorities.



**TABLE 8-0. POTENTIAL PRIORITY PLANNING AREAS**

Element	Potential Impacts	Vulnerability (impact level)	Estimated Risk	Potential Priority
<b>COASTAL RESOURCES</b>				
Shoreline Development	Increasing inundation from gradual sea level rise	High	High	High
	Increasing frequency and severity of storm surges	High	High	High
	Beach/bluff erosion with increasing rise/surges	High	High	High
Habitat viability	Increasing inundation from sea level rise forcing gradual migration to maintain viability	High	Medium-High	Medium-High
Estuarine beaches	Increasing inundation and loss from rising sea level	High	High	High
Marine Wetlands	Increasing inundation from higher tides, storm surges (estuarine)	High	High	High
Shellfish	Increasing inundation of shallows, estuaries	High	Medium-High	Medium-High
	Weakened viability due to habitat changes	High	Medium-High	Medium-High
Fin Fish	Increasing inundation of shallows, estuaries, spawning grounds	High	Medium-High	Medium-High
	Weakened viability due to habitat changes (temperature, acidification, etc.)	High	Medium-High	Medium-High
Waterfowl/ Shorebirds	Loss of forage areas and opportunities due to impacts on food sources	Medium-High	Medium-High	Medium-High
Shoreline Recreation	Increasing inundation of public beaches, parks from gradual sea level rise	High	High	High
	Storm-tidal surge flooding, gently sloping shorelines, or where surge tops bank/seawall/dikes	High	Medium-High	Medium-High
	Spread of contaminants through inundation/ flooding from higher tides, storm surges	Medium	Medium	Medium

Element	Potential Impacts	Vulnerability (impact level)	Estimated Risk	Potential Priority
<b>UPLAND RESOURCES</b>				
Upland wildlife/habitat	Degradation/conversion from higher temperature and increased wildfire incidence	High	Medium-High	Medium-High
	Stressed viability from habitat and temperature changes, forced migration	High	Medium-High	Medium-High
Freshwater	Declining consistency/ volume of in-stream flows, earlier peak runoff	Medium-High	Medium-High	Medium-High
Groundwater	Increasing salinization from salt water intrusion	Medium-High	Medium-High	Medium-High
Upland Wetlands	Decline/degradation of upland wetlands from reduced flow input	High	Medium-High	Medium-High
Forest Resources	Lower moisture content, increased potential for destructive wildfire	High	High	High
	Heat stress, increase in drought-tolerant species, decrease in drought-sensitive species	Medium-High	Medium-High	Medium-High
	Greater pest infestations, disease vectors (bark beetles, fungus, etc.)	Medium-High	Medium-High	Medium-High
Upland Development	Increased risk of wildfire from increasingly drier conditions (urban/forest interface zone)	High	High	High
Agriculture	Eventual inundation as rising high tide tops dikes	Medium-High	Medium-High	Medium-High
	Storm events push tidal surges over dikes	Medium	Medium-High	Medium
	Increasing salinization from salt intrusion with rising sea levels	Medium	Medium-High	Medium

Element	Potential Impacts	Vulnerability (impact level)	Estimated Risk	Potential Priority
<b>COMMUNITY INFRASTRUCTURE &amp; SERVICES</b>				
Stormwater Control	Backup of drainage/discharge from higher tides, surges	Medium	Medium	Medium
	Damage to discharge outfalls from bank erosion	High	Medium-High	Medium-High
Hazardous Sites	Spread of contaminants from inundation/flooding	High	Medium-High	Medium-High
Water	Reduced supply due to decreased source (river/ snowpack), increased demand	Medium	Medium	Medium
	Contamination of local supplies from inundation	Medium	Medium	Medium
Wastewater	Inundation of facilities from higher tides, storm surges	Low	Low-Medium	Low
Communications	Service disruption from severe storm events	High	Medium-High	Medium-High
Energy/Power	Service disruption from severe storm events	High	Medium-High	Medium-High
	Increased energy demand to counter higher temperatures	Medium	Medium	Medium
Waste Disposal	Spread of waste from local/loose containers during flooding from higher tides, tidal surges, storm events	Medium	Medium	Medium
Police	Increased demand for assistance/ response during storm events, outages, flooding	Medium	Medium	Medium
Fire	Increased demand for assistance/ response to wildfire, storm events, outages, flooding	Medium- High	Medium-High	Medium-High
Other Emergency	Increased demand for assistance/ response during storm events, outages, flooding	Medium	Medium	Medium
Access/ Circulation	Inundation of access routes, travel disruption, isolation from mainland, as higher tides top dikes	High	High	High
	Travel disruption/road closures due to stronger/more frequent storm/tidal surge events, wildfire	Medium-High	Medium	Medium-High
Road System Integrity	Flooding damage from storm/tidal surge, buckling/cracking from higher temperatures	Medium	Medium	Medium
Bridges	Erosion of bridge footings from higher tides/storm surges	Medium	Medium	Medium
	Increased deterioration/ fatigue of bridge joints from increased or prolonged heat	Medium	Medium	Medium
Marine transport facilities	Increasing inundation of marine facilities and ports from gradual sea level rise and higher tides	High	High	High

Element	Potential Impacts	Vulnerability (impact level)	Estimated Risk	Potential Priority
<b>PHYSICAL HEALTH</b>				
Heat-related illness	Increased demand for and stress on services to treat heat-related health issues (heat exhaustion, heat stroke, etc.)	Medium-High	Medium-High	Medium-High
Disease vectors	New/increased disease vectors, and related outbreaks	Medium	Medium	Medium
Pollution-related illness	Increased pollution-related illness exacerbated by weather and climate conditions	Medium- High	Medium-High	Medium-High
Solar radiation	Increase in skin cancers from higher UV radiation levels	Medium	Medium	Medium
Respiratory disease	Increasing incidence of asthma, and allergen-related problems	Medium- High	Medium-High	Medium-High
Toxic seafood contamination	Increased potential for toxic contamination of seafood from paralytic poisoning	Medium-High	Medium-High	Medium-High
<b>CULTURAL RESOURCES</b>				
Coastal sites/ artifacts	Increasing inundation of sites from gradual sea level rise	High	High	High
Burial sites, human remains	Disturbance/exposure from severe storm events	High	Medium-High	Medium-High
Cultural use plants	Loss/migration of traditional cultural use species	High	Medium-High	Medium-High
Shellfish harvesting	Potential loss of harvest sites and opportunities due to impacts to shellfish populations and habitat	High	High	High
Beach seining	Potential loss of beach seining sites and opportunities	High	High	High
Air Quality	Increasing stagnation, noxious elements/ parameters due to higher average temperatures	Medium	Medium	Medium

## 8.1 Coastal Resources

For the purposes of this analysis, coastal resources include shorelines and beaches, tidelands and marine habitat, estuarine wetlands, and marine species within these habitats, as well as coastal development located within these areas. There are approximately 26 miles of shorelines surrounding the Reservation, and the Tribe also holds approximately 2,900 acres of tidelands. Pocket estuaries harboring fish habitat and species can be found on both the eastern and western shorelines.

Productive shellfish beds can be found in certain locations within tidelands along the western side of the Reservation. Other important marine species such as eel grass can be found in specific locations and depths. Important development areas within the coastal zone include tribal economic development lands and enterprises on the north end of the Reservation, tribal agricultural lands, several isolated lease activities located on/near shoreline areas, low-lying portions of residential subdivisions and marina, and tribal fishing docks.



(photo courtesy of Swinomish Tribal Archives)

The primary impacts on coastal resources are potential inundation from sea level rise and storm surge and habitat viability changes in marine areas due to changes in factors such as temperature and acidity. Identified and discussed below are priorities for adaptation to impacts on coastal natural resources and for reducing the loss of these resources, including shellfish beds, finfish habitat such as spawning beaches, eelgrass beds, and estuarine wetlands. There are also risks to homes, businesses, and other structures. There are two basic approaches to address adaptation to sea level rise and storm surge: 1) allow, or even assist, the shoreward migration of key habitats and resources, including moving structures back from the shoreline; and 2) if appropriate, protect structures in place through dikes, soft armoring, bank armoring, and raising and hardening structures.

In some respects these two approaches work in opposition to each other, although each may have advantages depending on location, circumstances, and timing. Hardening in place will prevent the shoreward migration of coastal resources and ultimately result in some of these habitats being squeezed out between hard structures and the advancing sea. However, both strategies may have their place depending on local conditions and planning goals for specific areas. For example, where natural or rural shoreline upland zones coexist with sensitive coastal resources, there may be opportunities to promote shoreward migration of those resources. In urban or high intensity use shorelines it may be more feasible to protect existing structures and uses in place. These decisions should be deliberate and the result of coordinated long-term planning rather than the result of individual piecemeal determinations which collectively could have substantial impacts. Complete information on assessment of recommendations for all Coastal Resources impacts is presented in Table 8-1.

### 8.1.1 Inundation from sea level rise and storm surge

Inundation from sea level rise and storm surge poses potentially major impacts on coastal resources for both natural resources/habitat and shoreline development. Natural resources and habitat at risk include existing shorelines and beaches along steeper bluffs; a number of estuarine wetlands and pocket estuaries such as at Lone Tree Point and along the Swinomish Channel, including eel grass habitat used by forage fish; and tribal shellfish beds along the western shore of the Reservation, such as near Lone Tree Point and Kiket Island. Vulnerable development potentially includes the Tribe's primary economic development zone on the north end of the Reservation, in which currently are located a Tribal casino, gas

station, and RV park; agricultural lands south of SR20 and adjacent to the Swinomish Channel; three businesses on lease tribal land along the shoreline, including a log transport yard, boat repair facility, and large private campground; tribal fishing docks and facilities along the Swinomish Channel, in the Swinomish Village; and low-lying residences and facilities in the Shelter Bay Community and along the western shore of the Reservation.

Adaptation responses to these varied potential impacts will be equally varied, complex, and challenging. For the short term, diking exists to protect areas on the north end of the Reservation. Thorough planning and implementation of longer term strategies will need to be developed, including identifying and securing potential funding for implementation of long-term options. Given the different nature and characteristics of various shoreline zones around the Reservation, different combinations of strategies will likely be needed in respective zones, and follow-up studies may be required to more specifically pinpoint which combinations of strategies are appropriate for the various shoreline zones. Because the responses to these impacts carry enormous cultural and economic significance where issues such as traditional fishing, shellfish harvesting and economic development are concerned, they are assigned high priority and should be given due consideration for both short-term actions and long-term implementation.

**Sectors impacted:** Shoreline/beaches; tidelands and marine habitats; low-lying development

**Adaptation Risk:** High

**Applicable Goals:**

- Preserve the aesthetic value and natural systems of the beaches.
- Shoreline regulatory and management programs should identify and protect vital ecosystems and be conducive to implementing enhancement proposals.
- Balance, cultural, economic, and environmental goals.
- Protect human life.
- Protect Tribal economic investments, opportunities, and revenues.

**Adaptation Strategies:**

#### **8.1.1.1 Shoreline Controls**

Allowing or facilitating shoreward migration of a given habitat or coastal resource zone is mostly a matter of getting out of the way. However, this may require application of various regulatory incentives, tools, and strategies. Regulatory tools may include code changes for shoreline risk zones, zoning changes, setback changes, rolling easements, and bulkhead rules, as discussed below. Strategies may be optimized with a combination of tools.

**Shoreline Risk Zones:** Two inundation risk zones have been mapped for the Reservation, one for sea level rise and one for storm surge. The Swinomish Shorelines and Sensitive Areas (SSA) ordinance is one statute used to regulate development and use of the shoreline zone within the Reservation (Swinomish Tribal Code Chapter 19-04); other Tribal or Federal law may also apply. Many of the potential regulatory changes to address climate change adaptation could be approached as amendments to the SSA ordinance. The SSA ordinance could incorporate the concept of these risk zones as an additional type of “sensitive areas” in which specific rules apply. Under this approach, for example, regulatory restrictions might be placed on structures in the risk zone and risk reduction measures might be required. Such restrictions might include regulatory controls on new construction within risk zones and raising the threshold for allowing

repair or replacement of existing structures. In addition, areas at risk from bluff erosion may be subject to changes in protective regulations. Other regulatory tools may be adopted under different Tribal code sections.

**Setback changes.** One of the most obvious tools is to change regulatory setback requirements within risk zones. This might entail increasing the shoreline setback distance for structures to allow for shoreward migration in these at risk areas. For example, shoreline residential areas currently have a required 50-foot minimum setback from the ordinary high water mark (OHWM) for non-water dependent structures. This setback could be increased for any new structures within a risk zone as necessary to reduce or remove the risk. This would do little, however, to promote shoreward migration where structures currently exist.

**Bulkhead and bank armoring rules.** Even more important in reducing impacts to coastal resources, now as well as with future sea level rise, is addressing bulkhead and shore armoring. One tool is to require the removal or modification of bulkheads and shore defense works currently on Tribally-owned tidelands. Another option is to tighten the rules regarding bulkheads and shore defense works within the current SSA ordinance. New bulkheads and hard armoring could be prohibited except in narrow circumstances or in certain areas. Existing hard bank protection repair could be restricted in some areas or require replacement with softer practices in certain cases.

**Rolling easements.** Rolling easements are a type of easement acquired along shorelines that would allow upland property owners to engage in certain uses and activities within risk zones but prevent other types of use, in the interest of promoting shoreward migration. The easements would run a given distance shoreward from the line of mean high tide, within which, for example, shoreline stabilization structures could not be placed, but owners might be allowed to continue certain uses.

There are different ways such easements could be acquired. An ordinance could be developed to prohibit shore armoring within the rolling easement, as a regulatory approach that would still allow development but not halt shoreward migration. Alternately, such easements could function more like a traditional conservation easement in that it is purchased from a willing seller or donated to take advantage of tax benefits.

Rolling easements could help limit shoreline armoring and allow the slow shoreward migration of tidelands where appropriate. The advantage to the landowners under such a scenario is that they may be able to continue use of their shoreline properties in the interim but would have long advance notice of the shoreward migration that may eventually claim their homes. They also would allow the Tribe some certainty in providing for shoreward migration over time, and for addressing impacts to vital resources such as shellfish beds it would make it possible to plan for and facilitate long-term migration, where such migration could occur. One difficulty may be the cost to acquire such easements, although it would be less costly than acquisition of property. Also, since easements do not provide as much control over development as setbacks or other shoreline regulation, they may not provide as much shoreline resource protection as those options. Since easements would be with individual landowners, it may be difficult to coordinate protection and the shoreward migration of connected sections or drift cells of the shoreline.

**Required Authority/Capacity:** New shoreline code changes; Tribe currently has sufficient authority and capacity to enact and implement.

**Potential Partners/Coordination:** Skagit County, for fee land owners.

**Timeframe for Implementation:** Can be implemented immediately (1-3 yrs.)

**Priority:** HIGH

### 8.1.1.2 Physical Controls

Regardless of how shoreline controls might be implemented, actual on-the-ground actions are required for shoreward migration to occur. While it would be easier for the Tribe to pursue such actions on lands it owns or otherwise controls, such actions may also be enacted by interested shoreline owners or through cooperation in protecting shoreline resources in the face of future sea level rise.

**Bulkhead removal.** Bulkheads and riprap represent one of the most significant barriers to shoreward migration of beach and habitat, in addition to causing negative impacts to existing shoreline resources. Removal of bulkheads and shore defense works where legally required or otherwise feasible, as well as stricter regulation to prevent construction of new bulkheads and shore defense works, is key to shoreline restoration and adaptation to sea level rise where the desire is to preserve natural shoreline processes. Obviously, such removal projects by the Tribe would be easiest where the bulkheads or shore defense works are on lands owned by the Tribe. Tribally-owned shoreline properties with rip rap include leased lands, such as in Shelter Bay, and dikes along the Swinomish Channel. The Tribe may acquire other uplands with bulkheads or other shore defense works, either through purchase or through the shoreward shift of the MWH mark with sea level rise. Once a structure is on land owned by the Tribe, a determination can be made on whether to remove it or modify it to reduce impacts on shoreline resources.

Another approach might be to seek cooperation with upland landowners, who own a bulkhead on uplands, and for the Tribe to pay for removal of the structure. The advantage to the Tribe is removal sooner rather than at some later date when the structure has come to encroach on Tribal tidelands. The advantage to the upland owner may be money saved rather than being required to remove it, at their own cost, at some later date and more certainty in planning for the future. As an added incentive, this could include allowing replacement with soft bank protection if removed now, but no replacement if left for future removal.

**Bank/shore armoring.** Bank protection such as bulkheads and rip rap can be built to hold back tidal waters. This structural approach could be very expensive and might have to be built higher and larger over time as sea levels continue to rise, but could represent a short-term option to buy time for consideration of longer term strategies. It is also the least desirable from an impact on environmental and shoreline resources, causing damage in the near-term as well as potentially leading to complete elimination of certain shoreline resources and habitats where the sea rises against such structures. Despite the drawbacks for habit protection, it is an approach that may need to be considered for the short-term in at least some locations and circumstances, such as where major Tribal investments in upland development have been made that would not be easily or quickly relocated.

**Raising/hardening structures.** Other options, especially for buildings further back but still at risk from storm surge, may be raising the structure and hardening against storm surges. Some architectural designs allow waves to flow under the main level of a home and keep the living space above likely storm surge levels. Many of the more robust designs are feasible for new homes but are difficult to retrofit into existing homes. For new or replacement development, there may be an opportunity depending on lot size to build at a greater setback or entirely outside the risk zone. Maintain-in-place may be feasible for many structures and areas, but such actions should include mitigation of environmental impacts. Mitigation could be provided either through specific projects to assist adaptation to sea level rise on site or in nearby areas, or for small individual actions by allowing an in-lieu fee to go towards such projects. The latter is already



allowed in some circumstances under the SSA ordinance via a shoreline mitigation and restoration fund.

**Raising/extending dikes.** Where general protection from inundation is desired, building, raising and extending dikes is still an option. Given the expense and effort involved in dike construction as well as the cost to coastal resources, however, and given the projections of continued sea level rise, such protection may not be the most cost-effective solution, assuming that sea level rise may continue to top dike levels. Where necessary to protect substantial Tribal development investment, however, retaining existing diking may be useful and viable as a short-term option to allow time for more considered planning and implementation of long-range options, such as for retreat. Relocating major facilities and infrastructure requires long planning timelines and considerable funding, and maintaining protection in the interim with diking systems may in some cases be the reasonable short-term alternative.

**Required Authority/Capacity:** Owner authority; potentially substantial funding.

**Potential Partners/Coordination:** Landowners; Skagit County (for fee owners)

**Timeframes for Implementation:** 3 to 10 years (dependent on funding)

**Priority:** HIGH

### 8.1.1.3 Habitat Enhancement

**Fill removal.** The Swinomish Channel was dredged for navigation by the US Army Corps of Engineers with the spoils placed as fill along the shoreline of the channel. Out-migrating juvenile salmon need estuary habitat to rest and feed as they move from fresh to marine waters. Currently, pocket estuary restorations are being developed along the channel by the Tribe and SRSC, primarily by removal of areas of this fill. To date, three such pocket estuary restorations have been completed along the channel on the Reservation and a fourth is under construction. They are built to provide fish habitat at current sea levels. In the future they may be designed for future higher levels or over time new ones built at higher level to match gradual rises in sea level. Again, such projects are feasible for the Tribe where the Tribe owns the land. In most cases along the channel this is already the situation. It is likely that little acquisition would be needed to continue this approach as needed along the channel.

**Sediment input and maintenance of tidal habitat.** Sediment is needed for beach building and to maintain shellfish and eel grass beds in the future. Already there is a problem in maintaining beaches in some areas, and sufficient input of sediment could become even more critical as beach building is needed to allow for shoreward migration of those habitats. Shellfish and eel grass beds, especially those in periodically exposed tidal areas, could become permanently inundated with sea level rise. To maintain proper tidal elevations for shellfish habitat would require raising them to keep pace with the rise in sea level. Increasing natural inputs of sediment from feeder bluffs is especially critical. Input from some of these areas has been cut off through bank protection and stabilization works. Proper regulation of such feeder bluff areas to continue, or even increase, sediment inputs should be explored.

Another potential approach is to use fill removed from other areas as sediment inputs to maintain tidal habitat where needed. This could be done in a number of ways and may be very dependent on the location. Periodic additions of thin layers of material to beaches or shellfish beds from barges may be one approach. Another, where appropriate, may be a major beach nourishment project, adding larger amounts of sand to a given beach area and allowing natural hydraulic forces to move it within the system.

**Required Authority/Capacity:** Federal permits; project funding

**Potential Partners/Coordination:** Corps of Engineers; Fisheries/SRSC; upland owners (for shoreward migration)

**Timeframes for Implementation:** 3-10 years (dependent on funding)

**Priority:** HIGH

#### 8.1.1.4 Land Acquisition

**Description:** The Tribe currently owns tidelands surrounding the Reservation below the line of mean high tide. Acquisition of adjacent uplands is an option to provide for shoreward migration of uses where it is in the interest of the public or the Tribe to do so, but it is undoubtedly an expensive option, and it requires a willing seller. Tribal ownership of Reservation uplands immediately adjacent to the shorelines would allow the Tribe the flexibility to respond to pursue either a “protect-in-place” strategy to maintain key infrastructure or “managed retreat” to allow shoreline migration. This will likely only be feasible in a limited, targeted number of properties due to a shortage of funds and owner interest.

**Required Authority/Capacity:** Willing owner/seller, available financial resources

**Potential Partners/Coordination:** Landowners.

**Timeframe for Implementation:** Dependent on funding and motivation.

**Priority:** MEDIUM-HIGH

### 8.1.2 Decreased habitat viability due to changing water parameters

Tribal members have harvested shellfish from local marine waters and beds for centuries, and shellfish are one of the keystone species in tribal tradition, being deeply imbedded in tribal culture. The impacts on shellfish from even modest changes in water temperature and absorption of CO<sub>2</sub>, with consequent effects on pH acidity levels, are potentially enormous. Fin fish are also sensitive to changes in water parameters and may also experience significant impacts. Strategies to address these types of impacts on such important keystone species are daunting, given the technical expertise required and level of financial commitment.

A great deal more research is needed to identify potential options to maintain viable habitats especially for shellfish, in the face of these changes to water quality parameters. At this point few options have been formulated, and proposed options are highly speculative. Shellfish larvae are particularly at risk from acidity affecting their growth rates and ability to form shells. One option is aquaculture in tanks where acidity and temperature can be controlled. Once shells have been formed and the larvae are a sufficient age and size they can be planted in shellfish beds. However, this solution will not be sufficient if acidity reaches levels where juvenile shellfish given a head start in tank culture cannot survive and grow in marine waters.

**Sectors impacted:** Estuarine beaches, tidelands and marine habitats

**Adaptation Risk:** High

**Applicable Goals:**

- Fishery and shellfish resources and habitat of the Reservation should be restored and enhanced, maintaining the traditional livelihood based upon these resources.
- Seek off-reservation sites for shellfish harvest/cultivation.
- Preserve ability to fully exercise treaty rights and cultural practices and to improve physical and spiritual health.
- Reestablish natural diversity in harvestable clam populations.
- Biotic productivity and species diversity within the coastal zone should be maintained and enhanced.

**Adaptation Strategies:****8.1.2.1 Aquaculture Operations**

**Description:** As an experimental option, shellfish could be seeded in upland operations to allow for proper growth and development under controlled conditions. Once they reach sufficient size and maturity, they could be transplanted to established beds.<sup>16</sup>

**Required Authority/Capacity:** Tribe has authority; project funding

**Potential Partners/Coordination:** Fisheries/SRSC

**Timeframes for Implementation:** 3-10 years

**Priority:** MEDIUM-HIGH

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<sup>16</sup> <http://www.timescolonist.com/technology/Cockles+show+promise+aquaculture+product/3335494/story.html>

**TABLE 8-1. ASSESSMENT OF ADAPTATION STRATEGIES – COASTAL RESOURCES**

Climate Change Impact	Potential Adaptation Strategy	Objectives Met (see key)	Existing Authority/Capacity	Required Authority/Capacity	Potential Internal Partners	Potential External Partners	Timeframe
Shorelines/beaches (general)	Land acquisition	Yes – 2, 3, , 6 No – 1, 4?	Owner prerogative/ Limited funding	Owner agreement / Funding	Realty	Owners (County?)	3-10 yrs
	Incentives to relocate	Yes – 2,3, 5,6 No – 4 (?),1	Owner prerogative	Owner agreement/ Funding	Planning	Owners	3-10 yrs
	Diking/armoring	Yes – 4?, 5 No – 1,2,3,,6	Owner prerogative	Owner agreement/ Funding	Public works	Owners	3-10 yrs
	Development restriction/setbacks	Yes -1,2?,3,4,6 No - 5	Need additional authority	Code amendments / other regulatory?	Planning / Legal	County (owners?)	1-3 yrs
Inundation of tideland and marine habitat, loss of forage and spawning areas for fish and waterfowl	Incentives to relocate	Yes - 2, 3, 5, 6 No -1, 4?	Owner prerogative	Owner agreement/ Funding	Planning	Owners	3-10 yrs
	Diking/armoring	Yes – 4?, 5 No – 1,2,3,,6	Owner prerogative	Owner agreement/ Funding	Public works	Owners	3-10 yrs
	Development restriction/setbacks	Yes -1,2?,3,4,6 No -5	Need additional authority	Code amendments / other regulatory?	Planning / Legal	County (owners?)	1-3 yrs
	Fill addition/removal to maintain depths	Yes- 2?,3? 4? No -1, 5, 6?	Funding / federal permits	State cooperation? / Funding	Fisheries / Public works	Federal (State?) Agencies (Corps)	3-10 yrs
Inundation of shellfish beds	Shoreward habitat migration, reestablish beds	Yes-2?,3,4?,6? No – 1, 5	Upland owner authority	Tribal Initiative, owner agreement	Fisheries / SRSC	Agencies, owners, County	>10 yrs
Weakened shellfish viability (acidity, temperature)	Buffer acidity	Yes – 3,4?,5?,6 No – 1, 2	Uncertain capacity, mechanism	?	Fisheries, SRSC	?	> 10 yrs (studies needed)
	Aquaculture operations	Yes -1,2,5,6 (?) No – 4?	? / ?	? / funding	Fisheries, SRSC	?	3-10 yrs (studies needed)
Weakened viability of finfish (habitat changes)	Pocket estuary restoration	Yes -1,2,3, 4, 6 No - 5	Yes , depending on location / funding	Tribal initiative	SRSC	Fed agencies	1-3 yrs
Wetlands (Estuarine)	Pocket estuary – fill removal	Yes-2, ,3, 4?, 6 No- 1, 5	Yes (on Tribal lands)	Funding	SRSC	Fed agencies	1-3 years
	Remove dikes (Tribal agricultural lands)	Yes-2, 3, 4, 5,6 No- 1	Have authority	Funding	SRSC, allottees, Tenant Farmer	Federal agencies	>10 yrs
	Allow shoreward migration	Yes-2?,3?,4?,6 No- 1, 5	Uncertain	Funding and locations	SRSC	Owners / fed agencies	>10 yrs

Climate Change Impact	Potential Adaptation Strategy	Objectives Met (see key)	Existing Authority/Capacity	Required Authority/Capacity	Potential Internal Partners	Potential External Partners	Timeframe
Bank erosion on developed lots	Flood-proofing/armoring	Yes – 4, 5 No – 1, 2, 3, 6	Owner authority Owner capacity	Owner funding	Planning	Owners	> 10 yrs
	Development restriction/setbacks	Yes – 1, 2, 3, 4 No – 5, 6 (?)	Have authority Have capacity	Code amendments (?)	Planning	Owners, County (fee), BIA (?)	1-3 yrs
	Incentives for relocation/ avoidance	Yes – 1, 2, No –3, 4, 5, 6	Have authority Have capacity	Code amendments (?)	Planning	Owners	3-10 yrs
	Land acquisition	Yes – 1, 2, No – 3, 4, 5, 6	Owner authority Limited Capacity	Code amendments (?)	Realty	Owners, BIA	3-10 yr?
	Bank stabilization (vegetation, etc.)	Yes – 1, 2, No –3, 4, 5, 6	Owner authority	Owner funding	Planning	Owners, County (fee properties)	3-10 yrs
Inundation of low-lying structures/ parcels	Build/raise dikes	Yes – 3, 5, 6 No – 1, 2, 4	Have authority Limited capacity	Diking program / funding	Planning, Public Works	Diking district	3- 10 yrs
	Flood-proofing/armoring	Yes – 4, 5 No – 1, 2, 3, 6	Owner authority Owner capacity	Owner funding	Planning, Public Works	Owners	3-10 yrs
	Relocate higher/away from exposure	Yes-1,2,3,5,6 No –4 (?)	Owner authority Limited capacity	Owner funding	Planning, Public Works	Owners	> 10 yrs (?)
	Development restriction/setbacks	Yes –1, 2, 3, 4 No –5, 6 (?)	Have authority Have capacity	Code amendments (?)	Planning	County	1-3 yrs
	Acquire properties located in risk zone	Yes –1, 2, 3, 4 No –3,4, 5, 6	Have authority Limited capacity	Code amendments (?)	Planning, Legal	County	> 10 yrs

Evaluation Objectives key:

1 – Comprehensive; 2 – Sustainability; 3 – Dynamic response; 4 – Fiscal feasibility; 5 – Non-regulatory; 6 – Community goals

## 8.2 Upland Resources

As described previously, upland resources include forest lands, wildlife habitat, upland wetlands, and upland water resources. Upland water resources consist primarily of four small streams and Reservation groundwater. Forest lands exist in a mix of ownership and stand characteristics. While no true old growth remains within the Reservation and even mature stands are a mix of age classes and regrowth from previous timber harvests, the majority of Reservation uplands are covered in this mix of forest stands. As detailed in the Technical Report, much of Reservation residential development also lies in or near forested areas, mostly in the urban/forest interface in the southern and western areas of the Reservation. Groundwater within the Reservation has been tapped by a small number of private wells, and while two Tribal wells have been developed, they are primarily held in reserve with the bulk of groundwater resources.



(photo courtesy of Swinomish Tribal Archives)

Of the various potential impacts identified for upland resources, wildfire is by far deemed the most significant, especially in terms of risk to the Reservation population, given the number and relative density of private residences that exist within the urban/forest interface zone. The next most immediate threat to forest stands is the possibility of pest infestations and disease, driven by anticipated higher temperatures. Additional identified impacts include heat stress on forest and wildlife habitat, associated changes in and migration of forest and wildlife species, gradually declining wetland and freshwater resources, gradually declining volume and consistency of freshwater flows, and gradually declining recharge of groundwater resources, in addition to potentially increasing salt water intrusion in proximity of coastal areas. Complete information on assessment of recommendations for all Upland Resources impacts is presented in Table 8-2.

### 8.2.1 Increased Wildfire Risk

Of the 7,450 acres of uplands within the Reservation, approximately 4,700 are in some type of forest cover, and over 2,200 acres of uplands are within the primary wildfire risk zone (urban/forest interface), representing almost one-third of the upland Reservation. Within those 2,200 acres are approximately 1,560 structures and properties with an estimated value of over \$518 million. With increasing average temperatures and drier conditions, the potential risk of damaging wildfire is expected to increase proportionately. Given the clustering and relative density of residential structures within the risk zone, such an outbreak of wildfire under the right conditions could be potentially devastating. The primary objective in preventing disastrous wildfire is reducing or eliminating flashpoints and fuel loads where possible. While the Shelter Bay Community, the largest residential development with almost 900 homes, has adopted Firewise practices and standards, such action has yet to be applied to remaining residential areas on the Reservation. Even Firewise certified communities such as Shelter Bay must maintain vigilance during hot dry seasons, as witnessed in 2009 when a small beach fire threatened to race quickly up a grassy slope to engulf homes clustered above. Implementation of Firewise standards throughout the wildfire risk zone is therefore of paramount importance; such action does not require a substantial commitment of resources, but rather a concerted on-going program. Additionally, increased emphasis on key forest management practices and increased training and support for fire management response teams will improve control of wildfire risk.

**Sector impacted: Forest Stands & Urban/Forest Interface****Adaptation Risk: High****Applicable Goal(s):**

- Sustained yield forestry and ground cover management programs and controls should be developed on a Reservation-wide basis.
- Develop an old growth forest ecosystem that includes mature stands of cedar and other indigenous plants and trees.
- Maintain and expand diversity of forest lands, wildlife habitat, and wetlands.

**Adaptation Strategies:****8.2.1.1 Adopt and maintain Firewise community standards and fire buffer zones.**

**Description:** Establish/promote the Firewise program throughout the primary wildfire risk zone (urban/forest interface) to reduce flashpoints and fuel loads that may contribute to potentially damaging wildfire. Such action includes applying standards for minimum defensible space between structures and adjacent vegetated areas such as forest stands, removing and controlling flammable brush and debris in buffer areas, and requiring the use of fire-resistance materials in roofing and structure exteriors.

**Required Authority/Capacity:** The Tribe currently has sufficient authority and capacity to promote Firewise community standards as a program emphasis.

**Potential Partners/Coordination:** Fire District 13, Skagit Conservation District, local homeowners.

**Timeframe for Implementation:** Can be implemented immediately (1-3 yrs.)

**Priority: HIGH**

**8.2.1.2 Enhance training and support for wildfire management response.**

**Description:** Provide increased training and support for fire management response teams in major wildfire suppression. Increased training and support emphasis must be coordinated with all agencies involved in fire response on the Swinomish Indian Reservation.

**Required Authority/Capacity:** The Tribe must work with firefighting agencies to promote training emphasis and to help identify increased support.

**Potential Partners/Coordination:** Fire District 13, Washington Department of Natural Resources, local homeowners.

**Timeframe for Implementation:** Can be implemented immediately (1-3 yrs.)

**Priority: HIGH**

**8.2.1.3 Improved/revised forest management policies and practices.**

**Description:** Despite the shift in wildfire control policies in recent years toward allowing wildfires to burn, such policies are neither practical nor safe within the Reservation, given the relatively confined extent of forest lands and the presence of significant urban/forest interface. Policy emphasis within the Reservation, therefore, must still favor control, containment, and extinguishment, relying instead on proper application of forest management practices to help promote effective wildfire control. Such policies and practices would include increased

management emphasis on habitat enhancement and diversity to improve overall resilience of stands and species, thinning of stands where useful or appropriate, and elimination of fuel loads in areas within and adjacent to the urban/forest interface. Coordination of management policies and practices with other agencies would further promote effective control policies across fee lands within the Reservation.

**Required Authority/Capacity:** The Tribe maintains sufficient authority and capacity under its Self-Governance compact for development and administration of forest management plans and policies for Reservation trust lands.

**Potential Partners/Coordination:** BIA, Skagit County, Washington Department of Natural Resources, local landowners.

**Timeframe for Implementation:** Can be implemented immediately (1-3 yrs.)

**Priority: HIGH**



**TABLE 8-2. ASSESSMENT OF ADAPTATION STRATEGIES – UPLAND RESOURCES**

Climate Change Impact	Potential Adaptation Strategy	Objectives Met (see key)	Existing Authority/Capacity	Required Authority/Capacity	Potential Internal Partners	Potential External Partners	Timeframe
Stressed wildlife/habitat viability from temperature changes, forced migration (wetland and forest wildlife species/habitats)	Restoration / enhance diversity & resilience	Yes -2, 3, 4, 6; ? -1; No-5	Have authority/ Have capacity	Management plan & code amendments (?)	Planning	Owners, County (fee), BIA, DNR	1-3 yrs.
	Preserve migration & habitat corridors	Yes -2, 3, 4, 6; ? -1; No-5	Have authority/ Have capacity	Management plan & code amendments (?)	Planning	Owners, County (fee), BIA, DNR	1-3 yrs.
	Preserve Pacific Flyway area	Yes -2, 3, 4, 6; ? -1; No-5	Have authority/ Have capacity	Management plan & code amendments (?)	Planning	Owners, County (fee), BIA, DNR	1-3 yrs.
	Public & owner outreach/education	Yes-1, 2, 3, 4, 5, 6	Have authority/ Have capacity	Tribal initiative / Program support	Planning	Owners, County (fee), BIA, DNR	1-3 yrs.
Decline/degradation of upland wetlands from reduced freshwater flow	Wetland restoration / enhancement	Yes-3, 5, 6 ?-1, 2, 4	Have authority/ Have capacity	Tribal initiative / Program support	Planning	Owners, County (fee), BIA, DNR	3-10 yrs.
	In-stream/riparian enhancement	Yes-3, 5, 6 ?-1, 2, 4	Have authority/ Have capacity	Tribal initiative / Program support	Planning	Owners, County (fee), BIA, DNR	3-10 yrs.
Declining volume / consistency of freshwater flows, peak summer runoff (riparian uses)	Water conservation/ restrict diversions	Yes-2, 3, 4 ?-1, 6; No-5	Source dependent	Source dependent	Planning	Utilities? Owners	1-3 yrs.
	Increase storage capacity	Yes-2,3, 4, 5, 6 ?-1	Have authority?/ Have capacity	Tribal initiative/ Funding	Planning	Utilities	3-10 yrs.
	Drought management planning	Yes-1, 2, 3, 4, 5, 6	Have authority/ Have capacity	Tribal initiative/ Program support	Planning	Owners? Utilities	1-3 yrs.
	Riparian restoration/ management	Yes-3, 5, 6 ?-1, 2, 4	Owner authority/ Have capacity	Tribal initiative/ Program support	Planning	Owners?	3-10 yrs.
	Water transfers to supplement flows	Yes-3, 5 ?-4, 6; No-1, 2	Source dependent	Source dependent	SUA	Utilities	3-10 yrs.
	Public & owner outreach/education	Yes-1, 2, 3, 4, 5, 6	Have authority Have capacity	Tribal initiative / Program support	Planning	Owners, County (fee), BIA, DNR	1-3 yrs.
Salinization of groundwater from salt water intrusion, diminished recharge	Develop alternate/ new supply sources	Yes-3, 5, 6 ?-2, 4; No-1	Other authority	Owner authority/	SUA	Owners, Utilities	> 10 yrs.
	Increase storage capacity	Yes-3, 5, 6 ?-2, 4; No-1	Other authority	Tribal/owner initiative/funding	SUA	IHS?	3-10 yrs.
	Water conservation/ restrict drawdown	Yes-2, 3, 4 ?-1, 6; No-5	Other authority?	Tribal/owner initiative	Planning	Owners	1-3 yrs.
	Reverse osmosis for desalination	Yes-1,2, 3, 5, 6 ?-4; No-5	Other authority?	Tribal/owner initiative/funding	Planning, SUA	Owners	

Climate Change Impact	Potential Adaptation Strategy	Objectives Met (see key)	Existing Authority/ Capacity	Required Authority/ Capacity	Potential Internal Partners	Potential External Partners	Timeframe
Wildfire risk (forest stands, urban/forest interface)	Enhance training and support for wildfire management response	Yes-2,3, 4, 5, 6 ?-1	Other authority	Agency initiative / Program support	Planning	Fire District, DNR, Owners	1-3 yrs.
	Adopt and maintain Firewise community standards and fire buffer zones	Yes-1, 2, 3, 4, 5, 6	Have authority/ Have capacity	Tribal initiative / Program support	Planning	Fire District, Owners	1-3 yrs.
	Forest practices to reduce risk (thinning, controlled burns)	Yes-3, 4, 5, ?-1, 2, 6	Have authority/ Have capacity	Tribal initiative / Program support	Planning/Realty	Owners, BIA, DNR	1-3 yrs.
	Increase forest stand diversity to enhance resilience	Yes-2,3, 4, 5, 6 ?-1	Have authority/ Have capacity	Tribal initiative / Program support	Planning/Realty	Owners, BIA, DNR	3-10 yrs.
Forest species changes from heat stress	Forest management to promote diversity and resilient species	Yes-2,3, 4, 5, 6 ?-1	Have authority/ Have capacity	Tribal initiative / Program support	Planning/Realty	Owners, BIA, DNR	1-3 yrs.
	Tailored harvests and thinning to promote diverse mosaic	Yes-2,3, 4, 5, 6 ?-1	Have authority/ Have capacity	Tribal initiative / Program support	Planning/Realty	Owners, BIA, DNR	3-10 yrs.
	Extend harvest cycles to retain select species	Yes-2, 4, 5, 6 ?-1, 3	Have authority/ Have capacity	Tribal initiative / FMP update Program support	Planning	Owners, BIA, DNR	1-3 yrs.
Greater forest pest infestations, disease vectors (beetles, fungus, etc.)	Update inventory and increase monitoring to identify problems	Yes-1, 2, 3, 4, 5, 6	Have authority/ Have capacity	Tribal initiative / Program support	Planning	Owners, BIA, DNR	1-3 yrs.
	Forest thinning and controlled burns to eradicate problems	Yes-2, 3, 4, 5 ?-1, 6	Have authority/ Have capacity	Tribal initiative / Program support	Planning/Realty	Owners, BIA, DNR	1-3 yrs.
	Forest management to promote diversity and resilience	Yes-2,3, 4, 5, 6 ?-1	Have authority/ Have capacity	Tribal initiative / Program support	Planning/Realty	Owners, BIA, DNR	1-3 yrs.

Evaluation Objectives key:

1 – Comprehensive; 2 – Sustainability; 3 – Dynamic response; 4 – Fiscal feasibility; 5 – Non-regulatory; 6 – Community goals

## 8.3 Physical Health

Local climate change impacts could pose serious challenges to the Swinomish traditional practices that holistically link spiritual health with natural resources. If traditional seafood declines as expected, the Tribal community needs more than ever to draw on traditional strengths to build resiliency and find a way forward. The effort to build resiliency started with this project and is expected to become a permanent part of the Tribe. Results of other projects will be woven into an adaptation plan for Community Integrity and Health, such as recommendations from the Climate Change Education and Awareness Group (CCEAG), the Puget Sound Partnership inter-tribal study of community health, and other studies of water quality and the cultural keystone species, salmon and shellfish.



(photo courtesy of Swinomish Archives)

In many Native American communities, the Swinomish included, health is defined on a community level, consisting of inseparable strands of human health, ecological health, and cultural health woven together, all equally important. Within this definition, many of the dimensions of good health as defined by the Swinomish are difficult to quantify, such as participation in spiritual ceremonies, intergenerational education opportunities, and traditional harvesting practices, yet they may be negatively impacted or even destroyed when resources are scarce or disappear, as discussed in Chapter 4 of this report. For purpose of this report, the recommendations for traditional practices are not listed here but in Chapter 4.

Climate change is expected to add stress factors to a people already experiencing higher-than-normal levels of physical health issues. According to the Portland Area Office of the Indian Health Service, the tribal communities it serves experience “major health problems [of] ... hypertension, diabetes mellitus, obesity, and otitis media. Accidental injuries account for mortality and morbidity several times the national average. Substance abuse issues are a major concern.”<sup>17</sup> The major additional physical stressors from climate change are anticipated to be summer heat spells, higher levels of air pollutants, toxic contamination of and reduced availability of traditional foods such as shellfish. Complete information on assessment of recommendations for all Physical Health impacts is presented in Table 8-3.

### 8.3.1 Heat-related Illness

Heat exhaustion and heat stroke could increase as average temperatures are expected to increase by 3° - 8°F by 2100, with more frequent and/or intense periods of temperatures reaching into the 100's. While heat events may be sporadic during warmer months and may vary in duration and intensity, the potential severity of any single event could be increasingly significant as temperatures rise, with greater impacts on the elderly and infirm. Inability to find relief from major heat events, and any associated effects of heat exhaustion or heat stroke, could lead to more serious health effects on individuals, up to and including death. Despite the sporadic nature of such events, therefore, it will be important to provide the means and opportunity for relief, to attempt to prevent potentially widespread effects on the population. Primary actions toward this end would include public education on health effects, programs for increasing home cooling efficiency, and emergency measures for providing temporary relief, such as cooling centers.

<sup>17</sup> <http://www.ihs.gov/facilitieservices/areaoffices/portland/portland-our-story.asp>; accessed 08/04/2010

**Sector impacted:** Physical (Human) Health

**Adaptation Risk:** Medium-High

**Adaptation Goal(s):**

- Improve and enhance the quality of health services within the Reservation.
- Promote outreach and educational programs on critical health issues.

**Adaptation Strategies:**

#### **8.3.1.1 Education, emergency preparation, weather warning**

**Description:** Educate about risks through word-of-mouth, televised, and written messages, Identify and prepare cooling center(s) where temperatures can be maintained at healthy levels and there are adequate supplies, develop a heat alert warning system, develop a reservation-specific emergency plan.

**Required Authority/Capacity:** Tribe has authority to implement; capacity for education exists, capacity for cooling centers and warning system needs to be determined.

**Potential Partners/Coordination:** Health and emergency services: Swinomish Police, Fire District 13, Tribal Health Clinic, behavioral health, social services, building managers

**Timeframe for Implementation:** 1-3 years

**Priority:** MEDIUM-HIGH

#### **8.3.1.2 Housing retrofit and design for passive cooling<sup>18</sup>**

**Description:** Retrofit existing housing and landscaping and design new housing and landscaping to achieve sustainable cooling levels and minimize the need for cooling centers and/or electric air conditioners. Require passive cooling design in non-tribal new housing. Incorporate landscaping with cooling in mind. Designs could incorporate traditional longhouse features and native trees and shrubs, with deciduous trees on the southern and western exposures of homes.

**Required Authority/Capacity:** Have authority; need funding, code changes

**Potential Partners/Coordination:** Swinomish Housing Authority, designers such as architects and landscape architects, funding source

**Timeframe for Implementation:** Ongoing for retrofit/new construction; code changes 1-3 yrs.

**Priority:** MEDIUM -HIGH

### **8.3.2 Increased Risk of Respiratory Disease**

The tribal population within the Reservation is considered to have a higher than normal incidence of respiratory diseases and problems, such as from asthma and allergens. Higher temperatures, potentially greater stagnant air conditions, and higher levels of air pollutants may exacerbate such respiratory conditions and problems. Improvements and increased support for public health services to respond to

<sup>18</sup> Examples: [http://www.builditsolar.com/Projects/Cooling/passive\\_cooling.htm](http://www.builditsolar.com/Projects/Cooling/passive_cooling.htm); <http://www.house-energy.com/Cooling/Cool-Passive.html>

such problems may help to alleviate these health issues. Support for public health services should be complemented by actions under other priorities to address sources of air pollutants as possible.

**Sector impacted:** Physical (Human) Health

**Adaptation Risk:** Medium-High

**Adaptation Goal(s):**

- Improve and enhance the quality of health services within the Reservation.
- Promote outreach and educational programs on critical health issues.

**Adaptation Strategies:**

#### **8.3.2.1 Improve monitoring and reporting of respiratory disease; maintain public health service and strengthen as needed**

**Description:** Health professionals state that respiratory diseases such as asthma are high in the Swinomish Indian Tribal Community, echoing the pattern of higher-than-normal incidence found in regional tribes, especially among elders and young children. However, health reports are prepared at a summary level and do not document the specific incidence and trend for the Swinomish. Better reporting would help health professionals determine where to focus their attention and resources. Respiratory disease is sensitive to higher temperatures and to higher rates of airborne pollutants and allergens expected with climate change, including off-reservation industrial sources, as discussed in the Technical Report.

**Required Authority/Capacity:** Treatment of respiratory disease is within the Tribe's current authority. Additional authority is needed to negotiate air quality improvements in off-reservation sources.

**Potential Partners/Coordination:** Swinomish Tribal Health Center

**Timeframe for Implementation:** Ongoing

**Priority:** MEDIUM-HIGH

### **8.3.3 Toxic seafood contamination**

The long history and tradition of shellfish harvest and consumption is deeply embedded within tribal culture, as is reliance on salmon and other seafood species such as elk and deer. The potential for increased contamination of shellfish through PSP toxins, as well as potentially higher incidence of diseased and contaminated finfish, is expected to increase with increasing sea temperatures and changes in water quality parameters. Given the heavy continuing traditional reliance on such seafood, the tribal population is expected to be at greater risk of consumption of contaminated seafood, with consequent health effects. Increased monitoring of seafood for contamination will help to alert the population to potential health hazards; as traditional harvest beds and locations become increasingly inundated, it may also be possible to establish aquaculture operations to foster replacement populations of shellfish. Upland aquaculture, as a means of countering increasing common toxicity problems in local waters, is in need of further study as an alternative, but holds promise as an eventual option to continue traditional consumption.

**Sector impacted:** Physical (Human) Health

**Adaptation Risk: Medium-High**

**Adaptation Goal(s):**

- Preserve ability to exercise treaty rights, cultural practices, improve physical health.
- Construct more appropriate human health risk assessment for toxics in cultural keystone foods.
- Promotion of shellfish aquaculture on Tribal tidelands should be encouraged, emphasizing subsistence harvest practices.

**Adaptation Strategies:**

#### **8.3.3.1 Strengthen traditional food roles to identify whether seafood is safe**

**Description:** Other potential adaptive strategies will be identified in a follow-up study. Once the tribal knowledge base of the threats to and status of the Salish Sea has been established in the first phase of the study, a closer look at threats specifically from climate change may be undertaken, and priorities altered based on potential findings.

**Required Authority/Capacity:** Tribe has authority; project funding

**Potential Partners/Coordination:** Fisheries/SRSC

**Timeframes for Implementation:** 3-10 years

**Priority: MEDIUM-HIGH**

#### **8.3.3.2 Aquaculture operations**

**Description:** As an experimental option, shellfish could be seeded in upland operations to allow for proper growth and development under controlled conditions. Once they reach sufficient size and maturity, they could be transplanted to established beds.<sup>19</sup>

**Required Authority/Capacity:** Tribe has authority; project funding

**Potential Partners/Coordination:** Fisheries/SRSC

**Timeframes for Implementation:** 3-10 years

**Priority: MEDIUM-HIGH**

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<sup>19</sup> <http://www.timescolonist.com/technology/Cockles+show+promise+aquaculture+product/3335494/story.html>

**TABLE 8-3. ASSESSMENT OF ADAPTATION STRATEGIES – PHYSICAL HEALTH**

Climate Change Impact	Potential Adaptation Strategy	Objectives Met (see key)	Existing Authority/Capacity	Required Authority/Capacity	Potential Internal Partners	Potential External Partners	Timeframe
Heat-related illness	Education, emergency preparation, cooling centers, better alerts	Yes-1,2,3,4?,6 No-5 in part	Have authority/ partial capacity	Tribal initiative/ cooling center space	Public Works, Tribal Police, health clinic	Emergency services	1-3 yrs
	Housing retrofit/design for passive cooling	Yes-2,3,5,6 No-1,4	Have authority/ limited capacity	Tribal initiative/ design assistance	Housing Authority	Design services	Ongoing/ 1-3 yrs
Disease vectors	Maintain, strengthen public health services, vaccinations	Yes-1,2,3,4?,5,6	Have authority Some capacity	Tribal initiative/ Additional funding?	Health Clinic	Indian Health Board?	1-3 yrs
Respiratory disease	Improve monitoring/reporting, maintain/strengthen public health services	Yes-1,2,3,5,6 No-4?	Have authority/ Partial capacity	Tribal initiative/ Additional funding	Health Clinic	Indian Health Board, outside health services	1-3 yrs
Toxic seafood contamination	Health studies on options, strengthen community food roles	Yes-1,2,3,4,5,6	Partial capacity/ Detection, treatment: Have authority	Funding	Community-wide, Health Clinic	EPA grant partners	1-3 yrs (studies)
	Explore feasibility of sustainable shellfish aquaculture <sup>20</sup>	Yes-2,3,5,6 No-1,4	Have authority? Unknown capacity	Tribal initiative/ funding	SRSC	Aboriginal Aquaculture Assoc.	3-10 yrs
Spread of hazardous contaminants and solid waste due to flooding	Locate solid waste management, facilities outside risk zone	Yes-1, 2, 6 No-3, 4, 5	Have authority? Have capacity?	Tribal Initiative/ Funding	Planning, Public Works	EPA, WADOE (?)	> 10 yrs.
	Remove /contain hazardous materials in risk zone	Yes-1, 2, 3, 4, 5, 6	Limited authority? Limited Capacity?	Tribal Initiative/ Funding	Planning, Public Works	EPA, WADOE (?)	3-10 yrs.
Air pollution	Monitor/control on- and off-Reservation	Yes-2,3?,4,6? No-1,5	Partial authority/ "affected state"	Treatment as a State (TAS)/ funding	Planning, Sources	EPA, NW Clean Air Authority	1-3 yrs
Solar Radiation <sup>21</sup>	Education	Yes-1,2,3,4,5,6	Have authority/ have capacity	No additional required	Health Clinic	none	immediate

Evaluation Objectives key:

1 – Comprehensive; 2 – Sustainability; 3 – Dynamic response; 4 – Fiscal feasibility; 5 – Non-regulatory; 6 – Community goals

<sup>20</sup> <http://www.timescolonist.com/technology/Cockles+show+promise+aquaculture+product/3335494/story.html>

<sup>21</sup> Not directly related to increased GHG and climate change, but to reduction in atmospheric ozone; risk is stabilizing, expected to decline.

## 8.4 Community Infrastructure and Services

Community infrastructure for this adaptation strategy analysis includes transportation elements, utilities (water, sewer, storm drainage), and emergency services. Issues of most concern are those that have the potential to isolate the community by inhibiting access to and from the Reservation, and those that pose risk of disruption of essential services to large portions of the Reservation population, such as power and water supply disruptions. Other issues of concern are potential impacts to water supply due to decreased sources of freshwater from shift of a snow dominant storage basin to rain dominant, as discussed in the Technical Report. In addition, there are projected increased energy demands during the summer due to increase cooling needs, impacts to stormwater discharge, and bank erosion damaging stormwater discharge outfalls from increasing tidal surges and water levels.



(photo courtesy of Swinomish Tribal Archives)

Responses to these impacts will be a combination of complex, challenging strategies involving coordination with multiple jurisdictions and straightforward utility design. Protecting critical access routes to the Reservation will require working with agencies at both the state and local level on potentially expensive solutions. In working with these other agencies to preserve access to the Reservation, the Tribe will have to determine which strategy or combination of strategies will be most effective in the long run. Ensuring long term water supply to the Reservation may prove to be equally challenging, although the ultimate impacts and solutions required are less clear at this time. Based on the potential for increased frequency of severe storms, there is a need for improved emergency planning in the event of service disruptions, to provide for community needs during extended outages and to accommodate increased demand on emergency services. Complete information on assessment of recommendations for all Community Infrastructure and Services impacts is presented in Table 8-4.

### 8.4.1 Inundation of low-lying roads and bridge approaches.

One of the greatest potential climate change threats to the Reservation vicinity is impacts on access and circulation. As discussed in the Technical Report, increasing sea levels have the potential to inundate roads on and leading to the Reservation where such roads are not adequately protected by dikes, or where rising sea levels eventually top dikes. Responding to this threat will ultimately require daunting projects that will likely be both considerably expensive and considerably complex, especially considering the inter-jurisdictional coordination that will also be required. Given the uncertainties of the rate of sea level rise, it is not practical to implement strategies that are static and non-adaptive to changes, although early protections may be so due to the prohibitive cost of other options. Raising dikes and road levels may counter higher sea levels and storm surges in the short term, but will ultimately prove ineffective as sea levels continue to rise. Transportation facilities most vulnerable to these impacts are located in the inundation risk zone. Depending on the level of risk accepted by the community, there are a range of adaptation responses that can be applied, both short term and long term.

**Sector Impacted:** Transportation

**Adaptation Risk:** High



**Adaptation Goal(s):**

- A transportation network should be provided that will adequately satisfy the requirements for everyday access, tourism, and emergency vehicle access and evacuation in a safe and effective manner, while protecting and restoring coastal and natural resources.
- Road and utility construction should be prohibited from areas subject to excessive erosion and/or accretion.

**Adaptation Strategies:****8.4.1.1 Build/raise dikes**

**Description:** Build dikes or raise the elevation of existing dikes protecting roads located in the inundation risk zone, particularly low lying roads and bridge approaches.

**Required Authority/ Capacity:** The Tribe owns existing dikes on the north end of the Reservation, but lacks an established diking program; protection of off-Reservation access routes requires inter-jurisdictional coordination and substantial funding.

**Potential Partners/Coordination:** Diking District (off-Reservation fee lands), Town of LaConner, possibly US Army Corps of Engineers (USACE).

**Timeframe for Implementation:** Short term strategy, 3 to 10 years.

**Priority:** **HIGH** (with consideration of other options, possibly as a short term strategy)

**8.4.1.2 Raise road level**

**Description:** Raise elevation of roads in the inundation risk zone that are highly vulnerable to inundation from sea level rise and/or high tidal storm surges. Raising road elevation would maintain the existing routes and access to the Reservation.

**Required Authority/ Capacity:** Owners; Tribe, Skagit County, or Washington State Department of Transportation (WSDOT). The Tribe has limited capacity; requiring assistance from outside sources for planning, construction, and funding.

**Potential Partners/Coordination:** Depending on road ownership, Skagit County and/or WSDOT.

**Timeframe for Implementation:** Long term strategy, greater than 10 years.

**Priority:** **HIGH** (with consideration of other options)

**8.4.1.3 Relocate route**

**Description:** Relocation of routes within the inundation risk zone for better long-term protection of low-lying roads from inundation and of coastal resources from adverse impacts related to such routes.

**Required Authority/ Capacity:** Owners; Tribe, Skagit County, or WSDOT. The Tribe has limited capacity; requiring assistance from outside sources for planning, construction, and funding.

**Potential Partners/Coordination:** Depending on road ownership, Skagit County and/or WSDOT.

**Timeframe for Implementation:** Long term strategy, greater than 10 years.

**Priority:** **HIGH** (with consideration of other options)

#### 8.4.1.4 Abandon Route

**Description:** Vacate routes in the inundation risk zone, where possible and where alternate routes can be established. Abandoning routes subject to inundation may be a more desirable and fiscally feasible option since no construction or purchase/lease of ROW is required and coastal resources would be better protected.

**Required Authority/ Capacity:** Owner authority. Tribal capacity is dependent on road ownership, creating limitations.

**Potential Partners/Coordination:** Depending on road ownership, Skagit County and/or WSDOT. **Timeframe for Implementation:** 3 to 10 years.

**Priority:** HIGH (with consideration of other options)

### 8.4.2 Road closure from storm/tidal surge event and/or wildfire

Storm and tidal surges also pose potentially significant threats to Reservation access, as became apparent in 2006 and again in 2010. In contrast to the incremental but long term impact of sea level rise, storm/tidal surge events would be relatively short-lived, but are expected to become more frequent with increasing sea level rise, and even short-term surge events could create significant impacts on Reservation access and circulation depending on duration. Likewise, wildfire presents a similar short-term but potentially significant risk to travel within and to the Reservation, given the extent and density of forested areas within and adjacent to the Reservation. Approximately 2,128 acres of land and over 20 miles of roads miles are located in the identified wildfire risk zone.

Given the short-term nature of such events, response may be less extreme and challenging than for sea level rise. If possible, identifying and establishing alternate routes may suffice for some events, at least in the short term. Options developed to counter sea level rise will also serve to protect from storm and tidal surges, which may be necessary if alternate routes are not available. Other adaptation approaches that require little or no capital investment include preventing or limiting road construction in risk zones.

**Sector Impacted:** Transportation

**Adaptation Risk:** Medium (given uncertain frequency of events)

**Adaptation Goal(s):**

- A transportation network should be provided that will adequately satisfy the requirements for everyday access, tourism, and emergency vehicle access and evacuation in a safe and effective manner, while protecting and restoring coastal and natural resources.
- Road and utility construction should be prohibited from areas subject to excessive erosion and/or accretion.

**Adaptation Strategies:**

#### 8.4.2.1 Develop alternate route plan for roads in the inundation risk zone

**Description:** Identify or develop alternate route plans to accommodate traffic in the event that flooding or wildfire renders existing routes inaccessible. Develop an alternate route plan based on various potential weather and hazardous conditions through a broad assessment of possible road closure situations, with provisions for detours as needed.

**Required Authority/ Capacity:** Tribal initiative and funding

**Potential Partners/Coordination:** Depending on affected routes, Town of LaConner, Skagit County, and/or WSDOT.

**Timeframe for Implementation:** Can be implemented immediately; one to three years.

**Priority:** MEDIUM-HIGH

#### 8.4.2.2 Restrict construction of public roads in risk zones

**Description:** Limit/restrict construction of public roads within the inundation risk zone and urban/forest interface wildfire risk zone, to avoid reliance on routes that may be potentially at risk, and to better protect coastal and natural resources.

**Required Authority/ Capacity:** Tribe has the authority and capacity to implement this strategy for routes within its jurisdiction.

**Potential Partners/Coordination:** As may be needed, Skagit County and/or WSDOT.

**Timeframe for Implementation:** Can be implemented immediately; one to three years.

**Priority:** MEDIUM-HIGH

### 8.4.3 Reduced (potable) water supply due to decreased sources (river/runoff, groundwater recharge)

Climate change impacts on precipitation patterns and hydro-geologic patterns within watersheds are somewhat uncertain. General projections indicate that less precipitation will arrive in the form of snow and that snowmelt will occur early and with greater intensity, leading to greater frequency of flooding. As more precipitation comes in the form of rain, the loss of snowpack and the shrinking of glaciers will result in lower summertime stream flows. Major issues for water purveyors are reduced water supply due to decreased stream flows and decreased groundwater recharge. Key strategies include water conservation and reduced usage through water efficiency measures, increased water storage to meet temporary shortfalls, and recycled grey water treatment and usage. As with other types of impacts, application of a combination of strategies will likely prove most beneficial.

**Sector Impacted:** Public Utilities

**Adaptation Risk:** Medium

**Adaptation Goal(s):**

- Maintain adequate water supply and quality.
- Increase reliability and quality of water supply.
- Development relying upon wells should be restricted or discouraged and a buffer should be established between any development relying upon wells and groundwater recharge areas.
- Reservation groundwater aquifer should be investigated for designation as a sole source aquifer and managed to preserve long-term quantity and quality.

**Adaptation Strategies:**

#### 8.4.3.1 Develop water management plan for drought conditions

**Description:** Develop a water management plan for drought conditions that include preventative and prescriptive methods, operational measures, as well as restoration measures. A drought management plan focuses on preventative and conservation methods.

**Required Authority/ Capacity:** The Tribe currently has sufficient authority and capacity to develop and implement a plan.

**Potential Partners/Coordination:** City of Anacortes and Indian Health Service (IHS), as needed.

**Timeframe for Implementation:** Can be implemented immediately; one to three years.

**Priority:** MEDIUM

#### 8.4.3.2 Rate incentives/disincentives for water usage

**Description:** Creating incentives and disincentives; e.g., credit to be applied to utility bill for using less water or increased water rates. Incentives/disincentives can be adjusted to the needs and limitations of affected resources and changing circumstances.

**Required Authority/ Capacity:** The Tribe has authority to develop incentives and disincentives through use of programmatic and regulatory methods.

**Potential Partners/Coordination:** Swinomish Utility Authority (SUA), City of Anacortes as needed.

**Timeframe for Implementation:** Can be implemented immediately; one to three years.

**Priority:** MEDIUM

#### 8.4.3.3 Wastewater treatment of grey water for non-potable uses.

**Description:** Reusing/recycling grey water reduces the amount of needed freshwater supplies and reduces the amount of waste water entering sewer or septic systems.

**Required Authority/ Capacity:** The Tribe currently has authority but limited capacity; requiring additional funding treatment facilities.

**Potential Partners/Coordination:** EPA, IHS as applicable or needed.

**Timeframe for Implementation:** Development of policies and infrastructure would take approximately three to ten years.

**Priority:** MEDIUM

#### 8.4.3.4 Water efficient appliances/fixtures for facilities and housing

**Description:** Reduce water usage by increasing efficiency of water fixtures and appliances.

**Required Authority/ Capacity:** The Tribe currently authority but limited capacity; requiring additional funding for purchase and distribution of appliances/fixtures.

**Potential Partners/Coordination:** Puget Sound Energy, EPA, Washington State Department of Ecology (WADOE), as applicable.

**Timeframe for Implementation:** Can be implemented immediately within one to three years.

**Priority:** MEDIUM

#### 8.4.3.5 Voluntary/mandated water restrictions

**Description:** Implement voluntary watering restrictions for landscaping, lawns, and recreational uses when temperatures and water levels reach a specified threshold; restrictions may become mandatory if there are no significant reductions of water usage or there is drought warning.

**Required Authority/ Capacity:** Restrictions normally imposed by water purveyors, such as City of Anacortes, or perhaps Swinomish Utility Authority (SUA).

**Potential Partners/Coordination:** City of Anacortes, coordinating with SUA as necessary.

**Timeframe for Implementation:** Can be implemented immediately; one to three years.

**Priority:** MEDIUM

#### 8.4.3.6 Water conservation/ education

**Description:** Use of non-regulatory strategies for educating the community on the importance of water conservation and climate change impacts on community water supply through outreach and education efforts. This strategy is directed at adjusting individual's behavior and habits of water resource uses and adjusts to changing information and circumstances. Education empowers people to make a change in their community, creating ownership/stewardship of natural resources.

**Required Authority/ Capacity:** The Tribe has authority to implement this strategy. Requirements for implementation are funding to support educational outreach activities.

**Potential Partners/Coordination:** May be coordinated through a variety of Tribal departments; potential external partnerships may be necessary with Shelter Bay Community, Town of La Conner, and City of Anacortes.

**Timeframe for Implementation:** Development of policies and infrastructure would take approximately three to ten years.

**Priority:** MEDIUM

#### 8.4.3.7 Develop additional water storage.

**Description:** Plan for additional water storage through construction of new reservoirs, impoundments, or by creating/enhancing natural water storage methods. Increase usage of permeable surfaces for rainwater to be absorbed in ground and store as groundwater.

**Required Authority/ Capacity:** The Tribe has the authority but may need additional capacity for expertise of natural and technological water storage systems. Authority is also required from owners on fee lands.

**Potential Partners/Coordination:** City of Anacortes, IHS, as applicable, coordinating with SUA.

**Timeframe for Implementation:** Development of policies and infrastructure would take approximately three to ten years.

**Priority:** MEDIUM

### 8.4.4 Contamination of drinking water supplies from flooding

The City of Anacortes is the major supplier of public water for the Tribe, drawing water from the Skagit River. The treatment facility for the Anacortes supply system is located in Mount Vernon adjacent to the Skagit River, in a low-lying area that, while protected by a levee, has historically been susceptible to major flooding. Should climate change impacts increase severity of flood events, this major drinking water source could be jeopardized, forcing reliance on whatever backup supplies are available should the facility be impacted by a major event. Contamination caused by flooding could also impact groundwater wells within the Reservation that provide the Tribe additional public water supply. In addition to protecting vulnerable facilities, prudent measures include maintain stockpiles and additional storage of potable water for emergency use and testing of water sources as needed following flood events.

**Sector Impacted: Public Utilities****Adaptation Risk: Medium****Adaptation Goal(s):**

- Maintain adequate water supply and quality.
- Increase reliability and quality of water supply.
- Development relying upon wells should be restricted or discouraged and a buffer should be established between any development relying upon wells and groundwater recharge areas.
- Reservation groundwater aquifer should be investigated for designation as a sole source aquifer and managed to preserve long-term quantity and quality.

**Adaptation Strategies:****8.4.4.1 Stockpile/maintain emergency water supplies**

**Description:** Store and maintain potable water and filtration supplies for emergency events caused by flooding, contaminated wells or infrastructure disruption created by flooding. This strategy is also applicable to other emergency events of water shortages. Developing supplies is dependent on needs and demand so it can be adjusted to meet demand, responding to changing facts and circumstances.

**Required Authority/Capacity:** The Tribe has authority to develop a water storage and distribution program. However the Tribe may have limited capacity due to funding needed for supplies, storage, and maintenance.

**Potential Partners/Coordination:** IHS, as applicable.

**Timeframe for Implementation:** One to three years.

**Priority: MEDIUM**

**8.4.4.2 Identify/protect vulnerable facilities**

**Description:** Identify public water facilities located in the inundation risk zone that are at risk to flooding and develop plan for protection from major flood events.

**Required Authority/ Capacity:** This requires Tribal initiative and owner authority. Funding is necessary for implementing strategy.

**Potential Partners/Coordination:** City of Anacortes, coordinating with SUA.

**Timeframe for Implementation:** Long-term strategy, 3-10 years.

**Priority: MEDIUM**

**8.4.4.3 Develop well testing/disinfection program for flooding events**

**Description:** Establish program for well testing and disinfection following major flooding events.

**Required Authority/ Capacity:** Tribal initiative and authority of owners. Required capacity needed is for funding and technical support of that this may require teaching community members/ well users how to test and disinfect wells.

**Potential Partners/Coordination:** IHS, as applicable.

**Timeframe for Implementation:** Can be implemented immediately; one to three years.

**Priority: MEDIUM**

#### 8.4.4.4 Increase stormwater management capacity

**Description:** Increase stormwater system capacity, including replacement of existing culverts and use of Low Impact Development techniques such as rain gardens for water run-off detention and infiltration.

**Required Authority/ Capacity:** Owners to implement engineering strategies.

**Potential Partners/Coordination:** Skagit County, for fee lands

**Timeframe for Implementation:** Approximately three to ten years for development of partnerships and facilities.

**Priority:** MEDIUM

#### 8.4.5 Service disruption of communication and energy systems

Several major storm events on the Reservation in recent years have impacted the community through disruption of communications and power caused by downed trees and power lines. Such an event in 2006 lasted three days, prompting preparations for evacuation of residents to tribal facilities, without emergency provisions for food, water, or bedding. These events have highlighted the need for improved local emergency planning to accommodate future such events and avoid a potential crisis situation. The potential adaptation strategies listed also have a direct relation to mitigation activities; specifically developing alternative energy sources to meet adaptation goals listed below. Development of alternative energy systems is a comprehensive and effective approach to reduce limitations and dependency of outsourced energy sources.

**Sector Impacted:** Public/Private Utilities

**Adaptation Risk:** Medium-High

**Adaptation Goal(s):**

- Maintain capability and reliability of communications system.
- Develop alternate or emergency capability for communications to prevent disruption in the event of outage.
- Develop alternate or emergency power sources to supplement existing sources and minimize disruption in the event of outage.
- Decrease dependence on power grid.

##### 8.4.5.1 Develop alternate energy systems

**Description:** Develop alternate energy systems, for example, wind, solar, and biomass powered energy systems. This also includes developing backup system generators that are powered by alternative energy. Develop the necessary policy and infrastructure to support systems.

**Required Authority/ Capacity:** Requires owner and Tribal initiative. Funding and technical expertise needed for infrastructure and engineering.

**Potential Partners/Coordination:** US Department of Energy and other associated federal agencies.

**Timeframe for Implementation:** Long-term strategy, greater than ten years to implement.

**Priority:** MEDIUM-HIGH

#### **8.4.5.2 Develop alternate communication systems**

**Description:** Establish alternative communication system for use in the event of emergencies that disrupt normal communication systems. This may include a Swinomish Community radio system and usage of VHF radios. Other alternative communications systems include infrared, microwave, satellite phone, and VSAT.

**Required Authority/ Capacity:** The Tribe has authority to implement alternative communication systems. Required capacity is for funding and technical support of system.

**Potential Partners/Coordination:** Service providers

**Timeframe for Implementation:** 3 to 10 years.

**Priority:** MEDIUM-HIGH



**TABLE 8-4. ASSESSMENT OF ADAPTATION STRATEGIES – COMMUNITY INFRASTRUCTURE AND SERVICES**

Climate Change Impact	Potential Adaptation Strategy	Objectives Met (see key)	Existing Authority/Capacity	Required Authority/Capacity	Potential Internal Partners	Potential External Partners	Timeframe
Inundation of low-lying roads, bridge approaches	Build/raise dikes	Yes – 3, 5, 6 No –1, 2, 4	Other authority Limited capacity	Diking district/ funding	Planning, Public Works	Diking district	> 10 yrs.
	Raise road level	Yes – 3, 5, 6 No –1, 2, 4	Other authority Limited capacity	Owner initiative/ funding	Planning, Public Works	County, WSDOT	> 10 yrs.
	Relocate route	Yes – 1, 2, 3, 5 No –4, 6 (?)	Other authority Limited capacity	Owner initiative/ funding	Planning, Public Works	County, WSDOT	> 10 yrs.
	Abandon route	Yes – 1, 2, 4, 5 No –3, 6	Other authority Limited capacity	Owner initiative	Planning	County, WSDOT	3-10 yrs.
Road damage from intensified heat events	Increased pavement maintenance	Yes-1, 2,3, 4, 6 No – 5	Have authority Have capacity	Owner initiative/ funding	Planning, Public Works	County, WSDOT, BIA	Ongoing
	New design standards, materials, retrofit roads	Yes-1, 2,3, 4, 6 No- 5	Have authority Have capacity	Tribal Initiative Design standards	Planning, Public Works	County, WSDOT, BIA	1-3 yrs
Road closure from storm surge event, wildfire	Develop alternate routes in risk zones	Yes- 1, 2, 3, 4, 5, 6	Have authority Have capacity	Owner initiative	Planning, Public Works	County, WSDOT	1-3 yrs
	increase storm capacity, buffers from vegetation	Yes – 1, 2, 3, 4, 5, 6	Have authority Have capacity	Tribal Initiative Design standards	Planning, Public Works	County, WSDOT	3-10 yrs.
	ITS weather warnings/ fire danger levels	Yes – 1, 2, 3, 4, 5, 6	Have authority Limited capacity	Owner initiative/ funding	Planning, Public Works	County, WSDOT	3-10 yrs.?
	Build/ raise dikes	Yes – 5, 6 No –1, 2, 3, 4	Have authority Limited capacity	Diking program / funding	Planning, Public Works	County, WSDOT, Diking district	> 10 yrs.
	Restrict road construction in risk zones.	Yes-1, 2,3, 4, 6 No –5	Have authority Have capacity	Owner initiative	Planning, Public Works	County, WSDOT	1-3 yrs
Contamination of drinking water supplies from flooding	Stockpile/maintain emergency water supplies	Yes-1, 3,4, 5, 6 No –2	Have authority Have capacity	Tribal Initiative	SUA, Public Works	IHS	1-3 yrs
	well testing after flooding events	Yes-1, 3,4, 5, 6 No –2	Have authority Have capacity?	Owner, Tribal Initiative/ Funding	Planning, SUA	EPA? IHS	3-10 yrs.
	Increase stormwater capacity	Yes – 1, 2, 3, 4, 5, 6	Have authority Limited capacity?	Owner, Tribal Initiative/ funding	Planning, Public Works, SUA	County?	3-10 yrs.
	Identify/protect vulnerable facilities	Yes – 1, 2, 3, 4, 5, 6	Other authority	Owner initiative (Tribal participation)/ Funding	Planning, SUA	Anacortes	3-10 yrs

Climate Change Impact	Potential Adaptation Strategy	Objectives Met (see key)	Existing Authority/ Capacity	Required Authority/ Capacity	Potential Internal Partners	Potential External Partners	Timeframe
Reduced (potable) water supply due to decreased sources (river/runoff, groundwater recharge)	Develop drought management plan	Yes-1,2, 3, 4, 6 No -5	Have authority Have capacity?	Tribal Initiative Code amendments(?)	SUA, Public Works,	Anacortes, IHS	1-3 yrs.?
	Rate incentives/ disincentives for water usage	Yes - 1, 2, 3, 4, 5, 6	Have authority? Have capacity?	Tribal Initiative Code amendments(?)	SUA	Anacortes?	1-3 yrs.?
	Treatment of grey water for non-potable uses	Yes -1, 2, 4, 6 No -3, 5	Have authority Limited capacity	Tribal Initiative/ funding	SUA, Public Works, Planning,	IHS	3-10 yrs.?
	Water-efficient appliances/ fixtures for facilities & housing	Yes - 1, 2, 3, 4, 5, 6	Have authority Limited capacity	Tribal Initiative/ funding	SUA, Public Works, Planning, Housing	PSE? EPA? WADOE?	1-3 yrs
	Voluntary/mandated water restrictions	Yes - 3, 4, 6 No -1, 2, 5	Limited Authority Limited Capacity	Tribal Initiative Code amendments(?)	SUA, Public Works, Planning, Housing	Anacortes	1-3 yrs
	Water conservation/ education	Yes - 1, 2, 3, 4, 5, 6	Have authority Have capacity	Tribal Initiative Funding	Planning, Public Works, Social Services, SUA	Shelter Bay, La Conner, Anacortes	1-3 yrs
	Import water from local jurisdictions	Yes - 1 No- 2,3, 4, 5, 6	Have authority Limited capacity?	Tribal Initiative/SUA Local jurisdiction	Planning, Public Works, SUA	Water purveyor/ jurisdiction	> 10 yrs.
	Use Tribal aquifers for backup water supply	Yes - 1 No-2, 3, 4, 5, 6	Have authority? Have capacity?	Tribal Initiative	Planning, Public Works, SUA	BIA? EPA?	> 10 yrs.
Service disruption of communication, energy systems	Develop additional water storage, harvesting	Yes -3, 4, 5, 6 No -1, 2	Have authority Have capacity	Owner initiative	Planning, Public Works, SUA	Shelter Bay, IHS WADOE	3-10 yrs.?
	Develop alternate energy systems, (solar, wind etc.)	Yes - 1, 2, 3, 4, 5, 6	Have authority Limited capacity?	Owner & Tribal Initiative/ Funding	Planning, Public Works, SUA	USDOE, Federal agencies?	> 10 yrs.
	Develop backup energy supply (generators, etc.)	Yes - 1, 2, 3, 4, 5, 6	Have authority Have capacity	Owner, Tribal/ funding	IT, Public Works	Service providers	1-3 yrs
Increased demand on emergency services during severe storm/wildfire events	Develop alternate communication systems (radio, LAN, etc.)	Yes - 1, 2, 3, 4, 5, 6	Have authority Have capacity?	Owner, Tribal/ funding	IT	Service providers	1-3 yrs
	Community emergency preparedness training	Yes -1, 2, 3, 4, 5, 6	Have authority Have capacity	Tribal Initiative/ Funding	Planning, HESS, Police	Red Cross, IHS	1-3 yrs.
	Develop local emergency plan	Yes -1, 2, 3, 4, 5, 6	Have authority Have capacity?	Tribal Initiative/ Funding	Planning, Public Works, Housing, HESS	County, State (?)	1-3 yrs.

Climate Change Impact	Potential Adaptation Strategy	Objectives Met (see key)	Existing Authority/Capacity	Required Authority/Capacity	Potential Internal Partners	Potential External Partners	Timeframe
Increased energy demand to counter higher temperatures.	Retrofits for cooling efficiency	Yes –1, 2, 3, 4, 5, 6	Have authority Have capacity	Owner Initiative/ Funding	Planning, Public Works, Housing	USDOE	3-10 yrs.
	Develop energy conservation programs (energy audits/ savings)	Yes – 1, 2, 3, 4, 5, 6	Have authority Have capacity?	Tribal Initiative/ Funding	Planning, Public Works, Housing	USDOE	1-3 yrs.
	Use alternative energy systems to supplement increased energy demand	Yes –1, 2, 6 No –3, 4, 5	Have authority Have capacity?	Tribal Initiative/ Funding	Planning, Public Works, Housing	USDOE	3-10 yrs.
Inundation/backup of drainage discharge from higher tides, storm surges	Relocate discharge lines in risk zones.	Yes – 2, 3, 5, 6 No –1, 3, 4	Have authority Limited capacity?	Owner initiative/ funding	Planning, Public Works	County?	3-10 yrs.
	Increase storage capacity of pipes	Yes – 1, 5, 6 No –2, 3, 4	Have authority Limited capacity?	Owner initiative/ funding	Planning, Public Works	County?	3-10 yrs.
Erosion damage to stormwater outfalls	Replace/relocate discharge lines in risk zones	Yes – 2, 3, 5, 6 No –1, 3, 4	Have authority Limited capacity?	Owner initiative/ funding	Planning, Public Works	County?	3-10 yrs.

Evaluation Objectives key:

1 – Comprehensive; 2 – Sustainability; 3 – Adaptive response; 4 – Fiscal feasibility; 5 – Non-regulatory; 6 – Community goals

## 9 Action Plan Implementation

An Action Plan is only as useful and effective as the follow-up implementation. As part of evaluating strategies and developing action recommendations, project participants also identified a number of issues considered important for successful implementation or pertinent to specific proposed strategies or actions. Also as noted earlier, many of the discussions that need to occur regarding policy implications of recommended actions and strategies have only just started, or have yet to begin. This chapter presents a number of policy considerations that may need to be part of discussion for implementation, as collectively identified by participants, and concludes with suggestions for “next step” adaptation projects.

### 9.1 Practical Tips for Communicating and Implementing Actions

In addition to identification of strategy options and evaluation criteria, discussion with advisory group members also identified a number of practical considerations for communicating and implementing adaptation actions. As distilled from the collective experience of the group members, these are seen as key to effective implementation, and they are presented not as benchmarks for measurement of success but simply as guiding factors to consider when undertaking adaptation actions.

- **Flexibility in approaches:** Because of the number and complexity of many climate change issues, there may be few common solutions to the same basic impacts as they affect different areas; adaptive response may be required for changing circumstances.
- **Public education/outreach:** Communication, information, and training on identified issues are vital to building support within the community for action.
- **Relevancy to everyday life:** Relating to facts, current issues, and real world situations will help to make issues and actions more relevant to the local community (see further discussion below on community outreach).
- **Political realities:** Address and work through political constraints and institutional barriers realistically, while seeking solutions that offer incentives or benefits for overcoming such barriers.
- **Incremental approach:** Phasing and scaling of actions may help to cope with issues such as governmental inertia and challenging funding requirements.
- **Regional approach/partnerships:** Some issues are larger than individual jurisdictions; cooperative efforts may be useful or necessary to promote effectiveness or to increase capacity for response.

## 9.2 Tailoring Local Coastal Protection Options

Due to the varying geographic and environmental characteristics of the Reservation, it will likely be necessary or desirable to pursue different implementation strategies to address impacts in different areas within the Reservation. This section illustrates this need by discussing how such localized approaches may be tailored to better fit site-specific adaptive planning for sea level rise in varying locations.

### A. Natural Shorelines

Where shorelines are classified as “natural shorelines” under the Swinomish Shorelines & Sensitive Areas (SSA) ordinance, opportunity exists to allow shoreward migration of coastal resources and habitats. There are few structures in these areas, and where structures do exist, the Tribe could remove them from Trust uplands and negotiate for removal or relocation in other areas, so as to not inhibit adaptation of natural systems. In addition, the Tribe could explore options for enhancing shoreward migration to maintain estuarine beach and wetland habitats. In these areas, the primary approach would likely be to simply let the natural system seek a new equilibrium.

### B. Fill Along Swinomish Channel

Dredge fill material has been placed along the Swinomish Channel shoreline on adjacent trust lands. The Tribe has removed fill from three areas along the channel in recent years to construct pocket estuaries as new habitat, particularly for migrant Chinook salmon fry. More pocket estuaries may be added in the future, but constructed at a higher tidal elevation to provide habitat at a higher sea level. Existing pocket estuaries may be raised through the periodic addition of sediment materials for the same reason. However, results from recent pocket estuary restoration projects along the Swinomish Channel indicate that accretion from natural forces is sufficient to maintain sediment inputs and build estuarine wetland soils at 1 to 2 inches per year shortly after establishment. If this rate continues, it should keep pace with projected sea level rise.



Figure 9-1. View north along the Swinomish Channel in the vicinity of the Swinomish Village (left) and the Town of LaConner (right); Tribal facilities in this view include the Swinomish Planning office (gray building, middle left), fish plant (white building), and Tribal fishing fleet docks. (photo: Ed Knight, 2009)

### C. Shelter Bay Marina

The Shelter Bay Marina basin and the constructed peninsulas on which homes are built are on Tribal Trust land leased to non-tribal residents in an area deemed to be at high risk of impacts from sea level rise. This area is highly developed and little habitat potential has survived, with most of the constructed shoreline in hardened rip-rap. While sea level rise puts the homes and other infrastructure around the basin at risk, there appears to be little benefit to shoreline resources and habitat from removing structures in the basin, relative to the cost and difficulty of restoring habitat in this area. This may be one area where applying “protect-in-place” may be the preferred strategy, rather than retreating from the rising sea. The key question will be how to implement the strategy, and there are several options that will need to be explored. One option is raising the elevation of the peninsulas, which would be expensive and would require rebuilding or relocating homes, in addition to widening the base, thereby reducing marina basin area. Another option may be to raise the homes and harden their foundations and lower floors to inundation. More innovative solutions could be explored, such as replacing homes with floating structures that rise with the tide. Ultimately, if none of these are feasible, the final option would be abandoning this area to sea level rise.



Figure 9-2. Shelter Bay Community and Marina, south of Swinomish Village, west side of Swinomish Channel. (photo: Ed Knight, 2009)

### D. Pull-&-Be-Damned

Pull-&-Be-Damned is an area of allotted trust lands located on feeder bluffs along the western shore of the Reservation, containing tracts leased primarily to non-tribal residents. These bluffs provide sediment input to the hydro-geological system. Some of these parcels are large enough to apply greater setbacks from the top of the bluff. It may be prudent to apply increased setbacks to future construction along the top of the bluffs as a hedge against increased bluff erosion in the future. However, most of the lots along this section of shoreline have already been developed. The Tribe may consider prohibiting future bulkheads and other hardened bank protection along the toe of the slope, where such barriers would block sediment input. A next step would be to remove such existing bank protection where feasible to increase sediment input. Prior to physical removal of structures on leased allotments, the Tribe may also want to consider removing structures on Tribal tidelands. Beyond that the Tribe may need to explore options for a cooperative approach with a number of lessees along given sections of the shoreline to develop a program for removal of bank protection structures.

## **E. Shoreline Residential Fee Land**

One of the challenges in shoreline management in the face of sea level rise is the treatment of shoreline residential development threatened by ever-increasing sea levels, especially where the Tribe owns the tidelands adjacent to upland waterfront parcels. Many jurisdictions have struggled to find appropriate solutions to this problem. The Tribe will need to further explore potential tools noted previously in this report, including:

- Shoreline Regulation, such as increased minimum setback requirements and stricter rules regarding shoreline armoring.
- Rolling Easements or similar forms of adaptive strategies that change over time with rising sea levels.
- Protection of the Tribe's property interest in tidelands adjacent to upland waterfront parcels, and acquisition of upland waterfront parcels from willing sellers in certain areas containing critical coastal resources.
- Cooperative programs to assist homeowners in moving development back from the shore sooner rather than later.

In assessing these various options, the Tribe may wish to develop plans for different shoreline sections which look at areas of critical coastal resources and prioritize some areas for shoreward migration projects.

An additional challenge arises from the potential shift in the line of Mean High Tide (MHT). Currently, Tribal ownership of tidelands around the Reservation, with the exception of tidelands specifically sold out of trust, extends from the line of extreme low water to the line of MHT. As sea level rises, the line of MHT will shift shoreward, and the boundary between Tribally-owned tidelands and adjacent uplands will also shift shoreward. One consequence of this shift is that as existing structures fall below the line of MHT, the Tribe may have new options for either removal or modification of the structures or, in some areas, for allowing temporary continued use with a payment or lease fee. While exercising these options may lead to removal or modification of some structures, additional advanced planning would be needed to provide for gradual transition of habitats shifting shoreward. However, combined with appropriate regulation and other tools such as upland land acquisition or rolling easements, advanced planning and assistance of shoreward migration of coastal resources in key areas is possible.

## **F. Economic Development and Agricultural Lands**

Low-lying lands on the northern end of the Swinomish Indian Reservation and adjacent to the Swinomish Channel are in an area considered to be at greatest risk of impacts from sea level rise. This area, which contains upwards of 1,000 acres, is generally 5 to 10 feet above sea level and is currently protected by a system of dikes from tidal influence. Roughly the northern half of this area, which is bisected east-west by State Route 20, is designated as a Tribal Economic Zone, with lands designated Agricultural further south. The Tribal Economic Zone in the vicinity of SR 20 continues to be the primary focus for Tribal economic development projects, and it currently contains the majority of Tribal enterprises, including a casino and gas station. Current development planning now includes consideration of sea level issues, but the question of long-term prospects for the area has not yet been answered. For the immediate future, some decades ahead, the expectation is that the area can continue to be used for economic development; this assumes that measures to protect the area from tidal inundation will have to be taken. One such

measure could be to raise the dikes currently protecting the area from tidal inundation, or to raise the whole area to protect from increasing sea level rise. This short-term strategy has its limitations, however. Not only does it raise natural resource concerns, but at some point it ceases to be feasible or cost-effective to continue raising dikes as sea level continues to rise. The implications for the long term, therefore, are that planning strategic retreat will be the ultimate strategy; the gamble is that short-term protection will allow sufficient time to develop the longer-term strategy.

A similar scenario exists in the agricultural lands further south, where again the expectation is that existing dikes will not be sufficient in the long term to protect against continuing sea level rise. As with economic development lands to the north, dikes could be built higher to continue to protect farmland, but the cost of continuing to raise them over time would again become prohibitively expensive at some point, and ultimately ineffective. Given the economics of agricultural lands, this point would likely be reached much earlier for these lands than for the Tribal Economic Zone to the north. In any case, drainage would become a major problem. As the sea level rises outside the dikes, not only is there a risk of saltwater intrusion and shallow saline water table effecting crops, but draining land behind the dikes would require pumping, an added expense and complication. Again, as with economic development lands, the Tribe will eventually need to consider alternative uses for this area as salinization and high water tables, as well as costs to raise dikes and pump water, make these lands less attractive for continued agricultural production. It may be that this area will return to a marsh or tidal condition, as it once was; it should be a matter of timing and a carefully planned approach, though, rather than simply letting sea level rise render the area unusable.

A planned transition to estuarine marsh and other natural habitats for fish and wildlife in this area could offset other areas lost to the sea or squeezed out against hardened shorelines in the Tribal Economic Zone. Further study is needed to identify the best options for this transition. A transition would likely entail removal of some sections of the dike to allow inundation and the restoration of estuarine marsh. The Tribe might not want to open up the entire area at once to such inundation, but remove a section and protect other areas against immediate inundation. These early restorations could serve as demonstration and experimental opportunities. The lessons learned could be applied to future areas being restored. There are a number of factors to take into account before considering any of the options. For example:

- Will there be loss of freshwater stream and wetland habitat, and will the action result in a shift in species composition?
- Where sand removed from dikes is used for fill, will it be used to build new dikes to continue to protect some areas from inundation? Could it be used for beach nourishment in other areas?
- Does the Tribe wish to lose all agricultural lease income at once or slowly convert these lands to habitat?
- Are there sources of potential income from these converted lands to off-set loss of agricultural income, such as use for recreational tourism or enrollment in federal wetland reserve program?
- How long would it be feasible to maintain the current situation with mixed agriculture and riparian habitat, self-regulating tidegates and dikes?



### 9.3 Continued Community Involvement and Outreach

An essential ongoing component of any climate change project is communicating the issues to the affected community and involving the community in responses to identified issues. During the course of this project, the staff team made several presentations to the Reservation community at various locations, in the interest of bringing information to both tribal and non-tribal residents of the Reservation. A web site was also created to provide information, updates, and reports on climate change issues, resources, and project activities.<sup>22</sup> In addition to a Strategy Advisory Group formed to advise on inter-jurisdictional issues, a Climate Change Education & Awareness Group was formed to help engage the tribal community in the issues. To assist with this effort, the group was guided by a Communications Facilitator retained by the Tribe.

In working with community groups on climate change issues, it was quickly apparent that educating and engaging the community on the many complex issues would require a sustained and focused effort, one that has only begun with the relatively short scope of this two-year project. The array of climate impacts studied in this project will in some ways affect community members somewhat differently in different areas at the most local scale within the Reservation, and in other ways, such as with transportation issues, all are likely to be equally affected. The challenge for the Tribe will be to create understanding among the various community members, both tribal and non-tribal, of how the spectrum of issues will affect them, both at the local and regional scale, as well as to educate them about the options available to counter impacts.

In subsequent projects and phases of work, therefore, community outreach and involvement will continue to play an integral role in developing and implementing successful solutions to very challenging and complex issues. While support for such outreach efforts may to some extent be dependent on project funding as available, another challenge for the Tribe will be to establish a framework for community outreach and involvement that can become increasingly self-sustaining and less reliant on uncertain funding from relatively short-term projects (i.e., typical grant-funded projects of one to two years).

### 9.4 Building Organizational Capacity and Mainstreaming Adaptation Planning

Addressing climate change impacts over the long term will require a significant sustained effort and commitment of organizational resources for some time to come. While this initial project involved a number of Tribal staff across multiple disciplines, in addition to consulting advisors and support services, subsequent projects are likely to be less comprehensive in nature as implementation begins to focus on targeted priorities and actions. For effective implementation, the Tribe should continue to assess its organizational capacity for program and project support, and should take the necessary steps to build additional capacity as necessary to keep pace with adaptation needs.

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<sup>22</sup> [http://www.swinomish-nsn.gov/climate\\_change/climate\\_main.html](http://www.swinomish-nsn.gov/climate_change/climate_main.html)

Also, given that climate change impacts are expected to continue on many fronts into the foreseeable future, with the need for continued and dedicated effort on adaptation, it is recommended that the Tribe consider establishing a Climate Task Force to help ensure continuity of effort in responding to ongoing and emerging issues over the long term. Such a task force would ideally be a multidisciplinary team to assist with monitoring data and changes, advising on adaptation response and adaptive planning, and coordinating adaptation strategies and actions.

Concurrent with identifying and building organizational capacity for future phases of work, efforts should be made to institutionalize adaptation planning and issues into established ongoing planning activities and documents to help ensure continuity of effort on addressing impacts. The various types of planning efforts and documents that should incorporate adaptation considerations include the following:

- Comprehensive planning;
- Transportation planning;
- Capital facilities planning;
- Economic development planning;
- Financial planning;
- Utility master planning;
- Comprehensive regional water planning;
- Forest management planning.

The above planning processes and documents tend to have different respective update cycles, but to the extent possible, updates should reflect the latest updated information and approaches for climate change and adaptation issues.

Additional mention should be made of the need for further careful analysis of the fiscal requirements and impacts of recommended adaptation strategies. Given the numerous critical needs identified in this project and the limited financial resources available to the Tribe, policymakers will be faced with challenging decisions on how to proceed with and support climate adaptation actions, in the face of many competing and pressing financial responsibilities and obligations. While the Tribe was fortunate in winning funding for this initial project, external funding sources such as grants for support of climate change activities have been scarce to date, although there are indications of new funding opportunities emerging. With funding support for climate change work slow to develop, though, the Tribe will have to carefully consider how to factor adaptation planning needs into existing financial planning.

## **9.5 Interjurisdictional Coordination**

As noted throughout this report, numerous significant issues will require ongoing and at times complex coordination with agencies and entities outside the Reservation, particularly where regional infrastructure and facilities are concerned. This section discusses key challenges, issues, and opportunities to consider with respect to inter-jurisdictional coordination.

### **A. Coordination with the County**

To reduce the potential for jurisdictional disputes over regulation of non-Indian fee lands in applying adaptation responses to climate change, coordination between the Tribe and Skagit

County would continue to be beneficial. The Tribe and the County signed a Memorandum of Understanding (MOU) in 1998 which established a basis and process for coordination between the two entities on matters involving land use planning and decisions. For example, where permits and zoning on non-Indian fee lands within the Reservation are concerned, the MOU provides individuals the option to go through either of the two parties, with review by the other. Further coordination between the Tribe and the County could take several forms, as follows:

- Expand the MOU to specifically cover land use decisions addressing climate change adaptation. Continuing the current approach to Tribal-County cooperation, this could be applied, for example, to coordinate issuance of building permits where the Tribe may desire to increase shoreline setbacks.
- Work with the County to develop a subarea plan for fee lands on the Reservation that, in addition to coordination on zoning and shoreline classifications, allows for such tools as a sea level rise risk zone. This may also be a tool that, applied as a pilot project, provides a model process for responding to sea level rise. As a pilot project, the experience gained from application could be used to determine how best to apply such tools more broadly to address sea level rise.
- Coordination between the County and the Tribe on specific demonstration projects to address adaptation. Options for this could include specific projects that allow for shoreward migration of habitats, including agreement on abandonment of road easements where needed and possible and acquisition of lands or easements to allow shoreward migration to occur.

## **B. Regional Transportation Coordination**

Planning and implementation of transportation improvement projects typically requires long timelines and commitment of significant financial and organizational resources. Such projects are often logistically and technically complex, and identification and securing of funding must be undertaken well in advance of anticipated improvement needs. Where regional projects and priorities are concerned, efforts become even more logistically and politically complex.

Based on the anticipated potential impacts of storm surge and sea level rise on Reservation access, connectivity, and mobility, particularly as underscored by surge events in recent years and the extent of area potentially at risk, early regional coordination to address such impacts is all the more important. Given that other communities and local governments on Fidalgo and Whidbey Island will be facing the same potential impacts, there should be common interest and impetus for undertaking regional coordination on transportation impacts.

Local governments in Skagit and Island Counties already coordinate on transportation planning and issues through the Skagit/ Island Regional Transportation Planning Organization (RTPO) and Metropolitan Planning Organization (MPO), and this would seem to be a primary means through which to pursue new regional coordination on priority planning for adaptation issues affecting transportation. Toward that end, the Tribe held initial discussions with local governments on this matter and has developed and put forward a potential proposal for Fidalgo Access Corridor Preservation, as a first step toward regional coordination on these issues (see Appendices for draft proposal). Much work remains to be done on this proposal, but early response from other interested local entities appears to be positive thus far.

An additional challenge in regional planning is coordination with the Washington Department of Transportation (WSDOT) on potential impacts to State Route 20, the primary arterial connecting Fidalgo Island to the mainland of Skagit County (the other connection being the less direct and traveled route through LaConner onto the Reservation). While early talks with WSDOT representatives on these issues have been positive, it must be recognized that WSDOT has tremendous responsibilities and obligations for transportation projects statewide. Establishing a new priority, albeit a regionally significant one, within the state's current slate of transportation priorities, as assigned to WSDOT, poses a difficult long term challenge that carries an expensive price tag. WSDOT also participates in the RTP/MPO process, however, and will play a significant role in helping to shape an eventual solution. Encouragingly, WSDOT was recently funded to carry out an inventory of climate change impacts to transportation facilities, a very important first step, and the results of their study will no doubt help to determine direction for further coordination.

### **C. Regional Utility Coordination**

The Tribe currently participates in regional planning and coordination on utilities serving the Reservation, and is served in various ways by local government entities. The Swinomish Utility Authority (SUA), as the primary water purveyor to the Reservation, purchases water through an agreement with the City of Anacortes, which draws water from the Skagit River. The SUA also has an agreement with the Town of LaConner for wastewater treatment, under which SUA provides capacity and service to the Swinomish Village and west shore areas of the Reservation (the Shelter Bay Community, a private 900-unit subdivision, has separate water and wastewater treatment service).

While this project did not identify significant climate change issues for wastewater treatment, monitoring of regional water supplies will be prudent, based on potential long term impacts on river flows, such as for the Skagit River. Although the City of Anacortes purports to have overall excess water supply and capacity, the region has already experienced occasional seasonal water conservation advisories, a circumstance that may become more common if climate projections prove to be accurate. Ongoing monitoring and coordination may therefore become increasingly important, as will planning for backup supply and storage should shortages become more frequent.

## **9.6 Monitoring Climate Impacts and Adaptation Responses**

In planning and implementing actions to adapt to climate change impacts it must be remembered that climate change is a moving target with respect to the rate and types of change. There are likely to be unforeseen events and impacts as the global climate continues to change dramatically, and the Tribe must maintain flexibility in developing responses for effective and successful implementation.

An adaptive response means:

- Continued monitoring of climate changes;
- Providing feedback to planning and implementation of adaptation responses;
- Changing adaptation as needed to respond to changing circumstances or data.

For example, where coastal resources are concerned, the rate of sea level rise will have to be monitored over time as will the height and frequency of storm surges. Correlated effects such as beach erosion or accretion will need to be monitored as well. This and other information tracking changes and impacts will have to be reviewed and analyzed periodically in order to update plans and implementation actions. As with other long-term planning efforts, it would be useful to establish a regular cycle for such updates, such as, for example, a 5-year review of impacts under a number of parameters and what policies, plans and actions need to be amended to address these changing circumstances and new information.

## **9.7 Mitigation Activities**

While the focus of this project has been on adaptation to the effects of climate change, the Tribe recognizes the importance of reducing greenhouse gas emissions and contributing to related efforts to mitigate the causes of climate change. Toward that end, the Tribe has begun developing strategies for mitigation activities, as outlined below.

### **Resource Conservation Management Program**

The Tribe is participating with other jurisdictions in a Resource Conservation Management Program coordinated by the Skagit Council of Governments to identify energy usage and potential energy savings in governmental facilities and operations. This effort will assist the Tribe in prioritizing actions for energy conservation in existing Tribal facilities.

### **Shift to 4-day Workweek**

Beginning August of 2008, the Tribe shifted from a standard 5-day work week for most employees to a 4-day, 10-hour per day workweek. This allows closing offices on Friday, providing energy savings from reduced commuting and building operations such as heating and cooling.

### **Alternative Energy**

With assistance from federal stimulus funds, the Tribe installed a photovoltaic panel array on the Tribal Health Clinic as a solar demonstration project. The system is rated 4.02kW and is connected to the electrical grid.

### **Energy Efficiency and GHG Emissions Reduction Strategy**

The Tribe is drafting a Strategy for “Energy Efficiency and Conservation, Renewable Energy Development and Greenhouse Gas Emission Reduction.” While still early in development, this strategy is to provide a framework for more detailed energy conservation and renewable energy development plans and to help identify Tribal priorities in energy use and conservation, the development of renewable energy and reductions of greenhouse gas emissions. The draft goals of the strategy are:

- Reduce Energy use by and costs to the Tribal government;
- Reduce GHG emissions within the Reservation to contribute to mitigation of global climate change;
- Encourage development of “green jobs;” and
- Encourage and develop sustainable practices for community and economic development and natural resource management.

Development of the strategy will include estimates of energy usage, cost and greenhouse gas (GHG) emissions within the Reservation. This information will assist in identifying sectors or uses with high emissions and potential savings. It will also help to identify and develop appropriate targets for energy conservation and GHG emission reduction. The strategy will address application of policies for energy use and emissions reduction in several functional areas, including:

- Energy conservation and efficiency in existing Tribal facilities;
- Energy efficient design for new Tribal facilities;
- Transportation;
- Tribal housing;
- Zoning, building, and energy codes;
- Renewable energy development;
- Natural resource management practices (i.e., for forestry and agriculture); and
- Carbon sequestration and potential carbon credits.

## **9.8 Next Steps**

As stated at the start of this report, this is only a beginning. Even with this effort to assess and distill recommended priority actions, there are many tasks and priorities ahead. To assist policymakers in identifying and prioritizing implementation of initial follow-up actions, several project concepts have been formulated based on review of priority issues and proposed actions in each of the categories discussed in Chapter 8, and as further discussed for certain issues in this chapter. These potential project concepts address a cross-section of the most critical issues identified, and they represent a suggested starter list of projects to begin action concurrently on a number of fronts. Project concepts were conceived to make it possible for the Tribe to pursue efforts both on programmatic actions, such as for Firewise planning to address wildfire impacts or local emergency planning, and on more complex critical projects requiring substantial funding support, such as for sea level rise impacts. These projects therefore range from relatively inexpensive planning activities to more costly and technically complex adaptation projects, as presented in Table 9-1 below. For each potential project concept, the corresponding targeted priority actions in Chapter 8 are noted, along with potential timeframes and funding needs.

**TABLE 9-1. RECOMMENDED ADAPTATION PROJECTS.**

<b>Adaptation Project Concept</b>	<b>Targeted Priority Actions</b>	<b>Description</b>	<b>Timeframe/ Duration</b>	<b>Potential Funding Needs/Sources</b>
Coastal Protection Implementation	8.1.1.1, 8.1.1.2	Delineation of protection zones, targeting of actions to specific zones	1-3 years (delineation, define/target actions)	\$100,000-\$500,000; NOAA, ANA, EPA, other federal agencies
Coastal Resource Research	8.1.1.3, 8.1.2.1	Research to evaluate/ study alternatives & solutions for impacts to sensitive coastal resources (shellfish, etc.)	3-5 years	\$200,000-\$500,000; NOAA, EPA, other federal agencies
Dike Maintenance Authority/Program	8.1.1.2, 8.4.1.1	Establish dike maintenance authority and program for ongoing short-term support of shoreline diking (where appropriate)	3-5 years; ongoing (program)	Authority: \$50,000/yr (new capacity) Program: TBD
Regional Access Preservation/ Coordination	8.4.1, 8.4.2	Coordinate with local jurisdictions/entities on regional access/mobility preservation	1-3 years (planning); ongoing (implement)	Planning: \$0 (existing capacity) Implement: TBD
Wildfire Risk Management/ Mitigation	8.2.1	Establish/promote new Reservation-wide program for wildfire risk mitigation	1-3 years	Planning: \$0 (existing capacity) Mitigation: TBD (program support)
Local Emergency Planning	8.2.1, 8.3.1.1, 8.4.2, 8.4.5	Coordinate with local entities and emergency responders on local emergency planning to respond to extreme weather/other emergency events (e.g., local evacuation, cooling centers, etc.)	1-3 years	Planning: \$0 (existing capacity) Implement: \$5000 (provisions)





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**SWINOMISH CLIMATE CHANGE INITIATIVE  
CLIMATE ADAPTATION ACTION PLAN**

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**APPENDIX 1**



**PROCLAMATION**  
**OF**  
**THE SWINOMISH INDIAN SENATE**  
**ON**  
**A SWINOMISH CLIMATE CHANGE INITIATIVE**

**WHEREAS**, there is overwhelming evidence of climate change occurring both globally and regionally, as supported by scientific documentation of the effects of climate change and global warming; and

**WHEREAS**, the effects of climate change, while evident globally and regionally, have the potential for significant impacts on the local community, including the Swinomish Indian Tribal Community, the Swinomish Indian Reservation, and Swinomish Usual and Accustomed areas, due to projected impacts from rising temperatures, rising sea level, and other associated effects on the local environment, natural resources, water supplies, fish and wildlife, and critical infrastructure on which the Swinomish Indian Tribal Community has traditionally relied; and

**WHEREAS**, the projected impacts of climate change may include loss of tidelands and habitat, reduced viability of fish and wildlife species, damage to shoreline property and forest resources, damage to infrastructure and facilities, and associated risks to public health and welfare; and

**WHEREAS**, it is the duty and responsibility of the Swinomish Indian Senate to provide for the well-being of the Swinomish Indian Tribal Community, as well as attend to the well-being of those resources, natural systems, and human systems which provide crucial support to the Swinomish Indian Tribal Community and the Swinomish Indian Reservation; and

**WHEREAS**, the Senate has considered the potential effects and impacts of climate change on the Swinomish Indian Tribal Community, the Swinomish Indian Reservation, and attendant resources, natural systems, and human systems sustaining the community, and has registered concern for such effects and impacts;

**NOW THEREFORE, THE SENATE HEREBY PROCLAIMS** support for a Swinomish Climate Change Initiative and declares the intent and commitment of the Senate to address the potential effects of climate change, and also hereby declares and directs the following actions to be taken under this Initiative:

To undertake efforts as possible to determine the potential local effects of climate change as may affect the Swinomish Indian Tribal Community and the Swinomish Indian Reservation, including effects and projected impacts on the local environment, forestry resources, agriculture, fish and wildlife, water resources, and shorelines, as well as critical infrastructure and public health;

To develop appropriate policies and strategies for addressing effects and projected impacts of climate change on the Tribe and the Swinomish Indian Reservation and for contributing to reduction of the causes of climate change and global warming;

To develop appropriate goals for addressing effects of climate change and for contributing to reduction of the causes of climate change;

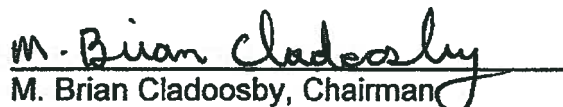
To develop potential programmatic and/or regulatory actions and changes consistent with said policies, strategies, and goals as appropriate to addressing the effects of climate change and contributing to reduction of the causes;

To communicate and coordinate with local, state, regional, and national entities and jurisdictions on addressing projected impacts of climate change, including government-to-government cooperation and identification of funding sources and opportunities as possible and available; and

To communicate to and with the local community about issues and concerns regarding the effects and projected impacts of climate change; and

**BE IT FURTHER PROCLAIMED** that all Swinomish governmental committees and departments shall assess how best to implement the actions under this Initiative as specified above, how best to incorporate such actions into ongoing programs and activities or into such new activities as may be proposed, and that the Senate hereby designates a Swinomish Climate Change Task Force to be comprised of designated representatives of the Swinomish Office of Planning and Swinomish Public Works Department, working in cooperation with the Swinomish Utility Authority and Skagit River System Cooperative, to coordinate implementation of this Initiative and to provide support for Swinomish governmental committees and departments in this effort, under the guidance and direction of the Senate.

By the authority vested in the Swinomish Indian Senate, this Proclamation is made this 2nd day of October, 2007.

  
M. Brian Cladoosby, Chairman  
Swinomish Indian Senate

**SWINOMISH CLIMATE CHANGE INITIATIVE  
CLIMATE ADAPTATION ACTION PLAN**

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**APPENDIX 2**





# **Climate Change Impacts in the Pacific Northwest: Implications for the Swinomish Indian Reservation**

Prepared for the Swinomish Indian Tribal Community

by

Ingrid M. Tohver and Nathan Mantua, PhD

Climate Impacts Group

University of Washington, Center for Science in the Earth System



# Climate Change Impacts in the Pacific Northwest: Implications for the Swinomish Indian Reservation

by

Ingrid M. Tohver and Nathan Mantua, PhD

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University of Washington, Center for Science in the Earth System

## *I. Global climate change impacts on temperature and precipitation*

### *A. Temperature*

The projections of climate change vary depending on future greenhouse gas emissions and global climate model used. The Intergovernmental Panel on Climate Change (IPCC) considered a range of possible emissions scenarios (SRES) based on socioeconomic and energy production developments to generate global projections of future temperature and precipitation. Here we focus on the “A1B” emissions scenario, which is considered the middle-of-the-road scenario, where population peaks mid-century and there is an intermediate rate of adopting clean energy initiatives. The Climate Impacts Group (CIG) at the University of Washington has created regional projections from 20 global climate models used in the IPCC’s fourth assessment report (Mote and Salathé 2009). Mote and Salathé’s (2009) estimates for the average increases in temperature for the Pacific Northwest under the A1B scenario are 1.3 °C (2.3 °F) by the 2020s, 2.3 °C (4.1 °F) by the 2040s and 4 °C (7.1 °F) by the 2080s, with the greatest increases occurring in summer months<sup>1</sup>. Other analyses attempt to capture the local effects of topography and coastal-terrain on regional climate to determine the temperature projections on 6x6 km grids (Elsner, Cuo et al. 2009; Salathé, Leung et al. 2009). From the resulting projections of these latter analyses, we can determine the average change in temperature using 12 models under the A1B scenario for the gridpoint containing the Swinomish Reservation. Monthly average temperature changes from the 1970-99 average are shown for each of 12 global climate models in Figure 1. It is worth noting that individual projections differ by as much as +/- 2 °C for any given year or decade, with the short-term variations reflecting both the “natural variability” and differences in each model’s response to the same specified changes in greenhouse gas emissions. The heavy black line shows the ensemble average, which is approximately 3.5 °C by the year 2100, while the majority of individual model projections range between 2 and 4 °C for 2100.

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<sup>1</sup> Projected changes are relative to the 1970-99 averages.

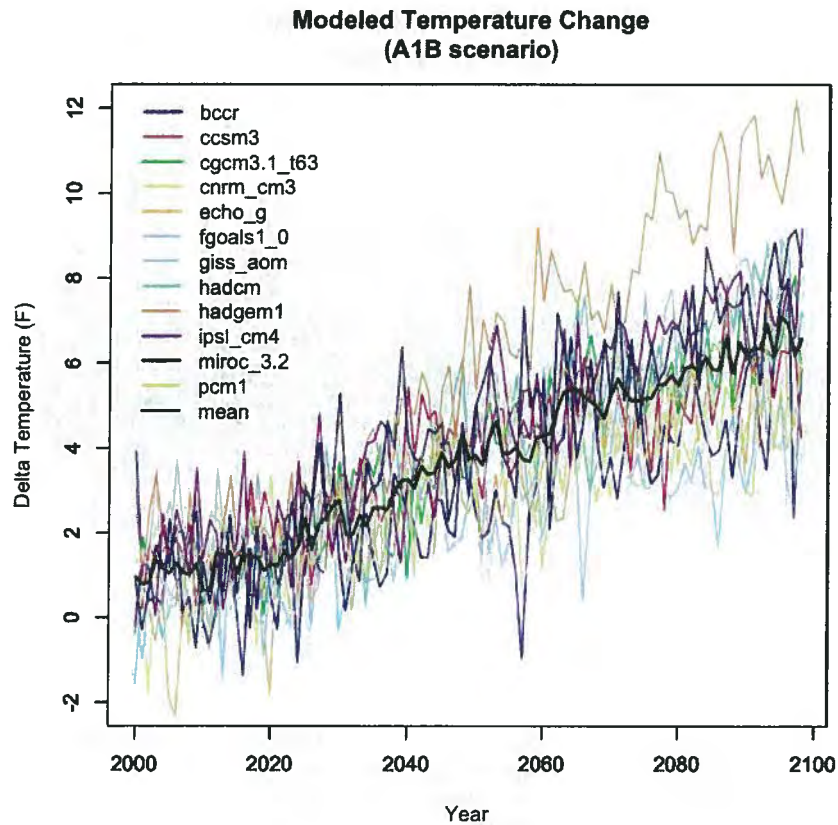


Figure 1: Average change in annual mean temperature compared to the 1970-1999 levels.

### *B. Precipitation*

Although the uncertainties for precipitation trends are greater than for temperature, most projections agree that the changes in precipitation will have a seasonal signal in the Pacific Northwest region. In general, the projected changes in regional precipitation are minimal, but on balance climate models indicate wetter winter months and drier summer months (Thomson, Bornhold et al. 2008; Casola, Cuo et al. 2009; Mote and Salathé 2009). Specifically for the A1B scenario, regional models estimate an average 4.2% increase in winter precipitation and a 11.2% decrease in summer precipitation by the 2040s, compared to the 1980s (Mote and Salathé 2009). These future precipitation patterns have implications for snowmelt and freshwater flows (discussed later in this report).

Much like Figure 1 for temperature, Figure 2 shows the change in average precipitation compared to the 1970-1999 levels for the gridpoint overlying the Swinomish Reservation. Notably, the trend is less detectable for precipitation than for temperature in the future, where the simulated interannual variations for any given model are much larger than the longer-term trends. One way to interpret these scenarios is that future years will continue to see large variations that make it difficult to identify an obvious trend due to human-caused climate change.

### Modeled Precipitation Change (A1B scenario)

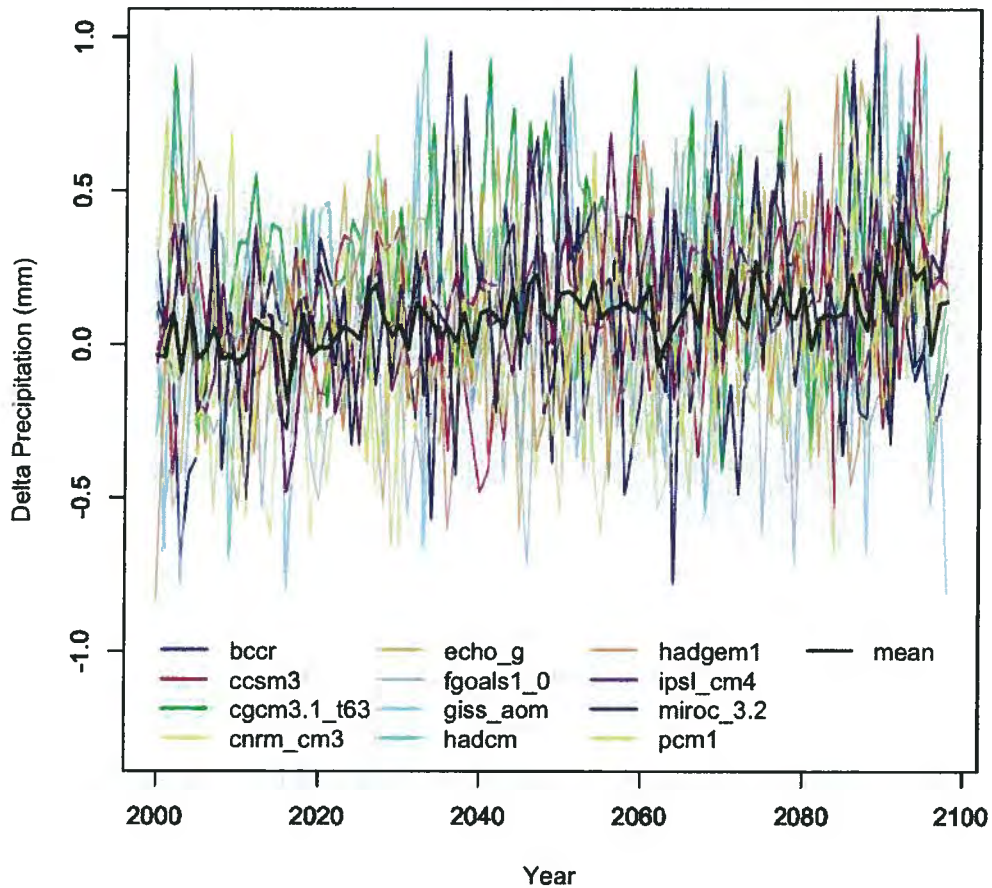


Figure 2: Monthly average changes in precipitation for 12 models (A1B scenario) compared to 1970-1999 levels.

## II. Coastal vulnerabilities

### A. Global sea level rise

Projections of global sea level rise (SLR) vary considerably among studies. The magnitudes of contributing factors to global SLR, like melting glaciers and ice sheets and thermal expansion, contain sizeable uncertainties. In 2007 the IPCC released projections of global SLR in its fourth Assessment Report (IPCC 2007). These projections of SLR over the 21<sup>st</sup> century range from 18-38 cm (7-15”) for the low emissions scenario to 26-59 cm (10-23”) for the high emissions scenario (Table 1). Recent studies indicate that the IPCC underestimates the role of accelerated melting of the Greenland and Antarctic ice sheets (Thomas, Rignot et al. 2004; Zwally, Gioveinnetto et al. 2005; Murray 2006; Velicogna and Wahr 2006) and the role of thermal expansion (Rahmstorf 2007), thereby pointing to more rapid rates of SLR.

IPCC emissions scenario	90% probability of SLR by 2100 relative to 1980-1999 levels
<b>B1</b> (population growth peaks at 2050, rapid measures of mitigation)	18-38 cm (7-15")
<b>A1T</b> (population growth peaks at 2050, implementation of non-fossil fuel-based technologies)	20-45 cm (8-18")
<b>B2</b> (intermediate population and economic growth, locally implemented measures of mitigation)	20-43 cm (8-17")
<b>A1B</b> (population growth peaks at 2050, intermediate response to mitigate)	21-48 cm (8-19")
<b>A2</b> (high population growth, slow economic development and response to mitigate)	23-51 cm (9-20")
<b>A1FI</b> (population growth peaks at 2050, fossil fuel intensive energy use)	26-59 cm (10-23")

Table 1: Projections of global SLR by 2100 (IPCC 2007).

### *B. Regional sea level rise*

Various factors influence regional estimates of SLR, including local atmospheric pressure and circulation (changes in wind patterns can force coastal waters towards or away from shore) and local vertical land movement (VLM) resulting from tectonic activity and isostatic rebound. A recent Canadian technical report considers these factors to conduct a province-wide assessment of SLR in British Columbia (Thomson, Bornhold et al. 2008). Of the areas investigated, this report draws attention to the extreme rise of sea levels in the Fraser River delta ( $50 \pm 20$  cm) by 2100 as a result of local subsidence, and an even greater rise (120 cm) by 2100 under a scenario of rapid the ice sheet melt. Another factor contributing to the more extreme rates of SLR in the Fraser River delta is the effect of urbanization and river management that prevents sedimentation deposits in the delta, which would normally elevate the delta bottom. Along the coastal regions in the Pacific Ocean, El Niño Southern Oscillation (ENSO) events increase the thermal expansion of oceanic waters, elevating local SLR. Strong northward winds can contribute ~50 cm (20") in the winter along the Washington coast (Mote et al. 2008); this phenomenon is exacerbated during El Niño years elevating sea levels by an additional 30 cm (12"), on average, for the entire winter. Estimates of the VLM in the Puget Sound range from low-to-medium subsidence rates of 1-2 mm/year (Holdahl, Faucher et al. 1989) to greater magnitudes of subsidence in the future, resulting in 10 cm (4") by 2050 and 20 cm (8") by 2100 (Verdonck 2006). Mote et al. (2008) approximated local SLR in the Puget Sound by applying these contributions of regional atmospheric dynamics and VLM to the average of 18 IPCC global model projections of SLR (Table 2). These estimates range from very low, 8 cm (3"), by 2050 to very high, 128 cm (50"), by 2100.

Scenario	Factors	2050	2100
Very low	Global SLR	9 cm (3.5")	18 cm (7")
	Atmospheric	-1 (0.5")	-2 (1")
	VLM	0	0
	Total	8 cm (3")	16 cm (6")
Medium	Global SLR	15 cm (6")	34 cm (12")
	Atmospheric	0	0
	VLM	0	0
	Total	15 cm (6")	34 cm (12")
Very high	Global SLR	38 cm (15")	93 cm (36")
	Atmospheric	7 cm (3")	15 cm (6")
	VLM	10 cm (4")	20 cm (8")
	Total	55 cm (22")	128 cm (50")

Table 2: Projections of regional SLR for the Puget Sound

### C. Tidal surges

On a smaller time scale, from hours to days, storm surges can also rapidly elevate sea levels. The combination of a storm surge event during high tide can have devastating effects, particularly in areas of low elevation, as occurred in 2006) in the Swinomish Reservation and the adjacent town of La Conner. When these events are coupled with projections of SLR, the effects are even more alarming. In 2008 the King County, WA released a report describing a tool that considers the range of possibilities of storm surge events, tide levels and SLR projections (DNR 2008). The resulting range of sea levels can be overlaid onto the elevations of known facilities to determine the possibilities of inundating of facilities of interest. The National Oceanic and Atmospheric Administration (NOAA) monitors tide levels can be found for various sites in WA and their data can be found at the following web link:

[http://tidesandcurrents.noaa.gov/station\\_retrieve.shtml?type=Historic%20Tide%20Data&state=Washington&id1=944](http://tidesandcurrents.noaa.gov/station_retrieve.shtml?type=Historic%20Tide%20Data&state=Washington&id1=944)

The closest tidal stations in this dataset to the Swinomish Reservation with a long-term record (1 year) are LaConner/Swinomish Slough (station ID 9448558) and Snee-Oosh/Skagit Bay (station ID 9448576). A study by Zervas (Zervas 2005) calculated the water level above the Mean High High Water (MHHW) for various sites in WA when a 100-year storm occurs (a storm with a 1% chance exceedance in any given year). The MHHW is the average of the higher high water height of each tidal day during a tidal epoch (19 years). Since many coastal locations have semidiurnal tides, or a cycle of two low and two high tides per day, the higher high water height refers to the higher of two daily high tides. Zervas' (2005) study indicates that for sites near the Swinomish Reservation (Friday Harbor, Cherry Point, Port Townsend and Port Angeles) the range of increase in water levels from MHHW resulting from a 100 year storm surge is from 1 m (3') to 1.19 (3.6'). The elevations of facilities and sites of cultural importance on the Swinomish Reservation can then be mapped onto the areas at risk of inundation to determine the vulnerability of these sites of importance.

*D. Sea level rise impacts on coastal habitats in Skagit, Padilla, Port Susan Bays*

National Wildlife Federation conducted a study in 2007, investigating the effects of sea level rise (SLR) for 11 sites on the Pacific Northwest coast, including the Skagit, Padilla and Port Susan Bays. The study applied SLR scenarios projected by the IPCC (2001), accounting for local effects of land elevation changes resulting from geological uplift and subsidence, and from sedimentation and marsh accretion. This study also considered a more rapid, drastic SLR scenario for 2100 not included in the IPCC report. Subsequent studies indicate that the rates of SLR revealed in the 2001 IPCC report are too low and that higher levels of SLR should be considered (Chen, Wilson et al. 2006; Otto-Bliesner, Marshall et al. 2006; Overpeck, Otto-Bliesner et al. 2006; Rahmstorf 2007). The model used to determine habitat shifts and erosion rates is the Sea Level Affecting Marshes Model (SLAMM), designed to incorporate seawater inundation, topography characteristics and long-term SLR into its projections. Taking into consideration the effects of diking, models were executed with and without dikes. This report shows the results from the SLAMM applications of SLR levels from IPCC (2001) A1B scenario, adjusted to address the concerns that the rates were too low: 0.28 m (11.2 in) by 2050, 0.69 m (27.3 in) by 2100 and 1.5 m (59.1 in) by 2100. For the Skagit, Padilla and Port Susan Bays region, the regional forecasts of SLR are 0.35 m (13.6 in) by 2050, and 0.78 m (30.8 in) or 1.59 (62.5 in) by 2100 (Glick, Clough et al. 2007). The wetland habitats in this region have been extensively altered by dikes and drainage for agricultural purposes. Marsh and beach habitats near sea walls are particularly vulnerable to saltmarsh or tidal flat conversion, although the dry land will be protected from inundation. The major habitat shifts in this region resulting from seawater inundation are the conversion of brackish marsh to saltmarsh and smaller tracts of dry land conversion to transitional marsh. Padilla Bay hosts a productive Dungeness crab industry because of its abundant eelgrass population. In the Skagit Bay area, estuarine beach habitats are particularly vulnerable to permanent inundation under all scenarios, shifting to estuarine open water or tidal flats.

<b>Table 3. Nearshore Marine and Estuarine Habitat Use by Salmonid Species in Pacific Northwest</b>			
	<b>Nearshore Marine and Estuary Use</b>		
<b>Species</b>	<b>Adult Residence</b>	<b>Adult and Juvenile Migration</b>	<b>Juvenile Rearing</b>
<b>Chinook Salmon</b>	<b>Extensive Use</b>	<b>Extensive Use</b>	<b>Extensive Use</b>
<b>Chum Salmon</b>	<b>Little or Unknown</b>	<b>Extensive Use</b>	<b>Extensive Use</b>
<b>Coho Salmon</b>	<b>Some Use</b>	<b>Extensive Use</b>	<b>Some Use</b>
<b>Sockeye Salmon</b>	<b>Little or Unknown</b>	<b>Extensive Use</b>	<b>Little or Unknown</b>
<b>Pink Salmon</b>	<b>Little or Unknown</b>	<b>Extensive Use</b>	<b>Extensive Use</b>
<b>Cutthroat Trout</b>	<b>Extensive Use</b>	<b>Extensive Use</b>	<b>Extensive Use</b>
<b>Steelhead</b>	<b>Little or Unknown</b>	<b>Extensive Use</b>	<b>Some Use</b>
<b>Bull Trout</b>	<b>Extensive Use</b>	<b>Extensive Use</b>	<b>Extensive Use</b>

Source: Williams, G.D. and R.M. Thom. 2001. *Marine and Estuarine Shoreline Modification Issues* (Sequim, WA: Battelle Marine Sciences Laboratory/Pacific Northwest National Laboratory), p. 14.

Table 3 From Glick (2007) Sea-level Rise and Coastal Habitats in the Pacific Northwest.

### *E. Ocean acidification*

Of growing concern in the ocean environment is the rising acidity of marine waters associated with increases in atmospheric carbon dioxide. The full suite of implications for the marine ecosystems is not fully understood, but some well-established effects of ocean acidification include reduced calcification and growth rates for shell-forming organisms and increased photosynthetic carbon fixation rates (Doney, Fabry et al. 2009). For the past 200 years, the ocean has absorbed about one-third of anthropogenic CO<sub>2</sub> (Sabine, Feely et al. 2004), changing the chemistry of the ocean from a slightly alkaline to a more acidic environment through a process that decreases carbonate availability for shell formation. Rising acidity of marine waters will further negatively impact shell-forming organisms because the higher acid concentrations dissolve the calcium carbonate from which shells are constructed. The evidence for ocean acidification inhibiting shell formation is particularly conspicuous at higher latitudes, where cooler water temperatures and higher pressure zones increase the solubility of calcium carbonate (Fabry, Seibel et al. 2008; Feely, Fabry et al. 2008). The implications of losing populations of shellfish species are widespread in the marine food chain, ranging from Pacific king salmon to the shellfish industry in Puget Sound. The shellfish industry may have already undergone some detrimental repercussions from crab and clam population declines in the Puget Sound (OSU 2008; Welch 2009).

### *III. Freshwater timing and quality*

#### *A. Changes in spring snowpack*

Any changes in snowpack are strongly linked to shifts in temperature and precipitation, although historically temperature has had a greater effect on snowpack than precipitation in the Cascades (Hamlet and Lettenmaier 1999; Mote, Peterson et al. 2008; Mote and Salathé 2009). The conventional method to determine changes in snowpack is by measuring the snow water equivalent (SWE) on April 1. Mote et al. (2008) reported losses of up to 35% of springtime SWE from the mid-20<sup>th</sup> century to 2006 in Washington's Cascade Mountains. Using projections of temperatures and precipitation, Elsner et al. (2009) models the changes in SWE on April 1 for three future time horizons for the Pacific Northwest. According to their results, across the state of Washington under the A1B scenario, April 1 SWE declines by 29% in the 2020s, by 44% in the 2040s and by 65% in the 2080s, compared to the 1980s levels. The most sensitive areas are at elevations with warmer temperatures during the winter months, so lower elevations will undergo greater decreases in snowpack. In an analysis conducted by Casola et al. (2009), the variability in precipitation was removed to isolate the effects of warming temperatures on snowpack. Using this approach, the SWE losses for the Skagit River Basin is 19% for 1° C increase in temperature.



*B. Freshwater timing (flood/low flow shifts)*

The implications of a diminishing snowpack and rising temperatures are widespread for watersheds in Washington State. Many watersheds will shift from a snow dominant to transient basins, or ones fed by a mixture of rainfall and snowmelt. Snow dominant basins are supplied primarily by snowmelt and undergo peak flows in the spring and summer. As temperatures increase and snowpack declines, peak flows will be lower in the summer and rainfall will play an increasing role in contributing to runoff in the Skagit watershed, elevating streamflows in the fall and winter and diminishing them in summer and early fall. Figure 3 depicts a hydrograph of modeled monthly average flows for the Skagit River at Mount Vernon comparing patterns of historical (1970-1999) flow to three future time horizons. In this simulated hydrograph the peak flows in the summer months from melting snow decline as snowpack decreases and the winter flows fed by rainfall increase under the A1B scenario. The magnitude of flooding is projected to rise for any given recurrence interval in the future, becoming increasingly severe at the end of the century.

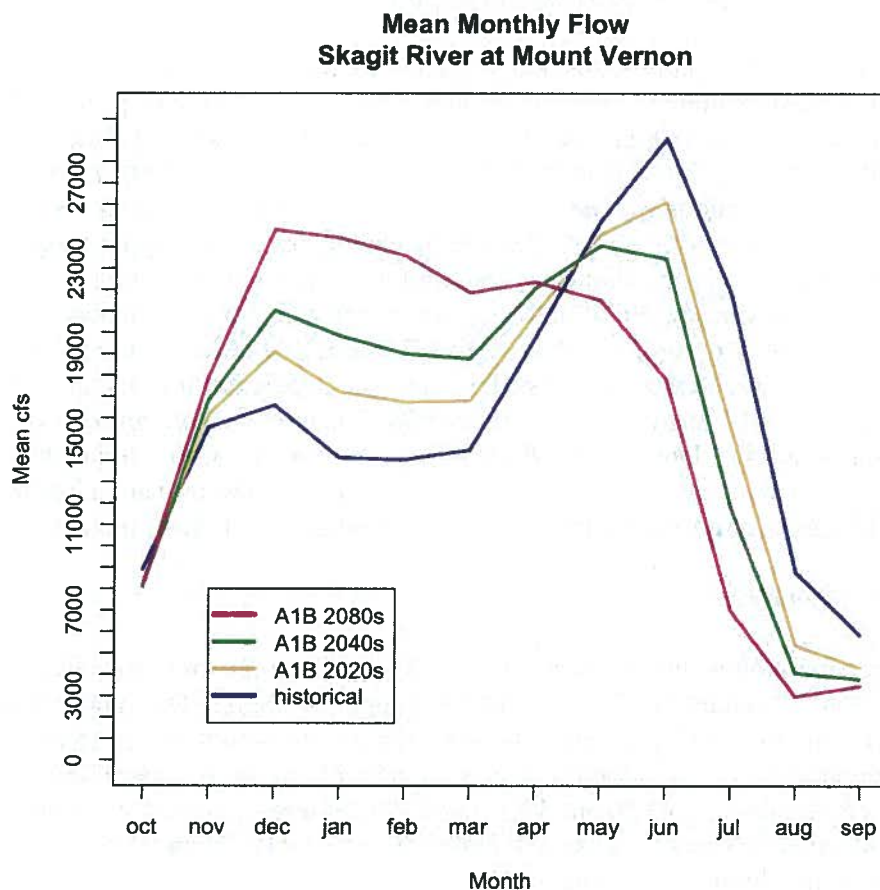


Figure 3: Hydrograph of the Skagit River at Mount Vernon based on monthly average flows (cubic feet per second) for the historical and 3 future time horizons projected by the A1B scenario.

#### *IV. Forest impacts*

##### *A. Rise in Fire risk*

The seasonal changes in temperature and amount of precipitation are major factors in the forest fire susceptibility. Projected conditions of warmer, wetter winters combined with increased temperatures and lower precipitation in the summer months trigger greater wintertime vegetation production and summertime accumulations of woody and leafy debris on the forest floor (Littell, McKenzie et al. 2009). Prolonged hot, dry summers provoke fuel loads to dry and build up, elevating the risk of more frequent and severe forest fires. Under future climate change scenarios, the median area of forest projected to burn increases from 0.5 million acres during the 1916-2006 period to 2.0 million acres by the end of the 21<sup>st</sup> century (Littell, Oneil et al. 2009). Among the regions at the greatest risk of forest fires are the lower elevations, particularly in the drier forests east of the Cascade Range.

##### *B. Changes in species distribution/composition*

Also under warmer, drier conditions, trees undergo an increase in Vapor Pressure Deficit (VPD), which provokes them to draw more water from their roots. The projected area of Washington state forestland that is severely water-limited will rise by 32% in the 2020s, by 44% in the 2040s and by 66% in the 2080s (Littell, Oneil et al. 2009). Although the severity of water limitations is expected to be greater east of the Cascades, the forest disturbance in areas west of the Cascades is projected to arise from higher temperatures and lower soil moisture in the summer. These unfavorable conditions increase the potential evapotranspiration (PET), inducing water stress in many forest species. Species that are less adapted to drought conditions, like Western Red cedar (*Thuja plicata*) and Sitka spruce (*Picea sitchensis*), might suffer extensive population losses due to stressful conditions, particularly during the summer months. The area suitable for an economically important forest species, Douglas-fir (*Pseudotsuga menziesii*), was estimated to decrease by 32% by the mid-21<sup>st</sup> century. Projections for pine forests are a loss of 1 species in 85% of their current range and a loss of 2 species in 11% of their current range.

##### *C. MPB outbreaks*

Trees that are more physiologically stressed by drought become more susceptible to infestation from Mountain Pine Beetles (MPB), fungi and blights. Drought conditions tend to create positive feedback loops that exacerbate water stress among trees. Higher summer temperatures coupled with precipitation declines in the summer months increase the vapor pressure deficit (VPD) and PET among forest trees. Hot, dry conditions are conducive to MPB outbreaks. These outbreaks are projected to be more severe and concentrated in the higher elevation forests.

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**SWINOMISH CLIMATE CHANGE INITIATIVE  
CLIMATE ADAPTATION ACTION PLAN**

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**APPENDIX 3**





## **SWINOMISH CLIMATE CHANGE INITIATIVE**

### **Case Study Summary**

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#### **Background**

In 2007, the Swinomish Tribe passed a Climate Change proclamation in response to growing concerns about potential impacts of climate change on the Swinomish Indian Reservation. The motivation behind this proclamation related to recognition within the region about the potential impacts from climate change, the increase of climate-related natural disasters around the world, and the growing knowledge and observations about climate change among the scientific community, as well as local extreme weather events such as severe storms and tidal surge.

Regionally, the lower Skagit River area was identified as one of two high-risk areas within the state for sea level rise, and local events such as severe storms and flooding from tidal surges also prompted concern. These events served as a catalyst for developing projects and research to more thoroughly examine climate change issues and potential responses. The Proclamation promised to develop, strategize, and take actions necessary to assess the potential impacts of climate change on the Reservation community and resources. To further this goal, the Swinomish Tribe launched a climate change initiative in 2008 and began conducting research to determine the risks posed to the tribe in regards to health, culture, the built environment, and the natural environment.

#### **Projected Climate Change Impacts for the Swinomish Tribe**

In 2009, the tribe completed an impact assessment that examined a broad range of issues and sectors for potential climate change impacts from effects such as sea level rise and rising temperatures. The assessment found that many assets and resources within the Swinomish Indian Reservation would be impacted, in addition to impacts on public health and tribal traditions. The assessment found that approximately 15% of Swinomish tribe land is at risk of inundation from rising sea level, potentially threatening the Tribe's primary economic development land in which current enterprises are located, in addition to potential impacts on tribal agricultural land, shellfish beds, fishing docks, and private residential development. In addition, the assessment found that upland areas containing extensive forest resources and developed property worth over \$518 million may be at risk from potentially destructive wildfire.

The tribe's historic and cultural reliance on many traditionally used resources is at risk due to a multitude of climate change impacts. For several hundred years, the tribe has relied on salmon fishing, shellfish harvesting, and other marine resources, as part of their significant cultural tradition. The beaches and water that surround the reservation are considered to be an important traditional resource for the tribe. The tribe's economic and cultural reliance on fish and water is at risk due to rising sea levels as a result of global warming. This has spurred the Tribe to take action against the threat of sea level rise and biological diversity loss. The tribe has been performing water quality monitoring for a number of years, and intends to perform monitoring of impacts such as species loss, sea level rise, and fish stocks to gather necessary information to guide policy changes. Additionally, the impact assessment found that there is the potential for respiratory diseases, heat illnesses, and the possibility of infectious diseases as a result of climate change.

## Approach

The Swinomish Tribe has been at the forefront nationally in addressing climate change adaptation. The Swinomish Climate Change Initiative has been highlighted at tribal conferences, national websites, newsletters and other venues as a model for assessing the impacts from climate change and developing a climate change adaptation plan. The Swinomish Tribe secured 80% of project funding (\$400,000) from the Administration for Native Americans. The remaining 20% came from Tribal funds.

The model developed by the Swinomish Tribe focuses on building an understanding of climate change impacts in order to identify strategies for climate change adaptation. The Swinomish Tribe began preliminary efforts in 2007 to identify the scope of climate change issues. The Tribe began by gaining buy-in from tribal leaders through the proclamation, and then began to assess capacity and needs internally, as well as opportunity for collaboration with external partners. After defining their approach and methods, the Tribe began work on the Impact Assessment Technical Report, which was completed in 2009. This assessment provides a baseline of information the Tribe is using to develop the Climate Change Adaptation Action Plan.

## Swinomish Climate Change Initiative – Planning Process

### 2007 – 2009

- Tribal buy-in leads to issuance of the 2007 Climate Change Proclamation
- Secure funding, identify partners
- Development of advisory committee and identification of roles and responsibilities
- Development of the Impact assessment
  - Data review/analysis
  - Risk zone mapping/inventory
  - Vulnerability assessment
  - Risk analysis
- Policy/strategy scoping (intergovernmental)
- Community Outreach
  - Formed tribal outreach group
  - Held public meetings
  - Conducted personal interviews of tribal members & elders
  - Conducted storytelling workshop with tribal members

### 2010

#### Development of the Action plan

- Adaptation goals
- Strategy evaluation & priorities
- Action recommendations
- Coordination, funding needs
- Other implementation issues

### Future Work

- Action Plan Implementation
- Monitoring and Adaptive Management
- Update of the Impact Assessment



## Project Partnerships and Participants

The Swinomish Climate Change Initiative has relied on the participation and input of tribal community members, neighboring jurisdictions, public and private entities, and scientific researchers. Partners are highlighted in the table below.

Partner Organization	Partnership Role
U.S. Department of Health & Human Services, Administration for Native Americans	Grant funding agency
Center for Science in the Earth System University of Washington / Climate Impacts Group	Professional scientific review and advisory service
Skagit County	Neighboring jurisdiction with interests in common, participation in advisory group
Town of LaConner	Neighboring jurisdiction with interests in common, participation in advisory group
Shelter Bay Community	On-Reservation residential community in low-lying area, participation in advisory group
Skagit River System Cooperative	As fisheries branch of Tribe, advise on local conditions, projections and climate research data

## Challenges and Lessons Learned

The Tribe encountered numerous challenges and learned valuable lessons through this Initiative. Specific challenges have included the complexity of the subject and analysis of scientific data, working on an unfamiliar process and communication with diverse partners, and competing priorities. Those working on the Initiative have recognized that each step informs the next, which has called for thorough work, peer review and a strong understanding of findings among all partners and staff. Perhaps the most important lesson, however, has been that those working on the Initiative keep in mind that they are working for the future, and that while results of these efforts will likely not be seen by this generation, they are indeed working for future generations.

## Action Plan Development

In the fall of 2010 project staff completed work on the Climate Adaptation Action Plan. The Action Plan includes a summary of the impact and risk analysis, and details adaptation goals and objectives, strategy options and evaluation criteria. Action recommendations and priorities will focus on Coastal Resources, Upland Resources, Physical Health, and Community Infrastructure. Action Plan Implementation will include policy considerations, community involvement, fiscal impact and funding requirements, organizational capacity, inter-jurisdictional coordination, monitoring and adaptive response, and mitigation activities.

## References and Resources

Swinomish Climate Change Initiative:

[http://www.swinomish-nsn.gov/climate\\_change/climate\\_main.html](http://www.swinomish-nsn.gov/climate_change/climate_main.html)

Swinomish Climate Change Initiative -- Impact Assessment Technical Report:

[http://www.swinomish-nsn.gov/climate\\_change/project/reports.html](http://www.swinomish-nsn.gov/climate_change/project/reports.html)

## **Contacts**

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***Tribal Climate Change Profile Project:***

The University of Oregon and the USDA Forest Service Pacific Northwest Research Station are embarking on a project to develop tribal climate change project profiles as a pathway to increasing knowledge among tribal and non-tribal organizations interested in learning about climate change mitigation and adaptation efforts. Each profile is intended to illustrate innovative approaches to addressing climate change challenges and will describe the successes and lessons learned associated with planning and implementation.

*For more information, contact:*

- Kathy Lynn, University of Oregon Environmental Studies Program, [kathy@uoregon.edu](mailto:kathy@uoregon.edu)
- Ellen Donoghue, USDA Forest Service Pacific Northwest Research Station, [edonoghue@fs.fed.us](mailto:edonoghue@fs.fed.us)

**SWINOMISH CLIMATE CHANGE INITIATIVE  
CLIMATE ADAPTATION ACTION PLAN**

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**APPENDIX 4**



**WHITE PAPER:  
PROTECTING FIRST FOODS IN THE FACE OF CLIMATE CHANGE,  
SUMMARY AND CALL TO ACTION**

**Coast Salish Gathering Climate Change Summit, July 2010**

Jamie Donatuto, Ph.D., and Catherine A. O'Neill, J.D.

*The purpose of the Climate Change Summit was to provide an opportunity for Coast Salish Nations' leaders, policy analysts, legal staff and scientists to gather for dialogue on climate change impacts and planning—sharing and strengthening science and policy in addressing environmental impacts on natural resources, traditional rights and cultural sustainability. Organized by the Coast Salish Gathering and hosted by the Tulalip Tribes, the Summit occurred April 26<sup>th</sup> and 27<sup>th</sup>, 2010. One of the key reoccurring themes throughout the Summit was first foods. This paper, based on the presentations given at the Summit, highlights how first foods may be impacted by climate change and discusses the rights of Coast Salish peoples to protect these foods.*

*Suggestions are provided to prepare for potential impacts, for example:*

- (1) create a baseline inventory documenting all foods, medicines, and other materials each tribe traditionally relied upon;*
- (2) assess the vulnerabilities of a community's resources, homeland, and "infrastructure" (built, natural, and human) to climate change impacts;*
- (3) document changes observed in natural resources over time;*
- (4) preserve the practices and knowledge associated with first food; and*
- (5) generate innovative approaches by enlisting legal and policy instruments to ensure resiliency of Coast Salish lifeways.*

First foods, also known as traditional foods or cultural foods, are natural resources that tribal members have depended on since time immemorial. These foods do more than satisfy caloric needs, they are considered 'cultural keystone' species, with significant meaning and identity in tribal values and practices.<sup>i</sup> First foods are revered through specialized harvest and preparation techniques, consumption, celebration, sharing, reciprocity (giving thanks to the species), education, and spiritual relationships for the people. Enduring beliefs about the qualities received by harvesting and consuming first foods are often central to cultural expression, identity and well being.<sup>ii</sup> These principles apply for all tribes, yet the first foods themselves, and associated values and practices, may be different in different tribal communities.

### *Identifying Potential Impacts to First Foods*

Native people and other researchers have observed that climate change is already affecting first foods, with likely additional and accelerated effects in the near future. The impacts are many and not well understood, yet potentially severe. For the peoples of the Salish Sea (United States and Canada), keystone species such as salmon, shellfish, deer, elk, ducks, trees, shrubs, tubers, and berries have been identified as currently or potentially impacted. Climate change has the potential to usher in extraordinary changes to the ecosystems that support these species – on a scale and at a pace that may be difficult to comprehend. These changes will potentially include alterations from declining glaciers, wildly fluctuating precipitation patterns, increasing in-stream temperatures, rising sea levels, and escalating ambient temperatures. As the land and waters change, the ecology changes—species are forced to adapt, migrate, or disappear. Participants provided examples of resulting potential impacts: perturbations in all stages of the salmon lifecycle (“gravel to gravel”); degradation and inundation of shellfish habitat; shifts northward in latitude and/or upward in altitude of roots, berries and other culturally important plants; and ultimately, impacts to the lifeways that are bound up with these first foods.

### *Defending Coast Salish Peoples’ Rights in the Face of Climate Change*

Given these and other potential impacts to the resources on which Coast Salish peoples have always depended, participants in the Climate Change Summit considered how the *rights* of Coast Salish peoples to resources may be affected. As tribal elders present emphasized, a first source of answers to this question lies in Coast Salish languages, teachings, and understandings of inherent sovereignty and aboriginal laws. A second source of answers to this question lies in other laws, including the laws and treaties that frame the relationship between the Coast Salish peoples and, respectively, the United States and Canada.

Courts in the United States, for example, have recognized numerous facets of tribes’ treaty-secured rights to take fish, including shellfish, and to hunt and gather that are relevant to a future in which climate change must be contemplated. These courts have interpreted the “right of taking fish at all usual and accustomed grounds and stations” so as to recognize the permanent nature of this right, despite “[t]he passage of time and changed conditions affecting the water courses and the fishery resources;”<sup>iii</sup> and to affirm the treating parties’ mutual, ongoing obligations to ensure the future health of the treaty resource. Although fewer cases address tribes’ hunting and gathering rights, U.S. courts have interpreted the treaty-secured “privilege of hunting and gathering roots and berries on open and unclaimed lands” and grappled with its geographic scope and how that scope might be viewed as changing over time.

How can Coast Salish peoples ensure that their rights are both recognized in theory and able to be exercised as a practical matter in a changing climate? Those present at the Summit highlighted the need for tribes and First Nations to reflect upon the treaties and other agreements that they have made or are in the process of making, in order to think carefully about how predicted changes throughout their traditional territories might affect their ability to access, manage, harvest, use, and pass on knowledge about the resources on which they have always depended.

While climate change poses a daunting challenge, it also provides an opportunity for the Native Nations of the Salish Sea to exercise their sovereignty and craft charters for “environmental self-determination.” To this end, Coast Salish peoples can draw upon the unique synergies of traditional knowledge and western science to generate their own climate change policies – shaping management approaches for culturally important resources and places and asserting these within the national and global policy contexts.

### *Preparing for Impacts on Multiple Fronts*

As Coast Salish peoples determine how to respond to climate change, they might organize their efforts around their relationship to their first foods – ensuring that they can uphold their responsibilities and exercise their rights for generations to come. In doing so, they will need to grapple with unique considerations raised by their dependence on these first foods – considerations unlikely to be adequately appreciated in mainstream policy discussions of climate change “mitigation” and “adaptation.” With these unique considerations in mind, Coast Salish peoples can determine how they can contribute to preventing or minimizing the impacts to first foods and the ecosystems that support them; and how they can plan for and adapt to a world altered by climate change.

Coast Salish peoples will likely need to prepare along multiple fronts. Participants at the Summit identified a host of activities that have been or might be undertaken to ensure the resilience of their first foods and lifeways. These activities range from formal to informal; they may be internal to one tribe or involve inter-tribal arrangements or collaboration with non-tribal entities; and they may vary in terms of scale and time. For example:

*Document Baselines.* Participants discussed creating a “baseline” inventory of first foods, to document which foods, medicines, and other materials each tribe traditionally relied upon. This effort would compile information about the numbers and kinds of animals, fish, and plants that used to be available in their traditional territories. It might require tribes to draw upon oral histories and work with their elders to include those foods, medicines, and materials that are no longer available today. It might also require tribes to enlist archaeologists’ records – even if these came about because of unfortunate events – to use GPS data, to walk the land, and to work with biologists and other scientists. (Teara Farrow Ferman, CTUIR)

*Assess Vulnerabilities.* Participants discussed assessing each tribe's particular vulnerabilities to climate change. This effort would gauge the sensitivity of a tribe's resources, homeland, and "infrastructure" (built, natural, and human) to climate change impacts, together with the capacity for adaptation. It would conduct this assessment in view of each tribe's values and priorities. (Ed Knight, Swinomish)

*Observe Changes.* Participants highlighted Coast Salish peoples' longstanding expertise as environmental managers, born of years of residency in place, close observation of the natural world, and intergenerational transfer of traditional knowledge; participants discussed the importance of continuing these ways and observing how individuals, species, and systems are adjusting to changing conditions. This effort would require that tribal members continue to have the ability to access, manage, harvest, and use traditionally important resources. This effort might involve additional mechanisms for compiling and sharing the data gleaned from tribal members' observations. Tribal managers might employ such data as they work with their resources and places to respond to climate change. For example, they might select for propagation those individuals and/or species that appear to better be adapting to warmer temperatures and other changes. As one tribal representative put it, "We have the opportunity to teach the plants and animals as well." (Terry Williams, Tulalip Tribes)

*Preserve Practices.* Participants discussed preserving practices associated with first foods and other traditionally important resources that might be affected by climate change, and thereby preserving the associated knowledge, values, and expressions of identity. Participants discussed the possibility that they might need to take short-term measures to ensure the continuity of techniques, knowledge and related values in the face of decreased availability of or access to traditional species or places due to changing conditions such as a shift in the range of plant materials so that they are no longer present in or near areas currently accessible by tribal basketweavers. These short-term measures might be undertaken as a bulwark against the loss of traditional knowledge or the scarcity of culturally important foods or materials, while long-term measures are pursued to restore the health of and access to these resources. These efforts might enlist or revive bartering or other practices involving sharing and reciprocity. These efforts might range from informal sharing among individual tribal members or families (e.g., individual Quileute and Hoh weavers obtained basketry materials from more northern First Nations weavers), to formal cultural exchanges between tribes (e.g., CTUIR and coastal peoples exchanged deer and elk for mussels, clams, and geoduck). (Teara Farrow, CTUIR)

*Generate Approaches.* Participants discussed the need to be innovative in enlisting legal and policy instruments that will enable Coast Salish peoples to ensure the resiliency of their lifeways and to chart a path forward in the face of changing conditions. Participants emphasized the importance of Native Nations' role in generating their own approaches and devising their own legal mechanisms to respond to the challenges and opportunities of climate change.



### *A Call to Action*

Because the impacts of climate change on Coast Salish peoples are both serious and unique, it will demand the best efforts of Coast Salish Nations' leaders and members, and of their technical, policy, and legal staff. The Coast Salish Gathering can continue to provide a venue for dialogue, a repository for data and ideas, and, a source for strengthening Coast Salish peoples' capacities to chart their own course, in an exercise of self-determination, in response to climate change.

As one elder succinctly summed it up, people are the youngest members of a family of brothers and sisters that includes animals and plants. We must learn from our brothers and sisters, or we will not survive.

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<sup>i</sup> Garibaldi and Turner 2004.

<sup>ii</sup> Arquette et al. 2002, Harris and Harper 2000, Kuhnlein and Receveur 1996.

<sup>iii</sup> *U.S. v. Washington*, 384 F. Supp. 312 (W.D. Wash. 1974).



**SWINOMISH CLIMATE CHANGE INITIATIVE  
CLIMATE ADAPTATION ACTION PLAN**

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**APPENDIX 5**



**Proposal to the Skagit Regional Transportation Planning Organization**  
**Regional Priority – Fidalgo Access Corridor Preservation**

**Background**

In September of 2008 the Swinomish Indian Tribal Community initiated a two year project to assess the impacts of climate change on the Swinomish Indian Reservation and vicinity. The Town of La Conner, Skagit County Planning, and Shelter Bay Community participate in an advisory group for this project, as assisted by the University of Washington Climate Impacts Group as scientific advisor. As part of this project, the Tribe released an Impact Assessment Technical Report in the fall of 2009 that identified broad range of projected impacts on the Reservation vicinity, including potentially significant impacts from sea level rise and storm surge. The Tribe is currently preparing an Action Plan that will specify recommendations for addressing identified impacts, and is engaging in discussion with other local governmental entities on cross-jurisdictional issues.

**Problem Statement**

Given the geographic location of the Reservation and lower Skagit valley vicinity accessing Fidalgo Island, there is a high risk of impacts from gradual sea level rise and intensified storm surges, as identified in the Swinomish Technical Report and as previously noted in a Washington Department of Ecology report issued in 2006.<sup>1</sup> There are two means of access from the mainland across the Swinomish Channel to Fidalgo Island and the Swinomish Indian Reservation, one via SR20 bridges to the north and one via the Rainbow Bridge in the LaConner area to the south. The north SR20 route provides primary access to Tribe's economic development area, Anacortes, the ferry terminal, and Fidalgo and Whidbey Island beyond. The SR20 bridge approaches on the east side of the Swinomish Channel are located in what Swinomish has identified as a potential inundation risk zone for seal level rise and storm surge. The southern access route to the Reservation and Fidalgo Island is through LaConner, leading to the Rainbow Bridge that crosses the Swinomish Channel. The Maple Avenue/Pioneer Parkway approach to the Rainbow Bridge is likewise located in a potential inundation risk zone, as it is within a low-lying area of LaConner with minimal protection from high tides. A storm surge event in 2006 very nearly flooded lower LaConner, as it nearly did a northerly access to the Swinomish Reservation along Reservation Road.

The major risks associated with possible inundation of these critical access routes include regional disruption of connectivity and access to Fidalgo Island, including the Swinomish Indian Reservation, Anacortes, the ferry terminal, and beyond, and potential isolation from the mainland, with corollary impacts of disruption of vital transport of goods and access to services. Such impacts have the potential to be magnified many times depending on the duration and/or frequency of disruption. Other impacts to transportation were identified in the Technical Report as shown in the table below.

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<sup>1</sup>Washington Department of Ecology (2006) Impacts of climate change on Washington's economy: A preliminary assessment of risks and opportunities. Publication No. 07-01-010.

**Proposal**

In preliminary discussion of these key issues between the Tribe and representatives of affected jurisdictions and stakeholders, including the Town of LaConner, Shelter Bay Community, City of Anacortes, Skagit County Public Works, and Skagit County Planning, there appears to be strong concern for these issues. Because of the multiple jurisdictions that have the potential to be impacted, as well as connectivity issues to the rest of the Fidalgo Island corridor, there also appears to be strong consensus among the affected stakeholders of the need to prioritize and elevate the issues through regional transportation planning processes, as a step toward developing solutions. We fully expect that other entities such as WSDOT will become key players in this effort. Toward that end, the concept of a RTPO priority for Fidalgo Access Corridor Preservation is being proposed, as a first step toward pursuing a regional process to address critical connectivity issues.

Below is an excerpt from the Impact Assessment Technical Report regarding identified transportation impacts, as well as mapping performed by the Tribe to illustrate potential inundation zones and projected impacts on the Reservation vicinity. Further information on the Tribe’s project is available through the Tribe’s Climate Change web site, which can be found at [http://www.swinomish.org/departments/planning/climate\\_change/project/reports.html](http://www.swinomish.org/departments/planning/climate_change/project/reports.html).

<b>Transportation Element</b>	<b>Potential Impacts</b>	<b>Vulnerability (impact level)</b>	<b>Estimated Risk</b>	<b>Potential Priority</b>
Access/ Circulation	Higher tides top dikes, causing inundation of access routes, travel disruption, isolation from mainland (long-term impact)	High	High	High
	Higher, more frequent storm/ tidal surges, causing travel disruption/road closures, restriction of access, isolation (short duration events)	Medium-High	Medium	Medium
Road System Integrity	Flood damage from storm/tidal surge, buckling/cracking from higher temperatures	Medium	Medium	Medium
Bridges	Erosion of bridge footings from higher tides/storm surges	Medium	Medium	Medium
	Increased deterioration/ fatigue of bridge structure and joints from increased or prolonged heat	Medium	Medium	Medium
Public Transit	Service disruption, impact-related closures	High	Medium-High	Medium-High
Marine transport facilities	Increasing inundation of marine facilities and ports from gradual sea level rise and higher tides	High	High	High

**SWINOMISH CLIMATE CHANGE INITIATIVE  
CLIMATE ADAPTATION ACTION PLAN**

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**APPENDIX 6**





# **Swinomish Climate Change Initiative**

## **Questions on Planning for Adaptation**

Climate change will have many effects on the Swinomish Indian Reservation and the tribal community, including cultural, environmental, social, and economic aspects of tribal life and traditions. Risks to the community from different impacts vary according to the type and severity of impact. As the Tribe considers different options and projects for adapting to climate change impacts, it will be important to determine how best to respond to these different risks and to establish goals to guide these efforts. The questions below are intended to help develop these goals. In looking at the attached information, please consider how you would answer these questions, and please feel free to add any other comments you may have.

### **OVERALL APPROACH**

What do you think are the most important things that make our Swinomish community unique? What do you think are the most important things that make our Swinomish community healthy and strong?

A) Have you heard about climate change? (If yes), what have you heard? Where did you hear it?

B) When you think about climate change, what comes to mind? Do you think that climate change might affect our community? If so, in what ways? (If more than one impact is named, you can ask that they rank the impacts in their opinion, in order of importance).

### **CULTURAL IMPACTS**

Do you think that climate change might harm Swinomish's culture? (If so) What parts of Swinomish's culture might be harmed? How/ in what ways might these parts of culture be harmed?

### **ENVIRONMENTAL IMPACTS**

Do you think that climate change might harm the natural resources and environment here? (If so) What parts of the natural resources and environment might be harmed? How/ in what ways might they be harmed? (If more than one aspect is named, you can ask that they rank them in their opinion, in order of importance) How important is it to you to try to save these resources/ environment? How much time and money should the tribe use to try to protect these natural resources?

## **SOCIAL AND ECONOMIC IMPACTS**

The tribal government manages several services for the community such as the health and dental clinic, road repair, boat docks, and water, sewer and other utilities.

Of the services that the tribal government provides, which are the most important to you? (If more than one aspect is named, you can ask that they rank them in their opinion, in order of importance). Do you think that any of these might be negatively affected by climate change? If so, how?

The tribal government also provides income to the community through operations like the casino and management of commercial tribal fisheries.

Of the income operations that the tribe manages, which are the most important in your opinion? (If more than one aspect is named, you can ask that they rank them in their opinion, in order of importance). Do you think that any of these might be negatively affected by climate change? If so, how?

Let's say that in the future, there are many severe climate change impacts to the community, such as more big storms every year, higher sea levels, and longer, hotter summers with droughts. How do you think the tribal government should spend time and money on public services versus private residential or other areas—should all funds go to one or the other, or be split? If they are to be split, how should it be split and why?

## Swinomish Climate Change Initiative

### Summary excerpts of interviews with Swinomish community members

<p><b><i>On Tribal Community Strengths</i></b></p>
<p>... The strength comes from the people... It goes back to people and how they made their living and the things that they did to be able to carry on their culture and their life. So I think all tribes in Western Washington have the same kind of program that we have, because fishing is our livelihood. Fishing is our game.</p>
<p>... People help each other out. ... Everybody works together real well and if anybody needs help there is always somebody there to help out and when we have community events, you know, the whole community helps out.</p>
<p>.. The Swinomish community is very, you might say self-contained. And to be healthy and strong, they work together when things get tough and bad things happen, they all pull together.</p>
<p>We place great importance on the community... We have a very large extended family, which means... we have to think beyond ourselves... The things that have always made Swinomish strong, again is if we go back to our traditional way of making a living. If you look at the Swinomish, for thousands and thousands of years, we chased salmon because of the super abundance of the salmon, and the seafood, the crabs, the clams, the bottom fish, the deer, the elk... so we're incredibly wealthy as a people. It made our cultures complex, and it helps develop the rules and laws of our society that has allowed us to continue to live and survive in today's world... If we continue to follow that model that has been left with us, our traditional laws, in caring for the environment and caring for the landscape around us... and not destroying it... it will continue to allow us to make our living and our wealth in a way that we are biologically acclimated to.</p>
<p>What makes our community so unique is probably the name of the community. <i>The Salmon People</i>. And we were uniquely set with water on three sides of us to be able to take advantage of being able to keep that part of our culture. The gathering of the foods, the salmon, the shellfish, that has always been available to us forever. It's part of who we are.</p>
<p>Probably what makes it most healthy and most strong is the education that's been passed down from our tribal elders from generation to generation. The family values, the family core of who we are, what family groups we belong to, who we are tied to and why we are tied to them through time.</p>
<p>Well we have to be mentally strong. Our bodies have to be physically strong and our surroundings have to be strong, I mean we can't live without the land. The land can live without us but we can't live without the land.</p>
<p><b><i>On Expected Impacts to Environment or Culture from Climate Change</i></b></p>
<p>We don't know how devastating it's going to be. Will it take away the things that they used to do and our social events, our social life, culture practice that we use and depend on, it'll be gone. Our main product is salmon and it's already gone. Climate change is not going to help it. Most of our big trees are gone...</p>
<p>..because we live by the water... it could affect our tidelands, it could affect some of the people that live closer to the shorelines. It'll affect some of our fisheries, like the shellfish and even it'll affect the salmon runs because temperatures of water changes and that affects the migration routes for salmon so if salmon are not migrating through the waters that we traditionally fish it'll affect fishermen being able to target those fish and it'll affect the food source for our community who eat salmon... At community gatherings we typically <i>will</i> serve a lot of seafood and even in home and people eat seafood year round. They will catch salmon in the summer and they'll can it and they'll freeze it and they'll smoke it. And so it will impact the culture in that we will have less access to those, to that our staple foods really... it's a genetic thing that we <i>need</i> to have salmon. It affects the way our brains work and develop; especially when we're young. So if we can't have access to that it's going to impact our people, impact our culture. I think cultures have a way of adapting but its still... a big thing for us.</p> <p>With encroachment or rising sea level that could impact people's wells and whether or not they will have fresh water or if they will have access to water.</p>

When I think about climate change, I think about the summers, because I don't handle heat very well and anytime it gets above 75, I start to suffer... So I just keep thinking if it would just stay cool now this summer, I'll have it made, but it isn't going to stay cool, it's going to get hot. And the elders, of course we don't have a lot of real old folks here anymore, but they suffer from the heat too. And some of the young ones also. And with my little new great grandchildren, they don't do too well in the heat either... the winds in the wintertime seem to be more severe than they used to be..

Because most of our archeological and a lot of our cultural resources are directly on the shoreline...[sea level rise] would further hide them and *protect* them. But, I guess I didn't realize that there was going to be a lot of other effects.

Our wealth comes from the salmon and it comes from the resources from the waters, and those continue to decline, we're going to be unable to pursue a livelihood in that way. I would just say, when you're a fisherman... and you're an Indian, in this part of the world, it's in your blood, that you're naturally adapted to do that. Our biological cycles are attuned to the life cycles of the salmon, and when we have to force ourselves to adapt to other patterns, it's generally going to have a severe impact on our well-being, our mental, or social or psychological well-being. It's going to put a strain on us that we've shown in the past that we've been unable to overcome. And it creates stresses in our community that contribute to the weakening of the Swinomish tribal community as we know it today.

...the way it would harm the culture is that the way that we've traditionally taught fishing to our younger people [through] fishing as a commercial venture, and that our young people, starting at young age used to go out in the boats with their parents or their grandparents... So that in effect, put the fathers, even the mothers... it put them in a teaching relationship with their children. It created a great connection with them, and taught them ...the traditional laws about catching the salmon, and how to read the tides, how to read the river, how to read the water... When you have to depend on a foreign education system to provide the livelihood for our young adults...it begins to take that education part away from the parents... You begin to see the traditional, the cultural, the social, the family laws that our elders hold, that knowledge that they hold begins to become not as important... It creates a break within our society that's difficult to overcome.

What scares me the most is, what are we going to lose? The potential loss of a lot of different aspects, probably the gathering part of our culture. The foods will disappear...berries [and other plants for medicinal use]...The animals will disappear, the deer, they'll be gone as will the salmon and shellfish. That's probably my biggest concern as far as what's going to happen with the climate because once the climate changes, then the animals change, the gathering is going to have to change. What are we going to gather? There's nothing else to replace it... The things that are going to be harmed, well, we are such strong believers in eating good food that once that food goes away, we can't replace it. We cannot replace that food. If the deer go away, we can't replace the deer. If the clams go away, we can't replace the clams.

... when I first started... listening to my teachers on... what climate change was and ... at first it didn't sound too dramatic but nowadays it's kind of more dramatic. Like it's coming, it's approaching us a lot faster than anticipated... Swinomish is, we're Coast Salish people, we're water people. ... We live right next to the water ... we thrive from what comes from the water ... that's our natural resource is in the water. And I think that is going to be a huge change within our community... the sea level will rise and that right there kind of changes the whole habitat. ... what lives in the water, the shellfish, the steamers, the fish in general. It will affect ..., all those animals that live in saltwater. And salt water is very critical to everything, the pH, the salinity. ... any change in that will affect the whole system. The fish, our sacred salmon...

[We live in the ]Salish Sea. We're a basin and we have all these tides so when the tides go out it kind of, like I think of it as gathering nutrients...the bottom of the life cycle...plankton and zooplankton...climate change is actually affecting that little group of animals because the algae is...not as nutritious anymore and that's what the zooplankton and the plankton survive off of. And so if it's affecting the bottom of the food chain, you think about what eats that .... As it gets bigger, these littler fish and then what the salmon eat, and then the salmon [are eaten by] sea otters, sea lions .... It affects, starting all the way at the bottom .... So that is huge.

What are cultural [impacts]? ...The deep connection with the earth. I mean it's really hard to feel the connection when it's the earth itself is being harmed right now. We have a lot of sacred salmon ceremonies and if our sacred salmon are being affected that's going to affect... The sacred salmon ceremony is a way for the people to give back to the salmon. This is ...my own interpretation of what it is. Thanking them... thanking the salmon for always coming back each year but when... they're not able to come back, how are we going to thank them? ...the fishermen gather and respect what they're doing...that's their way of life. If fish weren't out there, what would they be doing right now?

You know if we had a really, really dry summer, which we're going to have one of those times, those wells might drop considerably. There may not be enough water.

### ***On Changes Observed Already***

..everything is warming up. Our winters are not as severe as they used to be. The worst winter and the hardest winter that I can remember was back in '48 and '49 and we had 3 feet of snow here on the 15<sup>th</sup> of March. That was a really hard winter. That was the hardest winter, and there hasn't been one that bad since.

Twenty years ago I began to hear from other tribal leaders and the people who knew about the native plants and their medicine qualities that when they would go out to look for them, all of a sudden they weren't there anymore. And I think that was an early warning sign that there was something happening in the environment that we needed to pay attention to... in the last ten years we begin to see a downward trend in the salmon survival... [The rivers] are all practically un-fishable, and we can't get up there because the water levels are going down. The storm events, the flood events are getting higher ...every time that we have a severe storm event it changes the flow of the water, and it changes the habitat of the salmon, and it changes the effect on the shellfish that are out in the mouth of the Skagit River or Skagit Bay, Samish Bay..

...when the [salt] water gets into the [ground] water, then we got ground water that's messed up too. Once our ground water is gone, it's like a very important part of sustaining life is water... You've got to have the water to be able to survive. If we die off, what's it going to be like after we're done? Can this place live on? Can this world live, or would it be better without us?

Well if you think about the plants, they are trying to be in spring mode, and that traumatic change just, kind of puts them in a shock... All the insects that are trying to thrive right now, you know, the bees, the dragonflies, that affected them.

### ***On Priorities for Climate Change Actions***

It is very important to try to save these resources that impact our culture, impact our way of life, impact our food sources, and also our water supplies.

... my main concerns are the water, the sea and the food. I believe that we need to be able to take care of our groundwater... We're water people and that's where we need to concentrate our efforts. Whether it's our water that's being drunk from the faucet or whether it's the water that's being pumped out of our ground underneath our reservation.

I think one of the biggest things we need to do is we need to be able to educate our children on what's actually happening out here. What has happened from our grandparent's style of life to our fathers to ours and then show them look, this is just a three generation snapshot of what's happened since my grandfather was alive and show my granddaughter now look, this could be you but 10-fold by the time it gets to you. Because we look at the way our life has changed since our grandfather's to us and then we look at how, we try to show our granddaughters and our grandson's look, this is what could happen to you but this is going to be a much drastic more change in three generations what's going to happen from now until what happens when my granddaughter is my age or my grandson is my age. What is life going to be like for them. That's where we need to be able to say now look, you need to be able to somehow affect the lifestyle of what's going on around you.

I believe [preserving medicinal plants] is as important as our language. We have to rank it right up there with our language and who we are. We've already started recovering our language. I think next we need to be able to start recovering our medicines. There have always been stories of people traveling to Swinomish to be healed from something that their people could not take care of and then they would send their people to us. Well, we don't have that knowledge anymore. We need to be able

to recover that knowledge somehow, somewhere, to be able to retain the natural medications that people need within our culture right now. And this also ties in with health. You know, your health issues along with the climate change with those medicines disappearing and now you see two generations ago, there was nobody that died of cancer within our community. Now... somebody in everybody's life has been touched by cancer. And all of that has to do with the way that we as human beings treat this earth and how we live and where we're living... What we feed ourselves is what we feed the earth and the earth is going to eventually end up with a cancer too.

The only thing we can do is pay attention to the way we live and take care of the waste and the garbage and do it the right way. They're not taking advantage of the recycling programs. Recycling should be everybody's concern.

Big storms or sea level [rise], whatever is going to happen, [the Tribe] should have funds set aside for those emergencies.

I think that we need to put more time into developing... contingency plans on what we'll do if these resources are impacted the way that we're predicting. So that we can come up with other ways to maintain our culture, maintain people's ways of life, and food sources. And... supplies of water too, if that is going to be impacted, we're going to have to have contingency plans on being able to give water to homes that are scattered throughout the Reservation.

You've got to keep those [transportation] routes open because... without that it's like cutting the supply lines off to an army... if you don't have supplies you're pretty much dead in the water.

... The commercial fisheries... have direct links to our culture and to the livelihoods of our tribal members and to a lot of our social gatherings so I would have to kind of put that up there as one of the most important things.

It just all kind of comes down to contingency planning again because with the casino for example... it is sitting on a real low-lying area and it wouldn't take much of a sea level rise to make that area really, almost completely inhabitable because it'll be flooded. And if that happens... that will wipe out a major source... of revenue for the Tribe that if it's not available then that would impact everything else we could possibly do as far as services to the community. So just knowing what we are going to do ahead of time is going to be important.

Right now ... you can kind of allocate more resources to services that impact the greater community as a whole, like health care and things like that. But as these climate change things become more pronounced and private residences are more impacted directly, I think then that there might have to be a shift towards, towards that where more resources will have to be allocated to shore that up...

Ranking [services] in importance would be like ranking your children in importance. Every one of them have their own specific individual personality and just like all of these services that we have, each one have their own individual need for serving a certain amount of people within our community. They're all important.

This Tribe has always placed great emphasis on protecting the environment, and protecting the salmon.... So, I don't think that we have to change anything. We just have to keep that emphasis there. And the Tribes, as a whole, feel that the environment cannot be compromised. We can't compromise on those values because then it creates a negative influence on the world that may not be reinstated for generations or thousands of years, possibly. So, I think that's what the Tribes continue to say, that we can't compromise on the health of our environment because our very lives, not only our lives as Indian people, but the lives of everyone. The population of the world is at stake here.

I would hope that this country's recognition of climate change as a very dangerous threat to humanity, that we will take this seriously, and that they will include the Tribes as we go about trying to overcome that, and change the way that we live, to protect our environment. And that we become partners in this effort to overcome this threat, this crisis. It IS a crisis, but whether it's drastic enough to change the way that this society looks at life, and how we approach it, remains to be seen. It may have to get a lot worse before it gets better.

[Addressing climate change impact on natural resources] is very important if we want to keep our culture. If we want to keep feeding the culture and it's important to the point of everyone trying to get on the bandwagon to help change it because... they don't want to see their great grandchildren dealing with this. They want to help [address] the changes as time goes on.





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