Existing Conditions Report

Puyallup Tribe of Indians

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Key Findings and Implications for the Plan

Each chapter in the existing conditions report will inform the development of related goals and strategies outlined in the Puyallup Tribe of Indians' (PTOI) Comprehensive Plan. This summary highlights key takeaways from this information gathering phase to help guide the plan development process moving forward. A robust engagement and visioning effort will supplement the findings of this report.

Climate change is a major consideration and focus for PTOI planning efforts. Anticipated climate impacts influence all chapters of the plan and policies related to climate resilience are designated below with a globe symbol:



Cultural Resources

- The Comprehensive Plan process is an opportunity to elevate the protection and preservation of cultural resources for future generations of the PTOI community and recognize their interconnected nature across areas such as land use, transportation, and natural resources.
- Identifying areas with higher probability of cultural/archaeological resources establishes a framework for ensuring their protection.
- The protection and enhancement of cultural resources should be a priority for PTOI zoning. The Land Use Map should highlight areas of focus for preservation by the Tribe's Planning and Historic Preservation Departments.
- Current multijurisdictional coordination is insufficient and has resulted in enormous development pressures and urbanization within the Reservation and surrounding areas. This development pressure threatens the protection of cultural sites and has resulted in environmental degradation of the Puyallup River and its habitat.
- Climate change impacts include the potential loss of areas of high cultural value, such as shorelines, tidelands, prairies, forests, and other accustomed and traditional sites.

Open Space & Natural Habitats

- Conservation and restoration efforts should be a focus for building resilience, protecting habitats, and increasing connectivity for endangered and threatened species.
- All basins in the Planning Area support several salmonid populations, including populations of ESA-listed Chinook salmon and steelhead. Several stream corridors are disturbed by development, shown through fish passage barriers and elevated temperature and fecal coliform bacteria.
- Considering the type of development associated with critical aquifer recharge areas and wellhead protection zones could help improve water quality.
- Setting aside additional biodiversity corridors and fish and wildlife conservation areas would increase habitat connectivity.
- Establishing regulations to protect existing natural resource areas is an important focus for land use regulation. Consistency in critical area buffer widths across jurisdictions would address habitat fragmentation.
- Climate change will exacerbate many of the impacts associated with development, including erosive forces and water quality issues in streams associated with larger, more frequent storm events, and impaired delta and estuary conditions with sea level rise. Enhanced critical area protections would increase the amount of flood storage and improve water quality to respond to climate events. PTOI should continue their restoration

efforts, with a focus on removing fish passage barriers and improving habitat connectivity and stream and delta conditions.

- Wildlife conservation efforts must prioritize the classification of at-risk species and identification of suitable habitat sites. Climate change will have many impacts to different species in the Planning Area, including salmon and shellfish.

Climate Resiliency

- PTOI should continue its restoration actions where it has in the past: along the major waterways. These areas are most vulnerable to changing conditions and impacts from climate change and represent the best type of restoration strategy, since they both improve environmental conditions in the short term and create capacity for flood and other climate change-oriented impacts in the long term. Restoration should also make the landscape more resilient to changes brought by actions outside PTOI's control.
- In the Puyallup basin, the combined impacts of larger flood events and sea level rise, along with ongoing sedimentation and delta growth, will produce a hazardous situation in the next few decades. This places PTOI and its neighbors on the Puyallup River delta at risk.
- Both inside and outside the Planning Area, climate change impacts come primarily from stream temperature increases in those areas where reduced streamflow increases solar heating in the longer, drier summers. These impacts will primarily impact in-water species like salmonids.
- Climate change considerations should be woven throughout PTOI planning efforts. The future of the area's habitat, ecosystem, and land use will be impacted by more frequent and extreme weather events and differing conditions for various species' survival. The Puyallup Tribe can continue to demonstrate regional leadership in its policies that adapt to a changing environment.

Land Use

- Land use policies should address community health. This includes the health of the natural environment, especially fish and other fauna, as well as human health. Policies that support a transition to a lower carbon future, access to open space and recreation, as well housing, will be important priorities.
- As climate change alters the stream flow, the quantity of rainfall, and flooding patterns, the Tribe's important archaeological sites, resources, and traditions will also be more vulnerable. Cultural sites along the waterfront may experience more frequent and more intense flooding and storm surges. Land use policies should consider how significant sites, especially in highly vulnerable areas such as a beach or low-lying areas near water bodies such as the Puyallup River, can be protected.
- Development-driven vegetation loss and pollution has already compromised the health and abundance of the Tribe's natural areas—many of which had been used for ceremonial and traditional purposes for millennia. Land use policies should consider focusing development in areas that are already developed and similar strategies to reduce the impacts of development on the natural environment.
- A modern land use code that reflects Tribal values and describes desired outcomes will bring more predictability to zoning and the development review and approval processes. It can serve as a resource for those who seek general information about the Tribe, as well as those who want to understand how the Tribe views land use, its vision for future land use patterns, and how it plans to respond to particular issues and problems.

- Development that encroaches into wetlands and critical areas damages habitats and results in more flooding. Limiting low density development near natural and cultural resources, and promoting moderate and higher density development within existing neighborhoods, are strategies with potential for positive environmental impacts.

Housing

- Housing affordability is a pervasive challenge across the Planning Area. Programs that offer homebuyer education and assistance or place households in income-restricted affordable housing within the Planning Area can address this challenge and offer much needed stability and connection to Puyallup homelands.
- PTOI staff have identified priority populations for housing assistance programs, focusing on Tribal elders, those in substance abuse recovery, and those transitioning out of juvenile and adult prison systems.
- The Planning Area's housing stock is dominated by single family homes, typically the most expensive housing type and the type with the largest environmental footprint. Land use policy can limit low-density development and prevent sprawl into environmentally sensitive areas.
- Many PTOI members live in areas that have been identified as having high risk factors for social vulnerability. Continued efforts for climate education and disaster preparedness can improve community resilience.
- Lack of access to affordable housing is a root cause of homelessness. However, addressing housing affordability alone is not enough to address the complex issue of homelessness. A systemic approach that identifies and addresses needs for emergency shelters, transitional housing, and permanent supportive housing that pairs housing with wraparound services are all needed as part of a robust community response to end homelessness.
- A holistic support system serving youth and adults could address the housing challenges affecting the community's most vulnerable members. Permanent supportive housing is an important need identified by Tribal staff. Permanent supportive housing can combine housing with supportive services that build skills for independent living and tenancy and address the issue of chronic homelessness.

Transportation

- The Puyallup Tribe does not have full control over its transportation network, and multijurisdictional planning efforts can overlook the needs most important to Tribal members. The transportation network within the 1873 Survey Area includes dated infrastructure in need of upgrades and safety improvements. The Puyallup Tribe has identified focus corridors for safety improvements and has prioritized working with local jurisdictions to address these concerns.
- Implementing complete streets initiatives will bring opportunities to enhance the multimodal transportation network in the areas most important to the PTOI community.
- Link Light Rail development is coming to the Planning Area, and the Tribe can proactively plan appropriately for development and connectivity with this mass transit access. Light Rail service is a valuable community asset, expanding the range of available employment opportunities and amenities. The Comprehensive Plan will incorporate transit-oriented development considerations in the 5- and 10-minute walksheds of proposed stations.

- Many of the transportation corridors of importance to the Tribe are located in areas that have been identified by climate studies as being at risk of flooding or landslides. Access to residential communities and employment centers in the PTOI Planning Area is threatened by the destructive potential of these climate events, which are predicted to increase in frequency and intensity. The plan should consider these future risks and plan for increased resilience and regional preparedness.

Economic Development

- The existing conditions analysis shows that the Puyallup Tribe's businesses on the Reservation support jobs and careers. Key industries include gaming, fishing, retail, education, and healthcare. While the Tribe operates several businesses, gaming operations remain its largest source of revenue. A more diversified portfolio that combines different economic activities and industries can reduce the overall risk profile for the Tribe.
- Natural capital is a critical part of the Puyallup Tribal economy, with implications for Tribal employment, fish habitat, climate regulation, flood protection, recreation, and cultural practices. Loss of natural capital, including loss of fish habitat and diminishment of natural resources because of climate change, will create challenges for the Tribal economy. Economic goals should include protecting the value of existing natural resources and habitats.
- Land acquisition is an important focus of Tribal investments and economic development, tied to the protection of natural habitats, economic diversity, and cultural values. A more intentional and strategic land acquisition program would allow the Tribe to leverage its assets, build on regional strengths, and create a strong, diverse economic foundation.
- Leveraging the Tribe's competitive advantages and engaging in strategic partnerships will create economic opportunity.
- A sustainable economy will require regulatory policies and physical infrastructure to support Tribal businesses and member businesses to keep dollars within the Tribal membership.
- Programs that invest in human capital will bring economic opportunities. Such programs include workforce development, teacher recruitment and training at Chief Leschi schools, and entrepreneurship training.
- Transportation programs are vital to a community's economic development and security. The Tribe's major transportation needs include significant funding increases for Tribal transportation programs, new safety programs to address the high rates of traffic injuries and deaths, and streamlining of existing transportation programs and funding mechanisms.
- Transportation programs are vital to a community's economic development and security. The tribe's major transportation needs include significant funding increases for Tribal transportation programs, new safety programs to address the high rates of traffic injuries and deaths, and streamlining of existing transportation programs and funding mechanisms.

Government Services, Capital Facilities, and Utilities

- The Puyallup Tribe provides many important government services for its community. Government services including public safety, justice, health, environmental, and educational services help community members to access resources they need to thrive.
- The Puyallup Tribe operates several government office buildings and facilities for administration and service delivery. Costs to operate multiple facilities are anticipated to grow over time and streamlining these facilities

will be an important step to continue to provide existing levels of service.

- The Puyallup Tribe will need to continue to coordinate land use planning and capital facilities planning. PTOI staff identified the need for a centralized location for providing services, particularly social services. Also, it is reported that due to an overall lack of space, the youth center is often used as a multi-purpose facility, detracting from its core function as a place for young people.
- The Puyallup Tribe operates and maintains a power loop facility that provides electricity at wholesale rates to its facilities that are connected to the loop. Continued investment of that facility will lower operating costs and lower overall costs of operating government services.
- Climate change will impact capital facilities, as they were not designed for the rising temperatures and extreme weather events. Many current Tribal facilities are located in zones anticipated to be impacted by sea level rise by 2050. New capital development programs should plan with climate impacts in mind and consider the vulnerability of sites to flooding that could damage facilities or block transportation access.
- Climate change impacts are felt most strongly by the community's most vulnerable residents. Demand for services may also increase due to the effects of climate change. The PTOI's social support services, housed in capital facilities that are already filled past capacity, need additional space to provide essential services to those affected by climate impacts such as flooding, landslides, and heat waves.
- Utility services will be affected by drought, source water quality, sea level rise, and storms and flooding. The United States Environmental Protection Agency (EPA) has developed a Climate Change Adaptation Resource Center to provide utilities with strategies to adapt to climate impacts that can affect water infrastructure.
- It is recommended that the PTOI monitor planned development in the City of Tacoma's Downtown regional growth center and Port area. These two areas overlap the Planning Area and could potentially have the greatest impact on water, wastewater, stormwater, and solid waste services.
- The PTOI should consider having an active role in the implementation of Stormwater Management Action Planning (SMAP) process, which is a requirement for both Phase I and II Permittees. Part of the SMAP process requires assessing receiving water conditions, which could potentially impact the PTOI's fishing activities.
- To prepare for the potential impacts of climate change, the PTOI should continue to collaborate with all utilities, cities, and private entities within the Planning Area to ensure the risks associated with climate change are considered in their decision-making process and investments.

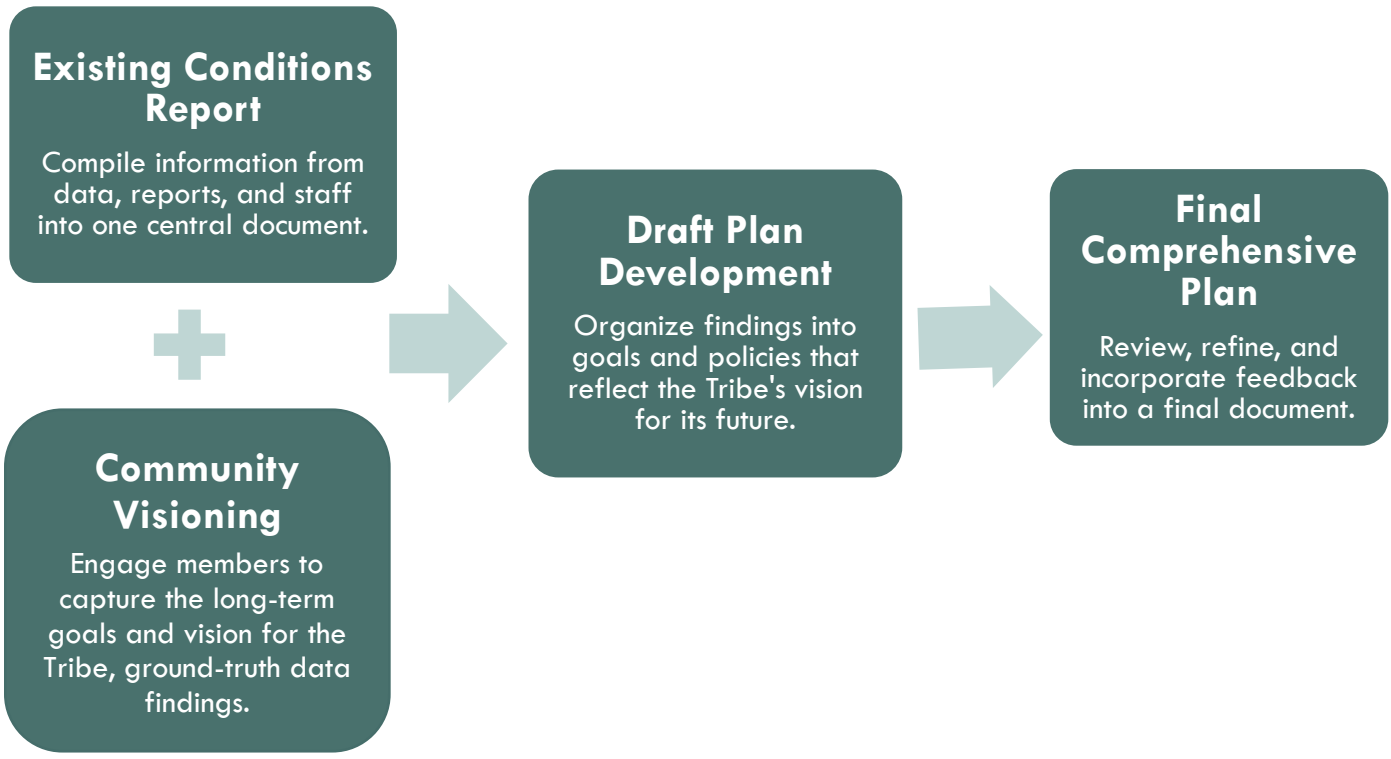
1. Introduction

This document is an early step in the planning process, illustrated in Exhibit 1-1, describing existing conditions in the study area. The next phase will be the creation of a draft plan, which will turn the organized findings of this report into goals and policies for each element of the Comprehensive Plan. This draft will then be reviewed and refined into a final Puyallup Tribe of Indians Comprehensive Plan that will guide decision-making, policies, and programs for PTOI departments.

Topics addressed in this report are listed below.

1. Cultural Resources
2. Open Space and Natural Habitats
3. Climate Resiliency
4. Land Use
5. Housing
6. Transportation
7. Economic Development
8. Government Services, Capital Facilities, and Utilities

Exhibit 1-1: Comprehensive Planning Process, Illustrative Diagram.



Compiled from existing data and research findings, the information in this report will help inform the future Comprehensive Plan. Chapters will be a resource for Tribal departments as they compile, organize, and synthesize information into a central document. Many maps were created for this report, which involved the cleaning and compilation of several jurisdictions' data.

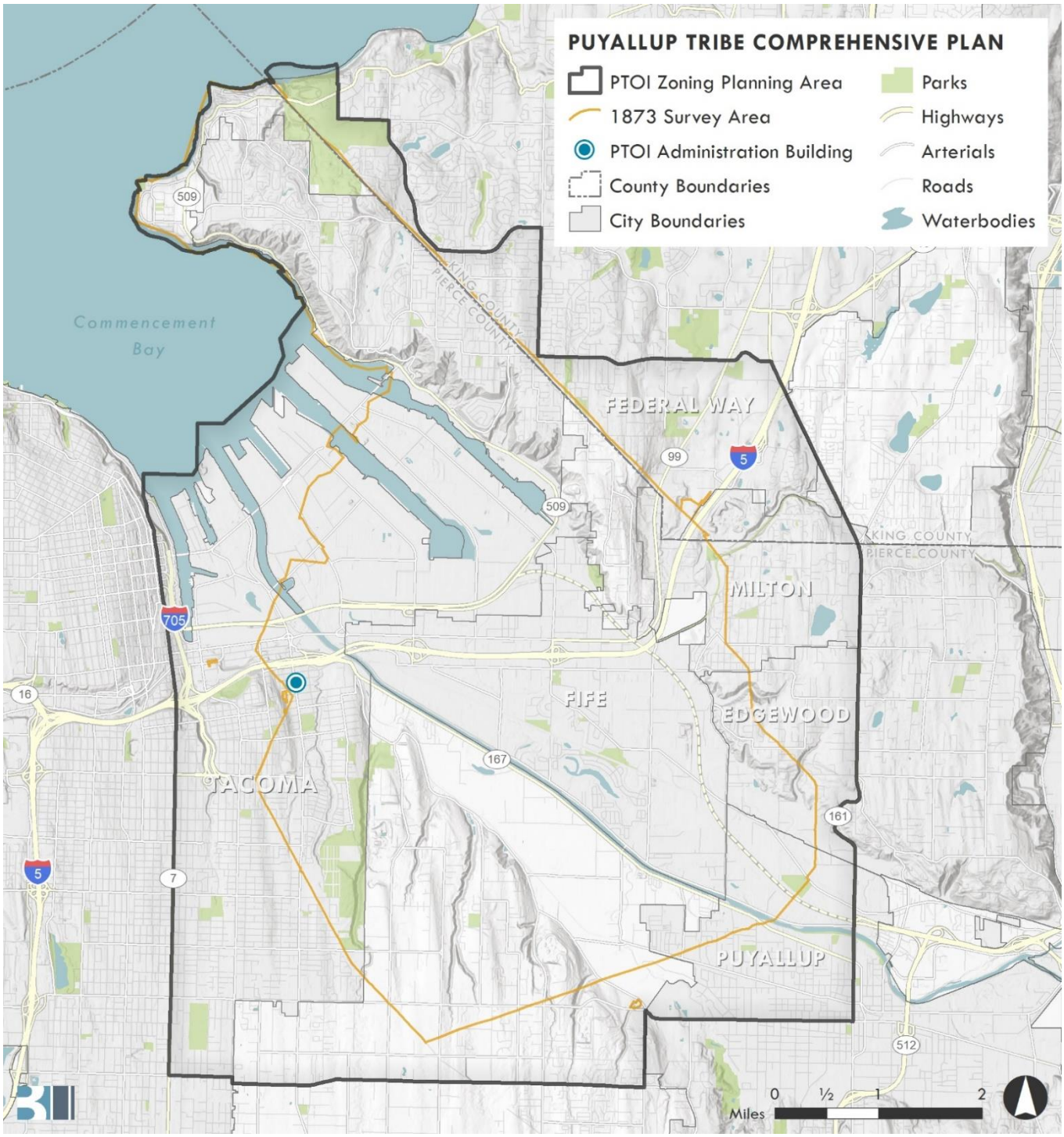
A short summary of overarching themes and key findings associated with each of these topics is included in the section preceding this introduction. The balance of this report contains more detailed discussion of existing conditions for each topic area.

PLANNING AREA

The Planning Area for the Comprehensive Plan, shown in Exhibit 1-2, is based on an expanded growth area beyond the 1873 Survey Area. This Planning Area boundary is intended only for analysis purposes in the development of the Plan and as the applicable area for the Future Land Use Map. Other chapters will incorporate boundaries beyond the Planning Area to reflect economic, land use, natural, and cultural geographies. Exhibit 1-3 identifies fisheries management areas and Exhibit 1-4 shows hunting management areas.

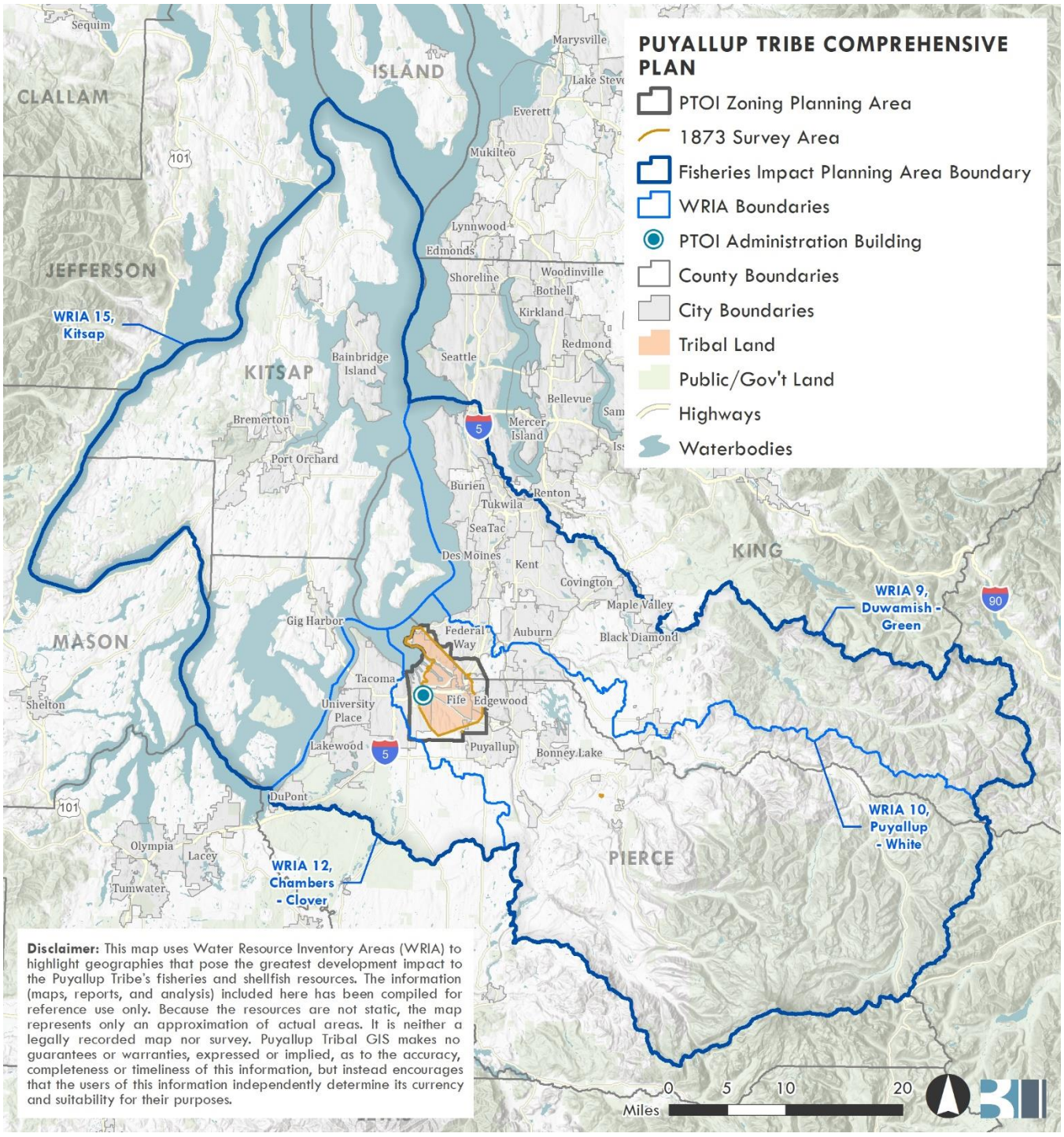
The maps in this Plan identify the Planning Area as well as the 1873 Survey Area. The boundary of the Puyallup Indian Reservation is similar, but not identical, to the 1873 Survey Area. The boundary on these maps reflects a more current version of the line surveyed in 1873 including lands that are part of the Puyallup Indian Reservation as a result of the 1988 Puyallup Land Claims Settlement, 25 U.S.C. §1773. In this report, the terms "1873 Survey Area" and "Reservation" refer to this geography, outlined in gold on maps.

Exhibit 1-2: PTOI Comprehensive Plan Study Area.



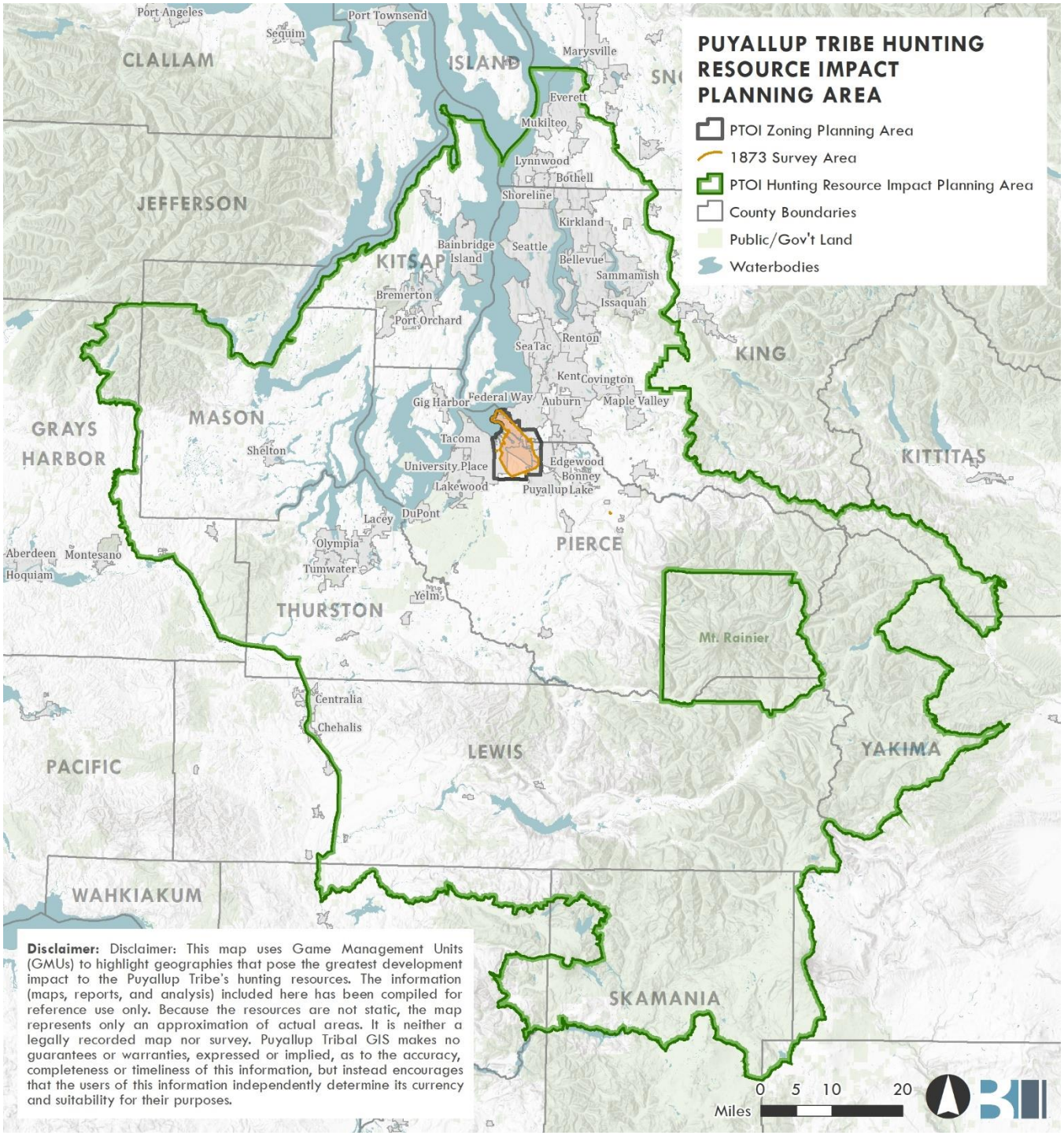
Source: BERK, 2020; Puyallup Tribe of Indians, 2021.

Exhibit 1-3: Puyallup Tribe Fisheries Impact Area



Source: Puyallup Tribe of Indians, 2021; BERK, 2021.

Exhibit 1-4: Puyallup Tribe Hunting Resource Impact Planning Area.



Source: Puyallup Tribe of Indians, 2021; BERK, 2021.

2. Community Profile

"In our Lushootseed language we are known as the spuyalәpabš. The literal translation of this word means 'people from the bend at the bottom of the river.' This refers to the many dispersed villages that spanned outward from the mouth of the Puyallup River, near the present day site of the Tacoma Dome. The name spuyalәpabš also became associated with our peoples' welcoming and generous behavior. Over time the meaning of spuyalәpabš, or Puyallup, has taken on this association.

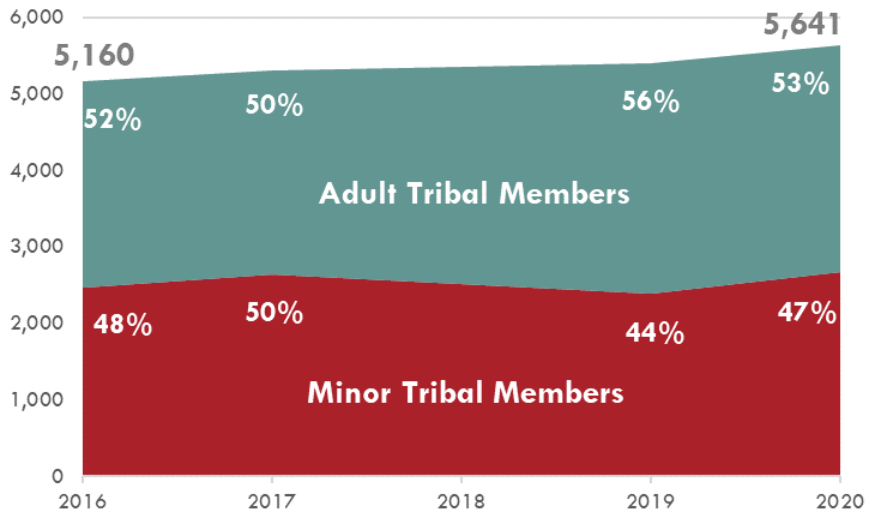
We are one of the many Lushootseed speaking peoples of the northwest. Prior to European settlement, our people lived in villages from the foothills of tәqʷuʔmaʔ/tәqʷuʔbәd along the rivers, creeks, and prairies to the shores and islands of the Puget Sound." - "Our Tribe" from PTOI Website

The data in this community profile overview is based on American Community Survey (ACS) reporting for the residents within the Puyallup Tribe Reservation and Off-Reservation Trust Land, as defined by the US government. This extends beyond Tribal membership and is represented by the "1873 Survey Area" boundary on maps in this report. Where available, data from the PTOI enrollment office adds detail about Tribal members.

POPULATION AND DEMOGRAPHICS

There are 5,641 enrolled Tribal members (2021). Counter to regional trends, the membership has a relatively large and stable proportion of minors. The membership has grown by 9% over 4 years (2016-2020), and the population is split almost evenly between minors and adults. In comparison, the total population within the Survey Area (Reservation) has only 28% of its population aged 19 and under. Counter to regional trends showing increasing proportions of older residents (55+) and decreasing proportions of adults 35-54 and school-aged youth (5-19), the membership has a relatively large and stable proportion of minors. See Exhibit 2-3.

Exhibit 2-1: Tribal Enrollment, by Age, 2016-2020.

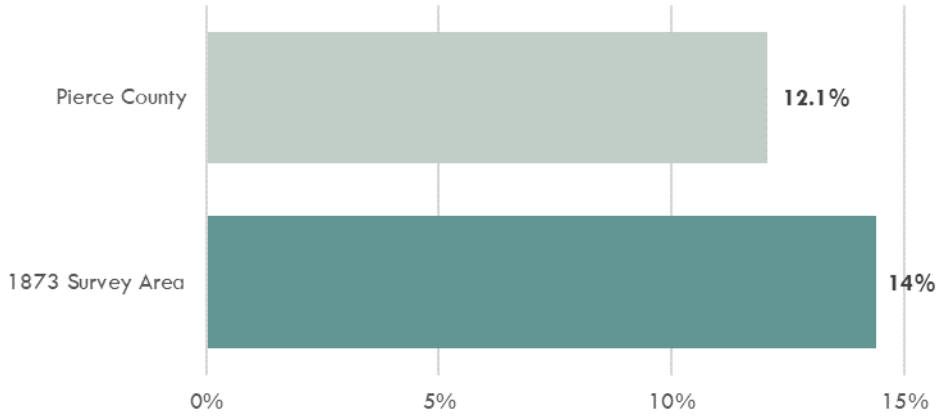


Sources: PTOI Enrollment, 2021; BERK, 2021.

Given the Tribe's values to make decisions ensuring the welfare of the seven generations ahead—and the large proportion of younger Tribal members—**goals and policies that respond to the diverse needs of younger members will be an important piece of the Comprehensive Plan.**

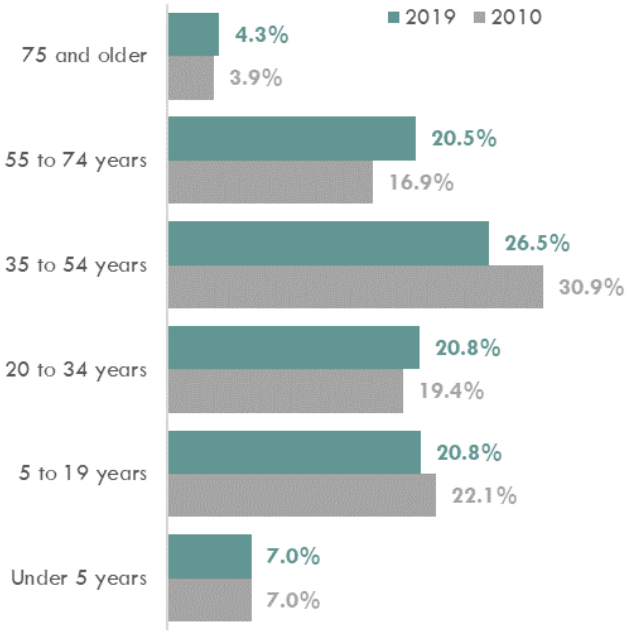
There are 53,026 residents within the Survey Area, and approximately 19% of enrolled Tribal members live within this area.[1] The total population in this area has grown by 14% between 2010-2019, or an average annual growth of 741 people. See Exhibit 2-2. Residents in the Reservation Area include all age cohorts, with increasing proportions of older residents (55+) and decreasing proportions of adults 35-54 and school-aged youth (5-19). See Exhibit 2-3. The increase in older adults reflects trends in the greater Pierce County area, where adults 65 and older are expected to continually increase as a proportion of the population, reaching 21% in 2040.[2]

Exhibit 2-2: Population Growth 2010-2019, 1873 Survey Area and Pierce County.



Sources: American Community Survey, 5-year estimates, 2010 & 2019; BERK, 2021.

Exhibit 2-3: 1873 Survey Area Population by Age Cohort, 2010 & 2019.



Between 2010 and 2019, the general population within the Reservation area saw increasing proportions of older residents (55+) and decreasing proportions of adults 35-54 and school-aged youth (5-19). Affordable and accessible services, housing, and transportation are key to quality of life for people of all ages, but especially for older adults.

Sources: American Community Survey, 5-year estimates, 2010 & 2019; BERK, 2021.

[1] PTOI Enrollment Office, 2021. Member residence location is approximate and based on ZIP code.
[2] Washington OFM Medium-Series Projections, 2017.

Between 2010 and 2019, the Planning Area became more racially and ethnically diverse. Residents who identify as American Indian and Alaska Native, however, decreased slightly during this same time period. The Census reports data on residents by self-identified race, ethnicity, and country of origin. The options available for selection by racial identity include American Indian and Alaska Native (AI/AN), Asian, Black or African American, Native Hawaiian and Other Pacific Islander, White, and Some Other Race. Respondents are allowed to select more than one racial identity. While some Puyallup Tribal members would select AI/AN when choosing a racial identity, others will be lost in the shuffle by selecting one or more alternatives from the options provided. Identity by race is not a perfect proxy for identifying Puyallup Tribal members within Census data. It is still an important group to track, however, as many Puyallup members are likely to be identified in this group. See the sidebar for additional information on this topic.

In 2019, the American Indian and Alaska Native population within the Planning Area is 1,122. There was a slight decrease in Planning Area residents who identify as American Indian and Alaska Native from 2010 to 2019, shown in Exhibit 2-4. Looking at the total Planning Area population during this period, non-White residents grew as a proportion of the population: from 30% to 37%. Groups that increased proportionally over this time include Asian residents (9% to 11%), Native Hawaiian and Pacific Islander residents (0.9% to 3.3%), those who identify as Some other race (2.9% to 4.4%), and those who identify with Two or more races (6.3% to 7.9%). Planning Area residents who identify as Hispanic, regardless of race, also increased from 10% to 14% over the same time period.

"When we respond to the census, we declare our rights to OUR fair percentage of jobs, financing, and services. We also made obvious any discrimination in education or law enforcement. We cannot be pushed aside, we count."

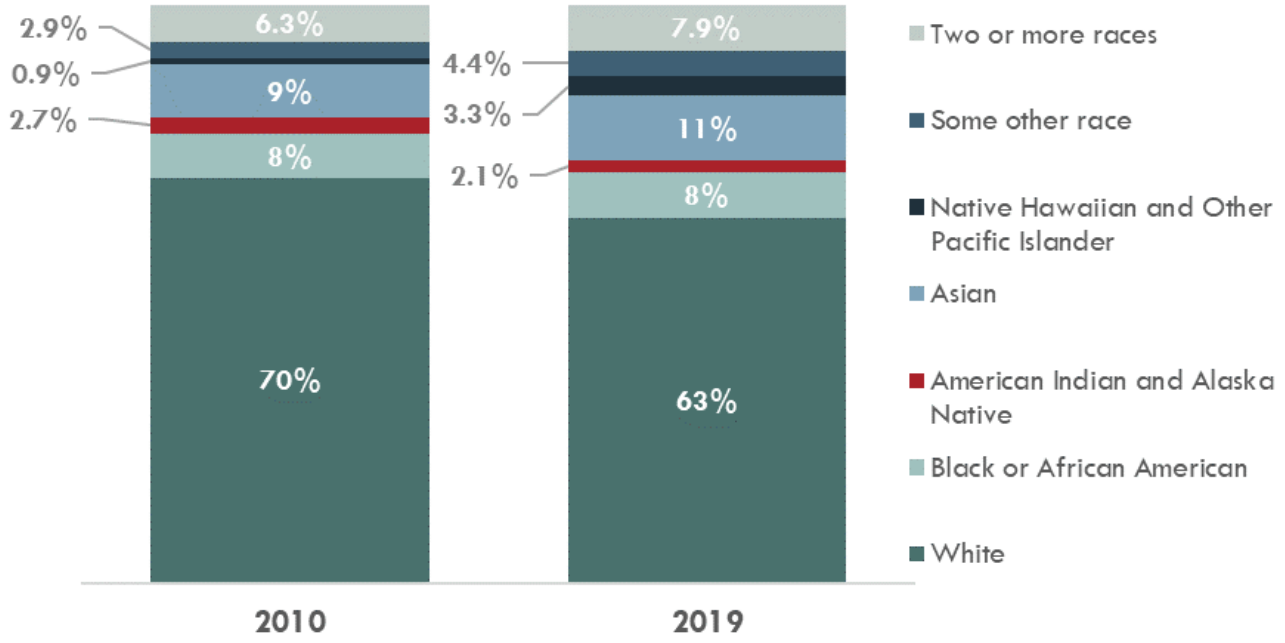
– Ramona Bennett, Puyallup Tribe of Indians

Best Practices for American Indian and Alaska Native (AI/AN) Data Collection.

Many AI/AN individuals are unidentified with current ACS collection practices. There is a large proportion of Indigenous people who identify as multi-racial, and without the ability to disaggregate selections within the "Two or more races" category, these individuals cannot be recognized as part of the larger AI/AN community. Organizations such as the Urban Indian Health Institute advocate solutions for this loss of identity, such as the addition of a space to identify Tribal affiliation within the surveys. To date this problem remains unaddressed.

-Source: UIHI, 2021.

Exhibit 2-4: Race Identity of 1873 Survey Area Residents, 2010 & 2019.



Sources: American Community Survey, 5-year estimates, 2010 & 2019; BERK, 2021.

Considering country of origin is one additional method for identifying Puyallup Tribe members within the geographic boundaries considered in ACS reporting. **In 2019, 1,996 residents selected American as their national origin.** This ranks 5th in order of most common national origin for residents within the Planning Area boundary. See Exhibit 2-5.

Exhibit 2-5: National Origin for 1873 Survey Area Residents, 2019.

Rank	National Origin	% of Total
1	German	13%
2	Irish	9%
3	English	8%
4	Norwegian	4%
5	American	4%

Sources: American Community Survey, 5-year estimates, 2010 & 2019; BERK, 2021.

INCOME

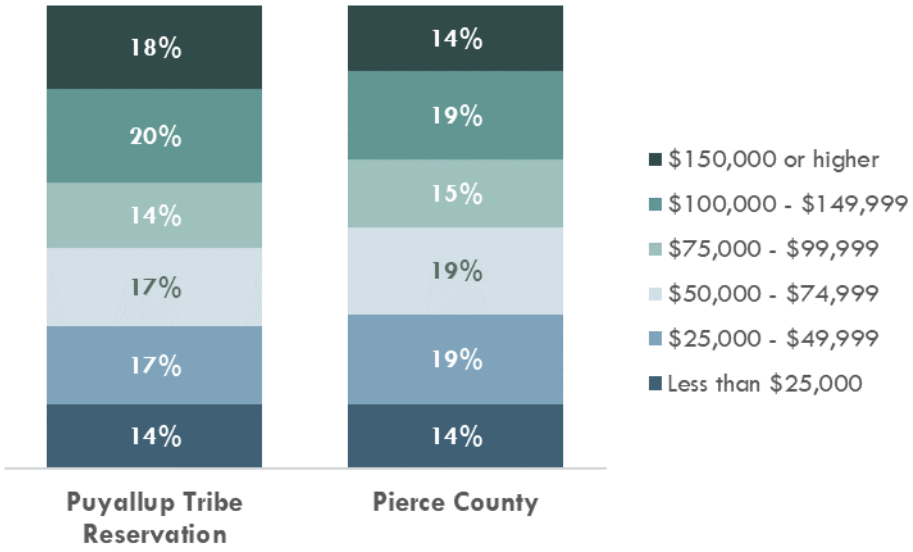
Residents within the Planning Area have slightly higher median household incomes than the county overall. The 2019 median household income for residents of the Planning Area is $78,526. This is slightly higher than the countywide median, as shown in Exhibit 2-6. The overall distribution across income brackets is similar for Planning Area residents as in Pierce County. The Planning Area has more residents in the highest earning income brackets, however, with 38% of its population earning $100,000 or more annually, compared to 31% countywide. The relative proportions of income brackets represented across Planning Area residents suggests a balance of income groups within the community. See Exhibit 2-7.

Exhibit 2-6: Median Household Income for the 1873 Survey Area and Pierce County, 2019.



Sources: American Community Survey, 5-year estimates, 2010 & 2019; BERK, 2021.

Exhibit 2-7: Household Income Brackets for the 1873 Survey Area and Pierce County, 2019.



Based on 2021 income thresholds and the income brackets identified in the graph to the left, between 30% - 50% of Puyallup Reservation residents have incomes representing low-income categories. Residents with lower incomes are disproportionately impacted by lack of affordable housing, accessible services, and amenities. They are also more vulnerable to crises such as the recent COVID pandemic or economic recessions.

Sources: American Community Survey, 5-year estimates, 2010 & 2019; BERK, 2021.

The US Department of Housing and Urban Development (HUD) establishes income thresholds that categorize "low-income," "very low-income," and "extremely low-income" households. These thresholds are based on household

size, shown in Exhibit 2-8. These limits are used in determining a family's eligibility to participate in certain housing assistance programs. For a family to be eligible for federal housing assistance in Pierce County, the total household income must not exceed these established yearly income limits listed in Exhibit 2-8.

Based on 2019 income estimates, somewhere between 30-50% of Planning Area residents fall into one of HUD's low-income household categories. These residents are more likely to face challenges balancing household costs such as housing, transportation, healthcare, and education. Residents with lower incomes are likely to be disproportionately affected by lack of affordable housing, accessible services, and amenities. They are also more vulnerable to crises such as the recent COVID pandemic or economic recessions.

Exhibit 2-8: HUD-Area Income Thresholds for Low-Income Households in Pierce County, 2021.

	Household Size				
	1-person	2-person	3-person	4-person	5-person
Extremely low-income (30% AMI or less)	$ 19,140	$ 21,870	$ 24,600	$ 27,330	$ 29,520
Very low-income (30 - 50% AMI)	$ 31,900	$ 36,450	$ 41,000	$ 45,550	$ 49,200
Low-income (50 - 80% AMI)	$ 51,040	$ 58,320	$ 65,600	$ 72,880	$ 78,720

Sources: Washington State Housing Finance Commission, 2021; BERK, 2021.

3. Cultural Resources

One of the purposes of the Puyallup Tribe's Comprehensive Plan is to integrate cultural resources knowledge and management into all Tribal planning efforts—from land use to economics and beyond. This section sets a framework for discussion of the Tribe's history, values, sites of significance, and existing programs. In addition to this section, cultural resources topics are integrated throughout the Plan to support an integrated approach to cultural resources.

INTRODUCTION

The 1873 Survey Area and usual and accustomed (U&A) hunting and fishing areas represent portions of the homeland of the Puyallup Tribe of Indians. Protection of cultural resources is a key tenet driving the development and implementation of this Plan. In addition to this section, cultural resources are woven throughout the entire Plan, and consideration of cultural resources has guided the development of the entire Plan.

Tribal history and values are critical components to the Tribe's identity. This chapter covers a history of the Tribe, an overview of Tribal values, sites of significance, a discussion of existing programs, and key findings.

The terms **"cultural"** and **"cultural resources"** are used throughout this chapter and the entirety of this report. For the purposes of this Plan, "Cultural" is defined as the Tribe's customs, ideas, practices, and values that embody the Tribe's identity. "Cultural resources" are defined as physical locations, areas, and structures that have ceremonial, historical, archaeological, and/or other significant meaning to the Tribe.

EXISTING CONDITIONS

Tribal History

spuyalәpabš cәł, We are Puyallup

In our Lushootseed language we are known as the spuyalәpabš. The literal translation of this word means "people from the bend at the bottom of the river." This refers to the many dispersed villages that spanned outward from the mouth of the Puyallup River, near the present-day site of the Tacoma Dome. The original river once took a turn into Commencement Bay but has since been straightened by the Army Corps of Engineers. The name spuyalәpabš also became associated with our peoples' welcoming and generous behavior. Over time the meaning of spuyalәpabš, or Puyallup, has taken on this association.

We are one of the many Lushootseed speaking peoples of the northwest. Prior to European settlement, our people lived in villages from the foothills of tәqʷuʔmәʔ, along the rivers, creeks, and prairies, to the shores and islands of the Puget Sound.

Because of the abundance of salmon, shellfish, and other marine resources, historians have often noted that "when the tides were out, the table was set."

Our people lived in villages throughout the region until the signing of the Medicine Creek Treaty, which relocated thousands of Native people onto what is now the Puyallup Indian Reservation.

Creation of the Puyallup Indian Reservation and Beginnings of the Land Grab

The Puyallup River Valley, its surrounding hills, and usual and accustomed areas were once the exclusive home of our people, the spuyalʌpabš, also known as the Puyallup Tribe of Indians. When Washington became a territory of the United States in March of 1853, the newly appointed Governor and Superintendent of Indian Affairs, Isaac I. Stevens, was assigned the task of extinguishing Indian title to the lands. On December 26, 1854 the Treaty of Medicine Creek was signed by members of the Nisqually, Puyallup, and Squaxin Island Tribes. The Treaty ceded to the United States lands within all or part of present-day Kitsap, Mason, Thurston, King, and Pierce Counties.

The Treaty of Medicine Creek set aside reservations for three Tribes, including "a square tract containing two sections, or twelve hundred and eighty acres, for Puyallup lying on the south side of Commencement Bay" in the area that is now downtown Tacoma. Its location away from the Puyallup River and its tributaries were completely unsatisfactory for Tribal members. They continued to use their accustomed areas in the River valley, and the result was a series of armed conflicts with non-Indian settlers, which left victims killed on both sides.

Alarmed by the continued conflicts and killings, Isaac Stevens returned to meet with Tribal members in August of 1856 on Fox Island. Stevens understood the difficulty and agreed with the Tribe to expand the Reservation to include the 18,000 plus acres that are now roughly reflected in the 1873 Survey Area. That increase was made official by a Presidential Executive Order in January of 1857.

This added land lies on both sides of the Puyallup River, extending from the mouth upstream about seven miles toward and to the edge of what is now the City of Puyallup, as well as what is now Northeast Tacoma and the City of Fife. The Reservation boundary was again modified by an Executive Order in 1873 to include certain tidelands in Section 34 (in the heart of what is now the Port of Tacoma) that had been inadvertently left out by a survey after the 1857 Executive Order.

The City of Tacoma was established in 1865, increasing the non-Indian community's interest in Reservation land. Efforts by the U.S. to control and correct intrusions onto the Reservation were at best uneven and sometimes non-existent over the years. Federal land grants made to the railroads (as well as to private individuals) increased the pressure to make Reservation land available. Although the decision later changed, the Northern Pacific Railroad announced in the early 1870's that the western terminus for its trans-continental line would be Tacoma. Disputes over land between non-Indians and members of the Tribe became more frequent.

Edwin Eells, Indian Agent for the area coined one of the all-time classic and timeless descriptions of the non-Indian community's crusade against the Tribe and its members. His report in 1883 pointed to the need for "safeguards … to protect … [the Indians'] ownership of [land] from the rapacity of avaricious and unprincipled white men …"

The federal government was, from the beginning of its active involvement with Puyallup Reservation matters, supportive of the concept of assimilation of Indians generally, and Puyallup Indians in particular, into the non-Indian community. That underlying philosophy was never far from the surface. R.H. Milroy, Superintendent of Indian Affairs for the Washington Territory, commented in 1877 that giving Indians title to individual parcels of land "would do more to stimulate and encourage the Indians of this agency in improving their homes and in habits of industry and civilization than anything else that could be done." In 1880 he reported that, "The children of both the Squaxins and Nesquallies are growing up in the ignorance, barbarism, and superstitions of their parents, and our government alone has the power and ability to rescue them." In 1883 Eells posited that "The example of the more

energetic Caucasian will stir up his more phlegmatic and untutored neighbor to greater efforts for himself …" The principal and teacher of the Puyallup Reservation school at the same time observed that "the school buildings … form quite an attractive feature of the scenery hereabouts to eastern visitors philanthropically inclined, and interested, as all good citizens should be, in a wise and Christian solution of the Indian problem."

Allotment of Puyallup Reservation Land

Allotment of land on Indian reservations refers to transferring ownership of parcels of communally-owned Tribal land to individual Indians. It became common practice throughout the country, usually with the goal of making the land easier to acquire by non-Indians. Article 6 of the Medicine Creek Treaty had authorized that process on the Puyallup Reservation.

The federal government's policy was—from the time the treaties were signed—to bring an end to Indians' separate identity, culture, in very existence. An integral part of the program to achieve that goal was allotment of reservation land. The Indian agents for the Puyallup Agency, R. H. Milroy from 1872-1882 and Edwin Eells from 1882-1895, pushed the plan forward. Although they expressed concern that allotment would result in assimilation of Tribes into the non-Indian population and culture, they initiated the work that would bring about allotment at Puyallup.

Eells was uncomfortable with the plan for allotment, but he was given instructions to make a list of those who had settled on and improved land on the Reservation. He did that. In 1886, President Cleveland formally issued 167 allotments covering almost the entire 18,000+ acres of the Reservation. The allotments gave title to those individuals. That left only the approximately 600 acre Agency Tract unallotted and in the Tribe's ownership. The Agency Tract is now labeled the Indian Addition in the City of Tacoma's platting system and covers roughly the area bordered by what is now the Puyallup River and the Ceremonial Grounds on the north, a jagged line between half a block and two blocks west of Portland Avenue on the west, a line angling across Sherman and Fairbanks Streets on the south, and Grandview Avenue on the east.

Allotment did not, however, clear all of the obstacles remaining in the way of acquisition of the land by non-Indians. Eells in his 1886 report noted that as a result of that reality, strong opposition was made by the railroad and land companies interested to the granting of these patents, and great credit is due to the administration for its fearless and efficient protection of their [the Indians'] rights.

The view of those companies was obviously quite narrow because allotment was a major step toward making Reservation land available, both at Puyallup and in Indian country generally. The railroads wanted to be able to deal with a single entity, the Tribe, rather than a host of individual Tribal members.

1890 Congressional Act and the first Land Commission

Statehood for Washington in 1889 created a much more focused vehicle for the goal sought by the Tacoma business community: making Puyallup Indian Reservation land available for acquisition by non-Indians. The City of Tacoma pushed eastward toward the Reservation, through the development of more and more land as well as expansion of the city limits. The demand for land intensified and by the late 1880s had reached a fever pitch.

The business community and particularly the railroads stepped up pressure to remove the prohibition on conveyance of Reservation land. Descriptions of that process confirm its toxicity. In 1885, Eells described the Puyallup Reservation as having on it "a large body of excellent land, which excites the envy and cupidity of the rich and the powerful." A few years later he noted that, "The unscrupulous and inveterate efforts of speculators to

get possession of their lands requires constant vigilance and effective work to check them." The Commissioner of Indian Affairs made note of that dynamic in his 1888 report:

> *The great and increasing value of the land belonging to the Indians of the Puyallup Reservation makes it an object of desire to the covetous and avaricious, many of whom are unprincipled and unscrupulous in the means they take to try to get possession of it. This has been one of the causes of the troubles.*

In 1889, the newly created state legislature removed the restrictions on Puyallups selling their land. Under the language of the Treaty, that step would become effective only upon Congressional consent to that action.

Pressure to remove those restrictions took many forms and cited many justifications, not all of them internally consistent. The underlying theme was that Puyallups were not developing their land as it was meant to be developed, at least as that characterization was understood in the Anglo lexicon and perspective. Puyallups were sometimes characterized as undeserving because some were not full-blooded Indians. On the other hand, Indians were generally characterized by the non-Indian community as less intelligent and not able to take care of their own interests, itself another shorthand phrase for failing to develop the land.

The situation was made even more chaotic by animosity between the local business community and the national railroads. Local entrepreneurs not only wanted the land for their own uses, they feared what would be done with the land if it fell into the railroads' hands. Yet another factor putting pressure on the Tribe and its members was the federal government's ill-advised program of trying to turn Indian folks into farmers. That left some Tribal members in a bind of wanting to hold on to their land but unable to use it for the purpose the government was pressuring them toward.

Congress in 1890 set the process in motion to open Reservation lands to the outside community. In an Act on August 19, 1890, 26 Stat. 354, it established a Commission assigned to investigate several issues concerning the Puyallup Indian Reservation. But the Commission's mandate was spelled out in the purposes listed in the Act and was very clearly not to determine what was best for the Tribe or its members but rather how to take the land away from them.

The Commission carried out its investigation over the next year and in February of 1892, issued its report to the Secretary of the Interior and the President. Its conclusion, not surprisingly, was that the Reservation land should be sold. "That all the land not necessary for the maintenance and support of the Indians should be disposed of is a proposition undisputed." Undisputed, at least, within the non-Indian community whose interests the Commission was very obviously pursuing and carrying out.

That it is a serious detriment to the City of Tacoma to have such a body of unoccupied land blocking its growth and hindering its commercial, manufacturing, and social development seems to us incontrovertible.

The Commission recommendations, if followed, would have resulted in retention of about 4,700 acres by Puyallups, approximately 25% of the land, but the sale of the other three-quarters of the Reservation. In short, the recommendation if carried out would have sold the majority of the land on the Reservation, but ironically far less than what was in fact taken from the Tribe and its members over the next two decades.

1893 Congressional Act and the Second Land Commission

On March 3, 1893, Congress enacted 27 Stat. 612. That Act authorized a second three-person federal commission, but this one, in sharp contrast to the first commission, was designed and assigned to get the job done –

to set up a process to sell land on the Puyallup Indian Reservation and to oversee the sales.

The Act did put a number of requirements and restrictions on the process; the Commission, however, proceeded to sell land paying little attention to those guidelines, skirting some of them and flatly ignoring others. The most important was to sell only land that was not needed by Tribal members for their homes. The Commission instead sold any land for which they could find a buyer without paying any attention to whether the Tribal members wanted to sell the land or needed it for their homes.

The sales initially went very slowly, caused by a nationwide depression, by Tacoma's competition from Seattle to be the western terminus of the railroad, and by the difficulty of precisely determining the owners and their shares of each parcel. But the process gradually ramped up and in the first decade or so after the sales began in 1895, about 7,000 acres were sold, or about 40% of the Reservation. Explicit documentation generated at that time demonstrates that the Commission violated a host of the 1893 Act's requirements and limitations. It (1) did not observe the limits on selection of lands to be sold; (2) did not obtain appraisals of the properties selected for sale; (3) appointed guardians far beyond what was authorized by the Act; (4) appointed as guardians people with dramatic conflicts of interest; (5) sold some properties without Secretarial approval; (6) sold many properties without the consent of the owner; (7) sold properties without conducting public auctions; (8) did not pursue or even require the subsequent payments from purchasers who paid only the required down payment when they took possession; (9) did not make any realistic effort to obtain, and in fact did not obtain, either the highest possible price for land that was sold nor prices matching what similar properties outside the Reservation boundaries were bringing at the same time.

Removal of Restrictions on Sale; 1904 Congressional Act

The 1893 Congressional Act provided that the allottees would not have the power of alienation of the lands they retained for a period of ten years from the date of the passage of this act …" As a result, that restriction expired on March 3, 1903. Although there was some doubt about whether the 1893 Act had accomplished that step, Congress clarified shortly after the ten years had expired that the Act had indeed "expressed the consent of the United States to the removal of restriction upon alienation by said Puyallup Indians to their allotted lands from and after the expiration of [ten years and that the Act] shall be given effect of [the grants of allotted land] having been made without any restrictions upon the power of the allottee to alienate his land." 33 Stat. 565, April 28, 1904.

In short, federal law placed no restriction on Puyallup Tribal members' authority to sell their land after 1903. They could do that without any involvement by the Commission or by the federal government in any form. The result was very quickly disastrous. Toward the end of 1903, only a few months after the restriction had been lifted, the Commissioner of Indian Affairs reported that, "the removal of the restrictive clause upon the sale of the Puyallup lands … has been a detriment to the Indians and will result disastrously to them." He concluded with the dispirited observation that, "There is no law to prevent an Indian or a white man from throwing his property away if he desires to do so."

The overall, big picture result was that in the ten years or so after the restrictions were lifted, most of the rest of the Reservation land left Indian hands. By 1915, it was reported that fewer than a dozen Puyallup families still owned land there.

The first half of the 20th century did not see any significant improvement in land ownership by the Tribe or its members. The picture began to change, though, in the 1960s and beyond.

Tribal Legal Assertion of Ownership and Authority in 1960's-1980's

Although the Tribe had been seeking the return of its land ever since the takings had begun, it was the mid part of the century before the Tribe began to regain the resources needed to make serious pursuit of that goal. Litigation was the focus of those efforts. The Tribe in 1979 filed the lawsuit Puyallup Tribe v. Port of Tacoma, a case known informally as the former riverbed case. The suit claimed rightful title for the Tribe to 12.4 acres of land, not in use at that point, bordering the Puyallup River. The parcel was part of the bed of the River when the Army Corps of Engineers channelized the lower portion of the River (in the late 1940's), leaving this parcel as dry land bordering the River. The Port had record title to the land since that point.

In order to succeed in the case, the Tribe had to demonstrate two legal conclusions:

First, when the Reservation was expanded in 1857, the intention of the United States and the Tribe was to include the bed of the River as part of the Tribe's ownership. That would require an exception to the general rule that the United States retains title to the beds of navigable waterways when in sets aside land for a purpose such as an Indian reservation.

Second, under Washington state law (+) the Tribe's ownership of the bed shifted to 'follow' the bed with the gradual movement of the River over the years resulting from the regular flooding, and (+) the Tribe retained ownership of what had formerly been land on the bed of the River when it became dry land as a result of the sudden channelization of the River by the Corps.

Judge Jack E. Tanner ruled in the Tribe's favor on both issues in 1981. His ruling on the first issue was based on the importance of the River and its salmon to the Tribe and the awareness and acknowledgement of that importance that Territorial Governor Isaac Stevens had and expressed when he led the federal delegation that negotiated the Treaty with the Tribe then expanded the Reservation shortly thereafter. His ruling on the second issue recognized standard and accepted principles of state law concerning the movement of rivers.

The Port appealed the case and in 1984 the Ninth Circuit Court of Appeals upheld Judge Tanner's ruling. The Port petitioned the United States Supreme Court to review the case. The Supreme Court declined.

The Tribe did two things at that point. It sent a letter to several dozen people who lived on properties near the Puyallup River. Those properties had the same key characteristic as the land in the just-concluded lawsuit – they were part of the bed of the River but were left as dry land when the River was channelized. The Tribe alerted these property owners to the decision in the former riverbed case, and politely informed them that if they wished to discuss the status of their lands, the Tribe would be glad to get together with them for that kind of discussion.

The Tribe also filed another land claims case, this one directed at establishing title to a much larger area in the heart of the Port of Tacoma and its operations. Preparations for that case began, this time involving attorneys for the title companies who had been made very well aware of the Tribe and its litigation.

The combination of these two steps, the letter and the lawsuit, generated an outcry in the community. That reaction was enhanced by several other court cases that had taken place in the late 1970's and early 1980's.

- In City of Tacoma v. Andrus, the City was unsuccessful in its attempt to convince the federal court to rule that the Secretary of the Interior was not authorized or allowed to put land in trust for the Puyallup Tribe or its members.
- In Puyallup Tribe v. Army Corps of Engineers the federal court issued an injunction requiring the Corps to suspend the permit it had given the Port of Tacoma to build a marina in Hylebos Waterway. That marina was never built.

- The still ongoing treaty fishing rights case United States v. Washington was, in the 1970's and 80's regular, front page news and had the state and non-Indian fishing groups in a complete uproar. Judge Boldt made the original ruling in the case, holding that the treaties entitled Tribes in Washington to the opportunity to take 50% of the harvestable salmon and steelhead on each fish run, as well as the right to co-manage the fishery resource with the state government. The Court of Appeals and the U.S. Supreme Court upheld the decision.

A continuing series of rulings in the nearly 50 years since Judge Boldt's decision has extended the principles established in the case and decided a variety of issues related to the fisheries. Those include the treaty right to hatchery bred as well as wild fish runs and the right to protection of the fishery habitat.

The rulings in the case and its decades-long and continuing life have impressed on the community more broadly the continuing effectiveness of the treaties. Gone are the days (we trust) when otherwise responsible public officials blithely contended that the treaties were old and no longer deserving respect. A series of Washington's elected officials learned to their dismay that disregard of the treaties gets them nothing but slapped down (and sometimes criticized) by the courts.

Puyallup Land Claims Settlement

The Tribe had made known to the larger community the belief that the Tribe was the rightful owner of large areas of land that had been stolen from the Tribe and from Tribal members by the land 'sales' in the 1890's and 1900's. The Tribe's success in Puyallup Tribe. v. Port of Tacoma in particular, combined with the existence of several dozen parcels of land in the River valley, adding up to several hundred acres, with the same title history created overwhelming fear in the non-Indian community, from individuals all the way through the Port of Tacoma and local elected officials, that the Tribe would continue to pursue lawsuits that would, from the non-Indian perspective, disrupt long-held expectations about their land ownership.

Those circumstances brought non-Indian governments and their elected officials to the realization that the area's economy and development would grind to a halt if issues with the Tribe were left to play out over years or decades one lawsuit at a time. Key local elected officials, some private businesspeople, and Representative Norm Dicks approached the Tribe proposing a comprehensive negotiation aimed at settling the Tribe's land claims. The Tribe agreed.

Those negotiations lasted for about four years and resulted, after one proposal was rejected by a vote of the Tribal membership, in the Puyallup Tribal Land Claims Settlement Agreement. The negotiations concluded in 1988; the resulting Agreement was approved by all the parties over the next year and a half, and the Settlement went into effect in March of 1990. Now over 30 years later, the document remains effective, binding on all the parties, and relevant to the Tribe and the local governments today.

The Land Claims Settlement is a far-reaching and tremendously important agreement reached by 12 parties including, among others, the Tribe, the Cities of Tacoma, Fife, and Puyallup, Pierce County, and the Port of Tacoma. The key points in the Settlement can be summarized as follows:

- Land and funding provided to the Tribe. The Tribe received parcels of land for several purposes including economic development, fisheries habitat, and governmental services, and substantial funds for the development of those lands and conduct of programs.
- Additional protection for the fishery resource and habitat, in the form of technical, scientific standards by which development projects are evaluated, measures the local governments agree to carry out, and a dispute resolution procedure for disagreements over whether a proposed development will harm the resource.
- Relinquishment of many of the Tribe's land claims. The Tribe and the United States gave up all of their claims to the Tribe's ownership of land other than a list of claims (and in some cases established title) spelled out in

the Agreement that the Tribe retained.

- Tribe's agreement not to exercise jurisdiction over non-Indians on fee land. This provision did not affect the Tribe's authority over its own fee land or Tribal members' and other Indians' fee land.
- Provisions concerning governmental authority and cooperation. This included a variety of measures including standards for evaluating proposed land use decisions and a consultation process when either the Tribe or a local government considers a qualifying land use decision.
- Blair Waterway funding. The Port received from Congress a little over $25 million for widening of the Blair Waterway.

Continued Traditions

2021 marks over 200 years since the first contact between the Puyallup Tribe and white settlers. Unfortunately, negative actions toward the Puyallup community and its Reservation by non-Indian governments and business interests were systematic and largely successful.

Against all odds, the Indian way of life continues to this day. Fishing remains a significant means of perpetuating the traditions and values associated with living in harmony with the natural environment. We, the Puyallup people continue to sustain family growth and development within and around our ancestral homelands, the Puyallup River Valley and the Reservation. Although we have witnessed the destruction of the fishing, hunting, and gathering activities within the Puyallup River Delta, we help to raise awareness among jurisdictions and provide leadership in restoring fish resources and implementing natural resources management practices.

In essence, we have ensured our own survival through an exceptional determination to adapt and adjust to the change of time and ruthless impositions. Now, with the advent of successful Tribal entrepreneurship, we are expanding our exercise of sovereignty and self-determination by acquiring lost lands and building new facilities that will help perpetuate important cultural and traditional values in harmony with the natural environment.

The Puyallup Tribe experiences insufficient and inefficient coordination with the cities within our own Reservation. The impact of this includes enormous development pressures and urbanization in the Puyallup Reservation that have occurred over many decades and without our input. This development pressure threatens the continued destruction to some of our most precious cultural sites and has resulted in environmental degradation of the Puyallup River, Commencement Bay, and other habitats within the Reservation. Along with development pressure and urbanization, climate change is threatening natural resource areas that have high cultural resource value such as shorelands, tidelands, prairies, forests, and other natural areas. Extreme weather events are becoming more frequent and sea level rise is projected to increase over the next decades. These issues highlight the need for increased multijurisdictional coordination and the urgency with which such coordination must take place in order to secure a stable future for the Tribe and others who live on the Reservation.

Despite all of the efforts to eradicate our people, we are still here! Despite all the disease, desecration of sacred sites, destruction of our homes, and the death of 90% of our population, our people have endured! We once again number in the thousands. Our greatest priorities have been re-established: health, prosperity, and wellbeing of our Tribal community and culture. We continue to honor many of the traditions our ancestors have practiced for generations. We raise our children and care for our elders on the same lands that our ancestors have called home since time immemorial. We protect our natural resources, speak our language, share our rich history, practice our culture, and exercise our treaty rights.

We are the culmination of the resiliency of our ancestors.

spuyaləpabš čəɬ. We are Puyallup!

Culturally Significant Sites

This section outlines some of the known culturally important areas within the Puyallup Reservation. These sites are some of the areas the Tribe wishes to preserve and protect for the future and will inform the Comprehensive Plan's Future Land Use Map.

The Puyallup Reservation is rich in archaeological and cultural sites of great significance. These areas may have buried resources, are used for ceremonial purposes, or are used for traditional practices. Many are threatened by climate change. Sites along the waterfront may experience higher frequency and greater intensity of flooding, and temperature and precipitation changes may affect traditional plants and species, such as salmon.

Puyallup River[3]

The Puyallup River is approximately 45 miles long, with headwaters on the west side of Mount Rainier. It flows generally northwest and empties into Commencement Bay in the Puget Sound. Because the river is glacially-fed, it contains a high volume of sediment deposits. These sediment deposits lower water capacity, which leads to flooding. Historic flooding events led to the river being modified over time. In 1913, a legal settlement between King County and Pierce County led to the beginning of an effort to straighten the Puyallup River over the next several decades. Levees and revetments that still exist today were built during this time. Today the Puyallup River looks very different than it did prior to river modifications. There is still a very high likelihood of cultural resources along both the original alignment as well as the altered alignment.

[3] https://content.libraries.wsu.edu/digital/collection/maps/id/679/

Exhibit 3-1: Map of Puyallup River Alignment, 1876 and 2013.

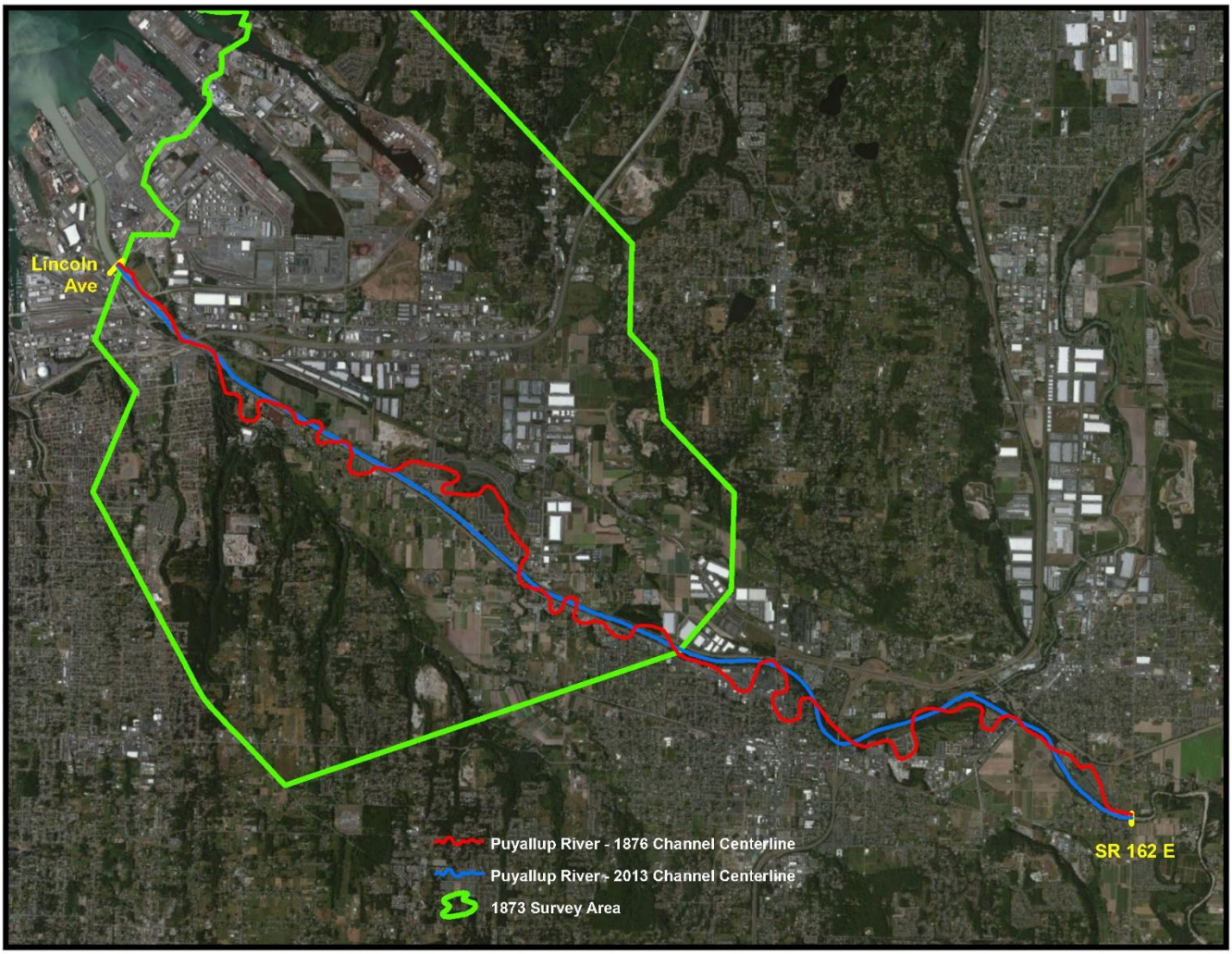


Image Source: PTOI GIS Department, 2013.

Puyallup River Original Alignment (1907)[4]

The Tribe has existed along the historic alignment of the river and its tributaries, where they fished for salmon and other resources. Salmon were also important in Tribal ceremonies. The river itself—along with several pre-contact and burial sites along the river—are all part of the culturally significant ecosystem of the Puyallup River.

There is a known large traditional Tribal village located on high ground near the original mouth of the Puyallup River. There are additional known cultural and archaeological sites along the Puyallup River and its tributaries, and there is a high probability that there are yet undiscovered cultural resources and sites.

The Puyallup River and its tributaries continue to be a significant historical, cultural, and economic resource for the Tribe. The Puyallup's "Ceremonial Grounds," another area of great cultural and spiritual significance, are also located in a wooded area along the bank of the Puyallup River between the Fishing Wars Memorial Bridge (formerly known as the Puyallup River Bridge) and the I-5 Puyallup River Bridge. Many traditional ceremonies and

[4] https://content.libraries.wsu.edu/digital/collection/maps/id/679/

events, such as the First Fish Ceremony, are held along the Puyallup River.

Puyallup Indian School/Cushman Indian School[5]

One of the promises made in the Treaty of Medicine Creek was that a free school education would be provided for Indian children. The Puyallup Indian School (later renamed to the Cushman Indian School) was the first boarding school to open on the Puyallup Reservation. The Puyallup Indian School was a boarding school that originally opened in 1860 but was relocated in 1864, opening that year as the Puyallup Indian School. It educated Native American children for over 60 years and closed in 1920. The school focused on assimilating Native American children through a Western-based curriculum. While it mostly educated Puyallup children, the school eventually expanded to enroll children from other tribes.

Exhibit 3-2. Puyallup Indian School, 1889.



Image Source: Washington State Historical Society Collection

The school served as an extension of the U.S. Government's efforts to assimilate Native American children into the dominant Western worldview and culture. Residential boarding schools were established by the federal government for the purpose of assimilating Native children. Children were forcefully removed from the love and care of their families and tribes and placed in the care of church staff, where they were forbidden from speaking their language or practicing their culture. Physical, emotional, and sexual abuse were rampant. Though the schools left a devastating legacy, they failed to eradicate Native American cultures as they had hoped. By the 1910s, many families were seeking education for their children elsewhere in the area. In 1915 local Indian children were allowed to attend local public schools. When many families sent their children to the Fife public schools, attendance at the Puyallup Indian School began to suffer. Plagued by low enrollment and a shift toward industrial-based training, the newly renamed Cushman Indian School began to falter, closing temporarily in 1917 due to a lack of funding. During this time, there was an upswelling in political and social measures for Native American self-

[5] Sources: https://historylink.org/File/20736, https://www.federalwayhistory.org/wp-content/uploads/2020/04/FtHylebosJuly92009.pdf

determination. Combined with shifts in the sociopolitical climate and funding and enrollment issues at the school, the school closed permanently in 1920.

St. George's Indian School[6]

St. George's Indian School was a boarding school established by Father Peter Hylebos, the pioneer Priest of Tacoma. Following Father Hylebos's search for funding to establish a boarding school, he obtained money from a woman named Katharine Drexel, the Bureau of Catholic Indian Missions in Washington, D.C., grants from the government, and the support of a group of Franciscan Sisters from Philadelphia. Shortly after acquiring funding, Father Hylebos opened the "St. George's Industrial School for Indians" in 1888.

Exhibit 3-3: St. George's Indian School.



Image Source: The Puyallup Tribal Language Program Video "The Boarding School & Cushman Project"

Recently the Tribe's Historic Preservation Department was engaged in The Boarding School & Cushman Project.

The purpose of the project was to collect and hear the stories of Tribal Elders who attended St. George's Indian Boarding School, Cushman Indian Boarding School, or the Cushman Indian Hospital & Sanatorium. A full txʷəlšucid immersion video in the voices of the First People of the land is available on the Tribe's website that describes the experiences that Elders had attending these schools.

Like the Puyallup Indian School/Cushman Indian School, the intent of the St. George's Indian School was to assimilate Native American children into dominant culture. Children were separated from their families and completely assimilated into Western culture. Speaking native languages was forbidden and children learned new trades. Issues of abuse mirrored the experience described above from the Puyallup Indian School. The school continued through the 1920s and early 1930s.

Facing money troubles and massive debt during the Great Depression, the school closed in 1936. In 1944 a Bishop involved in the school wrote in a letter to the Bureau of Catholic Indian Missions admitting that financial concerns were not the only reason the school closed: The government's attempt to assimilate Native American children into Western culture was a failure. The school buildings remained intact for years until they were razed to construct the St. Gethsemane Cemetery.

[6] Sources: https://www.stjames-cathedral.org/history/holythings/35hostiron.aspx; https://www.federalwayhistory.org/wp-content/uploads/2020/04/FtHylebosJuly92009.pdf

St. George's Cemetery[7]

St. George's Cemetery was established in 1886 in connection with St. George's Indian School. St. George's Cemetery is adjacent to the modern Gethsemane Cemetery. When I-5 was built, part of the east side of the school property just outside the cemetery was forcibly sold for the interstate. In 1980 the Catholic Church donated the land covering the original St. George's Cemetery to the Puyallup Tribe of the Puyallup Reservation. There are many grave markers piled in the northwest portion of the property.

Records show that many Indians, nuns, and pioneers were buried in the cemetery until the 1920s. The exact locations of burial plots are largely unknown and the identities of those buried are largely obscured. Many Native Americans went by European surnames, as they were easier for White settlers to pronounce. These surnames were often inscribed on gravestones, making it harder to identify the Puyallup people buried there.

Gethsemane Cemetery[8]

The Gethsemane Cemetery is at the original location of St. George's Indian School and follows the eastern border of SR 99. St. George's Indian School buildings were demolished in 1971, after which the Catholic Church began construction of the present Gethsemane Cemetery.

Cushman Indian Cemetery

The Cushman Indian Cemetery is located south of the I-5 Puyallup River Bridge and is a culturally important area to the Tribe.

Emerald Queen Casino[9]

The purpose of this Existing Conditions Report and the Comprehensive Plan is to not only protect significant historic and archaeological resources, but also protect current Tribal enterprises and future culturally significant resources. As such, the Emerald Queen Casino is an example of a modern cultural resource and enterprise that merits inclusion in this report and the Comprehensive Plan.

[7] Source: https://www.federalwayhistory.org/wp-content/uploads/2020/04/FtHylebosJuly92009.pdf
[8] Ibid
[9] Source: https://www.thenewstribune.com/news/local/article239724883.html

Exhibit 3-4: Emerald Queen Casino's new location in Tacoma.



Image Source: The News Tribune, 2020.

The Tribe is finishing construction of a new Emerald Queen Casino at 2920 East R Street in Tacoma, replacing the old Emerald Queen Casino on I-5. The facility was completed after more than 20 years of planning and 5 years of construction. A 12-story, 170-room hotel and spa will open later in 2021. The hotel will also have conference space and a rooftop restaurant.

The Emerald Queen Casino represents a modern cultural resource that will be managed through the Comprehensive Plan's new land use districts for cultural resources.

Current Regulations to Protect Cultural Resources

The Puyallup Tribe's first zoning ordinance was adopted in 1997 and currently contains a "Historical, cultural, and other significant lands" district (PTC 15.12.190) that is intended to protect historic, cultural, and other significant lands. Additionally, the "Forests, wetlands and other significant resource lands" zone (PTC 15.12.210) provides protection for areas of undeveloped forest, wetlands, and other significant resource lands. The new Comprehensive Plan builds on these zoning districts and provides additional clarity and protection for cultural resources.

Existing Programs

The Puyallup Tribe has a long tradition of conducting programs, ceremonies, events, and historic preservation within the Reservation. Many are currently available and included in this Existing Conditions Report.

Exhibit 3-5: First Fish Ceremony, 2019.



Image Source: Puyallup Tribe of Indians

Traditional Events

The Tribe hosts many traditional events annually, including the canoe awakening ceremonies, canoe nights, cedar harvesting ceremonies, maple bark harvests, nettle harvests, pine harvests, first fish events, camas harvests, and other events. These take place at locations of cultural significance to the Tribe. The Comprehensive Plan aims to protect and preserve these lands to support these traditional activities for future generations.

Historic Preservation

The Puyallup Tribe's Historic Preservation Department preserves and shares the Tribe's rich culture and traditions. The Department educates Tribal and non-Tribal members about the history of the Tribe, provides context and information about Tribal holidays, and implements programs such as the Puyallup Tribe's Oral History Collection and the First Fish Ceremony.

KEY FINDINGS AND IMPLICATIONS FOR THE PLAN

Key findings from the Existing Conditions Analysis include:

- The protection and enhancement of cultural resources should be a priority for PTOI zoning. The Land Use Map should highlight areas of focus for preservation by the Tribe's Planning department.
- Current multijurisdictional coordination is insufficient and has resulted in enormous development pressures and urbanization within the Puyallup Reservation. This development pressure threatens the protection of cultural sites and has resulted in environmental degradation of the Puyallup River and its habitat.
- Cultural resources, both known and yet-to-be-found, could be affected if there are not sufficient protections in place.

Cultural resource impacts from climate change could include:

- Loss of natural resource areas that have high cultural resource value such as shorelands, tidelands, prairies, forests, and other natural areas from extreme weather events and sea level rise.
- Decline in the salmon and shellfish populations from ocean acidification and rising temperatures.

The Comprehensive Plan is a unique opportunity to define and protect cultural resources for future generations. A few of those opportunities include:

- Elevating the importance of cultural resources for the Tribe as a whole.
- Emphasizing the interconnectedness of cultural resources in other disciplines, such as land use, transportation, natural resources, and others.
- Identifying areas with higher probability of cultural/archaeological resources and providing a framework for ensuring their protection.

4. Open Space & Natural Habitats

INTRODUCTION

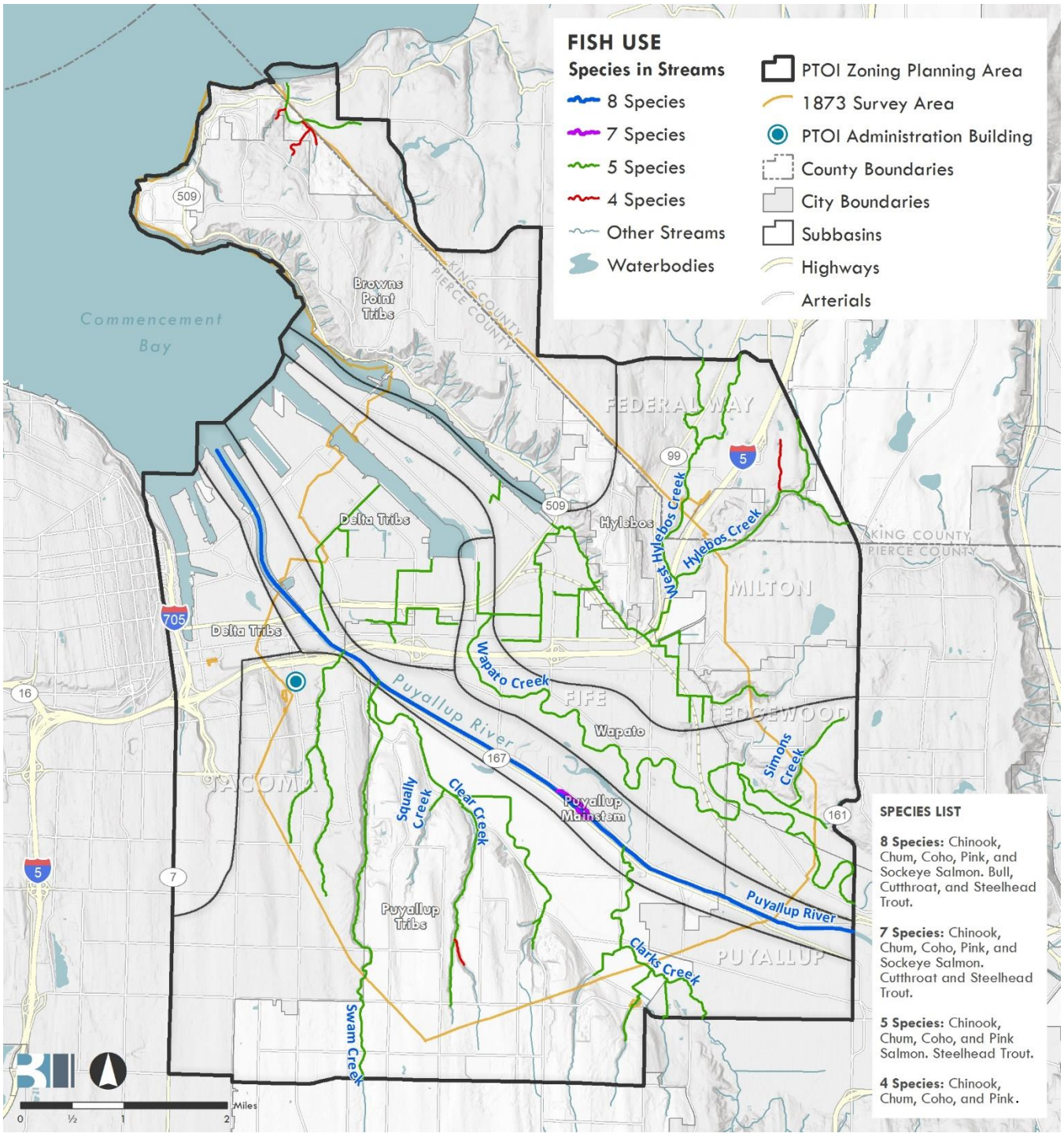
Open space and natural resource designations protect areas from development and preserve natural habitats for native plant and animal species and natural communities. The open space and natural resource areas sustain and protect clean water, provide natural flood control, enhance wildlife habitat and biodiversity, and provide areas for human recreation and relaxation. The designated open space and natural resource areas often contain critical areas: aquifers, frequently flooded areas, geological hazard areas, wetlands and streams, and/or fish and wildlife conservation areas. The regulation of critical areas and associated buffers is vital for the protection of not only fish and wildlife, but also human life and infrastructure. This chapter describes the existing condition of fish and water resources, open space and natural resource areas, and critical habitats, as well as the existing regulations in place to protect these important habitats.

EXISTING CONDITIONS

Fisheries & Water Resources

The PTOI Planning Area includes several fish-bearing streams. This report separates them into six basins: Puyallup mainstem, Hylebos, Wapato, delta area streams, Browns Point streams, and Puyallup tributary ravines. See Exhibit 4-1.

Exhibit 4-1: Fish Use in the Puyallup Tribe Planning Area.



Note: The PTOI Fisheries Department compiles annual reports on salmon species observed in each stream, which identifies more species than shown on this map featuring WDFW data. The department plans to adapt these reports to mapping data in the future.

Source: WDFW, 2021; BERK, 2021.

Puyallup Mainstem

The Puyallup River drainage basin originates in the glaciers of təqʷuʔməʔ and flows through the Puget Sound lowlands to Commencement Bay. It covers approximately 970 square miles, approximately 3.81 of which are within the Planning Area. The downstream reach of the Puyallup mainstem flows through a heavily developed area with a narrow riparian buffer, much of which has been artificially straightened and armored with levees and dikes. Artificially straightened channels reduce habitat diversity and floodplain connectivity, reducing available salmonid rearing habitat and refugia. Channelized banks are often unstable, requiring additional support and armoring, such as riprap, that provide cover for predator species, hinder natural hydrologic and geomorphic processes, and limit riparian cover and overhanging vegetation. This channelization has resulted in the loss of 3.58 miles of river length.[10] Exhibit 4-2 compares the 1874 course of the Puyallup River to its current alignment.

Exhibit 4-2: 1874 Map of the Puyallup River with the Existing Channel Alignment Overlay.



Image Source: Puyallup Tribe of Indians.

The Puyallup mainstem supports rearing Chinook (*Oncorhynchus tshawytscha*) and coho salmon (O. *kisutch*) and migrating chum (O. *keta*), steelhead trout (O. *mykiss*), sockeye salmon (O. *nerka*), pink salmon (O. *gorbuscha*), and bull trout (*Salvelinus confluentus*). Exhibit 4-3 shows stream reaches within the Planning Area listed by the Washington State Department of Ecology (Ecology) as impaired under Category 2 (Water of Concern – water bodies that have some evidence of a water quality problem but not enough to show persistent impairment) and Category 5 (polluted waters listed on the 303(d) list of the Clean Water Act that require a water improvement project). The lower reaches are listed as both a water of concern (Category 2) for dissolved oxygen, and a

[10] "Puyallup River: Comparison of Historic (1876) and Current (2013) River Channels", PTOI GIS Department, 2013.

polluted water (Category 5) for elevated temperature and mercury in the water. The Tribe regulates water quality of the lower Puyallup within the 1873 Survey Area of the Reservation, and its Surface Water Quality Standards were approved by EPA in 1994. In the lower-most reach of the River, there was a dissolved oxygen measurement that exceeded the criterion in 2000 but none after 2001, so the reach was listed as a water of concern. PTOI submitted data showing maximum daily temperature exceedances observed over seven consecutive days on August 9, 2002. For mercury contamination, PTOI data reported an excursion beyond the chronic criterion from three samples collected in 2002.[11] Of the four crossings on the Puyallup mainstem within the Planning Area, none presented barriers to fish passage.

Exhibit 4-3: Ecology Waters of Concern (Category 2) & 303(d) Listed Waters (Category 5) in the Planning Area.

Basin	Assessment Category	Water body	Water Quality Issue
Puyallup Mainstem	2	Puyallup River	Dissolved oxygen
	5	Puyallup River	Temperature, mercury
Hylebos	2	Hylebos Creek, mainstem	Dissolved oxygen
	5	Hylebos Creek, west fork	Dissolved oxygen, bacteria, temperature
	5	Hylebos Creek, east fork	Copper
Wapato		Wapato Creek	Bacteria
		Simons Creek	Dissolved oxygen, bacteria
Puyallup tributary ravines	2	Unnamed Trib to Clear Creek	pH
	5	Rody Creek	Fine sediment, pH, and/or temperature
	5	Diru Creek	Fine sediment, pH, and/or temperature
	5	Silver Creek	Fine sediment, pH, and/or temperature
	5	Meeker Creek	Fine sediment, pH, and/or temperature
	5	Deer Creek	Bacteria
	5	Clarks Creek	Bacteria

Source: Department of Ecology, 25021.

Hylebos

The Hylebos Creek headwaters include east and west forks that combine near I-5 in Pierce County, just south of the King County line. From there, Hylebos Creek flows from Federal Way through Fife and Milton, emptying into Commencement Bay in Tacoma. Approximately 10.11 square miles of the lower basin are within the Planning Area. The upper portion of the Hylebos basin is in forested hills developed with residential and commercial properties. The lower reaches below the confluence of the east and west forks flow through low floodplains converted to agricultural land and a heavy commercial/industrial area. Restoration of the lower Hylebos near the mouth of the stream began in 2007, reconnecting a portion of the channel that had been isolated from Hylebos Creek by a manmade berm. The reestablished estuarine habitat now benefits spawning and rearing coho and chum salmon, migrating Chinook salmon and steelhead, as well as other native fish and wildlife species. The mainstem portion of Hylebos Creek that flows through floodplains converted to agricultural land is currently in the design phase of restoration as mitigation for the SR 167 Gateway Project. The Hylebos mainstem is listed as a Water of Concern (Category 2) for dissolved oxygen. See Exhibit 4-3. PTOI submitted data for the Hylebos

[11] https://geodataservices.wdfw.wa.gov/hp/fishpassage/index.html

mainstem that showed low dissolved oxygen measurements in 2001and 2002. There are four records of polluted waters (Category 5) in the Hylebos watershed: the west fork is on Ecology's 303(d) list for dissolved oxygen, bacteria and temperature, and the east fork is listed for copper (see Exhibit 4-3). The Hylebos basin includes several crossings and four culverts, none of which were identified as fish passage barriers.

Wapato

Wapato Creek flows from the area north of the City of Puyallup through Fife, emptying into Commencement Bay in Tacoma. Based on topography, the Wapato drainage basin encompasses 4.63 square miles of the Planning Area. Near the mouth, Wapato Creek is confined to a narrow channel with minimal floodplain connectivity or access to historic mudflats and estuarine habitat. Upper reaches are less confined, but salmon's access to these upper reaches is limited by downstream barriers. Wapato Creek provides rearing and migrating habitat for coho and chum salmon as well as steelhead. There are no listings of impaired waters (Category 2) in the Wapato basin. Most of the mainstem of Wapato Creek downstream of SR 167 is on Ecology's 303(d) list (Category 5) for bacteria. Simons Creek, a tributary to Wapato Creek, is on the 303(d) list for bacteria and dissolved oxygen. See Exhibit 4-3. The Wapato basin includes several potential fish passage barriers, including two of unknown barrier status and two complete barriers at the downstream-most reach near the mouth of the Creek. As part of the construction of the SR 167 Gateway Project, it is expected that restoration and mitigation along the mouth of the Wapato Creek will restore mudflat habitat and habitat connectivity, which includes the removal of the two downstream fish barriers. Other endangered species like the Western Pond Turtle (Clemmys marmorata) have been documented in the stream.[12]

Delta Area Streams

The delta area streams flow through low-lying industrial areas in North Tacoma and the Port of Tacoma into Commencement Bay. The total basin area is approximately 7.2 square miles. The delta area streams are heavily developed and channelized with minimal riparian corridors and limited native vegetation. Fish use of the delta area streams is limited to for non-natal rearing and foraging. Water quality has not been assessed in the delta area streams. There are five potential fish passage barriers (one complete barrier and four of unknown status) along the delta area streams.

Browns Point Streams

Browns Point includes an approximately 8.45-square mile basin of streams that flow to Puget Sound. The north part of the basin has been heavily developed and natural areas within the Planning Area are limited to parks, including Dash Point State Park, and stream corridors along steep slopes in the southern portion of the basin. The streams support rearing and migrating coho, chum, and pink salmon, as well as steelhead. Other species may use the mouths of streams for non-natal rearing and forage habitat. No water quality data is available for these small streams. There are three total fish passage barriers and one barrier of unknown status along the delta area streams basins, two of which are near the mouth of the streams.

[12] Northwest Power and Conservation Council, Volume III Ch. 10 Western Pond Turtle 10-6.

Puyallup Tributary Ravines

Included in the Puyallup drainage basin, the Puyallup tributary ravines drain approximately 15.86 square miles of the City of Tacoma. Streams found in the ravines basin include First Creek, Swan Creek, Squally Creek, Clear Creek, and Clarks Creek, as well as several unnamed tributaries. Although the area surrounding the Puyallup River and its tributaries is well developed, the Puyallup tributaries that flow through ravines have wide, naturally forested buffers. While the tributaries support spawning, rearing, and migrating Chinook, coho, chum, and pink salmon, as well as steelhead, the distribution is limited to the lowest reaches. An unnamed tributary to Clear Creek was listed as impaired (Category 2) for pH. See Exhibit 4-3. Rody Creek, Diru Creek, Silver Creek, and Meeker Creek are on the 303(d) list (Category 5) for fine sediment, pH, and/or temperature. Deer Creek and an unnamed tributary to the Puyallup River were previously on the 303(d) list for bacteria, but these issues are being addressed by the Puyallup River Bacteria Total Maximum Daily Load (TMDL). Similarly, Clarks Creek was previously listed for bacteria but now has a TMDL in place to address the issue. There are numerous fish passage barriers that represent a mix of partial, complete, or unknown barrier status within the Puyallup tributary ravine basin. Many of the fish passage barriers identified are along First Creek, the upper reaches of Swam Creek, and the lower reaches of Clear Creek.

Wild Game & Hunting Resources

Due to urban development and residential districts, the Planning Area does not contain appropriate areas for traditional wild game. Deer, elk, and other game have little presence within the Planning Area and, where present, are not appropriate to hunt given the dense nature of property ownership. Despite this, the Tribe works with state and federal partners to access public lands for hunting within the usual and accustomed areas of the Tribe. The Tribe does not have a co-management agreement to hunt on private lands despite retaining the right to do so. Executing such an agreement would expand access to many forestlands within the Usual and Accustomed areas with plentiful wild game.

PTOI operates a Hunting Department that provides the regulatory oversight of hunting licenses for members, provides traditional wild game and livestock for elders, and works with bison farms to provide meat to Tribal members. The department is limited in providing these resources due to inadequate hunting and agricultural lands.

Shellfish Resources

Most tidelands and nearshore lands within the Planning Area are developed or armored, limiting shellfish harvest and aquaculture. Shellfish, such as crab and geoduck, are traditional foods that are also profitable enough to be an income source for Tribal shellfish divers.

The Tribe's Shellfish Department manages shellfish tracts throughout the Usual and Accustomed areas and provides licenses and regulatory oversight of the Tribal shellfish harvest; the primary managed fisheries are geoduck and crab. Many locations in Commencement Bay within the Planning Area are regularly monitored for contaminants to help characterize the health of the shellfish fishery.

Open Space & Natural Habitats Areas

Historically, the land cover in the Planning Area consisted of forest and floodplain that was converted to agricultural lands following the arrival of European settlers.[13] Open space within the Planning Area encompasses

[13] Puget Sound River History Project, University of Washington.

1,120.1 acres of parks and trail corridors and 958.1 acres of natural and conservation areas in the cities of Federal Way, Milton, Fife, Edgewood, Puyallup, Tacoma, and in unincorporated Pierce County. Of this total acreage, 59% falls within the 1873 Survey Area. See Exhibit 4-4.

Types of open space within the Planning Area include:

- Park space and areas operated and maintained for recreational purposes, such as team sports, child play areas, and picnicking;
- Trails operated and maintained for recreational hiking, biking, horseback riding, and observing nature; and
- Non-park natural areas for active recreation that are designated as conservation areas. These natural areas are set aside to protect unique or important habitats for threatened or rare species and/or for an ecological benefit.

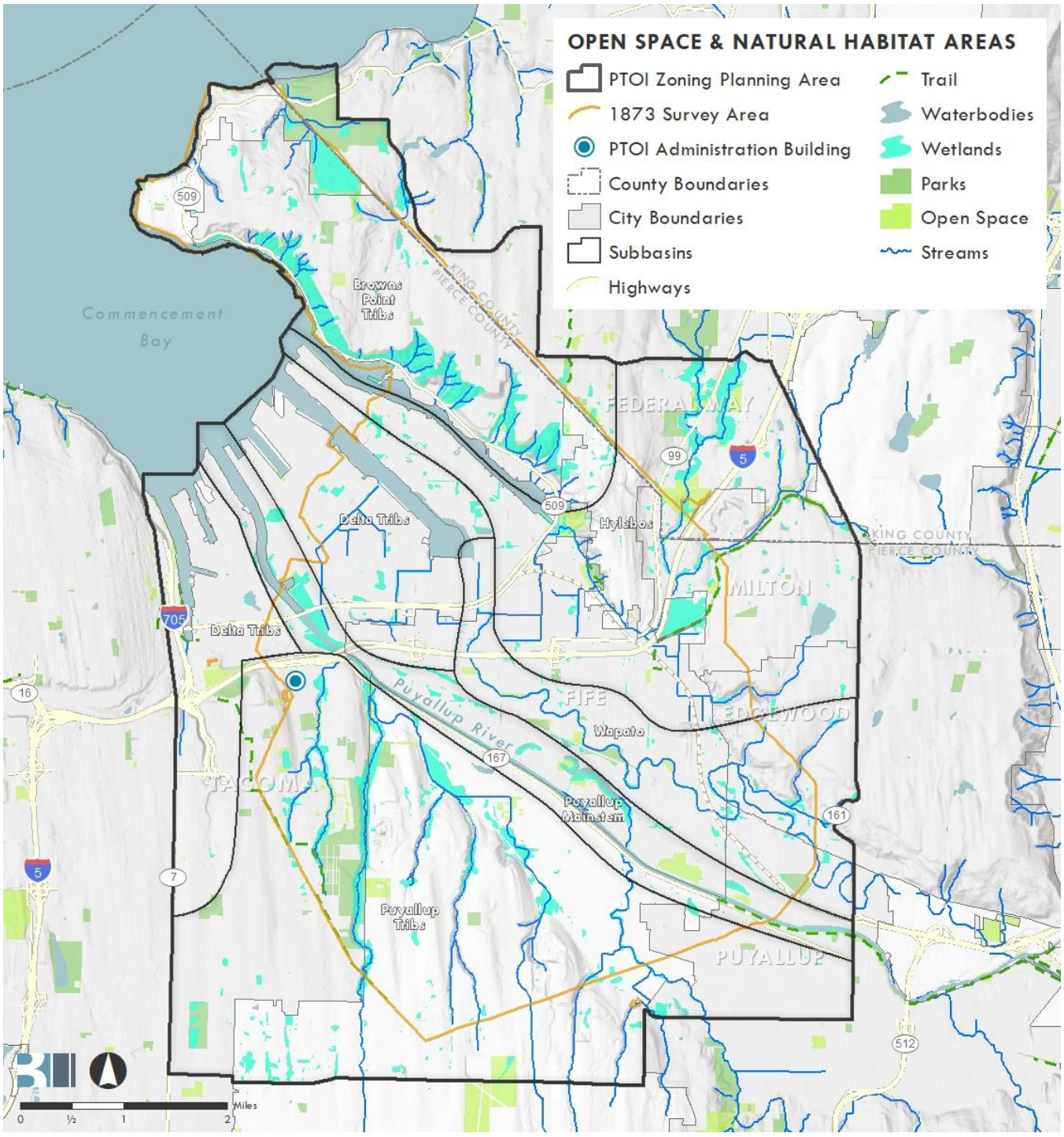
While open spaces provide recreational opportunities for other cultures, Tribal members visit natural areas to:

- Renew their connection with their ancestral lands;
- Teach and perform traditional ceremonies; and
- Practice their Usual and Accustomed gathering rights through the foraging of roots, berries, and other edible plant material.

Natural areas offer valuable habitat for rare or endangered species, stormwater retention and treatment, and improved air and water quality. The functions and value of natural areas depend on the quality of the habitat and on connectivity with other habitat areas. Open space and natural habitat areas often contain critical areas such as streams, wetlands, steep slopes, and animal and plant habitat. These areas help buffer the effects of extreme heat, in direct contrast to hardscapes like warehouses and pavement.

Local jurisdictions regulate designated open spaces with open space plans. While goals and policies vary between jurisdictions, these plans aim to provide safe, convenient, and equitable access to parks and recreational areas; promote community stewardship and partnerships; and manage natural areas to protect unique urban habitats and maintain a connection with nature. Access to open space and natural resource areas may be limited by the availability and proximity of public transportation and parking. While many of these areas are accessible by main roads, areas not designated as parks may not offer parking or easy access via public transportation.

Exhibit 4-4: Open Space and Natural Habitat Areas.



Source: Wetlands layers from all jurisdictions (Edgewood, Federal Way, Fife, Milton, Puyallup, Tacoma, Pierce County, King County, WDFW); WA DNR, NHD (National Hydrography Dataset). Parks layers: King County, Pierce County. Open Space: Pierce County, 2021; Forterra, 2012. BERK, 2021.

Critical Areas

A critical areas designation defines critical areas on or near a project site, establishes buffers and other required regulatory measures to protect habitat and natural functions, and minimize future risk. These include critical aquifer recharge areas (CARAs) and wellhead protection zones, frequently flooded areas, geologically hazardous areas, wetlands and streams, and fish and wildlife conservation areas.

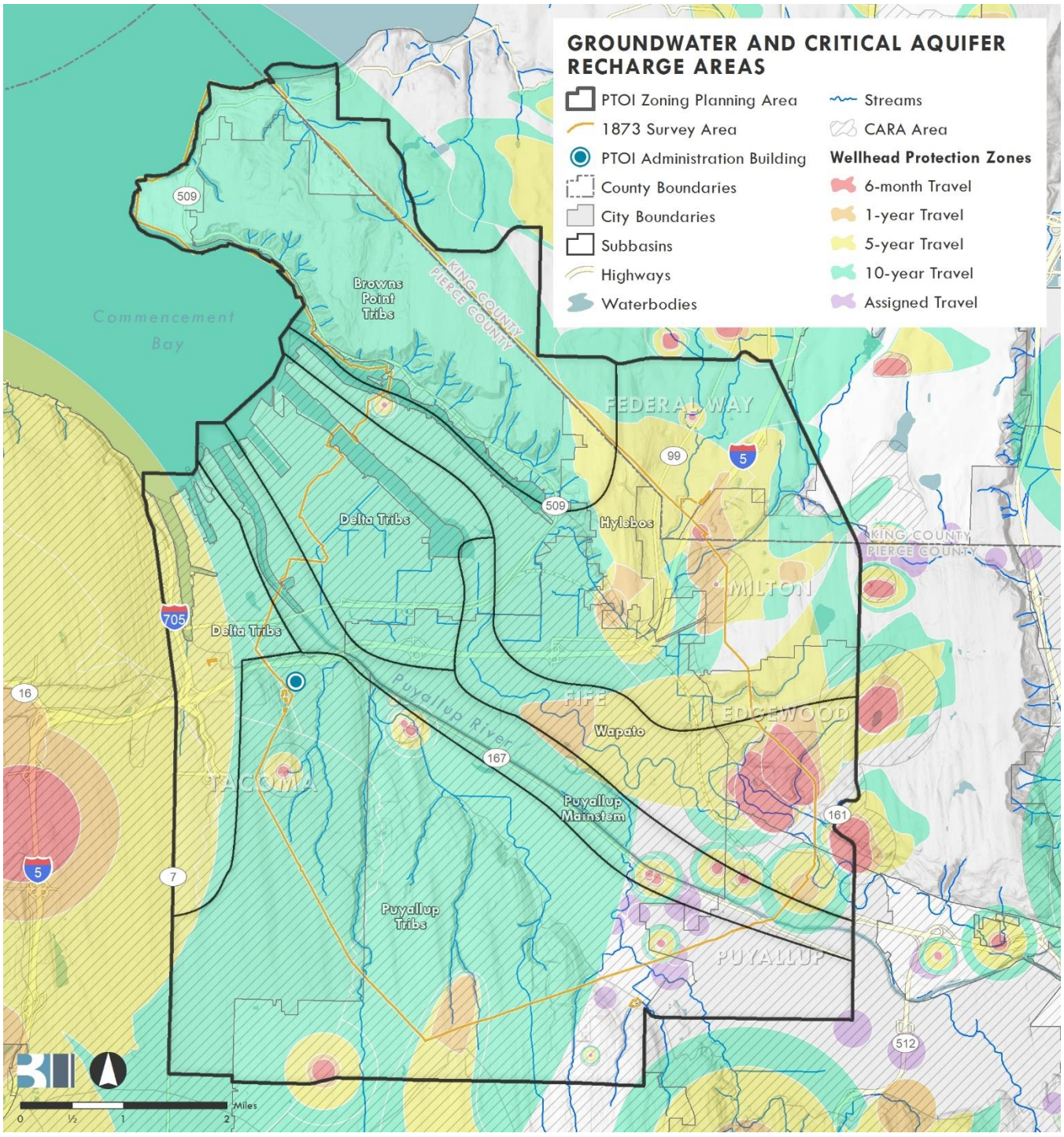
Critical Aquifer Recharge Areas (CARAs) and Wellhead Protection Zones

Aquifers are layers of underground rock or sand that store groundwater that can then serve as a drinking water source or a source of water to streams. Critical Aquifer Recharge Areas (CARAs) occur where the underlying geology allows water to infiltrate and replenish the aquifer. Land development activities and infrastructure have historically conveyed stormwater to the nearest water body, which both circumvents the land's ability to absorb and retain water and increases the possibility of contamination. Except for the area along Browns Point streams basin and the upper portion of the Hylebos basin, almost all of the Planning Area is designated as a CARA. See Exhibit 4-5.

Wellhead protection zones surround the Planning Area's 27 wellheads, protecting them from potential pollution. The zones are delineated based on how long it would take a particle of water to travel from the wellhead protection zone boundary to the well. The Puyallup mainstem, lower Wapato, delta area streams, Browns Point streams, and Puyallup tributary ravines basins are within the 10-year travel wellhead protection zone, where potential high- and medium-risk contaminant sources are subject to increased regulatory attention through municipal code, with an emphasis on pollution prevention and risk reduction. The Hylebos and upper Wapato basins are within the 5-year travel wellhead protection zone, which provides information to planners when siting future high- and medium risk potential contaminant sources. The 1-year and 6-month travel wellhead protection zones, found in the lower Hylebos, middle and upper Wapato, and Puyallup tributary ravines basins are managed to protect the drinking water supply from viral, microbial, and direct chemical contamination. Areas identified within the 5-year, 1-year, and 6-month travel wellhead protection zones are considered higher risk for groundwater contamination. Planners should consider this information when siting future development that might have higher contamination risk.

CARAs and wellhead protection zones are protected under municipalities' critical area ordinances that overlap with the Planning Area. Existing regulations include lists and descriptions of allowable alterations and land use, performance standards, and activities and uses that are prohibited in CARAs, which vary between jurisdictions. While development is allowed within CARAs, land use activities and types of development that generate pollutants may be restricted or prohibited by the critical area ordinance regulations.

Exhibit 4-5: Groundwater and Critical Aquifer Recharge Areas.



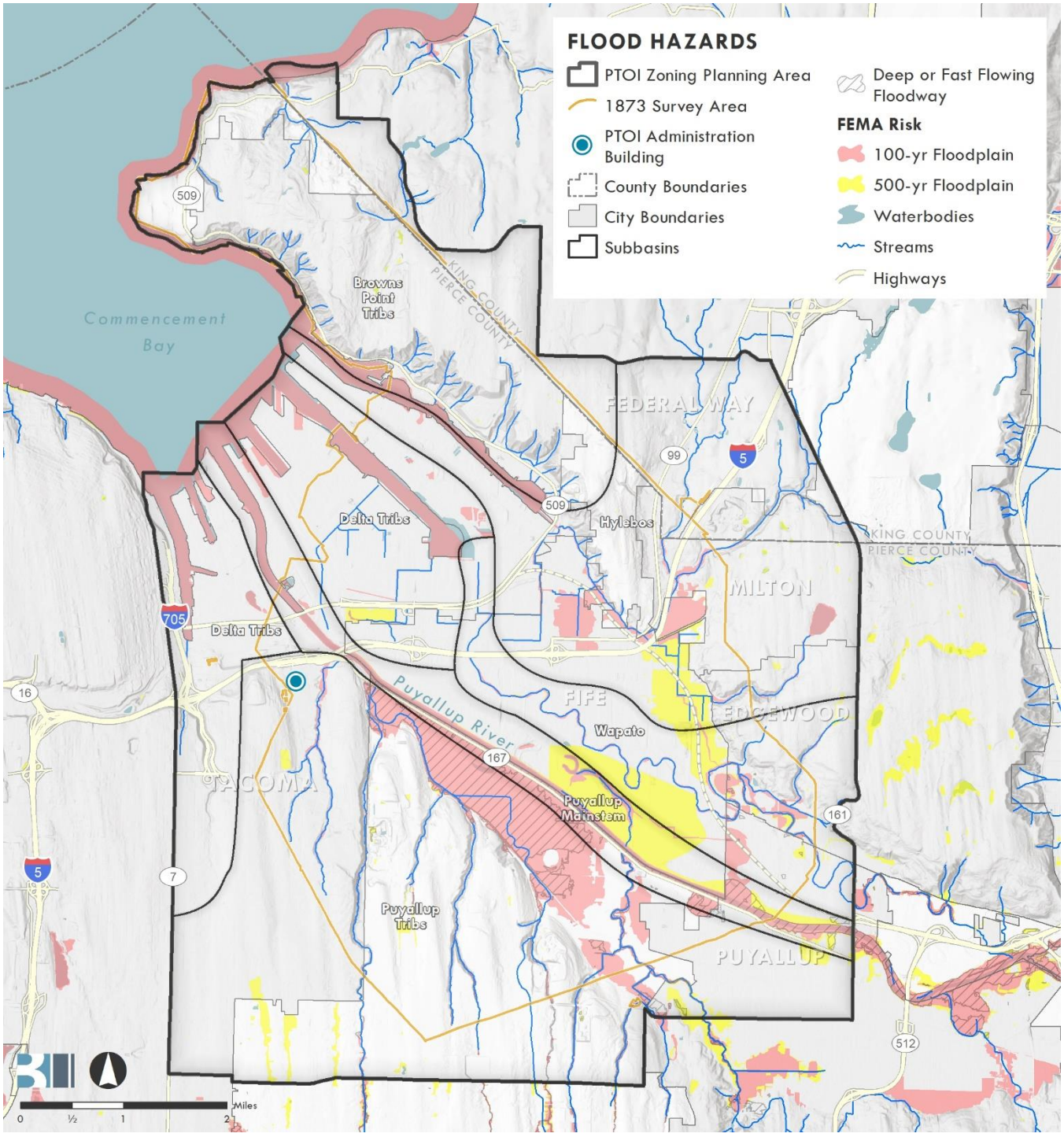
Source: WA DOH, 2021; Pierce County, 2021; BERK, 2021.

Frequently Flooded Areas

Frequently flooded areas are in a floodplain and are subject to a one percent or greater chance of flooding in any given year. This includes but is not limited to areas such as streams, lakes, and wetlands. Flood hazards were determined by the FEMA 100-year flood map and GIS data from the Cities of Tacoma, Puyallup, Fife, Edgewood, Milton, Federal Way. The area along the Port of Tacoma and the Puyallup mainstem are within the 100-year

floodplain and portions of the Puyallup mainstem and Wapato basins include areas within the 500-year floodplain. See Exhibit 4-6. Development in floodplains increases flooding risk. Frequently flooded areas are regulated by municipal shoreline master programs.

Exhibit 4-6: Flood Hazards.



Source: FEMA, 2021; Pierce County, 2021; BERK, 2021.

Geologically Hazardous Areas

Geologically hazardous areas are susceptible to erosion, sliding, earthquake, or other geological events. They pose a threat to the health and safety of residents when incompatible commercial, residential, or industrial development is sited in areas of significant hazard. The combination of steep topography and erodible soils has created geologically hazardous areas along the Delta area small tributaries and Puyallup tributary ravines basins. See Exhibit 4-8.

In addition to the landslide hazards, the Puyallup mainstem, Wapato, lower portion of Hylebos, and delta area streams basins are within the volcanic hazard area, representing the lahar flow path if təqʷuʔməʔ (Mount Rainier) were to erupt. The municipalities that overlap with the Planning Area have critical area ordinances in place to protect these geologically hazardous areas.

Exhibit 4-7: Təqʷuʔməʔ (Mount Rainier) Volcanic Hazard Zones.

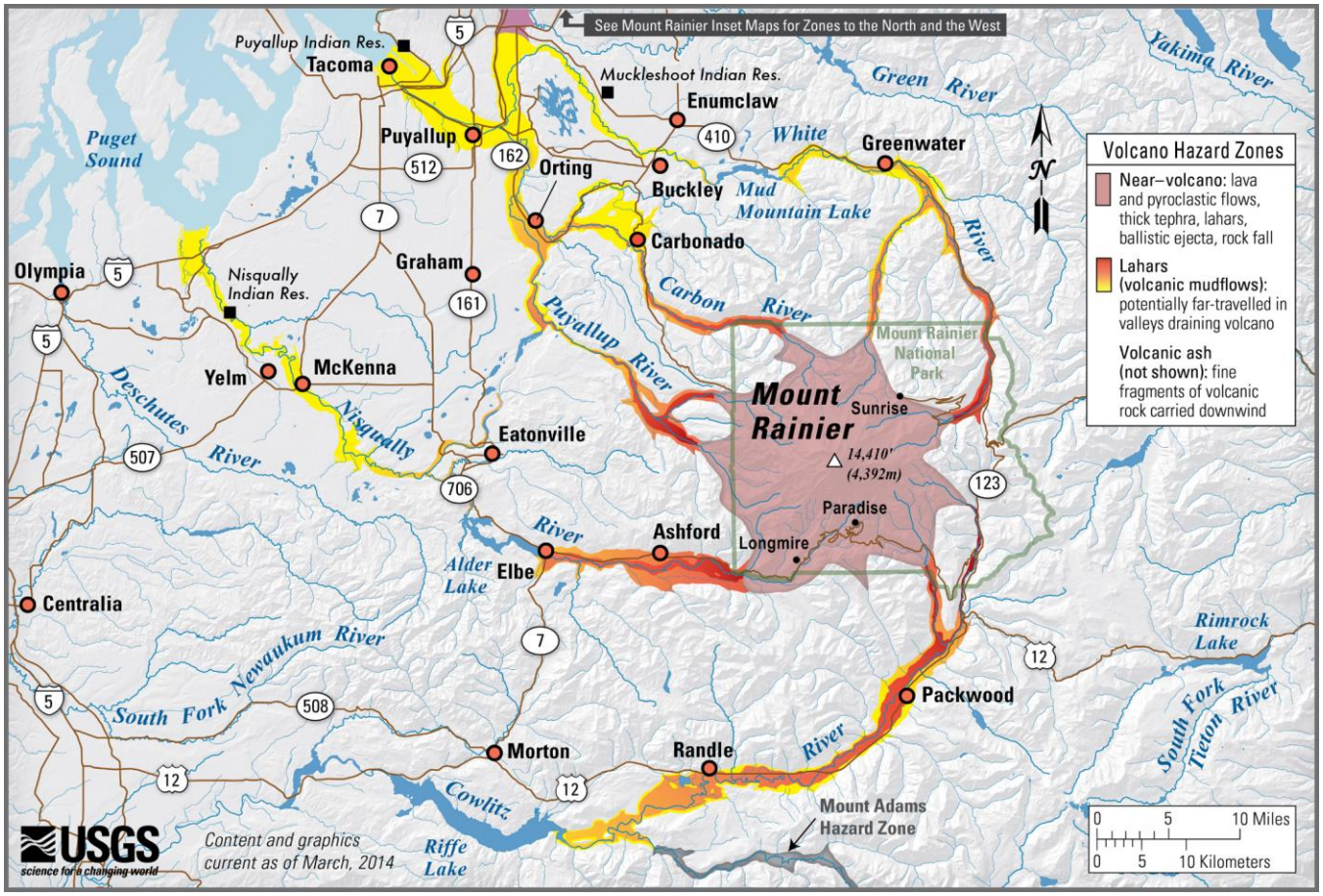
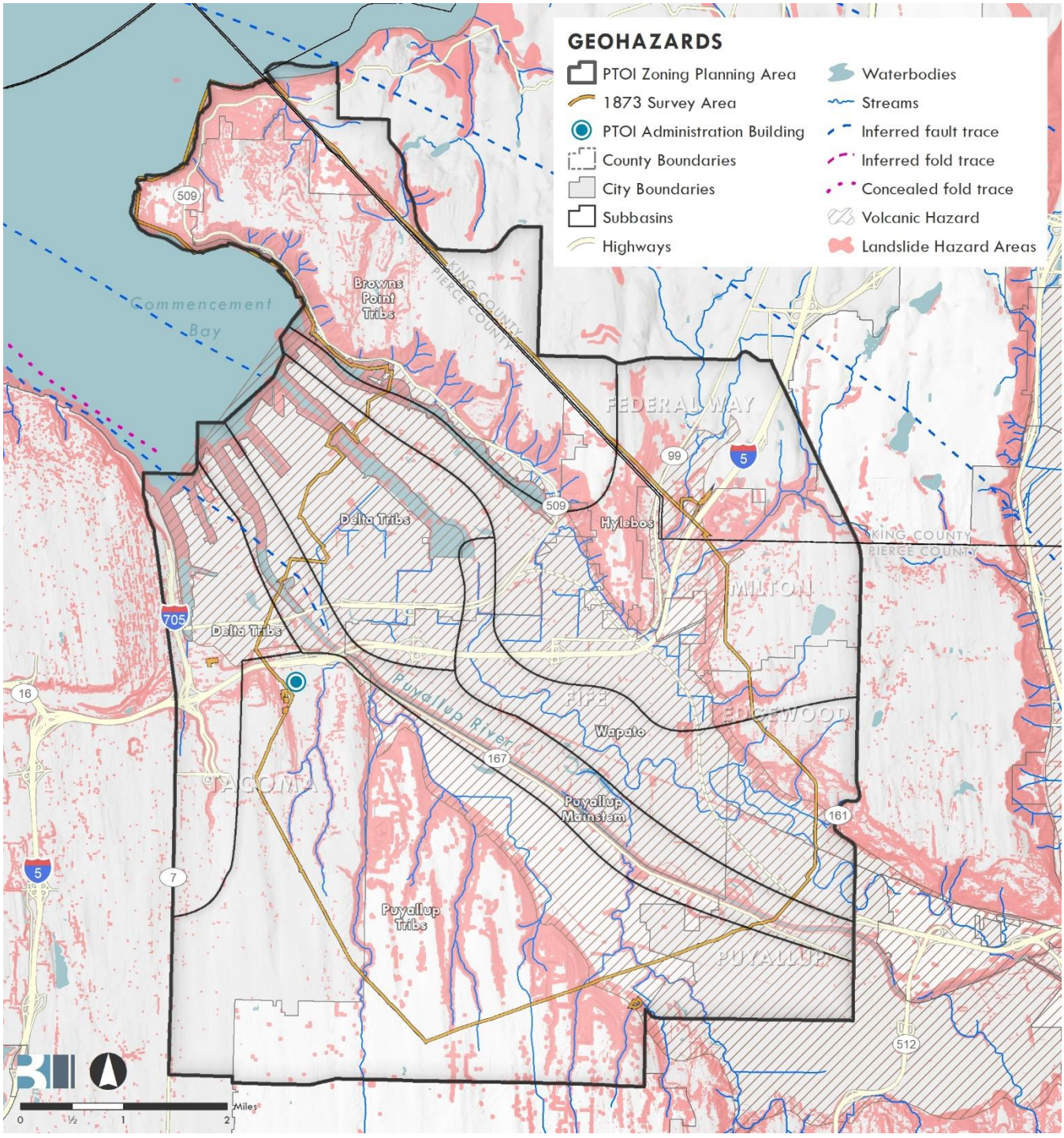


Image Source: USGS, 2014.

Exhibit 4-8: Geohazards.



Source: WA DNR, 2021; Federal Way, 2021; King County, 2021; Pierce County, 2021; BERK, 2021.

Wetlands and Streams

Wetlands provide flood storage and improve water quality by trapping and absorbing sediments and filtering pollutants. Wetlands are also productive biological areas that provide diverse habitat for wildlife. The National Wetlands Inventory (NWI) and GIS data from cities within the Planning Area were used to identify wetlands throughout the Planning Area. See Exhibit 4-10. The Hylebos basin in particular has a wetland that has been a

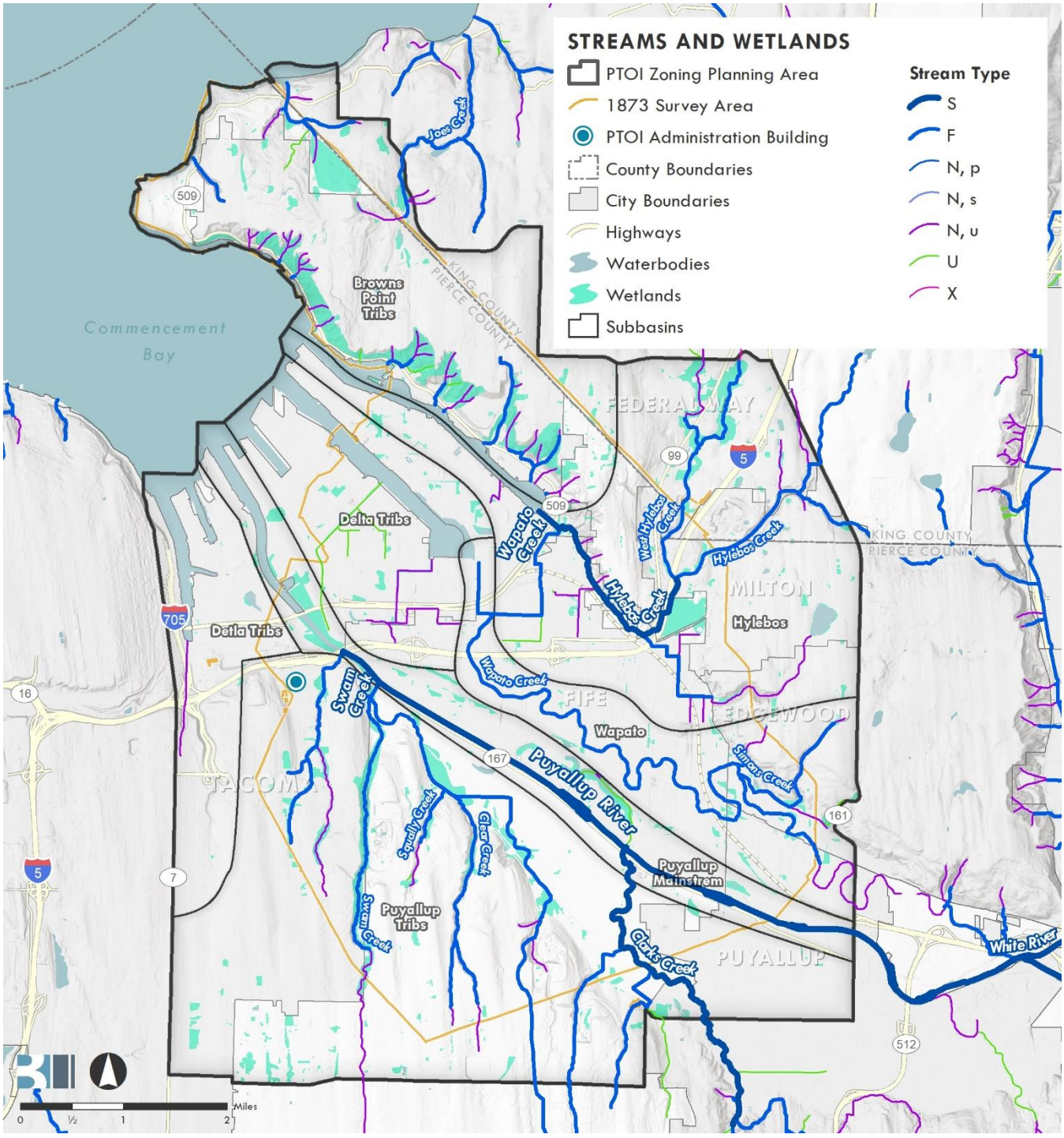
focus of restoration to improve habitat connectivity. As part of the SR 167 Gateway Project, both the Hylebos and Wapato wetlands are proposed for additional restoration as mitigation for impacts associated with extending the highway. Wetlands and streams in the Planning Area have been substantially affected by development. The natural system has been altered and, in many areas, no longer provides many of its original functions or habitats. The municipalities that overlap with the Planning Area have critical area ordinances in place to protect wetlands and streams. Cities may permit development that results in the loss of wetlands if certain criteria are met, but require compensatory wetland mitigation, such as through wetland creation, restoration, enhancement, or payment into an in-lieu fee program. Most of the mapped wetlands are associated with stream corridors.

Critical areas ordinances also include measures to protect streams by establishing protective buffers limiting activities that can occur those areas. Buffer widths vary based on municipality and stream type. Stream buffers are critical in sustaining needed habitats and species and maintaining the functional integrity of the stream ecosystem. Exhibit 4-9 summarizes stream types found within the Planning Area, shown on the map in Exhibit 4-10.

Exhibit 4-9: Stream Types within the Planning Area

Stream Type	Location(s) within Planning Area	Description
S	▪ Puyallup mainstem (including Clarks Creek) ▪ Hylebos Creek mainstem	Shorelines of the state. "S" is a special category of shorelines in which statewide interests take priority. Specific uses are preferred, and the shorelines are protected with the greatest required buffer width.
F	▪ Hylebos Creek forks ▪ Wapato Creek ▪ Approximately half of the delta area streams ▪ Browns Point streams ▪ The lower reaches of the Puyallup tributary ravines	Fish habitat. Type "F"—streams have the second largest required buffer widths—are segments of natural waters connected to fish habitat and accessible to fish during some part of the year.
N, u	▪ Upstream reaches of the Browns Point streams ▪ Upstream reaches of the Puyallup tributary ravines	No known fish use and unknown status.
N, p		No known fish use and perennial status.
N, s		No known fish use and seasonal status.
U	▪ Delta area streams	Unnamed streams that have not been typed or modeled.
X	▪ Delta area streams	Unnamed streams that do not meet the definition for typed water and therefore have no water type designation (e.g., pipelines, sub-surface, or artificial connectors).

Exhibit 4-10: Streams and Wetlands.



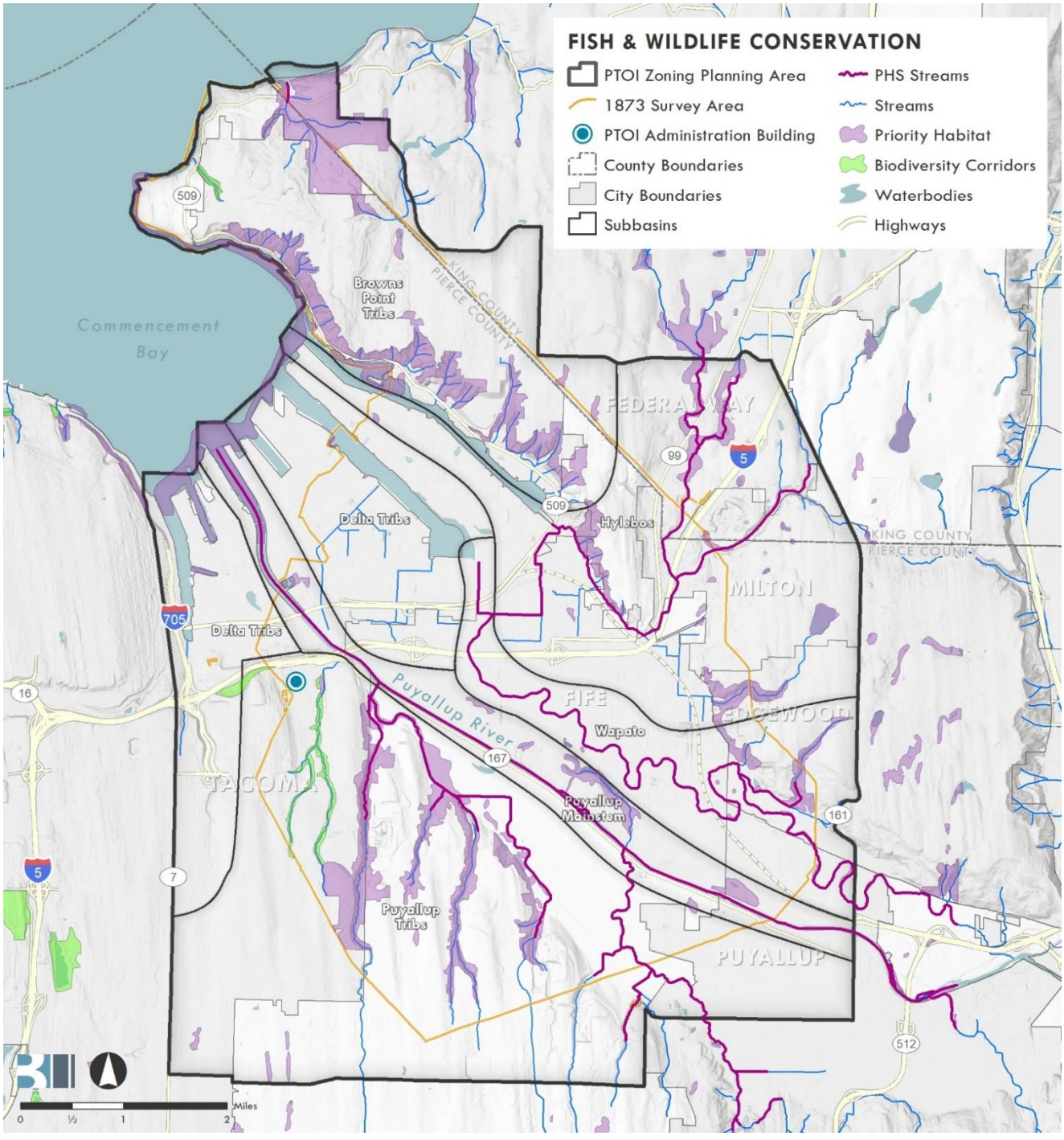
Source: Wetlands layers from all jurisdictions (Edgewood, Federal Way, Fife, Milton, Puyallup, Tacoma, Pierce County, King County, WDFW); WA DNR, NHD (National Hydrography Dataset); BERK, 2021.

Fish and Wildlife Conservation Areas

The Washington Department of Fish and Wildlife's Priority Habitat and Species (PHS) database and GIS data from cities within the Planning Area was used to identify PHS streams (i.e., streams that support priority species), priority habitat, and biodiversity corridors. See Exhibit 4-11. PHS streams were identified along the Puyallup

mainstem, Hylebos, Wapato, and the downstream reaches of the Puyallup tributaries. Priority habitats include buffers along the downstream portion of the Puyallup mainstem and Hylebos Creek, all the delta area streams and Browns Point streams (Dash Point State Park), and the downstream portion of the Puyallup tributary ravine. The buffers along the Puyallup River mainstem and middle reaches of Hylebos Creek are minimal due to adjacent agricultural and industrial land use. The three existing biodiversity corridors along all streams within the Planning Area should be preserved: two near the downstream-most Puyallup tributary ravine stream, which includes McKinley Park in Tacoma, and one on Browns Point.

Exhibit 4-11. Fish & Wildlife Conservation.



Source: WDFW, 2021; Tacoma, 2021; BERK, 2021.

Existing Programs

The PTOI Tribal Fisheries Department's mission is to "preserve, protect and enhance salmon in usual and accustomed areas, and the water resources that determine their viability." The goal of the department is to fulfill its mission by leading and participating in habitat restoration efforts, harvest management/policy, fish enhancement projects, and research and monitoring activities. The PTOI Salmonid Escapement Monitoring and Evaluation Program combines watershed monitoring and evaluation efforts to determine the status, trends, responses, and uses by various life history stages of salmonids within the Puyallup/White River watershed. This program monitors and evaluates adult and juvenile escapement, survival, migration, distribution, and habitat utilization, as well as effects of in-river harvest management actions. PTOI also operates up to six acclimation ponds in the Puyallup/White River watershed to reestablish and enhance spring/fall Chinook salmon, winter steelhead, and coho stocks. In doing so, PTOI is rebuilding threatened Chinook and steelhead stocks to lead to their removal from the Endangered Species Act listing.

The PTOI Shellfish Department's mission is to "maximize and optimize the shellfish harvest rights secured through the Treaty of Medicine Creek. The Department protects habitats and populations of shellfish while providing a safe environment for commercial, ceremonial, and subsistence fishing for Tribal members." In addition to tracking and posting regulations and guidelines for activities such as commercial geoduck permitting and commercial spot prawn regulation, the Department collects data and posts analysis for reports such as the Dungeness Crab Survey or the Geoduck Harvest Forecast.

The Puyallup Tribe leads several habitat restoration efforts at risk of climate impacts.

Restoration sites within the PTOI Planning Area are threatened by rising sea levels and other climate change impacts. These areas, such as the Hylebos Waterway, Outer Hylebos, Clear Creek, and West Fork Hylebos Creek are important for building resilience and protecting local ecosystems.

Several wildlife species, such as the wolverine, northern spotted owl, and elk, are at risk of impacts both from climate change and development pressures. The Tribe is actively working to identify and preserve spaces for these species to thrive.

The PTOI Hunting & Wildlife Department protects hunting rights and tracks regulations related to wildlife. Their mission statement is: "We hunt to stay connected to our land, identity and to honor the traditions set forth by our ancestors to protect and preserve wildlife." A map of Tribal Hunting Impact Areas can be found in Exhibit 1-4.

Each municipality that overlaps with the Planning Area has open space plans that guide management and conservation of urban forest lands, parks, trails, and recreational areas. The cities' critical areas ordinances and codes protect critical areas, including those that overlap with open space and natural resource areas. Shoreline master programs (SMPs) are local land-use policies and regulations adopted by each municipality within the Planning Area. The SMPs protect natural resources, provide public access to public waters and shores, and plan for water-dependent uses.

KEY FINDINGS AND IMPLICATIONS FOR THE PLAN

All basins in the Planning Area support several salmonid populations, including populations of ESA-listed Chinook salmon and steelhead. Several stream corridors are disturbed by development, with fish passage barriers and

elevated temperature and fecal coliform bacteria. Although past and present restoration projects have ameliorated some impacts from development, further restoration and conservation would increase connectivity and improve water quality and salmonid habitat. Improved water quality in streams and habitat connectivity could be achieved by:

- Considering the type of development associated with CARAs and wellhead protection zones.
- Creating green design guidelines to minimize impervious surfaces associated with development.
- Setting aside additional biodiversity corridors and fish and wildlife conservation areas.
- Establishing regulations to protect existing natural resource areas and expand buffers within developed areas to preserve biodiversity corridors, reduce erosion risk, and establish regulated buffers.
- Increasing opportunities for infiltrating stormwater.
- Encouraging adjacent cities to adopt stormwater plans that have improved measures for flow control.

The regulations within each municipality that overlaps with the Planning Area vary in buffer widths to protect critical areas. Consistent buffer widths and coordinated restoration and conservation efforts would reduce habitat fragmentation. Further management of the buffers—such as requiring parameters for riparian cover and native plant diversity and eliminating buffer averaging and variances—would enhance the beneficial functions of riparian corridors adjacent to stream habitat.

Acquisition remains a high priority for supporting fisheries, shellfish, and hunting activities both within and outside of the Planning Area.

Climate change will exacerbate many impacts associated with development. These include erosive forces that degrade habitat, water quality issues in streams associated with larger and more frequent storms, and impaired delta and estuary conditions due to sea level rise and saltwater intrusion. Enhanced critical area protections—including conservative buffer widths and improved habitat connectivity—would increase flood storage and improve water quality to respond to additional flood events, rising sea levels, and increased water temperatures and suspended sediment loads. PTOI should continue their restoration efforts, especially those focusing on large multi-benefit projects that restore habitat, improve water quality, remove fish passage barriers, and improve habitat connectivity.

Climate change will have many impacts on different species in the Planning Area. Salmon migration timing can change with warmer temperatures, reducing growth rates and increasing vulnerability to disease. It will be harder for shellfish to form and maintain their shells with ocean acidification, and rising sea levels will reduce the extent of their shoreline habitats. Wildlife will experience impacts to survival and seasonality with changes in temperature and precipitation. Conservation efforts must prioritize actions that will mitigate the adverse consequences of our changing climate.

5. Climate Resiliency

INTRODUCTION

With impacts spanning all chapters of this Existing Conditions Report, climate resiliency is key in this comprehensive planning effort. This chapter discusses different aspects of climate change and natural resiliency, as well as strategies to increase resiliency.

Climate Change Impacts on the Puyallup Watershed

Climate change will affect PTOI in many ways, including sea level rise that threatens critical infrastructure and residential communities, precipitation changes, increased flood frequency and magnitude, saltwater intrusion, habitat loss, and elevated temperatures in salmon-bearing streams. Changes in stream hydrology, including temperature, may affect the timing of salmonid migration, reduce growth rates, increase egg mortality (from increased temperatures and high flows), and increase vulnerability to toxins, parasites, and diseases. Hazardous events such as floods, heat waves, and coastal and stream bank erosion will increase in intensity and frequency, putting additional pressure on critical infrastructure, such as the Puyallup River levees, which are necessary to prevent catastrophic damage from flood events. The Planning Area is particularly climate-sensitive; several recent studies are referenced in this chapter to summarize these vulnerabilities. The summary of key drivers of change and anticipated impacts included below is followed by sections describing existing conditions in more detail.

Key drivers of change in the Puyallup watershed are due to many factors, including:

- Substantial warming
- Increasing heavy rainfall
- Changes in hydrology such as snow and streamflow
- Sea level rise
- Changes in ocean conditions

All scenarios indicate rapid warming in the region. By mid-century, average annual temperatures are likely to exceed those observed in the 20th century.

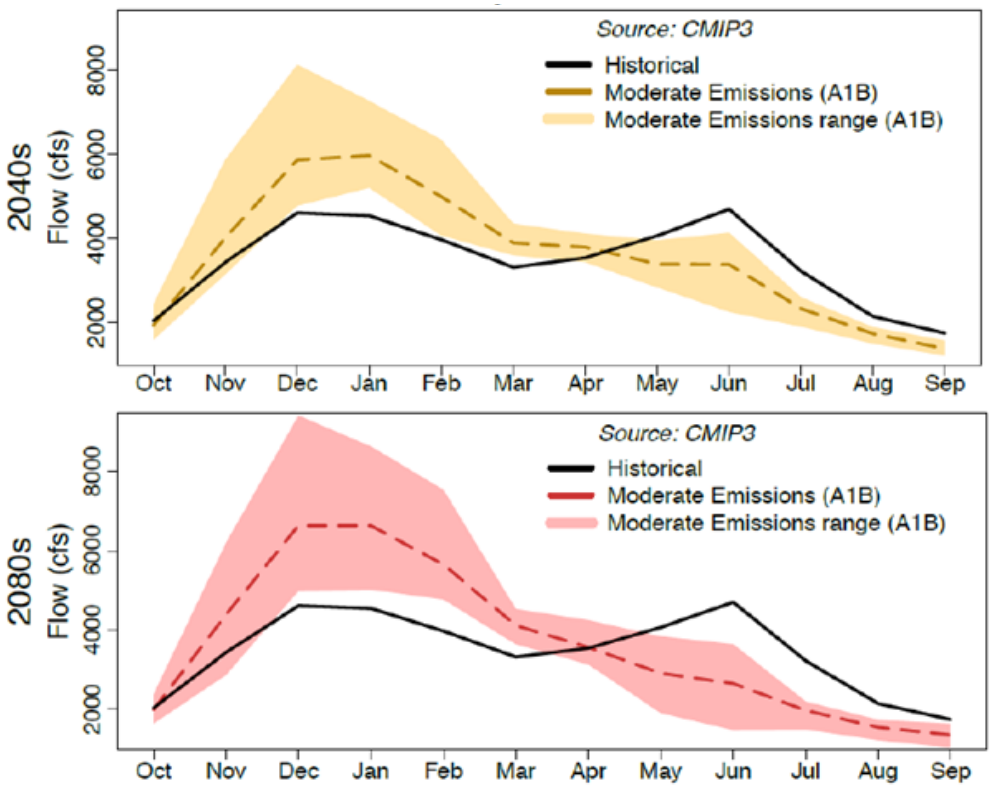
Exhibit 5-1: Projected temperatures, 2050s-Tacoma (2040-2069, relative to 1950-1999).

Emissions Rate	Projected Temperature Change in the 2050s
Low Emissions (RCP 4.5)	+4.0 Degrees F (2.8-5.3 Degrees F)
High Emissions (RCP 8.5)	+5.3 Degrees F (4.1-7.0 Degrees F)

Source: Climate Impacts Group; Data source: Downscaled climate projections developed by Abatzoglou and Brown (2011). Tacoma changes: Tohver and Whitely Binder 2015.

Continued variability in precipitation is also expected, including modest increases in average annual precipitation that would reinforce seasonal patterns and bring more intense rain events. Snowpack—the region's main mechanism for storing water—is projected to decline by as much as 55% by 2080 under a high greenhouse gas emissions scenario.[14] This is projected to shift precipitation from snow to rain, increase winter streamflow (with peak runoff occurring as much as two to six weeks earlier), lower summer streamflow, and extend the low-flow period.

Exhibit 5-2: Projected Shifts in Monthly Streamflow for the Puyallup River.



Note: Naturalized flows (flows without the influence of dams) Source: State of Knowledge, Climate Change in Puget Sound, 2015.

Projected snowpack decline, and increased rainfall, have contributed to increases in streamflow volume and increased flood risk within the Puyallup watershed.

Exhibit 5-3. Projected Changes in Streamflow for the Puyallup River by 2080 Under a Moderate Greenhouse Gas Emissions Scenario

Watershed Impact	Projected Change for Puyallup River
100-Year Event Streamflow	+37% (+10% to +88%)

Note: Changes relative to 1970-1999. Sources: State of Knowledge, Climate Change in Puget Sound, 2015; An Overview of the Columbia Basin Climate Change Scenarios Project, Atmosphere Ocean, 2013.

[14] State of Knowledge, Climate Change in Puget Sound, 2015; An Overview of the Columbia Basin Climate Change Scenarios Project, Atmosphere Ocean, 2013.

With these changes, increased fire risk in western Washington would affect habitat quality, though the extent of this effect is difficult to quantify. Increased fires can also affect stream temperature and sediment/nutrient loading rates.

Lastly, increased sea level rise is expected in the watershed. Prior to inundation, sea level rise increases the risk of flooding, storm surge reach, shore/bluff erosion, habitat loss, toxics mobilization, and saltwater intrusion.

Informative studies on climate change for this area can be referenced for additional detail and technical analysis include:

- Puyallup Climate Change Impact Assessment (2016)
- Tacoma Climate Action Plan (2021)
- State of Knowledge: Climate Change in Puget Sound (2015)

EXISTING CONDITIONS

Precipitation and Streamflow

The timing and duration of annual precipitation patterns are expected to bring wetter winters and drier summers, though changes will affect basins differently. The Planning Area will transition from a rain-on-snow dominated basin to a rain dominated basin, which will affect the timing of peak river flows—the Puyallup River usually experiences an annual bimodal peak flow distribution. The transition to a rain dominated pattern will likely affect salmon run timing and migration. See Exhibit 5-3.

Puyallup Mainstem

Recent research shows summer low flows in the Puyallup will be reduced, due primarily to reduced snowpack in its headwaters on təqʷuʔməʔ. The largest flood events, associated with "atmospheric rivers"—relatively narrow regions in the atmosphere that transport most of the water vapor outside of the tropics—are expected to increase in frequency and magnitude. Sediment supply is anticipated to continue at consistent levels and remains a problem in the Puyallup. United States Geological Survey (USGS) estimates that a million cubic yards of sediment comes down the Puyallup system from the glaciers.[15] The lower Puyallup within the 1873 Survey Area is a depositional area for some of this sediment. PTOI's Fisheries Department has worked over the years to prevent dredging and gravel bar scalping to prevent further habitat degradation.

Turbidity, or cloudiness in water, is a key water quality parameter and is high in both the White and Puyallup Rivers. While glaciers drive sediment into the Puyallup in summer, changes to peak air temperatures that melt glaciers may alter the timing of glacial flows. Effects of this change on juvenile salmon outmigration are unknown. The lower Puyallup is a salt wedge estuary that is important for smoltification—juvenile fishes' transition from fresh to salt water—of salmon migrating to the ocean. The extent and salinity gradient is likely to change with climate change and this could affect the viability of smoltification sites.

[15] https://pubs.er.usgs.gov/publication/sir20105240

Hylebos

Hylebos will experience the same changes as the Puyallup mainstem, though to a lesser extent. Continued development, however, may exacerbate these changes more than in the Puyallup, despite new stormwater regulations that prohibit increases in runoff. Low flows will be moderated by groundwater inputs, particularly downstream of the forks, but remain a limiting factor for salmonid use. This will not mitigate the existing issues on salmonid habitats due to low flow events.

Wapato

Wapato streamflow will be strongly influenced by precipitation changes because it was less groundwater input than Hylebos and its headwaters are more developed, likely resulting in less infiltration of runoff. These conditions will contribute to decreased low flows. Ongoing stormwater diversions to the Puyallup will exacerbate these changes. Channel modifications also affect hydrology, including lowering the groundwater table, further exacerbating the effects of altered streamflow and elevated water temperature. Lowering the groundwater table can lead to more frequent and greater magnitude low water events, which will further affect limiting factors for salmon if not mitigated.

Delta Area Streams

These small tributaries are strongly affected by small, intense thunderstorms, which are expected to increase in magnitude and frequency. The lowest flows will continue to be supported by groundwater—though more variable than in Hylebos—but increased salinity from sea level rise could affect habitat and water quality. The mitigating effect of ground water input on low flows and higher stream temperatures in the delta streams were not modeled and are therefore uncertain. The salt wedge on small delta streams is likely to penetrate further upstream, particularly at high water due to sea level rise. This would affect both conditions within coastal wetlands, vegetation patterns in riparian areas, and large woody debris recruitment in streams.

Browns Point Streams

Like the small delta tributaries, the small, intense thunderstorms that dominate the hydrology of this basin will become more frequent, increasing flooding and potentially sediment input and erosion.

Puyallup Tributary Ravines

Like the other small tributaries, small, intense thunderstorms will become more frequent, increasing flooding and potentially sediment input and erosion. In the case of this basin, existing and future development could exacerbate these impacts, particularly dense development. These low elevation tributaries are especially important for chum, which do not migrate further up in the watershed. Moderating the impacts of more frequent and intense storms in the fall and winter is imperative when salmon life stages are so fragile.

Stream Temperature & Ocean Acidification

Ocean acidification will continue. Shellfish productivity is expected to decline and food web changes in the open areas of Commencement Bay and Puget Sound are expected to trend away from fin fish (e.g., salmon and rockfish) to pelagic invertebrates (e.g., krill and jellyfish). The more significant change will be elevated stream temperatures, which can be lethal for salmon. While impacts will be different for each basin, most streams in the Planning Area are already experiencing warmer conditions.

Puyallup Mainstem

Puyallup mainstem stream temperatures are expected to increase throughout the year, especially in the low-flow summertime. Lower flows combine with more radiative forcing (heating) to significantly impair the river for anadromous fish over time. These changes make identification of cold water refugia, restoration of hyporheic inputs, and acquisition of property to protect these features crucial for fisheries and overall water quality.

Hylebos

In its lower reaches, Hylebos is greatly influenced by groundwater and is one of the coolest Puget Lowland streams, particularly in the summer. Groundwater input buffers changes in atmospheric forcing (heating) and the annual hydrograph, conditions expected to continue until at least 2050. Using 2.5 feet of sea level rise, modeling determined that groundwater will overpower surface water quality issues, specifically related to temperature. While models do not predict sea level rise beyond 2.5 feet by 2050, greater uncertainty exists for projections beyond 2050.

Wapato

Climate change will influence temperatures in Wapato more than in Hylebos. As a slightly steeper stream in its lower reaches, Wapato it is less influenced by groundwater inputs and more influenced by runoff, which will change due to the precipitation changes mentioned above. If allowed to continue, stormwater diversions will cause further temperature increases in summer. Increased stormwater may also contribute to additional pollutants in Wapato Creek.

Delta Area Streams

The stream temperature impacts mentioned above for the other basins will also occur in delta area streams, with reduced impacts in marine areas due to cool water input from tidal action.

Browns Point Streams

Stream temperatures will be impacted less than in other basins because these tributaries have intact groundwater supply and riparian corridors. Marine influence is minimal because their estuaries have been largely obliterated by SR 509 and associated fill and development.

Puyallup Tributary Ravines

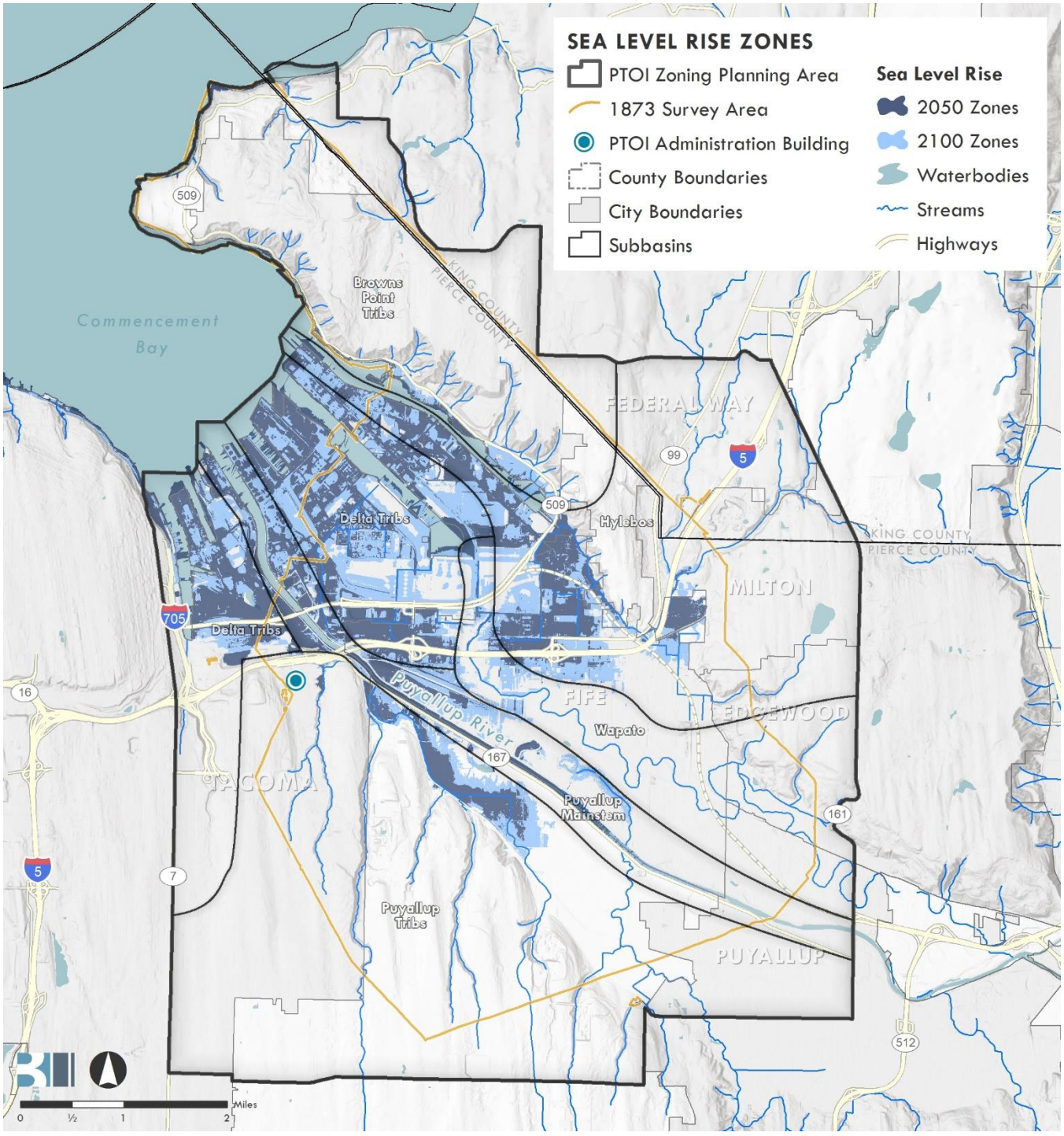
Stream temperatures in these freshwater tributaries will be influenced by increased air temperatures, increased heat forcing of contributing waters in developed areas, and increased water temperatures in the Puyallup itself. Maintaining groundwater inputs, promoting infiltration via permeable surfaces, and protecting and enhancing all categories of wetlands can help mitigate rising stream temperatures. There are very few opportunities for juvenile salmon to escape treacherous conditions on the mainstem. Puyallup River tributaries are critical habitat and provide a refuge from flows, temperatures, pollution, etc. These areas should be prioritized for protection and restoration.

Sea Level Rise

Sea level rise has already impacted the project area, though the impacts to date have been modest. The most significant has been to the Puyallup River itself, with sedimentation in the levee reaching several feet in places, but

inland-advancing salt wedges and marine life can be seen in most of the major drainages. Exhibit 5-4 shows the areas expected to be inundated during exceptionally large tides for 2050 and 2100. Sea level rise will continue beyond 2100, with many additional changes expected: although a risk to wells closest to marine areas, saltwater intrusion should be mitigated by artesian conditions that are present throughout the delta. Impacts to different basins and detailed below.

Exhibit 5-4: Sea Level Rise Zones.



Notes: Map includes king tides and the sea level rise is added to a 100-year high water event. Precipitation is not included.

Source: City of Tacoma 2016; BERK, 2021.

Puyallup Mainstem

Changes to the Puyallup River include increased water surface elevations and flooding, increased sedimentation in the lower river, and further upstream movement of the salt wedge, particularly in the low-flow period. These changes will collectively increase the frequency and magnitude of flooding of low-lying, adjacent floodplain areas, such as tributary basins like Clear Creek. These changes also bring the risk of catastrophic failure of the confining levees, which could have major consequences to PTOI and surrounding communities. While they protect critical Tribal resources, levees and bank armoring confine channels, resulting in altered sedimentation patterns, increased streamflow rates, altered channel complexity, reduced floodplain elevations, and other habitat impacts. Failed levees can result in hazardous conditions for downstream communities, degraded habitat connectivity, and potential impacts to spawn survival/emergence.

Hylebos

Sea level rise has been studied in Hylebos associated with the SR 167 Completion project. Due to the peculiarities of Hylebos, impacts are relatively limited to the lowest mile or so. Since much of the lower stream will be protected from development once the SR 167 Completion project is completed, these impacts should have a relatively minor impact on adjacent land uses. The existing section of creek near the SR 167 project will serve as a mitigation site and expand the capacity of the creek under current design.

Under existing sea level rise modeling, the mouth of Hylebos near "Place of Circling Waters" is expected to experience heavy inundation. It is a mitigation site and has a high likelihood of cultural resources. Impacts to this part of Hylebos are likely be some of the first major incidents given current sea level rise modeling.

Wapato

Impacts associated with sea level rise are less well known in the Wapato, but the relatively steep nature of this floodplain creek makes sea level rise impacts modest. Impacts are largely confined to areas downstream of I-5. While past fill also mitigates these impacts, it is likely that filled areas will be inundated in the latter half of the 21st century.

Delta Area Streams

Some of the most profound impacts from sea level rise will occur in these basins and surrounding areas. Even if gated, these low-lying, low-gradient streams will be significantly affected. Increased sea levels will prevent draining and create increasingly routine "nuisance flooding." In several instances, these impacts will affect both economic activity and major transportation corridors, such as I-5.

Browns Point Streams

These tributaries will be minimally affected by sea level rise due to their steep slope.

Puyallup Tributary Ravines

Sea level rise impacts in the ravines will be limited due to their steep slope and their relative disconnection from marine influence by the Puyallup River. Only the lowest reaches on the valley floor will be affected, with impacts both mitigated and magnified by the Puyallup River. Overall impacts will include the further penetration of the salt wedge up the Puyallup River with minor additional inundation of the lowermost reaches of the tributaries of the Valley floor, including Swan Creek, Squally, Clear Creek and Clarks Creek. If the tide gate is removed from the mouth of Clarks Creek, additional flooding is likely to occur in the lower reaches and near the confluence with the Puyallup River.

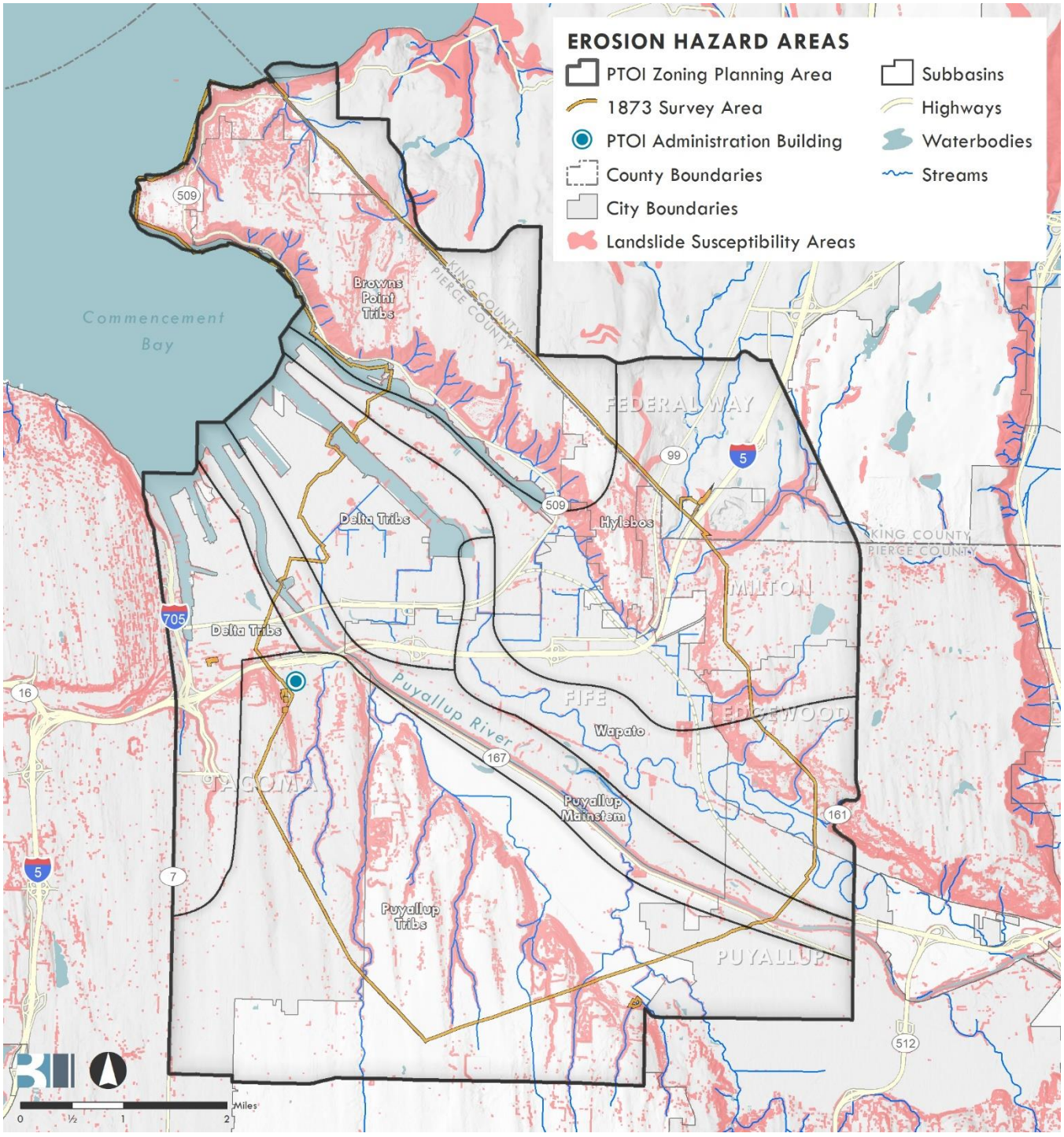
Other Natural Hazards

While wildfire hazard is expected to increase, little is known about the character of that hazard in these basins. More research is needed to understand how increased summer dryness will affect the developed forest canopies in the Puget Lowland. Regardless of the changing local hazard, air quality is likely to be affected by distant fires throughout the region.

Similarly, little is known about landslide hazard to the steeper portions of the Reservation. Increased tidal prism may undermine channel banks, leading to mass movement. More intense precipitation is likely, which can contribute to slope stability issues in areas that are already sensitive, but it is unclear whether the nature of the increases (e.g., their relatively short duration) would trigger increased instability in areas that are currently stable. See Exhibit 5-5. Increasingly short wet seasons might reduce landslide hazards in areas that are currently stable.

And as was discovered in June 2021, extreme heat waves may become more common. The degree of this hazard for the Reservation is largely unknown and remains a significant data gap.

Exhibit 5-5: Climate Erosion Hazard Areas.



Source: WA DNR, 2021; Federal Way, 2021; King County, 2021; Pierce County, 2021; BERK, 2021.

Existing Restoration and Adaptation Efforts/Programs

The Puyallup Tribe published a *Climate Change Impact Assessment and Adaptation Options* report in 2016, detailing the expected environmental impacts of climate change and outlining strategies for response and adaptation. This full report is attached in Appendix A: Climate Change Impact Assessment. The Tribe's

Sustainability Committee works to integrate sustainable practices into Tribal government and facilities as well as improve environmental conditions in the Planning Area. Efforts are underway to establish a new position for a Sustainability Manager to implement recommendations of the Emergency Climate Resolution approved by Tribal Council in 2019.[16]

Many of the strategies outlined in this assessment focus on restoration along major watercourses to build resilience and improve the environmental landscape. The following description of existing programs by watershed details efforts underway throughout the Planning Area.

Puyallup Mainstem

Restoration in the Puyallup River and its floodplain is difficult due to the amount and intensity of adjacent development. Confinement of the River has presented an unstable situation that will be exacerbated by climate change and sea level rise. While a General Investigation has been developed by the US Army Corps of Engineers to address these deficiencies, the plan is not currently funded and the risk of failure to the Puyallup River levees will increase with time.

Restoration efforts in several areas have made significant local improvements to fish habitat. Large projects—such as the Clear Creek tide gate removal and floodplain project proposed by Pierce County—are expected to provide meaningful reductions to stream temperature impacts and improvements in fisheries habitat. The scale of these efforts requires many partnerships with outside groups.

Clear Creek Tide Gate Removal and Floodplain Project

Pierce County has proposed a long-term plan to remove the existing Puyallup River tide gates. The current gates prevent the river from flooding the Clear Creek residential areas, but the gates also stop the creek waters from entering the river which can result in creek flooding of the areas the gates are meant to protect. The project proposes a ring levee system to replace the gates, as well as a wildlife habitat restoration site.

Project details can be found here.

Hylebos

Significant efforts to restore the lower sections of Hylebos Creek in the last 30 years have had encouraging results. Unlike the Puyallup, these smaller, piecemeal efforts can have a relatively larger impact, such that more than 90% of Hylebos Creek floodplain will be restored following the completion of Hylebos Riparian Restoration Program. Fish passage should be unimpeded to steeper portions of all its tributaries. Water quality remains a concern in this basin, requiring vigilance to ensure that increased development in the uplands does not undercut habitat restoration progress downstream.

Wapato

The Wapato basin has experienced fewer restoration efforts than Hylebos, although there are some ongoing and proposed restoration projects. Several new restoration actions are planned that will begin to build the buffer needed around the stream to protect in-water species and reduce adjacent climate-change-related flooding impacts to adjacent upland uses. Port infrastructure in the lowest reaches of Wapato should be a target for future restoration and adaptation to climate change, particularly sea level rise. Proposed restoration should address much of the potential flooding concern by providing greater flood storage and creating delta and estuarine habitat for rearing and migrating salmonids.

[16] http://news.puyalluptribe-nsn.gov/wp-content/uploads/2019/12/Signed-Resolution_Climate-Emergency.pdf

Delta Area Streams

Little restoration has been undertaken in this basin, partly because of the industrial nature of these watercourses. While they are not impacted from a hydraulic and geomorphic perspective, significant contamination has occurred from both historical (from past land uses) and ongoing (mainly from transportation-related) sources. The existing industrial land use and infrastructure provide little opportunity for restoration. Due to the low habitat value and current flood protection offered by the watercourses in the delta area streams, restoration projects in this basin should be a low priority and should not reduce the drainage associated with continued development, as this will be an increasing problem in the future.

Browns Point Streams

These ravines have not been intensely developed. While they provide little instream fish habitat due to the steep topography, they do represent an ecotype to be preserved, as well as place to store carbon and clean fresh water emanating from the uplands.[17] The shoreline includes valuable eelgrass and kelp habitat, essential for rearing juvenile salmonids. These tributaries will be minimally impacted by sea level rise due to their steep slope.

Puyallup Tributary Ravines

While some protection and restoration actions have been taken in publicly owned areas such as McKinley Park, considerable land in this basin remains in private ownership and is at risk for future infill development. Unless properly regulated, future development could exacerbate the impacts of climate change.

KEY FINDINGS AND IMPLICATIONS FOR THE PLAN

In the Puyallup basin, the combined impacts of larger flood events, sea level rise, ongoing sedimentation, and delta growth will pose a risk to the infrastructure and safety of those in the Planning Area, as well as additional risk to PTOI's fishery, shellfish, and natural resources. This places the PTOI and its neighbors on the Puyallup River delta at risk, affecting all elements of this Comprehensive Plan. Elsewhere, climate change will fundamentally alter the magnitude, duration, and timing of stream flows; continue to warm already-impaired streams; and reduce oxygen in the water column. These impacts will primarily impact in-water species. Sea level rise may also change environmental conditions and locally influence other chapters of the Plan, though impacts before 2050 should be localized near areas where flooding already occurs.

PTOI should continue its restoration actions where it has in the past: along salmon bearing rivers and streams throughout the watershed. These areas have the highest risk of changing conditions and impacts from climate change and represent the best restoration strategy, since they both improve environmental conditions in the short term and allow the landscape to adapt over time. Restoration should also make the landscape more resilient to changes brought by actions outside PTOI's control.

Climate change considerations should be integrally woven throughout PTOI planning efforts. The future of the area's habitat, ecosystem, and land use will be affected by more frequent and extreme weather events and differing conditions for various species' survival. The Puyallup Tribe can continue to demonstrate regional leadership in its policies that adapt to a changing environment and continue to focus on the seven generations.

[17] https://cms.cityoftacoma.org/Planning/Shoreline/Presentations/PC_SMP_Review_101806.pdf

6. Land Use

INTRODUCTION

This chapter describes existing land use patterns, development types, and character of the built environment across the Study Area. It also summarizes the Puyallup Tribe's pertinent plans, policies and regulations related to land use. Seven subareas organize the Planning Area into distinct zones, defined by waterways and natural features. This categorization is consistent with PTOI's focus on maintaining and restoring the integrity of natural habitats.

The PTOI Planning Area overlaps with boundaries of eight city and county jurisdictions. This interjurisdictional landscape introduces inconsistency in regulations and demands regional coordination for policymaking. The Puyallup Tribe can enact land use policy to promote climate resilience and community health. Regulations for housing development, commercial activity, and industrial uses are explored as a method for envisioning a strong future for current and future generations.

EXISTING CONDITIONS

Jurisdictional Boundaries

The Indian Reorganization Act (IRA) of 1934 ended the erosion of Tribal land through allotment and brought constitutions, governments, and Tribal sovereignty to Tribal communities across the country, including the Puyallup Tribe. By then, the allotment era (1887–1934, read more on page 3-3) had reduced the Puyallup's Tribe's ownership of lands within its homeland with a large proportion of land moving to non-Indian ownership. Today, the Planning Area overlaps with jurisdictional boundaries for six cities: Tacoma, Fife, Puyallup, Edgewood, Milton, and Federal Way. These cities span Pierce and King Counties and include both urban areas and unincorporated areas. Each jurisdiction has its own land use policies and zoning categories. Many state and local statutes and ordinances require notice and consultation with the Tribe before, during, and after project review. The federal government, state of Washington, Pierce County, the Port of Tacoma, and local municipalities have a government-to-government relationship with the Puyallup Tribe.

The Cultural Resources chapter explores the Puyallup Tribe's history in more detail, including the seizure of its ancestral homelands. Currently, land ownership for the Tribe or Tribal members falls into one of the below categories[18]:

- **Tribal Trust:** Land held in Tribal Trust is under the authority of the PTOI government. It is collectively owned by the membership and cannot be sold per the Puyallup Tribe Constitution and Bylaws. It is not subject to local property taxes.
- **Membership Trust Lands:** The General Allotment Act also known as the Dawes Act passed in 1887 altered the relationship of the Tribe with its homelands. Representatives of the federal government, called Indian agents, platted Indian homelands and "allotted" them to Tribal members. Allotments were made to Tribal

[18] Natural Resource Conservation Service

members according to arbitrary formulas included in the Act. There are few existing original allotments in the Planning Area.

Additionally, individual Tribal members are able to work directly with the Bureau of Indian Affairs to take fee simple land and apply to designate that land into trust status. This process requires the land to be owned outright and to undergo environmental assessment.

- **Fee Simple Ownership:** In 1906 the Dawes Act was further amended by the Burke Act. This introduced the fee simple patents or ownership into the allotment process that would allow Tribal members to own land outright. Fee simple lands are subject to local taxes. Historically, Tribal members were unfamiliar with these taxes, lacked access to support, and accrued large tax burdens. They often sold their lands to non-Indians in this situation.

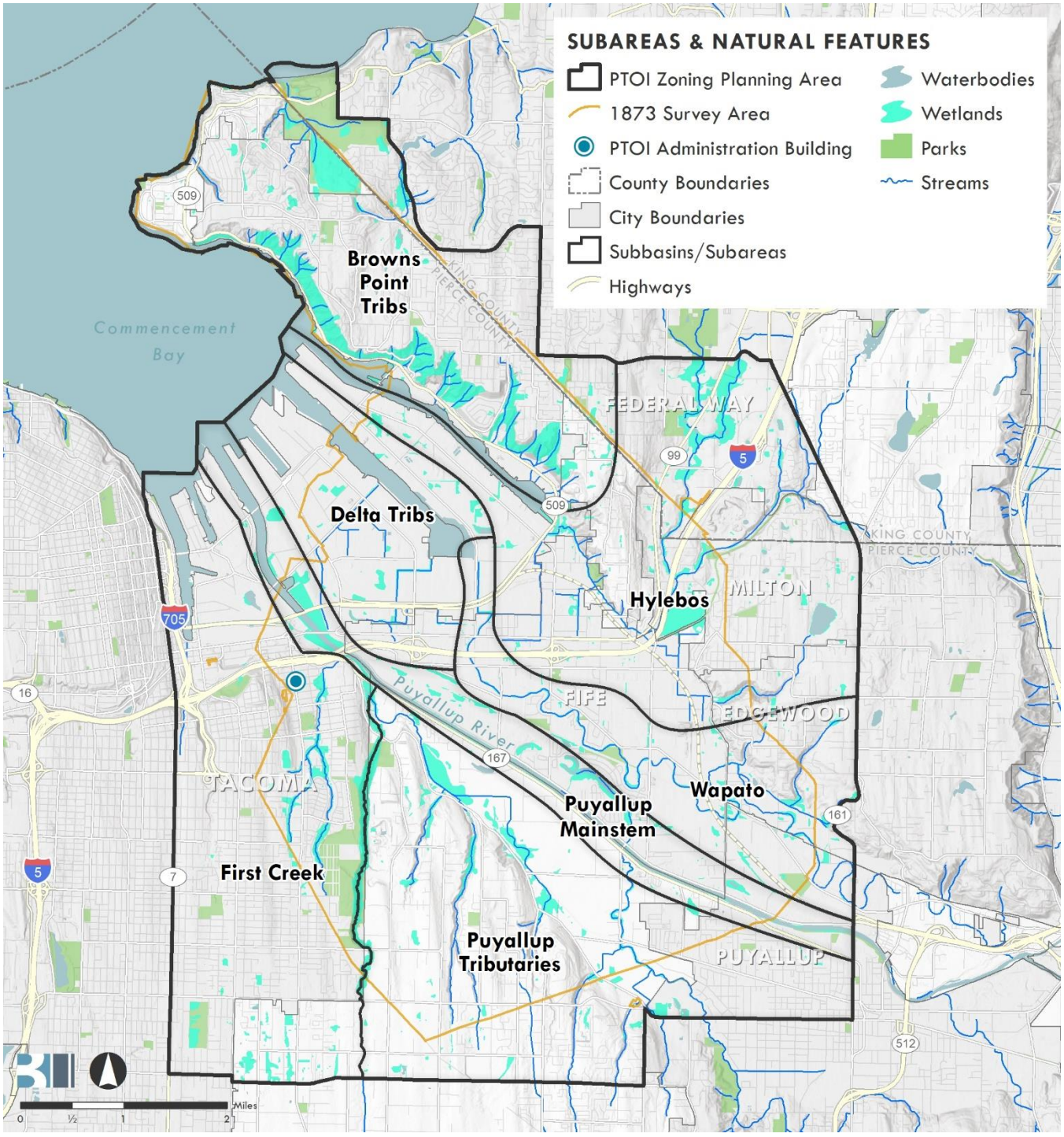
Planning Subareas

For planning purposes, this Plan considers the Planning Area in seven distinct subareas. These subareas are based on watersheds and natural features, rather than political boundaries or conceptual lines. This aligns with PTOI's focus on natural resource preservation and protection as the starting point for planning efforts. These subareas are shown in the Subarea Map in Exhibit 6-10 and described in this section.

Leading with Natural Resources: PTOI's Planning Approach

The subareas defined in this Comprehensive Plan reflect the watersheds and natural features of the area's geography. While this does not neatly align with the political boundaries of neighboring jurisdictions, it reflects the region's natural systems and is a more historically and culturally accurate representation of the Tribe's stewardship of the lands and waterways. The Puyallup Tribe demonstrates regional leadership through its commitment to prioritizing the health of natural resources.

Exhibit 6-1: Subarea Map, PTOI Planning Area.



Sources: PTOI, 2021; BERK, 2021.

Puyallup Mainstem

The Puyallup River drainage basin originates in the glaciers of təq^{w}uʔməʔ and flows through the Puget Sound lowlands to Commencement Bay and covers approximately 970 square miles, of which approximately 3.81 square miles are within the PTOI Planning Area. This subarea runs centrally through the Planning Area and includes the Puyallup River. This area represents the Tribe's top priority for protection and preservation of natural resources. The boundary overlaps with portions of Tacoma, Fife, Edgewood, Puyallup, and unincorporated Pierce County.

Landmarks and activity centers in this district include The Riverwalk Trail, a 5-mile pedestrian/bike path within the City of Puyallup; commercial and industrial development in the cities of Puyallup and Fife; Tacoma Junction at the crossing with I-5; and the mouth of the river opening into Commencement Bay.

Exhibit 6-2: Satellite view of Puyallup Mainstem Subarea, south of I-5.



Image source: Google Maps, 2021.

Browns Point Tributaries

Browns Point includes an approximately 8.45-square-mile basin consisting of streams that flow to Puget Sound. The subarea includes Dash Point State Park to the north, shoreline on western and southern boundaries, and PTOI-owned Chinook Landing. The future Tribal Dock and Facility is also located in this subarea. Development patterns are predominantly residential; the central portion of the subarea includes some of the highest residential density in the Planning Area. Highway 509 is a primary transportation corridor. This subarea overlaps with portions of Federal Way in King County as well as Northeast Tacoma and portions of unincorporated Pierce County.

Exhibit 6-3: Satellite view of Browns Point Tributaries.

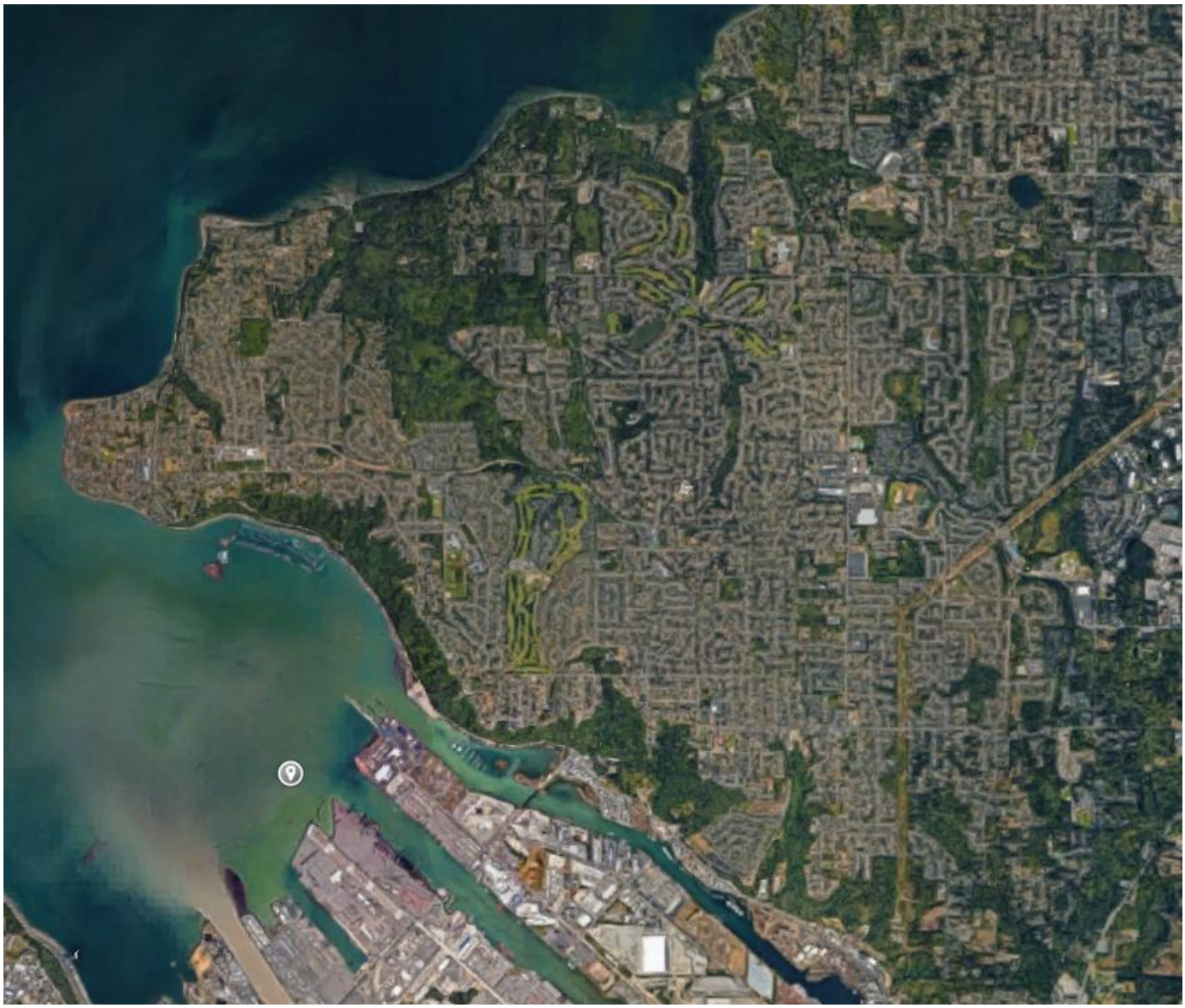


Image source: Google Maps, 2021.

Hylebos

Hylebos Creek flows from the city of Federal Way through the cities of Fife and Milton and empties into Commencement Bay in the city of Tacoma. Approximately 10.11 square miles of the lower basin are located within the PTOI Planning Area. There are commercial activity nodes along Highway 99 in Milton and along I-5 in Fife. The Emerald Queen Casino and Hotel is located in this subarea. The boundary overlaps with portions of Federal Way, Milton, Edgewood, Fife, and unincorporated Pierce County.

Exhibit 6-4: Emerald Queen Casino.



Image source: EmeraldQueenCasino.com, 2021.

Exhibit 6-5: Satellite view of Emerald Queen Casino and Hotel in Hylebos Subarea.

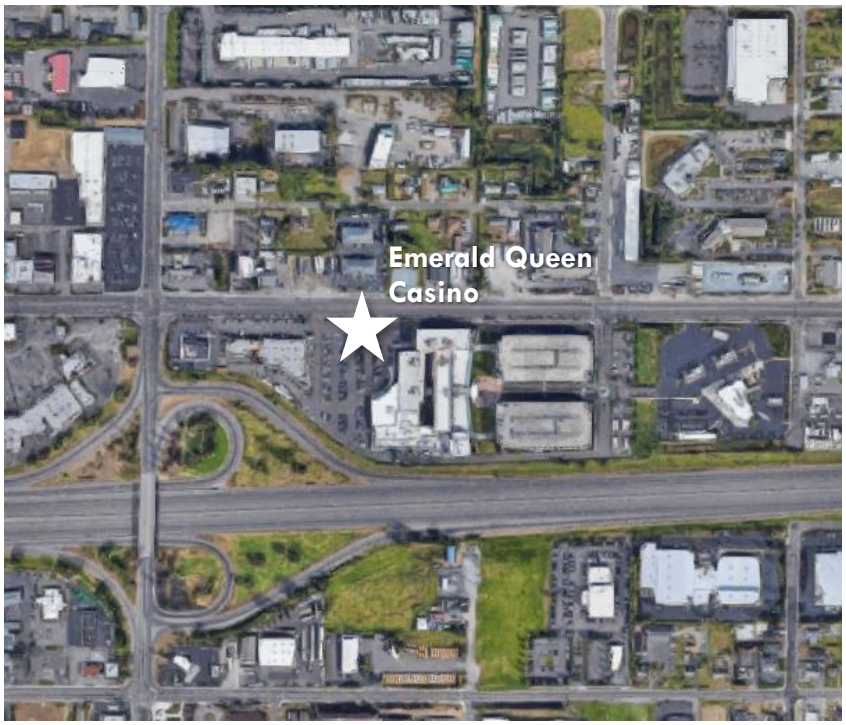


Image source: Google Maps, 2021.

Wapato

Wapato Creek flows from the area north of the city of Puyallup, through Fife, and empties into Commencement Bay in the city of Tacoma. The Wapato drainage basin encompasses 4.63 square miles of the PTOI Planning Area. The area captures some of the commercial activity along I-5 through Fife. It overlaps with the cities of Fife, Milton, and Puyallup, as well as areas of unincorporated Pierce County.

Exhibit 6-6: Commercial Development through Fife in Wapato Subarea.



Image source: Google Maps, 2021.

Delta Tributaries

The delta area streams flow through low-lying industrial areas in North Tacoma and the Port of Tacoma into Commencement Bay. The total basin area is approximately 7.20 square miles. This subarea incorporates much of what is commonly referred to as the "Tacoma Tideflats" area, including the Port of Tacoma. Development is heavily industrial, and this subarea is entirely within the city of Tacoma. The PTOI owns significant land here and is collaborating with other jurisdictions on a subarea plan for the area.

Exhibit 6-7: Satellite view of Delta Tributaries Subarea



Image source: Google Maps, 2021.

First Creek

This subarea includes all of the Planning Area south of the Puyallup River and west of Swan Creek, including First Creek and its tributaries. Swan Creek Park runs north/south along the eastern border of the subarea. Development in this subarea is predominantly residential. It also includes a small portion of the Tideflats, west of Puyallup River, and is home to the site of the newly opened Emerald Queen Casino's second location. The boundary overlaps with portions of Tacoma and a small area of unincorporated Pierce County.

Exhibit 6-8: Satellite view of Emerald Queen Tacoma and PTOI Administration Building, along with residential neighborhoods in First Creek subarea.



Image Source: Google Maps, 2021.

Puyallup Tributaries

This area includes all of the Planning Area south of the Puyallup River and east of Swan Creek. This includes the Squally, Clarks, and Clear creeks and their tributaries. Pioneer Way and Canyon Road are two main transportation corridors through this area. This subarea includes the most agricultural property within the Planning Area, as well as Chief Leschi School. Downtown Puyallup is located in the southeast corner of the area. The boundary overlaps with much of unincorporated Pierce County and portions of the City of Puyallup.

Exhibit 6-9: Satellite view of residential and agricultural land, Chief Leschi Schools in the Puyallup Tributaries subarea.



Image Source: Google Maps, 2021.

Land Use Regulations: Puyallup Tribal Code

The Puyallup Tribe operates and administers a set of laws and regulations collectively referred to as the Puyallup Tribal Codes (PTC). Title 15 of the PTC addresses land use with a Zoning Ordinance (Chapter 15.12) that contains district classifications for all lands within its jurisdiction. In addition, the Land Use Consultation Process Ordinance (Chapter 15.08) sets out the process for land use decisions by the Tribe and local governments.

The PTC establishes 14 zoning districts. These 14 districts are summarized in Exhibit 6-10. There are three

residential zones, three commercial zones, two industrial zones, and six zones for public facilities, natural resource protection, and agriculture. The zoning district classification system is typical of a growth management oriented city and does not accommodate unique Tribal values or land use needs. As noted earlier, given the zoning has not been applied geographically, existing zones are limited in their utility and impact on existing or future land use.

Exhibit 6-10: Existing Zoning Districts

Zoning District		Intent
1.	Rural single-family residential district	A transitional and residential district to provide for estate-type residential development and for the performance of limited agricultural activities. This district would normally be located in rural areas and serve as a buffer between urban and unlimited agricultural uses. These areas are generally beyond the service area of city sewer and water facilities.
2.	Single-family residential district	A residential district to provide areas for urban single-family development; should have good thoroughfare access, and be in proximity to community and neighborhood facilities, i.e., schools, parks, shopping areas, etc. This development will normally require all public utilities.
3.	Multiple-family residential district	A residential district to provide areas for urban multiple-family development; should have good thoroughfare access, and be in proximity to community and neighborhood facilities, i.e., schools, parks, shopping areas, etc. This development will require all public utilities.
4.	Neighborhood commercial district	A business district to provide certain commercial and professional offices uses where such uses are compatible with the adjacent residential areas. This district should serve as a buffer between residential areas and other commercial districts and primarily serve the daily needs of the surrounding residential populations.
5.	General commercial district	A business district to provide areas for the development of community shopping areas, to serve the range of a number of neighborhoods to a major segment of the Planning Area.
6.	Freeway commercial district	A business district to provide areas for those retail sales and service functions and businesses whose operations are typically characterized by outdoor display, storage and/or sale of merchandise, by major repair of motor vehicles, and by outdoor commercial amusement and recreational activities.
7.	Light industrial district	An industrial district to provide areas for those industrial uses that typically do not create objectionable characteristics such as dirt, noise, glare, heat, odor, smoke, etc., which extend beyond the lot lines. Light industrial uses would include light manufacturing, processing, fabrication and assembling of products or materials, warehousing and storage and transportation facilities.

Zoning District		Intent
8.	Heavy industrial district	An industrial district to provide areas for heavy manufacturing, processing, fabrication and assembling of products or materials.
9.	Public lands and institutions district	A public district to provide and reserve areas for public uses in order to preserve and provide adequate land for a variety of community facilities which serve the public health, safety and general welfare. Such public uses would include schools, public buildings, parks and open space areas.
10.	Shoreline district	A district to provide protection for the water and near shore resources. A district which may allow for limited development when it can be determined that the development is consistent with the needs of the environment and that development preserves the Tribe's right to access the shoreline areas.
11.	Tidelands district	A district to provide protection for tidelands and near tidelands resources. A district intended to protect and enhance the natural processes of tidelands ecology.
12.	Historical, cultural and other significant lands district	A district to provide protection for historical, cultural and other significant areas which are of importance to the Puyallup Tribe of Indians.
13.	Agriculture district	A district for commercial agricultural development.
14.	Forest, wetlands and other significant resource lands	A district for areas of undeveloped forest, wetlands, and other significant resource lands.

Land Use Mix

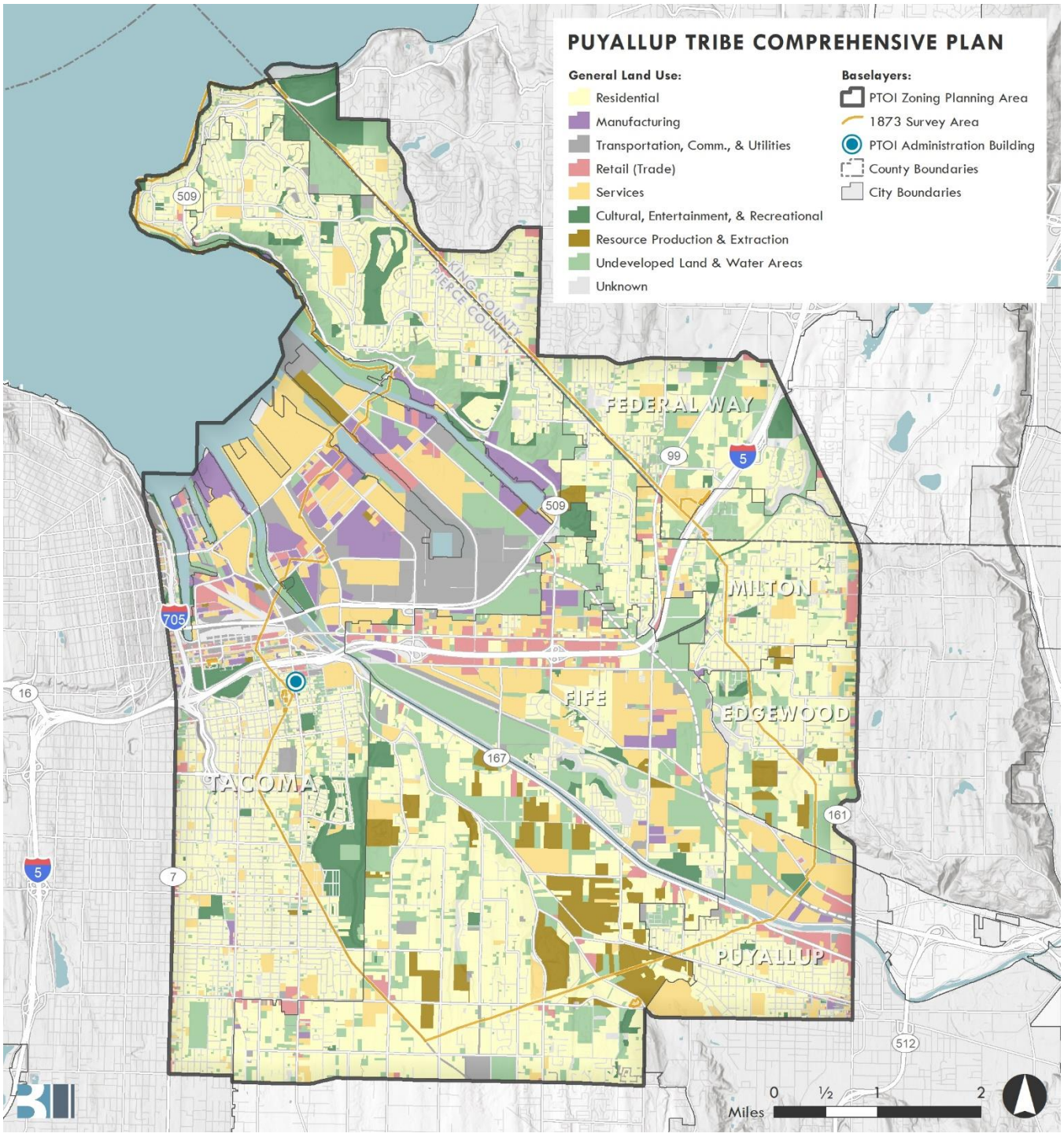
The study area includes 26,400 acres. 91% of this land is within Pierce County and the remaining 9% is within King County. Land use within the study area is predominantly residential, with close to 44% of land devoted to housing. Service uses are a distant second in terms of land use by acreage, accounting for only 14% of study area acreage. See Exhibit 6-11.

Exhibit 6-11: Parcel Acres by General Land Use Category, PTOI Planning Area.

Land Use Category	Pierce County	King County	All	% Total
Residential	10,218	1,342	11,561	44%
Manufacturing	938	0	938	4%
Retail (Trade)	865	28	894	3%
Transportation, Communication, & Utilities	1,497	0	1,497	6%

Land Use Category	Pierce County	King County	All	% Total
Services	3,618	146	3,764	14%
Cultural, Entertainment, & Recreational	1,180	278	1,458	6%
Resource Production & Extraction	1,092	0	1,092	4%
Undeveloped Land & Water Areas	4,523	675	5,198	20%
TOTAL ACRES:	**23,931**	**2,469**	**26,400**	

Exhibit 6-12: Land Use Map, PTOI Planning Area.



Sources: Pierce County Assessor, 2021; King County Assessor, 2021; BERK, 2021.

KEY FINDINGS AND IMPLICATIONS FOR THE PLAN

PTOI's land use policy map should build on Tribal history and its values of land stewardship and conservation when considering land development. The implementation of regulations such as zoning should be modernized to reflect

these values as well. A modern land use code that reflects Tribal values and describes desired outcomes will bring more predictability to zoning and development review and approval processes. It can serve as a resource for those who seek general information about the Tribe, as well as those who want to understand how the Tribe views land use, its vision for future land use patterns, and how it plans to respond to particular issues and problems.

Land use policies should address community health. This includes the health of the natural environment, especially fish, shellfish, and other fauna, as well as human health. Policies should prioritize support for transition to a lower carbon future and access to open space, recreation and housing.

As climate change alters the stream flow, the quantity of rainfall, and flooding patterns, the Tribe's important archaeological sites, resources, and traditions will become more vulnerable. Cultural sites along the waterfront may experience more frequent and more intense flooding and storm surges. Land use policies should consider how significant sites can be protected, especially in highly vulnerable areas such as beaches or low-lying areas near the Puyallup River or other water bodies.

Development-driven pressures add to climate-related impacts. Development-driven vegetation loss and pollution has already compromised the health and abundance of the Tribe's natural areas, many of which have been used for ceremonial and traditional purposes for centuries. Land use policies should consider focusing development in areas that are already developed and similar strategies to reduce the impacts of development on the natural environment.

Growth and development patterns are intrinsically linked to climate change. Housing, commercial uses, and other development is resource intensive. Development that encroaches into wetlands and critical areas damages habitats and results in more flooding.[19] The PTOI land use map, as a policy map, can reflect the Tribe's focus on conserving natural habitat and limit further residential development into undeveloped areas. The Plan can also concentrate development in already developed areas. Limiting low density development, and incentivizing moderate and higher density development within existing neighborhoods, are additional strategies with potential for positive climate impact.

[19] "The First National Flood Risk Assessment: Defining America's Growing Risk" -First Street Foundation, 2020.

7. Housing

INTRODUCTION

Safe and adequate housing is an essential need for all PTOI members. Housing conditions can provide connection to one's community and a sense of stability and security. Housing is often the largest expense in a household budget, however, and when rising costs cause housing insecurity it can become challenging for households to focus on other life priorities. This section explores the existing conditions of housing availability and affordability within the Planning Area.

Housing is intrinsically tied to land use and transportation networks. Development patterns, when approached with respect and intention, can promote community health and environmental sustainability. Understanding the current needs, opportunities, and challenges for housing among PTOI members can inform the Comprehensive Planning process by highlighting priorities.

This section summarizes publicly available data relevant to housing for the survey area. Focus topics such as homelessness are explored and related to the PTOI community as much as possible. Existing Tribal initiatives that provide safe housing and address challenges for the membership are summarized.

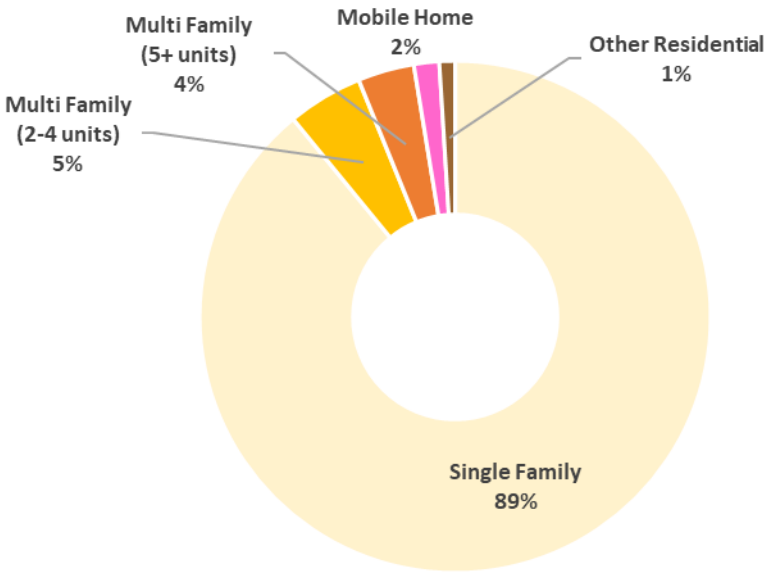
EXISTING CONDITIONS

Land Use and Residential Density

The chart in Exhibit 7-1 and map in Exhibit 7-3 identify residential land use across the Planning Area by housing type, highlighting single family, multifamily, and mobile/manufactured housing units. Single family housing is the dominant residential land use, representing 89% of residential parcels in the Planning Area. Multifamily buildings of 5+ units are dispersed across the area, particularly within Fife and Milton. Mobile/manufactured housing is most prevalent in areas that overlap with unincorporated Pierce County. Single family housing is often owner-occupied and sold at higher prices than other unit types, such as condominiums.

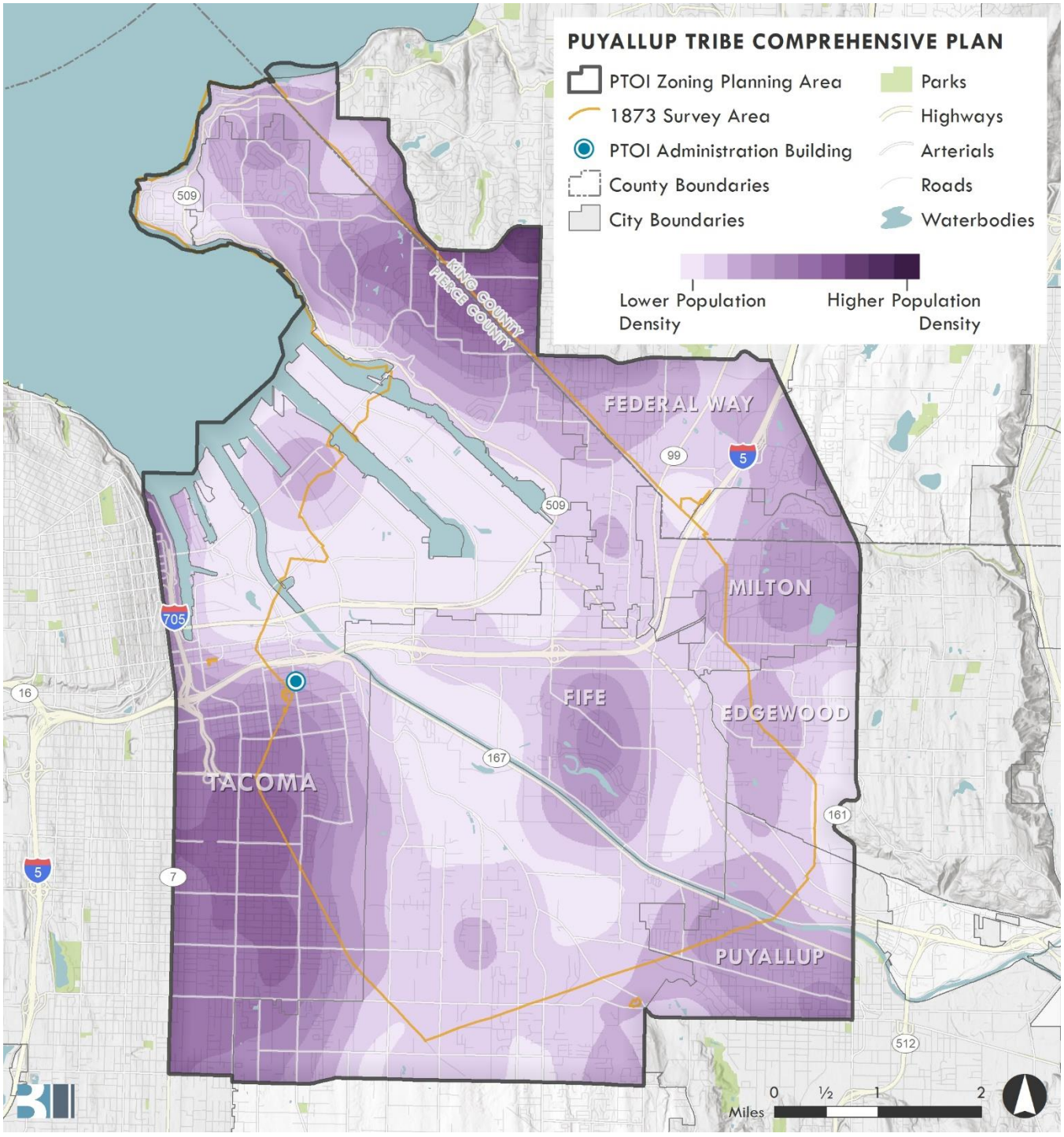
Residential hubs across the Planning Area include areas that overlap with Tacoma to the west and King County to the north. There are also population concentrations within the cities of Fife, Milton, Edgewood, and Puyallup. See the map in Exhibit 7-2. Connectivity between these communities is offered through major roads such as I-5 and SR 167, as well as a local street network.

Exhibit 7-1: Residential Parcels by Housing Type, Puyallup Planning Area



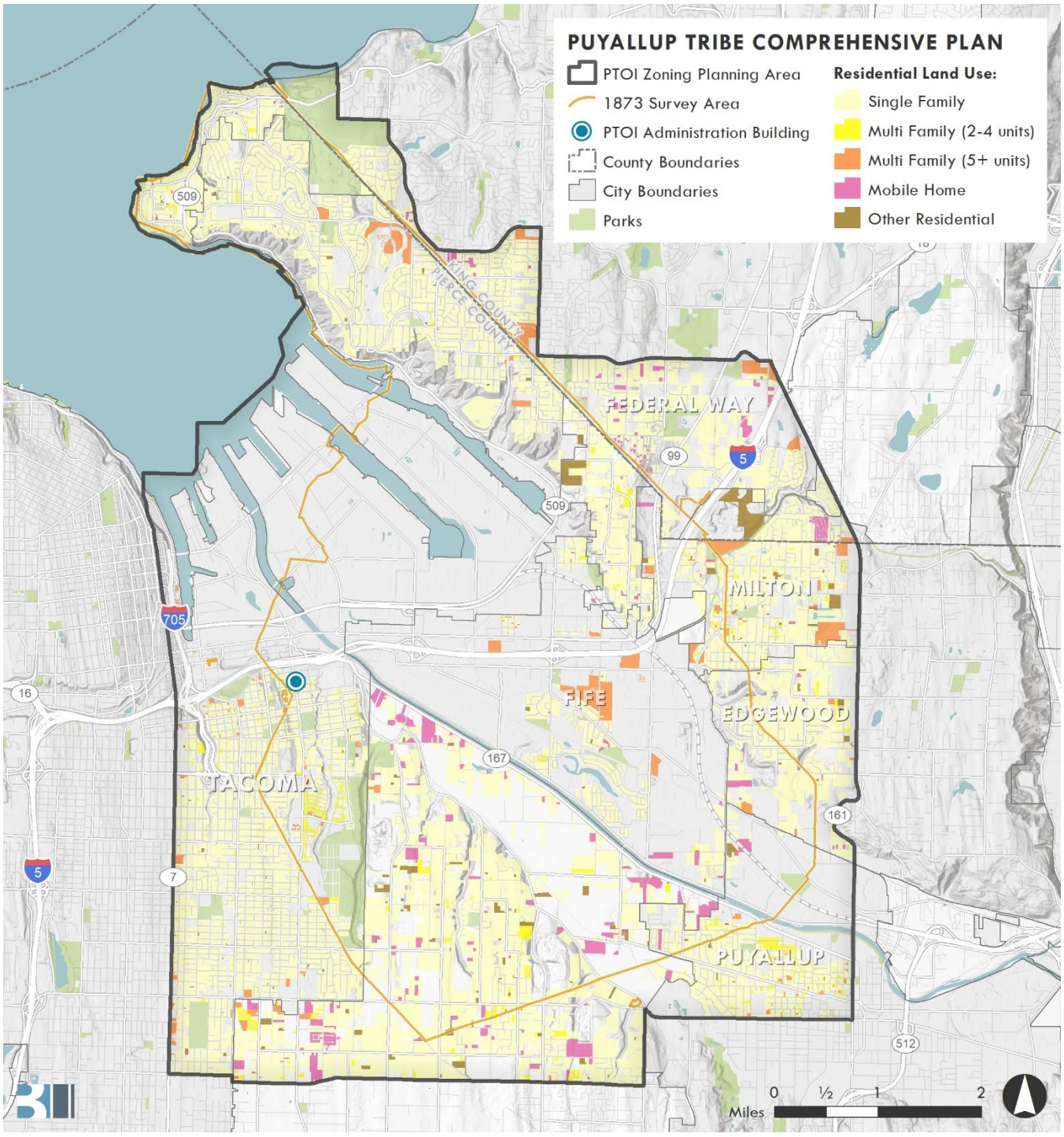
Sources: Pierce County Assessor, 2021; King County Assessor, 2021; BERK, 2021.

Exhibit 7-2: Population Density Across the Puyallup Tribe Planning Area, 2020.



Sources: Washington OFM, 2020; BERK, 2021.

Exhibit 7-3: Residential Land Use Across the Puyallup Tribe Planning Area, 2020.



Source: Pierce County Assessor, 2021; King County Assessor, 2021; BERK, 2021.

Residential Patterns of PTOI Members

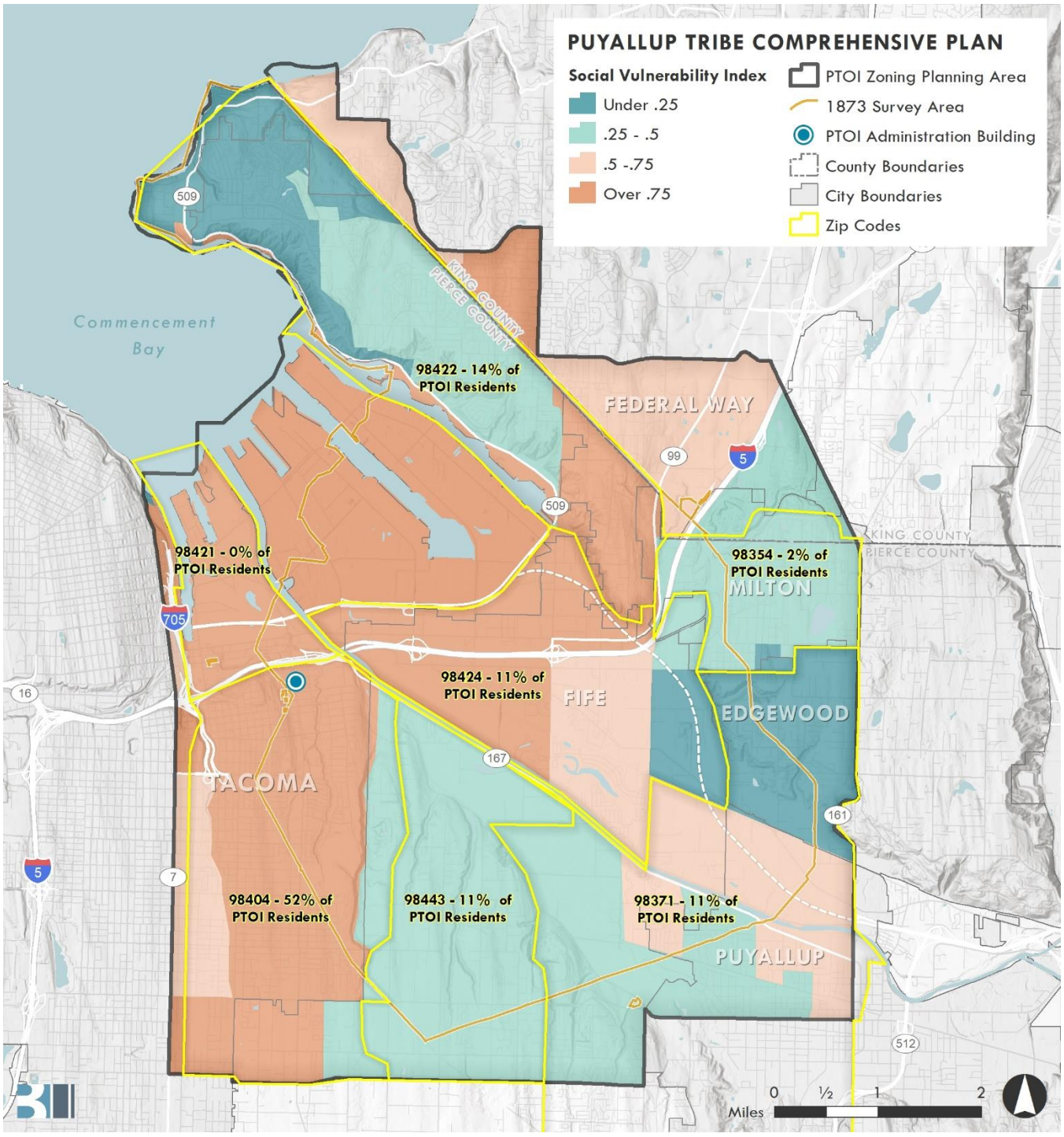
Puyallup Tribe of Indians members live across the globe in seven different countries, as reported by the enrollment office. Data for the 2021 PTOI membership show that 78% of members live within Washington state and 19% live in and around the Planning Area. For PTOI members who live within the Planning Area, over half live within the First Creek Subarea (or northeast Tacoma, ZIP code 98404), as shown in the map in Exhibit 7-5. This is also an area identified as vulnerable based on social vulnerability risk factors. Census tracts in this area, shown in dark orange on the map, score above 0.75 on the Social Vulnerability Index (SVI), as defined by the CDC. SVI scores range from 0–1.0, and higher scores demonstrate higher relative risk levels across themes such as socioeconomic status, household composition, language and ethnic diversity, and transportation access. The SVI was developed to help public health officials and emergency response planners identify and map the communities that will most likely need support before, during, and after a hazardous event. The First Creek Subarea should be a focus for planning, public health, and hazard mitigation efforts for the Puyallup Tribe of Indians, considering the increased risk of climate events throughout the Planning Area (read more in the Climate Resiliency chapter), the concentration of PTOI membership, and higher social vulnerability risk factors. More detail and documentation of the Social Vulnerability Index can be found in Appendix B: Social Vulnerability Index Documentation.

Exhibit 7-4: PTOI Membership Residential Distribution Across Planning Area.

Planning Area ZIP	Percent (%) of Planning Area residents	Subarea of ZIP code boundary (approximate)
98422	14%	Puyallup Tributaries
98421	0%	Delta Tributaries
98354	2%	Hylebos
98424	11%	Wapato/Hylebos
98371	11%	Puyallup Tributaries/Wapato
98404	52%	Tacoma, First Creek
98443	11%	Waller

Sources: PTOI Enrollment Office, 2021; BERK, 2021.

Exhibit 7-5: PTOI Membership Distribution and Social Vulnerability Index Scores within the Planning Area.

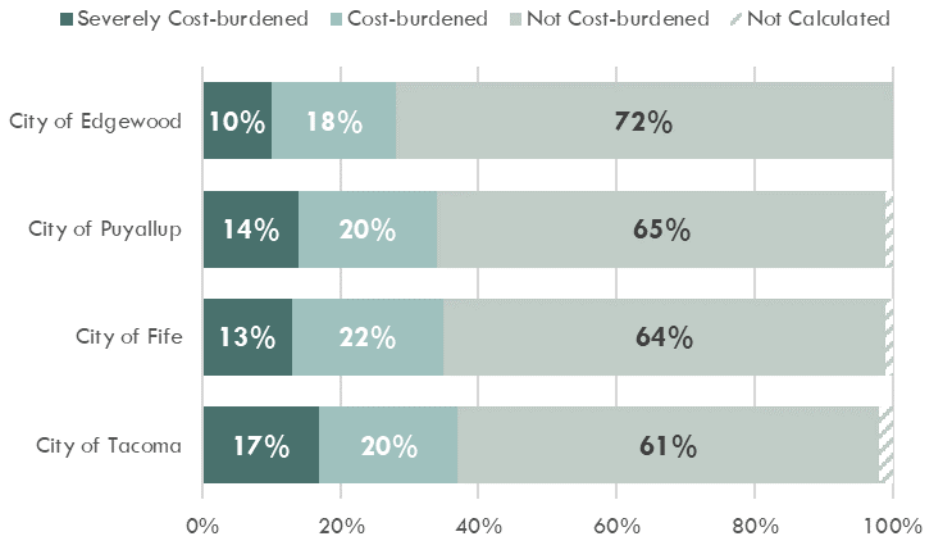


Sources: PTOI Enrollment Office, 2021; CDC SVI Index, 2014-218; BERK, 2021. See full documentation for the Social Vulnerability Index in ***Appendix B: Social Vulnerability Index Documentation****.*

Affordability and Homelessness

Housing affordability is a major concern across Washington state. Housing cost burden is an established metric for gauging trends in housing affordability relative to income within a community. Households are considered cost-burdened when their housing costs, including utilities, account for 30% or more of gross annual income. Severely cost-burdened households spend 50% or more of income toward housing. Rates of cost burden across Tacoma, Fife, Edgewood, and Puyallup range from 28% to 37% of total households. See Exhibit 7-6.

Exhibit 7-6: Rates of Housing Cost Burden Across Overlapping Jurisdictions, 2017.



Sources: HUD CHAS summaries (based on ACS 5-year estimates), 2017; BERK, 2021.

Home prices within the Survey Boundary are rapidly increasing. As shown in Exhibit 7-8, home values increased by 77% in the decade between 2010 and 2020, while area-wide median incomes increased by only 25%. This imbalance creates a barrier to home ownership for first-time buyers who earn moderate incomes. Potential buyers may feel forced to search outside their preferred neighborhoods or jurisdictions to identify suitable housing for their needs, or they continue to rent and experience high annual increases in rents.

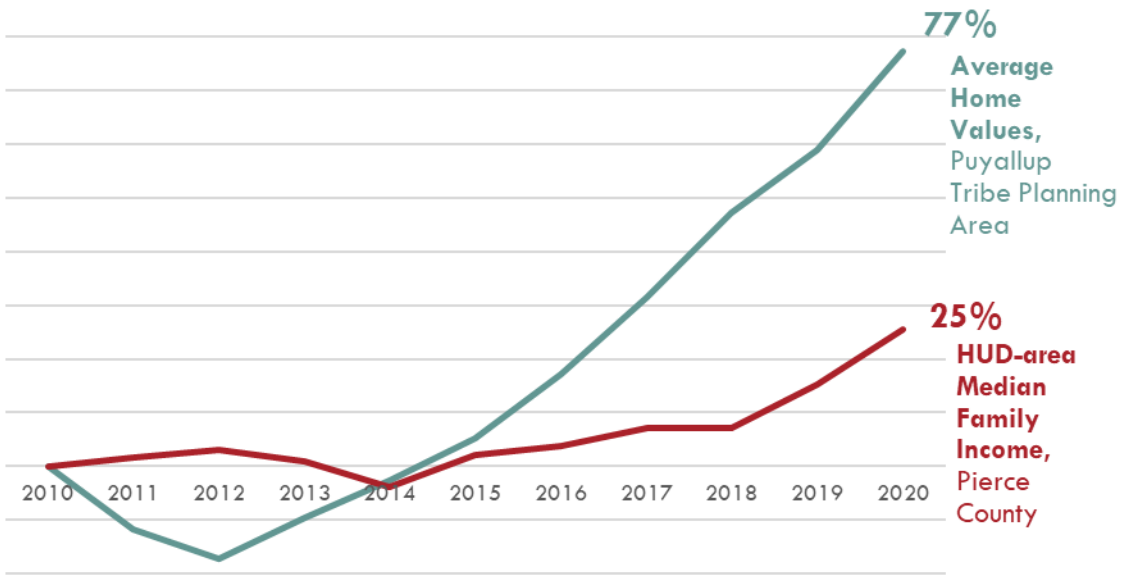
Current average home values vary geographically across the Survey Boundary, from $327,869 to the west, overlapping with Tacoma, to $509,341 in the central area overlapping with Fife. A mortgage for homes at these prices is likely to be affordable only for households earning the median income or higher. Puyallup Tribe staff report that home prices push many residents outside of the Survey Boundary, displacing the community from ancestral territory. This displacement fractures communities and social networks, adding to the hardship of those no longer able to afford a life connected to the geography of their heritage.

Exhibit 7-7: PTOI Planning Area, Average Home Value Variation Across ZIP Codes, 2020.

ZIP Code	2020 Average Home Value	Location
98404	$327,869	Primarily located within the First Creek Subarea
98421	$334,647	Primarily located within Delta Tributaries Subarea
98424	$416,405	Roughly aligned with City of Fife boundary, in Wapato and Hylebos Subareas
98354	$419,636	Roughly aligned with City of Milton boundary, in Hylebos Subarea
98443	$420,899	Western portion of Puyallup Tributaries Subarea
98371	$447,588	Eastern portion of Puyallup Tributaries Subarea, plus area north of Puyallup River.
98422	$509,341	Primarily located within Browns Point Tributaries Subarea

Sources: Zillow, 2021; BERK, 2021.

Exhibit 7-8: Percent Increase from 2010 in Home Values and Incomes, 2010-2020.



Sources: Average home values taken from ZIP codes within the Puyallup Tribe Planning Area boundary on Zillow, 2021; Income estimates from HUD, 2021.

Exhibit 7-9: Mortgage Affordability by Average Home Values within Puyallup Planning Area, 2019.

Monthly Mortgage - 10% down payment			
		Average Home Price, First Creek Subarea (2020)	Average Home Price, Browns Point Tributary Subarea (2020)
Cost to Purchase	Sales Price ($)	327,869	509,341
	Assumed 10% down payment ($)	32,787	50,934
	Mortgage amount ($)	295,082	458,407
	Interest rate	4%	4%
	Monthly payments over course of loan	360	360
	Monthly mortgage payment ($)	1,409	2,189
Annual Housing Expenses			
	Mortgage payments ($)	16,905	26,262
	Property tax ($)	4,262	6,621
	Private Mortgage Insurance ($)	2,951	4,584
	Home Insurance ($)	1,639	2,547
	Annual costs ($)	**25,758**	**40,014**
	Monthly costs ($)	**2,146**	**3,335**
Affordability			
	Annual income needed to afford	**$ 85,859**	**$ 133,381**
	% of AMI	**98%**	**153%**

Sources: Home values from Zillow (ZIP 98404 & 98422), 2021; AMI is Pierce County HUD-area MFI, 2020; BERK, 2021.

Housing Policy Across Jurisdictions

Several jurisdictions which overlap with the Planning Area have recognized the issue of housing affordability and have adopted various housing policies in response. Examples of strategies identified in Tacoma, Fife, and Puyallup include[20]:

- Encouraging missing middle housing types (see sidebar) through infill pilot programs, and rewriting zone definitions to allow these housing types in more residential areas
- Encouraging accessory dwelling units (ADUs) by removing regulatory barriers to construction
- Rezoning areas for higher density housing types
- Introducing or updating incentive programs and fee waivers for income-restricted affordable housing programs
- Connecting residents to supportive services to avoid or mitigate foreclosure, eviction, and displacement

MISSING MIDDLE HOUSING

"Missing middle" is a term used to describe a range of housing types that fall between single family homes and high-rise apartments in terms of building bulk and/or lot size. Examples include:

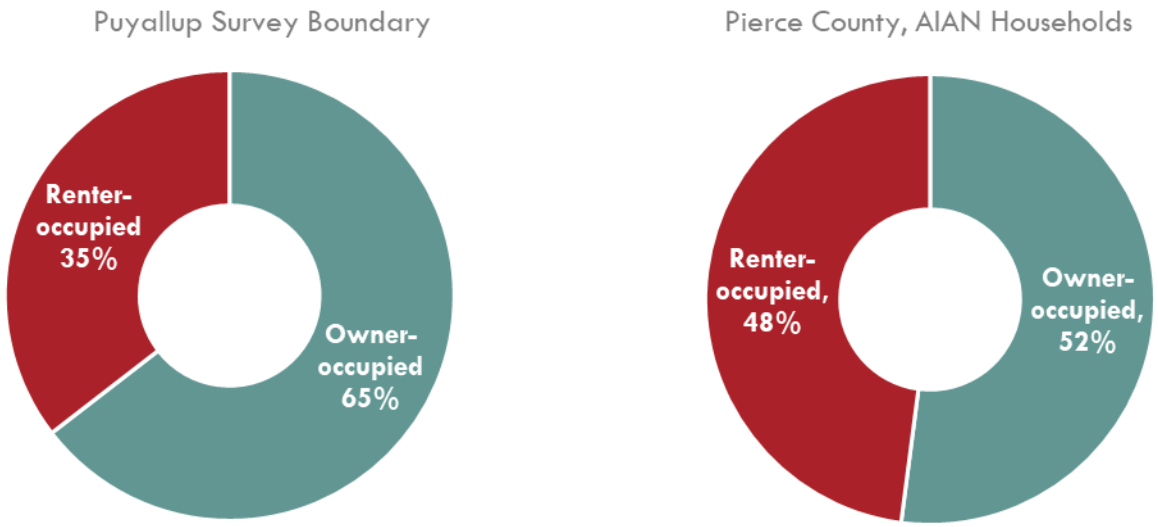
- Townhomes
- Cottage housing
- Duplex/Triplex/Four-plex
- Courtyard apartment buildings

[20] *Puyallup Housing Action Plan presentation, April 2021; Home in Tacoma: Housing Action Plan, 2021; City of Fife Proposed Amendments to Zoning Code, 2021*

Home Ownership

Across the Puyallup Tribe Survey Boundary area, 65% of households live in owner-occupied housing and 35% live in renter-occupied housing. There are no official numbers to calculate the rate of home ownership among Puyallup Tribal membership. However, looking countywide at home ownership trends, 52% of American Indian/Alaska Native (AI/AN)[21] residents live in owner-occupied housing. This is 10% lower than the overall rate for residents within the Puyallup Survey Boundary. With increasing affordability challenges, access to home ownership may be unattainable for many first-time home buyers.

Exhibit 7-10: Housing Tenure for Puyallup Tribe Survey Boundary Households and American Indian and Alaska Native Pierce County Households, 2019.



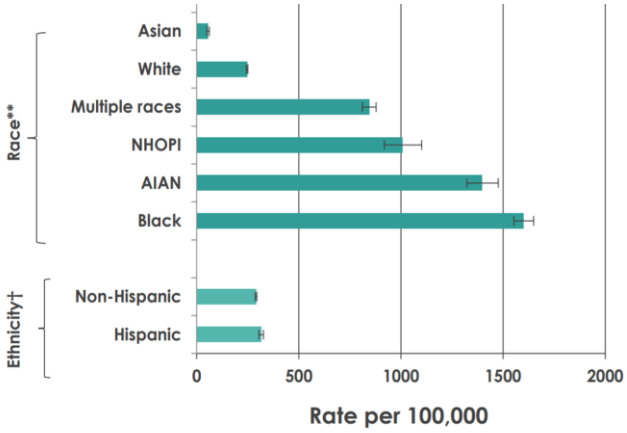
Sources: ACS 5-year estimates, 2018; BERK, 2021.

Homelessness

Homelessness is a statewide issue in Washington. State reporting identifies a disproportionately high rate of AI/AN individuals as homeless in each year's annual Point-in-Time homelessness count when compared to other racial groups. Rates of homelessness among the AI/AN population in Washington are more than four times as high as the rates among the White population. See Exhibit 7-11. A national study on housing issues affecting AI/AN urban populations finds that homelessness disproportionately affects AI/AN individuals nationwide, who are more likely to struggle with issues such as poverty and housing cost burden. It is also more common that, given the strong community bonds between AI/AN residents, household crowding is used as a strategy to prevent homelessness or in intermediate periods prior to homelessness for AI/AN individuals. This results in transience, as homeless individual bounce between the homes of family members or friends on and off their Survey Boundary.[22]

[21] See a definition and discussion of the AI/AN racial category on page 2-3.
[22] "Housing Needs of American Indians and Alaska Natives in Urban Areas" – US Department of Housing and Urban Development, 2017.

Exhibit 7-11: Rates of Homelessness by Race (Sheltered & Unsheltered) in Washington State, 2017



Source: Washington State Health Assessment, Department of Health, 2018.

In Pierce County, 1,897 people were identified as homeless in 2020.[23] This includes both sheltered and unsheltered individuals. In 2017, the City of Tacoma declared a state of public health emergency to address health and safety concerns associated with an increased prevalence of encampments across the city. This declaration remains in place at the time of this publication. Social service providers for the Puyallup Tribe of Indians report various forms of homelessness among Tribal membership, such as couch surfing, living in a car, or living on the street.

Existing Policies and Programs

The Puyallup Tribe of Indians offers a wide range of programs and services to residents who struggle to secure adequate and affordable housing.

- **Tiny Home Village.** The PTOI Tiny Home Village is a community of 30 homes, constructed in response to the COVID-19 pandemic. These homes offer transitional housing for Tribal members struggling with homelessness. Case workers partner with residents to connect with social services, childcare, employment, and eventual placement in stable, long-term housing.



Image Source: Puyallup Tribe of Indians, 2021.

- **The Puyallup Housing Department** develops and manages safe, sustainable, healthy, and affordable housing for Tribal members. The Department is funded through the Native American Housing Assistance and Self Determination Act (NAHASDA) grant program under HUD. The Department places families in affordable housing and maintains a waitlist of 162 Native families who are income-qualified for future placement, as resources become available.

[23] Pierce County Point-in-Time Estimate, 2020.

  - **Tribal Housing.** This inventory includes existing housing units owned and/or operated by PTOI.
    - Eastside Housing (30 units)
    - Grandview Housing (22 units)
    - Northeast Tacoma Longhouse (20 units)
    - Northeast Tribal Housing (27 units)
    - Recovery House (6 units)
    - Waller Road Housing (10 units, duplexes for Tribal elders)
  - **Resident Opportunity and Self Sufficiency** program. The Puyallup Housing Department was awarded a 3-year grant from HUD to provide families who live in Tribal housing relevant resources to assist in becoming self-sufficient. Services aim to help connect families with opportunities and skills for greater economic freedom and stability.
- **Set Aside Housing Program.** This program offers monthly rental and mortgage assistance funds, as well as a first-time home buyer assistance program. The goal of these programs is to benefit Tribal members who do not meet the income guidelines under NAHASDA funding but still need support to attain home ownership or financial stability.
- **Extreme Emergency Assistance Program.** This program assists with energy bills or eviction or foreclosure intervention for elder Tribal members or Tribal members with children.
- **Elder's Assisted Living.**
- **Emergency Housing Repair.** This program assists Tribal members with costs associated with home repairs necessary to sustain safe, sanitary housing conditions.
- **Crisis Assistance Program.** This program provides monetary assistance up to $2,000 for rent, mortgage, or power/utility bills to Puyallup Tribe families in crisis situations.

KEY FINDINGS AND IMPLICATIONS FOR THE PLAN

Housing affordability is a pervasive challenge across the Planning Area. Many PTOI members desire to live on their ancestral lands, but struggle to secure suitable housing to be able to do so. When housing insecurity occurs, it impacts many other areas of one's life, such as health, finances, and overall wellbeing. Stable housing for children is linked to better life outcomes and with breaking the intergenerational persistence of poverty. Housing that meets the diverse needs of older residents is also an important need.

Expanding programs like Set Aside and Tribal Housing that offer homebuyer education and assistance or place households in income-restricted affordable housing within the Planning Area can address these challenges and offer much needed stability and connection to Puyallup homelands. PTOI staff have identified priority populations for these housing assistance programs, focusing on Tribal elders, those in substance abuse recovery, and those transitioning out of juvenile and adult prison systems.

Planning, public health, and hazard mitigation efforts should focus on the Planning Area's heightened vulnerability to climate events as well as the concentration of PTOI members in areas with high social vulnerability risk factors. Continued work to increase education and preparedness among members who live within hazard-prone areas will build resilience for the Tribe's current and future generations.

The lack of variety in housing types in the Planning Area contributes to housing affordability problems. Housing stock is dominated by single family homes, typically the most expensive housing type and the type with the largest environmental footprint. Land use policy can limit low-density development and prevent sprawl into environmentally sensitive areas.

Lack of access to affordable housing is a root cause of homelessness. However, addressing housing affordability alone is not enough to address the complex issue of homelessness. A systemic approach that identifies and addresses needs for emergency shelter, transitional housing, and permanent supportive housing that pairs housing with the Tribe's Wrap Around Program to provide services such as case management, human services, and health programs are all needed as part of a robust community response to end homelessness.

AI/AN individuals experience homelessness at a higher rate than the broader population, both regionally and nationally. A coordinated approach to providing shelter and social services for individuals in need of assistance would improve the level of care and experience for PTOI members. A holistic support system serving youth and adults could address the housing challenges affecting the community's most vulnerable members. The Tribe has identified permanent supportive housing as an important need. Permanent supportive housing combines housing with supportive services that build skills for independent living and tenancy and address the issue of chronic homelessness. It is also a cost-effective solution which has been shown to lower public costs associated with the use of crisis services such as shelters, hospitals, jails, and prisons.

8. Transportation

INTRODUCTION

This section of the report presents a review of multimodal transportation conditions in the study area. The current land-side transportation environment is documented for automobiles, transit, pedestrians, bicycles, safety, and parking. This section also identifies transportation needs and challenges faced by Tribal members. The study area has a complex, multijurisdictional transportation system. The Tribe does not own or control most of the transportation networks within the study area. Given this, Comprehensive Plan policies and goals are anticipated to focus on collaboration with jurisdictions to ensure transportation and mobility investments align with and implement the Tribe's vision and improve quality of life.

EXISTING CONDITIONS

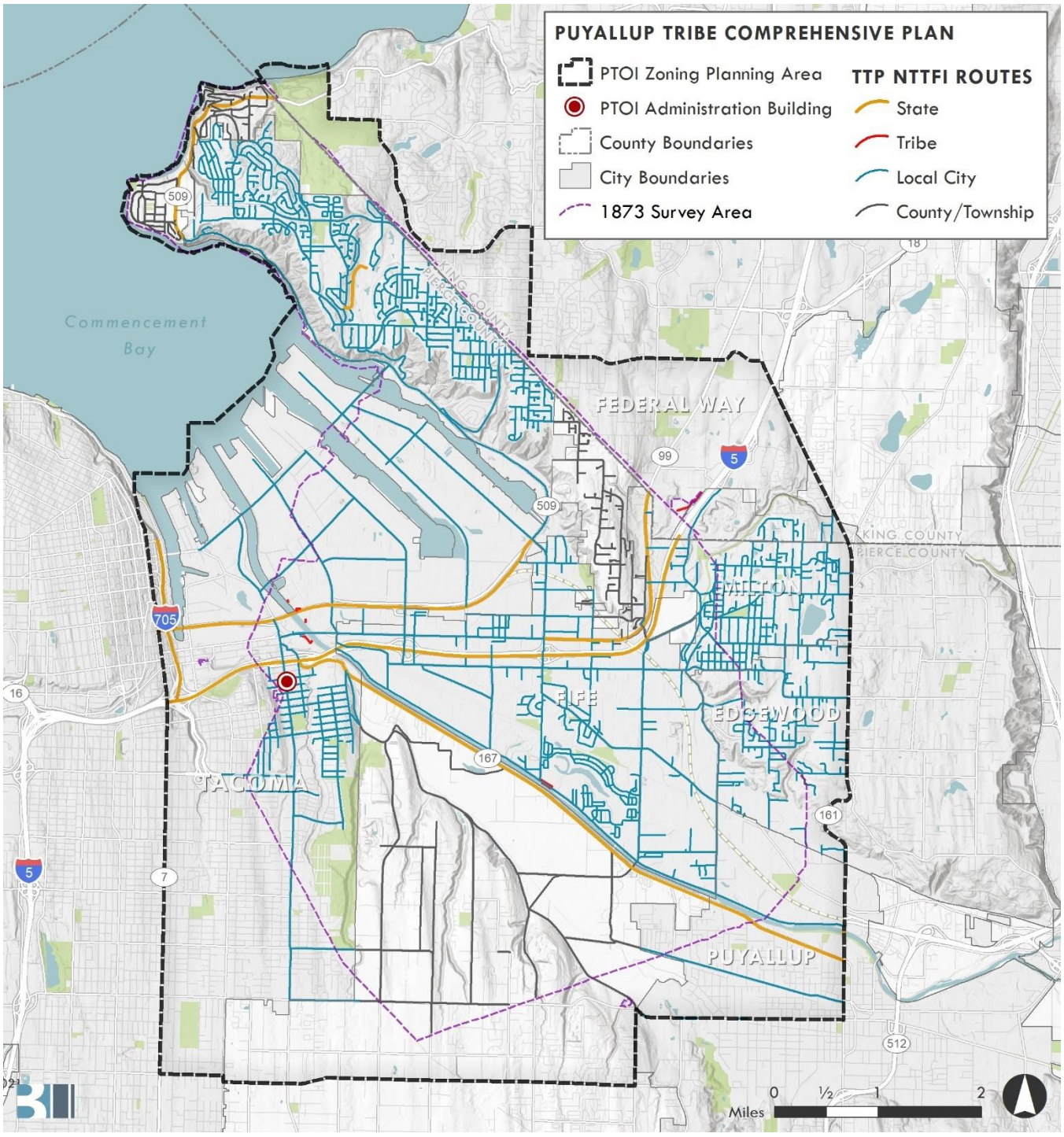
Transportation Network

The Tribe manages its transportation systems mainly through funding provided by the Tribal Transportation Program (TTP) which encourages coordination, collaboration, and consultation with local and regional jurisdictions to ensure a safe and efficient transportation network is maintained for public use. The program is governed by the Federal Highway Bill that passes through Congress every four to seven years. At the time of this report, continuing resolutions from the Fixing America's Transportation Act (FAST Act) are in place and awaiting the next infrastructure bill promised by the current president and Congress. The TTP Program is a set-aside program of the highway bill and is governed by the regulations primarily set forth in the Federal Register 25 CFR part 170 and 23 U.S.C. The program is jointly administered by the individual Tribal transportation departments, the Bureau of Indian Affairs (BIA), and the Federal Highway Administration (FHWA).

The TTP funds maintenance, rehabilitation, and improvement of the Puyallup Tribe's multimodal transportation infrastructure. The Tribe strives to focus the TTP and other transportation funds such as the gas tax to improve the safety and connectivity of its multimodal transportation network for Tribal members and the traveling public on and through Tribal lands.

The Tribe has identified its transportation network and service area as documented in the National Tribal Transportation Facility Inventory (NTTFI) and recorded in the Roads Inventory Field Data System (RIFDS), an Oracle database managed and operated by the Bureau of Indian Affairs and Federal Security-Clearance approved Tribal Transportation Specialists. Under this program the Tribe identifies their entire transportation network which represents various jurisdictional ownerships. The Tribe maintains a GIS driven inventory mapping system combined with a narrative Long Range Transportation Plan (LRTP). The LRTP supports the NTTFI and identifies the prioritized project list. It is completed every five years in support of the Tribe's Transportation Improvement Program (TTIP), which is approved by the FHWA annually. The following map illustrates the Puyallup Tribe's established transportation system within the study area, officially recorded in the NTTFI system.

Exhibit 8-1: PTOI Transportation Network, Roads by Ownership.



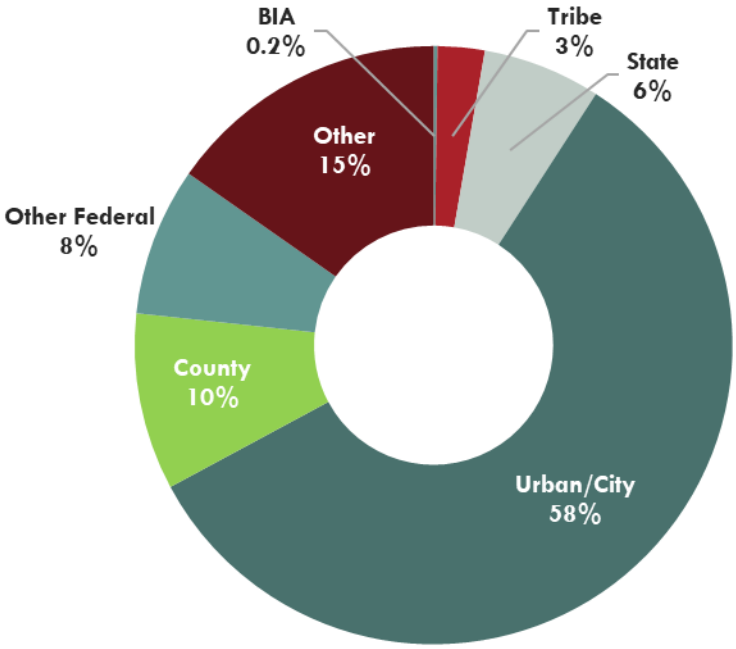
Sources: NTTFI RIFDS, 2021; BERK, 2021.

The Puyallup Tribe has identified a transportation network totaling 330.5 miles considered to be the most critical transportation infrastructure supporting access to the service area's goods and services, the promotion of economic development, and access to Tribal government and health resources for Tribal members and the general public alike. The critical transportation facilities are identified in the Tribe's NTTFI. The inventory is summarized in the following pages, and the charts below illustrate the characteristics of the transportation network as detailed in the tables located in Appendix C: NTTFI Transportation Network which have been directly exported from the RIFDS

database program.

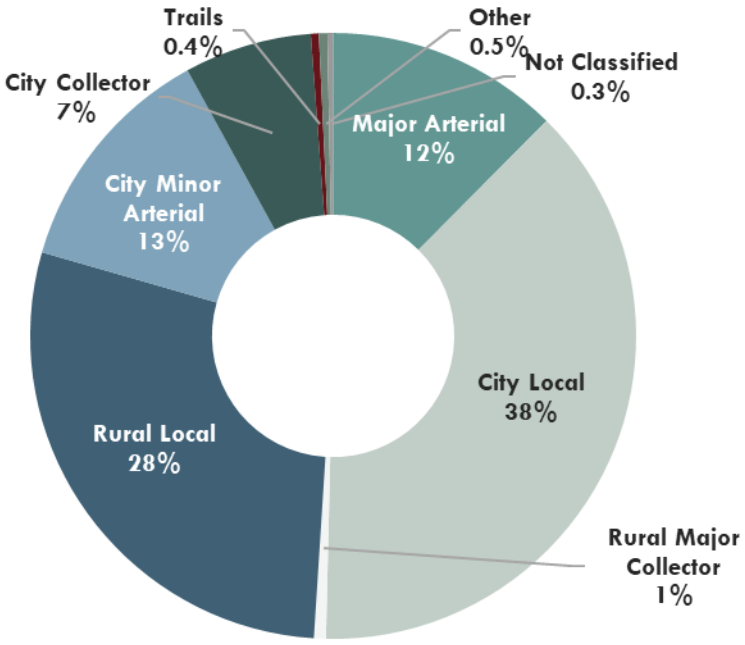
As illustrated in Exhibit 8-2, Exhibit 8-3, and Exhibit 8-4, the Tribe's NTTFI roadway network is a uniquely urbanized transportation network in compared to other tribal networks across the Indian Country. The Puyallup Tribe's transportation network is set in a highly urban and developed area resulting in diverse and complex roadway jurisdictions and ownerships, more highly classified major arterials and urban collector/local roads with higher traffic volumes, and a mostly paved roadway surface type (72% paved). The Tribe and BIA have ownership and jurisdiction over just 3.2% of the Tribe's identified transportation network, yet the complete transportation network is critical infrastructure serving a diverse population of both Tribal and non-Tribal members. Tribal transportation managers must focus on coordination, consultation, and collaboration, considering they work with the broadest array of non-Tribal jurisdictions of any Tribe in the United States.

Exhibit 8-2: NTTFI Roads, by Ownership



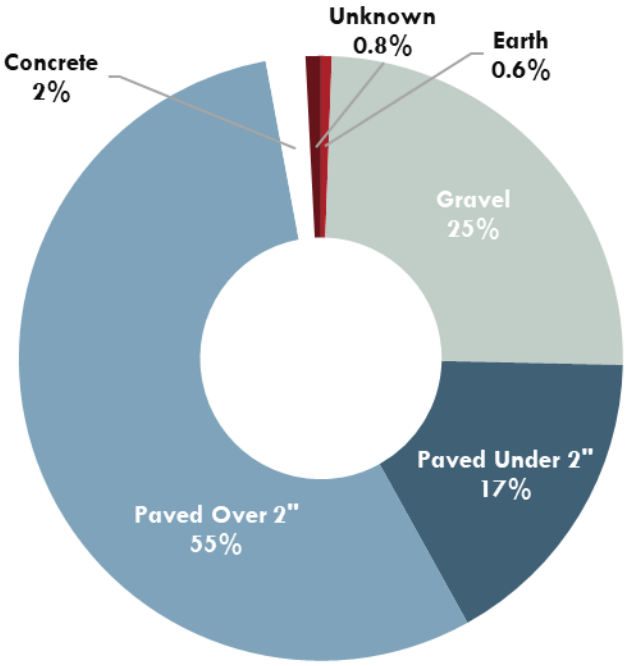
Sources: NTTFI, 2021; BERK, 2021.

Exhibit 8-3: NTTFI Roads, by Functional Class



Sources: NTTFI, 2021; BERK, 2021.

Exhibit 8-4: NTTFI Roads, by Surface Type



Sources: NTTFI, 2021; BERK, 2021.

Pedestrian & Bike Network

Non-motorized transit routes within the PTOI Planning Area are fractured and inconsistent. The network of sidewalks, trails, and bike lanes in the Planning Area lack cohesive coordination and investment. Jurisdictional transportation planning efforts have historically prioritized enabling automobile traffic to move as quickly as possible. This comes at a cost to the safety and comfort of nonmotorized travelers, such as those who walk or bike. Given the multijurisdictional nature of the Planning Area, coordination across boundaries is needed to promote safety and connectivity between the Puyallup Tribe's communities and key destinations. Tribal leaders have identified a need for transportation projects including: sidewalk improvements near senior living centers and Tribal housing communities; multimodal infrastructure in and around the future light rail station, Tribal government facilities, and economic development ventures; and active transportation connections for key destinations such as shopping and schools. These improvements will promote health and wellness among the PTOI community. A "complete streets" program would promote livability, neighborhood beautification, and pedestrian safety across the Planning Area. See sidebar for additional detail on complete streets.

Road Safety

Transportation safety is a complicated matter, considering how many transportation networks operate under various jurisdictions in the service area. The Tribe has access to tribal-focused funding sources such as the TTP and other federal programs, and maintains essential partnerships with adjacent jurisdictions and land owners to coordinate strategies for acquiring funding for transportation network safety projects.

Under the TTP program over the past five years, the Tribe applied for and received funding from the Tribal Transportation Program Safety Fund, a set-aside program of the TTP which focuses on safety analysis and improvement of the transportation network. . In 2014, the Tribe completed an introductory Transportation Safety Plan which identified specific corridors of concern based on the previous five-year crash statistics. In 2016, as a result of the successful Safety Plan, additional TTPSF funding was awarded to the Tribe to perform Roadway Safety Audits (RSAs). The RSAs studied ten corridors identified as high priority concerns for the Tribe, as they are located near Tribally held lands and development. The maps in Exhibit 8-6 and Exhibit 8-7 represent the Safety Plan and the ten corridor RSAs within the study area. The safety analysis, findings, and recommended safety improvements along these corridors will inform future development priorities and recommendations for specific land parcels to be developed.

The data-driven development of the Transportation Safety Plan (TSP), as



COMPLETE STREETS

Policies promoting complete streets prioritize safe, multimodal transportation within existing rights-of-way. There is no single design or policy framework for a complete street, but the goal is to calm traffic speeds and enhance comfort and safety for all forms of transportation. The following examples illustrate some of the complete street priorities that promote livability for all users of the road:

- Sidewalk improvements
- Added or expanded bike lanes
- Accessibility features such as curb cuts and tactile paving
- Dedicated bus lanes
- Comfortable bus stops or public transportation stations
- Roundabouts
- Street trees

Source: www.smartgrowthamerica.org
Image: www.calbike.org

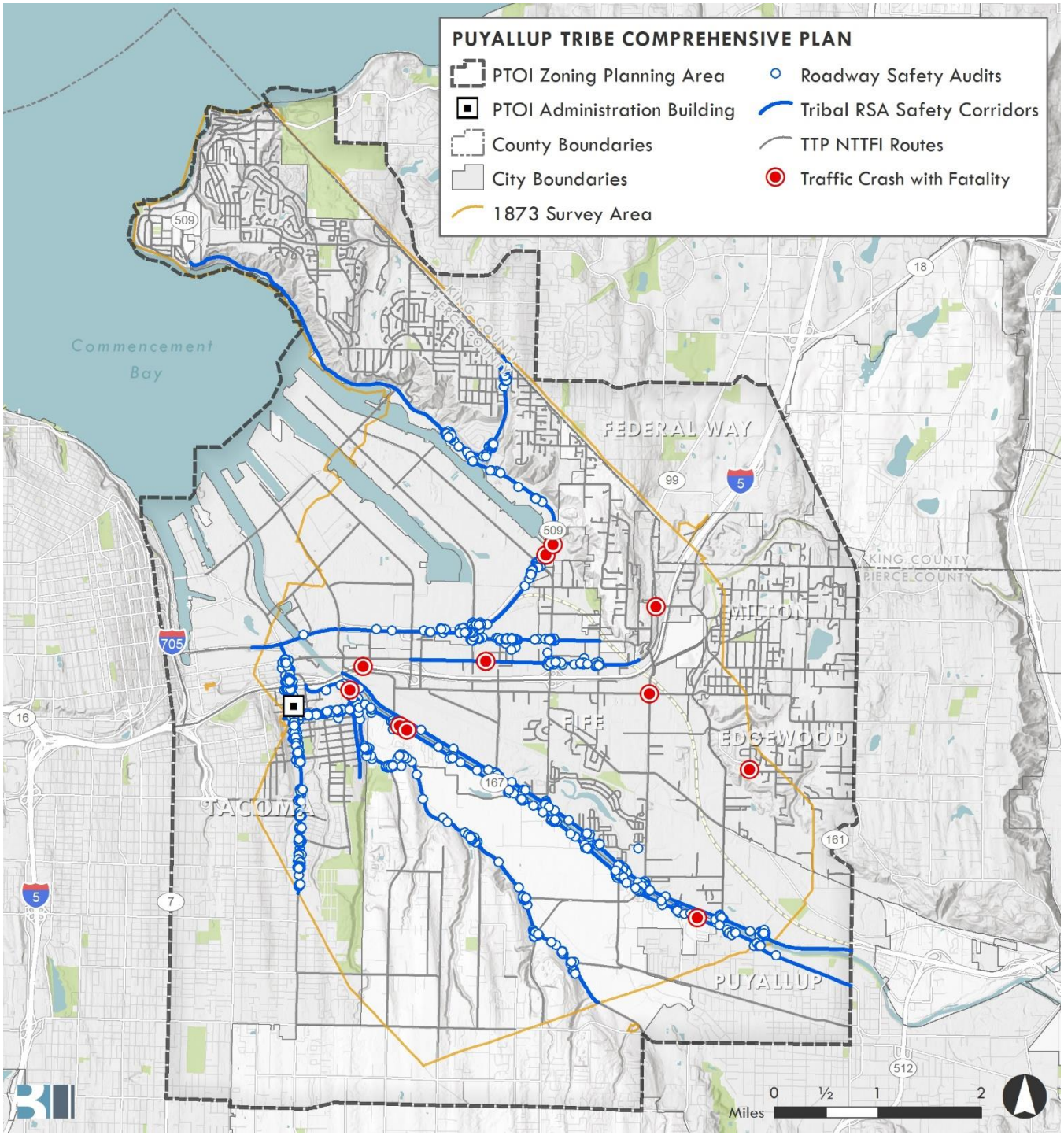
required by FHWA and supported by the Tribe, was centered creating a map of the Tribe's complete NTTFI transportation network in relation to crash statistics. The Safety Plan analysis, as summarized in the maps in Exhibit 8-6 and Exhibit 8-7, tell a story of crash locations, including frequency, severity, and contributing factors, among many other reported statistics. The map identifies road segments, intersections, and travel corridors where severe crashes occur most frequently.Within the TSP's study area, most reported crashes occur on I-5 due to its high traffic volumes, but the TSP focuses on other urban and rural minor arterials, collectors, and local roads within the Tribe's transportation network. The TSP's comprehensive analysis identifies the most unsafe corridors, as illustrated in the map on Exhibit 8-6 and listed in the table below.

Exhibit 8-5: Road Safety Audit Corridors

Route Name	Average Daily Traffic (ADT)
River Rd/SR 167 – Route 1500	9,300 – 28,000 (2015)
SR 509/Marine view Dr – Routes 1400 & 2660	9,900 – 36,000 (2015)
32nd St – Route 6100	No ADT
E. Portland Ave – Route 3430	22,000 (2007)
N. Levee Rd – Route 1000	6,200 (2008)
Norpoint Way – Route 3100	14,455 (2007)
Pioneer Way – Routes 3410 & C341	No ADT Available
I-5 – Route 800 (No RSA)	170,000 – 209,000 (2015)
Pacific Hwy E/SR 99 – Route 1600	21,000 – 22,000 (2015)
E Grandview Ave – Route 1580	576 (1998)
12 St E – Route F031	No ADT Available

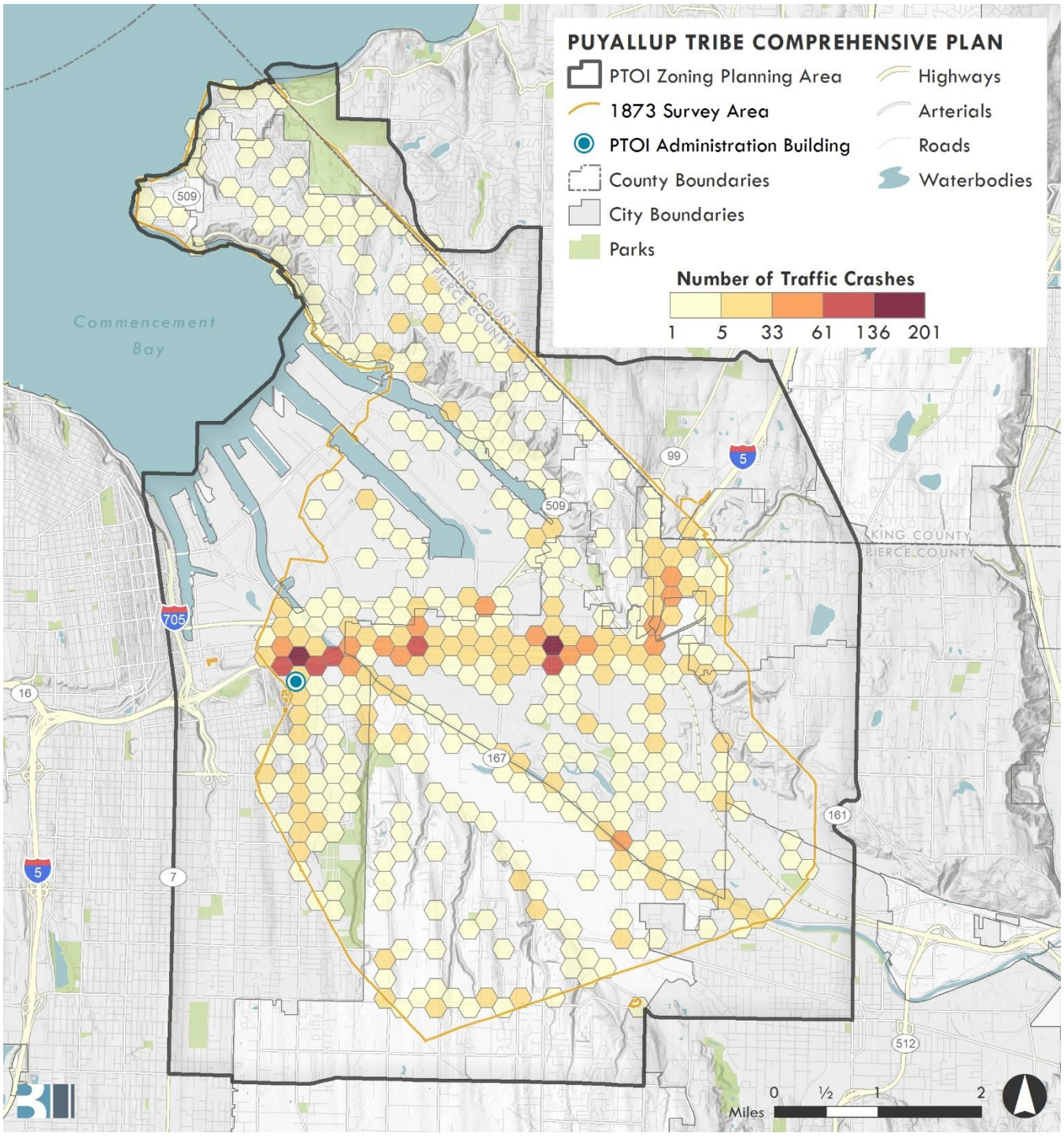
Sources: NTTFI RIFDS, 2021; BERK, 2021

Exhibit 8-6: PTOI Traffic Safety Corridors and Roadway Safety Audits.



Sources: NTTFI RIFDS, 2021; BERK, 2021

Exhibit 8-7: Traffic Crash Frequency Summary in 1873 Survey Area



Sources: PTOI, 2021; BERK, 2021.

The findings in the Transportation Safety Plan and Roadway Safety Audits clearly tell the story of an outdated and overloaded transportation network which makes implementing effective transportation safety improvements more challenging. Significant systemic safety improvements are needed throughout the service area, particularly for older infrastructure with higher traffic volumes and potential for multimodal user conflicts. Many of the local jurisdictions within the Planning Area are incorporating safety improvements in newer transportation infrastructure developments, however, the older transportation system provides many barriers to the safety improvements and enhancements required to bring the facilities up to current safety standards. The transportation network accommodates a large and growing volume of traffic generated from mixed use urban development, port and commercial activities, suburban residential communities, rural areas, and integrated Tribal lands. This combination of demands put on the network complicates the challenges of safety, maintenance, improvement, and expansion. Safety improvement planning must carefully balance the tradeoffs between maintaining traffic volumes and speeds for vehicular and freight traffic versus protecting vulnerable roadway users such as pedestrians and cyclists.

Climate Change

Major transportation routes within the PTOI Planning Area are threatened by increased flooding and landslide risk from climate change. The WSDOT *Climate Impacts Vulnerability Assessment* identifies key corridors of concern[24]:

- Highway 509 from downtown Tacoma to Dash Point
- Interstate 5 from Lakewood to Federal Way
- Highway 99 from connecting the Reservation to Federal Way
- Highway 167 from north Puyallup to Auburn

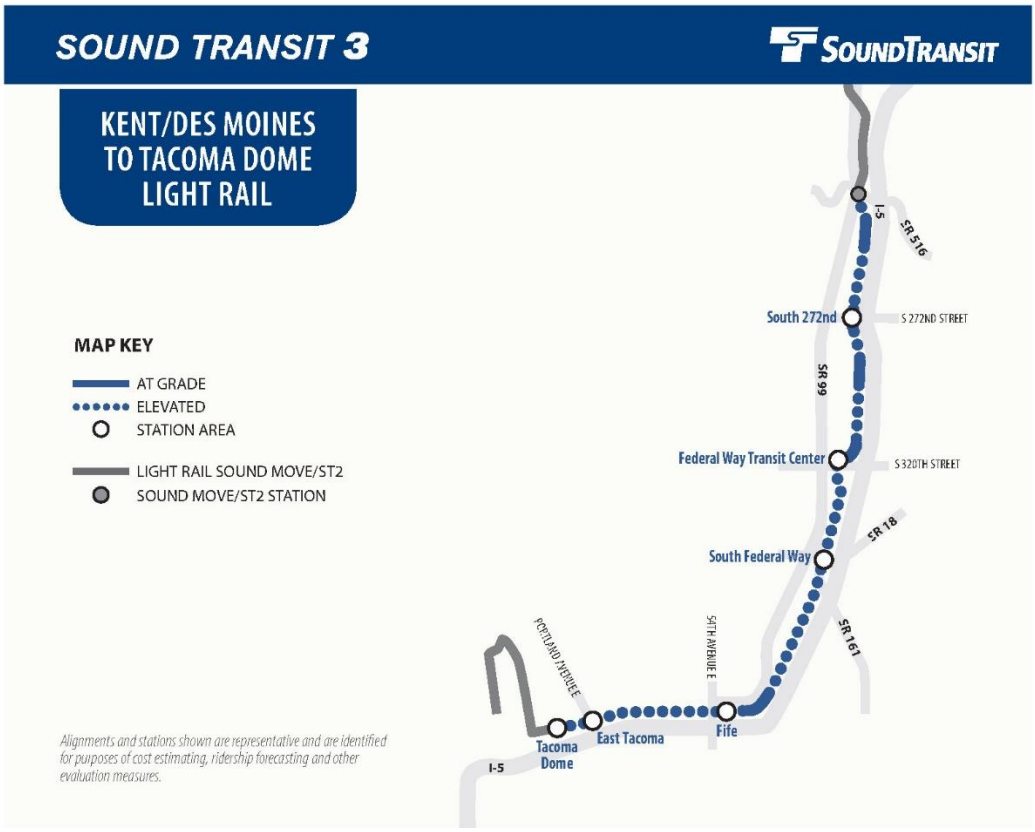
Flooding or landslide damage to these transportation routes would dramatically impact the local economy and safety of residents living in the Planning Area. Infrastructure planning and projects should consider climate impacts and prioritize the inclusion of mitigation efforts such as green stormwater infrastructure in roadway improvement projects.

Existing Programs

As part of Sound Transit's ST3 expansion program, plans have been developed to extend Link Light Rail into Tacoma, offering residents near the corridor greater access to City of Tacoma centers as well as SeaTac airport and activity hubs in King County. The station locations will also provide access to both Emerald Queen Casino locations. Continued coordination with Sound Transit should focus on walkable access to stations, transit connections between stations and Tribal housing developments, and for habitat restoration projects in and around station areas.

[24] https://wsdot.wa.gov/sites/default/files/2017/11/15/ENV-Climate-VulnerabilityAssessment.pdf

Exhibit 8-8: ST3 Extension Plans.



Source: Sound Transit, 2021.

The Riverwalk Trail Project is a five-mile stretch of walking and biking trail along the Puyallup River. The project was first dedicated in 1998 and its third phase of development was completed in 2007. A future phase will connect the path to the Pierce County Foothills Trail, offering access to a regional trail system extending into Mount Rainier National Park, the City of Sumner, and north to Tukwila. This system is a valuable recreation amenity for the surrounding region, and The Tribe was also part of a multijurisdictional cohort in 2020 to finish the planning of this trail to connect with Tacoma.[25]

The Tribe operates targeted van share and shuttle programs to serve its members. An after-school van share program offers service from Chief Leschi schools to the Youth Center. The health authority operates a service providing transportation for those living in treatment centers to get to their medical appointments. Shuttle service to the Emerald Queen casino offers connections between gaming facilities and key destinations such as public and employee parking lots. These services offer much needed community support and connectivity.

Pierce Transit Service operates transit services within the PTOI Planning Area including approximately 15 fixed routes providing service within the Planning Area and extending to Tacoma, Puyallup, Federal Way, Fife, and more. The Planning Area is also home to four of Pierce Transit Service Centers/Stations: Commerce Street Transfer Area, Tacoma Dome Station, 72nd and Portland Transit Center, and the Puyallup Station. The map in Exhibit 8-9 illustrates the complete service area of Pierce Transit Service.

[25] City of Puyallup; https://wsdot.wa.gov/sites/default/files/2020/06/10/T2P-Route-Analysis-Study-Report.pdf.

Exhibit 8-9: Pierce Transit System Map

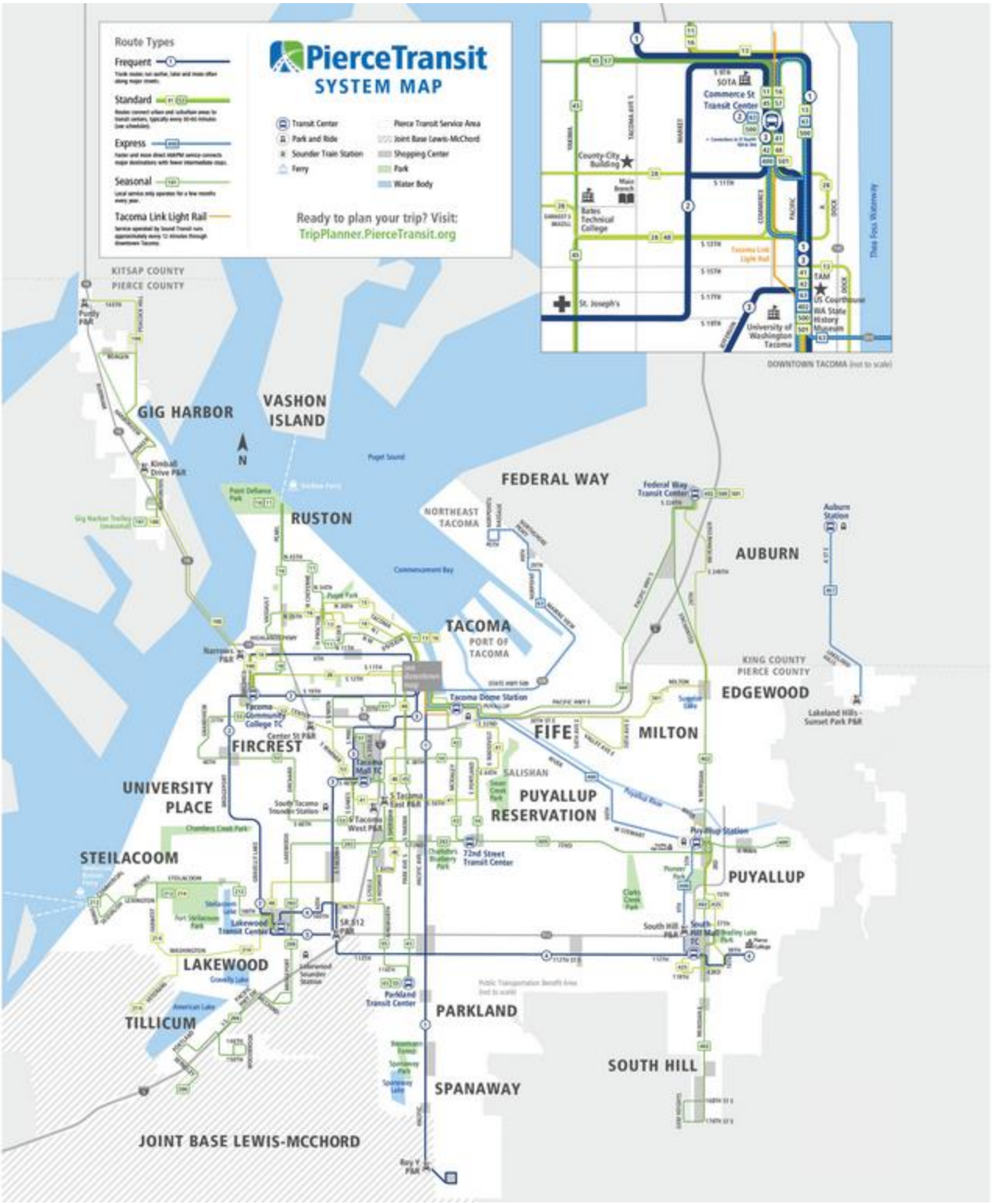


Image Source: Pierce Transit, July 2021.

The Puget Sound Gateway Program

WSDOT, with support from regional transportation stakeholders, is currently developing The Puget Sound Gateway Program, a large transportation project that will have significant impacts to the PTOI Planning Area's transportation network. It will provide important road connections to the Port of Tacoma and I-5. As part of this project, SR 167 will be connected north from Meridian Avenue (SR 161) in Puyallup to I-5 and further improved north to SR 509, providing better direct access from Puyallup to the Port of Tacoma. The connection is planned in phases and construction is underway. The first phase of construction began in Fife at the I-5 Wapato Way Bridge overpass, near the center of the overall project area. The next phase, slated for construction in 2022–2026, will connect north two miles from the overpass and will connect west to SR 509. Following this phase, the remaining four-mile segment of SR 167 will be constructed, extending south from Wapato Bridge through the PTOI Planning Area and ending at the SR 512 interchange in Puyallup. This final phase of the project is slated for 2024–2028.

The Puget Sound Gateway Program is designed to sustain the region's continued economic development and address under-designed infrastructure to align with new uses and needs. The use of this corridor has significantly changed over the past few decades as a system designed to support passenger vehicles has been increasingly inundated with heavier freight vehicles. This extensive and ongoing project is designed as a multimodal facility friendly to a mix of users, including pedestrians and cyclists. It will continue to require significant planning and investment by all regional stakeholders including the Puyallup Tribe of Indians.

Exhibit 8-10: Puget Sound Gateway Program Project Maps (2).

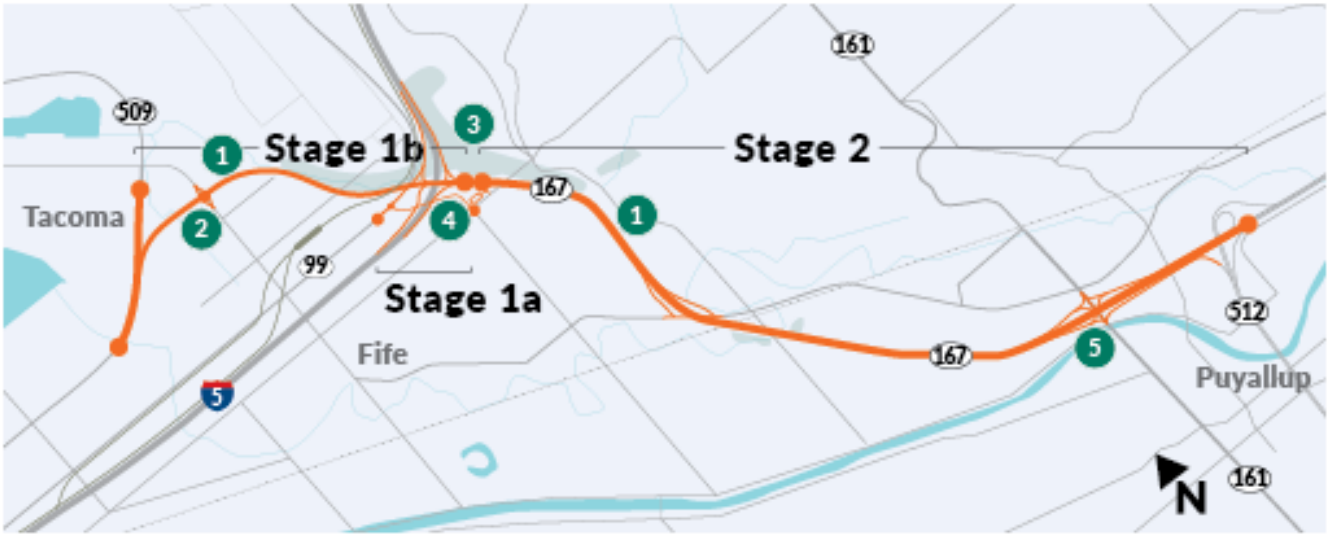




Image Sources: WSDOT, 2021.

KEY FINDINGS AND IMPLICATIONS FOR THE PLAN

The Tribe faces obstacles to making its transportation network safe and accessible, as PTOI does not have full control over its transportation network. Multijurisdictional planning efforts can overlook the needs most important to Tribal members and the Tribe as a whole. The transportation network within the 1873 Survey Area includes dated infrastructure in need of upgrades and safety improvements. The Puyallup Tribe has identified focus corridors for safety improvements and has prioritized working with local jurisdictions to address these concerns. Implementing complete streets initiatives will bring opportunities to enhance the multimodal transportation network in the areas most important to the PTOI community.

The Tribe receives minimal program funds through the TTP and other grant and tax programs and does not currently budget or program additional funding specifically to the general maintenance and improvement of its transportation network outside of critical needs given the lack of ownership of the majority of the transportation

infrastructure through the study area. Most transportation improvements are related to specific Tribal or regional land development projects and therefore typically do not account for the larger needs of the region or transportation network, while only focused on meeting the critical needs of the specific developments they support. Often as projects get planned and implemented the Tribe does not receive adequate opportunity to provide Tribal-specific input or comment on the project. While inter-jurisdictional cooperation, consultation, and collaboration is improving in recent years through Tribal planning efforts, it is clear there is still a significant gap in true regional transportation planning amongst the many stakeholders and transportation infrastructure owners.

Link Light Rail development coming to the Planning Area, and the Tribe can plan appropriately for development and connectivity with this mass transit access. Light Rail service is a valuable community asset, expanding the range of employment opportunities and amenities. The Tribe's Comprehensive Plan can support investments that allow Tribal members to leverage this amenity to the greatest possible community benefit. The Plan will incorporate transit-oriented development considerations in the 5- and 10-minute walksheds of proposed stations.

Pierce Transit Service is a critical transit service provider within the PTOI Planning Area. Continued coordination and collaboration will be needed as the area continues to grow and evolve. PTOI must maintain and improve coordination with Pierce Transit Service to ensure its programs are capable of supporting future development and community transit needs.

PTOI should continue to help shape the Puget Sound Gateway Program transportation infrastructure improvements within the Planning Area. With the early phases already complete and operational, the northern two-mile segment of the SR 167 extension project from the I-5 overpass to SR 509, and the southern four-mile segment from I-5 to SR 512, will continue to evolve through planning, design, and construction phases. The Tribe must be prepared to continue its involvement and influence on this project, given its major impacts on the local transportation system. This project's impacts should be considered for future economic development and land use planning, in particular. This project offers many opportunities for regional connectivity and economic development. PTOI involvement in planning efforts can address and mitigate any community concerns for challenges involved in these infrastructure changes.

Many of the transportation corridors of importance to the Tribe are located in areas that have been identified by climate studies as being at risk of flooding or landslides. Access to residential communities and employment centers in the PTOI Planning Area is threatened by the destructive potential of these climate events, which are predicted to increase in frequency and intensity. Plans should set goals for increased resilience and regional preparedness, and consider strategies such as alternative routes that ensure emergency vehicle access, evacuation routes, and continued access where risks are high; minimizing paved surfaces for improved permeability; and the construction of slope control structures.

9. Economic Development

INTRODUCTION

The Planning Area economy includes built, human, social, and natural capital, which together have supported the community and provided jobs and careers. Understanding the current landscape of opportunities and challenges in economic development can inform this comprehensive planning process, highlighting areas where land use, regulatory, or capital facility policies could support economic development on the Reservation.

This chapter includes a survey of existing conditions related to employment industries, the unemployment rate, and a map of current employment density in the 1873 Survey Area. We describe key Tribal investments and economic activities, including in gaming and fishing, and summarize opportunities for workforce development for youth and adults. Finally, this chapter concludes with key findings and implications.

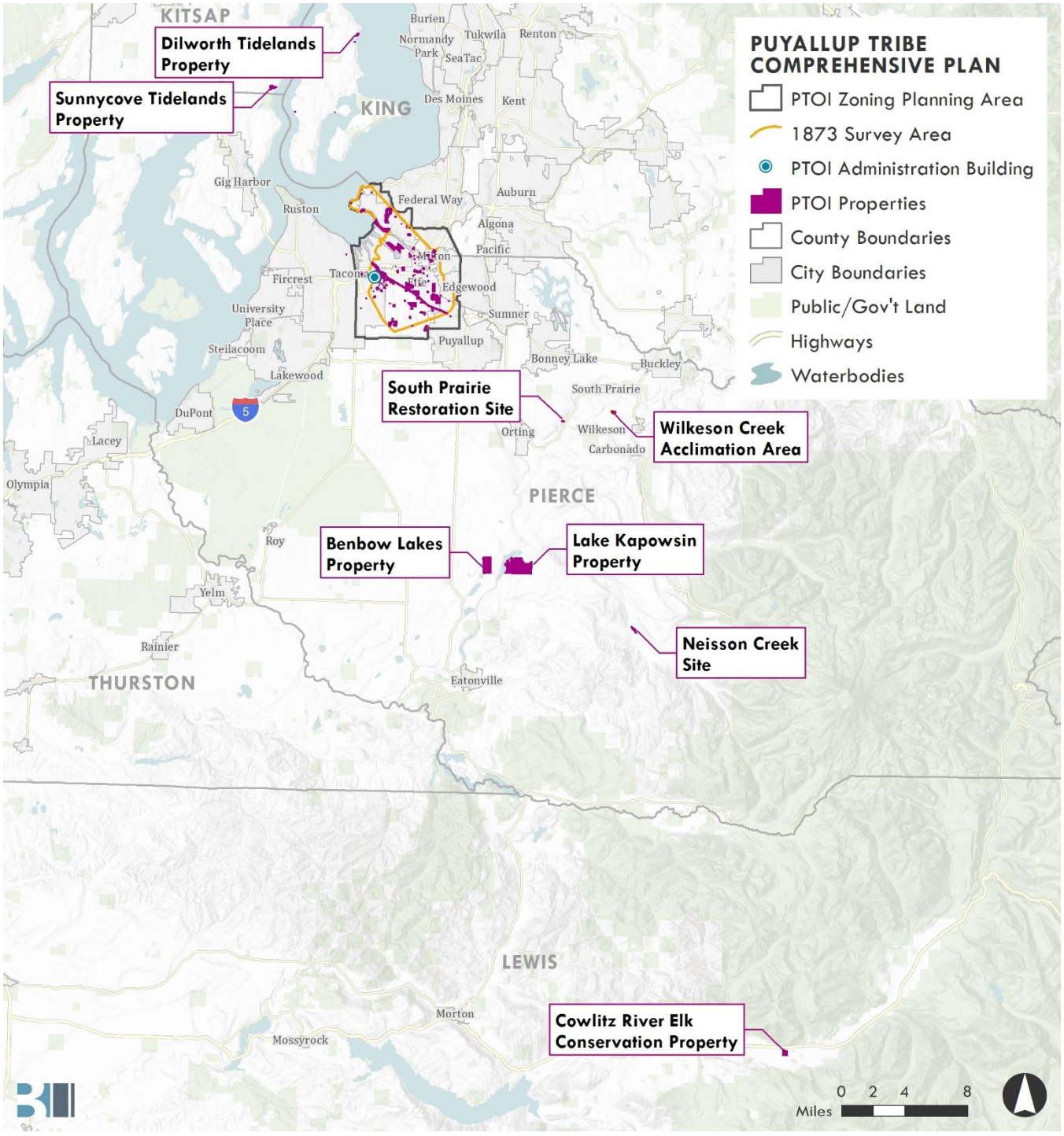
The PTOI has economic interests and ownership outside of the Planning Area. The map in Exhibit 9-1 shows this larger geography of the Tribe's economic development interests.

Properties outside the Planning Area owned by the Tribe include:

- **Dilworth Tidelands Property:** Shellfish tidelands
- **Sunnycove Tidelands Property:** Shellfish tidelands
- **South Prairie Restoration Site:** Tribal Fisheries restoration site
- **Wilkeson Creek Acclimation Area:** Tribal Fisheries site acclimation area for chinook
- **Lake Kapowsin Property:** Primarily purposed to support Tribal Fisheries but camping and gathering activities occur here as well
- **Benbow Lakes Property:** Camp site for the Gang Resistance Education and Training program and a Kwawachee Counseling Center support site
- **Neisson Creek Site:** Tribal Fisheries site - Settlement site, landlocked by electron dam
- **Cowltiz River Elk Conservation Property:** Elk conservation site

For the purposes of the Comprehensive Plan, these areas will be addressed by policies, but are not included in the existing conditions analysis.

Exhibit 9-1: Tribal Land Ownership and Economic Development Activities



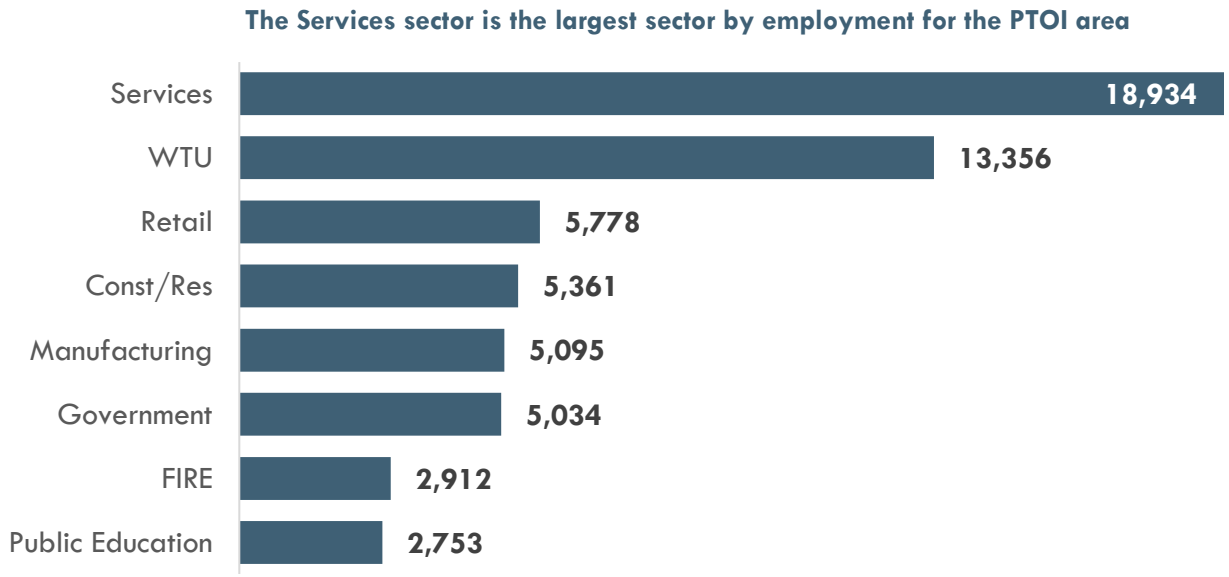
Source: PTOI, 2021; BERK, 2021.

EXISTING CONDITIONS

Employment in the Planning Area

Exhibit 9-2 shows total employment by sector in the PTOI Planning Area based on data provided by the Puget Sound Regional Council (PSRC). Of the 59,222 people employed in the PTOI Planning Area, 32% work in the services sector and 23% work in the Wholesale Trade-Transportation-Utilities (WTU) sector.

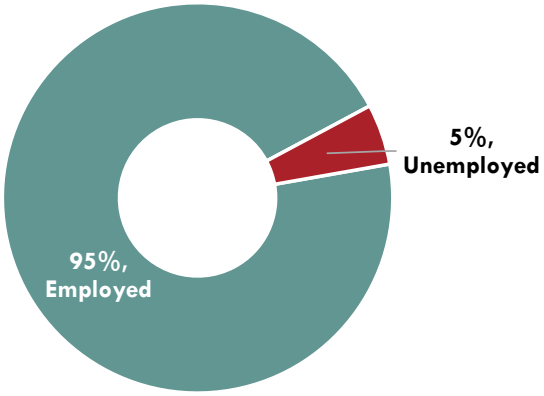
Exhibit 9-2: Total Employment in PTOI Area



Sources: PSRC, 2019; BERK, 2021.

Exhibit 9-3 shows the unemployment rate in the Planning Area. In 2019, there were 1,366 unemployed individuals in the civilian labor force of 27,141, which represents an unemployment rate of 5%. This is comparable to the county and state unemployment rates.[26]

Exhibit 9-3: Unemployment Rate, 2019

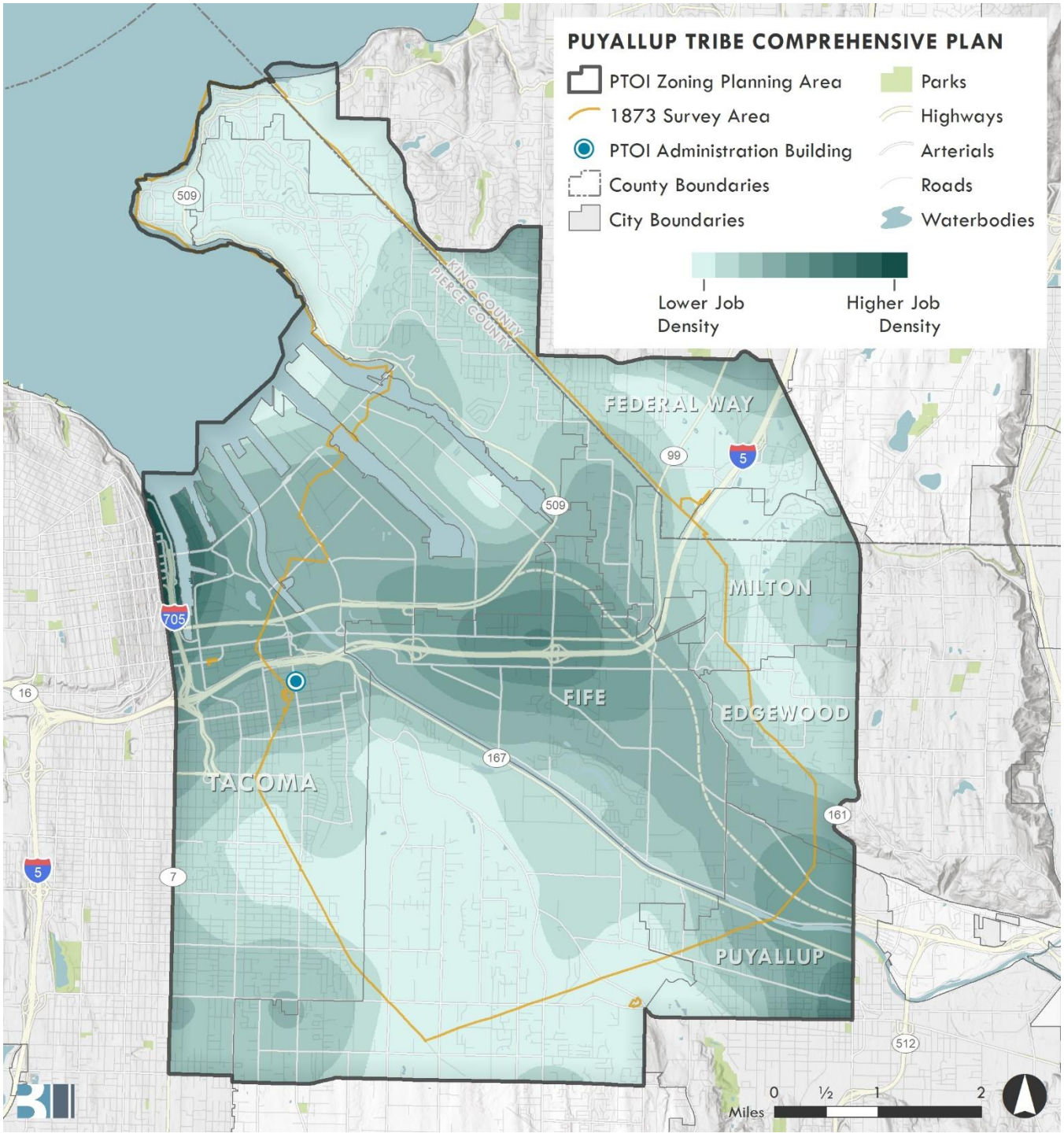


Sources: ACS, 2019; BERK, 2021.

Exhibit 9-4 maps employment density in the 1873 Survey Area, also referred to as the Reservation Area. Employment hubs are identified to the north in the Tideflats, centrally along I-5 and in Fife, and to the southeast in the city of Puyallup. The Port of Tacoma is a major employer in the Tideflats and Emerald Queen Casino is a large employer in Tacoma and Fife. A large commercial district within the City of Puyallup includes employers in the auto and manufacturing industries. Combined, the Puyallup Tribe entities are the 7th largest employer in Pierce County.[27]

[26] ACS 5-year S2301 Estimates
[27] Economic Development Board of Tacoma and Pierce County, 2020

Exhibit 9-4: Employment Density



Sources: Washington OFM, 2021; BERK, 2021.

Tribal Employment

Exhibit 9-5 summarizes employment in Tribal operations based on a 2018 WIGA survey. The table details the number of full-time employees, part-time employees, and temporary employees. Tribal operations employ 4,303 people, almost all of which are full-time employees. Emerald Queen Casinos is the largest employer, making up around 68% of total jobs from Tribal operations. While 84% of PTOI employees are registered members, only 15% of employees at Emerald Queen Casinos are members, along with 16% of Marine View Ventures, 46% of PTCE and 41% of Puyallup Tribal Health Authority.

Exhibit 9-5: Employment 2018 WIGA Survey

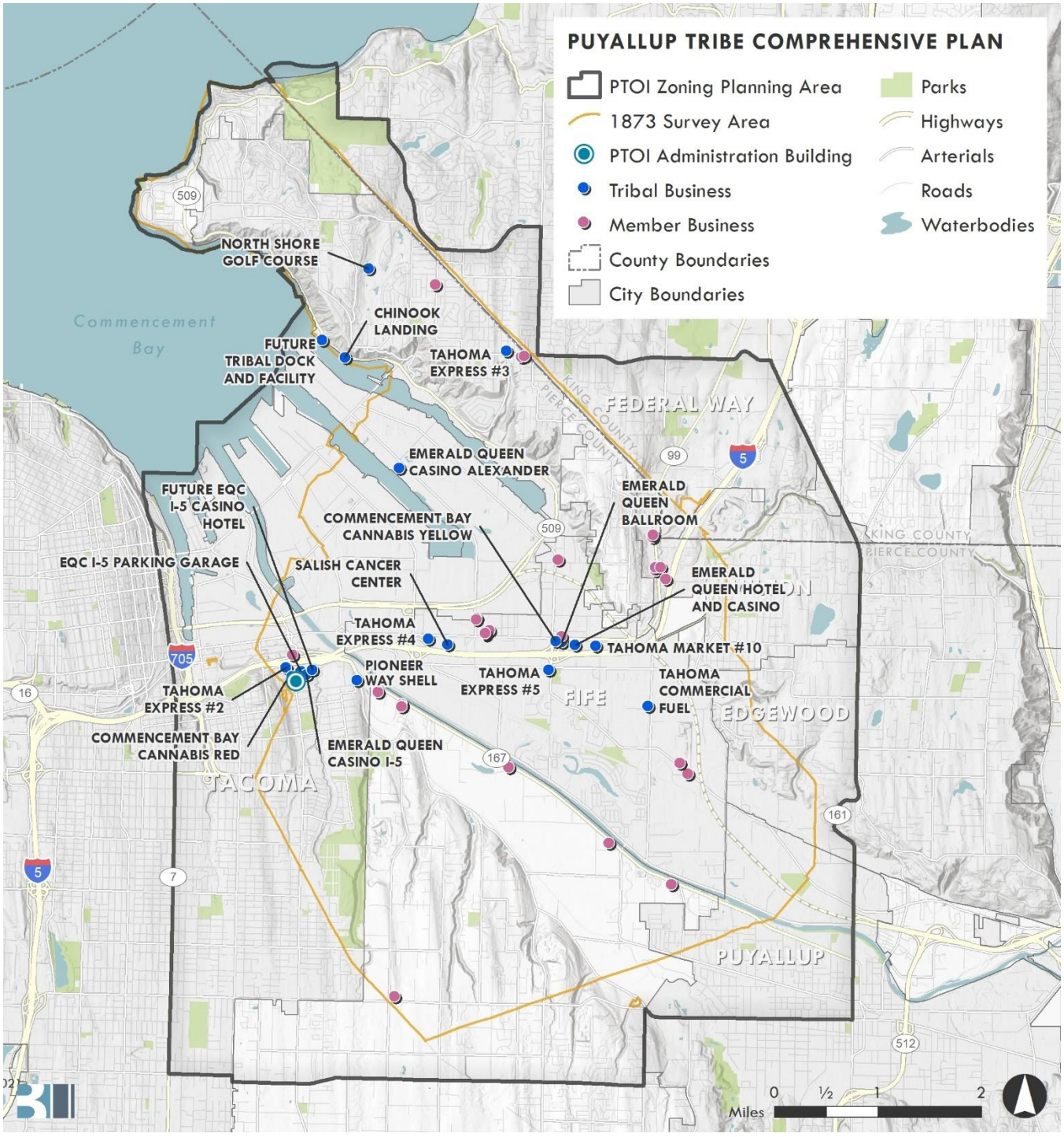
ENTITY	TOTAL EMPLOYEES	FULL-TIME	PART-TIME	TEMPORARY	% INDIAN
Puyallup Tribe of Indians	596	562	12	22	84%
Emerald Queen Casinos	2,934	2,772	162	0	15%
Marine View Ventures	115	76	39	0	16%
PTCE, Inc.	103	103	7	0	46%
Puyallup Tribal Health Authority	293	270	18	5	41%
Salish Integrative Medicine INC	29	29			7%
Qwibil	2	2			
Chief Leschi Schools	231	228	3	0	
Total	**4,303**	**4,042**	**241**	**27**	

Sources: WIGA, 2018; BERK, 2021.

Tribal Investments and Activities

The Tribe owns and operates seven businesses, including two casinos, a marina, and four gas stations. The Tribe also leases its industrial and commercial lands in and around the Port of Tacoma to a range of businesses which bring additional jobs and economic activity to the region. These businesses include car import and export, warehousing, shipping container storage, and manufacturing. The map in Exhibit 9-6 identifies Tribal businesses as well as businesses owned by Tribal members. Many are clustered along the I-5 corridor running east-west across the boundary.

Exhibit 9-6: Tribal Businesses within the Survey Boundary



Source: PTOI, March 2021; BERK, 2021.

Gaming Sector

The gaming and entertainment sector is a core economic driver for the Puyallup Tribe, which owns the Emerald Queen Casino (EQC)[28]. The Tribe is among the approximately 50% of 500 federally recognized tribes that own and run gaming operations. In 2020, the EQC employed 2,146 full-time workers, including more than 400 Tribal members, and was the 11th largest employer in Pierce County.[29]

The PTOI pays a dividend to each Tribal member from their casino profits for general welfare and income. Tribal casinos support jobs beyond direct employment at the casino. While the casino does not pay corporate taxes, it does pay payroll and other taxes, just like any other business operating in the United States. Through a multiplier effect, casino jobs also support other employment in the area. Casino employees spend income on healthcare, transportation, food, and other daily needs, helping to stimulate the economy across the community. When employees spend income on other businesses owned by members, that money stays within the Tribal membership. Through income and growing career paths, these jobs also build generational wealth for Tribal members as well as generate even more employment opportunities in the community.

The Emerald Queen Casino also operates the EQC Ballroom & Conference Center, with over 5,000 sq feet of event space that is rented out for banquets, performing arts, and educational events.

The Casino is a product of the self-determination of tribal governments and their sovereignty. It plays a key role in the Tribe's economy and revenues from gaming fund many public services that the Tribe is able to undertake.

Fisheries Sector

The **Puyallup Tribe Fisheries** maintains a large presence in the Puyallup River watershed. Fishing and harvesting salmon, geoduck, crab, and other species is a treaty protected practice that provides economic opportunity for the Tribe as well as traditional foods that are important to Tribal culture. The mission of the Fisheries Department is to preserve, protect, and enhance salmon populations through habitat restoration efforts, harvest management and policy, fish enhancement projects, research, and monitoring. The Shellfish Department of the Puyallup Tribe of Indians strives to maximize and optimize the shellfish harvest rights secured through the Treaty of Medicine Creek. The department is tasked with protecting the habitats and populations of shellfish while providing a safe environment for the purpose of commercial, ceremonial, and subsistence fishing opportunities for Tribal members.

Fisheries are essential to the Tribe economically, socially, and culturally. The Puyallup Tribe, as a steward of the land and marine waters in the usual and accustomed fish and shellfish areas, has both treaty and governmental obligations and responsibilities to manage natural resources for uses beneficial to the regional community.

The Tribe exercises its treaty-protected right to fish and gather where their ancestors fished since time immemorial. Today, fishing and gathering practices strengthen the community and provide economic support to a large portion of Tribal families. The protection of natural resources is vital to the health of the Puyallup Tribe. Pollution and climate change threaten the health of the environment and fisheries. Rising temperatures, droughts, floods, rising seas, and ocean acidification hinder the life cycle of marine organisms that form the base of the marine food chain. Climate shifts cause disruptions as marine species migrate toward cooler environments.[30] To protect the fisheries

[28] https://www.edbtacomapierce.org/wp-content/uploads/2020/12/Economic-Development-Board-for-Tacoma-Pierce-Co.-uncategorized-772.pdf; retrieved June 2021.
[29] Economic Development Board of Tacoma and Pierce County, 2020
[30] https://www.fisheries.noaa.gov/insight/understanding-our-changing-climate

sector, it is important to ensure fish stocks remain adequately abundant for harvesting. The fishing season that used to last several months has been reduced to a series of days, if not hours.

The decline in fisheries harvests also threatens Tribal fishing license tax revenue that supports the fisheries programs. The economic survival and health of the Tribe depends on the health of its natural resources. Initiatives that support the environmental health of the Puget Sound and that respect the voice and sovereignty of PTOI in regional negotiations are important for economic prosperity.

Recreation Sector

The Northshore Golf Course was built in 1961. The Tribe acquired the 18-hole course in 2015 and in 2018 added a Golf Shop. There are plans for a new 15,000 sq ft clubhousethat will accommodate up to 300 guests and will support a variety of event venues.

Healthcare Sector

The **Salish Cancer Center** is another Tribal entity that offers employment to healthcare providers and culturally appropriate and accessible healthcare resources for Tribal members. The center serves both native and non-native patients with all types of cancer. The center's medical team has a philosophy of considering all aspects of the patient, including the body, mind, and spirit. Treatment plans use the best of modern medicine in conjunction with an optimized integrative care plan. The center offers naturopathic medicine and conventional oncology, traditional Chinese medicine, and traditional native healing practices. Traditional healing is founded on Tribal cultural beliefs and practices that are rooted in connections to the natural environment, natural cycles, and connections to the spirit of all things.

Retail Sector

Many of the Tribe's retail activities also connect to traditional practices for healing and a healthcare approach rooted in connection to the natural environment.

Commencement Bay Cannabis operates three retail locations that are part of Puyallup Tribal Cannabis Enterprises (PTCE), an organization that utilizes the growing popularity of the cannabis industry to create jobs and careers, education, and training to Tribal members. PTCE is looking to expand to additional locations.

Medicine Creek Analytics is a full-service lab that provides full Washington state I-502 compliance testing, terpenes, and additional microbial panels. The lab also performs tests for pesticides and heavy metals. Medicine Creek Analytics is the only lab in Washington certified to perform such testing.

Development Ventures

Marine View Ventures (MVV) is the economic development arm of the Puyallup Tribe, which focuses on leveraging existing assets to create jobs and job training opportunities for Tribal members. MVV's objectives are to activate existing assets and to build its land asset base. MVV operates seven gas/convenience locations, real estate portfolios with over 300 acres, the Chinook Landing Marina, and a car wash.

Through the Puyallup Land Settlement Act of 1987, the Tribe received more than 300 acres of land located on the Blair and Hylebos Waterways on Commencement Bay. The Tribal port properties are within or adjacent to the Port of Tacoma. The Tribe is looking for opportunities to capitalize on this deep water port area and surrounding

industrial lands.

Partnerships and land leasing of underutilized Tribally owned properties is an economic opportunity the Tribe has relied upon for non-gaming related revenue. This sector is expected to increase as Tribal projects partnering with private developers on Tribal land are more easily coordinated than typical private development on city and county land. The Tribe uses these partnerships to generate revenue, provide jobs for Tribal members, and provide for infrastructure improvements.

Workforce Development

Workforce development is an important aspect of economic development by supporting and providing people with the skills and training needed to secure permanent employment. High quality education is valuable to the Tribe's economic development.

The **Puyallup Tribal Workforce Development Program** (TWFD) provides members with opportunities to secure meaningful employment. Staff assists members in seeking employment both inside and outside Puyallup Tribal programs and departments. Employment is becoming more difficult to obtain without the required jobs skills or education, or simply because of life events that may have prevented Tribal Members from working.[31] Programs offered by TWFD include the following:

- The 240 Hour Program provides 240 hours of full time or part time employment to Puyallup Tribal Members, paid at the recognized minimum wage. This opportunity allows members to develop job skills and employment history to help them find permanent full time jobs.
- Clean Our Rez is a 240 hour program that provides an opportunity for one-year employment for Tribal members who are willing to work outdoors to clean up the Reservation.
- The Tribal Employee Rights Program (TERO) provides Puyallup Tribal members, their spouses, and other federally recognized Tribal members the opportunity to find work in qualifying trades. TERO protects Tribal Sovereignty by supporting Tribal member self-sufficiency through enforcing Indian Preference requirements in employment, training, and contracting opportunities. TERO was created as a national advocacy voice to provide protection to Native Americans working on the Reservation.
- TERO's purpose is to remove employment barriers for Native Americans living on and off the reservations by providing employment referrals, support services, and job training, and assisting with other situations as they may arise. The program also assists Native-owned businesses with locating projects, legal counsel, outreach, and other support services to provide them the opportunity to better grow their businesses.
- TERO collects a 2.5% fee on all projects within its jurisdiction. This revenue supports job training programs, services to match job-seeking clients with contractors, and outreach to contractors regarding TERO, Tribal Law, Culture, and Traditions.

KEY FINDINGS AND IMPLICATIONS FOR THE PLAN

The existing conditions analysis shows that the Puyallup Tribe's businesses on the reservation support jobs and careers. Key industries include gaming, fishing, retail, education, and healthcare. While the Tribe operates several

[31] http://news.puyalluptribe-nsn.gov/Tribal-workforce-development-program-information/

businesses, gaming operations remain its largest source of revenue. A more diversified portfolio that combines different economic activities and industries can reduce the overall risk profile for the Tribe.

Natural capital is a critical part of the Puyallup Tribal economy, with implications for Tribal employment, fish habitat, climate regulation, flood protection, recreation, and cultural practices. Loss of natural capital, including loss of fish habitat and diminishment of natural resources because of climate change, will create challenges for the Tribal economy. Economic goals should include protecting the value of existing natural resources and habitats.

Land acquisition is an important focus of Tribal investments and economic development, tied to the protection of natural habitats, economic diversity, and cultural values. A more intentional and strategic land acquisition program would allow the Tribe to leverage its assets, build on regional strengths, and create a strong, diverse economic foundation.

A sustainable economy will require regulatory policies and physical infrastructure to support Tribal businesses and member-owned businesses to keep dollars within the Tribal membership. Jobs from Tribal businesses, such as the casino, can provide multiplier effects that benefit the Tribal membership when employees spend their incomes in other industries. However, this is only true if those dollars stay on the Reservation and are spent at Tribal and member-owned businesses. The Tribe can support this effect by creating and sustaining opportunities for residents and visitors to purchase goods and services at Tribal and member-owned businesses. For example, investing in a workshop and market space could provide potential opportunities for many Tribal members who work in artisanal trades.

Investing in human capital is another key opportunity. Investments in developing the pipeline, for example, of STEM teachers at Chief Leschi, are needed. Existing workforce development programs are poorly matched to the needs of the Tribe, and investing in more suitable programs will provide greater opportunities to members. Robust programs should train workers not just for secretarial or construction jobs but also for higher skilled jobs. Expanding existing workforce training programs to include entrepreneurship training and support would help Tribal members develop careers and build the futures they want to see.

The National Congress of American Indians (NCAI) has a Partnership for Tribal Governance that works with Tribal nations to document innovative approaches to workforce development.[32] The NCAI published policy recommendations for the federal government that include increased funding, congressional oversight, protecting codified funding, rectifying data shortcomings, providing technical assistance, and creating pathways for youth employment.[33]

Transportation programs are vital to a community's economic development and security. The Tribe's major transportation needs include significant funding increases for Tribal transportation programs, new safety programs to address the high rates of traffic injuries and deaths, and streamlining of existing transportation programs and funding mechanisms.

A key need is greater flexibility in using the Tribe's Tribal Transportation Program (formerly known as Indian Reservation Roads) dollars for roads that provide access to treaty protected resources. TTP is federal funding distributed to Tribes based on a statutory formula that considers a Tribe's prior year funding share, Tribal population, road mileage, and average funding over several years. The funds are distributed directly to Tribes

[32] https://www.ncai.org/ptg/workforce-development
[33] https://www.ncai.org/ptg/NCAI_WORKFORCE_DEVELOPMENT_BRIEF_v2.0_2020.pdf

without passing through WSDOT. As an example of a problem caused by inflexible funding restrictions, the Tribe is not allowed to apply TTP funding to maintenance of private roads that are essential for access to Tribal fisheries facilities. s

10. Government Services, Capital Facilities, and Utilities

INTRODUCTION

Communities plan for government services and capital facilities to ensure that there are adequate spaces and services to support community development, that levels of service do not fall below established standards, and that the community can financially support the development of additional facilities. The Puyallup Tribe continues to plan for maintaining existing infrastructure and investing in expanded or new infrastructure to support the needs and goals identified in this plan.

Utilities in the PTOI Planning Area are provided by local jurisdictions. The Comprehensive Plan will outline community priorities for coordination with these outside entities. This section includes an inventory of existing capital facilities, government services, utilities, and programs.

EXISTING CONDITIONS

Capital Facilities

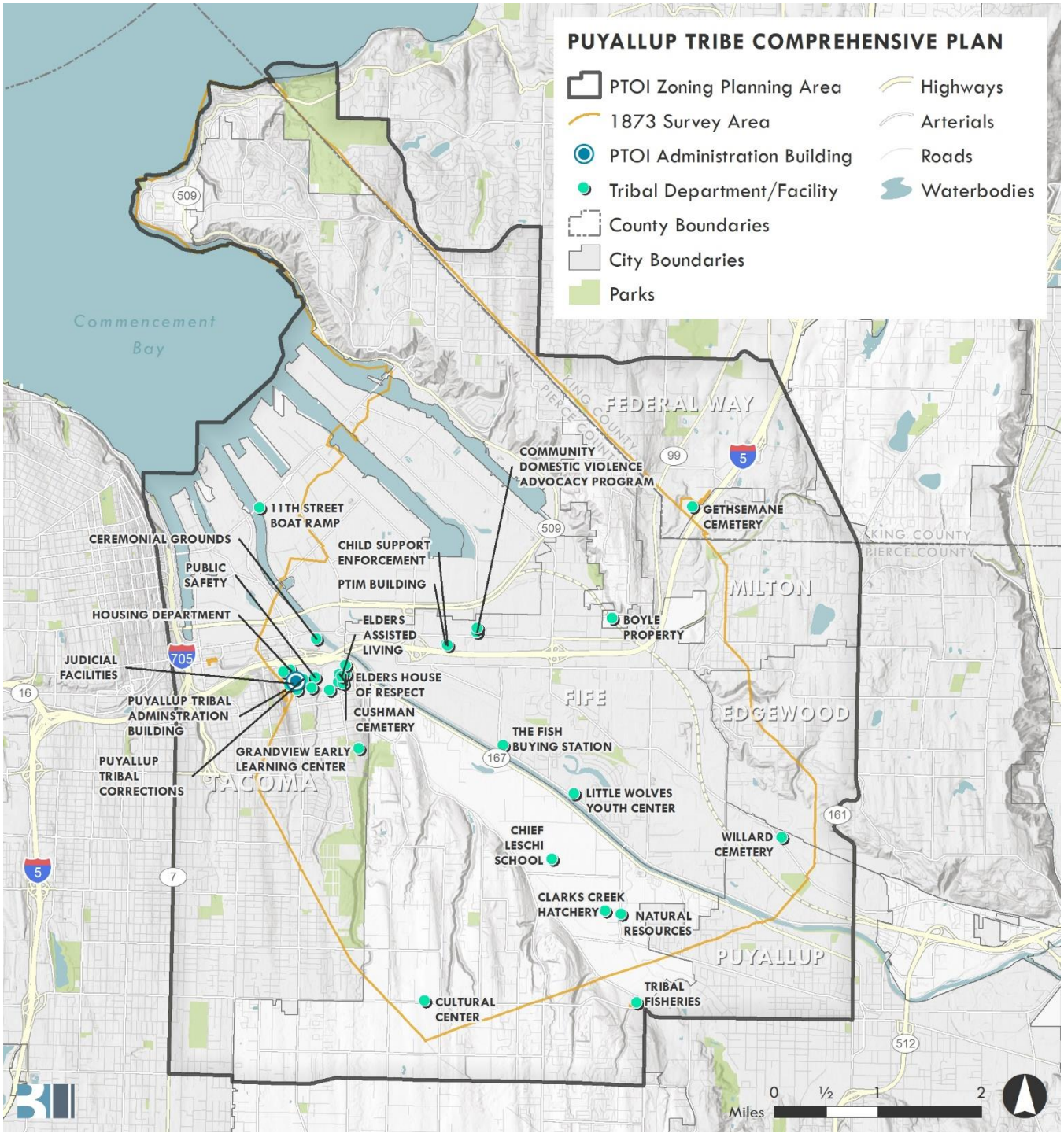
There are 35 Tribal capital facilities in the PTOI Planning Area, including facilities for administration, judicial services, natural resources, elders care, childcare and youth services, and other services. These facilities are listed in Exhibit 10-1 and mapped in Exhibit 10-2. A cluster of facilities in the First Creek Subarea near the junction south of I-5 surrounds the PTOI Administration building. Other facilities are spread across the Planning Area, several located near the Puyallup River.

Exhibit 10-1: Tribal Capital Facilities

TYPE	FACILITY
Administration	Puyallup Tribal Administration Building
	Purchasing and Receiving Building
Judicial	Tribal Court Building
	Incubator Building (Tribal Police)
	Puyallup Tribal Corrections (Justice Center)
	Public Safety Department Office
Natural Resources	Clarks Creek Hatchery
	Tribal Fisheries
	Natural Resources
	The Fish Buying Station
Health and wellness	Community Domestic Violence Advocacy Program
	Takopid Puyallup Tribal Health Authority

TYPE	FACILITY
	Puyallup Tribal Integrative Medicine (PTIM) Building
Elders Care	Elders House of Respect (care facility)
	Elders Assisted Living (housing)
	Elders Lawn Care
Children/Youth	Grandview Early Learning Center
	Little Wolves Youth Center
	Children of the River Child Advocacy Center
	Chief Leschi School
Wellness	Kwawachee Counseling Center
	Wrap Around Department Offices
	Flames of Recovery (recovery house)
	Church of the Indian Fellowship
	Culture Department
Cemetery and ceremonial grounds	Cushman Cemetery
	St. George Cemetery
	Willard Cemetery
	Ceremonial Grounds
Utilities and general services	STO BE LAH Electrical Substation
	Maintenance Facilities & Offices
	Housing Department Building
Other	EQC Casino & Hotel (Fife)
	EQC Casino & Hotel (Tacoma)
	EQC Riverboat & Property
	Chinook Marina
	Kapowsin Property
	Tacoma Dome Property
	Graham Property (site of G.R.E.A.T. camp)
	Marine View Ventures
	Commencement Bay Cannabis Retail Locations
	Tahoma Market & Gas Stations
	North Shore Golf Course
	General Purpose Vacant Property

Exhibit 10-2: Puyallup Tribe Government Facilities



Sources: Puyallup Tribe of Indians GIS Department, 2021; BERK, 2021.

Government Services

The Puyallup Tribe provides a broad range of services across the following areas:

- **Administration**, including finance, human resources, and communications.
- **General services**, including facilities, maintenance, security, land use, and transportation.
- **Tribal membership services**, including emergency housing repair, funeral and medical services, emergency assistance, and higher education support.
- **Tribal community wellness**, including child support, youth services, domestic violence support, elders services, housing services, community/family services, and wraparound services.
- **Tribal natural resources**, including fisheries, hunting and wildlife, shellfish, and fish buy.
- **Tribal justice and safety**, including law enforcement, probation office, prosecutor's office, and Tribal court.
- **Other Tribal entities**, including Chief Leschi Schools, Commencement Bay Cannabis, Emerald Queen Casino, Marine View Ventures, Puyallup Tribal Health Authority, and Salish Cancer Center.
- **spuyalʔpabš (Puyallup People)** culture, language program, and historic preservation.

Fire

The Tribe has no standing fire department and relies on local municipalities for fire protection throughout the Planning Area. The Tribe reimburses local fire districts through 2% Casino Impact Fees. Riverside Fire and Rescue is a special tax district dedicated to providing fire and emergency services to Pierce County Fire District 14. The fire district was established in 1952 and now provides services from the City of Puyallup to the City of Tacoma along the Puyallup River to the north and along Pioneer Way to the south. Riverside Fire and Rescue serves the Puyallup Tribal Community at Chief Leschi Schools, fish hatcheries, local businesses, and residential properties.

Schools

Chief Leschi Schools was founded in 1976 to address the high youth dropout rate among students from the Puyallup Tribe. The Cultural Resources chapter details more of this historical context starting on page 3-11. One of around 200 Tribal schools in the United States, it is the largest of seven Tribal schools in Washington state and one of the largest Tribal schools funded by the Bureau of Indian Education.

The first school operated in a Tacoma School District building on the site that is now occupied by the Tacoma Dome. In the early years, the schools encountered several hardships including poor working conditions, high staff turnover rate, an unsafe building, and congested rooms. In response to these hardships, the staff, school board members, parents, students, friends, and Tribal Council developed a model Tribal school. They pursued federal appropriations for years before receiving funds to build the current Chief Leschi campus. To support this endeavor, the Puyallup Tribe bought 68 acres of farmland that includes a farmhouse and outbuildings for the school.

Today, the school is a $32 million, 200,000 square-foot facility. In the first year of operations, the school had 788 students and 32 graduating seniors. The school has a focus on honoring the Tribe's culture and recognizing and celebrating the cultural heritage of the students. Native American students at this school have a better graduation rate than the statewide average for Native American high schoolers: 68% at Chief Leschi compared to 62% overall for the state.[34]

[34] Washington OSPI, 2019.

Police

The Puyallup Tribe operates its own police force that is cross deputized with local jurisdictions on the Puyallup Reservation. It is the mission of the Puyallup Tribal Police department to safeguard life and property, to enforce Tribal law in a fair and impartial manner, to preserve peace and order within the boundaries of the Puyallup Reservation, to work with Tribal members in usual and accustomed hunting and fishing areas, and to aggressively pursue this mission in conformance with the culture and values of the Puyallup Tribe of Indians. It is their vision to provide dedicated professionals to provide excellent service that enhances the quality of life for the community.

Judicial

Puyallup Tribal law defines the judicial system as a separate, co-equal branch of government, consisting of three separate courts: the Puyallup Tribal Court, the Puyallup Tribal Children's Court, and the Puyallup Tribal Court of Appeals. All three courts operate within a shared court facility, identified as Judicial Facilities on the map in Exhibit 10-2.

In addition to the courthouse, the Puyallup Tribe operates a Tribal correctional facility, Tribal law enforcement, a probation office, and the Prosecutor's office.

Parks & recreation

The Puyallup Tribe does not own or manage their own park department. However, there are several vacant sites and sites with limited development that support recreational activity. There are 48 parks within the Planning Area boundary, ranging from small neighborhood parks to larger, regional feature parks. The larger and most notable parks include:

- **Dash Point State Park**, 461 acres to the north of the Planning Area, includes coastline with water access, hiking and biking trails, and 141 campsites.
- **Swan Creek Park** is 373 acres running north-south and serving as the dividing line between the First Creek and Puyallup Tributaries Subareas in this plan. The park features bird watching, hiking and walking trails, mountain biking, and picnic sites.
- **Puyallup Riverwalk Trail** offers 5 miles of walking and biking trails along the Puyallup River within the City of Puyallup. Future extension plans would connect the trails to an extensive regional trail network.
- **Charlotte's Blueberry Park** is 20 acres on the site of historic blueberry farms in the First Creek Subarea. The City of Tacoma maintains blueberry bushes on half of the site, which are open to the public for berry picking July through September.
- **Portland Ave Park & Community Center** is in the First Creek Subarea and located near the PTOI Administration Building and Emerald Queen Casino. It offers a playground, picnic shelters, wading pool, tennis courts, basketball courts, and baseball fields, and a Community Center that can be reserved for events.

Health Clinic

The Puyallup Tribal Health Authority, established in 1976, is the first ambulatory health clinic to enter into a 638 Self Determination contract with the Indian Health Service. As a 501(c)(3) organization chartered by the Puyallup Tribe, PTHA has demonstrated commitment to quality through national accreditation by AAAHC and COLA.

Utilities

The utilities identified and detailed in this section include electricity, drinking water, wastewater, solid waste, and

stormwater.

Sto-be-lah Electrical Substation & Power Loop

The Puyallup Tribe, in partnership with Tacoma Public Utilities, operates franchise power conduit to key Tribal facilities within the First Creek Subarea. The purpose of the power loop is to provide growing electrical capacity to the development activity within the subarea and surrounding areas. The power loop provides wholesale power rates, reducing the overall electrical bill by 30% to major facilities. It also provides dependable power as the conduit is all underground and not typically subject to weather related outages.

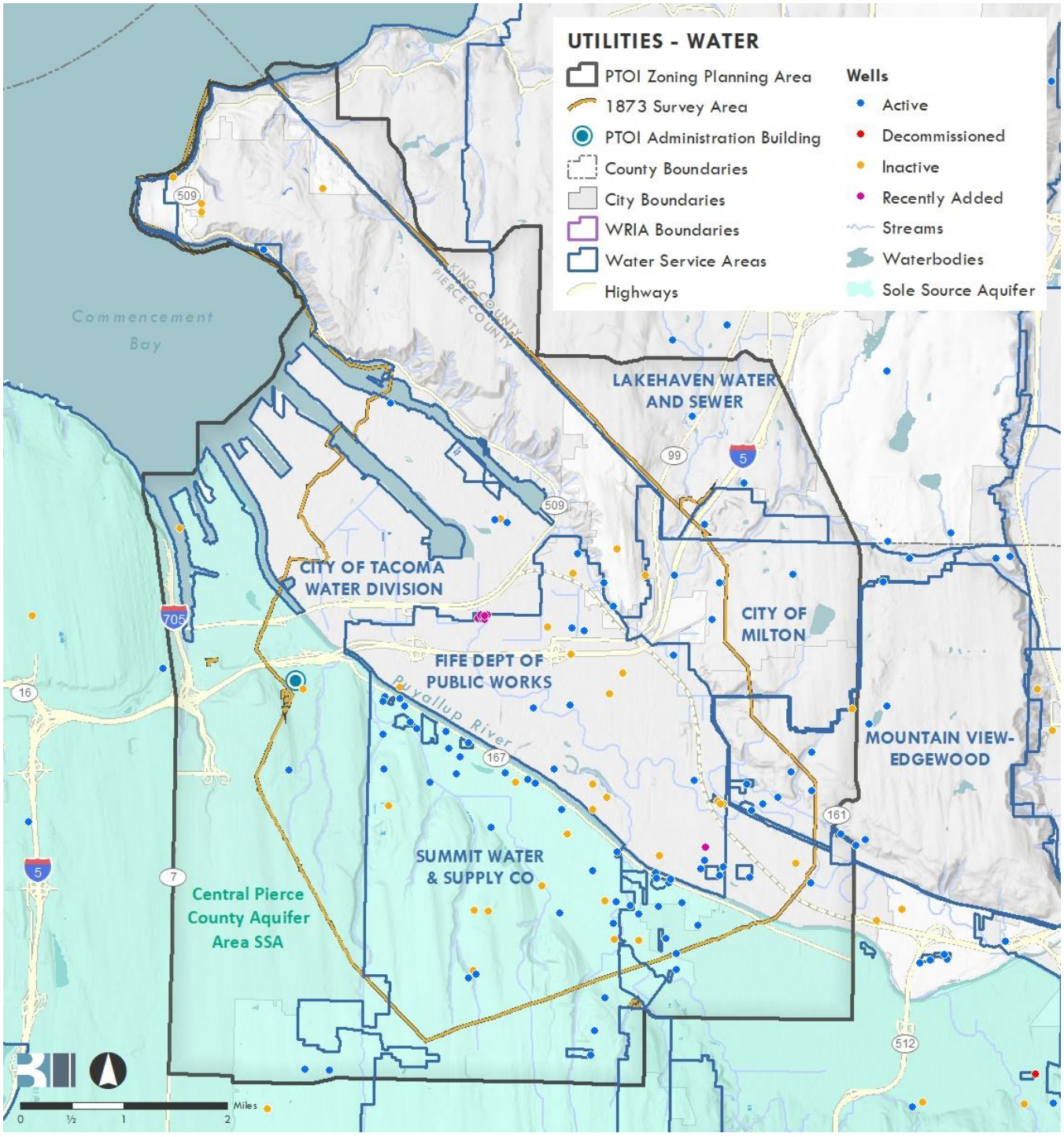
Drinking Water

Within the PTOI Planning Area, drinking water is provided by the following providers:

- Tacoma Water (Tacoma Public Utilities)
- City of Milton's Water Division
- Lakehaven Water District (Lakehaven Water & Sewer District)
- Summit Water and Supply Company
- Mountain View-Edgewood Water Company

Existing water infrastructure located within the PTOI Planning Area is shown in Exhibit 10-3. This includes the presence of eight wells which have been confirmed by the Fisheries department, identified in pink.

Exhibit 10-3: Water infrastructure.



Source: WA DOH, 2016; Pierce County, 2021; BERK, 2021.

Tacoma Water

Tacoma Water, a division of Tacoma Public Utilities, provides potable drinking water to approximately 46.2% of the PTOI Planning Area. Tacoma Water serves the City of Tacoma and is a supply partner to the City of Fife Public Works and City of Puyallup Public Works. Up to 150 million gallons per day (mgd) is supplied from the Green River and 48 mgd is supplied from wells. Water from the Green River is treated at the Green River Filtration Facility, located near the town of Cumberland in southern King County. Although Tacoma Water currently has an abundant supply of water and is far from reaching its full capacity for delivering that supply, they have developed water conservation strategies as described in the 2018 Water Conservation Plan.

City of Puyallup's Water Division

As of 2015, the City of Puyallup produced 1.38 billion gallons of drinking water per year. The drinking water sources include spring water from Maplewood and Salmon Springs (70%), well water (29%) from four deep wells, and surface water (1%) purchased from the City of Tacoma. Currently, nine welded steel reservoirs store 19.3 million gallons of drinking water. The City of Puyallup overlaps with approximately 7.0% of the PTOI Planning Area.

City of Milton's Water Division

Drinking water from the City of Milton is produced from five groundwater wells. In 2020, the City of Milton produced a total of 316,899,000 gallons of water with 3.1% leakage, which is less than the State goal of 10%. The City of Milton overlaps with approximately 6.7% of the PTOI Planning Area.

Lakehaven Water District

Lakehaven Water District, a division of the Lakehaven Water & Sewer District, includes 25 wells with groundwater treatment plants and connections to the Second Supply Pipeline (SSP). The total active pumping capacity of their wells is 22,880 gallons per minute (gpm) or 32.95 mgd, but due to operational considerations, stream flows, and water quality, the wells are estimated to provide only 7.6 mgd on an annual average basis. The SSP provides the Lakehaven Water District with up to 12.6 mgd. The average annual water production over the last five years has been 9.5 mgd, which is less than the supply available from the wells. During this time there has been an increasing reliance on the SSP, and this trend is expected to continue. The Lakehaven Water District overlaps with approximately 7.29% of the PTOI Planning Area.

Summit Water and Supply Company

Summit Water and Supply Company (Summit Water) is a private, non-profit, member-owned company that provides drinking water to East Tacoma and unincorporated Pierce County. They have a pumping capacity of approximately 3,500 gpm, a water right of 2,800 gpm, and storage capacity of 7.1 million gallons. Summit Water overlaps with approximately 16.7% of the PTOI Planning Area.

Mountain View-Edgewood Water Company

Similar to Summit Water, Mountain View-Edgewood Water Company (Water Company) is also a private, non-profit, member-owned company. The Water Company provides non-chlorinated drinking water to the majority of the City of Edgewood. They have seven wells that can source 3,500 gpm and a storage capacity of 3.2 million gallons. The Water Company overlaps with approximately 2.9% of the PTOI Planning Area.

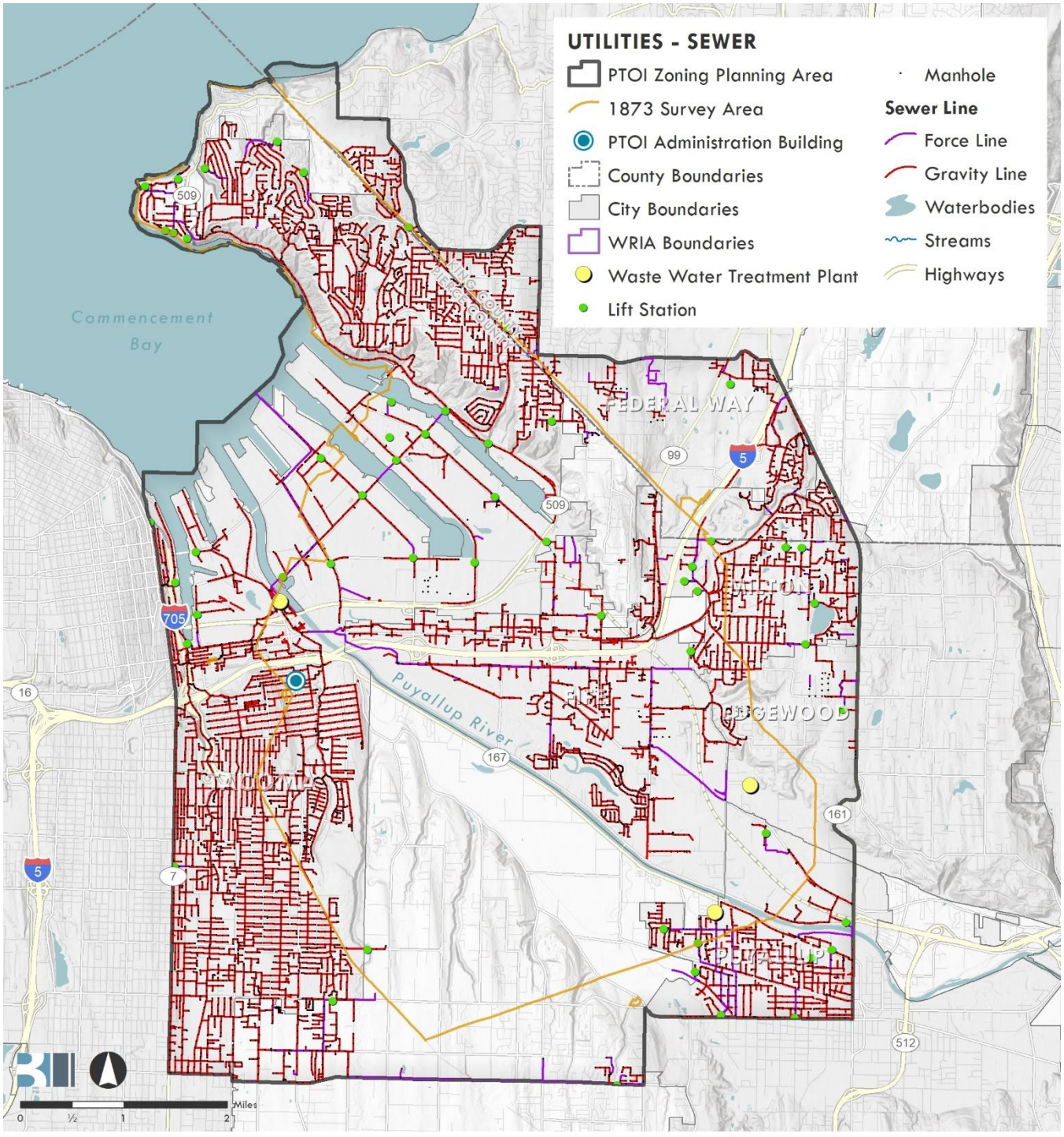
Wastewater

Within the PTOI Planning Area, wastewater services are provided by the following providers:

- City of Tacoma Department of Environmental Services
- Lakehaven Sewer District (Lakehaven Water & Sewer District)
- City of Fife Public Works
- City of Puyallup Public Works
- Pierce County Sewer Utility

The majority of wastewater infrastructure within public streets and rights-of-way is managed by the City of Tacoma Department of Environmental Services. The Lakehaven Sewer District, a division of the Lakehaven Water & Sewer District, services the wastewater collection systems of the City of Federal Way and the City of Edgewood. The City of Fife Public Works department services the City of Fife and a small portion of the City of Edgewood. A small portion of the PTOI Planning Area is also serviced by the City of Puyallup Public Works department (for the City of Puyallup) and Pierce County Sewer Utility (for the City of Milton). Existing wastewater infrastructure located within the PTOI Planning Area is shown in Exhibit 10-4. The utilities with wastewater treatment plants (WWTPs) serving the project area are described below.

Exhibit 10-4: Wastewater infrastructure.



Source: Edgewood, Fife, Lakehaven Water & Sewer District, Milton, Puyallup, Tacoma, Pierce County, King County, 2021; BERK, 2021.

City of Tacoma Department of Environmental Services

City of Tacoma Environmental Services operates two wastewater treatment plants: Central Wastewater and North End. The Central WWTP, located on the Tideflats along the Puyallup River, services the Planning Area. This WWTP uses high purity oxygen and beneficial aerobic bacteria to remove organics from wastewater. Biosolids material processed at the Central WWTP is recycled and turned into gardening mix and potting soil. During large storm events, the plant receives and treats more than 130 million gallons of wastewater a day. In 2014, a flood wall was constructed around the Central WWTP to prevent overflow of untreated wastewater during flood events.

Lakehaven Sewer District

Lakehaven Sewer District, a division of Lakehaven Water & Sewer District, operates the Lakota and Redondo WWTPs. The portion of the Planning Area serviced by Lakehaven Sewer District flows to the Lakota WWTP, which was constructed as a primary treatment plant in 1967 and upgraded to secondary treatment in 1991. The Lakota WWTP was designed for a peak monthly flow of 10 mgd and a peak hourly flow of 22.2 mgd, and has room for expansion when dictated by growth and development.

Solid Waste

Within the PTOI Planning Area most curbside solid waste collection, including food and yard waste, as well as recycling drop off services, is performed by the City of Tacoma Department of Environmental Services. The solid waste utility operates a full-service transfer station, with a recycling center and household hazardous waste collection facility, as well as the Call-2-Haul residential bulk item disposal service. In the City of Federal Way solid waste is handled by Waste Management, Inc. Their services include garbage, composting collection, and recycling. The rest of the study area is serviced by private service providers. The Cities of Edgewood, Fife, Puyallup, and Milton use Murrey's Disposal Company (also known as D.M. Disposal or Murrey's American Disposal).

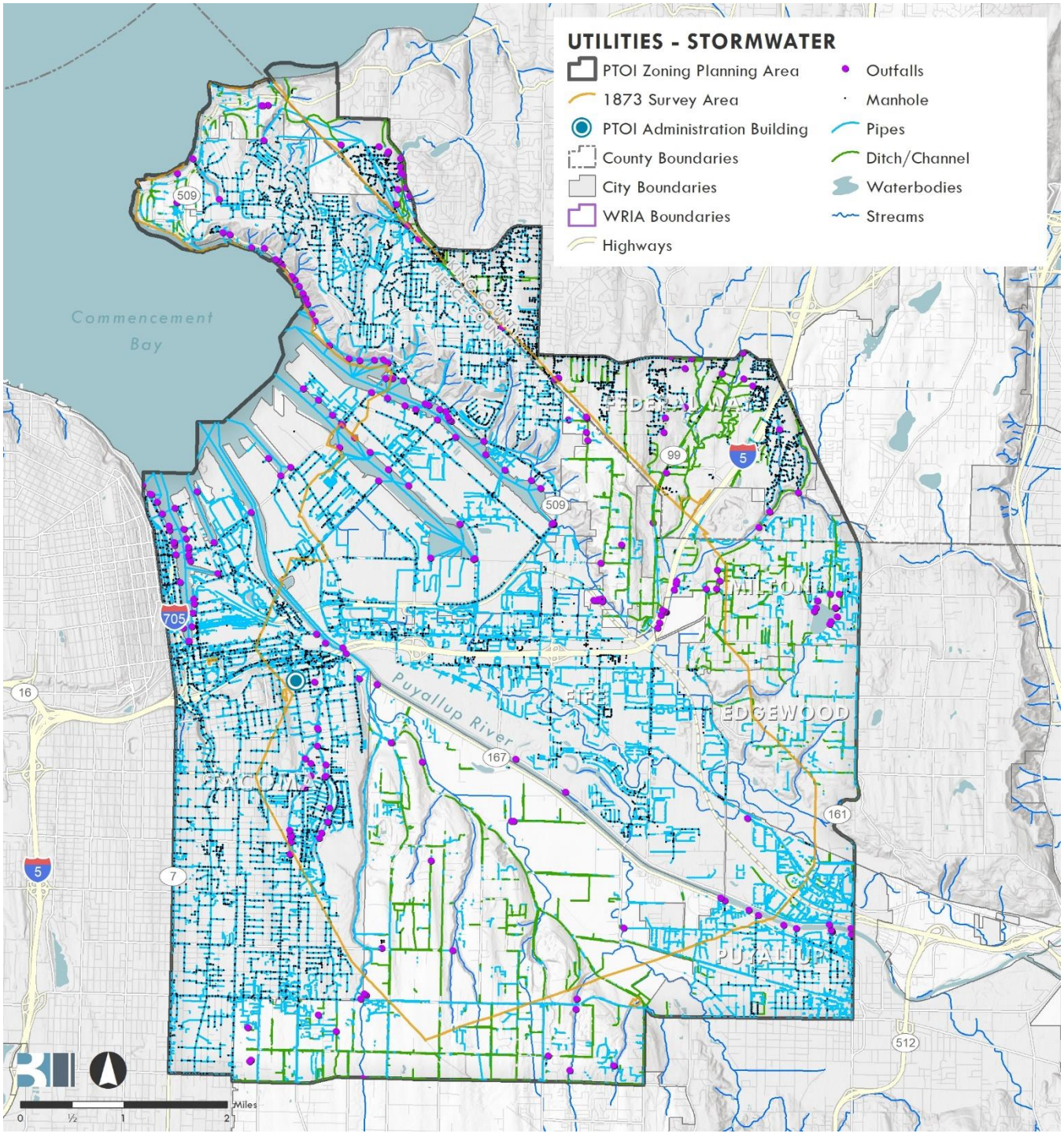
Stormwater

Within the PTOI Planning Area, stormwater infrastructure within public streets and rights-of-way is managed by the following utilities and government agencies:

- City of Tacoma Department of Environmental Services
- Washington Department of Transportation (WSDOT)
- City of Federal Way Surface Water Management Division
- City of Milton Surface Water Division (Stormwater Division)
- City of Fife Public Works Department
- City of Edgewood Public Works Department
- City of Puyallup Public Works – Stormwater Management Section

Existing stormwater infrastructure is shown in Exhibit 10-5.

Exhibit 10-5: Stormwater infrastructure.



Sources: Cities of Edgewood, Federal Way, Fife, Milton, Puyallup, and Tacoma; Pierce County; King County, 2021; BERK, 2021.

Stormwater is captured primarily by open ditches and swales as well as catch basins and culverts, and is discharged to tributary streams of the Puyallup River and Commencement Bay. Stormwater infrastructure built and maintained by private developers and utilities has been subject to the Stormwater Management Manual for Western Washington (SWMMWW) and the equivalent or stricter requirements of local jurisdictions. Stormwater management programs are subject to the Western Washington NPDES Phase I & II Municipal Stormwater Permits. The City of Tacoma and unincorporated Pierce County are regulated under the Phase I Permit. The Cities of

Federal Way, Milton, Fife, Edgewood, and Puyallup are regulated under the Phase II Permit. WSDOT is regulated by the WSDOT Municipal Stormwater Permit.

Existing Programs

Drinking water

Tacoma Water

Every 10 years, Tacoma Water develops a comprehensive water system plan. In the latest plan, the 2018 Water System Plan, Tacoma Water forecasted that their total average day demand (ADD) is expected to decrease from 49 mgd in 2017 to 44 mgd in 2037. However, they are expecting that some areas will continue to grow and develop. In particular, growth is anticipated within the City of Tacoma including the Downtown Regional Growth Center, Tacoma Mall regional growth center, Port area, and Town of Ruston.

City of Milton Water Division

The City of Milton developed a Water Utility Plan in 2010. As part of the planning process, the City developed population and demand projections up to 2029. It is anticipated that the City's population will increase from 7,947 in 2009 to 12,371 in 2029 (1% growth in 2009, 2% in 2010 and 2011, and 3% in 2012 through 2029). This will result in an increase in ADD from 0.93 mgd (2009) to 1.4 mgd (2029) and peak day production from 2.0 mgd (2009) to 3.2 mgd (2029).

City of Puyallup Water Division

The City of Puyallup developed a Water System Plan in 2011 and a citywide Comprehensive Plan in 2020. As discussed in the Utilities section of the Comprehensive Plan, the City anticipates that their water rights will exceed demand and meet capacity needs through 2030.

Lakehaven Water District

Lakehaven Water District last updated their Water System Plan in 2016. As part of the planning process, the District developed population and demand projections up to 2040. It is anticipated that the District's high ADD will increase from 11.43 mgd (2014) to 15.03 mgd (2024).

Summit Water and Supply Company

Summit Water developed a plan titled Water Use Efficiency Measures and Goals. In 2019, Summit Water had 6,950 customers with an ADD per user of 222 gallons per day (gpd). It is anticipated that by 2035, Summit Water will have 7,282 customers with an ADD per user of 229 gpd.

Mountain View-Edgewood Water Company

The Water Company developed a Water System Plan in 2017. At the end of 2016, the Water Company served a population of approximately 8,054 people and had an ADD of 863,052 gpd. It is anticipated that the service area population will increase to 13,460 and an ADD of 1.4 mgd. As discussed in the previous section, the growth of the Tribe is not expected to impact the Water Company's drinking water capacity planning process.

Wastewater

City of Tacoma Department of Environmental Services

The City of Tacoma currently owns and operates two WWTPs, Central Wastewater and North End. Between these two WWTPs, the City has a permitted peak hydraulic capacity of 179.9 mgd. The One Tacoma Plan, created in 2015, states that hydraulic capacity at the WWTPs and their current collection systems infrastructure should be able to meet demand for the next six years or more, but that there is no guarantee that every development need will be met.

Lakehaven Sewer District

The Lakehaven Sewer District currently owns and operates two WWTPs, Lakota and Redondo. The study area is served by the Lakota WWTP. The District's 2015 Comprehensive Plan describes that Lakota WWTP has capacity for expansion.

Solid Waste

City of Tacoma Department of Environmental Services

The City of Tacoma Department of Environmental Services developed a Sustainable Materials Management Plan in 2015, outlining phased strategies to divert 70% of the City's solid waste from landfills by 2028.

- Phase I (2017–2020): Aggressive Education & Outreach; Limited Regulations
- Phase II (2021–2022): Continue Aggressive Education; Additional Regulations; Limited Investment
- Phase III (2023–2028): Maximum Regulations & Programs or Acquire MRF Capacity
- Phase IV (2028 and Beyond): Optional Strategies to Exceed 70 Percent

Since a large portion of the Tribe is served by the City of Tacoma Department of Environmental Services, it is advised that the Tribe continue to work with the City on solid waste education.

Cities of Federal Way, Edgewood, Fife, Puyallup, and Milton

The Cities of Federal Way, Edgewood, Fife, Puyallup, and Milton are all serviced by private waste management companies. These companies have not published documentation for future planning efforts.

Stormwater

As described in the Water Existing Conditions, the cities and unincorporated areas in Pierce County are expecting to experience population growth over the next few decades. As population growth continues to increase, the need for development and redevelopment will increase.

As development and redevelopment continue in the Planning Area, developers will be required to provide treatment for runoff from pollutant generating impervious surfaces when the size of development exceeds thresholds in the applicable stormwater manuals. Additional water quality and habitat improvement programs and projects will be implemented under the Phase I and Phase II Permits.

KEY FINDINGS AND IMPLICATIONS FOR THE PLAN

Government Services & Capital Facilities

The existing conditions analysis shows that the Puyallup Tribe provides many important government services for its community. Government services including public safety, justice, health, environmental, and educational services help community members to access resources they need to thrive. These services are often housed in capital facilities such as administration buildings, housing facilities, schools, the courthouse, and community centers. Natural resource facilities such as the hatchery and fish buy station are important resources to the community.

PTOI staff report a lack of office space within Tribal facilities, as well as long distances between offices for various social support services. Greater coordination among social service providers and more office space for PTOI departments would improve the capacity and functioning of various programs and departments.

The Puyallup Tribe will need to continue to coordinate land use planning and capital facilities planning, and invest in existing and expanded infrastructure to support future development in line with its population growth and resulting land use needs. PTOI staff identified the need for a centralized location for providing services, particularly social services. Also, it is reported that due to an overall lack of space, the youth center is often used as a multi-purpose facility, detracting from its core function as a place for young people.

Climate change will impact capital facilities, as they were not originally designed for the rising temperatures and extreme weather events now projected. Climate change impacts are felt the strongest among the community's most vulnerable residents. The effects of climate change may also increase demand for services. The PTOI's social support services, housed within capital facilities that are already filled past capacity, need additional space to provide needed services to those affected by climate impacts such as flooding, landslides, and heat waves. Many current Tribal facilities are located in zones anticipated to be impacted by sea level rise by 2050. New capital development programs should plan with climate impacts in mind and consider the vulnerability of sites to flooding that could damage facilities or block transportation access. The Comprehensive Plan should support activities to prepare and plan so that services provided by capital facilities, including emergency services, are consistently available to at-risk populations.

Utilities

The PTOI Planning Area is served by multiple providers of water, wastewater, solid waste, and stormwater services. Most of the Planning Area's utilities fall under the jurisdiction of the City of Tacoma within the Department of Environmental Services and Tacoma Public Utilities. The growth of PTOI should have limited impact to the level of service that the City of Tacoma provides to their customers due to the City planning for growth within their service areas. It is expected that the growth of the PTOI will also have limited impact on the other utilities since these utilities make up a small portion of the Planning Area.

To keep up with the demand of an increasing population within the PTOI Planning Area, there will be a need to invest in additional water, wastewater, solid waste, and stormwater infrastructure. Climate change will impact all cities, utilities, and private entities within the PTOI Planning Area.

Water services will be affected by drought, source water quality, sea level rise, and storms and flooding. The United States Environmental Protection Agency (EPA) has developed a Climate Change Adaptation Resource Center to provide utilities with strategies to adapt to climate impacts that can affect water infrastructure.

Wastewater, stormwater, and solid waste services are also impacted by storms and flooding, which will to increase

in frequency and severity with climate change. This extreme weather will lead to more untreated wastewater and additional stress on wastewater and stormwater conveyance systems. It could also potentially negatively impact solid waste infrastructure and property.

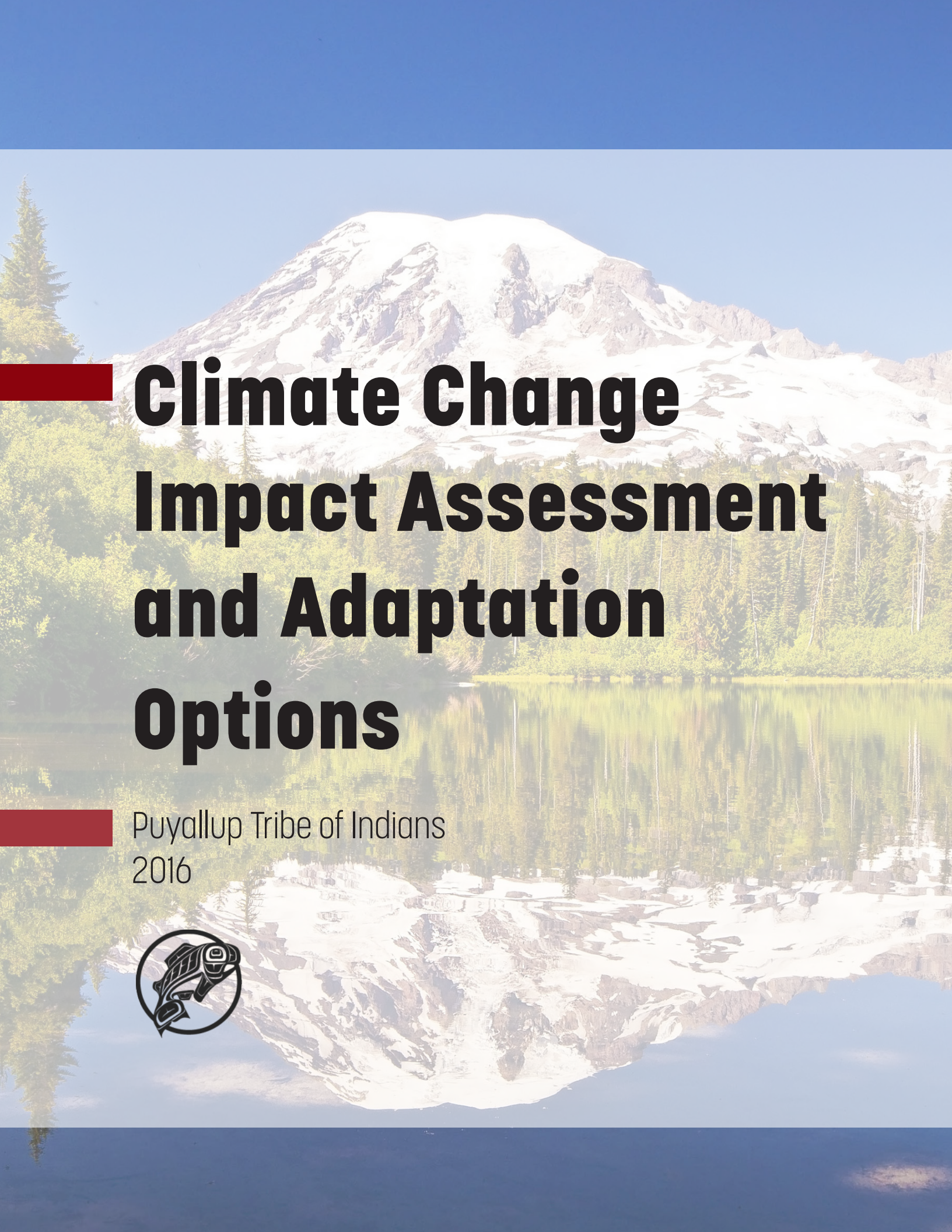
It is recommended that PTOI monitor future development in the City of Tacoma's Downtown regional growth center and Port area. These two areas, portions of which overlap the Planning Area, could potentially have the greatest impact on water, wastewater, stormwater, and solid waste services. The Tribe should coordinate with both Tacoma Water and City of Tacoma Department of Environmental Services regarding the planning efforts in these areas to ensure that the PTOI's goals and future needs are met. The PTOI should continue partnering with the City of Tacoma Department of Environmental Services regarding recycling and composting where applicable. Appropriate waste management practices will reduce the amount of greenhouse gas emissions from Tribal activities.

As planning for stormwater projects and programs continues within the Planning Area, the PTOI will be able to influence prioritization and implementation of stormwater initiatives that align with the PTOI's goals and future growth. The PTOI should consider having an active role in the implementation of Stormwater Management Action Planning (SMAP) process, which is a requirement for both Phase I and II Permittees. Part of the SMAP process requires assessing receiving water conditions, which could potentially impact the PTOI's fishing activities.

To prepare for the potential impacts of climate change, the PTOI should continue to collaborate with all utilities, cities, and private entities within the Planning Area to ensure the risks associated with climate change are considered in their decision-making process and investments.

11. Appendices

APPENDIX A: CLIMATE CHANGE IMPACT ASSESSMENT



Climate Change Impact Assessment and Adaptation Options

Puyallup Tribe of Indians
2016

Acknowledgments

This assessment would not have been possible without the tremendous contributions of many individuals, listed below.

Project Team

Mary Basballe, Air Quality
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David Winfrey, Shellfish

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A collaboration of the Puyallup Tribe of Indians and Cascadia Consulting Group.

Prepared for the Puyallup Tribe by
Cascadia Consulting Group

Letter of Introduction

Puyallup Tribe of Indians

For thousands of years, the Puyallup River and coasts of the Puget Sound have sustained our way of life by giving to us the salmon, shellfish, wild game, roots, berries, and cedar trees that are the foundation of our culture, traditions, and heritage. In spite of the many challenges we have faced, our spirits remain tied to this land, and our stewardship has ensured that the Puyallup Tribe will continue to enjoy the natural gifts we receive in exchange.

But we are faced with a new challenge. Climate change is threatening the natural resources we have relied upon for centuries, as well as our health, economy, and infrastructure. For our people, climate change is no longer a "tomorrow" issue—we must address this challenge now.

We must choose to act responsibly and swiftly to guarantee we are as prepared as possible to face the uncertainties of the future. This *Climate Change Impact Assessment and Adaption Options* report is among those actions we are taking together to help us continue our culture of resilience, perseverance, and prosperity. It is the culmination of more than a year of research, analysis, and engagement with our Tribal members and staff, as well as external partners.

We have confronted hardships in the past, and it was our strong connections to the land and each other that got us through. Our best chances of success in preparing for what climate change will bring is through our collective commitment to remain steadfast. Thank you for your support.

Sincerely,

Bill Sterud

Bill Sterud,
Puyallup Tribal Council Chairman

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Executive Summary

From 2015 to 2016, the Puyallup Tribe worked with Cascadia Consulting Group to conduct a Climate Change Impact Assessment and identify options for adaptation. The assessment aimed to help Tribal staff and members better understand and prepare to proactively manage climate risks to ensure that Tribal customs and the Tribal community can thrive for many generations to come, despite a changing climate.

How is the climate changing?

Changes in the climate have been observed already, including the following:

- **Average annual temperatures for the Pacific Northwest have risen 1.3°F since 1895.** One of the implications has been a longer frost-free season.
- **The cumulative area of Mt. Rainier's glaciers decreased -27% between 1913 and 1994**.
- **Sea level has risen by 7.8 inches** in our region over the last century.
- **Ocean pH has already dropped by about 30%** as the oceans absorb increasing amounts of carbon dioxide.

The climate will continue to change into the future as the concentration of carbon dioxide and other greenhouse gas emissions in the atmosphere continues to rise. Specific anticipated changes include:

- **Average temperatures in Washington State could rise as much as 9.4°F above current levels by 2100.** The most significant temperature increases are anticipated to occur in the summer months.
- Total annual precipitation in the Pacific Northwest is not projected to change substantially, but **heavy rainfall may be more frequent and intense, and summer precipitation may decrease**.
- **More rain and less snow will fall in the winter.**
- **Stream temperatures in the Pacific Northwest are protected to increase** 1°F over 1980 averages by 2020 and 3°F by 2080.
- **Flooding may become more common and more intense** in places like the Puyallup River.
- With warmer, drier summers, **more wildfires** are expected.
- **Landslides are likely to become more frequent in winter and spring** as precipitation rates and soil moisture increase during these months.
- **By 2050, some areas of Washington State could see as much as 19 inches of sea level rise over 2000 levels**; by 2100, the increase could be up to 56 inches.
- Sea level rise combined with storm surge and high tides can cause **more frequent flooding events, coastal erosion, loss or shifting of habitat, and saltwater intrusion** into water sources.
- **Ocean acidification is expected to increase** by 38 to 109% by 2100 relative to 2005 levels.

What impacts might we see locally?

The assessment focused on eight key resources or sectors. Some of the anticipated impacts of climate change in these sectors include the following:

Fisheries and hatcheries: Warmer stream temperatures and summer lower flows can alter salmon migration timing, reduce growth rates, and increase vulnerability to toxins, parasites, and diseases. Increased winter high-flow events can scour the streambed, increasing the risk of egg mortality.

Shellfish: Ocean acidification makes it more difficult for shellfish including oysters, clams, mussels, and crabs to form and maintain their shells. Rising sea levels can reduce the extent of habitats like estuarine beaches; where shorelines are armored, it can be impossible for intertidal zones to shift and adapt, thereby reducing habitat for the species that depend on these zones.

Wildlife: Warming temperatures and precipitation changes will alter the survival, distribution, and seasonality of some wildlife and game species.

Restoration sites: Restoration sites may be affected by rising sea levels and other climate change impacts. They also help to build resilience by protecting important ecosystem functions and habitats.

Water quality: Lower summer precipitation and higher temperatures can concentrate pollutants in waterways.

Cultural resources and archaeological sites: The accessibility and availability of traditional plants, roots, and other resources may change as distributions and habitats of species shift. Cultural sites along the waterfront or near rivers may experience more frequent and more intense flooding, which may temporarily or permanently inundate some places and limit access.

Transportation: Many of the Tribe's important transportation routes lie in areas at risk of flooding or landslides.

Public health and safety: Heat waves, changes in air quality, foodborne illness, and other changes associated with climate change will present new threats to the health and safety of our Tribal members, particularly the young and the elderly and those with existing health conditions.

What can we do to build resilience?

While the Tribe is already undertaking a number of programs that will help to build resilience, even if they were not designed with climate change in mind, additional action will be needed to protect resources, infrastructure, and people as the climate continues to change. Tribal staff therefore developed a shortlist of potential adaptation measures for further consideration and evaluation. These options are presented at the end of the document, and they fall into five broad categories:

1. Implement protection, restoration, and management practices
2. Provide education and guidance
3. Reevaluate policies, plans, and protocols
4. Gather additional information
5. Leverage partnerships

Introduction

As the climate changes, higher temperatures, rising sea levels, changes in precipitation, and other projected impacts will have far-reaching implications for the resources, livelihoods, and health of the Puyallup Tribal community. The Tribe has nearly 4,000 members today, many of whom live on the reservation. By planning ahead, the Tribe can help ensure that Tribal customs and traditions thrive for many generations to come. This report describes how climate change could affect our people and our resources and how we can take steps to build our resilience.

We already have experience with climate variability, and we can therefore begin to anticipate problems we could face in the future. In 2015, for example, we experienced challenges similar to those anticipated to occur more often in a future changing climate, including hotter temperatures, reduced snowpack, and increased wildfire risk.

Climate change also interacts with other stressors that are already affecting our Tribal resources, including population growth, development, and pollution. Our people have lived in this area for thousands of years. Today, the Puyallup reservation is highly urbanized; the cities of Edgewater, Federal Way, Fife, Milton, Puyallup, and Tacoma have grown around us and overlap, to some degree, with our reservation land. Therefore, through this assessment we also sought to understand how climate change can exacerbate some of these existing issues.

This report provides a picture of where we have been, where we are now, and where we are heading. It combines the latest climate knowledge for the region with input from Tribal staff and members, and it presents key projected impacts as well as actions that will build resilience of our Tribe. The report is organized into the following sections:

- Methodology
- Climate Impacts and Projections
- Sector-Specific Impacts
- Adaptation Options

The appendices include a glossary of climate terms, additional maps, and citations.



Methodology

The Tribe's Environmental Department spearheaded this effort, supported by a team of consultants. We sought to engage program staff from a range of other departments, such as Transportation, Air Quality, Water Quality, Fisheries, Languages, Cultural Resources, Housing, and GIS.

Based on input from program staff who attended the kick-off meeting in April 2015, we focused this assessment on how climate change impacts could affect particular resources and sectors, listed below.

We began with a compilation of climate science and projections for the region to understand how changes in sea level, precipitation, and temperature will affect Tribal people, resources, traditions, and infrastructure. The analysis included a spatial assessment of particular areas that may be most at-risk from sea level rise and storm surge.

We conducted interviews and three workshops with Tribal staff to assess current and potential vulnerabilities to climate variability and change related to the priority resources and sectors. We also consulted scientific literature from local and regional sources to supplement these findings.

This report does not represent the end of this process. Rather, it gives us a foundation from which to begin building our resilience to climate change impacts and to educate our Tribal staff, members, and youth about what the future may hold and what we can do to prepare. We intend to revisit and update this report in the future as new information about climate change becomes available and as we continue to clarify our own needs and priorities. The adaptation options that are listed are a promising starting point. These options will benefit from additional discussion and evaluation to help develop a comprehensive plan that has broad support from across the Tribal community.

Priority Resources and Sectors

- Fisheries and hatcheries
- Shellfish
- Wildlife
- Restoration sites
- Water quality
- Cultural and archaeological sites
- Transportation
- Public health and safety

Climate Impacts and Projections

Defining the Puyallup Tribe's vulnerability to climate impacts begins with understanding how the climate is projected to change in southern Puget Sound. This section summarizes projections of potential climate threats facing the Puyallup Tribe of Indians. To provide broader context and fill gaps in local data, we also provide an overview of impacts affecting Washington State and the Pacific Northwest more broadly.

The climate impacts information and projections discussed below represent the best available information from well-known and trusted datasets, literature, and studies. Conditions for 2050 and beyond will depend upon economic trends, policy decisions, and technological developments in the coming decades. The long-term projections can still be valuable tools for long-range and strategic planning.

Additionally, while the climate is changing, natural climate variability will continue to affect our region and dominate what we observe over the next few decades and, thus, should also be considered when assessing local impacts.

A Changing Climate

Anthropogenic (human-caused) greenhouse gas emissions are expected to increase over the next 100 years. The concentration of carbon dioxide (CO_2) in the atmosphere has almost doubled since before the Industrial Revolution, from 280 parts per million (ppm) to the current concentration of 400 ppm.* "Business as usual" global greenhouse gas emissions scenarios, which assume no significant change in current trends, predict that atmospheric CO_2 could reach levels as high as 936 ppm by 2100.[1]

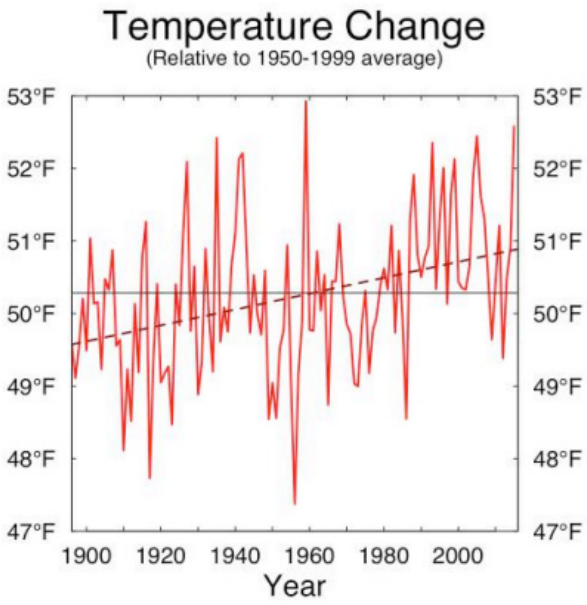
To determine how these projections will manifest at regional scales, researchers use global and regional climate models that reflect future emissions scenarios. Models often take into account changes in population, technology, and other factors that influence anthropogenic emissions rates. This report draws from the conclusions of numerous studies based on the most up-to-date global emissions scenarios referred to as Representative Concentration Pathway (RCP) scenarios, adopted by the Intergovernmental Panel on Climate Change in 2014. This report also includes studies based on the Special Report of Emissions Scenarios (SRES), which preceded the RCP scenarios and were used in climate modeling research conducted between 2000 and 2013. Many of these studies were undertaken by scientists affiliated with the University of Washington (UW) Climate Impacts Group.

[*] Monthly average concentrations in carbon dioxide vary due to seasonal and monthly variations in carbon dioxide emissions from human and natural sources (e.g., plant respiration). For example, monthly values in 2014 ranged between 395.26 ppm (Sept 2014) and 401.78 ppm (May 2014). The highest monthly mean value reported to date since measurements began at Mauna Loa in March 1958 is 407.7 ppm (May 2016).

Temperature

Average annual temperatures for the Pacific Northwest have risen 1.3°F since 1895.[2] This change has resulted in a longer frost-free season and increases in nighttime heat waves over the last century, particularly during winter, fall, and summer.[3, 4] Figure 1 below shows the warming trend in average annual temperature in the Pacific Northwest since 1895.

Figure 1. Average annual temperatures (solid red line) since 1895 in the Puget Sound region. Dashed line indicates the warming trend. Source: UW Climate Impacts Group 2015.[5]



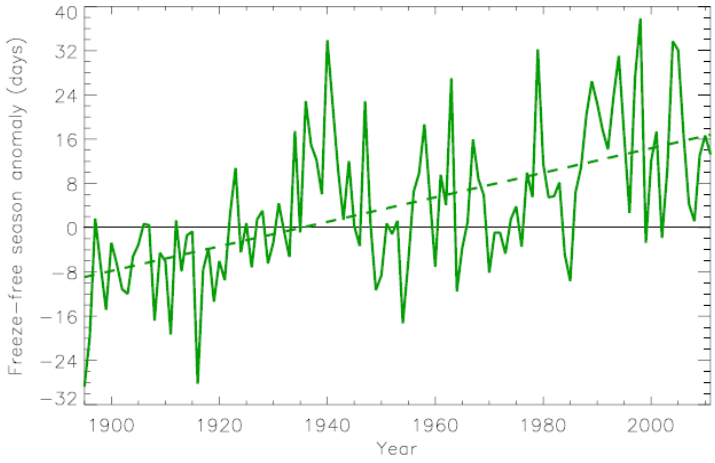
Projections suggest warming will occur across all four seasons in the Pacific Northwest over the 21st century, but the most significant increases are anticipated to occur in the summer months. Temperature projections for Washington State under a high emissions scenario (RCP 8.5) show that average temperatures could rise as much as 9.4°F above current levels by 2100.[6] Table 1 below shows projected increased temperature ranges by the 2050s for the Puyallup area.

Table 1. Projected increase in average annual temperature by 2050 (relative to 1980) for Puyallup under low and high emissions scenarios. Source: UW Climate Impacts Group 2015.[7]

Emissions Scenario	Projected Increase
Low emissions (RCP 4.5)	+4.2°F (range: 2.8 to 5.7°F)
High emissions (RCP 8.5)	+5.5°F (range: 4.3 to 7.3°F)

While summer months are projected to see the largest increases in average temperatures, winter months will see an increase in minimum temperatures and the number of frost-free days.[4] The frost-free season for this region has lengthened steadily since 1895 and is expected to continue increasing throughout the 21st century.[8] Figure 2 shows the increasing trend in the duration of the frost-free season between 1895 and 2010.[2] Meanwhile, the area of Mt. Rainier's glaciers decreased 27% between 1913 and 1994.[9]

Figure 2. Extension in the frost-free season for the Northwest U.S. between 1895 and 2010.
Source: Kunkel et al. 2013.[8]



Precipitation and Streamflow

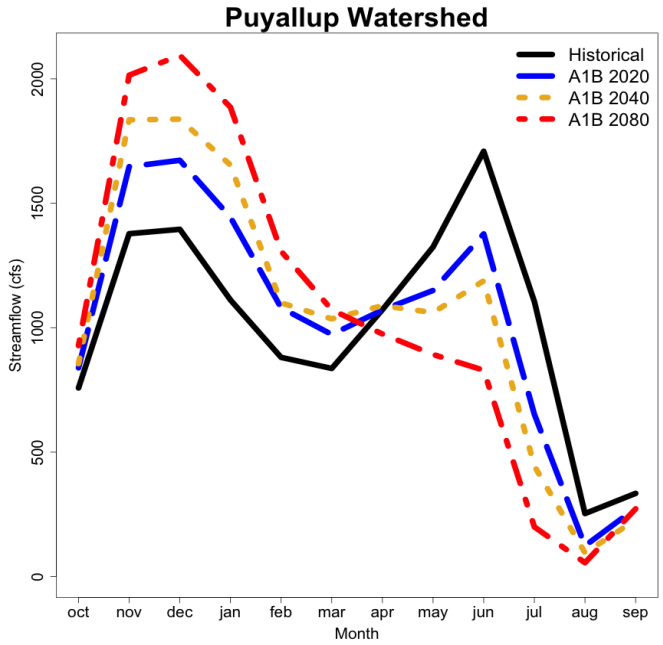
Scientists project slight increases in winter, spring, and fall precipitation and decreases in summer precipitation (see Table 2).[10] Total annual precipitation in the Pacific Northwest is not projected to change substantially, but occurrences of heavy rainfall may be more frequent and intense.[5]

Table 2. Projected decrease in average summer precipitation by 2050 (relative to 1950-1999) under low and high emissions scenarios. Source: Mote et al. 2013.[11]

Emissions Scenario	Projected Decrease in Summer Rainfall
Low emissions (RCP 4.5)	-6%
High emissions (RCP 8.5)	-8%

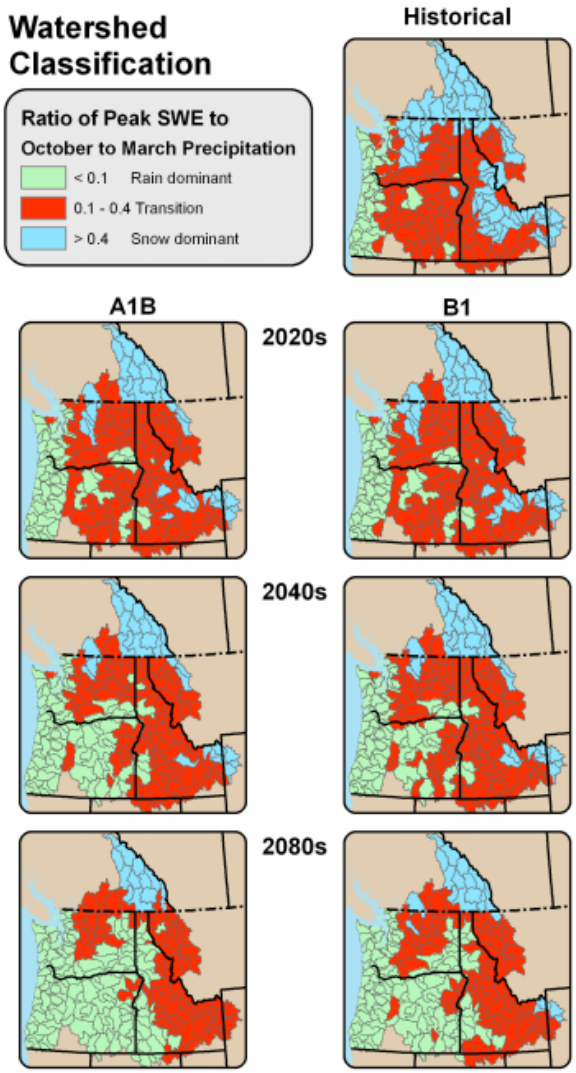
More precipitation will fall as rain during winter months, and snow will melt earlier in the year, resulting in a shorter snow season and earlier peak streamflow.[12] This trend is shown in Figure 3 below, which depicts estimated changes in the magnitude and timing of streamflow for the Puyallup watershed in 2020, 2040, and 2080.

Figure 3. Monthly graph of streamflow estimated for the Puyallup watershed over three time periods (2020, 2040, and 2080). Changes are relative to historical flows over the 1916-2006 time period. Source: UW Columbia Basin Climate Change Scenarios Project.[13]



Records for Washington's Cascade Range show that average snowpack declined throughout the 20th century.[14] Climate projections suggest that snowpack will continue to decline in the Pacific Northwest; Figure 4 below illustrates the projected shift from snow-dominant to rain-dominant watersheds.[15] Note that under the moderate emissions scenario (A1B), there is a total loss of snow-dominant basins in the Cascades by the 2080s.[16]

Figure 4. Shifts in watershed classification compared to historical averages for the Pacific Northwest under two future emissions scenarios. (Snow water equivalent, SWE, is a measure of the amount of water contained in snowpack.) Source: Tohver et al. 2014.[16]



Increases in temperature, declining summer precipitation, and reduced snowpack will alter ecosystem composition and health and increase wildfire risk. Extended periods of drought are thought to be among the largest contributing climatic factors in declining forest health observed across the globe.[17] In the Pacific Northwest, research shows that a decline in snowpack is having considerable health impacts on cedars, indicated by stunted growth patterns.[18] Rising winter air temperatures could lead to delayed leaf emergence in Douglas fir due to an inability to meet winter chilling requirements.[5] These changes will likely reduce the area of climatically suitable habitat for Douglas fir in lower elevations of the south Puget Sound region by the end of the 2060s.[5]

Wildfire

According to the Washington State Department of Natural Resources, the declines in forest health noted above can contribute to more frequent and widespread wildfires.[19] Climate change will increase fire activity across the Puget Sound region, including in areas previously unaffected by fire.[5] Past fire records show a strong correlation between warm, dry summers and higher rates of area burned in the Pacific Northwest.[20] Drought and warm temperatures combine to lower moisture content in both live and dead fuels and increase flammability.[20] Scientists attribute the extensive wildfires throughout Washington State in 2015 to the summer drought during that season.[21]

Research suggests that the area burned west of the Cascade crest could more than double by the late 21st century.[5] Further research is needed to fully understand how changing climate conditions may alter wildfire risk and severity in the region.[5]

Flooding

Higher annual temperatures, changes in precipitation, and resulting changes in snowpack and streamflow will alter downstream flood regimes. For example, snowmelt runoff or rain-on-snow events can cause flooding downstream when warmer winter temperatures rapidly melt thick snow cover or increase the amount of precipitation falling as rain instead of snow.[22]

While more research is needed to assess any specific flood-related impacts or risks to the Puyallup Tribe, regional modeling simulations suggest an increasing flood risk for most areas of the Pacific Northwest. The Puyallup River watershed is already among the highest flood risk areas in the state of Washington (see current FEMA-designated flood hazard areas in Figure 5 on the following page and Figure 14 in Appendix B).[23, 24] The Tribe's Public Safety office has noted incidents of repeated flooding in Lower Clear Creek and along the basin near River Road. According to the UW Climate Impacts Group, most models show that the volume of water during the historical 100-year flood event (or a flood with an annual probability of 1%) is expected to increase by the 2040s, suggesting that what are already the most extreme flooding events in the region will become even more intense.[7] Table 3 below shows the increases in water volume of 100-year flood events in the Puyallup watershed based on two emissions scenarios.

Table 3. Projected increases in water volume associated with 100-year flood events in the Puyallup Watershed by 2040 (relative to 1980) under low and moderate emissions scenarios. Source: UW Climate Impacts Group 2015.[7]

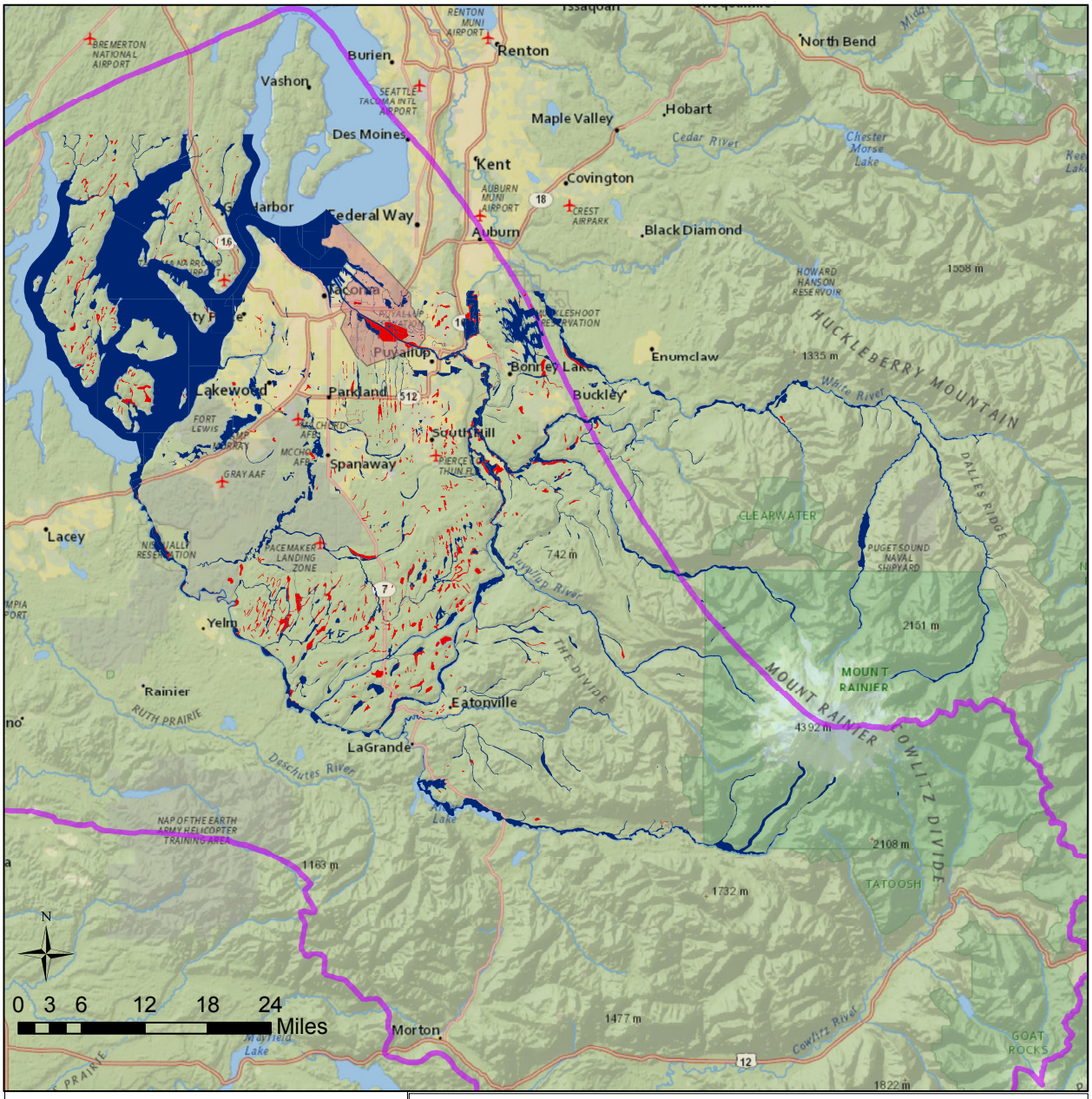
Emissions Scenario	Projected Water Volume
Low emissions (B1)	+39% (range:-14 to +85%)
Moderate emissions (A1B)	+56% (range: +22 to +115%)

The frequency of "atmospheric rivers"—a band of water vapor transport from the tropics and a significant driver of flooding in the Pacific Northwest—will also likely be different with climate change. Climate projections and modeling simulations for the Pacific Northwest indicate that severe precipitation events caused by atmospheric rivers will become more common and severe in the Puget Sound region.[25] Analysis of the flooding event in January 2012 suggests that the extensive flooding was driven by a combination of increased sediment loads in streams and extreme rainfall brought on by an atmospheric river (see the ***Landslides and Sediment Transport*** section for information on the impacts of increased sediment).[26, 27]

Although heavier winter rainfall is expected, climate models do not project a change in wind speed or strength of low-pressure systems in the Puget Sound region.[28]



Figure 5. Current FEMA flood hazard areas (see Figure 14 in Appendix B for a more detailed map). Source: Pierce County, Puyallup Tribe.



Legend

- 100-Year Flood
- 500-Year Flood
- Reservation Area
- Medicine CreekTreaty Ceded Area

This theme shows both 100-year and 500-year flood hazard areas. A 100-year flood is a flood that has a 1% chance of being equaled or exceeded in any given year. An area inundated during the base flood is sometimes called the 100-year floodplain. A 500-year flood is a flood that has a 0.2% chance of being equaled or exceeded in any given year.

Data Sources: Pierce County Geospatial Data Portal, Puyallup GIS Department, Vertical Datum: NAVD 88

Stream Temperature

Stream temperatures will rise in conjunction with rising air temperatures throughout the Puget Sound region, including in the Puyallup watershed.[29] Modeling simulations on the correlation between air and stream temperature show that stream temperature rises approximately 2.8°F for every 3.5°F increase in air temperature.[30] Climate models project that stream temperatures in the Pacific Northwest will increase 1°F over 1980 averages by 2020 and 3°F by 2080.[31] These increases may be more pronounced at lower elevations, where rivers tend to slow and widen and where air temperatures are warmer. Projected mean August stream temperatures projected for the Puyallup watershed region in 2040 range from 7 to 22 °C (45 to 72 °F) as shown in Figure 6. Table 4 below shows projected temperatures for streams in or near the Puyallup reservation. All streams except Canyonfalls Creek are projected to be within the range for increased disease risk in adult salmon (see Table 5 for a list of salmonid temperature thresholds).

Table 4. Projected 2040 average August stream temperatures for selected streams in the Puyallup Tribal region. Source: US Forest Service Regional Database and Modeled Stream Temperatures 2014.[32]

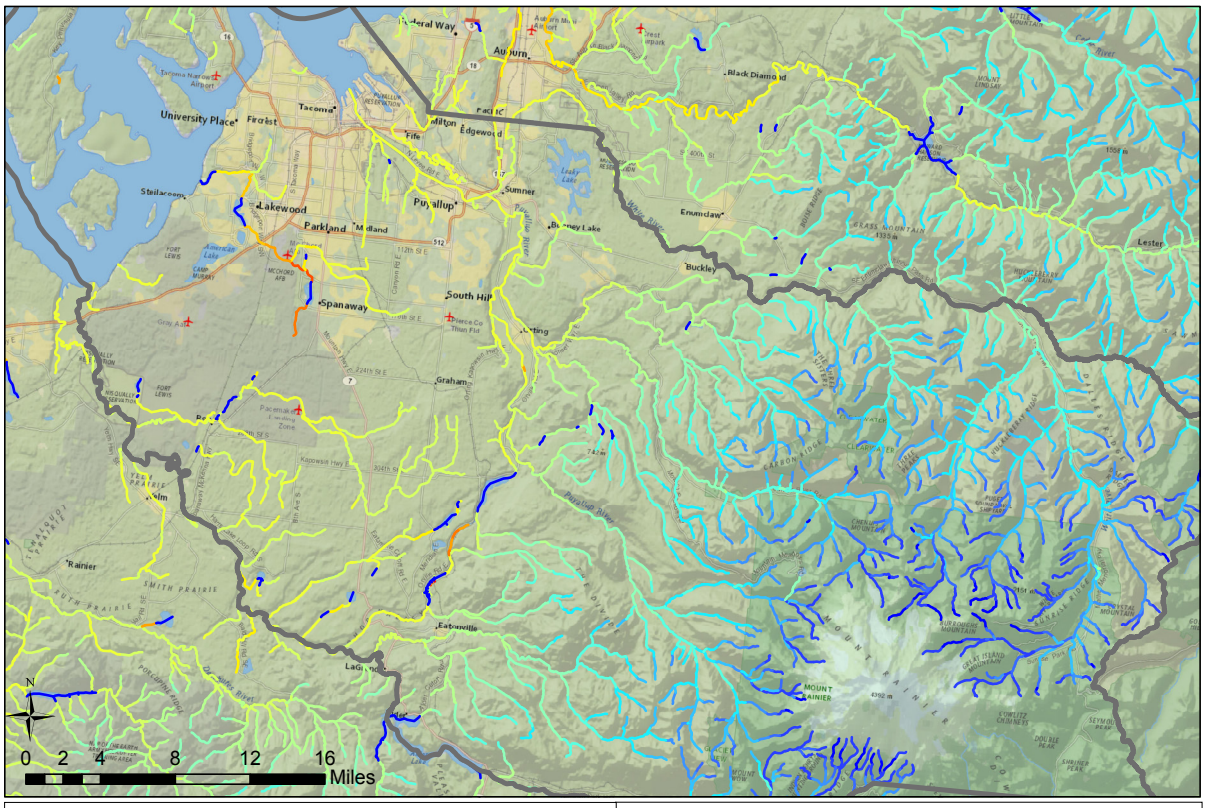
Stream	2040 Projected August Stream Temperature (°C)
North Fork Clover Creek	16.5
Clover Creek	16.5
Puyallup River	16.4
Hylebos Creek	16.3
Clarks Creek	16.2
Wapato Creek	16.2
Carbon River	16.2
White River	16.1
Clear Creek	15.8
West Hylebos Creek	15.8
Swam Creek	15.8
Fennel Creek	15.5
Canyonfalls Creek	15.1*

*All streams except Canyonfalls Creek are projected to be within the range for increased disease risk in adult salmon.

Table 5. Salmonid temperature thresholds. Source: National Wildlife Federation 2011.[33]

Salmonid Temperature Thresholds	
<58.1°F (<14.5°C)	Optimal range for salmon spawning, rearing, and migrating
59.9–67.1°F (15.5–19.5°C)	Range for increased disease risk in adult salmon
68.9–70.7°F (20.5–21.5°C)	Threshold for adult salmon mortality
>70.7°F (21.5°C)	Threshold for juvenile salmon mortality

Figure 6. Projected average August stream temperatures for the Puyallup watershed region in 2040 (A1B moderate emissions scenario). Source: US Forest Service Regional Database and Modeled Stream Temperatures 2014.[32]



Legend

Projected Stream Temperature, 2040 degrees Celsius

6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

Pierce County Boundary

Future August mean stream temperature scenario based on global climate model ensemble average projected changes in August air temperature and stream discharge for the A1B warming trajectory in the 2040s (2030-2059). Future stream deltas within a NorWeST unit account for differential sensitivity among streams so that cold streams warm less than warm streams.

Data Sources: United States Department of Agriculture, Pierce County Geospatial Data Portal, Vertical Datum: NAVD 88

Landslides and Sediment Transport

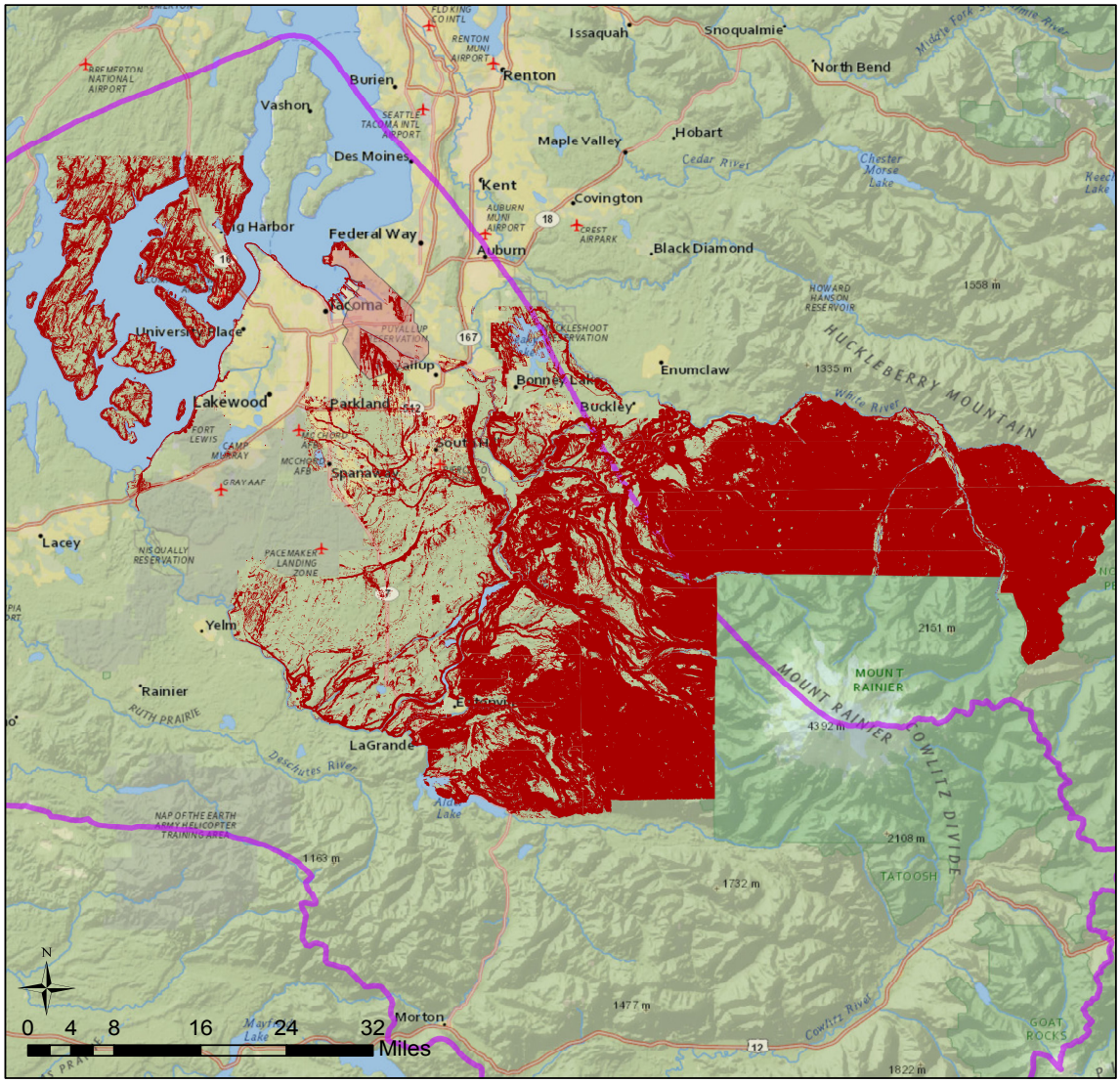
While landslide risk projections based on future climate scenarios for the Puyallup Reservation are not currently available, landslides are likely to become more frequent in winter and spring as precipitation rates increase during these months, thereby increasing soil moisture content. Incidence of drought followed by severe rainfall events—a combination that climate projections suggest will become more common[34]—increase landslide risk in communities located in or adjacent to hilly topography, including downstream and downslope areas (see Figure 7 on the following page). Landslide risk is projected to decline during summer months, however, as summers become drier and hotter.

Puyallup Tribal infrastructure and facilities that are already in or near landslide hazard zones include:

- Diru Creek Hatchery
- Some smokeshops and convenience stores on River Road



Figure 7. Current landslide hazard areas (see Figure 15 in Appendix B for a more detailed map). Source: Pierce County 2014.



Legend	
Hazard	Landslide hazard areas, as depicted on the 2014 Critical Areas Atlas-Landslide Hazard Areas Map, are those areas where the suspected risk of slope instability and landslide is sufficient to require a geological assessment to assess the potential for active landslide activity.
Reservation Area	
Medicine CreekTreaty Ceded Area	Data Sources: Pierce County Geospatial Data Portal, Puyallup GIS Department, Vertical Datum: NAVD 88

Landslides, declining snowpack, receding glaciers, and heavy rainfall events will increase sediment loads in waterways and alter streambank erosion and accretion.[35] Sea level rise and extreme storms will accelerate sediment-driven erosion and accretion along coastlines, affecting wildlife and marine species such as salmon that rely on shoreline sedimentation and habitat.[36, 37] According to a 2015 analysis by the UW Climate Impacts Group, loss of snowpack and glaciers due to warming temperatures will contribute to increased flood flows in the Puyallup watershed and will expedite sediment flow.[7] Increased incidence of wildfires can also lead to greater sediment and debris flow, as root cohesion diminishes and soil composition changes after a fire.[38]

Sea Level Rise

Rates of sea level rise across Washington State are highly dependent on vertical land movement from plate tectonics, thermal expansion of water, seasonal wind patterns, and sedimentation. By 2050, some areas of the state could see as much as 19 inches of sea level rise over 2000 levels; by 2100, the increase could be up to 56 inches.[39] Table 6 below shows projected sea level rise for Washington, Oregon, and northern California by 2030, 2050, and 2100.

Table 6. Sea level rise projections relative to year 2000 for Washington, Oregon, and northern California. Projections (middle column) represent A1B moderate emissions scenario projections, while ranges (right column) represent average B1 (lower emissions) and A1F1 (higher emissions) scenario projections. Source: Department of Ecology 2012.[40]

Year	Projection (in inches)	Range (in inches)
2030	+2.6	-2 to +9
2050	+6.5	-1 to +19
2100	+24	+4 to +56

Sea level rise combined with storm surge and high tides can cause more frequent flooding events, coastal erosion, loss or shifting of habitat, and saltwater intrusion into water sources. Figure 8 and Figure 9 on the following pages show Puyallup Reservation and Tribal facilities that are projected to be exposed to intermittent flooding during extreme high tides in 2050 and 2100 respectively, using the high emissions scenario (RCP 8.5). Note that these illustrations of potential flooding areas are based purely on ground surface elevation and do not account for the presence or absence of water flow pathways. More detailed depictions of these maps are provided in Appendix B (Figure 12 and Figure 13).

Puyallup Tribal infrastructure and facilities that could be at risk of flooding during extreme high tides include:

In 2050:

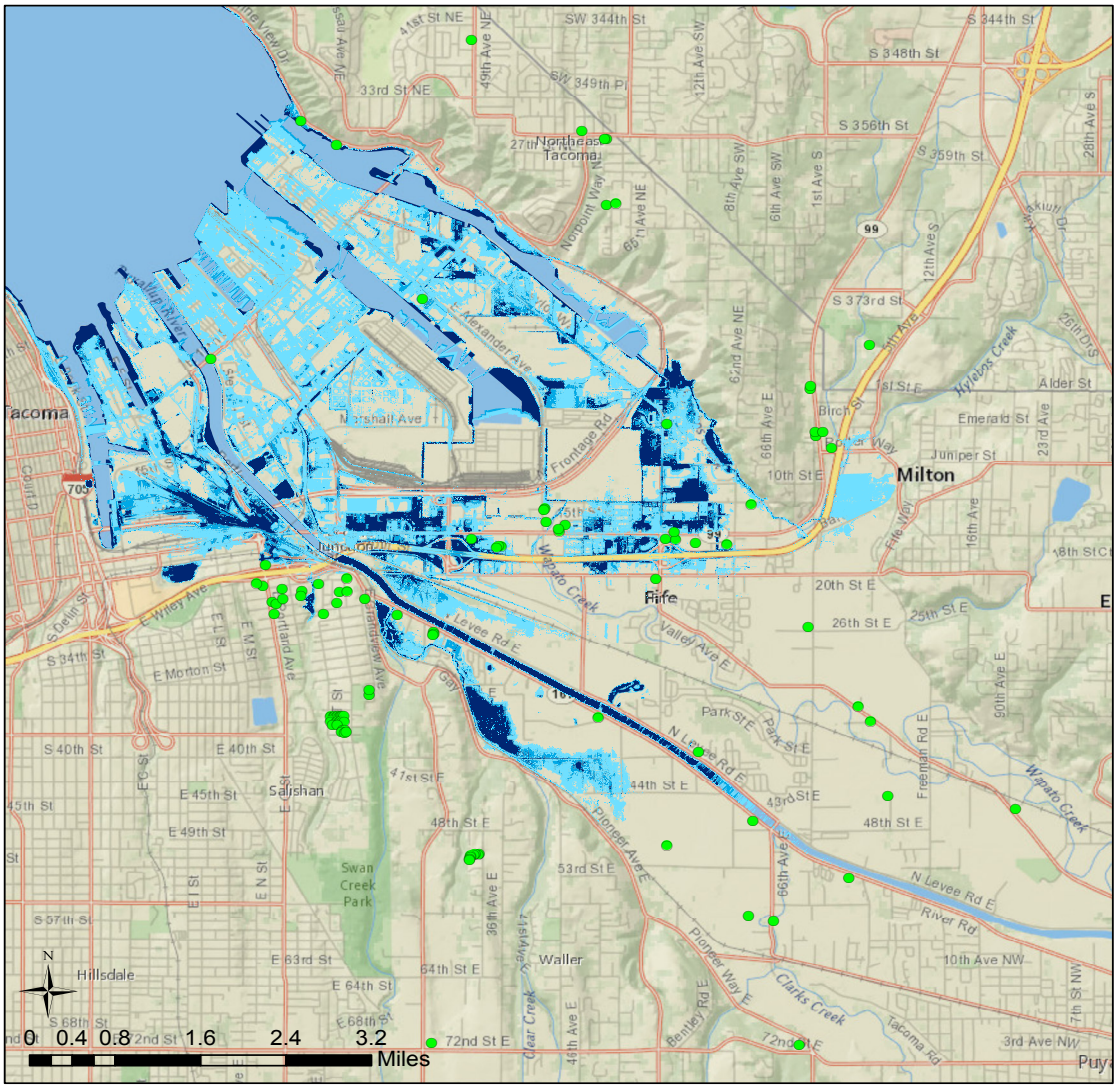
- Emerald Queen Riverboat (old casino) on Alexander Avenue
- Marine facilities such as Chinook Landing, the 11th Street boat ramp, and Ole & Charlie's Marina
- Some stores on Pacific Highway East

In 2100, those listed above, plus:

- Emerald Queen Ballroom
- Puyallup Tribal Integrative Medicine (PTIM) building
- Several convenience stores and smoke shops on Pacific Highway East, as well as a few on 54th Avenue East and Alexander Avenue



Figure 8. Tribal-owned facilities (green dots) projected to be at risk of flooding during extreme high tides in 2050. Dark blue areas are already below base flood elevation (BFE). Light blue are below BFE with 19 inches of sea level rise (the high-range estimate for 2050). Source: Herrera Environmental Consultants 2016



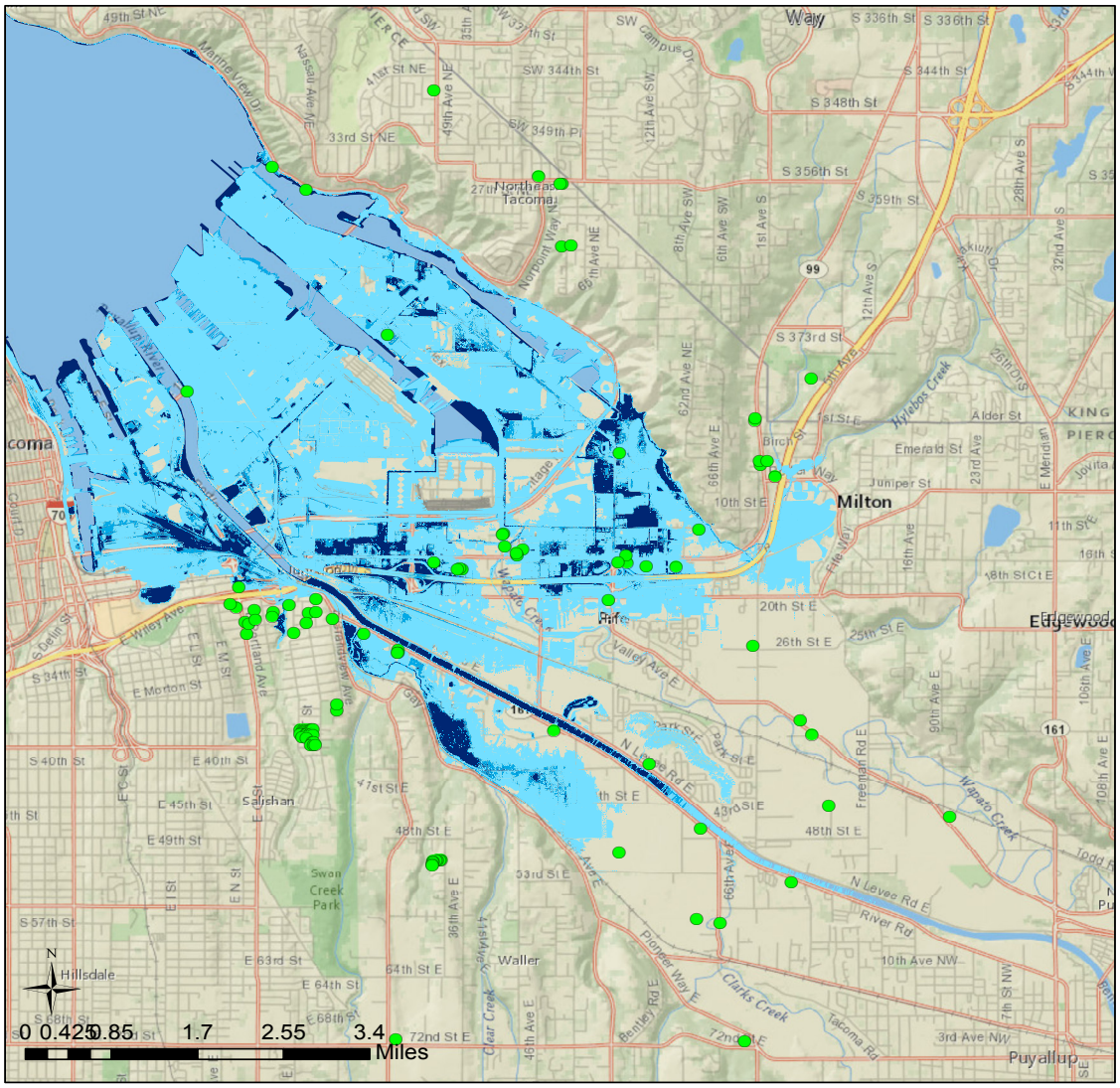
Legend

- Areas below the current regulatory 1-percent annual chance exceedance tidal flood elevation (current regulatory base flood elevation [BFE]). Below 12.50ft.
- Areas below the best scientific estimate of the 1-percent annual chance exceedance tidal flood elevation (likely future BFE). Between 12.50 ft. and 13.36 ft.
- Areas below the most conservative estimate of the year 2050 1-percent chance exceedance tidal flood elevation (19 inches of sea level rise). Between 13.36 ft. and 14.94 ft.
- Tribal Addresses

Areas Below Existing 1 percent Annual Chance Exceedance High Tide Elevation and Year 2050 1-percent Annual Chance Exceedance High Tide Elevation, (i.e., Areas Below year 2015 and 2050 "100-year" High Tide Elevations). Assumes 19 inches of Sea Level Rise for 2050.

Data Sources: Herrara Environmental Consultants, Puyallup GIS Department, Vertical Datum: NAVD 88

Figure 9. Tribal-owned facilities (green dots) projected to be at risk of flooding during extreme high tides in 2100. Dark blue areas are currently below base flood elevation (BFE). Light blue are below BFE with 56 inches of sea level rise (the high-range estimate for 2100). Source: Herrera Environmental Consultants 2016



Legend

- Areas below the current regulatory 1-percent annual chance exceedance tidal flood elevation (current regulatory base flood elevation [BFE]). Below 12.50 ft.
- Areas below the best scientific estimate of the 1-percent annual chance exceedance tidal flood elevation (likely future BFE). Between 12.50 ft. and 13.36 ft.
- Areas below the most conservative estimate of the year 2100 1-percent chance exceedance tidal flood elevation (56 inches of sea level rise). Between 13.36 ft. and 18.03 ft.
- Tribal Addresses

Areas Below Existing 1 percent Annual Chance Exceedance High Tide Elevation and Year 2100 1-percent Annual Chance Exceedance High Tide Elevation, (i.e., Areas Below year 2015 and 2100 "100-year" High Tide Elevations). Assumes 56 inches of Sea Level Rise for 2100.

Data Sources: Herrara Environmental Consultants, Puyallup GIS Department, Vertical Datum: NAVD 88

Ocean Acidification

As anthropogenic sources of atmospheric greenhouse gases have steadily increased since the Industrial Revolution, the oceans have absorbed more atmospheric carbon dioxide (CO_2), effectively raising concentrations of dissolved CO_2 and lowering the pH of the oceans by about 30%.[41] While there are no projections for ocean acidification specifically for Washington State, Table 7 shows projected global increases in ocean acidification by emissions scenario.

Table 7. Projected increases in global ocean acidification by 2100 relative to 2005 levels, by emissions scenario. Source: UW Climate Impacts Group 2015.[7]

Emissions Scenario	Projected Increase in Ocean Acidification
Low emissions (RCP 4.5)	+38 to +41%
High emissions (RCP 8.5)	+100 to +109%

Washington State's marine habitats are particularly at risk of the impacts of ocean acidification due to naturally occurring offshore upwelling processes that transport nutrient-rich yet corrosive water usually found at lower depths to shallower waters along the continental shelf.[42] These corrosive waters reach closer to the surface in the spring, summer, and early fall, limiting the ability of organisms such as clams, oysters, mussels, and pteropods (a key marine food source) to form shells.[43] Recordkeeping of pH levels in Puget Sound, which began in 2008, shows an overall trend of increased corrosive conditions; however, slight variations have occurred year-to-year and in specific locations within the Sound.[43]

Other contributing factors to ocean acidification include hypoxia (low dissolved oxygen) and nutrient runoff from urban and agricultural lands.[44] In hypoxic sections of Hood Canal, for example, eutrophication (excessive nutrients and resulting algal blooms) has increased acidification through the respiration of organic material.[43] Stratification (where water with different properties form layers that impede water mixing) is spatially and temporally variable in Puget Sound, with the most persistent and strong stratification found in Hood Canal, Whidbey Basin, and parts of south Puget Sound.[43]

These effects have already altered the development of shellfish in parts of Puget Sound, and they are projected to inhibit shellfish development more severely into the future.[43, 45]



Sector-Specific Impacts

This section describes the ways in which the changes in climate summarized in the previous chapter could affect sectors and resources of particular importance to the Puyallup Tribe.

Fisheries, Hatcheries, and Forage Fish

Our Tribal members and staff expect that climate change will result in important impacts to local fish habitat and Tribal fisheries infrastructure, including hatcheries. Simultaneous increases in water temperature and decreases in water availability could create conditions that increase diseases and associated fish health risks, affecting hatchery operations and increasing fish kills.[10] A recent study at the Winthrop National Fish Hatchery in eastern Washington found that projected hatchery environmental conditions remained within the general physiological tolerances for Chinook salmon in the 2040s (under the A1B moderate emissions scenario). Still, warmer water temperatures in summer accelerated juvenile salmon growth, increasing the likelihood of physiological stress due to anticipated decreases in water availability during those months.[46]

The Puyallup Tribe's two hatcheries both use groundwater or spring water, which are cooler sources than surface water. These hatcheries are therefore less vulnerable than some others in the region. However, the fish released from the hatcheries still need to swim downstream through sun-exposed river stretches that are projected to present warmer temperatures.

Warmer ocean waters and ocean acidification will also affect fishery production. Scientists have found that a +1.8°F increase in sea surface temperature—the warming projected for the northeast Pacific Ocean by the 2040s—could reduce salmon species survival from northern California to southeast Alaska by 1 to 4%.[28] Other important fish species will be subject to diminishing food availability as corrosive waters disrupt the ability of some organisms to develop shells and skeletons.

Climate change will also affect habitats and health of a range of aquatic organisms, including those not managed in fisheries or hatcheries. Coastal erosion and inundation from sea level rise, for example, will dramatically alter intertidal ecosystems and landscapes, changing the extent and composition of tidal wetlands, eelgrass beds, and estuaries.[47] One study of Puget Sound found that sea level rise will increase tidal flat area overall but will reduce estuarine beach, brackish marsh, tidal swamp, and tidal freshwater marsh area. Tribal staff have already observed disappearing mudflats resulting from development, pollution, and storms.

Altered streamflows will also bring changes to the landscape, including alterations to sediment delivery and deposition in wetland habitats—processes that are critical for maintaining wetland habitats as sea level rises. Although we anticipate sediment supplied from rivers to increase under future climate conditions, it is not known what proportion of that sediment will reach estuaries and whether it will be sufficient to offset sea level rise inundation.[28]

Dikes and dams within fish-bearing streams can exacerbate climate impacts on fish habitat and survival. After the 1930 flood, the Puyallup River was diked to control future flooding. The dike resulted in a loss of 14 miles of river. Recently, oxbows were reintroduced to improve salmon habitat. Management actions to minimize habitat loss in areas where dikes and dams remain will support climate resilience of instream habitat.

Other non-climate stressors, such as increased development in and around the Puyallup Reservation, will exacerbate climate change impacts on fisheries, hatcheries, and forage fish habitat. Tribal members and staff emphasized that hard beach-armoring infrastructure, such as sea walls, can be detrimental to organisms such as forage fish that rely on the water-land interface. Culverts and other hard stormwater infrastructure components can impede fish migration and degrade habitat quality. Low levels of shading along local waterways, such as from development, further increases instream water temperature. Studies show that the loss of shade from the replacement of forests and agricultural land with urbanization can raise stream temperatures by an additional 4°F.[48]

To address flood risks on local hatcheries, the Tribe's Fisheries and Environmental departments recently worked with Washington State Emergency Management and the Federal Emergency Management Agency (FEMA) to stabilize the riverbank at a fish hatchery near Buckley. In response to the 2009 flood, this $1 million project incorporated natural bank stabilizers such as logs and woody debris instead of cement banks and riprap to slow water flow through the river and provide more habitat for fish. Projects such as these will help ensure that our fish populations can withstand current and future risks from extreme events.

Salmon-specific vulnerabilities

Salmon in Puget Sound are already at risk from a range of different stressors. At the Tribe's 2014 First Fish ceremony, only one fish was caught—highlighting the dire state of our native salmon populations and the need for heightened support and recovery efforts.

Climate change will place additional stress on our salmonid populations, especially for species such as steelhead, sockeye, coho, and stream-type Chinook for which juvenile development occurs in freshwater streams.[5] Even minimal changes in stream temperature can alter salmon migration timing, reduce growth rates, and increase vulnerability to toxins, parasites, and diseases.[49] Warmer stream temperatures also increase salmon metabolism, diminishing critical energy stores for swimming and spawning.[50] Many diseases that affect salmon increase in warmer temperatures, including ***columnaris*** (tail rot) and ***furnuncolosis***, which infects the gills, peritoneal cavity, and liver of salmon.[51] Climate projections indicate that Puget Sound rivers will more frequently exceed thermal tolerances for adult salmon and char by 2080.[5] As drought leads to low streamflows, spawning and rearing habitat will decline, resulting in reduced thermal shelters, increased competition for resources, and perhaps greater vulnerability to predators.[52]

Increased winter high-flow events can scour the streambed, increasing the risk of egg mortality and potentially washing juvenile salmonids downstream prematurely.[5, 53] The Tribe takes coho and spring Chinook to nine acclimation ponds at higher elevation, and releases other species directly from the hatcheries. The Tribe has already seen its facilities affected by flood flows, leading to costly repairs, and is concerned that salmon redds are being scoured by the same flood events.



Shellfish

Anticipated future changes in the ocean's acidity will hinder the growth and survival of calcifying organisms, such as oysters, clams, mussels, pteropods, and crabs. These organisms rely on a non-corrosive environment to form and maintain their skeletons and shells. The Tribe has observed that oyster seed seems to be in short supply and that this may be influenced by ocean acidification. Although limited field studies on ocean acidification have been conducted in Puget Sound, studies elsewhere suggest that ocean acidification will reduce the mussel and oyster shell formation rate by 40%, growth rate by 17%, and survival rate by 34% by the end of the century.[5] These impacts may threaten the Tribe's current reliance on the natural recruitment and reproduction of shellfish stock, bringing considerable consequences for the livelihoods of the approximately 100 geoduckers and 100 to 130 commercial crabbers within the Tribe.

Population growth and development have already caused visible changes in shellfish habitat, and climate change will exacerbate these impacts. Studies suggest that sea level rise will cause a 64 to 91% loss of south Puget Sound's estuaries by 2100.[54] Extreme precipitation events can rapidly change sedimentation, potentially damaging commercial harvesting operations and shellfish populations with little warning.[55]

Armored shorelines impede adaptation of intertidal zones, a critical habitat for shellfish, to sea level rise.[54] Urban development around our Tribal lands and low tree canopy cover along streams can also exacerbate climate-driven temperature increases, heightening the risk of hypoxia and toxic phytoplankton outbreaks (also called harmful algal blooms, or HABs).

Since the 1950s, Puget Sound has seen steady increases in the frequency and geographic scope of HABs that are known to cause paralytic shellfish poisoning (PSP) in humans.[56] Other known health risks associated with shellfish contamination from HABs include amnesic shellfish poisoning and diarrhetic shellfish poisoning.[57, 58] These types of poisoning can bring serious consequences, from gastrointestinal ailments to muscle paralysis and even death in extreme cases.[59] To date, harmful algal blooms have not been a major concern for the Tribe, but the Tribe continues to monitor Washington State's toxin testing results to identify any changes.

Projected changes in water quality resulting from climate change will also favor the growth of the bacteria ***Vibrio***. Excess ***Vibrio*** can contaminate shellfish the same way HABs do and can lead to vibriosis in humans, which also causes gastrointestinal issues.[60]



Wildlife

Warming temperatures and precipitation changes will alter the survival, distribution, and phenology of some wildlife and game species—especially those not able to keep pace with a shifting climate. For many species, non-climate stressors like land use changes will exacerbate these impacts. For example:

- **Wolverine** is a highly snow-dependent species, so changes in snowpack will greatly affect wolverine vulnerability to climate change.[61] Overall, wolverine habitat is projected to shift significantly to higher elevations in western Washington and decline overall.[5] Recently, Puyallup Tribal staff identified a potential new wolverine habitat area near the Goat Rocks wilderness. Staff are currently collecting additional data to determine whether a population of wolverine inhabits the area, or if the sighting was an isolated occurrence.
- **Northern spotted owl** habitat may decline due to wildfire and loss of high-quality habitat.[5]
- **Elk** are less sensitive to climate change relative to other species in the Puyallup region because they are habitat and forage generalists, and they can move long distances and tolerate a large range of climatic conditions.[61] Increased wildfire frequency and intensity may produce more early successional habitat area for herds. Still, climate change as well as non-climate stressors like development put the herds at risk. Pressures like habitat fragmentation and conversion may weaken population resilience and challenge elk survival;[62] when land is converted to agriculture and other uses, it can reduce the herds' critical winter ranges. Introduction of and expansion of existing invasive species, diseases, and parasites could bring new or heightened threats to elk food sources and population health. Canopy closure and meadow disappearance in alpine and subalpine habitats could also limit the quantity and quality of forage in summer ranges for elk as well as for black bear and deer. In particular, there is concern about the continued availability of the subalpine huckleberry.[61] Additional research is needed to fully understand how climate change may affect specific elk populations—like the South Rainier herd in the Upper Cowlitz basin—that are hunted by the Puyallup Tribe.







The Tribe has taken steps to better understand elk population threats and potential management solutions. A recent study of the South Mt. Rainier Elk Herd by Tribal wildlife biologist Barbara Moeller identified critical winter habitat areas along the Cowlitz River valley and found that the elk would benefit from expanded protection and restoration of their winter range.[63] The Tribe has restored more than 300 acres of winter elk habitat in the Cowlitz valley and started an elk reserve with 45 acres of bottom land. The Tribe is also working with Pierce County and landowners to encourage increased riparian buffers.

Habitat Restoration

The Tribe has spearheaded several habitat restoration efforts to improve and preserve important ecosystem functions and services within Tribal areas. These restoration projects will be critical for ensuring continued ecological services and functions in the face of a changing climate. Examples of important restoration sites within the Tribal reservation include the following:

- **Hylebos waterway:** The result of a settlement agreement with the Port of Tacoma, the Hylebos waterway restoration site is an 88-acre conservancy that provides critical protection for juvenile salmon. Shellfish harvesting is restricted within the former Superfund site, which was historically used for log sorting and an auto repair shop.
- **Outer Hylebos:** The Tribe received a second site from the Port of Tacoma in 1986, located near the mouth of the Hylebos waterway that was previously used for aquaculture. The Tribe restored the intertidal mudflat and wetland in 2013.
- **Jordan (West Fork Hylebos Creek):** A joint restoration site with the Port of Tacoma, the Jordan restoration site is a 42-acre stream and floodplain restoration project that includes Wapato Creek. The area used to be filled with invasive reed canarygrass, which forms a thick sod layer that can exclude all other plants.
- **WSDOT and the Port of Seattle** have several mitigation sites within the reservation.



Water Quality

Climate change will likely exacerbate stressors that are already degrading the quality of streams and waterways that the Tribe depends on for recreation, cultural activities, and sustenance. Lower summer precipitation combined with warmer summer temperatures will stress streamside vegetation and worsen summer low flows in urban and rural streams, concentrating pollutants and increasing instream temperatures in the Puget Sound region.[29] These conditions will strain aquatic species and increase the risk of harmful algal blooms, as well as worsen dissolved oxygen levels and other parameters regulated under state surface water quality standards. Lower-elevation, downstream waterways with slower and wider characteristics will be most affected by increased temperatures, and the amount of time these and other rivers exceed thermal thresholds will likely lengthen.

The Tribe's Water Quality department has already observed changes to their monitored streams—many of which have little riparian canopy and have undergone channelization or bank modifications. The department, which has had a water quality monitoring program since 1998, has observed the following trends related to water quality of monitored streams:

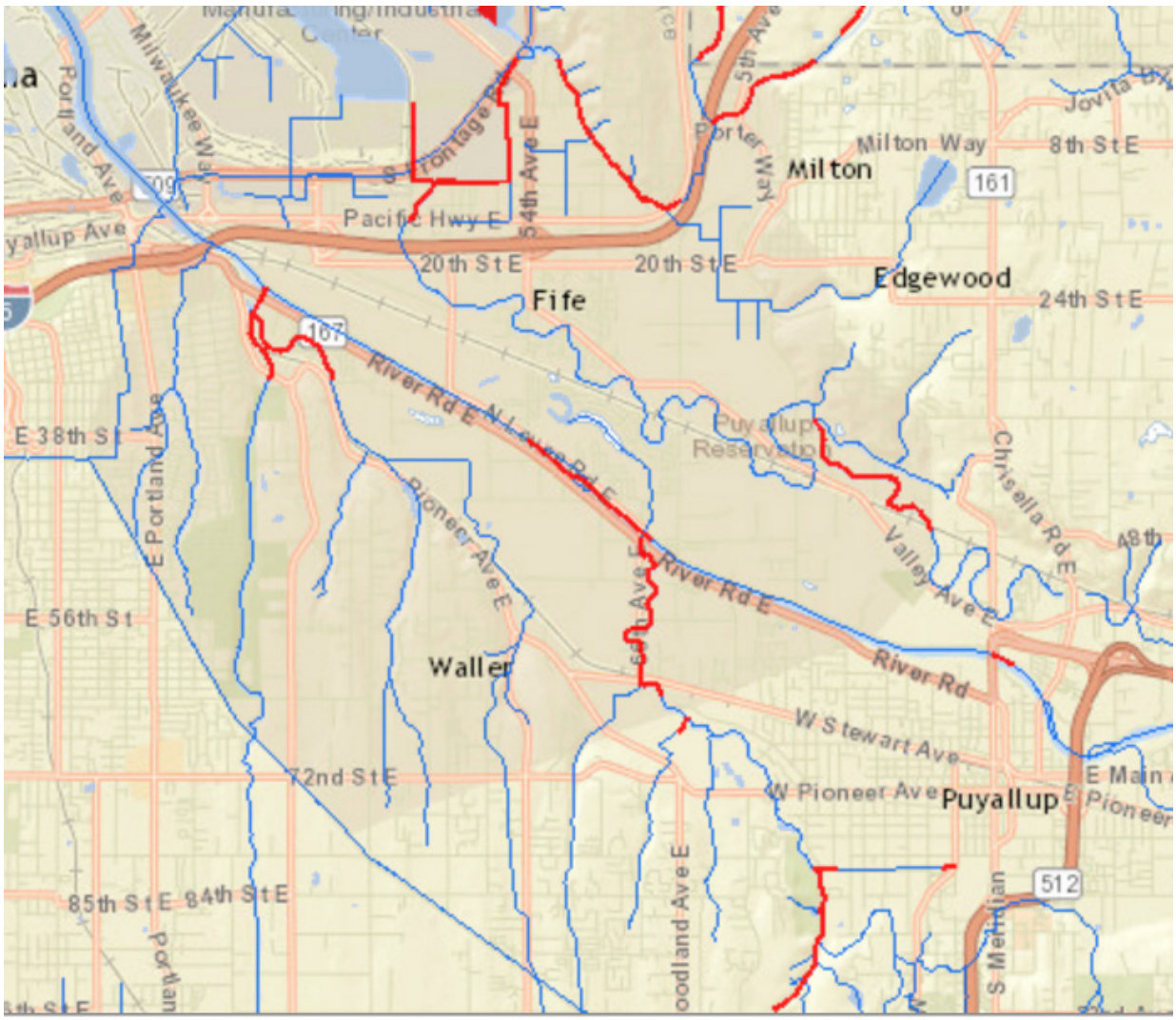
- Streams are consistently and increasingly exceeding federal standards for temperature, especially South Prairie Creek—an important stream for salmon migration.
- Heavy rainfall events have resulted in observed impacts to sedimentation and turbidity, and these events are projected to increase in frequency and intensity over the next century.

Streams that support salmon migration and growth will suffer from higher temperatures and reduced dissolved oxygen levels, in addition to the existing stress of an urbanized environment.

Clarks Creek, a highly urbanized stream, has especially suffered from an influx of stormwater-driven sediment, pollution, and temperature increases during high rainfall events.

- Many of the Tribe's important fish-bearing streams suffer from low dissolved oxygen levels, likely due to a combination of fish density and temperature and nutrient loads.
- Elodea algal blooms have become an increasingly challenging issue that worsens with nutrient loading and temperature increases.
- Other waterways that already suffer from impaired water quality include the Puyallup River, Swan Creek, Wapato Creek, Green Water River, Clear Creek, Clearwater River, and Huckleberry Creek.

Figure 10. Federally designated impaired streams on the 303(d) list of the Clean Water Act within the Puyallup Tribal region. Impaired streams, noted in red, include Clarks Creek, Puyallup River, Swan Creek, and Wapato Creek. Source: Washington State Department of Ecology 2016.[64]



Population growth and development will also continue to strain water quality and quantity in the region, and saltwater intrusion from rising sea levels may affect instream salinity levels. Actions that preserve base flows and habitat—such as reestablishing meanders, buffering along the floodplain, increasing floodplain and channel connectivity and complexity, and enhancing vegetative cover—will help address these water quality risks. The Tribe has undertaken a number of these types of projects through partnerships with local and federal agencies, including the following:

- The Tribe recently worked with the City of Puyallup to remove elodea from **Clarks Creek,** where a steelhead hatchery is located. The Tribe also purchased property along the streambank and worked with the Pierce County Conservation District to improve vegetation cover along the stream through tree planting.
- The Tribe is also working with the City of Puyallup on two channel stabilization projects to remove sediment and slow down flows to allow infiltration in the incised area of **upper Clarks Creek**. The stabilization projects will reduce (and store) over 90 tons of sediment per year from the upper watershed. This stabilization will benefit downstream uses, including operations of the Tribe's Chinook hatchery.
- The Tribe is also working with the Pierce County Conservation District to reestablish the natural meander of **South Prairie Creek** through land acquisition and river restoration.
- The Tribe's Water Quality department is working with the Tribe's Fisheries department on a feasibility study to reestablish the meander patterns of **Boise Creek** and improve fish passage past the falls.

Continued restoration efforts at these and other threatened streams such as Wapato and First creeks will support climate resilience while protecting important habitat, species, and cultural traditions.

Cultural Resources and Traditions

The Tribe's important archaeological sites, resources, and traditions will also be subject to the hazards of a changing climate. Cultural sites along the waterfront may experience more frequent and more intense flooding and storm surges. Changing precipitation and temperatures may alter the availability of traditional plants for a range of purposes. Diminishing salmon populations will continue to threaten traditional ceremonies and nutrition.

It is critical to consider the exposure of our Tribe's archeological sites and assets to climate impacts such as flooding to ensure their continued protection and preservation. This study did not examine specific sites due to the sensitivity of that information; however, we can anticipate how different sites may be vulnerable based on their locations and characteristics. Assets on a beach or low-lying area near water bodies such as the Puyallup River, for example, may be at risk of flooding or sea level rise impacts, which may temporarily or permanently inundate sites, impede access, and corrode certain materials. More frequent and intense rainfall may inundate areas near rivers and streams that were previously outside flood risk zones.

The accessibility and availability of traditional plants, roots, and other resources may change as species distributions and habitats shift. The abundance of warmer, lower-elevation forests rich in species like Douglas fir are expected to decline by the end of the 2060s due to summer water availability limitations, especially in south Puget Sound and in the southern Olympic Mountains. At the same time, high-elevation species such as western hemlock, cedar, and whitebark pine may experience a longer growing season as snowpack declines.[5] Future drought conditions could threaten traditional ceremonies that require



cedar bark, as cedar trees' weakened resilience to pest and disease outbreaks during droughts may outweigh any benefits of a longer growing season.[12] Regardless of type or abundance, all forests in Washington State will be subject to increased risks of wildfire, disease, and pests, which could cause quick, significant loss of forest habitat and the resources therein in some years.

The Tribe has already observed a declining abundance and changing seasonality of traditional cultural resources. Wild berries, including huckleberries, ripened two weeks earlier in 2015 than in previous years, requiring an adjustment in the timing of traditional harvesting activities. High wildfire risk in the summer of 2015 prevented the Tribe from lighting traditional sweat fires.

Development-driven pressures add to these climate-related stresses, putting our resources further at risk. Development-driven vegetation loss and pollution has already compromised the health and abundance of the Tribe's natural areas—many of which had been used for ceremonial and traditional purposes for centuries. Addressing these kinds of non-climate stressors is one way to help build resilience.[1]

Transportation

Many of the Tribe's important transportation routes lie in flood- or landslide-risk areas. The Washington State Department of Transportation's (WSDOT) ***Climate Impacts Vulnerability Assessment*** identified relative vulnerabilities of the State's highway infrastructure to climate change impacts including sea level rise, precipitation change, temperature change, and fire risk. Findings from this study, depicted in Figure 11 on the following page, suggest that the following highways in or near our reservation may be highly vulnerable to climate change impacts, based on the specific potential impacts and the criticality of these routes:

- Highway 509 from downtown Tacoma to Dash Point
- Interstate 5 from Lakewood to Federal Way
- Highway 99 from the edge of the reservation to Federal Way
- Highway 167 from north Puyallup to Auburn

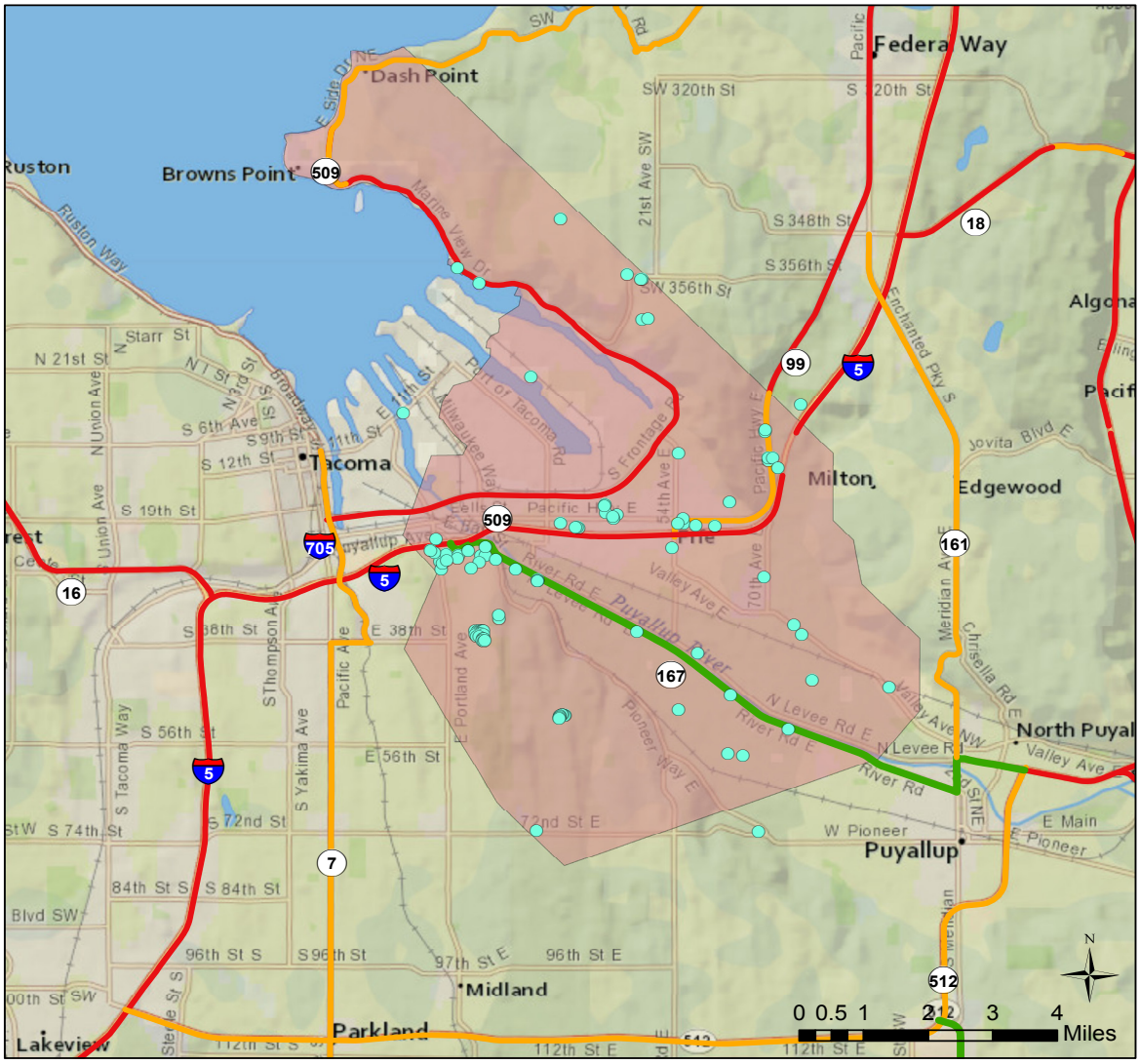
Highway 512 is rated as having medium vulnerability.

It is likely that climate-driven flooding and landslides will also affect other local transportation routes that were not assessed by WSDOT; further study would be required to assess the relative vulnerability of these routes.

Considering climate change in constructing or updating transportation infrastructure will ensure that transportation systems can withstand future impacts. Plans to construct the Puyallup River bridge next year, for example, serve as an opportunity to proactively build in resilience at the onset of major infrastructure projects.



Figure 11. Vulnerability of Puyallup-area highways to one or more climate change impacts.
Source: Washington State Department of Transportation 2011.[65]



Legend

- Low Vulnerability
- Moderate Vulnerability
- High Vulnerability
- Reservation Area
- Tribal Addresses

Climate change vulnerability for highways surrounding the Puyallup Reservation Area. Considers several environmental factors including sea level rise,precipitation change,temperature change, wind, and fire risk.

Data Sources: WSDOT, Puyallup GIS Department, Vertical Datum: NAVD 88

Public Health and Safety

Changes in air quality, foodborne illness risks, extreme events, and other environmental factors associated with climate change will present increased threats to the health and safety of our Tribal members.[56, 66, 67] Sensitive and vulnerable populations such as the young, elderly, disabled, and homeless are especially at risk.

More frequent and severe extreme heat, flooding, and algal bloom events could increase the risk of respiratory illness, foodborne illness, and physical injury.

In the last decade, more Americans have died from extreme heat than from any other weather-related cause.[68] Heat waves are frequently accompanied by increased ground-level ozone concentrations that can cause respiratory problems for certain vulnerable populations. This threat is especially critical in Pierce County, where asthma is already a concern; studies have shown a 1 to 7% increase in asthma diagnoses between 2002 and 2012, with 30% of children in Pierce County public schools experiencing an asthma attack in 2012.**[69] Indoor mold prevalence is also an air quality-related health concern that Tribal staff fear could be exacerbated by a changing climate. More research is needed to determine how these risks may change under future climate conditions and how those changes may affect health in the Puget Sound region and among Puyallup Tribal members.

Heavy rain and flood events can also jeopardize the health and safety of Puyallup Tribal members. Flooding of structures and roads can limit the ability of residents to move out of harm's way, as well as the ability of first responders to reach those in need. Tribal staff have observed that River Road and Lower Clear Creek are particularly susceptible to flooding; residents had to evacuate the area during previous flooding events. During these disaster events, the Emerald Queen Casino serves as a critical site for emergency shelter and food.

Climate change could also heighten the risk of foodborne illness. Warmer air and water temperatures, ocean acidification, and increased nutrient runoff during heavy precipitation events will likely create favorable conditions for a number of phytoplankton species, many of which produce toxins that accumulate in shellfish.[70] The frequency and severity of harmful algal blooms is projected to increase in Puget Sound; these blooms could lead to beach closures and human health risks if contaminated shellfish are ingested.[66] See the ***Shellfish*** section above for more information.

To respond to these and other public health and safety risks, Tribal staff have recently updated emergency response and preparedness plans, including the Hazard Mitigation Plan, Comprehensive Emergency Management Plan, and the Threat and Hazard Identification and Risk Assessment. The Tribe is currently developing plans to increase public education and engagement in the emergency preparedness process to ensure that Tribal members understand how to prepare for and respond to extreme situations.

The Tribe lacks funds to undertake many other preventative and response measures to address these risks, including building retrofits, cooling centers, redundant emergency shelters, mold remediation, and emergency services. To date, the Tribe has had limited capacity to seek funding through FEMA's Hazard Mitigation Assistance programs, which can help fund restoration projects post-disaster, development of preparedness plans, and retrofits of properties in repetitive flood zones.[71] Currently, the Tribe relies heavily on the response of outside municipalities during emergencies, particularly for fire and paramedic crews. Increasing our internal prevention and response capabilities would help us better protect the health and safety of our Tribe in the face of climate variability and change. It is also important that the Tribe remain engaged in external stakeholder meetings—such as with adjacent localities and owners/operators of critical infrastructure—to ensure emergency response and hazard mitigation plans are aligned and coordinated.

** Includes children between grades 8 and 12.

Adaptation Options

Existing Programs and Plans

The Puyallup Tribe has already undertaken important actions to improve the general resilience of its natural and built systems. As described in the preceding chapters on ***Climate Impacts and Projections*** and ***Sector-Specific Impacts***, Tribal plans, programs, and activities that address climate change threats include the following:

- **Habitat Restoration:** Habitat preservation and restoration is a high priority for the Tribe. The Tribe partners with local jurisdictions such as the Port of Tacoma to acquire, protect, and restore important systems and functions, including coastal intertidal habitat along the Hylebos waterway and floodplain habitat along Clarks, South Prairie, and Boise creeks.
- **Hatchery and Fishery Management:** To address flood risks affecting local hatcheries, the Tribe's Fisheries and Environmental departments recently worked with Washington State Environmental Management and FEMA to stabilize the riverbank at a fish hatchery near Buckley.
- **Monitoring:** The Tribe monitors water quality and other indicators on a regular basis.
- **Emergency Management:** Tribal staff have recently updated emergency response and preparedness plans, including the Hazard Mitigation Plan, the Comprehensive Emergency Management Plan, and the Threat and Hazard Identification and Risk Assessment.
- **Public Education and Outreach Programs:** The Tribe participates in joint presentations about air quality health risks and asthma with the U.S. Environmental Protection Agency at Chief Leschi School. The Tribe is currently developing plans to increase public education and engagement in the emergency preparedness process to ensure that Tribal members understand how to prepare for and respond to crises.

Despite this progress, more work will be needed to adequately prepare for and respond to the risks of climate change. The adaptation approaches below present initial ideas that Tribal staff have developed to build upon successes to date with actions and strategies that protect the health and livelihood of the Tribe's most vulnerable people, places, and resources.

Adaptation Approaches

During the project's third workshop, in April 2016, Tribal staff reviewed adaptation measures adopted by other communities and tribes, brainstormed potential adaptation measures, and used the following criteria to conduct a preliminary screening:

- **Effectiveness:** Likelihood that the action will work to address identified climate vulnerabilities.
- **Affordability:** Overall expense and ease of covering the costs with Tribal budget, grants, or other funds.
- **Feasibility:** Encompasses both technical and political feasibility; includes the likelihood of obtaining support for action and whether the measure is possible to implement.

The adaptation options listed below performed well against these criteria during the screening exercise conducted at the workshop. Additional criteria to include in further evaluation of the proposed adaptation options may include flexibility, consistency with Tribal priorities, urgency, near-term windows of opportunity, and co-benefits.

The adaptation options are presented by sector/resource and categorized under these five main strategies within each sector/resource:

1. Implement protection, restoration, and management practices
2. Provide education and guidance
3. Reevaluate policies, plans, and protocols
4. Gather additional information
5. Leverage partnerships

Fisheries, Hatcheries, and Shellfish

Strategy #1: Implement protection, restoration, and management practices

- **Use hatchery practices (e.g., on-water floating nurseries) to get shellfish larvae past the vulnerable stage**; use out-planting methods.
- **Reduce sources of nutrients that contribute to harmful algal blooms**; in the future, as conditions worsen, this effort could include exploring the use of mussels to filter out excess nutrients.
- To increase stormwater system capacity, **use Low Impact Development (LID) techniques** such as rain gardens for water runoff detention and infiltration.
- **Update the heat exchange system at the Clark Creek Hatchery.**
- **Expand efforts to stabilize headwaters above spawning habitat** (e.g., using large wood, vegetative mattresses). Help seek funding for local jurisdictions to implement such efforts beyond the Puyallup Reservation.

Strategy #2: Provide education and guidance

- **As needed in the future, conduct more outreach to Tribal members** regarding beach closures and response to biotoxin events; information could be shared through the Tribal newspaper, email lists, and at the point of permitting.

Strategy #3: Reevaluate policies, plans, and protocols

- **Lobby for state changes in hatchery management** (e.g., increases in shading, augmenting flows with cooler groundwater when necessary).

Strategy #4: Gather additional information

- **Continue to track data from Washington State** on emerging biotoxins in the region.

Strategy #5: Leverage partnerships

- **Continue to work with the Army Corps of Engineers** to increase shading downstream from Tribal hatcheries.

Public Safety, Air Quality/Health, Transportation, and Infrastructure

Strategy #1: Implement protection, restoration, and management practices

- **Develop redundant services to accommodate system disruptions due to flooding and more frequent storms**, such as by building "rescue roads" and redundant power and communications systems. Ensure that primary and alternate transportation routes can continue to provide everyday access, emergency vehicle access, and evacuation in a safe and effective manner, in the context of a changing climate.
- **Ensure that services provided by critical facilities, including medical and emergency services, are consistently available to at-risk populations.**
- **Increase urban water absorption capacity by minimizing paved surfaces**, using absorptive or permeable construction materials, and increasing public awareness and participation in reducing runoff.
- To extend the life of infrastructure and reduce risks of pollution due to flooding, **locate structures and equipment at higher elevations**. In new construction areas, consider revising ground level requirements to accommodate increased winter flooding.
- Strengthen existing structures and **build protective infrastructure, including slope control structures, to prevent landslides** along elevated and exposed transportation routes.
- **Plant drought- and heat-resistant plant species for erosion control**.
- **Develop natural protective infrastructure** such as embankments, sea walls, beach nourishment, and/or natural infrastructure such as marshes, reefs, beaches, barrier islands, and vegetated shorelines in combination with road construction.
- Work with other agencies and jurisdictions to **consider building new set-back levees** to channel flood waters away from critical roads and abutments of important bridges.
- Consider anticipated increases in peak streamflows when **designing and constructing the new Puyallup River bridge**.

Strategy #2: Provide education and guidance

- **Incorporate climate resilience into current public outreach and education programs**, such as those for air quality.

Strategy #3: Reevaluate policies, plans, and protocols

- **Integrate future climate risk when updating emergency plans and hazard mitigation plans.**
- **Incorporate climate resilience into planning efforts and land use development,** recognizing where new development could be at-risk and adjusting decisions as needed. For example, locate facilities where climate risks are lower.
- **Maintain and periodically update flood contingency and emergency response action plans**, and conduct drills.
- **Consider climate change impacts when planning new assets or rehabilitating existing assets,** especially as part of strategic asset management efforts.
- **Monitor changes in design standards** relating to drainage, and consider applying floodplain-level standards in areas vulnerable to flooding in the life of the project even if they are not located in the current 100-year floodplain.

- **Prohibit road and utility construction in areas subject to excessive erosion and/or accretion.**
- **Consider changing the permitting process** to include sea level rise and other climate change datasets. Review projects not only to consider immediate impacts but also medium- and longer-term anticipated impacts.

Strategy #4: Gather additional information

- **Continue to evaluate risks and devise plans for protecting facilities** that will be exposed to future flood risks during high tides.

Strategy #5: Leverage partnerships

- **Team with other agencies to provide flood mitigation/protection around critical infrastructure** (e.g., repurpose transportation agencies' right-of-way to provide additional flood storage and/or increased conveyance).
- **Coordinate with the City of Tacoma as the city completes its Climate Change Resilience Study** and prepares to make decisions about further studies or adaptation actions.
- **Improve communication with nearby localities (e.g., Tacoma, Fife, Federal Way) to ensure coordinated emergency response and preparedness plans,** especially with regard to services that the Tribe relies on external agencies to provide (e.g., fire and emergency medical services).
- **Increase Tribal participation in road planning projects by strengthening relationships and communication with WSDOT and other stakeholders, and including climate change considerations on meeting agendas.** For example, urge WSDOT to increase scour and erosion protection at bridges and to provide increased river conveyance at bridge crossings (or culverts), such as enlarging culverts or increasing bridge deck elevation to accommodate increased flows.
- **Explore using FEMA funds to implement adaptation projects.** For example, seek funding from FEMA's Hazard Mitigation Assistance grant programs to fund acquisition or elevation of structures in repetitive flood zones.
- Explore joining the National Flood Insurance Program.

Natural Resources (Habitat and Wildlife Restoration and Conservation), Water Quality

Strategy #1: Implement protection, restoration, and management practices

- **Implement on-the-ground habitat and water quality restoration projects** that serve one or more of the following functions:
  - **Enhance floodplain connectivity**, such as by:
    - Improving and reconnecting side channels
    - Setting back levees and dikes
    - Reestablishing stream meanders
    - Daylighting streams (uncovering and restoring buried streams)
    - Focusing on areas within the current 100-year floodplain
  - **Provide refuges for fish** from summer high temperature and winter/spring high-energy flows, such as by:
    - Identifying, protecting, and restoring off-channel habitat
    - Identifying and protecting cool water inflows, undercut banks, and deep stratified pools
    - Increasing shading of streams by planting native trees
  - **Reduce discharge of warm water and stormwater into rivers and streams** (e.g., from irrigation, point source discharges from industry and power plants).

- **Reduce forest susceptibility** to severe fire, insect outbreaks, and drought by establishing or enhancing planned treatments of forest sites that specifically manage for these impacts.
- **Restore high-quality freshwater habitat** through the reintroduction of beavers, wetland mitigation and restoration, groundwater recharge, and flow augmentation.
- **Maintain and increase biological diversity and connectivity** to increase large-scale resilience of vulnerable landscapes to droughts, wildfires, and flooding.
- **Diversify vegetation and enhance water-retaining areas**, such as by abutting wetland projects to agricultural areas to reduce flood vulnerability.
- **Provide corridors between conservation areas** to help plants and animals migrate to new locations with suitable habitat.
- **Protect undeveloped areas that are up-gradient from tidal wetlands** to allow wetland migration and buffer intact ecosystems.
- **Restore badly eroded streams at coastal outfalls.**

- **Accommodate and facilitate inland/upland migration of tidal freshwater habitats** by creating/restoring wetlands in place with boundary protection (e.g., sill, rock), planned elevation increases, and considering development upstream that could affect species migration.
- **Use vegetation species for restoration that are more flood- and drought-tolerant** and that can withstand higher salinity.

Strategy #2: Provide education and guidance

- **Educate landowners and stakeholder groups about the importance of** conservation and restoration of key corridor habitats, such as buffer areas along riparian systems and critical winter range habitat for elk.
- **Educate Tribal members about existing habitat conditions** and the benefits of building the resilience of those habitats.
- **Use public access points, nature centers, and hunting and fishing regulation guides to inform people of climate change impacts** on wildlife, and what they can do to help.

Strategy #3: Reevaluate policies, plans, and protocols

- **Introduce new policies that encourage or require native and/or drought-tolerant vegetation** in all landscaping and restoration projects.
- **Examine how restoration project maintenance may need to be restructured in drought years**.
- **Incorporate climate change considerations into existing and new management plans** for protecting sensitive and vulnerable species.
- **Update natural resource protection plans, land use plans, and water resources management plans** to address climate change considerations for species and ecosystems.
- Work with partner jurisdictions to evaluate opportunities for improving **current land use permitting processes.**

Strategy #4: Gather additional information

- **Continue examining climate impacts to alpine and subalpine habitats** and associated threats to wildlife such as wolverine, bear, deer, and elk.
- **Work with EPA to initiate research on groundwater influence on stream temperature** within Tribally monitored streams.
- **Continue to monitor and document elk populations** to better understand trends and the impacts of climate change and other stressors, such as effects of increased wildfires on availability of early successional foraging habitat and changes in disease and parasite threats.

Strategy #5: Leverage partnerships

- **Work with partner jurisdictions to leverage seed funding for habitat restoration projects.** For example, fund the design phase internally and partner for the construction phase.
- **Work with conservation groups and nonprofits** to encourage private landowners to protect critical habitat areas through conservation easements.
- **Work with the Army Corps of Engineers to allow more vegetation and shade along levees** through their variance process.
- **Encourage the City of Tacoma and the Port of Tacoma to remove bulkheads and shore defense works** to restore shoreline, preserve natural processes, and help adapt to sea level rise.
- **Work with partner jurisdictions to encourage management of forest density** to reduce susceptibility to severe fire, insect outbreaks, and drought by establishing or enhancing structural prescriptions.

Appendix A. Terms and Definitions

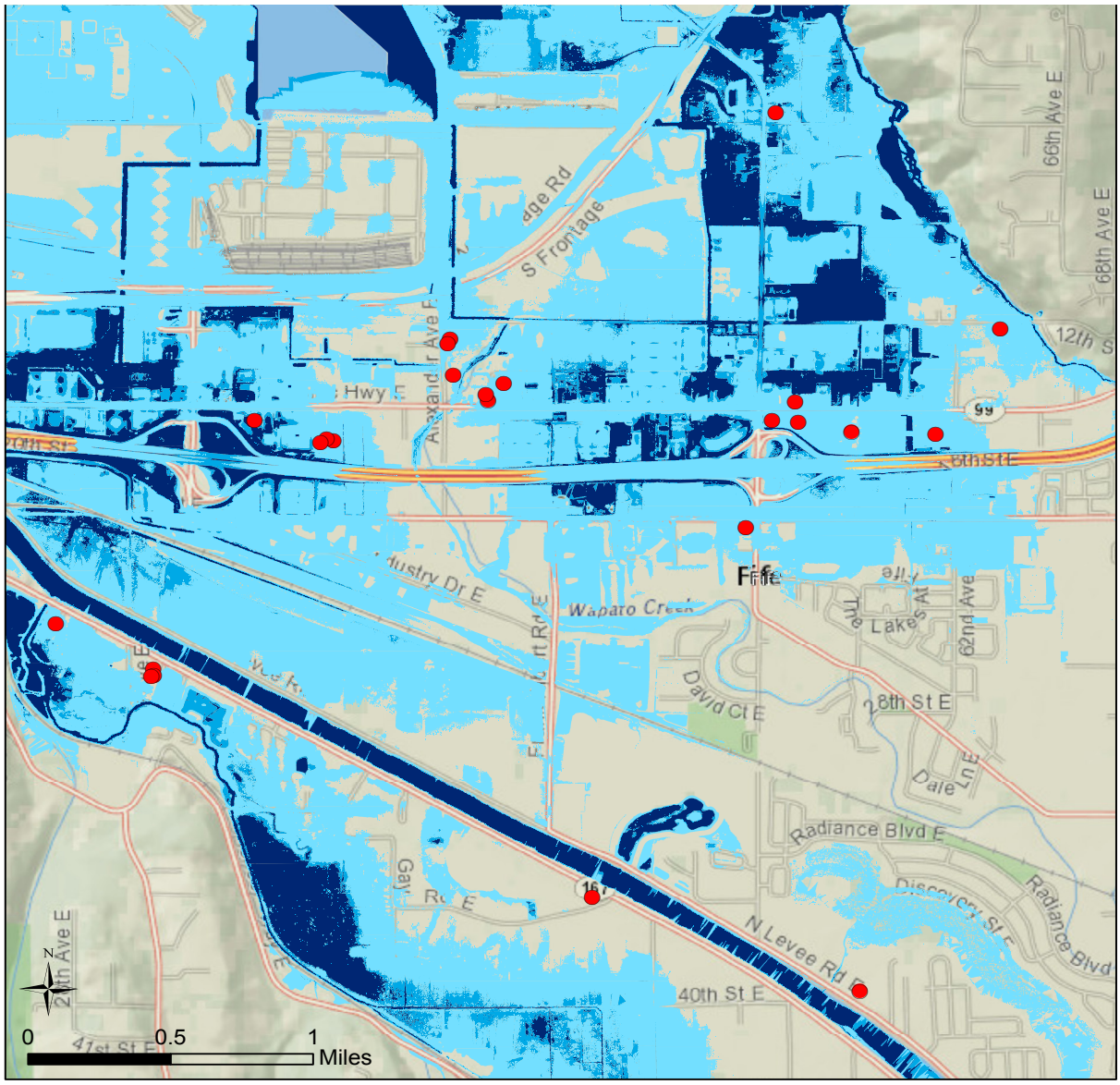
100-year flood	A flood that statistically has a 1-percent chance of occurring in any given year.
Accretion	The gradual accumulation of additional layers or matter.
Adaptation	In human systems, the process of adjustment to actual or expected climate and its effects, to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate.
Anthropogenic	Originating in human activity.
Adaptive capacity	The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.
Atmospheric river	A narrow band of water vapor transport extending from the tropical Pacific to the west coast of North America during the winter months.
Base flood elevation	The 100-year flood elevation used by FEMA.
Climate	The statistics of weather. In other words, the average pattern for weather over a period of months, years, decades, or longer in a specific place.
Emissions	The release of greenhouse gases and/or their precursors and aerosols into the atmosphere over a specified area and period.
Exposure	The presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected by climate change.
Extreme weather event	An event that is rare within its statistical reference distribution at a particular place.
Greenhouse gases	The gaseous constituents of the atmosphere, both natural and anthropogenic (including carbon dioxide, methane, and other gases), that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds.
Hypoxia	Low or depleted oxygen in a water body.
Levee	A natural or human-made earthen barrier along the edge of a stream, lake, or river.

Ocean acidification	Increased concentrations of carbon dioxide in sea water causing a measurable increase in acidity (i.e., a reduction in ocean pH). This may lead to reduced calcification rates of calcifying organisms such as corals, mollusks, algae, and crustaceans.
Peak flow	The maximum instantaneous discharge of a stream or river at a given location.
pH	The pH scale measures how acidic or basic a substance is. It ranges from 0 to 14. A pH of 7 is neutral. A pH less than 7 is acidic, and a pH greater than 7 is basic.
Projection	A potential future evolution of a quantity or set of quantities, often computed with the aid of a model. ***Projections*** are distinguished from ***predictions*** to emphasize that projections involve assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realized.
Redd	A spawning nest that is built by salmon and steelhead in the gravel of streams or the shoreline of lakes.
Resilience	The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.
Scenario	A plausible and often simplified description of how the future may develop based on a coherent and internally consistent set of assumptions about driving forces and key relationships.
Sensitivity	The degree to which a system is affected, either adversely or beneficially, by climate variability or change.
Snow water equivalent	The amount of water contained within the snowpack.
Storm surge	The temporary increase, at a particular locality, in the height of the sea due to extreme meteorological conditions (low atmospheric pressure and/or strong winds).
Vulnerability	The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.
Weather	The atmospheric conditions at a specific place at a specific point in time.

These definitions are drawn from the Environmental Protection Agency (including its Glossary of Climate Terms), the US Department of Agriculture Forest Service Climate Change Glossary, the Intergovernmental Panel on Climate Change, and the University of Washington Climate Impacts Group website.

Appendix B. Additional Maps

Figure 12. Tribal-owned facilities (green dots) for a portion of Puyallup Reservation north of SR-167, south and east of North Frontage Road, and west of 62nd Avenue East projected to be at risk of flooding during extreme high tides in 2050. Dark blue areas are already below base flood elevation (BFE). Light blue are below BFE with 19 inches of sea level rise (the high-range estimate for 2050).



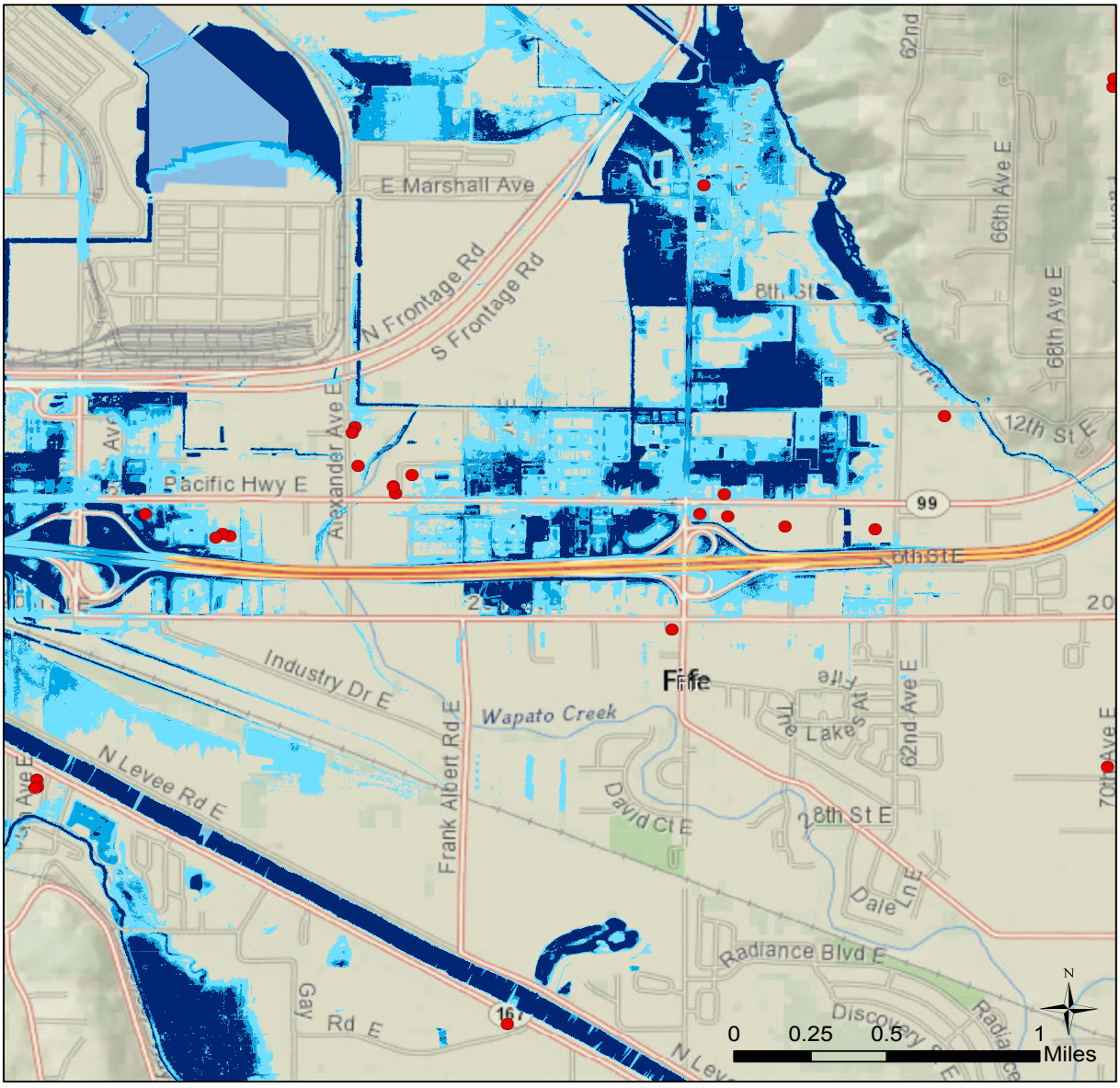
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- Areas below the current regulatory 1-percent annual chance exceedance tidal flood elevation (current regulatory base flood elevation [BFE]). Below 12.50 ft.
- Areas below the best scientific estimate of the 1-percent annual chance exceedance tidal flood elevation (likely future BFE). Between 12.50 ft. and 13.36 ft.
- Areas below the most conservative estimate of the year 2100 1-percent chance exceedance tidal flood elevation (56 inches of sea level rise). Between 13.36 ft. and 18.03 ft.
- Tribal Addresses

Areas Below Existing 1 percent Annual Chance Exceedance High Tide Elevation and Year 2100 1-percent Annual Chance Exceedance High Tide Elevation, (i.e., Areas Below year 2015 and 2100 "100-year" High Tide Elevations). Assumes 56 inches of Sea Level Rise for 2100.

Data Sources: Herrara Environmental Consultants, Puyallup GIS Department,Vertical Datum: NAVD 88

Figure 13. Tribal-owned facilities (green dots) for a portion of Puyallup Tribe Reservation north of SR-167, south and east of North Frontage Road, and west of 62nd Avenue East projected to be at risk of flooding during extreme high tides in 2100. Dark blue areas are already below base flood elevation (BFE). Light blue are below BFE with 56 inches of sea level rise (the high-range estimate for 2100).



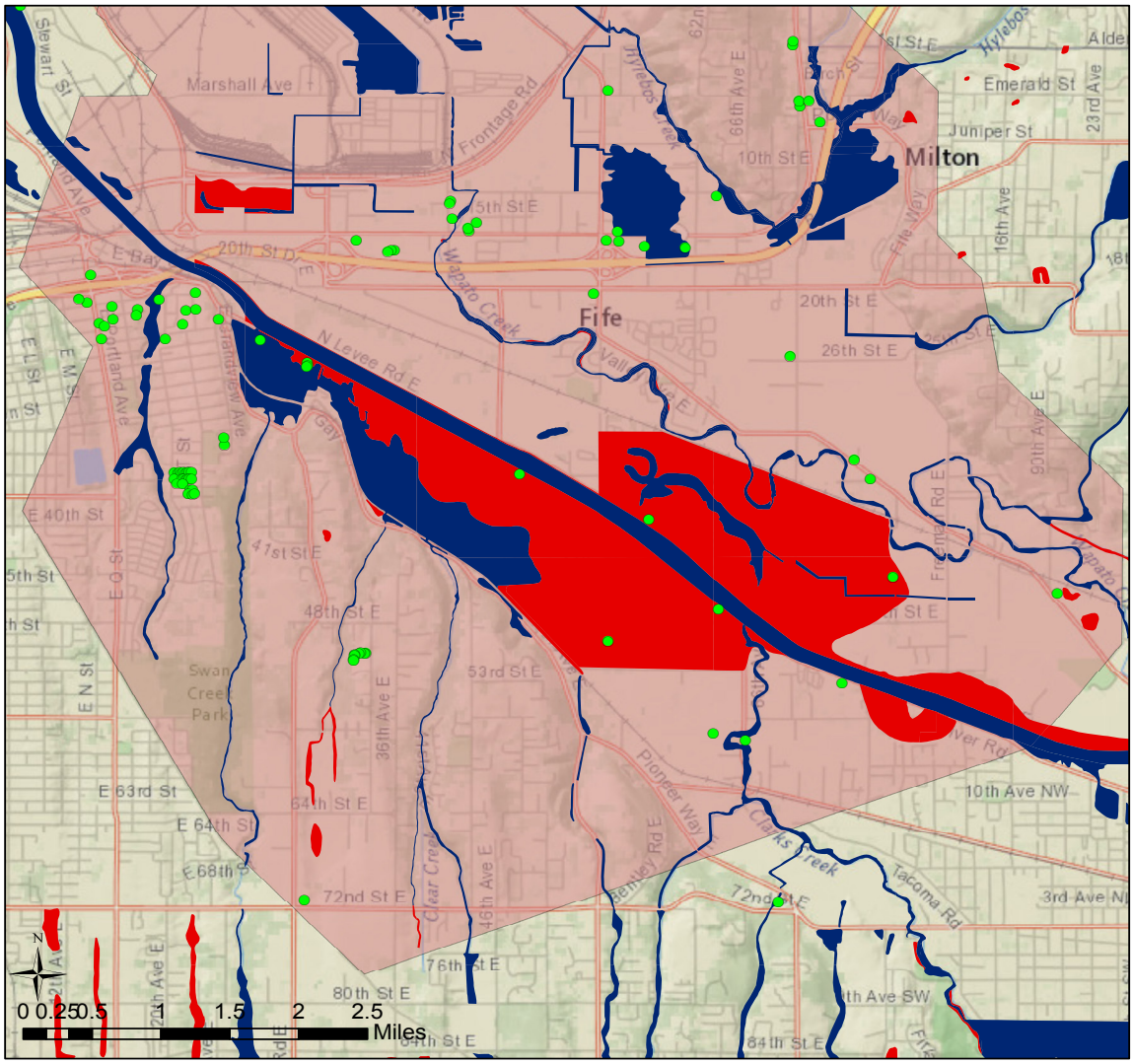
Legend

- Areas below the current regulatory 1-percent annual chance exceedance tidal flood elevation (current regulatory base flood elevation [BFE]). Below 12.50 ft.
- Areas below the best scientific estimate of the 1-percent annual chance exceedance tidal flood elevation (likely future BFE). Between 12.50 ft. and 13.36 ft.
- Areas below the most conservative estimate of the year 2050 1-percent chance exceedance tidal flood elevation (19 inches of sea level rise). Between 13.36 ft. and 14.94 ft.
- Tribal Addresses

Areas Below Existing 1 percent Annual Chance Exceedance High Tide Elevation and Year 2050 1-percent Annual Chance Exceedance High Tide Elevation, (i.e., Areas Below year 2015 and 2050 "100-year" High Tide Elevations). Assumes 19 inches of Sea Level Rise for 2050.

Data Sources: Herrara Environmental Consultants, Puyallup GIS Department,Vertical Datum: NAVD 88

Figure 14. Current FEMA flood hazard areas for a portion of the Puyallup Tribe Reservation.
Tribal-owned facilities are marked with green dots.



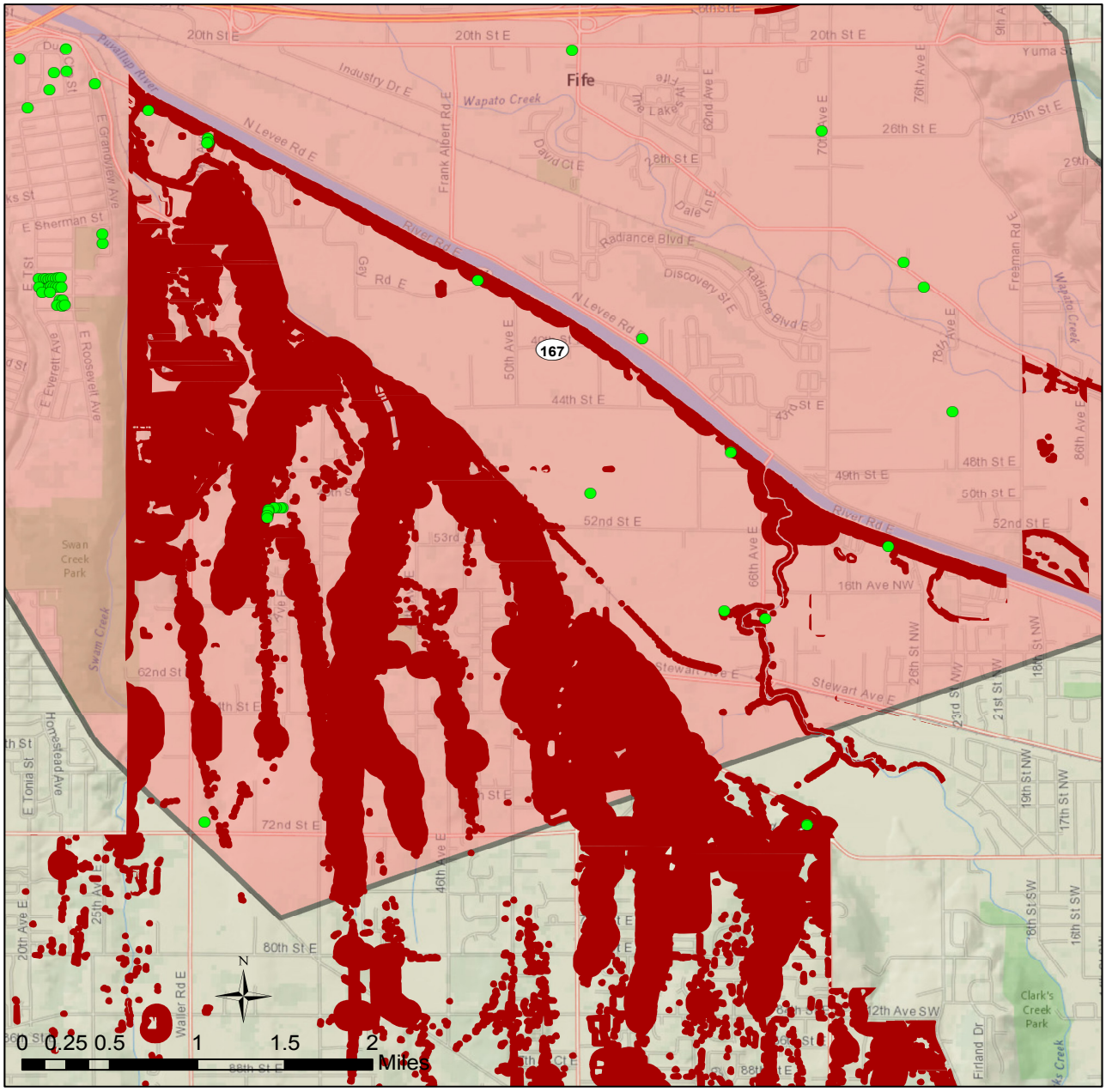
Legend

- 100-Year Flood
- 500-Year Flood
- Reservation Area
- Tribal Addresses

This theme shows both 100-year and 500-year flood hazard areas. A 100-year flood is a flood that has a 1% chance of being equaled or exceeded in any given year. An area inundated during the base flood is sometimes called the 100-year floodplain. A 500-year flood is a flood that has a 2% chance of being equaled or exceeded in any given year.

Data Sources: Pierce County Geospatial Data Portal, Puyallup GIS Department, Vertical Datum: NAVD 88

Figure 15.Landslide hazard areas for a portion of the Puyallup Reservation.



Legend

- Hazard
- Reservation Area
- Tribal Addresses

Landslide hazard areas, as depicted on the 2014 Critical Areas Atlas-Landslide Hazard Areas Map, are those areas where the suspected risk of slope instability and landslide is sufficient to require a geological assessment to assess the potential for active landslide activity.

Data Sources: Pierce County Geospatial Data Portal, Puyallup GIS Department, Vertical Datum: NAVD 88

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the PUYALLUP TRIBE of INDIANS

GENEROUS AND WELCOMING TO ALL PEOPLE

APPENDIX B: SOCIAL VULNERABILITY INDEX DOCUMENTATION

CDC SVI 2018 Documentation - 1/31/2020

Please see data dictionary below.

Introduction

What is Social Vulnerability?

Every community must prepare for and respond to hazardous events, whether a natural disaster like a tornado or a disease outbreak, or an anthropogenic event such as a harmful chemical spill. The degree to which a community exhibits certain social conditions, including high poverty, low percentage of vehicle access, or crowded households, may affect that community's ability to prevent human suffering and financial loss in the event of disaster. These factors describe a community's social vulnerability.

What is CDC Social Vulnerability Index?

ATSDR's Geospatial Research, Analysis & Services Program (GRASP) created Centers for Disease Control and Prevention Social Vulnerability Index (CDC SVI or simply SVI, hereafter) to help public health officials and emergency response planners identify and map the communities that will most likely need support before, during, and after a hazardous event.

SVI indicates the relative vulnerability of every U.S. Census tract. Census tracts are subdivisions of counties for which the Census collects statistical data. SVI ranks the tracts on 15 social factors, including unemployment, minority status, and disability, and further groups them into four related themes. Thus, each tract receives a ranking for each Census variable and for each of the four themes, as well as an overall ranking.

In addition to tract-level rankings, SVI 2010, 2014, 2016, and 2018 also have corresponding rankings at the county level. Notes below that describe "tract" methods also refer to county methods.

How can CDC SVI help communities be better prepared for hazardous events?

SVI provides specific socially and spatially relevant information to help public health officials and local planners better prepare communities to respond to emergency events such as severe weather, floods, disease outbreaks, or chemical exposure.

CDC SVI can be used to:

- Allocate emergency preparedness funding by community need.
- Estimate the type and amount of needed supplies such as food, water, medicine, and bedding.
- Decide how many emergency personnel are required to assist people.
- Identify areas in need of emergency shelters.
- Create a plan to evacuate people, accounting for those who have special needs, such as those without vehicles, the elderly, or people who do not speak English well.
- Identify communities that will need continued support to recover following an emergency or natural disaster.

Important Notes on CDC SVI Databases

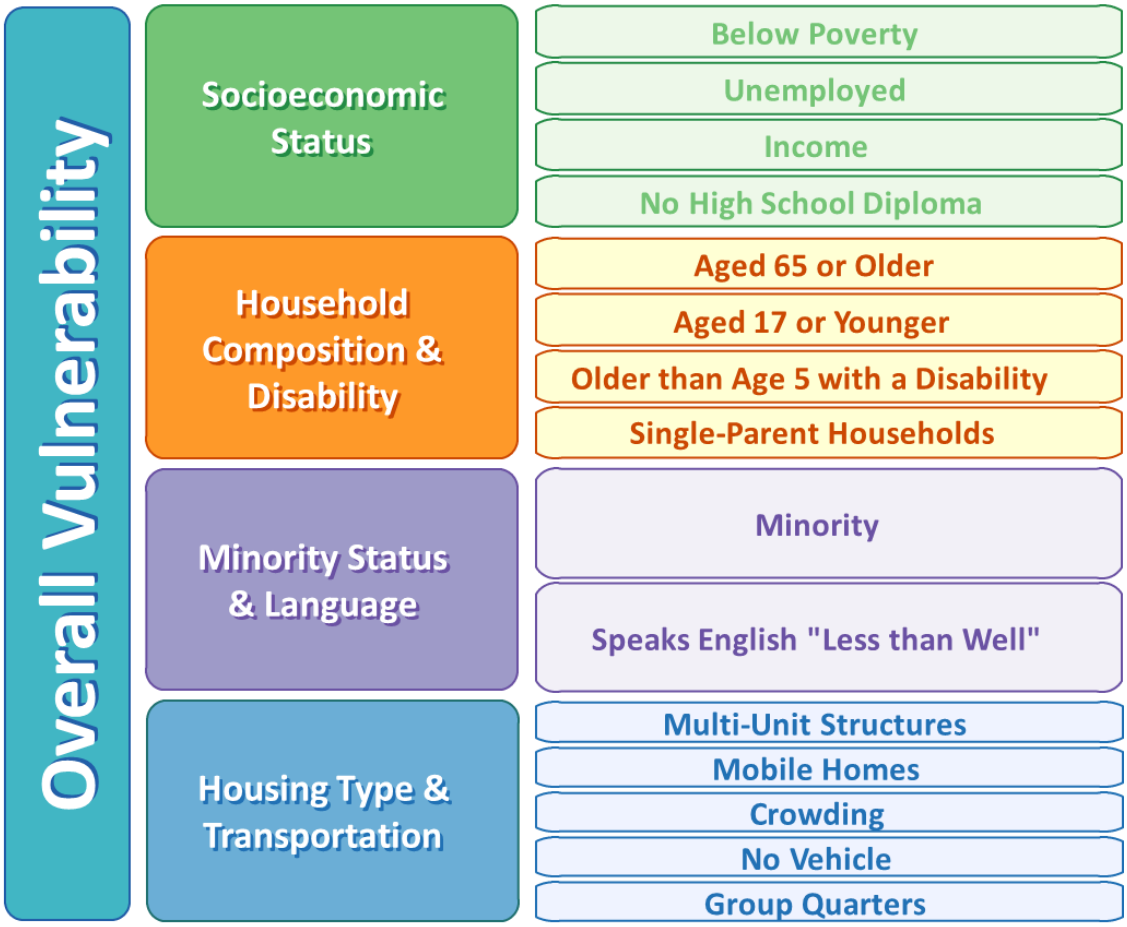
- SVI 2014, 2016, and 2018 are available for download in shapefile format from https://svi.cdc.gov/SVIDataToolsDownload.html. SVI 2014 and 2016 are also available via ArcGIS Online. Search on "CDC's Social Vulnerability Index."
- For SVI 2000 and 2010, keep the data in geodatabase format when downloading from https://svi.cdc.gov/SVIDataToolsDownload.html. Converting to shapefile changes the field names.
- ACS field names have changed between SVI 2016 and 2018. Name changes are noted in the Data Dictionary below.

- For US-wide or multi-state mapping and analysis, use the US database, in which all tracts are ranked against one another. For individual state mapping and analysis, use the state-specific database, in which tracts are ranked only against other tracts in the specified state.
- Starting with SVI 2014, we've added a stand-alone, state-specific Commonwealth of Puerto Rico database. Puerto Rico is not included in the US-wide ranking.
- Starting with SVI 2014, we've added a database of Tribal Census Tracts (http://factfinder.census.gov/help/en/tribal_census_tract.htm). Tribal tracts are defined independently of, and in addition to, standard county-based tracts. The tribal tract database contains only estimates, percentages, and their respective margins of error (MOEs), along with the adjunct variables described in the data dictionary below. Because of geographic separation and cultural diversity, tribal tracts are not ranked against each other nor against standard census tracts.
- Tracts with zero estimates for total population (N = 645 for the U.S.) were removed during the ranking process. These tracts were added back to the SVI databases after ranking. The TOTPOP field value is 0, but the percentile ranking fields (RPL_THEME1, RPL_THEME2, RPL_THEME3, RPL_THEME4, and RPL_THEMES) were set to -999.
- For tracts with > 0 TOTPOP, a value of -999 in any field either means the value was unavailable from the original census data or we could not calculate a derived value because of unavailable census data.
- Any cells with a -999 were not used for further calculations. For example, total flags do not include fields with a -999 value.
- Whenever available, we use Census-calculated MOEs. If Census MOEs are unavailable, for instance when aggregating variables within a table, we use approximation formulas provided by the Census in Appendix A (pages A-14 through A-17) of *A Compass for Understanding and Using American Community Survey Data* here: https://www.census.gov/content/dam/Census/library/publications/2008/acs/ACSGeneralHandbook.pdf If more precise MOEs are required, see Census methods and data regarding Variance Replicate Tables here: https://www.census.gov/programs-surveys/acs/technical-documentation/variance-tables.html. For selected ACS 5-year Detailed Tables, "Users can calculate margins of error for aggregated data by using the variance replicates. Unlike available approximation formulas, this method results in an exact margin of error by using the covariance term."
- The U.S. Census Bureau reports that data collection errors prohibited the inclusion of income and poverty data from Rio Arriba County, New Mexico. Please see a more detailed explanation provided by the Census Bureau here: https://www.census.gov/programs-surveys/acs/technical-documentation/errata/125.html.
- FIPS codes are generally defined as text to preserve leading zeros (0s). If you're working with csv files, leading 0s are required to properly join or merge tables. ArcGIS maintains leading 0s in the FIPS code fields of csv files. To preserve leading 0s and create an Excel file in Excel for Office 365, follow these steps:
    - Open a blank worksheet in Excel.
    - Click Data in the menu bar and choose the icon From Text/CSV
    - Navigate to the csv file and choose to Import
    - In the dialog box that opens, choose to Transform Data
    - In the Power Query Editor dialog box, for each of the FIPS columns (ST, STCNTY, FIPS for tracts and ST, FIPS for counties), right click the column name and choose to Change Type to Text.
    - As prompted in the Change Column Type dialog box, choose to Replace current. Click Close and Load.
    - Save As an Excel xlsx file.
- See the ***Methods*** section below for further details.
- Questions? Please visit the SVI website at http://svi.cdc.gov for additional information or email the SVI Coordinator at svi_coordinator@cdc.gov.

Methods

Variables Used

American Community Survey (ACS), 2014-2018 (5-year) data for the following estimates:



For SVI 2018, we included two adjunct variables, 1) 2014-2018 ACS estimates for persons without health insurance, and 2) an estimate of daytime population derived from LandScan 2018 estimates. These adjunct variables are excluded from SVI rankings.

Raw data estimates and percentages for each variable, for each tract, are included in the database. In addition, the margins of error (MOEs) for each estimate, at the Census Bureau standard of 90%, are also included. Confidence intervals can be calculated by subtracting the MOE from the estimate (lower limit) and adding the MOE to the estimate (upper limit). Because of relatively small sample sizes, some of the MOEs are high. It's important to identify the amount of error acceptable in any analysis.

Rankings

We ranked Census tracts within each state and the District of Columbia, to enable mapping and analysis of relative vulnerability in individual states. We also ranked tracts for the entire United States against one another, for mapping and analysis of relative vulnerability in multiple states, or across the U.S. as a whole. Tract rankings are based on percentiles. Percentile ranking values range from 0 to 1, with higher values indicating greater vulnerability.

For each tract, we generated its percentile rank among all tracts for 1) the fifteen individual variables, 2) the four themes, and 3) its overall position.

Theme rankings: For each of the four themes, we summed the percentiles for the variables comprising each theme. We ordered the summed percentiles for each theme to determine theme-specific percentile rankings.

The four summary theme ranking variables, detailed in the Data Dictionary below, are:

- **Socioeconomic - RPL_THEME1**
- **Household Composition & Disability - RPL_THEME2**
- **Minority Status & Language - RPL_THEME3**
- **Housing Type & Transportation - RPL_THEME4**

Overall tract rankings: We summed the sums for each theme, ordered the tracts, and then calculated overall percentile rankings. Please note; taking the sum of the sums for each theme is the same as summing individual variable rankings. **The overall tract summary ranking variable is RPL_THEMES**.

Flags

Tracts in the top 10%, i.e., at the 90th percentile of values, are given a value of 1 to indicate high vulnerability. Tracts below the 90th percentile are given a value of 0.

For a theme, the flag value is the number of flags for variables comprising the theme. We calculated the overall flag value for each tract as the number of all variable flags.

For a detailed description of SVI variable selection rationale and methods, see A Social Vulnerability Index for Disaster Management (https://svi.cdc.gov/A%20Social%20Vulnerability%20Index%20for%20Disaster%20Management.pdf).

Reproducibility Caveat

When replicating SVI using Microsoft Excel or similar software, results may differ slightly from databases on the SVI website or ArcGIS Online. This is due to variation in the number of decimal places used by the different software programs. For purposes of automation, we developed SVI using SQL programming language. Because the SQL programming language uses a different level of precision compared to Excel and similar software, reproducing SVI in Excel may marginally differ from the SVI databases downloaded from the SVI website. For future iterations of SVI, beginning with SVI 2018, we plan to modify the SQL automation process for constructing SVI to align with that of Microsoft Excel. If there are any questions, please email the SVI Coordinator at svi_coordinator@cdc.gov.

CDC SVI 2018 Data Dictionary – American Community Survey field names that changed between 2016 and 2018 are noted in RED

Theme Colors
Socioeconomic
Household Composition/Disability
Minority Status/Language
Housing Type/Transportation

Variables beginning with "E_" are estimates. Variables beginning with "M_" are margins of error for those estimates. Values of -999 represent "null" or "no data."

The four summary theme ranking variables, detailed in the Data Dictionary below, are:

- **Socioeconomic - RPL_THEME1**
- **Household Composition & Disability - RPL_THEME2**
- **Minority Status & Language - RPL_THEME3**
- **Housing Type & Transportation - RPL_THEME4**

The overall tract summary ranking variable is RPL_THEMES.

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
ST	State-level FIPS code	SVI	FIPS	In Excel, from Tract-level FIPS code, LEFT (FIPS, 2)		
STATE	State name	S0601	NAME	In Excel, use DATA|Text to Columns to extract state name		GEO.display-label
ST_ABBR	State abbreviation	N/A	N/A	Joined from Esri state boundary shapefile		
STCNTY	County-level FIPS code	SVI	FIPS	In Excel, from Tract-level FIPS code, LEFT (FIPS, 5)	In the county-level SVI database, the 5-digit STCNTY field is the FIPS field, used for joins.	GEO.id
COUNTY	County name	S0601	NAME	In Excel, use DATA| Text to Columns to extract county name		GEO.display-label
FIPS	Tract-level FIPS code	S0601	GEO_ID	In Excel, RIGHT (GEO.id, 11)		
LOCATION	Text description of tract, county, state	S0601	NAME			GEO.display-label
AREA_SQMI	Tract area in square miles	Census Cartographic Boundary File - U.S. Tracts 2018 500K	ALAND * 3.86102e-7	Conversion from square meters to square miles		
E_TOTPOP	Population estimate, 2014-2018 ACS	S0601	S0601_C01_001E			HC01_EST_VC01
M_TOTPOP	Population estimate MOE, 2014-2018 ACS	S0601	S0601_C01_001M			HC01_MOE_VC01

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
E_HU	Housing units estimate, 2014-2018 ACS	DP04	DP04_0001E			HC01_VC03
M_HU	Housing units estimate MOE, 2014-2018 ACS	DP04	DP04_0001M			HC02_VC03
E_HH	Households estimate, 2014-2018 ACS	DP02	DP02_0001E			HC01_VC03
M_HH	Households estimate MOE, 2014-2018 ACS	DP02	DP02_0001M			HC02_VC03
E_POV	Persons below poverty estimate, 2014-2018 ACS	B17001	B17001_002E			HD01_VD02
M_POV	Persons below poverty estimate MOE, 2014-2018 ACS	B17001	B17001_002M			HD02_VD02
E_UNEMP	Civilian (age 16+) unemployed estimate, 2014-2018 ACS	DP03	DP03_0005E			HC01_VC07
M_UNEMP	Civilian (age 16+) unemployed estimate MOE, 2014-2018 ACS	DP03	DP03_0005M			HC02_VC07
E_PCI	Per capita income estimate, 2014-2018 ACS	B19301	B19301_001E		Fewer rows than other variables - joined to Census 2016 tracts. Contains null cells (i.e. -999).	HD01_VD01
M_PCI	Per capita income estimate MOE, 2014-2018 ACS	B19301	B19301_001M		Fewer rows than other variables - joined to Census 2016 tracts	HD02_VD01
E_NOHSDP	Persons (age 25+) with no high school diploma estimate, 2014-2018 ACS	B06009	B06009_002E			HD01_VD03
M_NOHSDP	Persons (age 25+) with no high school diploma estimate MOE, 2014-2018 ACS	B06009	B06009_002M			HD02_VD03

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
E_AGE65	Persons aged 65 and older estimate, 2014-2018 ACS	S0101	S0101_C01_030E			HC01_EST_VC32
M_AGE65	Persons aged 65 and older estimate MOE, 2014-2018 ACS	S0101	S0101_C01_030M			HC01_MOE_VC32
E_AGE17	Persons aged 17 and younger estimate, 2014-2018 ACS	B09001	B09001_001E			HD01_VD01
M_AGE17	Persons aged 17 and younger estimate MOE, 2014-2018 ACS	B09001	B09001_001E			HD02_VD01
E_DISABL	Civilian noninstitutionalized population with a disability estimate, 2014-2018 ACS	DP02	DP02_0071E			HC01_VC106
M_DISABL	Civilian noninstitutionalized population with a disability estimate MOE, 2014-2018 ACS	DP02	DP02_0071M			HC02_VC106
E_SNGPNT	Single parent household with children under 18 estimate, 2014-2018 ACS	DP02	DP02_0007E+ DP02_0009E	Estimate male householder, no wife present, family - With own children under 18 years + Estimate female householder, no husband present, family - With own children under 18 years		HC01_VC09 + HC01_VC11
M_SNGPNT	Single parent household with children under 18 estimate MOE, 2014-2018 ACS	DP02	SQRT (DP02_0007M^2 + DP02_0009M^2)	SQRT (MOE male householder, no wife present, family - With own children under 18 years^2 + MOE female householder, no husband present, family - With own children under 18 years^2)		SQRT(HC02_VC09^2 + HC02_VC11^2)

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
E_MINRTY	Minority (all persons except white, non-Hispanic) estimate, 2014-2018 ACS	B01001H	E_TOTPOP - B01001H_001E	Estimate total population – white, Non-Hispanic population		E_TOTPOP - HD01_VD01
M_MINRTY	Minority (all persons except white, non-Hispanic) estimate MOE, 2014-2018 ACS	B01001H	SQRT(M_TOTPOP^2 + B01001H_001M ^2)	SQRT (MOE total population^2 + MOE white, non-Hispanic^2)		SQRT(M_TOTPOP^2 + HD02_VD01^2)
E_LIMENG	Persons (age 5+) who speak English "less than well" estimate, 2014-2018 ACS	B16005	B16005_007E + B16005_008E + B16005_012E + B16005_013E + B16005_017E + B16005_018E + B16005_022E + B16005_023E + B16005_029E + B16005_030E + B16005_034E + B16005_035E + B16005_039E + B16005_040E + B16005_044E + B16005_045E +	Estimate; Native: - Speak Spanish: - Speak English "not well" + Estimate; Native: - Speak Spanish: - Speak English "not at all" + Estimate; Native: - Speak other Indo-European languages: - Speak English "not well" + Estimate; Native: - Speak other Indo-European languages: - Speak English "not at all" + Estimate; Native: - Speak Asian and Pacific Island languages: - Speak English "not well" + Estimate; Native: - Speak Asian and Pacific Island languages: - Speak English "not at all" + Estimate; Native: - Speak other languages: - Speak English "not well" + Estimate; Native: - Speak other languages: - Speak English "not at all" + Estimate; Foreign born: - Speak Spanish: - Speak English "not well" + Estimate; Foreign born: - Speak Spanish: - Speak English "not at all" + Estimate; Foreign born: - Speak other Indo-European languages: - Speak English "not well" + Estimate; Foreign born: - Speak other Indo-European languages: - Speak English "not at all" + Estimate; Foreign born: - Speak Asian and Pacific Island languages: - Speak English "not well" + Estimate; Foreign born: - Speak Asian and Pacific Island languages: - Speak English "not at all" + Estimate; Foreign born: - Speak other languages: - Speak English "not well" + Estimate; Foreign born: - Speak other languages: - Speak English "not at all"		HD01_VD07 + HD01_VD08 + HD01_VD12 + HD01_VD13 + HD01_VD17 + HD01_VD18 + HD01_VD22 + HD01_VD23 + HD01_VD29 + HD01_VD30 + HD01_VD34 + HD01_VD35 + HD01_VD39 + HD01_VD40 + HD01_VD44 + HD01_VD45

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
M_LIMENG	Persons (age 5+) who speak English "less than well" estimate MOE, 2014-2018 ACS	B16005	SQRT(B16005_007M ^2 + B16005_008M ^2 + B16005_012M ^2 + B16005_013M ^2 + B16005_017M ^2 + B16005_018M ^2 + B16005_022M ^2 + B16005_023M ^2 + B16005_029M ^2 + B16005_030M ^2 + B16005_034M ^2 + B16005_035M ^2 + B16005_039M ^2 + B16005_040M ^2 + B16005_044M ^2 + B16005_045M ^2)	SQRT (MOE Native: - Speak Spanish: - Speak English "not well"^2 + MOE Native: - Speak Spanish: - Speak English "not at all"^2 + MOE Native: - Speak other Indo-European languages: - Speak English "not well"^2 + MOE Native: - Speak other Indo-European languages: - Speak English "not at all"^2 + MOE Native: - Speak Asian and Pacific Island languages: - Speak English "not well"^2 + MOE Native: - Speak Asian and Pacific Island languages: - Speak English "not at all"^2 + MOE Native: - Speak other languages: - Speak English "not well"^2 + MOE Native: - Speak other languages: - Speak English "not at all"^2 + MOE Foreign born: - Speak Spanish: - Speak English "not well"^2 + MOE Foreign born: - Speak Spanish: - Speak English "not at all"^2 + MOE Foreign born: - Speak other Indo-European languages: - Speak English "not well"^2 + MOE Foreign born: - Speak other Indo-European languages: - Speak English "not at all"^2 + MOE Foreign born: - Speak Asian and Pacific Island languages: - Speak English "not well"^2 + MOE Foreign born: - Speak Asian and Pacific Island languages: - Speak English "not at all"^2 + MOE Foreign born: - Speak other languages: - Speak English "not well"^2 + MOE Foreign born: - Speak other languages: - Speak English "not at all"^2)		SQRT(HD02_VD07^2 + HD02_VD08^2 + HD02_VD12^2 + HD02_VD13^2 + HD02_VD17^2 + HD02_VD18^2 + HD02_VD22^2 + HD02_VD23^2 + HD02_VD29^2 + HD02_VD30^2 + HD02_VD34^2 + HD02_VD35^2 + HD02_VD39^2 + HD02_VD40^2 + HD02_VD44^2 + HD02_VD45^2)
E_MUNIT	Housing in structures with 10 or more units estimate, 2014-2018 ACS	DP04	DP04_0012E + DP04_0013E	Estimate; UNITS IN STRUCTURE - Total housing units - 10 to 19 units + Estimate; UNITS IN STRUCTURE - Total housing units - 20 or more units		HC01_VC19 + HC01_VC20
M_MUNIT	Housing in structures with 10 or more units estimate MOE, 2014-2018 ACS	DP04	SQRT(DP04_0012M ^2 + DP04_0013M ^2)	SQRT (MOE UNITS IN STRUCTURE - Total housing units - 10 to 19 units^2 + MOE; UNITS IN STRUCTURE - Total housing units - 20 or more units^2)		SQRT(HC02_VC19^2 + HC02_VC20^2)
E_MOBILE	Mobile homes estimate, 2014-2018 ACS	DP04	DP04_0014E			HC01_VC21
M_MOBILE	Mobile homes estimate MOE, 2014-2018 ACS	DP04	DP04_0014M			HC02_VC21

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
E_CROWD	At household level (occupied housing units), more people than rooms estimate, 2014-2018 ACS	DP04	DP04_0078E + DP04_0079E	Estimate; OCCUPANTS PER ROOM - Occupied housing units - 1.01 to 1.50 + Estimate; OCCUPANTS PER ROOM - Occupied housing units - 1.51 or more		HC01_VC114 + HC01_VC115
M_CROWD	At household level (occupied housing units), more people than rooms estimate MOE, 2014-2018 ACS	DP04	SQRT(DP04_0078M ^2 + DP04_0079M^2)	SQRT (MOE OCCUPANTS PER ROOM - Occupied housing units - 1.01 to 1.50^2+ MOE OCCUPANTS PER ROOM - Occupied housing units - 1.51 or more^2)		SQRT(HC02_VC114^2 + HC02_VC115^2)
E_NOVEH	Households with no vehicle available estimate, 2014-2018 ACS	DP04	DP04_0058E			HC01_VC85
M_NOVEH	Households with no vehicle available estimate MOE, 2014-2018 ACS	DP04	DP04_0058M			HC02_VC85
E_GROUPQ	Persons in institutionalized group quarters estimate, 2014-2018 ACS	B26001	B26001_001E			HD01_VD01
M_GROUPQ	Persons in institutionalized group quarters estimate MOE, 2014-2018 ACS	B26001	B26001_001M			HD02_VD01
EP_POV	Percentage of persons below poverty estimate	S0601	S0601_C01_049E			HC01_EST_VC67
MP_POV	Percentage of persons below poverty estimate MOE	S0601	S0601_C01_049M			HC01_MOE_VC67
EP_UNEMP	Unemployment Rate estimate	DP03	DP03_0009PE		The ACS calculated Unemployment Rate = E_UNEMP/civilian population age 16+ in the labor force	HC03_VC12

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
MP_UNEMP	Unemployment Rate estimate MOE	DP03	DP03_0009PM			HC04_VC12
EP_PCI	Per capita income estimate, 2014-2018 ACS	B19301	B19301_001E		Value is the same as E_PCI	HD01_VD01
MP_PCI	Per capita income estimate MOE, 2014-2018 ACS	B19301	B19301_001M		Value is the same as M_PCI	HD02_VD01
EP_NOHSDP	Percentage of persons with no high school diploma (age 25+) estimate	S0601	S0601_C01_033E			HC01_EST_VC46
MP_NOHSDP	Percentage of persons with no high school diploma (25+) estimate MOE	S0601	S0601_C01_033M			HC01_MOE_VC46
EP_AGE65	Percentage of persons aged 65 and older estimate, 2014-2018 ACS	S0101	S0101_C02_030E			HC01_EST_VC31
MP_AGE65	Percentage of persons aged 65 and older estimate MOE, 2014-2018 ACS	S0101	S0101_C02_030M			HC01_MOE_VC31
EP_AGE17	Percentage of persons aged 17 and younger estimate, 2014-2018 ACS	SVI	(E_AGE17 / E_TOTPOP)*100	(Persons aged 17 and younger estimate / Total population estimate) * 100	This calculation resulted in some division by 0 errors in cases where E_TOTPOP equals 0. These rows were revised with the estimated proportions set to 0 and their corresponding MOEs set to -999.	

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
MP_AGE17	Percentage of persons aged 17 and younger estimate MOE, 2014-2018 ACS	SVI	((SQRT(M_AGE17^2-((EP_AGE17/100)^2*M_TOTPOP^2)))/E_TOTPOP)*100	((SQRT(MOE Population under 18 years^2 - (Estimated proportion of persons aged 17 and younger^2 * MOE Total Population^2))) / Total population estimate) * 100	Some MOE calculations resulted in errors because the value under the square root was negative. For these rows, as the Census Bureau suggests, we used the formula for derived ratios, as opposed to that for derived proportions. Instead of the subtraction in the standard formula, we add. See *A Compass for Understanding and Using American Community Survey Data*, page A-15 (https://www.census.gov/content/dam/Census/library/publications/2008/acs/ACSGeneralHandbook.pdf).	
EP_DISABL	Percentage of civilian noninstitutionalized population with a disability estimate, 2014-2018 ACS	DP02	DP02_0071PE			HC03_VC106
MP_DISABL	Percentage of civilian noninstitutionalized population with a disability estimate MOE, 2014-2018 ACS	DP02	DP02_0071PM			HC04_VC106
EP_SNGPNT	Percentage of single parent households with children under 18 estimate, 2014-2018 ACS	SVI	(E_SNGPNT / E_HH) * 100	(Single parent household with children under 18 estimate / Households estimate) * 100	This calculation resulted in some division by 0 errors in cases where E_HH equals 0. These rows were revised with the estimated proportions set to 0 and their corresponding MOEs set to -999.	

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
MP_SNGPNT	Percentage of single parent households with children under 18 estimate MOE, 2014-2018 ACS	SVI	((SQRT(M_SNGPNT^2-((EP_SNGPNT/100)^2*M_HH^2)))/E_HH)*100	((SQRT(MOE Single parent households^2 - (Estimated proportion single parent households^2 * MOE Households^2))) / Households estimate) * 100	Some MOE calculations resulted in errors because the value under the square root was negative. For these rows, as the Census Bureau suggests, we used the formula for derived ratios, as opposed to that for derived proportions. Instead of the subtraction in the standard formula, we add. See *A Compass for Understanding and Using American Community Survey Data*, page A-15 (https://www.census.gov/content/dam/Census/library/publications/2008/acs/ACSGeneralHandbook.pdf).	
EP_MINRTY	Percentage minority (all persons except white, non-Hispanic) estimate, 2014-2018 ACS	SVI	(E_MINRTY/E_TOTPOP)*100	(Minority estimate / Total population estimate) * 100	This calculation resulted in some division by 0 errors in cases where E_HH equals 0. These rows were revised with the estimated proportions set to 0 and their corresponding MOEs set to -999.	
MP_MINRTY	Percentage minority (all persons except white, non-Hispanic) estimate MOE, 2014-2018 ACS	SVI	((SQRT(M_MINRTY^2-((EP_MINRTY/100)^2*M_TOTPOP^2)))/E_TOTPOP)*100	((SQRT(MOE Minority^2 - (Estimated proportion minority^2 * MOE Total population^2))) / Total population estimate) * 100		

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
EP_LIMENG	Percentage of persons (age 5+) who speak English "less than well" estimate, 2014-2018 ACS	SVI and B16005	(E_LIMENG/B16005_001E)*100	(Persons who speak English "less than well" estimate / Population age 5 and over estimate) * 100	This calculation resulted in some division by 0 errors in cases where total population age 5 and over equals 0. These rows were revised with the estimated proportions set to 0 and their corresponding MOEs set to -999.	(E_LIMENG/HD01_VD01)*100
MP_LIMENG	Percentage of persons (age 5+) who speak English "less than well" estimate MOE, 2014-2018 ACS	SVI and B16005	((SQRT(M_LIMENG^2 - ((EP_LIMENG/100)^2 * B16005_001M^2)))/ B16005_001E)*100	((SQRT(MOE Persons who speak English less than well^2 - (Estimated proportion persons who speak English less than well^2 * MOE population age 5 and over^2))) / Population age 5 and over estimate) * 100	Some MOE calculations resulted in errors because the value under the square root was negative. For these rows, as the Census Bureau suggests, we used the formula for derived ratios, as opposed to that for derived proportions. Instead of the subtraction in the standard formula, we add. See *A Compass for Understanding and Using American Community Survey Data*, page A-15 (https://www.census.gov/content/dam/Census/library/publications/2008/acs/ACSGeneralHandbook.pdf).	((SQRT(M_LIMENG^2 - ((EP_LIMENG/100)^2 *HD02_VD01^2)))/ HD01_VD01)*100
EP_MUNIT	Percentage of housing in structures with 10 or more units estimate	SVI	(E_MUNIT/E_HU)*100	(Housing in structures with 10 or more units estimate / Housing units estimate)*100	This calculation resulted in some division by 0 errors in cases where E_HU equals 0. These rows were revised with the estimated proportions set to 0 and their corresponding MOEs set to -999.	

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
MP_MUNIT	Percentage of housing in structures with 10 or more units estimate MOE	SVI	((SQRT(M_MUNIT^2-((EP_MUNIT/100)^2*M_HU^2)))/E_HU)*100	((SQRT(MOE Housing in structures with 10 or more units^2 - (Estimated proportion housing in structures with 10 or more units^2 * MOE Housing units^2))) / Housing units estimate) * 100	Some MOE calculations resulted in errors because the value under the square root was negative. For these rows, as the Census Bureau suggests, we used the formula for derived ratios, as opposed to that for derived proportions. Instead of the subtraction in the standard formula, we add. See *A Compass for Understanding and Using American Community Survey Data*, page A-15 (https://www.census.gov/content/dam/Census/library/publications/2008/acs/ACSGeneralHandbook.pdf).	
EP_MOBILE	Percentage of mobile homes estimate	DP04	DP04_0014PE			HC03_VC21
MP_MOBILE	Percentage of mobile homes estimate MOE	DP04	DP04_0014PM			HC04_VC21
EP_CROWD	Percentage of occupied housing units with more people than rooms estimate	SVI and DP04	(E_CROWD/DP04_0002E)*100	(Occupied housing units with more people than rooms estimate / Occupied housing units estimate)*100	This calculation resulted in some division by 0 errors in cases where HC01_VC04 equals 0. These rows were revised with the estimated proportions set to 0 and their corresponding MOEs set to -999.	E_CROWD/HC01_VC04)*100

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
MP_CROWD	Percentage of occupied housing units with more people than rooms estimate MOE	SVI and DP04	((SQRT(M_CROWD^2 - ((EP_CROWD/100)^2 * DP04_0002M^2)))/ DP04_0002E)*100	((SQRT(MOE Occupied housing units with more people than rooms^2 - (Estimated proportion of occupied housing units with more people than rooms^2 * MOE Occupied housing units^2))) /Occupied housing units estimate) * 100	Some MOE calculations resulted in errors because the value under the square root was negative. For these rows, as the Census Bureau suggests, we used the formula for derived ratios, as opposed to that for derived proportions. Instead of the subtraction in the standard formula, we add. See *A Compass for Understanding and Using American Community Survey Data*, page A-15 (https://www.census.gov/content/dam/Census/library/publications/2008/acs/ACSGeneralHandbook.pdf).	((SQRT(M_CROWD^2 - ((EP_CROWD/100)^2 *HC02_VC04^2)))/ HC01_VC04)*100
EP_NOVEH	Percentage of households with no vehicle available estimate	DP04	DP04_0058PE			HC03_VC85
MP_NOVEH	Percentage of households with no vehicle available estimate MOE	DP04	DP04_0058PM			HC04_VC85
EP_GROUPQ	Percentage of persons in institutionalized group quarters estimate, 2014-2018 ACS	SVI	(E_GROUPQ/E_TOTPOP)*100	(Persons in group quarters estimate / Total population estimate) * 100	This calculation resulted in some division by 0 errors in cases where E_TOTPOP equals 0. These rows were revised with the estimated proportions set to 0 and their corresponding MOEs set to -999.	

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
MP_GROUPQ	Percentage of persons in institutionalized group quarters estimate MOE, 2014-2018 ACS	SVI	((SQRT(M_GROUPQ^2-((EP_GROUPQ/100)^2*M_TOTPOP^2)))/E_TOTPOP)*100	((SQRT(MOE Persons in group quarters^2 - (Estimated proportion persons in group quarters^2 * MOE Total population^2))) / Total population estimate) * 100	Some MOE calculations resulted in errors because the value under the square root was negative. For these rows, as the Census Bureau suggests, we used the formula for derived ratios, as opposed to that for derived proportions. Instead of the subtraction in the standard formula, we add. See *A Compass for Understanding and Using American Community Survey Data*, page A-15 (https://www.census.gov/content/dam/Census/library/publications/2008/acs/ACSGeneralHandbook.pdf).	
EPL_POV	Percentile Percentage of persons below poverty estimate	SVI	In Excel: PERCENTRANK.INC on EP_POV array with 4 significant digits			
EPL_UNEMP	Percentile Percentage of civilian (age 16+) unemployed estimate	SVI	In Excel: PERCENTRANK.INC on EP_UNEMP array with 4 significant digits			
EPL_PCI	Percentile per capita income estimate	SVI	In Excel: 1-(PERCENTRANK.INC on EP_PCI array with 4 significant digits)		Per capita income necessarily reversed as high income equates with low vulnerability and vice versa.	
EPL_NOHSDP	Percentile Percentage of persons with no high school diploma (age 25+) estimate	SVI	In Excel: PERCENTRANK.INC on EP_NOHSDP array with 4 significant digits			

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
SPL_THEME1	Sum of series for Socioeconomic theme	SVI	EPL_POV + EPL_UNEMP + EPL_PCI + EPL_NOHSDP		Null values (-999) removed before calculating output sum. Output for sums with null values in the same row set to -999.	
RPL_THEME1	Percentile ranking for Socioeconomic theme summary	SVI	In Excel: PERCENTRANK.INC on SPL_THEME1 array with 4 significant digits		Null values (-999) removed from the array before calculating output percentile ranks. Output for -999 input cells set to -999.	
EPL_AGE65	Percentile percentage of persons aged 65 and older estimate	SVI	In Excel: PERCENTRANK.INC on EP_AGE65 array with 4 significant digits			
EPL_AGE17	Percentile percentage of persons aged 17 and younger estimate	SVI	In Excel: PERCENTRANK.INC on EP_AGE17 array with 4 significant digits			
EPL_DISABL	Percentile percentage of civilian noninstitutionalized population with a disability estimate	SVI	In Excel: PERCENTRANK.INC on EP_DISABL array with 4 significant digits			
EPL_SNGPNT	Percentile percentage of single parent households with children under 18 estimate	SVI	In Excel: PERCENTRANK.INC on EP_SNGPNT array with 4 significant digits			
SPL_THEME2	Sum of series for Household Composition theme	SVI	EPL_AGE65 + EPL_AGE17 + EPL_DISABL + EPL_SNGPNT			
RPL_THEME2	Percentile ranking for Household Composition theme summary	SVI	In Excel: PERCENTRANK.INC on SPL_THEME2 array with 4 significant digits			

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
EPL_MINRTY	Percentile percentage minority (all persons except white, non-Hispanic) estimate	SVI	In Excel: PERCENTRANK.INC on EP_MINRTY array with 4 significant digits			
EPL_LIMENG	Percentile percentage of persons (age 5+) who speak English "less than well" estimate	SVI	In Excel: PERCENTRANK.INC on EP_LIMENG array with 4 significant digits			
SPL_THEME3	Sum of series for Minority Status/Language theme	SVI	EPL_MINRTY + EPL_LIMENG			
RPL_THEME3	Percentile ranking for Minority Status/Language theme	SVI	In Excel: PERCENTRANK.INC on SPL_THEME3 array with 4 significant digits			
EPL_MUNIT	Percentile percentage housing in structures with 10 or more units estimate	SVI	In Excel: PERCENTRANK.INC on EP_MUNIT array with 4 significant digits			
EPL_MOBILE	Percentile percentage mobile homes estimate	SVI	In Excel: PERCENTRANK.INC on EP_MOBILE array with 4 significant digits			
EPL_CROWD	Percentile percentage households with more people than rooms estimate	SVI	In Excel: PERCENTRANK.INC on EP_CROWD array with 4 significant digits			
EPL_NOVEH	Percentile percentage households with no vehicle available estimate	SVI	In Excel: PERCENTRANK.INC on EP_NOVEH array with 4 significant digits			

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
EPL_GROUPQ	Percentile percentage of persons in institutionalized group quarters estimate	SVI	In Excel: PERCENTRANK.INC on EP_GROUPQ array with 4 significant digits			
SPL_THEME4	Sum of series for Housing Type/ Transportation theme	SVI	EPL_MUNIT + EPL_MOBIL + EPL_CROWD + EPL_NOVEH + EPL_GROUPQ			
RPL_THEME4	Percentile ranking for Housing Type/ Transportation theme	SVI	In Excel: PERCENTRANK.INC on SPL_THEME4 array with 4 significant digits			
SPL_THEMES	Sum of series themes	SVI	SPL_THEME1 + SPL_THEME2 + SPL_THEME3 + SPL_THEME4		Null values (-999) removed before calculating output sum. Output for sums with null values in the same row set to -999.	
RPL_THEMES	Overall percentile ranking	SVI	In Excel: PERCENTRANK.INC on SPL_THEMES array with 4 significant digits		Null values (-999) removed from the array before calculating output percentile ranks. Output for -999 input cells set to -999.	

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
F_POV	Flag - the percentage of persons in poverty is in the 90th percentile (1 = yes, 0 = no)	SVI	EPL_POV >= 0.90			
F_UNEMP	Flag - the percentage of civilian unemployed is in the 90th percentile (1 = yes, 0 = no)	SVI	EPL_UNEMP >= 0.90			
F_PCI	Flag - per capita income is in the 90th percentile (1 = yes, 0 = no)	SVI	EPL_PCI >= 0.90		Output for -999 input cells set to -999.	
F_NOHSDP	Flag - the percentage of persons with no high school diploma is in the 90th percentile (1 = yes, 0 = no)	SVI	EPL_NOHSDIP >= 0.90			
F_THEME1	Sum of flags for Socioeconomic Status theme	SVI	F_POV + F_UNEMP + F_PCI + F_NOHSDP		Null values (-999) removed before calculating output sum. Output for sums with null values in the same row set to -999.	
F_AGE65	Flag - the percentage of persons aged 65 and older is in the 90th percentile (1 = yes, 0 = no)	SVI	EPL_AGE65 >= 0.90			
F_AGE17	Flag - the percentage of persons aged 17 and younger is in the 90th percentile (1 = yes, 0 = no)	SVI	EPL_AGE17 >= 0.90			

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
F_DISABL	Flag - the percentage of persons with a disability is in the 90th percentile (1 = yes, 0 = no)	SVI	EPL_DISABL >= 0.90			
F_SNGPNT	Flag - the percentage of single parent households is in the 90th percentile (1 = yes, 0 = no)	SVI	EPL_SNGPNT >= 0.90			
F_THEME2	Sum of flags for Household Composition theme	SVI	F_AGE65 + F_AGE17 + F_DISABL + F_SNGPNT			
F_MINRTY	Flag - the percentage of minority is in the 90th percentile (1 = yes, 0 = no)	SVI	EPL_MINRTY >= 0.90			
F_LIMENG	Flag - the percentage those with limited English is in the 90th percentile (1 = yes, 0 = no)	SVI	EPL_LIMENG >= 0.90			
F_THEME3	Sum of flags for Minority Status/Language theme	SVI	F_MINRTY + F_LIMENG			
F_MUNIT	Flag - the percentage of households in multi-unit housing is in the 90th percentile (1 = yes, 0 = no)	SVI	EPL_MUNIT >= 0.90			
F_MOBILE	Flag - the percentage of mobile homes is in the 90th percentile (1 = yes, 0 = no)	SVI	EPL_MOBILE >= 0.90			

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
F_CROWD	Flag - the percentage of crowded households is in the 90th percentile (1 = yes, 0 = no)	SVI	EPL_CROWD >= 0.90			
F_NOVEH	Flag - the percentage of households with no vehicles is in the 90th percentile (1 = yes, 0 = no)	SVI	EPL_NOVEH >= 0.90			
F_GROUPQ	Flag - the percentage of persons in institutionalized group quarters is in the 90th percentile (1 = yes, 0 = no)	SVI	EPL_GROUPQ >= 0.90			
F_THEME4	Sum of flags for Housing Type/ Transportation theme	SVI	F_MUNIT + F_MOBILE + F_CROWD + F_NOVEH + F_GROUPQ			
F_TOTAL	Sum of flags for the four themes	SVI	F_THEME1 + F_THEME2 + F_THEME3 + F_THEME4		Null values (-999) removed before calculating output sum. Output for sums with null values in the same row set to -999.	

2018 VARIABLE NAME	2018 DESCRIPTION	CENSUS or SVI TABLE(S)	2018 TABLE FIELD CALCULATION	CALCULATION DESCRIPTION	NOTES	2016 TABLE FIELD CALCULATION if changed
E_UNINSUR	Adjunct variable - Uninsured in the total civilian noninstitutionalized population estimate, 2014-2018 ACS	S2701	S2701_C04_001E			HC04_EST_VC01
M_UNINSUR	Adjunct variable - Uninsured in the total civilian noninstitutionalized population estimate MOE, 2014-2018 ACS	S2701	S2701_C04_001M			HC04_MOE_VC01
EP_UNINSUR	Adjunct variable - Percentage uninsured in the total civilian noninstitutionalized population estimate, 2014-2018 ACS	S2701	S2701_C05_001E			HC05_EST_VC01
MP_UNINSUR	Adjunct variable - Percentage uninsured in the total civilian noninstitutionalized population estimate MOE, 2014-2018 ACS	S2701	S2701_C05_001M			HC05_MOE_VC01
E_DAYPOP	Adjunct variable - Estimated daytime population, LandScan 2018	N/A		Derived from LandScan 2018 - http://web.ornl.gov/sci/landscan/index.shtml. We followed ORNL's instructions for processing in ArcGIS, loading the LandScan grid first and maintaining WGS84 projection parameters. Using Spatial Analyst, we ran the Zonal Statistics as Table function to sum estimated daytime population for each LandScan raster cell to obtain an estimated daytime population for each SVI 2018 census tract.	Tracts having no LandScan cells that overlay have been assigned null values (i.e. -999). LandScan daytime populations are unavailable for Puerto Rico, therefore all Puerto Rico tracts and municipios are assigned -999.	

APPENDIX C: NTTFI TRANSPORTATION NETWORK

Indian Reservation Roads Program
Miles of Road by Class and Surface Type
Present System
FY 2021 Inventory

P - Northwest
P10 - Puget Sound
P10115 - Puyallup

	Existing Roads & Trails (CN 0 1 2 or 3) Classified by Surface Type								New Roads (CN 4) Classified by Future Surface Type				Total (mi)	Bridges	
Class*	Proposed** (0)	Earth (1)	Gravel (3)	< 2 inch (4)	> 2 inch (5)	Concrete (6)	Trail (9)	None (null)	Earth (E)	Gravel (G)	Paved (P)	None (null)	CN 0 1 2 3 4	Count	Length (ft)
1 - Major Arterial	0.0	0.0	0.0	0.0	34.8	6.3	0.0	0.0	0.0	0.0	0.0	0.0	41.1	39	23,545
2 - Rural Minor Arterial	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
3 - City Local	0.0	0.2	2.5	42.4	79.2	0.7	0.0	0.0	0.4	0.0	0.0	0.0	125.4	3	2,288
4 - Rural Major Collector	0.0	0.0	0.0	1.1	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0	0
5 - Rural Local	0.0	0.3	78.5	5.0	9.2	0.0	0.0	0.0	0.0	1.0	0.0	0.0	94.0	11	1,095
6 - City Minor Arterial	0.0	0.0	0.0	2.2	38.6	0.0	0.0	0.0	0.0	0.7	0.0	0.0	41.5	7	849
7 - City Collector	0.0	0.0	0.0	4.1	18.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.5	1	160
8 - Trails	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0	0
9 - Other	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.5	0	0
10 - Airstrips	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
null - No Class Specified	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0	0
Total:	0.0	1.9	81.9	54.8	182.2	7.0	0.0	0.0	0.4	1.7	0.0	0.6	330.5	61	27,937

*Class 11 (overlap) is excluded.

** Surface type is 0 (proposed) and CN not 4 (new construction).

Indian Reservation Roads Program
Miles of Road by Class and Organizational Responsibility
Present System
FY 2021 Inventory

P - Northwest
P10 - Puget Sound
P10115 - Puyallup

Ownership	Mileage (mi) Classified According to Class Code with class 11 (overlap) excluded*											Total Mileage (mi)		
	Major Arterial (1)	Rural Minor Arterial (2)	City Local (3)	Rural Major Collector (4)	Rural Local (5)	City Minor Arterial (6)	City Collector (7)	Trail (8)	Other Trans Fac (9)	Airstrip (10)	None (null)	Classes 1 2 3 4 5 6 7 8	Classes 9 10 none	Classes 1 2 3 4 5 6 7 5 9 10 none
1 - BIA	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.7
2 - Tribe	0.0	0.0	0.9	0.0	5.6	0.0	0.0	1.4	0.5	0.0	0.0	7.9	0.5	8.4
3 - State	17.5	0.0	0.6	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	21.1	0.0	21.1
4 - Urban	18.0	0.0	122.2	2.1	2.5	30.3	15.6	0.0	0.0	0.0	1.0	190.7	1.0	191.7
5 - County And Township	5.6	0.0	1.0	0.0	9.9	8.2	6.9	0.0	0.0	0.0	0.0	31.6	0.0	31.6
6 - Other BIA Offices	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7 - Other Federal	0.0	0.0	0.0	0.0	25.5	0.0	0.0	0.0	1.0	0.0	0.0	25.5	1.0	26.5
8 - Other	0.0	0.0	0.0	0.0	50.5	0.0	0.0	0.0	0.0	0.0	0.0	50.5	0.0	50.5
Total:	41.1	0.0	125.4	2.1	94.0	41.5	22.5	1.4	1.5	0.0	1.0	328.0	2.5	330.5

*Mileage includes proposed construction (CN=4).

Indian Reservation Roads Program
Miles of Road by Organizational Responsibility and Surface Type
Present System
FY 2021 Inventory

P - Northwest
P10 - Puget Sound
P10115 - Puyallup

	Mileage* (mi) with CN of 0, 1, 2, or 3 Classified by Existing Surface Type Code								Mileage* (mi) with CN = 4 Classified by Future Surface Type Code				Total (mi) CN 0 1 2 3 4	Bridges	
Ownership	Proposed** (0)	Earth (1)	Gravel (3)	< 2 inch (4)	> 2 inch (5)	Concrete (6)	Trail (9)	None (null)	Earth (E)	Gravel (G)	Paved (P)	None (null)		Count	Length (ft)
2 - Tribe	0.0	1.9	4.8	0.7	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	8.4	1	70.0
8 - Other	0.0	0.0	50.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	50.5	3	212.0
1 - BIA	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0	0.0
3 - State	0.0	0.0	0.0	0.0	14.8	6.3	0.0	0.0	0.0	0.0	0.0	0.0	21.1	22	17,254.0
4 - Urban	0.0	0.0	2.6	48.8	139.1	0.7	0.0	0.0	0.4	0.1	0.0	0.0	191.7	19	8,422.0
6 - Other BIA Offices	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0
5 - County And Township	0.0	0.0	7.1	5.3	18.5	0.0	0.0	0.0	0.0	0.7	0.0	0.0	31.6	9	1,221.0
7 - Other Federal	0.0	0.0	17.3	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	26.5	7	758.0
Total:	0.0	1.9	81.9	54.8	182.2	7.0	0.0	0.0	0.4	1.7	0.0	0.6	330.5	61	27,937.0

*All mileage in OFFICIAL records excep for class 11 (overlap).
**This column contains mileage where the surface type is 0 (proposed) but the construction need is not 4.