Port Gamble S'Klallam Tribe (Benjamin Harrison)

Attachments to Port Gamble S'Klallam Tribe's Comments on WRIA 15 Rulemaking

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THE SUQUAMISH TRIBE
PO Box 498 Suquamish, WA 98392-0498

April 26, 2021

Mary Verner, Water Resources Program Manager
Water Resources Program Northwest Regional Office
Washington State Department of Ecology
3190 - 160th Ave. SE, Bellevue, WA 98008

RE: WRIA 15 Watershed Restoration and Enhancement Plan

Dear Ms. Verner:

The Suquamish Tribe ("Tribe") is a federally recognized tribe and signatory to the 1855 Treaty of Point Elliott within which the Tribe reserved its right to take fish at all of its "usual and accustomed (U&A) fishing grounds and stations". Over appropriation of water and the cumulative impacts of water withdrawals has resulted in stream flows that continue to decline putting Treaty reserved fishing rights at risk.

The Streamflow Restoration Act (RCW 90.94) passed in 2018, clarifies that local governments can issue building permits for homes that intend to use permit exempt wells for their water supply. The law directs local planning groups in 15 watersheds to develop or update plans that, if implemented, is intended to offset (or "mitigate") impacts to instream flows associated with permit-exempt domestic groundwater withdrawals; and provide a Net Ecological Benefit to the Water Resource Inventory Area (WRIA). Offsets are projects or actions intended to compensate for permit-exempt consumptive water use over the next 20 year planning period (2018-2038). NEB is the outcome that is anticipated to occur through implementation of projects and actions identified in the plan that result in a benefit greater than the impact within the planning period.

Over the past two years, the Tribe has participated in good faith in the WRIA 15 Watershed Restoration and Enhancement Planning Committee and has collaborated with other federally recognized tribes and regulatory agencies engaged in the WRIA planning effort under this law. Comments were provided to Ecology on Chapters 1-7 of the draft plan via email on 10/2/2020 and on the complete draft plan (all chapters) also via email on 1/14/2021. After participating in the WRIA 15 committee meetings, providing comments to Ecology on the draft WRIA 15 plan, and further deliberating on the potential impacts to streamflow and water resources in WRIA 15, the Tribe is opposed to plan approval. A summary of the Tribe's key concerns are provided below.

Uncertainty regarding streamflow benefits

Although many of the projects have some offset benefit there is not enough detailed analysis to accurately estimate the offset benefit amount. The law requires that plans include projects that have reasonable assurance of success and provide sufficient documentation of those methods, assumptions, data, and implementation considerations. None of the projects include estimates of the timing on when the benefit would be realized. Ecology Guidance (Final Guidance for Determining Net Ecological Benefit, GUID-2094 Water Resources Program Guidance, July 31, 2019) requires both annual and seasonal impacts of water offset projects be considered and this information is not provided. The Tribe cannot support this lack of certainty.

Over Reliance on Habitat Projects

Although the draft plan contains some great projects with specific regard to streamflow, the draft plan places an over reliance on habitat projects. For example, for West Sound there are only three water offset projects (Koch Creek regional storm water facility, Kitsap Creek outlet structure removal and KPUD stream augmentation); six habitat projects with some offset; nine habitat projects with no offset component; and three managed aquifer recharge projects. The only offset projects that may provide assurance of "in time" and "in kind" instream flow benefit are the Kitsap Creek outlet structure removal and the KPUD stream augmentation. Even then, while augmentation has its assurances it is essentially taking water from deeper aquifers to augment shallow aquifers, in other words robbing Peter to pay Paul.

Adaptive Management and Assurance of Plan Implementation

According to the law and Ecology Guidance, once a WRIA plan is finalized Ecology will cease participation and involvement with the stakeholder group. There are no assurances or requirements on local governments that the projects will be implemented. Commitments to plan implementation made by local jurisdictions are laden with funding contingencies. This is unacceptable given the juxtaposed certainty that future permit exempt wells will impact instream flows, habitat, and fish. Furthermore, many of the projects are still very conceptual and lack an assigned 'sponsor' with responsibility for project implementation and monitoring. This is not consistent with Ecology Guidance. Finally, there is no enforcement mechanism, monitoring program or robust adaptive management plan including performance standards to ensure project success or address failures to comply with the identified offsets required in the plan.

For the key reasons stated above, the Suquamish Tribe will vote against plan approval during the meeting on Monday April 26, 2021. There was a very short timeline for developing this plan which may have hampered the committees ability to incorporate elements that would better assure beneficial stream flow and habitat outcomes. We hope that Ecology will strongly consider the comments that the Tribe, other tribes and WDFW have provided throughout the process to bring forward a revised plan that will more effectively and more assuredly mitigate the impacts of permit-exempt wells on stream flows and ensure that there is water to support salmon for future generations. The Tribe extends its gratitude to Stacy Vinn-McKinstry for her diligent efforts in organizing and facilitating the WRIA 15 meetings.

Sincerely,

Leonard Forsman, Tribal Chairman
Suquamish Tribal Council

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SUQUAMISH INDIAN TRIBE
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October 13, 2023

Megan Duffy, Director
Recreation and Conservation Office
P.O. Box 40917
Olympia, WA 98504

RE: WRIA 15 Watershed Restoration and Enhancement Plan

Dear Director Duffy:

The Suquamish Indian Tribe of the Port Madison Reservation ("Tribe" or "Suquamish Tribe") is a federally recognized tribe and signatory to the 1855 Treaty of Point Elliott. In negotiating the Treaty of Point Elliott, the Tribe's U& A extends well beyond the Port Madison Indian Reservation boundaries and includes marine waters of Puget Sound from the northern tip of Vashon Island to the Fraser River in Canada, including Haro and Rosario Straits, the streams draining into the western side of Puget Sound and Hood Canal. The U& A of the Suquamish Tribe encompasses all of Kitsap County while also extending west into Jefferson County, south into Mason County, and east to King County.

The Tribe protects all its treaty-reserved resources throughout its aboriginal homeland and U&A. Water quality and quantity is critical for healthy fish populations. In the Kitsap Watershed, Water Resource Inventory Area (WRIA) 15, there are no large rivers. Streams and springs in WRIA 15 tend to be smaller and seasonal and are often dependent on ground water recharge. Over appropriation of water in WRIA 15 is resulting in depleted stream flows which do not support fish populations and jeopardizes the Tribe's treaty-reserved fishery.

Under the Treaty of Point Elliott, the Port Madison Reservation was reserved and subsequently expanded by Secretarial Order on October 21, 1864, to accommodate the Suquamish Tribe at the request of Chief Seattle. The Tribe's on-reservation *Winters* water rights are among the most senior water rights in the WRIA.

I. WRIA 15 Planning

The Streamflow Restoration Act (RCW 90.94) passed in 2018, clarifies that local governments can issue building permits for homes that intend to use permit exempt wells for their water supply. The law directs local planning groups in 15 watersheds to develop or update plans that, if implemented, are intended to offset, or "mitigate," impacts to instream flows associated with permit-exempt domestic groundwater withdrawals and provide a Net Ecological Benefit (NEB) to the WRIA. Offsets are projects or actions intended to compensate for permit-exempt consumptive water use over the next 20-year planning period (2018-2038). NEB is the outcome that is anticipated to occur through implementation of projects and actions identified in the plan that result in a water benefit greater than the impact within the planning period.

The Tribe has participated in good faith in the WRIA 15 Watershed Restoration and Enhancement Planning Committee and has collaborated with other federally recognized tribes and regulatory agencies engaged in the WRIA planning effort under this law. Comments were provided to Ecology on Chapters 1-7 of the draft plan

via email on October 2, 2020 and on the complete draft plan (all chapters) also via email on January 14, 2021. After participating in the WRIA 15 committee meetings, providing comments to Ecology on the draft WRIA 15 plan, and further deliberating on the potential impacts to streamflow and water resources in WRIA 15, the Tribe voted to oppose the plan.

Unfortunately, there have not been substantial changes to the plan and many of the Tribe's concerns remain outstanding. In addition to concurrence with many of the WRIA 15 Watershed Plan comments outlined in the Squaxin Tribal letter dated October 9, 2023, a summary of the Suquamish Tribe's key concerns are provided below.

II. Uncertainty regarding streamflow benefits

In the WRIA 15 draft plan, there are projects that have some offset benefit but there is simply not enough detailed analysis to accurately estimate the offset benefit amount. The law requires that plans include projects that have reasonable assurance of success and provide sufficient documentation of those methods, assumptions, data, and implementation considerations.

None of the projects identified in the draft plan include estimates of the timing on when the benefit would be realized. Ecology Guidance (Final Guidance for Determining Net Ecological Benefit, GUID-2094 Water Resources Program Guidance, July 31, 2019) requires both annual and seasonal impacts of water offset projects be considered and this information is not provided. The Tribe cannot support this lack of certainty.

III. Over Reliance on Habitat Projects

The draft plan does identify some projects that would be beneficial to streamflow, the draft plan relies too heavily on the habitat projects to offset exempt wells. Habitat projects do not mitigate for water withdrawal. Water must be mitigated with water.

Another issue with the draft plan is the inclusion of culvert projects. Culvert projects should be removed from the list and not be included as mitigation because the State is subject to a federal injunction requiring the replacement of fishing blocking culverts and under Washington State law fish blocking culverts and dams are illegal.

No project in the draft plan should impact or alter naturally occurring wetland habitat, resulting in rerouting of streams or include instream structures (including but not limited to flow controls, storm water facilities etc.). Alteration of flows or hydroperiod can impact water quality and other wetland components (pH, temperature, system functions, etc.). In addition, hydrologic changes can impact mammal populations in wetlands by diminishing vegetative habitat.

The habitat projects included in the draft are problematic. Many do not have accurate project cost estimates and lack detail that would assure a measurable benefit to streamflow, and some have already been completed.
For example, for West Sound there are only three water offset projects (Koch Creek regional storm water facility, Kitsap Creek outlet structure removal and KPUD stream augmentation); six habitat projects with some offset; nine habitat projects with no offset component; and three managed aquifer recharge projects. The only offset projects that may provide assurance of "in time" and "in kind" instream flow benefit are the Kitsap Creek outlet structure removal and the KPUD stream augmentation. Even then, while augmentation has its assurances it is essentially taking water from deeper aquifers to augment shallow aquifers, in other words robbing Peter to pay Paul. Due to augmentation being one of the only projects providing assurances we request that it remain as an option if needed even if not ideal.

IV. Adaptive Management and Assurance of Plan Implementation

According to the law and Ecology Guidance, once a WRIA plan is finalized Ecology will cease participation and involvement with the stakeholder group. There are no assurances or requirements that the projects will be implemented. Commitments to plan implementation made by local jurisdictions are laden with funding contingencies. This is simply unacceptable. Future permit exempt wells will impact stream flows, habitat, and fish populations and must be mitigated for within in-kind and in-time projects that are implemented. If Ecology ceases to hold local jurisdictions accountable for the projects, then the state threatens to undermine all the work that has been spent to develop the WRIA plans and to continue allowing residential permit-exempt wells.

Further, in the WRIA 15 draft plan many of the projects are conceptual and lack an assigned 'sponsor' with responsibility for project implementation and monitoring. This is not consistent with Ecology Guidance. Finally, there is no enforcement mechanism, monitoring program or robust adaptive management plan including performance standards to ensure project success or to address failures to comply with the identified offsets required in the plan.

We hope that you will strongly consider the comments that the Tribe, other tribes and WDFW have provided throughout the process to bring forward a revised plan that will more effectively and more assuredly mitigate the impacts of permit-exempt wells on stream flows and ensure that there is water to support salmon for future generations.

Sincerely,

Alison O'Sullivan

Ecosystem Recovery Program Manager

2025 State of Our Watersheds

A Report by the Treaty Tribes in Western Washington

WRIAs 1-23

Member Tribes of the Northwest Indian Fisheries Commission

2025 State of Our Watersheds Report

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Cover: Sockeye salmon. *David Herasimtschuk, Freshwaters Illustrated*

Letter from the Chair

Dear Reader,

Recently while getting a cup of coffee in the kitchen at the Northwest Indian Fisheries Commission, I was pleasantly surprised to be met by one of my young granddaughters who was visiting the office. She embodied such clear, unfettered happiness and connection. Sitting now, preparing to share the 2025 State of Our Watersheds Report, I cannot help but reflect on her, the future and our responsibilities to the next generation.

In sharing this report, last updated in 2020, I want to convey that urgency and commitment to the continued work ahead.

We must work harder, individually and collectively.

We must never forget the value of salmon to the spiritual, communal and economic vitality of tribes and the health of the watersheds that sustain us all.

We must acknowledge that our salmon continue to decline because we are continuing to allow loss of their habitat faster than we are investing in restoring it. We must reverse that trend. We must protect what sustains them. We must protect what sustains us.

We aren't managing salmon just for today. We are managing them for future generations.

If cutting harvest were the answer to restoring salmon, we would have been successful a long time ago. State and tribal fishers have reduced their chinook harvest by 60-95% since the 1980s, and continue to so, yet salmon continue to disappear. That is because restoring and protecting salmon habitat are the true keys to salmon recovery.

This update provides a watershed-by-watershed characterization of current conditions and the cumulative results of our choices. It continues to document changing environmental conditions to hold us all accountable to the truth and need for urgent action necessary to protect our region's salmon and their habitats.

Each tribal chapter focuses on habitat conditions as they relate to individual watersheds, communities, economies and treaty-reserved fishing rights. Data from tribal, federal, state and local jurisdictions and partnerships document current salmon habitat conditions, trends and shared efforts to resolve our most pressing problems. This year's report finds that explosive and sustained population growth, polluted stormwater runoff, climate change and land-use policies, rules and oversight that do not require net ecological gain continue to threaten marine and freshwater ecosystems and the water-dependent resources, economies and lifeways that rely on them.

No stocks have been delisted since the initial 1999 listing of Puget Sound Chinook, and this report's findings remain grim.

Still, there is cause for hope.

Time and time again, the salmon show a persistent resilience, with a near immediate positive response to every barrier removed and restoration project completed. We must save what is left while continuing to improve and restore what has been lost.

At the urging of tribes, Washington Gov. Jay Inslee in late 2019 directed his state natural resources agencies to develop a consistent approach for uniform, science-based riparian (streamside) habitat management to protect salmon and their habitat. Riparian habitat is among the most important for salmon for survival. Among its many benefits is shade from trees and other vegetation that helps keep water temperatures low to aid salmon survival at all life stages. We are continuing to drive that work forward. This, coupled with work to remove blocking culverts, is intended to allow access to more habitat.

Our homelands boast incredible marine and freshwater environments. They provide unparalleled cultural and economic values. Reconnecting the hydrology of our streams, rivers and estuaries and protecting them with buffers is necessary so the water we all depend on is protected everywhere on the landscape, regardless of jurisdiction or land use.

We continue to advance solutions to support salmon recovery and treaty rights protection through gw∂dzadad, our strategy for protecting and rebuilding salmon habitat, which takes its name from the Lushootseed word meaning "Teachings of our Ancestors."

Both the 2025 State of Our Watershed Report and the gw∂dzadad habitat strategy are available at *nwifc.org/sow* and *nwtreatytribes.org/habitatstrategy*.

We know the status quo isn't working when it comes to salmon recovery. We know what the science says needs to be done. We know that we must move forward together to address habitat because it is the most important action, we can take recover salmon.

We share a common connection to our future—each of us share the legacy we leave to our children and grandchildren. We must act now. My friend, and mentor Billy Frank Jr., told us a decade ago… "We are at a crossroads, and we are running out of time."

My hope is that we use this collection of stories and science from each watershed to empower the change that's needed to recover our region's salmon.

Executive Summary

Since time immemorial, the treaty Indian tribes have lived in harmony throughout the watersheds of western Washington. They have always been and continue to be leaders in the region's salmon recovery effort and conservation measures. No other people know these watersheds as well as the tribes. The tribes believe that if salmon are to survive, their partners (state and federal agencies, and local governments) must make real gains in habitat protection and restoration, today not tomorrow. We all have a stake in the protection and restoration of salmon and while habitat improvement is a major component to sustain salmon productivity, it is recognized that without protecting existing habitat functions, restoration activities cannot reverse the decline of salmon populations.

Over the past several decades, habitat loss and degradation have been explicitly identified as contributing to the steady decline in fish abundance. Habitat limiting factors include the lack of water in critical areas, a significantly altered estuary, road development, fish passage barriers blocking access to spawning and rearing habitat, aggressive logging practices, inadequate riparian buffers, incised river channels, and reduced levels of large woody debris. The treaty tribes believe salmon recovery efforts should focus on the protection and restoration of these watersheds.

The State of Our Watersheds (SOW) Report examines key indicators of habitat quality and quantity across more than 20 watersheds in western Washington that lie within tribal Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the restoration, protection and harvest of the salmon resource.

The goal of the SOW Report is to assess the health of western Washington watersheds and to gauge progress toward recovering salmon. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information on this initiative can be found at *treatyrightsatrisk.org.*

For this report, tribes focused on the portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the SOW Report is republished on a regular schedule to reflect the current habitat status and trends. The report provides both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify how regional salmon recovery plans are progressing.

Principal Findings

Fish Passage Barriers Block Vast Amounts of Habitat

Fish passage barriers are one of the main obstacles to salmon recovery. Fish must be able to swim upstream to their freshwater habitat to reproduce and back again to the ocean to survive. Fish passage barriers, such as culverts, tide gates and levees, persist in all watersheds, impacting a significant number of stream miles. Progress and commitments have been made by the state but there are serious concerns about the lack of prioritization and proper funding to accomplish the repairs within the court-ordered timeline and before the extinction of the species.

There are over 15,500 fish passage barriers culverts in the tribes' Usual and Accustomed Area: 11,623 in the Puget Sound region and 3,919 in the Pacific Coast region that have been identified by the Washington Department of Fish and Wildlife to impact migrating salmonids. While many of these barriers are owned by the state and fall under the rulings of the Culvert Case in *U.S. v. Washington*, the majority are owned by other government agencies and private landowners. These culverts continue to restrict salmon's access to habitat while the state has offered no timeline for replacement.

Climate Change Is Here—Impacting the Region's Resources

As the climate continues to change, impacts on the daily tribal way of life continue. Reductions in glaciers, sea level rise, extreme weather events and the changes in streamflow, both quantity and timing, are all signs that our climate is changing. Recent streamflow data from USGS stream gauges reveal significant seasonal deviations from historic baselines and these alterations indicate potential climate change impacts on critical freshwater ecosystem conditions.

There is an observed shift in the coastal rivers' streamflow that will have a direct impact on the salmon and steelhead populations of the area. Peak flow values are showing an increasing trend while low flows are showing a decreasing trend. This was the same observation as reported in the 2016 and 2020 SOW Reports.

As temperatures rise due to climate change, some of these glaciers are retreating or going extinct; in fact, it is projected that most Olympic Peninsula glaciers will continue to shrink in response to warming temperatures and will largely disappear by 2070. The rivers also are experiencing a shift in streamflow timing, with the daily streamflow becoming higher from October through January and lower from June through August. This corresponds with the climate change impacts of rising air temperature, more annual precipitation as rain and less as snow in the winter, and less overall precipitation in the summer.

Water Quality Management Is Not Working

Streams across the region are being impaired by high water temperatures, reduced dissolved oxygen and increased turbidity. Total Maximum Daily Limits (TMDLs) are being exceeded, and additional actions need to be taken to bring these water bodies into compliance with their permits. Overall, from 2012 to 2018, the region's water quality decreased.

According to the Washington Department of Ecology's 2018 305(b) & 303(d) report to EPA, 54% (Pacific Coast Region) and 60% (Puget Sound Region) of the assessed waters were determined to be impaired for one or more parameters, with temperature and bacteria being the most prevalent issues. Notably, 88-90% of these impaired waters are identified as salmonid-bearing, raising significant concerns about the long-term viability of salmon populations in the region.

Impervious Surface and Population Growth Impacts Water Quality and Salmonid Habitat

High population densities lead to large amounts of impervious surfaces, such as roads, buildings and other infrastructures, which lead to stormwater runoff that negatively impacts local watersheds, resulting in loss of salmon habitat. Sensitive stream habitat conditions may be lost when 10% of the watershed is covered by impervious surface area. Impervious surface area has been on the

rise in the Puget Sound region particularly in the region's lowlands. Between 2001 and 2021, the percentage of impervious surface increased from 4.72% to 5.23%. The majority of this increase has occurred in Pierce, King and Snohomish County watersheds. While the coastal regions of Washington state have not seen the drastic increase in the impervious surface that the Puget Sound region has seen, there was still an increase over the last 20 years. Between 2001 and 2021, the percentage of impervious surface increased from 1.30% to 1.45%. Most of this increase has occurred near the cities of Aberdeen and Centralia. In the Stillaguamish watershed, the population has increased by nearly 20,000 people, a 46% increase since 2000. Over 60% of new residents moved into Arlington, Stanwood, Granite Falls and their associated Urban Growth Areas. But the watershed's population remains rurally dispersed, with over 60% of residents still living outside of cities, towns and Urban Growth Areas.

Commercial Shellfish Growing Conditions Dependent on Proper Water Quality Management

Shellfish have long provided cultural, ecological and economic value to western Washington. However, shellfish growing beds have been experiencing degraded water quality conditions caused by human activities. Washington Department of Health conducts sanitary surveys and water quality assessments in shellfish growing areas to determine harvest suitability; and conducts point-source pollution evaluations to determine the causes of pollution. It is critical that water resources are protected in the watersheds for there to be a productive shellfish industry. In the Stillaguamish Area of Interest, the nonpoint source pollution and wastewater treatment are causing 1,343 acres of commercial shellfish growing area to be prohibited from harvest in Port Susan and South Skagit bays. This is an increase of 1,043 acres (347%) from 300 acres prohibited in Port Susan and South Skagit bays in 2016.

Overall, the Puget Sound shellfish industry has not seen large-scale improvements in water quality to expand the "fully approved" shellfish area but there have been local successes leading to a re-opening of some areas. The Skokomish Indian Tribe has been working with partners to reestablish the native Olympia oyster near the mouth of the Skokomish River. Efforts by the tribe and others to improve water quality near Hoodsport has also led to a mile of shellfish beach to be declared safe for harvesting for the first time in 45 years.

Stormwater Runoff Impacts Salmon Survival

For a long time, scientists wondered why half or more of the Coho salmon (*Oncorhynchus kisutch*) returning to spawn in Puget Sound streams and rivers were dying before they could lay their eggs. In 2020, a group of scientists finally figured out the culprit. When it rains, stormwater carries fragments of old automotive tires into nearby creeks and streams. Those tire fragments contain 6PPD, a chemical preservative that prevents automotive tires from breaking down too quickly and helps them last longer. When 6PPD is exposed to air, it reacts with ozone to create 6PPD-quinone (also known as 6PPD-Q) which causes salmon mortality. Based on recent predictive modeling in Puget Sound, stormwater runoff from high-traffic roads is resulting in salmon pre-spawn mortality rates between 10% and 40%.

Continued Increase in Permit-Exempt Wells Threatens Instream Flows for Salmon

The state of Washington provides a water right permit exemption to property owners not served by a community water system, allowing users to pump up to 5,000 gallons of groundwater per day. When more water is extracted from an aquifer than is being recharged, the aquifer volume is reduced and the natural outflow from the aquifer decreases. This reduces the amount of fresh water available to lakes, wetlands, streams and the Puget Sound nearshore, which can harm salmon at all stages of their life cycle.

Since 1980, over 43,000 permit-exempt wells have been developed in the Pacific Coast and Puget Sound regions, with a recent acceleration in growth. Between 2019 and 2024, 3,878 new wells have been constructed, representing a 16% increase in the Pacific Coast region and 3.7% increase in the Puget Sound region from the previous five-year period (2014-2019).

Between 2020-2024, water wells were added to most watersheds and all were located near local communities' land development. In the Nisqually watershed, 7,726 water wells were installed between 1980-2019 and between 2020-2024, 355 additional water wells were added, representing a 4.6% increase. Most of the new wells are located between the towns of Yelm and Eatonville, along fish-bearing streams that flow into the Nisqually River.

In WRIA 1, between 2020 and 2024, an estimated 331 new water wells were drilled and 85% of those are estimated to be permit-exempt water wells. Approximately 80% of all permit-exempt water wells in WRIA 1 are in basins either seasonally closed or closed year-round to water withdrawal due to instream flow levels that are less than the minimum flows established in 1985. This increasing rate of new well installations threaten groundwater availability and ecosystem health across the region, and actions need to be implemented to protect the instream flows that the fish and wildlife habitat depend upon.

Riparian Forest Cover Requires Active Management

Since statehood in 1889, Washington has lost an estimated 50% of its riparian habitat. Diminishing riparian forests in the lowlands of western Washington continues to impair habitats critical to the recovery of the region's anadromous salmon. In 2011, the National Marine Fisheries Service identified degraded riparian areas as a limiting factor to the recovery of Chinook salmon in most of Puget Sound.

According to the Washington Department of Ecology, Lower Skagit Stream Temperature TMDL compliance by 2080 would require, "100% of all stream miles of these creeks to be protected by riparian shade or enrolled as part of larger creek restoration and improvement projects by 2020." Unfortunately, Ecology not only failed to meet its 100% goal of riparian planting by 2020, but it also has taken no active steps since then to redress this significant adverse impact to Skagit basin water quality and salmon. The riparian planting strategy remained opportunistic and voluntary with no commitment to try and meet the 100% plant goal that was missed in 2020.

On a brighter note, since 2020, the Skagit watershed riparian planting has accelerated along the Skagit and Sauk rivers and their tributaries. According to the Skagit Watershed Council Riparian Database, riparian implementers, including the Skagit Land Trust,

the Skagit Fisheries Enhancement Group, the Skagit River System Cooperative, Skagit County and the Skagit Conservation District, planted 472 acres between 2020 and 2023, compared to 321 acres between 2016 and 2019.

Forest Cover and Land Conversion Has Mixed Results

The loss of forest cover occurs as timber harvest operations and land conversions take place. In the Puget Sound lowlands, approximately 822,000 acres of floodplain habitat exist, with a land cover composition of 49% forest/shrub, 27% agriculture, 17% developed and 7% other/natural areas. From 2011 to 2021, there was an estimated 1,989-acres net loss of forest cover in the lowlands of the Snohomish River basin. Over 90% of that loss occurred in areas zoned for Rural Residential land use, while in areas zoned for Agricultural land use there was a 247-acre increase in forest cover.

On a positive note, in the Nooksack watershed, the 50-year salmon recovery target for hydrologic mature forest cover was met in 2021, with 316,590 acres of hydrologically mature forest. All geographic areas except for the lower mainstem currently meet the 50-year goal and all areas except the lower mainstem have shown an increase in hydrologically mature forest since the adoption of the Salmon Recovery Plan. Preserving functional floodplains is crucial for Puget Sound's watersheds and ensuring salmonids retain essential shelter, refuge and food sources.

Conversion of forestlands continues in some lowland watershed areas that are already in severely damaged condition. For the overall health of critical salmon habitat, attention needs to focus on preventing the permanent loss of forest cover and restoring it in lowland forests.

Alarming Number of Stream Crossings, High Road Densities

The number of road crossings are continuing to negatively impact the health of aquatic life in lowland watersheds, from blocking fish passage to contaminated runoff entering the waterways. The projected population growth in western Washington and associated land conversions will require more roads and stream crossings throughout lower portions of the watersheds. While some improvements are taking place in both forest and urban environments, the negative impacts outweigh the limited gains.

In the Quinault Indian Nation's Area of Interest, road density values were over 3 miles/square mile in virtually all watersheds outside the Olympic National Park, where the values are generally less than 1 mile/square mile. Between 2016 and 2024, about 36% of the watersheds in the area had increases of over 1 mile/square mile, showing that the road density conditions may be getting worse. Stream road crossings were generally highest with values of over 3/mile of river in the upper reaches of the Chehalis River, Skookumchuck River and Stillman Creek.

Streams Lack Large Woody Debris

Large woody debris (LWD) plays an important role in channel stability, habitat diversity and overall habitat quantity and quality. Unfortunately, the potential to restore LWD to improve salmon habitat is often restricted by land management approaches and policies. Land-use decisions and forest and river management have all resulted in extremely decreased quantities of instream wood, and impacted the habitat forming processes from hydromodified banks, levees and floodplain development in western Washington. To address decreased quantities of instream wood in western Washington, tribes are undertaking restoration efforts to construct engineered logjams in their local watersheds to rebuild the supply and/or create opportunities to retain LWD in key salmon and steelhead streams.

For example, between 2020 and 2024, there were eight instream projects in the Nooksack River watershed that resulted in 160 engineered log jams (ELJ) and 10 other instream structures or activities. The Nooksack Indian Tribe and the Lummi Nation sponsored all eight of the projects, each sponsoring four respectively. The Nooksack Indian Tribes projects resulted in 123 ELJ structures and three other structures and the Lummi Nation projects resulted in 37 ELJ structures and seven other structures. These projects have resulted in positive habitat responses including rapid pool development, accumulation of gravels, side-channel development and increased floodplain connectivity.

Degraded Nearshore Habitat Unable to Support Forage Fish

Nearshore areas provide critical rearing and foraging habitat for salmon and steelhead and are important cultural gathering locations. During the past century, these nearshore areas have been directly and negatively degraded by human development. Shoreline modifications, such as armoring, interrupting the movement of sediment and can starve beaches of sediment, which negatively affects forage fish spawning habitat.

Washington state has roughly 2,460 miles of shoreline in the Puget Sound and the Strait of Juan de Fuca alone. Of the total miles of shoreline, 26.39% (598.9 miles) are armored to some degree. From 2020 to October 2024, there have been a total of 202 hydraulic project approvals (HPAs) for shoreline armoring work. Repairs, replacements and modifications to existing armor account for 85% of these HPAs. Only nine HPAs were for the removal of armoring.

Another example of shoreline modification is found along the shorelines of Lake Sammamish, Lake Washington and the Lake Washington Ship Canal, where approximately 4,000 privately owned docks impact lakeshore habitat by creating prime accommodations for salmon predators and significantly increasing the distance juvenile salmon must travel around docks to reach marine waters.

Along the marine shorelines, near the Nisqually Reach, forage fish spawning locations have been impacted by shoreline armoring. It has been documented that 45% of sand lance and 55% of surf smelt spawning locations occur along shorelines with armoring greater than 50%.

Estuary Habitat Restoration Is Occurring, but More Funding and Staff Time Are Needed

The habitat provided by the estuaries in western Washington continue to be degraded by the region's population growth. Tidal obstructions, such as tide gates, beach berms, dikes and culverts are major barriers to historically accessible salmonid habitat. A large amount of estuary habitat has been lost throughout Puget Sound, along the straits and along the coast. Nonetheless, in some areas there are signs of improvement.

The Snohomish River Basin Salmon Conservation Plan had a 10-year goal to restore 1,237 acres of tidal marsh and blind channel habitat by 2015. Projects and planned work include the 415-acre Spencer Island project, which includes 80 acres restored in 1994

and planned restoration for the remaining 335 acres in 2026, the Tulalip Tribes' ~340-acre Qwuloolt restoration project completed in August of 2015, the 378-acre Smith Island project completed in the spring of 2018, and the 353-acre Blue Heron Slough project completed in 2022. All contributed to the Snohomish Estuary exceeding the 10-year restoration targets set in the Snohomish River Salmon Recovery Plan.

Habitat Protection and Restoration Are Showing Signs of Improvement

The protection of high-quality habitat is critical to the survival of salmon and other species western Washington residents depend upon and enjoy. Restoration of habitat is also important, but more expensive than just protecting the critical habitat in the first place. More needs to be done to counter the impacts of a growing population and past mismanagement of the region's resources. A highlight over the past 14 years was the removal of the Elwha River dams. Conditions in the Elwha River watershed have improved and there have been positive responses for salmon and steelhead. Another example is the Port Gamble Integrated Cleanup and Habitat Restoration Project which is expected to be completed in the summer of 2025. This project will restore contaminated soils, remove hardscapes, and return the land and intertidal habitats to natural and healthy functioning processes at the former mill site in Port Gamble Bay.

Invasive Species Continue to be a Problem

The control and eradication of invasive species (plants and animals) are critical to the protection of habitat of local species. Invasive plant species continue to be a problem in the riparian zones in western Washington and control measures have significantly reduced their numbers. Besides Japanese knotweed, other plant species like Scotch broom, herb robert, spotted jewelweed, Himalayan blackberry, and tansy ragwort are now more widespread. In the Hoh watershed, there has been a general increase in the number of acres occupied by these species between 2020 and 2024.

In addition to plants there also is the ever-increasing population of European green crab, *Carcinus maenas*, in western Washington, a highly invasive species first discovered in the Salish Sea in 2012. European green crab feed on many subsistence species critical to treaty tribes, negatively impact eelgrass beds necessary for salmon to thrive, and displace native Dungeness crab. In the Makah Tribe's Area of Interest, European green crab has continued to expand its range and abundance. More than 45,000 crabs were caught between 2020 and 2024, totaling more than 47,600 green crabs removed from Makah waterways since first detecting them in 2017.

Ocean Conditions Still a Concern

Ocean conditions have been heavily impacted by warming oceans, including marine heatwaves, ocean acidification and hypoxia and harmful algal blooms (HABs), which all are exacerbated by climate change. These stressors have severely limited salmon returns and led to the widespread closure of beaches accessed by tribal fishers due to high levels of toxins. Ocean conditions are predicted to continue to worsen in coming years without significant, coordinated effort at the local, state, national and international levels.

In 2021, hypoxic conditions started earlier than normal and continued until late September even in shallower inner-shelf waters. Domoic acid concentrations from HABs were high enough to close fisheries in 2021 and 2023. Summertime hypoxia has caused fish kills with hundreds of dead fish washing up on the beaches. In 2021, a severe fish kill occurred off the Hoh reservation, with hundreds of dead fish washing up on the beach near the village. Tribal members have noted that they have been finding smaller razor clams with thinner shells than they have in the past.

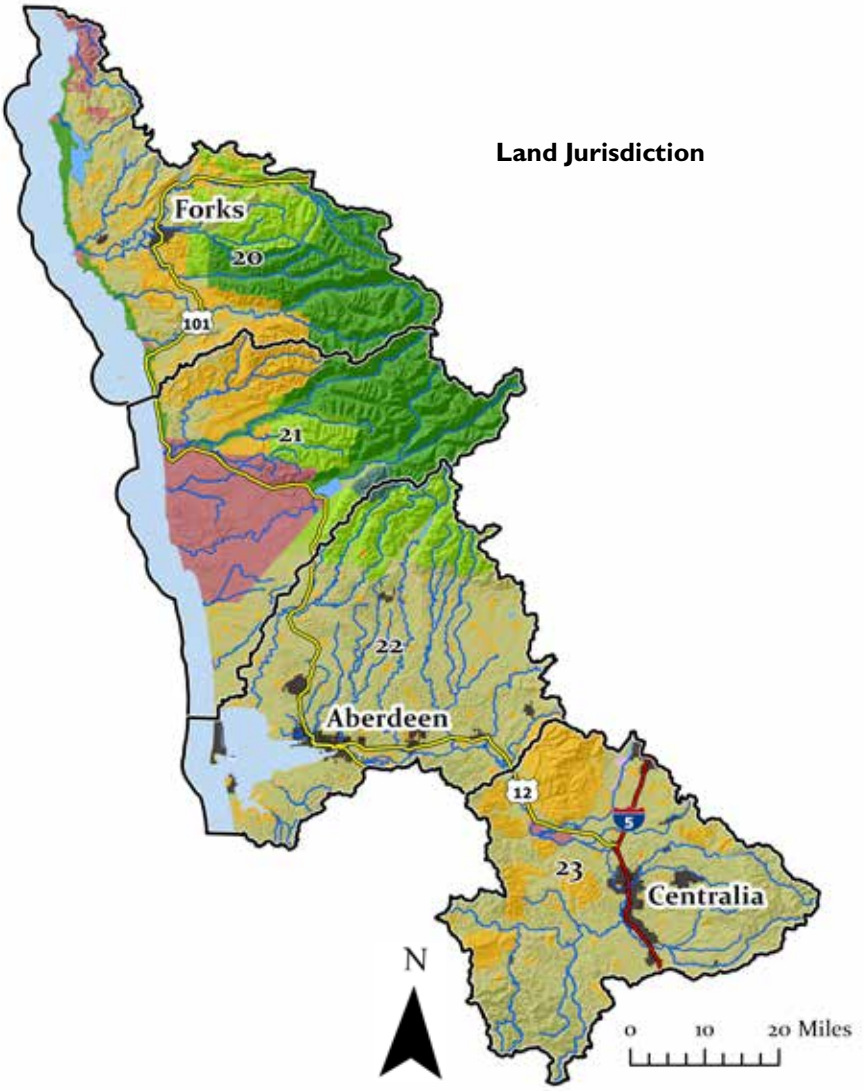
Conclusion

A consistent trend identified in the 2025 State of Our Watersheds Report is that key habitat indicators, such as riparian vegetation, fish passage barriers, increasing population growth, climate change, water quality and quantity, and forest cover are important to the survival of the tribes and the species they depend upon. The continued loss and degradation of habitat, changing climate and ocean conditions threatens salmon, tribal cultures and tribal treaty-reserved rights, wildlife habitat, water quality, and western Washington's economy and quality of life. While habitat improvement is a major component to sustain salmon productivity, it is recognized that without protecting existing habitat functions, restoration activities cannot reverse the decline of salmon populations within Puget Sound. The principal findings in this report illustrate the alarming trends, while each tribe's chapter provides a look into the key habitat issues they face.

As sovereign nations, the 20 member tribes of the Northwest Indian Fisheries Commission signed treaties with the United States, ceding most of the land that is now western Washington, but reserving rights to harvest salmon and other natural resources. Today those fishing rights are being rendered meaningless because the federal and state governments are allowing salmon habitat to be damaged and destroyed faster than it can be restored. Tribal harvest has been reduced to levels not seen since before the 1974 *U.S. v. Washington* ruling that reaffirmed tribal treaty-reserved rights and status as co-managers with the right to half of the harvestable salmon returning to Washington waters. As the salmon disappear, tribal cultures, communities and economies are threatened like never seen before. Some tribes have lost even the most basic ceremonial and subsistence fisheries that are a foundation of tribal life and culture.

The State of Our Watersheds Report is a means to assess, address and monitor progress toward protecting and enhancing salmon and wildlife habitat and water quality throughout western Washington. The report also serves as a bellwether—both an indicator and warning—that the trend of habitat loss and degradation must be reversed if we are to restore the salmon resource. If we do not, we will continue down the path we are on now, leading to the extinction of salmon and the loss of tribal treaty-reserved rights, economies and cultures, and a degradation of quality of life and economic vitality for all people of the region. This vision of the future is unacceptable to the treaty Indian tribes in western Washington.

2025 Pacific Coast Regional Report

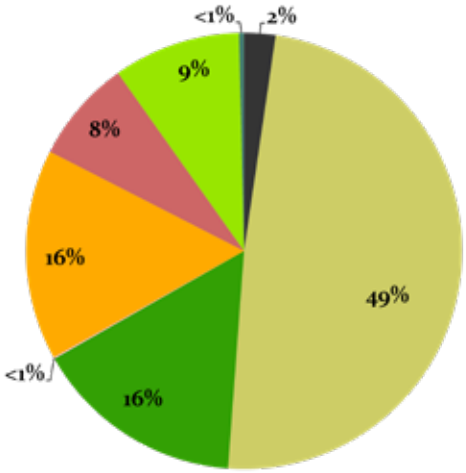


The Pacific Coast region includes WRIAs 20-23, which extend along the Pacific coastline of Washington state. The land area of these WRIAs covers approximately 4,976 square miles and consists of watersheds in the western half of the Olympic Peninsula and south to the Chehalis River basin. This area is heavily forested with small human population centers, except for parts of the Chehalis River basin. Economies rely upon timber, agriculture, commercial fishery and recreational activities. The Chehalis River basin is the second largest river basin in Washington state, outside the Columbia River basin.

The Pacific Coast area contains eight major river systems, from the Tsoo-Yess River near Neah Bay, south to the Chehalis River and Grays Harbor estuary. The Grays Harbor estuary is one of two major estuaries on the Washington coast and includes the only deepwater navigation channel and major port. The northern watersheds originate in the steep high-elevation headwaters of the Olympic Mountains and receive more than 200 inches of rain per year, while the upper Chehalis watershed receives just 47 inches of rain per year.[1]

The Pacific Coast watersheds are the ancestral and current homelands to the Makah, Quileute, and Hoh tribes and Quinault Indian Nation who have lived and managed the natural resources along the Pacific Coast since time immemorial. The Makah Reservation is located at the northwestern tip of Washington state and, moving south, is followed by the Quileute, Hoh and Quinault reservations.

The Pacific Coast watersheds are home to Pink, Chum, Chinook, Coho and Sockeye salmon, plus steelhead, bull trout and cutthroat trout. Lake Ozette Sockeye and bull trout are listed as threatened species under the Endangered Species Act. The Lake Ozette Sockeye Salmon Recovery Plan was approved by NOAA in May 2009,[2] and notice of the Final Recovery Plan for the coastal (including Puget Sound) recovery unit of bull trout was published in the Federal Register in September 2015 by the USFWS.[3]



Map Data Sources: DOD 2023[4], SSHIAP 2004[5], USFWS 2024[6] WADNR 2024a[7], WADNR 2024b[8], WAECY 2020[9], WAECY 2021[10], WAECY 2024a[11], WAECY 2024b[12], WSDOT 2018[13], WSDOT 2023[14]

Chapter Summary

The Northwest Indian Fisheries Commission member tribes have fished, hunted, gathered and harvested along the rivers and tributaries of the Pacific Coast watersheds since time immemorial. No one on this earth is more connected to the watersheds, its water, plants, fish and animals than the region's tribes. At the heart of that connection is salmon, which has always been a primary source of life for the tribes.

The limiting factors to salmon recovery include habitat quantity and quality in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribes' Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org.*

For this status report of the Pacific Coast region, the tribes have focused on the issues that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Developed Impervious Surface Continues to Increase

While the coastal regions of Washington state have not seen the drastic increase in impervious surfaces that the Puget Sound region has seen, its rate has still seen an increase over the last 20 years. Between 2001 and 2021, the percentage of impervious surfaces increased from 1.30% to 1.45%. The majority of this increase has occurred near the cities of Aberdeen and Centralia.

Forest Cover

Within the Pacific Coast region (WRIA 20-23), there are approximately 3,300 square miles of land within the state's jurisdiction. Using newly available data, it is estimated that 73.7% (2,450 square miles) of this region is forested as of 2021 with trees greater than 15 feet in height.

Riparian Forest Cover

In the Pacific Coast region, there is roughly 1,455 square miles of riparian habitat within the state's jurisdiction. This habitat is vital for water quality, salmon health and many other critical ecosystem functions. As of 2021, 80.74% of this riparian area was forested by trees taller than 15 feet in height.

Fish Passage Barriers Continue to Be Identified along the Pacific Coast

There are 3,919 fish passage barriers in the Pacific Coast region that have been identified by the Washington Department of Fish and Wildlife to impact migrating salmonids. While many of these barriers are owned by the state and fall under the rulings of the Culvert Case injunction, the majority are owned by other government agencies and private landowners. These culverts continue to restrict access to habitat for salmon while often having no timeline for replacement.

Water Quality

According to the Washington Department of Ecology's 2018 305(b) & 303(d) report to EPA, 54% of the assessed waters in the Pacific Coast region were determined to be impaired for one or more parameters. Notably, 90% of these impaired waters are identified as salmonid-bearing, raising significant concerns about the long-term viability of salmon populations in the region.

Groundwater Withdrawals Impact Surface Flows

Since 1980, over 8,000 permit-exempt wells have been developed in the Pacific Coast region, with a recent acceleration in growth. Between 2019 and 2024, 903 new wells were constructed, representing a 16% increase from the previous five-year period (2014-2019). The Chehalis watershed (WRIAs 22-23) hosts the majority of these wells, posing significant threats to groundwater availability and ecosystem health, particularly impacting salmon habitats.

Streamflow Trends

Recent streamflow data reveal significant seasonal deviations from historic baselines (1948-1998), with increasing days of below-normal flows in summer (July-October) and spring (April-June) and heightened variability in late fall and winter (November-March). These altered hydrological patterns signal critical climate change impacts on freshwater ecosystems, threatening habitat integrity and diverse aquatic communities.

Recreation Impacts

A mounting body of research confirms what tribal members and resource managers are seeing across the landscape, recreational activities can and do have significant impacts on the environment and on the resource itself. Tribes are currently working with state and federal land managers to ensure recreation management policy is based on best available science, tribal knowledge, cross-jurisdictional coordination and ecological sustainability. This will result in smarter and more consistent recreation planning and management across state and federal public lands

Ocean Conditions

The coastal tribes are taking an active role in the research and monitoring efforts of the offshore ocean conditions.

Climate Change

The watersheds of the Pacific Coast are experiencing changes driven by the climate crisis that will likely accelerate in the future: more frequent extreme heat events, warmer stream temperatures, subsequent increases in fish disease, shrinking glaciers and snowpack, lower summer streamflows, more extreme winter floods, shifts in streamflow patterns and timing, more frequent wildfires,

warmer ocean temperatures, changing ocean chemistry, and flooding and erosion from more intense winter storms and rising sea levels. These changes are compounded by the effects of habitat destruction and fragmentation described in this report. Efforts to restore habitat integrity and diversity contribute to the resilience of the species and ecosystems that are fundamental to tribal treaty rights and traditional ways of life.

Conclusion

The tribes want to maintain and restore natural ecosystem conditions that sustain salmon productivity in all watersheds of the Pacific Coast region. While habitat improvement is a major component to sustain salmon productivity, it is recognized that without protecting existing habitat functions, restoration activities cannot reverse the decline of salmon populations within the region. In this regard, conclusions for the State of the Watershed Report in 2025 are very concerning.

There are clear strategies for restoration. Ongoing restoration is resulting in the acquisition and restoration of critical salmon habitats along the Pacific Coast. However, restoration is expensive and funding remains a challenge. Restoration also requires political leaders and landowners to be willing participates, which is a challenge. As restoration and acquisition continues, these two factors greatly affect the pace at which it occurs.

The legacy of European colonization of the landscape remains largely unchanged. Floodplain land cover and riparian forest cover are in critical condition in the Chehalis watershed, nonpoint pollution continues to threaten salmon habitat and barrier culverts are in need of replacement. There is a high demand for the forest products of the region and people continue to move into the watersheds, either reinforcing development patterns of the past, or bringing new development to previously undeveloped areas.

Changing this legacy of resource and land use is a long, slow and very contentious process. It requires adherence to the laws and regulations of federal, state and local governments. Implementation of those laws, which happens locally, is often left to volunteerism, on the part of the landowner. Politically, this is most palatable, but it has proven inadequate for the needs of salmon habitat recovery. Moving forward, as more people move into the region, better enforcement of the regulatory framework will become even more necessary.

Review of the trends for these key environmental indicators shows a steady loss for most and real concerns for a few:

Tribal Indicator	Status	Habitat Trend
Impervious Surface	Between 2001 and 2021 the percentage of impervious surface increased from 1.30% to 1.45%. The majority of this increase has occurred near the cities of Aberdeen and Centralia.	**Declining**
Forest Cover	In the Pacific Coast region (WRIA 20-23) there are approximately 3,300 square miles of land within the state's jurisdiction. Using newly available data, it is estimated that 73.7% (2,450 square miles) of this region is forested as of 2021 with trees greater than 15 feet in height.	**Concerns**
Riparian Forest Cover	In the Pacific Coast region there is roughly 1,455 square miles of riparian habitat within the state's jurisdiction. This habitat is vital for water quality, salmon health, and many other critical ecosystem functions. As of 2021, 80.74% of this riparian area was forested by trees taller than 15 feet.	**Concerns**
Barrier Culverts	There are 3,919 fish passage barriers in the Pacific Coast region that have been identified by the Washington Department of Fish and Wildlife to impact migrating salmonids. While many of these barriers are owned by the state and fall under the rulings of the culvert case, the majority are owned by other government agencies and private landowners. These culverts continue to restrict access to habitat for salmon while often having no timeline for replacement.	**Declining**
Water Quality	According to the Washington Department of Ecology's 2018 305(b) & 303(d) report to EPA, 54% of the assessed waters in the Pacific Coast Region were determined to be impaired for one or more parameters. Notably, 90% of these impaired waters are identified as salmonid-bearing, raising significant concerns about the long-term viability of salmon populations in the region.	**Declining**
Stream Flows	Recent streamflow data reveal significant seasonal deviations from historic baselines (1948-1998), with increasing days of below-normal flows in summer (July-October) and spring (April-June) and heightened variability in late fall and winter (November-March). These altered hydrological patterns signal critical climate change impacts on freshwater ecosystems, threatening habitat integrity and diverse aquatic communities.	**Concerns**
Wells	Since 1980, over 8,000 wells have been developed in the Pacific Coast region, with a recent acceleration in growth. Between 2019 and 2024, 903 new wells were constructed, representing a 16% increase from the previous five-year period (2014-2019). The Chehalis watershed hosts the majority of these wells, posing significant threats to groundwater availability and ecosystem health, particularly impacting salmon habitats.	**Declining**
Climate Change	The watersheds of the Pacific Coast are experiencing changes driven by the climate crisis that will likely accelerate in the future: more frequent extreme heat events, warmer stream temperatures, subsequent increases in fish disease, shrinking glaciers and snowpack, lower summer streamflows, more extreme winter floods, shifts in streamflow patterns and timing, more frequent wildfires, warmer ocean temperatures, changing ocean chemistry, and flooding and erosion from more intense winter storms and rising sea levels.	**Concerns**

The tribes continue to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they rely on for survival.

Looking Ahead

Although the watersheds within the Pacific Coast region continue to sustain salmonid species, significant threats to fish habitat remain. Land-use practices and population growth continue to alter watershed processes, resulting in degradation of water quality, water quantity and stream channel complexity. There is a need for greater communication and cooperation between natural resources managers and local government to assure achievement of the goals set in the watershed recovery plans for the Pacific Coast region.

We are still witnessing the continued loss and fragmentation of habitat through land conversion, barrier culverts, forest cover removal and extraction of groundwater. The lack of progress on the protection of existing habitat remains the biggest impediment to salmon recovery.

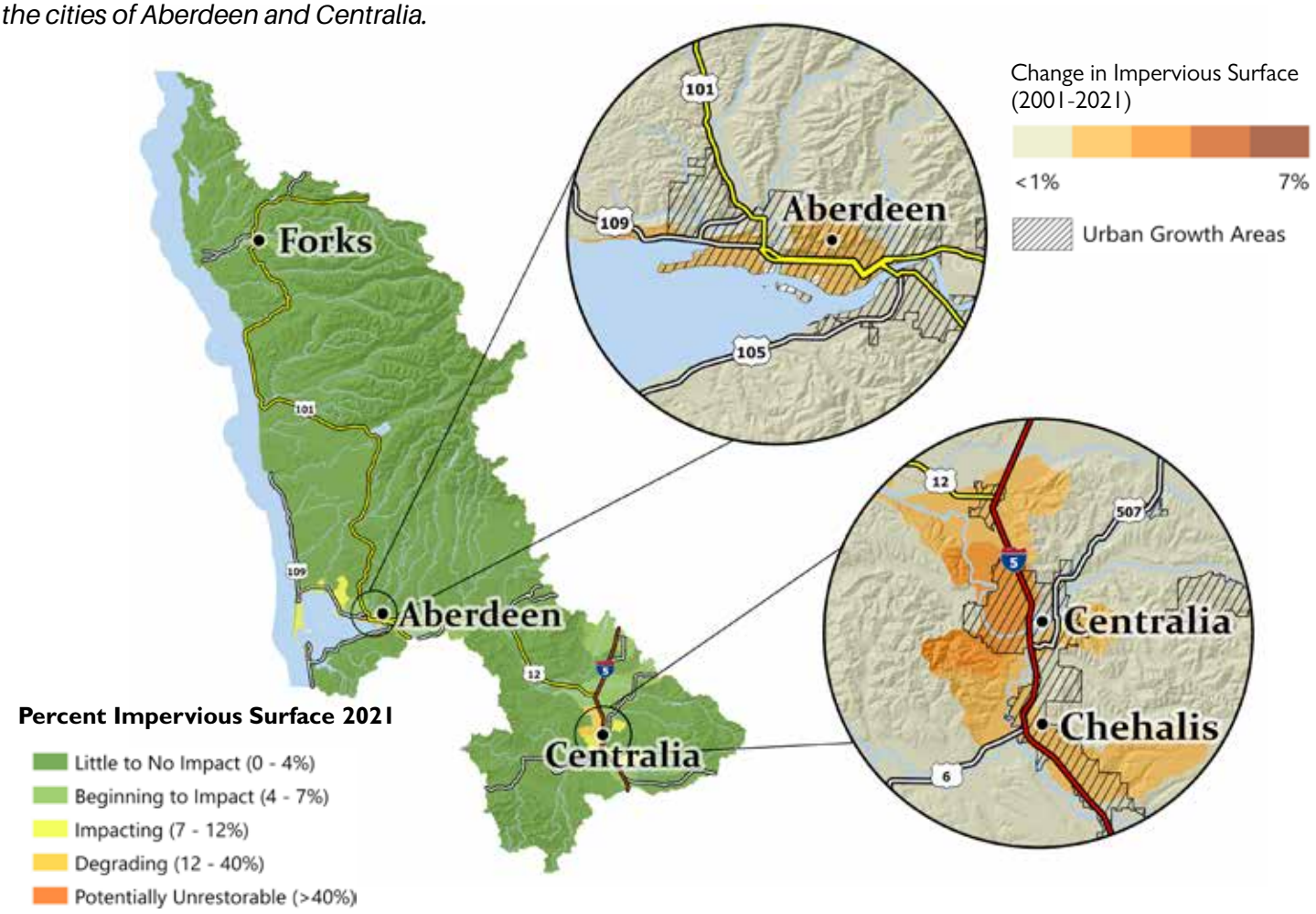
Pressure from population growth, agricultural practices and timberland use will continue to present challenges to salmon conservation and recovery efforts. Land-use management and forest practice regulations continue to allow the further degradation of floodplain and riparian habitat throughout the watershed.

Current habitat conditions and trends indicate the need for continued restoration efforts and land-use regulation reform. The regulatory framework that protects salmon habitat must be upgraded if the underlying assumption to all recovery goals is to be realized—that existing habitat will be protected from loss.

The tribes are committed to partnering with government and private groups to make improvements to salmon habitat, continue participation in the lead entity and regional recovery process, develop strategies for recovery, and participate in the efforts to seek grant funding for the Pacific Coast region.

Developed Impervious Surface Continues to Increase

While the coastal regions of Washington state have not seen the drastic rise in impervious surface that the Puget Sound region has seen, its rate has still seen an increase over the last 20 years. Between 2001 and 2021, the percentage of impervious surface increased from 1.30 % to 1.45%. The majority of this increase has occurred near the cities of Aberdeen and Centralia.



Impervious surfaces are non-porous land cover such as paved roadways, parking lots and roofs that impact how water moves in a watershed. As impervious surface increases so does stormwater runoff and its impacts on water quality.[1] These impacts can trickle down to affect aquifer, ecosystem and fisheries health.

Since the last State of Our Watershed Report that analyzed 2016 impervious surface data, the Coast region has continued to see impervious surface rise from 1.40% in 2016, to 1.45% in 2021. These surfaces prevent rainfall and snowfall from being absorbed into the ground where they would otherwise recharge aquifers and surface waters. The water that does manage to get absorbed in these developed environments does so at a lessened rate as the soil tends to have decreased water storage and infiltration abilities due to compaction.[2] Greater rates of runoff cause higher peak flows during wet times and lower dry weather flows due to lack of groundwater recharge.[3]

Aquifer recharge and surface water storage is particularly important considering Washington's increasing population and the statewide drought conditions declared by the Department of Ecology in April 2024.[4] Between 2001 and 2021, roughly 11.3 square miles of impervious surface was added to the Coastal region, which represents an increase from 1.30% to 1.45% impervious surface. The majority of this development is concentrated in the Centralia and Grays Harbor region where runoff is more likely to enter our rivers and estuaries.[1] The disruption of this flow also inhibits the natural physical, biological and chemical processes that help to remove pollutants and sediments from entering our waterways.[5] Contaminated runoff poses significant threats to freshwater, estuarine and marine species, including the Pacific Northwest's salmon and steelhead runs.[6]

Common pollutants such as heavy metals, pesticides, petroleum-based products and other toxins can lead to increased harmful algal blooms and decreased aquatic insect populations that salmonoids rely on.[6] These toxins are also known to impact salmon nervous systems which can disrupt feeding and predator avoidance.[6]

The health of the current and future salmon populations is dependent on maintaining consistent and healthy water flows, particularly in the critical coastal habitat.

Map Data Sources: SSHIAP 2004[7], USGS 2001[8], USGS 2016[9], USGS 2018[10], USGS 2021[11], WAECY 2021[12], WAECY 2024[13]

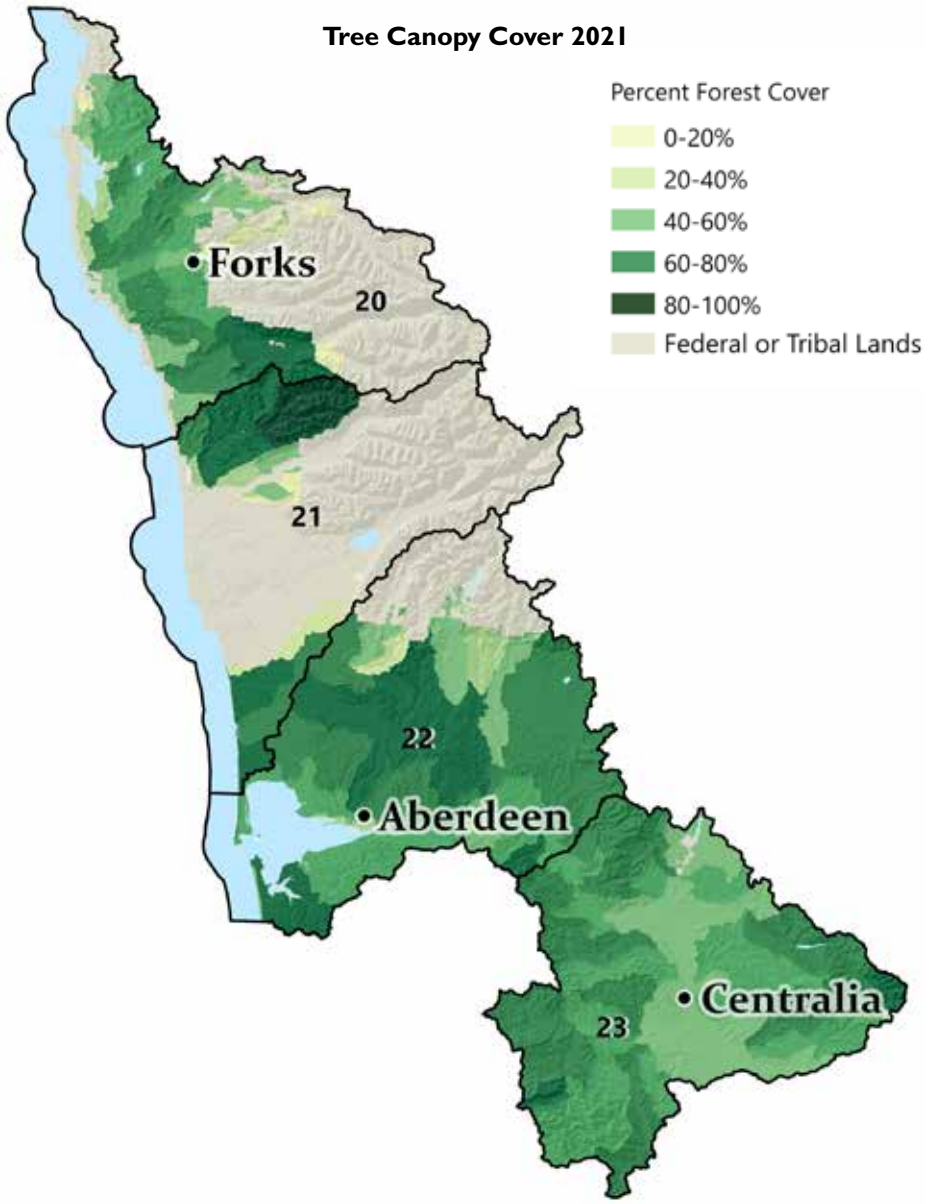
Forest Cover

Within the Pacific Coast region (WRIA 20-23), there are approximately 3,300 square miles of land within the state's jurisdiction. Using newly available data, it is estimated that 73.7% (2,450 square miles) of this region is forested as of 2021 with trees greater than 15 feet in height.

In past State of Our Watershed Reports, canopy cover data available at a large regional scale was limited to low resolution datasets based on 30-meter satellite imagery. In 2021, NOAA's Coastal Change Analysis Program (C-CAP) transitioned to producing canopy data at 1-meter resolution. With this improved data, we can now more accurately capture and estimate the extent of tree canopy cover in the state of Washington. Data at this resolution is better suited to capturing the loss and gain of individual trees overtime.

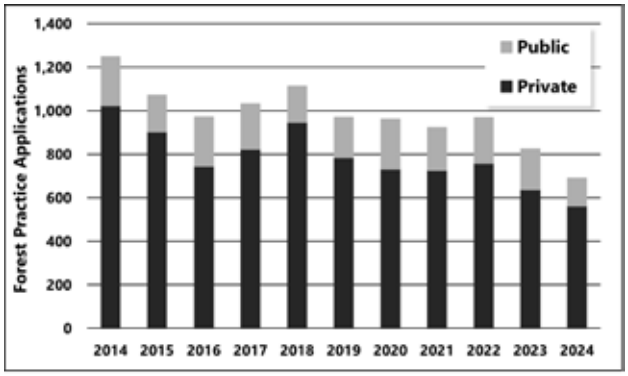
Within the Pacific Coast region (WRIA 20-23), there are approximately 3,300 square miles of land in the state's jurisdiction, 1,900 mi^2 of this land is within coastal lowlands (≤ 500 feet in elevation). Using the new data, it is estimated that 73.7% (2,450 square miles) of this region is forested as of 2021 with trees greater than 15 feet in height. Preserving this forested habitat in the coastal region is vital to water quality, salmon conservation and overall ecosystem function. Ensuring that our harvest and development are sustainable is important in protecting the longevity of forest health and connectivity.

The Washington Department of Natural Resources implements Forest Practice Applications to regulate and track forestry within the state. From 2014 to 2024, roughly 613 square miles of land in the Pacific Coast region have been harvested or will be in the near future. The vast majority of these applications were issued for even-aged harvest types on privately owned land.[1,2] Even-aged harvest types typically result in clear cuts as the trees are of equal harvestable size. Moving forward, it is important that the state maintains forestry policies that not only take into account the economy but also conservation and the protection of our state's unique biodiversity.



Percent forest cover on state lands in Water Resource Inventory Areas 20-23

WRIA	Water Resource Inventory Area	Lowland Forest Cover (<500ft elevation)	Upland Forest Cover (>500ft elevation)
20	Sol Duc	74.60%	79.30%
21	Queets - Quinault	79.10%	90.80%
22	Lower Chehalis	75.80%	78.80%
23	Upper Chehalis	57.70%	73.50%



Forest Practice Applications for timber harvest on private vs. public lands from 2014-2024

Map Data Sources: NASA JPL 2013[3], NOAA 2021[4], SSHIAP 2004[5], USGS 2018[6], WADNR 2025[7], WAECY 2000[8], WAECY 2024[9]

Riparian Forest Cover

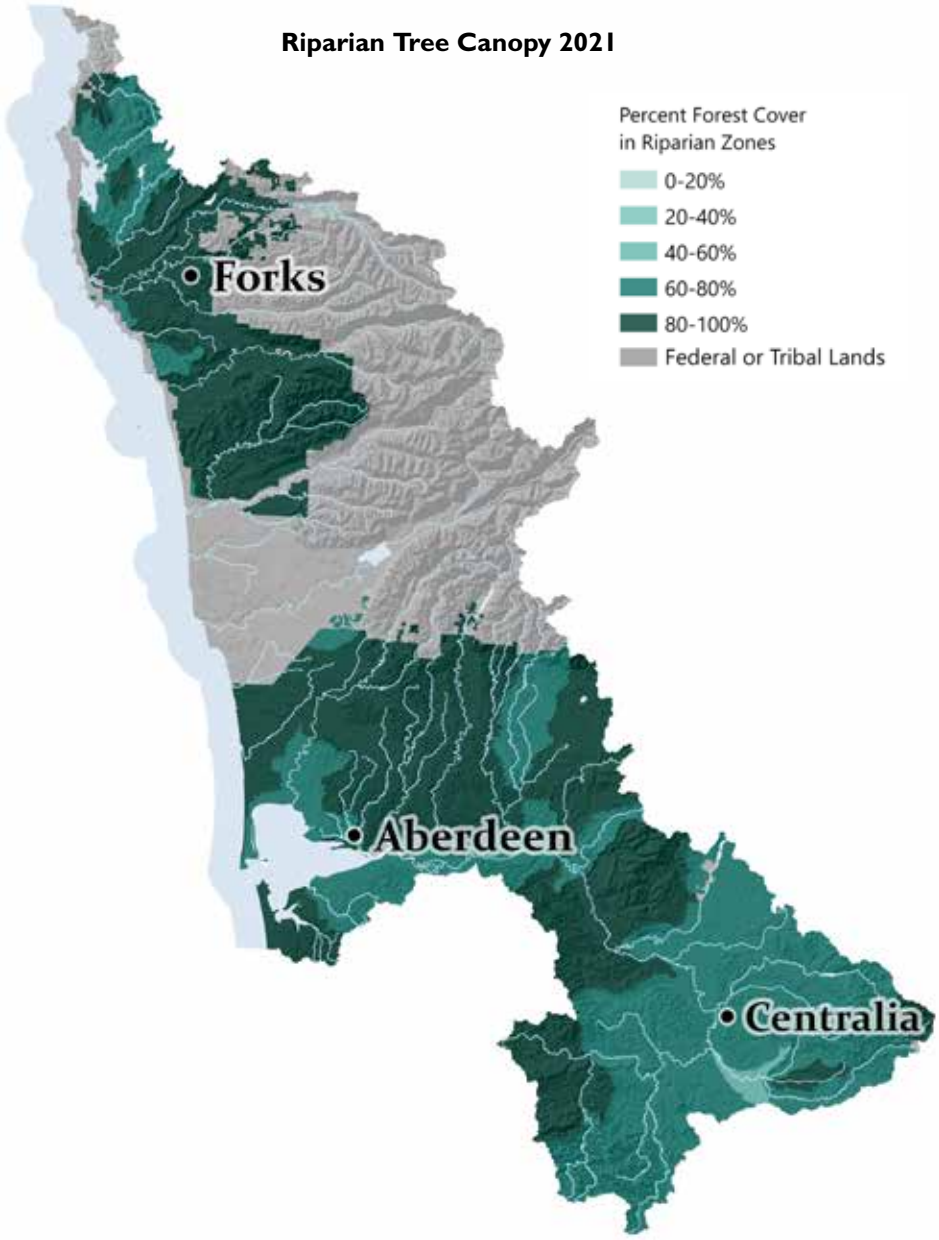
In the Pacific Coast region, there are roughly 1,455 square miles of riparian habitat within the state's jurisdiction. This habitat is vital for water quality, salmon health and many other critical ecosystem functions.[1] As of 2021, 80.74% of this riparian area was forested by trees taller than 15 feet in height.

In forested ecoregions such as the Olympic Peninsula and Pacific Coast, a riparian buffer aligned with a stream's site potential tree height is recommended by WDFW to protect the habitat's full ecological function.[2] However, state or local stream buffer requirements for development often don't align with these buffers. Analyzing the amount of tree canopy within these buffers can provide a good indicator for riparian health.

For past State of the Watershed Reports, it has been difficult to accurately calculate forest cover change due to the coarseness of data available and the characteristically small nature of riparian habitat. Prior to 2021, tree canopy data was only available based on 30-meter aerial imagery at an extent large enough to use for regional analysis. With changes to data in 2021, 1-meter data became available which is more suited to accurately estimating riparian tree canopy cover.

While it is not the only factor to consider in habitat health, forest cover is associated with many key riparian functions. Directly, tree canopy cover provides shade to riparian areas that regulate water and air temperature.[3] This is important to many aquatic and terrestrial organisms that have narrow ranges of temperature and moisture that they can tolerate.[4] Mature native trees and shrubs also provide large woody debris to streams which support macroinvertebrate communities, a key food source in the salmonid life cycle.[1] Forests affect other key riparian ecosystem functions including streambank stability, detrital nutrient flow and pollution removal.[3] Particularly in the heavily logged Coastal region, pollution removal and sediment trapping are invaluable for the health of salmonoids in otherwise functional habitat.[5] Intact riparian zones with native vegetation are better able to decrease the impacts of nonpoint source pollution on streams that can degrade water quality.[5] Runoff from agriculture and stormwater when filtered through a riparian buffer can be transformed through physical, chemical and biological processes that reduce the overall concentration of the pollutants entering the stream.[2]

Riparian Tree Canopy 2021



If development and logging continue as it has in the region, stronger riparian habitat protections need to be enforced to preserve their health. Combined with the impervious surface increase seen in parts of the region, riparian habitat is under threat. It has been observed that stream conditions become severely degraded when total forest cover dips below 65% when combined with effective impervious surface over 10%.[6] While the amount of impervious surface for the entirety of the Coastal region is low at 1.45% (2021),[7] it is invaluable to protect this habitat that has less development pressures than other parts of the state such as the Puget Sound. Development and clearing in all areas of the watershed need to be more closely monitored but particularly within the recommended buffers for riparian habitat.

Map Data Sources: NOAA 2021[8], SSHIAP 2004[9], USGS 2018[10], WAECY 2024[11], WDFW 2020[12]

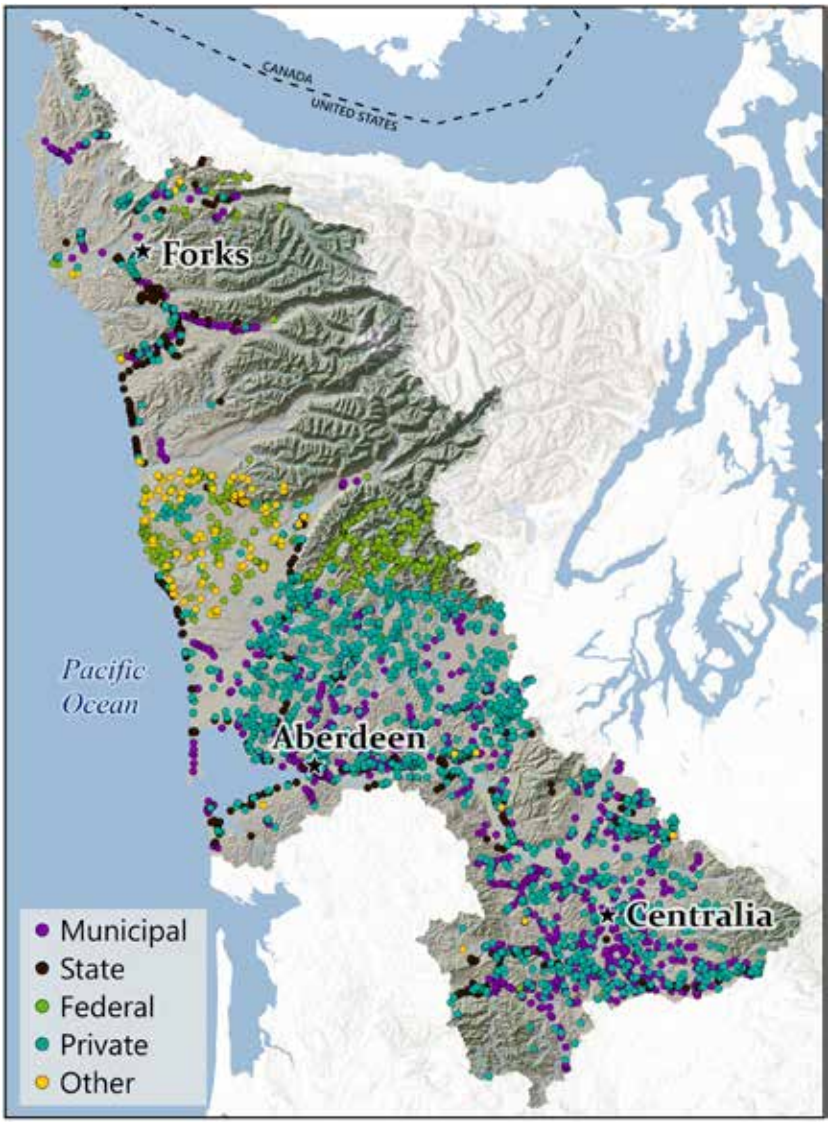
Fish Passage Barriers Continue to Be Identified along the Pacific Coast

There are 3,919 fish passage barriers in the Pacific Coast region that have been identified by the Washington Fish and Wildlife Department to impact migrating salmonids. While many of these barriers are owned by the state and fall under the rulings of the Culvert Case injunction, the majority are owned by other government agencies and private landowners. These culverts continue to restrict access to habitat for salmon while often having no timeline for replacement.

Fish passage barriers are infrastructure, most often culverts, used to divert streams under roadways. These culverts can prevent salmon from traveling upstream to reach their native spawning habitat. Traditional culvert designs prioritize the efficient movement of water under these roads and do not take into account fish passage needs.[1] Low water levels, debris blockages within culverts, and increased water velocity are common problems that prevent salmon from being able to traverse culverts.[1] Often culverts are also poorly aligned to stream beds with openings too high or low for fish to use them.[1] Bridges and fish-friendly culverts need to be installed in order to make upstream habitat available to salmonids.[2]

Many of these barriers are owned by Washington state agencies and fall under the rulings of the *US v. Washington* court case (Culvert Case injunction). Barriers considered as a part of this case have the potential to be corrected by the state if they meet certain criteria for habitat gain and fish use.[2] Considering that only 10.21% of the fish passage barriers in the Coast region are owned by the state is where a greater problem arises. The majority of culverts on the coast are owned by other government agencies or private landowners. Roughly 32.97% of the culverts surveyed have been deemed to fall under the jurisdiction of municipal governments in the area including cities and counties. Another 10.90% have been identified to fall under the jurisdiction of the federal government, primarily the National Parks Service and the U.S. Forest Service. This also does not take into account the 42.61% of surveyed culverts identified on privately owned lands; this category especially is suspected to be greatly underestimated. Surveying efforts organized by Washington Fish and Wildlife have prioritized public lands and publicly owned roadways, so often culverts lying on private lands have gone unidentified. While there have been efforts through some tribes and nonprofits to identify these barriers, continued surveying and analysis of these properties need to be done to more accurately understand the extent of culverts' impacts.

To open up the most habitat for salmonid recovery in the region, more extensive mapping of fish passage barriers needs to be completed and compiled. With better data on culverts, environmental agencies can better prioritize culverts that will benefit salmonids populations the most.



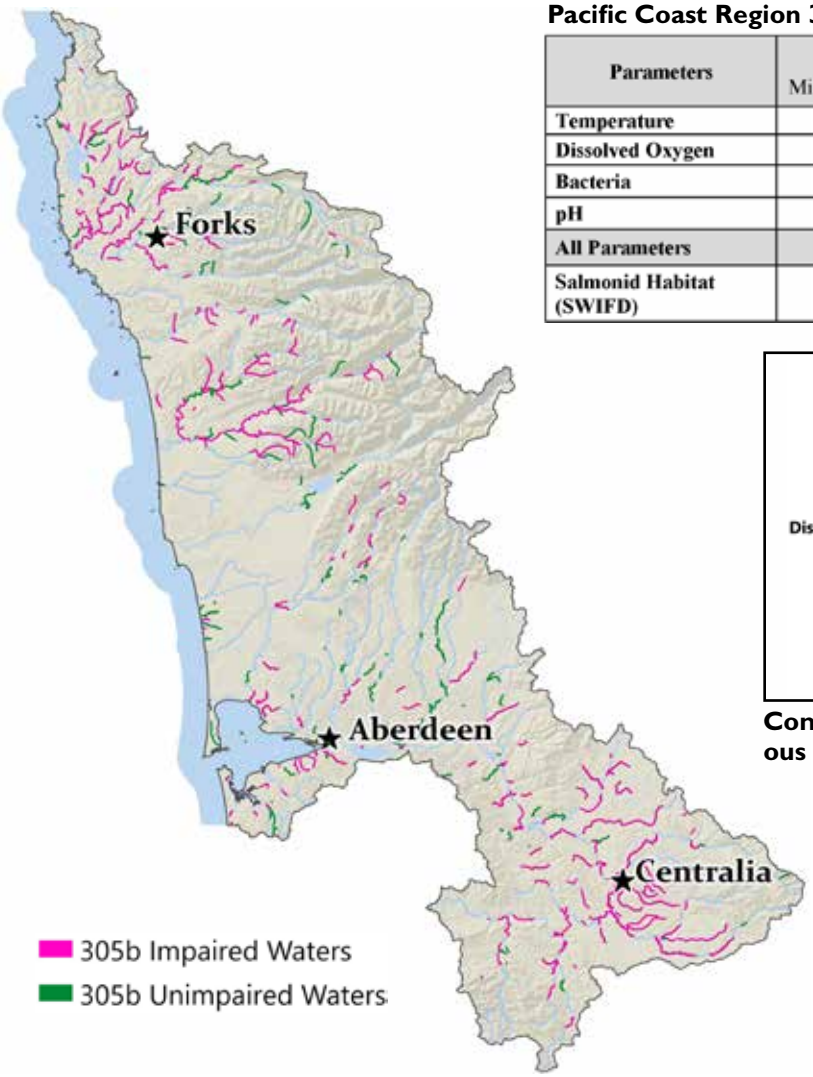
Fish passage barrier ownership in the Pacific Coast Region

Ownership	Fish Barriers	Percent
Municipal	1,292	32.97%
City	185	4.72%
County	1,107	28.25%
State	400	10.21%
Federal	427	10.90%
Private	1,670	42.61%
Other	130	3.32%
Total	**3,919**	**100%**

Map Data Sources: NASA JPL 2013[3], SSHIAP 2004[4], WAECY 2024[5], WDFW 2025[6]

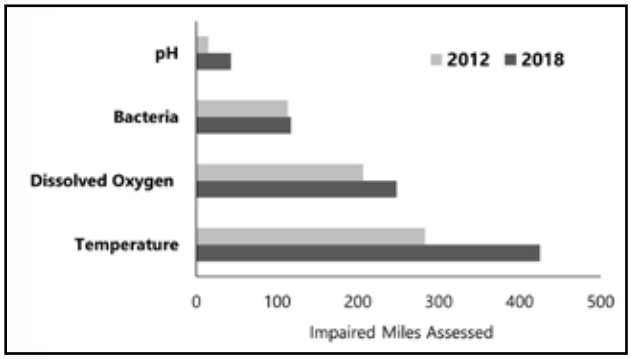
Water Quality

According to the Washington Department of Ecology's 2018 305(b) & 303(d) report to EPA, 54% of the assessed waters in the Pacific Coast region were determined to be impaired for one or more parameters. Notably, 90% of these impaired waters are identified as salmonid-bearing, raising significant concerns about the long-term viability of salmon populations in the region.

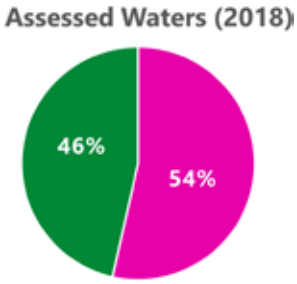


Pacific Coast Region 305(b) (2018)

Parameters	Impaired		Unimpaired	
	Miles Assessed	% Assessed	Miles Assessed	% Assessed
Temperature	425.19	51%	206.08	29%
Dissolved Oxygen	247.73	30%	225.08	31%
Bacteria	116.88	14%	205.23	28%
pH	42.73	5%	171.46	24%
All Parameters	832.52	54%	722.62	46%
Salmonid Habitat (SWIFD)	749.27	90%	621.45	86%



Comparison of impaired miles assessed for various water quality parameters in 2012 and 2018. [5, 7]



Water quality is essential for salmonid survival, which necessitates cool temperatures, high dissolved oxygen levels, natural nutrient concentrations and low pollutant levels.[1] The Washington Department of Ecology's 303(d) report to the U.S. EPA identifies waters failing to meet these standards. In the Pacific Coast region, the 2018 data shows that 54% of assessed waters are impaired, with temperature (51%) and dissolved oxygen (30%) being the most prevalent issues.

A comparison between 2018 and 2012 data reveals a concerning trend of increased impairment across all parameters. The most significant changes were observed in temperature (33.44% increase) and pH (65.22% increase). It is important to note that there has been an increase in the number of assessed streams since 2012, which may partially account for the observed increases in impairment.

Washington state's coastal salmonid habitats face a severe threat, with 90% of the impaired streams assessed for water quality that support salmon showing impairment for one or more parameters, up from 86% in 2012. This alarming increase underscores the urgent need for comprehensive water quality management strategies in the Pacific Coast region, especially in salmonid-bearing streams. The total impaired stream miles increased by 215.13 miles (25.84% change) from 2012 to 2018.

Efforts must focus on addressing primary pollution sources to preserve the region's vital salmon populations. Climate change is likely exacerbating these issues, with studies projecting increased water temperatures and altered streamflow patterns in Washington state's freshwater habitats[2]. These changes could further stress salmon populations, highlighting the importance of adaptive management strategies and ongoing water quality monitoring to protect these critical species and their habitats.

Map Data Sources: SSHIAP 2004[3], WAECY 2012a[4], WAECY 2012b[5], WAECY 2018a[6], WAECY 2018b[7], WAECY 2018c[8], WAECY 2024[9], WDFW/NWIFC 2023[10]

Groundwater Withdrawals Impact Surface Flows

Since 1980, over 13,600 permit-exempt wells have been developed in the Pacific Coast region (WRIAs 20-23). Between 2019 and 2024, 825 new permit-exempt wells were constructed, representing a 16% decrease from the previous five-year period (2014-2019). The Chehalis watershed (WRIAs 22-23) hosts the majority of these wells, posing significant threats to groundwater availability and ecosystem health, particularly impacting salmon habitats.

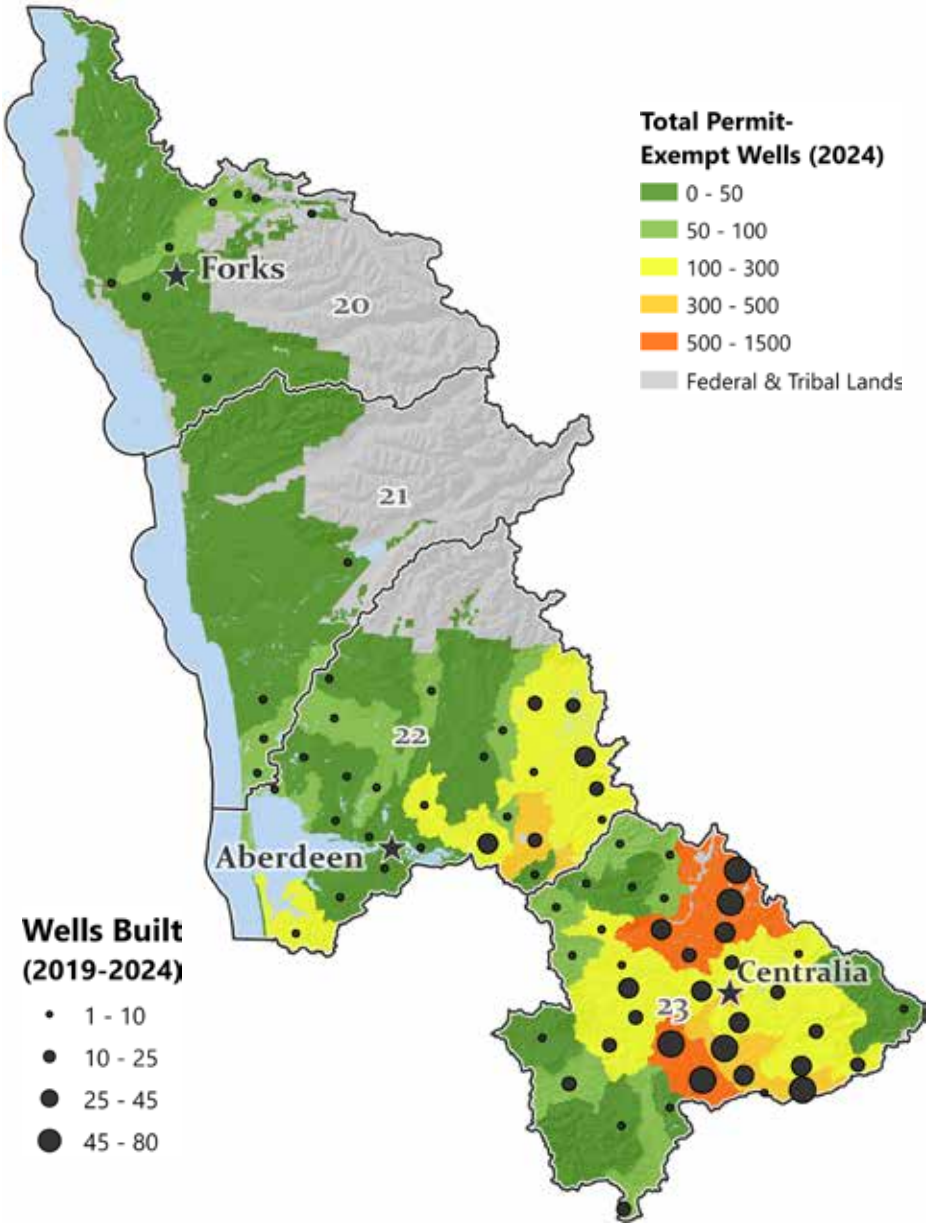
The Pacific Coast region, particularly the Chehalis watershed, is experiencing a significant increase in domestic well installations, leading to growing pressure on groundwater resources. Groundwater plays a crucial role in maintaining stream baseflows, especially during naturally low surface water flows in dry seasons. Salmon, a keystone species in the region, rely heavily on these groundwater-fed streams for critical life cycle stages, including spawning, migration and rearing.[1]

In 2021, after technical review and coordination with the Salmon Recovery Funding Board, the Washington Department of Ecology adopted the Chehalis Basin Watershed Plan Addendum as part of the Streamflow Restoration Law. This addendum projected 4,555 new permit-exempt wells between 2018-2040, and as of 2024, the installation of these new permit-exempt wells is proceeding at a slower rate, approximately 51% below the projected rate[2].

Under current Washington state law, new domestic wells can withdraw up to 5,000 gallons of groundwater per day without requiring a permit, based on scientific evidence of water availability.[3] This regulatory leniency has facilitated well development, outpacing the natural recharge rates of aquifers. As aquifers become depleted, the resultant reduction in streamflow, particularly during critical periods for salmon, such as late summer and early fall, poses a significant threat to salmon populations.[4] Diminished streamflow leads to elevated water temperatures and reduced dissolved oxygen levels, both of which are detrimental to salmon health and reproductive success.

Additionally, reduced freshwater inputs increase pollutant concentrations, placing further stress on aquatic ecosystems.[5]

The current approach to well development in the Pacific Coast region, characterized by minimal regulatory oversight and permit-exempt groundwater extraction, poses a significant threat to the delicate balance of aquatic ecosystems. While new permit-exempt wells in the Chehalis watershed are proceeding at a slower rate than initially projected, the need for continued vigilance remains critical.[2] As groundwater demands continue to increase, sustained monitoring, restoration efforts and adaptive management strategies are essential to protect the region's water resources, preserve salmon populations, and ensure the long-term ecological sustainability of the Pacific Coast watershed.



Map Data Sources: SSHIAP 2004[6], USGS 2018[7], WADNR 2018[8], WADOH 2023[9], WAECY 2000[10], WAECY 2024a[11], WAECY 2024b[12]

Streamflow Trends

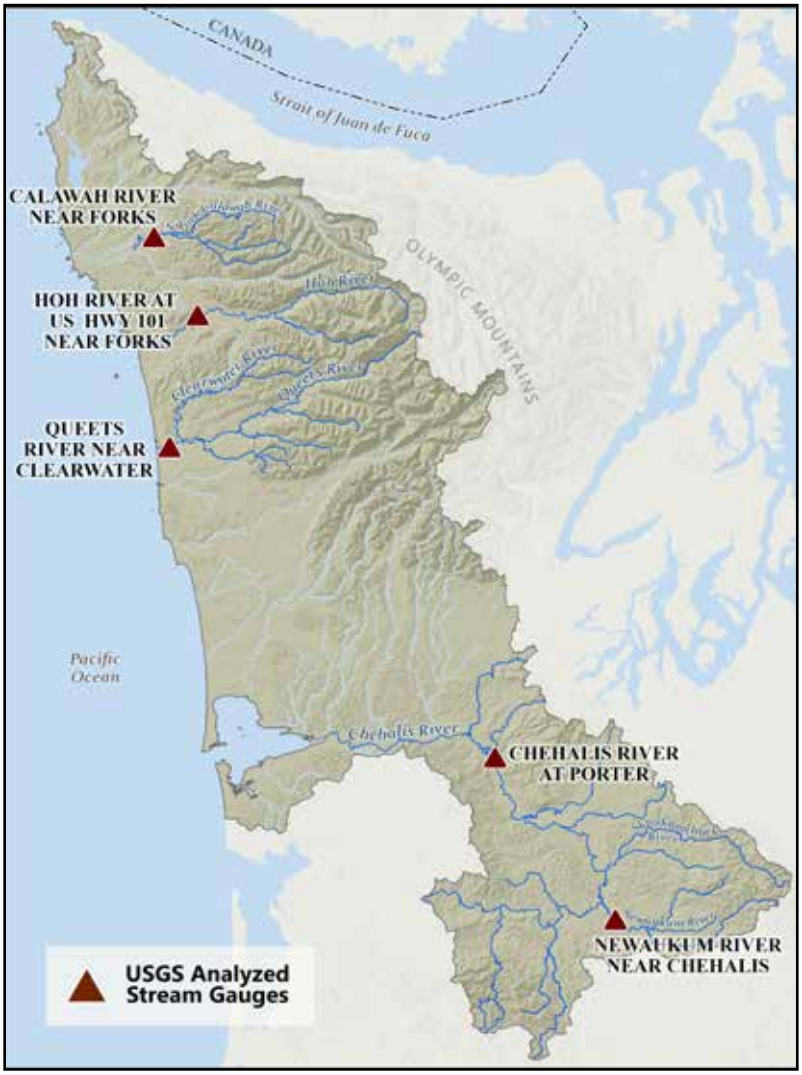
Recent streamflow data reveal significant seasonal deviations from historic baselines (1948-1998), with increasing days of below-normal flows in summer (July-October) and spring (April-June) and heightened variability in late fall and winter (November-March). These altered hydrological patterns signal critical climate change impacts on freshwater ecosystems, threatening habitat integrity and diverse aquatic communities.

The data from Figures 1-3 demonstrate seasonal streamflow patterns that critically affect salmon populations. During late fall and winter (November-March, Figure 1), streamflows exhibit significant variability, with some years experiencing many days of above-normal flows driven by heavy precipitation and rapid snowmelt, while other years show numerous days of below-normal flows, signaling potential drought conditions.[1] These elevated winter peak flows can scour streambeds and destroy salmon eggs in their redds, particularly as more precipitation falls as rain rather than snow.[2]

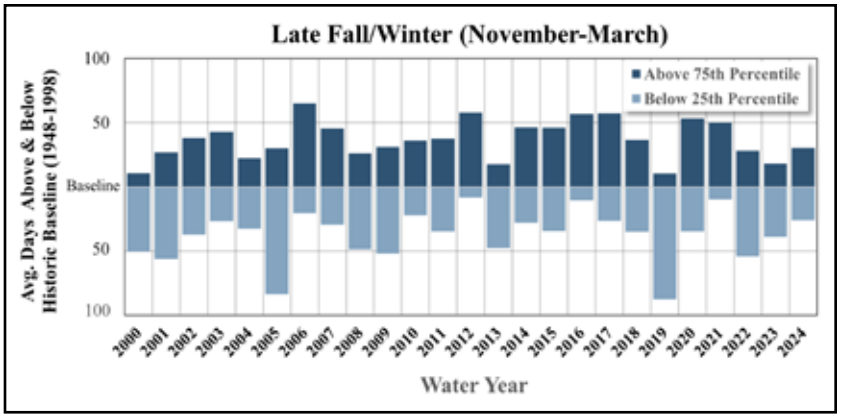
Summer patterns (July-October, Figure 3) and spring flows (April-June, Figure 2) reveal concerning trends toward more frequent below-baseline flows. These low flows lead to warmer water temperatures and reduced oxygen levels, adversely impacting salmon health and increasing mortality rates among eggs and juvenile fish.[3] Lower water levels also restrict accessible habitat, making salmon more vulnerable to predators and increasing competition for limited resources.[1,4] The challenges are particularly acute during critical migration and rearing periods when adequate flows are essential for survival.

Climate change intensifies these streamflow challenges through multiple pathways. Increased temperatures lead to more rapid snowmelt, altering the timing and intensity of peak flows.[3,4] The shift from snow to rain in winter precipitation increases the frequency of high-flow events that can destroy salmon redds, while earlier snowmelt contributes to lower summer flows.[1]

These changes create a recurring pattern of habitat disruption that threatens salmon survival rates, reproductive success, and overall population health. The observed trends underscore the broader impacts of climate change on aquatic ecosystems and highlight the importance of continued monitoring and management to preserve salmon populations that are ecologically and economically vital to the region.



Distribution of USGS Hydro-Climatic Data Network (HCDN) stream gauge locations around the Pacific Coast Region, where streamflow conditions primarily reflect climatic variations and are minimally affected by human disturbance.



Average number of days during late fall/winter (November through March 2000–2024) where flows at five Pacific Coast stream gauges fell outside the 25th and 75th percentiles of the 1948–1998 historic baseline.

Map Data Sources: SSHIAP 2004[5], USGS 2024[6], WAECY 2024[7]

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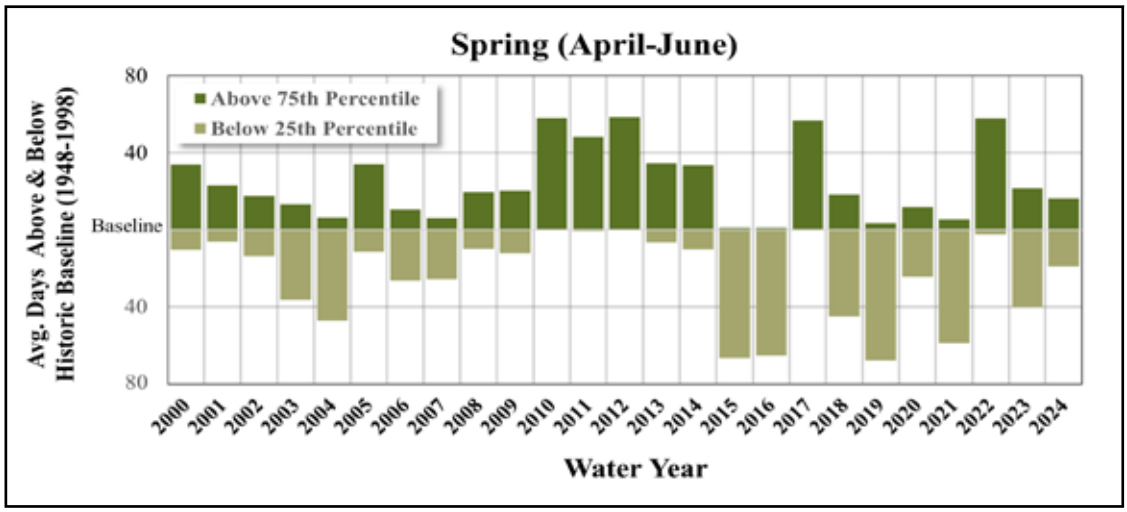
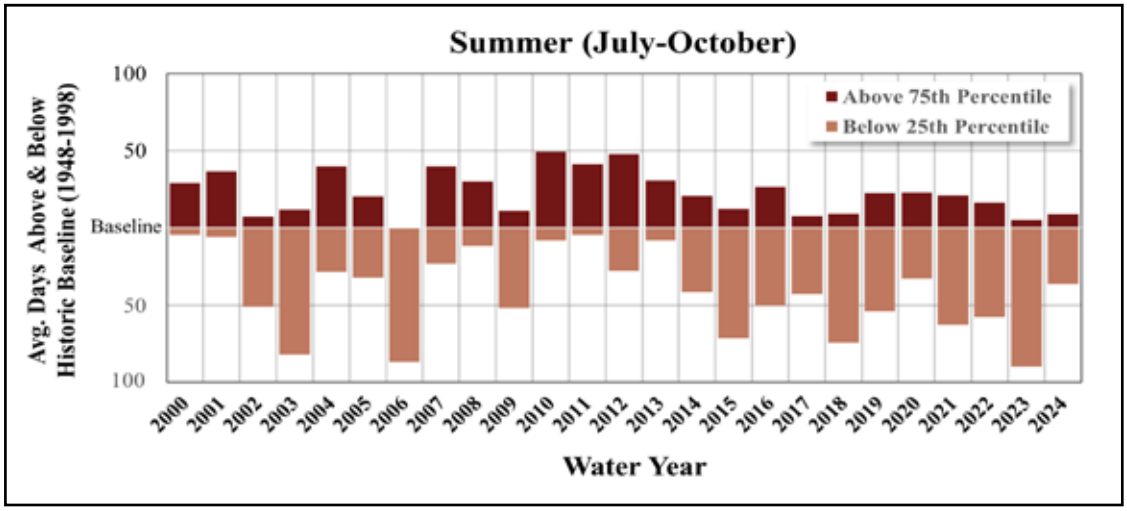


Average number of days during spring (April through June 2000–2024) where flows at five Pacific Coast stream gauges fell outside the 25th and 75th percentiles of the 1948–1998 historic baseline.



Average number of days during summer (July through October 2000–2024) where flows at five Pacific Coast stream gauges fell outside the 25th and 75th percentiles of the 1948–1998 historic baseline.

NWIFC

A pink salmon travels upstream to spawn in the early fall low flows in Washington state.

Washington Water Science Center

Calawah River near Forks, WA, during November 2021 high flows.

Tribes, State and Federal Land Managers Address the Environmental Impacts of Outdoor Recreation in Washington State

According to a recent economic analysis, outdoor recreation directly contributed over $18.8 billion to the state's economy. Over two-thirds ($12.65 billion) of that trip activity occurred in the western Washington, the core treaty area of the western Washington treaty tribes. The economic, societal and individual benefits of outdoor recreation in western Washington come at a cost to tribal treaty resources and to the ecological health of these watersheds.

A mounting body of research confirms what tribal members and resource managers are seeing across the landscape, recreational activities can and do have significant impacts on the environment and on the resource itself. These recreational activities include both motorized and non-motorized uses as well as recreational fisheries in marine and freshwaters. Direct and indirect effects of this use have been found to be damaging to the environment causing degradation of upland, riparian and coastal habitats. Outdoor recreation has been known to cause damage to vegetative communities, changes to the range and health of fish and wildlife, and the compromise of cultural and spiritual sites.

The impacts from these activities have resulted in human disturbance throughout even the most remote areas of public lands and treaty areas. Although we understand the many benefits outdoor recreation provides to Washington residents and visitors, these areas need improved protection to preserve fish, wildlife, plants and habitat that treaty rights depend upon.

Dan Coe, WA Dept. of Natural Resources

Visitors at Ruby Beach in Olympic National Park

Tribes are currently working with state and federal land managers to ensure recreation management policy is based on best available science, tribal knowledge, cross-jurisdictional coordination and ecological sustainability. This will result in smarter and more consistent recreation planning and management across state and federal public lands. By doing so, this will result in recreation that better upholds tribal treaty rights and improves protection and management of treaty-reserved resources. Such a policy will help protect the long-term ecological health of lands and resources not just for tribes, but for all who value them.

WA Dept. of Fish and Wildlife

Crowds gather for a razor clam dig at Copalis Beach.

Ocean Conditions

The marine Areas of Interest for the tribes on the Washington outer coast have been heavily impacted by ocean warming, including marine heat waves, hypoxia and harmful algal blooms (HABs).

In recent years, the California Current System (CCS) has experienced nearly annual marine heat waves, defined as periods when the surface sea water temperature exceeds the seasonally averaged threshold for at least five days over a large area.

None of these marine heat waves were as intense or long lived as the 2014-2016 “Blob," but they have had the potential to impact fisheries off the West Coast. Additionally, in 2024-25, tribal fishers reported encountering anomalously warm waters on their fishing grounds well into the winter.

On a broader scale, the Pacific Basin has also experienced a 3-year La Niña, followed by a 1-year El Niño. During La Niña conditions, wind and ocean circulation in the central Pacific weaken, typically resulting in cooler marine conditions on the West Coast that are favorable for salmon. During an El Niño, the opposite occurs, and warmer, subtropical waters intrude up the West Coast, and can disrupt marine food webs and ecosystem productivity.

The cold, nutrient rich waters that are upwelled off the Washington coast are part of the reason why these waters are highly productive. However, this high productivity is also the driver of seasonal hypoxia and locally enhanced acidification, which is typically observed in the summer months.

Hypoxia off the Olympic Coast of Washington is most severe between Grays Harbor and La Push. Seasonal moorings deployed by the Olympic Coast National Marine Sanctuary since 2006 have documented the increasing severity and duration of hypoxic conditions off of the Olympic Coast, with hypoxic conditions being in place in waters greater than 40 meters depths for more than half of the summer in most years.

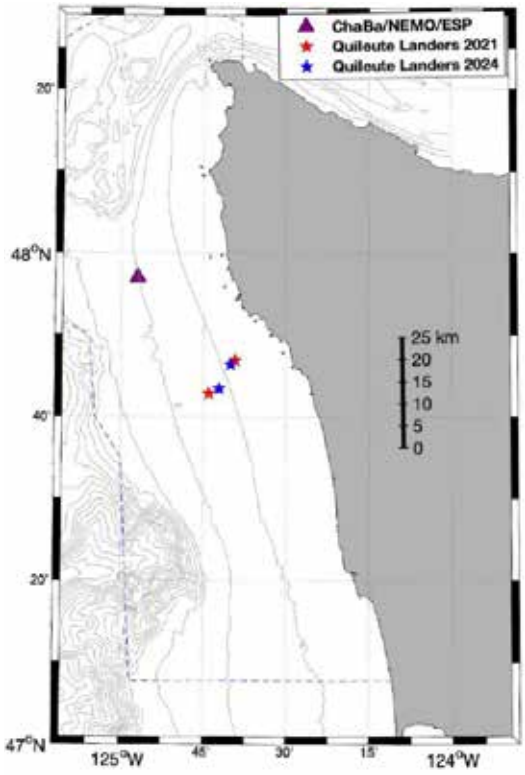
HABs generally occur during warm periods when southward winds drive upwelling of nutrient-rich waters followed by northward wind that can cause downwelling and also push these highly productive waters onto the coast. McCabe et al. and McKibben et al. have found that HABs in the CCS are strongly correlated with El Niño events and warm phase of the Pacific Decadal Oscillation.[1,2]

Domoic acid concentrations were high enough in 2021 and 2023 to temporarily close tribal shellfish fisheries. All major *Pseudo-nitzschia* HAB events have occurred after periods of warming, and projected warming across the region raises concerns about the frequency and severity of HAB events in the region.[3]

The most severe HAB in recent history occurred in 2015, when a prolonged severe HAB was driven by the combination of a severe marine heat wave and a strong El Niño. This HAB event caused widespread closures of shellfish fisheries, including razor clams and Dungeness crab and likely impacted marine mammals on the U.S. West Coast.

In response to the changing marine conditions and their impacts on fisheries, tribes on the outer coast have been actively leading research and monitoring efforts to document and better understand what is happening in the marine environment.

The Quinault Indian Nation has been monitoring hypoxia conditions on their crab grounds by deploying dissolved oxygen sensors in crab pots. The Quileute Tribe has invested in two benthic lander buoys, which are transmitting real-time bottom water conditions throughout the summer. Both the Quinault and Quileute are actively engaged in the Backyard Buoys program, and have deployed wave buoys off their coasts, allowing them to monitor marine conditions and help ensure the safety of their fishers. All tribes on the outer coast are actively monitoring for HABs, including offshore productivity monitoring.



Quileute 2021 and 2024 Lander Deployment Sites.

Kathy Hough

Quileute and UW Applied Physics Laboratory staff demonstrate the assembly and deployment of landers aboard the Olympic Coast National Marine Sanctuary Research Vessel Storm Petrel in 2024.

Climate Change

The watersheds of the Pacific Coast are experiencing changes driven by the climate crisis that will likely accelerate in the future: more frequent extreme heat events, warmer stream temperatures, subsequent increases in fish disease, shrinking glaciers and snowpack, lower summer streamflows, more extreme winter floods, shifts in streamflow patterns and timing, more frequent wildfire, warmer ocean temperatures, changing ocean chemistry, and flooding and erosion from more intense winter storms and rising sea levels. These changes are compounded by the effects of habitat destruction and fragmentation described in this report. Efforts to restore habitat integrity and diversity contribute to the resilience of the species and ecosystems that are fundamental to tribal treaty rights and traditional ways of life.

Extreme Events

In the northwest, extreme events such as droughts, floods and record-setting high temperatures have resulted in decreasing animal and plant populations and ecosystem transformation. Air temperatures are projected to increase during all seasons of the year throughout the watersheds of the Pacific Coast, but especially in the summer.[1] Extreme rainfall, floods and droughts are projected to increase in both frequency and intensity in the Pacific Northwest.[2] Along the Pacific Coast, precipitation during the late summer is projected to decrease by as much as 20%, while winter precipitation is expected to increase by 9% by the end of the century under a high greenhouse gas (GHG) emissions scenario.[3]

Snowpack and Glaciers

Along with changes to precipitation patterns, warmer temperatures are also driving loss of snowpack and glaciers in higher elevations. Glaciers and snowpack in the high elevations of the Olympic Mountains have historically provided a reliable reservoir that gradually supplied water to rivers during the spring and summer melt. In the western U.S., snowpack records show trends toward smaller volumes, earlier peak accumulation dates, and decreasing duration.[4] By the end of the 21st century, the amount of snowpack in the mountains of the Pacific Coast (measured as snow water equivalent on April 1st) is projected to decrease by 90% in a high GHG emissions scenario.[5]

Streamflow and Water Temperature

Salmonids and other aquatic species in Pacific Coast watersheds are adversely affected by changing freshwater conditions: warmer stream temperatures, higher peak flows, lower summer flows, and changes in timing of low and peak flows.[6] Stream temperatures in the Pacific Northwest have been warming for the last 50 years.[7] Lower flows and warmer air temperatures both contribute to this trend. By the end of the 21st century, the average August temperatures in many mainstem river locations that salmonids rely on for migration will exceed their thermal tolerances.[8] Annual maximum temperatures will likely be even higher.

Across the watersheds of the Pacific Coast, winter streamflows are projected to continue to increase, with the greatest growth in the rivers of the Olympic Mountains as snowpack decreases and more precipitation falls as rain instead of snow.[9] The Olympic Mountains are also projected to have the largest declines of summer low flows.[10] As surface water and snowmelt diminishes, groundwater levels will also decrease.[11] Regional variations in groundwater withdrawal interacting with climate drivers complicate projections, but warmer temperatures and increasing severity and duration of droughts lead to higher demand for groundwater for human use during times when aquatic ecosystems are most vulnerable to water deficits.

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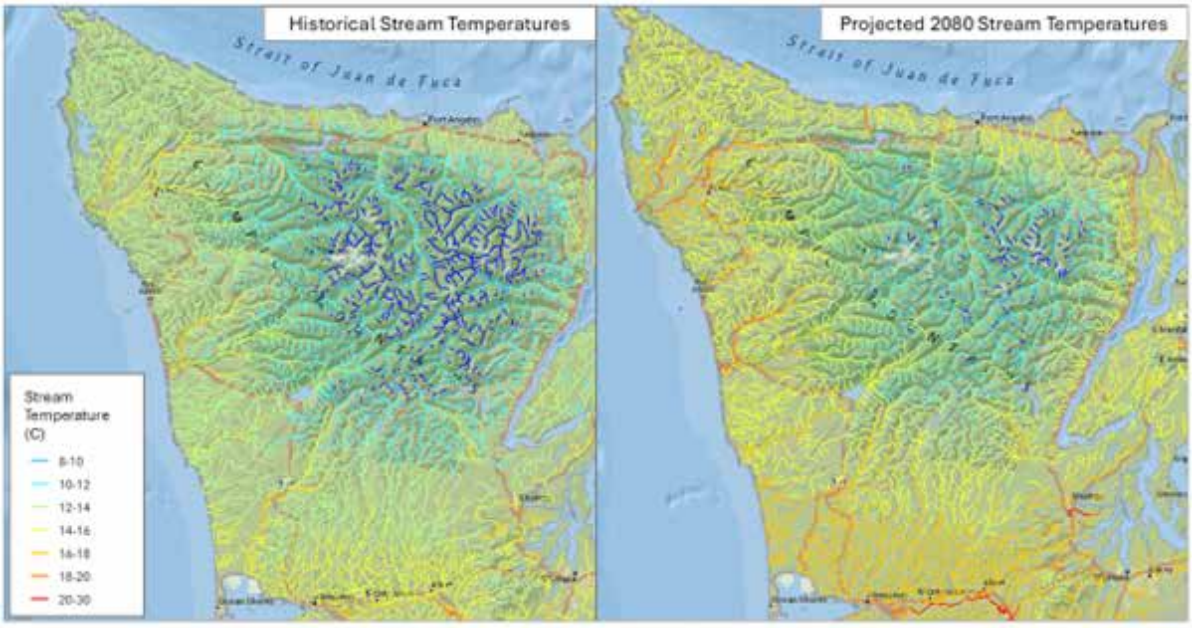

Average August stream temperatures for the Olympic Peninsula. Left: Historical record for 1993-2011. Right: Projections for 2080 under a moderate GHG emissions scenario.[12]

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Terrestrial Ecosystems

Terrestrial plants and animals are vulnerable to major ecosystem disturbances such as wildfire, pests and invasive species. Low to mid-elevation moist forests of the Olympic Mountains are projected to experience a small increase of wildfire frequency and extent and high-elevation forests are projected a moderate increase in risk by the end of the 21st century.[13] Warmer air temperatures, drier summers and earlier snowmelt contribute to these trends. Invasive species that can outcompete or displace species important to tribes are expected to spread as temperatures increase, especially in the winter, and as droughts become more frequent, longer and more severe.[14]

In June 2021, an extreme heat wave broke air temperature records across much of the Pacific Northwest. This extreme event would not have been possible without climate change.[15] Among the negative effects to ecosystems across the region was widespread conifer needle desiccation damage. Aerial surveys of tree canopy in Washington recorded 84,000 acres of damage with some of the highest concentrations of damaged trees in the western Olympic Peninsula.[16] While many tree species were affected, the damage was most visible on conifers such as Douglas fir, western hemlock, western red cedar and Pacific silver fir. Heat scorch was most pronounced on trees closer to the Pacific Coast, on south and west facing slopes, on younger trees, and on the southwest and western sides of canopies.[17] While larger and otherwise healthy trees may be able to recover from desiccation, drought damage from extreme events likely increases tree susceptibility to insects and disease.

Sea Level Rise

While global sea level rise (SLR) is the result of the melting ice sheets and glaciers combined with the physical expansion of ocean water as it warms, local SLR includes the effects of vertical land movement. Tectonic forces in our region vary over time and location, so relative SLR does as well. Vertical uplift in the Pacific Coast region is the most rapid in the northwest Olympic Peninsula at about 3.5 mm per year. Between La Push and Kalaloch, the land is subsiding at 0.5 to 1.0 mm per year.[18] The gradual inundation caused by relative SLR is occurring in conjunction with more extreme storm surge and king tides to exacerbate severe flooding and erosion that can damage coastal habitat and important tribal cultural sites. Projections of relative SLR for 2100 under a high GHG emission scenario vary geographically:[19]

- Neah Bay: 1.0 ft central estimate, likely in the range of 0.3 to 1.7 ft
- La Push: 1.9 ft central estimate, likely in the range of 1.2 to 2.7 ft
- Taholah: 1.7 ft central estimate, likely in the range of 1.0 to 2.5 ft

Strategies for Resilience

Tribes play a leadership role in understanding and responding to the effects of the climate crisis in their watersheds. Efforts to protect and restore habitat complexity and integrity boost the resilience of species and ecosystems to changing climate conditions. For example, reforestation of riparian zones along streams and reconnection of floodplains to their rivers reduce temperature impacts, create critical off-channel refuges from high temperatures and high flows for salmonids, and improve flood conveyance.[20] Tribes also are responding with actions to reduce GHG emissions through renewable energy production, energy efficiency, and carbon sequestration, or long-term storage in biological systems.

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2025 Pacific Coast Regional Report

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Developed Impervious Surface Continues to Increase

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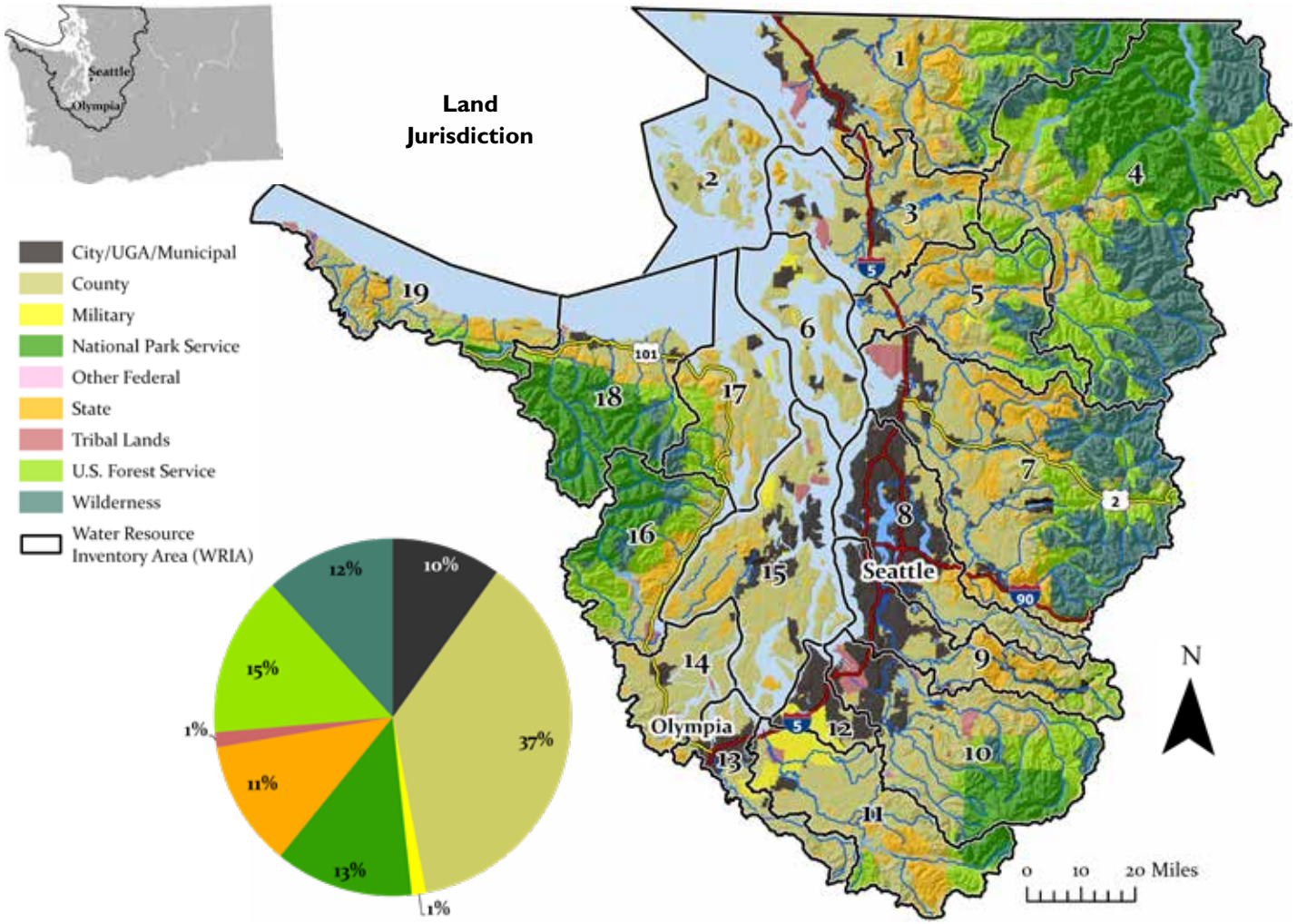
2025 Puget Sound Regional Report



The Puget Sound region includes the second largest estuary in the United States covering approximately 16,575 square miles, consisting of a complex estuarine system of interconnected marine waterways and basins. The Puget Sound has over 20 major river systems, from the Nooksack River along the Canadian border southwest to the Elwha River along the Strait of Juan de Fuca. Some of these watersheds originate in the steep high-elevation headwaters of the Cascade and Olympic mountains with an elevation of over 14,000 feet at the glaciers of Mount Rainier. Rainfall ranges from about 16 inches annually at Sequim, Wash., to over 100 inches at Mount Rainier.[1]

The Puget Sound region is the traditional home to 19 federally recognized tribes, who have harvested and managed the natural resources of Puget Sound since time immemorial. Euro-Americans began settling the area in the 1850s primarily for the logging resources, along with opportunities in farming and mining. Lowland land clearing for agriculture began in earnest by the 1890s. By the early 1900s, denudation of the forested lowland areas was complete, and nearly all of the lower portions of the basins were converted from forest production. Historically and presently, land use has been dominated by physical geography.

The foothills and mountains are mainly used for wood products and outdoor recreation. The lowlands are primarily used for agriculture and rural residential development. Most of the urban and industrial land use is concentrated near the deltas and lower floodplains.

The Puget Sound is home to two-thirds of the state's population, with a projected population increase to over 6 million by 2040.[2] The following pages look at the impacts of growth and its effects on the landscape and salmonids. Conditions such as increased impervious surface area, loss of floodplain connectivity, exempt well increases, forest cover loss, diminished riparian forest, culvert barriers and nearshore habitat impairment all negatively affect natural salmonid production. Sustainable natural salmonid production cannot increase unless the quality and quantity of habitat is increased. Natural production lost to habitat degradation and blocked passage must be mitigated by hatchery production to provide an opportunity for the tribes to exercise their treaty right to harvest salmon. Hatchery production cannot be reduced unless there is a commensurate increase in sustainable natural production and habitat recovery is required for that to happen.

The Puget Sound region supports eight different anadromous salmonid species, Pink, Chum, Chinook, Coho, Sockeye, steelhead trout, bull trout and cutthroat trout. Chinook, Hood Canal Summer Chum, steelhead trout and bull trout are all listed as threatened species under the Endangered Species Act and have Salmonid Recovery Plans outlining strategies for recovering these populations.

Map Data Sources: DOD 2023[3], SSHIAP 2004[4], USFWS 2024[5], WADNR 2024a[6], WADNR 2024b[7], WAECY 2020[8], WAECY 2021[9], WAECY 2024a[10], WAECY 2024b[11], WSDOT 2018[12], WSDOT 2023[13]

Chapter Summary

The Northwest Indian Fisheries Commission member tribes have fished, hunted, gathered and practiced their cultural identities along the rivers, tributaries and waters of the Puget Sound since time immemorial. No one on this earth is more connected to the watersheds, its water, plants, fish and animals than the region's tribes. At the heart of that connection is salmon, which has always been a primary source of life.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those watersheds.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

For this status report of the Puget Sound, the tribes have focused on the issues that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Shoreline Modifications Continue to Impact Nearshore Habitat

Washington state has roughly 2,460 miles of shoreline in the Puget Sound and the Strait of Juan de Fuca alone. Of the total miles of shoreline, 26.39% (598.9 miles) are armored to some degree. From 2020 to October 2024, there have been a total of 202 Hydraulic Project Approvals (HPAs) approved for shoreline armoring work. Repairs, replacements and modifications to existing armor account for 85% of these HPAs. Only nine HPAs were for the removal of armoring.

Impervious Surface Continues to Increase

Impervious surface area has been on the rise in the Puget Sound region particularly in the region's lowlands. Between 2001 and 2021, the percentage of impervious surface increased from 4.72% to 5.23%. The majority of this increase has occurred in Pierce, King and Snohomish county watersheds.

Forest Cover

In the Puget Sound region (WRIA 1-19), there are approximately 8,000 square miles of land within the state's jurisdiction. Using newly available data, it is estimated that 65.6% (5,250 square miles) of this region is forested as of 2021 with trees greater than 15 feet in height.

Riparian Forest Cover

In the Puget Sound region there are roughly 1,925 square miles of riparian habitat within the state's jurisdiction. This habitat is vital for water quality, salmon health and many other critical ecosystem functions. As of 2021, 71.47% of this riparian area was forested by trees greater than 15 feet in height.

Floodplain Land Cover Change Impacts

In the Puget Sound lowlands, approximately 1,285 square miles of floodplain habitat exist, with a land cover composition of 49% forest/shrub, 27% agriculture, 17% developed and 7% other/natural areas. Preserving functional floodplains is crucial for Puget Sound's watersheds and ensuring salmonids retain essential shelter, refuge and food sources.

Fish Passage Barriers Continue to be Identified in Puget Sound

There are 11,623 fish passage barriers in the Puget Sound region that have been identified by the Washington Department of Fish and Wildlife to impact migrating salmonids. While many of these barriers are owned by the state and fall under the rulings of the Culvert Case injunction, the majority are owned by other government agencies and private landowners. These culverts continue to restrict access to habitat for salmon while often having no timeline for replacement.

Water Quality

In the Puget Sound Region, 60% of assessed waters were determined to be impaired for one or more parameters according to the 2018 data, with temperature and bacteria being the most prevalent issues. Of the water quality assessed streams that are salmonid bearing, 88% are impaired for one or more parameters, potentially impacting the viability of salmonid populations.

Groundwater Withdrawals Impact Surface Flows

Since 1980, over 35,000 permit-exempt wells have been developed in the Puget Sound region. Between 2019 and 2024, 2,975 wells were built, representing a 3.7% increase compared to the previous five years. This growing rate of new water well installations pose a threat to groundwater availability and stream ecosystem health across the region.

Streamflow Trends

Recent streamflow data from 14 USGS stream gauges across the Puget Sound region reveal significant seasonal deviations from historic baselines (1948-1998), with increasing days of below-average flows in summer (July-October) and spring (April-June), and changing patterns in late fall and winter flows (November-March). These alterations indicate potential climate change impacts on critical freshwater ecosystem conditions.

Recreational Impacts

The economic, societal and individual benefits of outdoor recreation in western Washington come at a cost to tribal treaty resources and the ecological health of these watersheds.

A mounting body of research confirms what tribal members and resource managers are seeing across the landscape: recreational activities can and do have significant impacts on the environment and on the resource itself.

Puget Sound Climate Change

The watersheds of Puget Sound are exhibiting changes driven by the climate crisis that will likely accelerate in the future: more frequent extreme heat events, warmer stream temperatures, subsequent increases in fish disease, shrinking glaciers and snowpack, lower summer streamflows, more extreme winter floods, shifts in streamflow patterns and timing, more frequent wildfires, warmer ocean temperatures, changing ocean chemistry, and flooding and erosion from more intense winter storms and rising sea levels.

Conclusion

The tribes want to maintain and restore ecological processes that support natural ecosystem conditions that will sustain salmon productivity in all watersheds of Puget Sound in perpetuity. While habitat improvement is a major component to sustain salmon productivity, it is recognized that without protecting existing habitat functions, restoration activities cannot reverse the decline of salmon populations within Puget Sound. In this regard, conclusions in the State of Our Watersheds Report in 2025 are very concerning.

There are clear strategies for recovery that are resulting in the acquisition and restoration of critical salmon habitat in Puget Sound. However, restoration is expensive and funding remains a challenge. As well, restoration requires the participation of willing political leaders and landowners, which is not always readily available. As restoration and acquisition projects continue, these two factors (political support and willing landowners) greatly affect the pace at which it occurs.

The legacy of European colonization on the landscape remains largely unchanged. Floodplain land cover and riparian forest cover have reduced to critical levels, too much of the marine nearshore remains armored, and nonpoint pollution continues to threaten our waterways, salmon and shellfish populations. People continue to move into the Puget Sound Region, either reinforcing development patterns of the past, or bringing new development to previously undeveloped areas. Changing this legacy of land use is a long, slow and very contentious process. It requires adherence to the laws and regulations of federal, state and local governments. Implementation of those laws, which happens locally, is often left to the goodwill of landowners. Politically, this is most palatable, but it has proven inadequate for the needs of salmon habitat recovery. Moving forward, as more people move into the region, better enforcement of the existing regulatory framework or an overall shift in how we manage development will become even more necessary.

Review of the trends for these key environmental indicators shows a declining trend for most and a real concern for a few:

Tribal Indicator	Status	Habitat Trend
Shoreline Modifications	Washington state has roughly 2,460 miles of shoreline in the Puget Sound and the Strait of Juan de Fuca alone. Of the total miles of shoreline, 26.39% (598.9 miles) are armored to some degree. From 2020 to October 2024 there have been a total of 202 HPAs approved for shoreline armoring work. Repairs, replacements, and modifications to existing armor account for 85% of these HPAs. Only nine HPAs were for the removal of armoring.	**Concerns**
Impervious Surface	Impervious surface area has been on the rise in the Puget Sound region particularly in the region's lowlands. Between 2001 and 2021, the percentage of impervious surface increased from 4.72% to 5.23%. The majority of this increase has occurred in Pierce, King, and Snohomish County watersheds.	**Declining**
Forest Cover	In the Puget Sound region (WRIA 1-19) there are approximately 8,000 square miles of land within the state's jurisdiction. Using newly available data, it is estimated that 65.6% (5,250 square miles) of this region is forested as of 2021 with trees greater than 15 feet in height.	**Concerns**
Riparian Forest Cover	In the Puget Sound region there is roughly 1,925 square miles of riparian habitat within the state's jurisdiction. This habitat is vital for water quality, salmon health, and many other critical ecosystem functions. As of 2021, 71.47% of this riparian area was forested by trees taller than 15 feet in height.	**Concerns**
Land Cover - Floodplain	In the Puget Sound lowlands, approximately 1,285 square miles of floodplain habitat exist, with a land cover composition of 49% forest/shrub, 27% agriculture, 17% developed, and 7% other/natural areas. Preserving functional floodplains is crucial for Puget Sound's watersheds and ensuring salmonids retain essential shelter, refuge, and food sources.	**Declining**
Barrier Culvert	There are 11,623 fish passage barriers in the Puget Sound region that have been identified by the WDFW to impact migrating salmonids. While many of these barriers are owned by the state and fall under the rulings of the culvert injunction, the majority are owned by other government agencies and private landowners. These culverts continue to restrict access to habitat for salmon while often having no timeline for replacement.	**Declining**
Water Quality	In the Puget Sound region, 60% of assessed waters were determined to be impaired for one or more parameters according to the 2018 data, with temperature and bacteria being the most prevalent issues. Of the water quality assessed streams that are salmonid bearing, 88% are impaired for one or more parameters, potentially impacting the viability of salmonid populations.	**Declining**

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Review of the trends for these key environmental indicators shows a declining trend for most and a real concern for a few:

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Wells	Since 1980, over 35,000 permit-exempt wells have been developed in the Puget Sound region. Between 2019 and 2024, 2,975 wells were built, representing a 3.7% increase compared to the previous five years. This growing rate of new water well installations pose a threat to groundwater availability and stream ecosystem health across the region.	**Declining**
Stream Flows	Recent streamflow data from 14 USGS stream gauges across the Puget Sound region reveal significant seasonal deviations from historic baselines (1948-1998), with increasing days of below-average flows in summer (July-October) and spring (April-June), and changing patterns in late fall and winter flows (November-March). These alterations indicate potential climate change impacts on critical freshwater ecosystem conditions.	**Concerns**
Climate Change	The watersheds of Puget Sound are exhibiting changes driven by the climate crisis that will likely accelerate in the future: more frequent extreme heat events, warmer stream temperatures, subsequent increases in fish disease, shrinking glaciers and snowpack, lower summer streamflows, more extreme winter floods, shifts in streamflow patterns and timing, more frequent wildfires, warmer ocean temperatures, changing ocean chemistry, and flooding and erosion from more intense winter storms and rising sea levels.	**Concerns**

The tribes continue to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded and conducting research to understand the organisms and their interactions with the habitats they rely on for survival.

Looking Ahead

The increasing population of western Washington negatively impacts the landscape both physically and biologically. With population growth comes increased negative effects upon the landscape and the ecological process that sustain salmonids: developed impervious surfaces; forestland conversions for housing and infrastructure; pollution; water consumption; increased opportunity for invasive species; landscape modification (e.g., docks, piers, levees, culverts, bank hardening, channel modification); reduction in species diversity/density; loss of contiguous habitat (e.g., riparian, migration corridors); and related effects (e.g., sedimentation, mass wasting, climate change, diminished water quality, aquifer/groundwater depletion, native species endangerment/extirpation). While population growth is expected to continue, that growth needs to be managed to minimize its potential additional negative effects and ongoing and historic impacts must be mitigated and restored to ensure a resilient ecosystem for all species.

Among these impacts, impervious surfaces restrict groundwater recharge and contribute to increased pollution, both chemical and physical. Surface water withdrawals reduce streamflows and wetland volume downstream. Groundwater withdrawals, if not balanced by recharge, reduce streamflow, wetland volume and freshets into seawater. Larger and additional roads and railways increase the number of stream crossings with the potential to impact salmonid access to habitat and add additional impervious surfaces. Canopy cover is an important component of our hydrologic cycle; it supports life important to the salmonid life cycle. In the riparian zone, forests moderate temperature impacts, contribute woody debris, capture some pollutants otherwise released to the landscape, and reduce the potential for mass wasting events.

The increase in global average temperatures in the air and oceans contributes to the suite of climate change effects. Climate change occurs within the context of land and water use patterns that already have diminished the ecological integrity of our watersheds. These changes leave aquatic and terrestrial species increasingly vulnerable to changes in climate conditions in the Pacific Northwest region. The deep relationship between traditional tribal lifeways and the ecosystems of Puget Sound leave member tribes especially vulnerable to the effects of climate change. Critical tribal resources, including salmon, shellfish, traditional plants and wildlife, are already experiencing climate change related impacts. The tribes employ many strategies to protect natural resources but climate change could threaten the effectiveness of these strategies and the resilience of ecosystems in responding to historic and the ongoing impacts of land use and future development.

Shoreline Modifications Continue to Impact Nearshore Habitat

Washington state has roughly 2,460 miles of shoreline in the Puget Sound and the Strait of Juan de Fuca alone. Of the total miles of shoreline, 26.39% (598.9 miles) are armored to some degree. From 2020 to October 2024, there have been a total of 202 Hydraulic Project Approvals (HPAs) approved for shoreline armoring work.[1] Repairs, replacements and modifications to existing armor account for 85% of these HPAs.[1] Only nine HPAs were for the removal of armoring.[1]

Shoreline armoring is the addition of bulkheads, seawalls or riprap along the intertidal zone, most often to minimize erosion. While armoring is needed to protect infrastructure and development, it is known to be damaging to many nearshore ecological processes.[2]

King (55%) and Pierce counties (53%) have the highest percentage of armored shoreline whereas San Juan and Jefferson have the lowest. There are also 181.6 miles of artificial shoreline in the Puget Sound, which consists of areas with heavy armoring and fill. These areas are most often ports and urban waterfronts such as the Port of Everett or Seattle.

Particularly along feeder bluffs, minimizing the amount of armoring and shoreline modification is crucial. Feeder bluffs supply sand, gravel and nutrients to nearby beaches and estuaries.[2] This is known to impact the structure of nearshore habitat including beach slope, grain size and total intertidal habitat area.[3] Maintaining natural feeder bluffs also encourages terrestrial vegetation that contributes to shade and temperature in the ecosystem.[2] This process supports healthy intertidal invertebrate communities, which are a key source of food for juvenile forage fish and marine birds.[3]

Forage fish spawning success has been directly linked to the availability of nutrient and sediment supply from feeder bluffs.[4] Pacific herring (*Clupea pallasi*), surf smelt (*Hypomesus pretiosus*), and Pacific sand lance (*Ammodytes personatus*) spawn along intertidal and subtidal beaches composed of this sand and gravel. Surf smelt and Pacific sand lance are a key link in the Puget Sound food web between zooplankton and larger predatory fish and wildlife, such as salmonids.[4]

While the rate of new armoring being added to the Puget Sound region has decreased in the last 20 years, there are still Hydraulic Project Approval permits (HPAs) being approved to maintain existing shoreline modifications.[3] From 2020 to October 2024, there have been a total of 202 HPAs approved for shoreline armoring work.[1] Repairs, replacements and modifications to existing armor account for 85% of these HPAs[1]. Only nine HPAs were for the removal of armoring.[1] While tracking HPAs gives us a general idea of shoreline projects, they do not accurately track what work has actually been completed nor do they include detailed information on armoring length, height, materials or extent.

In order to gain a more accurate understanding of the extent of armoring in the Puget Sound, updated mapping needs to be done, and spatial requirements need to be added to the HPA process. While the map above relies on the best available dataset for the region currently, it is based on data collected from 2000-2013.

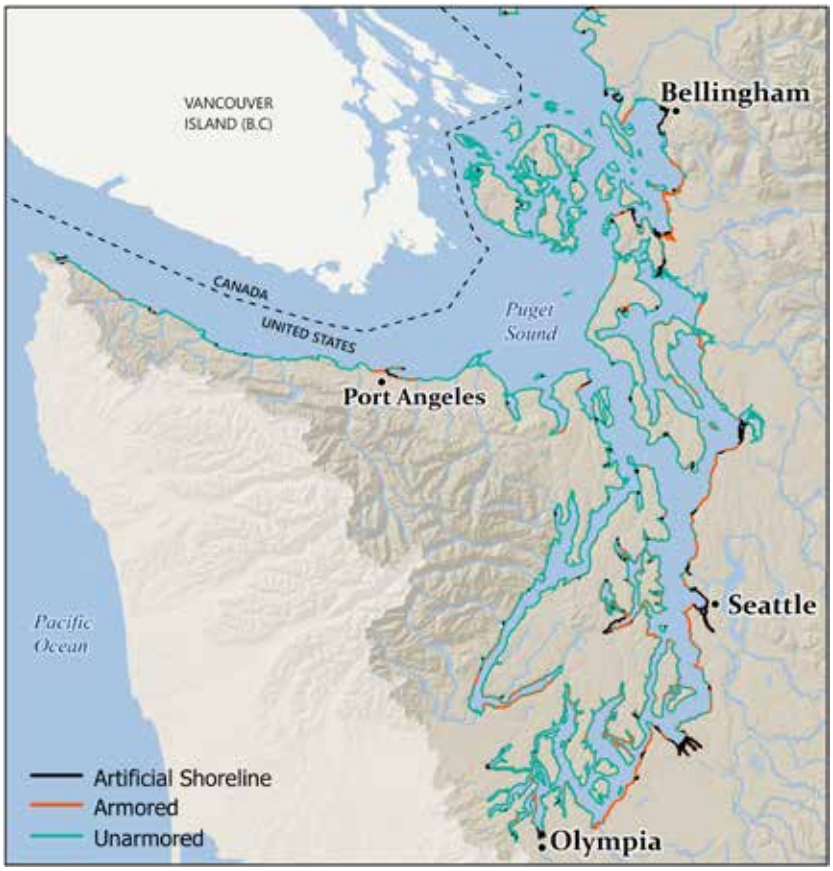
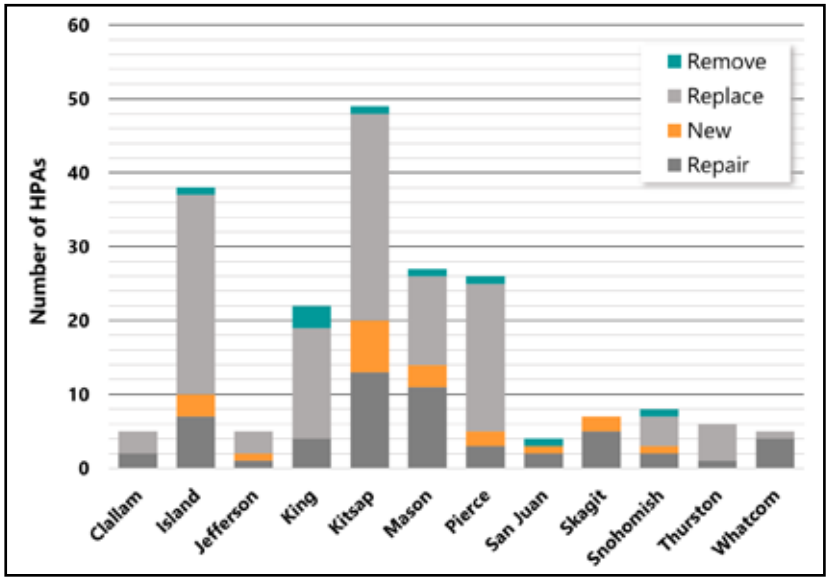


Chart 1. Shoreline Armoring HPAs (2020-Oct 2024)



Map Data Sources: CGS 2017[5], CGS 2020[2], PSP 2024[6], SSHIAP 2004[7], WAECY 2024[8], WDFW 2024[1]

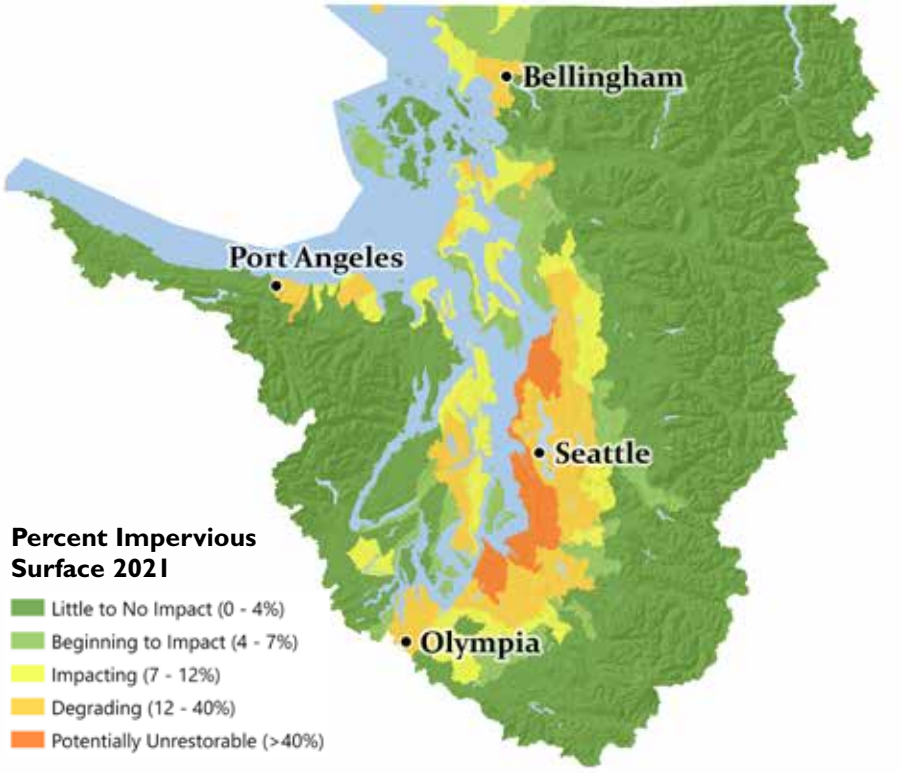
Impervious Surface Continues to Increase

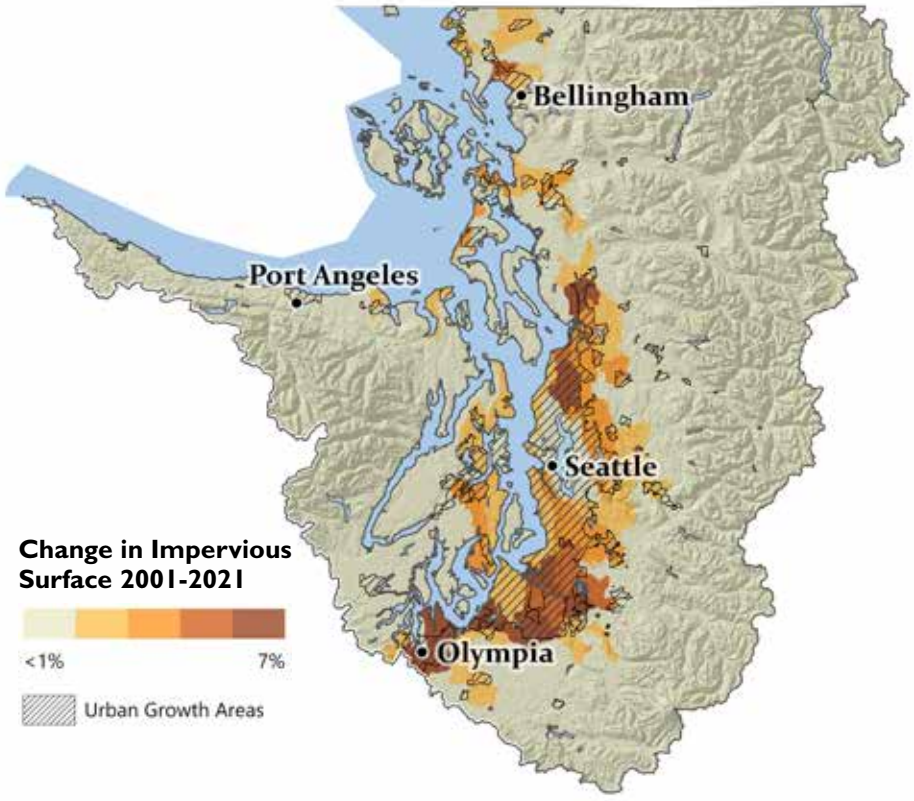
Impervious surface area has been on the rise in the Puget Sound region particularly in the region's lowlands. Between 2001 and 2021, the percentage of impervious surfaces increased from 4.72% to 5.23%. The majority of this increase has occurred in Pierce, King and Snohomish county watersheds.

Impervious surfaces are nonporous land cover such as paved roadways, parking lots and roofs that impact how water moves in a watershed. As impervious surface increases so does stormwater runoff and its impacts on water quality.[1] These impacts can trickle down to affect aquifer, ecosystem and fisheries health.

Since the last State of Our Watershed Report that analyzed 2016 impervious surface data, the Puget Sound region has seen impervious surface rise from 5.17% in 2016 to 5.23% in 2021. These surfaces prevent rainfall and snowfall from being absorbed into the ground where they normally would recharge aquifers and surface waters. The water that does manage to get absorbed in these developed environments does so at a lessened rate as the soil tends to have decreased water storage and infiltration abilities due to compaction.[2] Greater rates of runoff cause higher peak flows during wet times and lower dry weather flows due to lack of groundwater recharge.[3] Aquifer recharge and surface water storage is particularly important considering Washington's increasing population and the statewide drought conditions declared by the Washington Department of Ecology in April 2024.[4] Between 2001 and 2021, over 100 square miles of developed impervious surface has been added to the Puget Sound region, which represents an increase from 4.72% to 5.23% impervious surface. The majority of this development is concentrated in the lowlands where runoff is closer to entering our waterways.

The disruption of this flow also inhibits the natural physical, biological, and chemical processes that help remove pollutants and sediments from entering our waters.[5] Contaminated runoff poses significant threats to freshwater, estuarine and marine species, including the Pacific Northwest's salmon and steelhead runs.[6] Common pollutants such as heavy metals, pesticides, petroleum-based products and other toxins can lead to increased harmful algal blooms and decreased aquatic insect populations that salmonoids rely on.[6] These toxins are also known to impact salmon nervous systems which can disrupt feeding and predator avoidance.[6] The health of the current and future salmon populations is dependent on maintaining consistent and healthy water flows, particularly in habitat close to the Puget Sound.[1]





Map Data Sources: SSHIAP 2004[7], USGS 2001[8], USGS 2016[9], USGS 2018[10], USGS 2021[11], WAECY 2021[12], WAECY 2024[13]

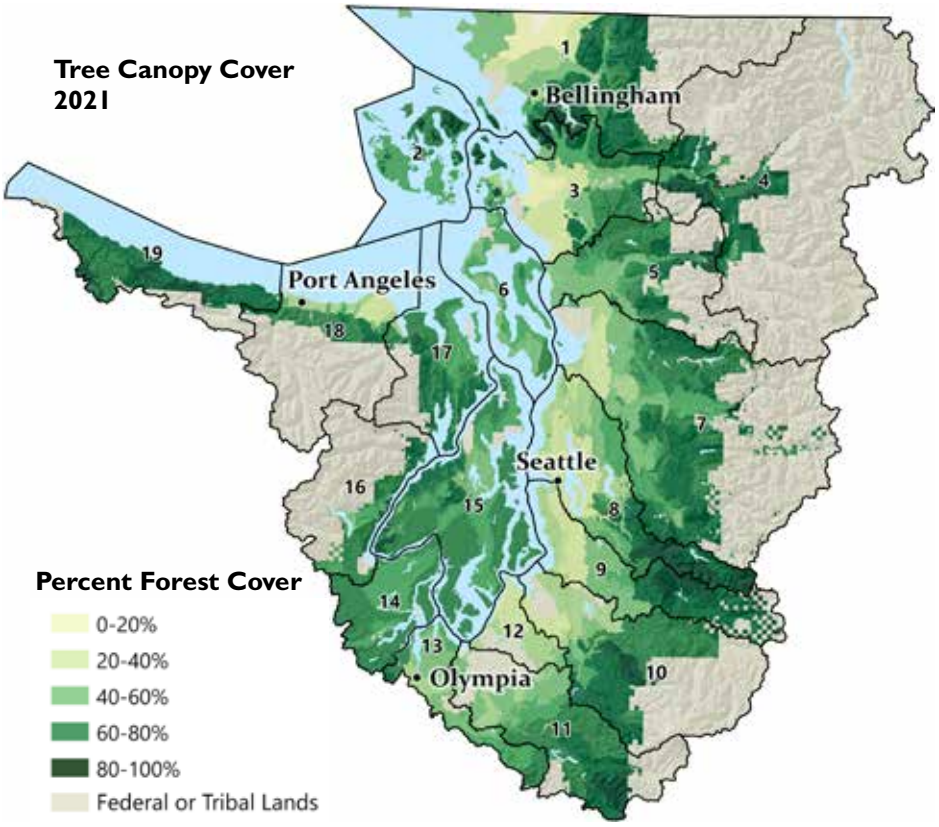
Forest Cover

In the Puget Sound region (WRIA 1-19), there are approximately 8,000 square miles of land within the state's jurisdiction. Using newly available data, it is estimated that 65.6% (5,250 square miles) of this region is forested as of 2021 with trees greater than 15 feet in height.

In past State of Our Watershed Reports, canopy cover data available at a regional scale was limited to low-resolution datasets based on 30-meter satellite imagery. In 2021, NOAA's Coastal Change Analysis Program (C-CAP) transitioned to producing canopy data at 1-meter resolution. With this improved data, we can now more accurately capture and estimate the extent of tree canopy cover in the state of Washington. Data at this resolution is better suited to capturing the loss and gain of individual trees over time.

Within the Puget Sound region, there are approximately 8,000 square miles of land in the state's jurisdiction; 4,085 mi^2 of this land is within the Puget lowlands (≤500 feet in elevation). Using the new data, it is estimated that 65.6% (5,250 square miles) of this region is forested as of 2021 with trees greater than 15 feet in height. Preserving this forested habitat in the Puget Sound is vital to water quality, salmon conservation and overall ecosystem function. Ensuring that our harvest and development are sustainable is important in protecting the longevity of forest health and connectivity.

The Washington Department of Natural Resources implements Forest Practice Applications to regulate and track forestry within the state. From 2014 to 2024, roughly 789 square miles of land in the Puget Sound region have been harvested or will be in the near future. The vast majority of these applications were issued for even-aged harvest types on privately owned land.[1, 2] Even-aged harvest types typically result in clear cuts as the trees are of equal harvestable size. Moving forward it is important that the state maintains forestry policies that not only take into account the economy but also conservation and the protection of our state's unique biodiversity.



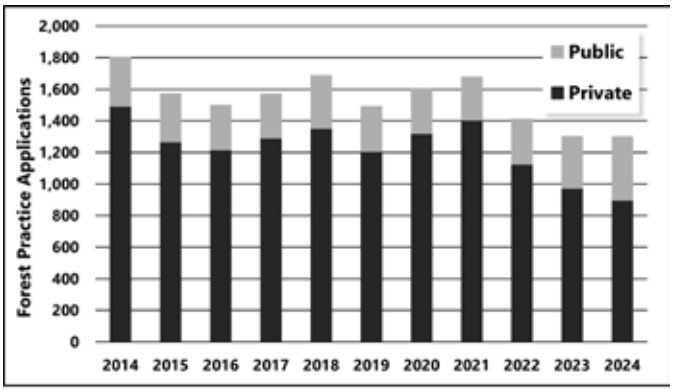


Chart 1. Forest Practice Applications for timber harvest on private vs. public lands from 2014 to 2024

Table 1. Percent forest cover on state lands in Water Resource Inventory Areas 1-19

WRIA	Water Resource Inventory Area	Lowland Forest Cover (<500 ft. elevation)	Upland Forest Cover (>500 ft. elevation)
1	Nooksack	35.6%	83.8%
2	San Juan	68.5%	92.4%
3	Lower Skagit - Samish	38.7%	78.0%
4	Upper Skagit	68.8%	79.3%
5	Stillaguamish	54.7%	77.0%
6	Island	60.6%	79.9%
7	Snohomish	48.6%	79.3%
8	Cedar - Sammamish	37.7%	80.0%
9	Duwamish - Green	32.7%	76.9%
10	Puyallup - White	31.2%	72.9%
11	Nisqually	44.3%	74.6%
12	Chambers - Clover	26.2%	32.3%
13	Deschutes	50.6%	70.7%
14	Kennedy - Goldsborough	70.8%	75.5%
15	Kitsap	71.9%	74.2%
16	Skokomish - Dosewallips	73.7%	68.5%
17	Quilcene - Snow	72.9%	74.1%
18	Elwha - Dungeness	38.6%	76.3%
19	Lyre-Hoko	87.4%	82.3%

Map Data Sources: NASA JPL 2013[3], NOAA 2021[4], SSHIAP 2004[5], USGS 2018[6], WADNR 2025[7], WAECY 2000[8] WAECY 2024[9]

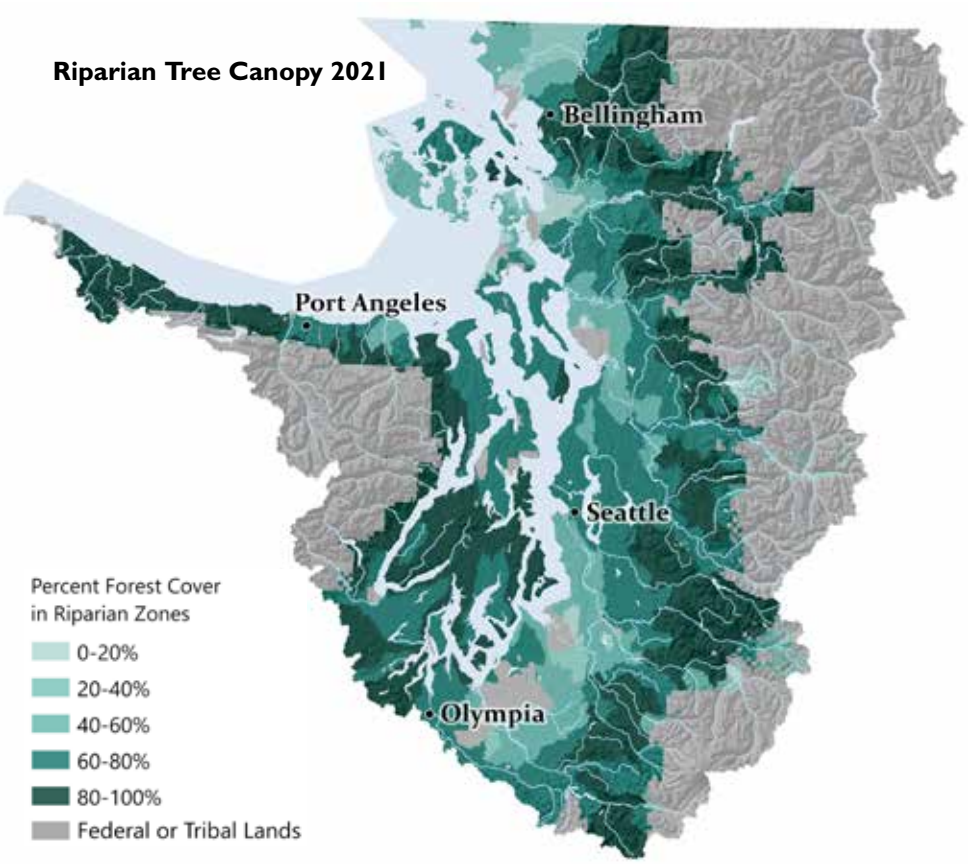
Riparian Forest Cover

In the Puget Sound region there are roughly 1,925 square miles of riparian habitat within the state's jurisdiction. This habitat is vital for water quality, salmon health and many other critical ecosystem functions.[1] As of 2021, 71.47% of this riparian area was forested by trees taller than 15 feet in height.

In forested ecoregions such as the Puget Sound, a riparian buffer aligned with a stream's site potential tree height is recommended by WDFW to protect the habitat's full ecological function.[2] However, state and local stream buffer requirements for development often don't align with these buffers. Analyzing the amount of tree canopy within these buffers can provide a good indicator of riparian health.

In past State of the Watershed Reports, it has been difficult to accurately calculate forest cover change due to the coarseness of data available and the characteristically small nature of riparian habitat. Prior to 2021, tree canopy data was only available based on 30-meter aerial imagery at an extent large enough to use for regional analysis. With changes to data in 2021, 1-meter data became available, which is more suited to accurately estimating riparian tree canopy cover.

While it is not the only factor to consider, forest cover can be a good indicator of riparian health due to its association with many key riparian functions. Directly, tree canopy cover provides shade to riparian areas that regulate water and air temperature.[3] This is important to many aquatic and terrestrial organisms that have narrow ranges of temperature and moisture that they can tolerate.[4] Mature native trees and shrubs also provide large woody debris to streams that support macroinvertebrate communities, a key food source in the salmonid life cycle.[1] Forests affect other key riparian ecosystem functions including streambank stability, detrital nutrient flow and pollution removal.[3] Particularly in the heavily developed Puget Sound region, pollution removal and sediment trapping are invaluable for the health of salmonoids.[5] Intact riparian zones with native vegetation are better able to decrease the impacts of nonpoint source pollution on streams that can degrade water quality.[5] Runoff from agriculture and stormwater when filtered through a riparian buffer can be transformed through physical, chemical, and biological processes that reduce the overall concentration of the pollutants entering the stream.[2]



If development in the Puget Sound region continues as it has, stronger riparian habitat protections need to be enforced to preserve their health. Combined with the impervious surface increase seen in the region, riparian habitat is under great threat. It has been observed that stream conditions become severely degraded when total forest cover dips below 65% when combined with effective impervious surface over 10%.[6] While the amount of impervious surface for the entirety of the Puget Sound region has risen to 5.23% (2021),[7] it is invaluable to consider the large portion of the Puget Sound urban corridor that has impervious values significantly higher than this. Development and clearing in all areas of the watershed need to be more closely monitored but particularly within the recommended buffers for riparian habitat.

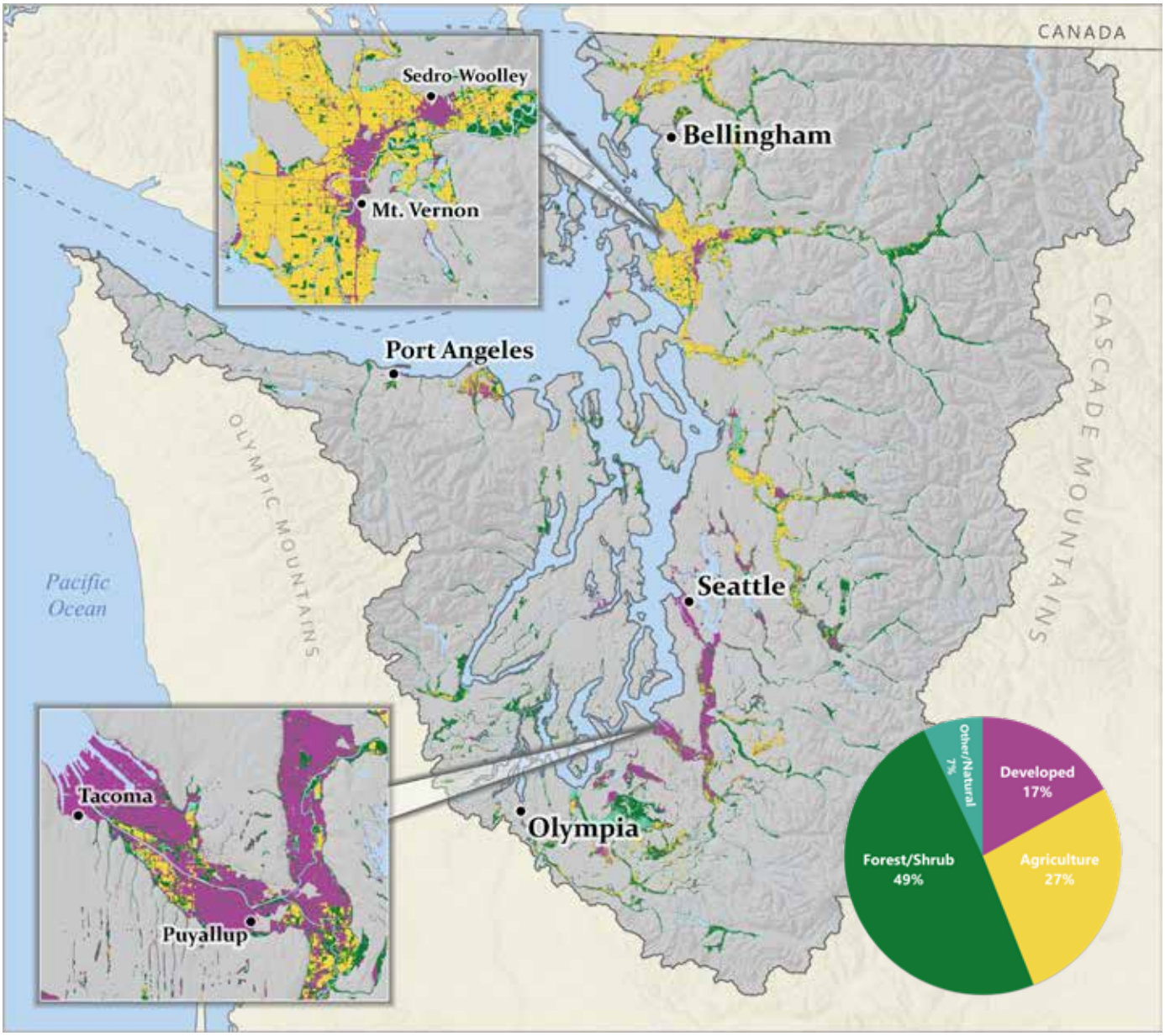
NWIFC

Dungeness River

Map Data Sources: NOAA 2021[8], SSHIAP 2004[9], USGS 2018[10], WAECY 2024[11], WDFW 2020[12]

Floodplain Land Cover Change Impacts

In the Puget Sound lowlands, approximately 1,285 square miles of floodplain habitat exist, with a land cover composition of 49% forest/shrub, 27% agriculture, 17% developed and 7% other/natural areas. Preserving functional floodplains is crucial for Puget Sound's watersheds and ensuring juvenile salmon retain essential shelter, refuge and food sources.



Floodplains are low-lying areas along rivers and streams that naturally flood during high water events, creating dynamic landscapes that connect land and water.[1] These complex ecosystems are characterized by high aquatic connectivity, featuring distributaries, sloughs, backwaters, side channels, oxbows and lakes, often with highly braided channel systems. For salmon populations, these connected areas are essential, providing juvenile salmon with sheltered spaces to overwinter, seek refuge from strong currents, and find food in the intricate network of sloughs, backwaters and side channels.[1]

Despite their ecological importance, only 38% (166,294 acres) of the total floodplain area remains highly functional, with 62% experiencing reduced ecological capacity.[2]

The 17 major rivers of Puget Sound have lost over 60% of their floodplain function in the last century, predominantly due to population growth and urban development.[3] Climate change and continued development increasingly threaten these vital ecosystems, with impervious surfaces, levees and flood control structures exacerbating flooding by increasing sediment loads, introducing pollutants and reducing access to critical distributary channels and pocket estuaries.[4]

Preserving the remaining functional floodplains is essential for maintaining the ecological integrity of Puget Sound's watersheds and supporting the survival of salmon populations.

Map Data Sources: NOAA 2021[5], SSHIAP 2004[6], USGS 2021[7], WAECY 2024[8], WSDA 2023[9]

Fish Passage Barriers Continue to Be Identified in Puget Sound

There are 11,623 fish passage barriers in the Puget Sound region that have been identified by the Washington Department of Fish and Wildlife to impact migrating salmonids. While many of these barriers are owned by the state and fall under the rulings of the Culvert Case injunction, the majority are owned by other government agencies and private landowners. These culverts continue to restrict access to habitat for salmon while often having no timeline for replacement.

Fish passage barriers are infrastructure, most often culverts, used to divert streams under roadways. These culverts can prevent salmon from traveling upstream to reach their native spawning habitat. Traditional culvert designs prioritize the efficient movement of water under these roads and do not take into account fish passage needs.[1] Low water levels, debris blockages within the culverts, and increased water velocity are common problems that prevent salmon from being able to traverse culverts.[1]

Often culverts are also poorly aligned to streambeds with openings too high or low for fish to use them.[1] Bridges and fish friendly culverts need to be installed in order to make upstream habitat available to salmonids.[2]

Many of these barriers are owned by Washington state agencies and fall under the rulings of *US v. Washington* (Culvert Case injunction). Barriers considered as a part of this case have the potential to be corrected by the state if they meet certain criteria for habitat gain and fish use.[2] Considering that only 10.48% of the fish passage barriers in the Puget Sound are owned by the state is where a greater problem arises. The majority of culverts in Puget Sound are owned by other government agencies or private landowners. Roughly 52% of the culverts surveyed have been deemed to fall under the jurisdiction of municipal governments in the area including cities, counties, ports, irrigation districts, drainage districts and diking districts. Another 1.88% have been identified to fall under the jurisdiction of the federal government, primarily the National Parks Service and the U.S. Forest Service. This also does not take into account the 33.28% of surveyed culverts identified on privately owned land; this category especially is suspected to be greatly underestimated. Surveying efforts organized by Washington Department of Fish and Wildlife have prioritized public lands and publicly owned roadways so often culverts lying on private lands have often gone unidentified. While there have been efforts through some tribes and nonprofits to identify these barriers, continued surveying and analysis of these properties need to be done to more accurately understand the extent culverts impacts.

To open up the most habitat for salmonid recovery in the region, more extensive mapping of fish passage barriers needs to be completed and compiled. With better data on culverts, environmental agencies can better prioritize culverts that will benefit salmonids populations the most.

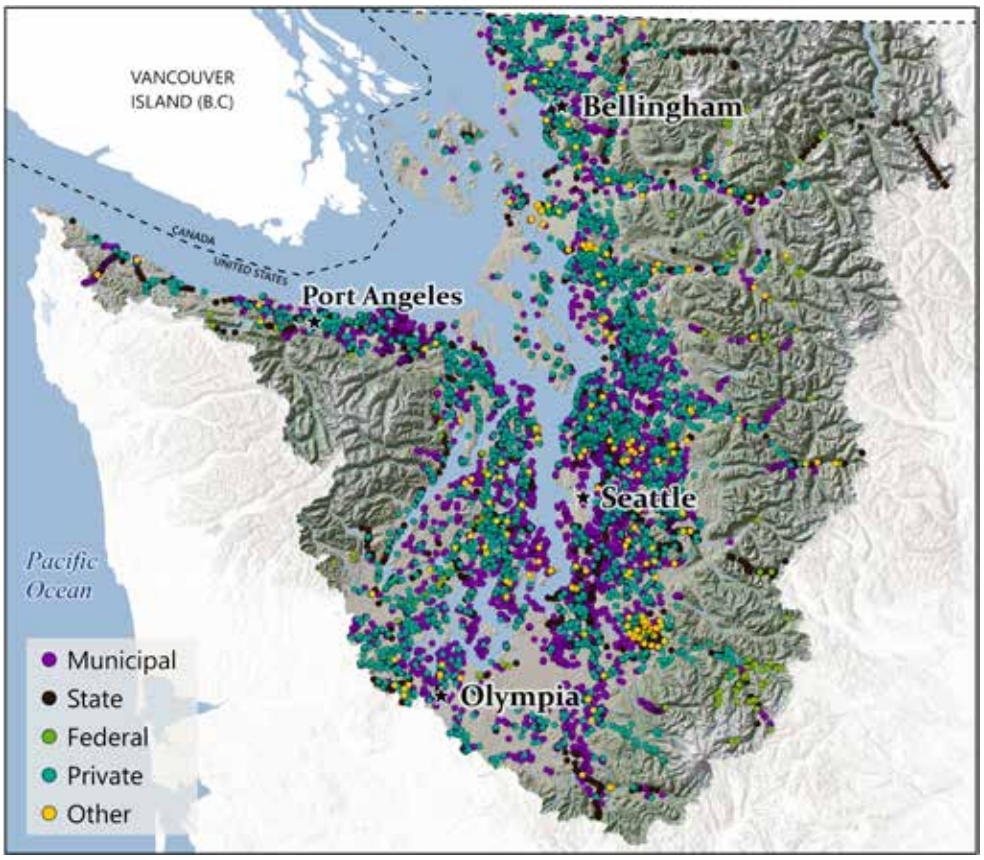


Table 1. Fish passage barrier ownership in the Puget Sound

Ownership	Fish Barriers	Percent
Municipal	6,050	52.05%
City	1,591	13.69%
County	4,444	38.23%
Port	8	0.07%
Water Districts	7	0.06%
State	1,218	10.48%
Federal	218	1.88%
Private	3,868	33.28%
Other	269	2.31%
Total	**11,623**	**100%**

Map Data Sources: NASA JPL 2013[3], SSHIAP 2004[4], WAECY 2024[5], WDFW 2025[6]

Water Quality

In the Puget Sound region, 60% of assessed waters were determined to be impaired for one or more parameters according to 2018 data, with temperature and bacteria being the most prevalent issues. Of the water quality assessed streams that are salmonid bearing, 88% are impaired for one or more parameters, potentially impacting the viability of salmonid populations.

The 2018 Water Quality Assessment data for the Puget Sound region, based on the Washington Department of Ecology's 305(b) and 303(d) reports, reveals significant water quality challenges. Of the 5,903 total miles assessed, 60% were found to be impaired (305(b) categories 4-5). The most prevalent impairments were bacteria (40% of assessed impaired waters), temperature (32%) and dissolved oxygen (23%). Comparing 2018 data to 2012 shows an increase in both impaired and unimpaired waters across all parameters, with the most significant increase in impairment observed in bacteria (33.26% change). This trend suggests growing risks to aquatic life, particularly salmonids, which require specific water quality conditions for survival, including cool temperatures, high dissolved oxygen levels and low pollutant concentrations.[1]

The increasing trend in impaired waters across all parameters from 2012 to 2018 is concerning, particularly given that 88% of assessed salmonid-bearing streams are impaired. Climate change is likely exacerbating these issues, with projections indicating warmer water temperatures and altered streamflow patterns in the Puget Sound region.[2] Stormwater runoff from impermeable surfaces in expanding urban areas is a significant contributor to water quality degradation.[3] While Ecology is working to address these challenges[4], the data suggests that continued efforts and potentially new strategies are needed to improve and maintain water quality in the Puget Sound Region, especially in salmonid-bearing streams.

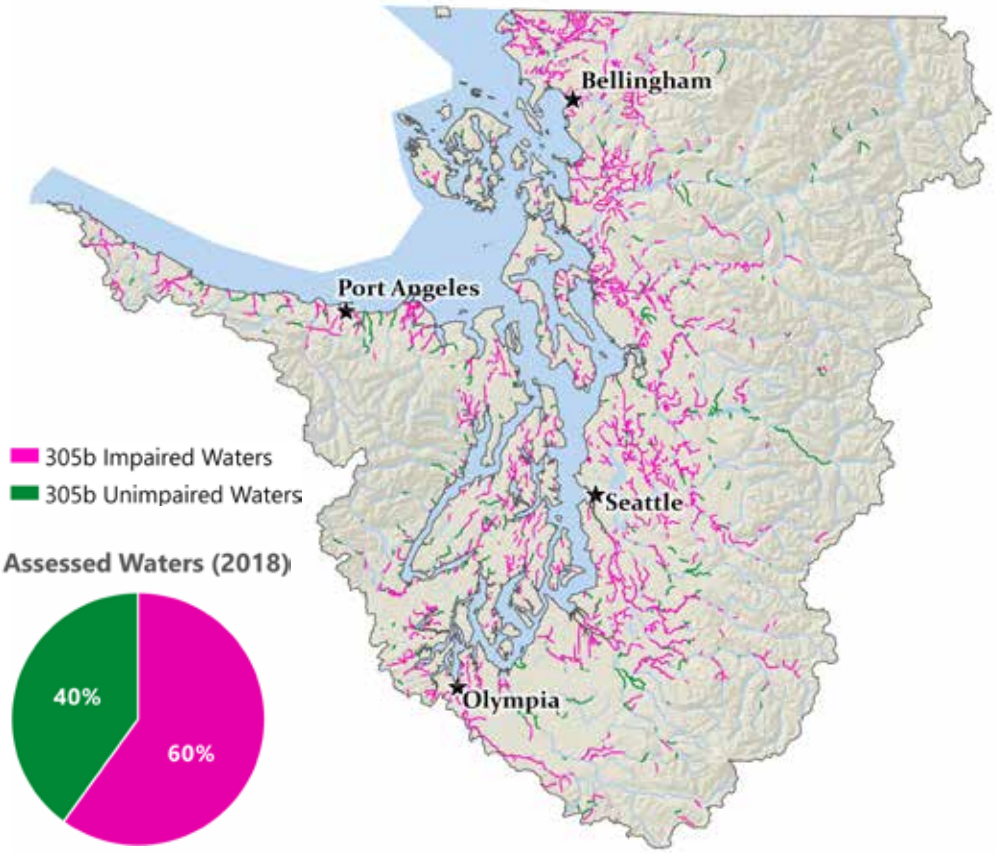
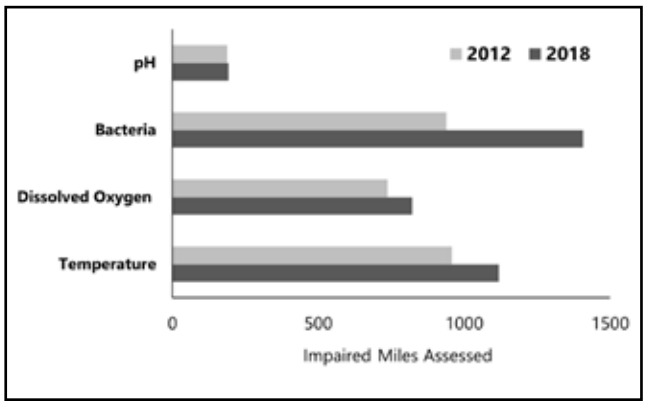


Table 1. Puget Sound Region 305(b) (2018)

Parameters	Impaired		Unimpaired	
	Miles Assessed	% Assessed	Miles Assessed	% Assessed
Temperature	1,119.32	32%	531.60	23%
Dissolved Oxygen	821.55	23%	610.75	26%
Bacteria	1,407.39	40%	516.57	22%
pH	193.03	5%	702.71	30%
All Parameters	3,541.29	60%	2,361.62	40%
Salmonid Habitat (SWIFD)	3,127.31	88%	2,107.20	89%

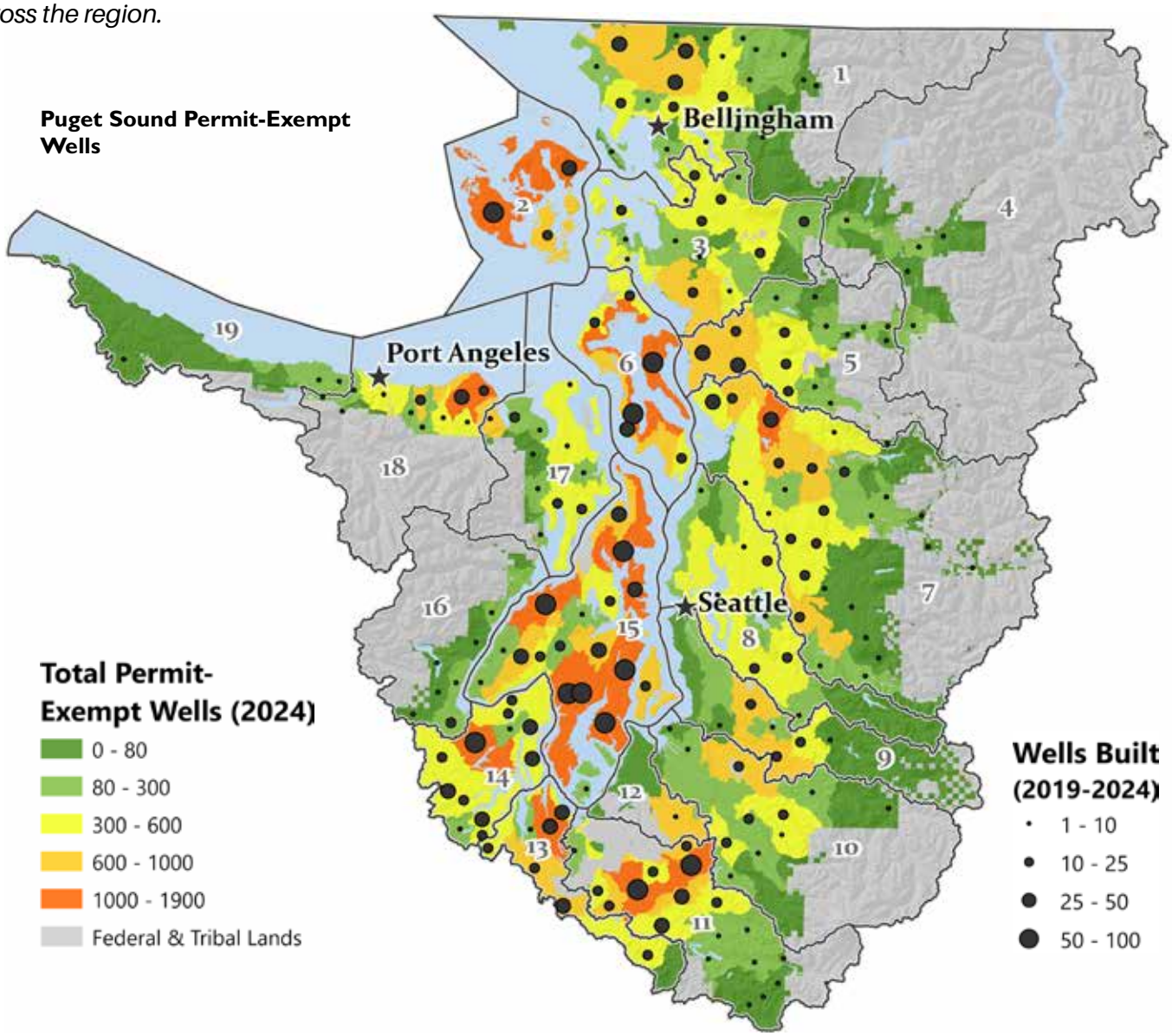
Chart 1. Comparison of Impaired Miles Assessed for Various Water Quality Parameters in 2012 and 2018.[6,8]



Map Data Sources: SSHIAP 2004[5] , WAECY 2012a[6], WAECY 2012b[7], WAECY 2018a[8], WAECY 2018b[9], WAECY 2018c[10], WAECY 2024[11], WDFW & SSHIAP 2023[12]

Groundwater Withdrawals Impact Surface Flows

Since 1980, over 87,000 permit-exempt wells have been developed in the Puget Sound region (WRIAs 1-19). Between 2019 and 2024, 3,000 wells were constructed, representing a 30% decrease compared to the previous five years. While the rate of permit-exempt well construction has decreased in the last five years, the growing number of new water well installations poses a threat to groundwater availability and stream ecosystem health across the region.



The Puget Sound region's significant population growth has increased demands on groundwater resources, challenging freshwater ecosystems and salmonid populations. While Washington state instream flow rules allocate river flow for ecological requirements, current state law permits new wells to withdraw up to 5,000 gallons of groundwater daily without scientific evidence of water availability.[1] Watershed plans developed by the Washington Department of Ecology under the Streamflow Restoration Act project that 23,165 new permit-exempt wells in 10 of the 19 WRIAs (WRIAs 1, 7-15) will be built from 2018-2040.[2]

Groundwater withdrawals cumulatively affect streamflows, especially during late summer when flows are naturally lowest. Aquifer outflow through springs, seeps and subsurface movement sustains stream baseflows, maintains lake levels, provides freshwater to nearshore environments, and prevents seawater intrusion.[3] As groundwater extraction exceeds recharge rates, reduced freshwater availability impacts lakes, wetlands, streams and Puget Sound,[4] with climate change further exacerbating these issues through increased drought conditions.[5]

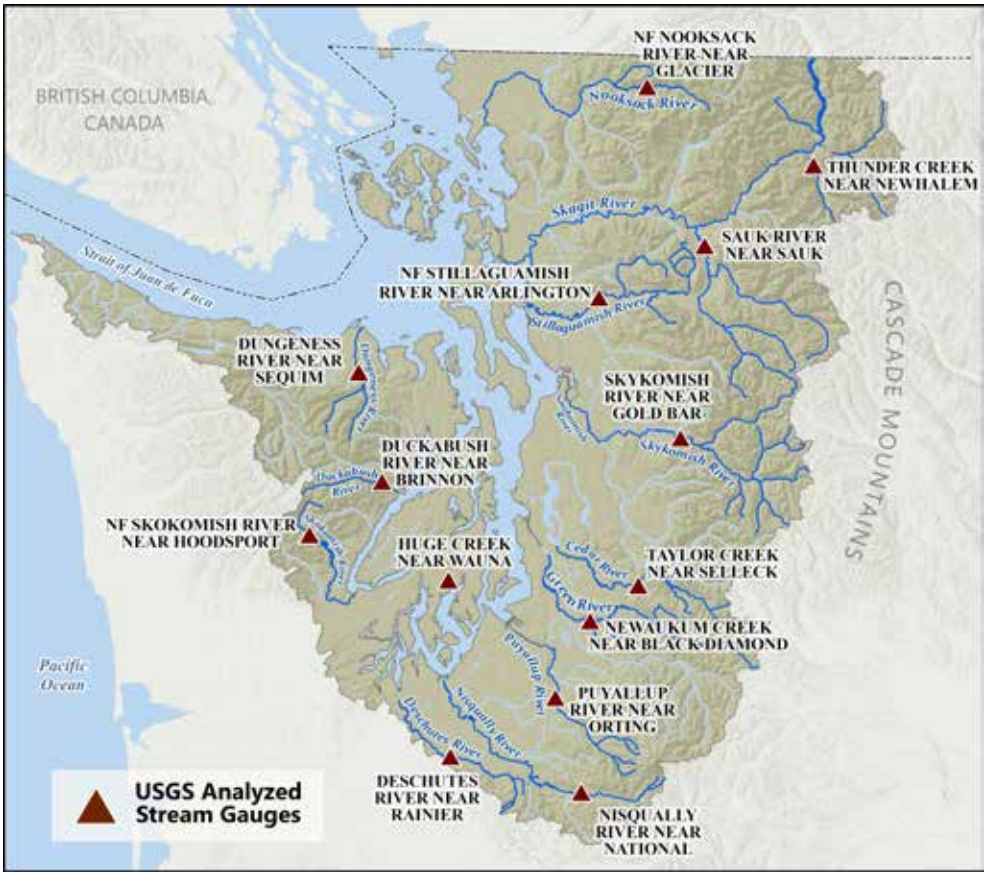
Reduced freshwater inputs negatively impact shellfish and juvenile salmonids,[6] while compromised water quality from decreased groundwater inputs concentrates pollutants, elevates temperatures, and reduces dissolved oxygen—all detrimental to salmonid life cycles.[7]

While watershed planning represents progress, enhanced restoration measures and preventative safeguards must be implemented to ensure groundwater withdrawals remain within sustainable ecological thresholds.

Map Data Sources: SSHIAP 2004[8], USGS 2018[9], WADNR 2018[10], WADOH 2023[11], WAECY 2000[12], WAECY 2024a[13], WAECY 2024b[14]

Streamflow Trends

Recent streamflow data from 14 USGS stream gauges across the Puget Sound region reveal significant seasonal deviations from historic baselines (1948-1998), with increasing days of below-average flows in summer (July-October) and spring (April-June), and changing patterns in late fall and winter flows (November-March). These alterations indicate potential climate change impacts on critical freshwater ecosystem conditions.



Distribution of USGS Hydro-Climatic Data Network (HCDN) stream gauge locations around the Puget Sound Region where streamflow conditions primarily reflect climatic variations; streamflow conditions are minimally affected by human disturbance.

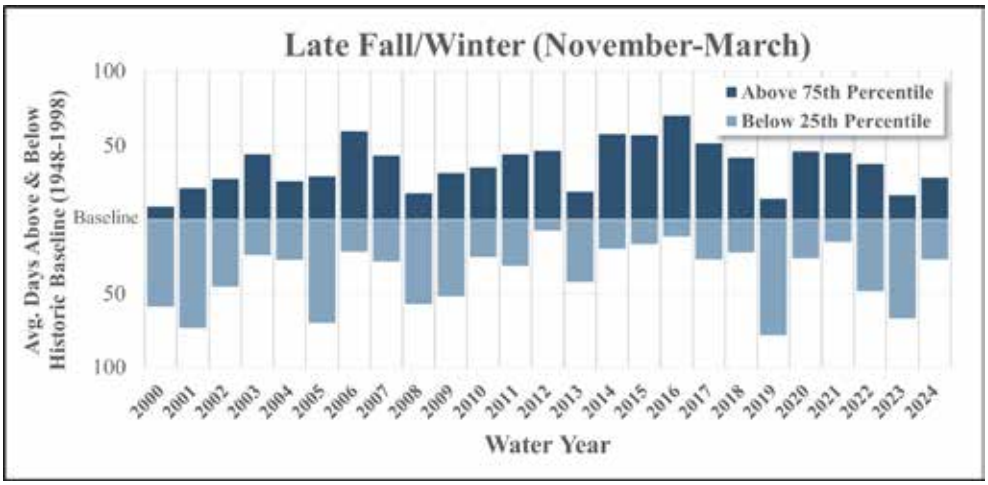


Figure 1. Average number of days during late fall/winter (November through March 2000–2024) where flows at 14 Puget Sound stream gauges fell outside the 25th and 75th percentiles of the 1948–1998 historic baseline.

The data from Figures 1-3 demonstrate distinct seasonal streamflow patterns that significantly impact salmon populations throughout the Puget Sound region. During late fall and winter (November-March, Figure 1), streamflows show substantial year-to-year changes, with some years experiencing more than 50 days of above-baseline flows. These elevated winter peak flows, often resulting from precipitation falling as rain rather than snow, can scour streambeds and destroy salmon eggs in their redds.[1]

Summer patterns (July-October, Figure 3) reveal a concerning trend toward more frequent below-baseline flows, particularly severe in recent years (2023-2024). Washington Department of Ecology declared a statewide drought emergency in 2024 due to low snowpack and forecasts of a dry, warm spring and summer.[2] These low summer flows, combined with reduced snowpack, significantly decrease available spawning habitat and increase water temperatures.[3] Similarly, spring flows (April-June, Figure 2) show increasing volatility with notable periods of below-baseline days during 2014-2016 and 2019-2021, affecting juvenile salmon during crucial development periods.

Climate change intensifies these streamflow challenges through multiple pathways. The shift from snow to rain in winter precipitation leads to more frequent high-flow events that can destroy salmon redds, while reduced snowpack contributes to the lower summer flows shown in the data.[1,4] These changes create a compound effect: winter flows that can disrupt salmon reproduction followed by diminished summer flows that limit habitat availability.[5]

The trends observed in these figures underscore the importance of understanding and managing seasonal flow patterns to protect salmon, which are vital both ecologically and economically to the Puget Sound region. Continued monitoring and adaptive management will be essential as climate change exacerbates these streamflow fluctuations and their impacts on salmonid habitats.

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Map Data Sources: SSHIAP 2004[6], USGS 2024[7], WAECY 2024[8]

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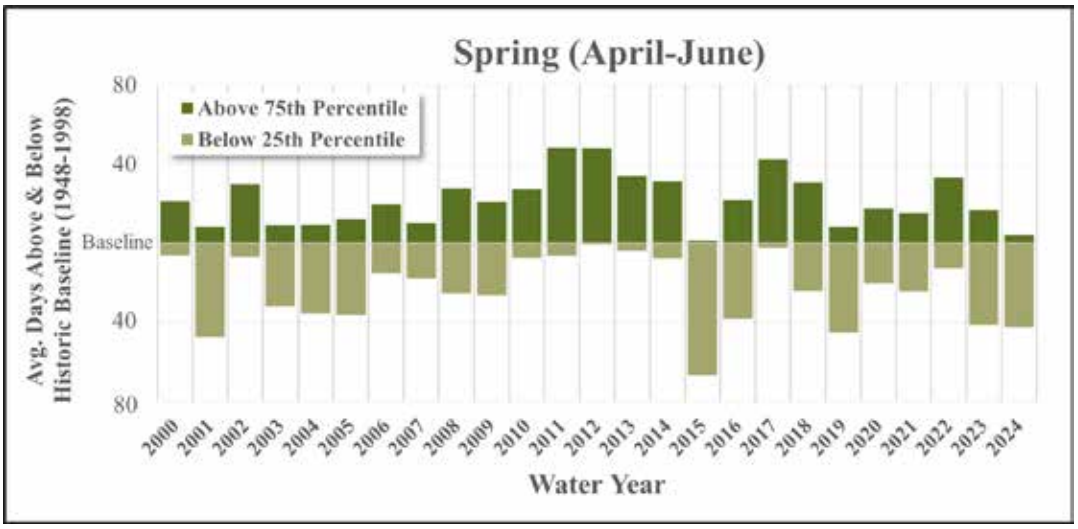


Figure 2. Average number of days during spring (April through June 2000–2024) where flows at 14 Puget Sound stream gauges fell outside the 25th and 75th percentiles of the 1948–1998 historic baseline.

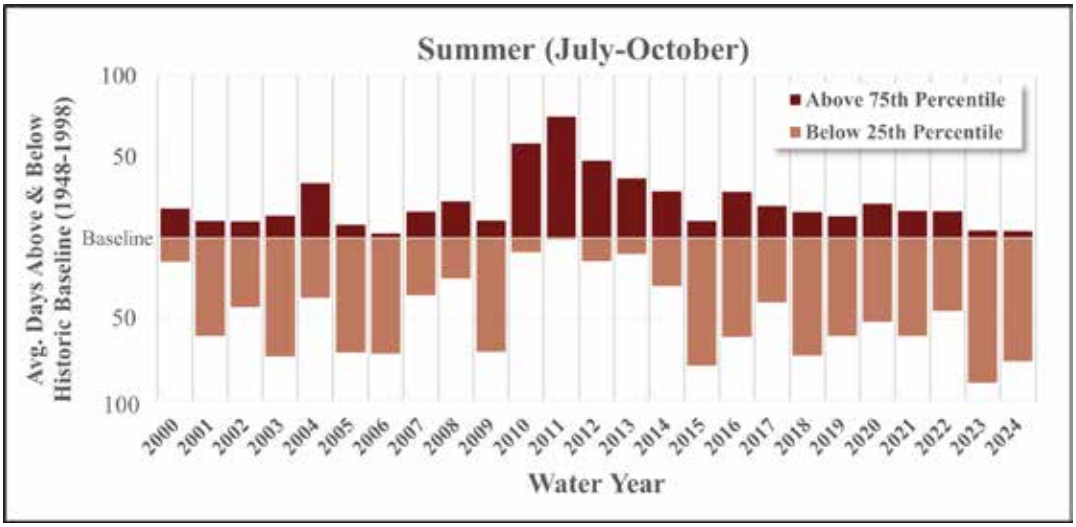


Figure 3. Average number of days during summer (July through October 2000–2024) where flows at 14 Puget Sound stream gauges fell outside the 25th and 75th percentiles of the 1948–1998 historic baseline.

NWIFC

Figure 4. North Fork Skokomish River - Low Flows - June 2019

Whatcom County

Figure 5. November 2021 Nooksack River flood in Sumas, Wash.

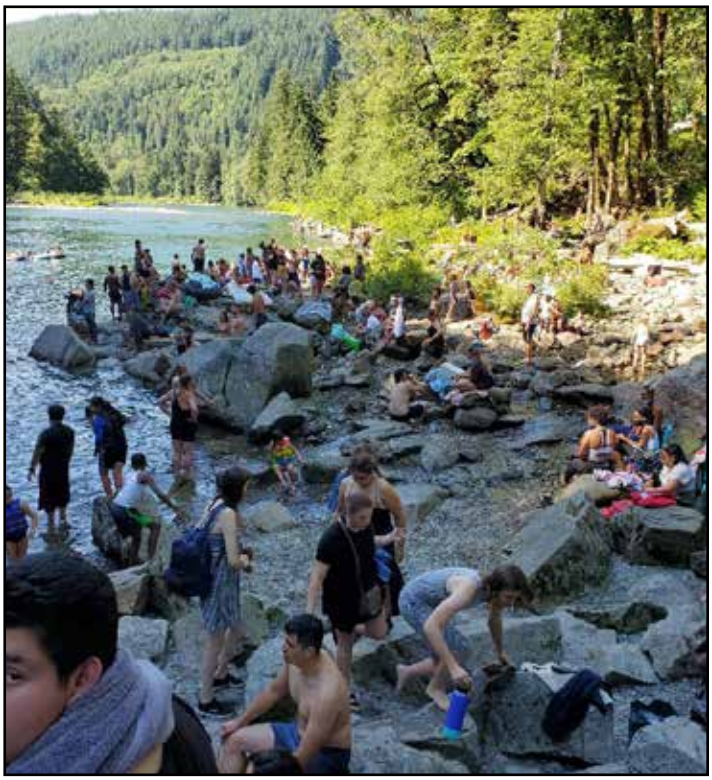
Tribes, State and Federal Land Managers Address Environmental Impacts of Outdoor Recreation in Washington State

According to a recent economic analysis, outdoor recreation directly contributed over $18.8 billion to the state's economy.[1] Over two-thirds ($12.65 billion) of that trip activity occurred in western Washington, the core treaty area of the western Washington treaty tribes[1]. The economic, societal and individual benefits of outdoor recreation in western Washington come at a cost to tribal treaty resources and the ecological health of these watersheds.

A mounting body of research confirms what tribal members and resource managers are seeing across the landscape: recreational activities can and do have significant impacts on the environment and on the resource itself. These recreational activities include both motorized and non-motorized uses as well as recreational fisheries in marine and fresh waters. Direct and indirect effects of this use have been found to be damaging to the environment causing degradation of upland, riparian and coastal habitats. Outdoor recreation has been known to cause damage to vegetative communities, changes to the range and health of fish and wildlife, and the compromise of cultural and spiritual sites.

The impacts from these activities have resulted in human presence and disturbance throughout even the most remote areas of public lands and treaty areas. Although we understand the many benefits outdoor recreation provides to Washington residents and visitors, these areas need improved protection to preserve fish, wildlife, plants and habitat that treaty rights depend upon.

Tribes are currently working with state and federal land managers to ensure recreation management policy is based on best available science, tribal knowledge, cross-jurisdictional coordination and ecological sustainability. This will result in "smarter" and more consistent recreation planning and management across state and federal public lands. This will result in recreation that better upholds tribal treaty rights and improves protection and management of treaty-reserved resources. Such a policy will help protect the long-term ecological health of lands and resources not just for tribes, but for all who value them.



U.S. Forest Service

Eagle Falls on the Skykomish River during summer 2020.

Seb And (video, Youtube)

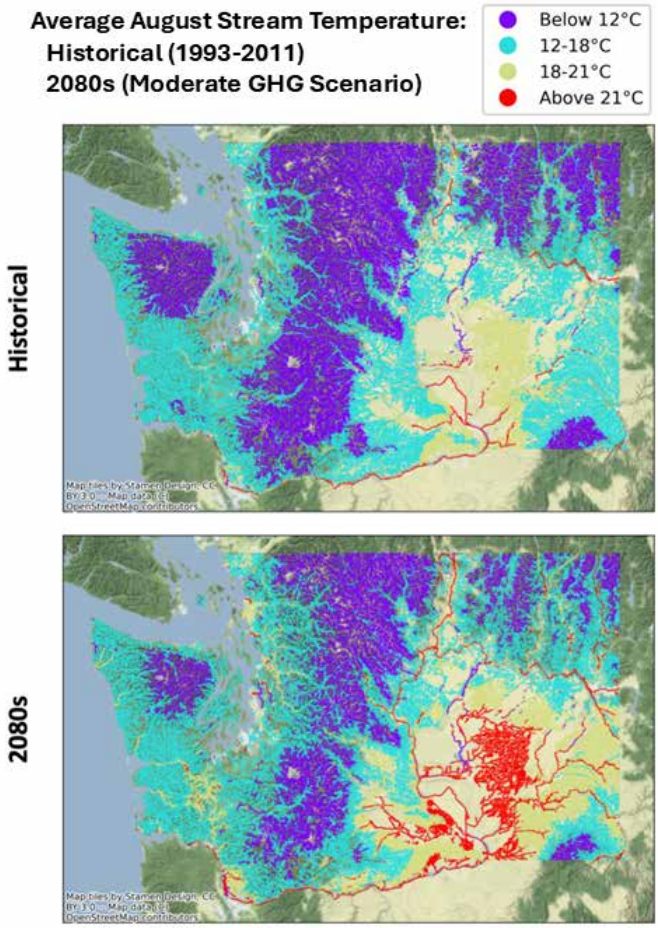
Crowds enjoy the view from Rattlesnake Ledge outside North Bend, Wash.

Puget Sound Climate Change

The watersheds of Puget Sound are exhibiting changes driven by the climate crisis that will likely accelerate in the future: more frequent extreme heat events, warmer stream temperatures, subsequent increases in fish disease, shrinking glaciers and snowpack, lower summer streamflows, more extreme winter floods, shifts in streamflow patterns and timing, more frequent wildfires, warmer ocean temperatures, changing ocean chemistry, and flooding and erosion from more intense winter storms and rising sea levels. These changes are compounded by the effects of habitat destruction and fragmentation described in this report. Efforts to restore habitat integrity and diversity contribute to the resilience of the species and ecosystems that are fundamental to tribal treaty rights and traditional ways of life.

Extreme Events

In the northwest, extreme events such as droughts, floods and record-setting high temperatures have resulted in decreasing animal and plant populations and ecosystem transformation. Air temperatures are projected to increase during all seasons of the year throughout the watersheds of Puget Sound, but especially in the summer.[1] Extreme rainfall, floods and droughts are projected to increase in both frequency and intensity.[2] In the Puget Sound lowlands, precipitation during the late summer is projected to decrease by as much as 26%, especially in the southern and eastern areas, while winter precipitation is expected to increase by 9% by the end of the century under a high greenhouse gas (GHG) emissions scenario.[3] Late summer precipitation is expected to decrease as much as 28% in the North Cascades, while winter precipitation increases by as much as 10%.[4]



Average August stream temperatures for Washington. Top: 1993-2011 historical record. Bottom: Projections for 2070-2099 for a moderate GHG emissions scenario. Colors represent temperature thresholds approximately related to thermal tolerances for salmonids. From Yoder and Raymond 2022.

Snowpack and Glaciers

Along with changes to precipitation patterns, warmer temperatures are also driving loss of snowpack and glaciers in higher elevations. Glaciers and snowpack have historically provided a reliable reservoir that gradually supplied water to rivers during the spring and summer melt. In the western U.S., snowpack records show trends toward smaller volumes, earlier peak accumulation dates, and decreasing duration.[5] A 25% decline in snowpack is expected by the middle of the 21st century.[6] Snow-dominated watersheds (where winter precipitation falls mainly as snow) and mixed rain-snow watersheds (where snow and rain alternate in winter) both show declining summer streamflow.[7] Projections for the Puget lowland watersheds suggest a shift to all rain-dominated watersheds by the end of the century, with higher winter streamflows, earlier peak flow timing, and lower summer low flows.[8] Similarly, few watersheds in the North Cascades are expected to retain their snow-dominated conditions, as more winter precipitation falls as rain.[9]

Stream Temperature and Streamflow

Salmonids and other aquatic species in Puget Sound watersheds are adversely affected by changing freshwater conditions: warmer stream temperatures, higher peak flows, lower summer flows, changes in timing of low and peak flows, and shifts of cold-water habitat to higher elevations.[10] Lower flows and warmer air temperatures both contribute to this trend. By the end of the 21st century, the average August temperatures in many mainstem river locations that salmonids rely on for migration will exceed their thermal tolerances (Figure 1).[11] Annual maximum temperatures will likely be even higher.

Across the watersheds of Puget Sound, summer low flows are decreasing while winter peak flows are increasing.[12] For example, summer low flow for the Puyallup River is projected to decrease by 20% to 39% by the end of the century (Figure 2), while Sauk River low flows are projected to decrease 33% to 77% by the end of the century for a high GHG emissions scenario.[13] As surface water and snowmelt diminishes, groundwater levels will also decrease.[14] Regional variations in groundwater withdrawal interacting with climate drivers complicate projections, but warmer temperatures and increasing severity and duration of droughts lead to higher demand for groundwater for irrigation and other human uses during times when aquatic ecosystems are most vulnerable to water deficits.

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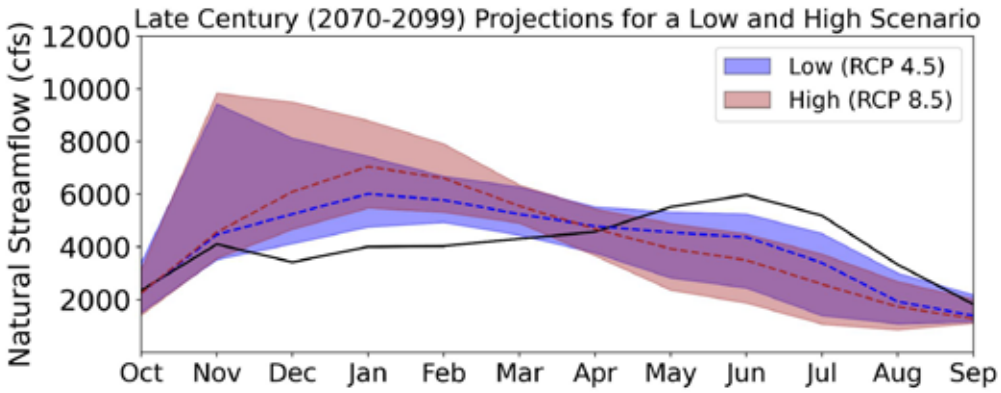

Figure 2. Puyallup River Monthly Streamflow. The black line is the simulated historical hydrograph. Dashed lines represent the median hydrographs of 40 models and shaded areas show the 10th and 90th percentile range. Peak annual flows are projected to occur in winter rather than early summer as the watershed hydrologic pattern shifts from mixed-rain-snow to rain-dominant. Projections represent conditions without withdrawals and regulation by dams. From Rogers 2024.

Terrestrial Ecosystems

Terrestrial plants and animals are vulnerable to major ecosystem disturbances such as wildfire, pests and invasive species. The average area burned per year in the western Cascade Mountains is projected to more than triple by the middle of the 21st century under a moderate GHG scenario.[15] In western Washington, the number of days with very high fire danger is projected to increase from 36 days per year in the late 20th century to 48 days by the mid-21st century.[16] Warmer air temperatures, drier summers and earlier snowmelt contribute to these trends. Invasive species that can outcompete or displace species important to tribes are expected to spread as temperatures increase, especially in the winter, and as droughts become more frequent, longer and more severe.[17]

Sea Level Rise

While global sea level rise (SLR) is the result of the melting ice sheets and glaciers combined with the physical expansion of ocean water as it warms, local SLR includes the effects of vertical land movement. Tectonic forces in our region vary over time and location, so relative SLR does as well. Along the Strait of Juan de Fuca, uplift is occurring on the western edge at 3.5 mm per year and decreases toward the east.[18] Puget Sound shorelines overall exhibit low rates of subsidence, or downward vertical land movement, at less than 1 mm per year, with the greatest rates in the south and lower rates toward the north.[19] The gradual inundation caused by relative SLR is occurring in conjunction with more extreme storm surge and king tides to cause more severe flooding and erosion that can damage coastal habitat and important tribal cultural sites. Projections of relative SLR for 2100 under a high GHG emission scenario vary geographically:[20]

- Port Angeles: 1.8 ft, likely in the range of 1.2 to 2.5 ft
- Bellingham Bay: 1.9 ft, likely in the range of 1.3 to 2.7 ft
- Port Susan: 2.2 ft, likely in the range of 1.5 to 3.0 ft
- Olympia: 2.7 ft, likely in the range of 2.0 to 3.4 ft

Strategies for Resilience

Tribes play a leadership role in understanding and responding to the effects of the climate crisis in our watersheds. Efforts to protect and restore habitat complexity and integrity boost the resilience of species and ecosystems to changing climate conditions. For example, reforestation of riparian zones along streams and reconnection of floodplains to their rivers reduce temperature impacts, create critical off-channel refuges from high temperatures and high flows for salmonids, and improve flood conveyance.[21] Tribes are also responding with actions to reduce GHG emissions through renewable energy production, energy efficiency, and carbon sequestration, or long-term storage in biological systems.

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2025 State of Our Watersheds Report
Hoh River Basin

Brian Hoffman

It's just me and a crew doing what us as people were meant to do anyway. We live on a coast for a reason. So we're coastal fisherman. That's always just been a drive of mine.

– Joe Hudson
Hoh Tribal Fisherman

— **Area of Interest**

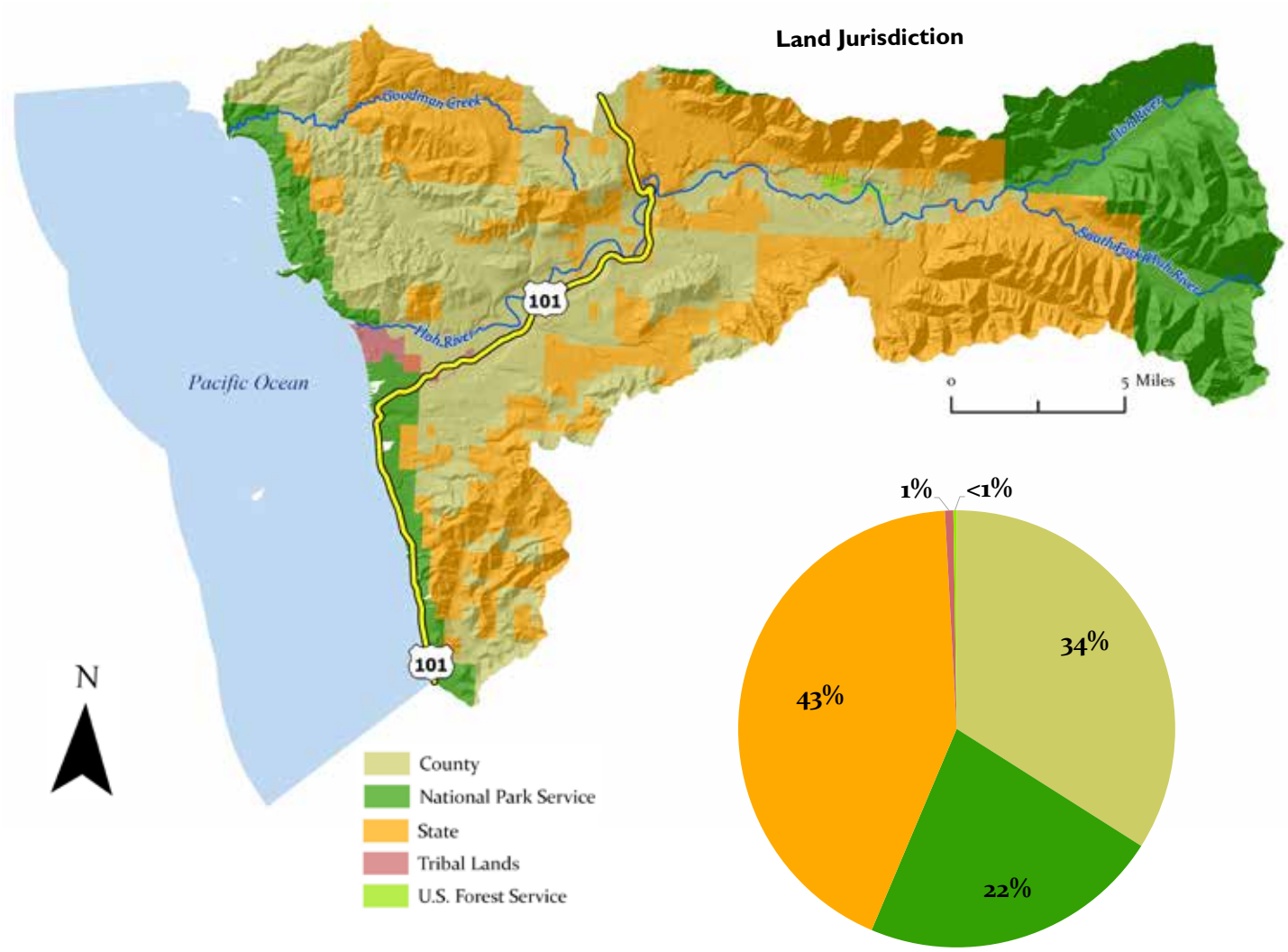
Hoh Tribe

Chalá·at: People of the Hoh River

The Hoh Indian Tribe signed the Treaty of Quinault in 1885 and continue to live on the Pacific Coast. When K'wati the Transformer got to the Hoh River, he discovered that the inhabitants of the area were upside down people, who walked on their hands and handled their smelt dipnets clumsily with their feet. K'wati set them right side up and showed them how to operate their nets with their hands. For that reason, Hoh elders still sometimes refer to themselves as p'ip'isodat'sili, Upside Down People. After he had set the Hoh upright, K'wati told the Ancestors, "You shall use your feet to walk. Go and fish smelt. You shall catch much fish when you fish smelt." Ever since then there is much smelt at Hoh. The Hoh remain dependent on the fish, wildlife and other natural resources of the Hoh River watershed for their subsistence and commercial economy. Protection and enhancement of the watershed is key to meeting the cultural and economic needs of the tribe.

Hoh Tribe

Hoh River Watershed and Independent Tributaries



The Hoh Tribe's Area of Interest comprises portions of WRIAs 20 and 21 along the west side of the Olympic Peninsula, from Goodman Creek south to Kalaloch Creek. The largest basin in the area is the Hoh River, which originates at the Hoh Glacier on Mount Olympus. From there, it flows westward through the Olympic National Park's temperate rainforest, then through foothills and a broad, flat floodplain before emptying into the Pacific Ocean at the Hoh Indian Reservation, the ancestral home of the Hoh people.

This Area of Interest is dominated by state and private forestlands and includes the Hoh Rain Forest, a large temperate rainforest protected within Olympic National Park. Although many pockets of forest remain, much of the forest outside the Park has been logged within the last century and will continue to be logged under its industrial forest designation.

The headwaters of both the Hoh and South Fork Hoh rivers originate from the glaciers of the Olympic Mountains. The tributaries and independent drainages outside the Park are rainfall-dominated with a mean annual precipitation between 140 to 165 inches, the highest in Washington state. Streamflow in the Hoh River has considerable seasonal variation, with summer discharge averaging about a third of winter flows.

The Area of Interest supports all five species of Pacific salmon as well as cutthroat trout and bull trout.[1,2,3] The Hoh River, along with some adjacent shoreline and tributaries, are designated critical habitat for bull trout.[4] Mountain whitefish and several species of lamprey are indigenous to the Hoh.

Smith[5] identified several factors limiting salmonid production in the basin downstream of the park. These include fish barrier culverts and cedar spalts, increased stream sedimentation, elevated stream temperatures, altered riparian areas, as well as scoured, incised channels with few spawning gravels and large woody debris. The WRIA 20 Watershed Plan[6] includes specific actions and management strategies for addressing these limiting factors.

Map Data Sources: SSHIAP 2004[7], WADNR 2024a[8], WADNR 2024b[9], WAECY 2018c[10], WAECY 2024[11], WADOT 2018[12], WADOT 2023[13], USFWS 2024[14]

Chapter Summary

The Hoh Tribe, the people of the Hoh River, have lived along the Hoh River since time immemorial. They are heavily dependent economically, culturally and spiritually on the natural resources found within its watershed for hunting, fishing and gathering. This basin supports all five species of Pacific salmon, cutthroat and bull trout, as well as many other fish and wildlife species.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Roads May Be Degrading Fish Habitat

A total of seven watersheds, representing about 80% of the land area, may not be properly functioning because of high road density values that exceed 3 miles per square mile. Similarly, all watersheds outside the Olympic National Park had road crossings of over 3 per mile of stream.

Culverts Continue to Impede Fish Passage

There are 51 state-owned culverts in the Culverts Case dataset in the Hoh Area of Interest. Of these, 31 (or 60.8%) are still barriers to fish. In another dataset of 316 barrier culverts, 154 (or 48.8%) are county-owned. Private ownership accounts for 64 (or 20.2%) while state ownership accounts for 52 (16.2%) of the culverts. In addition to action being taken to fix state-owned culverts, measures need to be taken to remove the impediments to fish passage caused by county- and privately-owned culverts.

Timber Harvest Activities

Between 2000 and 2023, about 170 square miles of forestlands have either been or will soon be harvested, with about 145 square miles (or 86%) in private ownership. The private forestland harvest operations were predominantly conducted between 2006 and 2017.

Invasive Species Continue to be a Problem

Invasive plant species continue to be a problem in the riparian zones of the Hoh River watershed. Control measures have significantly reduced knotweed numbers, but other species like Scotch broom, herb Robert, Himalayan blackberry, and tansy ragwort are now more widespread. Between 2020 and 2024, there has been a general increase in the number of acres occupied by these species.

Flow in the Hoh River and Adjacent Coastal Watersheds: Summer Minimums and Winter Maximums are Becoming More Intense

Since 1960, flows in the Hoh River have become more extreme, largely as a result of climate change. With less precipitation and warmer air temperatures during summer months, flows in rivers and streams are declining. In contrast, winter storms are becoming more severe, resulting in greater peak flood events.

Water Quality in Rivers and Streams is More Degraded

Warm water temperatures continue to degrade salmonid habitat in the Hoh Tribe's Area of Interest. Eight of the nine creeks monitored for water quality by the Hoh Tribe since 2007 have had summer water temperatures that exceed state water quality standards for core summer salmonid habitat or char spawning, rearing and migration in all monitoring years. Of the total 96 river miles monitored by the tribe in 2023, 60.4 river miles (62.9%) had water quality conditions (water temperature, dissolved oxygen or pH) that did not fully support salmonid or char life uses.

Climate Change Continues to Impact on Glaciers

Glaciers in the Olympic Mountains continue to thin and recede due to climate change. If carbon emissions are not abated, the Olympic Glaciers are predicted to be extinct by 2070. This will cause warmer and lower summer flows in the river, as well as the potential for increased sedimentation.

Ocean Continues to be Impacted by Stressors

The ocean area off the Hoh Area of Interest continues to be heavily impacted by ocean warming, including marine heatwaves, hypoxia and harmful algal blooms. In 2021, a severe fish kill occurred off the Hoh reservation, with hundreds of dead fish washing up on the beach near the village. Also, tribal members have noted that they have been finding smaller razor clams with thinner shells than they have in the past.

Conclusion

The Hoh watershed has experienced forestry operation related impacts over the past decades leaving a legacy of forest roads and crossings that need regular maintenance and monitoring. Other issues found in the watershed include state-owned barrier culverts needing correction, increase in invasive plants, increase of extreme streamflow events and no improvement in water quality since the last State of Our Watersheds report.

At the same time, the incremental decline in low flow conditions and increases in peak flow conditions raises concerns with the changing climate conditions. Although restoration is occurring, it is not enough to keep up with the impacts of a growing population and their resource demands from the watershed. People have to be held accountable to protecting, conserving and improving fish habitat in their land use decisions, and federal, state and local governments all have a role in that. Implementation includes education and voluntary action, but it also needs to include enforcement when those laws are broken. The future of tribal treaty rights in the Hoh River watershed depends on it.

Landscape-Scale Challenges Difficult to Address

A review of key environmental indicators for the Hoh basin area shows the watershed is still impacted by forestry relation operations, fish barrier culverts still present, invasive plants on a rise, stream flows still low in the summers and high in the winter.

There is a misconception that the Hoh watershed is relatively pristine and its fish stocks are healthy, but the system has been heavily impacted by timber harvests, road construction, infrastructure protection and other anthropogenic influences.

In spite of efforts to improve fish access, current and past logging practices continue to degrade fish habitat, water quality, hydrologic function and other ecological processes.

In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trend for these key environmental indicators shows a steady loss for several landscape-scale indicators in habitat status:

Tribal Indicator	Status	Habitat Trend
Road Density / Crossings	A total of 7 watersheds, representing about 80% of the land area may not be properly functioning because of high road density values that exceed 3 miles per square mile. Similarly, all watersheds outside the Olympic National Park had road crossings of over 3 per mile of stream.	**Declining**
Barrier Culverts	The state has completed about 39% of the repair of state-owned barriers in the Hoh's watershed since 2013, leaving about 30 Culvert Injuncion barriers to be corrected. In addition, there are another 316 barrier culverts needing corrective actions to allow fish passage within the Hoh watershed.	**Declining**
Timber Harvest Activities	Between 2000 and 2023, about 170 square miles of forestlands have either been or will soon be harvested, with about 145 square miles (or 86%) in private ownership. The private forestland harvest operations were predominantly conducted between 2006 and 2017.	**Concerns**
Invasive Species - Knotweed	Invasive plant species continue to be a problem in the riparian zones of the Hoh River watershed. Control measures have significantly reduced knotweed numbers, but other species like Scotch Broom, herb Robert, Himalayan blackberry and tansy ragwort are now more widespread. Between 2020 and 2024, there has been a general increase in the number of acres occupied by these species.	**Declining**
Stream Flows	Since 1960, flows in the Hoh River have become more extreme, largely as a result of climate change. With less precipitation and warmer air temperatures during summer months, flows in rivers and streams are declining. In contrast, winter storms are becoming more severe, resulting in greater peak flood events.	**Declining**
Water Quality	Warm water temperatures continue to degrade salmonid habitat in the Hoh Tribe's Area of Interest. Eight of the nine creeks monitored for water quality by the Hoh Tribe since 2007 have had summer water temperatures that exceed state water quality standards for core summer salmonid habitat or char spawning, rearing and migration in all monitoring years. Of the total 96 river miles monitored by the tribe in 2023, 60.4 river miles (62.9%) had water quality conditions (water temperature, dissolved oxygen or pH) that did not fully support salmonid or char life uses.	**Declining**
Climate Change	It is projected that most Olympic Peninsula glaciers will continue to shrink in response to warming temperatures and will largely disappear by 2070.	**Declining**
Ocean Conditions	The ocean area off the Hoh Area of Interest continues to be heavily impacted by ocean warming, including marine heatwaves, hypoxia and harmful algal blooms.	**Declining**

The Hoh Tribe continues to work toward the protection and restoration of healthy and functional watersheds and the ocean conditions, with a focus on protection while restoring critical habitat. The tribe also continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

Members of the Hoh Tribe have lived on the Olympic Peninsula since time immemorial. As a co-manager of stocks in their usual and accustomed area, the tribe strives to preserve their natural resources, which are inextricably linked to the cultural heritage and livelihood of their community.

Despite the largely rural nature of the Hoh Tribe's Area of Interest, many tribal indicators reflect habitat quality and quantity have declined since the publication of the last SOW report. Land management activities, such as large-scale forestry operations and road development, in tandem with climate change, are degrading salmon and steelhead habitat in the Hoh watershed.

Restoration is necessary to combat the loss of cold, well-oxygenated salmonid habitat in the Hoh Tribe's Area of Interest. To that end, the Hoh Tribe established a habitat restoration program in 2024 to center the tribe's longstanding stewardship practices in future restoration projects. Over the next four years, the newly formed program will work with project partners and landowners to reconnect salmon and steelhead to high quality spawning/rearing habitat through barrier removal, invasive species treatment, riparian replanting, and low-tech process-based restoration. The tribe's restoration efforts will be data-driven, being informed by long-term fisheries, habitat, and water quality monitoring, and directed by a Hoh Watershed Restoration Plan that is currently in development.

As glaciers melt, stream flows decline and water temperatures increase in the Hoh Tribe's Area of Interest due to global warming, building climate resilience is paramount. The tribe completed a Climate Change Vulnerability Assessment in 2025 to identify key natural resources of concern to tribal members. In 2026, the U.S. Geological Survey will complete a two-year study, funded by the tribe, investigating the effects of glacial retreat on instream conditions in the Hoh watershed. Based on results from the assessments, the tribe will finalize a Climate Change Adaptation Plan in the next four years to determine actions that best protect the Hoh community and their natural resources from the effects of climate change.

Along with investing in restoration efforts to improve habitat and planning for climate change, regulations must be enforced and revised to better protect salmonid habitat. While the Hoh Tribe continues to advocate for increased resource protection, additional support from state and federal regulatory agencies is needed.

By leading restoration work, monitoring co-managed resources, and promoting regulations that foster better habitat conservation, the Hoh Tribe aims to improve conditions for salmonid species over the next four years and for the next seven generations.

Roads May Be Degrading Fish Habitat

A total of seven watersheds, representing about 80% of the land area , may not be properly functioning because of high road density values that exceed 3 miles per square mile. Similarly, all watersheds outside the Olympic National Park had road crossings of over three per mile of stream.

Forest roads play an important role in the utilization and management of natural resources. They provide access for timber harvesting and management, fish and wildlife habitat enhancement, and a variety of recreational activities like fishing, hunting, hiking, camping and bird watching.

If not properly constructed or maintained, forest roads can be a source of sediments to streams which degrade fish habitat and water quality.

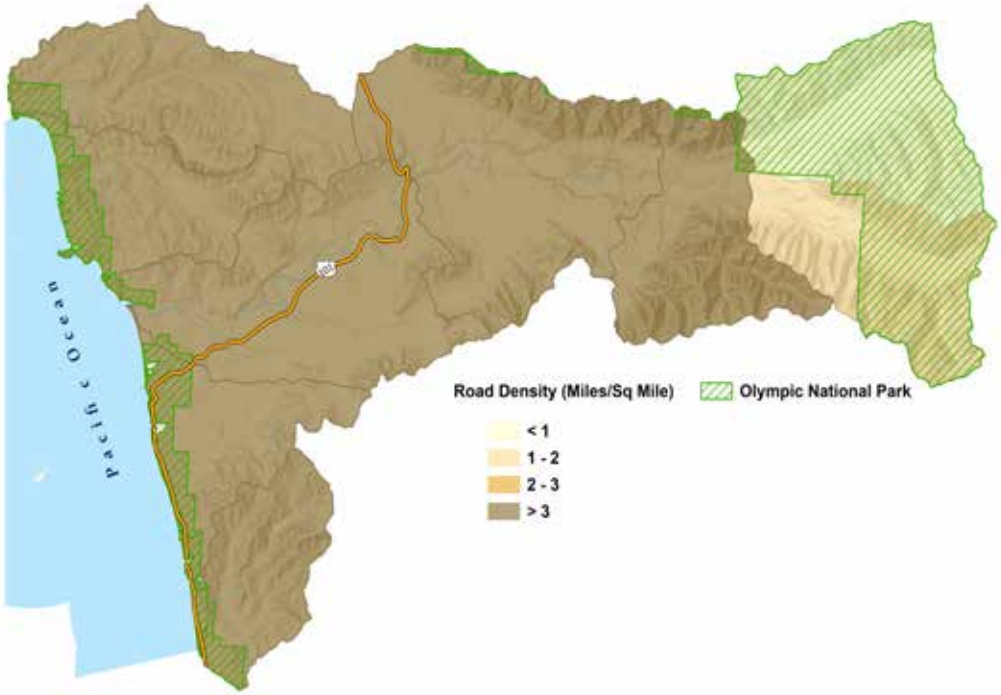
Many studies have correlated road density or indices of roads to fish density or measures of fish diversity.[1] Cederholm et al.[2] found increases in fine sediment in fish spawning habitat when road density exceeded 2.5% of the Clearwater watershed. It has also been reported that the proper functioning of salmon-bearing streams may be at risk when road densities exceed two miles of road per square mile of area and cease to function properly at densities over three miles per square mile.[3]

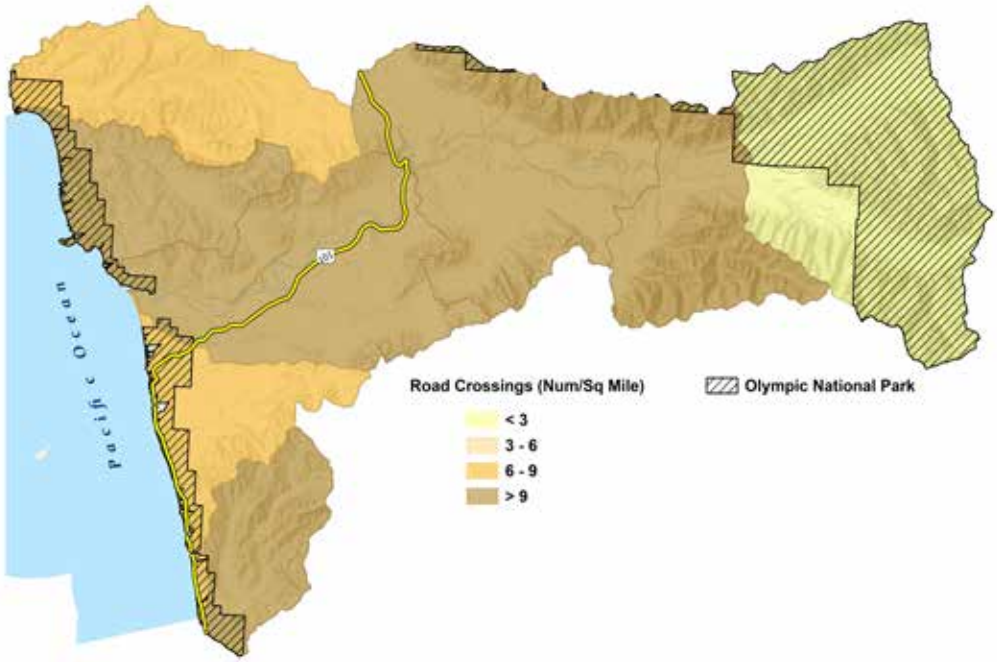
Road density values were over 3 miles/square mile in all watersheds outside the Olympic National Park where the values were less than 1 mile/square mile. A total of seven watersheds, representing about 80% of the land area may not be properly functioning because of high road density values that exceed 3 miles/square mile. This is the direct result of the network of roads built notably for timber harvest. Road densities were highest in the Nolan Creek-Hoh River and Kalaloch Creek watersheds.

Road crossings intercept stream channels at one or more locations where they intercept flow, disrupt natural drainage patterns, and cause erosion. Many of the culverts at stream crossings fail when they are plugged by sediment or wood or have a low discharge capacity to handle large flow volumes.

All watersheds outside the Olympic National Park had road crossings of over three per mile of stream. The Mosquito Creek-Frontal Pacific Ocean watershed had the highest number of crossings at 11.2 per mile of stream followed by Kalaloch Creek with 10.8 crossings per mile.

Extensive sedimentation resulting from high road densities and landslides was reported for many watersheds in the area by Smith[4] and the current road densities could be a major limiting factor on salmonid production.

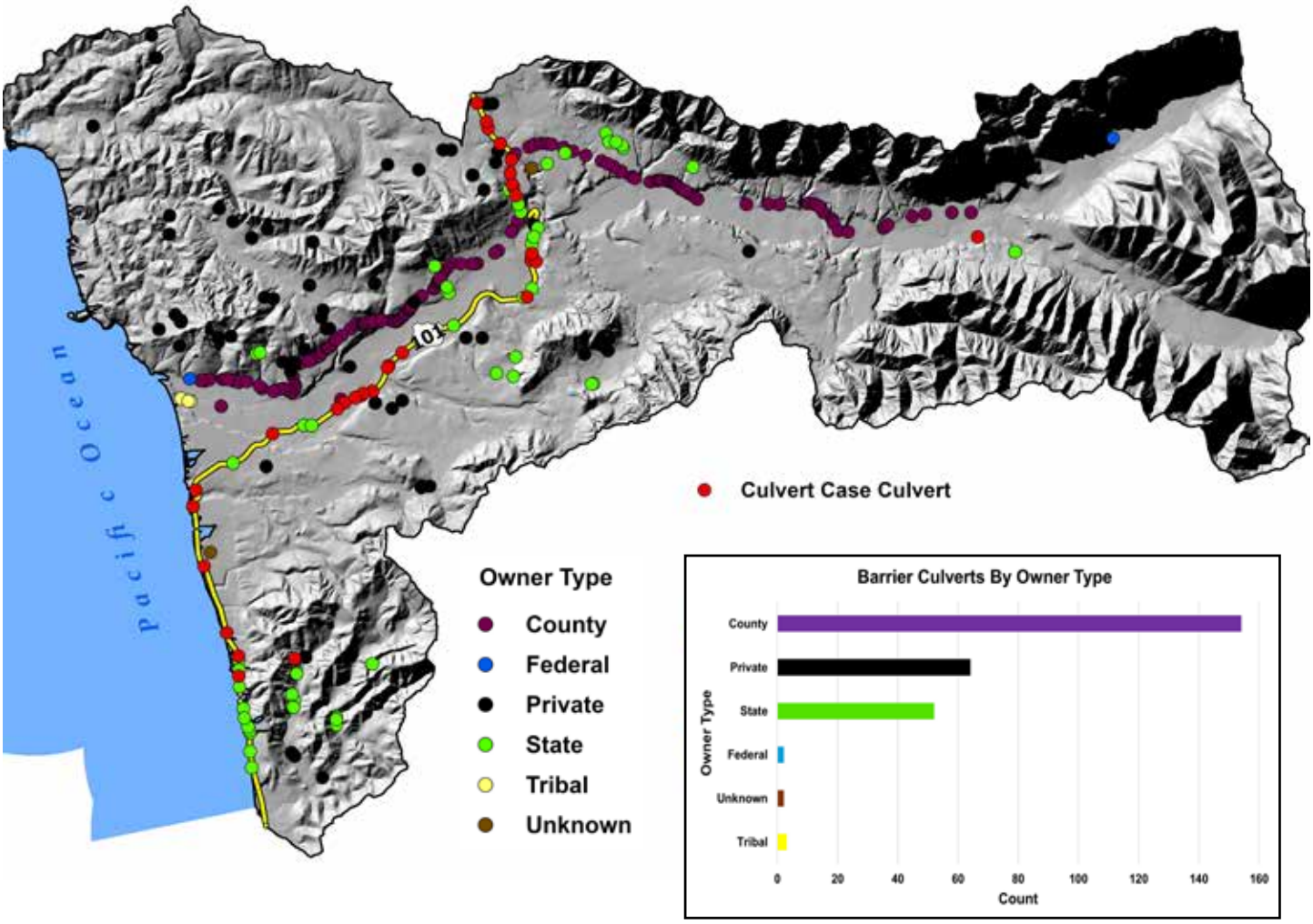




Map Data Sources: WADOT 2018[5], WAECY 2018[6]

Culverts Continue to Impede Fish Passage

There are 51 state-owned culverts in the Culverts Case dataset in the Hoh Area of Interest. Of these, 31 (or 60.8%) are still barriers to fish. In another dataset of 316 barrier culverts, 154 (or 48.8%) are county-owned. Private ownership accounts for 64 (or 20.2%) while state ownership accounts for 52 (16.2%) of the culverts. In addition to action being taken to fix state-owned culverts, measures need to be taken to remove the impediments to fish passage caused by county- and private-owned culverts.



Barrier culverts adversely impact fish migration particularly on small streams because the water velocity is too high, or flow is too shallow, or there is a waterfall into or out of the culvert. They prevent the fish from reaching their spawning grounds and the young cannot migrate to sea.

The 2020 State of Our Watersheds report for the Hoh Area of Interest mostly used data from the Road Maintenance and Abandonment Plan (RMAP)[1], a process developed as part of the Forest and Fish Rules in 2001. The schedule for repairs needed to upgrade road systems at stream crossings and address aquatic habitat and fish passage issues under that plan is largely complete. This report uses two other datasets of fish barrier culverts.

In the Culverts Case database are Washington state-owned barrier culverts. This dataset currently has 51 culverts in the Hoh Area of Interest. Of these, 31 (or 60.8%) are still barriers to fish. The others have been replaced by a passable structure or are not considered barriers because fish presence has not been recorded. The state is under a court injunction to replace the culverts with the worst impacts on fish habitat by 2030.

The other database includes 316 culverts that are owned by the state and the county as well as private corporations and individuals. County-owned roads have 154 (or 48.8%) of these culverts. Private ownership accounts for 64 (or 20.2%) while state ownership accounts for 52 (16.2%) of the culverts. About 7% of barrier culverts fall outside of these main ownerships.

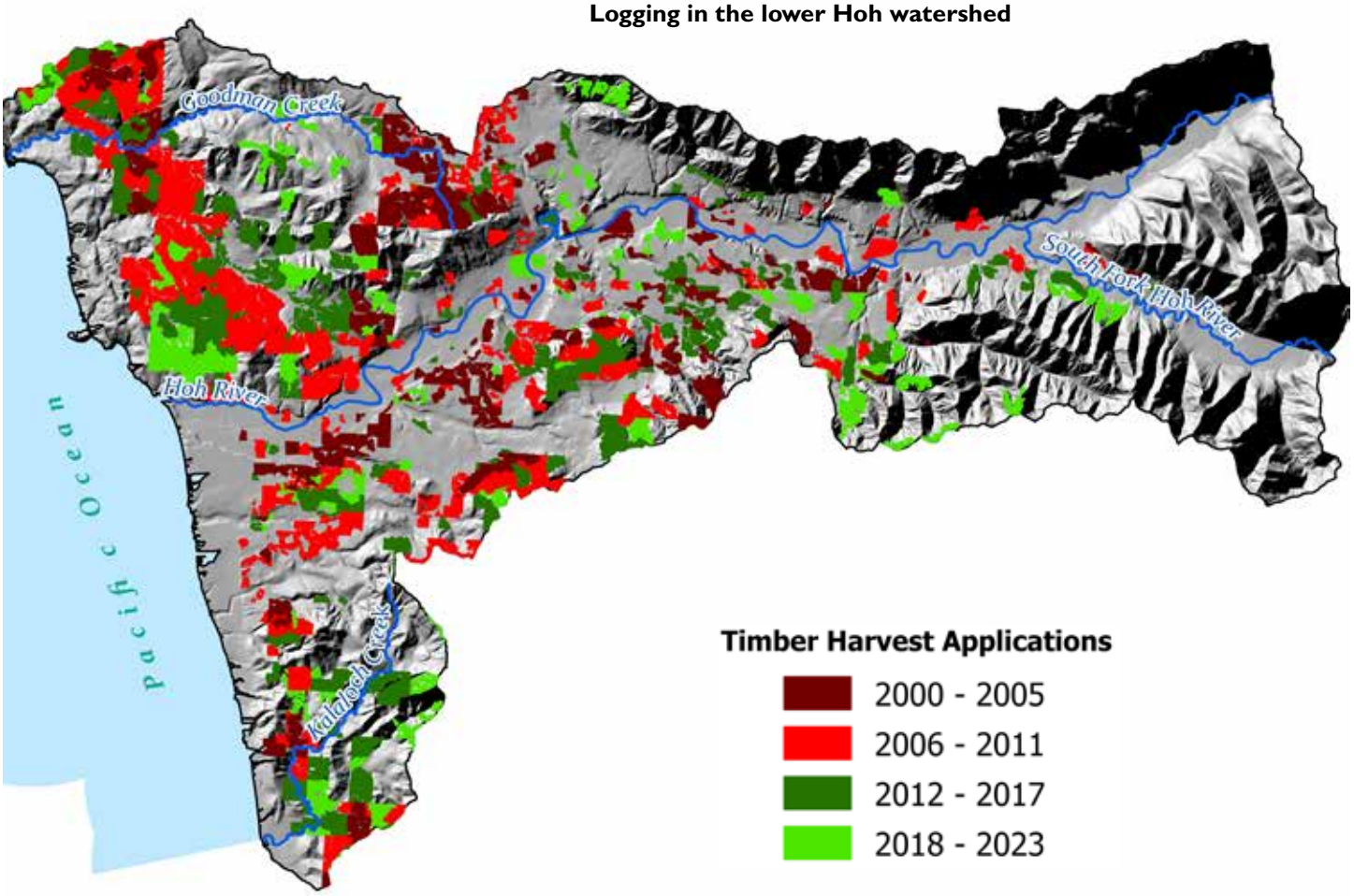
While steps are being taken to ameliorate the impact of state-owned culverts in the Culverts Case, it appears that similar steps need to be taken to improve and restore habitat and remove the impediments to fish passage caused by county- and privately-owned culverts.

Map Data Sources: CSP 2024[2], SSHIAP 2004[3], SSHIAP 2024[4], WADFW 2023[5], WADOT 2018[6], WAECY 2018[7]

Timber Harvest Activities

Between 2000 and 2023, about 170 square miles of forestlands have either been or will soon be harvested, with about 145 square miles (or 86%) in private ownership. The private forestland harvest operations were predominantly conducted between 2006 and 2017.

Logging in the lower Hoh watershed

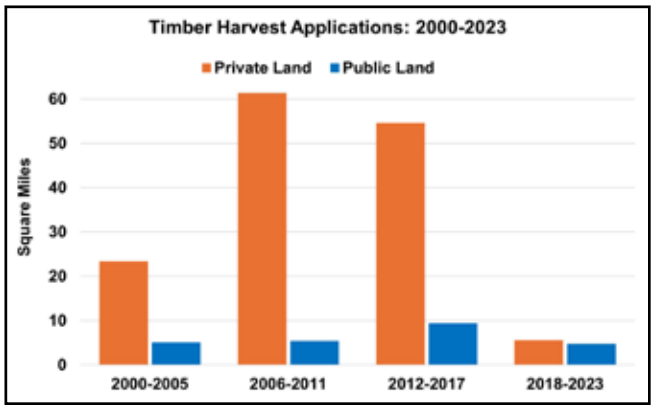


A healthy forest is a key component of most watershed processes, and the forested lands of the Hoh Area of Interest are major producers of salmon and trout. However, timber harvest activities can affect the quantity, quality, or timing of streamflow, gravel substrates, the supply of large woody debris, vegetative cover and food supplies required by all salmonids.

Forest practice activities within the Hoh Tribe's Area of Interest directly influence watershed vegetation through creating access to, as well as removal and re-establishment of forest vegetation. These practices can result in the absence of large woody debris in streams, less healthy riparian buffers, bank instability and erosion, and lack of shade in the basin.[1,2,3]

Forest practice applications filed for the purposes of cutting or removal of timber products within the area show that between 2000 and 2023, about 170 square miles of forestlands have either been or will soon be harvested, with about 145 square miles (or 86%) in private forestlands. These forest practice activities in private forestlands were predominantly carried out in the period between 2006 and 2017. In public lands, the level of such activities remained relatively the same for all periods between 2000 and 2023.

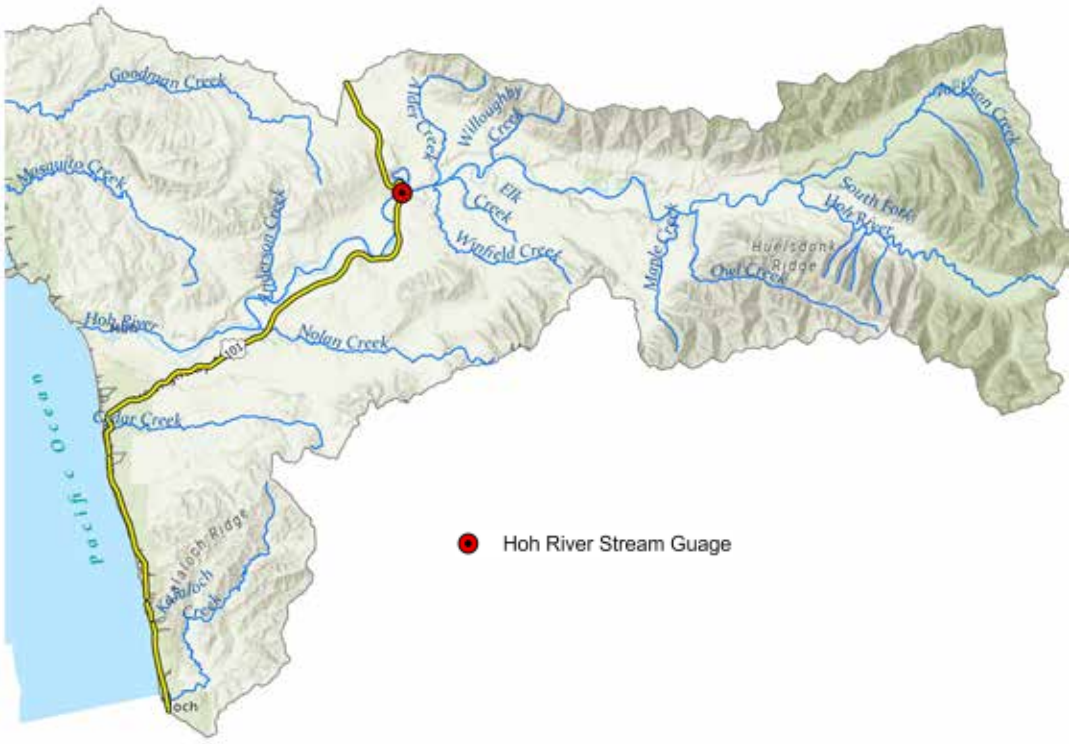
A study[4] in the Hoh watershed revealed that timber harvesting significantly impacts peak and mean daily flow of streamflow at watershed, sub-basin and basin level in descending order. Similarly, reductions in hydrologic maturity (age of vegetation) with the resultant degradation of floodplain habitat and poor large woody debris recruitment are significant habitat factors limiting salmonid production in this basin.[5] It is not clear why there was a marked reduction in timber harvest rates from 2018 to 2023 nor do we know whether this reduced rate will be sustained over a long period.

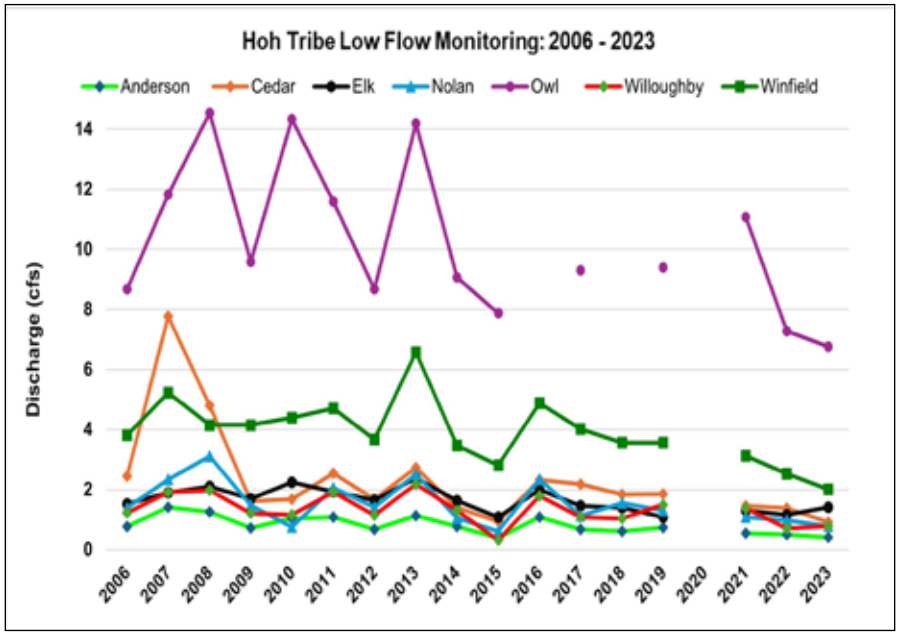


Map Data Sources: SSHIAP 2004,[6] WADNR 2021,[7] WAECY 2018[8]

Flow in the Hoh River and Adjacent Coastal Watersheds: Summer Minimums and Winter Maximums are Becoming More Intense

Since 1960, flows in the Hoh River have become more extreme, largely as a result of climate change. With less precipitation and warmer air temperatures during summer months, flows in rivers and streams are declining. In contrast, winter storms are becoming more severe, resulting in greater peak flood events.





Analysis of data collected at the Hoh River gauge at Highway 101 since 1960 suggest divergent patterns in flow during the summer and winter. Mean summer low flow has declined in the Hoh River over the past 60 years, in part due to warmer air temperatures and less precipitation resulting from climate change.[1,2,3] Additionally, flow during the dry season in creeks in the Hoh watershed and adjacent coastal watersheds has also measurably dropped, compared to previous years. From 2021-2023, low flows in creeks monitored by the Hoh Tribe from August through October were below averages from 2007-2019, suggesting a departure from historical conditions. In August 2023, the Hoh Tribe documented the all-time lowest flow since 2007 in two Hoh River tributaries (Owl and Winfield creeks). According to regional models, mean June through August flow is expected to decrease in the Hoh and South Fork Hoh Rivers by 24.3 to 69.2% by 2080.[4,5]

Salmon and steelhead require cold, clean water to migrate and reproduce. As cool, flowing water becomes scarcer in the summer, suitable salmonid habitat for juveniles and adults will become more limited. As a result, spawning adults may struggle to migrate upstream and are more likely to create redds in areas of the river or stream channel that may dry out later in the summer. Adult Chinook salmon that return to freshwater in the

(Continued on next page)

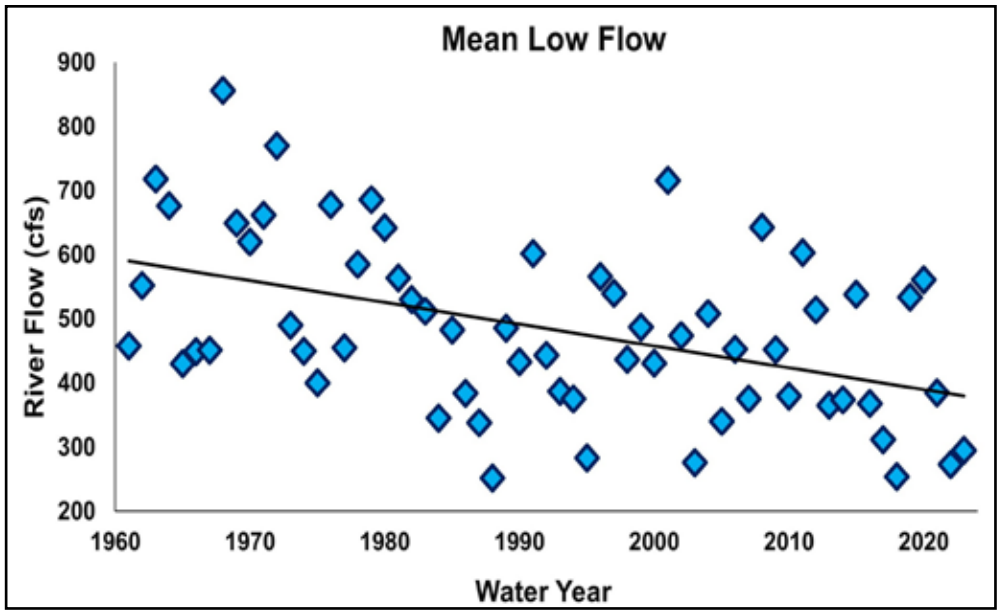
Map Data Sources: USGS 2019[8], Esri[9], WADOT 2018[10], WAECY 2018[11]

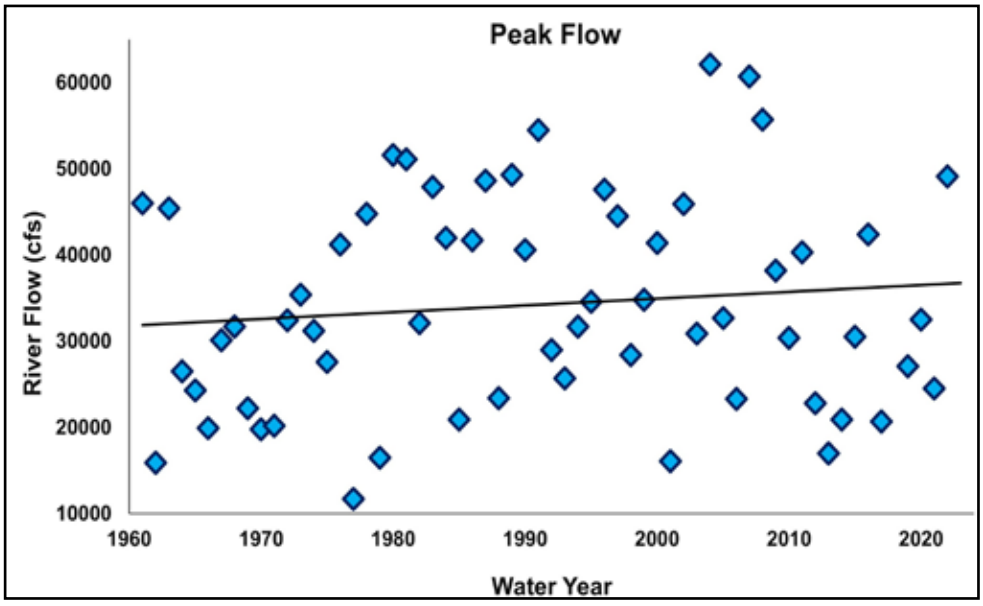
(Continued from previous page)

summer are especially susceptible to low flow conditions. During previous summers when flows were less than 300 cfs (1987, 2002), the water in the Hoh River was low enough to limit upstream migration of adult Chinook.[6] Juveniles that emerge in summer months may become trapped in pools and side channels that are disconnected from the mainstem due to a lack of flow and die from low dissolved oxygen concentrations, a phenomenon that has already been observed in the watershed.[7]

While water availably is declining in the summer, annual peak flow at the Hoh River gauge is increasing as winter storms become more severe. According to the Variable Infiltration Capacity Model, discharge across the watershed during a 25-Year flood event is expected to increase by 3.8-52.1 % by 2080.[4,5] With higher flows, unprotected redds are more likely to be scoured out during extreme storm events.

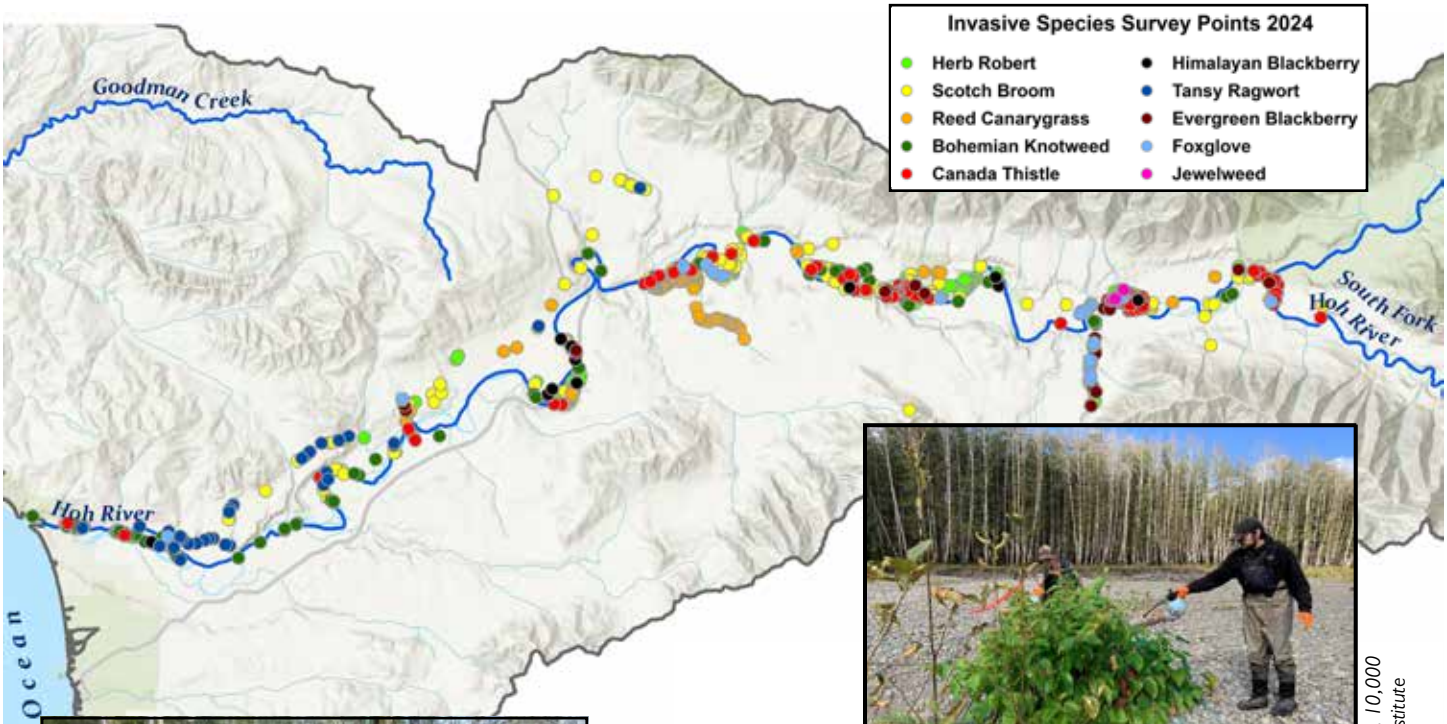
The observed and projected shifts in peak and low flow pose a particular threat to salmon and steelhead in the Hoh Tribe's Area of Interest. Flow conditions have worsened since the 2020 State of Our Watersheds Report.





Invasive Species Continue to be a Problem

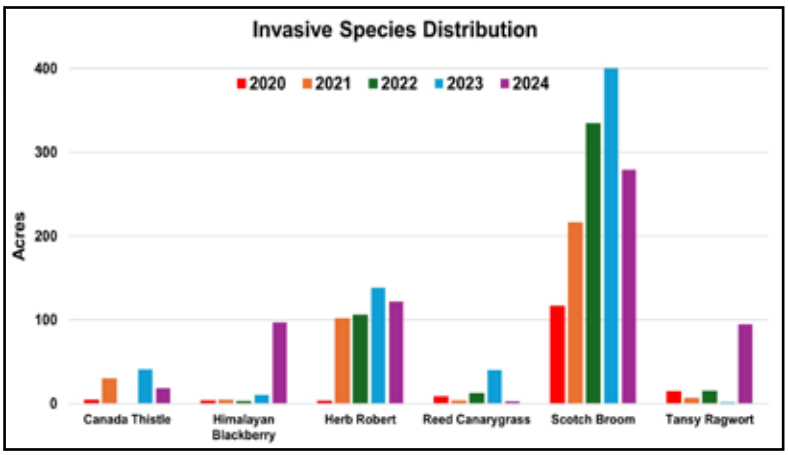
Invasive plant species continue to be a problem in the riparian zones of the Hoh River watershed. Control measures have significantly reduced knotweed numbers, but other species like Scotch broom, herb Robert, Himalayan blackberry and tansy ragwort are now more widespread. Between 2020 and 2024, there has been a general increase in the number of acres occupied by these species.



Jill Silver, 10,000 Years Institute

Treating invasive plant species.

Jill Silver, 10,000 Years Institute



Invasive plants species are a threat to salmonids and wildlife. They are known to crowd out native species and alter the physical and biological characteristics of native vegetative communities, disrupt nutrient cycling and reduce quality of liter inputs, and can cause long-term changes to the structure and functioning of the riparian forests and adjacent fish habitats.[1,2]

For the past two decades, the 10,000 Years Institute, the Hoh Tribe and other partners have carried out invasive plant species surveys, control, and effectiveness monitoring activities. These efforts were initially focused on knotweed (*Polygonum*). As noted in the last State of Our Watersheds Report[3], the control measures have resulted in a significant drop in knotweed numbers, and they are no longer as widely distributed as in previous years. This shows that sustained management can reduce knotweed populations through time, even in a dynamic river.[4]

With the decrease in knotweed, other invasive plant species have increased in the Hoh River riparian zone. The most recent data from the 10,000 Years Institute[5] shows that Scotch broom (*Cytisus scoparius*), herb Robert (*Geranium robertianum*), Himalayan blackberry (*Rubus armeniacus*), and tansy ragwort (*Jacobaea vulgaris*) are now more widespread. Other species of note include reed canary grass (*Phalaris arundinacea*), Canada thistle (*Cirsium arvense*), and evergreen blackberry (*Rubus laciniatus*). Between 2020 and 2024, there was a general increase in the number of acres occupied by the more common species.

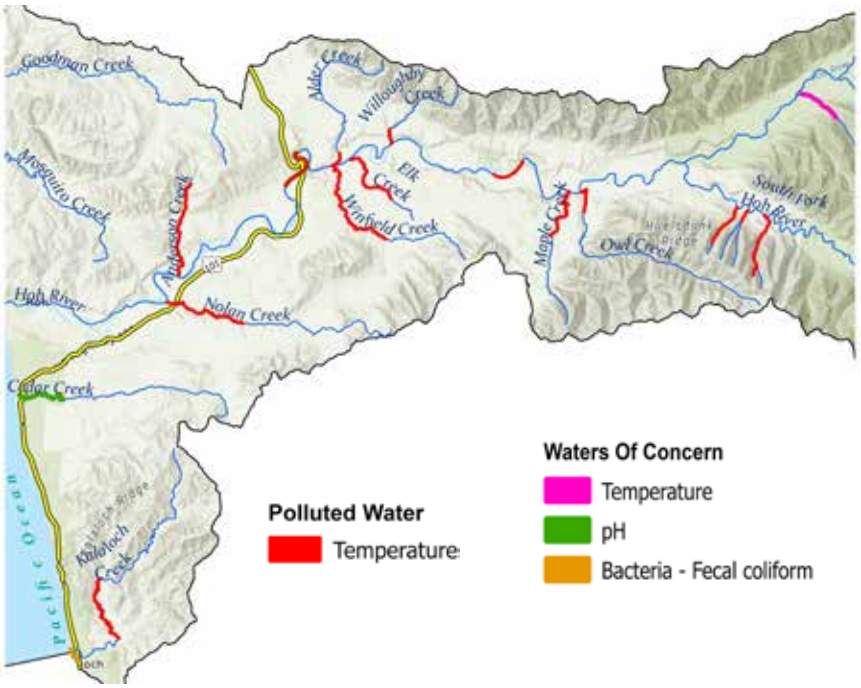
Although a lot of progress has been made in the control of knotweed, other invasive plant species remain a problem and the Hoh River's relatively healthy wild salmon populations could be threatened by their presence.

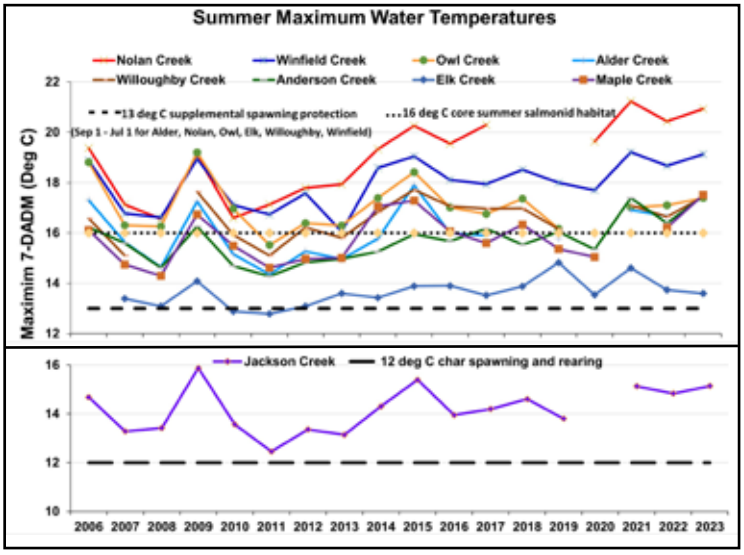
Map Data Sources: 10KYI 2024[5], WAECY 2018[6]

Water Quality in Rivers and Streams is More Degraded

Warm water temperatures continue to degrade salmonid habitat in the Hoh Tribe's Area of Interest. Eight of nine creeks monitored for water quality by the Hoh Tribe since 2007 have had summer water temperatures that exceed state water quality standards for core summer salmonid habitat or char spawning, rearing and migration in monitoring years. Of the 96 river miles monitored by the tribe in 2023, 60.4 river miles (62.9%) had water quality conditions (water temperature, dissolved oxygen or pH) that did not fully support salmonid or char life uses.

The Hoh Tribe has monitored the water quality of rivers and creeks in their Area of Interest for more than 20 years. The tribe's water quality monitoring program was created to 1) establish baseline conditions of water quality, 2) document changes from baseline conditions and 3) monitor for compliance with state of Washington water quality standards[1] with focus on salmon, steelhead and char habitat. Salmonids and char require cool, clean water to survive and reproduce. Parameters monitored through the program include those that affect salmonid habitat: dissolved oxygen, turbidity, conductivity and pH; summer low flow in tributaries; benthic macroinvertebrates in tributaries; and water chemistry. The Hoh Tribe shares water quality results from off-reservation waterways with the state of Washington for inclusion into its Water Quality Assessment Report. Waterways not fully supporting aquatic life due to water quality conditions are placed on the state's 303(d) List of Impaired Waters.[2]



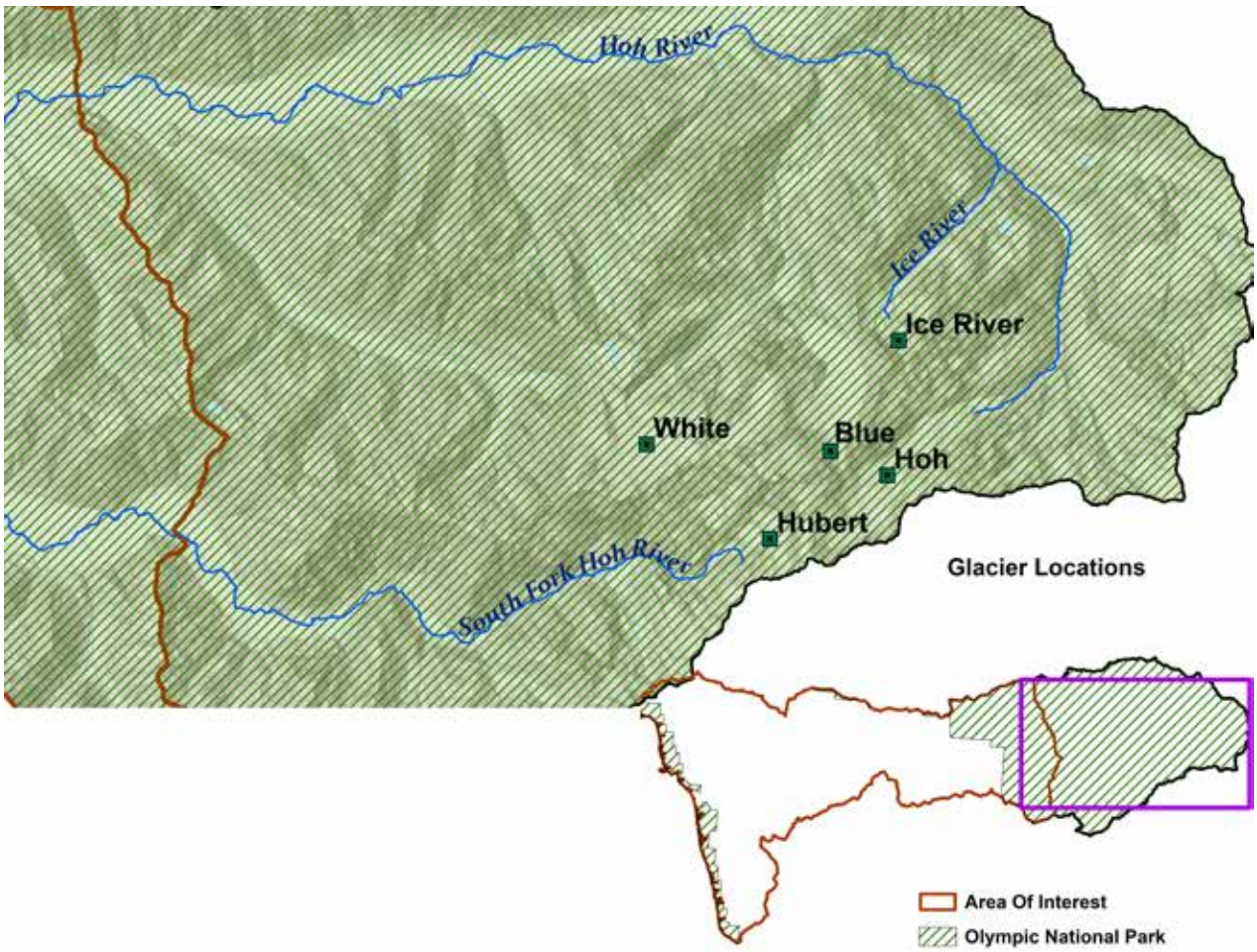


Through monitoring efforts, the Hoh Tribe identified water temperature as the primary water quality parameter of concern in our area of interest. The Hoh River and eleven of its tributaries are on the state of Washington's 303(d) List of Impaired Waters due to warm water temperatures that exceed aquatic life water quality standards.[3] In all of these waterways, the occurrence of high summer water temperatures that are known to stress salmonids are not new; these eleven Hoh River tributaries have been listed since 1996. The Hoh River was added in 2012. With declines in snowmelt and the loss of the glaciers that feed the Hoh and South Fork Hoh Rivers,[4] warm summer water temperatures that threaten salmonid habitat will become more prevalent in the lower extent of the watershed.[5] On top of sites with longstanding impairments due to elevated water temperatures, the Hoh Tribe documented temperature exceedances in fourteen tributaries not currently on the 303(d) List from 2020-2023.[6] Since the 2020 State of Our Watersheds Report, the Hoh Tribe also recorded low dissolved oxygen concentrations and acidic pH values that are unsuitable for salmonids in five creeks. Salmon and steelhead thrive in well-oxygenated waters with generally neutral pH.[1] Of the 96 river miles monitored by the tribe in 2023, 60.4 river miles (62.9%) had water quality conditions (water temperature, dissolved oxygen concentration and/or pH) that did not fully support salmonid or char aquatic life uses. Considering the documentation of warmer waters, low dissolved oxygen concentrations and/or acidic pH values in the Hoh River and some of its tributaries from 2020-2023, the water quality of rivers and creeks in the Hoh Tribe's Area of Interest has deteriorated since the 2020 State of Our Watersheds Report.

Map Data Sources: WAECY 2022[3], Bray 2023[6], WAECY 2021[7]

Climate Change Continues to Impact Glaciers

Glaciers in the Olympic Mountains continue to thin and recede due to climate change. If carbon emissions are not abated, the Olympic Glaciers are predicted to be extinct by 2070. This will cause warmer and lower summer flows in the river.



The Hoh River headwaters lie in the Olympic Mountains, a range of impressive peaks whose high altitudes contain over 150 glaciers. About 66% of the total glaciated landscape is in the Hoh watershed, including the Hubert, Hoh, Blue and White glaciers.[1] Melt from these glaciers and the snowfields in between them feeds into the Hoh River. This water is cool, creating habitat for cold-loving fish, and it helps maintain river levels as melt increases in the summer when rain decreases. However, rising global temperatures are causing the glaciers in the Olympic Mountains to shrink and go extinct which will dramatically change characteristics of the watershed.

The Olympic glaciers are particularly vulnerable to temperature shifts. They are relatively thin and exist at a low elevation where temperatures are relatively warm; at Hurricane Ridge (5,242 ft) on the northeastern side of the Olympic National Park, the winter average is 29°F.[2] Despite these warm temperatures, the west side of the Olympics get a large amount of precipitation which has, historically, fallen as snow in winter and been enough maintain their size.[3] Now, warmer winters mean that more precipitation falls as rain, which doesn't contribute to glacial growth or snowpack. Warmer summers then cause this dwindling snowpack, and the glacier's perennial ice, to melt quickly and early in the season.

From 1895 to 2011, the average temperature in Washington state has risen 1.3°F, having an incredible impact on the Olympic glaciers.[4] In 2015, the area of glacial ice and snowfields was only half of what it was in 1900.[5] This loss has sped up in recent decades; the melt rate observed from 2009-2015 was four times the melt rate seen from 1900-1980.[6] Not only does this melt diminish total glacial area, it also thins the ice, a vicious cycle making the glaciers more susceptible to melting in future seasons. From 1980-2009, temperature rise reduced the Hoh Glacier's thickness by 15%.[7] Glaciers are not getting the chance to gain their size back in winter as snowpack levels in the Olympics have been on a downward trend since 1949.[8] Glaciers are predicted to fully disappear from the Olympic mountains by 2070 if carbon emissions

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Map Data Sources: WAECY 2018[12]

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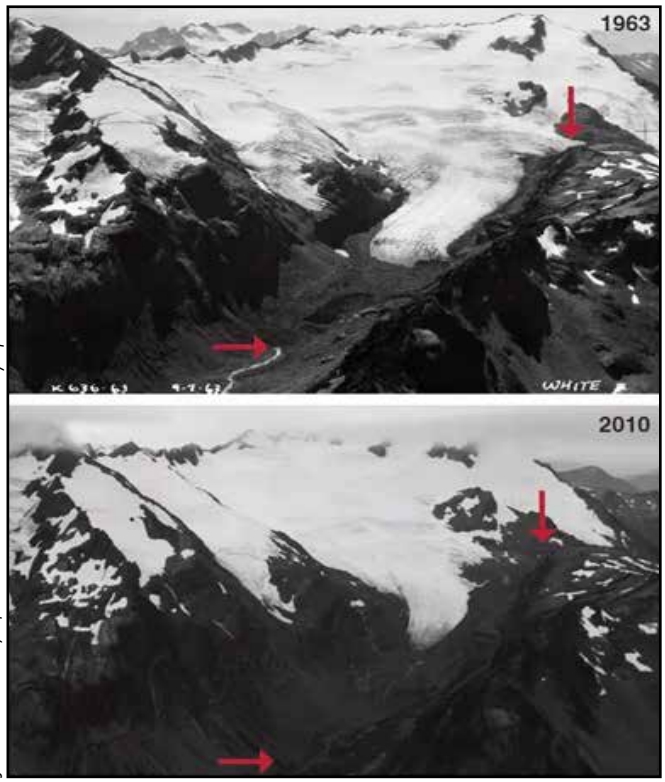
Blue Glacier



Olympic National Park

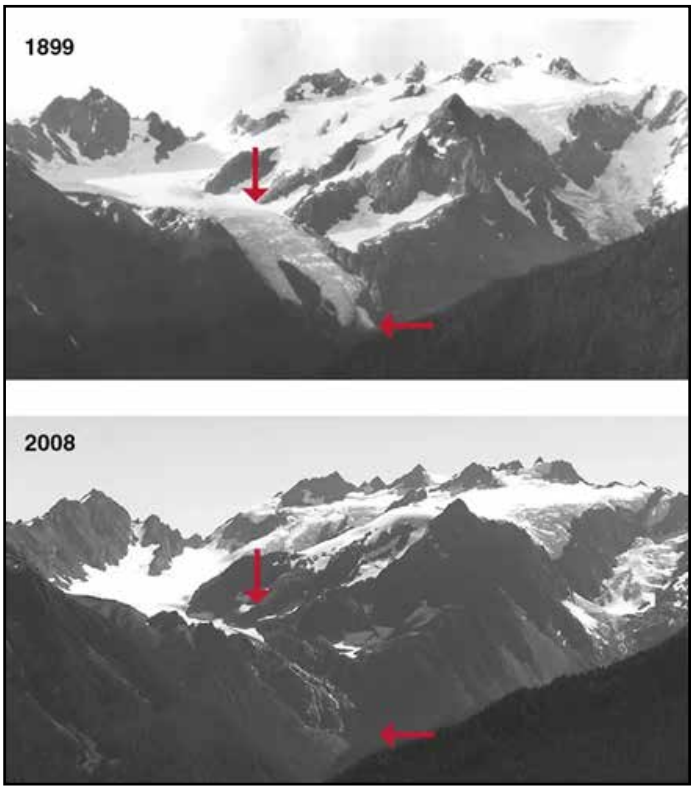
Jim Patterson, Olympic National Park

Comparison photographs show thinning and retreat of glaciers.

continue unabated.[9]

This reduction in area, and eventual extinction, has serious impacts on the Hoh watershed and river. Between 9 and 15.4% of the total summer flow in the Hoh River currently comes from glacial ice and snow melt. However, the glacial contribution can increase to as much as 18-30% of the flow in August, with 1/3 of that coming from melting glacial ice alone.[10] With less glacial ice, decreasing snowpacks, and decreasing summer rainfall predicted, summer flows in the Hoh River will be warmer, lower and less consistent, ultimately threatening the survival of salmon and steelhead.

White Glacier

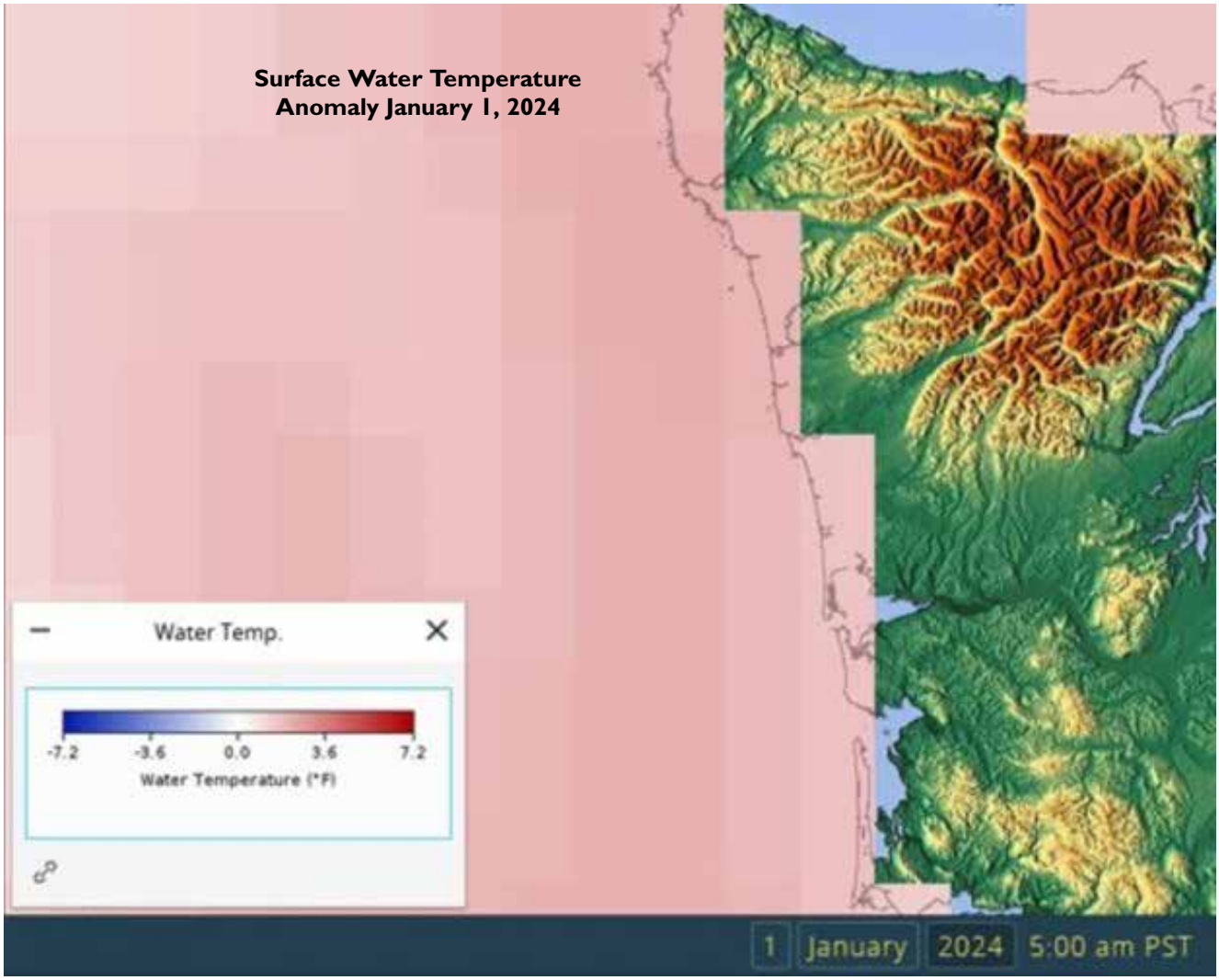


Olympic National Park

Olympic National Park

Ocean Continues to be Impacted by Stressors

The ocean area off the Hoh Area of Interest continues to be heavily impacted by ocean warming, including marine heatwaves, hypoxia and harmful algal blooms. In 2021, a severe fish kill occurred off the Hoh reservation, with hundreds of dead fish washing up on the beach near the village. Also, tribal members have noted that they have been finding smaller razor clams with thinner shells than they have in the past.



The marine Areas of Interest for the Hoh Tribe have been heavily impacted by ocean warming, including marine heatwaves (MHWs), hypoxia and harmful algal blooms (HABs). In recent years, the California Current System (CCS) has experienced nearly annual MHWs. None of these MHWs were as intense as the 2014-2026 MHW ("the Blob"), but they have had the potential to impact fisheries off the West Coast. On a broader scale, the region has also experienced a 3-year La Nina, followed by a 1-year El Nino. During La Nina conditions, winds and ocean circulation in the central Pacific weaken, resulting in cooler marine conditions on the West Coast that are typically favorable for salmon. During an El Nino, the opposite occurs and warmer, subtropical waters intrude up the West Coast.

Beaches in the Hoh Area of Interest have also experienced frequent harmful algal blooms, with domoic acid concentrations high enough to close fisheries in 2021 and 2023. Some studies[1,2] have found that HABs in the CCS tend to occur when southward winds drive upwelling of nutrient rich waters, followed by northward winds that drive downwelling and push these waters (and the phytoplankton bloom that can accompany them) onshore.

Additionally, summertime hypoxia has been a growing concern on the Washington continental shelf, with the most severe conditions occurring between Grays Harbor and La Push. In 2021, a severe fish kill occurred off the Hoh reservation, with hundreds of dead fish washing up on the beach near the village. Seasonal moorings deployed by the Olympic Coast National Marine Sanctuary since 2006 have documented the increasing severity and duration of hypoxic conditions in the Hoh Area of Interest, with hypoxic conditions being in place in waters greater than 40 meters depths for more than half of the summer in some years.

Tribal members have noted that they have been finding smaller razor clams with thinner shells than they have in the past. Additionally, they have also noted that smelt are much harder to find now; however, no information is currently available for smelt populations on the Olympic Coast.

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Ocean Continues to be Impacted by Stressors

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2025 State of Our Watersheds Report Dungeness River and Streams of the Northeastern Olympic Peninsula

We are reminded every day and every season that Climate Change is a reality and will be for many generations. It impacts our water resources, habitat and all other environmental conditions that threaten our salmon resources. Jamestown must join all concerned to do our part to counter it. We are committed to watershed health and making a difference for our culture and the salmon that represents our unique indigenous identity.

– W. Ron Allen
Chairman

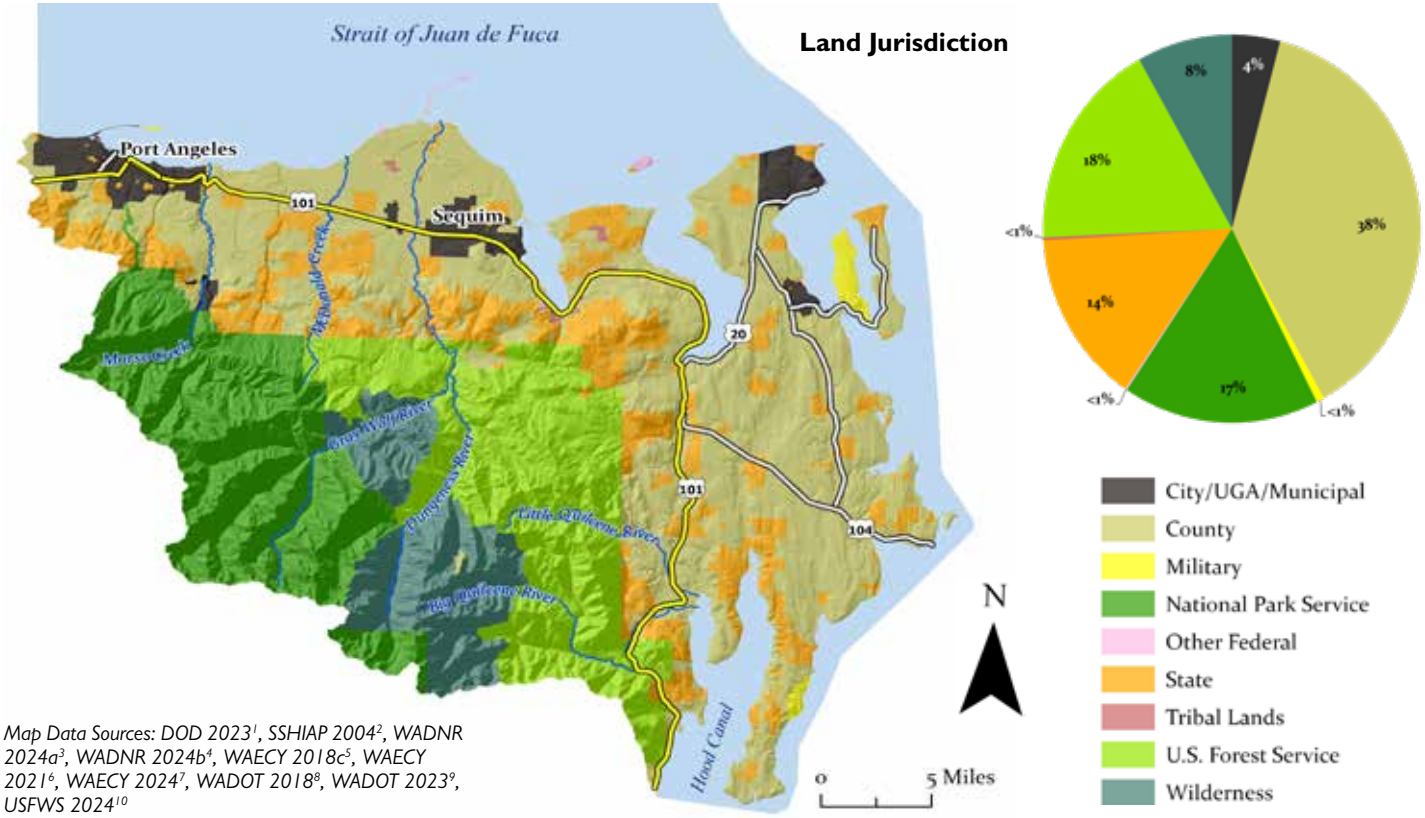
John Gussman

High tide at 3 Crabs Road and Meadowbrook Creek estuary near the mouth of the Dungeness River in January 2022.

Jamestown S'Klallam Tribe

The Jamestown S'Klallam people have been living in these areas since time immemorial in winter and summer communities along or near the shore of the Strait of Juan de Fuca and Hood Canal. As part of their way of life, the Jamestown S'Klallam people have fished and hunted in these areas for cultural, subsistence, spiritual and economic reasons, and continue to do so today. These watersheds and coastal areas have been changed by commercial forestry, agriculture and irrigation, rural residential and commercial development impacting water quality and habitat of the streams, rivers, and marine shore area. The Jamestown S'Klallam are working hard toward salmon recovery in this region and have achieved significant results in water resource management and floodplain restoration, while working towards climate resiliency.

Jamestown S'Klallam Tribe



Map Data Sources: DOD 2023[1], SSHIAP 2004[2], WADNR 2024a[3], WADNR 2024b[4], WAECY 2018c[5], WAECY 2021[6], WAECY 2024[7], WADOT 2018[8], WADOT 2023[9], USFWS 2024[10]

The Jamestown S'Klallam Tribe's area of primary interest for this report is in the northeast corner of the Olympic Peninsula, including portions of the Quilcene-Snow and Dungeness-Elwha drainage areas, which reside in the rainshadow of the Olympic Mountains. These watersheds include the Dungeness River, with headwaters in the Olympic National Park and U.S. Forest Service wilderness areas, plus the Big and Little Quilcene rivers, Jimmycomelately Creek and other independent drainages that empty into the Strait of Juan de Fuca and northwestern Hood Canal.

The S'Klallam were the first permanent human inhabitants in the eastern Strait region where they had villages and fishing camps along the shorelines and near the mouths of major streams, enjoying the benefits of the plentiful fish and shellfish resources.

With the signing of the Point No Point Treaty of 1855, the S'Klallam tribes retained the right to fish, hunt and gather in their Usual and Accustomed areas. These treaty-reserved rights were affirmed by Judge Boldt in the *U.S. v. Washington* ruling (Boldt decision), in the 1994 ruling by Judge Rafeedie affirming tribal shellfish harvest, and several other court cases.

By 1855, Euro-Americans had started settling in the area and became engaged in landscape-altering activities that negatively affected tribal fishery resources. These included:

- Creating farmlands by clearing floodplain forests, diking the estuaries and channelizing the lower reaches of the Dungeness, Big Quilcene and Little Quilcene rivers and the Jimmycomelately, Salmon and Snow creeks. The settlers had generally completed these actions before 1900.
- Logging the Dungeness River shorelines and driving the logs downstream to Dungeness Bay during the period 1860 to 1890.
- Diverting flows from the Dungeness River into agricultural irrigation systems. At times, the water withdrawals constituted more than 80% of the river's flow. From the late 1890s until the early 1930s, irrigators did not provide their diversions with fish screens.
- Diking and installing tidegates that blocked and converted valuable estuarine marsh habitats at Graysmarsh (a former Dungeness River mouth), Cline Spit, and Dungeness and Quilcene bays.
- Logging old-growth timber that dominated the landscape.
- Diking expansive areas of floodplains for "flood control" and to enable residential development and agriculture within floodplains.
- Clearing logjams from the Dungeness and Big Quilcene rivers. On the Dungeness River, wood removal was an institutionalized activity performed by public agencies until the 1980s.
- Early shallow wells that lowered the water table and contributed to the lower base flows.

Today, legacy impacts and a plethora of current day human impacts continue to degrade Dungeness River salmon habitat, as well as habitat of the other tributaries to the Strait, northwestern Hood Canal, and the accompanying nearshore environment. These impacts include agricultural water withdrawals, shoreline bank armoring, riparian clearing/residential development, sediment and pollution (bacteria, 6PPDQ, etc.) impacts. These contribute greatly to the decline of Dungeness salmon and char.

While the tribe and other stakeholders are making significant gains in restoring salmon habitat in our focus area, two of the direst impacts—the losses of floodplains and logjams—have mostly eluded correction. The tribe remains committed to salmon recovery but has become increasingly reliant on shellfish harvests for sustenance and income.

Chapter Summary

The Jamestown S'Klallam Tribe has fished, hunted and gathered in these watersheds in western Washington since time immemorial and are leaders in the state's salmon recovery effort, especially in the Olympic Peninsula and Hood Canal regions. The S'Klallams, among other tribes, have taken a large role not only culturally but also scientifically to understand these watersheds because of their significance to their people and their children's future. The tribe believes if salmon and shellfish are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery within the basin are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. Tribes believe the salmon recovery effort should focus on this.

The 2025 State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource. The goal of this report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery.

This report is part of the Treaty Rights at Risk initiative begun collectively by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

For this report, the Jamestown S'Klallam Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss, degradation of riparian zones, water quality impacts, increased biotoxins, tidal obstructions and invasive crabs. This document is considered a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon and other critical species habitats, and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Tidal Obstructions Reduce Salmonid Habitat

Tidal obstructions including tide gates, beach berms, dikes and culverts are major barriers to historically accessible salmonid habitat. The tribe would like to restore Cassalery Creek, Graysmarsh and Cline Spit with high quality habitat to sustain healthy populations of salmon.

Healthy Riparian Zones Critical for Salmon Recovery

Healthy riparian and channel migration zones are vital for salmon survival. However, much of the land within riparian zones has been developed or degraded.

Low Summer Flows Create Shallow Riffles that Challenge Adult Salmon Migration Upstream

Shallow riffles in the Dungeness River challenge salmon migrating during low summer flows. The tribe has been testing short-term fixes to make them passable and will be conducting a suitability study to install large woody debris as a long-term fix.

Biotoxins Sampling for Public Health

Biotoxin monitoring ensures that only shellfish safe for human consumption are harvested. Long-term data will help us understand what factors increase harmful algal blooms in the Salish Sea.

European Green Crab Threaten Native Species

European green crab (EGC) are a highly invasive species that were first discovered in the Salish Sea in 2012. They feed on many subsistence species critical for the tribe, negatively impact valuable eelgrass beds necessary for salmon to thrive and pose a displacement risk for the native Dungeness crab. EGC catch numbers have increased over time with the addition of more traps set.

Lower Quilcene Restoration Key to Salmon Recovery

The tribe has partnered with the Hood Canal Salmon Enhancement Group for the Big Quilcene Lower One Mile Construction Project. This project will restore habitat critical for salmon in the lower one mile of the Big Quilcene River and the surrounding floodplain. Construction is expected to begin in late 2025 and be completed by the end of 2026.

Dungeness Floodplain Restoration is Key to Salmon Recovery

Floodplains play an important ecological role in salmon recovery and create healthy functioning habitat for freshwater species. The tribe has been actively working on projects to restore the Dungeness River and its floodplains for more than 30 years.

Climate Change Impacts Tribes and Salmon from Rising Water Temperatures and Lower River Flows

Climate modeling predicts that by mid-century, the main channel of the Dungeness is likely to regularly exceed critical temperature thresholds for cold-water fish (e.g., 16°C 7DAD Max temperatures) and reduce summer flows. These changes will stress cold-water salmon throughout their life stages and be a barrier to migration. Lack of funding and capacity to prepare for these changes remain a challenge.

Conclusion

For more than a decade, the Jamestown S'Klallam Tribe has worked collaboratively with partners to restore areas along the Dungeness River watershed and estuary. However, more work still needs to be done to keep up with community development and associated habitat degradation. It is necessary to bring back healthy populations of salmon and wildlife in these watersheds. Lack of both funding and community willingness continues to hinder progress. Even though nearshore and riparian restoration has been implemented with success, additional efforts are still required in order to achieve net ecological gain.

There continues to be incremental decline in habitat conditions across the watersheds in the tribe's Area of Interest. Riparian zones continue to decline, biotoxins need to be monitored, European green crab threaten the shoreline environment, and climate models predict regular exceedances of water temperature thresholds and lower river flows all which impact salmon survival.

Restoration cannot keep up with the impacts of a growing population and insufficiently protective laws/ordinances that do not achieve the "no net loss" standard. Landowners should be held accountable for their land use decisions and should help work toward the improvement fish habitat in their home areas. Federal, state and local governments each play a role in regulating these areas and should collaborate with the tribes on these important issues. Current land use and water laws are designed to protect critical areas for healthy streams and habitats and need to be implemented and enforced. Implementation can include education and voluntary actions, but enforcement and forward-thinking revisions, amendments or updates are needed when laws are broken. The future of tribal treaty rights in this area depends on it. The tribe is working toward climate resilience, through monitoring and evaluation of impacts to their land and the surrounding areas where they hunt and fish.

Key Indicators All Show Declining Habitat Conditions

At the 20-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for Jamestown's Area of Interest shows that priority issues are degradation of riparian zones and floodplain processes, negative impacts to stream temperatures and flow based on a changing climate, and increased growth in invasive European green crab populations which impact critical habitats. In addition, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) which are needed to address implementation strategies, critical community engagement procedures necessary for restoration, protection, adaptive management and monitoring, and enforcement of existing regulations. Funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the status of these key environmental indicators shows a steady loss in habitat status:

	Status	Habitat Trend
Tidal Obstructions	Tidal obstructions including tide gates, beach berms, dikes and culverts are major barriers to historically accessible salmonid habitat.	**Declining**
Riparian	Healthy riparian and channel migration zones are vital for salmon survival. However, throughout the tribe's Area of Interest, much of the land within riparian zones has been developed or degraded.	**Declining**
Stream Flows	Shallow riffles in the Dungeness River challenge salmon migrating during low summer flows. The Jamestown S'Klallam Tribe has been testing short-term fixes to make them passable and will be conducting a suitability study to install large woody debris as a long-term fix.	**Concerns**
Invasive Species - Green Crab	European green crab (EGC) are a highly invasive species that were first discovered in the Salish Sea in 2012. They feed on many subsistence species critical for the tribe, negatively impact valuable eelgrass beds necessary for salmon to thrive and pose a displacement risk for the native Dungeness Crab. EGC catch numbers increase with traps set.	**Concerns**
Restoration - Floodplains	Floodplains play an important ecological role in salmon recovery and create healthy functioning habitat for freshwater species. The Jamestown S'Klallam Tribe has been actively working on projects to restore the Dungeness River and its floodplains for more than 30 years.	**Improving**
Climate Change	Climate modeling in the tribe's area predicts that by mid-century, the main channel of the Dungeness is likely to regularly exceed critical temperature thresholds for cold-water fish (e.g., 16°C 7DAD Max temperatures) and reduce summer flows. These changes will stress cold-water salmon throughout their life stages and be a barrier to migration. Lack of funding and capacity to prepare for these changes remain a challenge.	**Concerns**

As a leader in restoration efforts across the region, the tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, critical salmon habitat, and uses cutting edge research to better understand how to support healthy ecosystems for the future.

Looking Ahead

As the Jamestown S'Klallam Tribe looks ahead, the issues and indicators discussed in this report are priorities for implementation and monitoring. The tribe continues to highly prioritize Dungeness River floodplain recovery, including reconnecting floodplains by addressing human-caused stressors and reforesting riparian areas.

From 2020 through 2022, the tribe and partners undertook five floodplain reconnection projects on the Dungeness River—at Rivers Edge, Dungeness River Nature Center, the "Caldero" property, and at two engineered logjam (ELJ) projects sites at river miles 13 to 13.5, and 14 to 14.5.

The Rivers Edge project encompasses 143 acres of floodplain from approximately river mile 1 to river mile 3. The tribe applied process-based restoration (PBR) principles which culminated in nearly two miles of levee setback on the eastern side of the river, the addition of habitat-forming logjams, and massive tree planting efforts to expedite the growth of a riparian forest.

PBR techniques seek to restore the underlying processes that create healthy river systems. A key principal is to remediate underlying stressors to allow the river to access significant portions, if not all, of its historic floodplain. Stressors can include dikes and levees, incision-inducing channel straightening, and depletion of logjams. Implementing PBR can produce widespread benefits such as:

- Creating multiple river channels—side channels and anabranches—that provide diverse habitat for salmon, char and wildlife
- Raising the water table when the river is high, which then returns cool, subsurface flows in the late summer and fall
- Dispersing energy and reducing water velocities when the river is flooding so that spawning gravels, large wood, salmon redds and juvenile fish are not washed away
- Providing off-channel habitat for juvenile fish that prefer slow water in which to rear and over-winter
- Creating diverse habitat features like pools, glides, riffles and backwaters. Water flowing through these habitats and across floodplain surfaces sorts sediment into distinct communities of aquatic plants and insects that form the base of the food chain
- Creating vegetated islands, wetlands and increased riparian edges that are preferred habitats for a high percentage of bird, mammal and amphibian species
- Attenuating flood pulses and allowing fine sediment to settle out in low-energy depositional areas and nutrient cycling.

The tribe is at the forefront of addressing climate-related vulnerabilities and initiating preparation for climate change. As one of the first tribes in western Washington to complete a climate adaptation plan and vulnerability assessment, the tribe is informing its decisions and program implementation for infrastructure, economy, health and transportation with continuously updated climate and resource impact modeling.

In recent years, the state has issued multiple drought declarations for the Dungeness watershed. In response to the recurring drought conditions, the tribe and its partners have employed water conservation and fish passage mitigation tools.

Two water lease programs have been used to conserve water for the benefit of Dungeness River salmon: 1) dry-year leasing (during the last month of irrigation season, August 15-September 15), and 2) pulse flow leasing (strategic, temporary irrigation shutoffs during critical fish migration periods). A third party has coordinated these leasing efforts and secured compensation for the agricultural water users (irrigators) for the leased water. Additionally, crews using hand tools have modified channel conditions to aid adult fish migration upstream during critically low river flows. Looking ahead, the tribe is eager to better understand how shallow low flow riffles affect fish movement, and to mitigate these obstacles by adding large wood to the river and planting trees to eventually produce a full Site-Potential Tree Height 200 (SPTH200) riparian area along the river corridor.

Tidal Obstructions Reduce Salmonid Habitat

Tidal obstructions including tide gates, beach berms, dikes and culverts are major barriers to historically accessible salmonid habitat.[1] In the Jamestown S'Klallam Area of Concern, Cassalery Creek, Graysmarsh (Figures 1 and 2) and Cline Spit are especially vulnerable. The tribe would like to restore these areas to pre-disturbance conditions with high quality habitat to sustain healthy populations of salmon.

Figure 1. Graysmarsh 2019 conditions. 19 acres of channels and ponds, 43 acres of shrub/scrub, 66 acres of non-mowed emergent marsh and 72 acres of mowed emergent marsh. Extremely poor fish accessibility.

Figure 2. Graysmarsh desired (1870) conditions. 32 acres of channels and 168 acres of emergent marsh. Excellent fish accessibility.

Graysmarsh, an approximately 140-acre freshwater/brackish water marsh, lies six miles southeast of the Dungeness River mouth, where Gierin Creek empties into the Strait of Juan De Fuca.

The creek drains through a tidegate, preventing tidal and saltwater interaction with what was once a dynamic saltmarsh that benefited fish and wildlife habitat. The brackish portion has been reduced to approximately 30 acres, less than a quarter of its original salt marsh area. Removal of the tidegate would allow the creek and saltmarsh to return to its natural processes and restore vital salmonid habitat. However, the private owners of the Graysmarsh area wish to maintain it as hunting lands and do not want to remove the tidegate.[2]

Three miles southeast of the Dungeness River mouth and bounded by houses on both sides, Cassalery Creek drains into the Strait of Juan de Fuca through a culvert. This culvert severely restricts the creek's natural processes and has greatly reduced the salt marsh habitat historically available to salmon.

In 2022, Cline Spit became a flagship restoration site for the Dungeness Bay Shoreline Restoration Project. This project's goal is to work with "landowners to restore and permanently conserve ecological processes and salmon habitat throughout the nearshore environment of Dungeness Bay." The Cline Spit project includes removal of 992 feet of armoring, 262 feet of dikes, 4,423 square feet of overwater structures, 10,366 square feet of structures, and reopening the 1855 tidal inlet to restore the historic lagoon and salt marsh (Figure 3).[3]

Figure 3. Cline Spit areas of the Dungeness Bay Shoreline Restoration Project.

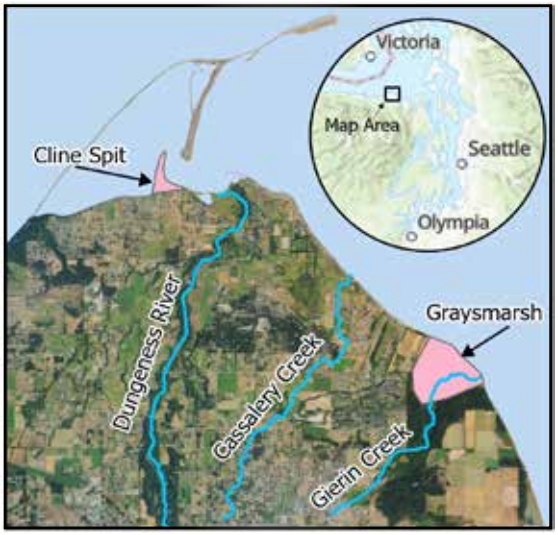


Figure 4. Locations of concerning tidal obstructions and areas for restoration.

Map Data Sources: USGS 2019[4], ESRI 2024[5], JST 2024[6]

Healthy Riparian Zones Critical for Salmon Recovery

The Jamestown S'Klallam Tribe plays a critical role in protecting and restoring riparian health in their area. Healthy riparian and channel migration zones are vital for salmon survival.[1] However, throughout their Area of Interest, much of the land within riparian zones has been developed or degraded.

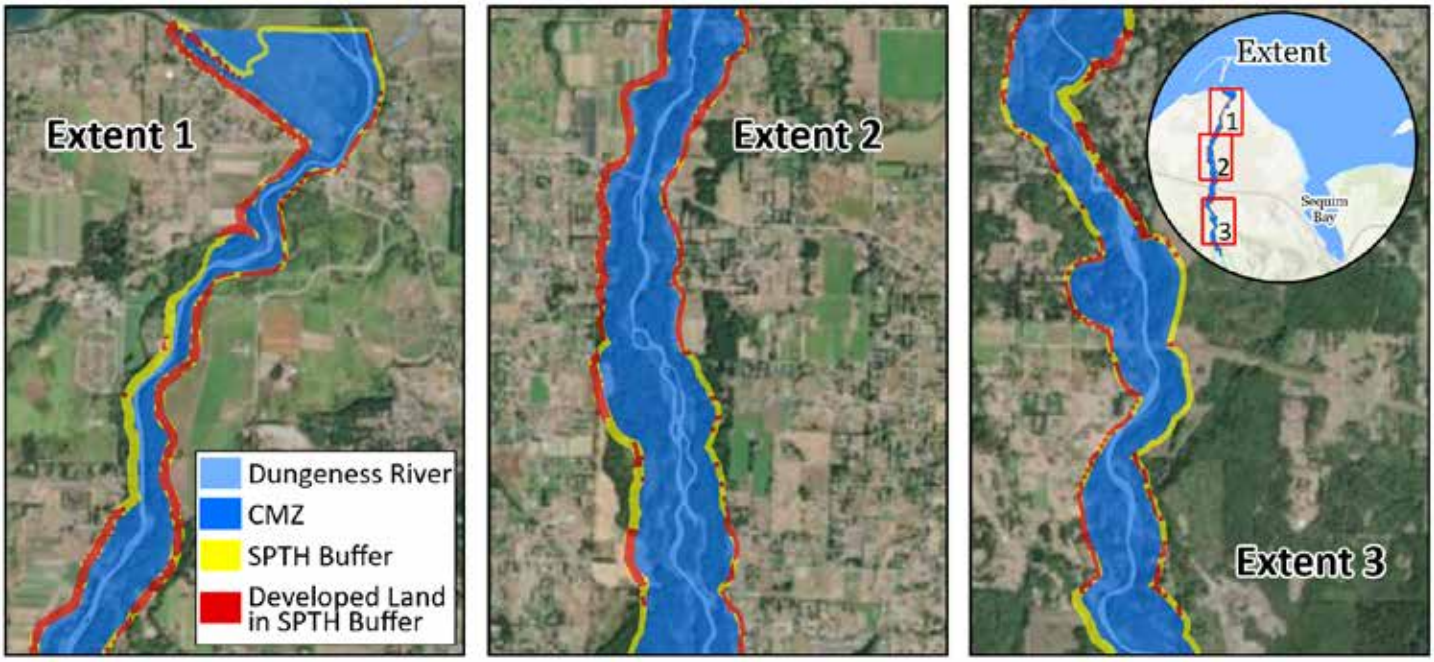


Figure 1. The Dungeness River channel migration zone and developed land within the Site Potential Tree Height buffer.

Healthy riparian zones provide ecological functions that are indispensable for salmon populations.

Riparian vegetation stabilizes streambanks, reducing erosion and sedimentation that can smother salmon eggs.[1] Overhanging trees and shrubs provide shade, which lowers water temperatures and provides cool water that salmon require to survive and reproduce.[2] Large woody debris from riparian trees creates instream structures like pools, riffles and logjams that provide essential spawning and rearing habitats for salmon, as well as refuge from predators and high-flow events.[3] Riparian zones absorb and slow floodwaters, which protects salmon habitat from degradation during extreme weather events, ensuring eggs and fry remain safe.[4]

An appropriate width for a riparian buffer zone is determined by using a site index curve called Site Potential Tree Height (SPTH). This method uses the average maximum height (at 200 years old per Washington Department of Fish and Wildlife standards) that the dominant tree species can grow which determines the development setback buffer, beginning at the stream's channel migration zone boundary.

Rivers and streams change course in a process called channel migration. This usually occurs slowly over decades, but can also occur rapidly during floods, high flow events, or from landslides blocking their flow. Channel migration is a natural geological process that builds diverse riverine habitats and promotes biodiversity. Identifying channel migration zones (CMZs) is an important component to river and stream restoration and protection, and can help keep development away from areas of potential flooding and erosion. Using established CMZs with SPTH methods helps regulators assess and define critical areas to maintain healthy riparian zones around the changing river. On the Dungeness River, 65% (0.41 square miles) of the SPTH buffer is either developed, farmed or impervious surface (Figure 1).

The preservation and rehabilitation of riparian zones and the accurate mapping of CMZs are fundamental to protecting and recovering salmon populations. Healthy riparian zones can mitigate the negative effects of habitat degradation, climate change, and other stressors that threaten salmon populations. Healthy riparian areas not only benefit salmon but also support the broader ecological integrity of freshwater ecosystems, ensuring these systems remain resilient for generations to come.

Map Data Sources: WADNR 2006[5], JST 2008[6], USGS 2024[7], WDFW 2022[8], Hexagon 2025[9]

Low Summer Flows Create Shallow Riffles that Challenge Adult Salmon Migration Upstream

Shallow riffles in the Dungeness River challenge salmon migrating during low summer flows. The Jamestown S'Klallam Tribe has been testing short-term fixes to make them passable and will be conducting a suitability study to install large woody debris as a long-term fix.

Low summer flows from a variety of factors, including less snowpack, agricultural diversions and drought, are increasingly affecting rivers in the Pacific Northwest.[1]

Due to lower base flows, many riffles along the Dungeness River have become very shallow, which can impede adult salmon passage.[2] These "barrier riffles" typically have a steep gradient and are often only inches deep. The Jamestown S'Klallam Tribe has been mapping barrier riffles along the Dungeness River since 2015 (Map 1) and have observed fish pooling below the barriers, waiting for increased water flow to make them passable.

Summer flows have been trending lower in recent years on the Dungeness, and 2023 was a particularly low summer flow year (Figure 1). This has become a priority concern for the tribe as salmonid populations continue to struggle in the Pacific Northwest.[3] In 2023, the tribe took many intervention methods to increase flow and water depth, including curtailed irrigation water pulse-flow releases, dry-year leasing with irrigators, rock-dam placement with Washington Conservation Corps, and temporary inflatable dams. These interventions were implemented on the lower Dungeness from river mile 0.5 to 7.5. In 2023, the tribe identified 24 barrier riffles within the study area. The tribe's staff observed that reaches with barrier riffles generally lacked large woody debris, structure and complexity, while riffles in reaches with these features were generally passable for salmon.

The tribe hopes to install engineered logjams (ELJs) that will transform barrier riffles into passable reaches by slowing the water, increasing water depth, and creating more pools that reduce the length and frequency of barrier riffles. ELJs can also provide pools between barrier riffles for rest and cover.

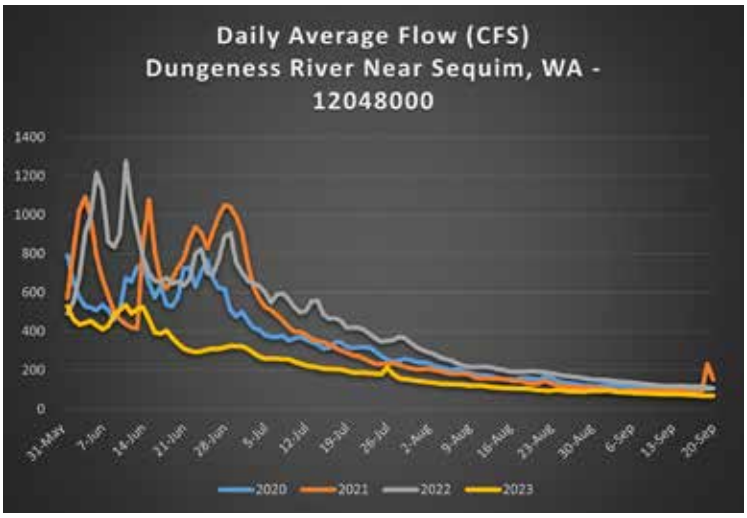
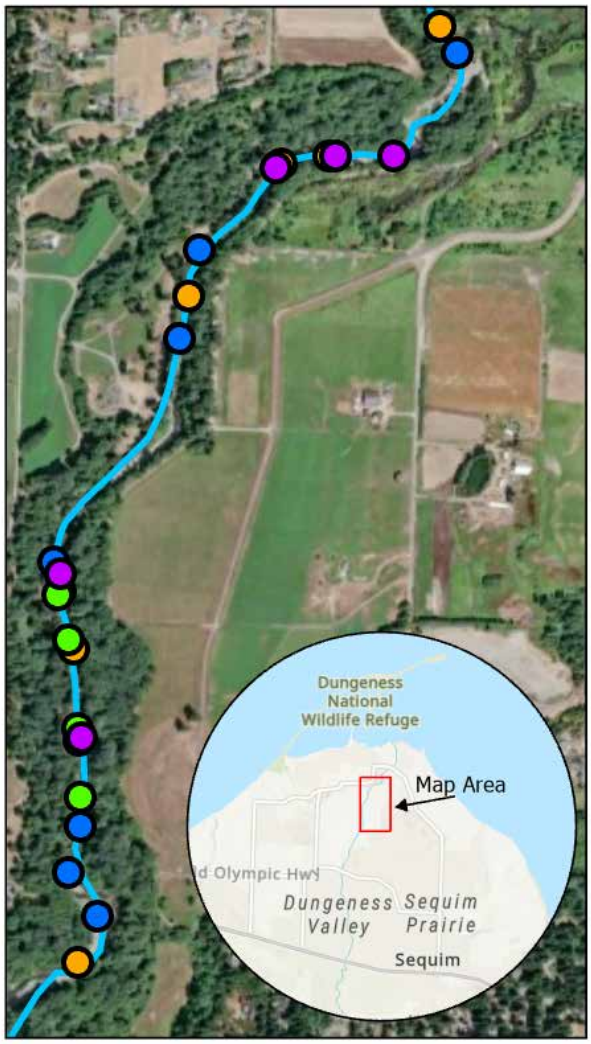


Figure 1. Daily average flow (CFS) from June-September 2020-2023.



Map 1. Barrier riffles on the lower Dungeness.

Map Data Sources: Esri 2024[4], USGS 2019[5]

Biotoxins Sampling for Public Health

Biotoxin monitoring in the Jamestown S'Klallam Tribe's Area of Interest ensures that only shellfish safe for human consumption are harvested. Long-term data will help the tribe understand what factors increase harmful algal blooms in the Salish Sea.

Sequim Bay is regularly impacted by all three of the common shellfish biotoxins in the Salish Sea: Paralytic Shellfish Poisoning (PSP), Diarrhetic Shellfish Poisoning (DSP) and Amnesiac Shellfish Poisoning (ASP). The Jamestown S'Klallam Tribe has monitored phytoplankton as part of the SoundToxins program since 2008 (Figure 1). This monitoring identifies harmful algal blooms (HABs) that make shellfish tissue toxic for consumption or have negative impacts on fish and shellfish.

The tribe conducts phytoplankton net tows, collects water samples and ancillary oceanographic data weekly in the summer and biweekly in the winter (Figure 2). These samples are examined through a microscope for species that can cause shellfish toxicity. The tribe takes shellfish tissue samples that are sent to the Washington Department of Health for analysis. Shellfish testing is ramped up when toxic species are present. Since 2012, Sequim Bay shellfish harvesting has been closed regularly due to toxin threshold exceedances unhealthy for human consumption (Figure 3).

There is concern that increased nutrient runoff into the Salish Sea may result in an increase of HABs and may be altering food webs.[2] In addition, some HABs can directly impact salmonid populations.

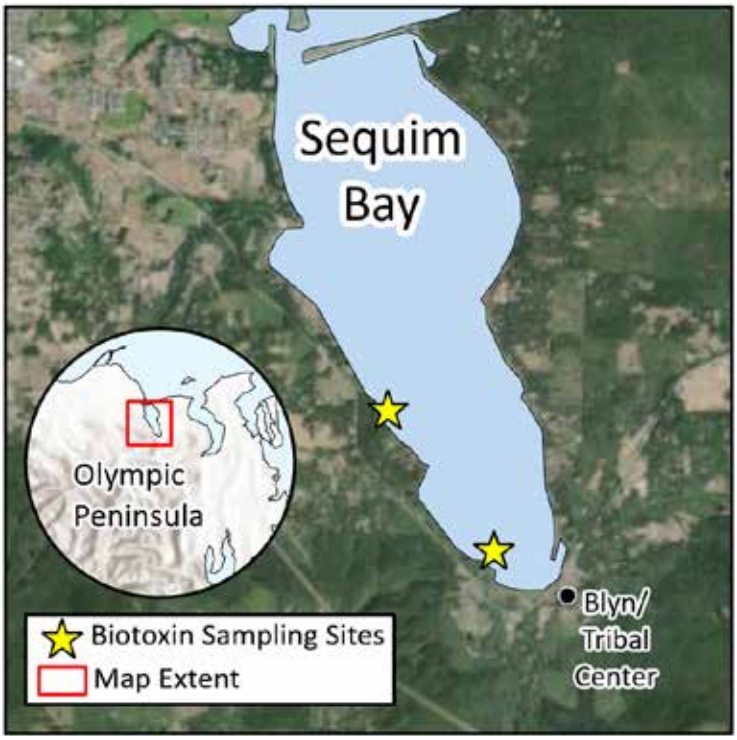


Figure 1. Sequim Bay biotoxin sampling sites.

Tiffany Royal, NWIFC

Figure 2. Net tow sampling in Sequim Bay.

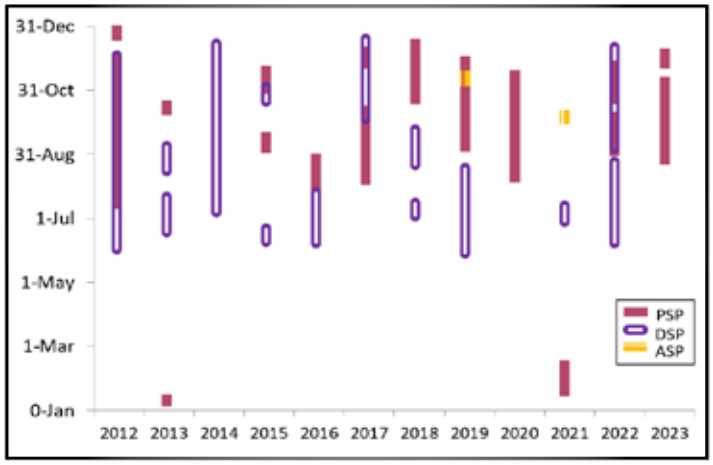


Figure 3. Annual Sequim Bay shellfish closures from unhealthy biotoxins levels (PSP, DSP and ASP).

Phytoplankton monitoring helps understand what is in the water that may cause public health issues with shellfish. Over time, monitoring will discern changes in the Salish Sea as the waters acidify, warm and become more nutrient rich.[3]

In 2021, the tribe completed a pilot study with Washington Department of Fish and Wildlife (WDFW) that added phytoplankton and nutrient sampling to the existing WDFW zooplankton monitoring program sites in northern Hood Canal and Admiralty Inlet. The zooplankton monitoring project is part of a larger effort of the Salish Sea Marine Survival Project, which aims to understand the factors affecting juvenile salmon survival in the Salish Sea.

By coupling these sampling efforts, the tribe may be able to better understand some of the factors impacting salmon survival, such as the presence of fish-killing HABs and nutritional importance of phytoplankton. Tribal biologists found that salmon-killing HABs were present during the outmigration period of salmon and that monitoring of both phytoplankton and zooplankton simultaneously was logistically feasible and necessary.

Figure 3 shows shellfish harvest closures from biotoxins in Sequim Bay since 2012. Sequim Bay has been subject to closures due to all three biotoxins, including several instances of dual closures.[4]

In 2019, soon after a DSP closure was lifted in late August, PSP levels exceeded the closure limits, forcing another shellfish harvest closure in September. This was soon compounded by an ASP closure lasting until November (See Figure 3, year 2019). This figure also illustrates how often clam and oyster subsistence and commercial harvest is interrupted by biotoxins annually after May 30. The comprehensive monitoring program keeps tribal citizens safe while they exercise their treaty rights to harvest and eat shellfish.

Map Data Sources: NAIP 2021[5], WADNR 2014[6]

European Green Crab Threaten Native Species

European green crab (EGC) are a highly invasive species that were first discovered in the Salish Sea in 2012.[1] They feed on many subsistence species critical for the tribe, negatively impact valuable eelgrass beds necessary for salmon to thrive, and pose a displacement risk for the native Dungeness crab.[2] EGC catch numbers have increased over time with the addition of more traps set.

The Jamestown S'Klallam Tribe and partners have been using baited traps that are left overnight to capture invasive European green crab (EGC) in Sequim Bay since they were first discovered at the nearby Dungeness National Wildlife Refuge in 2017. The tribe implements critical habitat and nearshore restoration projects in Sequim Bay to support healthy habitats for fish and eelgrass recovery, but the invasive green crab threatens these efforts.[2]

In 2017, from 372 traps set, one female EGC was captured in Sequim Bay, which may not seem consequential, however, EGC populations can quickly boom. In the tribe's area, WDFW reported 154 EGCs trapped in 2023 from 1,408 traps set, a dramatic increase from 2021. Another example of their exponential growth has been seen in Willapa Bay along the outer coast, where 176 EGCs were captured in 2019 and more than 10,000 were captured in 2021.[3]

The trapping method for EGC population control is a collaboration between the tribe, Washington Sea Grant, WDFW and several other agencies.[4] Discovery Bay is part of the EGC Incident Command System's Strait of Juan de Fuca Management Area, within the Salish Sea Branch.[5] The highest density of captured EGCs were found in Discovery Bay (Figure 1). The number of EGCs captured increased in proportion to the number of traps set (Figure 2). Trapping efforts hope to keep EGC populations low and prevent spread of this invasive species into the North Central Puget Sound Management Area.

EGC are a threat to tribes and ecosystems because of their impact to habitat loss, predation on native species, competition for food and habitat, and impacts to shellfish and salmon fisheries.

"I think we are right on the edge of the invasion," said Neil Harrington, the tribe's environmental biologist. "It is possible that we can hold back the tide. Discovery Bay is concerning, but I think with continued trapping, it is possible to keep the numbers down."[6]

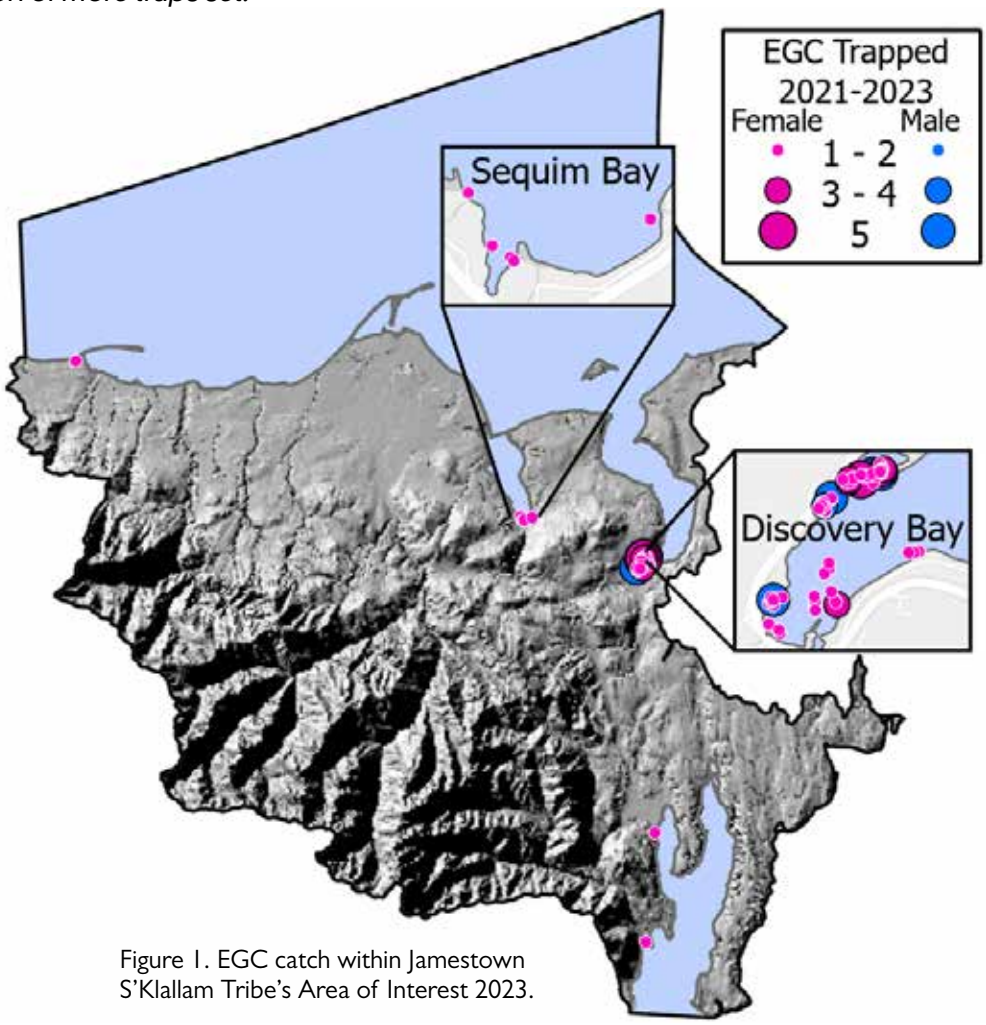


Figure 1. EGC catch within Jamestown S'Klallam Tribe's Area of Interest 2023.

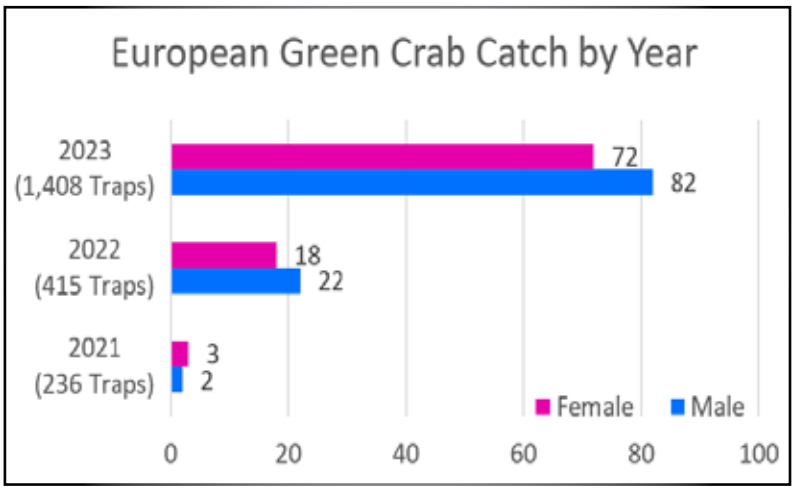


Figure 2. European green crab catch by year and gender within the Jamestown S'Klallam Tribe's Area of Interest with total number of traps set as reported by WDFW.

Map Data Sources: SSHIAP 2004[7], WDFW 2024[8], WAECY 2018[9]

Lower Quilcene Restoration Key to Salmon Recovery

The Jamestown S'Klallam Tribe has partnered with The Hood Canal Salmon Enhancement Group for the Big Quilcene Lower One Mile Construction Project. This project will restore habitat critical for salmon in the lower one mile of the Big Quilcene River and the surrounding floodplain. Construction is expected to begin in late 2025 and be completed by the end of 2026.

The Big Quilcene, from the river mouth to the first river mile, underwent a drastic transformation in the 1920s that channelized the river using levees and dikes. Dredging and diking continued into the 1990s and the delta migrated drastically into Quilcene Bay. These actions confined the once freely meandering river into a narrow 35-60 foot-wide channel nearly devoid of natural features necessary for high quality salmon habitat including large woody debris and cool water pools.[1]

The Big Quilcene Lower One Mile Construction Project will restore the natural processes of the river by reconnecting it to the floodplain, allowing side channels to form, creating instream pools, restoring the channel bed and adding logjams. An engineered channel and floodplain will be created with rich habitat features aiming to benefit the ESA-listed Hood Canal Summer Chum, Puget Sound Chinook and Puget Sound steelhead, as well as Coho and Pink salmon and bull trout.

This project will set back 684 feet of the south levee, and remove 2,250 feet of roadways and 1,455 feet of the north levee currently restricting the natural flow of the river. Additionally, 60 acres of invasive plant species will be removed and almost 8 acres of native vegetation will be planted. Restoration of the lower one mile reach will make the river more resilient to climate change as it transitions from a rain/snow-dominated watershed to a rain-dominated watershed.[1]

In the same area of the Big Quilcene Lower One Mile Construction Project, the tribe has received funds to replace the 81-foot bridge on Linger Longer Road with a 1,040-foot bridge that will span the entire restored floodplain to allow it to return to natural conditions.[1]

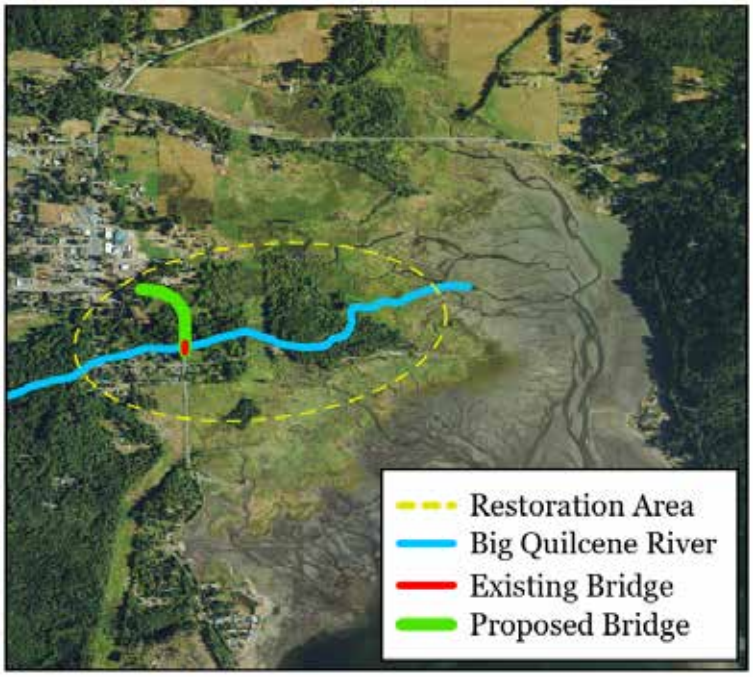


Figure 1. Big Quilcene Lower One Mile Restoration Area.

Restoration is key for assisting critical salmonid species survival in the river. The tribe continues to work in this and other key watersheds in the region. Not only is salmon culturally important for the tribe, it is a keystone species.[2] Restoration improves river and estuarine habitat health and assists in issues like water quality, vegetation cover and climate change impacts.[3]

WSRCO

Figure 2. Big Quilcene River delta, December 2009, as seen from the west.

WSRCO

Figure 3. Big Quilcene River delta, February 2024, as seen from Quilcene Bay.

Map Data Sources: Hexagon 2024[4], WADNR 2017[5]

Dungeness Floodplain Restoration is Key to Salmon Recovery

Floodplains play an important ecological role in salmon recovery and create healthy functioning habitat for freshwater species. The Jamestown S'Klallam Tribe has been actively working on projects to restore the Dungeness River and its floodplains for more than 30 years.

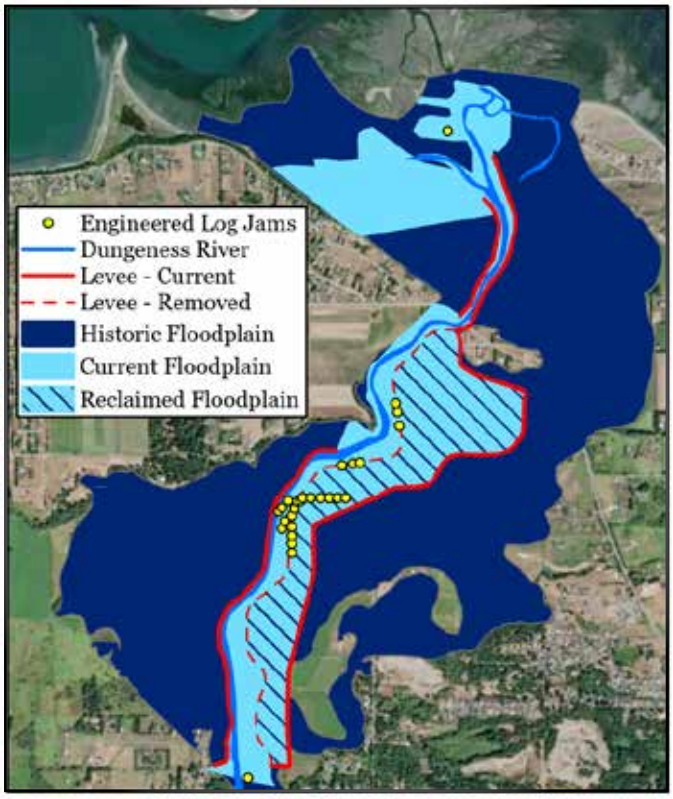


Figure 1. Dungeness River Floodplain.

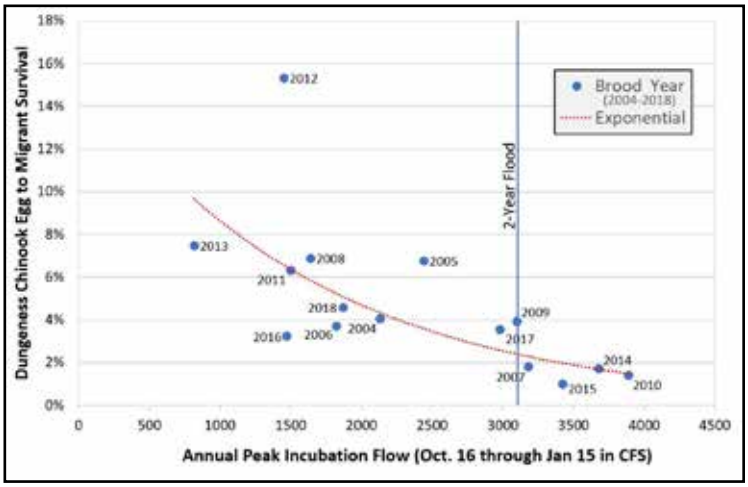


Figure 2. High-water flows during Chinook egg incubation period reduces the egg-to-smolt survival rate in the Dungeness River. The goal is to keep salmon survival rates high for healthy Chinook populations and to support the tribe's invaluable resource.

Figures 3 and 4. Dungeness River Floodplain at Robinson property, before (top) and after (above) restoration.

Before 1963, the historic Dungeness River floodplain was approximately 730 acres in the lower 2.75 river miles (RM). By 1990, only 169 acres of floodplain remained because of humans diking the river (Figure 1).[1] These dikes eliminated natural river processes and greatly reduced the available habitat for salmon. Floodplain loss contributes to the dire adverse effects of high winter streamflow impacts to Chinook productivity and survival (Figure 2) and all fish species.

In 2022, the Jamestown S'Klallam Tribe and Clallam County partnered under the Dungeness River Floodplain Project to relocate two miles of the Army Corps of Engineers dike as near to the edge of the historic 100-year floodplain as possible. This project reconnected 135 acres of lost floodplain (Figure 1). The project has transformed the river between RMs 1 and 3, creating a fully functioning river with side channels and river branches that have already formed. This stretch of river is now free to meander through a publicly owned and permanently protected floodplain that offers healthy salmon habitat.

Within this reclaimed floodplain, the Tribe has reforested 54 acres of pasturelands that settlers converted from previously forested floodplains and constructed 25 engineered logjams (ELJs). In addition, the tribe has constructed 74 ELJs and completed 19 other restoration projects in the lower 18 miles of the river that help preserve, protect, and restore salmon habitat in the Dungeness watershed (Figures 3 and 4). This work is the first step toward recovery of healthy salmon stocks for all to enjoy.

Map Data Sources: NAIP 2017[2], USGS 2018[3]

Climate Change Impacts Tribes and Salmon from Rising Water Temperatures and Lower River Flows

Climate modeling in the Jamestown S'Klallam Tribe's area predicts that by mid-century, the main channel of the Dungeness is likely to regularly exceed critical temperature thresholds for cold-water fish (e.g., 16°C 7DAD Max temperatures) and reduce summer flows. These changes will stress cold-water salmon throughout their life stages and be a barrier to migration. Lack of funding and capacity to prepare for these changes remain a challenge.

Are we worried and disappointed about climate change, water resources and the state of salmon habitat? Yes, we are but we refuse to be discouraged. We'll keep at it because salmon will always be who we are.

– W. Ron Allen
Chairman

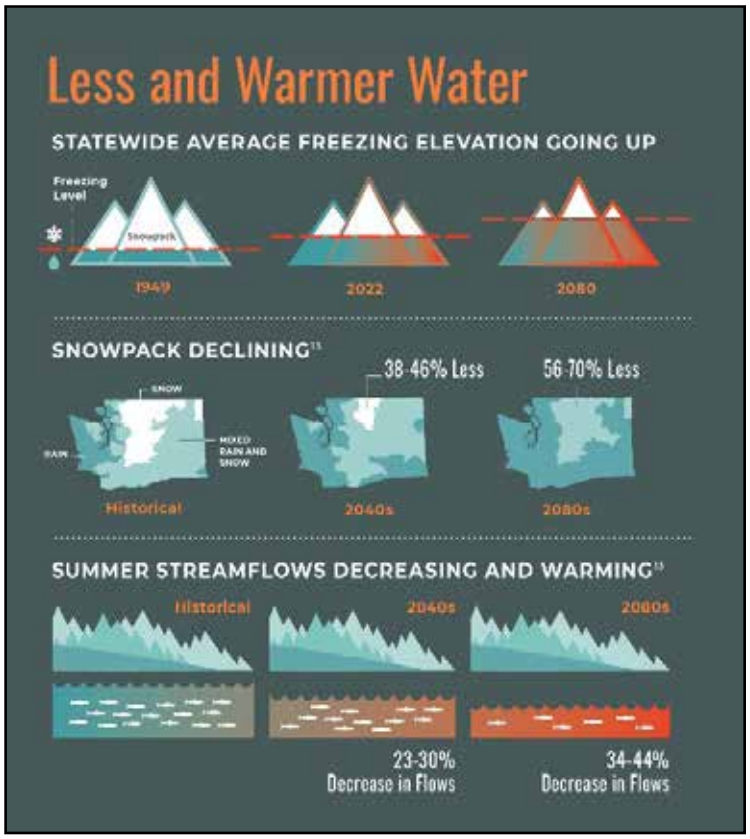


Figure 1. Less and warmer water from State of the Salmon Report.[1]

As one of the first tribes in western Washington to complete a climate adaptation plan and vulnerability assessment, the Jamestown S'Klallam Tribe has identified and prioritized areas where changing conditions (i.e. shifting precipitation patterns, sea level rise, ocean acidification) will leave tribal resources, infrastructure, economy and health most vulnerable.[2] Traditionally, salmon has provided the foundation for almost all aspects of cultural life for the tribe and continues to provide a valuable economic and nutritional resource for them, but a changing climate is impacting their habitat.

Climate modeling shows potential risks to critical salmon habitats by altering both water temperatures and water availability in salmon habitat (Figure 1,2).[3,4] Climate warming in critical fish-bearing mountainous watersheds such as the Dungeness River, where snowfall and rainfall have historically been plentiful during winter months, can lead to an increase in winter streamflows and decreased summer flows. These trends are already visible in the observational record and are expected to worsen as warming continues. While higher winter flows can lead to increased flood risk, they can also scour stream beds, harming fish spawning habitat. Lower summer flows can strand fish attempting to migrate upstream and reduce the amount of stream habitat available for fish. The tribe is concerned with the impact that warming stream temperatures will have on salmon habitat health. Because salmon require specific temperature conditions for each stage of life, any stream warming can be potentially detrimental. Importantly, there is concern over the impacts that warming might have on temperatures in critical side channels and tributaries, which are often left out of regional studies and are less-understood than the main channels.

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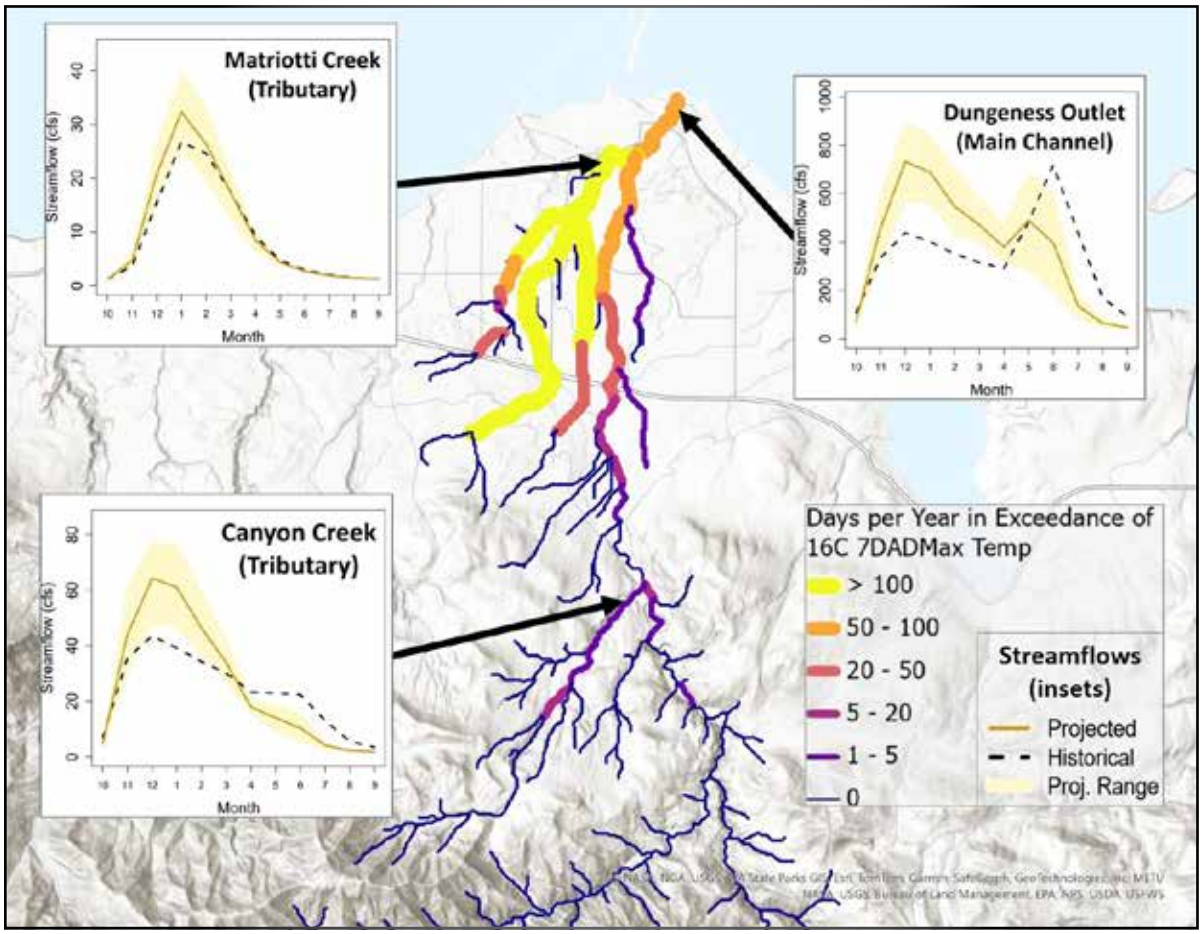

Figure 2. Stream temperature and streamflow projections under an RCP 8.5 scenario for the 2080s in the lower Dungeness River and its tributaries near Sequim, WA.

While the Dungeness River generally drains fast, reducing the time for solar and atmospheric heating in the main channel, the lower-elevation side channels and tributaries are often already relatively warm, making them especially susceptible to any further temperature increases.

By mid-century, even the main channel of the Dungeness is likely to regularly exceed critical temperature thresholds for cold-water fish (e.g., 16°C 7DAD (7-day average of the daily maximum temperatures) Max temperatures) during average years, and low-elevation tributaries are likely to be even warmer. By the end of the century, these conditions are projected to be substantially worse for cold-water fish (Figure 2).

The tribe's natural resources planners and managers are working to better understand climate warming and its impacts on stream conditions, and to take the next step to implement changes which can improve stream conditions for generations to come. Observations and climate/stream modeling are being utilized to guide restoration efforts, such as floodplain and riparian restoration projects.

However, given the breadth of work needed, there are many challenges that remain. Current challenges include: a lack of historical data, especially in the smaller side channels, and a lack of capacity and funding to collect, analyze and manage data. There also is a shortage of funding and capacity to implement temperature and low-flow mitigation measures.

Map Data Sources: NAIP 2013[5], WAECY 2011[6], USGS 2019[7]

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2025 State of Our Watersheds Report
West WRIA 18 – WRIA 19
Morse Creek to Neah Bay

I look forward to fishing the Elwha River. I have been on the river most of my life. It will provide food for my soul and family. It will keep the fishing culture alive not only for me, but for my 16-year-old son. So many youths and adults have given up gill net fishing as the economic value is not there. Many have turned to harvest of shellfish, which provides more value. I hope opening the river to fishing will revitalize our fishing culture and traditions.

– Russ Hepfer
Vice Chairman

Tiffany Royal, NWIFC

– Area of Interest

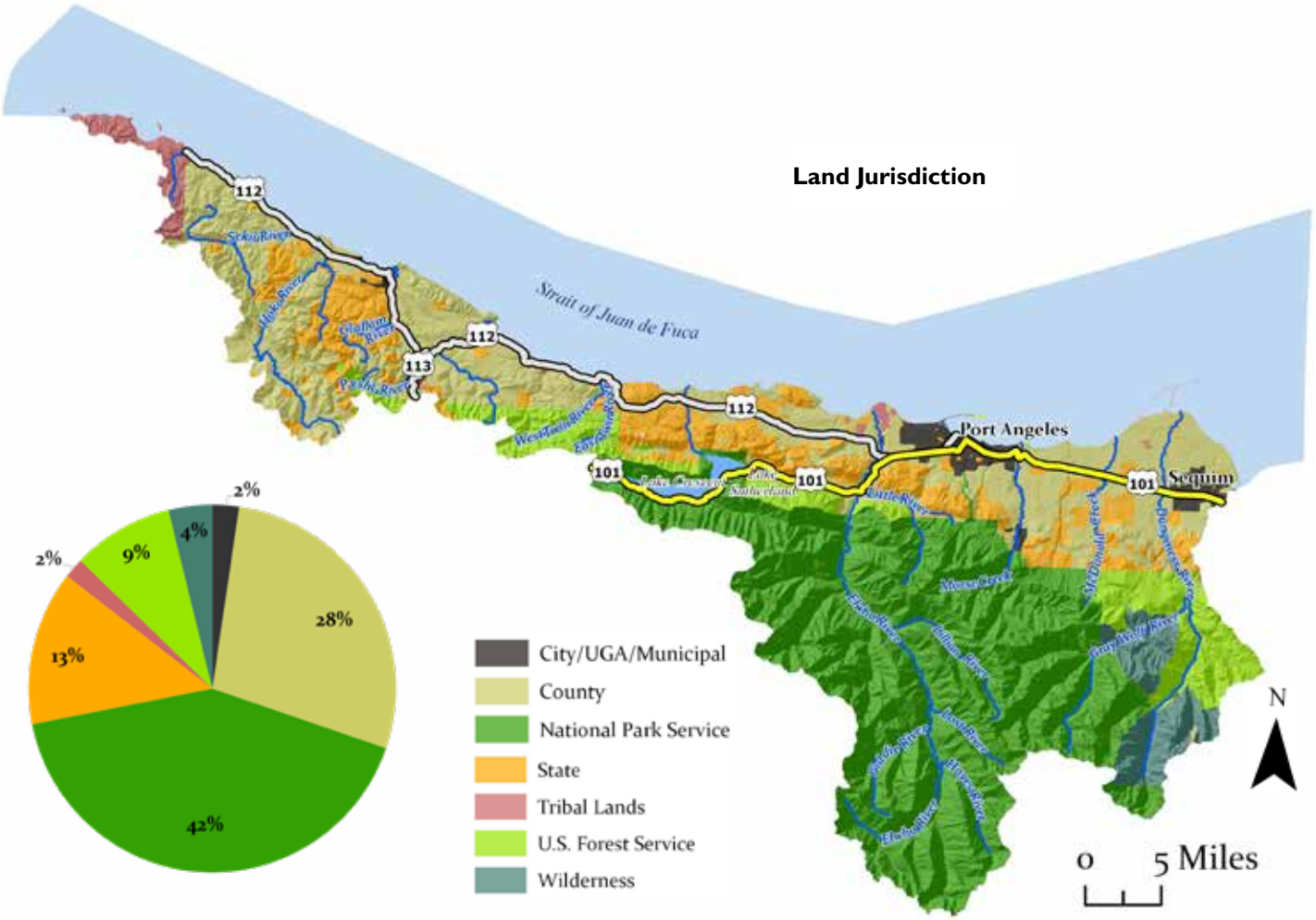
Lower Elwha Klallam Tribe

The Lower Elwha Klallam Tribe is part of the Klallam Band of Indians that has resided throughout the Strait of Juan de Fuca, Hood Canal and Port Gamble Bay for generations. They are party to the Point No Point Treaty of 1855, when tribes ceded most their traditional lands to the U.S. government.

The Elwha-Dungeness Basin (WRIA 18) and Lyre-Hoko (WRIA 19) have remained largely rural and forested with a natural resources-based economy focused on shellfish harvesting, commercial forestry, commercial fisheries, tourism and agriculture. Major land use impacts on salmon habitat have occurred from floodplain and shoreline development, road construction and past logging practices. This report will focus on the northwest portion of WRIA 18 basin and surrounding marine waters, which is only a portion of the area that the Lower Elwha Klallam Tribe co-manages.

Lower Elwha Klallam Tribe

Elwha-Dungeness and Lyre-Hoko Basins



The Lower Elwha Klallam Tribe's Area of Interest includes the Elwha-Dungeness (WRIA 18) and Lyre-Hoko (WRIA 19) basins. The area is located along the northeast portion of the Olympic Peninsula with its watersheds draining to the Strait of Juan de Fuca. The main watersheds include the Sekiu, Hoko, Clallam, Pysht, Lyre, Dungeness and Elwha rivers as well as Morse and McDonald creeks. The headwaters of the two largest basins, the Dungeness and Elwha, are found in the Olympic National Park and U.S. Forest Service wilderness areas, thus remaining in relatively pristine condition.

The topography and precipitation patterns of the area vary dramatically, from high mountain ridges with 240 inches of annual precipitation mostly as snow, to lowland valleys with 25 inches of annual precipitation predominantly as rain.

The Klallam were the first human inhabitants of the eastern Strait region, with villages and fishing camps most often associated with stream mouths and marine embayments where they could take advantage of plentiful fish and shellfish resources. With the Point No Point Treaty of 1855, the tribes ceded their lands to the U.S. government. However, by this time, Euro-Americans had already begun clearing and farming the floodplains and were soon cutting old-growth timber along the shorelines.

Much of the area remains rural and forested with about 42% within the Olympic National Park and another 13% within U.S. Forest Service land and wilderness areas. However, the city of Port Angeles, its main population center, has developed rapidly.

ESA-listed Puget Sound Chinook and steelhead as well as Hood Canal Summer Chum reside in the basin, along with Coho, Fall Chum, Pink salmon, steelhead trout, rainbow trout and bull trout. Historically, the Elwha River was one of the most productive rivers for its size in the Pacific Northwest.[1]

Following the passage of the Elwha River Ecosystem and Fisheries Restoration Act by Congress, the Glines Canyon and Elwha dams, which were located along the lower mainstem of the Elwha River and had blocked all anadromous fish access to the majority of the watershed since the early 1900s, were removed in 2014. Dam removal opened the upper watershed to salmon for the first time in 102 years. Today, the Elwha River flows freely from its headwaters to the Strait of Juan de Fuca.

Map Data Sources: DOD 2023[2], SSHIAP 2004[3], WADNR 2024a[4], WADNR 2024b[5], WAECY 2018c[6], WAECY 2021[7], WAECY 2024[8], WADOT 2018[9], WADOT 2023[10], USFWS 2024[11]

Chapter Summary

The Lower Elwha Klallam Tribe's Area of Interest includes the Elwha-Dungeness (WRIA 18) and Lyre-Hoko (WRIA 19) basins. The tribe resides in the Lower Elwha River Valley and adjacent bluffs on the north coast of the Olympic Peninsula just west of Port Angeles. With the Point No Point Treaty of 1855, the tribes ceded their lands to the U.S. government and by this time, Euro-Americans had already begun clearing and farming the floodplains and were soon cutting the old-growth timber along the shorelines. Much of the area remains rural and forested with about 42% within the Olympic National Park and another 13% within U.S. Forest Service land and wilderness areas. However, the city of Port Angeles, its main population center, continues to develop.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org.*

For this report, the Lower Elwha Klallam Tribe has focused on portions of their watersheds that are of concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Barrier Culverts Impact Fish

In the Lower Elwha Area of Interest, the state of Washington has about 81 barrier culverts of which 60 (or 74.1%) still need to be repaired. There are an additional 857 barrier culverts owned by the state and local governments as well as private corporations and individuals. Of these, there are 526 (or 61.4%) on county-owned roads while 257 (or 30%) are under private ownership.

Polluted Waterbodies Continue to Increase

There were 151 polluted water listings (about 204 miles) in 2018 compared to the 127 listings (about 184 miles) in 2012 for the most common pollutants—water temperature, dissolved oxygen, pH, bacteria and turbidity. This represents a 15.9% increase in listings and a 9.8% increase in miles between the two time periods. Water temperature was the most common pollutant with 74 listings, followed by bacteria with 40.

Tire Contaminant Threatens Treaty Right to Harvest Coho

The Lower Elwha Klallam Tribe's treaty right to harvest Coho salmon may be threatened by the presence of 6PPD in streams. Compared to other watersheds in Puget Sound, watersheds in the Lower Elwha Area of Interest have relatively low 6PPD vulnerability scores of less than 1. The highest risk of tire contaminant exposure in the area is in the Lower Dungeness River watershed, followed by the Pysht River watershed.

Urbanization Impacts Port Angeles Creeks

The six urban creeks in Port Angeles have been severely altered because of urbanization. The Lower Elwha Klallam Tribe is working with partners to correct fish passage barriers and improve floodplain and estuary habitat of these urban watersheds.

Of the seven streams in the Port Angeles Urbanized Area, only Morse Creek has a stream gage which monitors flow and temperature. Morse Creek and Deep Creek, a gauged stream farther west, have similar trajectories of increasing peak flows. It is therefore likely all streams in Port Angeles are experiencing increased peak flows. Several of the streams are known to be contaminated with fecal coliform and have low fish populations.

Ediz Hook Shoreline Restoration – Former Cooke Aquaculture Demolition/Restoration

In 2017, the U.S. Navy installed a large transit protection pier on the U.S. Coast Guard Base on the south shore of Ediz Hook to accommodate moorage of the twin blocker vessels used to escort Naval submarines through the Strait of Juan de Fuca. Following discussions with the tribe regarding mitigation options, the Navy agreed to complete mitigation projects to address treaty and compensatory mitigation.

Long Term Wood Placements Improve Salmon Habitat

To address the lack of wood in streams, the Lower Elwha Klallam Tribe and its partners have, over the years, placed wood in stream channels. Such long-term projects have taken place in the Pysht River, Little River, East Twin River and Deep Creek watersheds, among others. These projects have resulted in positive habitat responses including rapid pool development, accumulation of gravels, side-channel development and increased floodplain connectivity.

Elwha Watershed Restoration and Monitoring

As part of the Elwha Dam removal project, extensive and rigorous monitoring and adaptive management plans were developed by the co-managers and federal partners. While the monitoring funds have sunset, it is important to secure more funding for monitoring to know whether habitat or fish goals needed for recovery are being met and to adaptively manage the hatchery and future harvests.

Climate Change Impacts on Elwha River Streamflow

The predicted loss from climate change of winter snowpack and associated late spring/early summer runoff will result in fundamental changes to the Elwha River ecosystem. Habitat loss in the river is expected at flows of less than 400 cubic feet per second (cfs), a situation exacerbated by water withdrawals. In 2024, the Elwha River reached a low flow of 214 cfs.

South Fork Pysht River Habitat Condition: A Retrospective

The Lower Elwha Klallam Tribe's habitat protection and restoration program of the South Fork Pysht River has been ongoing for three decades. Recent survey results showed a mix of recovering habitat from both restoration and natural recovery with habitats that showed no sign of recovery. The upper seven kilometers of the river are on a recovery trajectory while the lower seven kilometers contains significant reaches that require further restoration.

Recovery Efforts Show Signs of Improvement But Still Lagging in Key Indicators

At the 20-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Lower Elwha area shows improvements for floodplain processes and restoration effort, but degradation of water quality and little improvement in correcting fish passage barriers. In addition, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat, and to monitor and enforce compliance of existing regulations. Funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trends for these key environmental indicators shows improvement for the restoration efforts and a steady loss for others in habitat status:

Tribal Indicator	Status	Habitat Trend
Barrier Culverts	In the Lower Elwha Area of Interest, the Culverts Case database of Washington state-owned barrier culverts has 81 culverts, 60 (or 74.1%) of which are still barriers to fish. There are an additional 857 barrier culverts owned by the state and local governments, as well as private corporations and individuals. Of these, there are 526 (or 61.4%) on county-owned roads while 257 (or 30%) are under private ownership.	Declining
Water Quality	There were 151 polluted water listings (~204 miles) in 2018 compared to the 127 listings (~184 miles) in 2012 for the most common pollutants – water temperature, dissolved oxygen, pH, bacteria and turbidity. This represents a 15.9% increase in listings and a 9.8% increase in miles between the two time periods. Water temperature was the most common pollutant with 74 listings, followed by bacteria with 40.	Declining
Water Quality - 6PPDQ	The Lower Elwha Klallam Tribe's treaty right to harvest Coho salmon may be threatened by the presence of 6PPD in streams. Compared to other watersheds in Puget Sound, watersheds in the Lower Elwha Area of Interest have relatively low 6PPD vulnerability scores of less than 1. The highest risk of tire contaminant exposure in the area is in the Lower Dungeness River watershed, followed by the Pysht River watershed.	Concerns
Urbanization Impacts	The six urban creeks of Port Angeles have been severely altered because of urbanization.	Declining
Restoration - Long Term Wood	Long-term wood restoration projects have taken place in the Pysht River, Little River, East Twin River and Deep Creek watersheds, among others. These projects have resulted in positive habitat responses including rapid pool development, accumulation of gravels, side-channel development and increased floodplain connectivity.	Improving
Climate Change	The predicted loss from climate change of winter snowpack and associated late spring/early summer runoff will result in fundamental changes to the Elwha River ecosystem. Habitat loss in the river is expected at flows of less than 400 cubic feet per second (cfs), a situation exacerbated by water withdrawals. In 2024, the Elwha River reached a low flow of 214 cfs.	Concerns
Habitat Restoration	The Lower Elwha Klallam Tribe's habitat protection and restoration program of the South Fork Pysht River has been ongoing for three decades. Recent survey results showed a mix of recovering habitat from both restoration and natural recovery with habitats that showed no sign of recovery. The upper seven kilometers of the river are on a recovery trajectory while the lower seven kilometers contains significant reaches that require further restoration.	Concerns
	As part of the Elwha Dam removal project, extensive and rigorous monitoring and adaptive management plans were developed by the co-managers and federal partners. The monitoring funds have sunset but it is important to secure more funding for monitoring to know whether habitat or fish goals needed for recovery are being met and to adaptively manage the hatchery and future harvests.	

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

The Lower Elwha Klallam Tribe has been at the forefront of large, ecosystem scale, restoration and environmental cleanup projects on the north Olympic Peninsula. The Elwha River restoration effort has set the precedent for an increasing number of dam removals across the United States and worldwide.

In the Elwha watershed, the tribe continues to conduct floodplain restoration as well as conserve unprotected private parcels. With nearly 96% of the watershed protected with federal, state and tribal ownership, it is feasible to protect the remaining 4% through fee simple purchase or conservation easements, leading to full watershed protection.

The tribe will continue to focus its efforts and resources on the restoration and protection of sensitive environments and critical habitats in floodplain, riparian, estuarine and nearshore systems on the North Central Olympic Peninsula. The tribe has restored miles of floodplain and riparian habitat across numerous systems (Hoko, Pysht, Deep, Twin, Lyre, Elwha, Ennis, Morse and Seibert watersheds). The tribe will continue to pursue funding to monitor stream health and restore systems throughout this region. The tribe also will continue to monitor the long-term recovery of the Elwha River ecosystem with its state and federal partners as salmonid populations grow.

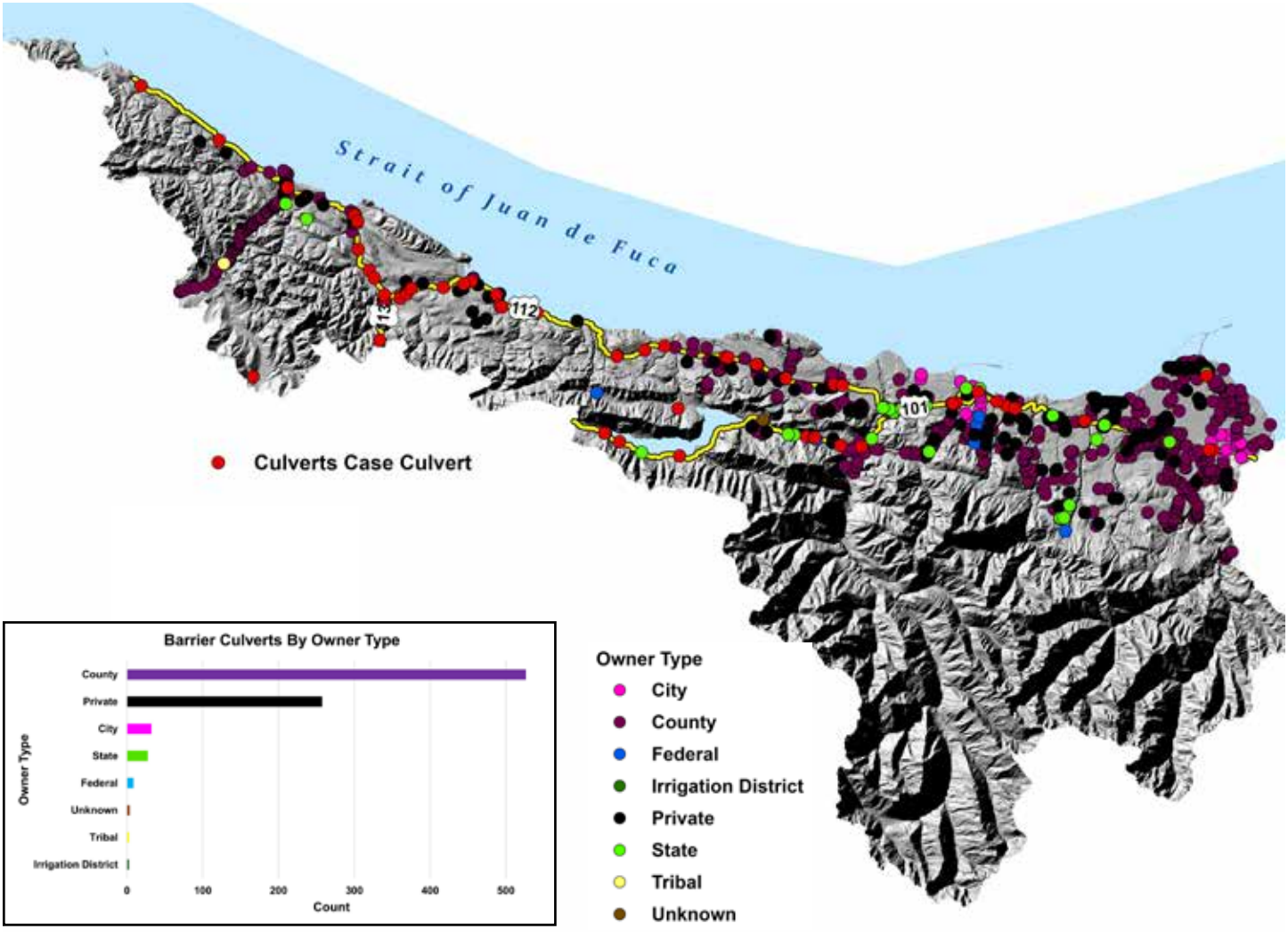
The tribe will continue to prioritize restoring degraded marine shorelines within Port Angeles Harbor and along the Strait of Juan de Fuca to encourage recovery of sensitive and critical nearshore systems like eelgrass meadows and estuaries. The tribe has completed four eelgrass plantings along Ediz Hook in partnership with the Pacific Northwest National Laboratory (PNNL). Eelgrass salvaged in summer 2017 from the U.S. Navy pier site at the Port Angeles Coast Guard Base has been the source of plant material for restoration efforts. Approximately 26,000 eelgrass plants have been planted along the interior of Ediz Hook. The remaining eelgrass in the PNNL outdoor tanks will be planted in spring 2026. This effort has complemented the extensive shoreline restoration the tribe has completed along the interior of Ediz Hook in recent years. The tribe plans to continue eelgrass planting and monitoring efforts.

Despite the low human population density across the North Olympic Peninsula, degradation of coastal systems and stream habitat have occurred in multiple watersheds. However, there are still opportunities to learn from development impacts elsewhere in Puget Sound and use science-based, low impact development strategies in local planning efforts. The tribe will continue to work with local governments through the shoreline master program, watershed planning and other regulatory processes to ensure that shoreline development practices minimize impacts to nearshore environments. The tribe will continue to advocate for limited shoreline development and the removal of armoring in favor of improved shoreline protection methods.

The tribe has been involved in the cleanup and restoration of Port Angeles Harbor since 1999, when it entered a three-party deferral agreement with state and federal agencies. This agreement, the first nationally for an Indian Tribe, provided the tribe with concurrence on all major cleanup decisions. The tribe expects to see significant progress in the cleanup of the western harbor and the Rayonier mill site and associated marine cleanup unit. The tribe will continue to work with the Port Angeles Harbor Trustee Council to find solutions to compensate for injuries to natural resources within the harbor, and advocate for a high quality clean up, culminating in resuming healthy and productive fisheries.

Barrier Culverts Impact Fish

In the Lower Elwha Area of Interest, the Culverts Case database of Washington state-owned barrier culverts has 81 culverts, 60 (or 74.1%) of which are still barriers to fish. There are an additional 857 barrier culverts owned by the state and local governments, as well as private corporations and individuals. Of these, there are 526 (or 61.4%) on county-owned roads while 257 (or 30%) are under private ownership.



Culverts can be an impediment to migration patterns for salmon and steelhead. When they are improperly designed or installed, fall into disrepair, or are blocked, water may still pass through the culverts but adult fish are prevented from reaching their spawning grounds, disrupting their spawning success.

In the Culverts Case injunction brought against the state of Washington by treaty tribes, the courts determined that state-owned culverts contributed to declines in the salmon runs and ruled that the state was in violation of its obligations under the treaties. Within the treaties, tribes reserved the right to take fish from their usual and accustomed grounds and stations. The state is under an injunction to replace the culverts with the worst impacts on fish habitat by 2030.

In the Lower Elwha Area of Interest, the Culverts Case database of Washington State-owned barrier culverts has 81 culverts, 60 (or 74.1%) of which are still barriers to fish. The others have either been replaced by a passable structure or are not considered barriers because no fish presence has been recorded.

The non Culverts Case culverts include 857 barrier culverts that are owned by state and local governments, as well as private corporations and individuals in the Lower Elwha Area of Interest. Of these, there are 526 (or 61.4%) on county-owned roads while 257 (or 30%) are under private ownership. The city and state governments own 32 (or 3.7%) and 27 (or 3.2%) culverts respectively. About 2% of barrier culverts fall outside of these ownerships.

In addition to efforts by the state, local governments and the private sector would need to take necessary measures to fix these culverts and remove impediments to fish passage.

Map Data Sources: SSHIAP 2004[1], SSHIAP 2024[2], WADFW 2023[3], WADOT 2018[4], WAECY 2018[5]

Polluted Waterbodies Continue to Increase

There were 151 polluted water listings (about 204 miles) in 2018 compared to the 127 listings (about 184 miles) in 2012 for the most common pollutants: water temperature, dissolved oxygen, pH, bacteria and turbidity. This represents a 15.9% increase in listings and a 9.8% increase in miles between the two time periods. Water temperature was the most common pollutant with 74 listings, followed by bacteria with 40.

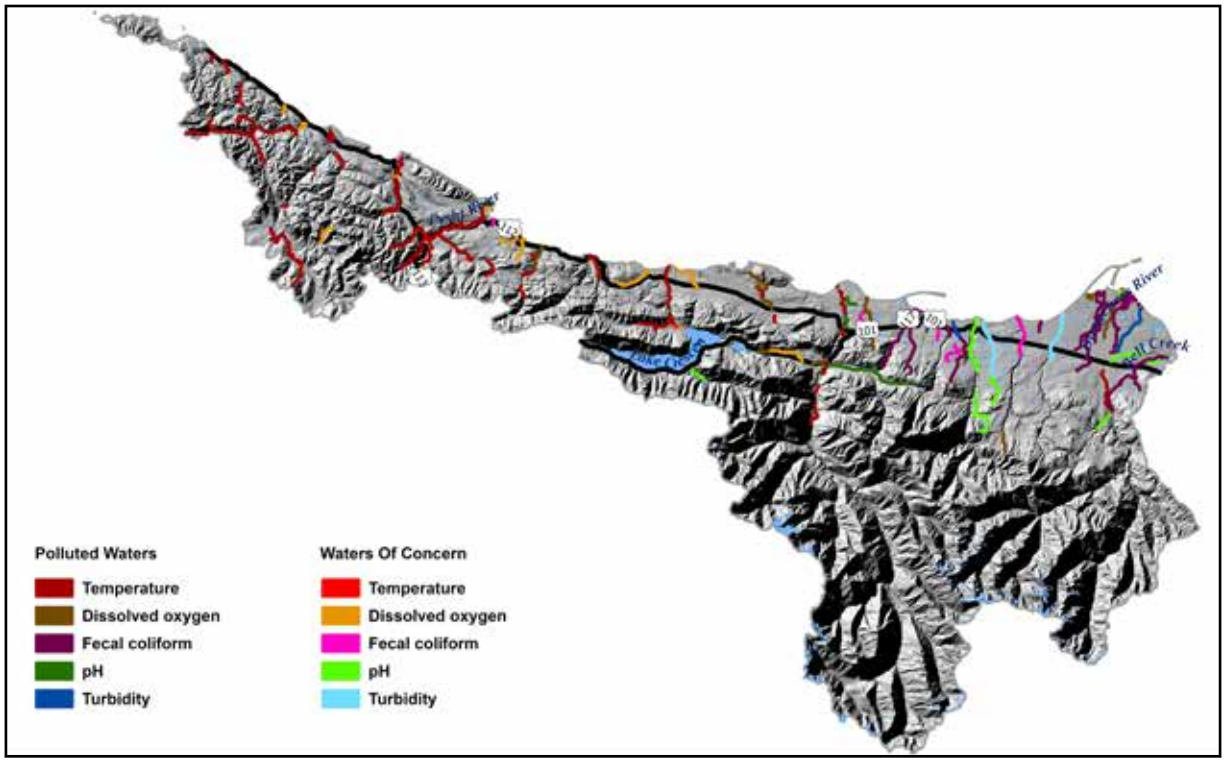
The suitability of aquatic habitats for salmonids depends on several factors. They prefer cold water; temperatures above 25 degrees Celsius are lethal to most species.[1] Salmonids also require well-oxygenated water throughout their life cycles, adequate nutrient levels and low levels of pollutants.

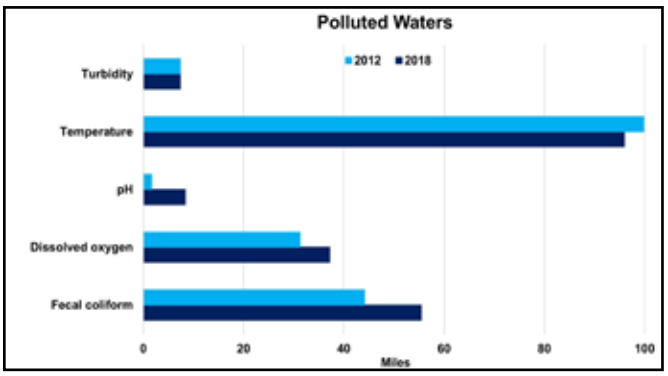
Under the Clean Water Act, states are required to monitor and report water pollution on waters that have been assessed. Waters that do not meet water quality standards because they are too polluted are called impaired. They are placed on a list for future actions to reduce the pollution.

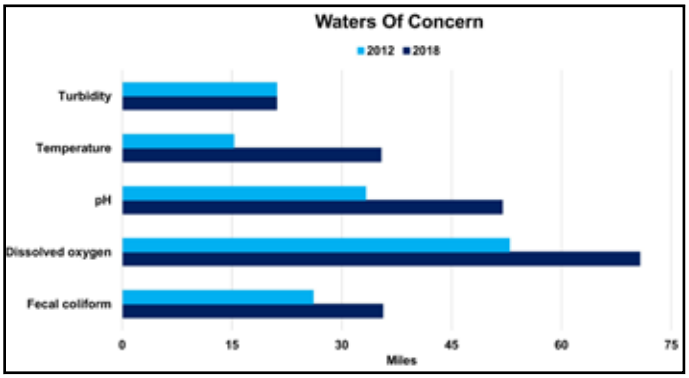
In the Lower Elwha Area of Interest, there were 151 polluted water listings (about 204 miles) in 2018 compared to the 127 listings (about 184 miles) in 2012 for the most common pollutants: water temperature, dissolved oxygen, pH, bacteria and turbidity. This represents a 15.9% increase in listings and a 9.8% increase in miles between the two time periods. Water temperature was the most common pollutant with 74 listings, followed by bacteria with 40. The stream length impaired by water temperature decreased from 99.8 miles in 2012 to 95.9 miles in 2018, (4.1 % decrease) while the length impaired by bacteria increased from 44.1 miles in 2012 to 55.4 miles in 2018 (20.1% increase).

There were an additional 109 listings in 2018 of waters of concern for water temperature, dissolved oxygen, pH, bacteria and turbidity. These are water bodies that have some evidence of a water quality problem, but not enough to show persistent impairment.

Some of the most polluted waterbodies were the Pysht River (11.9 miles impaired by water temperature), Dungeness River (5.7 miles by temperature and 3.8 miles by dissolved oxygen), and Bell Creek (4.8 miles by bacteria, 3.8 miles by dissolved oxygen and 0.5 miles by temperature).







Map Data Sources: WAECY 2018[2], WAECY 2022[3], WAECY 2022[4]

Tanker truck spills petroleum into Indian Creek

Nearly 3,000 gallons of gas and diesel leaked into the Elwha River tributary in July 2025, affecting salmon habitat and thousands of fish.

A fuel tanker truck flipped off Highway 101 on July 18, 2025, spilling 2,798 gallons of gas and 172 gallons of diesel into Indian Creek, a tributary to the Elwha River.

An emergency response team, composed of the Lower Elwha Klallam Tribe, the state Department of Ecology, Clallam County Sheriff's Office, U.S. Environmental Protection Agency, Jamestown S'Klallam Tribe, local fire departments, and the responsible party, PetroCard, worked together to respond effectively, protect public health and the environment, and support the needs of the affected area.

The area primarily affected was 1.25 miles of Indian Creek, from where the highway crosses over the creek and downstream to the confluence of the Elwha River. A quarter-mile section within the affected area had collected small amounts of fuel and was difficult to access due to dense vegetation and debris.

Cleanup efforts included agitating the creek bed to release collected fuel trapped beneath rocks and debris; removing contaminated soils; and flushing the creek shoreline with water to release fuel so it could be collected by sorbent materials.

Wildlife and shoreline monitoring started shortly after the incident. The tribe began monitoring environmental impacts, observing immediate aquatic animal mortalities, including juvenile steelhead, rainbow trout, lamprey, Coho, Chinook, bull trout and sculpin. As of Aug. 8, the confirmed fish mortality count was 2,134, with an additional 538 invertebrates, 1 bird and 1 rodent recorded by wildlife crews.

Knowing that Chinook and Pink salmon would soon be arriving in Indian Creek, the response team reviewed options to protect the returning fish. A panel of experts supporting the incident response, including representatives of the tribe, federal, state and local agencies, and environmental consultants, informed the decision.

Following discussion of all options, risks and tradeoffs, all parties agreed that Indian Creek would stay open for returning salmon to spawn, and be accompanied by monitoring and readiness to adapt if needed. This was decided based on the success of the response and natural cleanup actions, natural behavior of the habitat, and historically high survival rates of salmon in Indian Creek. There also will be an ongoing biological and chemical monitoring plan that could include placing hatchery embryos in affected areas to detect adverse impacts to salmon.

In addition to ongoing monitoring, the tribe, in partnership with local, state, federal, and tribal natural resource trust agencies, has initiated the Natural Resource Damage Assessment process under state and federal law. Through this process, the trustees are developing scientific studies to assess the lingering effects of the spill and scale the amount of restoration required to compensate for the impacts.

Restoration of the Elwha watershed has been a focus of the tribe and Olympic National Park over the past few decades. The work included removing two fish-blocking dams on the river between 2011-2014.

Since dam removal, Indian Creek has become one of the river's biggest producers of salmon, especially for Coho salmon. Coho have successfully migrated upriver past the old dam sites.

The tribe completed significant salmon habitat restoration in Indian Creek during the past decade, including adding woody debris for channel complexity and releasing surplus Coho salmon into the creek from the tribe and state hatcheries.

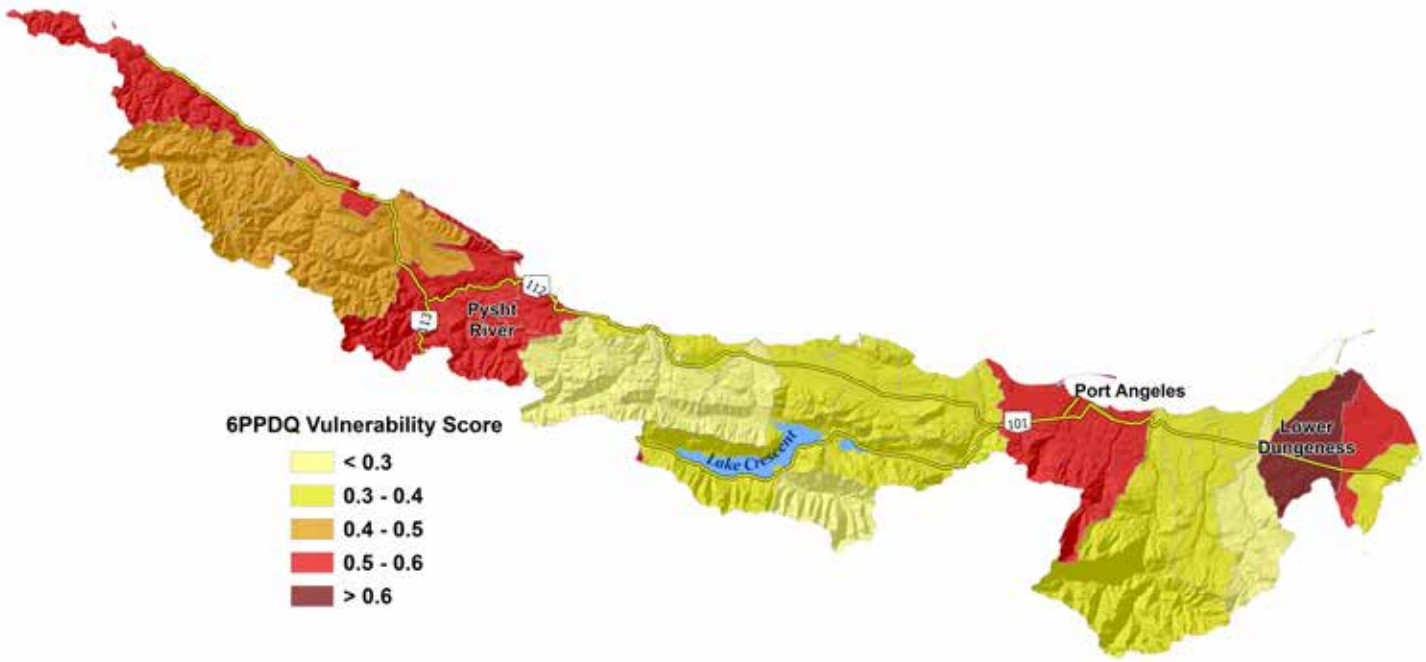
Washington Department of Ecology (2)

A PetroCard tanker truck overturned in Indian Creek in July 2025 after driving off Highway 101, west of Port Angeles.

Crews from fuel response contractor Republic Services and environmental consultant Landau Associates flush Indian Creek to release any fuel trapped within the creek.

Tire Contaminant Threatens Treaty Right to Harvest Coho

The Lower Elwha Klallam Tribe's treaty right to harvest coho salmon may be threatened by the presence of 6PPD in streams. Compared to other watersheds in Puget Sound, watersheds in the Lower Elwha Area of Interest have relatively low 6PPD vulnerability scores of less than 1. The highest risk of tire contaminant exposure in the area is in the Lower Dungeness River watershed, followed by the Pysht River watershed.



For two years in a row—2023 and 2024—the Lower Elwha Klallam Tribe was able to exercise its treaty right to harvest Coho salmon from the Elwha River after the removal of two fish-blocking dams. That right may be threatened by the presence of a tire-related chemical found in rivers and streams.

For a long time, scientists wondered why half or more of the Coho salmon (*Oncorhynchus kisutch*) returning to spawn in Puget Sound streams and rivers were dying before they could lay their eggs. In 2020[1], a group of scientists finally figured out the culprit. When it rains, stormwater carries fragments of old automotive tires into nearby creeks and streams. Those tire fragments contain 6PPD, a chemical preservative that prevents automotive tires from breaking down too quickly and helps them last longer. When 6PPD is exposed to air, it reacts with ozone to create 6PPD-quinone (also known as 6PPDQ) which causes salmon mortality.

This toxic chemical is not limited to the Puget Sound region. 6PPD appears to be used in all tires and tire wear particles are likely present in creeks near busy roads.

The Washington State Department of Ecology[2] carried out an online mapping effort to identify vulnerable watersheds for monitoring studies and site evaluations. Transportation, watershed and ecosystem characteristics were considered indicators of 6PPDQ vulnerability and exposure risk.

Compared to other watersheds in Puget Sound, watersheds in the Lower Elwha Area of Interest have relatively low 6PPD vulnerability scores of less than 1. This is likely the result of lower traffic and less urbanization. The highest risk of tire contaminant exposure in the area is in the Lower Dungeness River watershed, followed by the Pysht River watershed.

Tiffany Royal, NWIFC

A Lower Elwha Klallam tribal member exercises his treaty right to harvest Coho salmon from the Elwha River.

Efforts must be made to reduce the threat to salmon caused by 6PPDQ. These include treating stormwater before it enters the streams and rivers, as well as making tires "salmon-safe" by finding an alternative to 6PPD.

Map Data Sources: WAECY 2024[2], SSHIAP 2004[3], USGS 2014[4], WADOT 2018[5]

Urbanization Impacts Port Angeles Creeks

The six urban creeks of Port Angeles have been severely altered because of the urbanization. The Lower Elwha Klallam Tribe is working with partners to correct fish passage barriers and improve floodplain and estuary habitat of these urban watersheds.

Map Data Sources: SSHIAP 2004[1], WAECY 2018[2]

The six urban creeks of Port Angeles (Tumwater, Valley, Peabody, White, Ennis and Lees) all drain to Port Angeles harbor and have been severely altered as a result of the urbanization of Port Angeles. Fish passage barrier correction efforts will be completed by the Washington State Department of Transportation on Highway 101 in 2026 on Lees, Ennis and Tumwater creeks.

The Lower Elwha Klallam Tribe is working with partners including the City of Port Angeles, Port of Port Angeles and private property owners to correct additional barriers and improve floodplain and estuary habitat to improve the function of urban watersheds. These watersheds historically supported Coho, Chum, steelhead, bull trout, resident trout and cutthroat.

Improving riparian habitat and habitat connectivity will benefit fish and improve wildlife corridors along with helping to foster community awareness of the merits of urban watershed restoration. Lower Ennis Creek and its estuary are situated at the historic Klallam village site Y'Innis and remain severely deteriorated on account of a toxic site cleanup that has remained unresolved for more than 25 years at the former Rayonier mill site.

Mike McHenry, Lower Elwha Klallam Tribe

Lees Creek culvert at low flow.

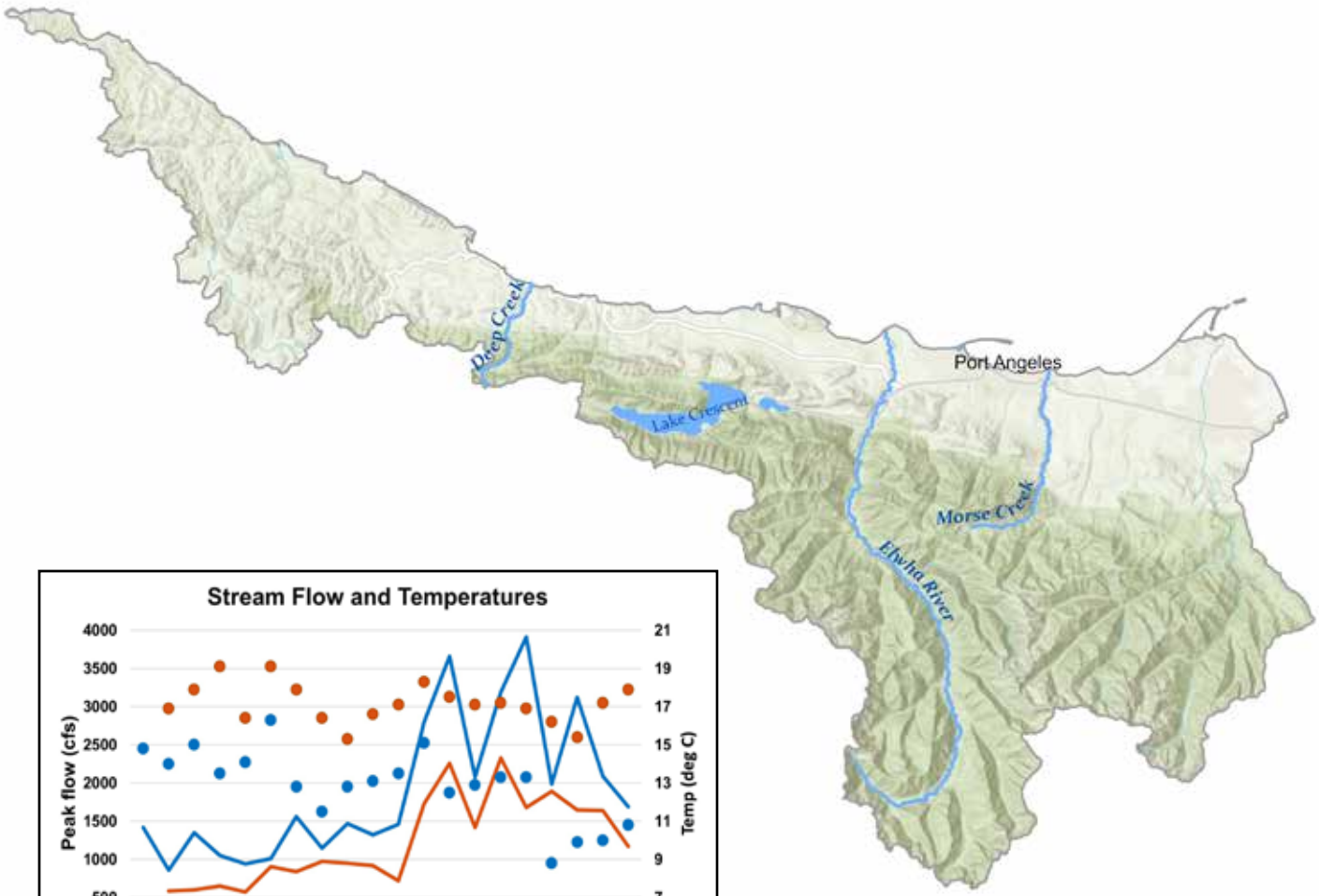
Mike McHenry, Lower Elwha Klallam Tribe

Ennis Creek culverts at high flow.

Google Earth

Urban Streams of Port Angeles

Of the seven streams in the Port Angeles Urbanized Area, only Morse Creek has a stream gauge which monitors flow and temperature. Morse Creek and Deep Creek, a gauged stream farther west, have similar trajectories of increasing peak flows. It is therefore likely all streams in Port Angeles are experiencing increased peak flows. Several of the streams are known to be contaminated with fecal coliform and have low fish populations.



The Port Angeles Urbanized Area has six watersheds with seven streams. Only one of these has a stream gauge which monitors flow and temperature, Morse Creek (Washington Department of Ecology). Comparing Morse with another gauged stream farther west, Deep Creek, they have similar trajectories of increasing peak flows, especially after 2014. Deep Creek has a fairly consistent maximum annual temperature regime, whereas Morse shows decreasing maximum annual temperatures, particularly for 2020-2023.

The Elwha River also has a stream gauge monitoring flows through USGS. When the river's dams were in place, flows were artificial and often depended on releases. The removal of both dams was completed in 2014 and flow regimes after removal show an increasing trend. It is therefore likely all streams in Port Angeles are experiencing increased peak flows.

Several streams in Port Angeles are known to be contaminated with fecal coliform. This is an indication of leaking septic tanks or a symptom of homeless people without access to restroom facilities. The last survey for stormwater contaminants was performed in 2002.

With the 2020 discovery of 6PPDQ and its role in adult Coho salmon mortality, the Lower Elwha Klallam Tribe is in the early stages of working with other agencies on ways to collect and test these streams for this deadly contaminant.

Fish populations in these streams are low. Pacific Lamprey are an important ecological species and are important prey for several other species of fish and mammals. However, they are missing from five of the seven urbanized streams. Three of these have major passage issues in the form of undersized culverts. Of the two remaining streams, their absence in one is likely due to poor habitat. Their absence in the other is surprising, with one hypothesis being past milling practices at the mouth of the stream causing contamination.

Map Data Sources: Esri 2025[1], WAECY 2018[2]

Ediz Hook Shoreline Restoration – Former Cooke Aquaculture Demolition/Restoration

Google Earth

Site before restoration (July 2013).

Google Earth

Site after restoration (July 2023).

In 2017, the U.S. Navy installed a large transit protection pier on the U.S. Coast Guard Base (USCG) on the south shore of Ediz Hook to accommodate moorage of twin blocker vessels used to escort naval submarines through the Strait of Juan de Fuca. Following discussions with the tribe regarding mitigation options, the Navy agreed to complete projects to address treaty and compensatory mitigation.

The U.S. Navy signed an Memorandum of Agreement with the Lower Elwha Klallam Tribe, Jamestown S'Klallam Tribe and Port Gamble S'Klallam Tribe that described the scope of the treaty mitigation project.

The mitigation plan identified the three restoration projects that the Navy would complete or fund as part of their required mitigation for this project. This included the following:

1) Compensatory mitigation. Removal of the 215-foot rock jetty on the harborside (south) of the USCG base that was formerly used to offload riprap for outer Ediz Hook shoreline armoring activities. This was completed in 2017.

2) Treaty mitigation. Removal of eelgrass from the planned footprint for the Navy pier site and replanting eelgrass at suitable shallow subtidal locations (Mean Lower Low Water to -6M Mean Lower Low Water) within state Department of Natural Resources tidelands along the Ediz Hook shoreline.

Approximately 3,500 eelgrass plants were salvaged from this site in 2017. Half of these plants were immediately planted in shallow subtidal areas along inner Ediz Hook. The remainder were planted in outdoor tanks at the Pacific Northwest National Laboratory. Since that time, approximately 26,000 eelgrass plants were planted between 2021 and 2024, and an estimated 9,000 more will be planted in spring 2026. Eelgrass survival post-planting has fared well relative to other efforts in Puget Sound, and also is likely benefiting from the deposition of fine sediments from the beach restoration projects along Ediz Hook.

3) Treaty mitigation. Removal of the Cooke Aquaculture 0.75 acre laydown area fill structure and two adjacent derelict structures. This site was the former uplands operations and storage area for the Cooke Aquaculture net pens that were located just offshore.

The Cooke Aquaculture laydown site restoration project involved the removal of the Cooke Aquaculture office building, the former Thunderbird concession stand, shoreline armoring/cribbing materi-

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Matt Beirne, Lower Elwha Klallam Tribe

Cooke Aquaculture upland office (foreground) and former Thunderbird concession stand (back) in September 2021.

Matt Beirne, Lower Elwha Klallam Tribe

Following structure removal and shoreline restoration in fall/winter 2022 (September 2023).

als and all fill materials from the approximately 0.75 acre site. Due to delays in Cooke Aquaculture vacating this site, the removal and restoration of the site was delayed by five years, which delayed restoration benefits under the mitigation project.

The U.S. Navy (NAVFAC NW) contracted with West Marine Construction, Inc. to complete the restoration project and led monthly planning meetings that included tribal staff from early design through final engineering and permitting in late summer 2022. Work began in fall 2022 with the removal of the former Thunderbird concession stand and Cooke Aquaculture office building. A crescent-shaped pocket beach was constructed by the contractor using sand/gravel sediments salvaged from the deconstructed artificial fill feature. Large wood was incorporated in the upper beach to provide habitat structure and help retain sediment. As with the previous five phases of Ediz Hook tribal-led shoreline restoration projects, the Lower Elwha Klallam Tribe installed site-appropriate native vegetation along the back beach areas following completion of the restoration work.

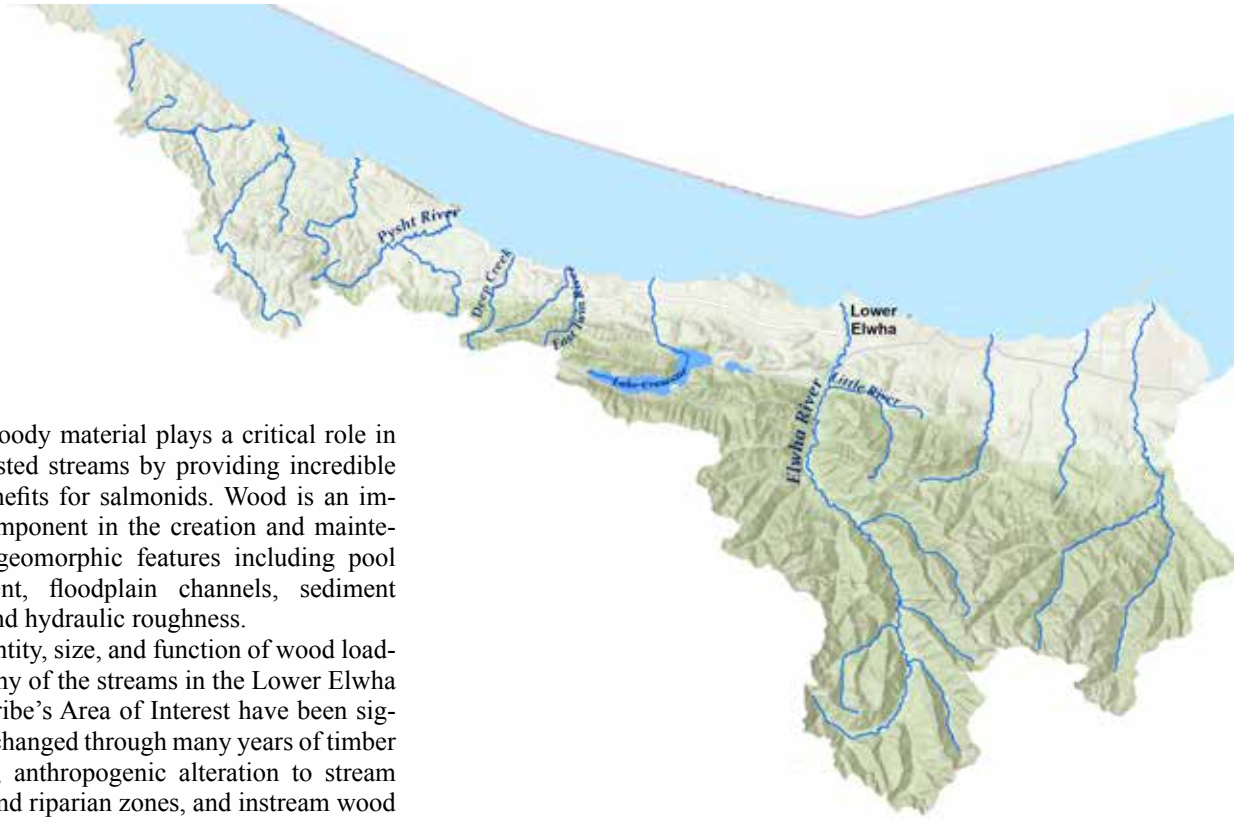
Approximately 20,000 cubic yards of the remaining fill material from the project site was suitable for reuse as beach nourishment and was provided to the tribe's habitat restoration crew. This material was used for beach nourishment applications along several sections of the inner Ediz Hook shoreline.

Matt Beirne, Lower Elwha Klallam Tribe

Newly restored shoreline at the former Cooke Aquaculture site in September 2023.

Long Term Wood Placements Improve Salmon Habitat

To address the lack of wood in streams, the Lower Elwha Klallam Tribe and its partners have placed wood in stream channels over the years. Such long-term projects have taken place in the Pysht River, Little River, East Twin River and Deep Creek watersheds, among others. These projects have resulted in positive habitat responses including rapid pool development, accumulation of gravels, side-channel development and increased floodplain connectivity.



Large woody material plays a critical role in many forested streams by providing incredible habitat benefits for salmonids. Wood is an important component in the creation and maintenance of geomorphic features including pool development, floodplain channels, sediment trapping and hydraulic roughness.

The quantity, size, and function of wood loadings in many of the streams in the Lower Elwha Klallam Tribe's Area of Interest have been significantly changed through many years of timber harvesting, anthropogenic alteration to stream channels and riparian zones, and instream wood removal. These changes have resulted in changes to stream channel form, function and degradation of aquatic habitat.

Over the years, the tribe and its partners have carried out restoration projects to address the lack of large woody debris (LWD) in streams by adding wood to stream channels to improve salmon habitat.

One major habitat limiting factor in the Pysht River is the lack of in-channel LWD.[1] To improve the situation, the tribe has carried out large wood and riparian restoration projects at multiple sites in the Pysht River and its major tributaries.[2,3] In different phases and reaches, large wood was added, engineered logjams and side-channels constructed, and extensive riparian revegetation efforts carried out. Monitoring has shown that these projects have resulted in positive habitat responses including rapid pool development, accumulation of gravels, side-channel development and increased floodplain connectivity. These channel and riparian habitat features are favored by salmon for spawning and rearing.

(Continued on next page)

Chris Korbulic

Engineered logjams were installed into the Elwha River Mainstem in 2024.

Map Data Sources: Esri 2021a[1], Esri 2021b[2], WAECY 2018[3]

Lower Elwha Klallam Tribe

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Another project was on Little River,[4,5] a large, low-to-moderate gradient tributary to the Elwha River and one of the first habitats upstream of the removed Elwha Dam. The lower portions of Little River located outside of Olympic National Park had been subjected to significant logging impacts. As a result, the river lost most of its in-channel large woody material and salmon habitat was degraded over time. The tribe implemented structural placement of LWD at 38 locations from river mile 0.2-1.5 using a combination of ground-based and helicopter methods. The project was highly successful in trapping gravels, creating pools and increasing floodplain connectivity. The tribe collected extensive pre- and post-restoration data that document significant changes to several habitat metrics including pool frequency, substrate size, wood volume and side-channel activation.

Mike McHenry, Lower Elwha Klallam Tribe

Engineered logjam on Little River.

Lower Elwha Klallam Tribe

Helicopter placing wood at East Twin River site.

In both the East Twin River and Deep Creek[6], wood was added to restore habitat complexity and reconnect off-channel habitat. These treatments were implemented from 1998 to 2022 and focused on the lower portions of both streams.

The repeated wood additions to sections of Deep Creek and East Twin River eventually resulted in observable habitat changes in some treated reaches.[7] In the lower five kilometers of Deep Creek, there was an increase in wood loading and channel-spanning logjams, which contributed to deeper and more frequent pools, a reduction in particle size, increases in sediment storage, reduced stream width, vegetation re-establishment in the riparian zone, and increased development and maintenance of floodplain channels.[8] The changes in habitat at Deep Creek increased juvenile Coho salmon parr-smolt survival. There also are indications that Coho salmon productivity (smolts per spawner) increased in Deep Creek.[9]

Lower Elwha Klallam Tribe

Little River engineered logjam that utilized rock collars as anchoring.

Lower Elwha Klallam Tribe

Deep Creek wood placement.

Elwha Watershed Restoration and Monitoring

As part of the Elwha Dam removal project, extensive and rigorous monitoring and adaptive management plans were developed by the co-managers and federal partners. The monitoring funds have sunset, but it is important to secure more funding for monitoring to know whether habitat or fish goals needed for recovery are being met and to adaptively manage the hatchery and future harvests.

Google Earth with annotations by Jamie Michel, Lower Elwha Klallam Tribe

Mike McHenry, Lower Elwha Klallam Tribe

Species composition at SONAR monitoring site.

The United States' departments of Interior and Commerce are authorized in the Elwha River Ecosystem and Fisheries Restoration Act[1] to expend funds to carry out the purposes of the Act, which encompasses the restoration of the ecosystem and native anadromous fisheries.

As part of the Elwha Dam removal project, extensive and rigorous monitoring and adaptive management plans were developed by the co-managers and federal partners. This includes long-term monitoring of Chinook, steelhead, and bull trout population abundance and productivity, the former reservoir revegetation plan implementation, and invasive species.

Further, the biological opinion to operate the hatcheries on the Elwha River requires monitoring returning salmon and the percentage of hatchery/wild origin.

This monitoring was federally funded for 10 years but those funds have sunset. It will be important to secure funding for essential monitoring needed in the Elwha River to know whether habitat or fish goals needed for recovery are being met and to adaptively manage the hatchery and future harvests.

Elwha Dam Site

The Elwha Dam was demolished in 2012 but significant river habitat and safety impediments remain at the former dam site. Approximately 0.15 miles of the Elwha River contain rebar and 6-foot-plus diameter concrete boulders associated with the former dam which impair natural river process and pose significant risk to boaters.

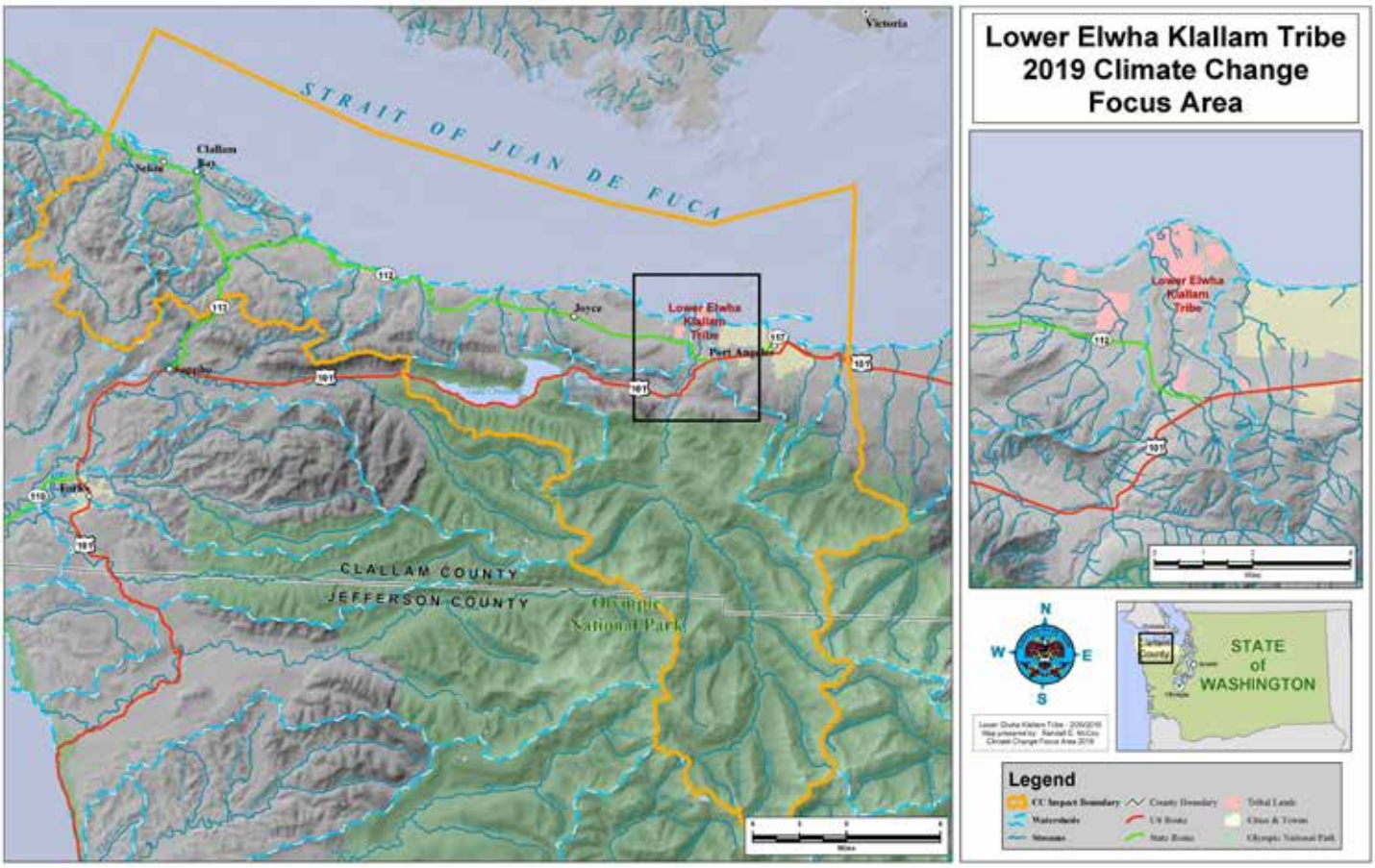
At the base of the former dam, a concrete cassion spans the entire river bottom. Approximately 0.5 acres of floodplain/riparian zone contain dam rubble. A large concrete footing/sheetpile complex associated with the former powerhouse extends about 30 feet into the river. The former dam site sits on lands currently managed by the National Park Service which are intended for transfer to the Lower Elwha Klallam Tribe. These dam impediments were not resolved at the time of dam removal but are of concern to the tribe.

Jamie Michel, Lower Elwha Klallam Tribe

Sheetpile and concrete foundation extending into Elwha River from former Elwha Dam powerhouse.

Climate Change Impacts on Elwha River Streamflow

The predicted loss from climate change of winter snowpack and associated late spring/early summer runoff will result in fundamental changes to the Elwha River ecosystem. Habitat loss in the river is expected at flows of less than 400 cubic feet per second (cfs), a situation exacerbated by water withdrawals. In 2024, the Elwha River reached a low flow of 214 cfs.



Randall McCoy, Lower Elwha Klallam Tribe

Sustaining the flow of the Elwha River is crucial to the lives of people and fish in the region. The Elwha River is home to 10 populations of seven anadromous salmonid species, three of which are listed under the Endangered Species Act.

The Elwha River was the site of a $360 million watershed restoration which removed two large-scale dams devoid of fish passage in 2011-2014.

In addition to the Elwha River sustaining fish, the river also is the sole source of the city of Port Angeles' municipal and industrial water supply. It should be noted that Port Angeles has a huge water right that, if fully utilized, would have a devastating impact on Pacific salmon.

The Lower Elwha Klallam Tribe completed a climate change vulnerability assessment[1] which indicated that the predicted loss of winter snowpack and associated late spring/early summer runoff will result in fundamental changes to the river's ecosystem. Lower base flows in the Elwha River during the late summer and early fall will mean less water available for aquatic habitats and human uses. Current low flows and withdrawals already result in trade-offs between habitat and human use, so future lower low flows means that the status quo for water allocations will not be sustainable.

Habitat loss in the lower Elwha River is expected at flows less than 400 cubic feet per second (cfs), and current water rights allow for withdrawals of more than 200 cfs (City of Port Angeles, 2017). When summer low flows drop below 400 cfs at the same time recovering Chinook salmon are returning to the river to spawn, water withdrawals further compromise available habitat and salmon recovery.

In 2024, the Elwha River reached a low flow of 214 cfs and the city of Port Angeles' water right of 200 cfs has the potential to claim almost the whole river's flow. Sustaining in-stream flows for salmonids will require balancing water allocations or finding alternative sources that don't impact salmon-bearing waters.

South Fork Pysht River Habitat Condition: A Retrospective

The Lower Elwha Klallam Tribe's habitat protection and restoration program of the South Fork Pysht River has been ongoing for 30 years. Recent survey results showed a mix of recovering habitat from both restoration and natural recovery with habitats that showed no sign of recovery. The upper seven kilometers of the river are on a recovery trajectory while the lower seven kilometers contains significant reaches that require further restoration.

The South Fork Pysht River is the largest tributary of the Pysht River, an independent tributary that drains into the western Strait of Juan de Fuca. The watershed contains extensive low gradient habitats that historically supported populations of Pacific salmon including Chinook, Coho, Chum, steelhead and cutthroat trout.

The overwhelming land use in the Pysht River is industrial forestry. In the South Fork, logging was initiated in the early 20th century, initially by railroad logging of old-growth timber resulting in a railway line being constructed that crossed the South Fork Pysht in 26 different locations. Other disturbances include the Burnt Mountain fire and salvage in 1939 which destabilized much of the upper watershed. This was followed by at least two rotations of timber harvest, most of which were conducted with minimal or no protections for floodplain and riparian habitats. It should be noted that the Fish and Forest Act, which arguably includes the most protective forest practice rules in the nation, was not enacted until 2000.

Mike McHenry, Lower Elwha Klallam Tribe

Figure 1. Wood-forced pool and spawning habitat in recovering upper South Fork Pysht River.

The Lower Elwha Klallam Tribe's habitat protection and restoration program was initiated in 1991. The tribe initially focused on understanding the conditions of watersheds as affected by historic and ongoing land uses within the tribe's treaty area.

The Pysht River watershed was selected as an area of focus because of the intensity of timber harvest that was occurring in the watershed as well as its historic importance to the tribe.

The tribe and Merrill and Ring, a private forest land owner, agreed to cooperate on watershed management issues with the goal of improving habitat conditions.

In 1994, the tribe conducted a basin-wide assessment of habitat conditions in the Pysht and its tributaries. In the South Fork Pysht, a survey of 8.5 miles found that habitat conditions were degraded from historic land uses that led to a dramatic loss of in-channel wood that triggered channel incision processes. When wood levels are reduced following intentional removal and loss of source recruitment, stream channels respond by vertically eroding into the channel bed. In extreme cases, erosion to bedrock may occur resulting in habitats that provide limited function for Pacific salmon (Figure 1).

In less extreme cases, the stream channel becomes greatly simplified (plain bed) and loses spawning habitat and rearing habitat (Figure 2). Based on the 1994 survey results throughout the watershed, these results were found to be widespread.

Mike McHenry, Lower Elwha Klallam Tribe

Figure 2. Incised reach of lower South Fork Pysht River lacking pool and spawning habitat.

Because the South Fork Pysht is owned entirely by Merrill and Ring, and because of its importance to salmon populations in the watershed, project partners elected to focus on actions to improve habitat conditions.

Two mechanisms were identified to achieve these results: 1) Forest practice rules and 2) wood restoration. The latter included the additions of wood (conifers) to the channel using heavy equipment or helicopters while the former utilized alternate plans that allowed for the removal of deciduous riparian forests in the riparian zone in exchange for the establishment of coniferous trees along with placement of wood in the channel.

Such treatments were deemed necessary because the pre-logging late successional forests had been converted to mostly alder-dominated stands of young trees. Those forests are incapable of providing the structural wood necessary to

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support habitat forming processes in the stream channel. They also are slow to recruit conifers because of shading from canopy and understory brush (Figure 3).

Between 1994-2006, the tribe and Merrill and Ring implemented a total of five alternate plans and four reach scale restoration projects. All of the alternate plans involved riparian manipulations: typically the removal of deciduous trees outside of a no-harvest core zone designed to maintain canopy cover over the streambed. These were paired with the placement of unanchored large wood including downed old growth material in the vicinity of the treatment sites. In contrast, the restoration projects were deliberate placements of wood in unanchored and anchored complexes using either ground-based machinery or a heavy lift helicopter (Figure 4). These treatments were applied to approximately six kilometers of the South Fork Pysht.

After 2006, there was only passive restoration, as riparian trees were protected under the Forest and Fish Rules, and those trees were allowed to grow.

In 2023, the tribe decided to take a critical look at the South Fork Pysht to see what changes had occurred over the two decades since restoration efforts were completed. The tribe used the 1994 habitat survey data as the baseline and repeated many of variables measured nearly 30 years earlier.

The results showed a mix of recovering habitat from both restoration and natural recovery with habitats showing no sign of recovery over three decades. On a broad scale, the total number of logjams increased from 90 to 269 and the total volume of in-channel wood increased from 17,948 to 61,499^{m3}.

The tribe further analyzed the number of wood pieces by 100m reaches and found that the majority of the 140 reaches increased in both number of pieces and total volume.

Data for pool parameters including maximum residual pool depth and percent pools showed much less change. However, survey conditions encountered in 2023 were exceptionally dry so comparisons between years was difficult. The tribe also used simple geomorphic descriptors of habitat condition for each reach and reached the following conclusions for the South Fork Pysht:

- As a result of both restoration and natural recovery, the upper seven kilometers of the South Fork Pysht are on a recovery trajectory and require no further action other than passive restoration to continue growing larger riparian trees (Figure 1).
- A 1.1 kilometer reach of the upper Pysht was found to be completely dry. This had never been observed before and suggests that drought conditions as a result of climate change increasingly may become an issue in this watershed.
- In contrast, the lower seven kilometers contains significant reaches that require further restoration including 2.5 kilometers of highly incised, bedrock bound channels (Figure 2). An additional 2.5 kilometers of channel was characterized as plain bed lacking significant wood and pools.

To address the recovery of habitat in the lower South Fork Pysht, the tribe and Merrill and Ring applied for a restoration and engineering design to the Salmon Recovery Funding Board in 2024. That application has been successfully vetted, ranked and awarded funding.

With funding, the project partners will hire a qualified engineering firm to conduct a hydrologic, geomorphic and hydraulic analysis of the project reach. That analysis will support a basis of design report that will include engineering drawings and cost estimates for restoration actions that can be implemented over time. The tribe will use this information to systematically complete restoration in the South Fork Pysht. The tribe's goal is to restore as much as possible at the watershed scale through the use of active restoration in combination with current forest practice rules that have shown improvement since the Forest and Fish Act was enacted in 1999.

Mike McHenry, Lower Elwha Klallam Tribe

Figure 3. Lower South Fork Pysht plain bed channel with alder-dominated riparian zone that is incapable of providing functional wood to affect salmon habitat.

Mike McHenry, Lower Elwha Klallam Tribe

Figure 4. Large rootwad being placed in South Fork Pysht by helicopter, fall 2006.

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Long Term Large Wood Placements Improve Salmon Habitat

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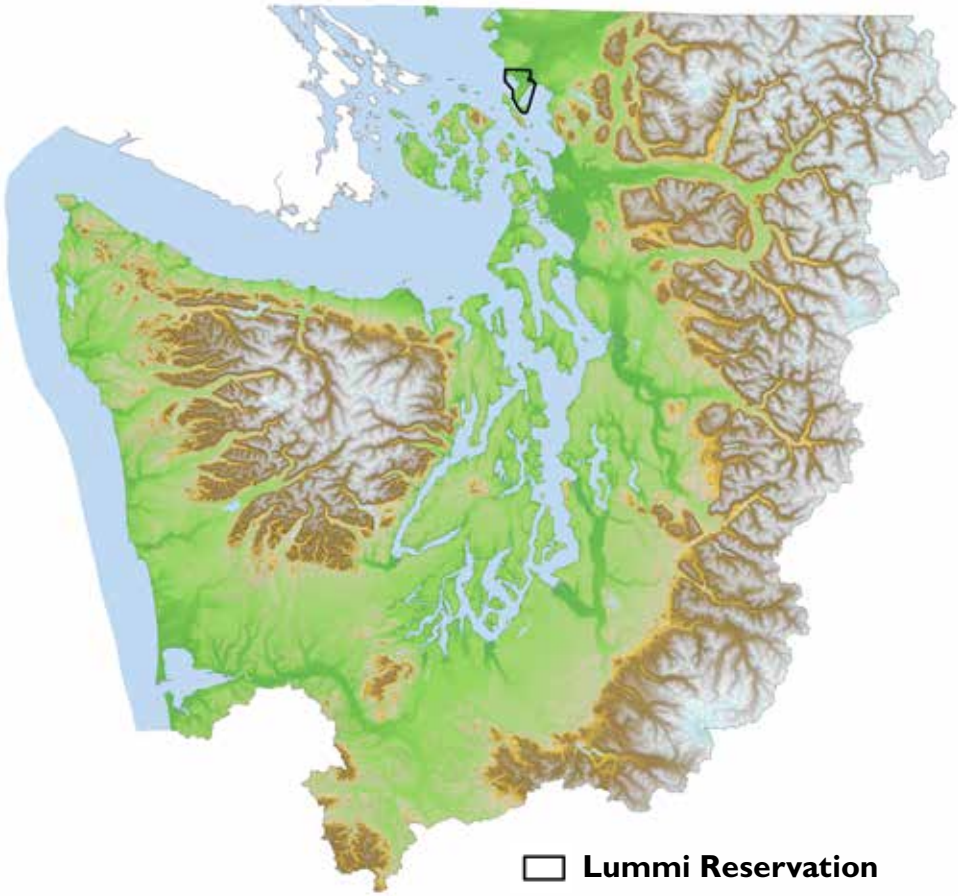
2025 State of Our Watersheds Report
Lummi Watershed

nixeenvironmental.com

Merle Jefferson, Sr. harvests salmon from the Nooksack River.

Our elders used to tell us salmon is good medicine. It's part of our Sche Lang en'*—our way of life. Now the salmon is in trouble, so our way of life is in trouble.*

– Merle Jefferson Sr.
Lummi Nation

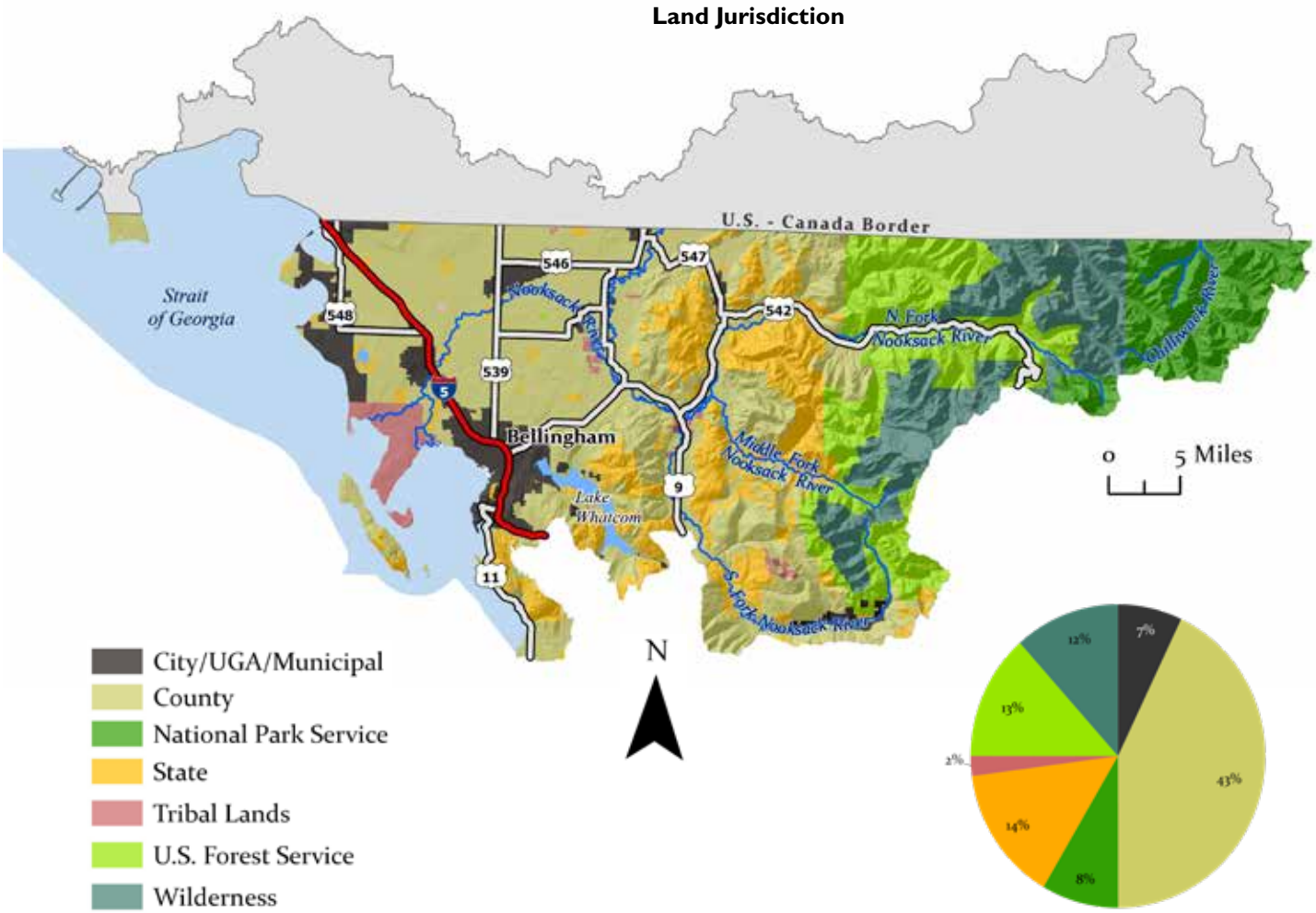


Lummi Nation

The Lummi people were among the original inhabitants of what is now Washington's northernmost coast and southern British Columbia. For thousands of years, they have worked, struggled and celebrated life on the shores and waters of the Salish Sea. The Lummi Nation is a self-governing, sovereign nation within the United States and one of the largest tribes in Washington state, with about 5,500 members. Lummi has the largest fishing fleet of all tribal nations in the U.S.

Lummi Nation

WRIA 1: Mountains to the Sea



The Nooksack River watershed is 832 square miles, the largest drainage in the state's Water Resource Inventory Area 1 (WRIA 1), and the fourth largest drainage in the Puget Sound. It has three main forks—the North, Middle and South—that originate in the steep, high-elevation headwaters of the North Cascades and flow westerly, descending into the flats of the Puget lowlands. The North and Middle forks are glacial rivers and originate from Mount Baker. The South Fork is a snow- and rain-fed river and originates from the non-glaciated slopes of the Twin Sisters peaks. The Middle Fork flows into the North Fork upstream of where the North Fork confluences with the South Fork to form the mainstem Nooksack River. The mainstem then flows as a low-gradient, low-elevation river until reaching Bellingham Bay. Historically, the Nooksack River alternated between flowing into Bellingham Bay and flowing through the Lummi River into Lummi Bay.

Lummi Nation is an aboriginal people who have fished, hunted and gathered throughout their traditional territory and at their usual and accustomed grounds and stations since time immemorial. Living in a region with many resources, the Lummis developed vibrant communities and a rich culture. Today, most of the nearly 5,500 Lummi tribal members continue to live on or near the over 20,000-acre Lummi Reservation.

Euro-Americans began settling the area in the 1850s primarily for the logging resources, with some arriving for opportunities in prairie farming and mining. Lowland clearing for agriculture began in earnest by the 1890s, and by 1925 nearly all of the lower mainstem and delta forests had been converted to agricultural land.[1,2] Since 1950, land-use conversion has primarily been for commercial, residential, urban and industrial development.[3]

The Nooksack River and independent watersheds in WRIA 1 have five species of anadromous salmon (Pink, Chum, Chinook, Coho and Sockeye) and three of anadromous trout (steelhead, cutthroat and bull trout).[4,5]

Map Data Sources: DOD 2023[6], SSHIAP 2004[7], WADNR 2024a[8], WADNR 2024b[9], WAECY 2018c[10], WAECY 2018d[11], WAECY 2021[12], WAECY 2024[13], WADOT 2018[14], WADOT 2023[15], USFWS 2024[16]

Chapter Summary

Brief Lummi History

Natural resources such as salmon, shellfish, wildlife and traditional plants are all important cultural resources critical to the traditional way of life (Sche Lang en') of the Lummi people, and Lummi Nation's fishing, hunting and gathering rights as retained in the Treaty of Point Elliott are viewed as an inherent right endowed by the Creator and protected and passed down through the wisdom of Lummi elders.

The Lummi people identify as the L'aqtemish, or people of the sea, and the most defining characteristic of the Lummi Nation is that since time immemorial, they have been a fishing people. In 1855, Lummi Nation, among other tribes, signed the Treaty of Point Elliott ceding lands to the United States government in exchange for reservation lands and guarantees to retain the rights to hunt, fish and gather at usual and accustomed grounds and stations and traditional territories. Lummi Nation has exercised these rights since time immemorial, intends to maintain these rights into perpetuity and currently has the largest tribal commercial fishing fleet in the U.S.

Treaty Resources Promised

In order for the treaty promises to be fulfilled, there must be a sustainable supply of fish, shellfish, game and plants to harvest and gather and ample access to those natural resources to meet cultural and subsistence needs and ensure Lummis can make a moderate living from fishing. In addition to naturally produced fish, hatchery fish are also treaty fish and provide necessary mitigation for the significant losses of returning harvestable salmon incurred through historic and ongoing habitat degradation.

Call to Action

While Lummi Nation did not create the problems that have led to the decline of salmon and the subsequent Endangered Species Act (ESA) listing of Nooksack early Chinook, the tribe has consistently worked toward recovering salmon. The ESA listing is viewed by Lummi as a sign of poor natural resources management, and the act has been applied more stringently toward harvest and hatchery management as compared with protecting habitat and water resources.

Challenges

To work toward recovery, Lummi Nation voluntarily closed its culturally important spring Chinook fishery in the late 1970s. Lummi has more recently worked with the state and tribal co-managers and NOAA Fisheries to develop and implement a program at the Skookum Creek Hatchery to preserve and recover South Fork Nooksack early Chinook. A recovery program for North Fork/Middle Fork spring Chinook was initiated at the Washington Department of Fish and Wildlife's Kendall Creek Hatchery in the early 1980s and continues to prevent extinction of this salmon population in partnership with Lummi Nation. The success of these hatchery programs has provided a small number of early Chinook for the Lummi First Salmon Ceremony and Stommish celebration for several years. In 2020, favorable natural-origin abundance forecasts coinciding with surplus hatchery-origin fish from both recovery programs provided a limited subsistence fishery for the first time since 2011.

Despite Lummi Nation's efforts to restore habitat, reduce harvest and support hatchery production in the Nooksack watershed and all of Puget Sound, the long-term average return of harvestable salmon remains static with no net increase in abundance or continues to decline. The primary limiting factors to salmon recovery are the quantity and quality of properly functioning habitat where salmon begin and end their lives in the watersheds. Habitat restoration efforts must continue to focus on increasing freshwater capacity for both spawners and juvenile fish.

Key Indicators

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The Lummi chapter is narrowly focused on issues within the local watershed related to habitat conditions, restoration, and water quality and quantity, and is not considered a comprehensive view of issues that Lummi Nation deems important to protect and preserve Lummi treaty rights and Sche Lang en'.

Principal Findings

Screw Trap Monitoring of Juvenile Salmonid Populations in the Nooksack River

Monitoring of juvenile salmon abundance over the past 15 years shows unchanged outmigration trends, suggesting a resilience to further decline but also a lack of progress toward meeting recovery goals.

Improving Habitat by Protecting and Restoring Tidal Wetlands in the Nooksack River Delta

Recent mapping found that Nooksack delta tidal wetland habitat increased between 2008 and 2013 from 2,209 acres to 2,273 acres. As habitat area has increased through restoration, natural processes in the delta have changed and improved habitat type. Since 2008, a 13-acre logjam on a large distributary channel has formed, increasing blind channel habitat area in the delta by 14 acres (+70%) and decreasing distributary channel area by 34 acres (-15%). The combined increase in habitat area and change in habitat type means there is more area for fish to occupy, resulting in an increased carrying capacity in the delta for Chinook salmon.

Portage Bay Shellfish Growing Area Shows Some Improvement

In 2024, the commercial shellfish growing area in Portage Bay experienced two changes: Lummi Nation and the Washington Department of Health upgraded 360 acres from conditionally approved to approved and reduced long-standing seasonal closures by one month.

Chinook Salmon Exposure to Copper in Stormwater is a Major Concern

During 2024 water quality monitoring conducted by Lummi Natural Resources, copper was found in 98% of marine water and 23% of freshwater samples. The effects of chronic and acute exposures to copper on aquatic organisms are a grave concern.

Exempt Well Development Expands in WRIA 1 While Instream Flow Rules Continue to be Violated

Between 2020 and 2024, an estimated 331 new water wells were drilled in Water Resource Inventory Area 1 (WRIA 1), and 85% of those are estimated to be permitted exempt water wells. Approximately 80% of all permitted exempt water wells in WRIA 1 are in basins closed either seasonally or year-round to water withdrawal due to instream flow levels that are less than the minimums established in 1985.

RMAP Implementation Complete in the Upper Nooksack Watershed

The state's Road Maintenance and Abandonment Plan (RMAP) has resulted in the repair or abandonment of 1,426 miles of private and state-owned forest roads in the upper Nooksack River watershed. The RMAP has also resulted in the repair or removal of 132 culverts on private and state-owned forest roads. Work on Sierra Pacific-owned lands that was uncompleted at the last update of this report in 2020 has now been completed.

Wetland Restoration Still Needed on Agricultural Lands in the Lower Nooksack River Floodplain

There has been little change in floodplain wetland area since the late 1990s. There was an estimated 1.5% loss of wetland area in the floodplain between 1996 and 2006, no further loss between 2006 and 2011, and a 1.5% gain of wetland area between 2011 and 2016. The fluctuation over the last 20 years is thought to be within the range of error of the data, and there has been little to no change overall since 1996.

Engineered Logjams and Long-term Commitment to Healthy Riparian Forests Key to Restoring Wood to the Nooksack River

Since 2001, Lummi Nation and the Nooksack Indian Tribe have constructed 758 engineered logjams (ELJs) and habitat structures in the Nooksack River watershed through the completion of 29 projects. Four more ELJ projects are in a conceptual design phase, six projects are in a preliminary design phase and four projects are actively progressing.

European Green Crab Inside the Salish Sea

The invasive European green crab (EGC), *Carcinus maenas*, threatens to disrupt nearshore habitats and balanced ecosystems wherever it is introduced. Lummi Nation has considerable tidelands and marshlands on its reservation, providing ample suitable habitat for the invasive species.

In the fall of 2019, EGC were detected in Lummi Bay for the first time. Since then, Lummi Natural Resources has responded nonstop to this environmental threat.

Climate Change is Resulting in Rising Stream Temperatures and Threatening Salmon Habitat

The 2018 Washington Department of Ecology Water Quality Assessment and listings report to the U.S. EPA is the first update since 2012. Based on the updated assessment, stream temperature pollution listings increased in the Nooksack River watershed. Rising stream temperatures threaten the health of salmon in the Nooksack River system.

Legal Adjudication is Necessary to Secure Water Rights in the Nooksack River Basin

Over 35 years of efforts to maintain and improve water flows in the Nooksack River basin have proven unsuccessful. The only measure left to use is adjudication, the legal determination of water rights for every water user in the basin.

Conclusion

Lummi Nation is actively working with partners throughout the Nooksack watershed to restore critical Chinook habitat. Habitat restoration objectives are most often monitored and assessed at the project level and with time are expected to have landscape-level impacts. However, with severely limited funding and capacity for effectiveness monitoring, it is difficult to determine whether salmon recovery projects will successfully provide the harvestable salmon Lummi relies on to practice its treaty-protected fishing rights.

Habitat restoration alone is too slow to address the critical state of the resource. Implementation of the WRIA 1 Salmonid Recovery Plan is lagging behind the pace originally anticipated during plan development. Restoration work has progressed with capital projects focused on restoring fish habitat and passage. However, WRIA 1 has faced significant funding shortages for restoration projects, limiting implementation progress.

Progress also has lagged on implementing regulatory and incentive programs to protect and restore salmonid habitat and habitat-forming processes. One small success is the completion of the RMAP process, but with habitat being lost faster than it is being restored and the severely lagging pace of high-priority restoration actions, it is not anticipated that restoration will fully restore the necessary sustainable supply of harvestable salmon in the foreseeable future.

In addition to volunteer restoration, the current regulatory framework needs to be better enforced. For example, Portage Bay will only be fully opened to year-round tribal shellfish harvest after landowners in the Nooksack watershed begin to plant and maintain riparian buffers, better manage dairy operations to protect water quality, properly manage waste from pets and non-dairy livestock, and maintain their septic systems. Furthermore, Lummi Nation is working toward increasing the number of harvestable salmon by implementing its 10-year, co-manager agreed hatchery production plan.

Recovery Efforts Show Signs of Improvement but Still Lagging in Key Indicators

At the 20-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Nooksack River basin shows improvements for forest fish-passage barrier removals and construction of engineered logjams. There is still a concerning trend for the quantity of water wells being drilled, and no trend for floodplain wetland and estuary habitats. There are mixed trends related to water quality.

In general, there is a shortage of agency staff at all levels (e.g., federal, state, tribal, county, city) needed to address the issues and implement actions to restore and protect habitat, and monitor and enforce compliance with existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

A review of the trend for these key environmental indicators shows improvement for some but continued decline for water wells and floodplain restoration:

Tribal Indicator	Status	Habitat Trend
Restoration - Estuary	Nooksack delta tidal wetland habitat has increased, distributary channel area has decreased, and the increase in habitat area and change in habitat type has resulted in an increase in carrying capacity in the delta for Chinook salmon.	**Improving**
Shellfish	In 2024, Lummi Nation and the Washington State Department of Health (WADOH) upgraded 360 acres of commercial shellfish growing area from conditionally approved to approved and reduced long-standing seasonal closures by one month.	**Improving**
Water Wells	Between 2020 and 2024, an estimated 331 new water wells were drilled in Water Resource Inventory Area 1 (WRIA 1), and 85% of those are estimated to be permitted exempt water wells. Approximately 80% of all permitted exempt water wells in WRIA 1 are in basins closed either seasonally or year-round to water withdrawal due to instream flow levels that are less than the minimums established in 1985.	**Declining**
RMAP	The state's Road Maintenance and Abandonment Plan (RMAP) has resulted in the repair or abandonment of 1,426 miles of private and state-owned forest roads in the upper Nooksack River watershed. The RMAP has also resulted in the repair or removal of 132 culverts on private and state-owned forest roads. Work on Sierra Pacific-owned lands that was uncompleted at the last update of this report in 2020 has now been completed.	**Improving**
Restoration - Floodplain Wetlands	There has been little change in floodplain wetland area since the late 1990s.	**Declining**
Restoration - ELJs	Since 2001, Lummi Nation and the Nooksack Indian Tribe have constructed 758 engineered logjams (ELJs) and habitat structures in the Nooksack River watershed through the completion of 29 projects. Another four projects are in a conceptual design phase, six are in a preliminary design phase and four are actively progressing.	**Improving**
Invasive Species - Green Crab	In the fall of 2019, European green crab were detected in Lummi Bay for the first time. Since then, Lummi Natural Resources has responded nonstop to this environmental threat.	**Concerns**
Climate Change	Based on the 2018 Washington Department of Ecology Water Quality Assessment, stream temperature pollution listings increased in the Nooksack River watershed. The effects of climate change are making themselves apparent in the South Fork Nooksack River where elevated summer water temperatures are creating adverse conditions for juvenile and adult spring Chinook salmon.	**Declining**
Water Quality	While a 2024 WADOH shellfish harvest area reclassification will open approximately 360 acres of shellfish beds, previously closed up to six months per year since 2009, to Lummi Tribal members for year-round harvest, there continue to be concerning levels of coliform bacteria coming on to the Reservation, which is located at the bottom of the Nooksack watershed. Mitigation must continue for all pollution sources that are harmful to the health of the Lummi People and the resources they rely upon.	**Concerns/ Improving, but still poor**
	High concentrations of copper have been discovered in Lummi and Portage bays. The effects of copper on aquatic organisms are of grave concern to Lummi Nation. Effects range from relatively subtle behavioral changes (e.g., avoidance of areas with elevated copper) to loss of reproductive success and acute mortality. Sessile organisms like shellfish are unable to move and avoid pollutants like copper, which can increase their susceptibility.	**Concerns**
Water Rights	Lummi Nation continues to protest new water wells and surface water withdrawals in WRIA 1. There is concern that water has already been over-appropriated by the state. On Reservation, the demand for water is at times is higher than the supply, and there is a reliance on water from the city of Bellingham. The Nooksack basin water rights adjudication process has begun in Whatcom County Superior Court. Adjudication is a legal process that brings all water users in a watershed together to quantify and confirm their water rights.	**Concerns**

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

Located at the bottom of the watershed, Lummi Nation is disproportionately impacted by flooding and urban, industrial and agricultural stormwater runoff and the toxins it carries. These pollutants flow through the Lummi Reservation then enter the Salish Sea, contaminating critical habitats for ESA-listed Chinook salmon, shellfish and other species vital to ecosystem health and tribal culture. As such, Lummi Nation is at the forefront of efforts to ensure water rights and address environmental degradation—advocating for stronger regulatory, source control and cleanup measures to reduce contamination and ensure the protection of treaty resources. Preserving and restoring water quality and water quantity both on and off reservation is necessary to ensure survival of salmon and shellfish and a healthy, culturally rich future for the Lummi people.

Managing Water Resources in the Face of Climate Change and Urban Growth

Both the Nooksack and Lummi river watersheds are under environmental pressures from rapid regional growth. The Lummi Nation has also been in a period of rapid economic/housing development. Due to the high cost of living in the Bellingham area, tribal members are seeking on-reservation housing.

Lummi Water Resources is updating existing regulations (i.e., water quality standards) and developing tools to better address and inform development patterns (i.e., wetlands and stormwater management) and to address climate change. Without adequate water management and effective coordination with other departments, reservation groundwater and surface water resources are vulnerable to diminishment from the effects of climate change, which include degradation of water quality, diminishment of aquifer recharge, saltwater intrusion into coastal groundwater systems, and an increase of surface water and stormwater runoff from changing rainfall patterns. Such impacts could ultimately lead to the loss of the primary water source for the Lummi Nation and could also leave Lummi vulnerable to increased coastal and riverine flooding, coastal erosion, and loss of culturally and commercially important treaty fishery and shellfish resources.

To increase coastal resilience and for sustainable development, taking a more holistic approach to wetland management with a reservation-wide wetland inventory is a priority for Lummi Natural Resources (LNR). LNR is working on wetland delineation and a GIS inventory within unmapped reservation areas to evaluate wetland function, connectivity and restoration opportunities to reduce risk of coastal and riverine flooding. From a land-use perspective, a holistic approach to wetlands management will help LNR evaluate and avoid cumulative impacts from future development, and will provide planning and natural resources management and policy tools for sustainable/low impact development.

Securing Drinking Water

The quantity and quality of the Lummi Nation's domestic water supply have long been of concern and are becoming more challenging to manage and protect over time with increased development pressure and a changing climate.

Reliable Supply

There is not enough water available to meet the drinking water needs of Lummi tribal households. Supply can't keep up with user demand. This is especially true during dry summer periods. Critical aquifer recharge areas must be identified and protected now to secure the tribal water supply, which relies on groundwater wells withdrawing from two underground aquifers on the reservation: Lummi Peninsula Aquifer and Northern Lummi Aquifer. Precipitation is the only source of recharge for this water supply source.

Self-sufficiency

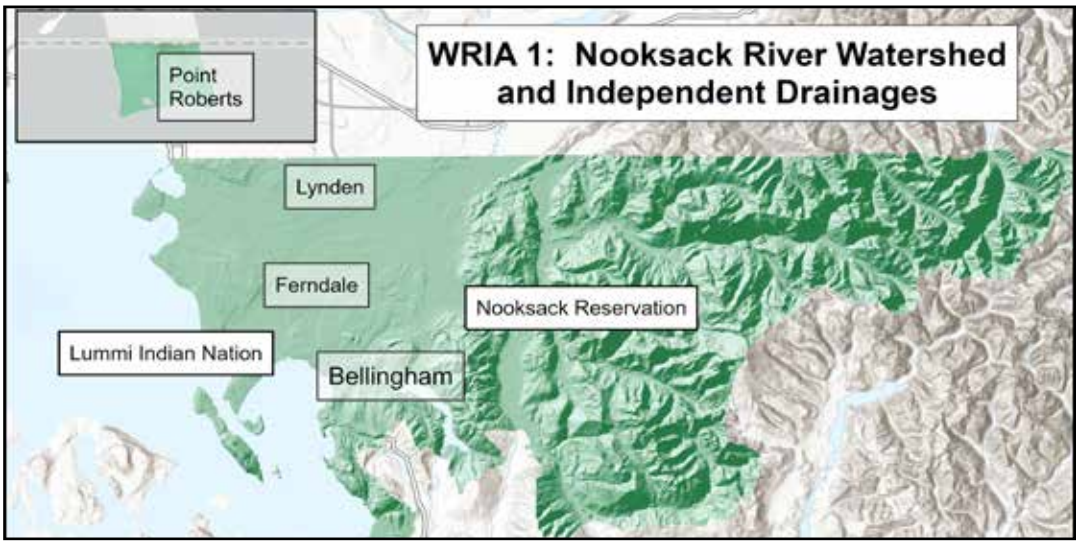
The Lummi drinking water system was connected to the city of Bellingham in an attempt to meet water quantity needs. Unfortunately, purchasing adequate water from Bellingham is far too costly. The arrangement makes the Lummi Nation dependent upon Bellingham and the city's decisions about water availability and costs. Lummi Water Resources assisted the Lummi Tribal Water and Sewer District in securing funding for an alternative water source to allow for the long-term self-sufficiency of the Lummi people. Vital funding was secured from the Washington Department of Commerce for geotechnical evaluation and mapping of groundwater recharge that will be protected from development pressure.

Lummi Natural Resources

Saltwater Intrusion

Saltwater intrusion in coastal aquifers is a growing problem in the Pacific Northwest. The Lummi Peninsula Aquifer is surrounded and underlain by salt water. Too much salt can ruin an aquifer and, in drinking water, can harm plumbing and cause health problems. Studies from the 1970s identified early signs of saltwater intrusion in Lummi groundwater. Since then, the drinking water supply has been at increasing risk and wells have been forced to close due to salt content. Excessive groundwater pumping can cause a high risk of saltwater intrusion in the groundwater supply. Besides quantity, salt water is the highest threat to our drinking water supply. Modeling suggests the risk of saltwater intrusion on the Lummi Peninsula will continue to increase due to sea level rise and climate change.

Securing Water Rights



Over 35 years of efforts to address water flows in the Nooksack River basin have ultimately proven unsuccessful, and as demonstrated in the Yakima basin and elsewhere in the western United States, adjudications create the environment for binding settlements of water rights and/or related issues. Through the Treaty of Point Elliott, tribes in the greater Puget Sound region ceded title to much of their ancestral homelands while reserving the right to hunt, fish and gather throughout their traditional territories as they had since time immemorial. Court decisions have affirmed that treaty rights include sufficient water to support those harvests, which includes rights to instream flows to support salmon. These water rights have a priority date of time immemorial and are therefore the most senior water rights in a given basin.

How do we make sure there's enough water in the Nooksack for salmon to thrive? Through adjudication. This is a legal process that brings all water users in a watershed together to quantify and confirm their water rights. Simply put, an adjudication is an inventory of who has a right to how much water, where it can be used and when it can be used. The process legally and permanently determines everyone's water rights, providing the certainty that is so important for fishing, business (including agriculture) and people.

Off-Reservation Stormwater is a Threat to Lummi Bay

Lummi Bay water quality is significantly threatened by flooding from upstream sources and the pollutants it transports. Stormwater runoff from the city of Ferndale contains fecal coliform levels that far exceed Lummi Nation water quality standards, which establish quantifiable limits to protect the tribe's water bodies and ensure the safety of shellfish harvest. Additionally, flooding of agricultural fields north of the reservation boundary—caused by heavy rainfall—is exacerbated by sediment buildup and inadequate ditch drainage. This further contributes to downstream pollution within the Lummi Reservation and in Lummi Bay. Although Lummi Bay remains open for shellfish harvest, continued contamination from stormwater runoff and other pollution sources may result in partial closures similar to the current regulations in Portage Bay.

Potential pollution sources within the Ferndale area include manure from dairy farms, non-dairy livestock operations, pets, wildlife, municipal stormwater and failing septic systems. Lummi Natural Resources is working to establish a partnership between Ferndale, Whatcom County and the Whatcom (Agricultural) Diking District to address this issue.

Beyond fecal coliform, other contaminants are also exceeding water quality standards in Lummi Bay and its associated waterways. Based on monitoring data and an assessment of current land-use and management practices within and around the reservation, stormwater pollutants of concern include 6PPD-Q (a compound found in tires), copper and zinc—all of which are highly toxic to aquatic life when present in excessive amounts.

Copper Contamination in Reservation Waters

In 2024, Lummi Natural Resources (LNR) evaluated potential impacts of stormwater on water quality and found that toxic contaminants affecting Chinook stocks are a major and urgent concern. For example, an estimated 98% of marine samples and 23% of freshwater samples tested for copper exceeded Lummi water quality standards to protect aquatic life.

The effects of chronic and acute exposures to copper on aquatic organisms are of grave concern to Lummi Nation. Effects range from relatively subtle behavioral changes (e.g., avoidance of areas with elevated copper) to loss of reproductive success and acute mortality. Sessile organisms like shellfish are unable to move and avoid pollutants like copper, which can increase their susceptibility. Copper can also affect the gills of crabs, reducing their ability to exchange and carry oxygen, resulting in hypoxia and even death (U.S. EPA 2016). Chinook salmon, Coho salmon and rainbow trout were some of the most sensitive fish to copper out of 27 species evaluated in a 2007 U.S. EPA analysis.

The LNR evaluation identified that potential sources of copper include agriculture, tires and brakes, boat anti-fouling paint, industrial stormwater, publicly owned wastewater treatment plants, individual industrial discharges (e.g., refineries) and toxic waste cleanup sites. Another potential source may be copper grounding mats left in place at the Navy's Marietta Naval Security Group Activity site that operated from 1952-1972 within Lummi Reservation boundaries. Minimal information specific to this site was available about copper and its disposal during site decommissioning. LNR has reached out to the U.S. Department of Defense to investigate.

Map Data Sources: SSHIAP 2004[1]

Screw Trap Monitoring of Juvenile Salmonid Populations in the Nooksack River

Monitoring of juvenile salmon abundance over the past 15 years shows unchanged outmigration trends, suggesting a resilience to further decline but a lack of progress toward meeting recovery goals.

Lummi Natural Resources

A rotary screw trap in operation at Hovander Homestead Park in Ferndale, WA.

Since 1994, Lummi Natural Resources has run a rotary screw trap at Hovander Homestead Park to track outmigration of juvenile salmonids in the mainstem Nooksack River. Catch data from the trap is used to estimate the total abundance of outmigrating juvenile salmon from the Nooksack River system (Figure 1).

In the past 15 years of monitoring, Chinook, Chum, Coho and steelhead populations have shown no definitive trends in juvenile outmigration abundance.

The Nooksack watershed is home to two distinct native populations of Chinook: the North Fork/Middle Fork early (spring) Chinook and South Fork early (spring) Chinook. Historically, the North Fork/Middle Fork population has represented a higher proportion of outmigrating juvenile salmon, but the proportion of recovering South Fork Chinook has increased in recent years.

Recovery goals for Water Resource Inventory Area 1 (WRIA 1) Chinook abundance suggest a minimum target of 690,000 outmigrating natural-origin Chinook (280,000 South Fork and 410,000 North Fork/Middle Fork), assuming productivity in the system is high. On average since monitoring, natural-origin Chinook outmigration abundance has been about 80% below the recovery goal.

With abundance estimates below recovery thresholds and no definitive positive trends in outmigration, continued recovery actions are needed to improve natural-origin juvenile Chinook abundance in the Nooksack basin.

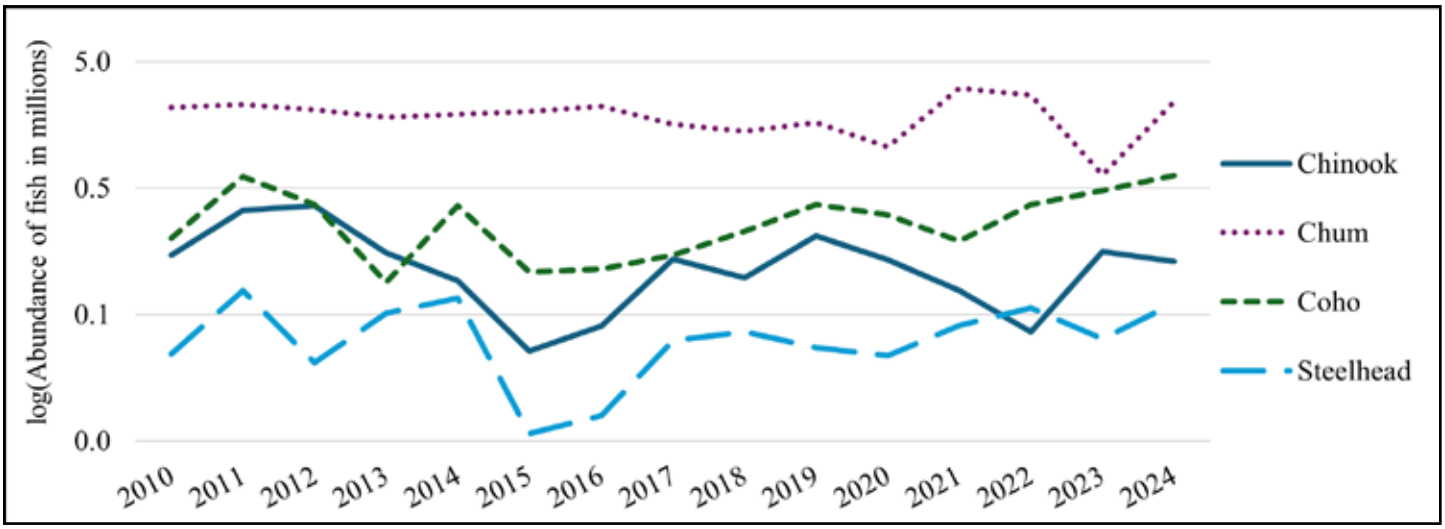
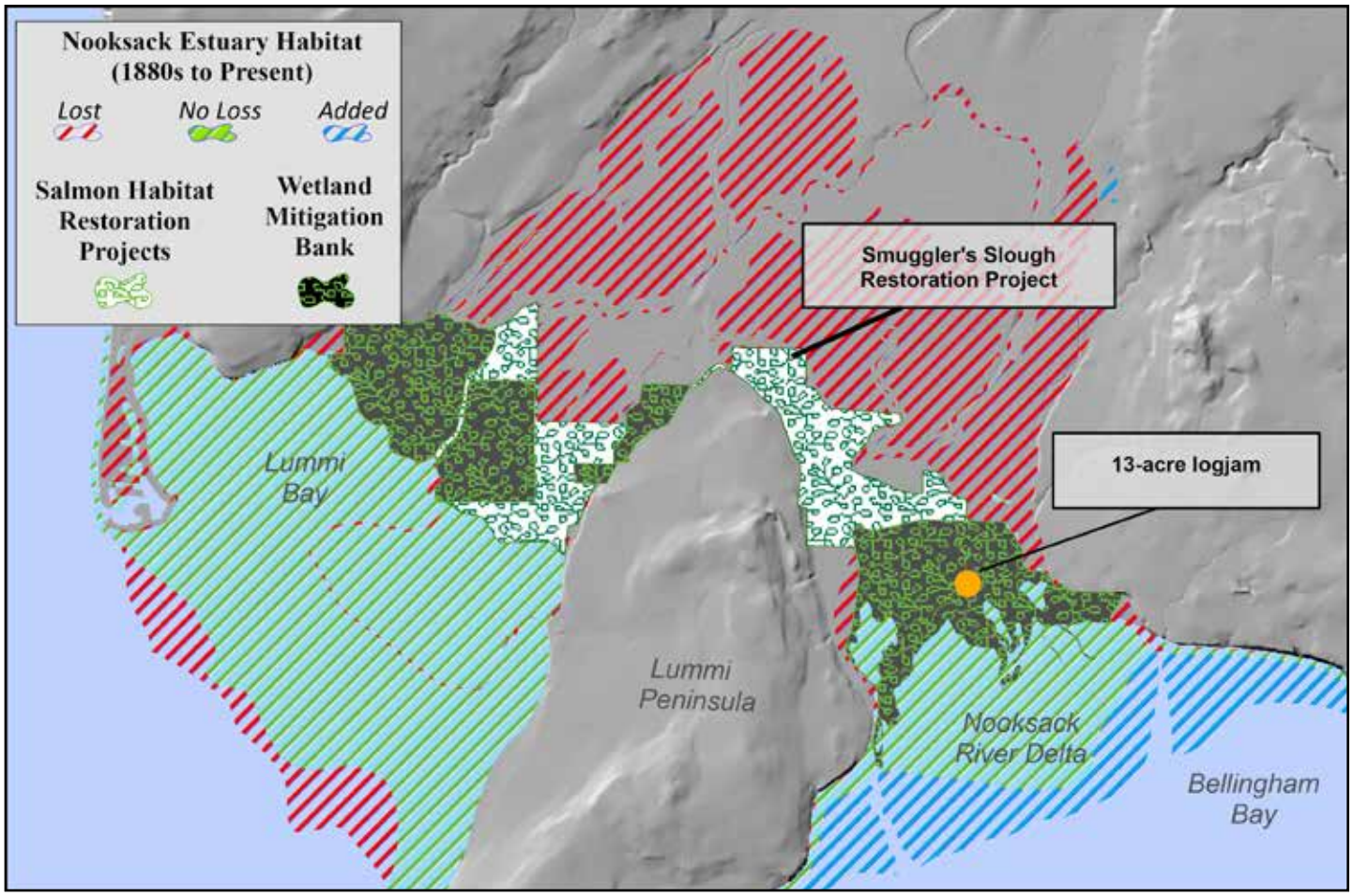


Figure 1. Abundance of natural-origin juvenile Chinook, Chum, Coho and steelhead estimated using an outmigration model.

Improving Habitat by Protecting and Restoring Tidal Wetlands in the Nooksack River Delta

Recent mapping found that Nooksack delta tidal wetland habitat increased between 2008 and 2013, from 2,209 acres to 2,273 acres.[1] As habitat area has increased through restoration, natural processes in the delta have changed and improved habitat type. Since 2008, a 13-acre logjam on a large distributary delta channel has formed, increasing blind channel habitat area in the delta by 14 acres (+70%) and decreasing distributary channel area by 34 acres (-15%).[2] The increase in habitat area and change in habitat type has resulted in more area for fish to occupy, increasing carrying capacity in the delta for Chinook salmon.[3]



While a lot of historical tidal wetland has been lost in the Lummi and Nooksack deltas, Lummi Nation is protecting and restoring what is left in the Nooksack delta tidal area through wetland restoration and wetland mitigation banking.

In the 1920s, a seawall was constructed along Lummi Bay and a levee constructed along the Lummi River to support the development of agricultural lands on the Lummi Reservation. This project significantly reduced historic sub-aerial estuarine habitat.[4] Since then, sediment deposition throughout the Nooksack River delta has expanded intertidal estuarine habitat along Bellingham Bay.

While the delta continues to expand, Lummi Nation has been working since the 1990s to further improve estuarine habitat in the Nooksack River and Lummi River deltas and to make up for the loss. The Lummi Wetland and Habitat Mitigation Bank, which was the first tribal wetland mitigation bank in the United States, became operational in 2012. The protection provided by the mitigation bank allows for natural processes, like the forming of large wood jams, to continue in the delta and improve habitat for Chinook. Wetland enhancement activities implemented in Phase 1A of the Lummi Wetland and Habitat Mitigation Bank, completed over the 2011-2024 period, included over 80 acres of reed canarygrass control though willow plantings and over 100 acres of deciduous forest enhancement through conifer underplanting.

Immediately adjacent to the mitigation bank is Lummi Nation's large Smuggler's Slough Restoration Project, which increased tidal wetland habitat area between 2008 and 2013. Together, the mitigation bank and Smuggler's Slough have directly increased and improved tidal habitat area for Chinook salmon in the Nooksack River delta.

Map Data Sources: LIBC 2012[5], PSNERP 2008[6], SSHIAP 2004[7]

Portage Bay Shellfish Growing Area Shows Some Improvement

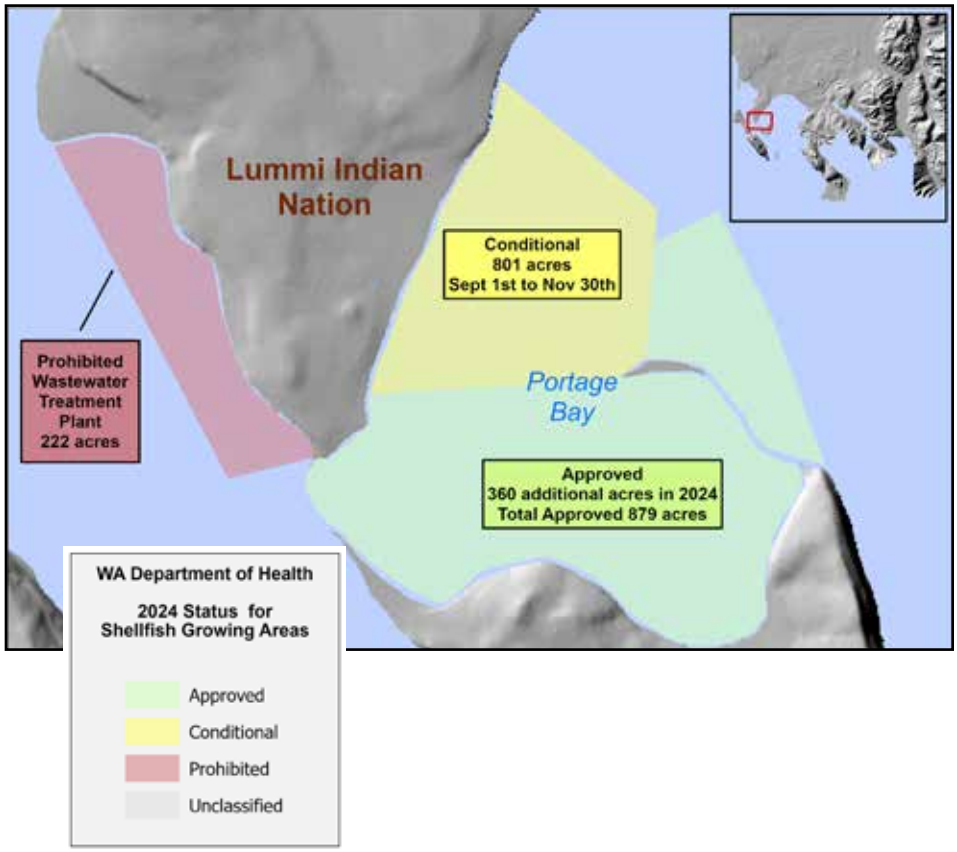
In 2024, the commercial shellfish growing area in Portage Bay experienced two changes: The Washington Department of Health (DOH) and Lummi Nation upgraded 360 acres from conditionally approved to approved and reduced long-standing seasonal closures to September 1st – November 30th.[1]

In September 2014, in order to protect public health and safety, Lummi Nation, in consultation with the DOH, voluntarily closed 335 acres of shellfish growing area in Portage Bay because National Shellfish Sanitation Program standards were not achieved at two water quality monitoring stations. After poor water quality affected additional stations in November 2014 and April 2016, Lummi and DOH reclassified a total of 820 acres from approved to conditionally approved. In 2024, conditions improved, and 360 acres of shellfish growing area was opened without conditions.

While the current reclassification is welcome, a conditional closure in Portage Bay continues to negatively impact the livelihoods of over 200 Lummi Nation families who earn their living from the commercial harvest of shellfish. This also impacts all 5,500 Lummi Nation tribal members whose treaty right guarantees them Portage Bay shellfish for ceremonial and subsistence harvests.

Degraded water quality in the Nooksack River watershed continues to reduce the amount of shellfish available for Lummi people to harvest, impacting their ability to exercise the treaty right guaranteeing them a sustainable shellfish harvest.

Portage Bay Commercial Shellfish Growing Area



Lummi Natural Resources

A Lummi tribal family collects shellfish in Portage Bay.

Map Data Sources: WADOH 2024[2]

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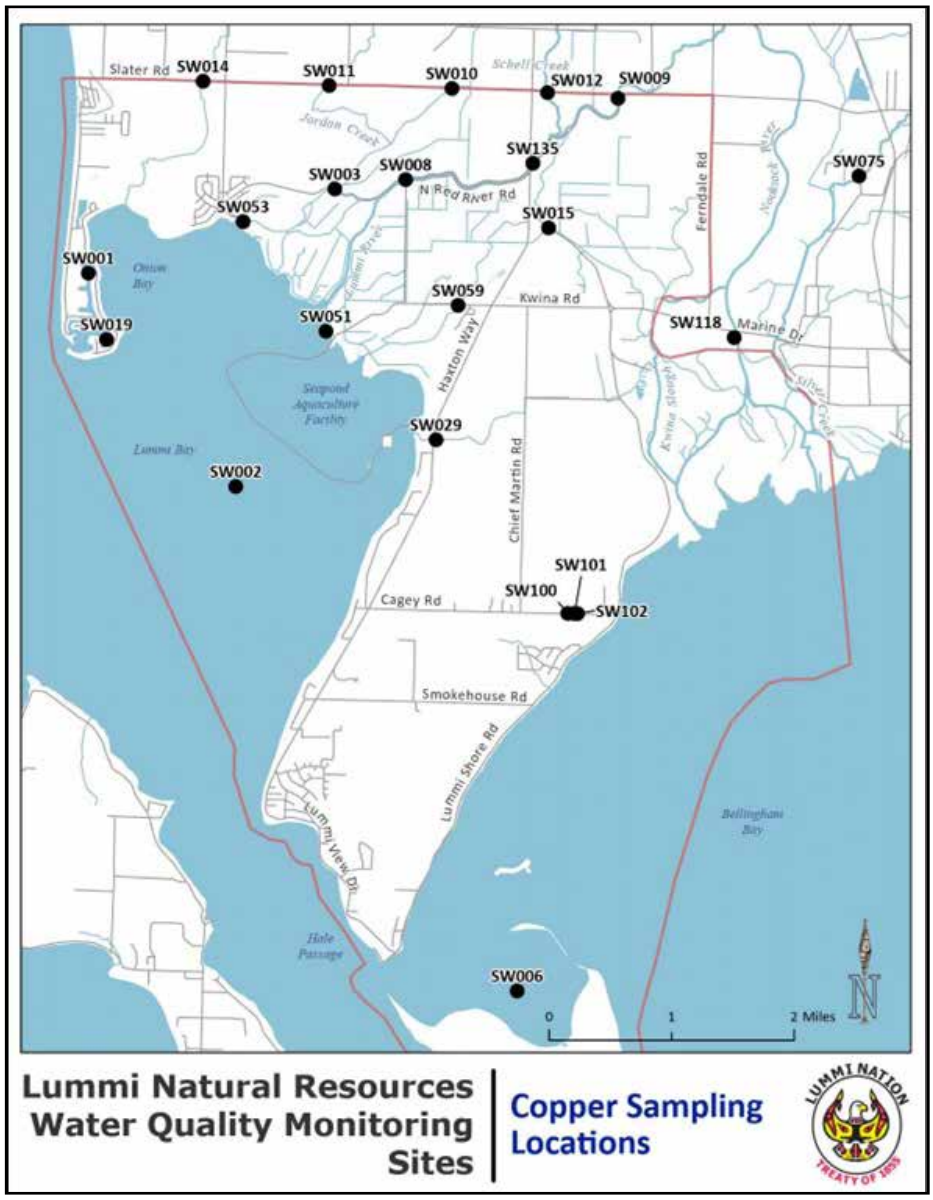
2024 Marine and Freshwater Water Quality Monitoring Sites



Lummi Natural Resources

Exempt Well Development Expands in WRIA 1 While Instream Flow Rules Continue to be Violated

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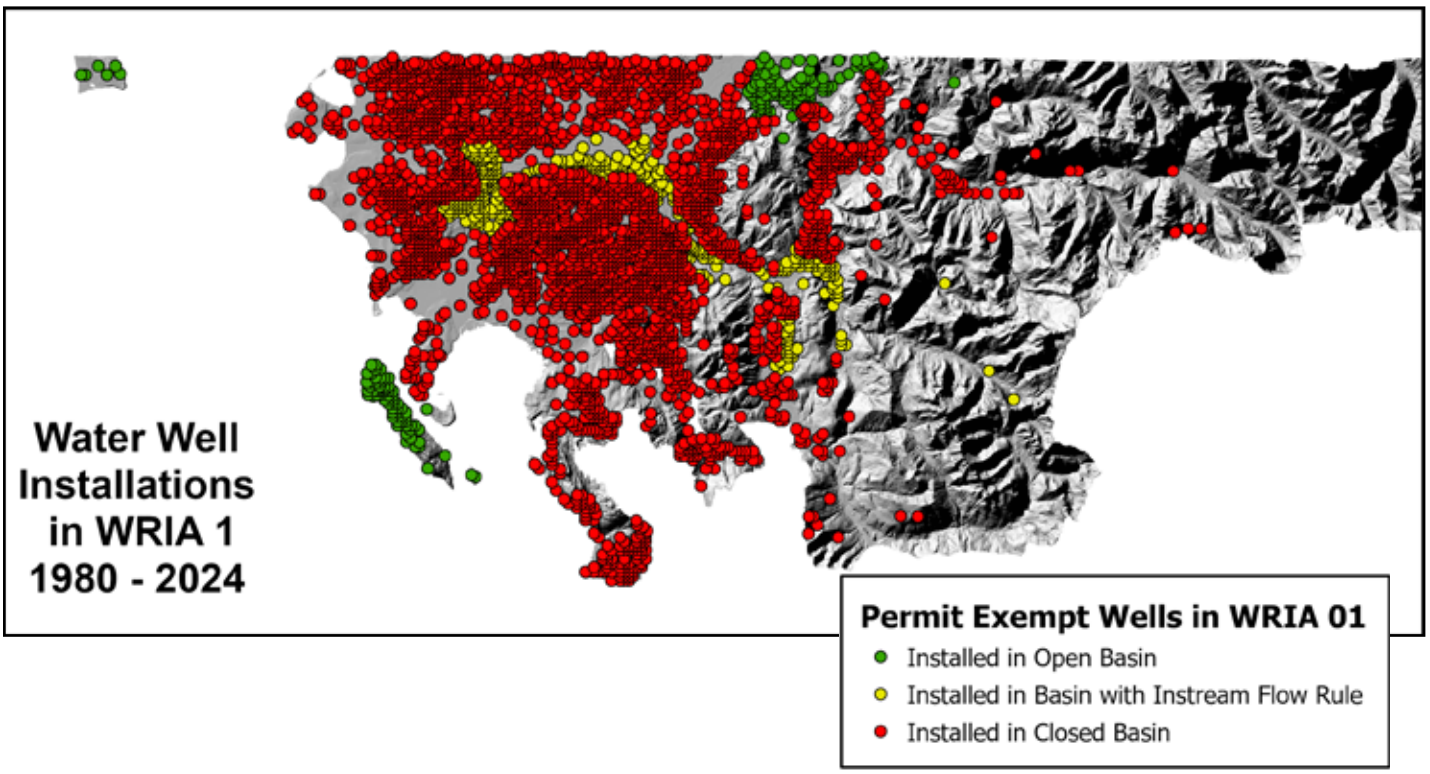
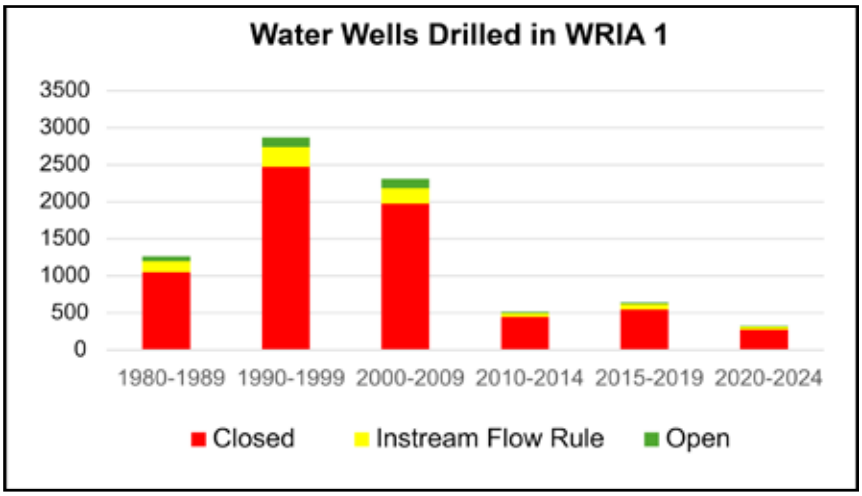


According to the WRIA 1 Salmonid Recovery Plan, not meeting instream low flows results in a loss of habitat connectivity, reduced habitat volume, stranding of juvenile salmon, higher stream temperatures and a general decrease in water quality. The WRIA 1 instream flow rules were set in 1985 to "protect and preserve" instream resources from low flow exceedance.

As displayed on the map and table, permitted exempt wells have continued to be developed in WRIA 1 since 1986. While legal under state water law, continued exempt well development in basins targeted for limited or no additional withdrawal under the instream flow rule is in direct conflict with the guidance of the Salmonid Recovery Plan, which recommends reducing out of stream uses in sub-basins impacted by low instream flows.



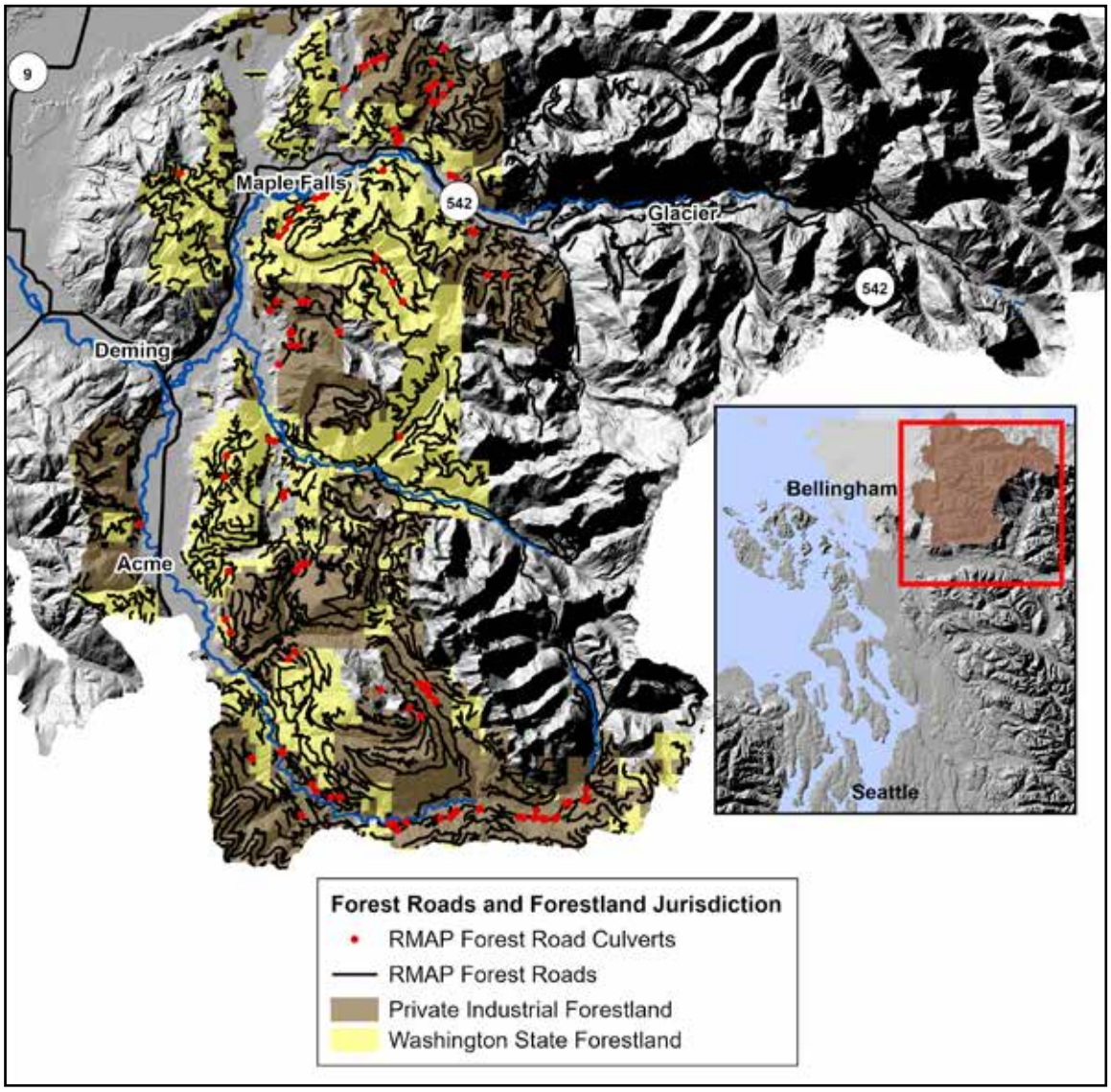
The trend of water well development inside closed basins in WRIA 1 has continued from 2020 to 2024, but at a lower rate than the 5-year period prior (2015-2019).

Map Data Sources: WAECY 2025[4], NWIFC 2015[5], WAC 173-501[6]

RMAP Implementation Complete in the Upper Nooksack Watershed

The state's Road Maintenance and Abandonment Plan (RMAP) has resulted in the repair or abandonment of 1,426 miles of private and state-owned forest roads in the upper Nooksack River watershed. The RMAP has also resulted in the repair or removal of 132 culverts on private and state-owned forest roads.[1] Work on Sierra Pacific-owned lands that was uncompleted at the last update of this report in 2020 has now been completed. This accomplishment is important because no alteration of the human landscape has a greater and more far-reaching effect on aquatic habitat than roads.

State and Private Forestlands Where RMAP Applies



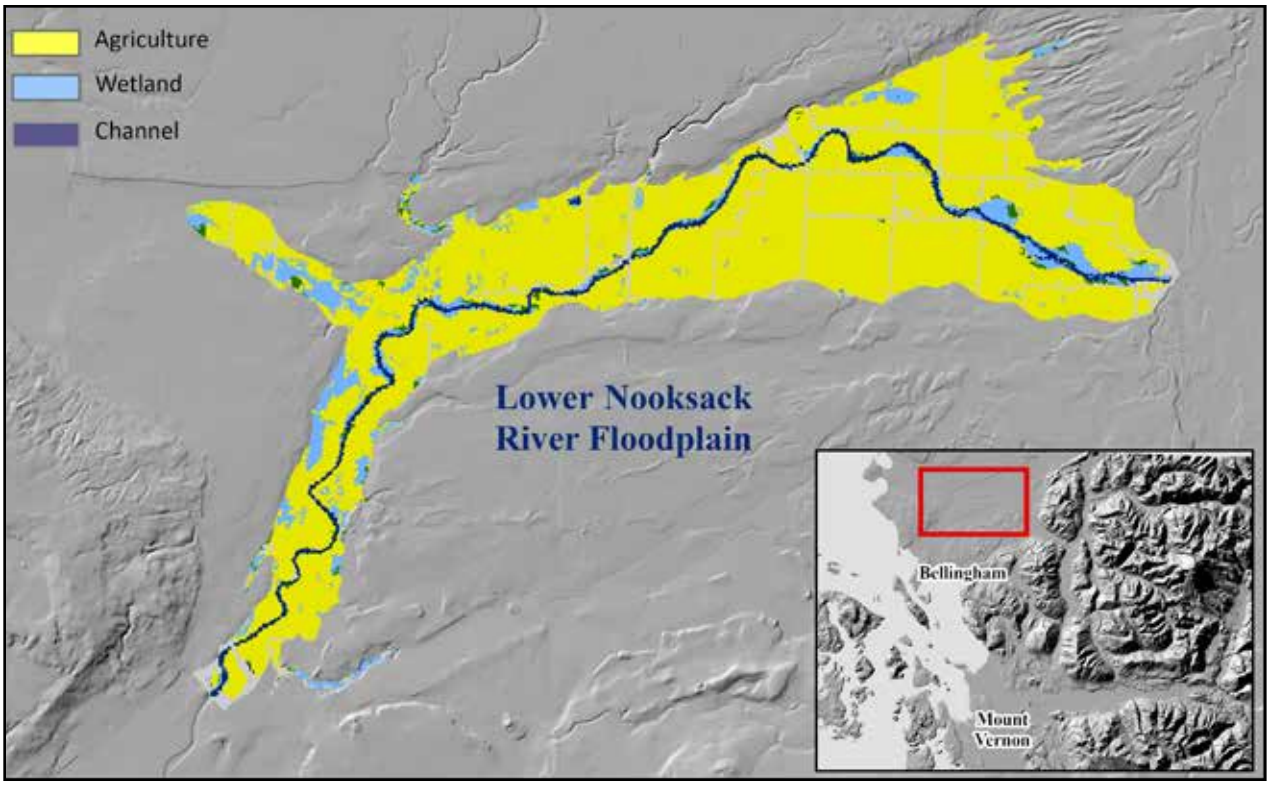
Most forest roads in the upper Nooksack River watershed are on private industrial and state-managed forestlands. All these roads fall under the RMAP mandate. It is expected that the completed RMAP road repairs and decommissioning will contribute to improved water quality in the upper Nooksack River watershed. Considering the role improved water quality plays in Chinook salmon habitat, the status of RMAP being complete in the upper Nooksack watershed is good news for salmon recovery.

Small forest landowners were not immediately required to develop RMAPs, and instead are expected to bring their roads up to standard and repair fish-passage barriers as the roads are used for forest practices activities. Since no plans are in place, there is a great deal of uncertainty about the condition of these roads.

Map Data Sources: Skagit Co. 2010[2], Whatcom Co. 2011b[3], WADNR 2014d[4], WADNR 2014c[5]

Wetland Restoration Still Needed on Agricultural Lands in the Lower Nooksack River Floodplain

There has been little change in floodplain wetland area since the late 1990s. There was an estimated 1.5% loss of wetland area in the floodplain between 1996 and 2006, no further loss between 2006 and 2011, and a 1.5% gain of wetland area between 2011 and 2016.[1,2] The fluctuation over the last 20 years is thought to be within the range of error of the data, and there has been overall no change in wetland area since 1996.



Agricultural land has been the dominant land use in the lower mainstem Nooksack River floodplain since the 1930s.

The Water Resource Inventory Area 1 (WRIA 1) Salmonid Recovery Plan recommends a return to historical wetland conditions in the lower mainstem floodplain of the Nooksack River.[3] Based on the most recent comprehensive wetland study of the lower mainstem floodplain of the Nooksack River, in 1880 there were 4,754 acres of wetlands and by 1998 wetlands had been reduced to less than 10% of that historical area.[4] The lower mainstem historically meandered through a complex of wetlands and beaver dams. Now, the lower mainstem is a single threaded river through cropland (e.g., raspberries, blueberries, silage corn, potatoes), hay fields and small municipalities.

The lower mainstem floodplain has suffered a great loss of habitat area and function from historical conditions, and the losses have been especially costly for rearing juvenile Chinook salmon. In addition, productivity of pre-spawning migrant, over-winter rearing and over-summer rearing life stages of Chinook are all limited by the loss of historic off-channel wetland habitat in the lower mainstem.[5] Restoration of floodplain wetland conditions in the lower mainstem toward historic conditions remains a long-term goal of the WRIA 1 Salmonid Recovery Plan.[6,7]

Anderson 2015

The Nooksack River flows through the agricultural landscape of the lower mainstem floodplain.[10]

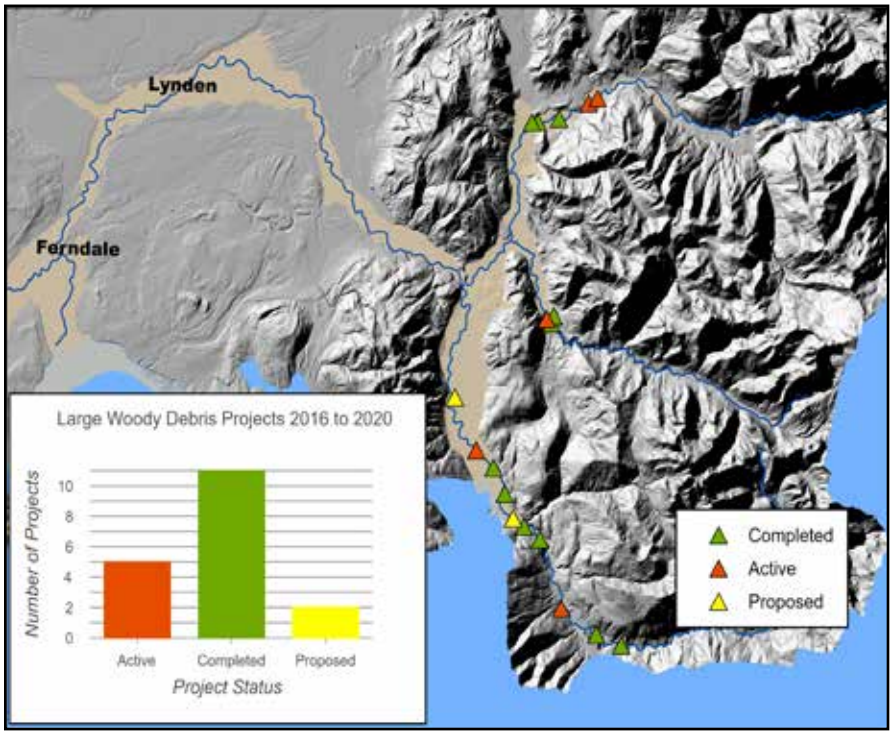
Map Data Sources: SSHIAP 2004,[8] NOAA 2019[9]

Engineered Logjams and Long-term Commitment to Healthy Riparian Forests Key to Restoring Wood to the Nooksack River

Since 2001, Lummi Nation and the Nooksack Indian Tribe have constructed 758 engineered logjams (ELJs) and habitat structures in the Nooksack River watershed through the completion of 29 projects. Four more projects are in a conceptual design phase, six are in a preliminary design phase and four are actively progressing.

According to the Water Resource Inventory Area 1 (WRIA 1) Salmonid Recovery Plan, instream wood has a role in channel stability, habitat diversity, and overall habitat quantity and quality.[3] The combination of land-clearing, riparian forest logging, splash damming and instream wood removal for navigation have combined to leave the Nooksack River with a relatively low abundance of instream wood. As a short-term strategy, engineered logjams are being consistently funded, placed and monitored throughout the North Fork, Middle Fork and South Fork of the Nooksack River. This has resulted in increasing densities of instream wood since 2005, and efforts continue.[4] As a long-term strategy, riparian restoration has to occur to provide a sustainable source of large woody debris in the future.

The lower mainstem Nooksack River continues to be managed for flood control and navigation. There is little to no accumulation of instream wood between Lynden, WA, and the delta of the river. The upper mainstem and the forks have a relative abundance of instream wood, but are still very low compared to historic levels. The relatively higher levels of wood instream in the upper watershed are in part attributable to the recent engineering and construction of logjams. Since riparian forests are still dominated by young, small-diameter trees, active logjam construction remains necessary to improve instream wood abundances in the Nooksack River system.[5]



Since 2016, 13 engineered logjam projects have been proposed, begun or completed to increase instream wood densities in the North, Middle and South forks of the Nooksack River system.

RCO 2020

Until riparian forests are mature enough to deliver key logjam-anchoring pieces of instream wood to the Nooksack River, engineered logjams remain essential to salmon habitat restoration throughout the system.

Map Data Sources: NNR 2015[6] SSHIAP 2004[7], WAECY 2011a[8], HWS 2020[9], RCO 2020[10]

European Green Crab Inside the Salish Sea

The invasive European green crab (EGC), Carcinus maenas*, threatens to disrupt nearshore habitats and balanced ecosystems wherever it is introduced. The Lummi Nation has considerable tidelands and marshlands on its reservation, providing ample suitable habitat for the invasive species. In the fall of 2019, EGC were detected in Lummi Bay for the first time. Since then, Lummi Natural Resources has responded nonstop to this environmental threat.*

Lummi Natural Resources

Lummi Natural Resources staff deploy and retrieve hundreds of traps each year in the effort to control the invasive European green crab population in Lummi Sea Pond and beyond.

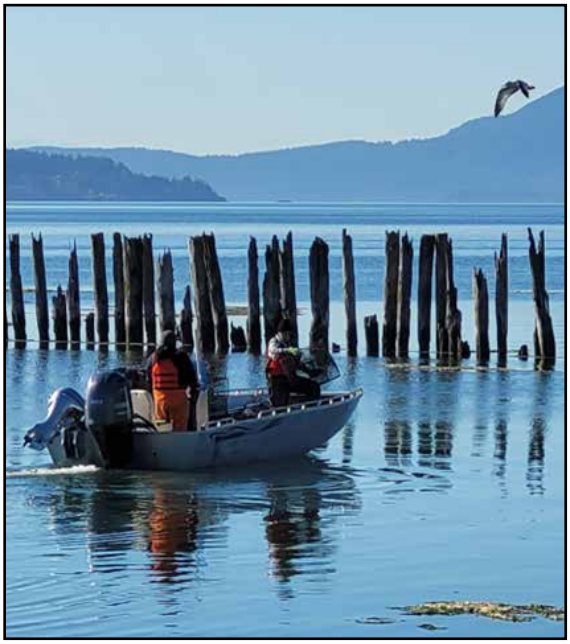
In late September 2019, the discovery of live European Green Crab (EGC) in Drayton Harbor prompted Lummi Natural Resources (LNR) to initiate a rapid trapping response on the tidelands of the Lummi Reservation. By the end of fall 2019, a total of 64 invasive EGC—comprising 32 females and 32 males—were captured after 180 trap nights in Lummi Bay. This marked the beginning of LNR's ongoing struggle with EGC.

In 2020, the situation escalated, with 2,600 EGC captured. In response, the Lummi Indian Business Council (LIBC) enacted RESOLUTION 2020-032, declaring a serious environmental threat and authorizing a response by the LNR. The following year, 2021, saw a significant increase in the EGC population in Lummi Bay, with LNR and its partners capturing 86,000 EGC. In response to this crisis, LIBC issued RESOLUTION 2021-158, declaring a European Green Crab disaster and establishing a European Green Crab Task Force. This led to the creation of the Aquatic Invasive Species Division (AIS) within LNR, which successfully removed 80,000 EGC from the area. As a result, a trapping threshold was established, which was causing measurable harm to the EGC population in Lummi Bay.

In 2023, AIS efforts combined with a harsh winter resulted in a recruitment failure, leading to a drop in EGC captures to 6,000, despite similar trapping pressure. In 2024, the number of EGC removed decreased to 2,700, remaining just above the capture numbers from 2021.

While these numbers seem promising, the 2024 EGC trapping season observed a strong emergence of young-of-year crabs in October, marking the first successful recruitment since 2021. This development, combined with a balanced male-to-female ratio, indicates a potential population rebound. The number of EGC captured in 2025 through July was already double that of those caught during the same period in 2024. Lummi clam diggers also have reported the first verified sightings of EGC in Portage Bay.

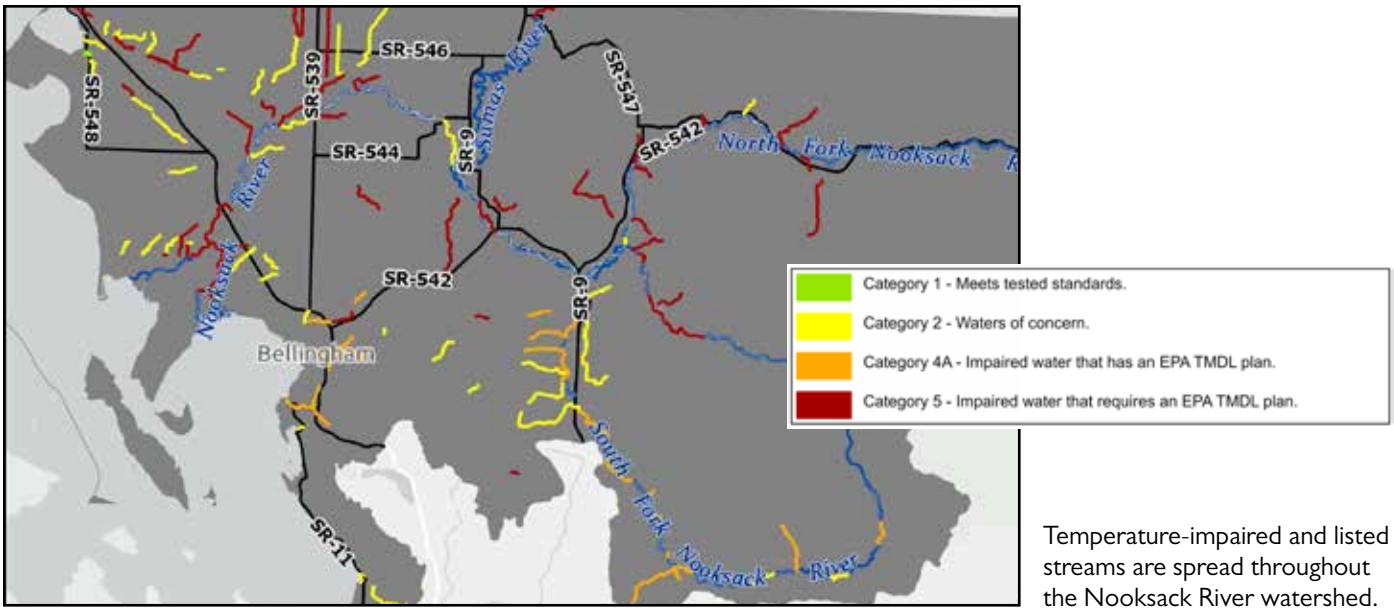
These findings raise several concerns for the LNR. If a population like seen in Lummi Bay becomes established in the Salish Sea, it could lead to further expansion of EGC into nearby marine areas. This could adversely affect juvenile clam and oyster populations, cause significant habitat destruction through excessive excavation or burrowing along marshy banks, and uproot eelgrass beds. Additionally, EGC consume and compete with native species for resources in the intertidal zone. For instance, young Dungeness crabs, which are culturally and economically important to the Lummi people, are among the top prey items for EGC. This means that Dungeness crabs will now face competition with EGC during their early life stages, as both species rely on similar resources in nearshore estuarine habitats.



Lummi Natural Resources

Climate Change is Resulting in Rising Stream Temperatures and Threatening Salmon Habitat

The 2018 Washington Department of Ecology Water Quality Assessment and listings report to the U.S. EPA is the first update since 2012. Based on the 2018 assessment, stream temperature pollution listings increased in the Nooksack River watershed. Rising stream temperatures threaten the health of salmon in the river system.



Temperature-impaired and listed streams are spread throughout the Nooksack River watershed.

The effects of climate change are making themselves apparent in the South Fork Nooksack River, where elevated summer water temperatures are creating adverse conditions for native juvenile and adult spring Chinook salmon.

For salmon, water temperature is the single most important environmental variable because of its far-reaching and profound impacts. These impacts occur both indirectly for factors such as dissolved oxygen and water chemistry, and directly. For example, water temperature profoundly impacts the rates at which salmon eggs and fry develop. The warmer the water, the faster salmon eggs develop and hatch, and the fry emerge from their nests, called redds, in the gravel along the river's bottom. This is a serious problem.

In the early part of this century, we observed that the fry of the South Fork Nooksack spring Chinook salmon population were emerging from their redds months before they would normally be found swimming in the river. Investigation into possible causes for this premature timing of emergence led to the conclusion that elevated water temperatures were, and remain, the cause. The result of premature emergence is decreased survival caused by exposure to adverse environmental conditions. Principle among these is when visibility is poor, food is scarce, and fry become inefficient at converting energy for growth.

At the other end of their freshwater lifecycle, returning adult South Fork Nooksack spring Chinook face high rates of pre-spawning mortality due to the effects of elevated water temperatures. These Chinook return to the South Fork in the spring and summer. Once there, they seek refuge in cool, quiet pools where they remain in near hibernation, waiting for their gonads to ripen for spawning in the late summer and early fall. Like other salmon, these fish stop feeding once they return to fresh water. There, they live off their stored energy reserves. In addition, their autoimmune system shuts down to conserve energy needed for the rigors of spawning.

Elevated water temperatures work against these adult Chinook in two ways. First, warmer water increases their base metabolic rate, causing them to exhaust their energy reserves before they can spawn. Second, warmer water increases the prevalence of thermally modulated, stress-induced disease from organisms such as the fungus *saprolegnia* and the bacterium *columnaris*. These organisms, and a host of other pathogens, are increasingly active at warmer temperatures. This is bad news for salmon with little to no autoimmune system to fight off infections. The net effect of these conditions driven by climate change are the die-offs of adult spring Chinook salmon that we are now witnessing.

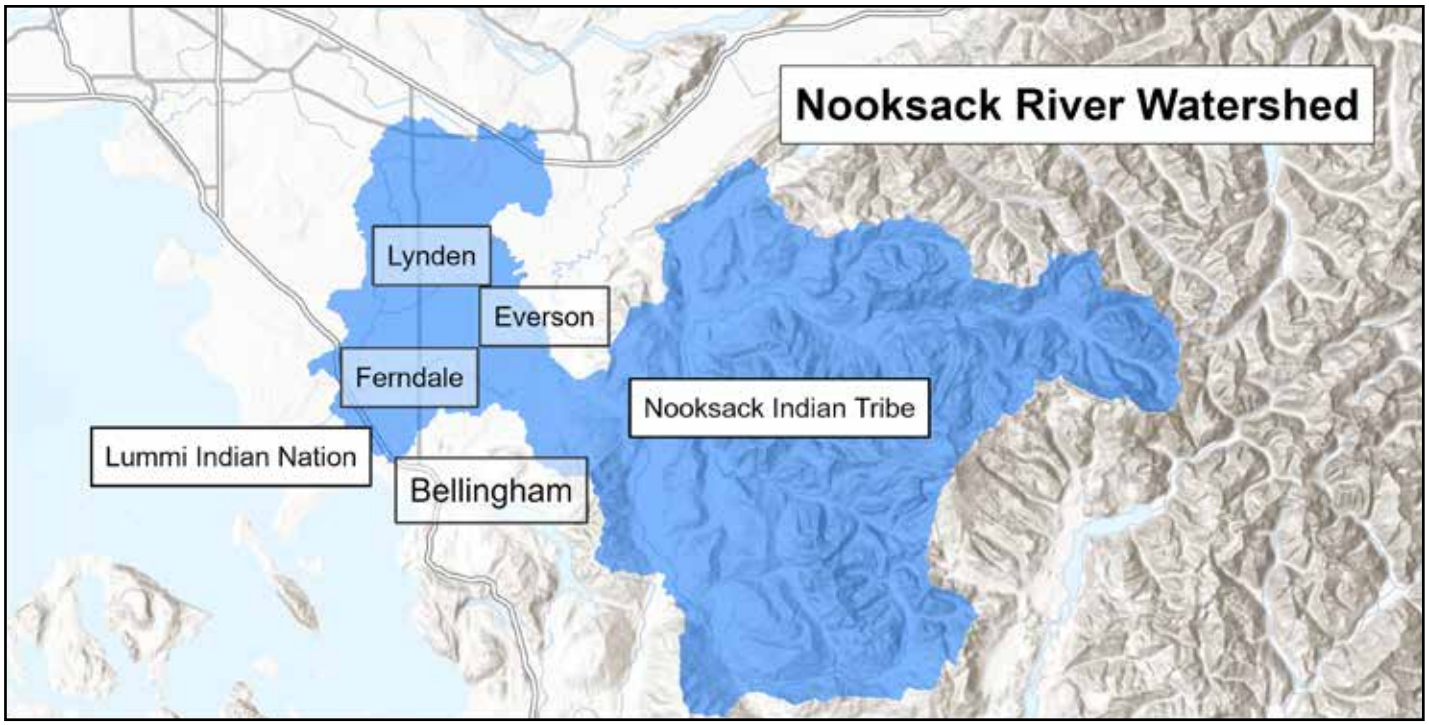
As if these climate change-driven issues weren't enough cause for concern, there are additional cumulative impacts from other anthropogenic changes to the environment. These include impacts to juvenile salmon survival from off-channel and secondary channel refuge habitat losses caused by diking and impacts across salmon's freshwater life histories from additional warming of water due to shade loss following deforestation.

Taken as a whole, we've created a near-perfect scenario for reducing, if not eventually eliminating, the potential for of the freshwater salmon habitat in the Nooksack watershed to continue producing our native salmon runs.

Map Data Sources: WAECY 2022[1]

Legal Adjudication is Necessary to Secure Water Rights in the Nooksack River Basin

Over 35 years of efforts to maintain and improve water flows in the Nooksack River basin have proven unsuccessful. The only measure left to use is adjudication, the legal determination of water rights for every water user in the basin.



Map Data Source: Whatcom County

Through the Treaty of Point Elliott, tribes in the greater Puget Sound region ceded title to much of their ancestral homelands while reserving the right to hunt, fish and gather throughout their traditional territories as they had since time immemorial. Court decisions have affirmed that treaty rights include sufficient water to support those harvests, which includes rights to instream flows to support salmon. These water rights have a priority date of time immemorial and are therefore the most senior water rights in a given basin.

How do we make sure that instream flows support salmon in the Nooksack basin? As demonstrated in the Yakima basin and elsewhere in the western United States, legal adjudications bring all water users in a watershed together to quantify and confirm their water right. An adjudication is an inventory of who has a right to how much water, where it can be used and when it can be used. The process legally and permanently determines everyone's water rights, providing the certainty that is so important for fishing, business (including agriculture) and people.

Paul Cline

A net is set during a tribal fishery for Nooksack River spring Chinook.

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Climate Change is Resulting in Rising Stream Temperatures and Threatening Salmon Habitat

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2025 State of Our Watersheds Report
Northwest Olympic Peninsula

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ʔuc̓ a·ʔaka·ɬ ʔiš ʔučaʔak̓ ʷidica·ɬ.

Our places from the ocean to the land and all living things there, they are important to us—the tiny bug to the enormous whale. Give thanks for them, take care of them and they will take care of you.[1]

– Makah Environmental Teachings

- - - Area of Concern

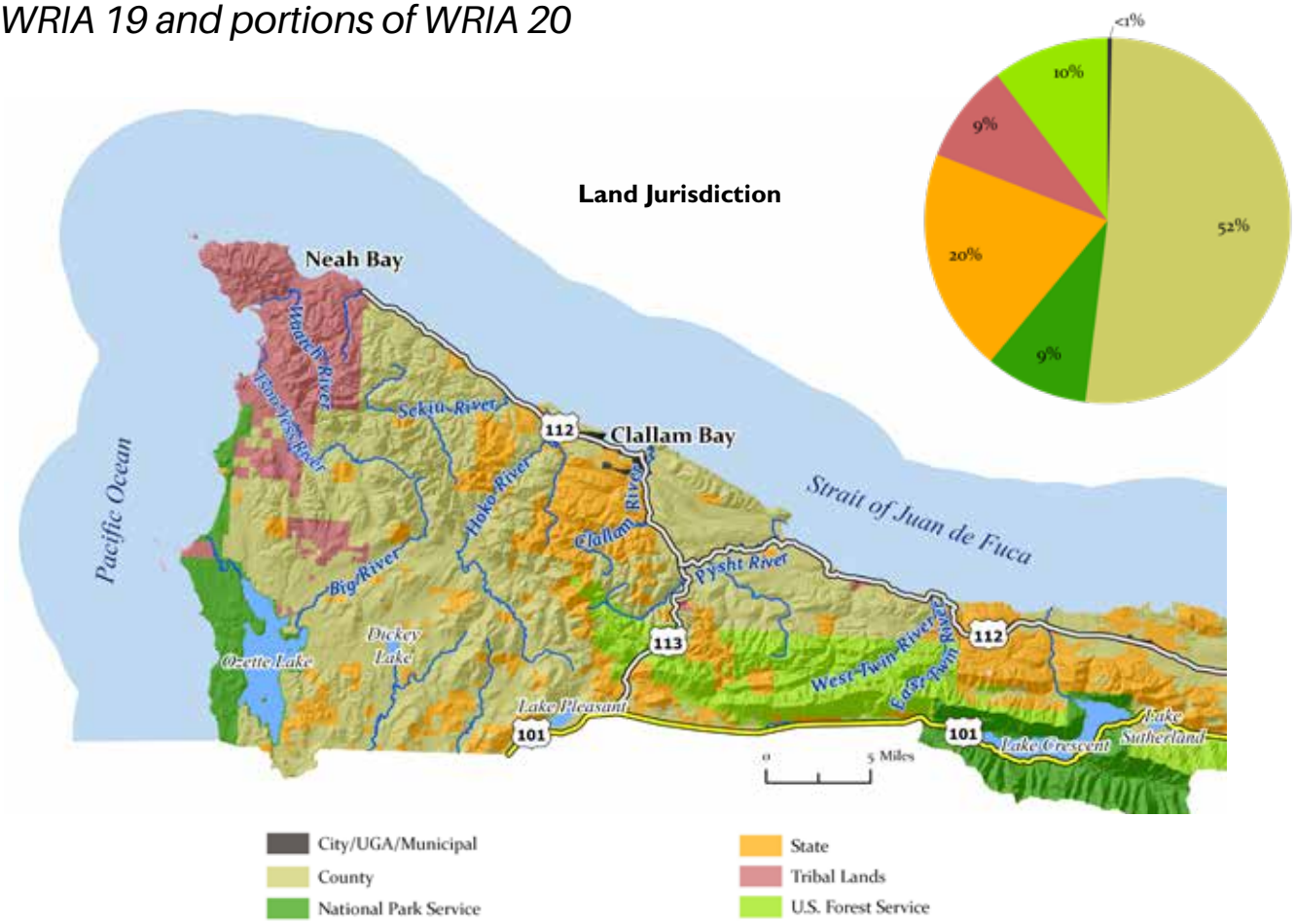
—— Area of Interest

Makah Tribe

Located on the northwest tip of the lower 48 states, the Makah Tribe always have utilized the bounty of the sea and the forests. From seals to salmon to whales, the sea was—and still is—a large part of the livelihood of the Makah. Within their territory, the Makah had many summer and permanent villages. The five permanent villages—the Wa'atch, Tsoo-Yess, Diaht, Ozette and Ba'adah—are located on the shoreline. This territory has been home to the Makahs for thousands of years. The Makah are highly skilled mariners, coming from a long line of ancestors who used sophisticated navigational and maritime skills to travel the rough waters of the Pacific Ocean and the Strait of Juan de Fuca to hunt whales and seals as well as travel. In 1855, the Makah, represented by 42 tribal dignitaries, negotiated and signed the Treaty of Neah Bay with the United States, retaining their inherent right to whale, fish, hunt and gather. The Makah Treaty of Neah Bay was the only treaty in the state that was associated with a single tribe. Tribal headquarters are located in Neah Bay, Wash.

Makah Tribe

WRIA 19 and portions of WRIA 20



Located on the northwest corner of the Olympic Peninsula, the Makah's Area of Interest includes many independent streams that flow from the foothills of the northern Olympic Mountains and enter the shores of the Strait of Juan de Fuca and the Pacific Ocean. The Makah Tribe is a predominately ocean-fishing tribe, therefore most of the tribe's fishing usual and accustomed areas are in the marine setting extending as far east as Tongue Point and as far west as 40 miles offshore. The tribe also historically hunted whales and other non-fish species as far out as 100 miles offshore.

However as a tribe that fishes pre-terminal fisheries, the health of all species that occur or migrate through Makah Territory are of concern. For hunting, gathering and cultural resources, the tribe relies upon a significant portion of the Olympic Peninsula landscape and has a vested interest in protection of these areas and their treaty reserved resources. The tribe's Area of Concern also extends seaward to the international boundary with Canada, and all of the exclusive economic zone to the mouth of the Columbia River, as many of the resources that migrate to Makah territory have a larger web of impact.

The largest watersheds in the Area of Interest are the Sekiu, Hoko, Clallam, Pysht, Tsoo-Yess, Ozette and Lyre rivers. Weathered sedimentary rock, sandstones and siltstones of the Twin River Formation have occurred in the watersheds west of the Twin Rivers, including the Pysht River. Streams east of the Pysht have a mixed geology, including less erodible basalt from the Crescent Formation in headwaters, glacial outwash in the lower plain, and siltstones of the Twin River Formation to the west. The variable geology of this region results in stream channels that are highly responsive to changes in flow and sediment inputs.

Chinook, Coho, Chum, Sockeye, cutthroat and winter steelhead reside in the area's watersheds, with the Lake Ozette Sockeye listed as threatened under the Endangered Species Act.

Traditionally flourishing off the land and sea, the Makah Tribe had villages and fishing camps throughout their traditional territory where they could take advantage of plentiful fish and shellfish resources. With the Stevens Treaties of 1854-55, the tribes agreed to cede their lands to the U.S. government while reserving and protecting their rights to hunt, fish and gather in their traditional territories.

Today, about 11% of the Area of Interest is tribal land, 36% is public land and 53% is private land predominantly owned by timber companies. The Washington Department of Natural Resources has been engaged in the exchange of state trust lands with land held by private timber companies within this area. The Makah Tribe has raised concerns that such exchanges may adversely affect treaty-reserved rights by restricting tribal access to vital resources.

Since the late 1800s, the Strait region has experienced extensive logging, with significant impacts on watershed health and salmon habitat. Although the region remains largely rural, industrial-scale forestry continues to dominate land use across much of the area.

Map Data Sources: DOD 2023[1], SSHIAP 2004[2], WADNR 2024a[3], WADNR 2024b[4], WAECY 2018c[5], WAECY 2021[6], WAECY 2024[7], WADOT 2018[8], WADOT 2023[9], USFWS 2024[10]

Chapter Summary

Located on the northwest corner of the Olympic Peninsula, the Makah Tribe's Area of Interest includes many independent streams that flow from the foothills of the northern Olympic Mountains and enter the shores of the Strait of Juan de Fuca and the Pacific Ocean. The tribe's Area of Concern extends seaward to the international boundary with Canada and all of the exclusive economic zone to the mouth of the Columbia River.

The largest watersheds in the Area of Interest are Ozette, Tsoo-Yess, Sekiu, Hoko, Clallam, Pysht and Lyre rivers. Chinook, Coho, Chum, Sockeye, cutthroat and winter steelhead occur in the area's watersheds, with the Lake Ozette Sockeye listed as threatened under the Endangered Species Act.

Flourishing off the land and sea, the Makah Tribe has villages and fishing camps most often associated with stream mouths where they can take advantage of plentiful fish and shellfish resources.

With the Point No Point and Makah treaties of 1855, the tribes agreed to cede their lands to the United States government while reserving and protecting their rights to hunt, fish and gather in their usual and accustomed areas. The Makah Tribe also explicitly reserved their right to whale and seal within the Treaty of Neah Bay.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable fish returning to Washington waters every year and established the tribes as co-managers of the resource.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Changing Ocean Conditions Continue to Impact Area

The Makah Tribe's Area of Interest has been impacted by changing ocean conditions, including warming oceans, marine heat waves, ocean acidification and hypoxia, harmful algal blooms, increasing tidal stages and storm surges, and invasive European green crabs.

Fish Barrier Culverts

As of December 2024, there were a total of 293 fish barrier culverts in the Makah Area of Interest. Of these, the state owns 111 (or 38%), while private and county ownership accounts for 100 (34 %) and 65 (22%) culverts respectively. Small landowners and the county would need assistance in terms of funds and partnerships to repair these culverts before new ones emerge.

Water Quality Conditions Decrease

There were 120 polluted water listings in 2018 compared to the 89 listings in 2012 for the most common pollutants—water temperature, dissolved oxygen and pH, representing a 25.8% increase. Water temperature remains the most common pollutant with 74 listings, followed by dissolved oxygen with 30. The stream length impaired by water temperature increased from 107.9 miles in 2012 to 113.5 miles in 2018 (a 4.9 % increase), while the length impaired for dissolved oxygen increased from 22.3 miles in 2012 to 48.1 miles in 2018 (a 53.6 % increase).

Hoko River Streamflow Changes

Peak flow values have increased in winter while flows in summer have decreased at precisely the time when streamflow is needed the most and when water temperatures are at their highest. Major storm events are becoming more frequent and changes in the distribution of precipitation have become more common. Four of the highest peak flow values and three of the lowest peak flow values have been recorded in the last 25 years. These changes alter the availability and type of instream fish habitat.

Lake Ozette Sockeye Status is Poor

Because they were in danger of going extinct, the Lake Ozette Sockeye population was listed as threatened under the Endangered Species Act in 1999. This listing status has been upheld following multiple 5-year reviews. Results from the 2022 Lake Ozette Sockeye Status Review shows the population is still unstable with the number of adult spawners ranging from 439 to 12,829 and none of the four population viability criteria being met.

European Green Crab Invasion

The European green crab (*Carcinus maenas*) has continued to expand its range and abundance within the Makah Area of Interest. More than 45,000 crabs were caught between 2020 and 2024, totaling more than 47,600 green crabs removed from Makah waterways since first detecting them in 2017. While the majority of catch continues to be in the coastal estuaries, new hotspots have been identified in the rocky intertidal habitats within Makah Bay and near the Ozette Reservation. In 2023, green crabs were detected for the first time inside of Neah Bay. Additional monitoring and research show both promise and alarm for the future of managing this invasive species.

Restoration of Neah Bay

The Makah Tribe has devoted significant efforts to protecting and improving Neah Bay, including building the Makah Marina and Port of Neah Bay facilities (1995-1997) and replacing the commercial fishing dock (2014), along with removing derelict legacy marine debris including dilapidated marine structures, abandoned and derelict vessels (ADV) and sunken vessels (2024). Future work includes removing the remaining ADV and the derelict T-dock, as well as restoring benthic substrate that has been covered for decades and exposed by the 2024 derelict structure removals.

Conclusion

In the Makah's Area of Interest, there has been an improvement in habitat conditions with the continued growth of forest cover but other habitat indicators are still declining. Over the past five years, there has been a decline in habitat conditions with the identification of barrier culverts, continued increase in peak flows and decrease in low flows and the decline in water quality conditions. At the same time, there has been an increase in the population of the European green crab, an invasive species that will threaten local fish and shellfish populations.

Although restoration is occurring, not enough is being done to keep up with the impacts of a growing population and their resource demands from the watershed. People have to be held accountable to protecting, conserving and improving fish habitat in their land use decisions, and federal, state and local governments all have a role in that. Implementation includes education and voluntary action but it also needs to include enforcement when those laws are broken. The future of tribal treaty rights of the Makah people depends on it.

Recovery Efforts Show Signs of Improvement But Still Lagging in Key Indicators

A review of key environmental indicators for the Makah area shows a degradation of water quality, identification of barrier culverts and climate impacts on low and peak flows. In general, there is a need to increase staff at all levels (e.g., federal, state, tribal and county) to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trends for these key environmental indicators shows improvements from restoration efforts but a steady loss for others in habitat status:

Tribal Indicator	Status	Habitat Trend
Ocean Conditions	The Makah Tribe's Area of Interest has been impacted by changing ocean conditions, including warming oceans, marine heat waves, ocean acidification and hypoxia, harmful algal blooms and invasive European green crabs.	**Concerns**
Barrier Culverts	As of December 2024, there were a total of 293 fish barrier culverts in the Makah Area of Interest. Of these, the state owns 111 (or 38%), while private and county ownership accounts for 100 (34 %) and 65 (22%) culverts, respectively. Small landowners and the county would need assistance in terms of funds and partnerships to repair these culverts before new ones emerge.	**Same**
Water Quality	There were 120 polluted water listings in 2018 compared to the 89 listings in 2012 for the most common pollutants—water temperature, dissolved oxygen and pH, representing a 25.8% increase. Water temperature remains the most common pollutant with 74 listings, followed by dissolved oxygen with 30. The stream length impaired by water temperature increased from 107.9 miles in 2012 to 113.5 miles in 2018 (a 4.9 % increase), while the length impaired for dissolved oxygen increased from 22.3 miles in 2012 to 48.1 miles in 2018 (a 53.6 % increase).	**Declining**
Streamflows	Peak flow values have increased in winter while flows in summer have decreased at precisely the time when streamflow is needed the most and when water temperatures are at their highest. Major storm events are becoming more frequent and changes in the distribution of precipitation have become more common. Four of the highest peak flow values and three of the lowest peak flow values have been recorded in the last 25 years.	**Declining**
Lake Ozette Sockeye	The Lake Ozette Sockeye population was listed as threatened under the Endangered Species Act in 1999 and the listing status has been upheld following multiple five-year reviews. Results from the 2022 Lake Ozette Sockeye status review shows the population is still unstable with the number of adult spawners ranging from 439 to 12,829 and none of the four population viability criteria being met.	**Concerns**
Invasive Species - European Green Crab	The European green crab (*Carcinus maenas*) has continued to expand its range and abundance within the Makah Area of Interest. More than 45,000 crabs were caught between 2020 and 2024, totaling more than 47,600 green crabs removed from Makah waterways since first detecting them in 2017. In 2023, green crabs were detected for the first time inside of Neah Bay.	**Declining**
Restoration	The Makah Tribe has devoted significant efforts to protecting and improving Neah Bay, including building the Makah Marina and Port of Neah Bay facilities (1995-1997) and replacing the commercial fishing dock (2014), along with removing derelict legacy marine debris including dilapidated marine structures, abandoned and derelict vessels (ADV) and sunken vessels (2024). Future work will be to remove the remaining ADV and the derelict T-dock, as well as restoring benthic substrate that has been covered for decades and exposed by the 2024 derelict structure removals.	**Improving**

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

When the Makah Tribe negotiated the Treaty of Neah Bay, our ancestors understood that we were tied to the land and sea and that the resources that we rely upon are necessary for our survival, both physically and spiritually. In the last 170 years, we have had to witness and battle against systematic efforts to not only destroy and change who we are as a people, but also to destroy the resources that we rely upon, both directly and indirectly. The Makah Tribe will never concede to that battle. Even today, we have to protect ourselves from efforts to minimize and diminish tribal fishing, hunting and gathering rights and resources.

We are a tribe that understands the need to manage for multiple uses. As one of the most remote tribes in Washington, majority of our economy is derived from natural resources and we understand the delicate sustainable thresholds and relationships between utilization and conservation. We are taught that everything is connected and that this landscape will provide for us, as long as we take care of it.

When we speak upon an issue as co-managers, it not only represents the concerns on behalf of the tribe, but on behalf of the resource as a whole. Thus, the actions we take as co-managers not only benefits the needs of the tribe but also others who rely upon the resource. The conversation and approach to sustainable management has to include adequate consideration of cumulative impacts.

When we look forward to not only what the future holds for us, but for how we should proceed with sustainable management, it is important to acknowledge that nature is resilient and adaptable. But the strength of that resiliency is a reflection of how much existing stress the resource is currently under. A condition representative of not only the current pressures but also the legacy impacts from which it is still healing.

Much of the Makah traditional territory has not succumbed to significant land conversion and urbanization, a condition that many other tribes have had to deal with. However, that does not mean that the issues that we face are any less severe. The legacy of managing solely for single economic goals, and not true ecosystem-based management, has plagued our territory significantly. In fact, many would argue that the legacy impacts of the historic land management regime in our territory has had the equivalent impact as urbanization, however those impacts are not obvious to the open eye.

The Makah traditional territory has provided for us since time immemorial but we fear for the future of those resources. It has become apparent that the cumulative impacts of current management, in addition to legacy impacts, has created a situation that jeopardizes the resiliency of not only our resources and our natural resource economies, but also our treaty rights. The cumulative impacts include depletion and extirpation (localized extinction) of salmon stocks, degradation of habitat quality, and policy decisions that destroy habitat and remove the tribe's ability to exercise our rights.

The future will hold some very blunt and hard conversations and decisions in order to truly achieve sustainable management. It is important for policy makers to realize that when tribes fight for their treaty rights, they are fighting for the resource in perpetuity. Where would the state of Washington be if it were not for the tribes and their lengthy and persistent legal effort to address barrier culverts? It would still be blocking the passage of fish unapologetically, detrimental not only to the ability for tribes to harvest, but also for the non-tribal interests. It should not take legal action between co-managers to do what is right.

Relationships are important and impact the success and functionality of working together. Tribes want to be respected and to have their voices heard. Agencies frequently demonstrate a lack of comprehension, which forces tribes to repetitively educate, explain and justify why they should be included and why their opinion is important. Tribal concerns have a legal foundational voice and seat at the table.

In order to understand a tribe, you have to understand their foundation. As a nation, we need to educate and improve our awareness, respect and understanding of what treaties and treaty rights are, why they are important, and the role that tribes, as co-managers, play in resource management. Treaties are foundational documents that helped shape this nation and it is imperative that we don't ignore that. The leadership of agencies need to better understand their obligated trust responsibilities and relationships with tribes, educate their staff and implement policies that demonstrate this. After more than a century of legal battles, ignorance of trust responsibility is no longer tolerated nor forgiven.

The Makah Tribe wants to see the future full of sustainable resource management, working with federal partners and state co-managers. The tribe wants to see the ability to exercise treaty rights, both in the marine and terrestrial areas, in perpetuity. We want to be able to continue to live as our ancestors have since time immemorial. We want to see our natural resource economy thrive as well. The tribe invests significant resources on natural resource management. We seek to protect, restore and enhance our treaty reserved rights and resources so that future generations also will be able to enjoy them.

The following chapter will contain a brief glimpse into a number of activities that the tribe is engaged in. Many of these projects rely heavily upon partnerships with federal, state and non-profit entities, as well as a heavy reliance on grant funding. It is imperative that there continues to be heavy financial invest into management of our resources in order to achieve our long term, sustainable goals.

Hoko floodplain at Warnick's Field inundated during the 2021 storm.

Changing Ocean Conditions Continue to Impact Area

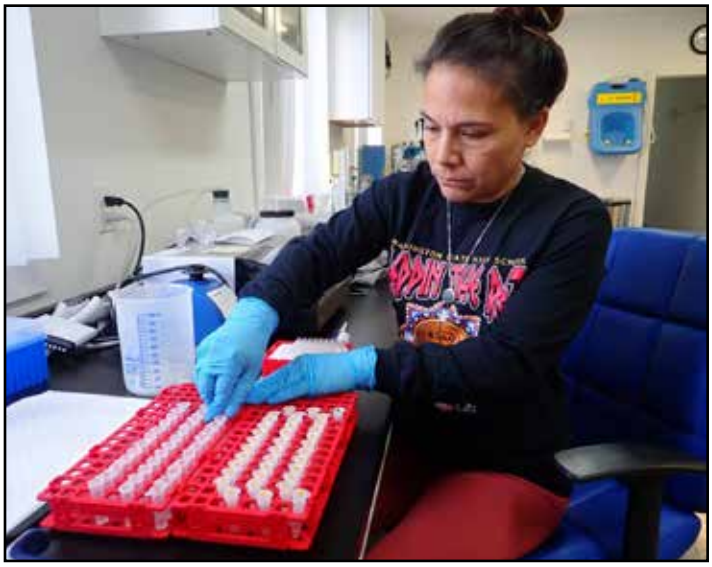
The Makah Tribe's Area of Interest has been impacted by changing ocean conditions, including warming oceans, marine heat waves, ocean acidification and hypoxia, harmful algal blooms and invasive European green crabs.

Ocean conditions in the Makah Area of Interest are influenced by basin-scale processes, and by flow into and out of the Strait of Juan de Fuca, circulation within the Juan de Fuca eddy, and the California Current. During the spring and summer, this area is affected by seasonal upwelling, which brings nutrient-rich waters to the surface, driving high primary and secondary productivity (i.e. phytoplankton and the organisms that feed on them), and the fisheries that depend on it.

Over the past five years, the region has experienced two minor El Niño events (2020-2021 and 2023-2024) and a three-year La Niña (2021-2023). In general, El Niño events are associated with warmer and less productive waters, while La Niña events are associated with cooler and more productive waters. Large marine heatwaves have become an annual feature of the northeast Pacific Ocean, with the second largest on record occurring during the summer of 2023.

Due to the local circulation patterns, these marine heatwaves have had minimal direct impact on the Makah Area of Interest but do impact migratory species that are important to the tribe. Additionally, local circulation patterns can affect the settlement and recruitment of invasive European green crabs.

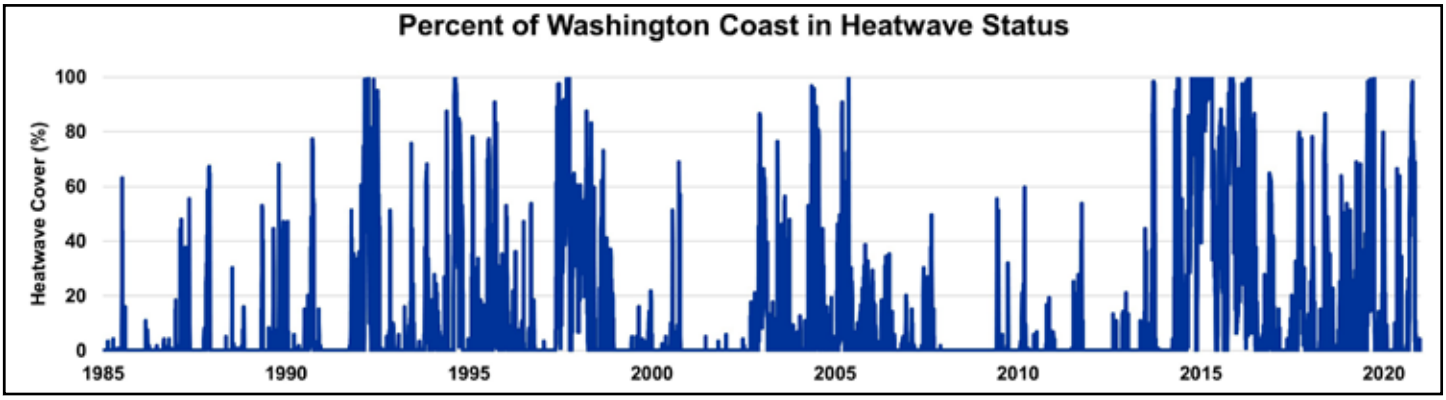
Seasonal hypoxia (low dissolved oxygen) in bottom waters has been increasing in severity and duration, with direct impacts on halibut and other benthic fisheries. This may be a factor behind reports of altered halibut migration patterns within the Makah Area of Interest, prior to their fall/winter spawning migration. Additionally, groundfish species that are normally found near the bottom have been encountered in the midwater (D. Sones, personal communication). Typically associated with lower dissolved oxygen levels, ocean acidification has been worsening and the aragonite saturation depth has been shoaling upwards over the past 17 years. (Aragonite is a calcium carbonate mineral that many shellfish use to form their shells).



Adrianne Akmajian, Makah Tribe

Lora Halttunen, Makah Tribe marine ecology technician, prepares to transfer diluted toxin samples into tubes to be spun in the centrifuge.

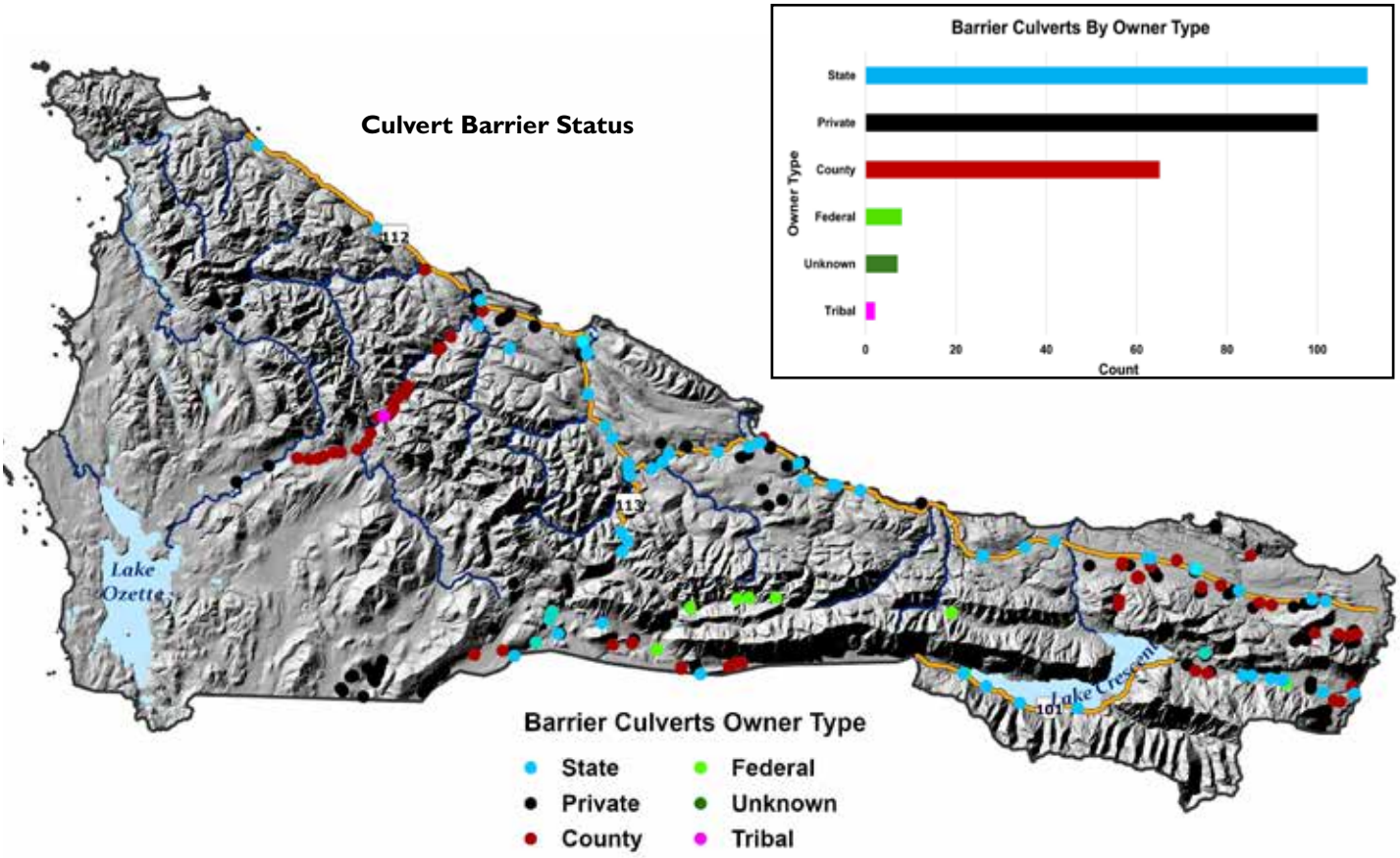
The highly productive waters in this region also drive large harmful algal blooms. Since 2020, there have not been any closures of the shellfish fishery due to domoic acid but the region has closed almost every year due to paralytic shellfish poisoning in both Makah and Neah bays. Changing ocean conditions have brought on changes in the phytoplankton species being seen in the area, including the percentage, frequency and duration of harmful algal species, resulting in longer shellfish closures.



Data Sources: NOAA 2024[2]

Fish Barrier Culverts

As of December 2024, there were a total of 293 fish barrier culverts in the Makah Area of Interest. Of these, the state owns 111 (or 38%), while private and county ownership accounts for 100 (34 %) and 65 (22%) culverts respectively. Small landowners and the county would need assistance in terms of funds and partnerships to repair these culverts before new ones emerge.



Barrier culverts impede movements of migratory fish.[1] Water in the culvert may be moving too fast or be too shallow for fish to go either upstream or downstream. The culvert may be too steep for fish migrating upstream to enter. Debris may collect in the culvert, blocking fish and water passage. As a result, barrier culverts prevent fish from reaching their spawning grounds and the young cannot migrate to sea.

A total of 782 culverts were reported in the 2020 State of Our Watersheds report for the Makah Area of Interest. A vast majority of those culverts were identified in the Road Maintenance and Abandonment Plan (RMAP),[2] a process developed as part of the Forest and Fish Rules in 2001. The schedule for repairs needed to upgrade road systems at stream crossings and address aquatic habitat and fish passage issues under that plan is largely complete. This report uses two other datasets of fish barrier culverts that do not include the RMAP culverts.

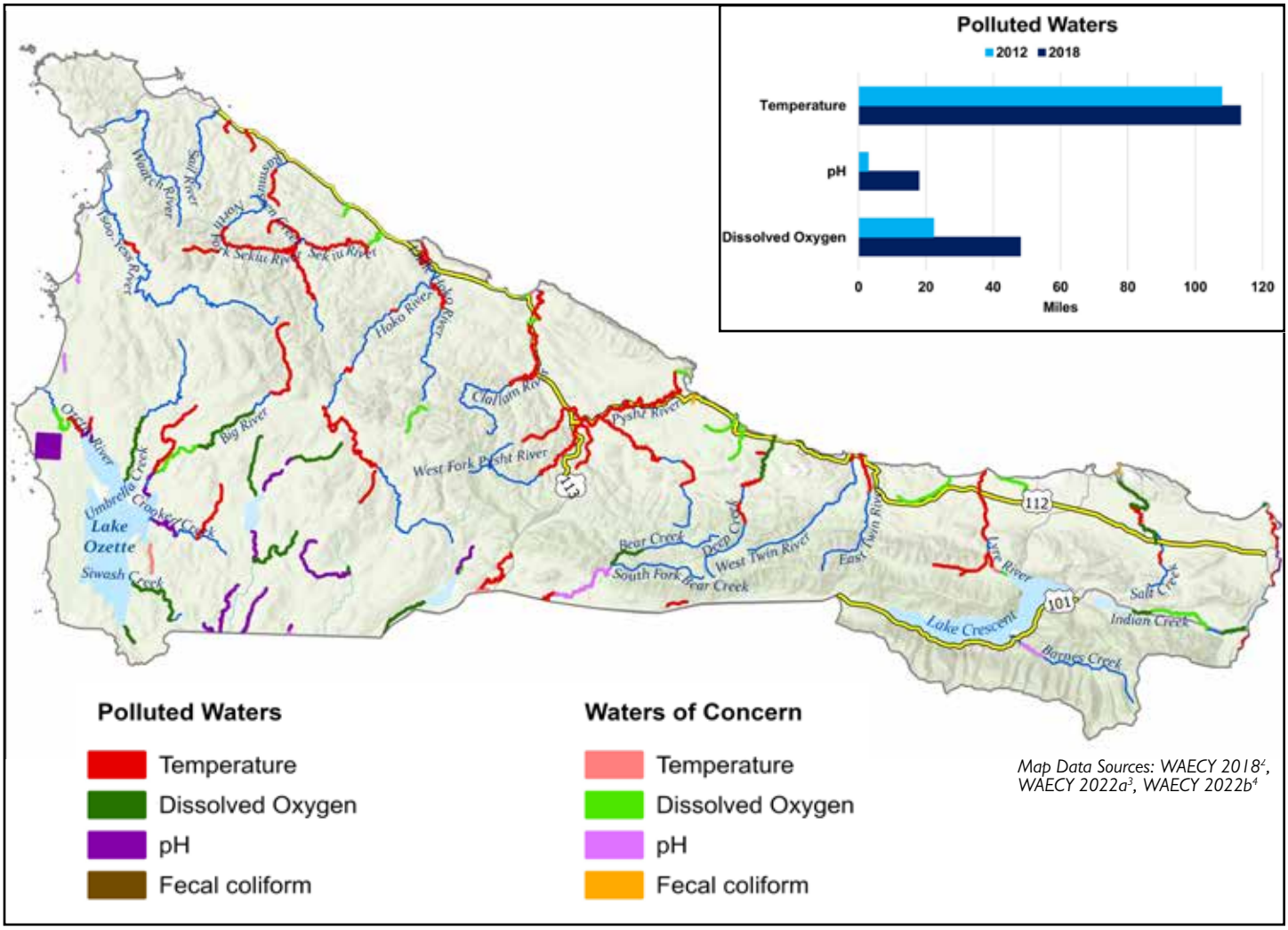
As of December 2024, there were a total of 293 fish barrier culverts in the Makah Area of Interest. Of these, the state owns 111 (or 38%), while private and county ownership accounts for 100 (34 %) and 65 (22%) culverts, respectively. About 6% of barrier culverts fall outside these major ownership categories. Some of the Washington state-owned culverts are in the Culvert Case database, for which the state is under a court injunction to replace those with the worst impacts on fish habitat by 2030.

A significant proportion of barrier culverts are owned by small landowners and the county who lack the resources to tackle this problem. They would need assistance in terms of funds and partnerships to repair these culverts before new ones emerge. Otherwise, these culverts will continue to have a significant impact on fish production.

Map Data Sources: SSHIAP 2004[3], SSHIAP 2024[4], WADFW 2023[5], WADOT 2018[6], WAECY 2018[7]

Water Quality Conditions Decrease

In 2022, EPA approved the 2018 Washington State water quality assessment and 303(d) list of polluted waters. There were 120 polluted water listings in 2018 compared to the 89 listings in 2012 for the most common pollutants—water temperature, dissolved oxygen and pH, representing a 25.8% increase. Water temperature remains the most common pollutant with 74 listings, followed by dissolved oxygen with 30. The stream length impaired by water temperature increased from 107.9 miles in 2012 to 113.5 miles in 2018 (a 4.9 % increase), while the length impaired for dissolved oxygen increased from 22.3 miles in 2012 to 48.1 miles in 2018 (a 53.6 % increase).



Map Data Sources: WAECY 2018[2], WAECY 2022a[3], WAECY 2022b[4]

To thrive, salmonids need waters with cool temperatures, high dissolved oxygen, natural nutrient concentrations and low levels of pollutants.[1] If the values of these factors exceed the desired range for a specific location and time of year, the ability of surface waters to sustain these fish populations is impaired.

Under the Clean Water Act, states are required to monitor and report water pollution on waters that have been assessed. Waters that do not meet water quality standards because they are too polluted are called impaired. They are placed on a list for future actions to reduce the pollution.

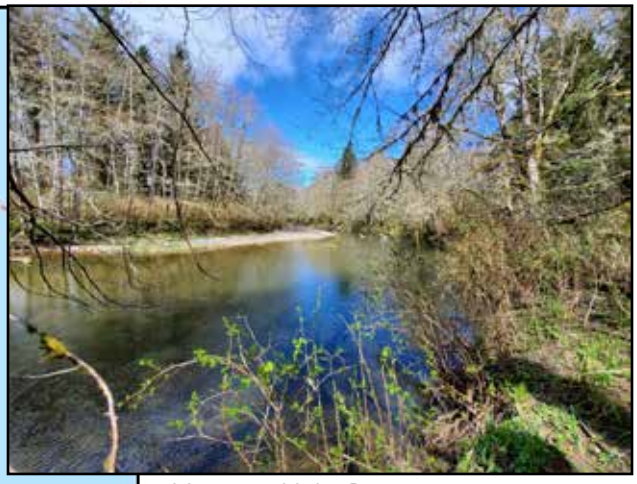
In 2022, the Environmental Protection Agency (EPA) approved the Washington state water quality assessment and 303(d) list of polluted waters. This list was based upon data collected up to 2018. In the Makah Area of Interest, there were 120 polluted water listings in 2018 compared to the 89 listings in 2012 for the most common pollutants—water temperature, dissolved oxygen and pH. This represents a 25.8% increase within that period. Water temperature remains by far the most common pollutant with 74 listings, followed by dissolved oxygen with 30. The stream length impaired by water temperature increased from 107.9 miles in 2012 to 113.5 miles in 2018 (a 4.9 % increase), while the length impaired for dissolved oxygen increased from 22.3 miles in 2012 to 48.1 miles in 2018 (a 53.6 % increase).

An additional 63 waterbodies in the Area of Interest were listed in 2018 (compared to 43 in 2012) as waters of concern for water temperature, dissolved oxygen, pH and bacteria. This represents a 32% increase within that period. These are waterbody segments where there is some evidence of a water quality problem, but not enough to be placed on the list for a pollution control plan.

The Pysht River was the single most polluted waterbody by total length with 11.9 miles impaired by water temperature, dissolved oxygen and pH. The Big River, Lake Creek and Hoko River have impaired segment lengths 10.8, 9.2, and 8.3 miles respectively.

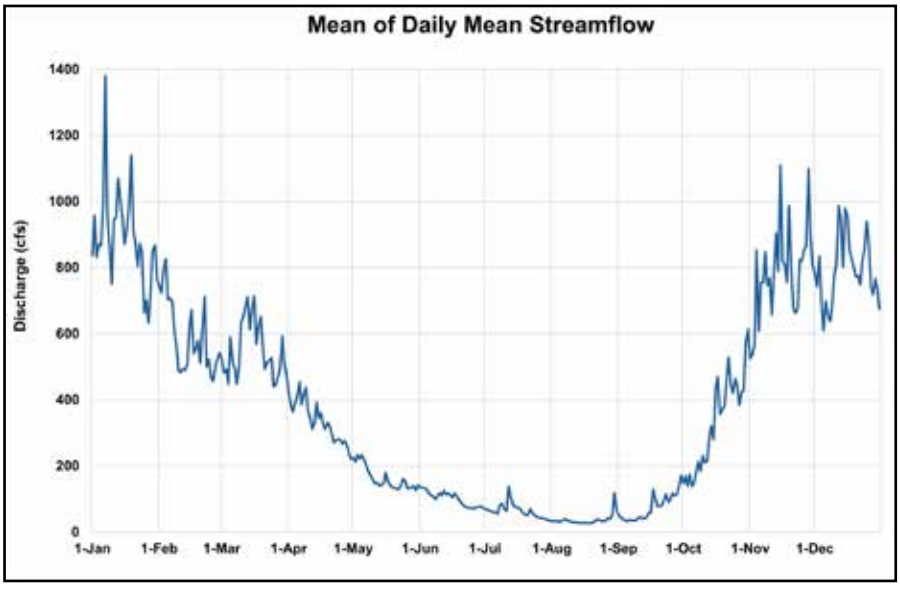
Hoko River Streamflow Changes

Peak flow values have increased in winter while flows in summer have decreased at precisely the time when streamflow is needed the most and when water temperatures are at their highest. Major storm events are becoming more frequent and changes in the distribution of precipitation have become more common. Four of the highest peak flow values and three of the lowest peak flow values have been recorded in the last 25 years. These changes alter the availability and type of instream fish habitat.



Mainstem Hoko River.

Makah Tribe



Changes in streamflow are critical to salmonid survival and production because they result in changes to water quality and quantity and impact salmon habitat and nutrient availability.[1] Streamflow data has been collected for the Hoko River near Sekiu by the United States Geologic Survey (USGS) from 1963 to date, although there were gaps during that period. During that period, the mean streamflow for all months was ~393 cfs; whereas the mean flow during summer months (June-September) was ~54 cfs and mean flow during winter months (December-March) was ~716 cfs. The data shows that over time, peak flow values have increased while flows in the summer have decreased at precisely the time when streamflow is needed the most and when water temperatures are at their highest.

The highest streamflows of 19,400 cfs were recorded on December 15, 1999 and November 15, 2021. Four of the highest peak flow values and three of the lowest peak flow values have been recorded in the last 25 years. Major storm events are be-

(Continued on next page)

Map Data Sources: USGS 2024[4], WADOT 2018[5], WAECY 2018[6]

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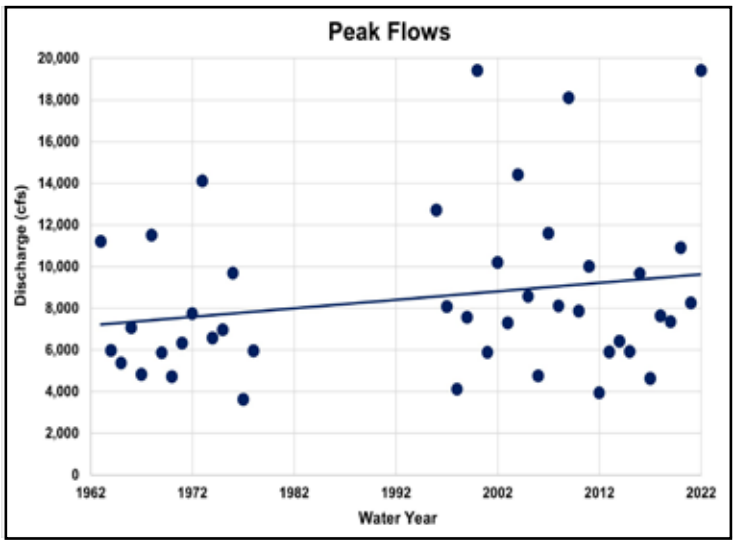
coming more frequent, with two 50- to 100-year storm events in the last 25 years. For instance, the November 15, 2021 storm, the second atmospheric river episode that month, was a set of three atmospheric rivers back-to-back-to-back. Up to 10 inches of rain fell in some areas, resulting in major river flooding and landslides.

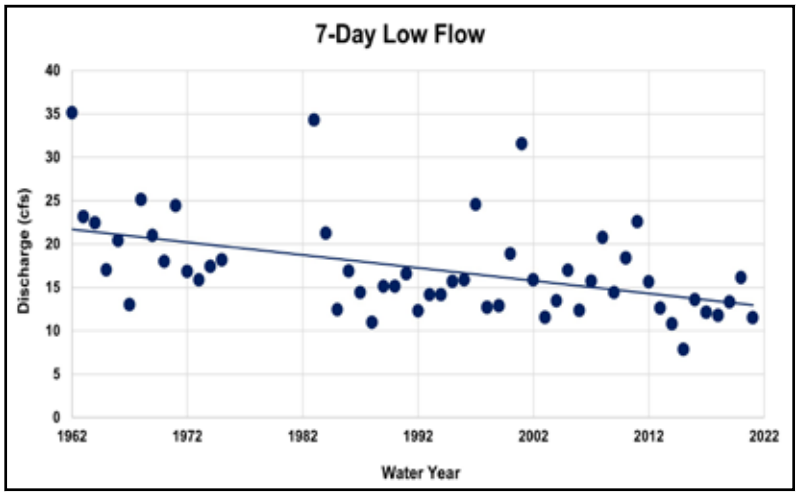
Changes in the distribution of precipitation have become more common since the last State of Our Watersheds Report. Drought caused by much below normal precipitation as well as delayed fall rains negatively impact fish returns and hatcheries. These conditions make the Makah Tribe go into emergency water conservation almost every year.



Makah Tribe

View of Hoko River from the road.

The Hoko, like other rivers in this region, are rain-dominant watersheds. They do not have glacial water storage and are dependent on rainfall patterns, making them susceptible to low water flows in the summer and early winter. However, human factors seem to be contributing to the problems of low and peak flows. These include climate change, water withdrawals for municipal water use, and land-use practices.



Low flows contribute to high water temperatures and limit the spawning distribution of fall Chinook to less stable areas of the mainstem, possibly increasing the likelihood of scouring redds during peak flow events.[2] The timing of these flows can also be a problem for Coho salmon.[3]

Lake Ozette Sockeye Status is Poor

Because they were in danger of going extinct, the Lake Ozette Sockeye population was listed as threatened under the Endangered Species Act (ESA) in 1999. This listing status has been upheld following multiple 5-year reviews. Results from the 2022 Lake Ozette Sockeye status review shows the population is still unstable with the number of adult spawners ranging from 439 to 12,829 and none of the four population viability criteria being met.

The Makah Tribe is engaged in significant efforts towards recovery of the Lake Ozette Sockeye. It has carried out many projects to research, monitor and evaluate the fish population, as well as track and evaluate the performance of its overall status. Data obtained from these projects will allow adaptive management of programs to enhance recovery, detect and address possible negative effects, and ultimately contribute to delisting of Lake Ozette Sockeye as an ESA-listed threatened species.

The tribe also has been involved in a hatchery program whose primary purpose is the creation of self-sustaining Sockeye salmon populations in Ozette Lake tributaries where past Sockeye salmon spawning and production may have occurred. In addition, the tribe continues to seek funding to carry out other priority restoration projects, build capacity at the tribe and work towards the recovery and delisting of the Lake Ozette Sockeye.

Lake Ozette, the third largest natural lake in Washington state is approximately 8 miles from north to south, and 2 miles wide. It has a surface area of 11.8 square miles and a maximum depth of 320 feet and contains 36.5 miles of shoreline.[1] The Lake Ozette watershed includes small and large tributaries like Umbrella Creek, Big River, Coal Creek, Crooked Creek and Siwash Creek. The lake drains to the Pacific Ocean through the Ozette River.

Historically, Lake Ozette salmon populations were sufficiently abundant to support tribal fisheries.[2,3] However, the Sockeye salmon (*Oncorhynchus nerka*) harvest numbers declined precipitously over time from a high of more than 17,500 in 1949[4] to 0 in 1974 and 1975[5]. Following extensive review, the Lake Ozette Sockeye population was listed as threatened under the ESA in 1999[6] because they were in danger of going extinct and were found nowhere else. This listing status has been upheld following multiple five-year reviews.[7]

In 2009, a detailed technical report[8] identified factors limiting Lake Ozette Sockeye productivity and viability, and identified factors that need to be addressed to rebuild

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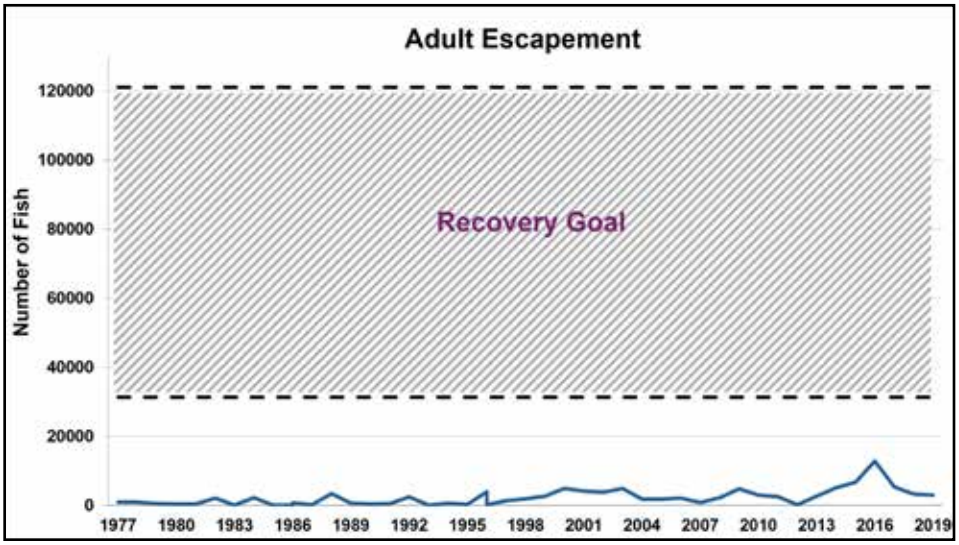

Map Data Sources: WDFW 2022[10], WAECY 2018[11]

Stephanie Martin, Makah Tribe

Traditional Makah territory at Lake Ozette, looking towards Tivoli Island.

(Continued from previous page)

the population to healthy self-sustaining levels. The factors include a decreased freshwater survival and a subsequent decrease in the number of Sockeye returning to spawn; changes in relative predator-prey abundances on Ozette spawning beaches which increased the proportion of adult Sockeye, eggs, and newly emerged fry consumed by predators; a reduction in the quality and quantity of beach spawning habitat; high stream temperatures and high sediment concentrations in the tributaries; and reduced streamflows.

Following the Lake Ozette Sockeye salmon listing in 1999, the Lake Ozette Sockeye salmon recovery plan[9] was developed in 2009 with recommendations for actions that may be taken to stop the downward trend of the species and restore the population to healthy, naturally self-sustaining levels. The plan has objective, measurable criteria, which when met, would result in the delisting of the species. The criteria are detailed below along with the 2022 review status. None of the four population viability criteria were met.

Parameter	Criteria	2022 Review Status
Abundance	Between 31,250 and 121,000 adult spawners, over a number of years.	In last 4 decades, adult spawners ranged from 438 to 12,829.
Productivity	Stable or increasing.	The population has alternated between positive and negative periods. No sustained increases in productivity.
Spatial structure	Multiple, persistent, and spatially distinct beach spawning aggregations, augmented by tributary spawning aggregations.	There is accumulating evidence of a sustained reduction in abundance and distribution of beach spawners.
Diversity	Include one or more persistent spawning aggregations from each major genetic and life history group historically present within the population. Maintain the distinctness between Lake Ozette Sockeye and kokanee.	The Ozette Lake Sockeye ESU consists of a single population, which by itself increases the risk of extinction because of limited demographic diversity and redundancy.

European Green Crab Invasion

*The European green crab (*Carcinus maenas*) has continued to expand its range and abundance within the Makah Area of Interest. More than 45,000 crabs were caught between 2020 and 2024, totaling more than 47,600 green crabs removed from Makah waterways since first detecting them in 2017. While the majority of catch continues to be in the coastal estuaries, new hotspots have been identified in the rocky intertidal habitats within Makah Bay and near the Ozette Reservation. In 2023, green crabs were detected for the first time inside Neah Bay. Additional monitoring and research show both promise and alarm for the future of managing this invasive species.*

The European green crab (*Carcinus maenas*) has continued to expand in both range and abundance within the Makah Area of Interest. Crabs have been detected on both the Pacific Ocean and Strait of Juan de Fuca sides of the Makah Reservation as well as in rocky intertidal habitats adjacent to the Ozette Reservation.

Since 2020, the numbers of green crabs in Makah waterways have increased substantially and new hotspots have been detected. Among these are rocky intertidal habitats in Makah Bay at Wa'atch Point and an area of wide rock platform off Tsoo-Yess Beach, known as Mad Bear Reef. In November 2023, green crabs were caught for the first time inside of Neah Bay.

Subsequent trapping has revealed that the crabs appear lower in abundance in Neah Bay compared to the coastal estuaries and are primarily larger crabs, likely settled in 2020 and 2021. Crabs in Neah Bay are also distributed higher on the shoreline in the rocky habitats in the upper intertidal, apparently restricted in range by the presence of healthy populations of native red rock crabs (*Cancer productus*) and other large Cancerids.

Adrianne Akmajian, Makah Tribe

Female European green crab with eggs caught in the Wa'atch River.

Catch per unit effort (CPUE) has remained high compared to early years, but has declined since a peak in 2022. Part of the change in CPUE is due to a change in gear type. The Makah Tribe almost exclusively uses shrimp traps for removal efforts, using two styles of traps, those with a 1" by 1" mesh, and those with ½" by ½" mesh. The two traps have trade-offs related to the size of green crabs they can catch and retain and the impacts to native species caught during removal efforts. In 2022 alone, the tribe removed more than 25,000 crabs. Since 2022, total catch and CPUE has declined, but new recruits in 2024, primarily caught by hand, signal more work in the years ahead. In 2024, 49.7% of all crabs removed were hand caught.

Green crabs in the Makah Area of Interest appear to be self-recruiting as well as recruiting from other estuaries

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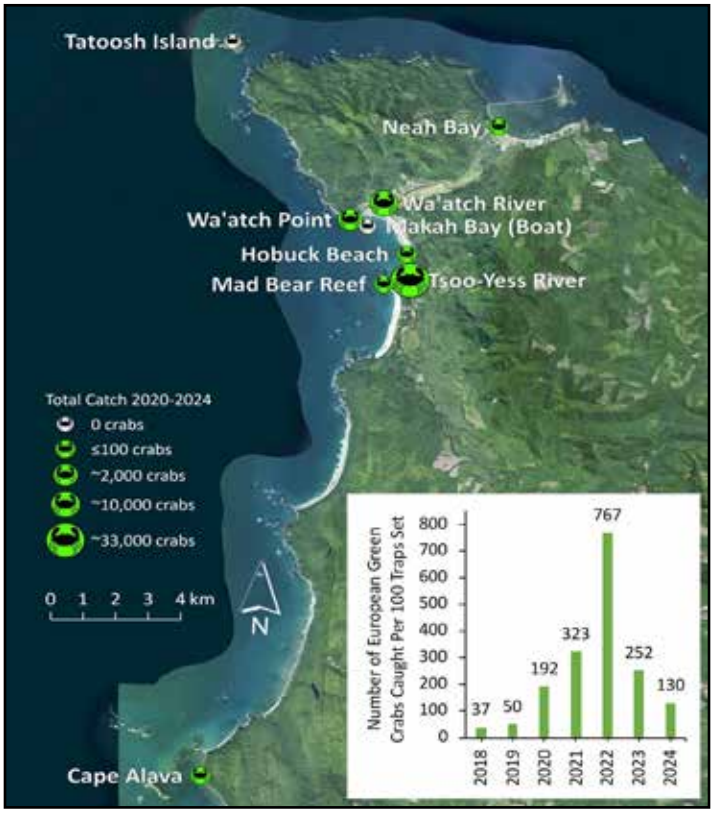
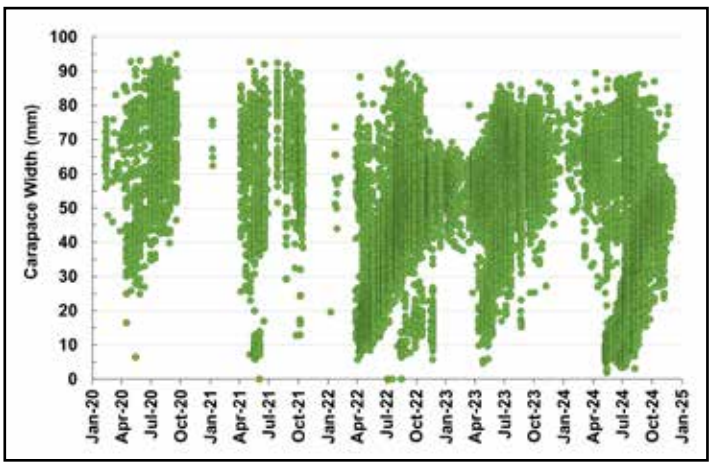


European green crab effort and catch conducted by the Makah Tribe in 2020–2024. Symbol sizes reflect relative catch. White symbols indicate zero catch. Note that CPUE does not account for crabs caught by unbaited methods such as by hand or seine net.



Carapace width (mm) of European green crab by date caught.

Adrianne Akmajian, Makah Tribe

European green crab tagged with a Floy T-Bar tag (FF-94).

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along the west coast of North America. Since 2020, the tribe has captured mating and pre-mating (clasping) pairs of crabs and gravid females with eggs.

The tribe has provided crabs to Woods Hole Oceanographic Institute for molecular analysis and found that the majority of crabs appear to be of an "outer coast" origin—genetically indistinguishable from crabs on the outer coasts of the U.S. and Canada. However, a small portion of the crabs caught in Makah Bay originated from a genetically bottlenecked population in Sooke Basin on Vancouver Island, indicating that Makah Bay crabs can be seeded by populations both to the north and south.

Settlement events of juvenile crabs occur annually in the spring/early summer and late summer/early fall, with small, <20 mm carapace-width crabs captured in both rivers. In recent years, the frequency and/or duration of settlement events appears to have increased, such that the settlement periods are prolonged with small, <20 mm carapace-width crabs observed nearly every month from April through November. These small crabs typically do not enter traps and are instead captured by hand.

Research and monitoring projects signal some promise in long-term management of the crabs, but also open new questions about their role in the broader ecosystem. Since 2021, the Makah Tribe has conducted mark-recapture studies using a variety of tagging methods for the purpose of estimating the population size and tracking crab movements. Most recently, the tribe marked green crabs with two methods, Floy T-Bar anchor tags (FF-94) and spine clips (cutting two of the marginal teeth) coded by river and capture area. Data collection and analysis is ongoing, but resights of several tagged crabs continued for over one year and through at least one molt cycle.

In 2022, a study using baited underwater video to look at competition between green crabs and subadult Dungeness crabs (*Metacarcinus magister*) found that similarly sized and larger subadult Dungeness crabs frequently outcompete adult green crabs for food. Dungeness crabs frequently outnumbered green crabs in the videos, even in sites that were selected due to frequent high catch of green crabs, and were successful at restricting green crabs from accessing the bait. These findings suggest some promise that native Dungeness crab are successful competitors.

In 2023 and 2024, in a study looking at the diet of North American rivers otters (*Lontra canadensis*) in the Wa'atch and Tsoo-Yess rivers, the Makah Tribe found evidence that river otters consume green crabs in both rivers. Further work is being done to quantify the extent of this predation relative to the population size of the crabs and estimate the biomass of green crabs being eaten by the otters. Predation on green crab may aid in keeping the green crab population in check. Further, it has the added benefit of lessening predation by this predator on other fisheries resources, including Dungeness crabs and salmonids.

Adrianne Akmajian, Makah Tribe

Still frame from baited remote underwater video (BRUV) from the Wa'atch River used to study European green crab and Dungeness crab (*Metacarcinus magister*) interactions.

Adrianne Akmajian, Makah Tribe

River otter scat with European green crab remains found at a latrine site on the Tsoo-Yess River.

Restoration of Neah Bay

The Makah Tribe has devoted significant efforts to protecting and improving Neah Bay, including building the Makah Marina and Port of Neah Bay facilities (1995-1997) and replacing the commercial fishing dock (2014), along with removing derelict legacy marine debris including dilapidated marine structures, abandoned and derelict vessels (ADV) and sunken vessels (2024). Future work will include removing the remaining ADV and the derelict T-dock, as well as restoring benthic substrate that has been covered for decades and exposed by the 2024 derelict structure removals.

Introduction

Neah Bay is located on the northeastern boundary of the Makah Reservation, where the Strait of Juan de Fuca meets the Pacific Ocean, within the Makah Treaty usual and accustomed fishing area (U&A) and adjacent to the Olympic Coast National Marine Sanctuary. This region has significant ecological value and importance as it contains highly productive marine waters due to upwelling and the confluence of the Alaska and California currents and the Strait of Juan de Fuca. The coastal environments in and surrounding Neah Bay provide critical habitat to numerous fish, marine mammal and bird species, including many endangered and/or threatened species, such as southern resident killer whales, marbled murrelet, Western snowy plover and bull trout. Bald eagles and many other birds, sea lions, seals and fish are frequently present in the Neah Bay.

Makah Tribe

Figure 1. Neah Bay Location Map.

Protecting and Restoring Neah Bay

The Makah Tribe has devoted significant efforts to protecting and improving Neah Bay, including building the Makah Marina and Port of Neah Bay facilities (1995-1997) and replacing the commercial fishing dock (2014), along with removing derelict legacy marine debris including dilapidated marine structures, abandoned and derelict vessels (ADV) and sunken vessels.

Older marine structures were typically constructed using creosote-treated timber that can introduce hazardous chemicals to the water column (primarily polycyclic aromatic hydrocarbons [PAHs] and heavy metals) and the benthic environment. ADV and sunken vessels typically contain hazardous materials including fuels, oils, asbestos-containing materials (ACM) and lead-based paint (LBP) that can impact water quality and harm organisms. Sunken and abandoned derelict vessels are generally old, in poor shape and at risk of sinking or breaking apart and releasing toxic chemicals into Neah Bay. The hazardous materials spills or deposits of ACM/LBP degrade water quality and marine habitat, endangering natural and cultural resources. An ADV or sunken vessel-related spill in Neah Bay could threaten the only tribal shellfish harvesting area in the bay and could impact treaty-protected and endangered species including Chinook salmon and the southern resident killer whales and habitat for Makah treaty resources.

(Continued on next page)

Global Diving & Savage

Figure 2. Removing a sunken vessel.

2002-2017	2018	2022	2023	2024
Makah Tribe Sunken Vessel/ADV Removals (28) $500K	**NOAA and Makah Tribe** Sunken Vessels Removal (3) $300k	**Puget Sound Partnership/NW Indian Fisheries Commission, and Makah Tribe** ADV Lightering (12) $184K	**Makah Tribe** ADV Removal (9) $400K	**NOAA/BIL FY 2023-National Marine Sanctuary Foundation, Makah Tribe** Pontoon, 4 ADV Disposal, 11 Sunken Vessels Removal, $6M **WA State Bill 5433-DNR, Makah Tribe** High Tide Seafood Facility, 733 creosote piles, 2 Sunken Vessels, $3M **Puget Sound Partnership, NW Indian Fisheries Commission, Makah Tribe** 8 ADV Lightering, $200K

Figure 3. Marine debris removal summary.

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Marine Debris Removal

The Makah Tribe has a long history of removing marine ADV—28 vessels were removed from Neah Bay between 2002 and 2016 using tribal funding. In 2018, the Port of Neah Bay began a focused effort on ADV, sunken vessels and derelict structures removal, using Tribal and National Estuary Program funding provided through Puget Sound Partnership grants, NOAA Marine Debris Program funding and Washington Department of Natural Resources (WDNR) legislative allocations. The marine debris removal projects completed between 2002 and 2024 are summarized in Figure 3.

2024 Marine Debris Removals

The marine debris removals from Neah Bay and the Makah Marina in 2024 were unprecedented, with a combined cost of more than $9 million. The 2024 work was focused on removing two significant derelict structures in Neah Bay (the High Tide Seafood Facility and the I-90 bridge pontoon) along with 13 sunken vessels and four ADV from the Makah Marina.

The Makah Tribe partnered with WDNR to remove the WDNR High Tide Seafood Facility (HTSF), a derelict former seafood facility timber dock and barge located on the southern shoreline of Neah Bay. WDNR received state legislative funding for removal of the HTSF along with two sunken vessels adjacent to the structure and derelict piles in the vicinity of the dock. A total of 733 creosote piles, creosote timber framing and decking were removed from the site, along with a 32' x 109' sunken and derelict wooden processing barge. Materials removed also included concrete and various types of metal. Approximately 4 million pounds of materials were removed.

The port also partnered with the National Marine Sanctuary Foundation and was awarded $15 million through the NOAA Marine Debris Program via the Bipartisan Infrastructure Law, of which $6 million was passed through to the Makah Tribe. That funding was used to achieve an unprecedented amount of marine debris removal from Neah Bay, including four ADV, 11 sunken vessels and a 220' x 60' derelict sunken reinforced concrete bridge pontoon. Approximately seven million pounds of materials were removed.

The removal of these structures has had a positive impact on the environment and the operations of the Makah Marina, which supports tribal fisheries, community well-being, cultural customs and tourism. These efforts are crucial for maintaining the health of the marine ecosystem and supporting the economic and cultural activities of the Makah Tribe.

RSS, Inc.

Figure 4. HTSF derelict structure.

RSS, Inc.

Figure 5. I-90 bridge pontoon derelict structure.

Future Activities

The port and the Office of Marine Affairs created a draft action plan for ADV prevention that will be implemented moving forward in 2025 and beyond. The future focus on Neah Bay will be to remove remaining ADV and the derelict T-dock, as well as restoring benthic substrate that has been covered for decades and exposed by the 2024 derelict structure removals.

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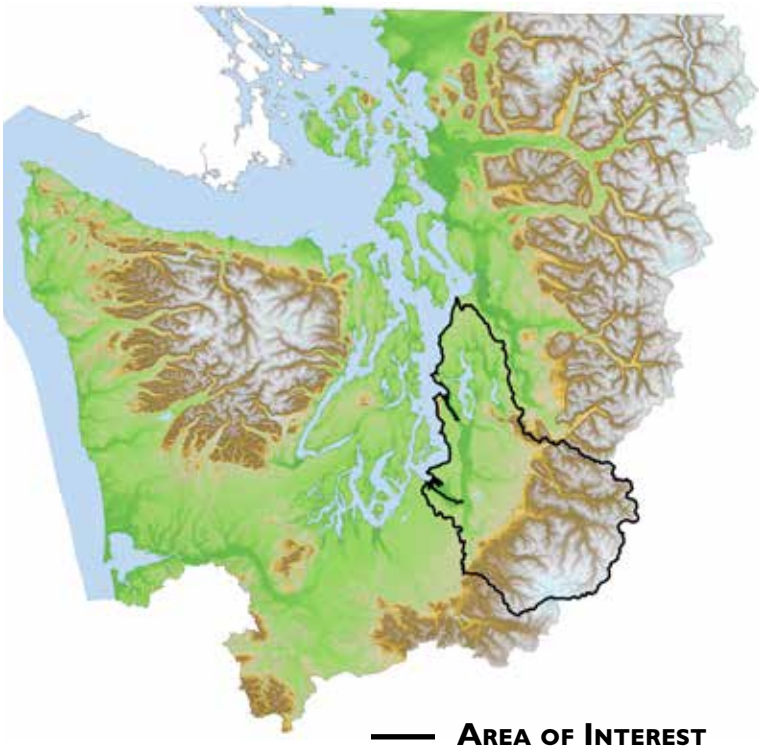
2025 State of Our Watersheds Report Green-Duwamish River, White-Puyallup River and Lake Washington Basins

We are the salmon people. For generations, salmon have sustained our way of life. Now we must sustain the life of the salmon.

– Phil Hamilton
Muckleshoot Fish Commission



Area of Interest

Muckleshoot Indian Tribe

The Muckleshoot Indian Tribe is a federally recognized Indian tribe whose membership is composed of descendants of the Duwamish and White River people who inhabited Central Puget Sound for thousands of years before non-Indian settlement.

The Tribe's name is derived from the native name for the prairie on which the Muckleshoot Reservation was established. Following the reservation's establishment in 1857, the Tribe and its members came to be known as Muckleshoot, rather than by the historic tribal names of their Duwamish and White River ancestors.

Today, the United States recognizes the Muckleshoot Indian Tribe as a tribal successor to the Duwamish and White River bands from which the Tribe's membership descends. Like all native people of western Washington, Muckleshoot ancestors depended on fish, animal and plant resources and traveled widely to harvest these resources. Village groups were linked by ties of marriage, joint feasting, ceremonies, commerce and use of common territory. Downriver people intermarried with other groups along the Sound, while people on the upper reaches of the drainages also intermarried with groups east of the Cascade Mountains. This network of kinship tied together ancestral Muckleshoot villages within the Duwamish watershed, extended across watersheds and the Cascade crest, giving Muckleshoot ancestors access to fishing, hunting and gathering sites throughout a broad area extending from the west side of Puget Sound across the Cascade crest.

Areas depicted do not necessarily correspond to Muckleshoot Usual & Accustomed fishing grounds and stations.

Muckleshoot Indian Tribe

Lake Washington, Green/Duwamish & White/Puyallup River Basins

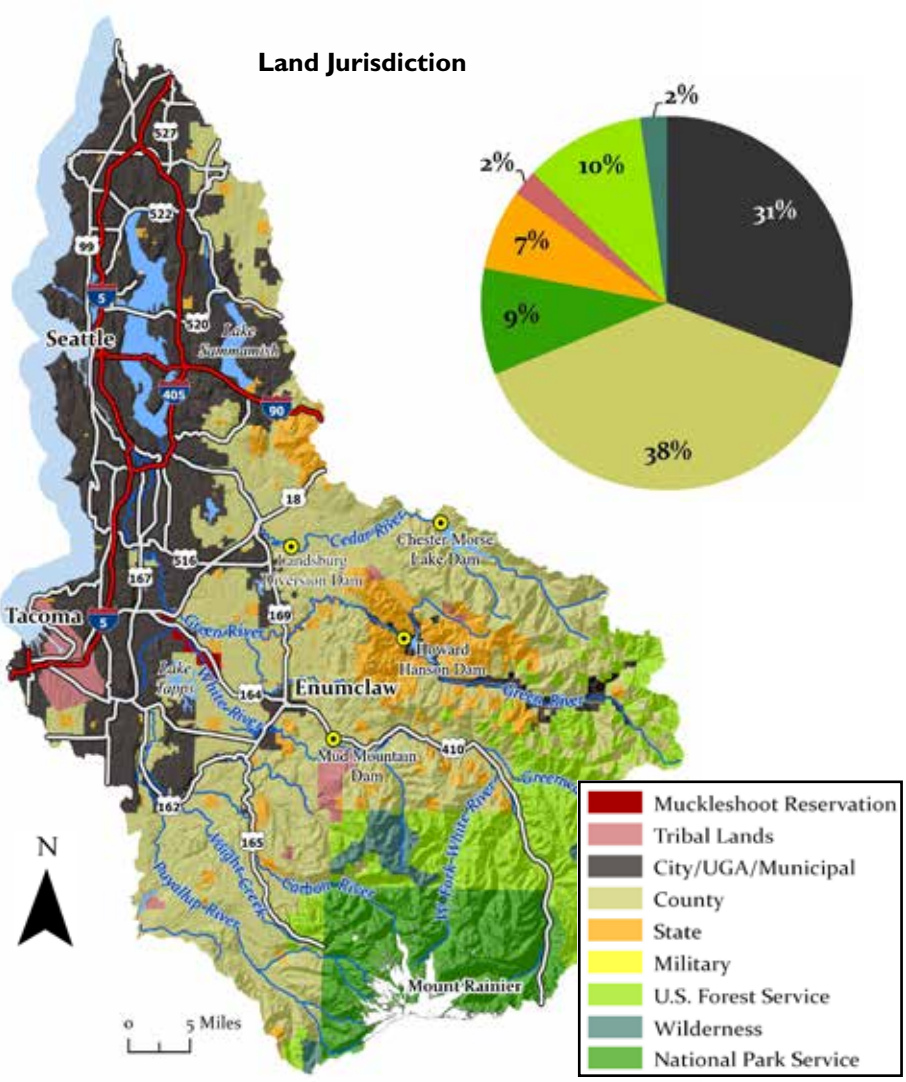
The Muckleshoot Indian Tribe's geographic Area of Interest includes all of WRIAs 8, 9 and 10. In this chapter, the Tribe's focus is on Lake Washington (WRIA 8), the Green/Duwamish River basin (WRIA 9) and the White/Puyallup River basin (WRIA 10). Anadromous salmonids in this area include Chinook, Coho, Sockeye, Chum and Pink salmon, and steelhead and bull trout.

The Green/Duwamish River basin was historically 1,736 square miles and included the White and Cedar rivers. The Cedar, Black and White rivers were diverted in the early 1900s, reducing the basin area to 556 square miles. The Green River flow regime is altered by flood control and storage at Howard Hanson Dam and by water withdrawals. The U.S. Army Corps of Engineers dam was constructed in the 1960s without fish-passage facilities, cutting off over 100 miles of mainstem and tributary habitat. Approximately 98% of historic intertidal marsh and mudflats have been replaced with commercial and industrial development. The basin includes Elliott Bay, which, along with the Duwamish River, is highly altered and contaminated with industrial discharges and urban runoff. The basin supports an estimated 684,500 people (up 6.6% from 2018) and about 31% lies within Urban Growth Area boundaries.[1]

The 686-square-mile Lake Washington basin includes the Cedar and Sammamish rivers and lakes Sammamish, Union and Washington. Major alterations include diverting the Cedar River into Lake Washington, channelization of the Sammamish River, and the construction of the Lake Washington Ship Canal and the Hiram M. Chittenden Locks. The basin is heavily urbanized, leading to highly modified stream hydrology and shorelines. With 30 cities and an estimated 1.9 million people (up 9.7% from 2018), Lake Washington is the most populated basin in Puget Sound with 55% of its land area inside Urban Growth Area boundaries.[2]

The White River drains 494 square miles and originates from Emmons Glacier on Mount Tacoma (Rainier). The river flows 68 miles from its origin to its confluence with the Puyallup River at Sumner. Most of the upper White River is managed for timber production and has been intensively logged since 1945, leading to slope stability problems and increased sediment loads in non-glacial tributaries.[3] At the U.S. Army Corps of Engineers' Mud Mountain diversion dam, adult fish are trapped and hauled upstream of Mud Mountain Dam. The river's flow and sediment regimes are heavily altered by flood control activities at the dam. From 1911 until 2004, Puget Sound Energy (PSE) diverted up to 2,000 cfs from the White River into the Lake Tapps reservoir, depleting river flows on the Muckleshoot Indian Reservation and devastating salmon and steelhead populations. A 1986 settlement with the Muckleshoot Indian Tribe and PSE required that the diversion increase the minimum instream flow from 30 cfs to 130 cfs. PSE's hydropower diversion ceased in 2004, and in 2007 an agreement was reached with the Cascade Water Alliance (CWA), a new water purveyor; this MIT/CWA agreement further limits water diversion to Lake Tapps. The basin includes Commencement Bay, which, along with the Puyallup River, is highly altered and contaminated with industrial discharges and urban runoff. This basin saw an estimated 7.6% increase in population since 2018.[4]

Land development along with hydrologic and channel modification have devastated ecosystem functions and severely diminished the potential for natural salmon production in these basins. Much of the habitat loss and degradation is not likely to be reversed, and new growth continues to increase impacts. As a result, hatcheries continue to play a crucial role in providing salmon for tribal treaty and other harvest, and in maintaining the abundance of naturally spawning fish. Nonetheless, habitat protection and restoration remain essential to sustain future salmon populations.



Map Data Sources: DOD 2023[5], SSHIAP 2004[6], WADNR 2024a[7], WADNR 2024b[8], WAECY 2018c[9], WAECY 2021[10], WAECY 2023[11], WAECY 2024[12], WADOT 2018[13], WADOT 2023[14], USFWS 2024[15]

Chapter Summary

The Muckleshoot Indian Tribe are leaders in the region's salmon recovery effort. No other people know these watersheds as well as the tribes and none has a greater stake in their future. The tribes believe that if salmon are to survive, real gains in habitat protection and restoration must be achieved. The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on improving the quality and quantity of habitat.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the Tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource. Tribes have a treaty right to protect fisheries habitat, a right which was affirmed by phase II of the Boldt decision.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

For this report, the Muckleshoot Indian Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Shoreline Armoring Reduces Habitat for Salmon and Forage Fish in Elliott Bay and Duwamish River

Elliott Bay and the Duwamish River are heavily modified with extensive shoreline armoring and levees. Approximately 91% (28 out of 31 miles) of Elliott Bay and the Lower Duwamish River shoreline are heavily armored (50-100%). Shoreline armoring and levees continue upstream along the Duwamish River, with only small and fragmented areas of natural habitat suitable for juvenile salmon.

Disconnected Floodplains Reduce Habitat Quality and Quantity, Hindering Salmon Productivity

Floodplains along the Green/Duwamish, White/Puyallup and Cedar rivers remain in poor health. In the Green River, about 80% of the historic ecological floodplain is no longer connected to the river. Approximately 28 miles of levee exist along a 21-mile stretch of the Green River. Reconnecting floodplains and restoring floodplain habitats is essential for increasing both the available rearing and refuge habitat and corresponding salmon productivity of the watershed.

Impervious Surface and Population Continue to Increase

Impervious surface land cover has led to severely degraded water conditions in the Lake Washington, Green/Duwamish and Puyallup/White basins. Population growth in traditionally rural areas continues to increase impervious surface cover. In 2023, Black Diamond was the fastest growing city in King County with a 40.6% growth rate.

Stormwater Runoff Connected to Pre-Spawning Mortality

A compound derived from tire wear, 6PPD-quinone, causes pre-spawning mortality in Coho salmon and acute toxicity in rainbow trout/steelhead. In the Muckleshoot area of interest, predictions have been made for areas where 6PPDQ will contribute to high pre-spawning mortality rates in Coho salmon.

Water Quality Impairments Require Corrective Actions

Washington Department of Ecology's current Water Quality Assessment lists approximately 167 waterbody segments as impaired for temperature and 298 waterbody segments as impaired for dissolved oxygen in the Cedar/Sammamish, Duwamish/Green and Puyallup/White river areas. In these Muckleshoot Areas of Interest, waterbody segments currently listed as impaired for water temperature and dissolved oxygen increased by 51 and 79, respectively, since the last assessment approved by EPA in 2012.

Summer Flows Remain Low as Groundwater Exploitation Continues

Population increases in the Muckleshoot area of interest have been significant over the last five years. Land development activities associated with this population growth are closely correlated with factors that can decrease groundwater recharge and decrease summer streamflow, particularly groundwater extraction for public water supply and exportation of wastewater to treatment plants. There are more than 500 public groundwater sources (wells or springs) in selected watersheds in the Muckleshoot Area of Interest in King County alone. These wells are relatively shallow and are often in hydrologic connection with streams.

Fish Barrier Culverts Continue to Impede Fish Passage

There are 6,071 barrier culverts impeding fish passage that are owned by the state, cities and counties, as well as private corporations and individuals in the Muckleshoot Area of Interest. Most of the barriers are owned by cities (2,042 barriers), followed by those owned by the counties (1,547 barriers) and privately owned (1,487 barriers). A federal court injunction requires Washington state to correct high-priority fish-blocking culverts by 2030. However, many barriers fall outside this requirement, such as those owned by cities, counties or private landowners, which are only replaced when a culvert fails or a road project triggers construction.

The Hiram M. Chittenden Locks and Lake Washington Ship Canal Create a Fish Passage Barrier for Salmon

The Hiram M. Chittenden Locks do not meet current fish passage standards. Juvenile and adult salmon are delayed, injured, trapped and killed by the infrastructure and operation of the Locks and the Lake Washington Ship Canal. Marine mammal predation in and around the facility is a serious and ongoing concern since the 1980s.

Overwater Structures Negatively Impact Salmon Out-migration and Increase Predation in Lake Washington System

In Lake Sammamish, Lake Washington and the Lake Washington Ship Canal, approximately 4,000 docks impact lakeshore habitat by creating prime accommodations for salmon predators and significantly increasing the distance juvenile salmon must travel around docks to reach marine waters.

Streams Still Lack Large Wood and Natural Habitat Features

Surveys indicate that the Lower Cedar and Green rivers contain less than 5% of the large wood pieces expected for healthy streams. This shortage of wood is a strong indicator that habitat complexity is severely lacking, not only in these rivers, but likely across other rivers in this region.

Conclusion

The Muckleshoot Indian Tribe's watersheds have seen very few positive trends in habitat recovery over the past decade. Most habitat indicators have stayed the same or worsened. The Green/Duwamish, Puyallup/White and Lake Washington basins in Central Puget Sound continue to support important salmon and steelhead runs despite dramatic habitat alterations and ecosystem decline. These watersheds are the most developed in all of Washington state. Their populations are continuing to grow rapidly which will undoubtedly continue to affect salmon populations in a negative way.

Almost all habitat indicators have a declining trend and/or remain degraded, including disconnected floodplains, impervious land cover, stormwater impacts from road surface runoff, water quality impairments, low summer flows, overwater structures, instream woody material, and fish passage barriers at the Hiram M. Chittenden Locks.

Improvements are marginally improving for two habitat indicators, including shoreline armoring and barrier culverts, but not enough to keep up with the impacts of a growing population and their land-use decisions. Land use and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented. Implementation includes education and voluntary actions, but it also must include enforcement when those laws are broken. The future of the Tribe's ability to exercise its treaty rights depends on it.

Recovery Efforts Show Improvement But Still Lagging in Key Indicators

At the 20-year mark of the Puget Sound Salmon Recovery Plan[1], a review of key environmental indicators reveals negative progress toward the recovery plan's goals and objectives. Priority issues include disconnected floodplains, impervious land cover, stormwater impacts from road surface runoff, water quality impairments, low summer flows, overwater structures, shoreline armoring, lack of instream woody material, and fish passage barriers. The Hiram M. Chittenden Locks continue to impact all salmon in the Lake Washington watershed. In general, there is a shortage of staff at all levels (e.g., federal, state, Tribal, county) needed to address the issues and implement actions to restore and protect habitat, and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the status for these key environmental indicators finds minimal improvements with many degraded conditions remaining.

Tribal Indicator	Findings	Status
Shoreline Armoring	Elliott Bay and the Duwamish River are heavily modified with extensive shoreline armoring and levees. Approximately 91% (28 out of 31 miles) of Elliott Bay and the Lower Duwamish River shoreline are heavily armored (50-100%). Shoreline armoring and levees continue upstream along the Duwamish River, with only small and fragmented areas of natural habitat suitable for juvenile salmon.	**Marginally Improving**
Disconnected Floodplains	Floodplains along the Green/Duwamish, White/Puyallup and Cedar Rivers remain in poor health. In the Green River, about 80% of the historic ecological floodplain is no longer connected to the river. Approximately 28 miles of levee exist along a 21-mile stretch of the Green River. Reconnecting floodplains and restoring floodplain habitats is essential for increasing both the available rearing and refuge habitat and corresponding salmon productivity of the watershed.	**Degraded**
Impervious Surface	Impervious surface land cover has led to severely degraded water conditions in the Lake Washington, Green-Duwamish and Puyallup-White basins. Population growth in traditionally rural areas continues to increase impervious surface cover. In 2023, Black Diamond was the fastest growing city in King County with a 40.6% growth rate.	**Degraded**
Stormwater Runoff Connected to Pre-Spawning Mortality	A compound derived from tire wear, 6PPD-quinone, causes pre-spawning mortality in coho salmon and acute toxicity in steelhead/rainbow trout. In the Muckleshoot Area of Interest, predictions have been made for areas where 6PPD will contribute to high pre-spawning mortality rates in Coho salmon.	**Degraded**
Water Quality Impairments	Washington Department of Ecology's current Water Quality Assessment lists approximately 167 waterbody segments as impaired for temperature and 298 waterbody segments listed as impaired for dissolved oxygen in the Cedar-Sammamish, Duwamish-Green and Puyallup-White river areas. In these Muckleshoot Areas of Interest, waterbody segments currently listed as impaired for water temperature and dissolved oxygen increased by 51 and 79, respectively, since the last assessment approved by EPA in 2012.	**Degraded and Declining**
Low Summer Flows	Population increases in the Muckleshoot Area of Interest have been significant over the last 5 years. Land development activities associated with this population growth are closely correlated with factors that can decrease groundwater recharge and decrease summer streamflow, particularly groundwater extraction for public water supply and exportation of wastewater to treatment plants. There are more than 500 public groundwater sources (wells or springs) in selected watersheds in the Muckleshoot Area of Interest in King County alone. These wells are relatively shallow and are often in hydrologic connection with streams.	**Degraded**
Fish Barrier Culverts	There are 6,071 barrier culverts impeding fish passage that are owned by the state, cities and counties, as well as private corporations and individuals in the Muckleshoot Area of Interest. Most of the barriers are owned by cities (2,042 barriers), followed by those owned by the counties (1,547 barriers) and privately owned (1,487 barriers). A federal court injunction requires Washington state to correct high-priority fish-blocking culverts by 2030. However, many barriers fall outside this requirement, such as those owned by cities, counties or private landowners, which are only replaced when a culvert fails or a road project triggers construction.	**Marginally Improving**
Hiram M. Chittenden Locks and Lake Washington Ship Canal	The Hiram M. Chittenden Locks (Locks) do not meet current fish passage standards. Juvenile and adult salmon are delayed, injured, trapped and killed by the infrastructure and operation of the Locks and the Lake Washington Ship Canal. Marine mammal predation in and around the facility is a serious concern.	**Degraded and Declining**
Overwater Structures	In Lake Sammamish, Lake Washington and the Lake Washington Ship Canal, approximately 4,000 docks impact lakeshore habitat by creating prime accommodations for salmon predators and significantly increasing the distance juvenile salmon must travel around docks to reach marine waters.	**Degraded**
Large Woody Material	Surveys indicate that the Lower Cedar and Green rivers contain less than 5% of the large wood pieces expected for healthy streams. This shortage of wood is a strong indicator that habitat complexity is severely lacking, not only in these rivers, but likely across other rivers in this region.	**Degraded**

The Tribe continues to work toward the protection and restoration of fisheries habitat and to conduct research to understand the different species and the habitats they occupy.

Looking Ahead

Salmon returns and treaty harvest opportunities continue to deteriorate in Central and South Puget Sound. The long-term outlook for the Muckleshoot Indian Tribe is challenging given significant habitat loss and degradation, rising human population, unstable marine conditions and other impacts associated with land development, hydrologic alterations and climate change. Dramatic improvements are required, along with a flexible approach to rebuilding salmon and steelhead populations to harvestable abundances.

Over the next five years, the Muckleshoot Indian Tribe will continue to work with Washington Department of Fish and Wildlife (WDFW) to implement the Co-Managers' Urban Salmon Strategy. This strategy is designed to optimize hatchery production and bypass bottlenecks affecting survival in the urban environment.

The Lake Washington basin will be a priority as salmonids entering and exiting this basin encounter passage problems, marine mammal predation and thermal blockages at the Hiram M. Chittenden and Lake Washington Ship Canal, miles of docks, bulkheads, riprap and light pollution outlining the basin, contaminated sediments, warm water, and the many native and exotic fish predators favored by those degraded conditions. The co-managers continue working to restore Lake Washington Sockeye to harvestable levels by implementing and evaluating delayed release strategies designed to increase survival and continue working to secure Seattle's mitigation obligations for the Landsburg Dam blockage.

Habitat priorities for the next five years include establishing a riparian shade corridor along the Green River (including 20 miles through Kent and Tukwila) to address unhealthy water temperatures and comply with Washington water quality standards. To accomplish this, support from local, state and federal agencies will be solicited to protect and establish riparian shade with land-use permit approvals and mitigation plans for levee construction and repairs.

Reducing lethal temperatures in the Lake Washington Ship Canal and the Sammamish River is another priority. ESA consultation for the U.S. Army Corps of Engineers' operation of the Hiram M. Chittenden Locks and Lake Washington Ship Canal has begun and presents an opportunity to address structural and operational deficiencies and marine mammal predation on listed salmonids passing through the facility. In addition, opportunities will be sought for the installation of in-channel large woody material and wood recruitment in the Green and Cedar rivers to enhance hydraulic complexity and create essential refuges for salmon. Finally, state and Tribal hatchery water supplies need to be secured against the degradation of water quality and quantity caused by the impacts of upstream land development and groundwater withdrawals.

Population growth and development will continue to challenge salmon rebuilding efforts in the urban environment. Reduced instream flows continue to confound progress for many habitat indicators. Trends indicate that we'll lose habitat even as restoration projects are implemented. Increasing implementation of priority restoration efforts and enforcing or revising regulations that are supposed to protect salmon habitat must occur if salmon populations are to be sustained into the future.

Natural salmon production alone will not support fisheries; more hatchery supplementation is essential to restore fishing opportunities for Tribal members and to fulfill treaty fishing rights. For the past century, the Tribe has relied on hatcheries for harvest and will continue to depend on hatchery production for years to come.

Shoreline Armoring Reduces Habitat for Salmon and Forage Fish in Elliott Bay and the Duwamish River

Elliott Bay and the Duwamish River are heavily modified with extensive shoreline armoring and levees. Approximately 91% (28 out of 31 miles) of Elliott Bay and the Lower Duwamish River shoreline are heavily armored (50-100%).[1] Shoreline armoring and levees continue upstream along the Duwamish River, with only small and fragmented areas of natural habitat suitable for juvenile salmon.

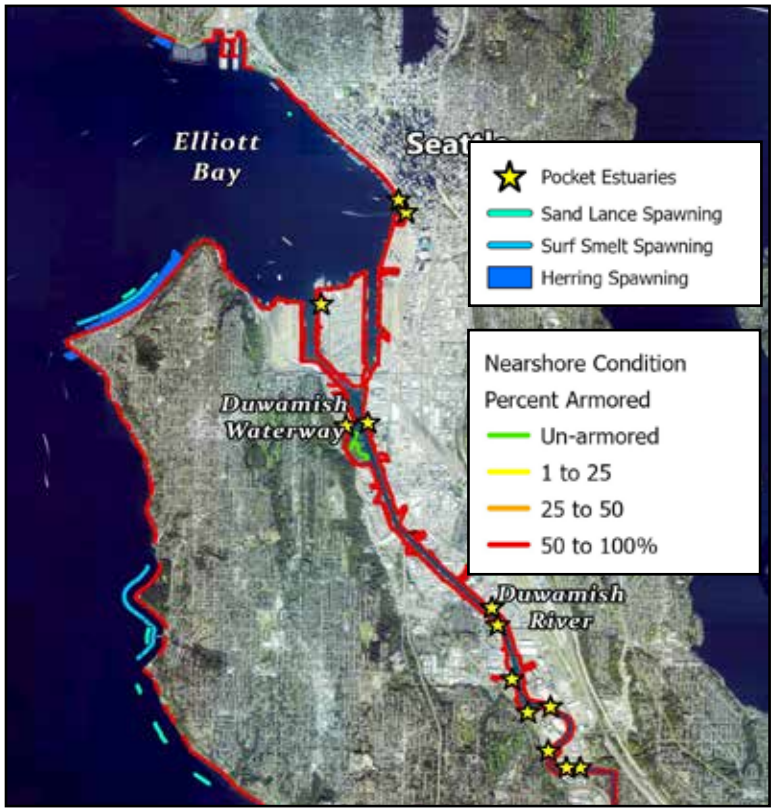
Shoreline armoring negatively impacts ecosystem processes, structure and function in the nearshore environment. Armoring can block sediment supply, reduce the abundance of large woody debris on beaches, and cause the direct loss of forage fish spawning habitat.[2] Surf smelt and Pacific sand lance lay their eggs in sand and gravel on intertidal beaches,[3] habitat that disappears when concrete bulkheads or riprap are used to armor shorelines. Elliott Bay and the Duwamish Waterway are heavily modified with shoreline armoring.

Juvenile salmon use shoreline habitat to feed and rest as they migrate from rivers to the ocean stages of their life.[4] The Duwamish River Estuary, once meandering through 9 miles of channels, 1,230 acres of tidal swamp, 1,270 acres of tidal marshes and 1,450 acres of intertidal shallows and mudflats, was straightened (channelized) and dredged, reducing the length down to five miles, to provide shipping lanes and new land for Seattle's industrial and manufacturing district.[5]

More than two-thirds of the water feeding the Duwamish Estuary was diverted when the Cedar and White rivers were moved into other basins. Today, the Duwamish River presents many challenges to salmon, associated with urbanization, including excessive summer temperatures, combined sewer overflow, stormwater runoff, contaminated sediment and industrial development.[5]

Steelhead, as well as Chinook, Chum, Coho and Pink salmon juveniles all migrate from the Green/Duwamish River to Elliott Bay and out into Puget Sound.[6] In Elliott Bay, shoreline armoring dominates and there is little nearshore habitat for migrating salmon. However, recent efforts have gained momentum to create additional small areas of habitat for salmon. The Elliott Bay Seawall Replacement Project was completed in 2017 and provides a narrow strip of intertidal habitat, encouraging the growth of algae and providing a shallow water pathway and a place for juvenile salmon to feed. Nearby, the Pioneer Square Habitat Beach was completed in 2020 and opened to the public in 2023, providing another pocket of shallow intertidal habitat for juvenile salmon in Elliott Bay.[7]

Another recent habitat restoration project benefiting juvenile salmon was completed in spring of 2023 to settle natural resource damage liabilities at Vigor Shipyards. In 2021, Vigor negotiated a settlement with federal agencies and local tribal governments, resulting in the conversion of approximately 10% of the active facility to a new aquatic habitat for juvenile salmonids, including 2.7 acres of intertidal mudflat, saltwater marsh, and riparian buffer.[8,9] The habitat restoration was completed in 2023, and within the first year of post-restoration monitoring, juvenile steelhead, Coho and Chinook were captured in netting efforts, indicating that juvenile salmon are potentially using the site as a rest stop as they migrate.[10]



Map Data Sources: CGS. 2020[1], SWIFD 2024[13], WDFW 2020[14], WDFW 2020[15]

Floyd Snider

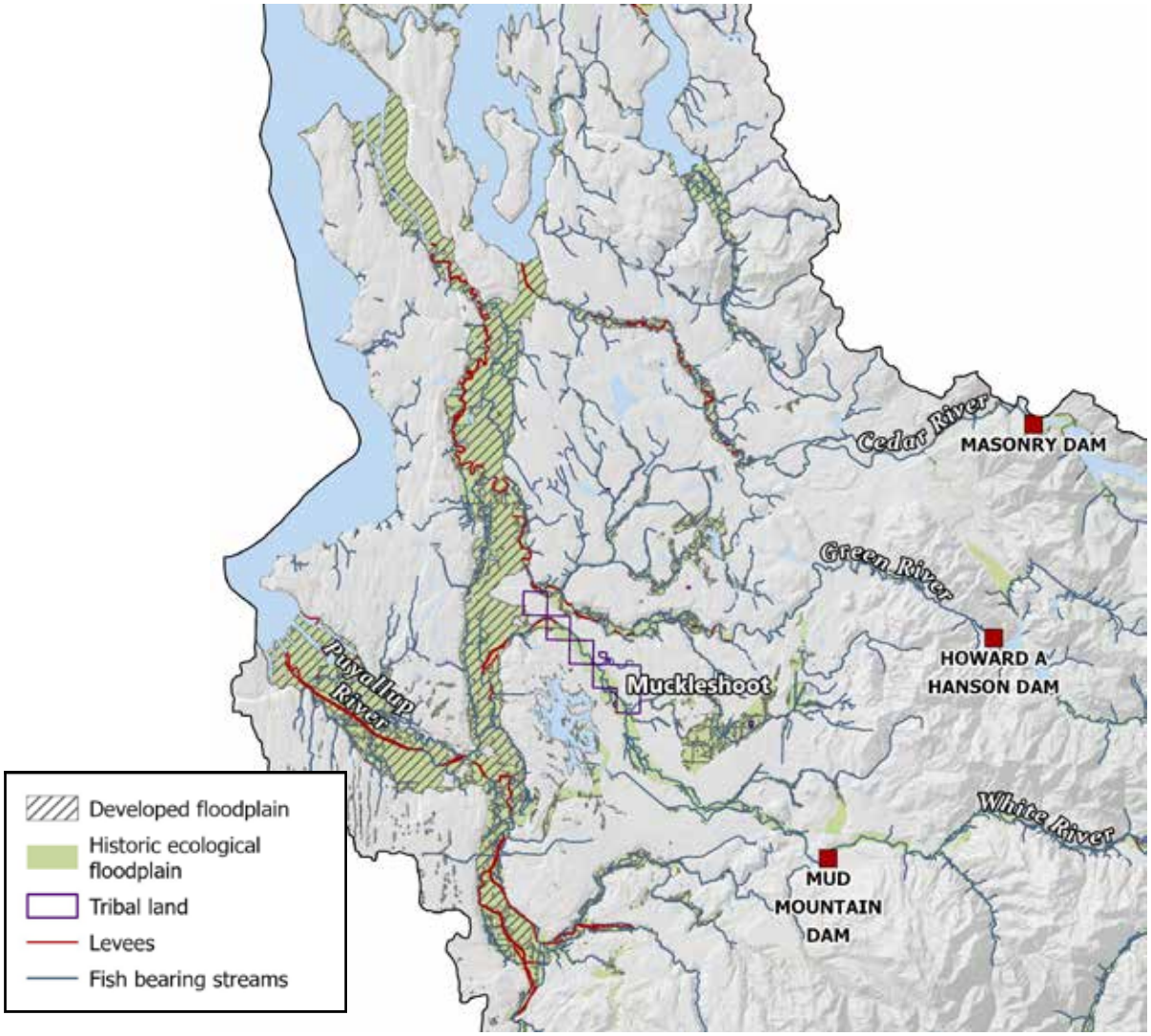
Vigor Shipyards habitat restoration on Harbor Island.

Further up the Duwamish River, the Port of Seattle completed a habitat restoration project in 2022 at the former Terminal 117 site, now called Duwamish River People's Park. The aquatic restoration project includes 5.5-acres of restored marsh and 2,500 linear feet of restored native riparian shoreline.[11] Fish use monitoring has shown that juvenile salmonids are using the site during their out-migration.[12]

Despite these examples of improvement to salmon habitat in Elliott Bay and the Duwamish River, the overall habitat conditions remain degraded. Substantial improvements are needed to create additional habitat for out-migrating salmonids and forage fish in Elliott Bay and the Duwamish River.

Disconnected Floodplains Reduce Habitat Quality and Quantity, Hindering Salmon Productivity

Floodplains along the Green/Duwamish, White/Puyallup and Cedar Rivers remain in poor health. In the Green River, about 80% of the historic ecological floodplain is no longer connected to the river.[1,2] Approximately 28 miles of levee exist along a 21-mile stretch of the Green River. [3] Reconnecting floodplains and restoring floodplain habitats is essential for increasing both the available rearing and refuge habitat and corresponding salmon productivity of the watershed.



Map Data Sources: NLCD 2021[1], NWIFC 2022[2], SSHIAP 2004[7], WADOT 2018[8], SWIFD2024[9], PSP 2024[10]

The main pre-1900s watershed supporting Muckleshoot Indian Tribe Fisheries is now cleaved into three separate basins by diversion of the White River into the Puyallup in 1906, by the Cedar River into Lake Washington in 1911 and by the Lake Washington basin directly into Puget Sound in 1916. The Green/Duwamish, White/Puyallup and Cedar rivers have been leveed and modified since then, mostly by governmental agencies seeking to manage flood risk and promote development. Each sub-basin was dammed for water supply and/or flood flow management: Masonry Dam (Cedar), Howard Hanson Dam (Green) and Mud Mountain Dam (White). This greatly diminished the capacity for channel-forming flows and overbank flooding downstream, and facilitated channel modifications. Straightened rivers, dredged channels, hardened river banks and constructed levees have further disconnected rivers from their historical floodplains, establishing enduring ecological impacts that continue today.

Loss of historic floodplain habitat in the Green/Duwamish, White/Puyallup and Cedar watersheds has significantly reduced habitat area and habitat complexity. Within the Muckleshoot Area of Interest, approximately 65% of the historic floodplain is no longer connected.[1,2] Historic acres of habitat with low water velocity are vastly diminished, reducing rearing and flood refuge habitat, groundwater storage and important cold-water recharge during summer months.

The Lower Green River is the most highly constrained; King County maintains a 28-mile levee system along a river length of only 21 miles.[3] The levees restrict access to historical salmon habitat that spanned several square miles.[4] About 17 miles of levee length is enrolled in the U.S. Army Corps of Engineers' (Corps) PL 84-99 program, which limits or complicates levee-repair outcomes beneficial to salmon. For exam-

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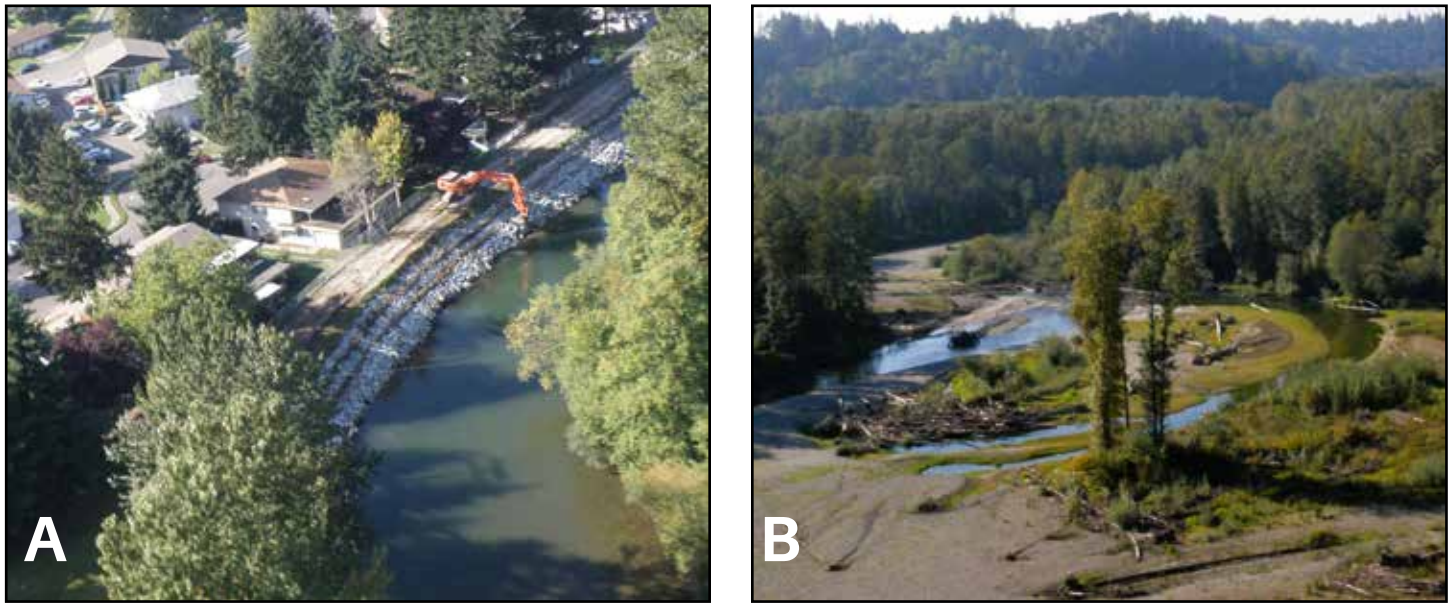
ple, at the Horseshoe Bend PL 84-99 levee repair completed in 2024, the Corps declined a King County-funded plan for habitat improvement and preserved the site as poor-quality habitat.

Leveed rivers are artificially maintained in a single channel, cutting the river off from its floodplain, thereby reducing or eliminating access to refuge and rearing habitats required by juvenile salmon (Figure 1a). In comparison, the natural process of channel migration within the floodplain creates side channels, backwater sloughs, and other off-channel habitats that are critical for juvenile salmon rearing and refuge (Figure 1b). Floodplains facilitate an exchange of nutrients and organic material between land and water, and provide important flood-storage capacity that can decrease flood risk to adjacent communities.[5]

Floodplain disconnection reduces the extent of off-channel aquatic habitat, and decreases floodwater and sediment storage, complicating flood-risk management. Disconnected floodplains caused by levees and revetments also diminish access to riparian forests causing increased solar exposure and water temperature, reduced input of large woody material, and reduced gravel recruitment.



Eric Warner, MITFD (2)

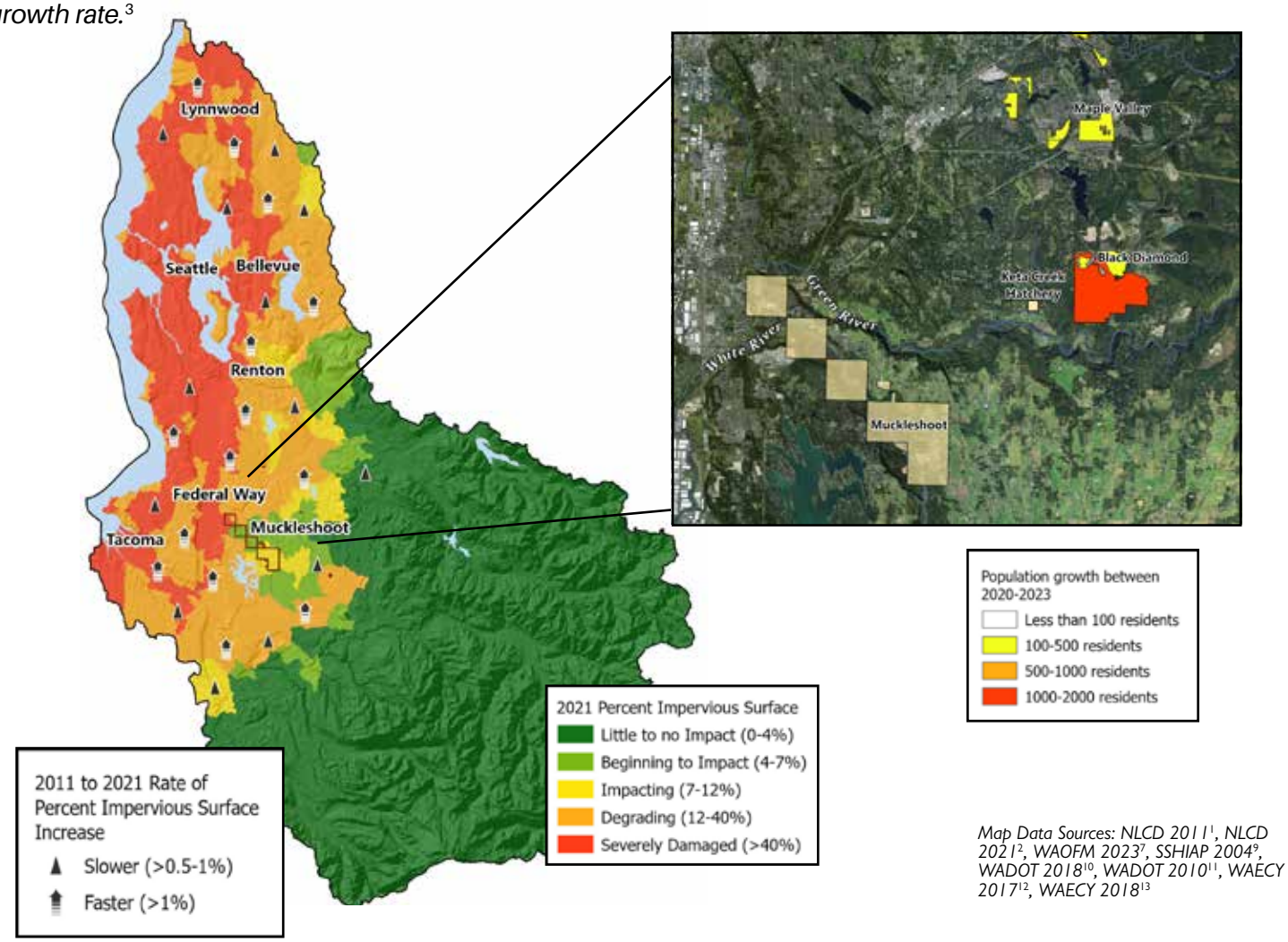
Figure 1. a) Levee maintenance of typical Green River levee at river mile 16.5; b) Naturally developing backwater areas on the Middle Green River, river mile 37.8.

The breadth of floodplain disconnection below dams on the Cedar, Green and White rivers requires a general, sustained and reliably funded effort by governmental agencies to maximize the extent of habitat improvement on the water side of levees. Expanding the extent of frequently inundated floodplains within levees will increase refuge habitat essential for juvenile salmon and corresponding salmon productivity of the Cedar, Green and White rivers. Levee setback projects offer a reliable approach.

The WRIA 9 Watershed Ecosystem Forum identified restoration and enhancement of floodplain connectivity as a primary strategy for salmon recovery. The 2021 Plan Update includes multiple projects with revetment or levee setback elements that would improve floodplain connection.[6] Land acquisition is often required for levee and revetment setback projects. County and local jurisdictions must prioritize land acquisition necessary to complete floodplain restoration and reconnection projects.

Impervious Surface and Population Continue to Increase

Impervious surface land cover has led to severely degraded water conditions in the Lake Washington, Green/Duwamish and Puyallup/White basins. Population growth in traditionally rural areas continues to increase impervious surface cover.[1,2] In 2023, Black Diamond was the fastest growing city in King County with a 40.6% growth rate.[3]



Map Data Sources: NLCD 2011[1], NLCD 2021[2], WAOFM 2023[7], SSHIAP 2004[9], WADOT 2018[10], WADOT 2010[11], WAECY 2017[12], WAECY 2018[13]

The Green/Duwamish and Lake Washington watersheds are among the most densely populated and developed in the state, resulting in many sub-watershed areas having greater than 40% impervious surface land cover.[2] Impervious surfaces prevent the infiltration of water, which reduces groundwater recharge and base flow in surface waters. Pollutants including pathogens, nutrients, toxic contaminants and sediment collect on impervious surfaces, and during rainfall events the stormwater carries these pollutants directly into waterways, causing harm to aquatic ecosystems. Existing urbanization and new development results in increases in impervious surfaces such as roads, parking lots, driveways, lawns and rooftops.[4,5] The central Puget Sound region is expected to grow by 1.5 million people by 2050, and local, state and federal governments are challenged to keep up with the needs of a growing population without continuing to degrade habitat.[6]

Between 2020-2023, population growth continued in and around the city of Seattle, in areas that are already severely degraded by impervious surfaces. In addition, the areas with the highest population growth were south of Seattle, near Black Diamond, Bonney Lake and Orting.[7] These areas are not yet severely degraded by impervious surfaces, but increases in population and development in these areas cause harm to aquatic ecosystems by increasing pollutants flowing into waterways, decreasing forested areas, and reducing riparian buffers surrounding streams and wetlands.

The Muckleshoot Indian Tribe operates the Keta-Crisp Creek Fish Hatchery, a facility whose sole water source is Crisp Creek, a small spring-fed tributary in the Green River watershed. Growth in the watershed, including unincorporated King County and nearby city of Black Diamond, is converting land from forested, to mixed residential and commercial developments. The Tribe is concerned that continued forest cover loss, increased stormwater runoff, groundwater withdrawals and increases in contaminants that accompany development, will degrade the high quality creek water and deplete its summer base flow levels, leading to impairment of both the Tribe's water rights and fish health and reduced fish production at the hatchery.[8] Similar concerns apply to water resources for other hatcheries the Tribe relies upon for harvest within the Lake Washington, Green/Duwamish, and White/Puyallup watersheds.

Stormwater Runoff Connected to Pre-Spawning Mortality

A compound derived from tire wear, 6PPD-quinone, causes pre-spawning mortality in Coho salmon and acute toxicity in steelhead/rainbow trout. In the Muckleshoot Area of Interest, predictions have been made for areas where 6PPD will contribute to high pre-spawning mortality rates in Coho salmon.

Adult Coho salmon returning from the ocean to spawn in urban basins throughout the Puget Sound region are prematurely dying at alarming rates. A compound derived from tire wear, 6PPD-quinone (6PPD-Q), has been found to be one of many causes of pre-spawning mortality (PSM) in Coho salmon. When Coho salmon are returning to streams to spawn where 6PPD-Q is present, they can experience PSM and die before they get a chance to spawn.[1] Fish affected by 6PPD-Q become disoriented, show surface swimming, gaping, loss of equilibrium and death on a timescale of a few hours.[2]

In 2017, NOAA's Northwest Fisheries Science Center used computer models to predict PSM rates throughout Puget Sound. Their modeling supports the conclusion that Coho in more urbanized watersheds are vulnerable to nonpoint source pollution regardless of the timing, intensity and frequency of storms. Green Stormwater Infrastructure (GSI) will be essential for reducing the high rates of Coho losses in subbasins that are currently urban or suburban. It will also prevent mortality in rural and forested subbasins where Coho runs are presently healthy but vulnerable to future development pressures.[2]

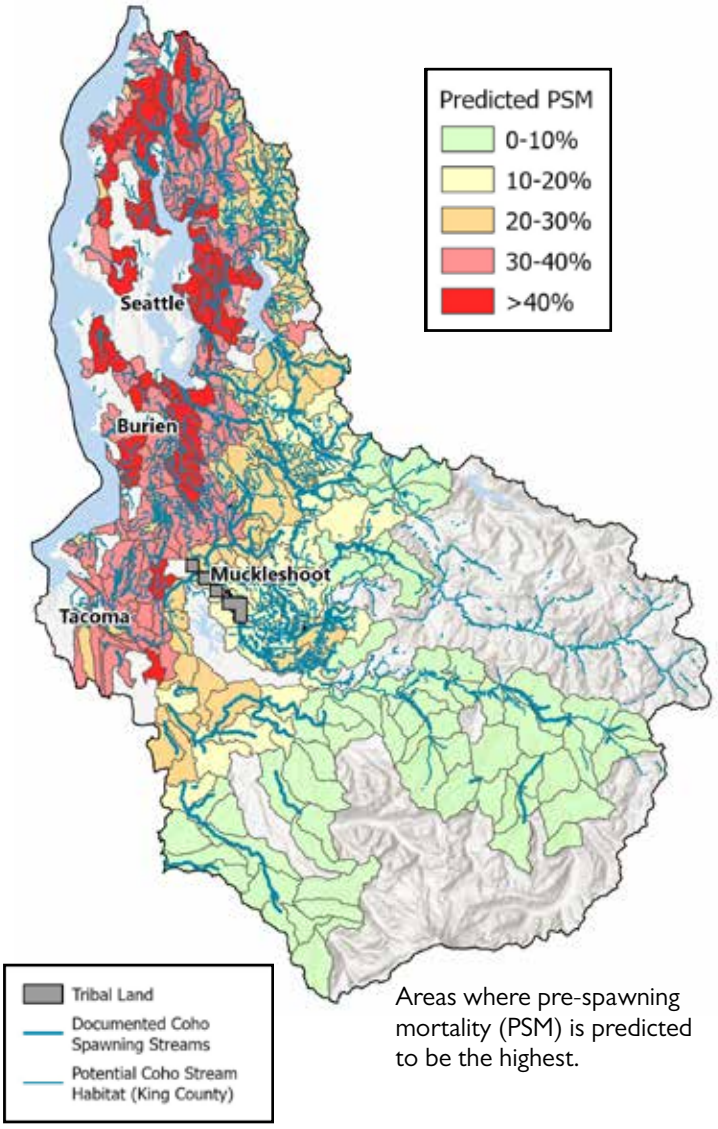
In October 2022, the Washington Department of Ecology published "6PPD in Road Runoff: Assessment and Mitigation Strategies" to identify which watersheds are particularly vulnerable to 6PPD-quinone pollution. It also summarizes current research on which actions have potential to reduce toxicity of 6PPD-Q.[3] In June 2022, Ecology also published an effectiveness study identifying best management practices that reduce the toxicity of 6PPD-Q in stormwater runoff.[4]

One of these is bioretention, which involves filtering stormwater through an engineered soil mix. This shows high potential for effectively reducing the toxicity of 6PPD and its byproduct 6PPD-Q.

Ecology's stormwater management manual specifies a standard mix of 60% sand and 40% compost in bioretention soil media used in GSI. Stormwater Action Monitoring put this mixture to the test and found that it prevents lethal stormwater impacts to adult Coho spawners. Bacteria, nutrients, metals and polycyclic aromatic hydrocarbons (PAHs) were measured and concentrations of all contaminants except arsenic, nickel and nutrients were also lower in filtered stormwater.[5]

Current research shows positive results in tests of a soil mix of sand, coconut fiber and wood ash called High Performance Bioretention Soil Mix (HPBSM) and in application of permeable pavement on roadways.[6] Specific filter media and permeable pavement layers are effective methods for removing 6PPD-Q, sediment, and some metals such as zinc and copper. An additional layer of sand placed under the primary layer is effective in removing phosphorus, a nutrient that promotes algae growth.

In 2024, King County amended its 2021 Surface Water Design Manual to include use of HPBSM for water quality treatment facilities and as an allowable flow control best management practice.[7]



Areas where pre-spawning mortality (PSM) is predicted to be the highest.

King County

A sedimentation pond and bioretention cell filling with stormwater runoff in Burien.

Map Data Sources: SSHIAP 2004[8], SWIFD 2024[9], WADOT 2018[10], WADOT 2010[11], PSM Predictions 2017[12], King County 2021[13]

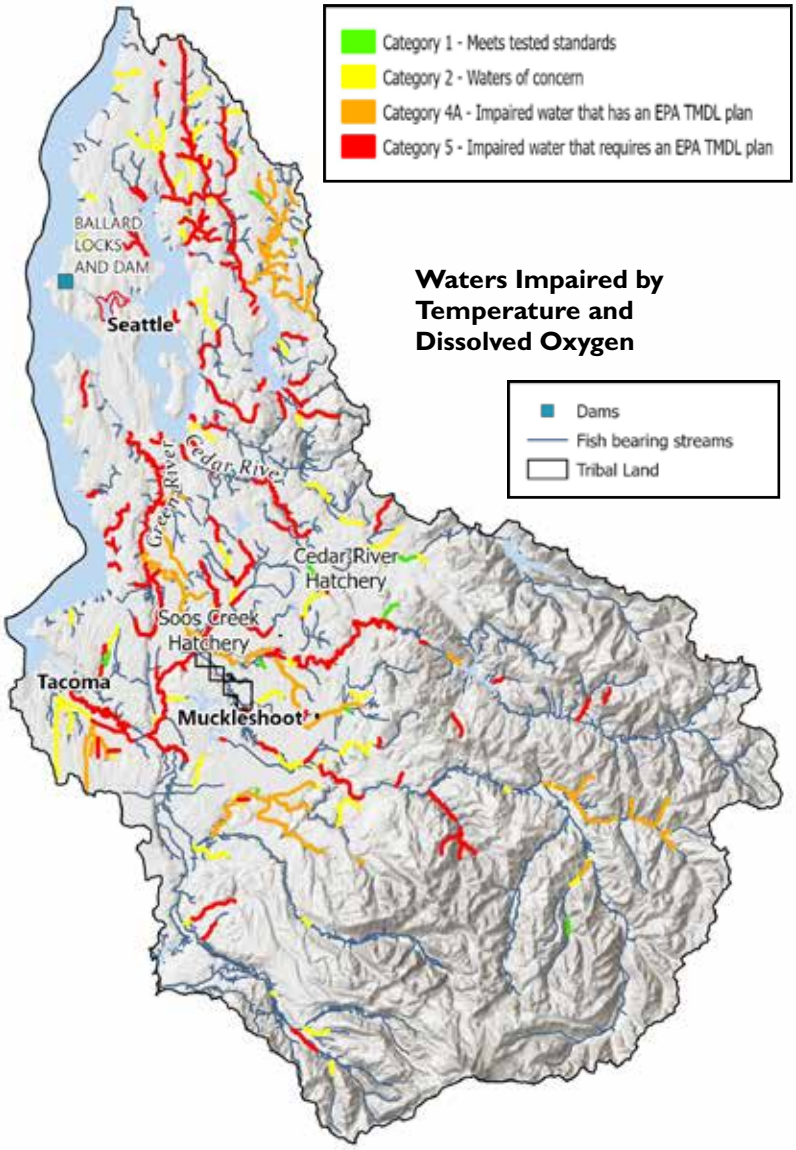
Water Quality Impairments Require Corrective Actions

Washington State Department of Ecology's current Water Quality Assessment lists approximately 167 waterbody segments as impaired for temperature and 298 waterbody segments as impaired for dissolved oxygen in the Cedar/Sammamish, Duwamish/Green and Puyallup/White river areas. In these Muckleshoot Areas of Interest, waterbody segments currently listed as impaired for water temperature and dissolved oxygen increased by 51 and 79, respectively, since the last assessment approved by EPA in 2012. [1]

Water temperature and dissolved oxygen are known to be significant limiting factors for survival of both juvenile and adult salmon. Fish stressed by multiple water quality parameters are less able to handle other stressors, such as toxic contaminants or pathogens.[2] The Lake Washington Ship Canal, the sole migration route for salmon to and from Lake Washington, routinely reaches temperatures of 21-23 °C by July each year, and lacks an approved water quality improvement plan. Seven-day average daily maximum temperatures in the lower Green River typically exceed 21° C, far exceeding the Washington state's surface water quality criteria of 16 °C and 17.5 °C that are established to protect core summer salmonid habitat and salmonid rearing and migration respectively.[1] These temperatures are high enough to promote disease outbreaks and pre-spawning mortality in migrating adult Chinook and other negative impacts on other species and/or life stages.

Under the Clean Water Act and in coordination with the Environmental Protection Agency, Ecology is responsible for developing water quality improvement plans for waterbody segments listed as impaired for not meeting standards to protect fish and other designated uses. These plans, also known as Total Maximum Daily Loads (TMDLs), are developed to identify corrective actions to address these impairments and to meet water quality standards.[3] Not only are these listed impairments increasing for water temperature and dissolved oxygen in the Muckleshoot waterbody Areas of Interest, but the implementation of corrective actions is hampered by land-use decisions and flood control facilities that are not regulated to comply with TMDLs.

In the lower Green River, the construction and maintenance of flood control facilities is a leading factor contributing to lethal temperatures and degraded salmon habitat in the lower 28 river miles. This river reach suffers from deficient tree shade, few deep pools for adult salmon, and essentially no natural floodplain rearing areas for salmon. Modeling conducted for Ecology's 2011 Green River TMDL found that tall tree shade along the lower river would reduce temperatures to meet or nearly meet the state temperature criteria.[4] However, the U.S. Army Corps of Engineers' PL 84-99 levee repair program in this river area mandates levee repairs with significant rock armoring, tree removals, and thinning that perpetuate ongoing habitat loss and thermal degradation despite mitigation measures. The lower Green River's entrenched and narrow confined condition within revetments and steeply sloped levees contributes to a cycle of repairs and reconstruction resulting in chronic impacts to habitat and to tribal fishing sites.



In 2016, the King County Flood Control District initiated a riparian restoration grant program called "Re-green the Green" to help address water temperatures in the lower Green River, using a voluntary approach and conservation easements. While some efforts by local jurisdictions have been made, more action is needed to improve water quality and avoid further degradation.

Map Data Sources: SSHIAP 2004[5], WADOT 2018[6], SWIFD 2024[7], WDFW 2013[8], USACE 2022[9], WAECY 2022[10]

Summer Flows Remain Low as Groundwater Exploitation Continues

Population increases in the Muckleshoot Area of Interest have been significant over the last 5 years. Land development activities associated with this population growth are closely correlated with factors that can decrease groundwater recharge and decrease summer streamflow, particularly groundwater extraction for public water supply and exportation of wastewater to treatment plants. There are more than 500 public groundwater sources (wells or springs) in selected watersheds in the Muckleshoot Area of Interest in King County alone. These wells are relatively shallow and are often in hydrologic connection with streams.

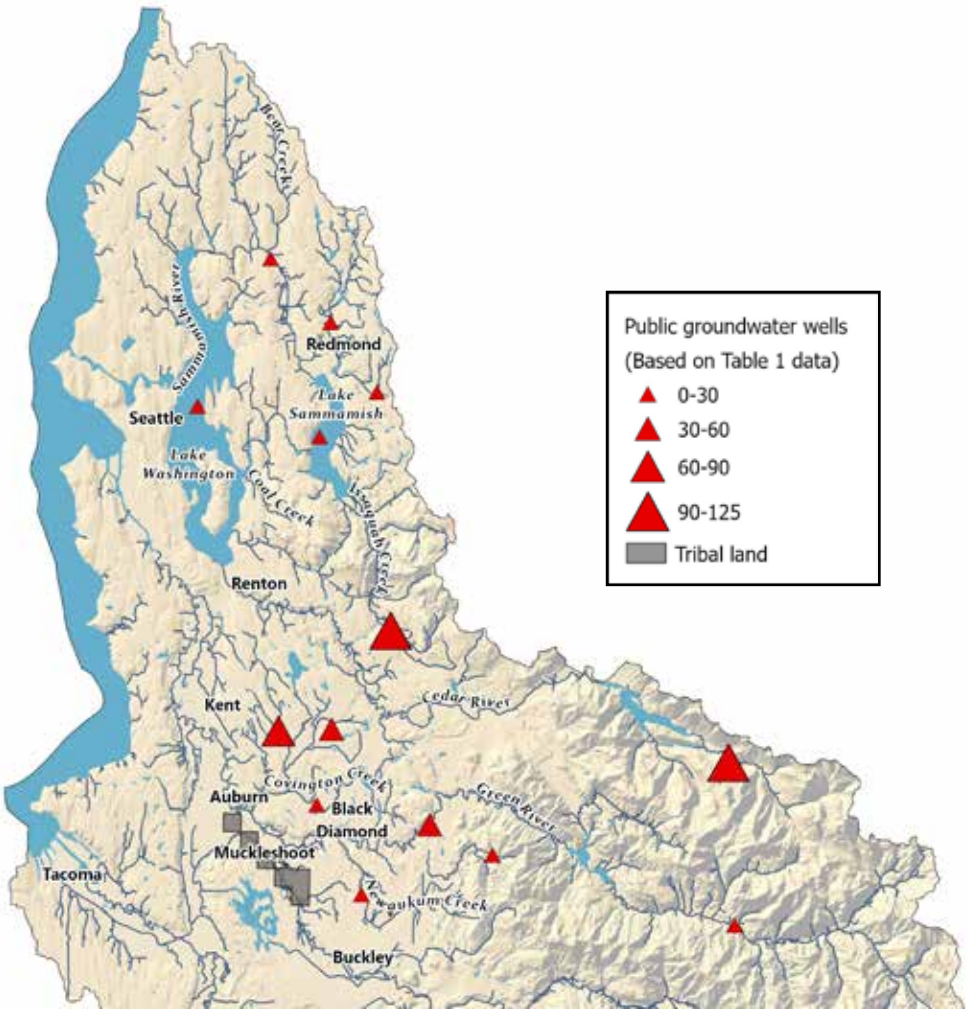
In the 4-year period from April 2020 to April 2024, the population of the central Puget Sound region increased by more than 250,000, despite a global pandemic.[1] King County has had the largest portion of the region's growth since 2022. While King County makes up 53% of the region's total population, King County accounted for 65% of the region's growth in 2024.[1]

Of the eight cities in central Puget Sound with the largest increases in population from 2023 to 2024, five are located in the Muckleshoot Area of Interest: Seattle, Tacoma, Redmond, Kent and Renton. In terms of cities with the highest population growth rates, three of the top eight are located in the Muckleshoot Area of Interest: Black Diamond, Buckley and Redmond.[1]

Land development activities associated with population growth are closely correlated with factors that can decrease groundwater recharge and decrease summer streamflow. These factors include the following:[2]

- Groundwater withdrawals
- Impervious surface coverage and soil compaction
- Rapid transmission of water from precipitation through storm sewers and modified channels
- Leakage of shallow groundwater into storm sewers
- Export of locally supplied water to wastewater treatment plants
- Export of groundwater via infiltration into wastewater collection systems

A recent study comparing climate change impacts and development impacts on summer low flows in Puget Sound streams suggests that future impacts of private wells and of reduced infiltration due to impervious cover may be relatively small compared to other impacts of urbanization, particularly export of wastewater to treatment plants outside focal basins when water is supplied from public wells within focal basins. The study further argues that uncertainty about future trends in low flows may have been underestimated.[2]



Public groundwater supply wells in the Muckleshoot Area of Interest tend to be relatively shallow (Table 1). The average depth of these wells is approximately 113 feet. These relatively shallow sources are more likely to impact streamflows, particularly in summer months when maximum water consumption occurs. Public water purveyors and municipalities with groundwater supplies that are hydrologically connected with streams within the Muckleshoot Area of Interest include Covington Water District, Lake Meridian Water District, Sammamish Plateau Water and Sewer District, Highline Water District, King County Water District 90, Northeast Sammamish Sewer and Water District, and the cities of Auburn, Enumclaw, Issaquah, Kent, Lakehaven, Redmond, Renton and Seattle.

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Map Data Sources: King County iMap3, SSHIAP 2004[4], WADOT 2018[5], WADOT 2010[6], SWIFD 2024[7]

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Stream	Number of Public Groundwater Wells[1]	Average Well Depth (feet)
Lower Cedar River	125	94
Issaquah Creek	98	147
Soos Creek	63	100
Middle Green River	52	81
Jenkins Creek	49	101
Lower Green River - East	26	150
Newaukum Creek	26	108
Bear Creek	20	144
Covington Creek	19	95
Coal Creek (Green)	17	85
Sammamish River	12	110
Evans Creek	11	245
West Lake Sammamish	11	167
East Lake Washington	10	45
Total	**539**	**113**

Table 1. Public water supply wells in selected watersheds in the Muckleshoot Area of Interest.[3]

Recommendations for mitigating and further evaluating impacts from groundwater withdrawals and from water exportation through stormwater and wastewater systems include the following:[2]

- Reducing infiltration and inflow to stormwater and wastewater pipelines and other conveyance components.
- Developing satellite wastewater treatment systems and associated groundwater recharge facilities to reduce exportation of wastewater from stream basins.
- Reducing outdoor water consumption by encouraging drought-tolerant and low-water landscaping.
- Mapping stream properties describing the degree of surface-groundwater interaction to identify critical areas.
- Reconstructing the history of development in watersheds to gain further insights about the impact on low flows of groundwater extraction and wastewater exportation.

Fish Barrier Culverts Continue to Impede Fish Passage

There are 6,071 barrier culverts impeding fish passage that are owned by the state, cities and counties, as well as private corporations and individuals in the Muckleshoot Area of Interest. Most of the barriers are owned by cities (2,042 barriers), followed by those owned by the counties (1,547 barriers) and privately owned (1,487 barriers). A federal court injunction requires Washington state to correct high-priority fish-blocking culverts by 2030. However, many barriers fall outside this requirement, such as those owned by cities, counties, or private landowners, which are only replaced when a culvert fails or a road project triggers construction.

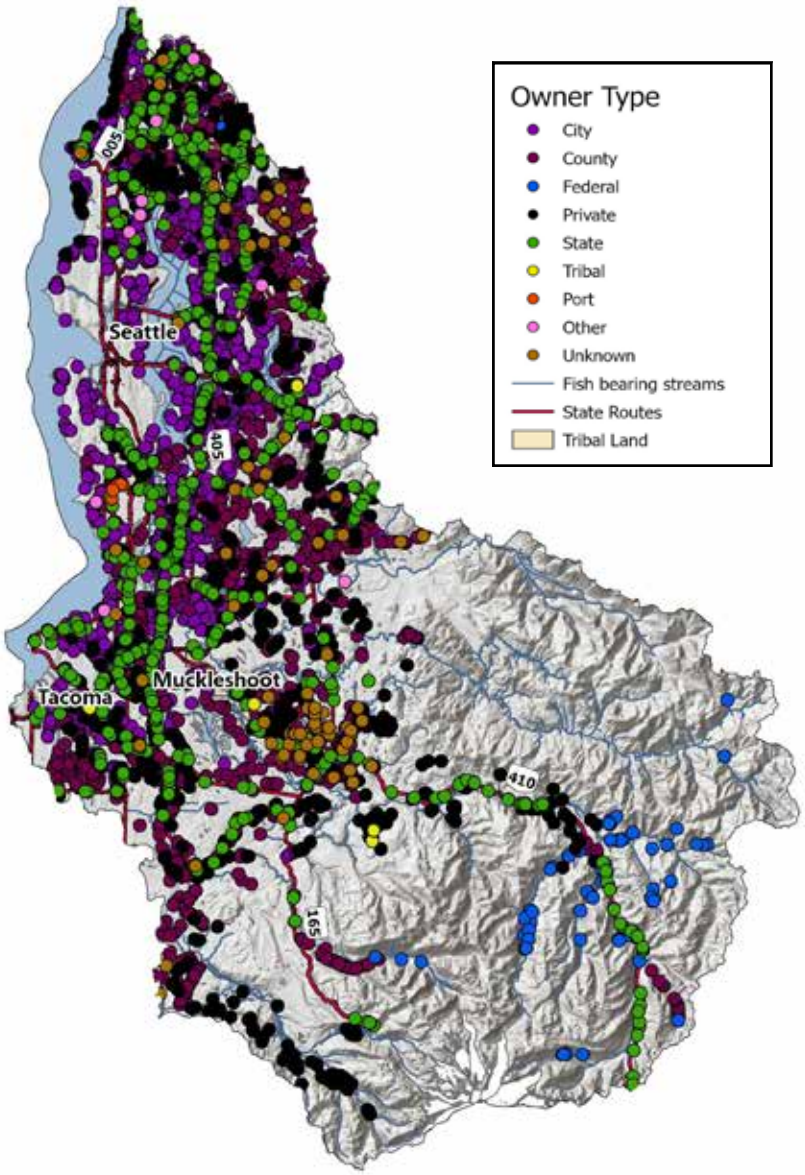
Culverts pass water under roads, railroad tracks and trails. Culverts can take a variety of forms, but if not properly designed, installed or maintained, they can severely impede fish passage. For migratory salmon, culverts with low flows, excessive velocity or perched outlets can block critical access to upstream spawning and rearing habitats. These structural barriers fragment habitat and contribute to long-term population declines. In urbanized watersheds with dense road networks, culverts are often the most widespread and chronic form of stream habitat fragmentation.[1,2] A federal court injunction requires Washington state to correct high-priority fish-blocking culverts by 2030.[3] However, many barriers fall outside this requirement, such as those owned by cities, counties or private landowners, which are only replaced when a culvert fails or a road project triggers construction.

Within the Muckleshoot Area of Interest, 6,071 culverts have been identified as barriers to fish passage. Of these, 2,042 are owned by cities, 1,547 by counties and 1,487 by private landowners. Additional ownership includes 736 by the state, 82 by the federal government and about 177 under other or unknown ownership categories.[4]

These culverts collectively block thousands of miles of stream habitat that could otherwise support salmon populations. The Washington State Recreation and Conservation Office (RCO) Salmon Recovery Progress reports that the state has so far removed 3,866 barriers blocking migrating fish, opening more than 5,000 miles of habitat.[5]

A similar investment in the Muckleshoot Area of Interest could yield comparable benefits—restoring connectivity and resilience for ESA-listed Chinook and steelhead, and Coho, Sockeye, Pink and Chum populations that are vital to Tribal fisheries.

More than 80% of the barrier culverts in the Muckleshoot area are owned by local governments and small private landowners. These entities face significant financial and technical challenges in removing barriers. Sustained funding and regulatory support are essential to accelerate progress and ensure that all fish—not just those blocked by state culverts—have a path to recovery.



Culvert replacement completed by King County in 2023.

King County

Map Data Sources: WDFW 2025[4], SSHIAP 2004[6], WADOT 2018[7], WADOT 2010[8], SWIFD 2024[9], WADOT 2024[10]

The Hiram M. Chittenden Locks and Lake Washington Ship Canal Create a Fish Passage Barrier for Salmon

The Hiram M. Chittenden Locks (Locks) do not meet current fish passage standards. Juvenile and adult salmon are delayed, injured, trapped and killed by the infrastructure and operation of the Locks and the Lake Washington Ship Canal. Marine mammal predation in and around the facility has been a serious concern since the 1980s.[1]

The Locks facility was built in 1916. It replaced a miles-long tidal estuary in the Black and Duwamish rivers with a fixed barrier in a newly constructed outlet to Lake Washington, resulting in one of the most modified estuaries on the West Coast of North America.[2] The Locks' "estuarine" location exacerbates water quality issues, starkly separating warm fresh water on one side from cool salt water on the other. This extreme difference is a shock to both juvenile salmon migrating to the ocean and to adult salmon migrating upstream to spawn.

Juvenile salmonids pass into and through the facility via several different routes—in spill over the dam or the smolt slides, through the lock chambers, the fish ladder, the unscreened lock chamber filling conduits or through the salt water drain.[3,4]

Juvenile salmon entering the filling conduits are subject to intense turbulent flow, shear stresses and impact with the walls. Passage into the saltwater drain is a dead-end; these fish become permanently trapped in the distribution well of the fish ladder.

Eric Warner, Muckleshoot Tribe

Ballard Locks from the East.

Eric Warner, Muckleshoot Tribe

Downstream end of drained large locks filling conduits with barnacles.

Juvenile salmon are delayed in multiple ways. Passage through the smolt slides is preferred when sufficient water is available, but this depends on the U.S. Army Corps of Engineers' assessment of its water budget.[5,6] Passage through the large locks route is not volitional, and smolts are often locked back upstream involuntarily, furthering their delay and re-exposing them to dangerous conditions in the Lake Washington Ship Canal.[7,8] Passage is delayed when surface temperatures become too warm. Delay exposes these fish to predators, like piscivorous birds, that capitalize on the passage failings. Gulls, terns, cormorants and great blue herons consume many smolts. Harbor seals consume many more, often congregating directly below the smolt slides.

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Eric Warner, Muckleshoot Tribe

Adult salmon have two passage options: the lock chambers or the fish ladder. Large locks passage has similar issues as for juveniles. Since passage is not volitional, fish may be involuntarily transported backwards in their migration. [9]

Juvenile and adult salmon experience temperature and osmotic (salinity) shock passing through the Locks. Regardless of the route, salmon experience the transition between warm fresh water and cool salt water instantaneously, rather than over a period of days to weeks.

The only volitional entry to the Lake Washington basin is the fish ladder, which is hazardous for adult passage. During peak Chinook migration, fish traversing the 22-step fish ladder may leave 13°C salt water (25 ppt salinity) to enter 23°C fresh water, separated only by a 6-meter thick dam. The top half of the ladder is substantially warmer than the lower section due to the lack of any cool saltwater drain input until the midpoint of the ladder. The 1970s-era raw concrete in the ladder causes abrasions and should be epoxy coated to minimize injuries.

Some Chinook exiting the ladder enter lethal or near lethal water temperatures and hold for up to a month and a half before migrating through the Lake Washington Ship Canal into Lake Washington.

Chinook hold upstream of the Locks in a deep sump area designed to collect and remove salt water that flows upstream with each lockage. Frequent lockages maintain good water quality here, without which temperatures would increase and dissolved oxygen levels would decrease. Prolonged exposure to elevated temperatures causes sub-lethal and lethal effects to adult salmon.[10,11]

Salmon that survive are more subject to predation and disease. Their eggs may have reduced hatching success.[12,13] This deep sump area is the site of at least two large fish kills in 2004 and 2007.

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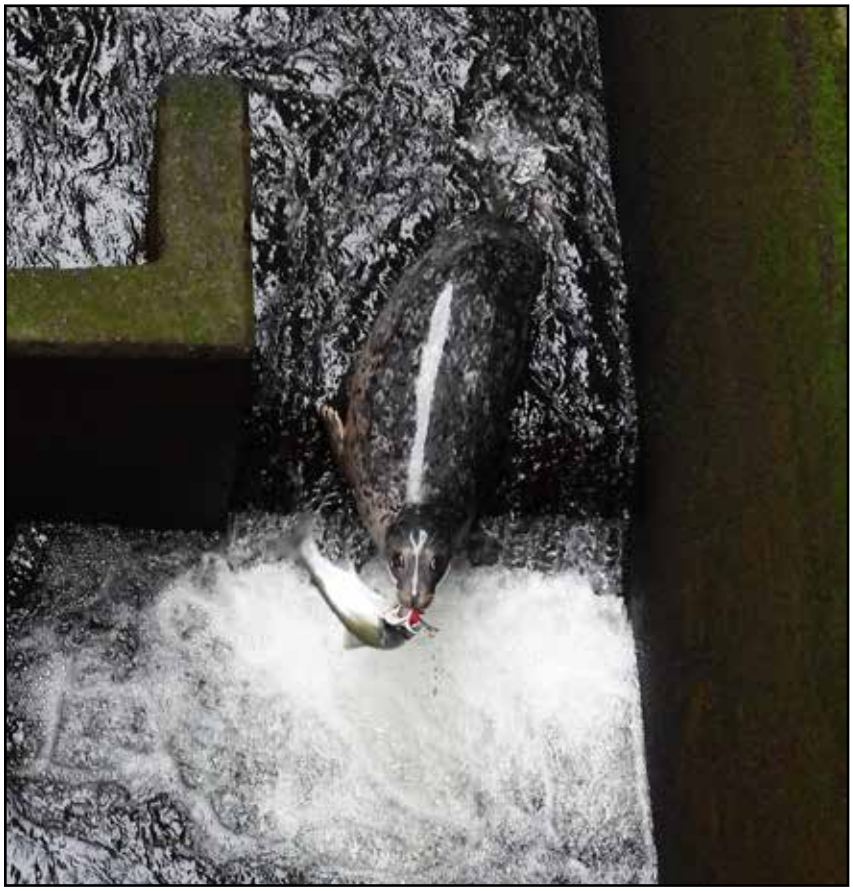

Eric Warner, Muckleshoot Tribe

Harbor seal with Sockeye in the fish ladder.

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Marine mammal predation has increased dramatically over the last few decades.[14] To enter the fish ladder, salmon must navigate through one of two narrow ladder openings (combined width 60-120 cm) while being pursued by seals or sea lions. Harbor seals now follow the fish into the ladder itself, up to seven at a time, to hunt salmon migrating upstream. The ladder needs a seal exclusion device on each end.[15] Predation also occurs in the lock chambers and many surviving fish are stressed and wounded.

The Lake Washington Ship Canal is designated as a Category 5 waterbody on Washington State's 303(d) List of Impaired Waterbodies, based on an observed violation of the water temperature criteria intended to prevent thermal barriers to salmonid migration. Barriers to adult salmonid migration are assumed to exist any time the temperature is greater than 22°C and the adjacent downstream water temperatures are 3°C or more cooler.

During some summer months, water temperatures in the Ship Canal create a thermal barrier that impedes the migration of adult Chinook as well as late-migrating smolts.[16]

Several essential improvements to the Locks facility and operation are required in the short term to mitigate impacts to salmon migration. These include, but are not limited to, epoxy coat the fish ladder, add additional saltwater drain flow to the top of the fish ladder, install pinniped exclusion devices on the ladder and add appropriate fish screens to the saltwater drain. Operationally, protocols must be developed for filling the locks to avoid killing smolts, the length of operation of the smolt slides should be extended and the area upstream of the locks should be managed as a Chinook refuge area with frequent lockages to maintain water quality in this critical zone. Securing funding to address these items must be a priority while longer-term solutions to the temperate barrier in the Lake Washington Ship Canal are addressed.

Eric Warner, Muckleshoot Tribe

Harbor seal in Locks tailrace with Chinook.

Eric Warner, Muckleshoot Tribe

Moribund Chinook losing equilibrium and swimming on its side (top fish) in the viewing window of the fish ladder.

Overwater Structures Negatively Impact Salmon Out-migration and Increase Predation in Lake Washington System

In Lake Sammamish, Lake Washington and the Lake Washington Ship Canal, approximately 4,000 docks impact lakeshore habitat by creating prime accommodations for salmon predators and significantly increasing the distance juvenile salmon must travel around docks to reach marine waters.

Every year, juvenile salmon use estuaries and nearshore habitat to rest and feed as they migrate to the ocean.[1] Natural shorelines provide complex habitat, which includes varied sediment sizes, dappled shade, leaves, twigs, branches, logs and varying depths for fish. Shoreline development, especially bulkheads and docks, simplifies this habitat.[2] The Lake Washington/Cedar/Sammamish Watershed (Water Resource Inventory Area 8) is home to several species of salmonids, including two populations of threatened Chinook salmon (Cedar and Sammamish populations), one population of threatened steelhead and a second population of steelhead that was extirpated.

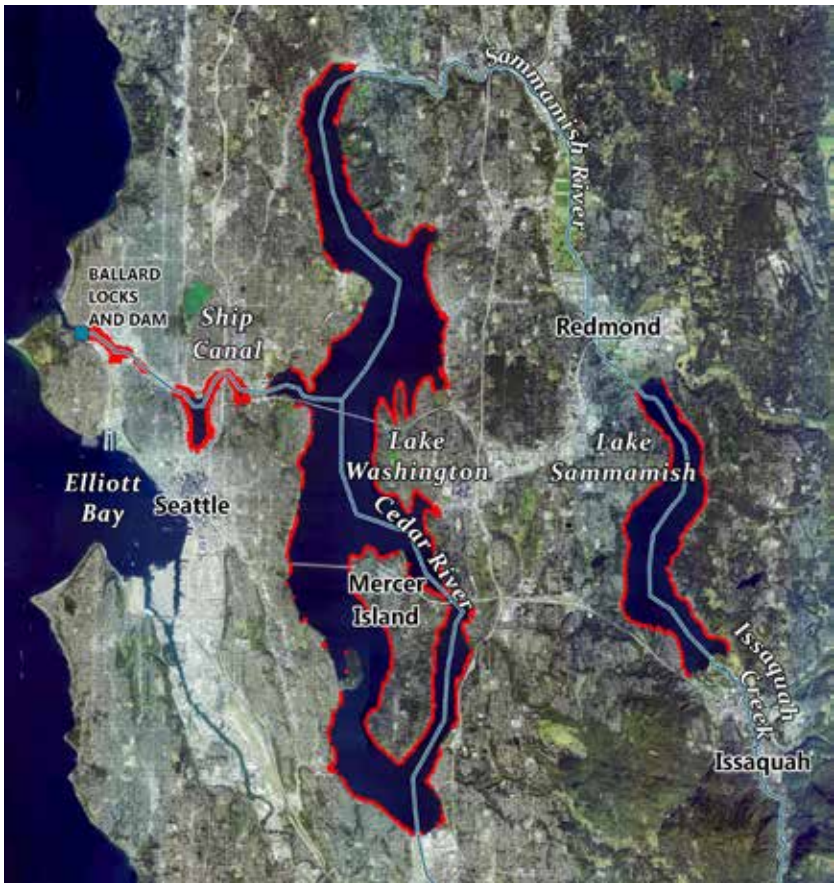
Lake-rearing juvenile Chinook use gently sloping sandy beaches with overhanging vegetation as refuge habitat. Shoreline modifications such as bulkheads and lakeshore armoring reduce habitat area and complexity for juvenile salmon. Over 70% of the shoreline on Lake Washington and Lake Sammamish is lined with bulkheads.[3]

Docks impact salmon in multiple ways. They eliminate spawning and feeding habitat, provide cover for predators, and disrupt the movement of sediment, causing beach erosion and impacting water depths around nearby structures. Docks also create shade; it can take 20-40 minutes for a salmon eye to adjust from light to dark, causing juvenile fish to swim out and around these structures.[3]

Research shows that migrating smolts in the Lake Washington/Cedar/Sammamish Watershed tend to swim around docks rather than underneath them.[4] This adds distance to their migration to marine waters, and as they swim out into deeper water within the lake, they are vulnerable to predators living there.[3] In Lake Washington alone, approximately 2,800 docks, including roughly 650 docks that line the shores of Mercer Island, impact smolt migration.[5]

Aaron Bosworth, WDFW

A yellow perch in Lake Washington that recently consumed a Chinook salmon smolt.



Privately owned docks are highlighted in red along the shores of Lake Sammamish, Lake Washington and the Lake Washington Ship Canal.

Shoreline alterations and invasive aquatic vegetation have reduced juvenile Chinook refuge habitat and increased habitat for non-native predators along hardened shorelines, under overwater structures, and within dense beds of aquatic weeds.

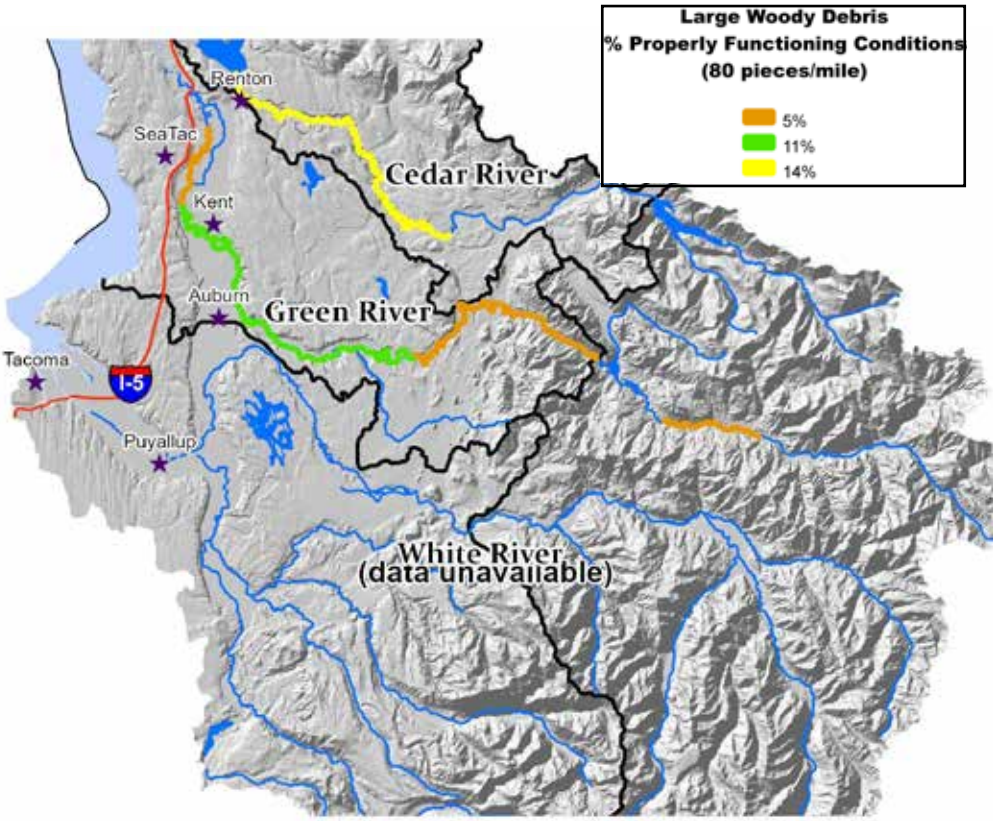
In recent years, yellow perch has emerged as an abundant predator of juvenile Chinook in Lake Washington, Lake Sammamish and the Lake Washington Ship Canal. Because of their tremendous abundance, yellow perch may have a higher predation impact on juvenile Chinook than other predators such as smallmouth bass, northern pikeminnow and cutthroat trout.[6]

Juvenile Chinook salmon would benefit from actions that reduce predation throughout their migratory and rearing corridors. There are several ways to improve conditions under or near docks, including using grated decking with openings that allow light to pass through, making ramps and walkways narrower, and designing docks so that the bottom of the entire structure is at least 18 inches above ordinary high water.[2] Bulkhead and dock removal, restoration of gently sloping sandy beaches, and removal of invasive aquatic vegetation would increase habitat for salmon while also decreasing habitat for predatory species.[6,7]

Map Data Sources: Esri, USDA FSA 2022[5], WADOT 2010[8], USACE 2022[9], SWIFD 2024[10]

Streams Still Lack Large Wood and Natural Habitat Features

Surveys indicate that the Lower Cedar and Green rivers contain less than 5% of the large wood pieces expected for healthy streams. This shortage of wood is a strong indicator that habitat complexity is severely lacking, not only in these rivers, but likely across other rivers in this region.



In-channel large woody material (LWM) and wood recruitment have been diminished compared to historic levels in many Pacific Northwest rivers, including the Green and Cedar rivers, due to logging of the streambank and clearing of floodplain forests for agriculture. Wood was also removed to address concerns about flooding, to facilitate navigation, and up until the late 1970s, to eliminate perceived barriers to upstream migration of salmonids. Reduction in in-stream LWM has been demonstrated to reduce fish population densities.[1]

Estimates of large woody material in the Cedar River fall significantly short of reference standards for Washington state.[2] The 2018 Cedar River wood survey found the monitored Capital Improvement Project reaches had LWM densities ranging from 8%-42% of the recommended target of 3,315 LWM pieces per mile (for rivers with 30-100 m bankfull width).[3] Similarly, for key wood pieces per river mile, field data show that current conditions are less than 20% of the 75th percentile regional targets across most reaches.[2,3]

Compared to both historic conditions and natural wood loads to which salmon are adapted, the Cedar River and other urbanized streams contain only a fraction of the necessary LWM to support properly functioning salmon habitat. Restoration of LWM in the Green-Duwamish and Lake Washington basins remains severely constrained by land use and policies prioritizing recreational river use. The Cedar, Green and Sammamish rivers are all designated recreational waterways by King County, where wood placement for restoration or mitigation is restricted. Wood considered hazardous to boaters or property is frequently removed, cut or repositioned, reducing the river's capacity to support essential habitat functions.

In recent decades, however, reintroducing LWM has emerged as a key restoration practice, helping to reestablish natural river processes and improve habitat diversity.[4] In King, Snohomish and Pierce Counties, LWM has been integrated into levee setbacks, revetment repairs, floodplain reconnection and habitat restoration projects. These efforts aim to reintroduce wood in natural volumes that mirror historical conditions to which salmon have adapted, increasing the likelihood of restoration success.[2] A prominent example is King County's Čakwab Levee Setback and Floodplain Restoration Project along the Green River, near the mouth of Burns Creek—an area of cultural significance to the Muckleshoot Indian Tribe.

Named Čakwab, meaning "something being taken to/towards the water,"[5] the project involved removing the Lones Levee (completed in 2021) and replanting native vegetation (in 2022).[6] Objectives included protecting adjacent agricultural land from erosion, restoring natural river dynamics, and expanding and diversifying salmon habitat. Approximately 600–800 trees removed from the levee and oxbow were redistributed across the floodplain as LWM to be naturally recruited over time, and nine engineered logjams were installed to further support erosion control.[3]

NOAA, Northwest Fisheries Science Center

Future LWM projects are essential to enhance hydraulic complexity, improve salmonid habitat features, and create refuges for salmon.

Map Data Sources: Draft Report 2018[9], King Co. 2011[10], SSHIAP 2004[11], USGS 2012[12], WADOT 2018a[13], WAECY 2018[14], WAECY 2000[15]

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Impervious Surface and Population Continue to Increase

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2025 State of Our Watersheds Report
Nisqually River Watershed

I am a Nisqually fisherman and, like my dad and his dad before him, the river flows through my veins. We need to be on the river to be whole. We need to always put our nets in the river and catch salmon forever because that is who we are. The work that we are doing in the Nisqually is aimed at making that real for generations to come.

– Willie Frank III
Nisqually Tribe

- - - Area of Concern

—— Area of Interest

Nisqually Indian Tribe

The Nisqually watershed is the center of the known universe. According to the tribe's creation story, first there was the Nisqually and then everything else followed.

It remains the center of the tribe's traditions, culture and exercise of its treaty rights that the tribe fought long and hard to have recognized.

The Nisqually have always been a fishing people. The salmon continues to be the mainstay of their diet, and the foundation of their culture as well.

The Nisqually Tribe is the recognized leader of stewardship of the Nisqually watershed's natural and cultural resources. In the 1854 Treaty of Medicine Creek, the Nisqually Tribe reserved their right to fish, hunt and gather in their traditional areas. Because of that constitutionally protected treaty between sovereigns, the federal government is obligated to protect those treaty-reserved trust resources.

This report will focus on the natural world of the Nisqually River basin and surrounding marine waters, the successes of the efforts of the tribe and its partners over the many years and the challenges of the future.

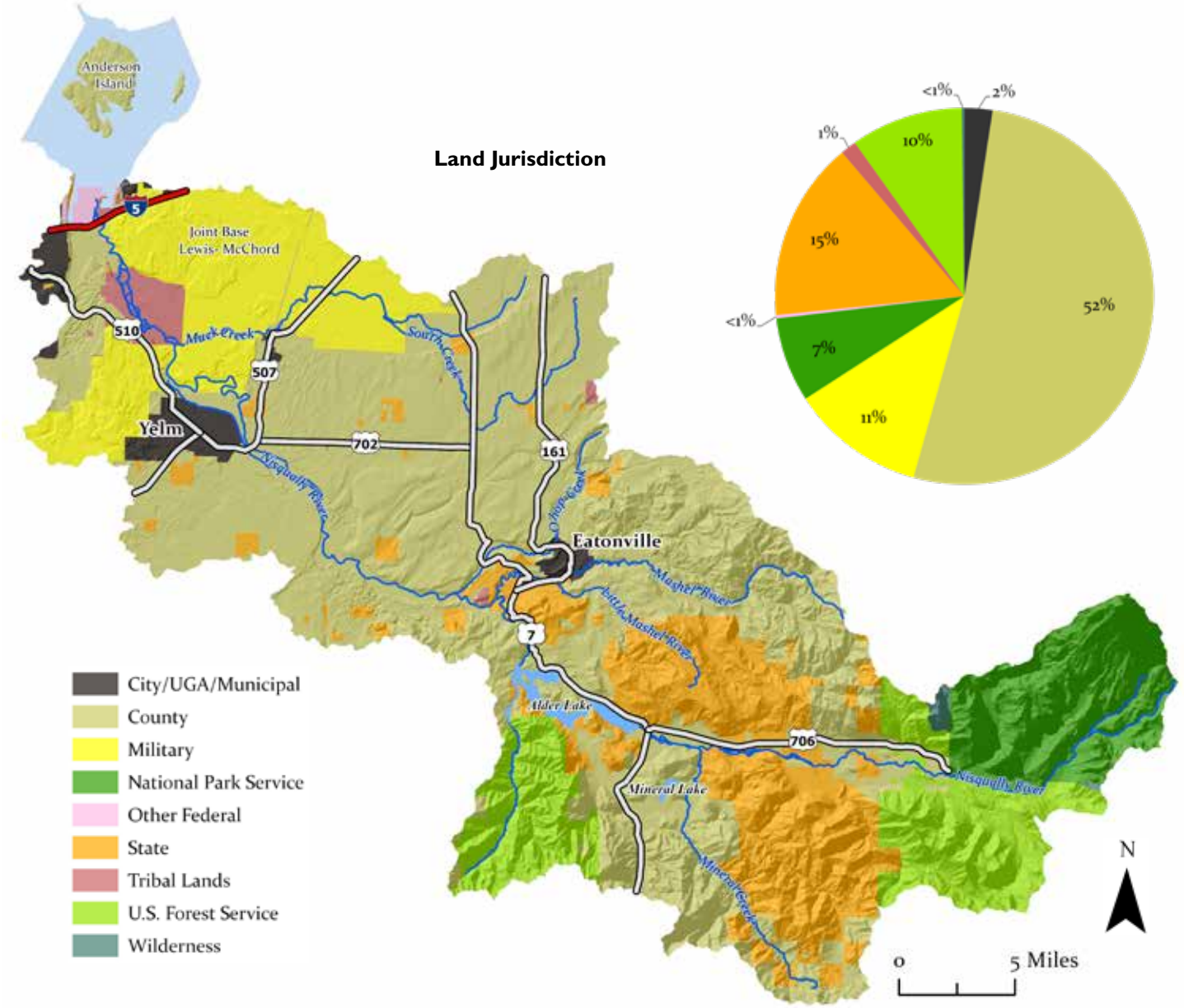
Nisqually Indian Tribe

Nisqually Watershed

The Nisqually River basin (WRIA 11) and the surrounding marine waters are the ancestral home of the Nisqually Indian Tribe. The basin includes the Nisqually River, which originates from five separate glaciers on Mount Rainier, including the Nisqually Glacier, to its delta at Puget Sound with a total drainage area of 720 square miles. The Nisqually is one of the least developed and most pristine major rivers in Washington state. The river flows through national and state parks and forests, public and private timberlands, municipal hydropower projects, farmlands, the Nisqually Indian Reservation, Fort Lewis and the Billy Frank Jr. Nisqually National Wildlife Refuge.

Based upon the Office of Financial Management population estimates, Thurston County population has increased by 42,529 or 16.9% from 2010-2020 and from 2020 to 2022, added another 5,707 or 1.9%.[1] Land use within the basin varies from agriculture in the valley bottom to forestry in the uplands, with increasing urban uses in several key areas in the watershed. The lower Nisqually watershed is one of the most intensely farmed basins in western Washington.[2]

Salmonid species existing within the basin include Chinook, Coho, Chum, coastal cutthroat, Pink, steelhead and bull trout. Chinook and steelhead are listed as threatened under the Endangered Species Act, while Coho are listed as a candidate. Treaty harvest has been significantly impacted by the reduction in abundance of most species of salmon and they are likely persisting in large part due to the aggressive protection and restoration actions led by the tribe.



Map Data Sources: DOD 2023[3], SSHIAP 2004[4], WADNR 2024a[5], WADNR 2024b[6], WAECY 2018c[7], WAECY 2021[8], WAECY 2024[9], WADOT 2018[10], WADOT 2023[11], USFWS 2024[12]

Chapter Summary

The Nisqually people have lived in the Nisqually River watershed for thousands of years. According to legend, the Squalli-absch (ancestors of the modern Nisqually Indian Tribe), came from the Great Basin and erected their first village in a basin now known as Skate Creek, just outside the Nisqually River watershed's southern boundary. Later, a major village would be located near the Mashel River. The Nisqually have always been a fishing people. The salmon has not only been the mainstay of their diet, but the foundation of their culture as well.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

For this report, the Nisqually Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Delta Recovery

Updates to infrastructure located in the Nisqually River Delta are needed to facilitate long-term recovery. New roadway and bridge structures on I-5 where it crosses the delta would reconnect historic channels to combat coastal squeeze, reduce flooding and increase resiliency.

Marine Mammal Predation Threatens Unique Late-Timed Nisqually Chum Salmon

Along the west coast of the United States, the number of California sea lions has risen as high as 300,000 individuals. A dramatic increase in California and Stellar sea lion utilization of the Nisqually River Delta has been observed between late November and early January, the same time as the Nisqually winter Chum salmon run.

Impacts to the Nearshore Threaten Shellfish

The Nisqually Indian Tribe Natural Resources Department has been conducting nearshore temperature monitoring since 2022, to contribute to research documenting the effects of temperature, salinity and pH on mortality rates of shellfish in the Puget Sound nearshore.

Shoreline Armoring Continues to Impact Forage Fish Spawning Habitat

In and around the Nisqually Reach, forage fish spawning locations have been impacted by shoreline armoring. It has been documented that 45% of sand lance and 55% of surf smelt spawning locations occur along shorelines with armoring greater than 50%.

New BNSF Relationships Show Promise for Large Scale Nearshore Restoration

Fish passage barrier locations along rail which runs adjacent to the shoreline have been prioritized for removal by BNSF rail near the Nisqually River Delta. The highest priority project is the Sequalitchew Creek Estuary and would include culvert removal and construction of a bridge or trestle-like structure to restore the fluvial processes of Sequalitchew Creek.

Fish Barrier Culverts Continue to Impede Fish Passage

There are 674 barrier culverts that are owned by the state, cities and counties, as well as private corporations and individuals in the Nisqually Watershed. Most of the barriers are owned by Pierce, Thurston or Lewis counties (296 barriers), or privately owned (201 barriers).

Impervious Surfaces Increase Slightly in the Nisqually Watershed

Between 2011 and 2021, impervious surfaces increased by approximately 1,249 acres (0.18%) within the Nisqually Areas of Interest and Concern (this does not include JBLM land).

Water Wells Increase Near Tributaries of the Nisqually River where Chinook Salmon Spawn

In the Nisqually Watershed, 7,726 water wells were installed between 1980-2019. Between 2020-2024, 355 water wells were added, a 4.6% increase. Most of the new wells are located between Yelm and Eatonville, along fish bearing streams that flow into the Nisqually River.

Muck Creek Watershed Has Lost its Climate Change Resilience Which Impacts Tribal Fishing Opportunities

Muck Creek Basin is the largest prairie system in the Nisqually River Watershed whose unique hydrology has driven the local adaptation of the Nisqually Chum, steelhead and Coho, but due to changes in the prairie ecosystem, it has lost much of its resilience to climate change. A comprehensive restoration plan needs to be developed to address habitat loss, low flow issues, and shoreline and wetland protection.

Biofiltration System Reduces Stormwater Impacts to Nearby Stream

A compound derived from tire wear, 6PPD-quinone (6PPD-Q), has been found to cause pre-spawning mortality in Coho salmon. Near Ohop Creek, the Nisqually Indian Tribe and partners have installed a pilot biofiltration system to capture and filter stormwater run-off from Highway 7. Preliminary results found that the system appears to be effective in removing over 90% of 6PPD-Q from untreated stormwater.

Protected Area Increases as the Nisqually Tribe Purchases Key Properties to Protect Important Tribal Resources

The purchase of key properties by the Nisqually Indian Tribe will protect and restore habitat and help counter failures in the Growth Management Act (GMA), Shoreline Management Act (SMA) and others.

Nisqually Community Forest Initiative

The Nisqually Indian Tribe and partners are changing the forest management paradigm to align with ecosystem recovery and management for culturally important forest resources. They are actively purchasing land rather than relying on regulatory processes to affect management and access. Tribal ownership guarantees access to hunting and gathering, and management can enhance those resources.

Conclusions

The Nisqually watershed has seen a few successes to the protection and restoration of habitat over the past decade but other habitat indicators have stayed the same or worsened. The number of water wells in the Nisqually watershed continued to grow, with most occurring in the central area of the watershed. Impervious surfaces have increased slightly, but with a looming threat of continued population growth, tribal leadership has concerns of the potential habitat impacts that come with it. Shoreline armoring continues to impact forage fish spawning habitat with little improvements. Even though restoration is occurring, it is not enough to keep up with the impacts of a growing population and their land-use decisions. Land use and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented. Implementation includes education and voluntary actions but also needs to include enforcement where those laws are broken. The future of treaty rights in the Nisqually River basin depend on it.

Population Growth and Groundwater Demands

At the 20-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Nisqually watershed shows that there are significant concerns with the continued growth of the watershed's population, especially in the middle of the watershed, along with the associated increase in water wells and impervious surface area. The continued restoration of marine shoreline habitat conditions remains a priority issue for the survival of the juvenile salmon leaving the Nisqually watershed. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects (e.g., Interstate 5 overpass/floodplain restoration) contribute to the slow pace of progress.

Review of the status of these key environmental indicators shows an improvement from protection efforts and restoration activities but a steady loss and/or real concerns for others.

Tribal Indicator	Status	Habitat Trend
Marine Mammal Predation	Along the west coast of the United States, the number of California sea lions has risen as high as 300,000 individuals. A dramatic increase in California and Stellar sea lion utilization of the Nisqually River Delta has been observed between late November and early January, the same time as the Nisqually winter chum salmon run.	Concerns
Shoreline Armoring / Forage Fish	In and around the Nisqually Reach, forage fish spawning locations have been impacted by shoreline armoring. It has been documented that 45% of sand lance and 55% of surf smelt spawning locations occur along shorelines with armoring greater than 50%.	Declining
Barrier Culverts	There are 674 barrier culverts that are owned by the state, cities and counties, as well as private corporations and individuals in the Nisqually Watershed. Most of the barriers are owned by Pierce, Thurston, or Lewis counties (296 barriers), or privately owned (201 barriers).	Concerns
Impervious Surface	Between 2011 and 2021, impervious surfaces increased by approximately 1,249 acres (0.18%) within the Nisqually Areas of Interest and Concern (this does not include JBLM land).	Declining
Water Wells	In the Nisqually Watershed, 7,726 water wells were installed between 1980-2019. Between 2020-2024, 355 water wells were added, a 4.6% increase. Most of the new wells are located between Yelm and Eatonville, along fish bearing streams that flow into the Nisqually River.	Declining
Water Quality - 6PPD-q Impacts	A compound derived from tire wear, 6PPD-quinone (6PPD-q), has been found to cause pre-spawning mortality in coho salmon. Near Ohop Creek, the Nisqually Indian Tribe and partners have installed a pilot biofiltration system to capture and filter stormwater run-off from Highway 7. Preliminary results found that the system appears to be effective in removing over 90% of 6PPD-q from untreated stormwater.	Concerns
Protected Areas Increase	The purchase of key properties by the Nisqually Indian Tribe will protect and restore habitat and help counter failures in the Growth Management Act (GMA), Shoreline Management Act (SMA), and others. Tribal ownership guarantees access to hunting and gathering and management can enhance those resources.	Improving

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the different species and the habitats they occupy.

Looking Ahead

Future projects, investigations and research efforts by the Nisqually Tribe:

- Seek planning and construction funding to complete NEPA process for complete reconfiguration of I-5 across the Nisqually Delta and begin construction within six years.
- Work on crafting a long-term management plan for the delta under a new I-5 configuration and the opportunity for significant restoration work.
- Develop plans for addressing substantial impacts to the habitat-forming processes in the delta, especially magnitude and delivery mechanisms of sediment.
- Continue research and monitoring in the delta restoration effort.
- Investigate effects of climate change-induced sea level rise and how it will impact delta structure and function if habitat-forming processes are not restored or enhanced.
- Continue building the size and ecological impact of our Community Forest project.
- Prepare for upcoming FERC relicensing of the Tacoma projects to better account for climate change, sediment delivery and salmon recovery.
- Using the I-5 configuration as a case study, continue to advocate for a shift in the current mitigation model to one aligned with improving the environmental baseline as a deliverable for all publicly funded projects as follows:

A New Model for Ecosystem Services Delivery from Publicly Funded Capital Projects

by David Troutt
Natural Resources Director, Nisqually Indian Tribe

Public investment in capital projects is a necessary outcome to a developing society. Economic health and quality of life are dependent on adequate transportation systems to support unencumbered movement of goods, services and people. Human health is dependent on clean water to drink and systems to treat our waste to levels that are compatible with human life and the other plants and animals that share this region. Proper handling of stormwater resulting from the impacts of our regional growth is critical to protect public and private rights and interests as well as to minimize pollution to our waterways and landscapes.

All of these publicly funded projects to solve various societal challenges come with their own problems. Many of these projects in the Puget Sound region are built along our lakes, streams and marine waters, and have significant associated environmental impacts. Our regulatory structures, from federal regulations to local ordinances, have been developed to facilitate these infrastructure investments for the public good while minimizing the negative environmental impact. The common mechanism to achieve these desired outcomes has been through mitigation, or offsets, to attempt to balance the environmental equation with the impacts associated

with growth. These systems have failed to deliver and the result is a continually degraded ecosystem. This fact is evident in the Endangered Species Act designation of fish, plants and animals in every watershed in the Puget Sound region with the key listing factor given as degraded and loss of habitat.

There are several fundamental flaws associated with this approach that have become abundantly clear over the past 40 years of implementation. The first is that the intent for most, if not all, of these programs is to minimize the impacts and, at best, result in no net loss of environmental function as a result of the project. No net loss mitigation could be a workable model if the ecosystem were functional and resilient enough to absorb the additional stress of a given infrastructure project. In most cases, and most certainly in and around urban areas, the impact of growth and human habitation has resulted in a significantly degraded environmental baseline so these critical systems have lost their resiliency. Since the intent of mitigation is generally to result in no net loss, the best-case scenario is a degraded environment that is no worse, and certainly no better, than before the project.

Second, the mitigation of these large capital projects are usually located "onsite" or adjacent to the impact caused by the infrastructure project. These locations are typically in degraded environments with heavily impaired ecosystem processes, which lead to a failure of most onsite mitigation projects. The regulations governing mitigation for infrastructure project impacts inhibit the ability to conduct mitigation in areas that have the best chance for increasing the environmental baseline of a given watershed. The end result of the current onsite and no net loss mitigation paradigm is a failure rate in excess of 80% and an ever increasing rate of widespread environmental degradation.

Third, the mitigation requirements are burdensome obligations to project proponents whose goal is the successful implementation of the capital project. Large-scale transportation projects may cost billions of dollars and do not spend equivalent amounts on achieving environmental outcomes. These projects are evaluated on their success to move traffic, goods, services, stormwater and wastewater, and not on the mitigation of the associated impacts. Infrastructure projects will be maintained and reconstructed if they do not achieve their desired outcomes; mitigation projects do not receive similar attention and resources if they fail.

The goal of no net loss, the location of mitigation projects in failing ecosystems, and the lack of accountability for success have all resulted in a net loss of ecosystem function associated with publicly funded infrastructure across the Puget Sound region. As a result, salmon are disappearing. Orcas are starving. Tribal treaty rights are not being honored. Local jobs and economies are being impacted. The adage of leaving the world better for the next generation is being subverted by our system of infrastructure investment and environmental mitigation.

This needs to change and change now. We are proposing a new way at looking at public investment and environmental outcomes. We are proposing that a deliverable for all publicly funded capital projects be a measurable improvement to the existing environmental baseline and an increase in the ecosystem services. Our proposal would effectively link the health of the human economy to the health of the natural economy. This idea would leave the natural world in a better place than before the project.

This could be accomplished by requiring as a project deliverable an implemented plan of action, developed by a team of local experts (including the tribes), to achieve a stated environmental outcome aligned with local conditions and goals for functioning habitat. This project element would receive the same amount of scrutiny, attention, resources, monitoring, maintenance and corrective actions as the road or bridge or wastewater treatment facility.

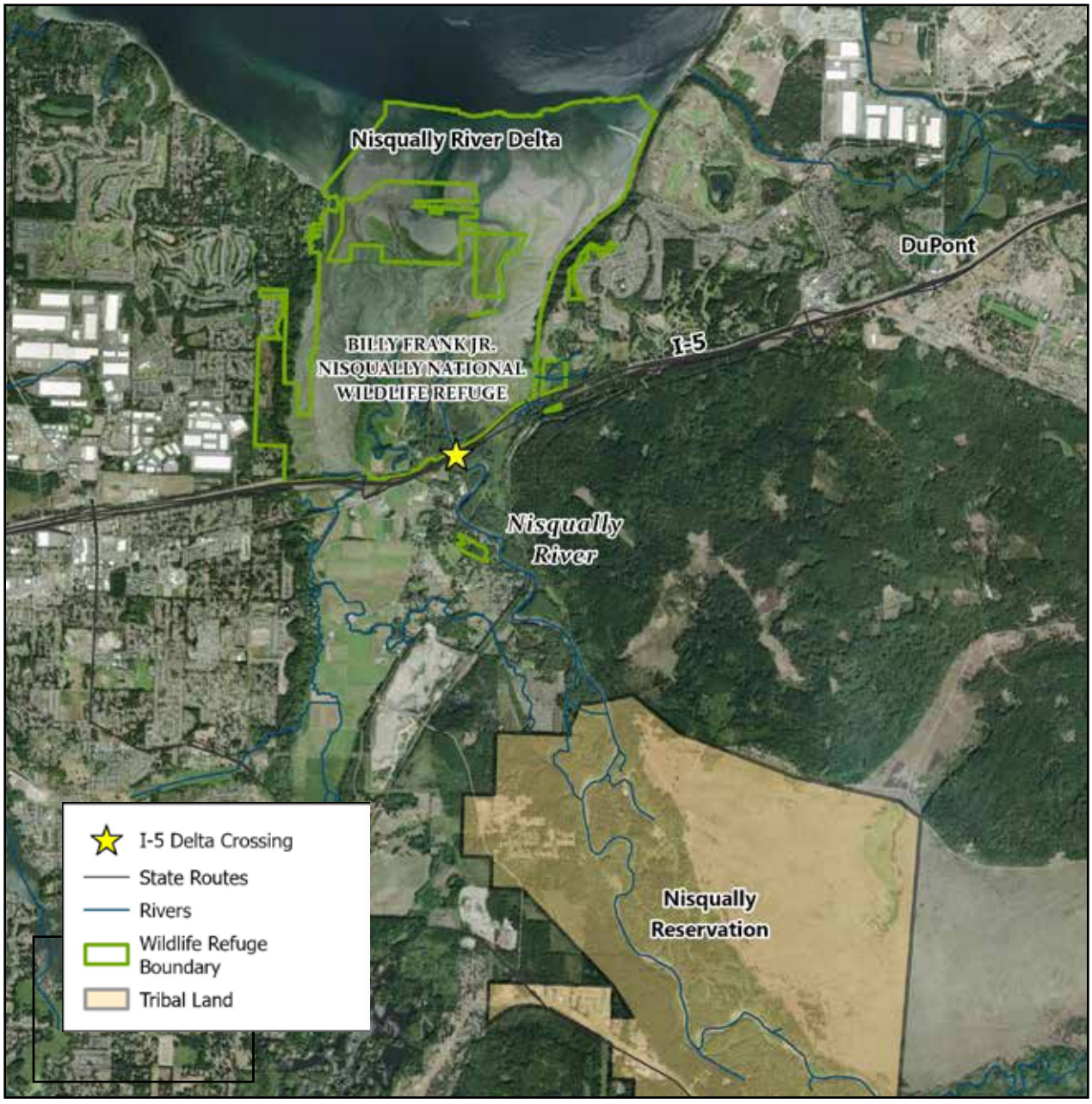
There are places and projects that could serve as models for this kind of effort. The crossing of the Nisqually Delta by I-5 has created significant but reversible negative impacts to the estuary and upstream private property. The Nisqually Indian Tribe, working with all of our partners in South Sound including the Washington State Department of Transportation, is leading an effort to incorporate a large scale transportation project into a significantly increased environmental baseline for the watershed. Although still in the planning phase, there is tremendous promise in this new model. The challenge will be keeping this momentum and mutually shared desired outcomes in the face of regulatory systems that do not promote this paradigm.

This model can be easily exported throughout Puget Sound to include all publicly funded infrastructure. This single yet important action can significantly alter the trajectory of our regional ecosystems and all of the things we care most about from clean air and water to more salmon and orcas. We are at a critical point in our existence in this region and its ability to support all of us and the natural world around us.

Time is not our friend. If we are to have any chance at recovery in our lifetimes before we lose more populations of salmon and our resident orcas, this action is needed now. If we are to expect the public sector to lead in this issue and reduce the burden on private property landowners, this action is needed now. If we want to leave this world a better place than when we found it, we need action now.

Delta Recovery

As restoration and monitoring continues in the Nisqually River Delta, updates to infrastructure are needed to facilitate long-term recovery. New roadway and bridge structures on I-5 where it crosses the delta would reconnect historic channels to combat coastal squeeze, reduce flooding,and increase resiliency.



Restoration of the Nisqually Delta at the Billy Frank Jr. Nisqually National Wildlife Refuge was completed in 2009. Since then, the Nisqually Indian Tribe and partners have implemented several years of research and monitoring, which has indicated that space and food available for juvenile Chinook has dramatically increased.[1] Sea level rise threatens the resiliency of the Nisqually tidal marsh moving forward.[2] One option to reduce the effects of sea level rise is to increase the supply of sediment from the Nisqually River Watershed to the wetlands in the delta.[3]

One way to accomplish this is to open up the Delta and surrounding habitat by retrofitting I-5 to a system that allows for increased flow exchange. Planning is underway by the Washington State Department of Transportation to add new roadway and bridge structures along I-5 where it crosses the Nisqually River Delta.[4] The fill associated with the I-5 crossing has resulted in the loss of historical estuarine habitat[5] and the removal of this fill would reconnect historic channels and improve the hydrology, functions and habitat value of existing wetlands.[4] Completion of this project would also allow the channel to migrate more freely and for the delta to be able to handle climate change impacts such as flooding and sea level rise.[3] Overall, the project is a case study in integrating infrastructure investments with ecosystem recovery.

Map Data Sources: SSHIAP 2004[6], WADOT 2018[7], SWIFD 2024[8], WADOT 2023[9], USFWS 2024[10]

Marine Mammal Predation Threatens Unique Late-Timed Nisqually Chum Salmon

Along the West Coast of the United States, the number of California sea lions has risen as high as 300,000 individuals. A dramatic increase in California and Stellar sea lion utilization of the Nisqually River Delta has been observed between late November and early January, the same time as the Nisqually winter Chum salmon run.

The Marine Mammal Protection Act (MMPA) is a federal law passed in 1972 to protect marine mammal population declines due to human activities. Its protections have stopped the decline of many populations and led to the recovery of several, such as humpback whales, gray whales and gray seals.[1] In Washington state marine waters, the MMPA has been successful at rebuilding the abundances of harbor seals, California sea lions and Steller sea lions.

Between 1975 and 2015, harbor seal populations in the Salish Sea grew from about 8,500 to nearly 78,000 individuals. Along the west coast of the United States, the number of California sea lions has risen as high as 300,000 individuals.[2] Large increases in harbor seal predation on smolts coupled with predation on adult salmon by seals and sea lions has impacted salmon recovery efforts in the Puget Sound. In a report prepared for the Washington Department of Fish and Wildlife, evidence taken together supports the hypothesis that current populations of pinnipeds are a contributing factor in the decline and depression of salmon populations in Washington state waters.[3]

Nisqually Indian Tribe fishermen and Nisqually Indian Tribe Natural Resources Department staff have observed a dramatic increase in California and Stellar sea lion utilization of the Nisqually River Delta between late November and early January. The sea lions appear to time their migration to overlap with the Nisqually winter Chum salmon run, which also overlaps with the Nisqually winter steelhead run. Nisqually winter Chum support a culturally and economically important fishery for the tribe and Nisqually winter steelhead are listed as 'threatened' under the federal Endangered Species Act.[4] In an NPR interview with Nisqually chairman Willie Frank III, he talks about seals and sea lions going after salmon in the Nisqually River: "…these are areas where they never used to come. They wouldn't come up to the I-5 bridge, but now they go well past that…I think the ecosystem is out of balance. You know, I've been fishing for 20 years and I'm seeing every day the lack of salmon coming back to the river. I mean, we used to catch 200-300 fish Sunday and Monday during King season…we're lucky to catch 100 fish now, the whole season."[5]

Parker Miles Blohm, KNKX

Nisqually Indian Tribe fishermen tend their nets at Frank's Landing on the Nisqually River.

Steve Ringman, The Seattle Times

A sea lion captures a Chum salmon swimming upstream to spawn in the Nisqually River.

Impacts to the Nearshore Threaten Shellfish

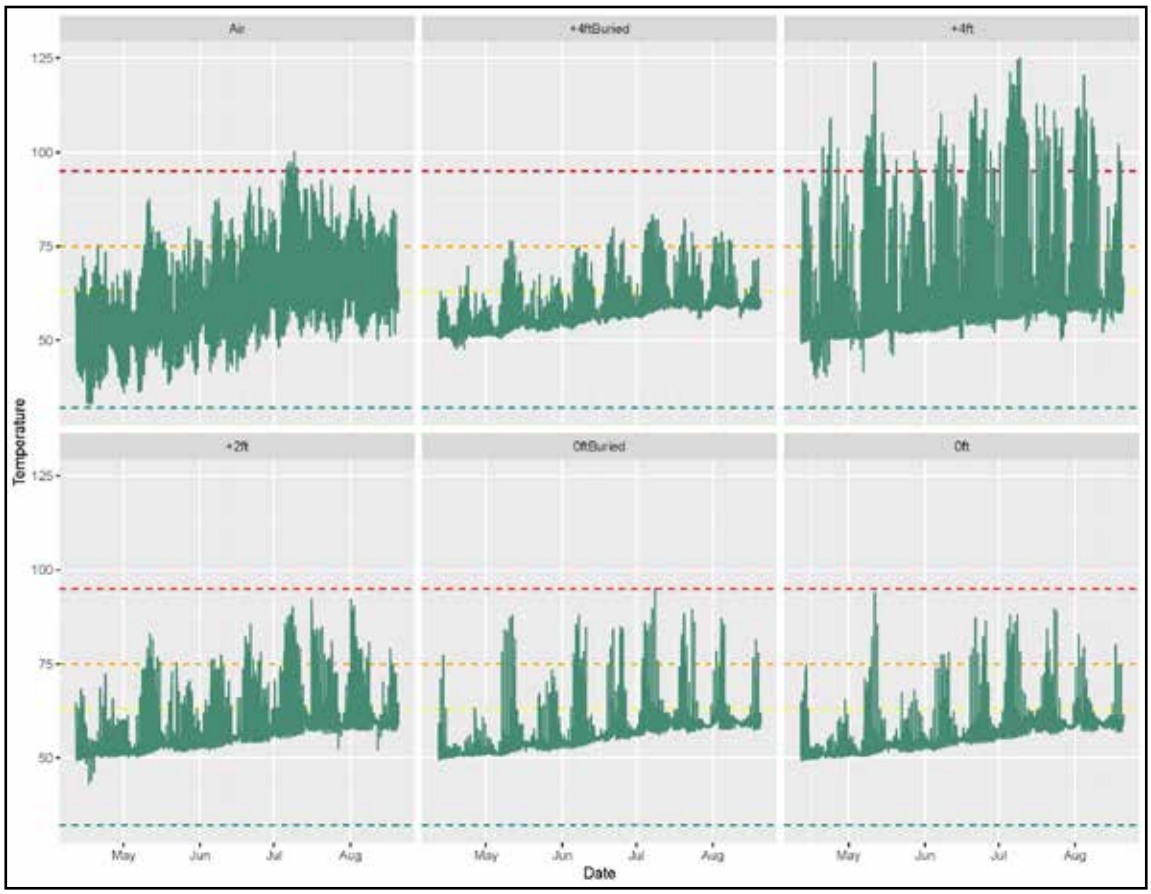
The intertidal zone and nearshore environment provide critical habitat for many culturally and economically important species including out-migrating salmon, juvenile Dungeness crab, and mollusks such as geoduck. The nearshore, however, is highly dynamic and the organisms that live in this area are vulnerable to a number of different stressors including climate change events like increased storm surge and marine heat waves.

From late June through early July 2021, the Pacific Northwest region experienced an unprecedented atmospheric heat wave known as the "Heatdome" that would have been virtually impossible without human-caused climate change. All-time heat records were set in multiple cities including Seattle, which set a heat record of 104°F on June 27, followed by a record of 108°F on June 28. The lowest tides of the year also fell between June 26 and 28, which led to reported mass mortalities of barnacles, mussels, clams and oysters on intertidal beaches during and immediately following the event.[1,2]

Impacts to the nearshore however can be seen even without climate events. Physical parameters such as temperature, salinity and pH have a large impact on the ecology and health of shellfish in the nearshore. Growth, local distribution and mortality rates are related to water temperature, salinity and pH in species such as the Olympia oyster,[3] native littleneck clams[4] and intertidal crabs (including juvenile Dungeness crabs)[5] which use the nearshore as nursery habitat.[6]

Warmer water temperatures seen in the summer months pose a threat to commercial oyster harvest as the growth rates of naturally occurring foodborne pathogens such as Vibrio increase dramatically at temperatures above 55°F and can cause severe stomach problems in humans, leading to food recalls and harvest closures.[7] Warmer waters can also increase the toxicity of certain species of harmful algae. In species such as *Alexandrium catenella*, growth rates and the production of toxins increase at temperatures above 56°F.[8] Shellfish eat those algae and can retain toxins. This can cause Paralytic shellfish poisoning when humans eat contaminated shellfish, leading to recalls, harvest closures and lower market demand.

Despite the complexity of the nearshore and the impact of nearshore environmental parameters such as temperature and salinity, we have a limited number of observation systems in the Puget Sound, and none provide measurements of intertidal parameters that are readily accessible to fisheries co-managers and researchers. The Nisqually Indian Tribe Natural Resources Department has been conducting nearshore temperature monitoring since 2022, with the goal of having a long-term record of parameters such as temperature and salinity across tidal heights and habitats that can be used in conjunction with other studies such as the work conducted by the Pacific Crab Research Group.[9,10]



Nisqually Indian Tribe Department of Natural Resources temperature data from 2024. Colored lines represent temperatures that affect shellfish in the nearshore.

Red: Pacific oysters and manila clams start to die at temperatures above 95°F

Orange: Littleneck clams start to die at temperatures above 75°F

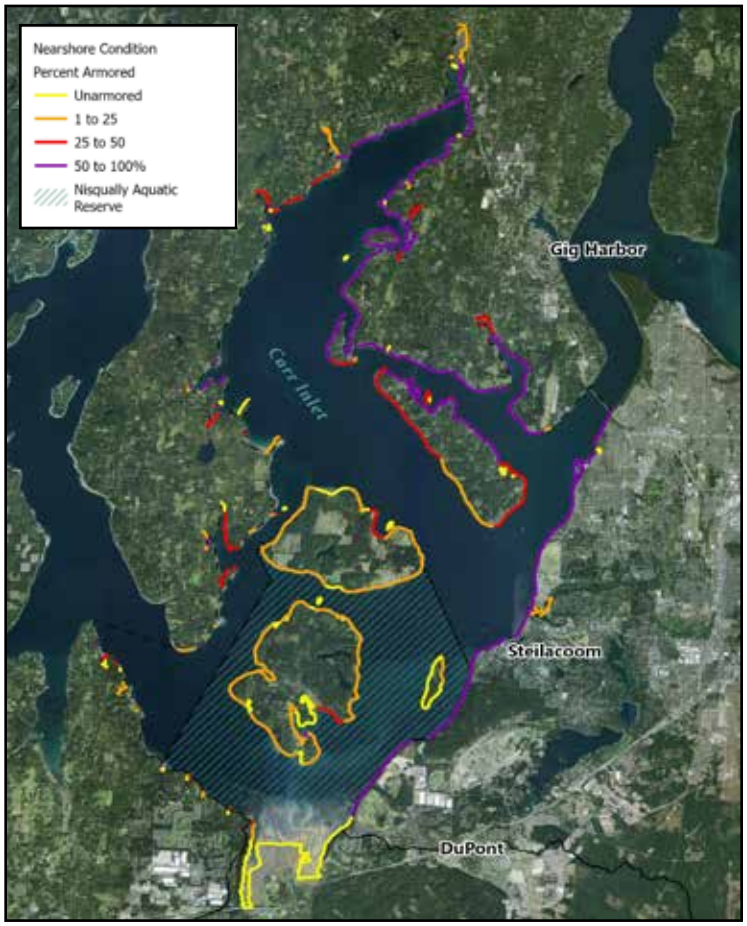
Yellow: Dungeness crab start to die at temperatures above 63°F

Blue: Many species die at temperatures below 32°F

Shoreline Armoring Continues to Impact Forage Fish Spawning Habitat

In and around the Nisqually Reach, forage fish spawning locations have been documented, with 45% of sand lance and 55% of surf smelt spawning locations occurring along shorelines with significant armoring (50-100%).

Shoreline armoring impacts ecosystem processes, structure and function in the nearshore environment. Armoring can block sediment supply, reduce the abundance of large woody debris on beaches, and cause the direct loss of forage fish spawning habitat.[1] The three most common forage fish species in the Puget Sound basin are surf smelt, Pacific sand lance and Pacific herring. Surf smelt and Pacific sand lance lay their eggs in sand and gravel on intertidal beaches, while Pacific herring spawn on marine vegetation such as eelgrass in shallow subtidal and low intertidal areas.[2] As a result of climate change, sea level rise and warming ocean temperatures are projected to impact the distribution and health of eelgrass beds. As water levels rise, eelgrass will need to grow closer to the shore, as it cannot survive in depths greater than 10 meters deep. If shoreline armoring is present, eelgrass growing areas will potentially become constricted. This could result in a loss of spawning and rearing habitat for forage fish and juvenile salmon.[3]



Nearshore conditions in and around the Nisqually Reach, with percent armored shoreline ranging from unarmored (yellow) to significantly armored, or 50-100% (purple).

Forage fish spawning locations in and around the Nisqually Reach, with 45% of sand lance and 55% of surf smelt spawning locations occurring along shorelines with significant armoring.

The Salish Sea Marine Survival Project found that the most significant problems killing juvenile salmon in Puget Sound and the Strait of Georgia are climate-driven changes to the salmon food supply and a dramatic increase in predators.[4] Changes in plankton and forage fish at the base of the food web mean that less food is available for juvenile salmon when they need it. Forage fish such as herring provide a high energy food source for salmon and help reduce predation on juvenile salmon because other fish, marine mammals and birds consume forage fish too.

The Nisqually Indian Tribe has traditionally harvested Pacific herring eggs from a now absent spawning population near Sequalitchew. The tribe has partnered with Long Live The Kings to monitor herring and understand their abundance and use within Nisqually Reach. Results of this work will inform salmon and herring recovery actions in the area.[5]

Map Data Sources: CGS 2020[6], WADNR 2018[7], WDFW 2020a[8], WDFW 2020b[9]

New BNSF Relationships Show Promise for Large Scale Nearshore Restoration

Fish passage barrier locations along rail which runs adjacent to the shoreline have been prioritized for removal by BNSF rail near the Nisqually River Delta. The highest priority project is the Sequalitchew Creek Estuary and would include culvert removal and construction of a bridge or trestle-like structure to restore the fluvial processes of Sequalitchew Creek.

Confluence Environmental Company

BNSF train on a track adjacent to the shoreline in Puget Sound.

The Burlington Northern Santa Fe (BNSF) rail corridor encompasses 52 miles of rail which runs adjacent to the shoreline and another 21 miles of track located within 200 feet of the shoreline in Puget Sound. The railroad causeway forms a barrier between the coastal watershed and the shoreline, restricting the movement of fish as well as affecting the ecosystem processes regulating the delivery of water, sediment, wood and organic matter into the nearshore.[1]

The Nisqually Indian Tribe has been trying to work with BNSF for the past 20 years to restore pocket estuaries north of the Nisqually delta, and recent interactions show promise for restoration projects to move forward. BNSF has prioritized fish passage barrier locations near the Nisqually delta, with the Sequalitchew Creek Estuary listed as the highest priority for restoration. This project would include culvert removal and construction of a bridge trestle-like structure that will provide unimpeded fish passage as well as sediment transport and other critical estuarine processes. The creek historically supported runs of Coho and Chum salmon and the greatest user of habitat on the north side of the culvert are juvenile Chinook salmon.[2]

The Nisqually Indian Tribe is encouraged by the collaborative efforts of BNSF and the progress of prioritizing and moving forward with fish passage barrier removal projects along the rail corridor in Puget Sound. However, coastal streams and pocket estuaries that don't have natal fish passage are key habitats for salmon, especially juvenile Chinook.[3,4] Long-term, the tribe hopes to collaborate and work together to address all crossings impacting nearshore habitat.

Location of the highest priority restoration site on the BNSF rail corridor near Nisqually.

Pacific Marine and Estuarine Fish Habitat Partnership

Railroad causeway and culvert at Sequalitchew Creek.

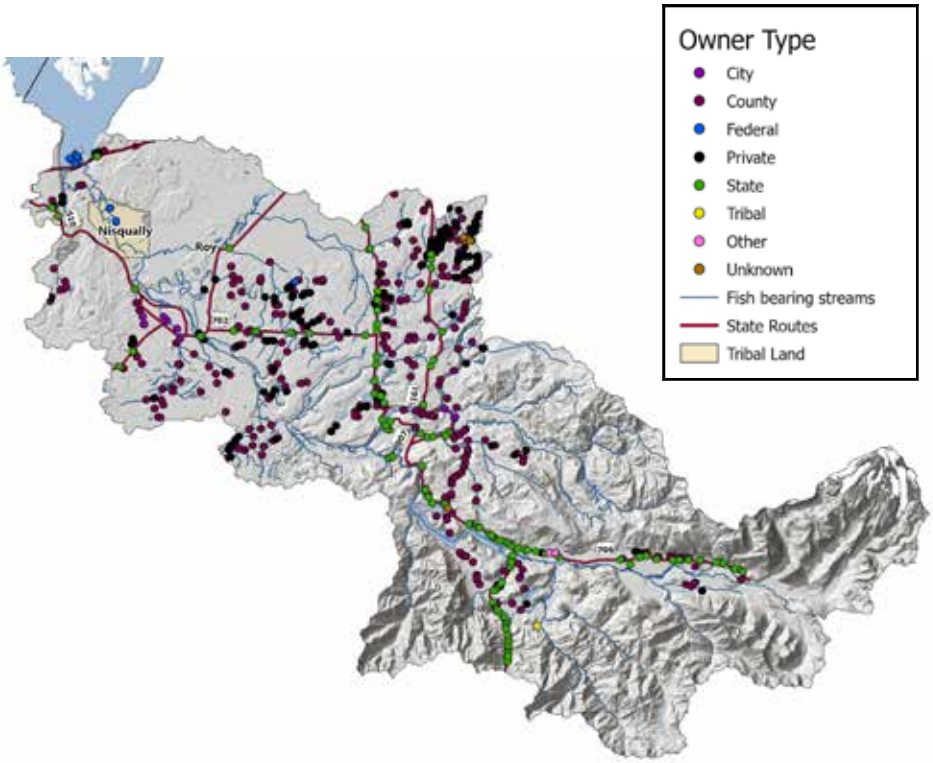
Map Data Sources: WAECY 2018[5], WADOT 2017[6]

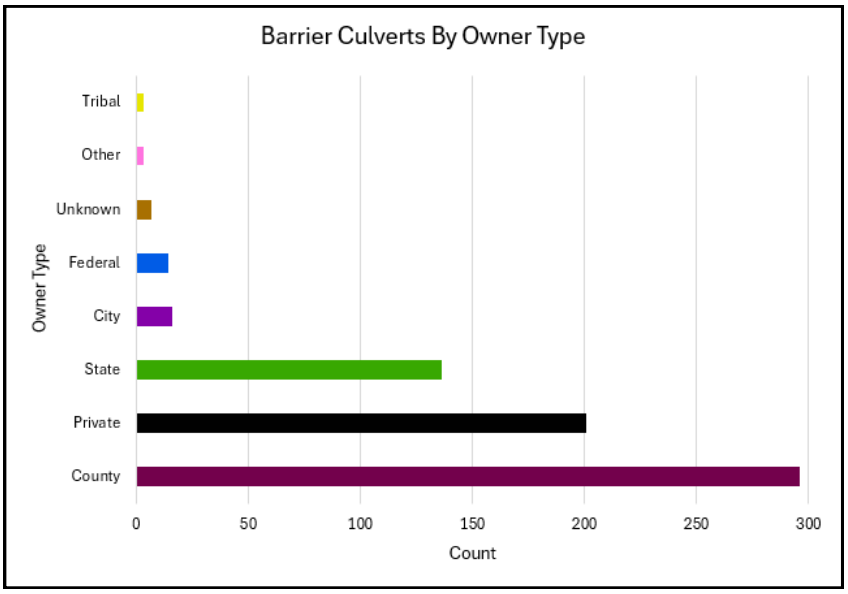
Fish Barrier Culverts Continue to Impede Fish Passage

There are 674 barrier culverts that are owned by the state, cities and counties, as well as private corporations and individuals in the Nisqually Watershed. Most of the barriers are owned by Pierce, Thurston or Lewis counties (296 barriers), or privately owned (201 barriers).

A fish passage barrier is anything that hinders fish from moving upstream or downstream. Culverts (large pipes that carry streams under roads) often block fish migration when water becomes too shallow, too swift, or if a waterfall is flowing into or out of the culvert. Removing these barriers can improve fish access for miles both upstream and downstream, allowing salmon to access the habitat they need to reproduce, access food resources, escape predators and find refuge from high winter stream flows.[1]

Washington state is under a court injunction to replace the barrier culverts opening 90% of potential habitat by 2030.[2] In addition to culverts identified by the Culvert Case Injunction, there are 674 barrier culverts that are owned by the state, cities and counties, as well as private corporations and individuals in the Nisqually Watershed. Private ownership accounts for 201 (30%) of the culverts while local governments, the federal government and Washington state own 312 (46.3%), 14 (2%), and 136 (20.2%) culverts, respectively. About 1.6% of barrier culverts fall outside of these ownerships.[3] Over three-fourths of these barrier culverts are owned by small landowners and local governments who are going to need significant resources to remove these impediments to fish passage and improve fish habitat.





Nisqually Indian Tribe

Nisqually natural resources manager James Slape Jr. inspects a culvert on Brighton Creek. The tribe and Pierce County have secured funding to start construction in 2026 to replace the culvert with a new channel-spanning culvert, benefiting Nisqually steelhead, Coho and winter Chum.

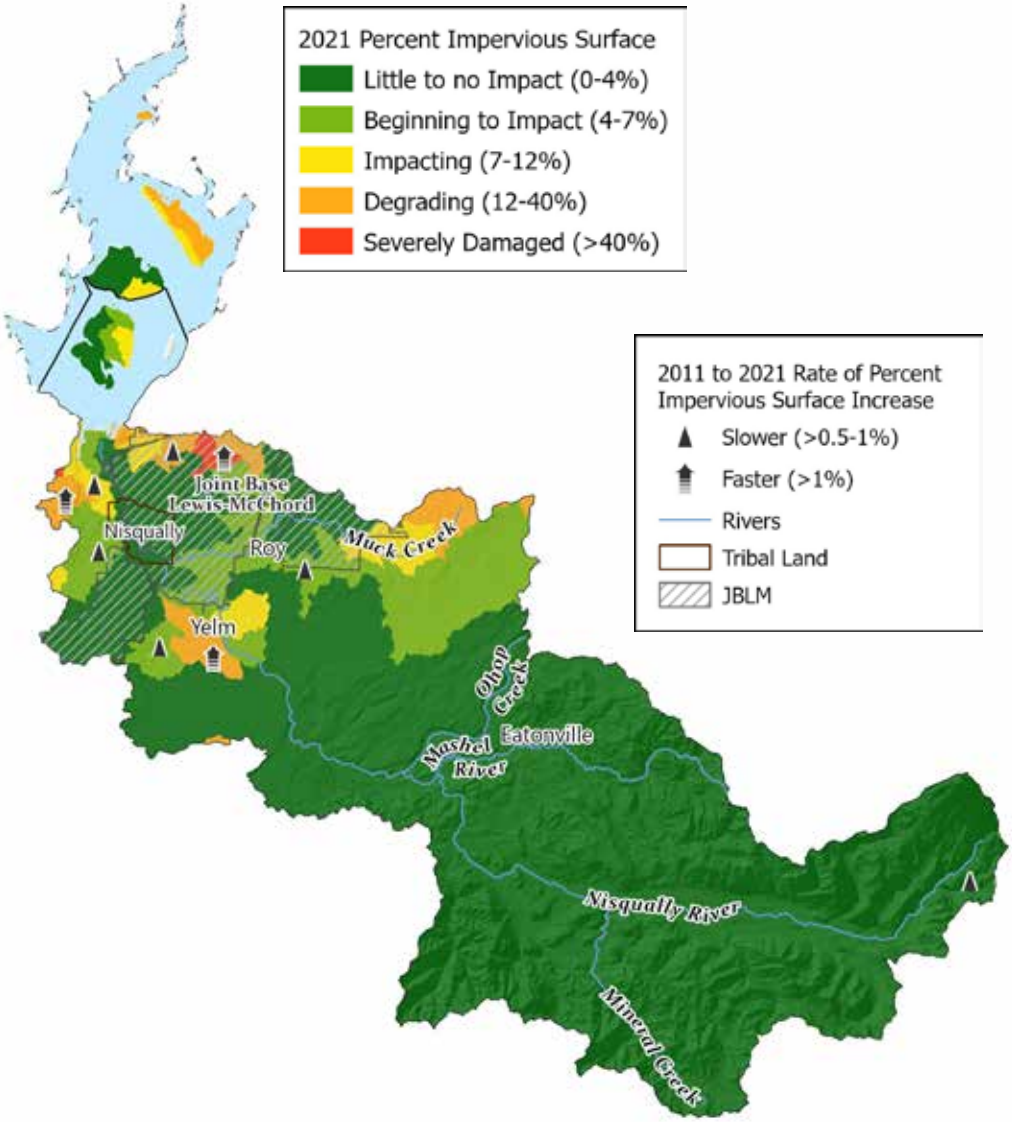
Map Data Sources: WDFW 2025[3], SSHIAP 2004[4], WADOT 2018[5], WADOT 2010[6], SWIFD 2024[7], WADOT 2024[8]

Impervious Surfaces Increase Slightly in the Nisqually Watershed

Between 2011 and 2021, impervious surfaces increased by approximately 1,249 acres (0.18%) within the Nisqually Areas of Interest and Concern (this does not include JBLM land).

Impervious surfaces prevent the infiltration of water, which reduces groundwater recharge and base flow. Non-point source pollutants, including pathogens, nutrients, toxic contaminants and sediment, collect on impervious surfaces and during rainfall events, the stormwater containing these pollutants flows directly into waterways, causing harm to aquatic ecosystems. Increasing urbanization and development results in increases in impervious surfaces such as roads, parking lots and rooftops.[1,2]

Between 2011 and 2021, impervious surfaces increased by approximately 1,249 acres (0.18%) within the Nisqually Areas of Interest and Concern (this does not include JBLM land). Within the Nisqually Watershed, impervious surface increases are being seen near the city of Yelm in Thurston County and the city of Roy in Pierce County.[3,4] Municipal stormwater permits issued by the Washington Department of Ecology require local stormwater management program implementation by counties in Washington state.[5] They must incorporate strategies such as low impact development (LID), a stormwater management strategy that is designed to minimize impervious surfaces, maximize native vegetation retention, and filter stormwater on site as much as possible.[6]



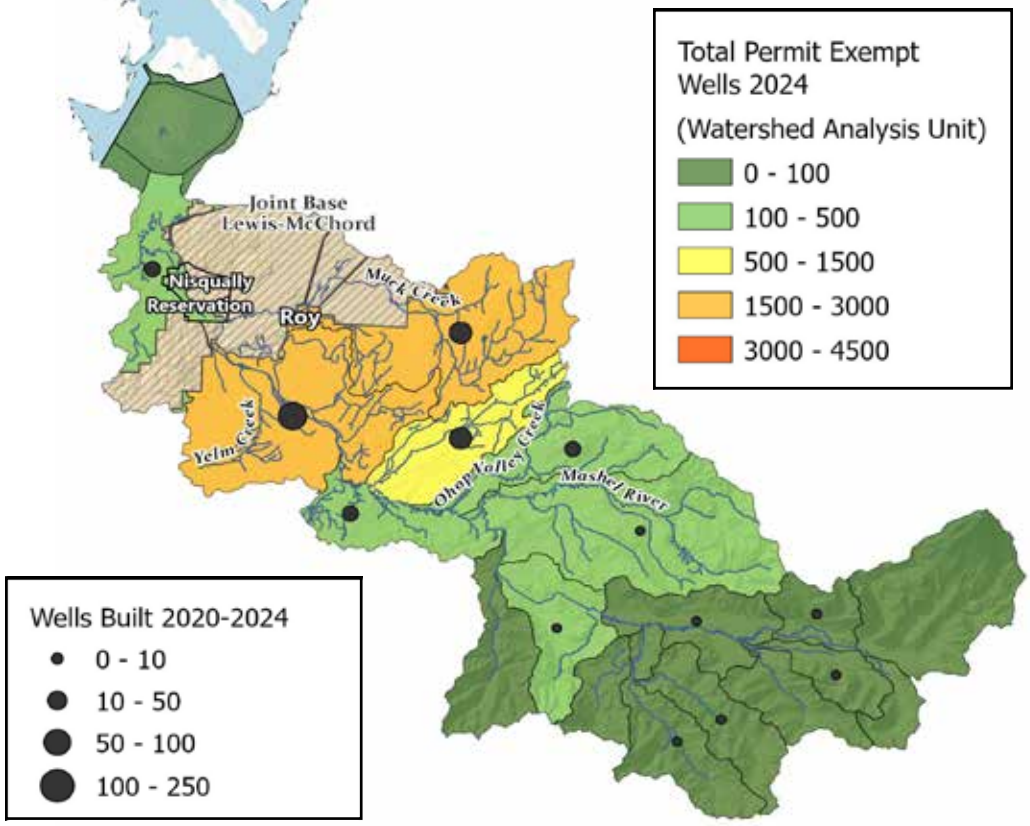
In Thurston County, the Stormwater Management Program Plan updated annually, and proposed changes for the 2024 update reflect new requirements in the latest Ecology permit. These include managing untreated rainwater runoff in older developments, prioritizing street sweeping to maximize its effect in preventing polluted runoff, supporting improving water quality in Budd Inlet, and mapping stormwater collection areas, tree canopy and overburdened communities to support stormwater management.[7] In Pierce County, the 2024 Stormwater Management Program Plan was released and the Pierce County Stormwater and Site Development Manual update is underway, with goals including managing stormwater to minimize contact with contaminants, mitigating the impacts of increased runoff due to urbanization, and making LID the preferred method for stormwater management.[8,9]

In addition to individual county plans, a community-based plan has been created that will be voluntarily implemented by landowners and neighbors and communities, cities and counties, state and federal governments, and the Nisqually Indian Tribe. The Nisqually Stewardship Plan considers the Nisqually Watershed as an integrated whole. The Nisqually River Foundation provides the staffing and funding power necessary to implement key portions of the Nisqually Watershed Stewardship Plan, as directed by the Nisqually River Council. With guidance from the Nisqually Stewardship Plan, the Nisqually River Council is currently working to reduce stormwater runoff and improve water quality through LID in the city of Eatonville.[10,11]

Map Data Sources: NLCD 2011[3], NLCD 2021[4], SSHIAP 2004[12], WADOT 2018[13], WADOT 2010[14], WAECY 2018[15], WAECY 2017[16], USDOT/BTS 2022[17]

Water Wells Increase Near Tributaries of the Nisqually River where Chinook Salmon Spawn

In the Nisqually Watershed, 7,726 water wells were installed between 1980-2019. Between 2020-2024, 355 water wells were added, a 4.6% increase. Most of the new wells are located between Yelm and Eatonville, along fish bearing streams that flow into the Nisqually River.



In the Nisqually Watershed, 7,726 water wells were installed between 1980-2019. Between 2020-2024, 355 water wells were added, a 4.6% increase.[1] Most of the new wells are located between the cities of Yelm and Eatonville, along fish bearing streams that flow into the Nisqually River. If summer low flows continue to decrease due to climate change impacts and demands for drinking water and wells increase due to factors such as population growth, there is potential for conflict between human and ecosystem needs.

Summer low flows—the lowest flows of the year—reduce water availability for aquatic habitat, fish hatcheries, irrigation and drinking water. Climate change impacts such as rising snow elevations, less snowpack and fewer rainfall events mean that summer low flows are becoming lower and longer lasting throughout the Pacific Northwest. Lower water levels can disconnect streams from their floodplains, reducing fish access to off-channel habitat. Juvenile salmon are then exposed to increased predation, concentrated pollutants and higher in-stream temperatures. Low flows during spawning season reduces fish passage and forces fish to build their redds in the main channel of the river where they are more vulnerable to scour during winter peak flows.[2,3]

The Nisqually River has only two tributaries (Mashel River and Ohop Creek) where Chinook salmon spawn.[4] Habitat restoration has been a high priority on these tributaries, and projects including the installation of logjams and native tree plantings have been completed by partners including the Nisqually Indian Tribe, Nisqually Land Trust, South Puget Sound Salmon Enhancement Group, Salmon Recovery Funding Board and Pierce Conservation District.[5,6] The Mashel River and Ohop Creek both experience low flows in the summer and early fall, causing waters to be too warm for young fish and too low for adult fish to migrate upstream. Climate change impacts and demands for drinking water near the cities of Yelm and Eatonville could put more pressure on these aquatic ecosystems, rendering tributaries unable to sustain salmon populations, despite habitat restoration efforts.

The Washington Department of Ecology adopted the Addendum to the Nisqually Watershed Management Plan in 2019. The plan will be implemented as local entities secure funding and develop projects intended to offset the impacts on streamflows from new domestic permit-exempt wells. The plan addendum for the Nisqually watershed projected 2,987 new permit-exempt wells to be installed between 2018-2040. The estimated impact of these wells on rivers and streams is 746.8 acre-feet per year (a volume equal to about 374 Olympic sized swimming pools).[7]

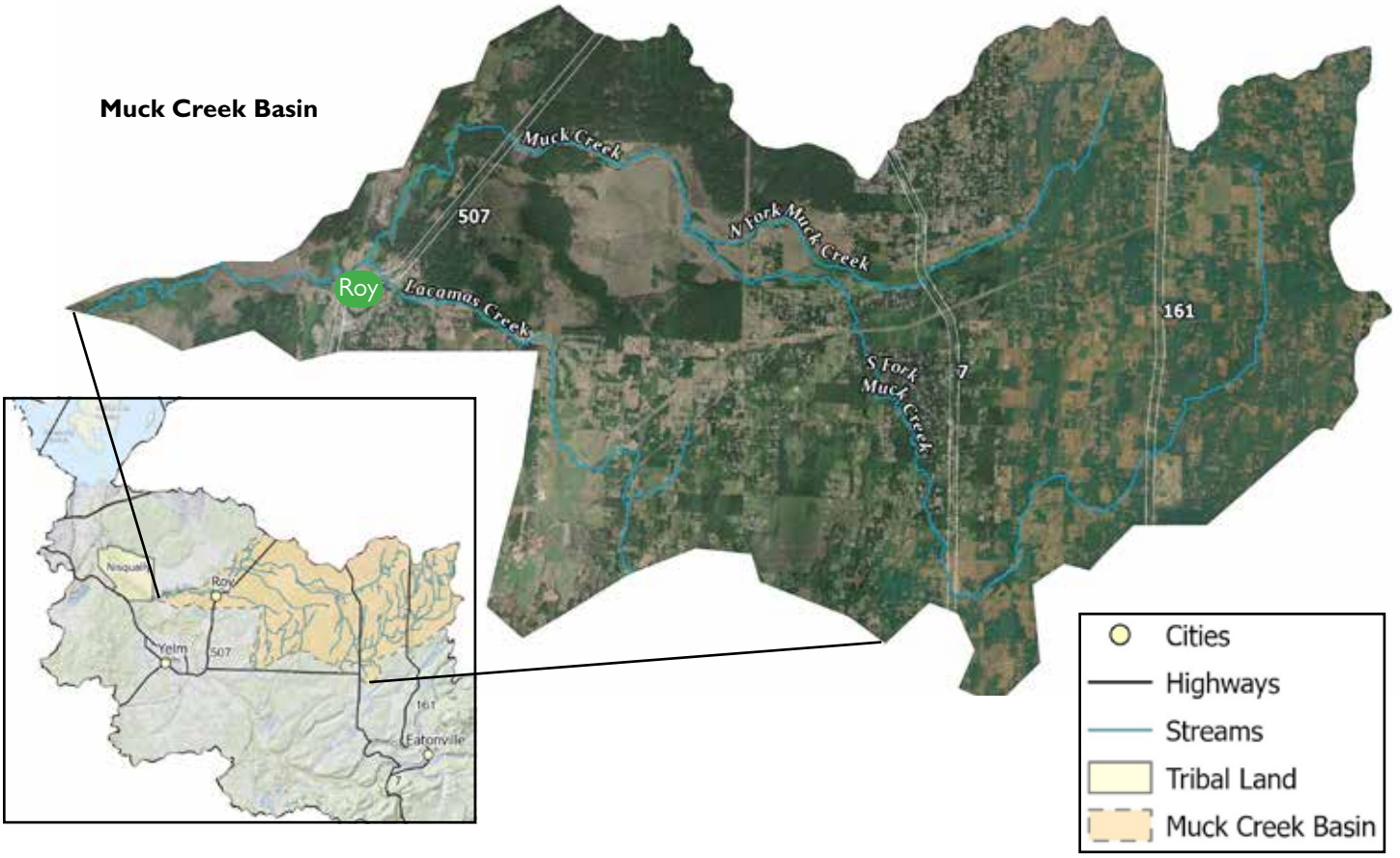
Nisqually Land Trust

Mashel River.

Map Data Sources: WAECY 2024[1], SSHIAP 2004[8], WADOT 2018[9], WADOT 2010[10], SWIFD 2024[11], USDOT/BTS 2022[12], WAECY 2017[13]

Muck Creek Watershed Has Lost its Climate Change Resilience Which Impacts Tribal Fishing Opportunities

Muck Creek Basin is the largest prairie system in the Nisqually River Watershed whose unique hydrology has driven the local adaptation of the Nisqually Chum, steelhead and coho, but due to changes in the prairie ecosystem, it has lost much of its resilience to climate change. The Muck Creek Watershed Restoration Strategy needs to be implemented to address habitat loss, low flow issues and wetland protection.



Muck Creek Basin is in the Nisqually River Watershed, located in southwest Pierce County. It includes three significant tributaries: Lacamas Creek, the North Fork of Muck Creek and the South Fork of Muck Creek. The creek flows across natural prairies and through second-growth coniferous and hardwood-forested riparian habitats. Muck Creek supports Nisqually Chum salmon, primarily in the lower and middle reaches of the main stem, below State Route 7.[1]

Nisqually Chum salmon run in the winter, with up to one-third of the run spawning in Muck Creek. They have adapted to prairie streams, particularly the hydrology of Muck Creek in the winter months. While other chum runs in the Puget Sound spawn in November, this run spawns in late December through January. This late-timed run is culturally significant to the Nisqually Indian Tribe because they are the only fish returning at a time when other salmon runs are over.[2]

Historically, the winter Chum run could support a fishing season, however with run size continuing to decline, they are no longer large enough to do so.[2] Loss of habitat and changes in the prairie ecosystem surrounding Muck Creek play a large part in the decline of Nisqually chum salmon. The prairies surrounding Muck Creek have been historically managed by the Nisqually people, creating the landscape which the Nisqually Chum salmon adapted to survive in. Prairie ecosystems are biodiverse and drought tolerant, meaning they are likely to tolerate the impacts of climate change better than lowland forests or floodplain agriculture. Restoration of the prairies surrounding Muck Creek would not only benefit the Nisqually Chum salmon run, but it would also increase climate resiliency in the landscape.[3]

The long-term outlook for Muck Creek suggests that low flow issues will worsen if land use patterns continue to move toward a more developed urban landscape.[4] The Muck Creek Watershed Restoration Strategy was completed in 2024 and lists several recommendations for Muck Creek including restoring prairie habitats, increasing water conservation in the watershed, protecting and restoring existing wetlands, and pursuing water rights acquisition for streamflow purposes. Implementation of this plan will likely take a 20-30 year sustained commitment and funding.[5]

Map Data Sources: Muck Creek[5], WADOT 2018[6], WADOT 2010[7], WAECY 2018[8], USGS 2020[9]

Biofiltration System Reduces Stormwater Impacts to Nearby Stream

A compound derived from tire wear, 6PPD-quinone (6PPD-Q), has been found to cause pre-spawning mortality in Coho salmon. Near Ohop Creek, the Nisqually Indian Tribe and partners have installed a pilot biofiltration system to capture and filter stormwater run-off from State Route 7. Preliminary results found that the system appears to be effective in removing over 90% of 6PPD-Q from untreated stormwater.

Long Live the Kings (2)

Pilot stormwater system in the Ohop Valley.[4]

In the Nisqually Watershed, some of the most important habitat to Coho salmon occurs in Ohop Creek, a tributary to the Nisqually River. The site is crossed by State Route 7, a major road that is increasingly busy as populations grow in the surrounding towns such as Eatonville.[1] This increased growth has led to higher traffic volume in the area, resulting in more chemicals entering Ohop Creek through stormwater run-off. Among these toxins, scientists have identified a compound derived from tire wear, 6PPD-quinone (6PPD-Q), which has been found to negatively impact fish, particularly pre-spawning mortality in coho salmon.[2]

At the site of the Lower Ohop Creek Restoration Project, the Nisqually Indian Tribe and Long Live the Kings have partnered with Cedar Grove to pilot a mobile biofiltration system designed specifically to capture and filter stormwater run-off from State Route 7.[3] Roadway run-off is collected and filters through layers of compost-based filtration media to remove toxic compounds.[4] Water quality samples are collected at three locations: where the run-off enters the filtration system, the middle of the system, and at the outlet where the water is released onto the Ohop Creek floodplain. Researchers then test the samples for several toxins including heavy metals and 6PPD-Q.[1] Three storm events in the spring of 2022 allowed for samples to be collected and sent to a lab for analysis, which found that the system appears to be effective in removing over 90% of 6PPD-Q from untreated stormwater.[4] Further data collection will continue and ultimately determine the effectiveness of this pilot study.

Protected Area Increases as the Nisqually Tribe Purchases Key Properties to Protect Important Tribal Resources

The purchase of key properties by the Nisqually Indian Tribe will protect and restore habitat and help counter failures in the Growth Management Act (GMA), Shoreline Management Act (SMA) and others.

Nisqually Indian Tribe

Busy Wild Creek near the Mashel River.[5]

The GMA was first adopted in Washington state in 1990, requiring fast-growing cities and counties to develop comprehensive plans to manage their population growth.[1] Even though tribes have treaty reserved rights to fisheries and water resources, under the GMA, there is no statutory authority to recognize those rights and there is no requirement for coordination and collaboration among local jurisdictions and tribes. Although some cities and counties have attempted to prioritize natural resource protection within their comprehensive plans, others have prioritized the protection of private property rights and economic development. This becomes more complicated when several cities and counties fall within a tribe's Area of Interest, each with their own comprehensive plan elements and development regulations which have varying effects on tribal resources.[2]

Washington state voters adopted the Shoreline Management Act in 1972. It requires all counties and most towns and cities with shorelines to develop and implement Shoreline Master Programs. The SMA applies to all Washington counties and about 250 towns and cities with stream, river, lake or marine shorelines. The SMA policies focus on shoreline use, public access and environmental protection.[3] However, the SMA was adopted prior to the Endangered Species Act (ESA) listing of salmon, and although the SMA is funded under the guise of coastal protection, it does not serve to protect coastal species such as ESA listed Chinook salmon and its habitat.[4]

The Nisqually Tribe recognizes the failures that the GMA and SMA have had in setting aside lands from development for the purpose of protecting tribal resources. That is why the tribe has begun purchasing land to do just that. In 2022, the Nisqually Tribe purchased 1,240 acres of land along the North Fork of Busy Wild Creek, which enabled the Nisqually Land Trust to purchase an adjoining 960 acres. These purchases permanently protect over three miles of Busy Wild Creek.[5] The protection and restoration of Busy Wild Creek is a high priority for the recovery of ESA-listed Chinook salmon and steelhead trout.[6] Additional purchasing of property by the Nisqually Indian Tribe will prioritize places such as Busy Wild Creek to ensure that key habitats for culturally important species are restored and protected for future generations.

Nisqually Community Forest Initiative

The Nisqually Indian Tribe and partners are changing the forest management paradigm to align with ecosystem recovery and management for culturally important forest resources. They are actively purchasing land rather than relying on regulatory processes to affect management and access. Tribal ownership guarantees access to hunting and gathering, and management can enhance those resources.

The Nisqually Community Forest (NCF) is a non-profit organization that supports a locally-owned, working forest managed to provide economic, environmental and cultural benefits to the Nisqually Watershed community.[1] NCF ownership, combined with timberlands owned by the Nisqually Indian Tribe, has led to the permanent protections and management of over 5,000 acres in total, a large portion of that being along Busy Wild Creek. This creek is in the headwater basin of the Mashel River, the primary tributary of the Nisqually River. The protection and restoration of Busy Wild Creek is a high priority for the NCF, as well as the Nisqually Tribe, for the recovery of ESA-listed Chinook salmon and steelhead trout.[1]

The Busy Wild Creek sub-basin has experienced decades of logging practices including clearcutting, which has negatively impacted salmon habitat in the area. The NCF has been managing forests with salmon in mind by thinning overcrowded forest stands and returning the property to native forest conditions.[1] This method creates resilient forests with increased capacity for stormwater retention and long-term storage of carbon. NCF timber harvest consists of annual thinning which supports local contractors and mills, contributing directly to the local economy.[2]

Nisqually Community Forest

Ecological forestry in the Busy Wild Creek sub-basin.[1]

The NCF is also providing community access to trails on the property. Mount Tahoma Trails Association's cross-country ski trail is popular in the winter and the NCF's extensive network of logging roads holds the potential for mountain biking, guided tours and hiking.[1] Research of the forests of the upper watershed is currently underway, including a long-term study on the effects of climate change.[2]

Nisqually Indian Tribe

Drone image of the Nisqually Community Forest.[3]

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Nisqually Community Forest Initiative

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2025 State of Our Watersheds Report
Nooksack River Basin

Nooksack Natural Resources

The Nooksack people and our way of life rely on fish, shellfish, wildlife, plants and the healthy ecosystems that sustain them. We have lost so much to past land and water use, and climate change, population growth and unsustainable land-use threaten what is left. The tribe continues to work tirelessly for protection and restoration of our watersheds, to the benefit of us all.

– RoseMary LaClair
Tribal Chairwoman

Area of Interest

Nooksack Indian Tribe

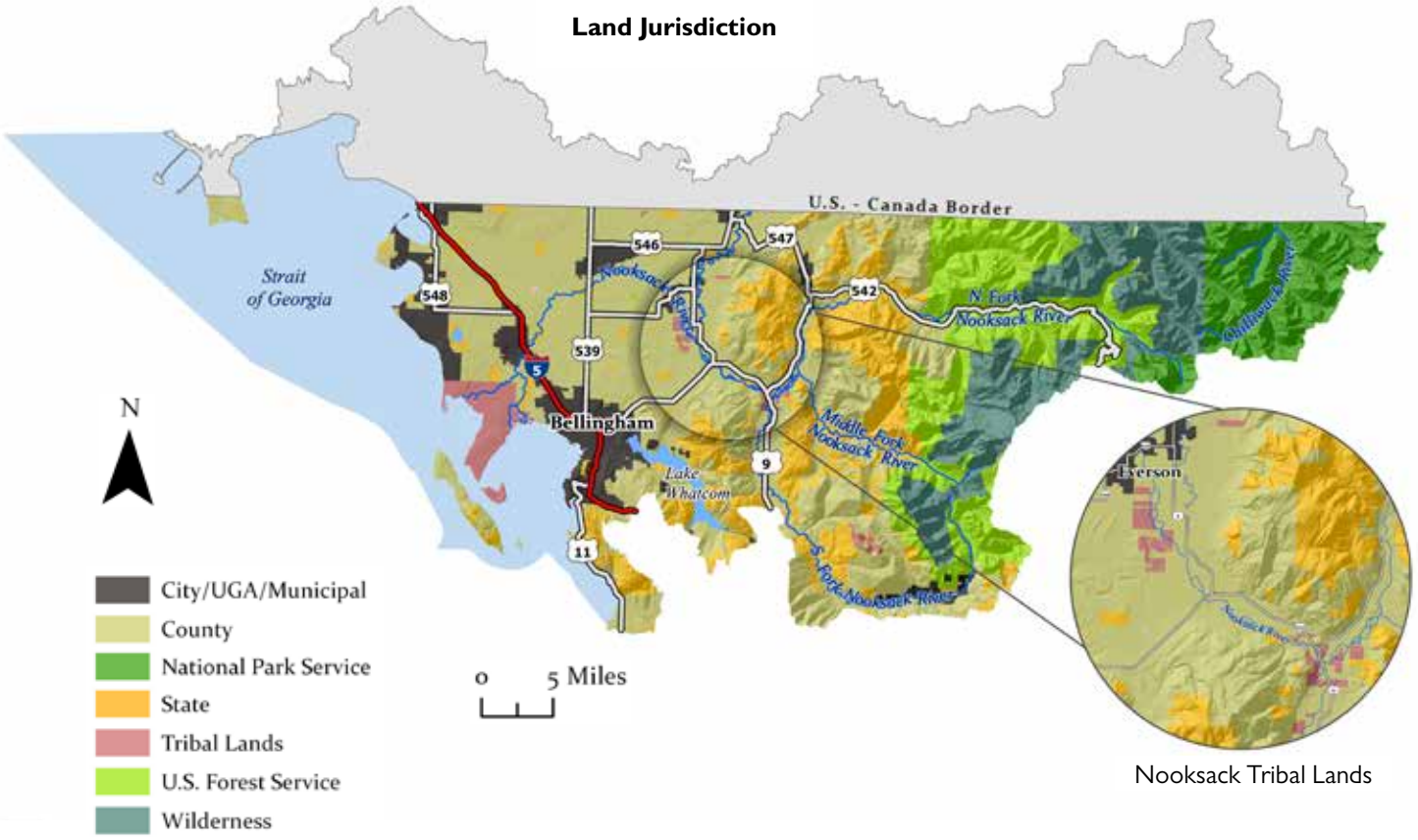
The Nooksack Indian Tribe is a recognized tribe under the Treaty of Point Elliott of 1855 and has about 2,000 enrolled members. Traditionally, the Nooksack people occupied the watershed of the Nooksack River from the high mountain areas surrounding Mount Baker to the salt water of Bellingham Bay, and extended into Canada north of Lynden and in the Sumas and Abbotsford areas. The primary Nooksack area was the Nooksack River watershed from near its mouth to the headwaters surrounding Mount Baker, plus most of the Sumas River drainage south of the present international border.

Traditionally, the tribe fished Nooksack River waters and by descent or marriage ties also fished the Fraser, Skagit and Samish rivers. Similarly, the resources of Birch Bay and Semiahmoo Bay would have been accessed through kin ties before these areas were abandoned by their native people in the early to mid-19th century.

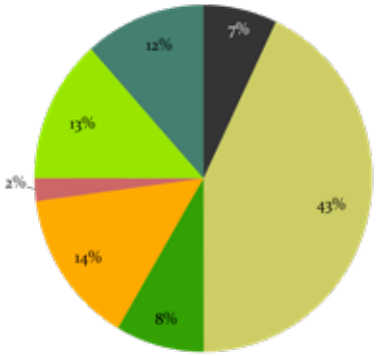
Nooksack is a place name that translates to "always bracken fern roots," illustrating close ties to the land and the resources that continue to give strength to the Nooksack people.

Nooksack Indian Tribe

WRIA 1: Mountains



Nooksack Tribal Lands



The Nooksack River watershed is 832 square miles, the largest drainage in the state's Water Resource Inventory Area 1 (WRIA 1) and the fourth largest drainage in Puget Sound. It has three main forks—the North, Middle and South—that originate in the steep, high-elevation headwaters of the North Cascades and flow westerly, descending into the flats of the Puget lowlands. The North and Middle forks are glacial rivers and originate from Mount Baker. The South Fork is a snow- and rain-fed river and originates from the non-glaciated slopes of the Twin Sisters peaks. The Middle Fork flows into the North Fork upstream of where the North Fork confluences with the South Fork to form the mainstem Nooksack River. The mainstem then flows as a low-gradient, low-elevation river until flowing into Bellingham Bay. Historically, the Nooksack River alternated between flowing into Bellingham Bay and flowing through the Lummi River and into Lummi Bay.

While the Nooksack Tribe's territory extended beyond current reservation and trust land areas and beyond the boundaries of the Nooksack River watershed into watersheds adjacent, the tribe's primary use area was and continues to be the Nooksack River watershed. The Nooksack Tribe's reservation is located along the Nooksack River in the town of Deming, downstream from the confluence of the North and South forks. Trust lands extend upstream to the lower reaches of the forks and downstream toward the town of Everson, as well as north into the Sumas watershed.

Euro-Americans began settling the area in the 1850s, primarily for the logging resources, with some arriving for opportunities in prairie farming and mining. Lowland clearing for agriculture began in earnest by the 1890s, and by 1925 nearly all of the lower mainstem and delta forests had been converted to agricultural land.[1,2] Since 1950, land-use conversion has primarily been for commercial, residential, urban and industrial development.[3]

The Nooksack River and independent watersheds in WRIA 1 have five species of anadromous salmon (Pink, Chum, Chinook, Coho and Sockeye) and three species of anadromous trout (steelhead, cutthroat and bull trout).[4,5]

Map Data Sources: DOD 2023[6], SSHIAP 2004[7], WADNR 2024a[8], WADNR 2024b[9], WAECY 2018c[10], WAECY 2018d[11], WAECY 2021[12], WAECY 2024[13], WADOT 2018[14], WADOT 2023[15], USFWS 2024[16]

Chapter Summary

Nooksack Indian history goes back thousands of years, or from time immemorial. There is nothing in that history of their people ever living anywhere outside of this region. The Nooksack Tribe were party to the Treaty of Point Elliott in 1855 and exchanged land holdings while retaining hunting, fishing and gathering rights. They were expected to move onto the Lummi Reservation, but few did. This affected their federal status as a tribe, but the Nooksack tribal community held together and remained a part of their ancestral home in the Nooksack watershed and surrounding areas. In 1973, full federal recognition was granted. They are currently a tribe of 2,000 members, and they continue to make their home in the Nooksack River watershed.

The primary limiting factors to salmon recovery are the quantity and quality of habitat where salmon begin and end their lives in the watersheds. The treaty tribes believe that salmon recovery efforts should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

For this report, the Nooksack Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Commercial Shellfish Growing Conditions Have Declined or Stayed the Same, Making Pollution Clean-up and Control Needs Critical to a Healthy Environment

Since 2019, there has been a 47% decline in fully approved commercial shellfish area in Drayton Harbor, while there has been no change in prohibited and/or unclassified acreage in Birch Bay.

Shoreline Armoring Threatens Erosional Drift Cells Critical to Nearshore Ecology

Around 37.5 miles (24%) of the nearshore marine shoreline is armored in WRIA 1 (the Water Resource Inventory Area for Nooksack and independent watersheds). Over the past 10 years there has been very little new armoring added to previously unarmored shoreline, but there have been an estimated 68 hydraulic permits accepted by the Washington Department of Fish and Wildlife that either replace or repair existing armoring. Most of this permitting is centered around the urban shorelines of Bellingham and Blaine, WA, and the industrial shoreline of the Cherry Point refinery area.

Streambank Riprap and Levees Continue to Degrade Salmon Habitat

Between 2005 and 2024 an estimated 9,700 feet of bank armoring (riprap or levees) was added to the mainstem and forks of the Nooksack River, with over 2,200 feet added since 2020. Since 2005, roughly 5,000 feet of bank armoring has either eroded or been removed, with over 750 feet of erosion/removal since 2020. Roughly 65 miles of bank armoring remain in the Nooksack River and its three forks.

Floodplain Development Has Increased in the Mainstem Nooksack Floodplain

Between 2006 and 2016, agriculture and developed land increased in the mainstem Nooksack floodplain by 241 acres (163 acres in the lower mainstem and 78 acres in the upper mainstem). During that same period, undeveloped land decreased by 374 acres (361 acres in the lower mainstem and 13 acres in the upper mainstem).

Engineered Logjams and Long-term Commitment to Healthy Riparian Forests Key to Restoring Wood to the Nooksack River

Between 2020 and 2024, there were eight instream projects in the Nooksack River watershed that involved a combined 193 engineered logjams (ELJs) and 23 other instream structures or activities. The Nooksack Indian Tribe and the Lummi Nation each sponsored four of the projects. The Nooksack projects resulted in 123 ELJ structures and three other structures added to the watershed.

Looking back farther, from 2001 through 2024, 52 instream restoration projects were implemented, involving the construction of 600 ELJs and 204 other woody structures and restoring 17.7 miles of habitat in the Nooksack River forks and major early Chinook tributaries. The Nooksack Tribe alone has implemented 23 projects involving the construction of 377 ELJs and 15 other woody structures and restoring 9.4 miles of habitat.

Nooksack Watershed Meeting Salmon Recovery Target for Forest Cover

The 50-year salmon recovery target of 316,590 acres of hydrologically mature forest cover across the Nooksack watershed was met in 2021. All geographic areas except for the lower mainstem currently meet the 50-year goal and all areas except the lower mainstem have shown an increase in hydrologically mature forest since the adoption of the Puget Sound Salmon Recovery Plan.

Reforestation Still Needed in Nooksack River Riparian Zone to Reach Long-term Chinook Recovery Targets

Between 2011 and 2021, the Nooksack River riparian zone lost 309 acres of its forest cover; 155 acres (about 50%) to human land use and 154 acres (about 50%) to natural channel migration and bank erosion.

Anadromous Barrier Culverts Have Increased

A total of 902 anadromous fish barrier culverts have been identified in WRIA 1 (the Water Resource Inventory Area for Nooksack and independent watersheds) through 2023, an increase from the 723 barrier culverts identified through 2019. There were 179 additional barrier culverts documented from 2020 through 2023. Over that same time period, approximately 77 culverts that were surveyed as blocking fish in 2019 were no longer considered blocking. The additional 179 barrier culverts identified since 2019 are not thought to be newly constructed barriers but had not been previously documented as barriers.

Increasing Water Quality Impairment Threatens Salmon Habitat

From 2012 to 2018, the length of temperature- and dissolved oxygen-impaired waters in the Nooksack River watershed increased.

Climate Change Impacts to Streamflow Threaten Nooksack River Salmon

A comparison of mean daily streamflow in the Nooksack River from 1967-1996 and 1997-2023 shows a shift in streamflow timing over the course of the water year. Mean daily streamflows are generally higher from October through January and generally lower from June through August in the more recent time period. This shift is consistent with modeling of future hydrology and is associated with climate change impacts including rising air temperature, more annual precipitation as rain, less precipitation as snow in the winter and less precipitation overall in the summer.

Conclusion

Climate continues to change the flow, water quality, and structure of fish habitat in Puget Sound and the Nooksack River watershed. Temperatures are rising and precipitation patterns are shifting, with less falling as snow and more as rain. Flows in the winter are variable, while summer flows are lower and remain so for an extended period of time in non-glacial systems like the South Fork Nooksack River—and Chinook are directly threatened.

Land-use patterns no longer change the landscape at a rapid pace; instead, they maintain the landscape in an ecologically degraded state, and improvement of the ecological baseline is either very slow or doesn't occur at all. Lowland forests were cleared in the region in the late 19th century and remain that way today. Shoreline armoring degrades freshwater and marine shorelines, and that degradation persists due to continued maintenance of existing armoring and the net gain of almost 5,000 feet of new armoring. There has been a 47% decline in approved commercial shellfish area in Drayton Harbor. An additional 241 acres of mainstem Nooksack River floodplain was developed between 2006 and 2016. With each passing year, we continue to find new barrier culverts.

On the other hand, the Nooksack Tribe, working with Lummi Nation and other salmon recovery partners in the region, makes constant strides with restoration efforts. The Nooksack Tribe has completed numerous instream restoration projects involving the construction of logjams. Pool and edge habitat in the lower South Fork is improving for juvenile salmon. Acres of riparian forest are being planted. The 50-year salmon recovery target for hydrologically mature forest cover was met in 2021 across the Nooksack watershed. All of the research, planning, education, cooperation, volunteering and on-the-ground work that goes into these projects is critical to salmon recovery.

Despite significant habitat restoration to date, considerably more restoration will be necessary to sustain and recover salmon and other treaty resources in a changing climate. Continued funding for habitat restoration projects, especially programs that integrate floodplain management and climate resilience, is critically important. Diversification of funding sources and mechanisms is also warranted, given shifts in federal and state funding availability and priorities.

The legal and regulatory framework already in place to uphold the treaty rights of the tribe and protect the salmon needs to be funded and enforced. Without priority funding and dedicated enforcement, the behavioral shift that needs to occur at a societal level will progress too slowly. Enforcement of the law will need to occur at all levels of government, including local government where most of the environmental laws are implemented.

Finally, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the complex array of environmental issues facing tribes, as well as to implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. The Nooksack Tribe's Natural Resources Department is entirely grant-funded, and the administrative burden of managing numerous grants from different agencies is considerable. Consolidating funding and/or aligning administrative requirements among agencies would greatly improve efficiency.

Recovery Efforts Show Signs of Improvement But Still Lagging in Key Indicators

At the 20-year mark of the Puget Sound Salmon Recovery Plan, a review of a selection of key environmental indicators for the Nooksack watershed shows gains in restoration and improvements in forest cover, but degradation of commercial shellfish areas and increases in shoreline armoring, floodplain development and barrier culverts. The Nooksack Tribe is leading the effort to conduct a broader accounting of habitat status and trends to inform an update of the Nooksack chapter of the Puget Sound Salmon Recovery Plan.

Review of the trend for these key environmental indicators shows improvements in forest cover and engineered logjam construction and declines for the rest:

Tribal Indicator	Status	Habitat Trend
Shellfish	Since 2019, Drayton Harbor has seen a 47% decline in fully approved commercial shellfish area, while Birch Bay has seen no change in prohibited and/or unclassified acreage.	**Declining**
Shoreline Armoring - Marine	Around 37.5 miles (24%) of the marine shoreline is armored in Water Resource Inventory Area 1 (WRIA 1). Over the past 10 years, there has been little new armoring added, but 68 hydraulic permits have been approved by the Washington Department of Fish and Wildlife to either replace or repair existing armoring.	**Declining**
Shoreline Armoring - River	Between 2005 and 2024, an estimated 9,700 feet of bank armoring (riprap or levees) was added to the mainstem and forks of the Nooksack River, with over 2,200 feet added since 2020. Since 2005, roughly 5,000 feet of bank armoring has either eroded or been removed, with over 750 feet of erosion/removal since 2020. Roughly 65 miles of bank armoring remain in the Nooksack River and its three forks.	**Declining**
Floodplain Development	Between 2006 and 2016, agriculture and developed land increased in the mainstem Nooksack floodplain by 241 acres, while undeveloped land decreased by 374 acres.	**Declining**
Restoration - ELJ	Between 2020 and 2024, there were eight instream projects in the Nooksack River watershed that involved 160 engineered logjams (ELJs) and 10 other instream structures or activities. The Nooksack Indian Tribe and Lummi Nation each sponsored four of the projects. The Nooksack projects resulted in 123 ELJs and three other structures.	**Improving**
Forest Cover	The 50-year salmon recovery target for hydrologically mature forest cover was met in 2021 with 316,590 acres across the Nooksack watershed.	**Improving**
Restoration - Riparian Planting	Between 2011 and 2021, the Nooksack River riparian zone lost 309 acres of its forest cover, 154 acres (about 50%) to natural channel migration and bank erosion and 155 acres (about 50%) to human land use.	**Declining**
Barrier Culverts	A total of 902 anadromous fish barrier culverts have been identified in WRIA 1 through 2023. There were 723 barrier culverts identified through 2019 and 179 additional barrier culverts documented from 2020 through 2023.	**Declining**
Water Quality	From 2012 to 2018, water quality decreased in the Nooksack River watershed.	**Declining**
Climate Change	A comparison of mean daily streamflow in the Nooksack River between 1967-1996 and 1997-2023 shows a shift in streamflow timing over the course of the water year. Daily streamflow is becoming higher from October through January and lower from June through August.	**Concerns**

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

The slow pace of recovery coupled with the additional pressures of population growth and climate change underscores the urgency and critical importance of efforts to protect and recover the Nooksack River watershed. Protection, restoration, collaborative planning and monitoring of the Nooksack Tribe's treaty resources—especially salmon—remain high priorities for the tribe's Natural Resources Department. As we look ahead into the coming months and years, the tribe will continue to evaluate impacts to treaty resources, and will comment and request consultation on those actions that threaten treaty resources and undermine tribal sovereignty. The following will present challenges and opportunities.

Policy and funding shifts with the new federal administration threaten to undermine both regulatory and voluntary programs. We are especially concerned about the rollback of environmental protections, for example, revising the definition of "waters of the United States," rescinding the definition of "harm" under the Endangered Species Act, and expediting environmental review of energy projects. Reductions in federal funding are further compounded by those that have occurred recently at the state level. Strong state environmental protections, however, help to buffer the impacts of reduced federal protections.

We expect to update the WRIA 1 (the Water Resource Inventory Area for Nooksack and independent watersheds) Salmonid Recovery Plan in the next year. The update will be informed by status and trends monitoring of Nooksack early Chinook and the tributary, riverine, estuarine and nearshore habitats on which they rely, as well as by implementation and effectiveness monitoring of recovery efforts to date. New salmon recovery strategies have been identified, and the detailed work plan will be updated annually. A monitoring and adaptive management framework has been developed to drive recovery progress; it involves annual reporting of Chinook status and trends, work plan progress, and monitoring of habitat status and trends every three years. Both long-term and near-term (10-year) habitat goals have also been adopted.

We continue to lead instream restoration efforts in the Nooksack River watershed, overseeing design and implementation of large, complex river restoration projects involving construction of engineered logjams and, to the extent landowners and stakeholders are willing, floodplain reconnection. Permit streamlining for restoration projects remains a high priority, especially related to FEMA's floodplain compliance and Conditional Letter of Map Revision/Letter of Map Revision requirements. We have co-convened the South Fork Nooksack Floodplain Permitting Workgroup and meet regularly to identify and develop streamlined solutions and to ultimately prepare a summary report.

Although habitat restoration efforts to date have focused on instream restoration, we have grown our riparian restoration program in recent years and are working closely with other restoration partners to plan and implement riparian plantings. We also are working with consultants to develop a spatial database to inform riparian restoration along fish-bearing rivers and streams in the Nooksack River watershed. The project will characterize riparian condition, identify and prioritize restoration needs, and track project implementation.

The Washington Department of Ecology filed WRIA 1 Water Rights Adjudication in May 2024, bringing a renewed focus to water resource management solutions. We have been working recently to expand our habitat restoration program to encompass hydrologic restoration, including beaver-related restoration and other strategies to restore natural water storage. We also continue to work with researchers to evaluate the impacts of forestry on upland hydrology.

The tribe will continue to actively participate in collaborative planning efforts, including the WRIA 1 Watershed Management Board, Whatcom County Floodplain Integrated Planning, and Stewart Mountain Community Forest forums. Tribal policy and technical staff will also continue to support programmatic fish passage restoration efforts in the Nooksack River watershed, including through the state culvert injunction and separate frameworks established to identify, prioritize and advance removal or replacement needs for Whatcom County and city of Bellingham fish passage barriers.

Our work is informed by the best available science, including local data where possible. Our annual monitoring focuses on salmon stock assessment and water quality and quantity, supplemented by periodic habitat status and trends and project effectiveness monitoring. Maintaining long-term monitoring programs into the future will be important to document impacts of land use, restoration and climate change.

Finally, we are advancing climate resilience and climate adaptation planning and otherwise integrating climate change factors into our work to ensure the persistence and recovery of species and habitats of importance to the tribe into the future.

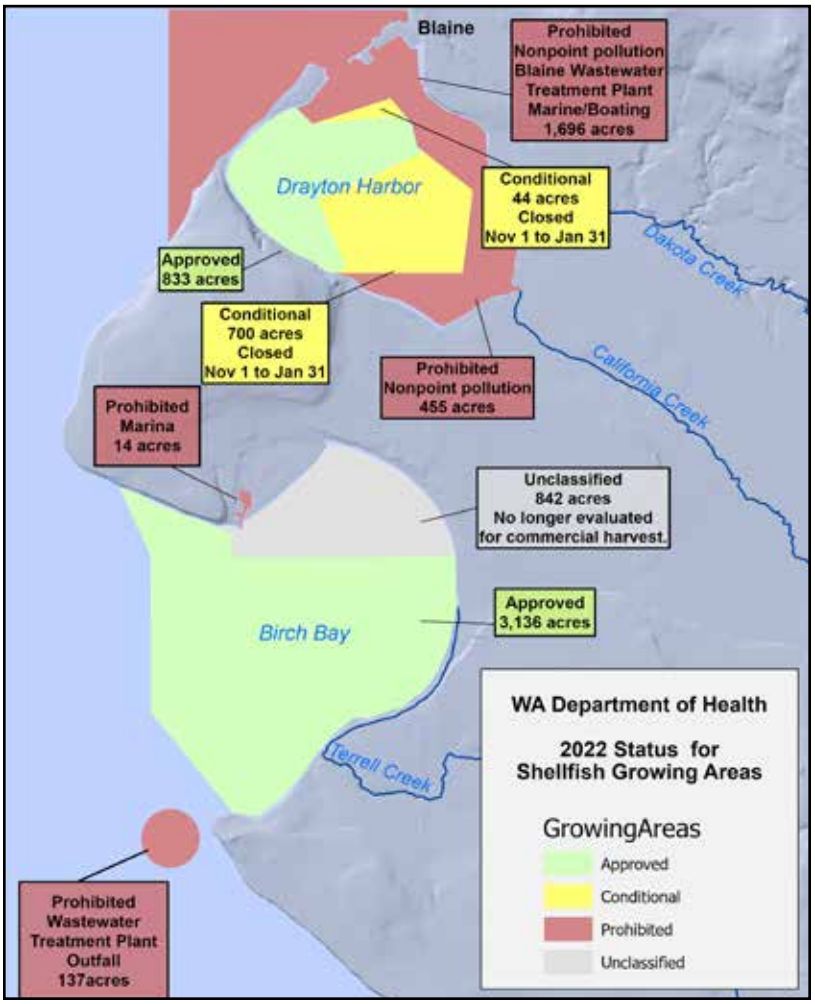
Commercial Shellfish Growing Conditions Have Declined or Stayed the Same, Making Pollution Clean-up and Control Needs Critical to a Healthy Environment

Since 2019, Drayton Harbor has seen a 47% decline in fully approved commercial shellfish area, while Birch Bay has seen no change in prohibited and/or unclassified acreage.

In 2024, the Washington Department of Health downgraded 744 acres in Drayton Harbor from fully approved to conditionally approved, leaving only 833 acres of commercial shellfish harvest area fully approved for harvest. Additionally, 2,153 acres of commercial shellfish growing area were fully prohibited from harvest. In Birch Bay, 3,136 acres remained fully approved, 151 acres remained prohibited and 842 acres remained unclassified.[1]

In both locations, non-point source pollution, wastewater treatment plants and boat traffic continue to force areas of commercial shellfish growing into prohibited and unclassified status. Moving forward, cleanup and management efforts will be tasked with keeping approved growing areas open, moving more prohibited areas towards approval, and bringing unclassified areas back to a condition that can be evaluated for possible approved classification.

Drayton Harbor and Birch Bay Commercial Shellfish Growing Areas



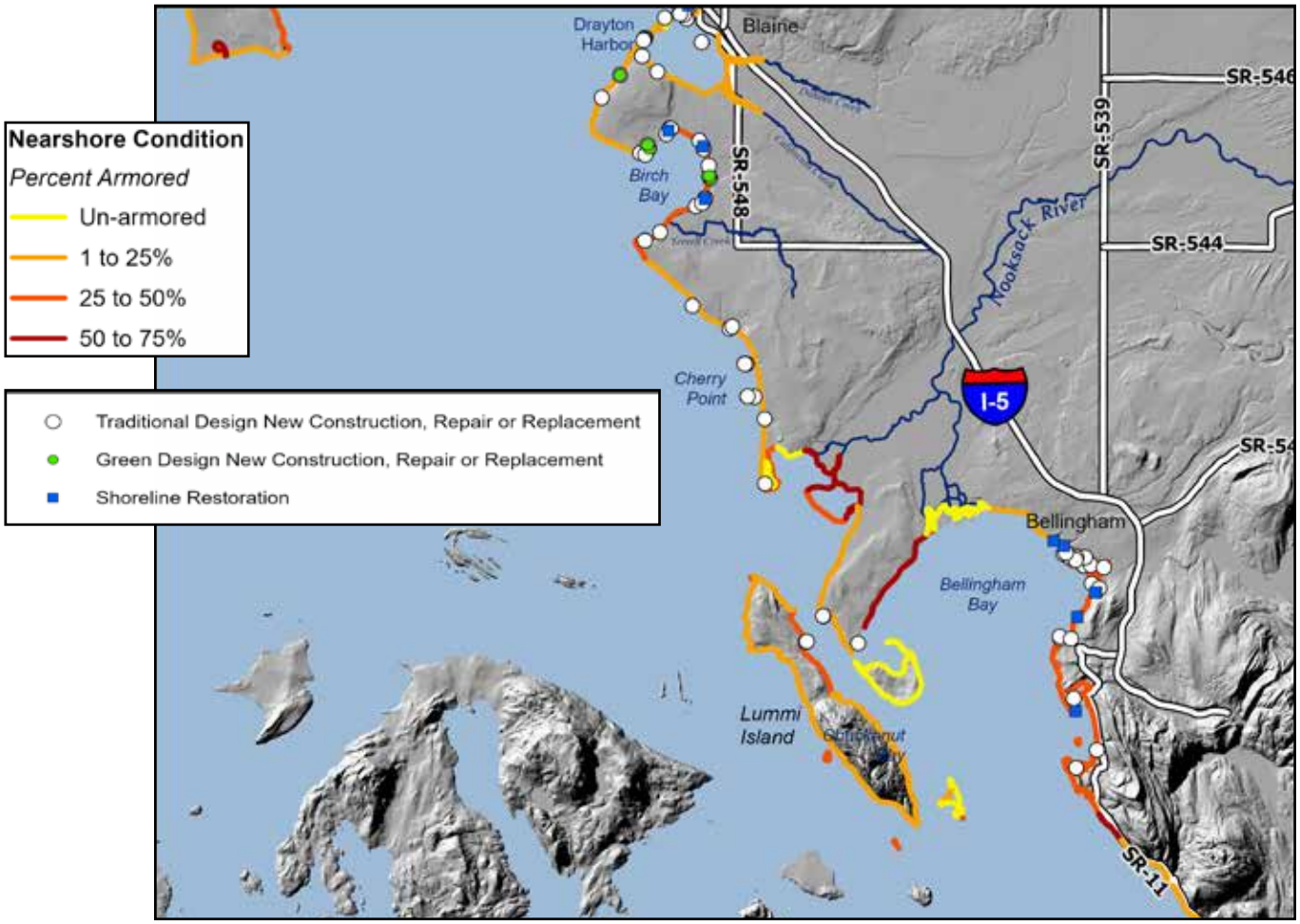
Washington Department of Ecology

A view of Drayton Harbor.

Map Data Sources: WADOH 2020[2], SSHIAP 2004[3], USGS 2018[4]

Shoreline Armoring Threatens Erosional Drift Cells Critical to Nearshore Ecology

Around 37.5 miles (24%) of the marine shoreline is armored in WRIA 1 (the Water Resource Inventory Area for Nooksack and independent watersheds).[1] Over the past 10 years there has been very little new armoring added, but there have been an estimated 68 hydraulic permits accepted by the Washington Department of Fish and Wildlife (WDFW) that either replace or repair existing armoring. Most of this permitting is centered around the urban shorelines of Bellingham and Blaine, WA, and the industrial shoreline of the Cherry Point refinery area.[2]



Close to 30 of the 140 miles of erosional drift cells in WRIA 1 are already armored or modified. Of the estimated 68 nearshore armoring replacement or repair permits issued since 2015, only five have been for "green design" or soft shore armoring projects. On a positive note, the cities of Blaine and Bellingham and the community of Birch Bay all sponsored nearshore restoration projects during this same time period.

The greatest impact to forage fish habitat on erosional drift cells is shoreline armoring, as it interrupts the erosion, distribution and accretion of sediment.[3] Impacts to forage fish are felt directly by federally-listed Chinook salmon, as they feed on forage fish. Forage fish spawning beaches are protected through the state's hydraulic code rules, Growth Management Act and Priority Habitats and Species Program, yet these habitats remain vulnerable to shoreline armoring and modification.[4]

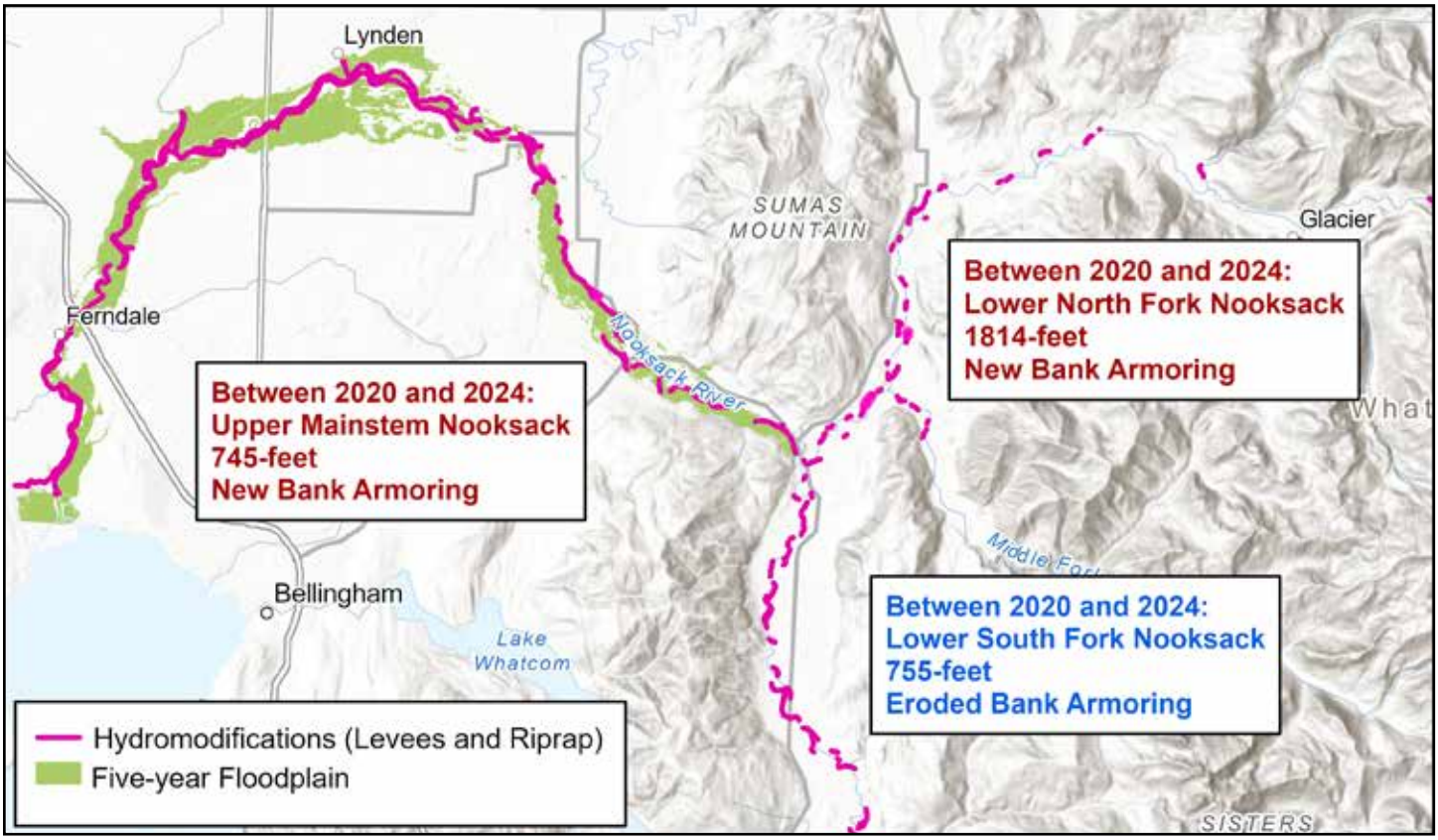
WDFW's Estuary and Salmon Restoration Program has completed a multi-phase project called Beach Strategies that resulted in a set of science-based tools that can be used by recovery practitioners to prioritize nearshore restoration and protection from armoring.[5] WDFW is the agency responsible for protecting the shorelines of the state through hydraulic permitting. While Beach Strategies prioritization is intended as guidance for salmon recovery practitioners, WDFW has a unique opportunity to also use the prioritization in its own hydraulic permitting. If an armoring replacement or repair application is within a high- or moderate-priority Beach Strategies area, for example, green design or soft shore armoring should be a requirement.

Map Data Sources: CGS 2020[6], WDFW 2023[7]

Stream Bank Riprap and Levees Continue to Degrade Salmon Habitat

Between 2005 and 2024, an estimated 9,700 feet of bank armoring hydromodifications (riprap or levees) was added to the mainstem and forks of the Nooksack River, with over 2,200 feet added since 2020. Since 2005, roughly 5,000 feet of bank armoring has either eroded or been removed, with over 750 feet of erosion/removal since 2020. Roughly 65 miles of bank armoring remain in the Nooksack River and its three forks.[1]

Changes in Shoreline Armoring



Since 2020, bank armoring has increased in the upper mainstem and lower North Fork of the Nooksack River but decreased in the lower South Fork.

The length of hydromodified banks can be tied to both degradation of instream habitat and alteration of habitat-forming processes. Riprap degrades juvenile salmon habitat along the channel edges, and levees disconnect the river from its floodplain, secondary channels and wetlands.[2]

In the Nooksack River, the salmon recovery goal for bank armoring can be considered met when the length of riprap is no longer limiting habitat formation and habitat quality. The ongoing increase in hydromodifications is associated with the continued decline in edge habitat quality and degradation of habitat forming processes.[3]

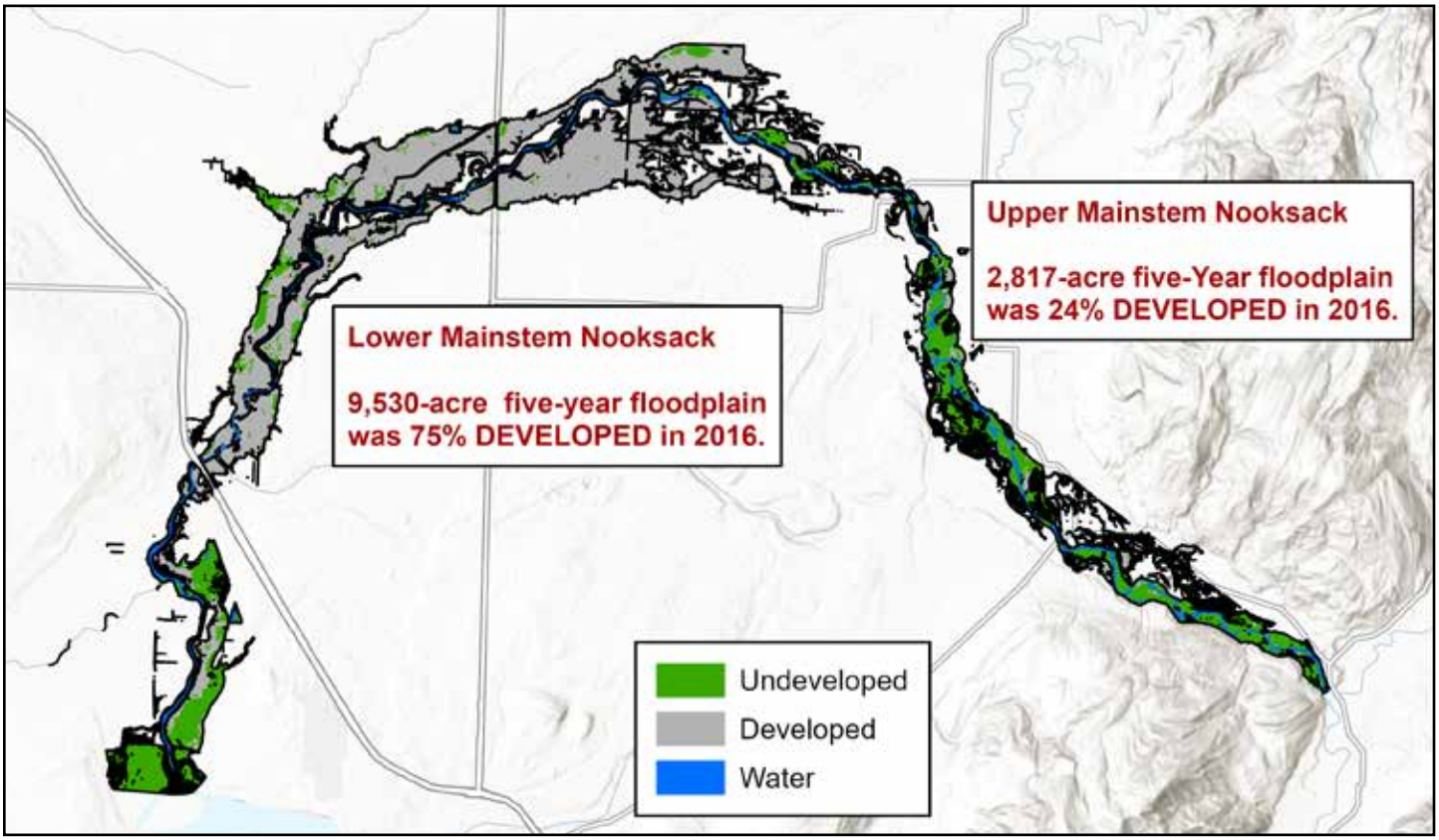
U.S. Army Corps of Engineers, 2023

Levee along the Nooksack River through the city of Ferndale.[5]

Map Data Sources: Maudlin 2021[4]

Floodplain Development Has Increased in the Mainstem Nooksack Floodplain

Between 2006 and 2016, agriculture and developed land increased in the mainstem Nooksack floodplain by 241 acres (163 acres in the lower mainstem and 78 acres in the upper mainstem). During that same time period, undeveloped land decreased by 374 acres (361 acres in the lower mainstem and 13 acres in the upper mainstem).



Opportunities to protect, conserve and restore the 5-year floodplain of the mainstem Nooksack River will primarily come from the lower mainstem. Its floodplain is much larger than the upper mainstem floodplain and has been developed at a much higher rate.

The 2021 update to the 2005 Puget Sound Salmon Recovery Plan calls for 9,260 acres of undeveloped land in the 5-year floodplain of the mainstem Nooksack River (upper and lower mainstem combined). This is roughly 75% of the area of the 5-year mainstem Nooksack River floodplain. As of 2016, there were only 4,543 acres of the 5-year floodplain undeveloped, and from 2006 to 2016 development increased in the floodplain.

For Nooksack River salmon recovery, not only does the current trend of increased development in the 5-year floodplain have to end, but there must be restoration of the floodplain from developed land back into undeveloped land, and there needs to be acquisition of floodplain acreage for the protection and conservation of undeveloped area.

Whatcom County

Agriculture dominates the developed landscape along the mainstem Nooksack River.

Map Data Sources: Maudlin 2021[1]

Engineered Logjams and Long-term Commitment to Healthy Riparian Forests Key to Restoring Wood to the Nooksack River

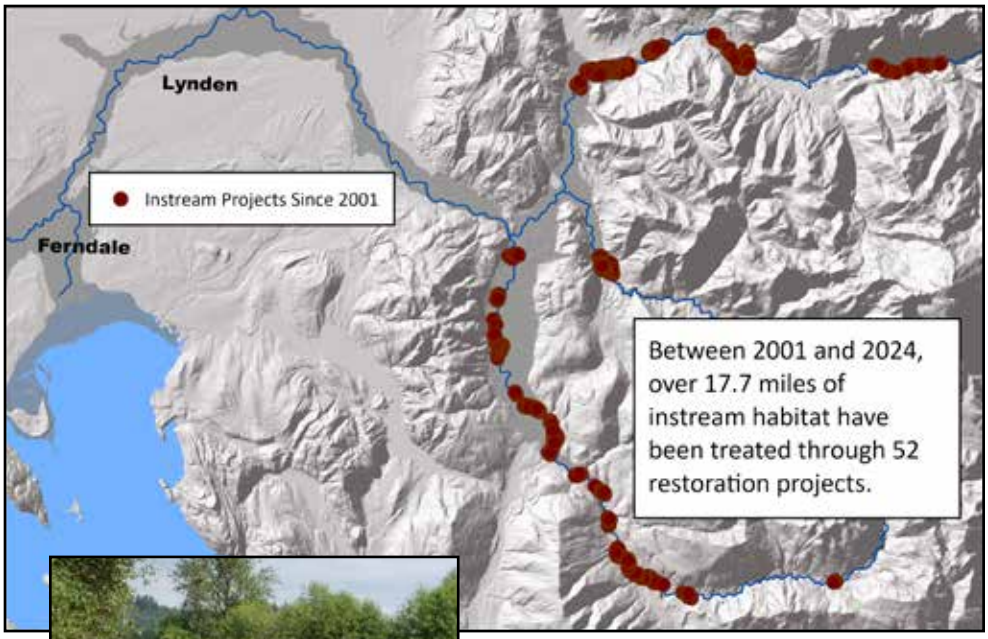
Between 2020 and 2024, there were eight instream restoration projects in the Nooksack River forks that involved construction of 193 engineered logjams (ELJs) and 23 other types of structures.[1] The Nooksack Indian Tribe and the Lummi Nation each sponsored four of the projects. The Nooksack projects resulted in 123 ELJs and three other structures, and the Lummi projects resulted in 70 ELJs and 20 other structures.[2]

According to the state's Water Resource Inventory Area 1 (WRIA 1) Salmonid Recovery Plan, instream wood has a role in channel stability, habitat diversity, and overall habitat quantity and quality.[3] The combination of land-clearing, riparian forest logging, splash damming and instream wood removal for navigation have combined to leave the Nooksack River with a relatively low abundance of instream wood.

As a short-term strategy, ELJs are being consistently funded, placed and monitored throughout the North Fork, Middle Fork and South Fork of the Nooksack River. Between 2001 and 2024, 52 instream restoration projects were implemented, involving the construction of 600 ELJs and 204 other woody structures and restoring 17.7 miles of habitat in the Nooksack River forks and major early Chinook tributaries. The Nooksack Tribe alone has implemented 23 projects involving the construction of 377 ELJs and 15 other wood structures and restoring 9.4 miles of habitat.[4]

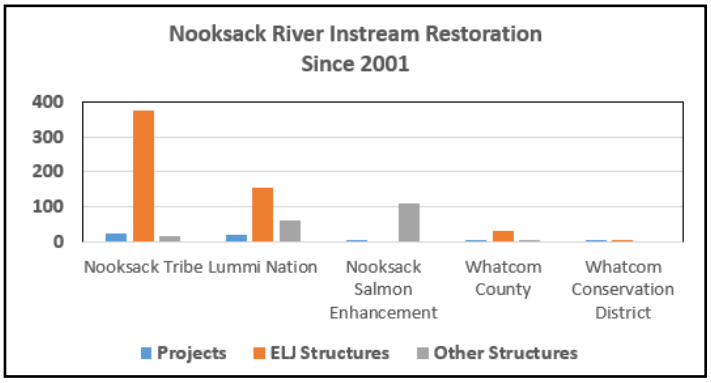
As a long-term strategy, riparian restoration is occurring to provide a sustainable source of large woody debris. The lower mainstem continues to be managed for flood control and navigation. There is little to no accumulation of instream wood between Lynden, WA, and the delta of the river. The upper mainstem and the forks have a relative abundance of instream wood, but it is still very low compared to historic levels. The relatively higher levels of wood instream in the upper watershed are in part attributable to ELJs.

Since riparian forests are still dominated by young, small diameter trees, active logjam construction remains necessary to improve instream wood abundances in the Nooksack River system.[5]



Nooksack Natural Resources

Until riparian forests are mature enough to deliver key logjam-anchoring pieces of instream wood to the Nooksack River, ELJs remain essential to salmon habitat restoration throughout the system.[11]



Since 2001, 52 instream restoration projects resulted in 600 ELJs and 204 other structures.[10]

Map Data Sources: NNR 2015[6], SSHIAP 2004[7], WAECY 2011a[8], NNR 2025[9]

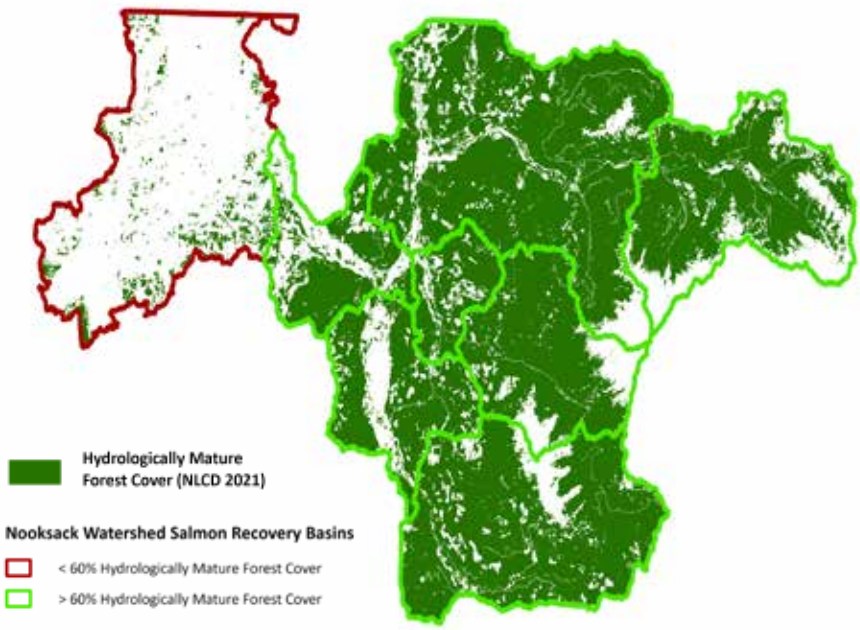
Nooksack Watershed Meeting Salmon Recovery Target for Forest Cover

The 50-year salmon recovery target for hydrologically mature forest cover was met in 2021 with 316,590 acres across the Nooksack watershed.[1,2] All geographic areas except for the lower mainstem currently meet their 50-year goals and all areas except the lower mainstem have shown an increase in hydrologically mature forest since the adoption of the Puget Sound Salmon Recovery Plan.[3,4]

A hydrologically mature forest helps moderate stream flows, both peak flows and low flows. For this analysis, hydrologically mature forest includes the deciduous, evergreen and mixed-forest land cover classes from the 2021 National Land Cover Dataset (NLCD).[5]

The Nooksack watershed was historically dominated by hydrologically mature forestland cover categories (80% of the area), mostly evergreen forest.[6] At the time of Salmon Recovery Plan adoption, the 2006 NLCD showed the Nooksack watershed was 57.3% forested, and in 2021 the Nooksack watershed was 63% forested. While the Nooksack watershed is now meeting the forest cover target, the lower mainstem sub-watershed of the Nooksack remains largely unforested and is meeting only 22% of its 50-year target of 40,855 acres of hydrologically mature forest cover.[7,8]

2021 NLCD Forest Cover and Nooksack Salmon Recovery Sub-watersheds



Comparisons of Hydrologically Mature Forest Cover Acreage in Areas of the Nooksack Watershed

Geographic Area	Historic Amount	2005 Plan Condition	Current Condition	50-year Habitat Goal	10-year Implementation Target
Upper North Fork	40,888	42,337	42,948	24,533*	n/a
Lower North Fork	107,506	91,488	100,227	64,504*	n/a
Upper Middle Fork	37,234	36,165	37,214	22,340*	n/a
Lower Middle Fork	14,933	12,060	13,276	8,960*	n/a
Upper South Fork	70,303	59,838	67,694	42,182*	n/a
Lower South Fork	34,377	20,508	26,976	20,626*	n/a
Upper Mainstem	28,580	14,359	19,219	17,148*	n/a
Lower Mainstem	68,091	9,132	9,034	40,855	6,345

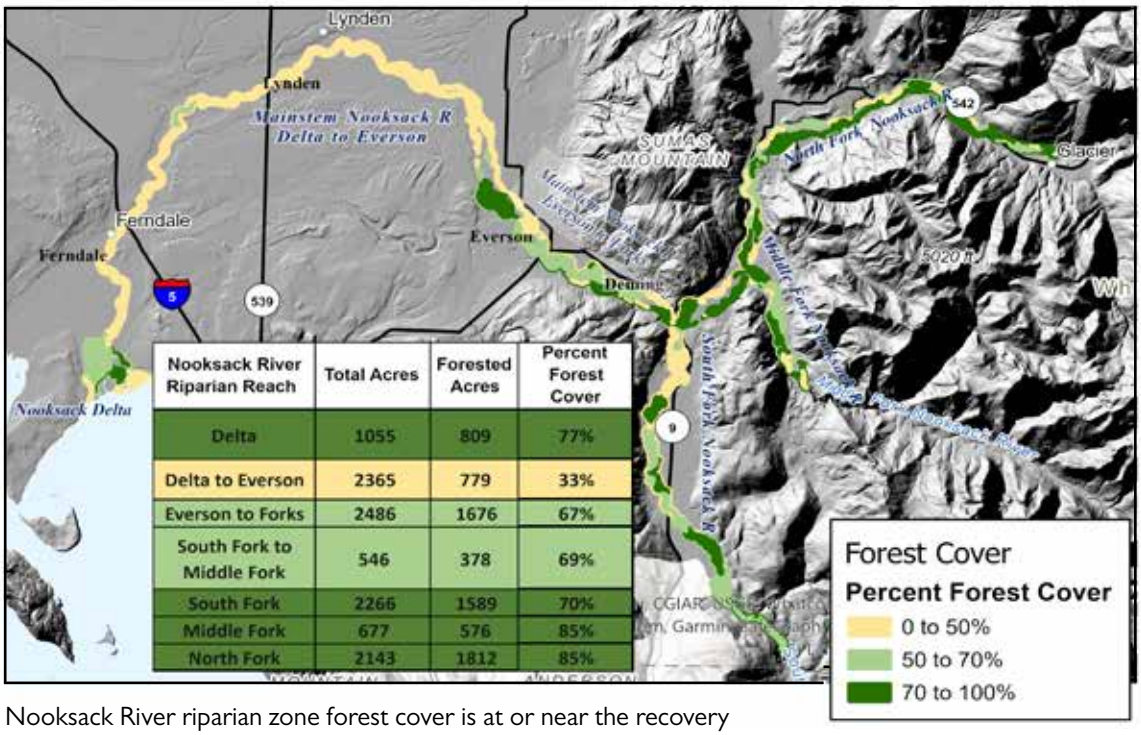
Current status toward 50-year salmon recovery targets for hydrologically mature forest cover in areas of the Nooksack watershed.[11,12]
*Indicates that the 50-year Puget Sound Partnership habitat goal is being met.

Map Data Sources: Maudlin, M. 2021[9], USGS 2021[10]

Reforestation Still Needed in Nooksack River Riparian Zone to Reach Long-term Chinook Recovery Targets

Between 2011 and 2021, the Nooksack River riparian zone lost 309 acres of its forest cover; 154 acres (about 50%) to natural channel migration and bank erosion and 155 acres (about 50%) to human land use.[1]

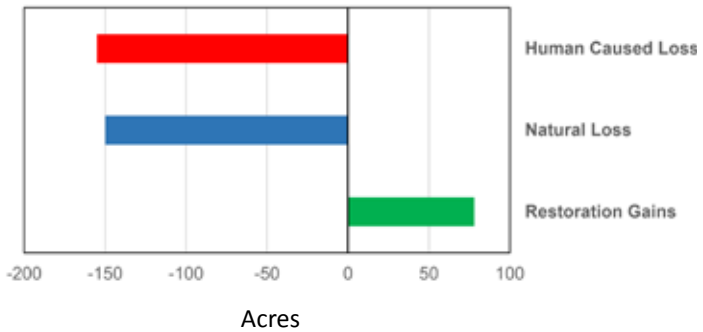
Nooksack River Riparian Zone Forest Cover



Nooksack River Riparian Reach	Total Acres	Forested Acres	Percent Forest Cover
Delta	1055	809	77%
Delta to Everson	2365	779	33%
Everson to Forks	2486	1676	67%
South Fork to Middle Fork	546	378	69%
South Fork	2266	1589	70%
Middle Fork	677	576	85%
North Fork	2143	1812	85%

Nooksack River riparian zone forest cover is at or near the recovery target conditions in the upper forks of the river, but well below target conditions in the lower mainstem.[5,6] Poor forest conditions in the riparian zone are primarily found in the lower mainstem, from the river delta to Everson, WA.[7]

Forest Cover Change in the Nooksack Riparian Zone (2011 to 2021)[8]



Forest cover from mature trees is critical to Chinook habitat, providing shade to regulate stream temperatures, large woody debris to help form pools, and cover and root structure to help stabilize stream banks.[2] The WRIA 1 (the Water Resource Inventory Area for Nooksack and independent watersheds) Salmonid Recovery Plan defines the riparian zone for the mainstem Nooksack and its forks as a 300-foot buffer on the historic channel occupation area and targets a condition of greater than 70% riparian forest cover.[3] The Nooksack River riparian zone was 67% forested in 2021.[4]

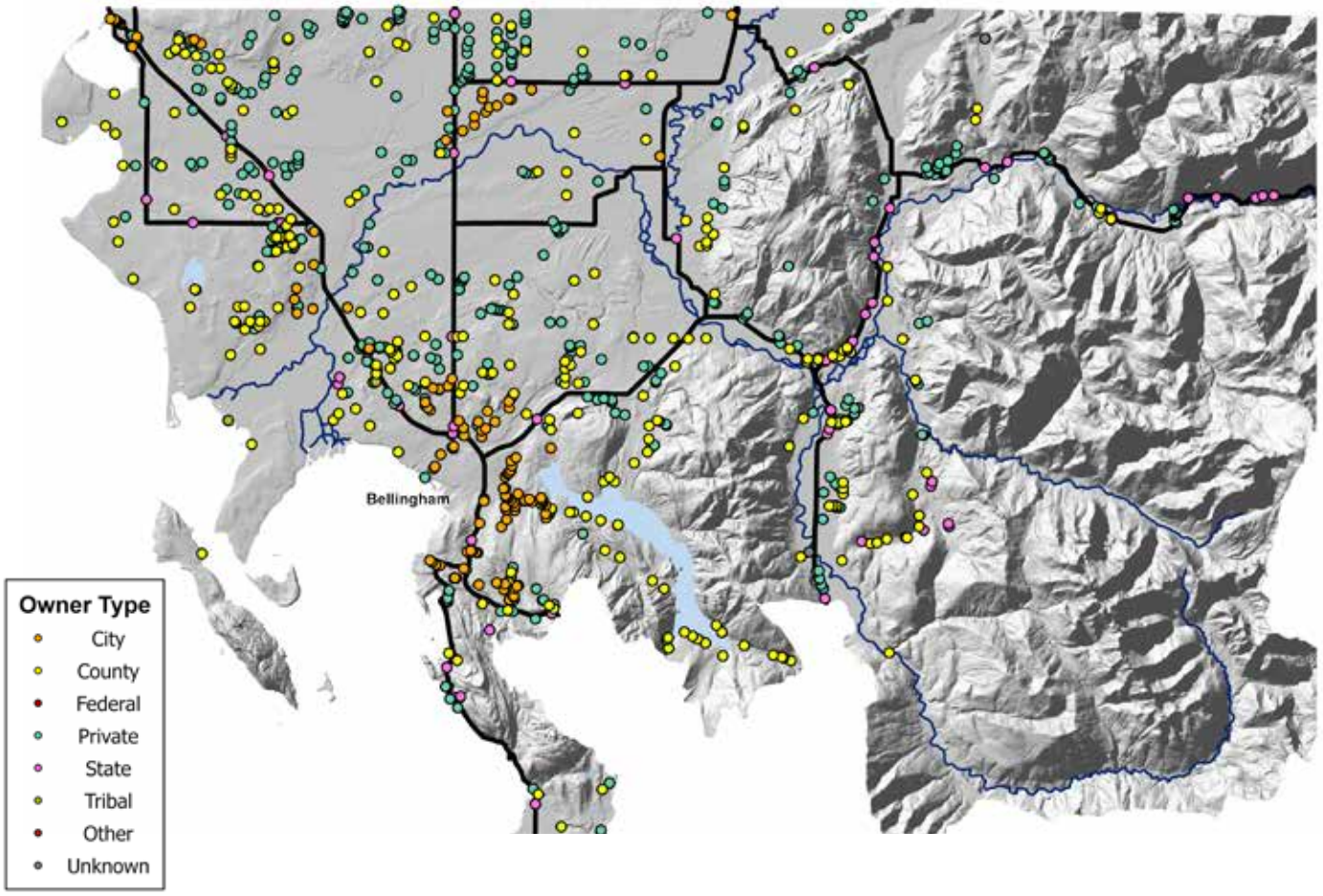
Forest cover is not distributed equally throughout the Nooksack River riparian zone. Most of the land needing riparian restoration to meet the 70% target is between the delta and Everson. Riparian restoration opportunities in this area are challenging to come by because it is primarily zoned for agriculture. If a 70% target is going to be reached, the state and county governments will need to place a higher priority on ensuring that landowners follow Washington Department of Fish and Wildlife guidance for site potential tree height buffers along large rivers as well as inside and outside of channel migration zones.

Map Data Sources: RCO 2024[9], NOAA 2023[10]

Anadromous Barrier Culverts Have Increased

A total of 902 anadromous fish barrier culverts have been identified in WRIA 1 (the Water Resource Inventory Area for Nooksack and independent watersheds) through 2023.[1] There were 723 barrier culverts identified through 2019 and 179 additional barrier culverts documented from 2020 through 2023. Over that same time period, approximately 77 culverts that were surveyed as blocking fish in 2019 were no longer considered blocking.[2] The additional 179 barrier culverts identified since 2019 are not thought to be newly constructed.

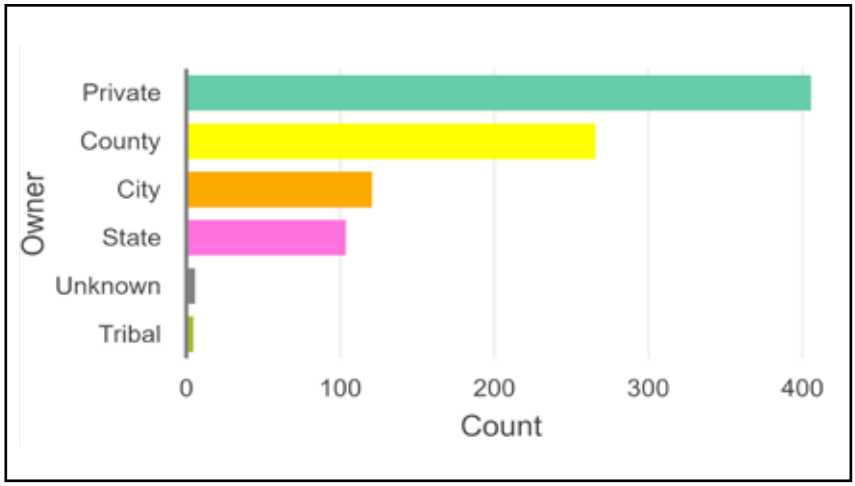
Barrier Culverts by Ownership Within the WRIA 1 Watersheds



Through 2019, there were an estimated 723 culverts at least partially blocking anadromous migration in the WRIA 1 watersheds, and through 2023 this number increased to 902 culverts. Currently over 74% of barrier culverts are either privately owned (45%) or county owned (29%). The remaining barrier culverts are owned by cities (13%) and the state (11%). About 1% of culverts fall outside of these four ownership categories.[3]

Even with culvert repair ongoing, more barrier culverts are being discovered over time. For barrier repairs to exceed the identification of new barriers, all ownership types need to accelerate their schedules for barrier culvert repair.[4]

Ownership of Fish Barrier Culverts in WRIA 1

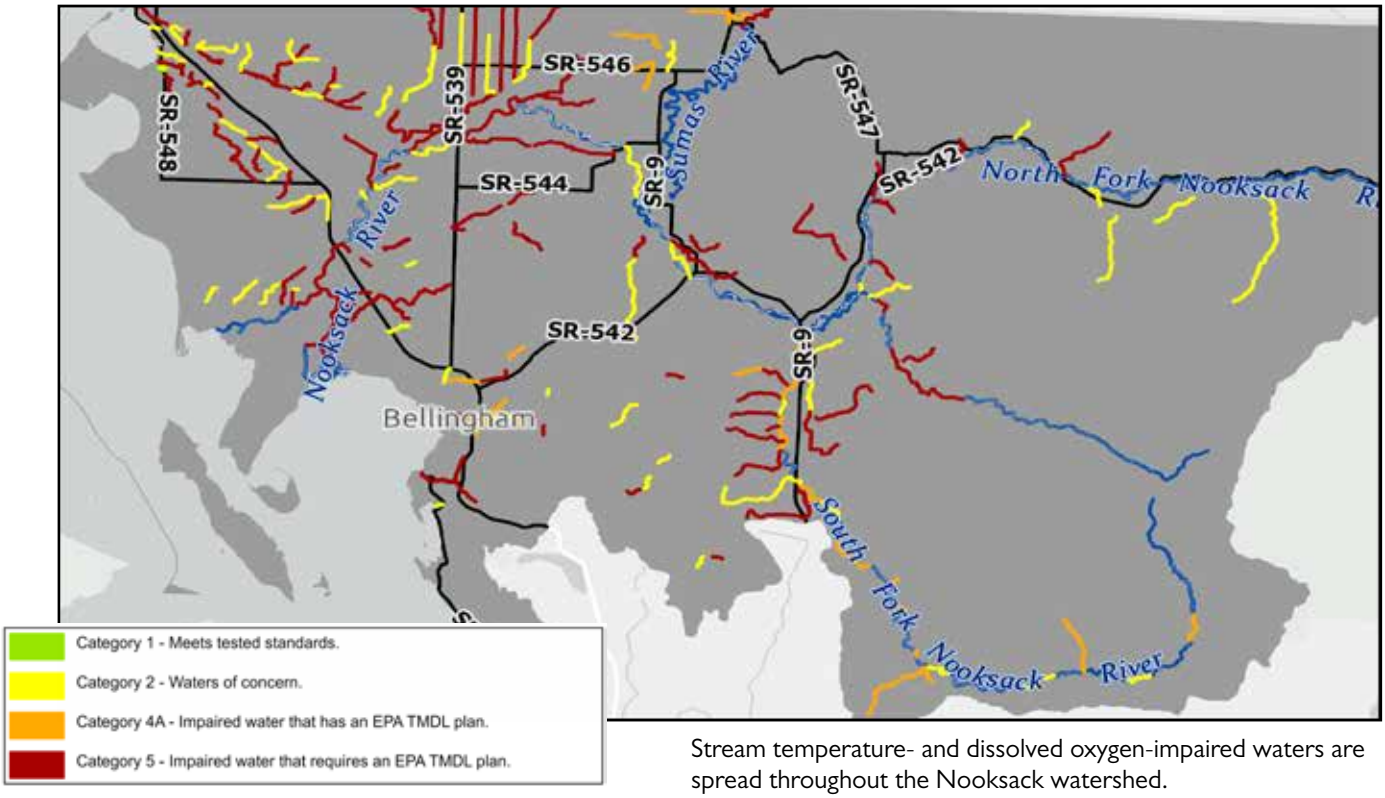


Fish-blocking culverts are largely under private ownership, followed by decreasing proportions of county, city, state and other types of ownership.[7, 8, 9, 10]

Map Data Sources: WADFW 2024[5], SWIFD 2024[6]

Increasing Water Quality Impairment Threatens Salmon Habitat

From 2012 to 2018, water quality decreased in the Nooksack River Watershed.

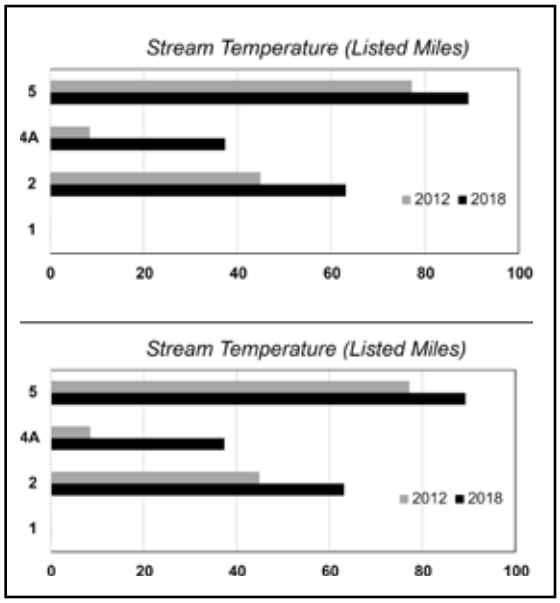


Stream temperature- and dissolved oxygen-impaired waters are spread throughout the Nooksack watershed.

The 2018 Washington Department of Ecology Water Quality Assessment and listings report to the U.S. EPA is the first update since 2012. In it, temperature impaired streams that need an improvement plan increased from 77.18 listed miles to 89.31 listed miles, and temperature impaired streams with a water improvement plan increased from 8.5 miles to 37.35 miles. Dissolved-oxygen impaired streams that need a water improvement plan increased from 162.65 listed miles to 182.14 listed miles.[1]

Pacific salmon require cold, well-oxygenated water across all life stages. High stream temperatures and low dissolved oxygen are lethal to salmon at certain thresholds.[2] Low levels of dissolved oxygen can also hinder embryo incubation, which can result in weaker fry that are more susceptible to predation and that don't feed or swim as well.

Stream temperature and dissolved-oxygen impairments are largely caused by nonpoint source pollution. The Clean Water Act provides limited authority to address nonpoint source pollution, so a lot of the total maximum daily load (TMDL) measures recommended for impaired waters are voluntary, encouraging landowners to take action to decrease pollution. Dating back to 2013, the Government Accounting Office reported on the challenges of nonpoint source pollution control measures and recommended that Congress consider revising the Clean Water Act's voluntary approach to cleaning up such pollution. As of the end of 2023, Congress had not taken action on these recommendations.[3] Under Washington state law and affirmed by the state Supreme Court, Ecology has some authority to regulate nonpoint source pollution, but the agency still relies largely on non-effective voluntary measures.



Between the 2012 to the 2018 Water Quality Assessments, stream miles impaired for temperature and for dissolved oxygen increased.[5]

Map Data Sources: WAECY 2022[4]

Climate Change Impacts to Streamflow Threaten Nooksack River Salmon

A comparison of mean daily streamflow in the Nooksack River between 1967-1996 and 1997-2023 shows a shift in streamflow timing over the course of the water year. Daily streamflow is becoming higher from October through January and lower from June through August (Figure 1).[1] This corresponds with the climate change impacts of rising air temperature and more annual precipitation as rain, less winter precipitation as snow and less summer precipitation overall.

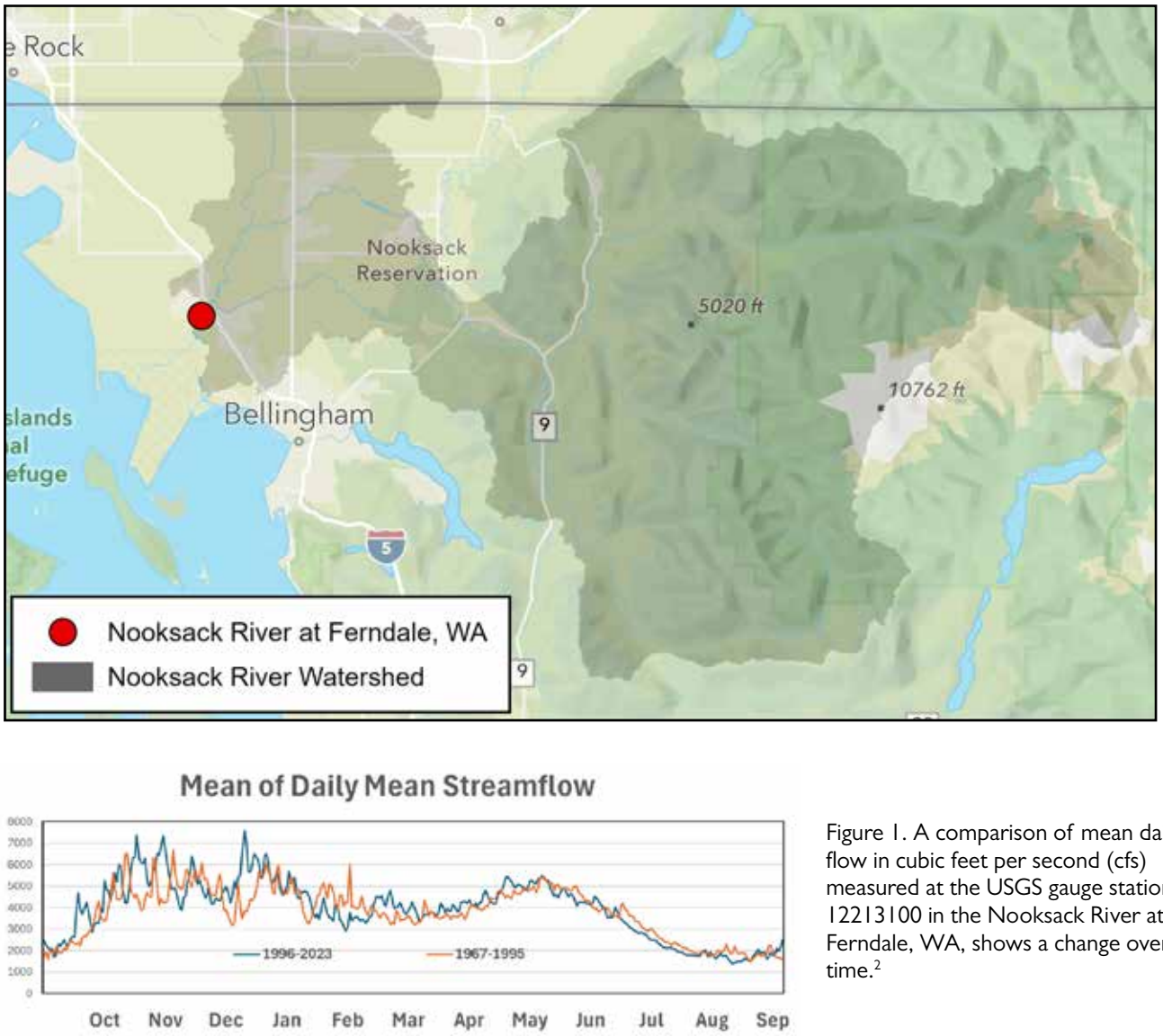


Figure 1. A comparison of mean daily flow in cubic feet per second (cfs) measured at the USGS gauge station 12213100 in the Nooksack River at Ferndale, WA, shows a change over time.[2]

Changes in streamflow are critical to anadromous salmon survival and production because they result in changes to water quality and quantity and impact salmon habitat and nutrient availability. Higher flow in the fall and winter potentially decreases the amount of usable spawning habitat due to higher velocities and shifting spawning gravels. Lower flow in the summer means less usable rearing habitat and higher water temperatures, which can be lethal to salmon.

Changes in flow within the Nooksack River watershed reflect changes throughout Washington state, and by the 2080s it is expected that winter streamflows will increase by 23-34%, and summer streamflows will decrease by 34-44%.[3] With this continued change in streamflow affecting salmon across their freshwater life stages, it is critical that we work to restore floodplain connectivity that slows down winter flow and creates more spawning habitat, restore forested wetlands that can store water for summer and restore riparian forest cover to provide shade that keeps streamflows cool in the summer.

Map Data Sources: USGS, Whatcom County

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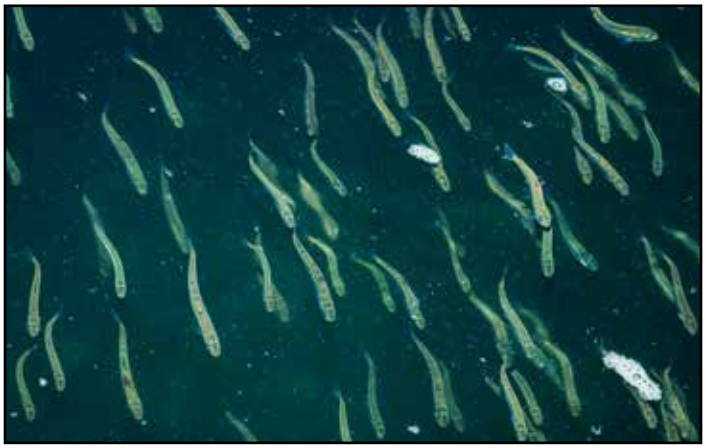
2025 State of Our Watersheds Report
Olympic & Kitsap Peninsulas

Protecting treaty rights is an ongoing challenge with increasing threats to biodiversity, ongoing political obstacles, and a changing climate. While these struggles persist, real progress is being made to strengthen the health of our resources and ensure continued tribal harvesting and fishing opportunities for future generations. Working collaboratively with other tribes and partners, we are moving priority actions forward to protect, restore and recover critically important species and habitats.

– Roma Call
Natural Resources Director



Leah Mellinger, PGST Finfish Program Manager

Chum smolts released from the Port Gamble S'Klallam Hatchery.

- - - - Area of Concern
—— Area of Study

Port Gamble S'Klallam Tribe

The Port Gamble S'Klallam Tribe is part of the Klallam Band of Indians that has resided throughout the Strait of Juan de Fuca, Hood Canal and Port Gamble Bay for generations.

The northern Hood Canal, WRIA 15 and WRIA 17 watersheds have remained largely rural and forested with a natural resources-based economy focused on shellfish harvesting, commercial forestry, commercial fisheries, tourism and agriculture. Major land use impacts on salmon habitat have occurred from floodplain and shoreline development, road construction and past logging practices. This report will focus on the WRIA 17 basin and surrounding marine waters, which is only a portion of the area where the Port Gamble S'Klallam Tribe works and manages.

Port Gamble S'Klallam Tribe

The Area of Study for the Port Gamble S'Klallam Tribe report encompasses the northeast corner of the Olympic Peninsula in the rainshadow of the Olympic Mountains, south to the Hamma Hamma watershed. The area includes many smaller watersheds that drain the low elevation terrain of the Kitsap Peninsula and the steep eastern slopes of the Olympic Mountains into the Hood Canal, Admiralty Inlet and the Strait of Juan de Fuca. The Area of Study is made up of portions of Kitsap, Jefferson, Clallam and Mason counties.

Geologic features in the landscape were created from a combination of seismic uplift, glaciation and fluvial processes. These past and current forces have had important consequences for the evolution of coastal shoreline features, stream drainages and headwater wetlands, many of which provide important spawning and rearing habitats in the nearshore for forage fish species and salmonids, including the Endangered Species Act (ESA) threatened Hood Canal/Eastern Strait Summer Chum and Puget Sound Chinook.

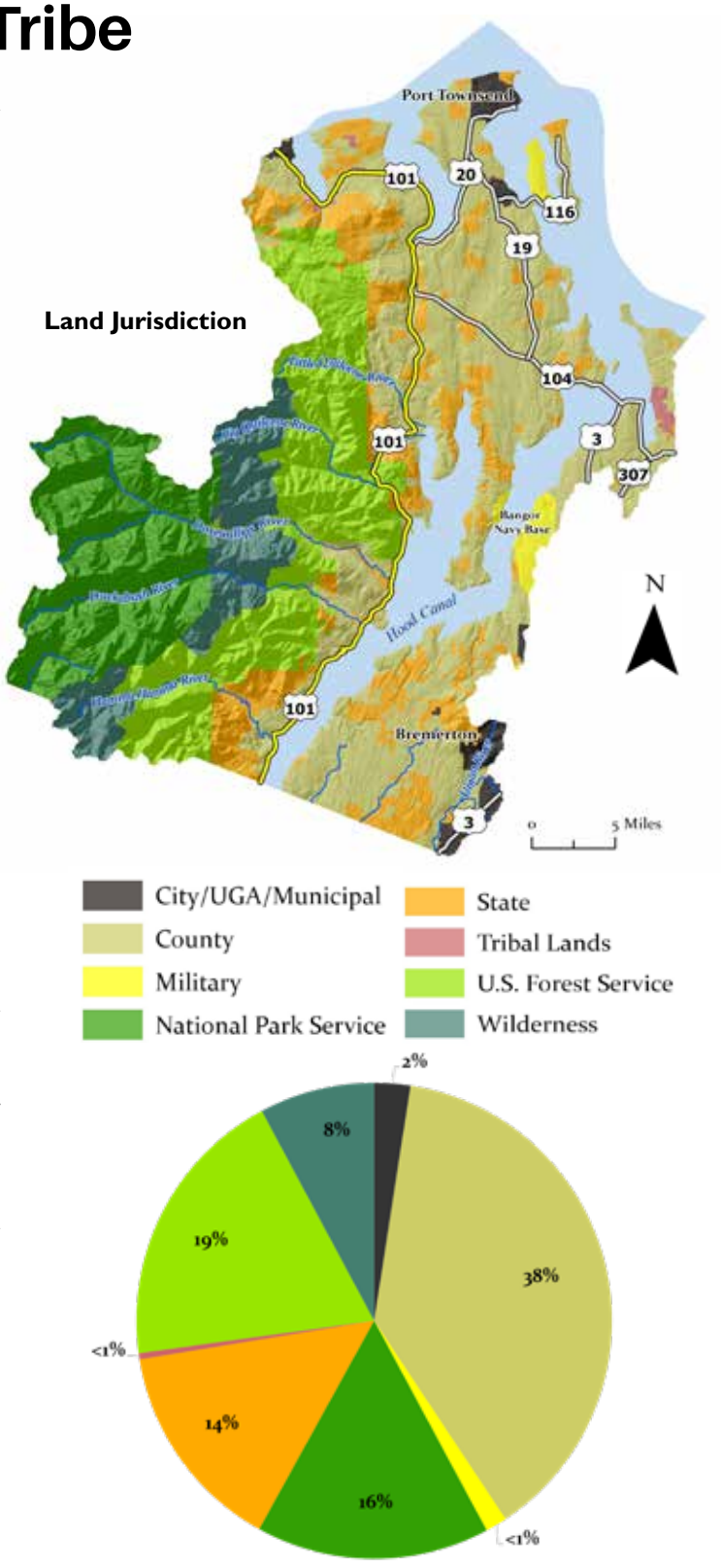
Many streams in the Area of Study have natural periods of low flows and may go dry during the summer months when precipitation is sparse. This tendency renders streams particularly vulnerable to human impacts on the habitat, such as from riparian vegetation removal and water extractions. While these streams may not flow year-round, they provide important spawning habitat for fish populations, including Coho, fall Chum and steelhead.

Native American people in the Hood Canal and eastern Strait region had villages and fishing camps along the shorelines and near the mouths of major streams where they could take advantage of plentiful fish and shellfish resources.

After the Point No Point Treaty of 1855, the Skokomish (traditionally the Twana) and S'Klallam tribes ceded their lands to the United States government and several Indian reservations were established. Euro-Americans had begun settlements around sawmills in the region to continue logging the old-growth timber that dominated the landscape.

Today the area is largely rural and forested, with communities relying on logging, fishing and recreation. The marine waters of Hood Canal are unique due to the slow exchange and mixing of waters in the extensive length of the canal. Depths generally exceed 50 fathoms with large areas of 70 fathoms and deeper. There are also shallow shelves and bays that provide warmer waters rich in nutrients.[1] The west side of Water Resource Inventory Area (WRIA) 15 contains streams and rivers larger than those of the east side, but originate in adjacent and similar headwater terrain. Moving from north to south, the major streams of West Kitsap flowing into Hood Canal include Big Beef Creek, Dewatto River, Anderson Creek, Tahuya River, Stimson, Little Mission and Big Mission creeks, and Union River. These systems support impressive populations of anadromous fish with at least two salmon species utilizing each stream.[1]

Sizable portions of WRIAs 16 and 17 are contained within the Olympic National Park or U. S. Forest Service (USFS) Wilderness Areas and are protected from major habitat alterations. Major land use impacts on salmon habitat include floodplain and shoreline development, roads and logging (especially in steep forested terrain). Today the vegetation is primarily made up of shrubs and young forests, with areas of primarily semi-rural residential and urban development across the landscape.



Map Data Sources: DOD 2023[2], SSHIAP 2004[3], WADNR 2024a[4], WADNR 2024b[5], WAECY 2018c[6], WAECY 2021[7], WAECY 2024[8], WADOT 2018[9], WADOT 2023[10], USFWS 2024[11]

Chapter Summary

The Port Gamble S'Klallam Tribe has fished, hunted and gathered in their watersheds in western Washington since time immemorial and are leaders in the region's salmon recovery effort, especially in the Olympic Peninsula and Hood Canal regions. The S'Klallam, among other tribes, are invested in protecting healthy watersheds culturally and scientifically because this area is important to their people and for future generations. The tribe believes that if salmon and shellfish are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The 2025 State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource. The goal of this report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun collectively by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

For this report, the tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. This document is considered a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Population Density and Impervious Surface Impact Water Quality

The total impervious surface area increased by 1.63% from 2016 to 2021 (compared to 0.8% from 2011 to 2016). Fifty-eight of the 328 sub-watersheds had impacted habitat conditions from impervious surfaces in 2021, and 167 increased in impervious surface area from 2016 to 2021. The areas with the highest population densities had the most impervious surface areas.

Water Extractions Impact Surface Flow and Fish Usage

From 1980 to 2019, 6,987 wells were installed in the Port Gamble Tribe's study area. From 2020 to 2024, 342 new wells were added. This is a 2% increase from the new well installations reported in 2020 (335 new wells installed from 2015-2019). Of the 342 new wells added from 2020 to 2023, 112 were installed in WRIAs 15 and 17, which are closed to new water withdrawals for at least part of the year.

Forest Cover Loss

Forest canopy cover in the tribe's Area of Interest decreased by 5.02 square miles overall from 2016 to 2021. Of the 330 sub-watersheds, 125 had losses greater than 0.5%, including 17 sub-watersheds with losses between 10 and 30%, none of which were within urban growth areas. In 2021, 193 of the 330 sub-watersheds had less than 65% forest canopy cover and only 31 had forest canopy cover greater than 75%.

Port Gamble Bay Upland Cleanup

The Port Gamble Upland Cleanup is expected to be completed in the summer of 2025. This project will restore contaminated soils, remove hardscapes, and return the land and intertidal habitats to natural and healthy functioning processes at the former mill site in Port Gamble Bay.

European Green Crab Threaten Native Species

European green crab (EGC) are a highly invasive species that were first discovered in the Salish Sea in 2012. The tribe is deeply concerned because these invasive crabs negatively impact eelgrass beds necessary for salmon to thrive; they feed on clams, oysters and other critical species used for tribal subsistence; and they pose a displacement risk for the native Dungeness crab. EGC catch numbers increase with the number of traps set.

Hood Canal Bridge is Detrimental to Salmon – New Mitigation Strategies are Found Effective

Up to 50% of migrating juvenile steelhead that encounter the Hood Canal Bridge (HCB) do not survive migration past the bridge. New mitigation strategies to decrease predation at the HCB are currently being tested and preliminary results are promising.

Climate Change Adaptation Measures

The tribe continues to monitor the impacts of a changing climate on their reservation and throughout the region. Of particular concern are changes in forested areas, wetlands and groundwater recharge resiliency on their reservation.

Kitsap Natural Resource Asset Management Program

The Kitsap Natural Resource Asset Management Program (KNRAMP) is a new approach for managing natural resources by treating them as assets. KNRAMP's goal is to employ a systematic process for making strategic decisions about these critical natural resources assets. The tribe was instrumental in developing this program with its partners.

Conclusion

The Port Gamble S'Klallam Tribe has identified several critical indicators of watershed and habitat health. Habitat conditions continue to incrementally decline across the area, additional water withdrawal continues to increase, impervious surfaces have expanded as populations increase, forest cover loss persists, and the invasive European green crab population is expanding. Restoration is not enough to keep up with the impacts of a growing population and their land uses.

Federal, state, and local governments, along with public and private landowners, need to be held accountable for protecting, conserving and improving fish habitat in their land use decisions. Land use and water laws designed to protect critical habitats and provide sustainable resources need to be implemented. Implementation includes education and voluntary action, but it also needs to include enforcement when laws are broken. The future of tribal treaty rights in this area depends on it.

The tribe has made climate resilience a priority and continues to monitor the impacts of changing climate patterns on their reservation and throughout the region. The tribe, along with Kitsap County, have been working together on a Kitsap Natural Resource Asset Management Program, which is designed to help make strategic decisions about critical natural resources for the entire community. While there is positive momentum with notable progress in certain areas, significant work remains to fully achieve recovery goals that will help the entire community.

Recovery Efforts Lagging

At the 20-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for WRIA 17 and northern Hood Canal area shows an increase in population density, impervious surface impacts, increases in groundwater withdrawals and degrading marine shoreline habitat conditions. All remain priority issues and while some improvements are occurring with restoration efforts, restoration alone cannot keep up with the loss of habitat. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the status of these key environmental indicators for the Port Gamble S'Klallam Tribe shows a steady loss in habitat but improvement in restoration efforts:

Tribal Indicator	Status	Habitat Trend
Impervious Surface / Population Density	The total impervious surface area increased by 1.63% from 2016 to 2021 (compared to 0.8% from 2011 to 2016). Fifty-eight of the 328 sub-watersheds had impacted habitat conditions from impervious surfaces in 2021 and 167 increased in impervious surface area from 2016 to 2021. The areas with the highest population densities had the most impervious surface areas.	**Declining**
Water Wells	From 1980 to 2019, 6,604 wells were installed in the Port Gamble S'Klallam Tribe's study area. From 2020 to 2023, an additional 228 new wells were added. Of the 228 new wells, 84 were installed in WRIAs 15 and 17, which are closed to new water withdrawals for at least part of the year.	**Declining**
Forest Cover	Forest canopy cover in the Port Gamble S'Klallam Tribe's Area of Interest decreased by 5.02 square miles overall from 2016 to 2021. Of the 330 sub-watersheds, 125 had losses greater than 0.5% including 17 sub-watersheds with losses between 10 and 30%, none of which were within urban growth areas. In 2021, 193 of the 330 sub-watersheds had less than 65% forest canopy cover and only 31 had forest canopy cover greater than 75%.	**Declining**
Habitat Restoration - Port Gamble Bay	The Port Gamble Upland Cleanup is expected to be completed in the summer of 2025. This project will restore contaminated soils, remove hardscapes, and return the land and intertidal habitats to natural and healthy functioning processes at the former mill site in Port Gamble Bay.	**Improving**
Invasive Species - Green Crab	European green crab (EGC) are a highly invasive species that were first discovered in the Salish Sea in 2012. The Port Gamble S'Klallam Tribe is deeply concerned because these invasive crabs negatively impact eelgrass beds necessary for salmon to thrive, they feed on clams, oysters and other critical species used for tribal subsistence, and they pose a displacement risk for the native Dungeness Crab. EGC catch numbers increase with the number of traps set.	**Concerns**
Climate Change	The Port Gamble S'Klallam Tribe continues to monitor the impacts of changing climate on their reservation and throughout the region. Of particular concern is changes in forested areas, wetlands and groundwater recharge resiliency on their reservation.	**Concerns**

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

The Port Gamble S'Klallam Tribe's priorities center around the protection of the marine resources in Hood Canal, including Port Gamble Bay, Strait of Juan de Fuca, Admiralty Inlet and north to the San Juan Islands for current and future generations. They are also focused on the terrestrial resources and the ecosystems they depend upon throughout the tribe's usual and accustomed area. Most of their efforts are intended to protect and sustainably manage as well as enhance existing resources.

Their programs focus on restoration, sustainable management, beach seeding and enhancement, including use of a shellfish nursery floating upweller system (FLUPSY) and protecting Hood Canal from impacts of threatening developments and pollution.

Greater focus and effort is required in conservation measures and restoration activities to offset negative habitat trends. Enhancement and restoration efforts are not on pace to achieve the identified 10-year goals due to the lack of funding, staff capacity and landowner expectations. Additionally, upgrading the regulatory framework that serves to protect salmon habitat must occur if the underlying assumption to meet all the recovery goals is to be realized—that existing habitat will be protected from loss. The 1999 recovery goals of keeping impervious covered areas maintained at or within the 10% threshold and rural growth rate of 1.08% have not been realized. A monitoring program on habitat status and trends should be implemented in conjunction with this regulatory reform to determine if observable differences can be detected because of the implementation of new land-use regulations. "Net Ecological Gain" is a nice sounding new effort with legislation starting to stack up but the political will or lack thereof is always the primary limiting factor.

Resilience to climate change is emerging as a key priority for the tribe. More science is needed to better determine the potential impacts of climate change including sea level rise, bluff erosion, high energy storm impacts, ocean acidification and changes in temperature. The tribe is focused on the conservation of forested areas for habitat, water resource infiltration, riparian system protection and climate resilience. Understanding the potential impacts is important but it must be followed by actions. The tribe plans to determine what the environment may look like in generations ahead and address the management challenges to ensure that sustainably fishable and harvestable resources are achieved.

The tribe is trying to secure healthy and sustainable salmon populations, as well as access to them, for future generations with limited resources. Another concern is with the population and availability of cockles which are an important subsistence resource for the tribe.

The tribe has placed much of its energy into nearshore work, including acoustic, beach seine and tow-netting studies to better understand the early marine life history of juvenile salmon. This includes a long-term partnership study on the effects of the Hood Canal Bridge on juvenile salmon. The tribe is looking at associated limiting and/or constraining factors with juvenile salmon and forage fish relating to their nearshore habitat use, the floating bridge in Hood Canal, and dependence and impacts from the large areas of altered shorelines.

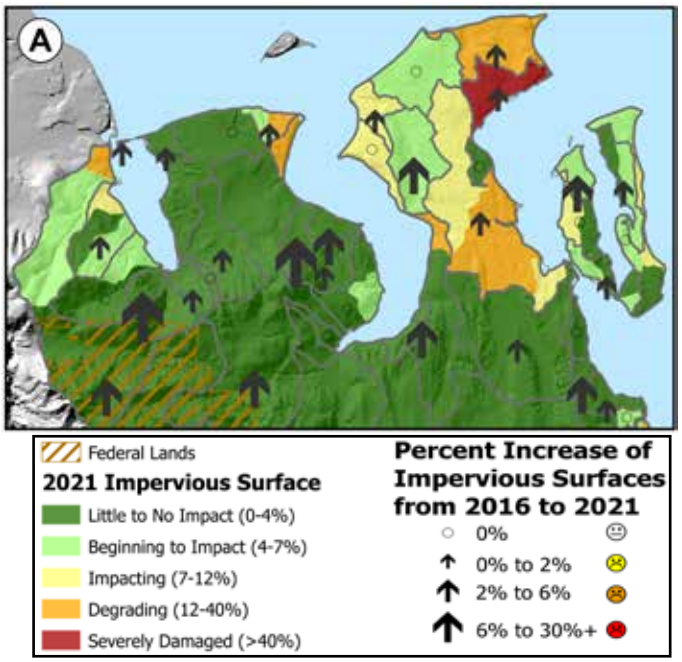
The tribe is involved in many projects to further understand and protect the resources within their usual and accustomed area. The tribe is one of many partners working to determine how the Hood Canal Bridge impacts salmon and steelhead migration. The anthropogenic impacts on the water quality of the Hood Canal and Port Gamble Bay are of great concern to the tribe. The cleanup efforts of Port Gamble Bay remain a priority for the tribe, as is the Pollution Identification and Correction program, which the tribe would like to see expanded.

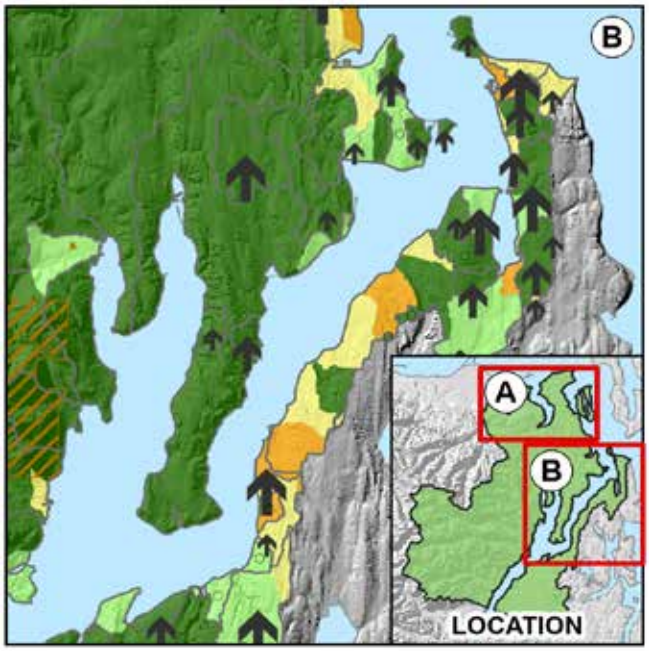
Further research on using DNA to identify source pollution has also emerged as a priority for the tribe.

Other emerging concerns include the contaminants found in fish that is consumed and associated effects on human health.

Population Density and Impervious Surface Impact Water Quality

Within the Area of Study, the total impervious surface area increased by 1.63% from 2016 to 2021 (compared to 0.8% from 2011 to 2016). Fifty-eight of the 328 sub-watersheds had impacted habitat conditions from impervious surfaces in 2021, and 167 increased in impervious surface area from 2016 to 2021. The areas with the highest population densities had the most impervious surface areas.



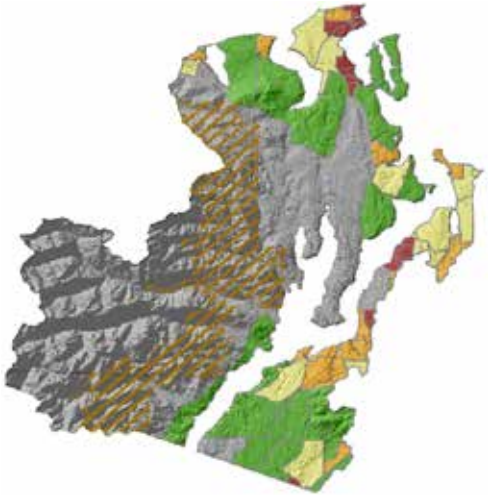


Any level of human disturbance has an impact on watershed processes. Impervious surface area is well documented as a coarse measure of human impact on watershed scale hydrology and biology.[1,2,3] The Hood Canal and Strait of Juan de Fuca Summer Chum Recovery Plan describes thresholds of 10% impervious surface area in a watershed at which sensitive stream habitat elements are lost, while 25% to 30% impervious surface area results in poor water quality.[4] Each watershed will have a different reaction to a given amount of impervious surface area: thresholds serve only to generalize the continuum of degradation that accrues as impervious surface area increases and forest cover is lost.[2] Many species within the watersheds show signs of stress and population decline well before the 10% impervious surface area threshold is reached.[5]

Impervious surface area causes increases in stream temperatures, decreases in stream biodiversity, and contributes to pollutants in point and non-point sources of stormwater run-off, which can contaminate local aquatic systems and lead to shellfish area closures.[6] Aquatic and marine organisms respond immediately to these changing habitat elements, resulting in fatalities, impaired physiological functions, or migration to areas that are more hospitable.[5,7] Research models show that impervious surfaces will increase if county regulations in this region are built out as allowed.[8]

Areas with high population densities also have large amounts of impervious surfaces. Clallam, Jefferson, Kitsap and Mason counties are projected to have a total increase in population of nearly 100,000 people between the years of 2020 and 2050; more than half of those people are projected to be in Kitsap County.[9]

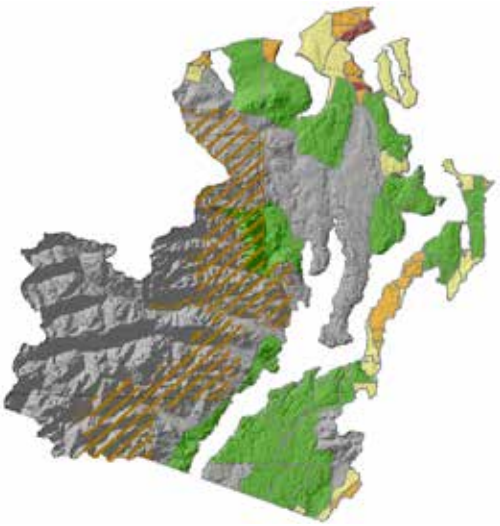
2021 Population Density



Persons/ Sq Mile	Impervious Surface
0 - 30	≤ 1%
30 - 140	1% - 5%
140 - 300	5% - 10%
300 - 700	10% - 30%
700 - 3000	≥ 30%

Impervious Surface Area Increases with Population Density

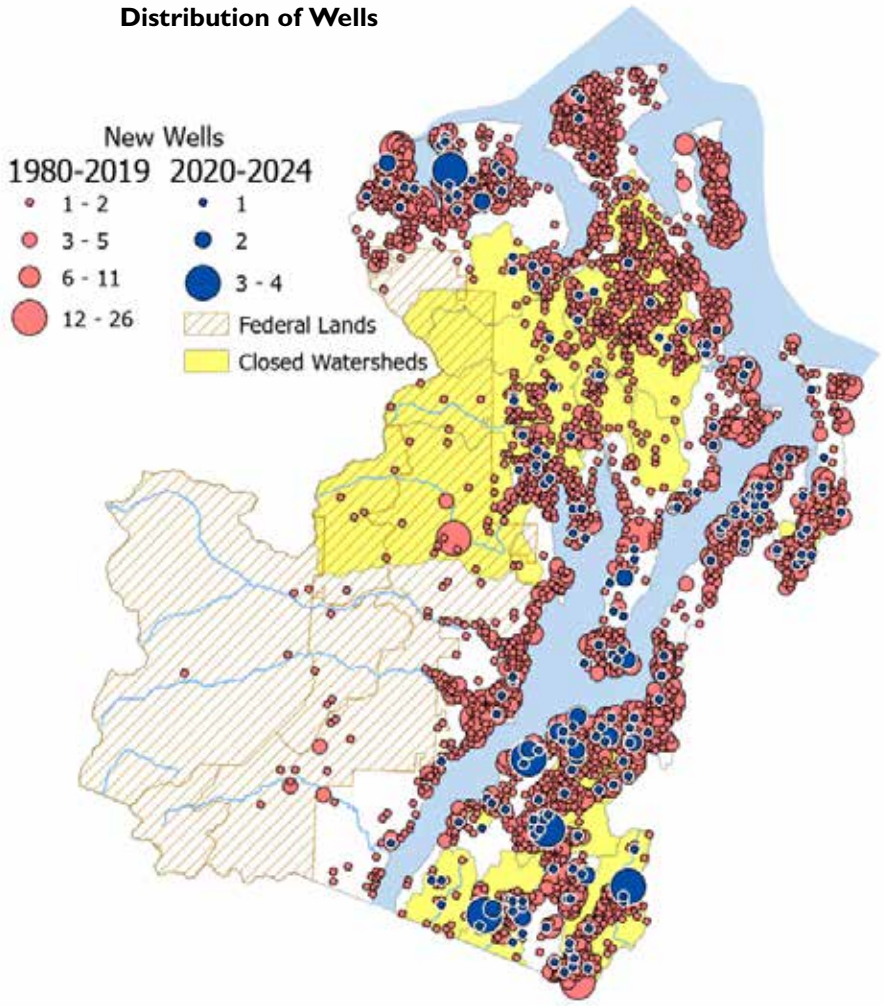
2021 Impervious Surface

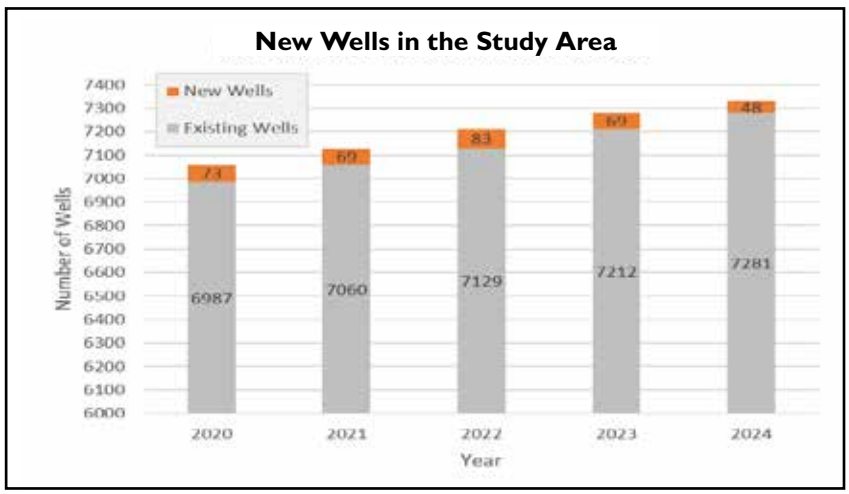


Map Data Sources: WAECY 1994[10], WAECY 2017[11], WAOFM 2023[12], WADNR 2014[13], Dewitz 2023[14,15]

Water Extractions Impact Surface Flow and Fish Usage

From 1980 to 2019, 6,987 wells were installed in the Port Gamble S'Klallam Tribe's study area. From 2020 to 2024, 342 new wells were added. This is a 2% increase from the new well installations reported in 2020 (335 new wells installed from 2015-2019).[1] Of the 342 new wells added from 2020 to 2023, 112 were installed in WRIAs 15 and 17, which are closed to new water withdrawals for at least part of the year.





New wells added each year from 2020 to 2024.

The watersheds within the study area receive 15-100 inches of precipitation per year, primarily in the winter months.[2,3,4] Little precipitation falls during the dry summer months when water needs are greatest, which then relies on stream recharge from groundwater sources. Groundwater and surface water are one resource and the changes to one will affect the other.[5]

Salmonid species, including ESA-listed Summer Chum and steelhead, rely on adequate streamflows for accessibility to suitable upstream spawning habitats with their preferred substrate and to regulate water temperatures.[6] Exempt wells are entitled to withdraw up to 5,000 gallons of water per day, which affects the instream flow of nearby salmon streams. With climate change influencing the area, summer low flow periods are likely to be longer, and can result in higher stream temperatures.[7] This will compound the negative effects of groundwater extractions on freshwater salmon habitats. This area experienced several periods of severe drought since the last SOW report.[8]

From 2020 to 2024, new well installations in the study area increased by 2% from the 2015 to 2019 period. Of the 342 new wells added since 2019, 112 were installed in WRIAs 15 and 17, which have eight streams closed to new surface and groundwater withdrawals at least part of the year, and 32 streams completely closed to all new water uses.[1,9]

The state Department of Ecology's instream flow rules are designed to protect instream resources by mandating minimum water levels for streams.[10] Even though the primary goal for instream flow rules is to protect salmon and ensure their ability to reproduce in the wild, these rules are inadequate and not achieving their desired result.[11] Tribes have attempted to update instream flow rules for important salmon-bearing streams through Ecology with little success, occasionally resorting to legal action.[12] The Port Gamble S'Klallam Tribe continues to take part in local and regional discussions to promote sustainable groundwater management, including the WRIA 15 Watershed Restoration and Enhancement Plan facilitated by Ecology.

Conservation of freshwater resources for instream and human uses is one of the five primary objectives in Puget Sound Partnership's Action Agenda.[13] Water withdrawals and diversions are listed as one of the high pressures on the local ecosystem within the Hood Canal Action Area.[14]

Map Data Sources: WAECY 1994[15], USGS 2018[16], WADNR 2018[17], WAECY 2024[18]

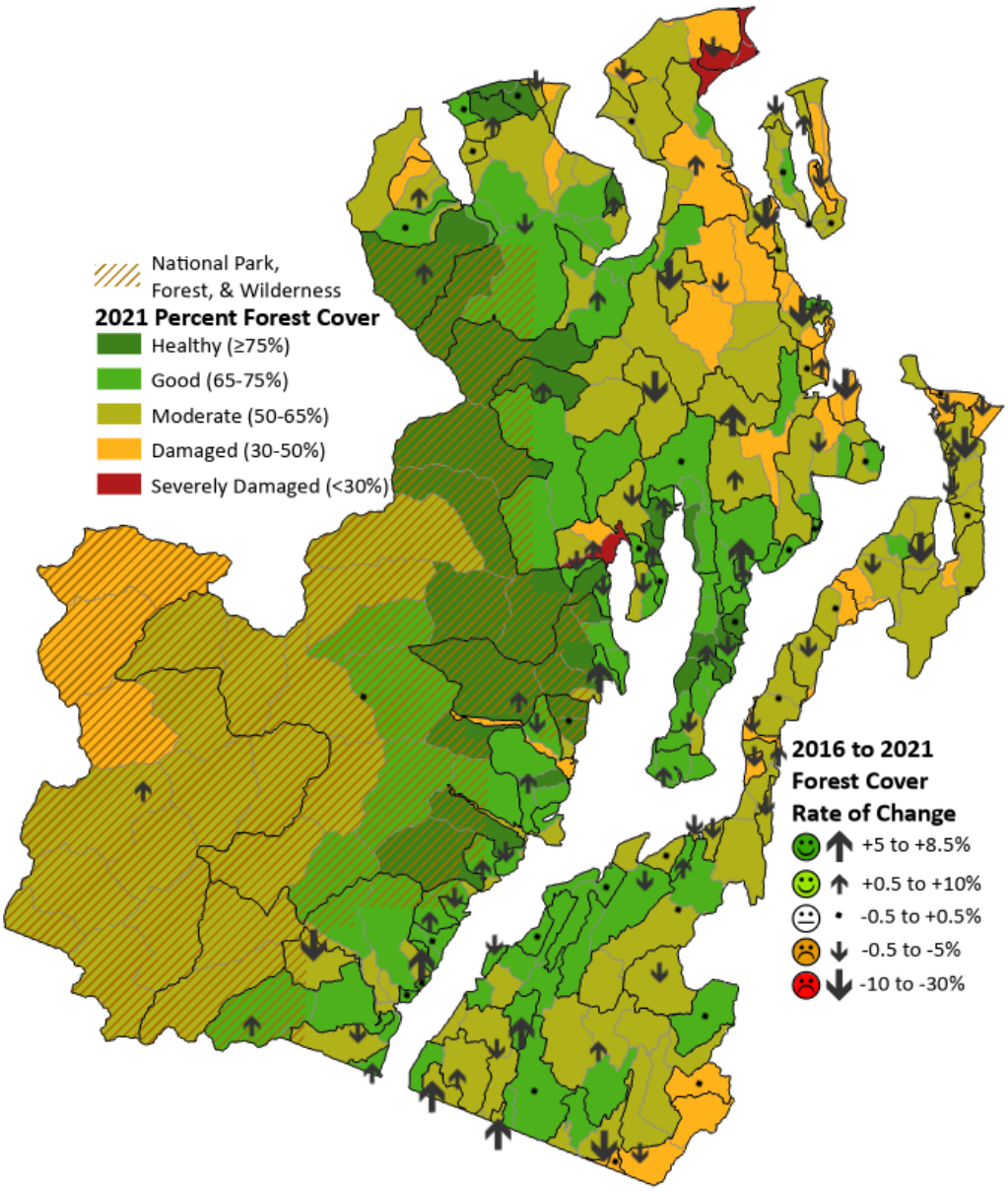
Forest Cover Loss

Forest canopy cover in the Port Gamble S'Klallam Tribe's Area of Interest (AOI) decreased by 5.02 square miles overall from 2016 to 2021. Of the 330 sub-watersheds, 125 had losses greater than 0.5%, including 17 sub-watersheds with losses between 10 and 30%, none of which were within urban growth areas. In 2021, 193 of the 330 sub-watersheds had less than 65% forest canopy cover and only 31 had forest canopy cover greater than 75%.

Healthy forested land cover is a critical component of functional stream ecosystems.[1] Forest cover loss by removal and modification of riparian forests causes increases in water temperatures, decreases in slope stability in floodplains, and reductions in large woody debris in streams, all of which negatively affect salmon health.[2]

Even in natural areas without impervious surfaces, loss of forest canopy cover degrades aquatic ecosystems.[3] The threshold to minimize stream degradation for fish health is 65% forest canopy cover; however, any level of disturbance negatively affects stream ecology and salmonid migrations.[3,4] Of the roughly 1,200 square miles analyzed in the tribe's AOI, only 336 square miles have forest canopy cover that is greater than 65% as of 2021.

Climate change is an increasing concern for forest health as warming temperatures and increases in droughts make forests more vulnerable to degradation from insects and disease.[5] Coupled with increases in deforestation through logging and development, forest canopy losses can be detrimental to salmon recovery efforts. The tribe's Priority Climate Action Plan includes measures to protect, maintain and restore healthy functioning forests which includes 1,200 acres of forest fully in trust.[6] Restoring forest cover through plantings in riparian and adjacent areas and protecting existing forest health and canopy cover are vital to salmon habitat recovery efforts and continue to be priorities of the tribe.[7]



Map Data Sources: USDA 2024[8], NPS 2024[9], USGS 2023[10], USGS 2023[11], WAECY 2011[12]

Port Gamble Bay Upland Cleanup

The Port Gamble Upland Cleanup is expected to be completed in the summer of 2025. This project will restore contaminated soils, remove hardscapes, and return the land and intertidal habitats to natural and healthy functioning processes at the former mill site in Port Gamble Bay.

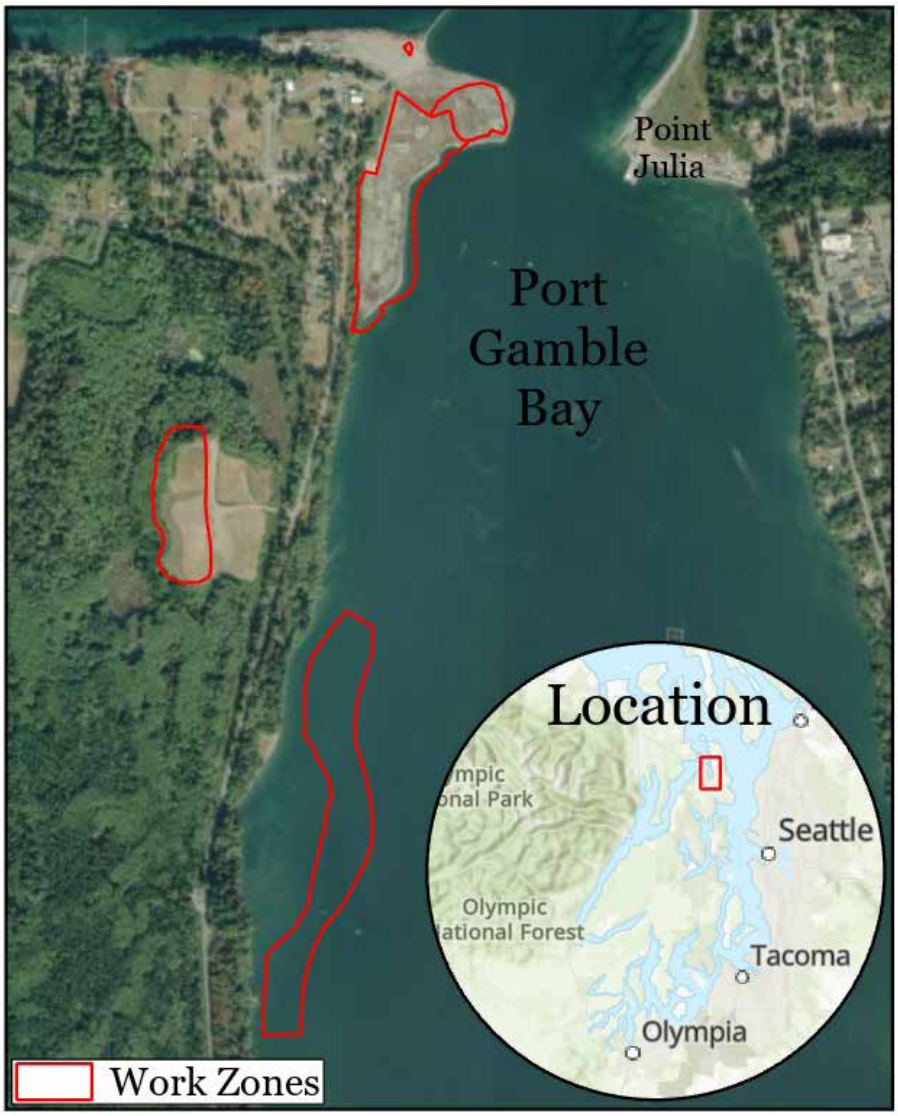


Figure 1. Port Gamble Mill Site upland cleanup restoration areas.

Anchor QEA

Figure 2. First day of excavation.

Anchor QEA

Figure 3. Excavating contaminated soil to 15 feet below the surface.

Anchor QEA

Figure 4. Completed beach backshore.

Port Gamble Bay lies at the northern tip of the Kitsap Peninsula where Hood Canal meets Puget Sound (Figure 1). Archaeological discoveries in Point Julia, at the mouth of the bay, indicate that the area has been inhabited for over 1,000 years by S'Klallam people.[1] Shellfish, forage fish, salmon and other wildlife populate the bay and surrounding areas and are important resources for S'Klallam members.

However, Port Gamble Bay has been polluted since a mill site was established on the western bank in 1853.[1] After 142 years of operation, the mill closed in 1995, leaving many toxic pollutants, including cPAHs, dioxins, furans and heavy metals, that led to shellfish closures in the bay, collapse of forage fish populations, and an overall unhealthy environment for fish and wildlife.

After more than a decade of court battles and planning, an agreement was reached in 2013 that outlined how the mill site's owners would restore the environment. In 2017, the in-water portion of the restoration process was completed which included removal of creosote pilings, wood waste, contaminated sediment, overwater structures and replacement of polluted sediment.[2] Environmental monitoring will continue through 2030 to ensure success of the project.[3]

In 2021, the Port Gamble S'Klallam Tribe purchased development rights on 18.9 acres of upland and the adjacent tidelands of their ancestral lands at the old mill site and established a conservation easement to protect the natural environment in perpetuity.[4] Work began on the upland cleanup in July of 2024 (Figure 1). The upland cleanup includes excavating and disposal of contaminated soil down to 15 feet below the surface (Figure 3), soil capping other areas that exceed pollutant thresholds, and removal of hardscapes. Upon completion of the restoration, approximately 58 acres of upland will be restored. The restoration includes reshaping intertidal slopes (Figure 2 and 4), and replanting native vegetation and eelgrass.[5] Environmental monitoring will continue for at least 10 years.[3] This work creates a healthier environment for all species and restores the natural processes of Port Gamble Bay.

European Green Crab Threaten Native Species

European green crab (EGC) are a highly invasive species that were first discovered in the Salish Sea in 2012.[1] The Port Gamble S'Klallam Tribe is deeply concerned because these invasive crabs negatively impact eelgrass beds necessary for salmon to thrive; they feed on clams, oysters and other critical species used for tribal subsistence; and they pose a displacement risk for the native Dungeness Crab.[2] EGC catch numbers increase with the number of traps set.

EGC are a highly invasive species that have colonized many habitats globally outside of their native range.[3] They colonize rapidly, are efficient predators and can significantly alter any ecosystem they invade.[3] In the Pacific Northwest, EGC pose a significant threat to the native Dungeness crab, clams, oysters and salmon.[4]

Washington Sea Grant, Washington Department of Fish and Wildlife (WDFW), tribes and other agencies, including citizen science groups, are working together to use aggressive trapping and removal practices in order to keep EGC invasions under control. Currently, ongoing monitoring and rapid response efforts are the most employed methods for dealing with EGC.[3]

The Port Gamble S'Klallam Tribe first began trapping for EGC on their reservation at Point Julia in 2020. This is a Washington Sea Grant Sentinel Site and the tribe, WDFW and Washington Sea Grant collectively monitor EGC trapping efforts. While no EGCs have been captured at the Point Julia site yet, many have been found in the Port Gamble study area (Figures 1 and 2).

The tribe continues to proactively trap for EGC and is developing an action plan for how to respond if found nearby or on the shores of the tribe's reservation. Many of the tribal staff participate in Sea Grant's EGC trainings to ensure rigorous scientific methods are used during trapping efforts. Currently, six traps are set monthly from May to October and regularly monitored. Habitat conditions and bycatch evaluations are examined and included in ongoing data reporting records.

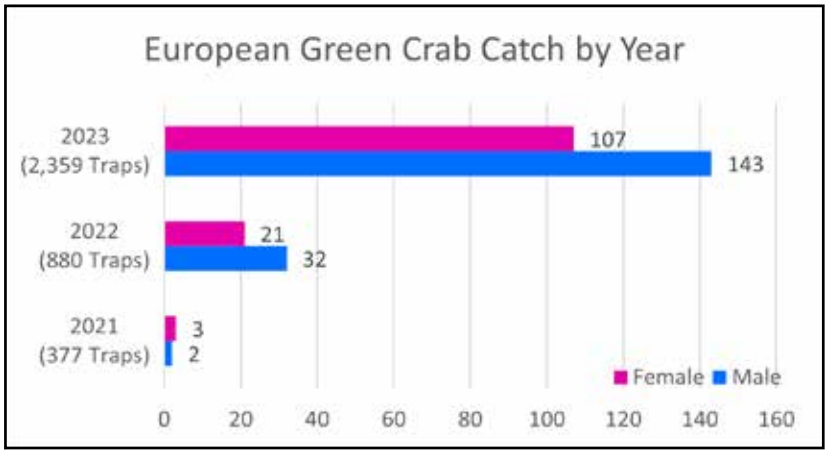


Figure 1. European green crab catch by year and gender within the Port Gamble Area of Interest with total number of traps set as reported by WDFW.

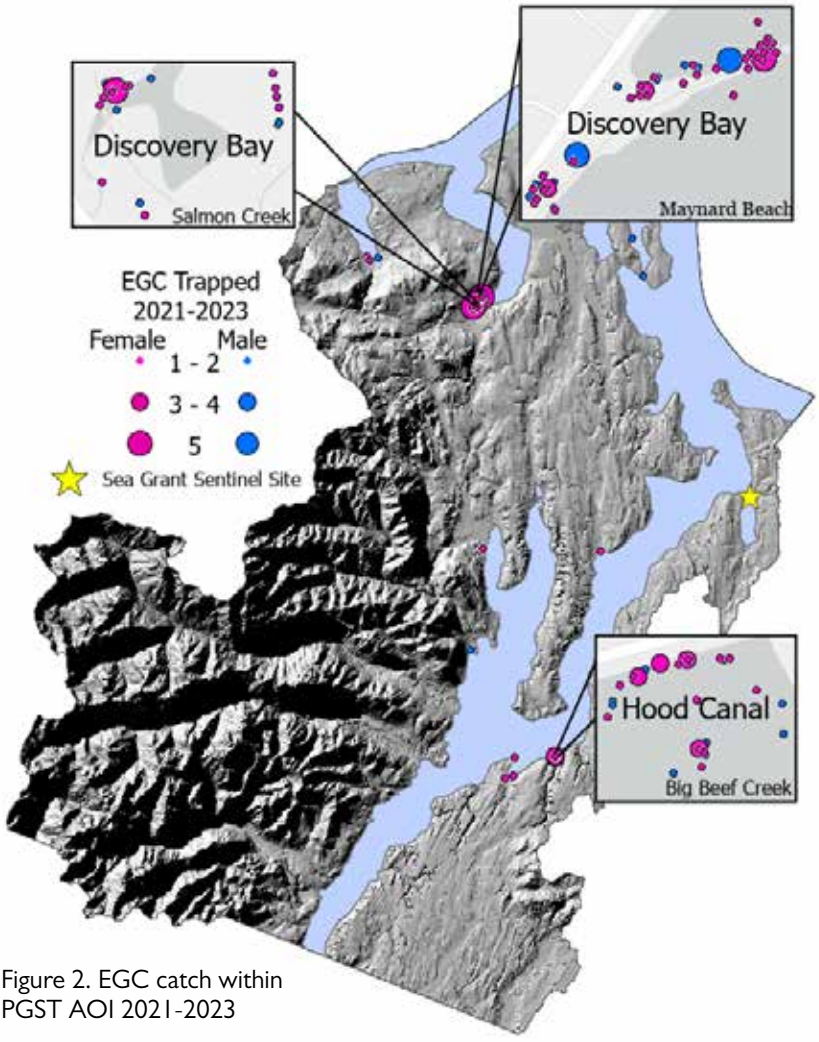


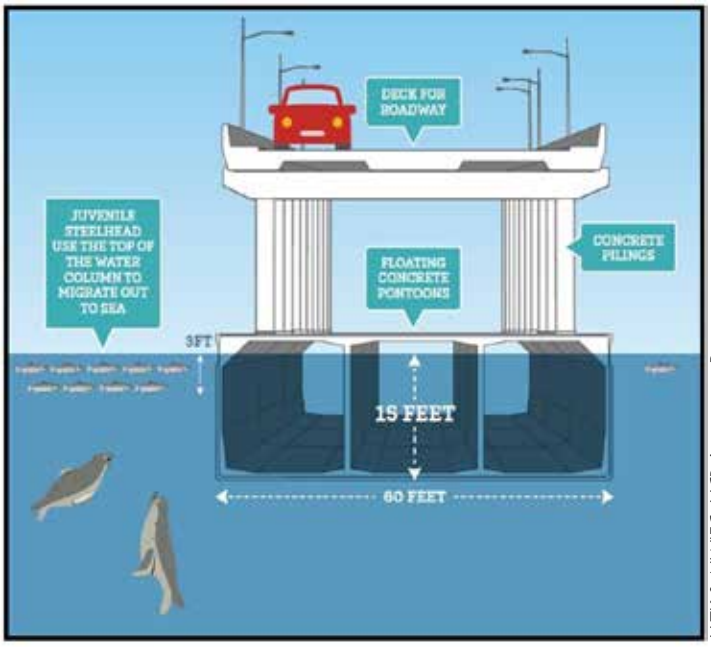
Figure 2. EGC catch within PGST AOI 2021-2023

Map Data Sources: SSHIAP 2004[5], WDFW 2024[6], WAECY 2018[7]

Hood Canal Bridge is Detrimental to Salmon – New Mitigation Strategies are Found Effective

Up to 50% of migrating juvenile steelhead that encounter the Hood Canal Bridge (HCB) do not survive migration past the bridge.[1] New mitigation strategies to decrease predation at the HCB are currently being tested and preliminary results are promising.

Figure 1. Location of Hood Canal Bridge.



LLTK & NWIFC: HCB Assessment Report

Figure 2. Floating pontoons block surface migration.

The Hood Canal Bridge Ecosystem Impact Assessment project is comprised of federal and state agencies, Long Live The Kings and other non-profits, the Port Gamble S'Klallam Tribe and other tribes.[2] The goal of the assessment is to understand how the HCB is affecting salmon and offer solutions to mitigate its impact. The bridge spans the northern outlet of Hood Canal, connecting the Olympic and Kitsap peninsulas (Figure 1). As a floating bridge, its pontoons span 83% of the width of Hood Canal and extend 15 feet down into the water (Figure 2).[3]

Using acoustic telemetry, Phase 1 of the assessment determined that salmon mortality greatly increased at the HCB.[2] Perhaps the greatest negative impact to salmon are the 90-degree angles of the bridge's floating pontoons. The sharp angles confuse the fish in their near-surface migration and cause them to turn around to avoid open water, leading to increased dwelling time, and allowing easier predation by pinnipeds, birds and other predators (Figure 3).[2]

Phase 2 began in 2023, which used two mitigation strategies to allow fish to pass the pontoon bottleneck more quickly. The first strategy uses the Targeted Acoustic Startle Technology (TAST) that will continue to be tested into the second quarter of 2025.[4]

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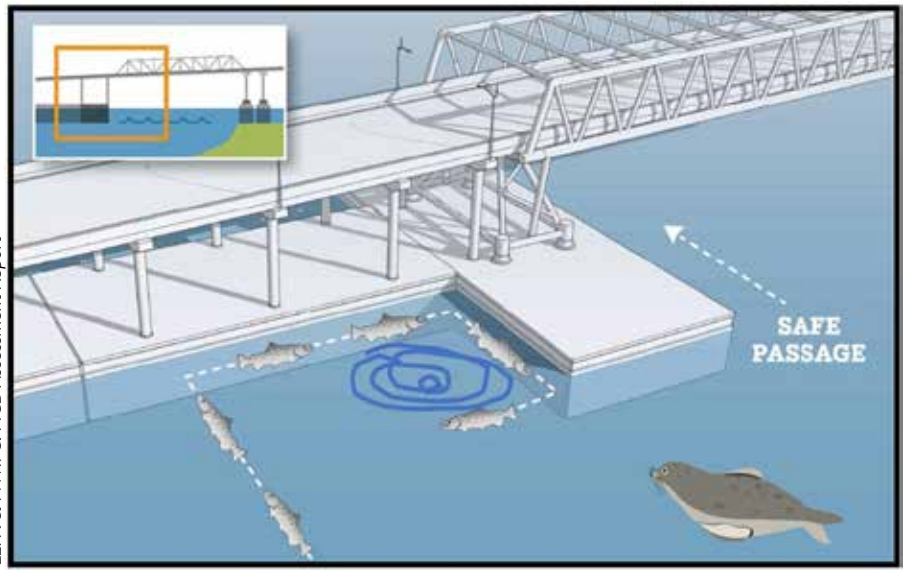

LLTK & NWIFC: HCB Assessment Report

Figure 3. Migrating fish behavior at the HCB pontoon corners.

Figure 4. TAST system controller (left) and transducer array (right).

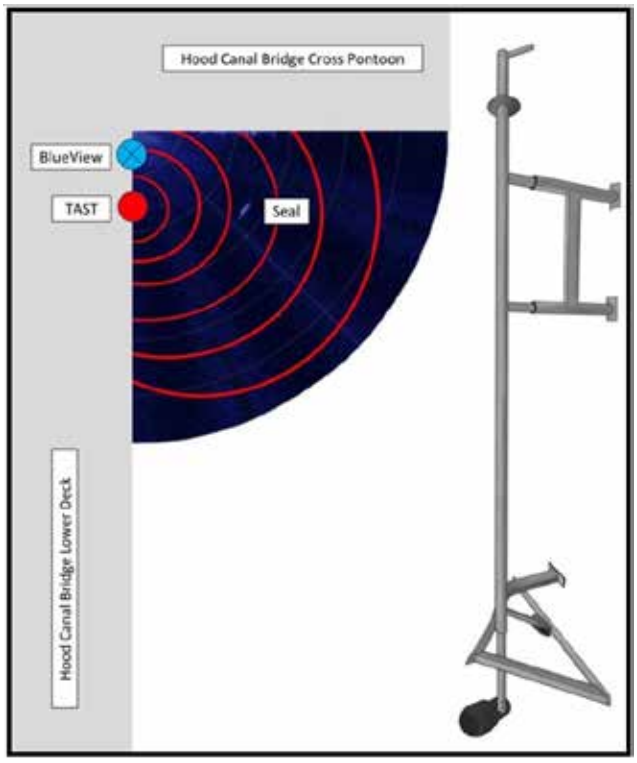

Figure 5. TAST system diagram and BlueView Sonar rendering.

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This system is an underwater auditory alarm that is placed near the corners of the pontoons to effectively deter predatory seals from the immediate vicinity (Figure 4). The TAST system is coupled with a BlueView™ multibeam imaging sonar to monitor the effectiveness of the system (Figure 5).[5]

The second strategy uses fish guidance structures, or fillets, that were placed in the corners of the bridge to change the 90-degree angle into two 45-degree angles (Figure 6). The fillets allow the salmon to navigate past the bridge more quickly than before and gives them an escape route, effectively reducing the ability of predators to herd them into the corners.[4]

Phase 2 of the project also will include a full analysis of all data by the tribe and the National Oceanic and Atmospheric Administration, along with a technical and summary report to be released by the end of 2025, a near-term adaptive mitigation plan, community outreach with a socioeconomic study, and a conceptual HCB replacement design.[4]

High salmon mortality at the HCB is a problem that can be fixed. The tribe and their partners are working together to find viable solutions that will help to ensure healthy salmon populations exist in Hood Canal for future generations.

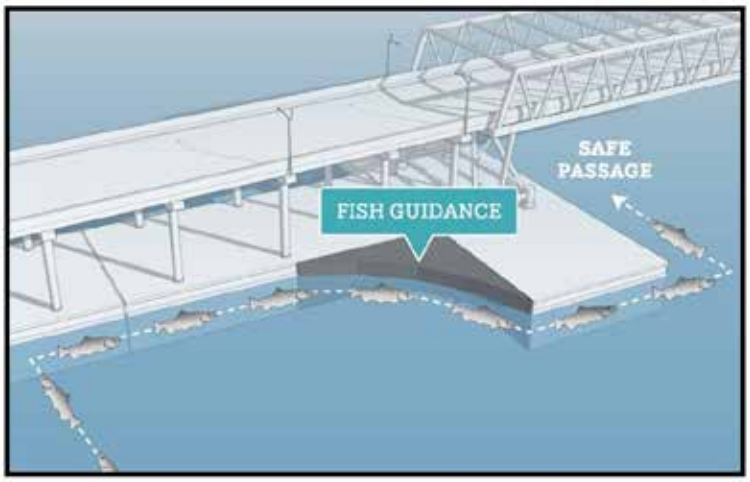


Figure 6. Fish guidance fillets.

LLTK & NWIFC. HCB Assessment Report

Use Your Phone to Scan and Watch

News Coverage of the HCB

Stories from Fox 13 Seattle.

Climate Change Adaptation Measures

The Port Gamble S'Klallam Tribe continues to monitor the impacts of changing climate on their reservation and throughout the region. Of particular concern is changes in forested areas, wetlands and groundwater recharge resiliency on their reservation.

In 2017, the tribe completed a Climate Impact Assessment and initiated an effort to study and reduce the risk of bluff erosion and sea level rise to homes and infrastructure. In 2023, the tribe received support to conduct further climate action planning linked to the evaluation of tribal carbon emissions and targets for drawdown. The tribe will tie together carbon assessments of the community and natural lands with ongoing efforts to monitor and protect the shoreline against erosion and habitat degradation.

Climate change is likely to cause moisture and temperature stress to tribal forestland in the coming years. Forest risk factors include high density, low species diversity and stand location on steep south-facing slopes (Figure 1).

The tribe is currently working to assess its natural lands to better understand their vulnerability to future climate impacts, monitor specific sites for signs of ecological stress, and plan mitigation strategies. Forest degradation could negatively impact riparian habitat and streamflow, as well as make stands vulnerable to wildfire. Furthermore, the tribe's undeveloped forests harbor many species key to cultural practices.

To assess climate resilience of undeveloped land, the tribe is conducting hydrological analysis of key watersheds to support base flow in fish-bearing streams and mapping of critical areas for shallow aquifer recharge (Figure 2).

Tribal wetlands depend, in part, on the function of forest soils and shallow aquifers to retain and transfer water to depressions and streams. Wetlands that either depend on current levels of shallow groundwater or are vulnerable to increased saltwater inundation from sea level rise are particularly vulnerable to climate-induced disruptions (Figure 2). The tribe will use these studies and upcoming research to better prepare for climate impacts to their critical resources.

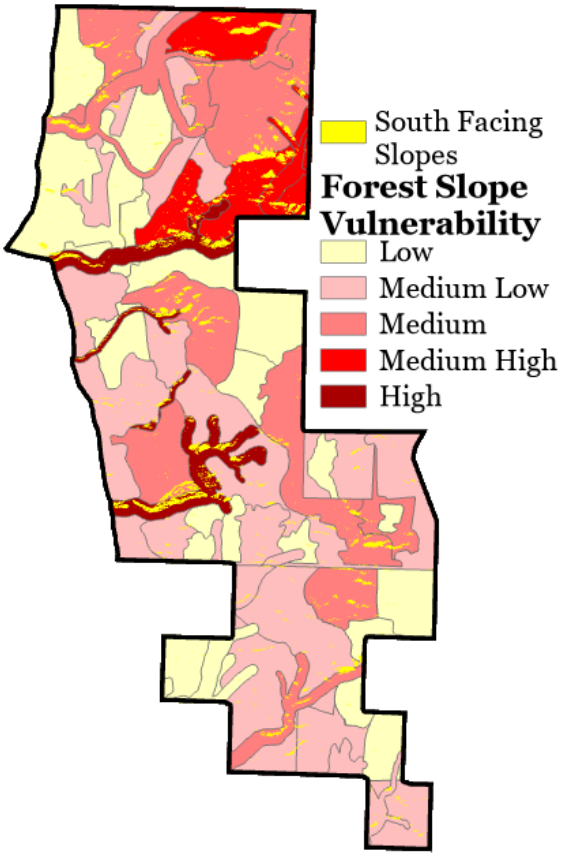


Figure 1. Forest slope vulnerability on the tribe's reservation. Darker areas indicate forest stands with a higher proportion of south-facing slopes that are expected to experience higher temperatures and show changes in ecology sooner than other parts of the reservation.

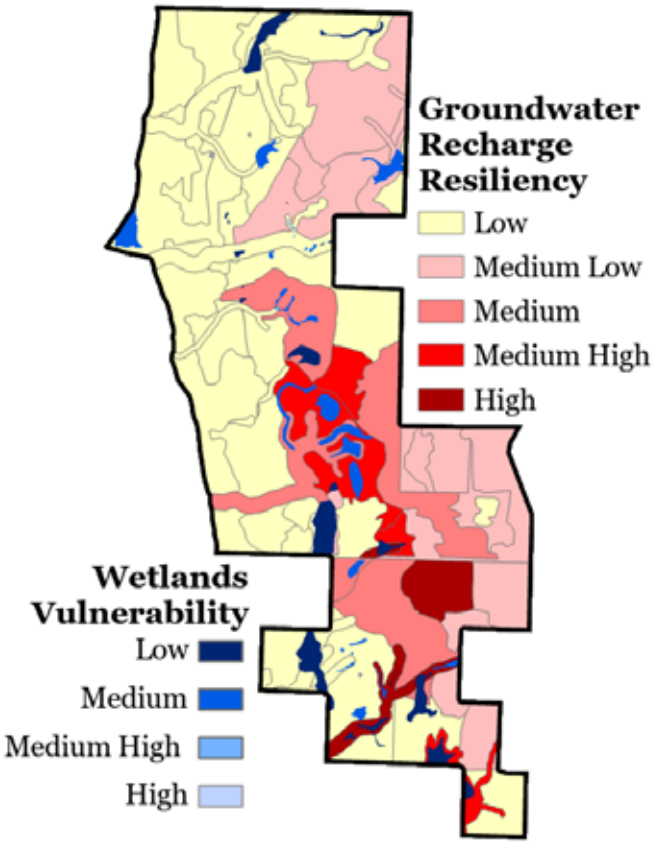


Figure 2. Forest groundwater recharge resiliency. Darker areas indicate forest stands with a greater area of permeable soils that recharge groundwater faster. These areas are important for supplying groundwater to streams and wetlands.

Map Data Sources: PGST 2024[4], PGST 2024[5]

Kitsap Natural Resource Asset Management Program

The Kitsap Natural Resource Asset Management Program (KNRAMP) is a new approach for managing natural resources by treating them as assets. KNRAMP's goal is to employ a systematic process for making strategic decisions about these critical natural resource assets. The Port Gamble S'Klallam Tribe was instrumental in developing this program with its partners.

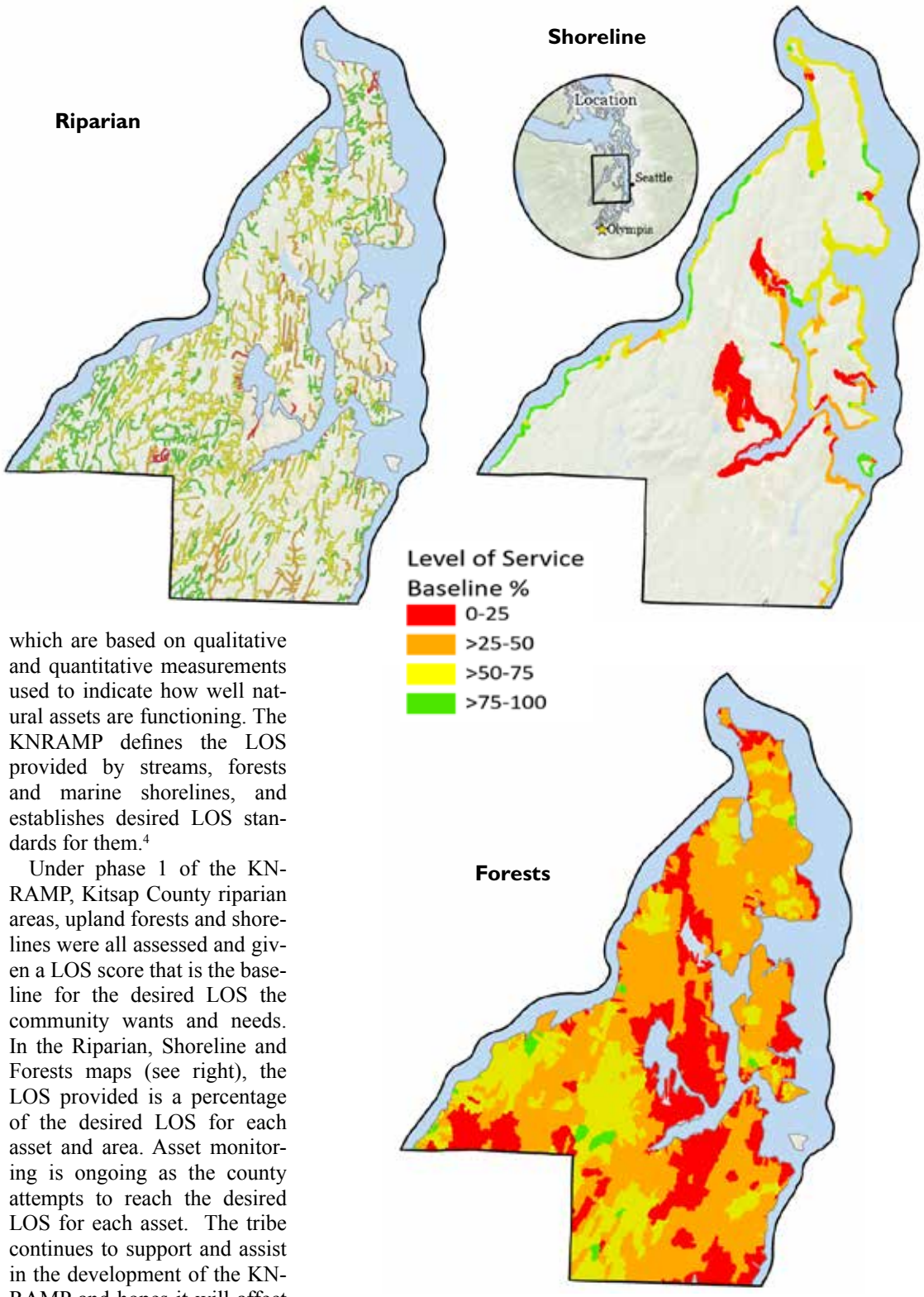
The Port Gamble S'Klallam Tribe, along with their partners, Kitsap County, the Washington Environmental Council, Wild Fish Conservancy and the Suquamish Tribe, began developing the KNRAMP in 2018.[1] This program evaluates ecosystem services provided by the natural resources on the Kitsap Peninsula.

The KNRAMP helps Kitsap County with financial, permitting, and management decisions related to natural resources and brings community awareness to the ecosystem services provided by the area's natural resources. Ecosystem services are the direct and indirect benefits that ecosystems provide humans. Ecosystem services considered in the KNRAMP include provisions (e.g., food, materials), regulation (e.g., flood control, clean air), cultural (e.g., recreation, heritage) and support services (e.g., nutrient cycling, wildlife productivity and diversity).[2]

By acknowledging natural resources like streams, forests and shorelines as assets for community wellbeing, Kitsap County can include their value into land-use decisions and protect their ecological functions. The goal of the program is to incorporate natural resource management and restoration alongside infrastructure construction and maintenance to ensure accountability and protection against natural resource degradation.[3]

The KNRAMP utilizes adaptive management strategies to continually monitor the assets and recalculate their value based on the desired level of service (LOS) which are based on qualitative and quantitative measurements used to indicate how well natural assets are functioning. The KNRAMP defines the LOS provided by streams, forests and marine shorelines, and establishes desired LOS standards for them.[4]

Under phase 1 of the KNRAMP, Kitsap County riparian areas, upland forests and shorelines were all assessed and given a LOS score that is the baseline for the desired LOS the community wants and needs. In the Riparian, Shoreline and Forests maps (see right), the LOS provided is a percentage of the desired LOS for each asset and area. Asset monitoring is ongoing as the county attempts to reach the desired LOS for each asset. The tribe continues to support and assist in the development of the KNRAMP and hopes it will affect preservation of critical natural resources as Kitsap County continues to grow and develop.



Map Data Sources: Kitsap County 2022[5]

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2025 State of Our Watersheds Report
Puyallup River Basin

"Electron Dam's operators have had a century to get it right," Puyallup Tribal Council said. "It is time for the dam to go. Its legacy will be one of dead fish and damage to the ecology of this beautiful place we all live in."

– PTI Newspaper, Dec. 30, 2020

Look at the unpermitted rock dam blocking migration on the Puyallup River!

Area of Interest

Puyallup Tribe of Indians

The Puyallup watershed was one of the earliest areas to be settled by Euro-Americans in the Puget Sound region. Consequently, it was also one of the first watersheds in Puget Sound to experience the full impacts of industrial, urban and agricultural development.

The filling of wetlands and conversion of floodplain, uplands and forestlands has completely altered the hydrologic conditions within the watershed to the detriment of salmonid production.

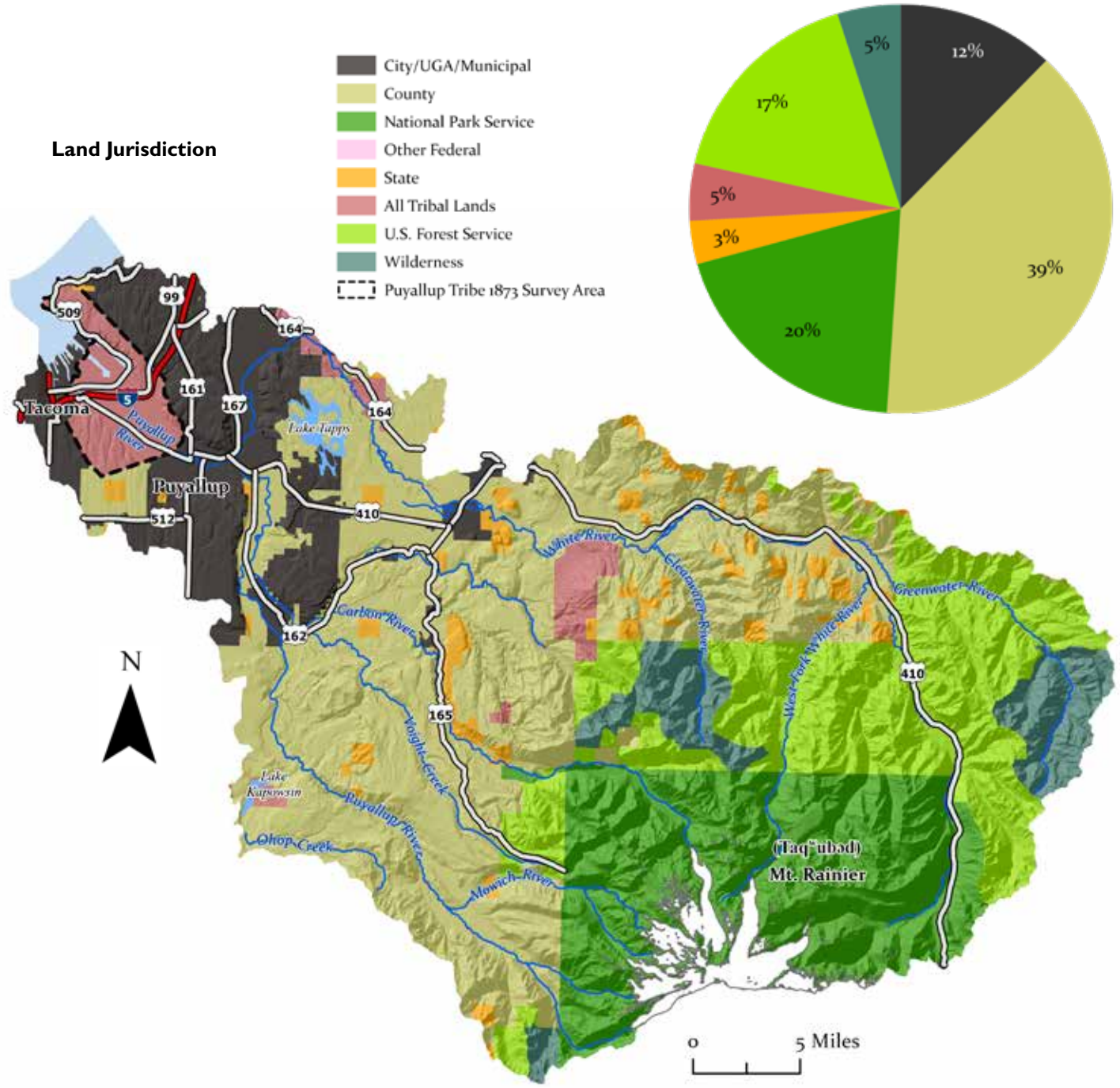
The Puyallup are fishing people. They lived on food provided by the fisheries since time immemorial. It was not until after the *U.S. v. Washington* court decision that they were able to exercise their rights to the fishery.

Puyallup Tribe of Indians

Puyallup River Basin

The Puyallup River Basin (WRIA 10) includes the White, Puyallup and Carbon rivers, which have their origins in the glaciers of the northwestern slopes of Mount Rainier. The Puyallup River basin flows to Commencement Bay at the Port of Tacoma, the third largest port in the western United States. Historically, the drainage did not always include the White River until 1906, when the White was diverted from the Green River to the south into the Puyallup for flood control purposes, which effectively doubled the flow in the lower Puyallup River. The basin drainage area is about 1,065 square miles, and has more than 4,300 miles of river and streams.

The Puyallup River basin has been substantially altered from its historic conditions. The basin has 96 miles of total levee in the system including the Puyallup, White and Carbon rivers. The system is not continuous; rather it is disconnected, particularly on the upper White River. Salmonid species existing within the basin include Chinook, Coho, Chum, coastal cutthroat, Pink, steelhead, bull trout and the occasional Sockeye. Chinook, steelhead and bull trout are listed as threatened under the Endangered Species Act, and Coho are listed as a candidate.[1]



Map Data Sources: DOD 2023[2], SSHIAP 2004[3], WADNR 2024a[4], WADNR 2024b[5], WAECY 2018c[6], WAECY 2021[7], WAECY 2024[8], WADOT 2018[9], WADOT 2023[10], USFWS 2024[11]

Chapter Summary

The Puyallup are fishing people. They lived on food provided by the fisheries since time immemorial. The Puyallup Tribe are leaders in the region's salmon recovery effort. No other people know these watersheds as well as the tribes and none has a greater stake in their future. The tribes believe that if salmon are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

For this report, the Puyallup Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Water Quality Impairment Increases in the Puyallup-White River Watershed

From the 2012 Water Quality Assessment and the most recent 2018 Assessment, the Puyallup-White watershed's amount of impaired streams increased for both temperature and dissolved oxygen by 28% and 96%, respectively. Additionally, none of the temperature- or dissolved oxygen-impaired streams improved from the 2012 to the 2018 assessments.

Tire-Rubber Derived Chemical 6PPD-Q in Urban Stormwater Causes Mortality in Coho Salmon

Following the discovery of 6PPD-Q, a chemical from tires that can kill Coho salmon in about 90 minutes, demand has grown for mitigation techniques and policies to be put in place to reduce or eliminate the chemical in streams.

Impervious Surface and Population Continues to Increase

The Puyallup River basin continued to see an increase in impervious surface (0.32%) from 2011 through 2021. Portions of the Clarks Creek basin fell from degraded to severely degraded, while portions of the South Prairie basin fell from impacted to degraded, with the remaining areas still experiencing little to no impact. Recent population growth near the city of Orting may lead to more development and increased impervious surface in and around the Clarks Creek and South Prairie basins.

Water Wells Increase Despite Summer Low Flows Threatening Salmon Survival

In the Puyallup Area of Interest, 3,040 water wells were installed between 1980-2019. Between 2020-2024, 85 water wells were added, a 2.8% increase. Most of the new wells are located near the Carbon River and South Prairie Creek, one of the most productive salmon-bearing streams in the Puyallup River watershed.

Fish Barrier Culverts Continue to Impede Fish Passage

There are 1,567 barrier culverts that are owned by the state, cities and counties, as well as private corporations and individuals in the Puyallup Area of Interest. Most of the barriers are privately owned (486 barriers) or owned by Pierce or King County (452 barriers).

Urban Development Threatens Setback Levee Opportunities in Pierce County

Strategies to reconnect floodplains through levee setbacks, side channel reconstruction and habitat restoration are being implemented in Pierce County, with approximately 9.4 miles of setback levees completed along more than 96 miles of levee. However, as sites are assessed for future projects, development in the floodplain could halt levee setback and restoration opportunities.

Habitat Restoration Continues in WRIA 10

In 2022, the Port of Tacoma removed sections of an access road which allowed Clear Creek to be connected to an adjacent wetland, improving flood storage and salmon rearing habitat. In the South Prairie Creek Preserve, Pierce Conservation District and the South Puget Sound Salmon Enhancement Group, among others, completed a Floodplain Restoration Project in 2020. This project occurred on 40 acres and included the excavation of a half mile of side channel habitat.

Thermal Refuges

The Puyallup Tribe and partners developed a thermal concept design with the goals of restoring, protecting or enhancing cold water refuges for salmonids during hot summer months. Two out of seven reaches along South Prairie and Wilkeson Creeks were selected for implementation of the thermal concept design. All data will be used to improve the design of future projects to protect and enhance cold water refuges for salmonids throughout the watershed.

Electron Hydro Pled Guilty to Numerous Violations on the Puyallup River

Electron Hydro, LLC, was sentenced to pay over $1 million in penalties and ordered to partially remove a rock dam and sheet pile wall on the Puyallup River. This was completed during the 2024 summer work window, providing volitional fish passage past the project for the first time in 120 years.

Conclusion

The Puyallup watershed has seen a few successes to the recovery of habitat over the past decade but other habitat indicators have stayed the same or declined. Tribal leadership are very concerned regarding health issues of tribal members from industry pollution in the Port of Tacoma and these sources of pollution need immediate attention.

Water quality impairment, impervious surfaces, and well development have all increased slightly but with a looming threat of continued population growth, tribal leadership have concerns of the potential impacts that come with an increasing population. The continued increase in the number of water wells, slow removal of barrier culverts, the lack of improvement in water quality and on top of this the impacts of the tire chemical 6PPD-Q on the salmon, all bring concerns of what the future brings.

Even though restoration is occurring it is not enough to keep up with the impacts of a growing population and their land-use decisions. Land-use and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented. Implementation includes education and voluntary actions, but it also needs to include enforcement when those laws are broken. The future of treaty rights in the Puyallup River basin depend on it.

Recovery Efforts Show Signs of Improvement But Still Lagging in other Key Indicators

At the 20-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Puyallup basin planning area shows a declining trend and concerns in a few indicators. Degradation from the increase of impervious surface areas, an increase in well development and the state's slow repairs to barrier culverts remain a concern.

Review of the trend for these key environmental indicators shows improvement only for the restoration efforts and a steady loss and/or real concerns for others.

Tribal Indicator	Status	Habitat Trend
Water Quality	Temperature and dissolved oxygen impaired streams have increased in the Puyallup-White watersheds. Additionally, none of the temperature or dissolved oxygen impaired streams improved from the 2012 to the 2018 assessments.	**Declining**
Water Quality - 6PPD-q Impacts	Following the discovery that a chemical (6PPD-q) which comes from tires can kill coho in about 90 minutes, demand has grown for mitigation techniques and policies to be put in place to reduce or eliminate the chemical in streams.	**Concerns**
Impervious Surface	The Puyallup River basin continued to see an increase in impervious surface (0.32%) from 2011 through 2021. Portions of the Clarks Creek basin fell from degraded to severely degraded, while portions of the South Prairie basin fell from impacting to degrading, with the remaining areas still experiencing little to no impact.	**Declining**
Water Wells	In the Puyallup area of interest, 3,014 water wells were installed between 1980-2019, and between 2020-2024 an additional 85 water wells (2.8% increase) were added.	**Concerns**
Barrier Culverts	There are 1,567 barrier culverts that are owned by the state, cities and counties, as well as private corporations and individuals in the Puyallup Area of Interest. Most of the barriers are privately owned (486 barriers) or owned by Pierce or King County (452 barriers).	**Concerns**
Urban Development Threaten Restoration Efforts	Strategies to reconnect floodplains through levee setbacks, side channel reconstruction and habitat restoration are being implemented in Pierce County, however, as sites are assessed for future projects, development in the floodplain could halt levee setback and restoration opportunities.	**Concerns**
Habitat Restoration	Habitat restoration continues in WRIA 10 and is making progress in habitat recovery.	**Improving**

Looking Ahead

The Puyallup-White River watershed continues to face significant challenges in salmon recovery, necessitating a multifaceted approach that addresses both ecological and institutional factors.

Greater strides must be taken in managing water resources and improving water quality in concert with habitat restoration in the Puyallup basin. New habitat projects must be wetted with adequate quantities of clean water. Resources need to be brought to bear on making sure this happens.

Some age-old problems remain, such as restoration of instream flows (particularly in the Electron reach of the upper Puyallup), lack of enforcement of TMDLs (or other mechanisms to improve water quality), and absence of TMDLs for water quality parameters that adversely affect fish. Enhanced stormwater treatment of roof runoff and cleanup prior to ground infiltration would greatly improve base flows in streams as well as water quality in the absence of truly protective prescriptions in stream temperature TMDLs, continuous monitoring, or monitoring for inadvertent releases of toxics to stormwater.

The projected population growth and associated economic development for the Puyallup watershed will continue to challenge salmon conservation and recovery efforts. Current trends indicate that land-use regulation reform is required (especially within CMZs of unincorporated Pierce County and rural communities.) Continued funding of habitat restoration activities is necessary in order to achieve recovery goals.

The continued decline in water quality and quantity remains the biggest impediment to recovery. Additional funding support is required to complete the development of an integrated, comprehensive strategy for recovery across all Hs (habitat, harvest and hatcheries). One of the biggest challenges remains securing the funding necessary for the large, multiyear restoration projects required to conduct levee setbacks and estuarine habitat creation.

Climate change introduces additional risks, including increasing stream temperatures, reduced summer flows, altered flow timing due to glacial retreat, and more frequent extreme weather events.

Critical habitats remain fragmented, and fish passage barriers limit population resilience. The lower river and estuary have experienced significant loss of rearing habitat due to urbanization and levee confinement, with sea level rise threatening future restoration efforts.

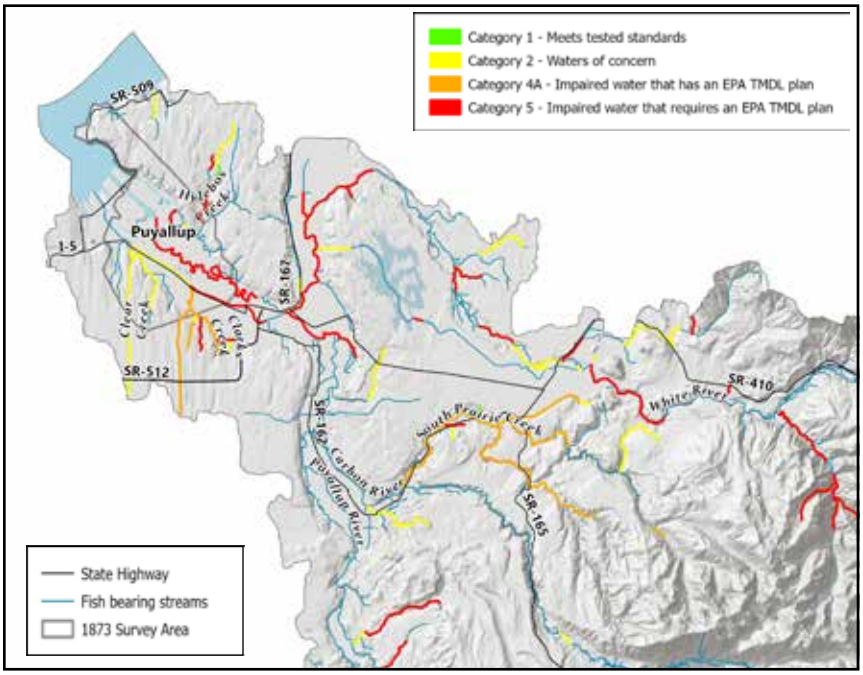
A growing challenge in the lower watershed is the expansion of transportation infrastructure. The region serves as a major freight and commuter corridor, and the addition of new transit projects puts more strain on salmon habitat. These developments encroach on riparian buffers, disrupt hydrologic connectivity, and introduce additional impervious surfaces and stormwater runoff. Cumulative impacts from these projects jeopardize restoration gains and underscore the need for proactive mitigation and the integration of fish friendly designs in transportation planning.

Institutional challenges, including a lack of strong federal regulations, declining agency staff capacity, and limited funding across jurisdictions have slowed progress in permitting, enforcement and implementation of salmon recovery actions. These constraints exacerbate existing ecological challenges and hinder the execution of critical restoration projects. Prioritizing secure funding sources for large, multiyear restoration projects, including levee setbacks and estuarine habitat creation are vital for long-term salmon recovery.

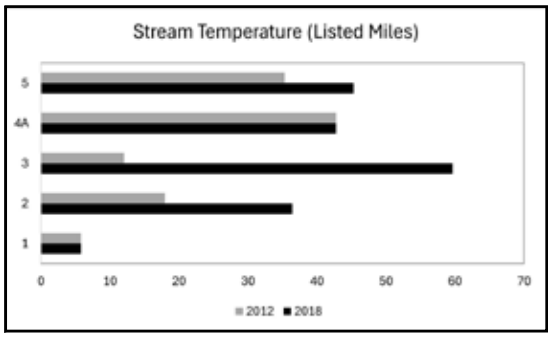
In addition, we need to strengthen federal and state regulations to support salmon recovery efforts, ensuring adequate enforcement and compliance mechanisms are in place.

Water Quality Impairment Increases in the Puyallup-White River Watershed

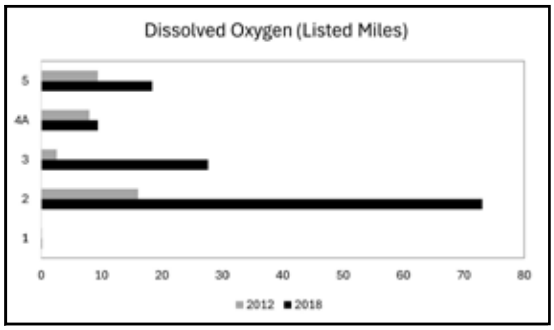
The Washington Department of Ecology 2018 Water Quality Assessment and listings report to the U.S. EPA is the first update released since 2012. In the Puyallup-White watershed, temperature-impaired streams that need a water improvement plan increased from 35.31 listed miles to 45.31 listed miles, and dissolved oxygen-impaired streams increased from 9.39 listed miles to 18.39 listed miles. Additionally, none of the temperature- or dissolved oxygen-impaired streams improved from the 2012 assessment to the 2018 assessment.



Temperature- and dissolved oxygen-impaired waters are spread throughout the Puyallup-White watershed.



Listed miles of impaired temperature streams for Section 305(b) categories in 2012 and 2018 in the Puyallup-White watershed.[4]



Listed miles of dissolved oxygen impaired streams for Section 305(b) categories in 2012 and 2018 in the Puyallup-White watershed. [4]

Cold, clean, and well-oxygenated water is vital for healthy salmon populations. Elevated water temperatures can delay or prevent salmon migration, increase susceptibility to certain diseases, and be lethal when exceeding certain thresholds at different life stages. Low levels of dissolved oxygen can affect salmon growth and development at different life stages. For example, low levels of dissolved oxygen can decrease the size of fry and feeding activity, and negatively affect swimming performance during migration. Fish stressed by multiple water quality parameters are less able to handle other stressors, such as toxic contaminants or pathogens.[1]

In the U.S. under Section 303(d) of the Clean Water Act, states are responsible for developing Total Maximum Daily Loads (TMDLs) and submitting them to the EPA for approval. A TMDL is the calculation of the maximum amount of a pollutant allowed to enter a waterbody so that the waterbody will meet and continue to meet water quality standards for that pollutant.[2]

The Washington Department of Ecology completes water quality assessments and puts water bodies into categories based on level of impairment. Water quality improvement projects are then developed and may include the TMDL process depending on what needs to change to reduce or eliminate pollution.[3]

The most up-to-date water quality assessment by Ecology is for the year 2018. As shown in the map, tested waters are ranked based on Section 305(b) categories. The ranking goes from Category 1: Meets tested standards, to Category 5: Impaired water that requires an EPA TMDL plan. The last water quality assessment before 2018 was the 2012 assessment. As shown in above, results from the 2018 and 2012 assessments are displayed for temperature and dissolved oxygen in the Puyallup-White watershed.

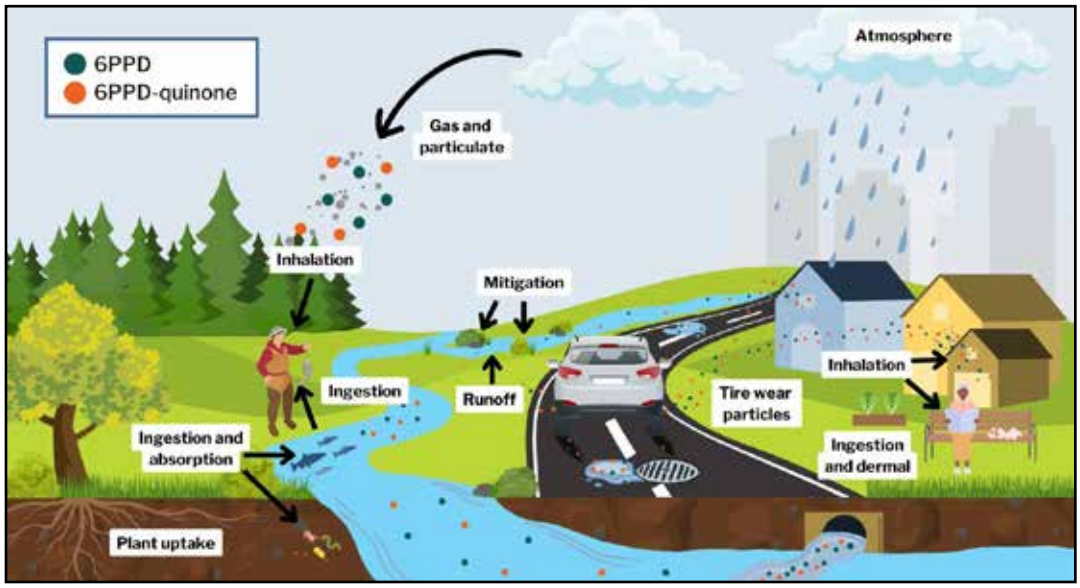
Temperature-impaired streams that require an EPA TMDL plan increased from 35.31 listed miles to 45.31 listed miles, and dissolved oxygen impaired streams increased from 9.39 listed miles to 18.39 listed miles. None of the temperature or dissolved oxygen impaired streams improved from the 2012 assessment to the 2018 assessment.

Map Data Sources: WADOT 2018[5], SSHIAP 2004[6], WADOT 2018[7], WADOT 2010[8], SWIFD 2024[9], WAECY 2022[10]

Tire-Rubber Derived Chemical 6PPD-Q in Urban Stormwater Causes Mortality in Coho Salmon

Coho salmon are an important resource to the Puyallup Tribe, and with the discovery that 6PPD-Q in small concentrations can kill Coho in about 90 minutes, demand has grown for mitigation techniques and policies to be put in place to reduce or eliminate the chemical in streams.

The Puyallup Tribe views the Puyallup and White rivers as a valuable cultural and economical resource to be protected. Currently, the tribe targets Fall Chinook, Coho and Chum salmon in its net fishery on the Lower Puyallup River with the goal to maintain a harvestable stock. However more than half of the Coho that return every fall to Puget Sound streams die before they can spawn.[1]



Interstate Technology Regulatory Council

6PPD-Q is contained in tires and other rubber products whose particles can be potentially inhaled or ingested by people. 6PPD-Q in surface waters can be ingested and absorbed by salmon that can then be ingested by other species and ultimately, the tribal membership and local communities.[4]

In 2020, scientists at the University of Washington-Tacoma, University of Washington and Washington State University Puyallup discovered that the culprit was a transformation product of a compound that is added to tires to extend the life of the tire.[2] 6PPD is present in most, if not all tires on the road today, and transforms when it encounters ozone, forming 6PPD-Q. Tire tread breaks down from wear on roads and is washed into streams along with stormwater runoff.[3]

Exposure to very small concentrations of 6PPD-Q can kill Coho salmon in about 90 minutes. This often occurs when adults are heading upstream to spawn and die before laying or fertilizing eggs, resulting in urban runoff mortality syndrome. Acute symptoms evident in Coho when exposed to 6PPD-Q mimic respiratory distress and include gasping at the water's surface, fin splaying and loss of equilibrium. Although Coho are particularly sensitive to 6PPD-Q at very low concentrations (in the low parts per billion, as low as 0.04), current research found toxicity from 6PPD-Q in other fish like rainbow and brook trout and other organisms at varying levels.[4]

In August 2023, Earthjustice submitted a petition on behalf of the Yurok Tribe, the Port Gamble S'Klallam Tribe, and the Puyallup Tribe of Indians under Section 21 of the Toxic Substance Control Act (TSCA). The petition requested that the EPA establish regulations prohibiting the manufacturing, processing, use, and distribution of 6PPD for and in tires under the EPA's TSCA. The petition requested that such regulation take effect as soon as practicable, to eliminate the unreasonable risk that 6PPD in tires presents to the environment.

The EPA granted the petition and plans to act to address the risk to the environment presented by 6PPD, and the transformation product 6PPD-Q, through an advance notice of proposed rulemaking under the TSCA. The EPA also plans to propose a rule under section 8(d) of the TSCA to require manufacturers (including importers) of 6PPD to report certain lists and copies of unpublished health and safety studies to the EPA.[6]

EPA regulations may eventually eliminate 6PPD from rubber products, but in the meantime the tribe recognizes the need to reduce stormwater contaminant loads. There are several mitigation treatment technologies that remove 6PPD from runoff, with varying levels of effectiveness. Scientists from the Washington Stormwater Center have demonstrated that running stormwater through a bioretention soil mix (stormwater compost and sand) that is designed as a component of a bioretention system prevents acute mortality in Coho.[7]

Another method of reducing stormwater contaminant loads can be achieved by controlling flows. The Washington Department of Ecology waived the stormwater flow control requirement based on the amount of buildout (impervious surfaces) in the Puyallup watershed and other urban watersheds.[8] This administrative action was particularly detrimental to the Puyallup Tribe's ability to reduce stormwater pollution in the Puyallup watershed. This policy should be revoked, as flow control could be a particularly effective tool for tribes with reservations located in urban watersheds to minimize stormwater pollutants from reaching rivers and streams. This could be especially meaningful and useful considering the listing of many species of salmon and trout in our watersheds under the Endangered Species Act.

Scan the QR code to watch a video of a rapidly dying Coho that was exposed to 6PPD-Q in Seattle's urban Longfellow Creek.[5]

Impervious Surface and Population Continues to Increase

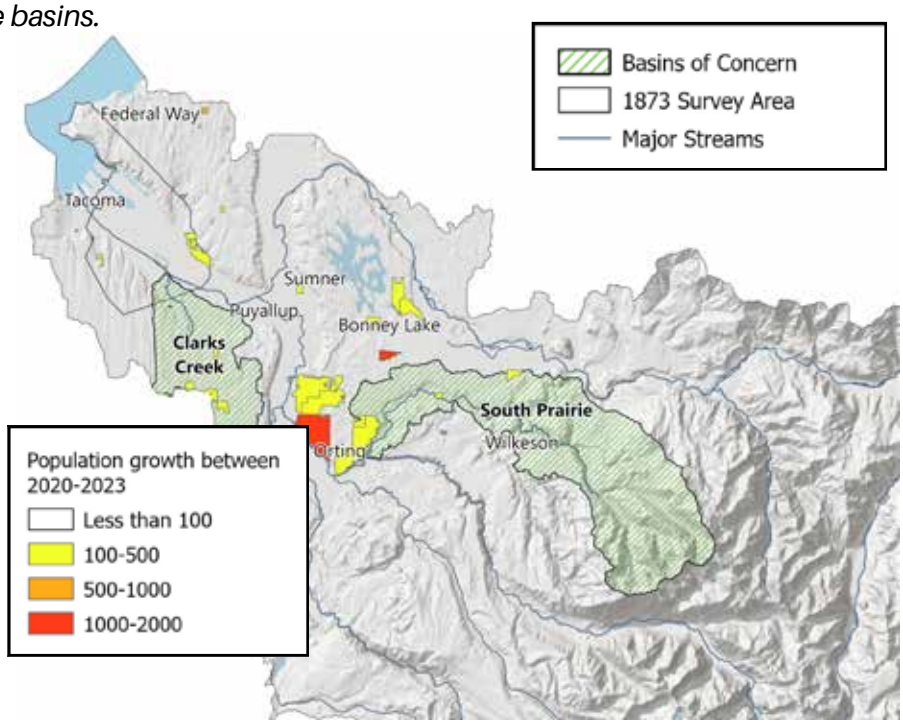
The Puyallup River basin continued to see an increase in impervious surface (0.32%) from 2011 through 2021. Portions of the Clarks Creek basin fell from degraded to severely degraded, while portions of the South Prairie basin fell from impacted to degraded, with the remaining areas still experiencing little to no impact. Recent population growth near the city of Orting may lead to more development and increased impervious surface in and around the Clarks Creek and South Prairie basins.

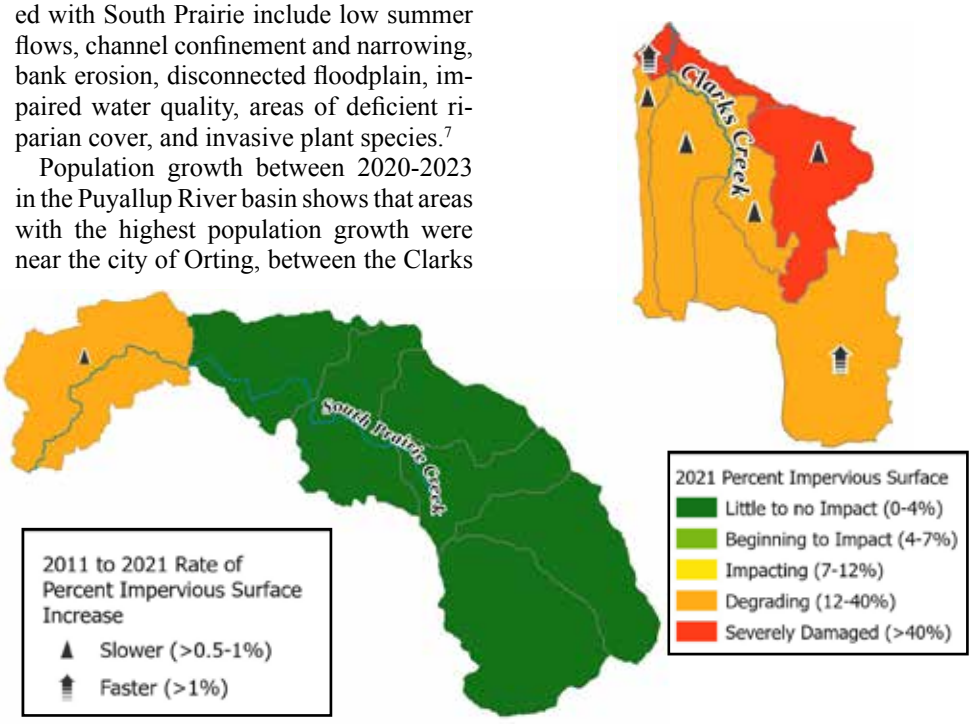
Impervious surfaces prevent the infiltration of water, which reduces groundwater recharge and base flow. Nonpoint source pollutants, including pathogens, nutrients, toxic contaminants and sediment, collect on impervious surfaces and during rainfall events, the stormwater containing these pollutants flows directly into waterways, causing harm to aquatic ecosystems. Increasing urbanization and development result in increases in impervious surfaces such as roads, parking lots, and rooftops.[1,2] The central Puget Sound region is expected to grow by 1.5 million people by 2050, and local, state and federal governments are challenged to keep up with the needs of a growing population without degrading habitat beyond repair.[3]

Within the Puyallup watershed, basins of concern for the Puyallup Tribe include Clarks Creek and South Prairie Creek. Clarks Creek is 4 miles long and flows through the suburban neighborhoods of the city of Puyallup before joining the Puyallup River. Because it is largely spring-fed, the creek has a consistent level of water throughout the year, making it great rearing habitat for juvenile salmon.[4] Clarks Creek provides habitat for five species of salmonids—Chinook, Coho and Chum salmon, steelhead and cutthroat trout. Two fish hatcheries operate on Clarks Creek, the state-run Puyallup Fish Hatchery and the Clarks Creek Salmon Hatchery, run by the Puyallup Tribe. Currently, the creek does not meet standards for dissolved oxygen and fine sediment. To help address this concern, the Washington Department of Ecology worked with the Puyallup Tribe, EPA, and local stakeholders to develop a total maximum daily load (TMDL) for the creek. The TMDL states that excess sediment, high volumes of untreated stormwater runoff, the overgrowth of a native aquatic macrophyte (Elodea), and high stream temperatures are the primary stressors causing Clark Creek's water quality impairments.[5]

South Prairie Creek is a major tributary of the Carbon River and is considered one of the most fish productive drainages in the Puyallup/White River watershed. Fall Chinook, Chum, Coho and Pink salmon, steelhead and bull trout utilize this system for spawning, rearing, foraging, migrating and over-wintering.[6] Limiting factors associated with South Prairie include low summer flows, channel confinement and narrowing, bank erosion, disconnected floodplain, impaired water quality, areas of deficient riparian cover, and invasive plant species.[7]

Population growth between 2020-2023 in the Puyallup River basin shows that areas with the highest population growth were near the city of Orting, between the Clarks Creek and South Prairie basins. Increasing population growth in that area may lead to more development and increased impervious surface, causing harm to aquatic ecosystems in both basins of concern.

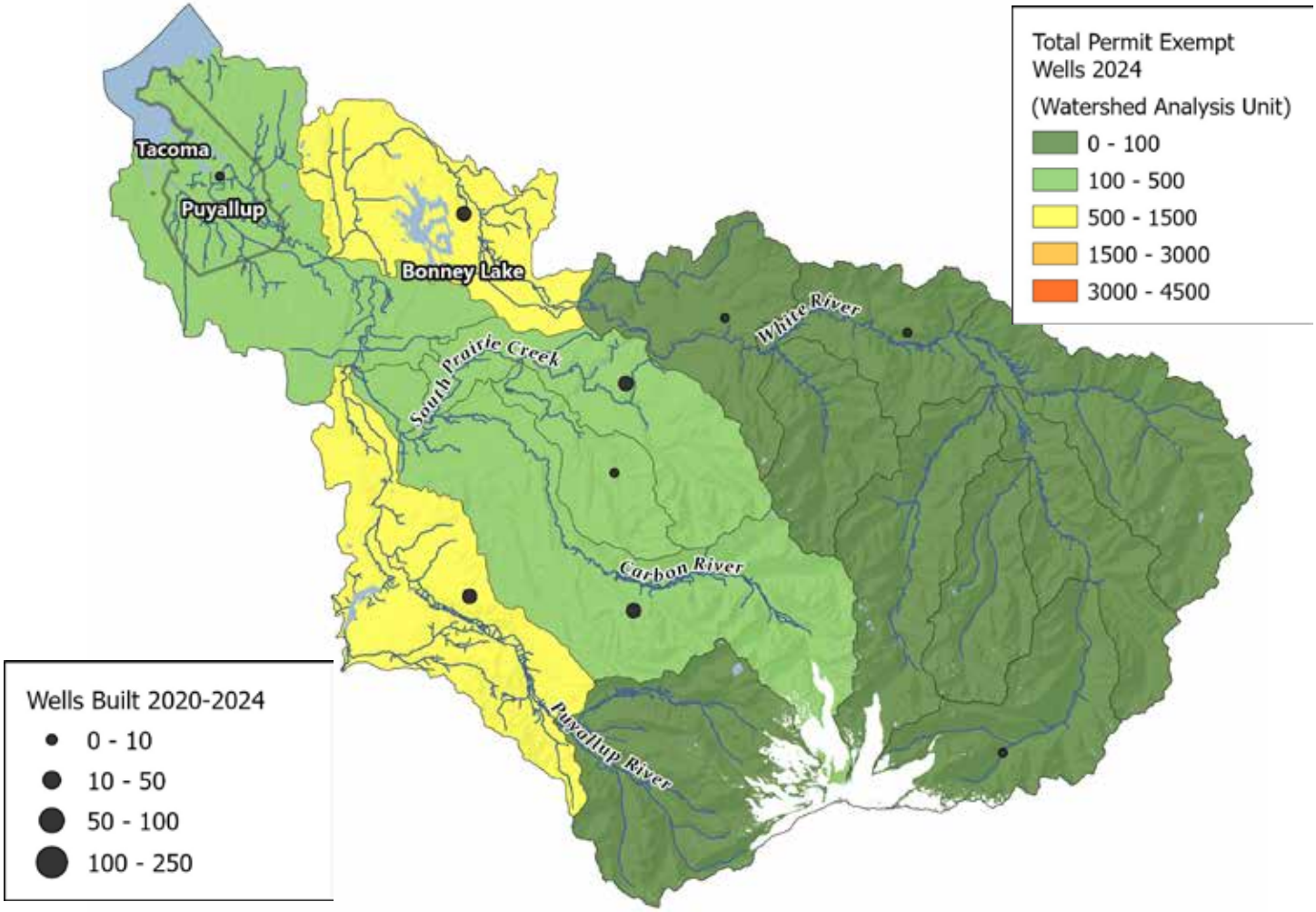




Map Data Sources: SSHIAP 2004[8], WADOT 2018[9], WADOT 2010[10], SWIFD 2019[11], NLCD 2011[12], NLCD 2021[13], WAECY 2017[14], WAOFM 2023[15]

Water Wells Increase Despite Summer Low Flows Threatening Salmon Survival

In the Puyallup Area of Interest, 3,040 water wells were installed between 1980-2019. Between 2020-2024, 85 water wells were added, a 2.8% increase. Most of the new wells are located near the Carbon River and South Prairie Creek, one of the most productive salmon-bearing streams in the Puyallup River watershed.



In the Puyallup Area of Interest, 3,040 water wells were installed between 1980-2019. Between 2020-2024, 85 water wells were added, a 2.8% increase. Most of the new wells are located near the Carbon River and South Prairie Creek. If summer low flows continue to decrease due to climate change impacts and demands for drinking water and wells increase due to factors such as population growth, there is potential for conflict between human and ecosystem needs.

Summer low flows—the lowest flows of the year—reduce water availability for aquatic habitat, fish hatcheries, irrigation and drinking water. Climate change impacts such as rising snow elevations, less snowpack and fewer rainfall events mean that summer low flows are becoming lower and longer lasting throughout the Pacific Northwest. Lower water levels can disconnect streams from their floodplains, reducing fish access to off-channel habitat. Juvenile salmon are then exposed to increased predation, concentrated pollutants, and higher in-stream temperatures. Low flows during spawning season reduce fish passage and force fish to build their redds in the main channel of the river where they are more vulnerable to scour during winter peak flows.[1,2]

In the Puyallup River Watershed, South Prairie Creek is one of the most productive salmon bearing streams, with Fall Chinook, Chum, Coho and Pink salmon, and steelhead, cutthroat and bull trout using the system for spawning, rearing, foraging, migrating, and over-wintering.[3]

Currently, summer low flow conditions result in elevated temperatures which cause thermal stress on upstream migrating Fall Chinook and Pink salmon. Summer stream temperatures also create thermal barriers for rearing and foraging Chinook, Coho, steelhead, cutthroat and bull trout.[4]

The Washington Department of Ecology adopted the Puyallup-White Watershed Restoration and Enhancement Plan in 2021 and is initiating rulemaking under the Streamflow Restoration Law. The plan will be implemented as local entities secure funding and develop projects intended to offset the impacts on streamflows from new domestic permit-exempt wells. The plan projects 688 new permit-exempt wells to be installed between 2018-2038. The estimated impact of these wells on rivers and streams is 277.4 acre-feet per year (a volume equal to about 140 Olympic sized swimming pools).[5]

Map Data Sources: SSHIAP 2004[6], WADOT 2018[7], WADOT 2010[8], SWIFD 2024[9], WAECY 2024[10], WAECY 2017[11]

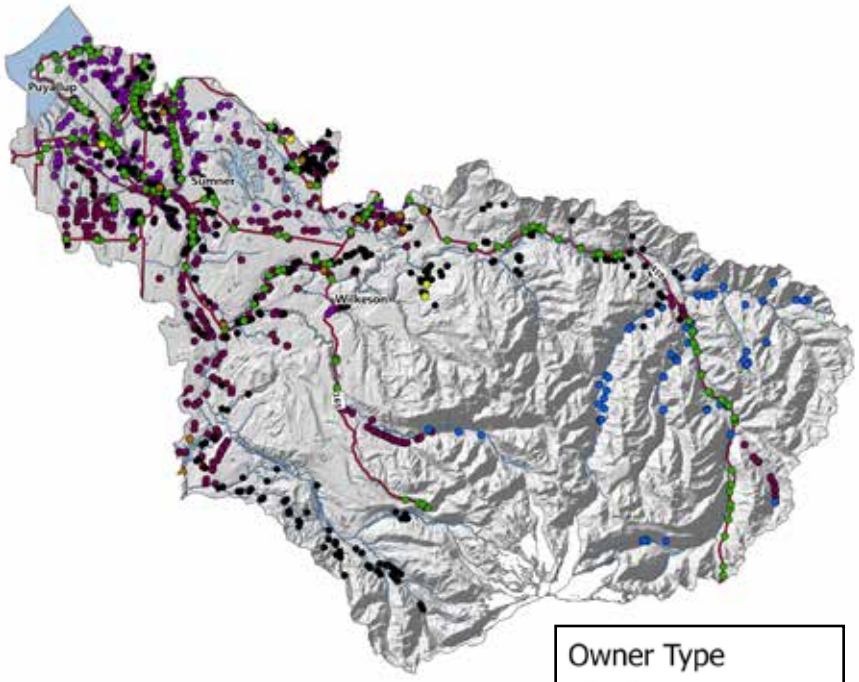
Fish Barrier Culverts Continue to Impede Fish Passage

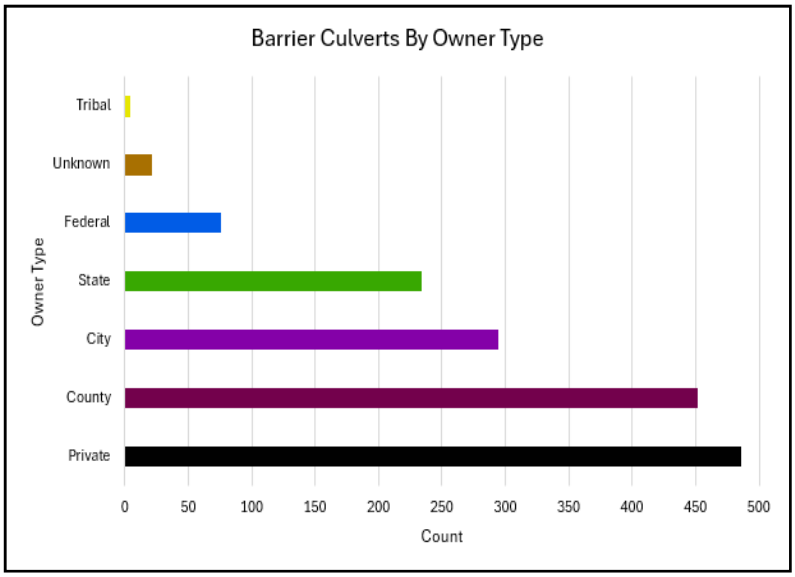
There are 1,567 barrier culverts that are owned by the state, cities and counties, as well as private corporations and individuals in the Puyallup Area of Interest. Most of the barriers are privately owned (486 barriers) or owned by Pierce or King County (452 barriers).

Fish passage is the ability of fish or other aquatic species to move through an aquatic system among all habitats necessary to complete their life cycle. An undersized or improperly placed culvert can impede or totally block fish and aquatic species from passing. Salmon depend on connected streams to move freely to feed, migrate and reproduce. By removing obsolete and dangerous infrastructure, fish passage projects eliminate public safety hazards, improve climate resilience, reconnect habitat and restore river ecosystems.[1]

Washington state is under a court injunction to replace the state-owned barrier culverts, opening 90% of potential habitat by 2030.[2] In addition to culverts identified by the culvert injunction, there are 1,567 barrier culverts that are owned by the state, cities and counties, as well as private corporations and individuals in the Puyallup Area of Interest. Private ownership accounts for 486 (31%) of the culverts while local governments, the federal government, and Washington state own 746 (47.6%), 76 (4.9%), and 234 (14.9%) culverts, respectively.

About 2% of barrier culverts fall outside of these ownerships.[3] Over three-fourths of these barrier culverts are owned by small landowners and local governments who are going to need significant resources to remove these impediments to fish passage and improve fish habitat.





Pierce County

A new box culvert and bridge replaced two culverts on Horsehaven Creek near Orting. The project was completed by Pierce County in 2023.

Map Data Sources: WDFW 2025[3], SSHIAP 2004[4], WADOT 2018[5], WADOT 2010[6], SWIFD 2024[7], WADOT 2024[8]

Urban Development Threatens Setback Levee Opportunities in Pierce County

Strategies to reconnect floodplains through levee setbacks, side channel reconstruction and habitat restoration are being implemented in Pierce County, with approximately 9.4 miles of setback levees completed along more than 96 miles of levee. However, as sites are assessed for future projects, development in the floodplain could halt levee setback and restoration opportunities.

The Puyallup, Carbon and White rivers have been continuously leveed and modified since the early 1900s. Channels were straightened, and the previously meandering rivers were disconnected from their floodplains to control flooding. Detachment of the floodplains has created conditions that are detrimental to both natural and developed environments, specifically the loss of channel complexity and aquatic habitat, normal floodplain functions such as flood and sediment storage, and off-channel aquatic and riparian habitat.[1]

Today, over 96 miles of levee exists along the Puyallup, White and Carbon rivers. Channel confinement by levees has dramatically reduced availability of suitable salmon spawning habitat. Setback levees are one of the solutions to mitigating this problem, however urban development within both Sumner and Puyallup has, in many cases, encroached so close to the levee that any setback opportunity has been lost.[2]

The Puyallup Tribe of Indians emphasizes that property buyouts and setback programs must be encouraged as they are the best opportunity for reestablishing floodplain connection and natural production.[2] Floodplains for the Future is a coordinated effort between the tribe, Pierce County, agricultural groups, small cities, the Port of Tacoma and others, and has developed watershed-wide strategies to improve and maintain floodplain health. This includes reconnecting floodplains through levee setbacks and side channel reconstruction, preserving agricultural land through conservation easements, and restoring habitat and watershed processes to sup-

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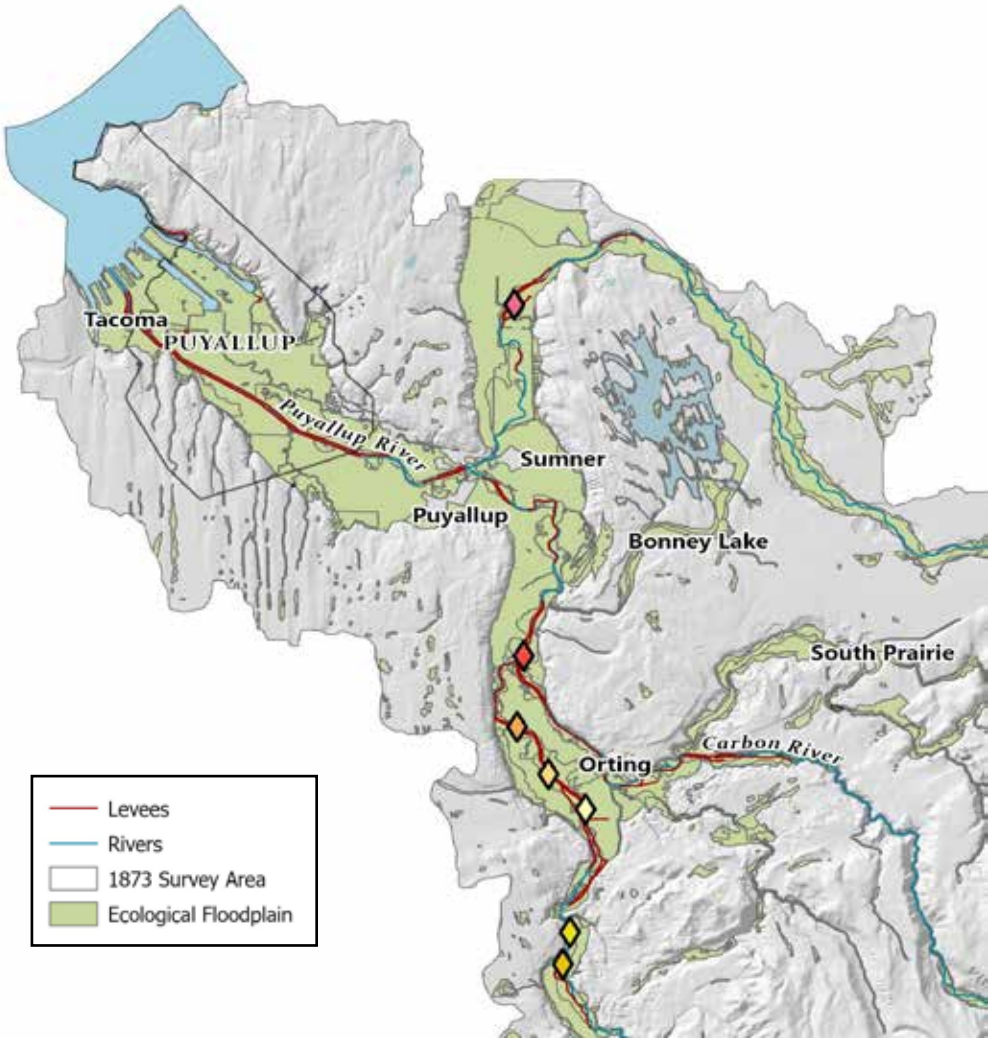

Portions of the Puyallup, Carbon and White rivers are confined by levees that do not allow them to flow onto their historic ecological floodplains (green areas). Setback levee projects have been completed in some areas (diamonds), but potential future projects need to be approved before urban development in the floodplain denies setback opportunities.

	Projects	River	Area (acres)	Length of Setback (miles)
◊	Ford Levee Setback	Puyallup	106	2.29
◊	Soldier's Home Setback	Puyallup	68	1.81
◊	Calistoga	Puyallup	47	1.37
◊	Countyline	White	113	1.35
◊	South Fork Road Floodplain	Puyallup	32	0.97
◊	Orville Road Setback (Phase 1)	Puyallup	15	0.15
◊	Orville Road Setback (Phase 2)	Puyallup	70	0.9

Map Data Sources: ESA 2022[1], SSHIAP 2004[9], WADOT 2018b[10], WAECY 2018[11], USGS & WDFW 2023[12], NWIFC 2022[13], PSP 2024[14]

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Pierce County[8] (2)

Before and after construction of a new setback revetment at Orville Road near the city of Orting.

port all salmon and trout species.[3,4]

Pierce County's Comprehensive Levee Setback Feasibility Study identifies, designs and implements projects to remove or modify levee structures in the Puyallup, Carbon and White River watersheds. The study lists 9 setback levee projects that have been completed, with the length of setbacks totaling approximately 9.4 miles, and the combined area of reconnected floodplain totaling approximately 450 acres. An additional 56 sites were evaluated in 2022 as potential setback levee projects to complete in the future.[1]

The most recently completed setback levee project by Pierce County and Floodplains for the Future is the final phase of the Puyallup River Flood Protection at Orville Road project. The project protects 2 miles of Orville Road near the city of Orting. The previous levee and revetment along the Orville Road side of the Puyallup River were damaged in multiple locations due to the river channel migrating toward Orville Road.

Completed in November 2022, the final phase of the project included the installation of 40 engineered logjams and approximately 3,000 linear feet of existing levee removal.[5] The project constructed a new revetment setback from the river to provide protection to Orville Road while allowing the river to reconnect with its floodplain. Within the first year, a minor flood event occurred, and the 70-acre project was inundated all the way through, recharging groundwater and reducing flood risk downstream.[6,7,8]

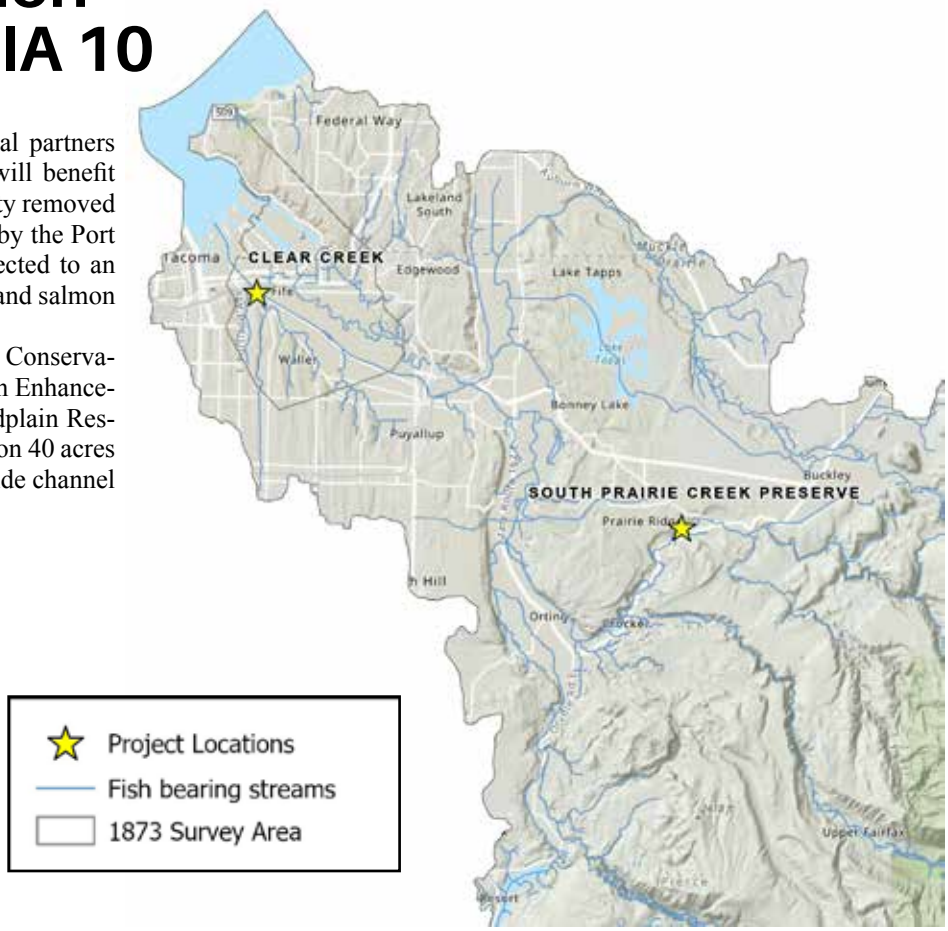
Lauren Gallup, NWPB[6]

The completed Orville Road revetment setback from the Puyallup River.

Habitat Restoration Continues in WRIA 10

The Puyallup Tribe has worked with several partners to complete habitat restoration projects that will benefit salmon in Pierce County. In 2022, Pierce County removed sections of an access road on property owned by the Port of Tacoma, allowing Clear Creek to be connected to an adjacent wetland and improving flood storage and salmon rearing habitat.

In the South Prairie Creek Preserve, Pierce Conservation District and the South Puget Sound Salmon Enhancement Group, among others, completed a Floodplain Restoration Project in 2020. This project occurred on 40 acres and included the excavation of a half mile of side channel habitat.



Clear Creek Habitat Restoration Project

Construction of this 16-acre site was completed by Pierce County in November 2022. The site is located off state Route 167 and involved removing sections of an existing access road that separated Clear Creek from an adjacent wetland owned by the Port of Tacoma. Funding was contributed in part by the Puyallup Tribe of Indians. Flood storage capacity has improved after project completion, as well as access to salmon rearing habitat. Riparian vegetation plantings and the installation of large woody debris also improve habitat for salmon and other wildlife.[4]

(Continued next page)

Pierce County[4]

Water moves freely between Clear Creek and the port's wetland habitat. Large woody debris was installed to prevent erosion and improve salmon-rearing habitat.

Map Data Sources: SSHIAP 2004[1], WADOT 2018b[2], SWIFD 2024[3]

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South Prairie Creek Habitat Preserve

South Prairie Creek is one of the most productive salmon bearing streams in the Puyallup River Watershed, with fall Chinook, Chum, Coho, Pink, cutthroat, steelhead and bull trout using the system for spawning, rearing, foraging, migrating and over-wintering. The South Prairie Creek Preserve includes approximately 129 acres of habitat and is the site of a floodplain restoration project whose construction phase was completed in 2020.[5] The core project partner team included the Puyallup Tribe of Indians, Pierce County Surface Water Management, Pierce Conservation District and the South Puget Sound Salmon Enhancement Group.[6]

This project occurred on 40 acres of the preserve. Highlights include the excavation of a half mile of side channel habitat, the installation of multiple log structures on the mainstem of South Prairie Creek as well as in the newly constructed side channel, demolition of existing infrastructure to open up riparian habitat, and extensive plantings of native trees and shrubs.[7]

Map Data Sources: SWIFD 2024[3], Pierce County District(b)[7]

Pierce Conservation District.[6]

Aerial image of South Prairie Creek Preserve.

Pierce Conservation District.[6]

The new side channel shortly after being connected to the mainstem of South Prairie Creek.

Thermal Refuges

The Puyallup Tribe and partners developed a thermal concept design with the goals of restoring, protecting or enhancing cold water refuges for salmonids during hot summer months. Two out of seven reaches along South Prairie and Wilkeson Creeks were selected for implementation of the thermal concept design. All data will be used to improve the design of future projects to protect and enhance cold water refuges for salmonids throughout the watershed.

Two out of seven reaches along South Prairie and Wilkeson Creeks were selected for implementation of the thermal concept design. The thermal concept aims to restore, protect or enhance cold water refuges for salmonids during hot summer months.

Water temperature is recognized as perhaps the most important abiotic driver within aquatic ecosystems. Water scarcity and thermal stress in freshwater ecosystems peak in summer months. Water levels drop to dangerously low flows in July and August and often through the fall months. Salmon that encounter these warm waters over a continuous period may reach thermal tolerance which has cascading effects for immune resistance, oxygen availability, and even death. This is especially threatening to Chinook salmon that return to their natal streams in July and August, juvenile Coho that stay in fresh water throughout the year, and trout including steelhead, bull trout and cutthroat that have life history stages in stream during these times.

Several processes contribute to river temperatures including hyporheic exchange, shade and air temperatures. The conventional solution to reducing instream temperatures is to plant trees for shade, but this only addresses one of the contributing factors to warming surface waters. In addition, it takes years for mature trees to provide these ecosystem services.

However, the largest constraint for relying on planting for shade are the limitations associated with private ownership of streamside lands. Access to easements for riparian planting have historically been inadequate to provide necessary cover and shade. The Puyallup Tribe and partners have recognized a need to find alternative solutions to temperature-impaired streams in WRIA 10, as effective shade alone doesn't provide the thermal diversity necessary for all life stages of salmon to thrive.

The Puyallup Tribe and the South Puget Sound Salmon Enhancement Group (SPSSEG) contracted Quantum Spatial Incorporated to collect airborne thermal infrared (TIR) data during the hot summer months of 2019. The survey encompassed over 361 miles of stream channels and floodplain with an analysis of the spatial variability of stream surface temperatures and thermal influence of point sources, tributaries, and springs. TIR data showed that, at the time of the survey, Wilkeson Creek was more than 2 degrees Celsius warmer than South Prairie Creek and South Prairie Creek was 4 degrees Celsius warmer than the Carbon River.

South Prairie Creek is the primary producer of Chinook and steelhead and hosts

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Map Data Sources: SSHIAP 2004[5], WAECY 2018[6]

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Pierce Conservation District

Chinook salmon in South Prairie Creek.

other salmonids including Coho, Chum, Pink and cutthroat. Restoration efforts have been implemented on South Prairie Creek for many years. Watershed partners are working toward improving instream habitat, off-channel habitat, riparian function and floodplain connectivity to support juvenile rearing, adult spawning and egg incubation for salmonids.

The Puyallup Tribe and SPSSEG contracted Natural Systems Design to investigate short-term solutions that can be executed in tandem with large habitat restoration efforts. The group verified the location of thermal influence of point sources, tributaries, and springs using the TIR data set in seven reaches along South Prairie and Wilkeson Creeks in the summer of 2022. Snorkeling surveys provided information on salmonid abundance and composition. As part of habitat surveys, the tribe recorded substrate, cover, human made structures, and a longitudinal temperature profile of the reaches.

A thermal concept was designed with the goals of restoring, protecting or enhancing cold water refuges for salmonids during hot summer months. Cold water refuges can drive the behavior and success of both adult and juvenile salmonids, providing cooler habitat refuges in the summer and warmer refuges in the winter for juveniles. Cold water provides higher oxygen availability and relief from maximum daily temperatures. The ability of salmon to move, migrate, feed and reproduce is driven by a river's thermal regime.

Using field research, desktop analyses, and expert consultation, two of the seven reaches were selected for implementation of the thermal concept design. Restoration actions will include deflecting warm mainstem flow away from cold tributary inflows, enhancing edge habitat in cold water plumes, increasing hyporheic and surface flow to enhance cold water areas, and increasing hydrologic connectivity between cold seeps and instream habitats.

Once implementation is complete, tribal staff intend to monitor post treatment for habitat quality, stream temperatures and fish use. All data will be used to improve the design of future projects to protect and enhance cold water refuges for salmonids throughout the watershed.[1,2,3,4]

Electron Hydro Pled Guilty to Numerous Violations on the Puyallup River

Electron Hydro, LLC, was sentenced to pay over $1 million in penalties and ordered to partially remove a rock dam and sheet pile wall on the Puyallup River. This was completed during the 2024 summer work window, providing volitional fish passage past the project for the first time in 120 years.

Eric Marks, Puyallup Tribe

Julian Close, a Puyallup Tribe fish biologist, stands on the rocks leading to the temporary rock wall dam and fish ladder built by Electron Hydro on the Puyallup River.

Russ Ladley, Puyallup Tribe

On a court order, Electron Hydro partially removed a rock dam and sheet pile in mid-2024.

Electron Hydro, LLC, operates a hydropower project (formally owned & operated by Puget Sound Energy, 1904-2014) using water directly diverted from the Puyallup River at River Mile (RM) 41.7. Approximately 26 miles of stream habitat located in the Upper Puyallup Basin (upstream of RM 41.7) was void of anadromous fish from 1904-2000 due to the construction of the Electron Diversion Dam in 1903/1904. The mid-to-upper Puyallup River (habitat upstream of RM 31.2) has been severely and adversely affected by over a century of water resource exploitation by the Electron Project. These harms have included the dam's blockage of all access to habitat and fish populations upstream of the dam for 96 years, the project's diversion of flow out of the Puyallup River, and harms to fish drawn and entrained into the project's flume and forebay, and drawn into the penstocks.

Several elements—including those listed above—have led to the Electron Project being identified as a significant threat to salmon, steelhead, bull trout and other fish populations in the Puyallup River. This is consistent with the listing decisions by the National Marine Fisheries Service and the U.S. Fish & Wildlife Service, who identify barriers like dams as a significant cause and/or contributor to the listing of salmonids under the Endangered Species Act (ESA) including—Chinook, steelhead and bull trout.[1]

In late July 2020, the current owners of the dam commenced work on a spillway replacement project to remove a section of the old wooden dam/spillway and install a 70-foot-wide, 12-foot-tall inflatable bladder dam. As part of the construction process, river flow was diverted through a "bypass channel."

Subsequently, as reported by Electron Hydro, approximately 617 square yards of the materials used to construct a three-layered bed "liner" [High Density Polyethylene (HDPE), geotechnical fabric, artificial grass turf/crumb rubber] placed in the bypass channel were discharged downstream from the project site when the HDPE and geotechnical fabric—as well as the turf placed under the HDPE and fabric—tore away in the river flow.

Discharged materials included, but were not limited to, artificial grass turf (generally composed of polyethylene plastic), HDPE plastic sheeting, geotechnical fabric (polypropylene or polyester plastic), and crumb rubber (derived from vehicle tires).[1] A highly toxic chemical derived from the crumb rubber (6PPD/6PPD-Q) has been proven to have sublethal and lethal effects on salmonid species.[2]

Having removed part of the wooden dam and unable to finish the installation of the proposed bladder dam, in October of 2020, Electron Hydro constructed an elevated rock dam and sheet pile wall in the Puyallup River channel at the project site. The rock dam work included the placement of a 70-foot-wide metal sheet pile wall. The sheet pile wall, with a sheer, sharp, and roughened edge, was installed vertically in the river and reinforced on the downstream side with the placement of immensely large rock (up to and greater than six-man-plus in size: 6,000-8,000lbs+/54in–60in+) from the

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sheet pile wall to approximately 70+ feet downstream.

The installation of the rock dam and sheet pile, as well as subsequent alterations (more large rock), created harmful conditions for upstream and downstream migrating fish (including three ESA-listed species). The rock dam and sheet pile itself was a barrier to fish passage. Furthermore, the predominant flow over the rock dam and sheet pile created a false attraction and dead end for fish searching for upstream passage around the project.

The fact that so much flow went over the rock dam and sheet pile is far from ideal and much less desirable for a facility whose fish passage systems have been repeatedly called into question and contributed to the false attraction of upstream migrating fish (away from the fish ladder). This false attraction toward and into the rock dam very effectively resulted in their exhaustion, injury and in all likelihood reduced their chances at reproducing successfully. These features are antagonistic to the collective efforts of many toward stock recovery and naturally reproducing populations of fish in the mid to upper Puyallup River.[1]

During late 2020, as a result of the numerous violations committed by Electron Hydro, LLC, and its COO/owner Thom Fischer, several lawsuits ensued. As a result of the multiple lawsuits filed, on June 18, 2021, Federal District Court Judge John C. Coughenour ordered Electron Hydro to keep its water intake closed until it obtained the required permits 10(a)(1) of the ESA.

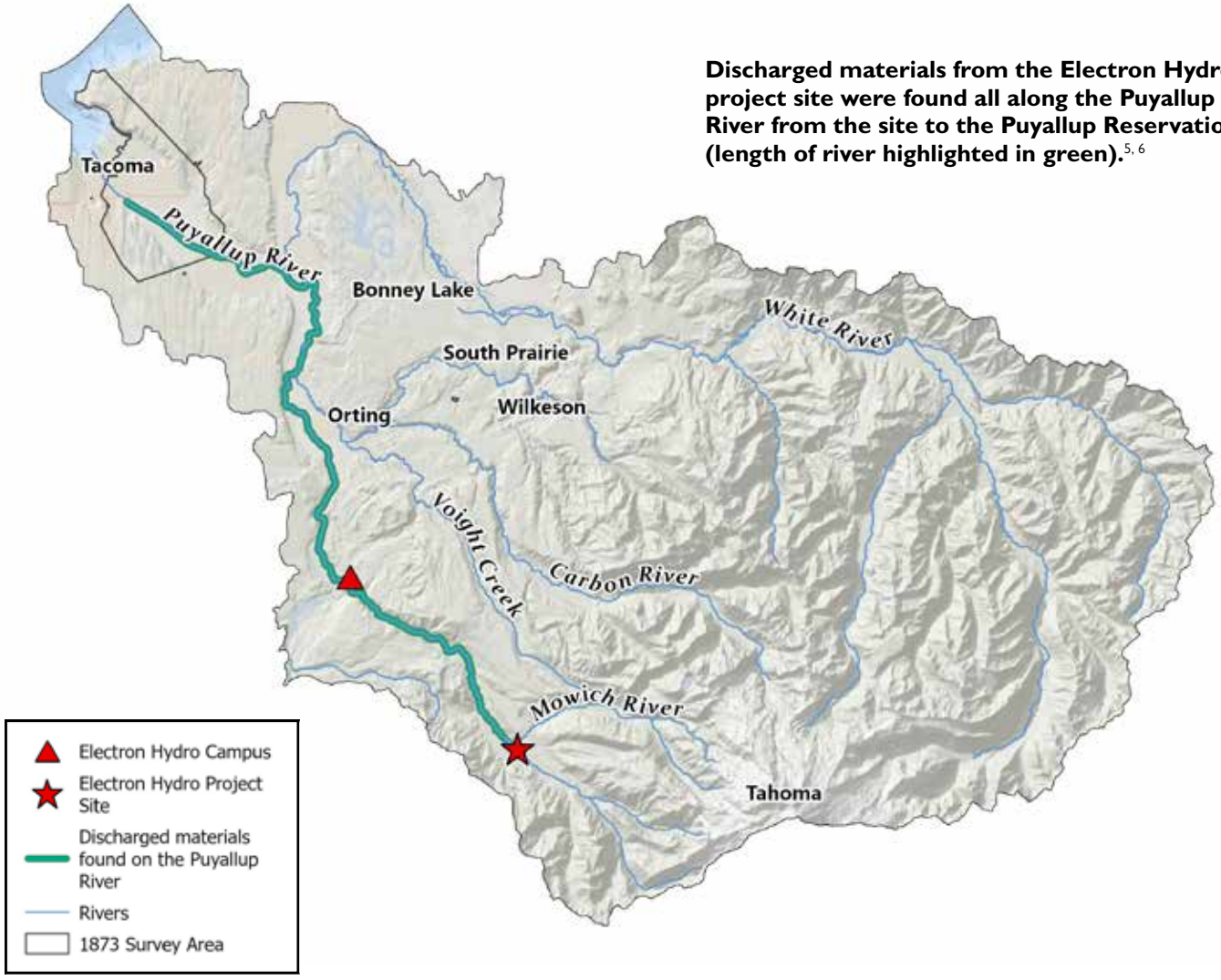
In response to criminal charges filed by the Washington Attorney General's office, Electron Hydro, LLC, and Thom Fisher both pled guilty to one count each of a gross misdemeanor violation of operating an unlawful hydraulic project. On May 5, 2023, a Pierce County Superior Court judge sentenced Electron Hydro to pay $250,000 in penalties. In addition, Electron Hydro was ordered to pay $745,000 to the Puyallup Tribal Fisheries Department to be used in Puyallup River habitat restoration.

Furthermore, on August 31, 2023, Judge Coughenour found both Electron Hydro and Thom Fischer legally responsible under the Clean Water Act for the illegal continuous discharge of artificial turf, crumb rubber and HDPE materials into the Puyallup River.[3]

On February 16, 2024, Electron Hydro, LLC, et al, were found to have violated the Endangered Species Act with the placement of the rock dam and sheet pile wall and its resulting harms—or "take"—on Chinook, steelhead and bull trout.[4]

The court ordered Electron Hydro to partially remove the rock dam and sheet pile to provide volitional fish passage past the project for the first time in 120 years. After nearly four years of litigation, this work was completed by Electron in mid-2024 in compliance with the federal court order.

Discharged materials from the Electron Hydro project site were found all along the Puyallup River from the site to the Puyallup Reservation (length of river highlighted in green).[5, 6]



Map Data Sources: SSHIAP 2004[5], USGS 2018[6]

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6 USGS. 2018. National Hydrography Dataset (NHD) Flowline and Waterbody GIS datasets. Downloaded from Washington Department of Ecology. U.S. Geological Survey, in cooperation with others.

2025 State of Our Watersheds Report
Quillayute River Basin

Sustainable fisheries are the primary economy of our tribe. If we are to continue our culture and way of life, protecting the habitat is key, whether it be the ocean, the rivers or on land.

– Frank Geyer
Natural Resources Director

Garrett Rasmussen, Quileute Tribe

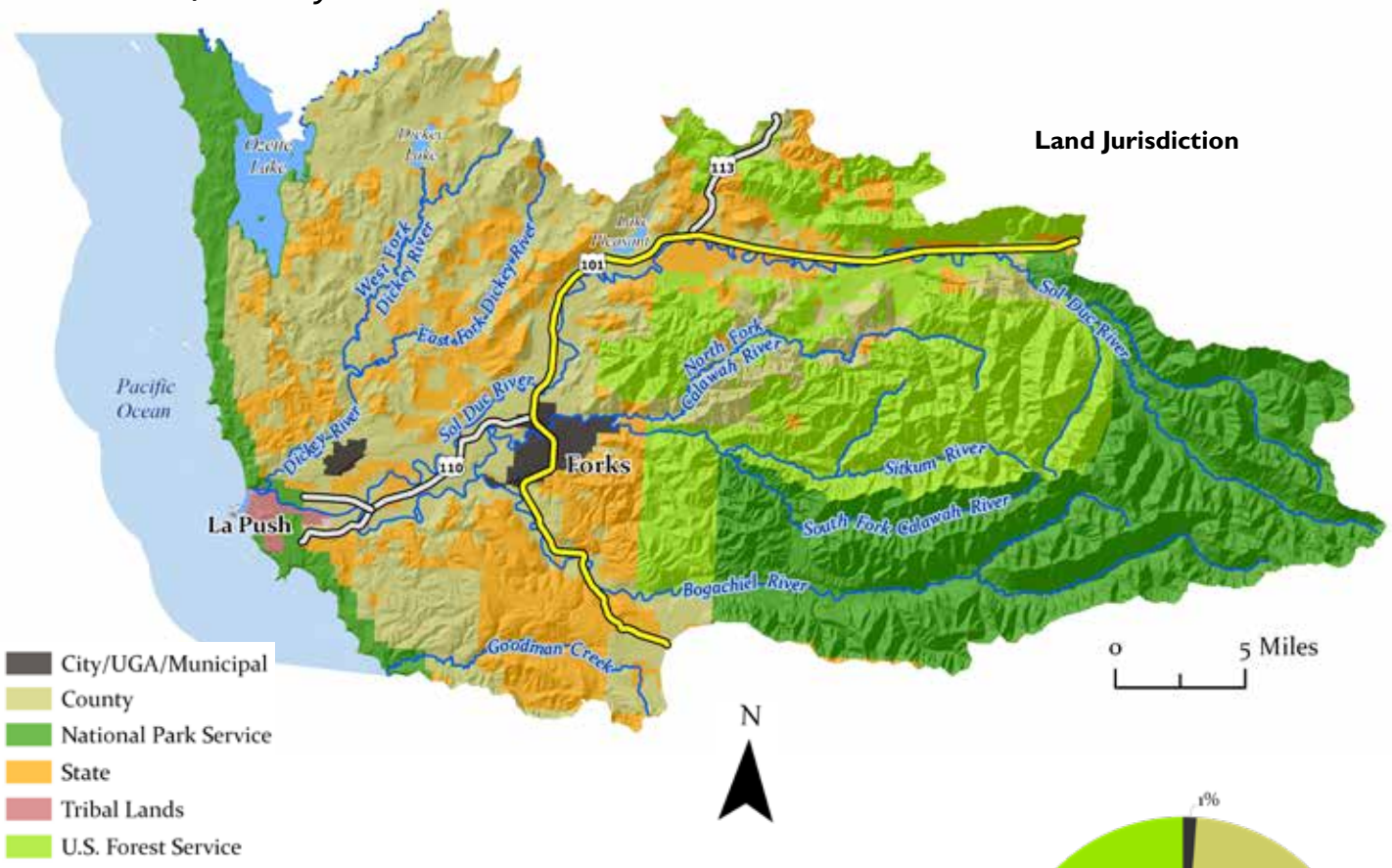
Quileute Tribe

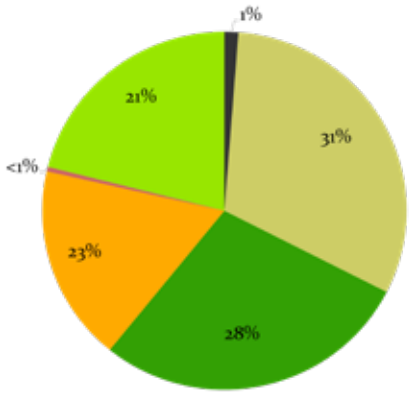
The Quileute Tribe is located in La Push, on the shores of the Pacific Ocean, where tribal members have lived, hunted and fished since time immemorial. Although their reservation is only about 2 square miles, the tribe's original territory stretched along the shores of the Pacific, from the glaciers of Mount Olympus to the rivers of the rainforests out offshore of the mighty Pacific Ocean. Much has changed since those times, but Quileute elders remember the time when the people challenged Kwalla, the mighty whale. They also tell the story of how the bayak, or raven, placed the sun in the sky.

— **Area of Interest**

Quileute Tribe

Lake Ozette, Quillayute River and Goodman Creek





Similar to the 2020 SOW report, the Quileute Tribe's Area of Interest includes the northern portion of Water Inventory Resource Area (WRIA) 20, from Lake Ozette to the Goodman Creek watershed. For this report, the area also extends east to include part of the Olympic National Park. The largest basin in the area is the Quillayute, with four major subbasins: the Dickey, Sol Duc, Calawah and Bogachiel rivers. The Quillayute River, a broad low gradient river, flows westerly from the confluence of the Sol Duc and Bogachiel rivers and empties into the Pacific Ocean at La Push, the ancestral home of the Quileute Tribe. The Bogachiel and Sol Duc rivers enter the Quillayute about 5.5 miles from its mouth ("Three Rivers"). The Calawah River, a major tributary of the Bogachiel River, enters the Bogachiel about 8.5 miles from the latter's confluence with the Quillayute River. The Dickey River enters the Quillayute River approximately one mile up from the mouth. The final one mile of the Quillayute River passes through a narrow strip of the Olympic National Park. A number of smaller independent streams, such as Cedar Creek and Goodman Creek, also drain into the Pacific Ocean.

Streamflows in the area are generally provided by abundant rainfall, the average of 120 inches a year being among the highest in Washington state. A part of the basin lies in Olympic National Park, which is managed for the protection of resources and does not allow timber harvest. Those lands outside the park include Olympic National Forest, state forests and private timberland.

The area supports Chinook, Coho, Sockeye, Chum and Pink salmon as well as steelhead and cutthroat trout.[1,2] Chum and Pink salmon are infrequent and all of the fisheries are co-managed with the state of Washington. The Quileute Tribe shares Usual and Accustomed areas with the Makah Tribe in the Lake Ozette basin.

In 1999, the National Marine Fisheries Service listed the Lake Ozette Sockeye as a threatened species under the Endangered Species Act (ESA)[3] and reaffirmed in 2005.[4] Although a recovery plan[5] was developed and is being implemented, a subsequent status review[6] found little evidence of an increasing trend in population abundance of the Lake Ozette Sockeye, therefore the species remains listed as threatened.

The Quillayute River Project Geomorphic Assessment and Action Plan (2020), approved by the tribe and other stakeholders, provides specific guidance and recommendations on water resources management. The detailed implementation plan was developed to guide the actions needed to protect, preserve and/or restore the natural resources in WRIA 20.[7]

Map Data Sources: DOD 2023[8], SSHIAP 2004[9], WADNR 2024a[10], WADNR 2024b[11], WAECY 2018c[12], WAECY 2021[13], WAECY 2024[14], WADOT 2018[15], WADOT 2023[16], USFWS 2024[17]

Chapter Summary

The Quileute Tribe has fished, hunted and gathered in their ceded area and the Pacific Ocean since time immemorial and are leaders in the region's salmon recovery effort. No other people know these resources as well as the tribe and none has a greater stake in their future. The tribe believes that if salmon are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Habitat Loss Causing a Decline in Fish Abundance

Over the past several decades, habitat loss and degradation have been explicitly identified as contributing to the steady decline in fish abundance. Habitat limiting factors include the lack of water in critical areas, a significantly altered estuary, road development, fish passage issues, logging, poor riparian vegetation, incised river channels and reduced levels of large woody debris.

Forest Practice Activities

Forest practice applications filed for the purpose of harvesting timber within the Quileute Area of Interest show that between 2000 and 2023, about 131 square miles (or 27.5%) of forestlands have either been or will soon be harvested, with about 107 square miles (or 82%) in private forestlands. Activities were highest in the 2012-2017 period and lowest in the 2018-2023 period, although there is no clear trend in both public and private forestlands.

Culverts are Fish Passage Barriers

Currently, there are 254 identified fish barrier culverts in the Quileute Area of Interest. Private ownership accounts for 77 (or 30.3%) while county ownership accounts for another 77 (30.3%). The state, federal and city governments own 65 (25.6 %), 23 (9.1%), and seven (2.7%) of these culverts.

Development Issues Impact Fish Habitat

Development pressures continue to impact the Quileute's watersheds, including such activities as unpermitted buildings and the continued development of water wells. Currently, there are 383 known water wells in the Quileute's Area of Interest.

Streams are Impaired by Pollutants

There were 109 listings (190.2 miles) of polluted streams in 2018 compared to the 58 listings (106.3 miles) in 2012 for the most common pollutants—water temperature, dissolved oxygen, pH and bacteria. This increase is likely the result of increased water quality monitoring in recent years rather than an accurate assessment of the rate of increase.

Restoration Efforts to Improve Quillayute River Habitat

The Quillayute River watershed has been impacted by anthropogenic activities which have contributed to the decline in salmonid habitat quality and quantity. The Quileute Tribe developed a multiphase implementation plan to restore salmon habitat, reduce flood risks to the tribal village of La Push, and support tribal fisheries. The tribe has completed the restoration of the lower Quillayute River and plans to undertake phased restoration efforts in the upper three reaches of the Quillayute River and lower Bogachiel River in the future.

Invasive Plants Remain a Problem and European Green Crabs Are Found for the First Time

The Quileute Tribe and its partners have continued the survey and treatment of knotweed species in the Quileute Area of Interest which have resulted in reducing knotweed infestation in the area. Other species like Himalayan blackberry, Scotch broom and spotted jewelweed remain a problem in the area. While previous efforts by the Quileute Tribe to capture European green crab were not successful, in 2024 an intensive sampling in the Quillayute estuary effort found several. These crab not only have the potential to impact juvenile Dungeness crab but also refugia for other species that utilize the estuary.

Impacts of Tourism

The large number of visitors to beaches in the Quileute Area of Interest may be causing significant habitat and water quality problems. There has been an increase in human fecal matter from outdoor recreationists and harmful bacteria from such fecal deposits may biocontaminate shellfish the tribe uses for subsistence and other traditional practices.

Climate Change Increasing Risk of Coastal Flooding

The cherished way of life of the Quileute Tribe is threatened by the increased frequency of major coastal flooding exacerbated by human-caused climate change. By 2100, sea level is projected to rise by 4 to 56 inches along the Pacific Northwest coast and by almost 20 inches along the Quileute coastline. In the 22-year period between 2003 and 2024, the Bogachiel River reached or exceeded the flood stage in 15 years, including three of the last five.

Ocean Conditions Continue to Worsen

The coastal waters off the Quileute Tribe‘s Area of Interest continue to face many threats like ocean warming, including marine heatwaves (MHW), hypoxia, and harmful algal blooms (HABs), conditions that are exacerbated by human-caused climate change. In 2024, hypoxic conditions started earlier than normal and continued into October even in shallower inner-shelf waters.

Conclusion

There are a number of restoration projects completed or are underway in the Quileute's Area of Interest which are making a difference in the habitat restoration efforts. Water quality has not improved, the number of water wells have increased and the control of invasive species has not been as effective as hoped. Recently European green crab were trapped for the first time in the area.

Restoration is not enough to keep up with the impacts of a growing population and their land use in the watershed. People have to be held accountable to protecting, conserving and improving fish habitat in their land-use decisions, and federal, state and local governments all have a role in that. Implementation includes education and voluntary action, but also needs to include enforcement when those laws are broken. The future of tribal treaty rights in the Lake Ozette, Quillayute River and Goodman Creek basins and along the shoreline of the Pacific Ocean depends on it.

Recovery Efforts Shows Signs of Improvement

A review of key environmental indicators for the Quillayute basin shows that priority resources such as water quantity and quality continue to be degraded, impacts from tourism and general land use practices unchecked by regulatory authorities (state and county) is providing a perfect storm for systematic degradation. However, there have been improvements in habitat conditions through the restoration efforts of the Quileute Tribe and their partners.

In general, there is a shortage of staff at all levels (e.g., federal, state, tribal and county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trends for these key environmental indicators shows an improvement from the restoration efforts, a reduction in the knotweed population and a slowdown in timber harvesting, but no improvements in water quality/quantity and an accelerated decline in habitat conditions over the past 50 years:

Tribal Indicator	Status	Habitat Trend
Habitat Loss Impacts Fish Abundance	Over the past several decades, habitat loss and degradation have been explicitly identified as contributing to the steady decline in fish abundance. Habitat limiting factors include the lack of water in critical areas, a significantly altered estuary, road development, fish passage issues, logging, poor riparian vegetation, incised river channels, and reduced levels of large woody debris.	**Declining**
Forest Practice Activities	Forest Practice applications filed for the purpose of harvesting timber have slowed since 2017.	**Improving**
Barriers Culverts	Currently, there are 254 identified fish barrier culverts in the Quileute Area of Interest. Private ownership accounts for 77 (or 30.3%) while county ownership accounts for another 77 (30.3%). The state, federal and city governments own 65 (25.6 %), 23 (9.1%) and 7 (2.7%) of these culverts.	**Declining**
Wells	Development pressures continue to impact the Quileute's watersheds, including such activities as unpermitted buildings and the continued development of water wells. Currently, there are 383 known water wells in the Quileute's Area of Interest.	**Declining**
Water Quality	There were 109 listings (190.2 miles) of polluted streams in 2018 compared to the 58 listings (106.3 miles) in 2012 for the most common pollutants—water temperature, dissolved oxygen, pH and bacteria.	**Declining**
Restoration	The Quillayute River watershed has been impacted by anthropogenic activities which have contributed to the decline in salmonid habitat quality and quantity. The Quileute Tribe developed a multi-phase implementation plan to restore salmon habitat, reduce flood risks to the tribal village of La Push, and support tribal fisheries. The tribe has completed the restoration of the lower Quillayute River and plans to undertake phased restoration efforts in the upper three reaches of the Quillayute River and lower Bogachiel River in the future.	**Improving**
Invasive Species	The Quileute Tribe and its partners have continued the survey and treatment of knotweed species in the Quileute Area of Interest which have resulted in reducing knotweed infestation in the area. Other species like Himalayan blackberry, Scotch broom and spotted jewelweed remain a problem in the area. While previous efforts by the Quileute Tribe to capture European green crab were not successful, in 2024 an intensive sampling in the Quillayute estuary effort found several. These crab not only have the potential to impact juvenile Dungeness crab but also refugia for other species that utilize the estuary.	**Concerns**
Impacts of Tourism	The large number of visitors to beaches in the Quileute Area of Interest may be causing significant habitat and water quality problems. There has been an increase in human fecal matter from outdoor recreationists, and harmful bacteria from such fecal deposits may biocontaminate shellfish the tribe uses for subsistence and other traditional practices.	**Concerns**
Climate Change	The cherished way of life of the Quileute Tribe is threatened by the increased frequency of major coastal flooding exacerbated by human-caused climate change. By 2100, sea level is projected to rise by 4 to 56 inches along the Pacific Northwest coast and by almost 20 inches along the Quileute coastline. In the 22-year period between 2003 and 2024, the Bogachiel River reached or exceeded the flood stage in 15 years, including 3 of the last 5.	**Concerns**
Ocean Conditions	The coastal waters off the Quileute Tribe's Area of Interest continue to face many threats like ocean warming, including marine heatwaves, hypoxia, and harmful algal blooms (HABs), conditions that are exacerbated by human-caused climate change. In 2024, hypoxic conditions started earlier than normal and continued into October, even in shallower inner-shelf waters.	**Concerns**

The tribe continues to address aquatic habitat degradation by focusing on restoration of the mainstem Quillayute River. One reach-scale project was completed in 2022, with three more reaches planned for restoration work in the next several years. They also collaborate with external partners to accomplish restoration projects on tributaries throughout the watershed.

Looking Ahead

Current trends indicate that continued funding of habitat restoration activities is necessary to achieve the identified salmon restoration goals for WRIA 20. Upgrading of the regulatory framework that serves to protect salmon habitat must occur if the underlying assumption to all the recovery goals is to be realized: that existing habitat will be protected from loss caused by development. Increasing tourism along the west end of the Olympic Peninsula, expansive growth and development along the rivers and lake shores and associated clearing of riparian vegetation for views and water access, are surging problems. The current regulatory framework clearly is not providing adequate protection of the water quality, instream flow and riparian habitat within the Area of Concern.

Quileute Natural Resources continues to work with government and private and public partners on improvements to salmon habitat, most recently with the continued participation in the Lead Entity and Regional Recovery Process (a fusion of four coastal lead entities), continuing to develop strategies for recovery and participating in the grant process. The tribe is actively combating aquatic habitat degradation through mainstem restoration in the Quillayute River. Following a completed reach-scale project in 2022, QNR plans to restore three more reaches in the coming years and collaborate with partners on tributary projects across the watershed.

The greatest need is continued funding, since habitat restoration is an ongoing process (e.g., culvert removals, bridge and road maintenance, and invasive species control). Funding is also needed for staff programs to monitor, assess and develop plans for needed habitat restoration and/or protection.

Water quality monitoring through federal and state programs is a vital part of salmon habitat protection and will need continued support as well. For more information about the efforts of the Quileute Natural Resources program, visit *quileutenation.org/naturalresources*.

Over the next five years, the tribe will continue to focus on maintenance of stream monitoring and salmon habitat restoration throughout WRIA 20. QNR is undertaking a multi-year program of reach-scale restoration along the Quillayute River to reduce the impacts of climate change on flooding and improve salmon habitat. A significant step in the next five years will be the Historic Oxbow Reactivation and Restoration project, which will reconnect two river miles of off-channel habitat and its floodplain to the Quillayute River mainstem. The tribe is also working on climate change concerns through existing federal grants from the EPA and BIA and is incorporating climate resilient watershed management practices (e.g., flood control, monitoring new precipitation cycles, low flows, and changes in invasive species or habitat for native species), the tribe will need to address such issues.

Habitat Loss Causing a Decline in Fish Abundance

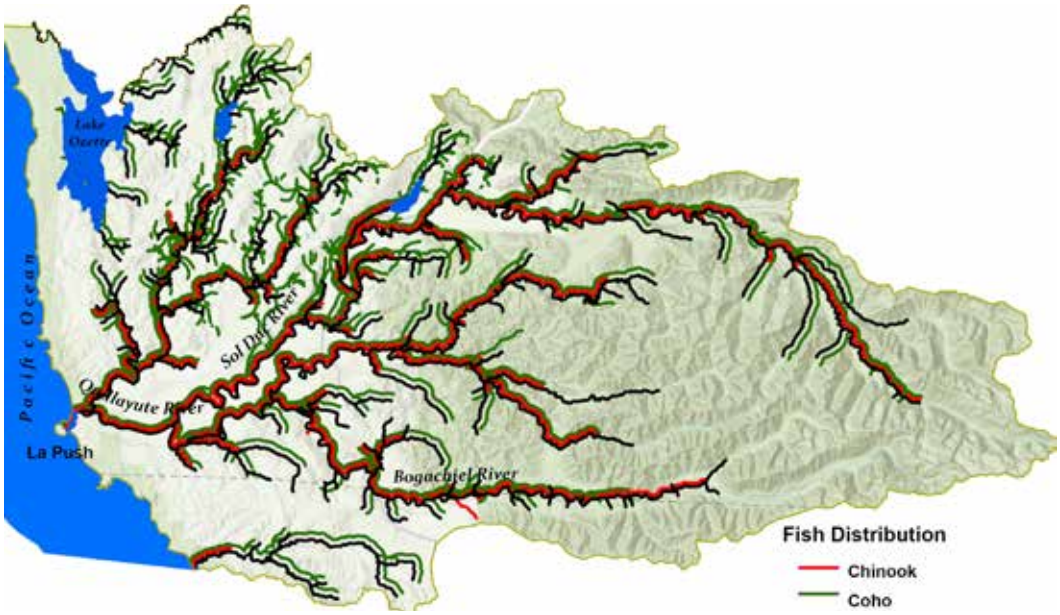
Over the past several decades, habitat loss and degradation have been explicitly identified as contributing to the steady decline in fish abundance. Habitat limiting factors include the lack of water in critical areas, a significantly altered estuary, road development, fish passage issues, logging, poor riparian vegetation, incised river channels and reduced levels of large woody debris.

Over the past several decades, habitat loss and degradation have been explicitly identified as contributing to the steady decline in salmonid abundance in the Quileute Area of Interest.

The lack of water in critical habitat areas as well as other habitat factors limiting salmonid production have been identified in many reports.[1,2,3,4] These include a significantly altered estuary, road development and fish passage issues. Other factors include logging, poor riparian vegetation, incised river channels, loss of habitat complexity and reduced levels of large woody debris, all of which affect stream channel morphology, water quality and the associated biotic communities.

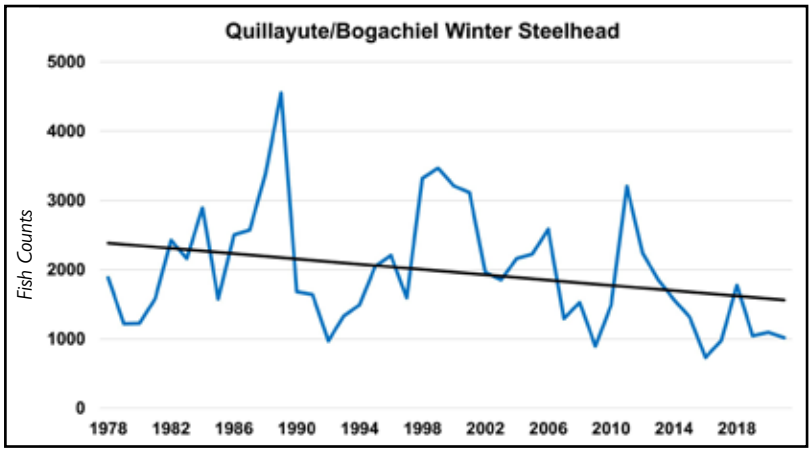
For the past 40 years, there has been a negative trend in adult returns (escapement) for most species of salmon and steelhead. Although none of these stocks has been listed under the Endangered Species Act, a petition was filed recently to list the Olympic Peninsula Steelhead Distinct Population Segment as threatened or endangered under the act. The destruction, modification or curtailment of its habitat or range was one factor identified in the petition.

To reverse this negative trend in salmonid escapement numbers, the habitat factors limiting salmonid production need to be addressed to attain cleaner streams and healthier watersheds for spawning, rearing and migration.



Robert Beck, Quileute Tribe

Spawned fish.



Map Data Sources: WADFW 2024[6], WAECY 2018[7]

Forest Practice Activities

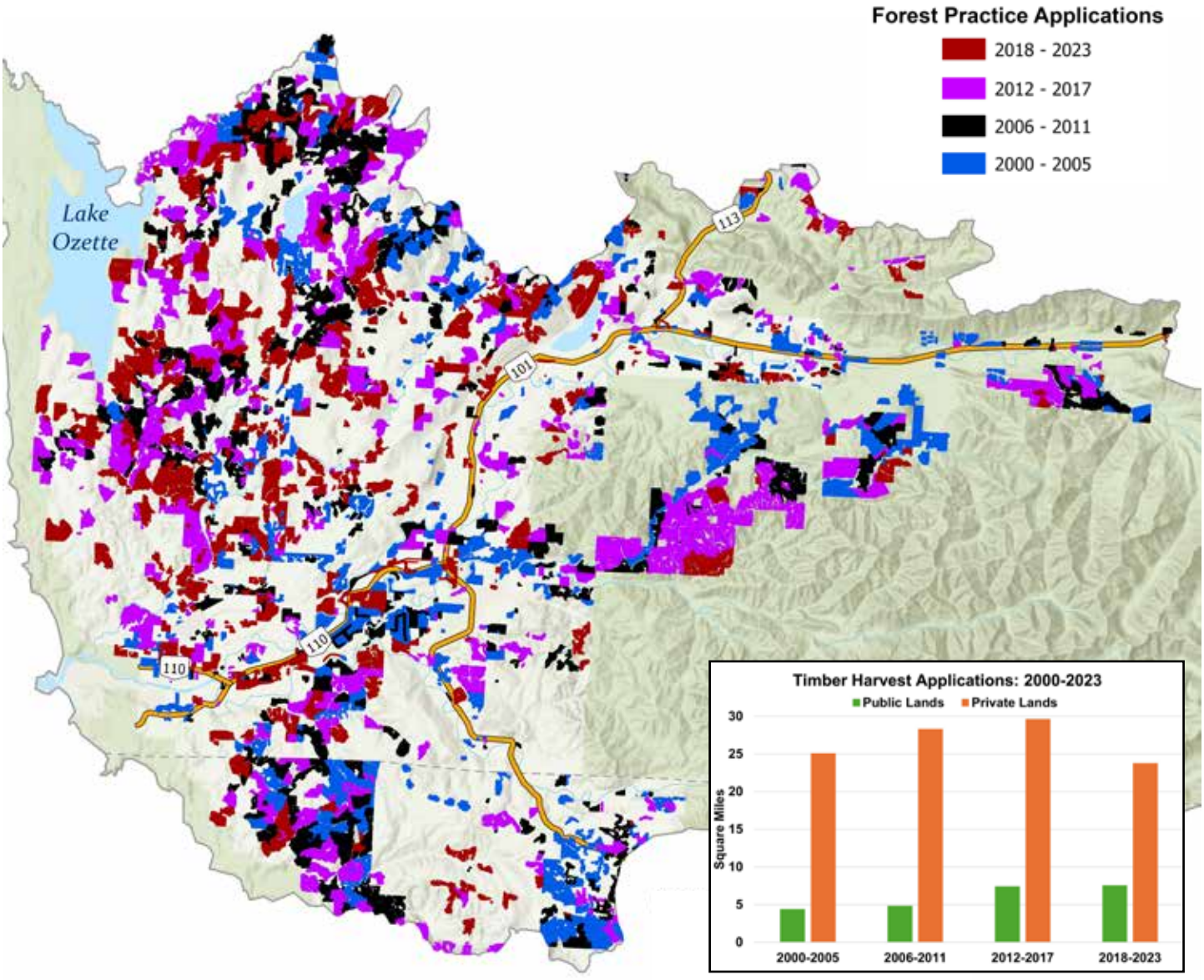
Forest practice applications filed for the purpose of harvesting timber within the Quileute Area of Interest show that between 2000 and 2023, about 131 square miles (or 27.5%) of forestlands have either been or will soon be harvested, with about 107 square miles (or 82%) in private forestlands. Activities were highest in the 2012-2017 period and lowest in the 2018-2023 period, although there is no clear trend in both public and private forestlands.

Forests play an incredible role in shading streams and keeping them cool. The leaves of riparian trees fall into the water, providing food and shelter for both young salmon and aquatic insect populations which also feed growing salmon. Tree roots stabilize streambanks to slow erosion and when they fall, trees supply streams large woody debris.

Poor riparian conditions, low quantities of in-stream large woody debris, and disconnection with the floodplain due to roads in the riparian areas have been identified as some of the limiting factors for salmon production in the Quillayute River drainage.[1,2,3] Forest practice activities within the Quileute Area of Interest have the potential to further limit salmon production in the area through increased visitation, and the processes involved with removal and re-establishment of forest vegetation.

Forest practice applications filed for the purpose of cutting or removal of timber products within the area show that between 2000 and 2023, about 131 square miles (or 27.5%) of forestlands have either been or will soon be harvested, with about 107 square miles (or 82%) in private forestlands.

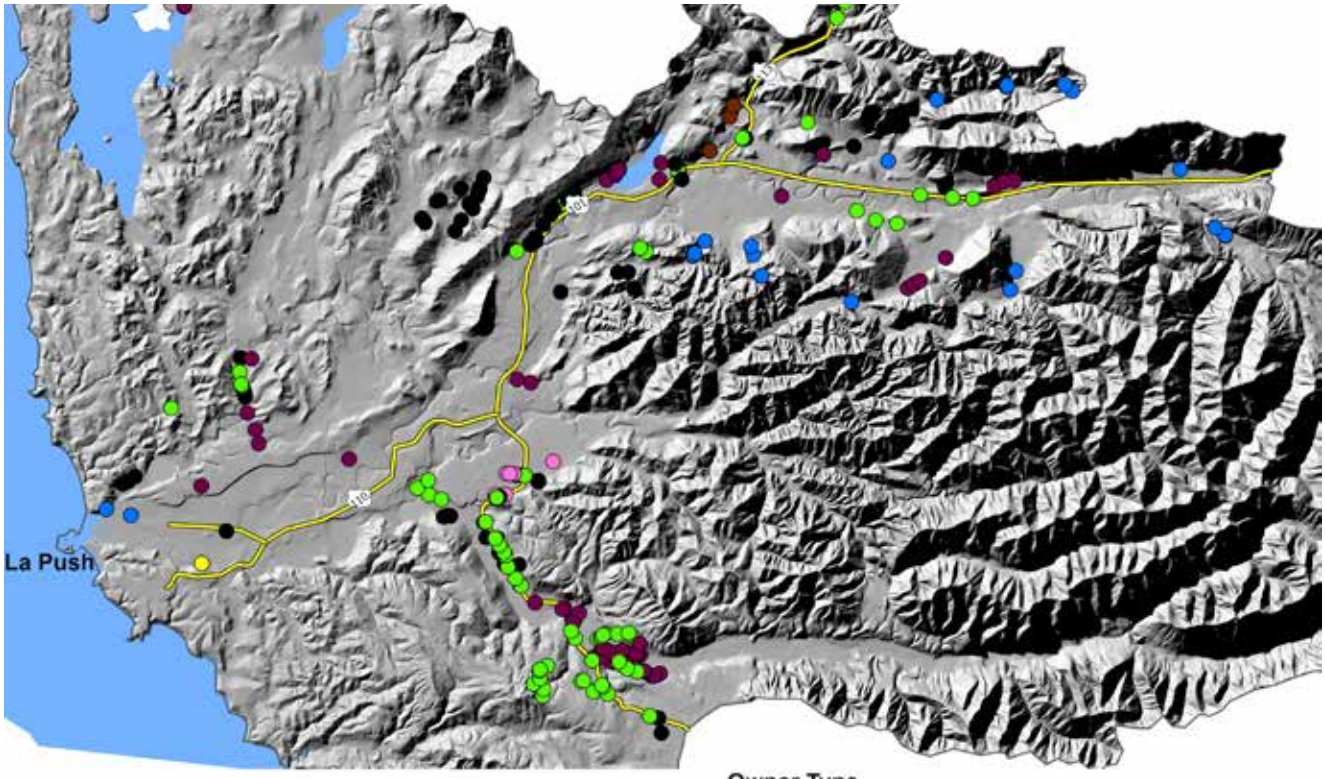
Forest practice activities were highest in the 2012-2017 period and lowest in the 2018-2023 period, although there is no clear trend in activities in both public and private forestlands.

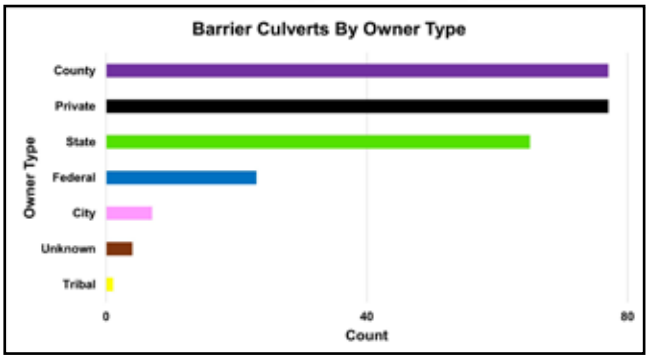


Map Data Sources: WADNR 2024[4], WADOT 2018[5]

Culverts are Fish Passage Barriers

Currently, there are 254 identified fish barrier culverts in the Quileute Area of Interest. Private ownership accounts for 77 (or 30.3%) while county ownership accounts for another 77 (30.3%). The state, federal and city governments own 65 (25.6 %), 23 (9.1%) and seven (2.7%) of these culverts.





The negative impacts of barrier culverts on salmon productivity cannot be overemphasized. These non fish-friendly structures disrupt stream hydraulic and biologic processes, prevent fish from reaching their spawning grounds and stop the young from migrating to sea, thereby disrupting their spawning success.

The Quileute Tribe's Geomorphic Assessment and Action Plan[1] identified non fish-friendly culverts along Mora Road creating fish passage issues to associated off-channel habitats near the Dickey River mouth on the mainstem Quillayute River. The tribe's plan is to replace the culverts with fish-friendly structures.

The 2020 State of Our Watersheds report for the Quileute Area of Interest mostly used data from the Road Maintenance and Abandonment Plan (RMAP)[2], a process developed as part of the Forest and Fish Rules in 2001. The schedule for repairs needed to upgrade road systems at stream crossings and address aquatic habitat and fish passage issues under that plan is largely complete. This report uses data from the Washington state Fish Passage database.[3]

Work is ongoing to identify and fix some of the barrier culverts with the worst impacts on fish habitat. Some have been replaced by a passable structure or are not considered barriers because fish presence has not been recorded.

Currently, there are 254 identified fish barrier culverts owned by the state, the county, as well as private corporations and individuals in the Quileute Area of Interest. Private ownership accounts for 77 (or 30.3%) while county ownership accounts for another 77 (30.3%). The state, federal and city governments own 65 (25.6 %), 23 (9.1%) and seven (2.7%) of these culverts. Less than 2% of barrier culverts fall outside of these main ownerships.

To ameliorate the impacts of these culverts on salmon, measures need to be taken to replace them with fish-friendly structures.

Map Data Sources: SSHIAP 2004[4], SSHIAP 2024[5], WADFW 2025[6], WADOT 2018[7], WAECY 2018[8]

Development Issues Impact Fish Habitat

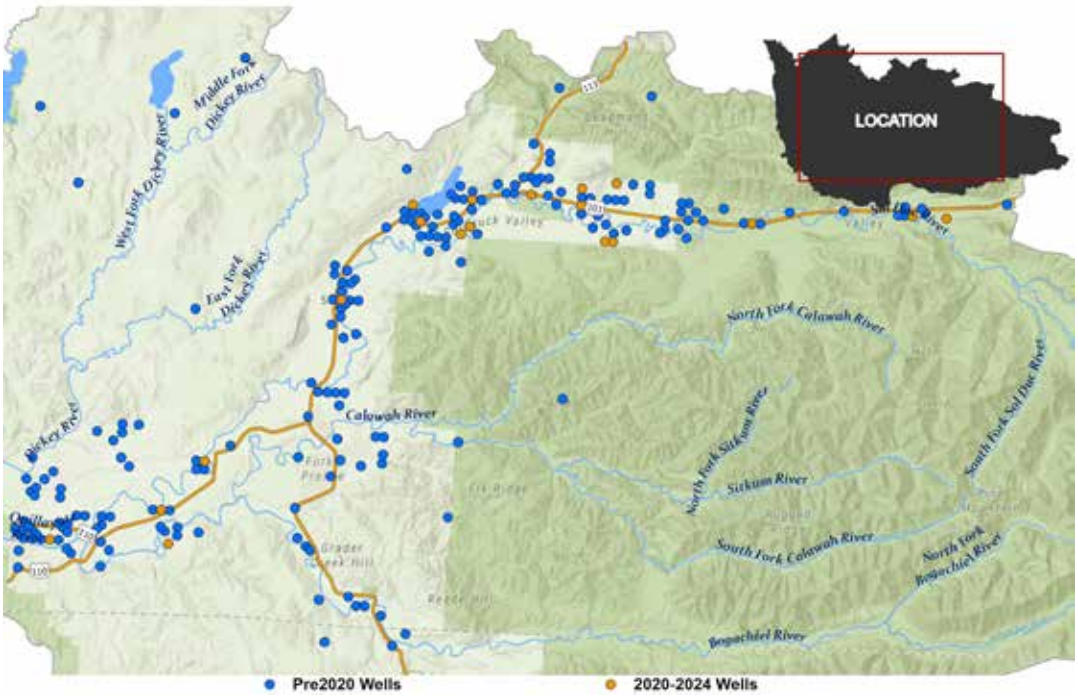
Development pressures continue to impact the Quileute's watersheds, including such activities as unpermitted buildings and the continued development of water wells. Currently, there are 383 known water wells in the Quileute's Area of Interest.

Some of the factors identified as limiting salmon productivity in the Quileute Area of Interest is poor floodplain connectivity to main stream channels, particularly in the Sol Duc and Lower Bogachiel reaches, poor riparian conditions, and sedimentation due to land use activities, development and roads in the riparian areas.[1,2,3]

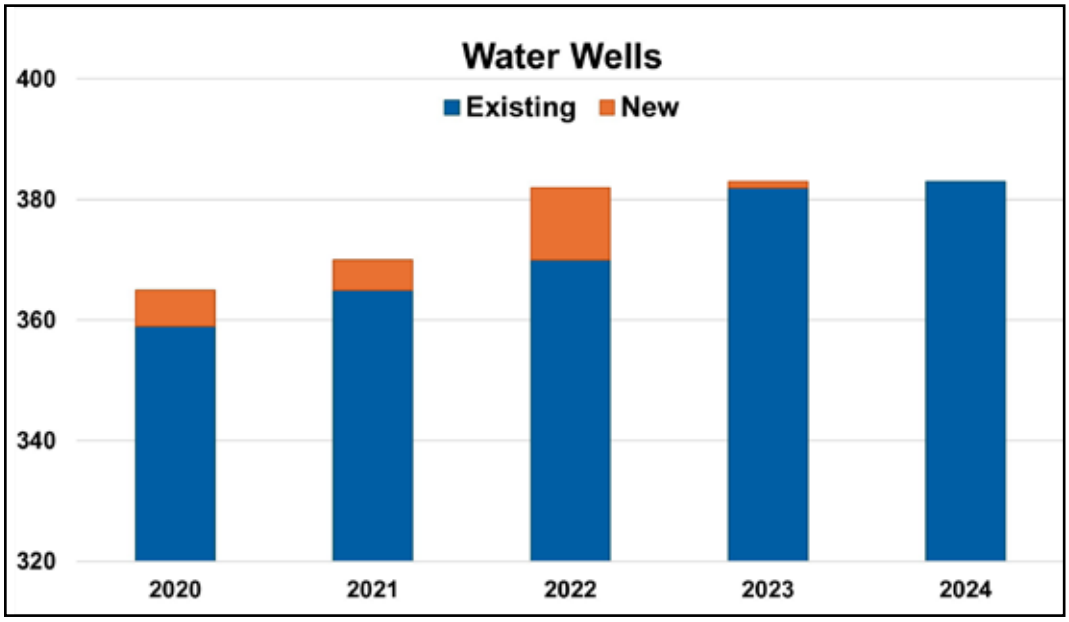
Other land use actions have degraded channel complexity and habitat availability. The Quileute Tribe has observed an uptick of unpermitted buildings constructed in the Quillayute floodplain. Some of this development has occurred without proper permits ever being obtained from the county. Such unpermitted structures can interfere with the natural flow of freshwater, leading to saltwater intrusion and contamination of groundwater in the floodplain.

Some weak infrastructure in the floodplain also disconnect the natural flow of freshwater. Non fish-friendly anthropogenic structures on Mora Road are an example of such infrastructure. They would need to be modified to restore natural riverine processes and reconnect floodplains, off-channel habitats and wetlands.

Another issue related to development is the construction of water wells which withdraw groundwater. Since groundwater and surface water systems are connected, groundwater discharge can be an important component of stream flow. Water withdrawals from wells can reduce the amount of groundwater that flows to streams which in turn affects water temperature, quantity and quality, particularly during low flow periods.



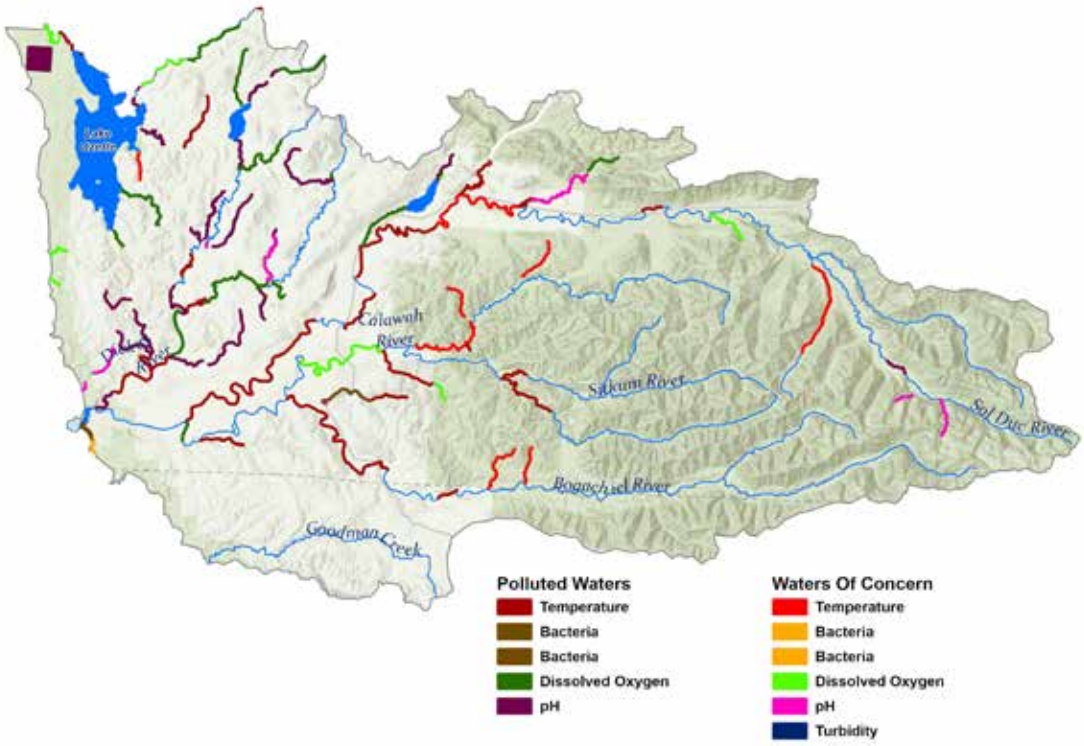
Currently, there are 383 known water wells in the Quileute Tribe's Area of Interest, most of which are in the Sol Duc Valley. Between 1980 and 2019, a total of 359 wells were completed in the area, representing an average rate of about nine new wells per year. Since 2020, an additional 12 wells have been added, representing a rate of about 2.4 new wells per year. The greatest number of new wells was completed in 2022 when 12 new wells were added. Although the cumulative number of wells has increased since 2020, the rate of increase has slowed, and no new wells were added in 2024.



Map Data Sources: WADOT 2018[4], WAECY 2018[5], WAECY 2024[6]

Streams are Impaired by Pollutants

There were 109 listings (190.2 miles) of polluted streams in 2018 compared to the 58 listings (106.3 miles) in 2012 for the most common pollutants—water temperature, dissolved oxygen, pH and bacteria. This increase is likely the result of increased water quality monitoring in recent years rather than an accurate assessment of the rate of increase.



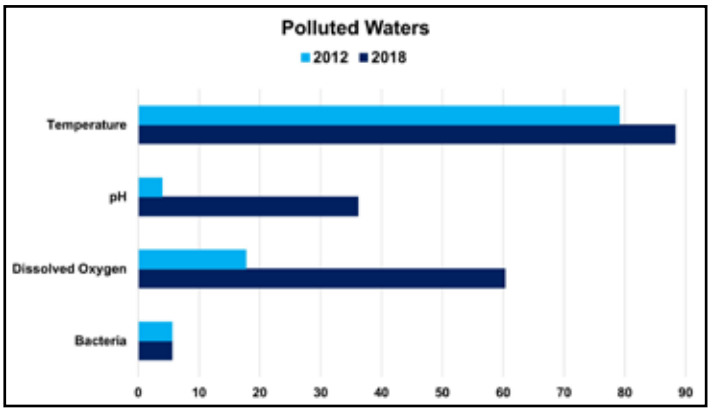


Chart 1: Polluted stream listings for the most common pollutants

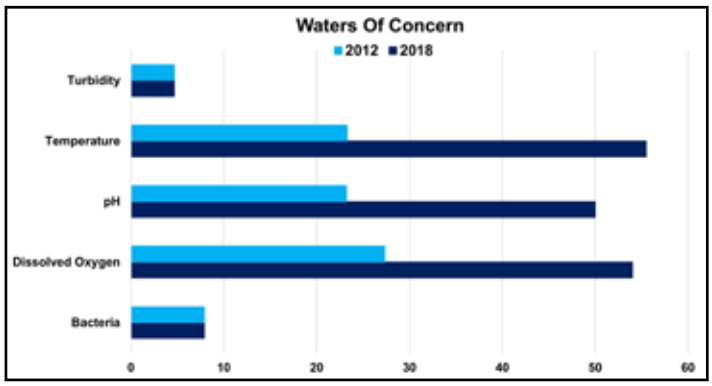


Chart 2: Waters of concern listings for the most common pollutants

Cold, clean water is essential to all salmonids in all life-history stages. Water quality significantly affects the distribution, abundance, health, growth development, and survival of salmon and steelhead species.[1,2]

In the Quileute Area of Interest, there were 109 listings (190.2 miles) of polluted streams in 2018 compared to the 58 listings (106.3 miles) in 2012 for the most common pollutants—water temperature, dissolved oxygen, pH and bacteria. This increase is likely the result of increased water quality monitoring rather than an accurate assessment of the rate of increase. The Quileute Tribe's water quality monitoring program started in 2012 with 48 sites which were likely not included in the previous impairment assessment (Robert Beck, Quileute Tribe - personal communication).

(Continued next page)

Map Data Sources: Quileute Tribe 2025[3], WAECY 2018[4], WAECY 2022a[5], WAECY 2022b[6]

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Water temperature was the most common pollutant with 45 listings, followed by dissolved oxygen with 36, and pH with 26. The stream length impaired by water temperature increased from 79.1 miles in 2012 to 88.3 miles in 2018, representing a 10.1% increase. The stream length impaired by dissolved oxygen increased from 17.7 miles in 2012 to 60.3 miles in 2018, representing a 70.4% increase. The stream length impaired by pH increased from 4.0 miles in 2012 to 36.1 miles in 2018.

There were an additional 109 listings (or 107.0 miles) in 2018 of waters of concern for water temperature, dissolved oxygen, pH, bacteria and turbidity. These are water bodies that have some evidence of a water quality problem, but not enough to show persistent impairment. The listings in 2012 were less than half—49 (or 86.4 miles).

Some of the most polluted waterbodies were the Sol Doc River which has 21.1 miles impaired by water temperature, the Dickey River (6.3 miles by temperature and 3.3 miles by dissolved oxygen, and 2.8 miles by bacteria), and the Bogachiel River (9.9 miles by temperature and 0.9 miles by dissolved oxygen).

Discrete water quality measurements by the Quileute Tribe also show that stream water temperature and dissolved oxygen levels are a major concern in many streams in the Area of Interest. A long-term water quality monitoring at the different sites is needed to understand fully the water pollution problem in the area.

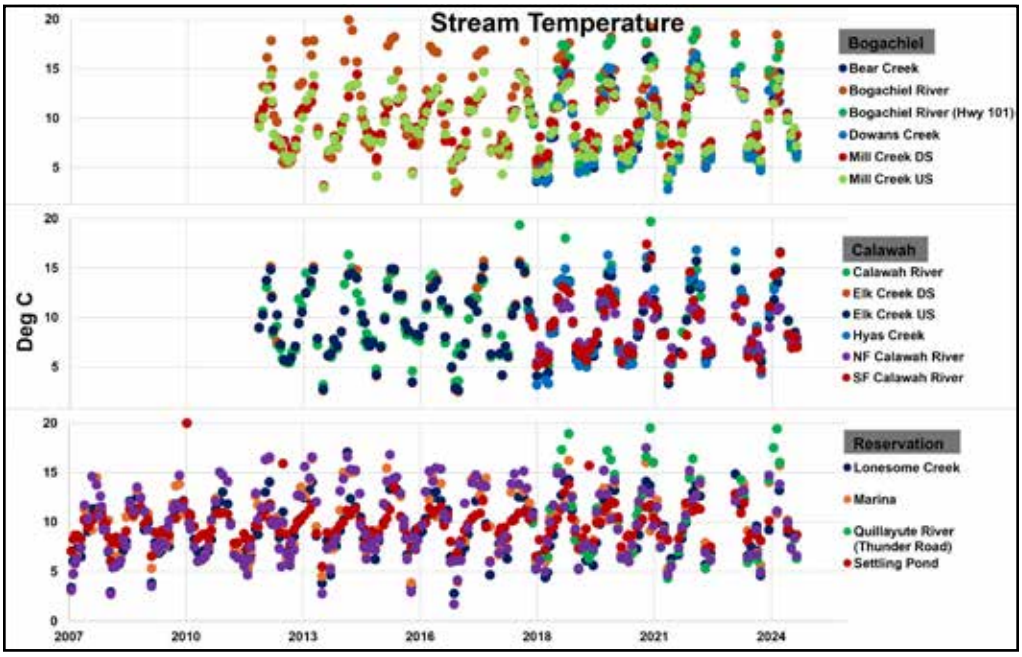

Chart 3: Discrete monthly stream water temperature values

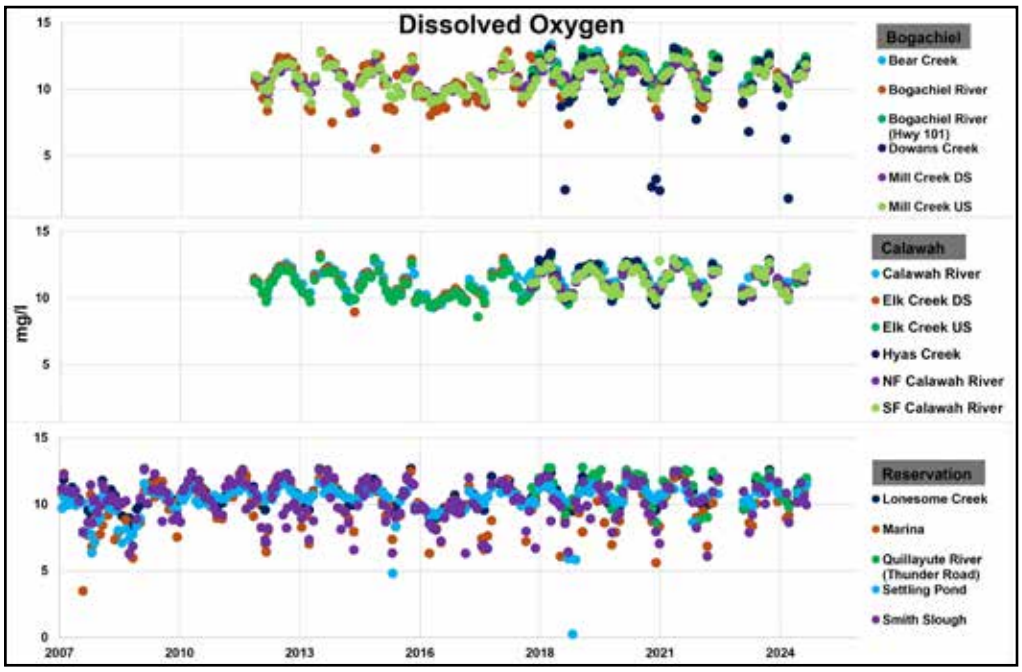

Chart 4: Discrete monthly stream dissolved oxygen values

Restoration Efforts to Improve Quillayute River Habitat

The Quillayute River watershed has been impacted by anthropogenic activities which have contributed to the decline in salmonid habitat quality and quantity. The Quileute Tribe developed a multi-phase implementation plan to restore salmon habitat, reduce flood risks to the tribal village of La Push, and support tribal fisheries. The tribe has completed the restoration of the lower Quillayute River and plans to undertake phased restoration efforts in the upper three reaches of the Quillayute River and lower Bogachiel River in the future.

Salmon habitat throughout the Quillayute River watershed has been impacted by anthropogenic activities including road development, logging, hydromodifications and other residential and commercial development.[1] These activities have caused bank erosion and instability, increased sedimentation, reduced quantities of large woody debris, disconnection from the river's floodplains and a loss of hydrologic maturity.[2] These effects have been exacerbated by climate change[3] which results in lower summer flows impacting fish passage and habitat use, more extreme flood events, and higher summer water temperatures.

The Quileute Tribe commissioned the development of an Action Plan that identifies reach-specific limiting factors and potential actions for restoration to improve habitat for 23 different stocks of salmonids, including Chinook, steelhead, Coho, Chum, Pink and Sockeye. Based on the Action Plan, the tribe developed a multi-phase implementation plan to restore salmon habitat, reduce flood risks to La Push, and support the tribal fisheries.

In 2022, the Quileute Tribe, in collaboration with the National Park Service and other partners completed the restoration of the lower Quillayute River (or "Reach 3").[4] The project involved excavating side channels in the floodplain to increase habitat complexity, installing large woody structures to deflect high water flows, and installing a fish-friendly log revetment for bank protection. A ramp for hand launching boats was constructed to provide easier access for tribal fishermen. The project addressed the lower Quillayute River's lack

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The tribe has worked to improve future fish passage on Hermison Creek, a tributary to the Historic Oxbow. It has successfully replaced a barrier culvert on Hermison creek with a pre-cast, more fish-friendly concrete bridge.

Sierra Hemmig, Quileute Tribe

Hermison Creek culvert outlet before construction.

Sierra Hemmig, Quileute Tribe

Hermison Creek after construction.

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of habitat complexity and improved salmonid habitat for both juveniles and adults. It also reduced the erosion threat and flood risk of the river to the tribe's culturally significant Thunder Field, and by extension, the tribal village of La Push.

The Quillayute River Historic Oxbow Project builds on the Reach 3 project. It is designed to reactivate a historic oxbow off the Quillayute River. The historic oxbow helped dissipate river energy during high flows which in turn reduced the potential for downstream erosion and flooding. In addition to reconnecting the oxbow, this project will install small and large instream wood structures to improve habitat complexity and off-channel habitat for salmon. It will improve floodplain connectivity and function by reconnecting wetlands and increase hyporheic exchange of surface and subsurface water.

The tribe improved future fish passage on Hermison Creek, a tributary to the Historic Oxbow by replacing a barrier culvert with a pre-cast concrete bridge.

Another project in the works is the Mora Road project. The road is frequently impacted by erosion from the Quillayute River. The current riprap to prevent erosion is not fish-friendly and culverts along the road block access to off-channel fish habitat. The project design phase is expected to be completed in 2025, and project implementation is planned for 2026. The project would replace barrier culverts, install instream wood structures to reduce high-flow forces, and replace the riprap with fish-friendly log revetments.

Restoration work for Reaches 4-6 of the Quillayute River will include mainstem restoration to improve habitat complexity and reduce river bank erosion. Planning is underway and construction is planned for 2027 and beyond.

The implementation of these projects will improve salmonid habitat conditions on the Quillayute River, reduce flood risks in La Push, and support important opportunities for tribal treaty fishing, hunting, gathering and recreation.

Archie Black, Quileute Tribe

Apex structures, a type of engineered log jam, being constructed for the Reach 3 Restoration Project.

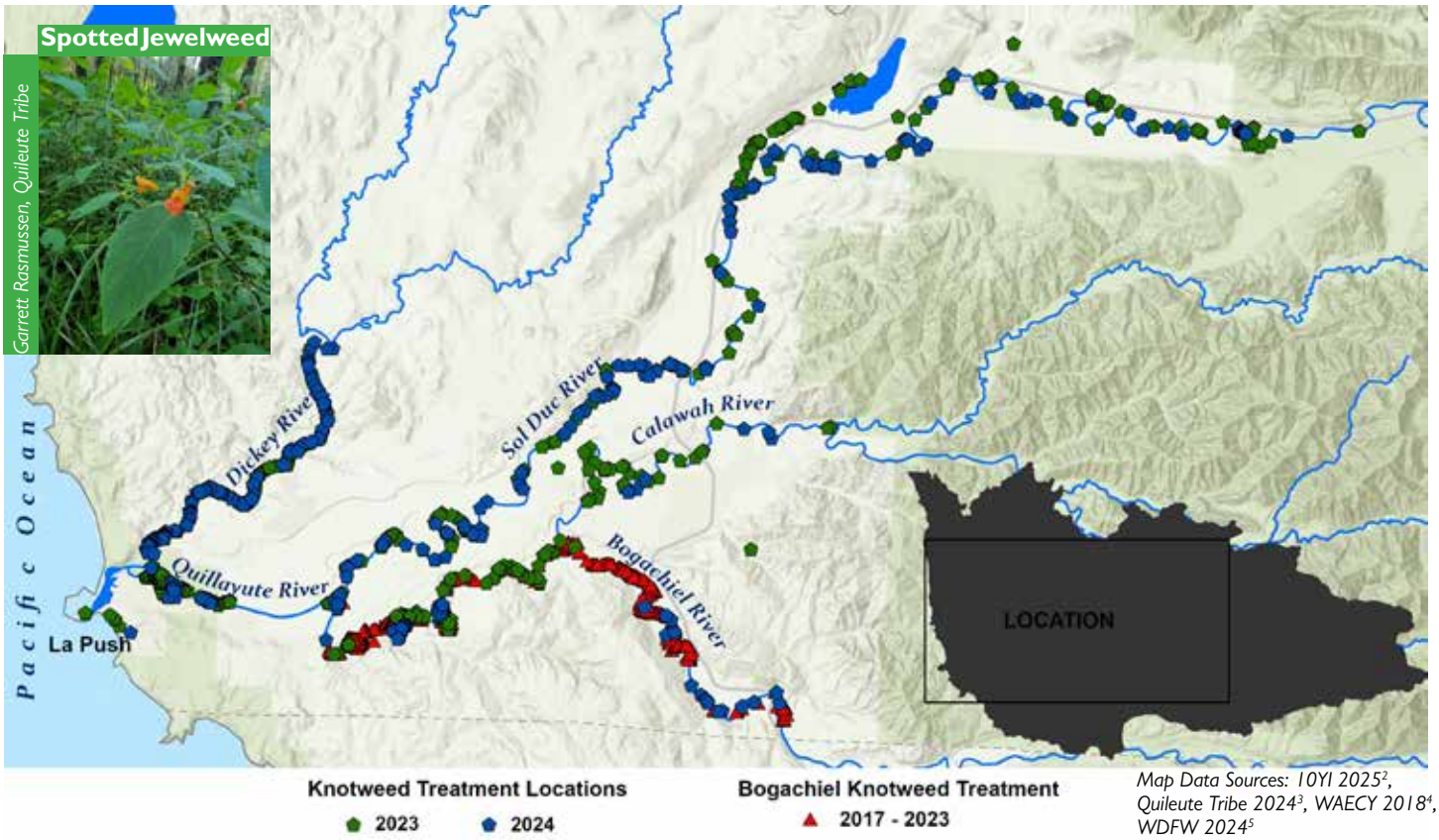
Archie Black, Quileute Tribe

Completed apex structures during high flows in the winter of 2022.

Invasive Plants Remain a Problem and European Green Crabs Are Found for the First Time

The Quileute Tribe and its partners have continued the survey and treatment of knotweed species in the Quileute Area of Interest which have resulted in reducing knotweed infestation in the area. Other species like Himalayan blackberry, Scotch broom and spotted jewelweed remain a problem in the area. Also, European green crab species were recently captured for the first time in the area.

Invasive Plants Survey Results



Map Data Sources: 10YI 2025[2], Quileute Tribe 2024[3], WAECY 2018[4], WDFW 2024[5]

The Quileute Tribe has continued its focus on the inventory and treatment of knotweed species in the Quileute Area of Interest. Knotweed surveys and treatments were also conducted in the Bogachiel watershed by the 10,000 Years Institute[1] with funding from the Washington Coast Restoration and Resiliency Initiative (WCRRI) and Washington state Department of Agriculture.

The tribe, 10,000 Years Institute and their partners conducted repeat surveys on foot or via drift boat. The teams located, mapped, flagged and treated scattered knotweed sprouts, stems and clumps on floodplains, riverbanks, mid-channel islands and gravel bars. These efforts have resulted in reducing the infestation size of knotweed in the Quileute Area of Interest and getting it to a maintenance level.

Other invasive plant species in the Quileute Area of Interest include Himalayan blackberry, Scotch broom and spotted jewelweed which is new in the area. These plants can grow aggressively. They can outcompete and displace other native vegetation and reduce biodiversity, increasing bank erosion and lowering the quality of riparian habitat for fish and wildlife. When the opportunity arises, the Quileute Tribe removes or treats these other invasive plant species particularly in riparian zones.

Another invasive species, the European green crab, was recently captured for the first time in the Quileute Area of Interest. Traps were deployed in the Quileute Marina in La Push on the Quileute Reservation, as well as nearby areas within the Quillayute River estuary. A total of 33 crabs were removed using both traps and hand captures.

The European green crab, which is found in shallow waters like estuaries, mudflats, intertidal zones and beaches threatens native shellfish, eelgrass and estuary habitat vital for salmon and many other species that are of cultural significance to the Quileute Tribe.

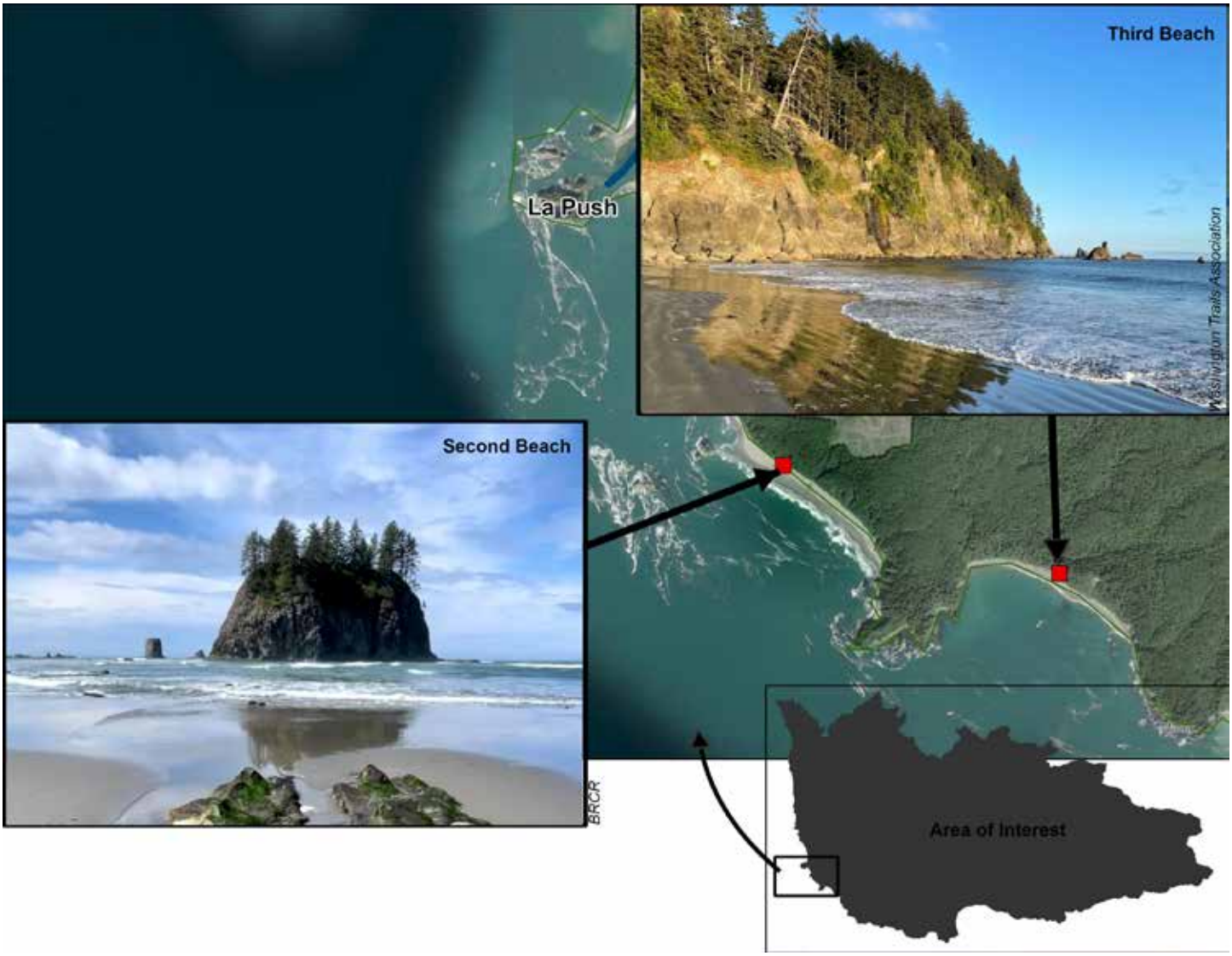
Salmon, steelhead, Dungeness crab and other species in the Quileute Area of Interest could be threatened by these invasive plant and crab species, making their continued monitoring and control very important.

Chris Terry, Quileute Tribe

Quileute Tribe staff treating invasive plant species.

Impact of Tourism

The large number of visitors to beaches in the Quileute Area of Interest may be causing significant habitat and water quality problems. There has been an increase in human fecal matter from outdoor recreationists and harmful bacteria from such fecal deposits may biocontaminate shellfish the tribe uses for subsistence and other traditional practices.



The beaches near La Push in the Quileute Area of Interest are very popular, particularly in the summer months. Visitors go there to get impressive views of the Pacific Ocean from clifftops, watch waves crashing against the beach, and explore the numerous rainforest hiking trails.

The popularity of the beaches may be causing significant habitat and water quality problems. According to the Quileute Tribe, there has been an increase in human fecal matter from outdoor recreationists deposited on two of their ancestral fishing grounds in the Second and Third beaches which are managed by Olympic National Park (ONP). Harmful bacteria (like fecal coliform and *Escherichia coli*) from such fecal deposits may contaminate the water and shellfish.

In collaboration with the Quileute Tribe, a study was carried out to understand the ecological, pathogenic and cultural impacts of this increase in human fecal matter and subsequent transfer of harmful bacteria on the shellfish the tribe uses for subsistence fishing and other traditional practices.[1] The research project was designed to answer a main question: To what degree are outdoor recreationists on Second and Third beaches in ONP impacting Quileute subsistence foods and traditional fishing grounds? The project traced the impacts of human fecal matter throughout the marine ecosystems on the beaches using spatial, cellular and molecular methods and studied the spatial and temporal relationships between the amount of human waste and E. coli distribution in beach sands and selected shellfish during the summer tourism season.

The study makes recommendations on ways to ameliorate the significant negative impacts of tourism on the Quileute people, their resources and traditional practices.

Map Data Sources: Esri 2025[2]

Climate Change Increasing Risk of Coastal Flooding

The cherished way of life of the Quileute Tribe is threatened by the increased frequency of major coastal flooding exacerbated by human-caused climate change. By 2100, sea level is projected to rise by 4 to 56 inches along the Pacific Northwest coast and by almost 20 inches along the Quileute coastline. In the 22 years between 2003 and 2024, the Bogachiel river reached or exceeded the flood stage in 15 years, including three of the last five.

Increases in temperature, increased winter rainfall and less snow in the higher elevations from human-caused climate change significantly increase the frequency of major coastal flooding. This is primarily due to rising sea levels caused by melting glaciers and thermal expansion of ocean water, making coastal areas more vulnerable to inundation during high tides and storms, leading to more frequent and severe flooding events. Increased wave action due to rising sea levels can accelerate coastal erosion, further exposing coastal areas to flooding.

More frequent flooding from sea level rise can push saltwater further inland, increasing the salinity of groundwater and contaminating freshwater as the denser saltwater pushes up and into a freshwater estuary or tidal river[1] leading to impacts to plants and habitat types.

The proximity of the Quileute Area of Interest to both the ocean and river makes it prone to flooding from high tides, coastal storms driving storm surges and large waves and high streamflow events. Climate change is linked to more intense storms, which can generate higher storm surges, further exacerbating coastal flooding.

By 2100, sea level is projected to rise by 4 to 56 inches along the Pacific Northwest coast and by almost 20 inches along the Quileute coastline.[2] Sea level increases matter more in places like the Quileute coastline with critical salmonid habitat and infrastructure like the La Push marina.

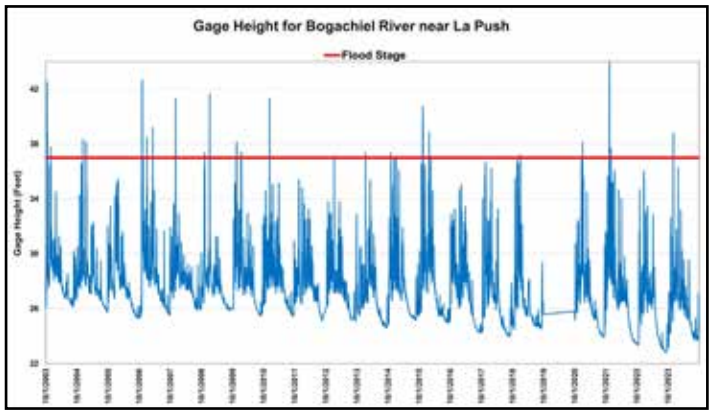
In cooperation with the U.S. Geological Survey, the Quileute Tribe operates a gage on the Bogachiel River at the Highway 110 bridge to track flooding and road access from Forks to La Push. In the 22-year period between 2003 and 2024, the river reached or the exceeded flood stage of 37 feet in 15 years, including three of the last five. Also, a stage height of 38.0 feet has been correlated to flooding along the low elevation portions of Highway 110, immediately northeast of the bridge and southwest of the Three Rivers Resort. Flooding at that stage height has been recorded a total of 21 times between 2003 and 2019.[3]

During a major storm in 2009, the U.S. Army Corps of Engineers used more than 6,000 tons of rock in a 35-hour nonstop effort to build a berm more than 1,320 feet long to protect the Quileute Tribe property in La Push.[4] The berm was not maintained and it degraded substantially[5] and no longer adequately protected the La Push community in the event of major flooding from the Quillayute River or from tidal events. The flood berm was rehabilitated by the Quileute Tribe, and up to 4 feet was added to its height.[6]

To keep the Quileute Tribe safe from impending tsunamis, high tides and extreme flooding events, and help the people preserve their livelihoods and rich heritage, the tribe embarked on a Move To Higher Ground project. This is a comprehensive plan to move critical tribal infrastructure and future housing to the safety of lands above the reach of tsunami waves and flood waters.

Quileute Tribe

Flooding on Highway 110 at Old La Push Road in October 2003 when the Bogachiel River Gage was at 42.5 feet.



Quileute Tribe

Thunder Road flooding in November 2015.

Ocean Conditions Continue to Worsen

The coastal waters off the Quileute Tribe's Area of Interest continue to face many threats like ocean warming, including marine heatwaves (MHW), hypoxia, and harmful algal blooms (HABs), conditions that are exacerbated by human-caused climate change. In 2024, hypoxic conditions started earlier than normal and continued into October even in shallower inner-shelf waters.

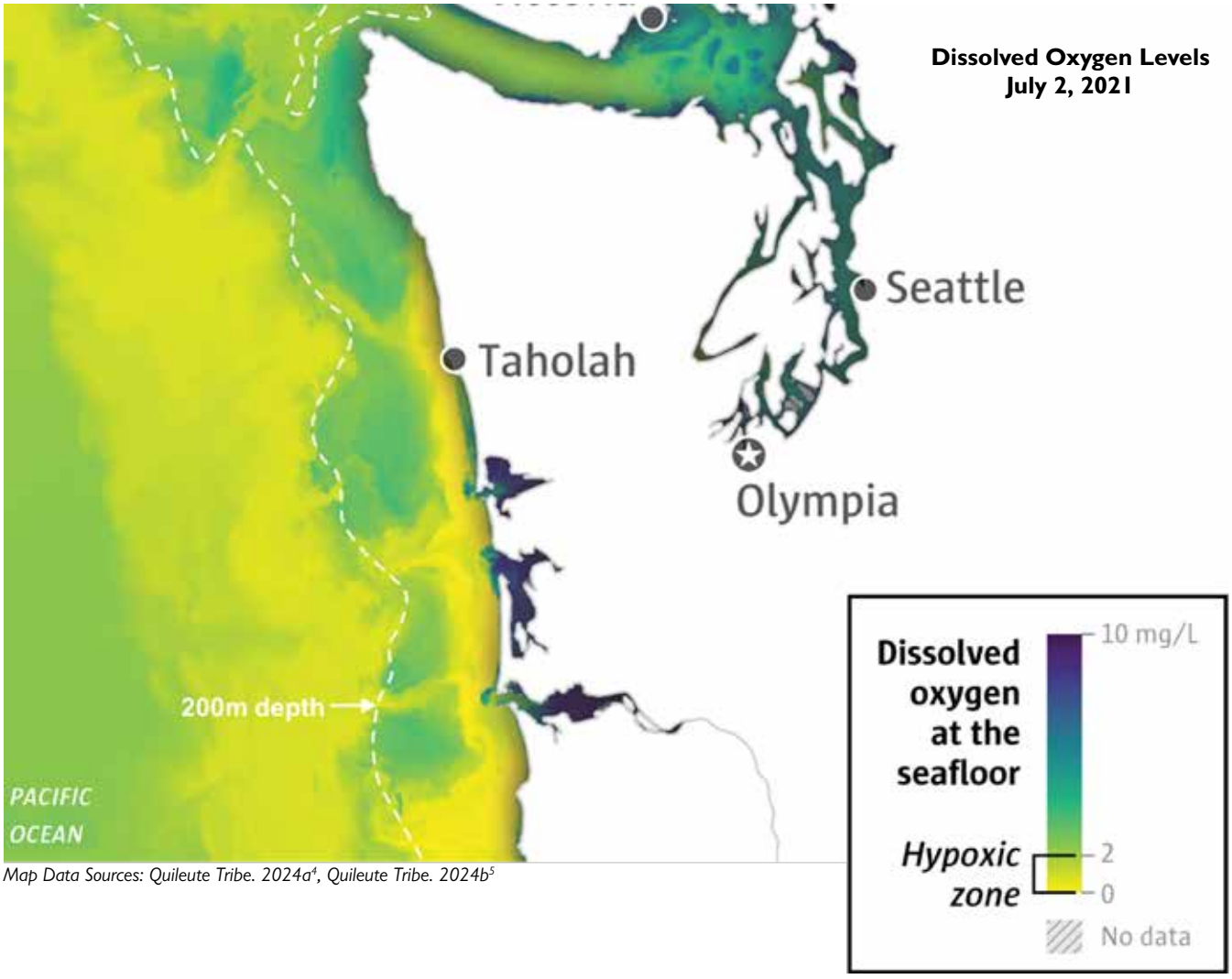


Figure modified from the Seattle Times, data from LiveOcean

Map Data Sources: Quileute Tribe. 2024a[4], Quileute Tribe. 2024b[5]

The coastal waters off the Quileute Tribe's Area of Interest continue to face many threats like ocean warming, including marine heatwaves (MHW), hypoxia, and harmful algal blooms (HABs), conditions that are exacerbated by human-caused climate change.

In recent years, the California Current System (CCS) has experienced nearly annual marine heat waves. None of these MHWs were as intense as the 2014-2016 MHW ("the Blob"), but they have had the potential to impact fisheries off the West Coast. On a broader scale, the region has also experienced a 3-year La Nina, followed by a 1-year El Nino. During La Nina conditions, winds and ocean circulation in the central Pacific weaken, resulting in cooler marine conditions on the West Coast that are typically favorable for salmon. During an El Nino, the opposite occurs and warmer, subtropical waters intrude up the West Coast.

Beaches in the Quileute Tribe's Area of Interest have also experienced frequent harmful algal blooms and seasonal high domoic acid concentrations. Some studies[1,2] have found that HABs in the CCS tend to occur when southward winds drive upwelling of nutrient rich waters, followed by northward winds that drive downwelling and push these waters (and the phytoplankton bloom that can accompany them) onshore.

Additionally, summertime hypoxia has been a growing concern on the Washington continental shelf, with the most severe conditions occurring between Grays Harbor and La Push. Seasonal moorings deployed by the Olympic Coast National Marine Sanctuary since 2006 have documented the increasing severity and duration of hypoxic conditions in the Quileute Tribe's Area of Interest, with hypoxic conditions being in place in waters greater than 40 meters depths for more than half of the summer in some years.

The second beach has episodic paralytic shellfish poisoning and seasonal domoic acid levels that exceed the threshold for safe subsistence harvest. In 2024, recommendations to not harvest intertidal species on these beaches began in July and ran through September.

Following the Quileute Tribe's Dungeness crab fishery economic disaster in 2015[3], the Quileute Department of Natural

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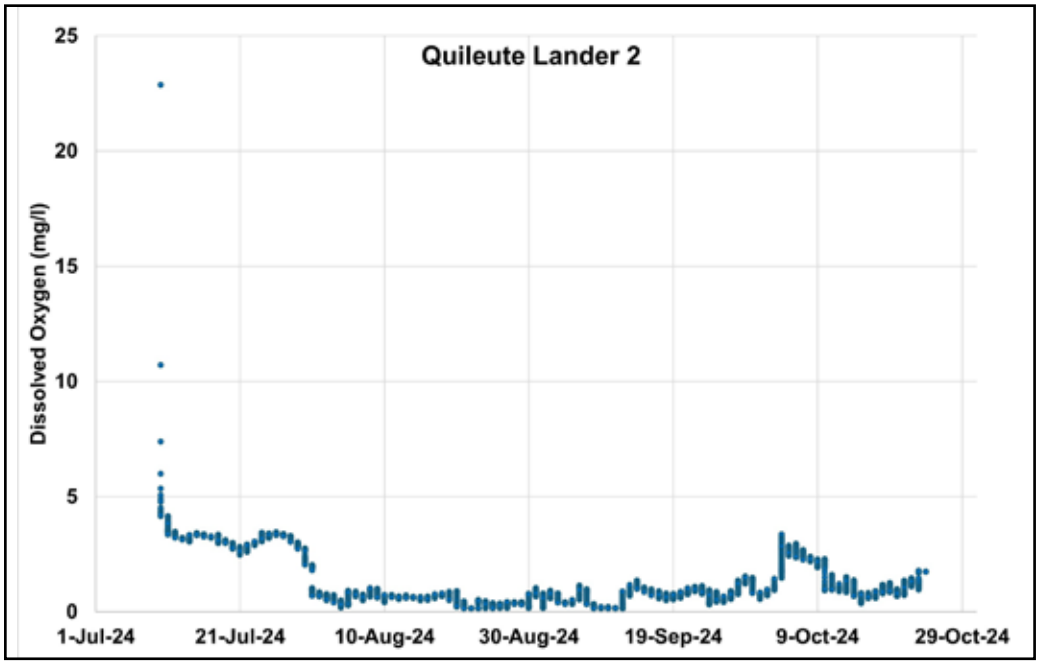
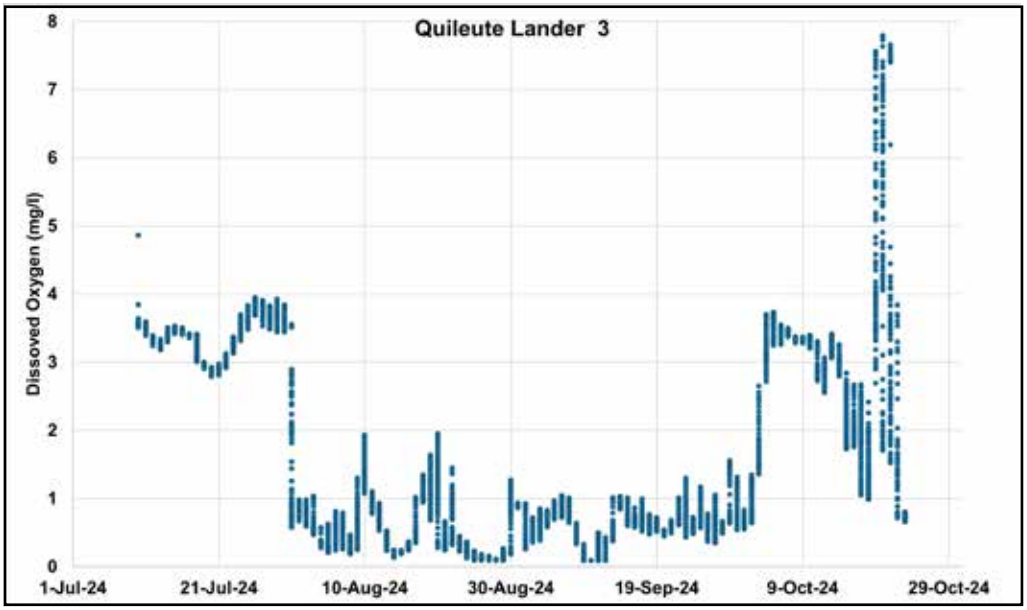


Resources invested some of their disaster relief funds into a pair of benthic lander moorings. Real-time observations[4,5] from these deployed systems, available on the NANOOS NVS website and on the UW Northwest Environmental Mooring Lab's website, allowed real-time monitoring of near-bottom dissolved oxygen levels and prediction of the movement of hypoxic water, allowing Quileute Natural Resources to make informed, timely resource management decisions. In particular, the landers captured a northward-moving mass of hypoxic bottom water in late July 2024, allowing both better understanding of these events and some level of event response to regions downstream (north) of the landers before the arrival of this water.

Quileute Landers 2 and 3 were deployed at depths of 60 m and 40 m to the southwest of La Push from July 10 to October 23, 2024. All four sensors (a CTD with DO and current meter on each lander) worked perfectly throughout this deployment. The hypoxic event starting on July 30 was characterized by a very rapid drop in dissolved oxygen (DO), changing from more than 4 mg/l to less than 1 mg/l in less than a day at the inshore (Quileute 3) lander.

The drop was more rapid and roughly occurred a day earlier at the 40 m location than at the 60 m depth, and at both locations was associated with a shift of flow to the north. This was consistent with reports from the Quinault Tribe that they were observing hypoxic water in the weeks prior to the arrival of this water at the Quileute landers, indicating that the water moved from the south. The earlier arrival at Quileute 3, which is inshore and to the northwest of Quileute 2, suggests that this hypoxic water is also more concentrated inshore, indicating that it may not be directly related to low-DO upwelled water but may instead have originated from the inner shelf to the south.



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2025 State of Our Watersheds Report
Queets—Chehalis Basins

The roots of the Quinault Indian Nation lie deep within the land. The land and its resources represent both our heritage from the past and our legacy to the future."

– Guy "Butch" McMinds

— **Area of Interest**

Quinault Indian Nation

The Quinault Indian Nation (QIN) consists of the Quinault and Queets tribes and descendants of five other coastal tribes: Quileute, Hoh, Chehalis, Chinook and Cowlitz.

Quinault ancestors lived on a major physical and cultural dividing line. Beaches to the south are wide and sandy, while to the north, they are rugged and cliff-lined. Quinault people shared in the cultures of the people to the south as well as those to the north.

Living in family groups in longhouses up and down the river, they were sustained by the land and by trade with neighboring tribes. Salmon runs, abundant sea mammals, wildlife and forests provided substantial material and spiritual wealth. A great store of knowledge about plants and their uses helped provide for the people. The western red cedar, the "tree of life," provided logs for canoes, bark for clothing, split boards for houses and more.

The Quinault are the Canoe People, the people of the cedar tree. Tribal headquarters are located in Taholah, Wash.

Quinault Indian Nation

The Queets, Quinault and Chehalis Watersheds

The Quinault Indian Nation's Area of Interest (AOI) for this report is the Queets-Quinault basin (WRIA 21) and Chehalis basin (WRIAs 22 and 23), but most of the data analysis will focus on the Queets and Chehalis watersheds. The tribe's Area of Concern (AOC) goes beyond the AOI and extends further south to the Columbia River.

WRIA 21 contains the tributaries to the Pacific Ocean from Kalaloch Creek in the north to Conner Creek in the south near Grays Harbor. Major watersheds include the Queets and Quinault, which originate from the Olympic Mountain range, as well as the Raft, Moclips and Copalis rivers and other independent drainages which begin at the foothills of this range. All these streams provide suitable spawning and rearing habitat for salmon.[1]

The Lower Chehalis (WRIA 22) is comprised mainly of the lower portion of the Chehalis River drainage, and includes major tributaries like the Wishkah, Wynoochee and Satsop rivers as well as a number of independent streams like the Humptulips, Hoquiam and Johns rivers which drain into Grays Harbor.

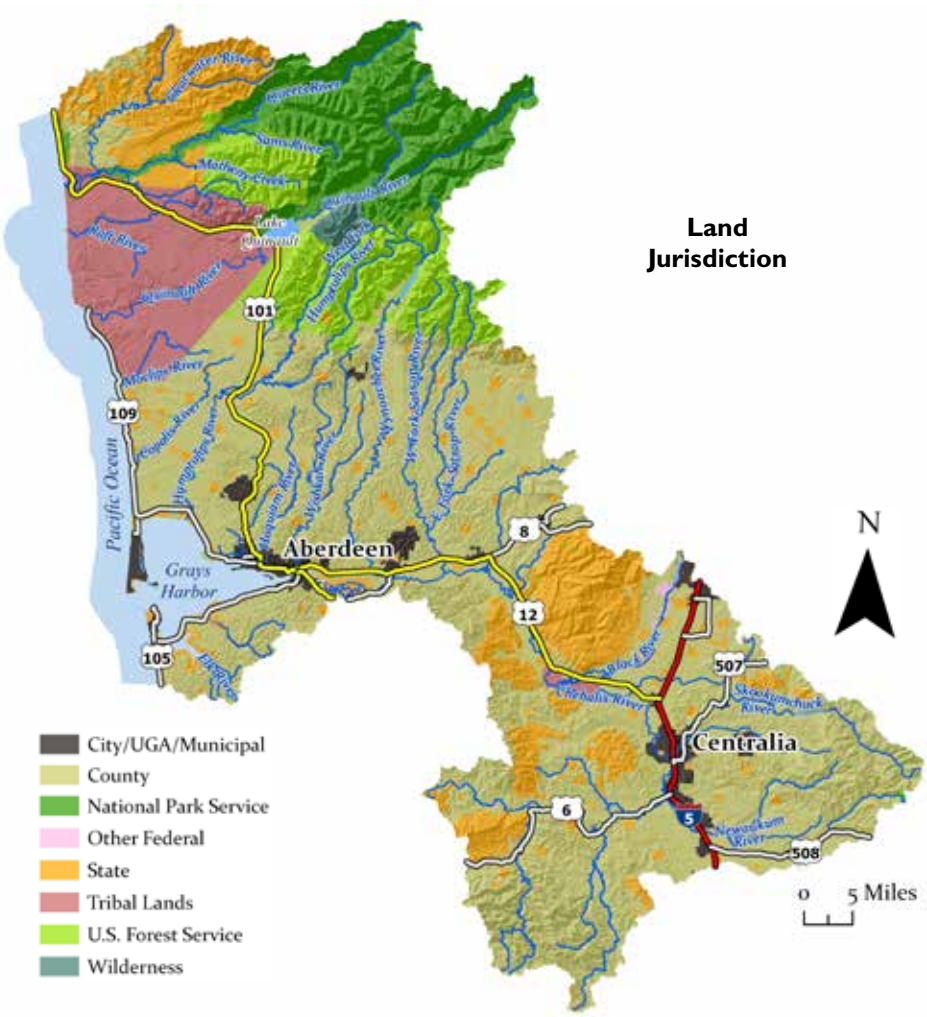
The Upper Chehalis (WRIA 23) includes the upper reaches of the Chehalis River drainage and a number of major tributaries such as the South Fork Chehalis, Newaukum, Black and Skookumchuck rivers. The Chehalis Basin, which is the largest river basin in western Washington, supports Chinook, Chum and Coho salmon, as well as steelhead and cutthroat trout.[2]

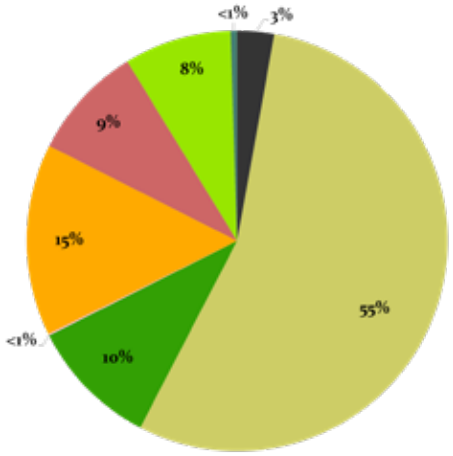
The majority of the area is forestland owned by corporations and government, including the Capitol State Forest, Quinault Indian Reservation, plus portions of the Olympic National Forest, the Gifford Pinchot National Forest and the Olympic National Park. The Quinault Nation has concerns about restricted tribal access to parts of the area with private timber companies locking forest roads and charging fees.

Although salmonids in this area have fared better than in Puget Sound,[3] several habitat factors limit salmonid production in the basin. These include increased channel incision, sedimentation, riparian loss or conversion, loss of large woody material, reduced channel complexity, water quality problems and reduction in streamflow.[4,5]

Most of these problems are caused and or exacerbated by human activity. As a result, once robust salmon runs are now a tiny fraction of their historic numbers.

To address the dual challenges of extreme flood damage and extensive loss of aquatic species habitat in the Chehalis Basin, the Washington state governor and legislature provided funding to develop a Chehalis Basin Strategy which is a collection of potential actions and projects.[6] The large longer-term projects are currently being reviewed for possible implementation.





Map Data Sources: DOD 2023[7], SSHIAP 2004[8], WADNR 2024a[9], WADNR 2024b[10], WAECY 2018c[11], WAECY 2021[12], WAECY 2024[13], WADOT 2018[14], WADOT 2023[15], USFWS 2024[16]

Chapter Summary

The Quinault Indian Nation is a sovereign nation with the inherent right to govern itself and deal with other tribes and nations on a government-to-government basis. Located on the southwestern corner of the Olympic Peninsula, the Quinault Indian Nation reservation's rain-drenched lands support important species of fish, wildlife and other natural resources. Its boundaries enclose more than 208,000 acres and includes some of the most productive conifer forestlands in the United States, swift-flowing rivers, gleaming lakes teeming with life, and 25 miles of Pacific coastline.

The Quinault people are proud to be among the small number of Americans who can walk the same beaches, fish the same waters and hunt the same lands their ancestors did centuries ago. But their way of life is threatened by decades of human-caused changes to the landscape, putting the waters, fish, wildlife, conifer forests and stands of hardwoods at risk.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters. The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

The Quinault Indian Nation's Area of Interest (AOI) for this report is the Queets-Quinault basin (WRIA 21) and Chehalis basin (WRIAs 22 and 23), but the Nation's Area of Concern (AOC) goes beyond the AOI and extends further south to the Columbia River.

Principal Findings

Forest Cover Conditions Decline

The 2021 tree canopy cover data shows that only 54 watersheds (about 46% of the land area) are in healthy or good condition. Many of the watersheds in poor condition were around the high population areas of Aberdeen and twin cities of Chehalis and Centralia. Overall, between 2011 and 2021, there was a slight increase in forest cover. The highest increase of 11.3% was in the Middle Wynoochee River watershed, while the highest decrease of 10.2% was in the headwaters of the Chehalis River.

Culverts Remain Impediments to Fish Passage

There are 3,055 barrier culverts in the Quinault Area of Interest. Private ownership accounts for 1,383 (or 45.3%) of the culverts while 952 (or 31.2 %) are owned by various counties. Washington state, cities, and the federal government, own 271 (8.9 %), 178 (5.8%) and 150 (4.9%) culverts, respectively.

Roads Continue to Impact Watersheds

Road density values were over 3 miles/square mile in virtually all watersheds outside the Olympic National Park, where the values were generally less than 1 mile/square mile. Between 2016 and 2024, about 36% of the watersheds in the area had increases of over 1 mile/square mile, showing that the road density conditions may be getting worse. The density of stream crossings over roads were generally highest with values of over 3 per mile of river in the upper reaches of the Chehalis River, Skookumchuck River and Stillman Creek.

Streamflow Conditions and Patterns

The variation and timing of mean streamflows in the Queets River near Clearwater and the Chehalis River at Porter show a similar pattern of peak flows in the winter months and low flows in the summer months. However, while the winter peak flow values were similar for both rivers, the summer low flows were consistently lower for the Chehalis, which can negatively impact fish habitat.

Water Quality Listings Decrease but Impairment Remains

There are 270 current listings with a total of 609.4 miles for waters whose beneficial uses are impaired by four of the most common pollutants—water temperature, dissolved oxygen, pH and fecal coliform bacteria. The number of listings represents a 15.9% decrease from the 2012 assessment. Water temperature, the most common pollutant, has 138 listings, representing a 17.9% decrease from the 2012 assessment.

Tire Contaminants Pose a Threat to Salmon

A preservative in car tires known as 6PPD has been identified as the toxic chemical responsible for the mortality of Coho salmon returning to spawn in streams and rivers. Watersheds around Aberdeen and in the Upper Black River just south of the greater Olympia area had the highest risk vulnerability scores for 6PPD exposure and are most likely to be impacted by these tire contaminants.

The Rate of New Water Wells May be Slowing

Currently, there are 13,677 water wells which may affect groundwater supply and instream flows in the Quinault Area of Interest. Between 1980 and 2019, 12,588 wells were completed in the area at a rate of about 323 wells per year. Since 2020, 1,089 wells were added at a rate of about 218 new wells per year. This represents a lower rate of new wells in the last five years. Also, in each year, there was a slightly lower number of wells than in the previous one. It remains critical to look at the cumulative impacts of both total volume consumption and timing of flows to determine impacts of permit-exempt wells.

Invasive European Green Crab Are an Urgent Threat

The proliferation of European green crab (*Carcinus maenas*) is fast becoming an urgent threat to the coastal ecosystem in the Quinault Area of Interest. Between 2022 and 2024, almost 240,000 European green crabs were caught in Grays Harbor by various stakeholders, with numbers increasing from about 24,000 in 2022 to almost 130,000 in 2024.

Marine Areas Continue to be Negatively Impacted

The marine areas of interest for the Quinault Indian Nation have been heavily impacted by ocean warming, including marine heatwaves (MHW), hypoxia, and harmful algal blooms (HABs). Domoic acid concentrations from the HABs were high enough to close fisheries in 2021 and 2023. Summertime hypoxia has caused fish kills with hundreds of dead fish washing up on the beaches.

Glaciers Continue to Rapidly Retreat

Higher temperatures from human-driven climate change are causing a rapid retreat of glaciers that feed many rivers in the Quinault Area of Interest. The Anderson Glacier, which fed the Quinault River, has disappeared. Other receding glaciers that feed the Quinault include the Linsleys, White and Christie while those that feed the Queets River include the Queets, Humes and Jeffers. The result is less fish habitat, higher stream temperatures and greater sediment load.

Conclusion

In the Quinault's Area of Interest, there have been successes in the restoration of habitat and improvement in water quality, but other habitat indicators have stayed the same or worsened. Growth continues with increases in groundwater use and increase road densities and stream crossings, plus loss of forest cover. With the looming threat of continued population growth, tribal leadership have concerns of the potential habitat impacts that come with it. Even though restoration is occurring, it is not enough to keep up with the impacts of a growing population and land use decisions. Land use and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented. This includes education and voluntary actions but also needs to include enforcement where those laws are broken. The future of the natural resources we all share depends on it.

Recovery Efforts Lagging

A review of key environmental indicators for the Queets to Chehalis basins shows that priority concerns continue to be degradation of water quantity and quality, loss of forest cover conditions, and habitat blocked to fish access.

However, there have been improvements in forest roads barriers. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat, and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trend for these key environmental indicators shows an improvement in water quality, but declining trends or concerns in habitat conditions for the other habitat indicators:

Tribal Indicator	Status	Habitat Trend
Forest Cover	The 2021 tree canopy cover data shows that only 54 watersheds (about 46% of the land area) are in healthy or good condition. Many of the watersheds in poor condition were around the high population areas of Aberdeen and twin cities of Chehalis and Centralia. Overall, between 2011 and 2021, there was a slight increase in forest cover. The highest increase of 11.3% was in the Middle Wynoochee River watershed, while the highest decrease of 10.2% was in the headwaters of the Chehalis River.	**Declining**
Barrier Culverts	There are 3,055 barrier culverts in the Quinault Area of Interest. Private ownership accounts for 1,383 (or 45.3%) of the culverts while 952 (or 31.2 %) are owned by various counties. Washington state, cities and the federal government own 271 (8.9 %), 178 (5.8%) and 150 (4.9%) culverts, respectively.	**Declining**
Road Density / Crossings	Road density values were over 3 miles/square mile in virtually all watersheds outside the Olympic National Park, where the values were generally less than 1 mile/square mile. Between 2016 and 2024, about 36% of the watersheds in the area had increases of over 1 mile/square mile, showing that the road density conditions may be getting worse. The density of stream crossings over roads were generally highest with values of over 3 per mile of river in the upper reaches of the Chehalis River, Skookumchuck River and Stillman Creek.	**Declining**
Stream Flows	For the past 90 years, the peak flows continue to have an increasing trend for both the Queets and Chehalis Rrivers, while the low flows are decreasing in the Queets river and are slightly increasing in the Chehalis River.	**Concerns**
Water Quality	There are 270 current water quality impairment listings across 609.4 miles for waters whose beneficial uses are impaired by four of the most common pollutants—water temperature, dissolved oxygen, pH and fecal coliform bacteria. The number of listings represents a 15.9% decrease from the 2012 assessment. Water temperature, the most common pollutant, has 138 listings, representing a 17.9% decrease from the 2012 assessment.	**Concerns**
Water Quality - 6PPD-q Impacts	A preservative in car tires known as 6PPD has been identified as the toxic chemical responsible for the mortality of Coho salmon returning to spawn in streams and rivers. Watersheds around Aberdeen and in the Upper Black River just south of the greater Olympia area had the highest risk vulnerability scores for 6PPD exposure and are most likely to be impacted by these tire contaminants.	**Concerns**
Wells	Currently, there are 13,677 water wells which may affect groundwater supply and instream flows in the Quinault Area of Interest. Between 1980 and 2019, 12,588 wells were completed in the area at a rate of about 323 wells per year. Since 2020, 1,089 wells were added at a rate of about 218 new wells per year. This represents a lower rate of new wells in the last five years. Also, in each year, there was a slightly lower number of wells than in the previous one. It remains critical to look at the cumulative impacts of both total volume consumption and timing of flows to determine impacts of permit-exempt wells.	**Concerns**
Invasive Species - Green Crab	The proliferation of European green crab (*Carcinus maenas*) is fast becoming an urgent threat to the coastal ecosystem in the Quinault Area of Interest. Between 2022 and 2024, almost 240,000 European green crabs were caught in Grays Harbor by various stakeholders, with numbers increasing from about 24,000 in 2022 to almost 130,000 in 2024.	**Declining**
Ocean Conditions	The marine Areas of Interest for the Quinault Indian Nation have been heavily impacted by ocean warming, including marine heatwaves (MHW), hypoxia, and harmful algal blooms (HABs). Domoic acid concentrations from the HABs were high enough to close fisheries in 2021 and 2023. Summertime hypoxia has caused fish kills with hundreds of dead fish washing up on the beaches.	**Concerns**
Retreat of Glaciers	Higher temperatures from human-driven climate change are causing a rapid retreat of glaciers that feed many rivers in the Quinault Area of Interest. The Anderson Glacier which fed the Quinault River has disappeared. Other receding glaciers that feed the Quinault include the Linsleys, White and Christie while those that feed the Queets River include the Queets, Humes and Jeffers. The result is less fish habitat, higher stream temperatures, and greater sediment load.	**Declining**

The Quinault Indian Nation continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

As we look ahead over the next five years, the Quinault Indian Nation faces significant challenges in protecting and restoring the health of our lands, waters and salmon populations. Habitat degradation remains a primary concern, driven by land-use pressures, climate change and emerging environmental threats.

Salmon populations, which are central to Quinault culture and livelihood, continue to be impacted by declining habitat quality, increasing water temperatures, and pollution. The toxic chemical 6PPD-quinone, a byproduct of vehicle tire wear, has been found to be highly lethal to Coho salmon, further exacerbating mortality rates in our waters. Additionally, the potential ESA listing of Spring-run Chinook salmon underscores the urgency of strengthening conservation measures to prevent further population declines.

The rapid increase of invasive European Green crab populations threatens the balance of our nearshore ecosystems, endangering native species and the sustainability of our fisheries. Marine Areas of Interest for the Quinault Indian Nation have also been heavily impacted by ocean warming, including marine heatwaves, hypoxia, and harmful algal blooms, which have led to mass fish die-offs along our beaches. These climate-driven events further threaten the stability of our marine resources and the communities that rely on them.

Additionally, ongoing habitat fragmentation from barrier culverts, high road densities, forest loss and groundwater depletion continues to degrade vital salmon habitats. While restoration projects like the Chehalis Basin Strategy's Aquatic Species Restoration Plan (ww) provide opportunities for habitat improvement within Quinault's U&A, long-term success will require sustained funding, landowner participation, and regulatory reforms to prevent further habitat degradation.

Moving forward, the Quinault Indian Nation will continue to advocate for stronger habitat protections, invest in restoration efforts, and push for meaningful action to address these growing threats to our resources and way of life. This commitment extents throughout the entirety of all of our watersheds both, on and off the reservation, reflecting our responsibility to care for all the lands and waters that sustain us.

Forest Cover Conditions Decline

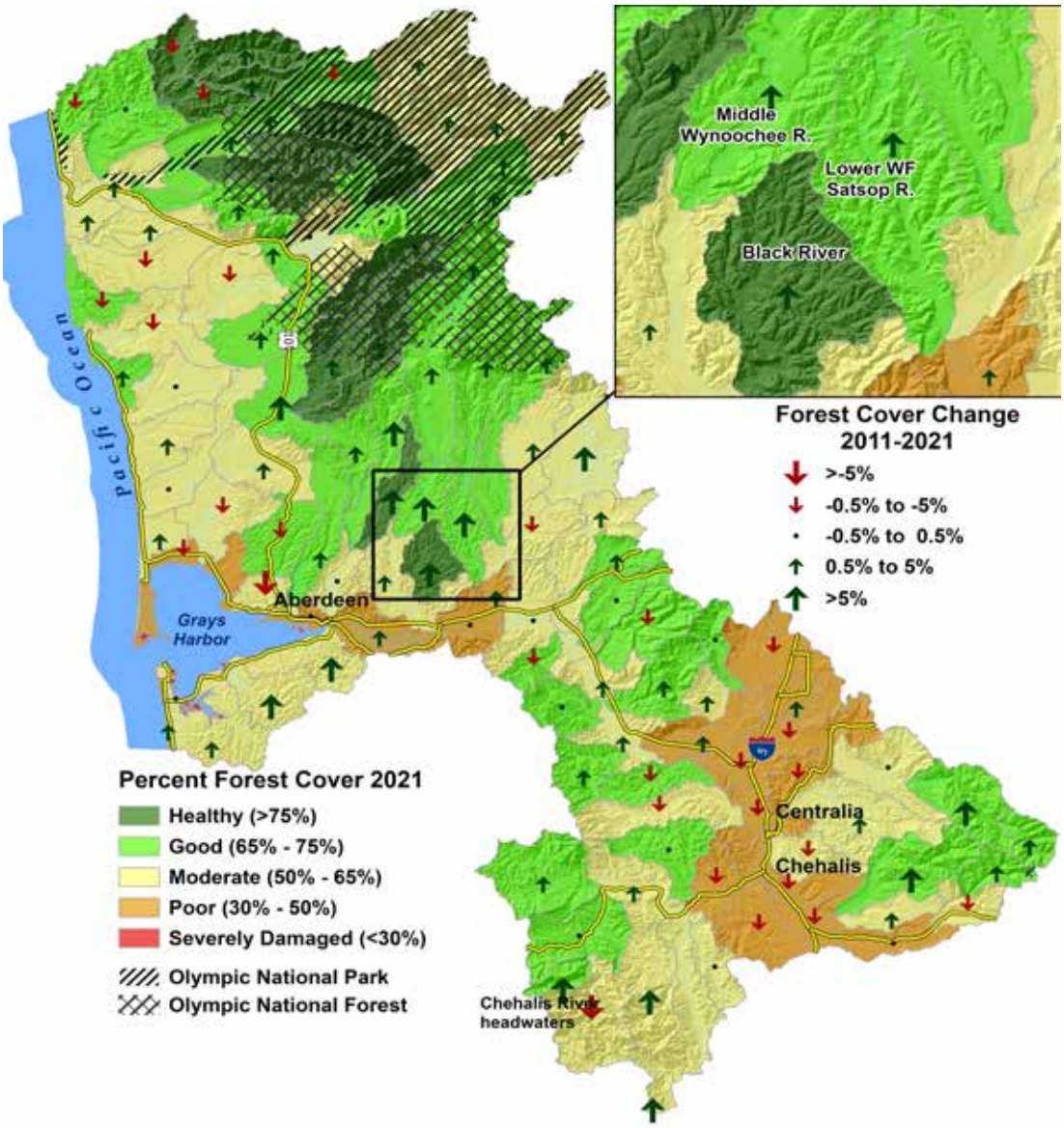
The 2021 tree canopy cover data shows that only 54 watersheds (about 46% of the land area) are in healthy or good condition. Many of the watersheds in poor condition were around the high population areas of Aberdeen and twin cities of Chehalis and Centralia. Overall, between 2011 and 2021, there was a slight increase in forest cover. The highest increase of 11.3% was in the Middle Wynoochee River watershed, while the highest decrease of 10.2% was in the headwaters of the Chehalis River.

The health and survival of salmon in rivers and streams are closely tied to the health of the forests that surround them. Forests provide many ecological benefits. They provide the shade that creates cooler water temperatures, which in turn store more critically needed dissolved oxygen. Trees help create complex habitats for salmon to spawn, grow and rear. In addition, they stabilize stream banks and provide valuable habitat for other species that are important for salmon survival. A decrease in forest cover negatively alters salmon habitat by increasing peak flow and water yield from a watershed, increasing sediment supply, reducing wood recruitment, decreasing water quality, and raising water temperatures.[1,2]

The extensive loss of riparian vegetation (coupled with the conversion of conifer to hardwoods) mainly from agriculture and urbanization has been identified as a factor limiting the production of salmonids in the basin.[3] The Chehalis Basin Habitat Restoration and Preservation Strategy[4] adopted the restoration and preservation of properly functioning riparian areas as an important strategy for addressing this limiting factor.

The Quinault Area of Interest includes parts of the Olympic National Forest, Olympic National Park, and Capitol State Forest which are not typically subject to the commercial and recreational activities that can affect the productivity of salmonid habitats. Even then, the 2021 tree canopy cover data shows that only 54 watersheds (about 46% of the land area) are in healthy or good condition. Outside of the Olympic National Forest and Olympic National Park, the number of watersheds in healthy or good condition drops to 49 (or 40% of the land area). Many of the watersheds in poor condition were around the high population areas of Aberdeen and twin cities of Chehalis and Centralia along the Interstate 5 corridor.

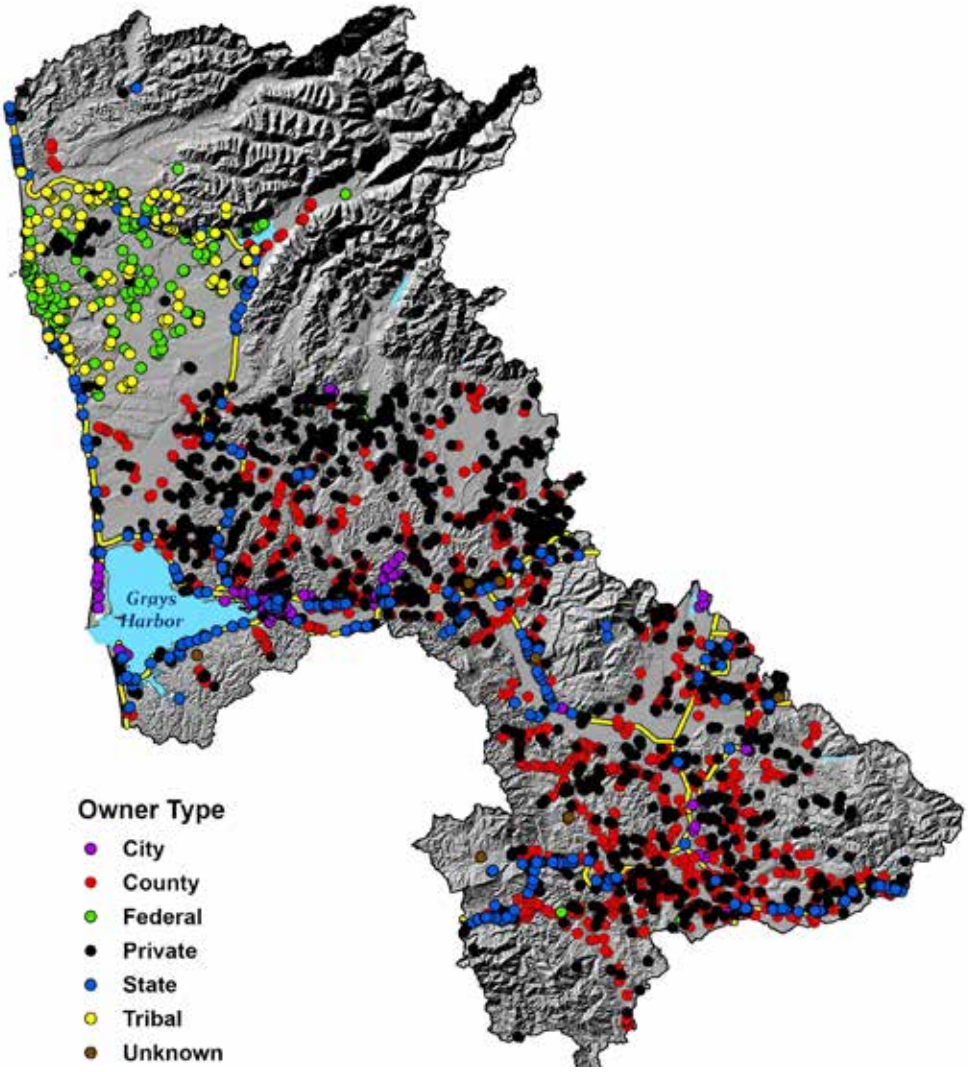
In the decade between 2011 and 2021, some watersheds had increases while others had reductions in forest cover. The highest increases of 11.3%, 13.1% and 15.1% were in the Middle Wynoochee River, Lower West Fork Satsop River and Black Creek watersheds, respectively, while the highest decrease of 10.2% was in the headwaters of the Chehalis River. Overall, there was a slight increase in forest cover during that period, which may be an indication that improvements in land use and timber harvest practices may be having a positive impact.

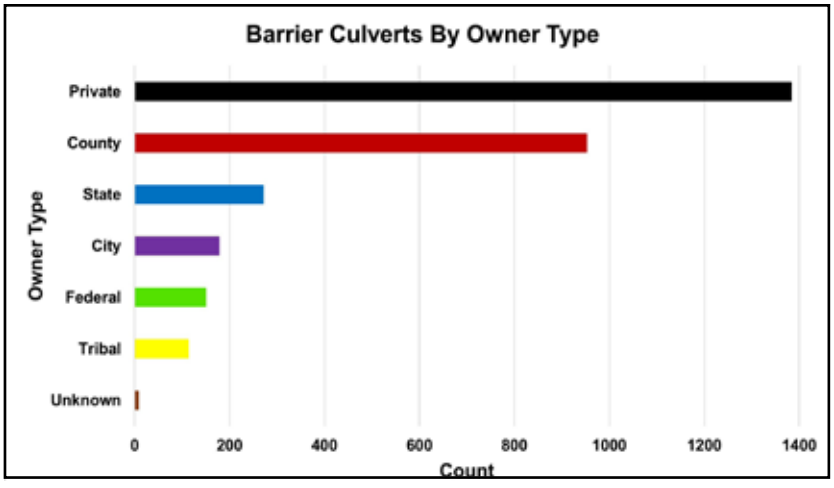


Map Data Sources: SSHIAP 2004[5], USGS 2014[6], USDA 2023a[7], USDA 2023b[8], WAECY 2018[9]

Culverts Remain Impediments to Fish Passage

There are 3,055 barrier culverts in the Quinault Area of Interest. Private ownership accounts for 1,383 (or 45.3%) of the culverts while 952 (or 31.2 %) are owned by various counties. Washington state, cities and the federal government own 271 (8.9 %), 178 (5.8%) and 150 (4.9%) culverts, respectively.





Culverts contribute to declines in salmon runs by impeding or blocking fish passage. They prevent the fish from reaching their spawning grounds and the young cannot migrate to sea. The ability of salmon to reach their spawning grounds is vital to their recovery.

The analysis of the impact of barrier culverts in the 2020 State of Our Watersheds report for the Quinault Area of Interest included data from the Road Maintenance and Abandonment Plan (RMAP)[1], a process developed as part of the Forest and Fish Rules in 2001. While the schedule for repairs needed to initially upgrade road systems at stream crossings and address aquatic habitat and fish passage issues under that plan is largely complete, the work on RMAP will continue as maintenance issues will need to be addressed as they arise. This report uses data from the Washington Department of Fish and Wildlife fish barriers database.

The Quinault Tribe was among the 21 treaty tribes, joined by the United States, that won the Culverts Case. The courts determined that Washington state had a duty under the treaties to fix state-owned culverts that were barriers to fish passage. Some of those culverts have been replaced by passable structures but others are still barriers to fish. The state is under a court injunction to replace those culverts with the worst impacts on fish habitat by 2030.

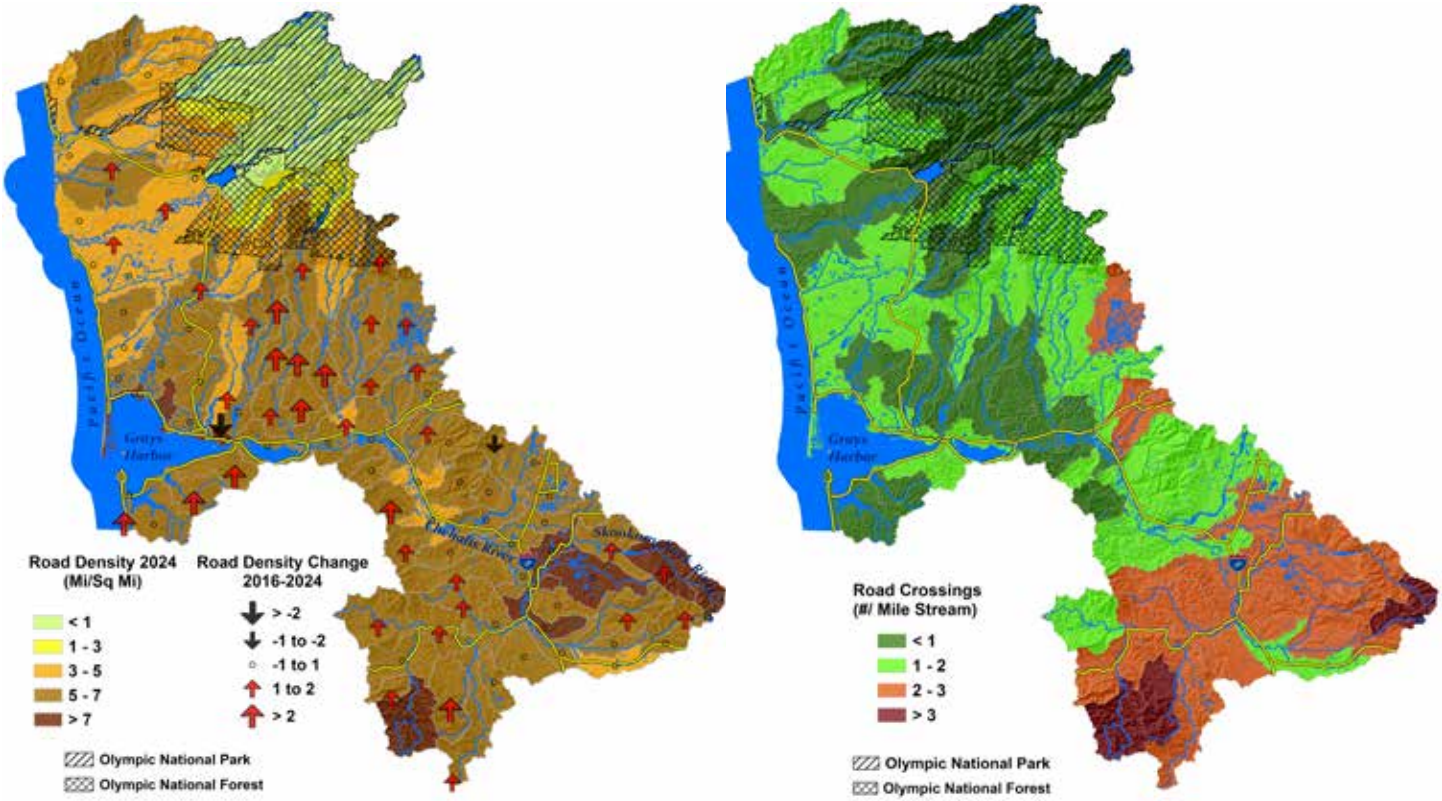
Currently, there are a total of 3,055 barrier culverts that are owned by the state, the county, as well as private corporations and individuals in the Quinault Area of Interest. There are 3,055 barrier culverts in the Quinault Area of Interest. Private ownership accounts for 1,383 (or 45.3%) of the culverts while 952 (or 31.2 %) are owned by various counties. Washington state, cities and the federal government own 271 (8.9 %), 178 (5.8%) and 150 (4.9%) culverts, respectively. About 4% of barrier culverts fall outside of these ownerships.

Over two-thirds of the barrier culverts are owned by small landowners and local governments who are going to need significant resources to remove these impediments to fish passage and improve fish habitat.

Map Data Sources: SSHIAP 2004[2], WADFW 2025[3], WADOT 2018[4], WAECY 2018[5]

Roads Continue to Impact Watersheds

Road density values were over 3 miles/square mile in virtually all watersheds outside the Olympic National Park, where the values were generally less than 1 mile/square mile. Between 2016 and 2024, about 36% of the watersheds in the area had increases of over 1 mile/square mile, showing that the road density conditions may be getting worse. The density of stream crossings over roads were generally highest with values of over 3 per mile of river in the upper reaches of the Chehalis River, Skookumchuck River and Stillman Creek.



Roads, particularly in the heavily forested areas of the Quinault Area of Interest, are crucial for managing and protecting those forests by providing access for timber harvesting, hunting, fishing, fire control and environmental management.

However, roads can exert a wide range of ecological effects on stream ecosystems. By contributing to increased imperviousness, roads indirectly bring about increased levels of erosion in watersheds,[1] leading to alterations to hydrological patterns, mass wasting, increased sediment delivery to streams and degradation of water quality. Elevated fine sediment levels, identified as a limiting factor by the Chehalis Basin Salmon Habitat Restoration and Preservation Strategy,[2] decrease the quality of spawning gravels.

Current road density values are over 3 miles/square mile in virtually all watersheds outside the Olympic National Park, where the values were generally less than 1 mile/square mile. In the Olympic National Forest, road density values are between 1-2 miles/square mile.

Between 2016 and 2024, about 36% of the watersheds in the area had increases of over 1 mile/square mile, showing that the road density conditions may be getting worse. Less than 2% of the watersheds had reductions in road density.

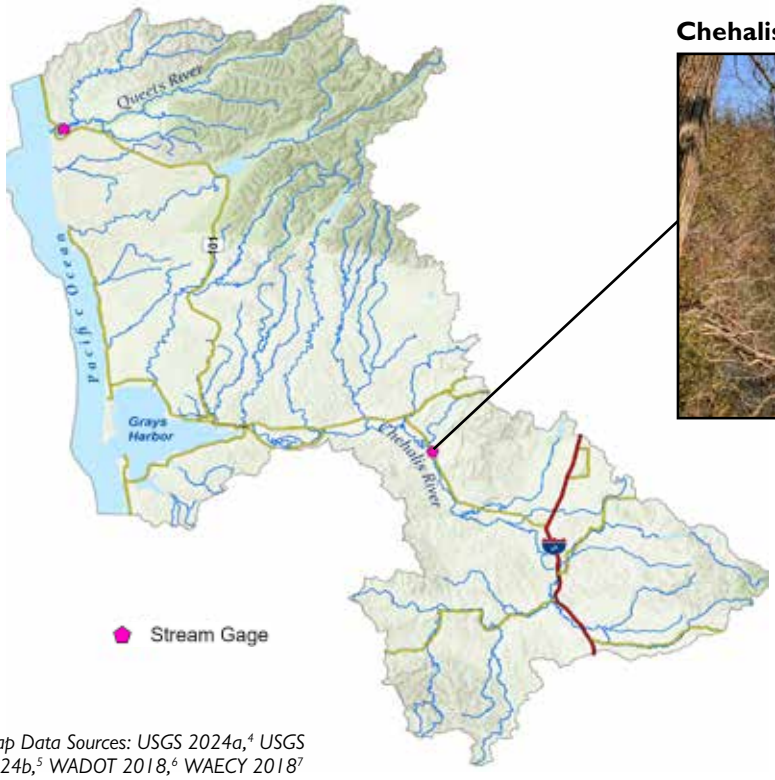
Several studies have correlated road density or indices of roads to fish density or measures of fish diversity.[3] Cederholm et al.[4] found increases in fine sediment in fish spawning habitat when road density exceeded 2.5% of the Clearwater watershed. The proper functioning of salmon bearing streams may be at risk when road densities exceed 2 miles of road per square mile of area and cease to function properly at densities over 3 miles per square mile.[5] About 88% of watersheds in the Quinault Area of Interest had road densities that exceeded this value.

Stream crossings by roads and other man-made structures can directly impact stream ecosystems, by altering stream hydrology and geomorphology. Since every intersection of a fish-bearing stream with a road is a potential culvert location, stream crossings also represent potential places with barriers to fish passage. Stream crossings were generally highest with values of over 3 per mile of river in the upper reaches of the Chehalis River, Skookumchuck River and Stillman Creek. They were lowest in watersheds in and around the Olympic National Park.

Map Data Sources: SSHIAP 2004[6], USGS 2014[7], WADNR 2019[8], WADNR 2024[9], WAECY 2024[10]

Streamflow Conditions and Patterns

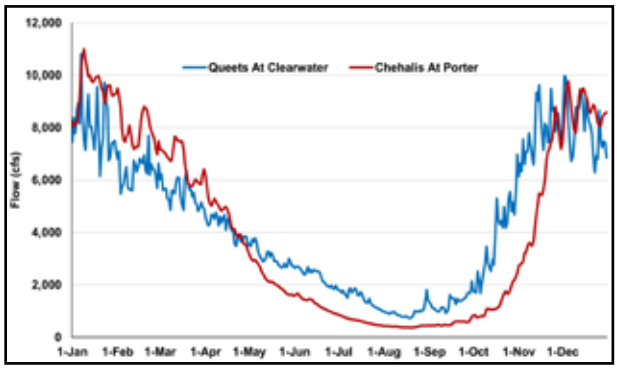
The variation and timing of mean streamflows in the Queets River near Clearwater and the Chehalis River at Porter show a similar pattern of peak flows in the winter months and low flows in the summer months. However, while the winter peak flow values were similar for both rivers, the summer low flows were consistently lower for the Chehalis, which can negatively impact fish habitat.



Map Data Sources: USGS 2024a,[4] USGS 2024b,[5] WADOT 2018,[6] WAECY 2018[7]

Chehalis River in Porter, Wash.

Chehalis Land Trust

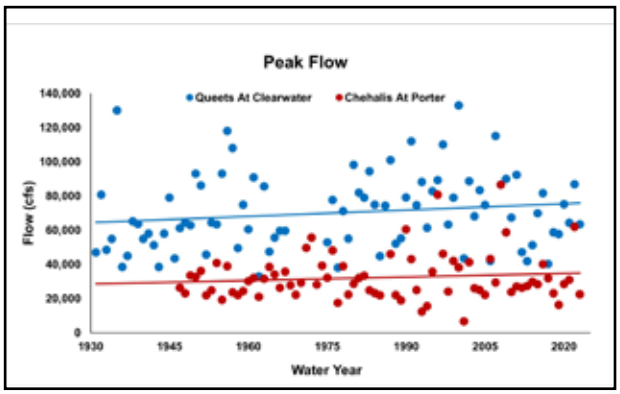


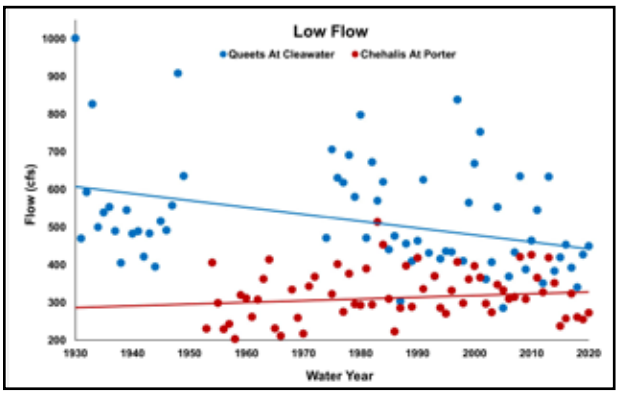
Streamflows are important for many reasons, including maintaining healthy ecosystems that provide food and habitat for fish.

The variation and timing of average streamflows plotted for the Queets River near Clearwater and the Chehalis River at Porter show a similar pattern of peak flows in the winter months and low flows in the summer months. However, while the winter peak flow values were similar for both rivers, the summer low flows were consistently lower for the Chehalis. In addition to being consistent for rain-dominant basins, the lower summer flows in the Chehalis may have been made worse by diversions for irrigation and domestic use, as well as groundwater withdrawals which typically increase in the drier and warmer summer months. Low streamflows have been identified as a factor limiting salmonid production in the Chehalis.[1]

Peak flows in the glacier-fed Queets River have shown an increasing trend over time while mean low flows have declined. This indicates that during periods of lowest flow, the river is now carrying less water than before. In contrast, both peak and mean low flows in the Chehalis River have increased, meaning that in the days of lowest flows, the river is now transporting more water than before.

These altered streamflows will likely negatively impact fish habitat and reduce the reproductive success of salmon populations.[2] In addition, increasing stream temperatures from climate change are likely to further limit suitable summer rearing conditions for juvenile salmon and steelhead.[3]





Water Quality Listings Decrease, Impairments Remain

There are 270 current water quality impairment listings across 609.4 miles for waters whose beneficial uses are impaired by four of the most common pollutants—water temperature, dissolved oxygen, pH and fecal coliform bacteria. The number of listings represents a 15.9% decrease from the 2012 assessment. Water temperature, the most common pollutant, has 138 listings, representing a 17.9% decrease from the 2012 assessment.

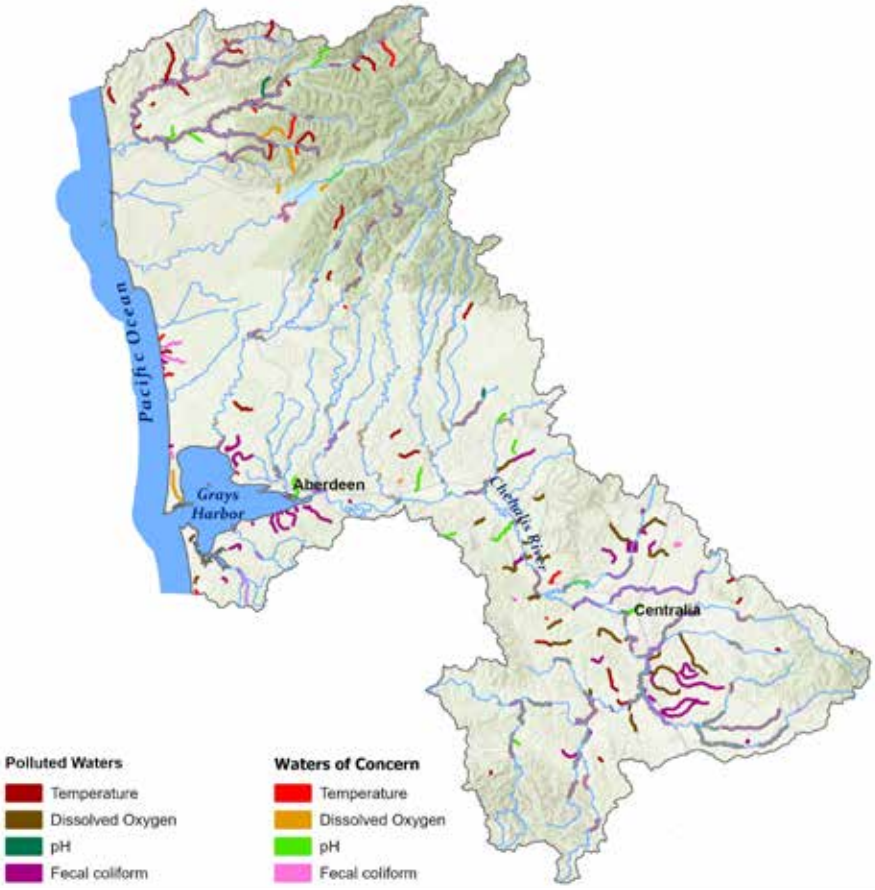
Water quality impairments caused by elevated water temperatures, low levels of dissolved oxygen, and the presence of other pollutants such as harmful bacteria can negatively impact the ability of these waters to provide habitat for fish and other aquatic life and sustain salmonid populations.[1,2]

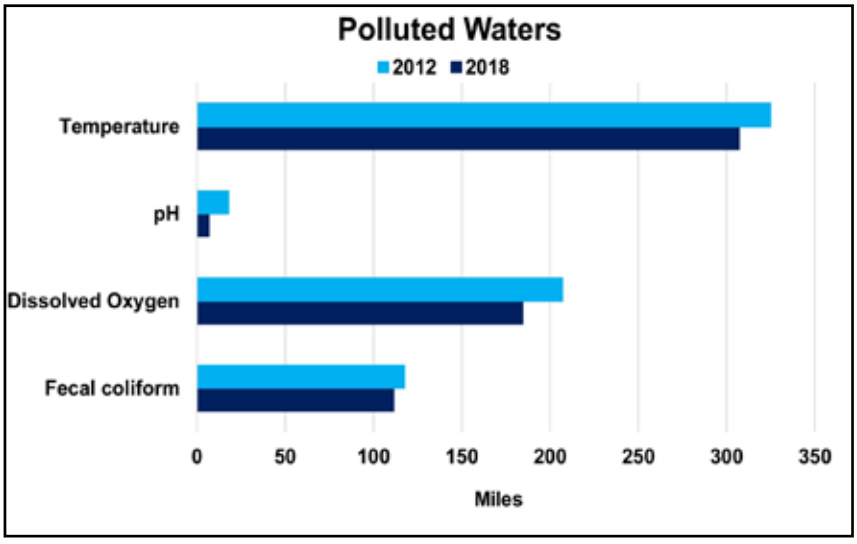
The 2018 water quality assessment by the Washington Department of Ecology to list water bodies that do not meet water quality standards was not finalized until 2022. This current assessment replaces the previous assessment of water quality health under the Clean Water Act and impaired water bodies are placed on the so-called "303(d)" list for future actions to reduce pollution.

In the Quinault Area of Interest, there are 270 current listings with a total of 609.4 miles for waters whose beneficial uses are impaired by four of the most common pollutants—water temperature, dissolved oxygen, pH and fecal coliform bacteria. The number of listings represents a 15.9% decrease from the 2012 assessment. Water temperature, the most common pollutant, has 138 listings, representing a 17.9% decrease from the 2012 assessment. The number of listings for fecal coliform, dissolved oxygen and pH all decreased slightly from the 2012 assessment. While there are many reasons why listings have decreased, it is not clear if this is a trend.

The main stem Chehalis River remains the single most polluted waterbody in the area with 41 listings and a total length of 81.5 miles impaired by water temperature, dissolved oxygen, pH and fecal coliform bacteria.

In addition to waters that are impaired, there are also waters of concern for which there is evidence of a water quality problem but one that is not persistent enough to be placed in the polluted category. In the current assessment, there are 173 listings for such waterbodies for water temperature, dissolved oxygen, pH and fecal coliform bacteria with a total length of 332.7 miles.





Map Data Sources: WAECY 2022a[3], WAECY 2022b[4], WAECY 2018[5]

Tire Contaminants Pose a Threat to Salmon

A preservative in car tires known as 6PPD has been identified as the toxic chemical responsible for the mortality of Coho salmon returning to spawn in streams and rivers. Watersheds around Aberdeen and in the Upper Black River just south of the greater Olympia area had the highest risk vulnerability scores for 6PPD exposure and are most likely to be impacted by these tire contaminants.

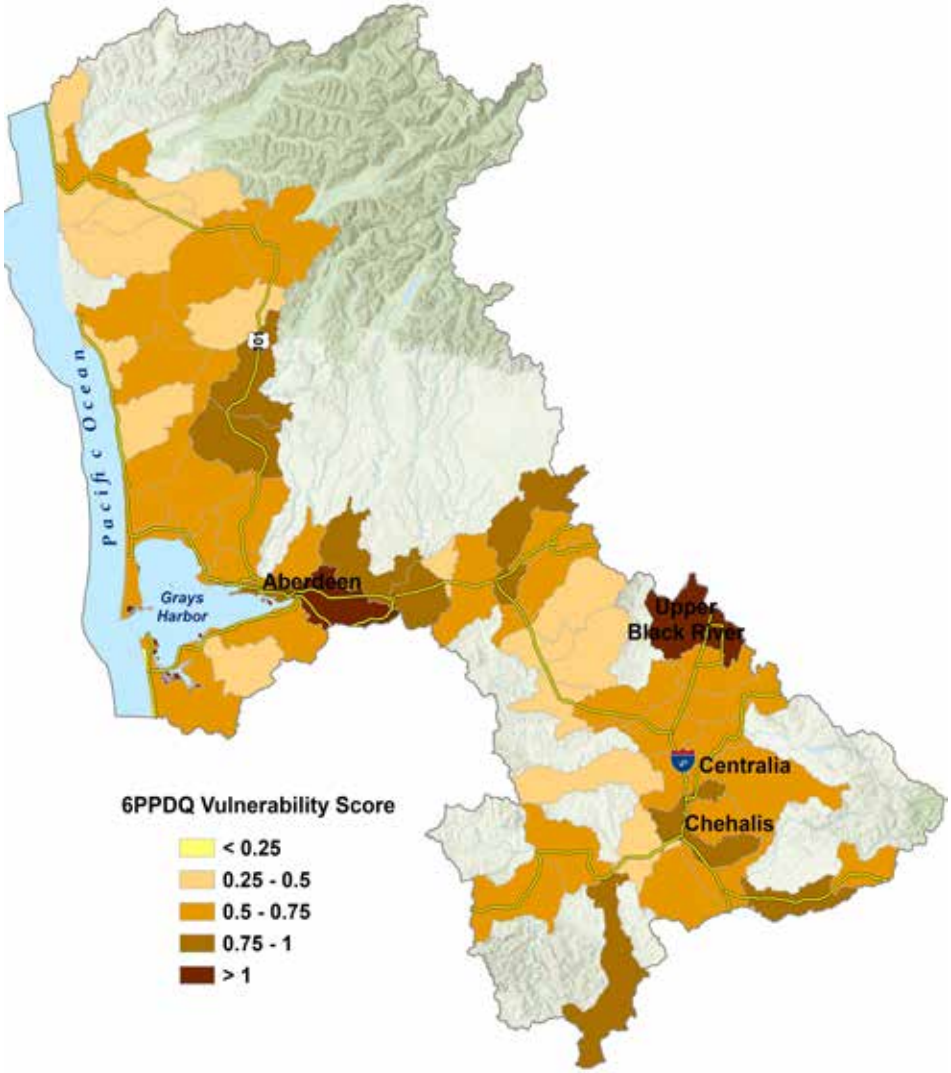
For a long time, scientists wondered why half or more of the Coho salmon (*Oncorhynchus kisutch*) returning to spawn in Puget Sound streams and rivers were dying before they could lay their eggs. In 2020,[1] a group of scientists finally figured out the culprit. When it rains, stormwater carries fragments of old automotive tires into nearby creeks and streams. Those tire fragments contain 6PPD, a chemical preservative that prevents automotive tires from breaking down too quickly and helps them last longer. When 6PPD is exposed to air, it reacts with ozone to create 6PPD-quinone (also known as 6PPDQ) which causes salmon mortality.

This toxic chemical is not limited to the Puget Sound region. 6PPD appears to be used in all tires and tire wear particles are likely present in creeks near busy roads.

The Washington Department of Ecology[2] carried out an online mapping effort to identify vulnerable watersheds for monitoring studies and site evaluations. Transportation, watershed and ecosystem characteristics were considered indicators of 6PPD vulnerability and exposure risk.

In the Quinault Area of Interest, the biological risk vulnerability scores derived from Ecology's mapping effort show higher values in 12-digit Hydrologic Unit Code (HUC) polygons near Aberdeen, the Upper Black River watershed just south of the greater Olympia area. Other areas of note are along the Interstate 5 corridor near Chehalis and Centralia. This shows that watersheds in those areas had higher vulnerability to 6PPDQ exposure because of higher traffic and/or urbanization near salmon habitats. Many of the watersheds in the area are still low risk because of lower traffic, less urbanization, and lower impervious surface values.

Efforts must be made to reduce the threat to salmon caused by 6PPDQ. These include treating stormwater before it enters the streams and rivers, as well as making tires "salmon-safe" by finding an alternative to 6PPD.



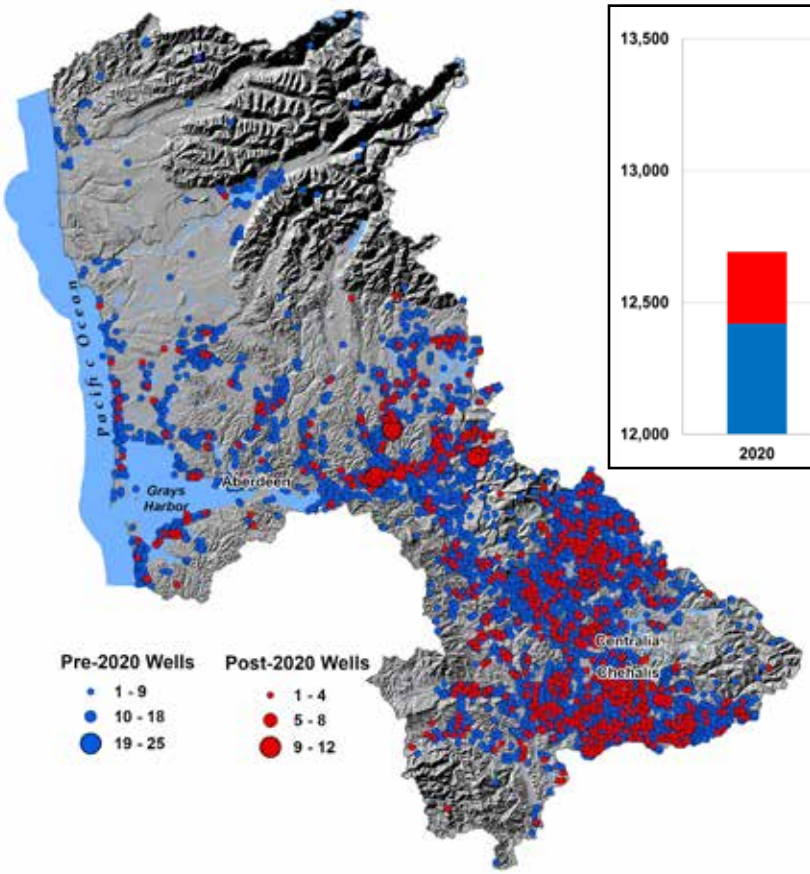
Roger Tabor, USFWS

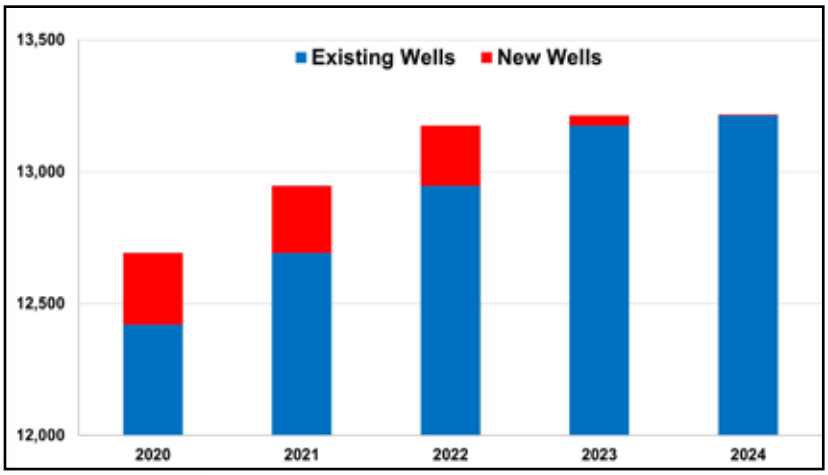
Coho salmon

Map Data Sources: WAECY 2024[2], USGS 2014[3], WADOT 2018[4]

The Rate of New Water Wells May Be Slowing

Currently, there are 13,677 water wells which may affect groundwater supply and instream flows in the Quinault Area of Interest. Between 1980 and 2019, 12,588 wells were completed in the area at a rate of about 323 wells per year. Since 2020, 1,089 wells were added at a rate of about 218 new wells per year. This represents a lower rate of new wells in the last five years. Also, in each year, there was a slightly lower number of wells than in the previous one. It remains critical to look at the cumulative impacts of both total volume consumption and timing of flows to determine impacts of permit-exempt wells.





Water wells are a source of water for many landowners. Although each well withdraws a relatively small amount of water, their cumulative impact can be significant and affect water quality, salmonid habitat and instream flows. The Chehalis Basin Salmon Habitat Restoration and Preservation Strategy[1] identified low summertime flows in some subbasins as a problem. An earlier assessment[2] found that in many streams and rivers, minimum stream flows are not met on many days from July through October. Because very little water is used for agriculture or urban purposes in the Queets-Quinault Basin, water withdrawal impacts there are expected to be low.[3]

Currently, there are 13,677 wells in the Quinault Area of Interest. The majority of wells are in the higher population areas around Aberdeen, Centralia, Chehalis and the I-5 corridor as well as in the agriculture areas, particularly in the upper Chehalis basin. Between 1980 and 2019, 12,588 wells were completed in the Quinault Area of Interest at a rate of about 323 wells per year. Between 2020 and 2024, an additional 1,089 wells were added at a rate of about 218 new wells per year. This represents a lower rate of new wells in the last five years. Also, in each year, there was a slightly lower number of wells than in the previous one.

In January 2018, the Washington State Legislature passed a law codified as Chapter 90.94 RCW that is intended to restore stream flows to levels necessary to support robust, healthy and sustainable salmon populations while providing water for homes in rural Washington. The law directs local planning groups to develop watershed plans that offset impacts from new domestic permit-exempt wells and achieve a net ecological benefit within the watershed.[4] The law was in response to the Hirst decision, a ruling made by the Washington State Supreme Court in October 2016 that limited a landowner's ability to get a building permit for a new home when the proposed source of water was a permit-exempt well.[5]

To comply with the 2018 state law, an Addendum[6] to the Chehalis Basin Watershed Management Plan was approved by the Chehalis Basin Partnership. The Addendum projected 4,555 new domestic permit-exempt wells from 2018 to 2040 in the Chehalis watershed. It also estimated the annual impact of these wells on rivers and streams at 504.8 acre-feet—equivalent to roughly 250 Olympic-sized swimming pools. While the rate of new well installations has been slower than anticipated, resulting in a reduced pace of associated water use impacts, it remains critical to consider not only the total volume of water withdrawn but also the timing of those withdrawals. With climate change expected to further reduce summer streamflows, the cumulative impact of new wells on already low summer flows warrants careful attention.

Map Data Sources: WAECY 2024[7]

Invasive European Green Crab Are an Urgent Threat

*The proliferation of European green crab (*Carcinus maenas*) is fast becoming an urgent threat to the coastal ecosystem in the Quinault Area of Interest. Between 2022 and 2024, almost 240,000 European green crabs were caught in Grays Harbor by various stakeholders, with numbers increasing from about 24,000 in 2022 to almost 130,000 in 2024.*

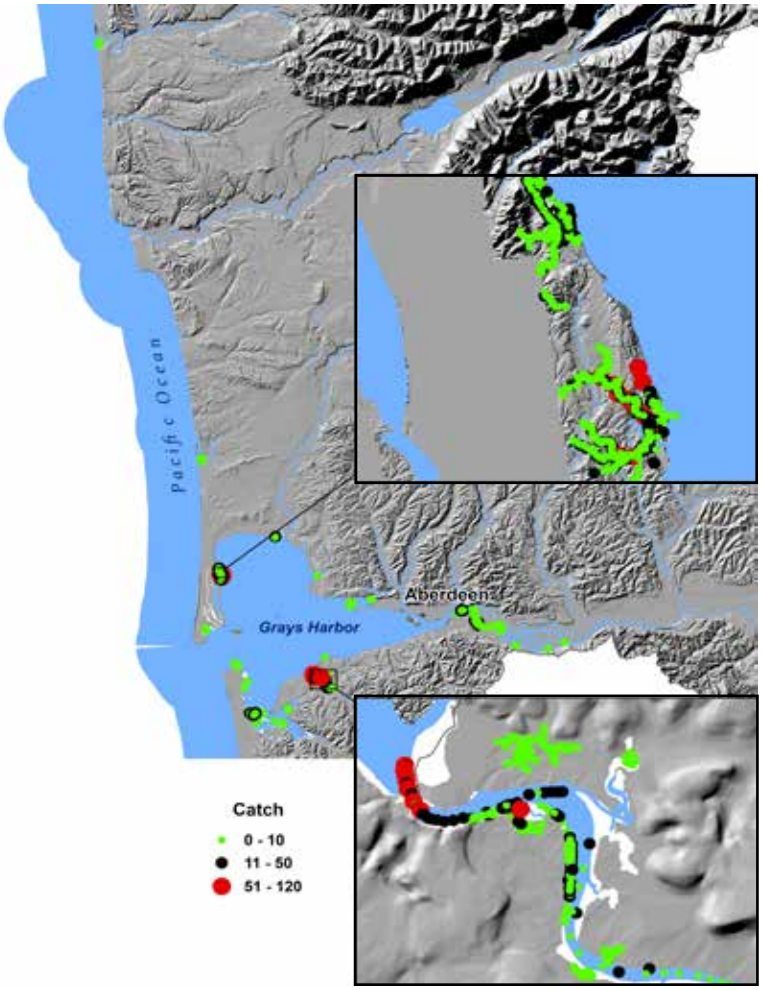
The proliferation of European green crab (*Carcinus maenas*) is fast becoming an urgent threat to the coastal ecosystem in the Quinault Area of Interest. These small, aggressive and voracious intertidal crabs are considered one of the world's worst invasive species. They prey on native species and are a threat to native shellfish, eelgrass beds and estuary habitat critical for salmon and many other species.

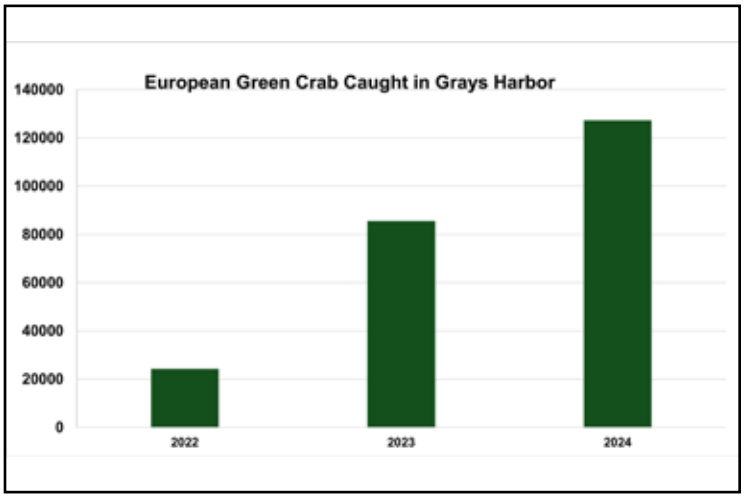
The conditions in Grays Harbor and the Pacific coastline are allowing the crab to form self-sustaining populations. They occupy what would otherwise be Dungeness crab (*Cancer magister*) habitat, and this treaty-protected species has been shown to suffer high mortality rates due to green crab predation.[1,2] As a result, if not controlled, European green crabs have the potential to severely impact or even wipe out the Dungeness crab fishery which is culturally and economically important to the Quinault Indian Nation.

In response to the increasing threat posed by European green crab, the Quinault Tribal Council has declared a state of emergency for Grays Harbor and the adjacent coast. The Nation has been trapping and removing crabs from various locations in the Area of Interest.

Between 2022 and 2024, almost 240,000 European green crabs were caught in Grays Harbor by various stakeholders, with numbers increasing from about 24,000 in 2022 to almost 130,000 in 2024. Although these are raw numbers that do not take into account the level of effort deployed to catch the crabs, the numbers indicate that this may be a growing problem.

The Washington Department of Fish and Wildlife (WDFW) responded to this emergency declaration by initiating government-to-government discussions between the Nation and WDFW to determine how best to address this threat. The state co-manager also offered technical assistance and staff resources for Quinault's control efforts and is aggressively seeking federal appropriations to tackle the European green crab problem.





Trevor Pyle, NWIFC

A European green crab trapped at the Quinault Marina.

Map Data Sources: SSHIAP 2004[3], WDFW 2024[4]

Marine Areas Continue to Be Negatively Impacted

The marine areas of interest for the Quinault Indian Nation have been heavily impacted by ocean warming, including marine heatwaves (MHW), hypoxia, and harmful algal blooms (HABs). Domoic acid concentrations from the HABs were high enough to close fisheries in 2021 and 2023. Summertime hypoxia has caused fish kills with hundreds of dead fish washing up on the beaches.

Jenny Waddell, NOAA

Massive die-off of Dungeness crabs on Kalaloch Beach on June 14, 2022.

The marine areas of the Quinault Indian Nation have been heavily impacted by ocean warming, including marine heatwaves (MHW), hypoxia, and harmful algal blooms (HABs). In recent years, the California Current System (CCS) has experienced nearly annual Marine Heat Waves (MHWs). None of these MHWs were as intense as the 2014-2026 MHW ("the Blob"), but they have had the potential to impact fisheries off the West Coast. On a broader scale, the region has also experienced a 3-year La Niña, followed by a 1 year El Niño. During La Niña conditions, winds and ocean circulation in the central Pacific weaken, resulting in cooler marine conditions on the West Coast that are typically favorable for salmon. During an El Niño, the opposite occurs and warmer, subtropical waters intrude up the West Coast.

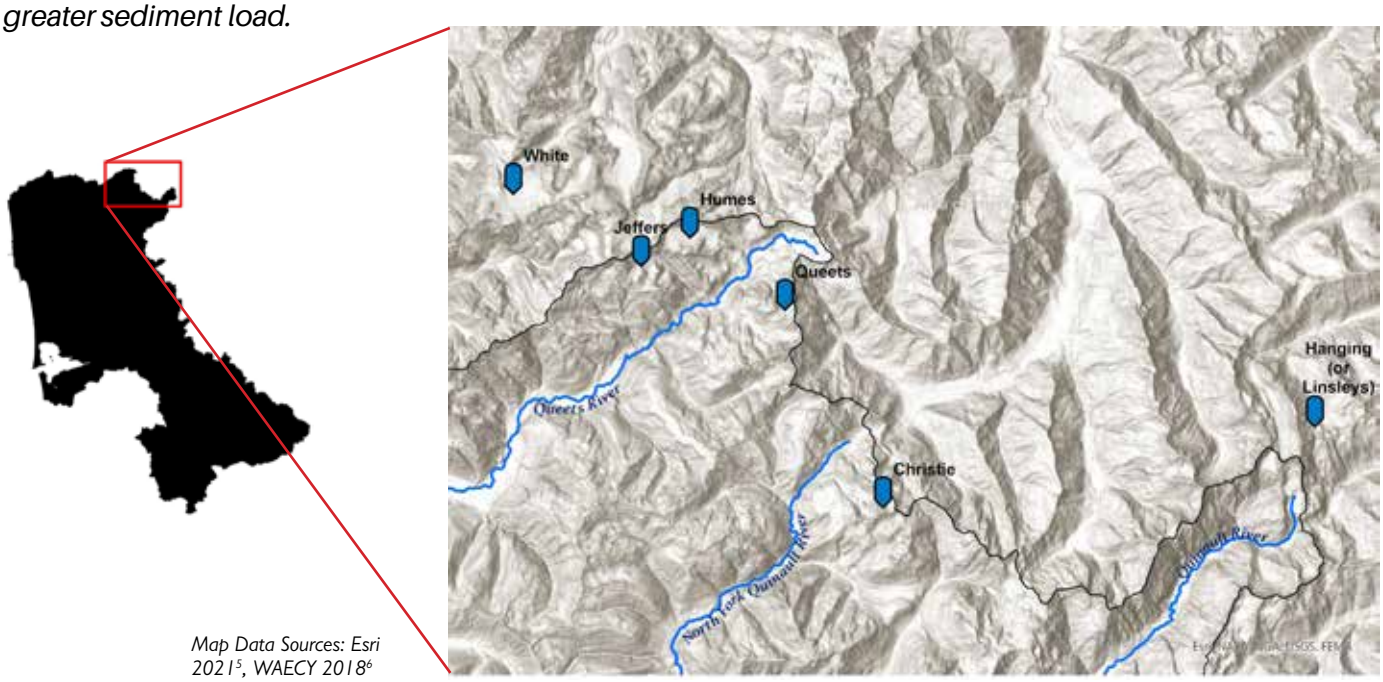
Beaches in the Quinault Area of Interest have also experienced frequent harmful algal blooms, with domoic acid concentrations high enough to close fisheries in 2021 and 2023. Some studies[1,2] have found that HABs in the CCS tend to occur when southward winds drive upwelling of nutrient rich waters, followed by northward winds that drive downwelling and push these waters (and the phytoplankton bloom that can accompany them) onshore.

Additionally, summertime hypoxia has been a growing concern on the Washington continental shelf, with the most severe conditions occurring between Grays Harbor and La Push. Seasonal moorings deployed by the Olympic Coast National Marine Sanctuary since 2006 have documented the increasing severity and duration of hypoxic conditions in the Quinault Area of Interest, with hypoxic conditions being in place in waters greater than 40 meters depths for the entire summer in some years. As a result, numerous fish kills have occurred within the Quinault Area of Interest, with hundreds of dead fish washing up on the beaches. These fish kills are likely caused by mixing and shoreward transport of deeper, hypoxic waters which trap fish and suffocate them.

Adverse marine conditions have caused the Quinault Indian Nation to close their Dungeness Crab fishery early due to severe hypoxia and crabs with low meat content have delayed the opening of the fishery.

Glaciers Continue to Rapidly Retreat

Higher temperatures from by human-driven climate change are causing a rapid retreat of glaciers that feed many rivers in the Quinault Area of Interest. The Anderson Glacier, which fed the Quinault River, has disappeared. Other receding glaciers that feed the Quinault include the Linsleys, White and Christie while those that feed the Queets River include the Queets, Humes and Jeffers. The result is less fish habitat, higher stream temperatures and greater sediment load.



Map Data Sources: Esri 2021[5], WAECY 2018[6]

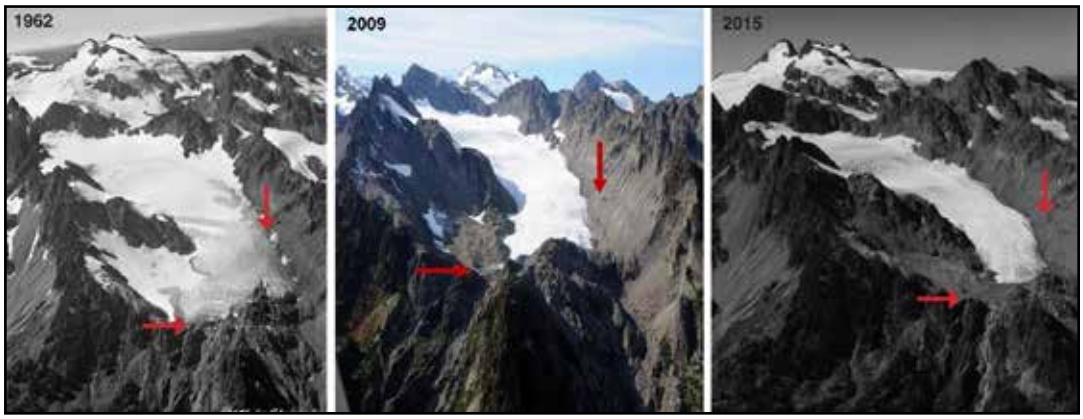
Glaciers in the Olympic National Park act as water storage in the winter that is gradually released in the spring and summer. However, increases in temperature from anthropogenic climate change is making these glaciers store less water because they are getting thinner and smaller in length. These temperatures are warming the fastest at higher elevations and latitudes. As a result, more precipitation is falling as rain instead of snow which does not nourish the glaciers. With warmer summers causing more ice melt and warmer winters causing less snowfall, the glaciers of the Olympic Mountains are rapidly shrinking, and it is projected that they will largely disappear by 2070.[1]

Many rivers in the Quinault Area of Interest are glacier-fed and the loss of glaciers will alter the area's ecosystems and impact critical habitat. The Anderson Glacier, one of the most geographically important mountain ranges in Olympic National Park that fed the Quinault River and Lake Quinault, has now disappeared.[2] Between 1927 and 2009, it had receded to less than 10% of its former size, and was essentially gone by 2015.[3]

Other receding glaciers that feed the Quinault include the Linsleys (or Hanging), White and Christie, while those that feed the Queets River are the Queets, Humes and Jeffers. The Humes on the south side of Mount Olympus is the largest remaining glacier and probably has more ice then all the others combined. Even so, it has retreated rapidly in the past few decades, clear evidence of the impact of human-driven climate change.

The retreat of glaciers that provide large amounts of cold water year-round likely means reduced accessibility by spring/summer Chinook (and possibly bull trout) to side channel networks preferred for spawning.[4] It also results in higher water temperatures and greater stream sediment load as large amounts of sediments once stored in the glaciers are washed onto the floodplain. All these have the effect of limiting salmon productivity and threatening the survival of many species.

Humes Glacier Changes Over the Years



1962 and 2015 - Natalie Rotramel, ONP
2009 - Larry Workman, QIN

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Water Quality Listings Decrease but Impairment Remains

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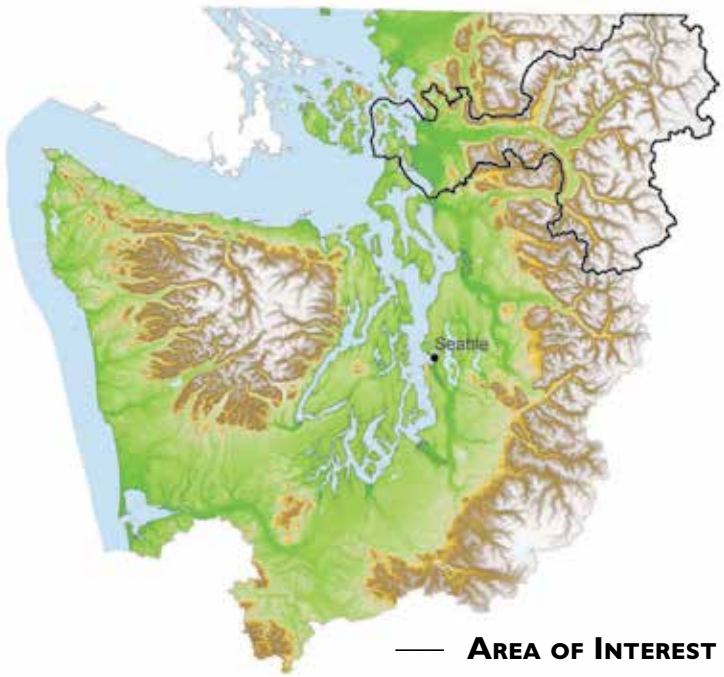
2025 State of Our Watersheds Report
Skagit River Watershed

We are salmon people. The resources within the Skagit River watershed have been a necessity of our people for time immemorial. The decline of fish and saltwater resources has been the root of many disputes amongst tribes. It is the duty of all to take care of these waters as they have taken care of us. The more we invest into this water system we love and care for, the more we may benefit from its natural resources that we have become accustomed to.

– Nino Maltos II
Chairman

Members of the Sauk-Suiattle Tribe for many years back before treaty times, we lived by shores of saltwater and up and down the Skagit River. Large canoes were used for the saltwater and also in the river. Sauks, Suiattles and Skagits all traveled the Skagit River watershed. The Baker River was a special fishing place for a special salmon called the sockeye. Many tribes fished in this place.

– The Late James Enick
Tribal Historian and Elder



— **Area of Interest**

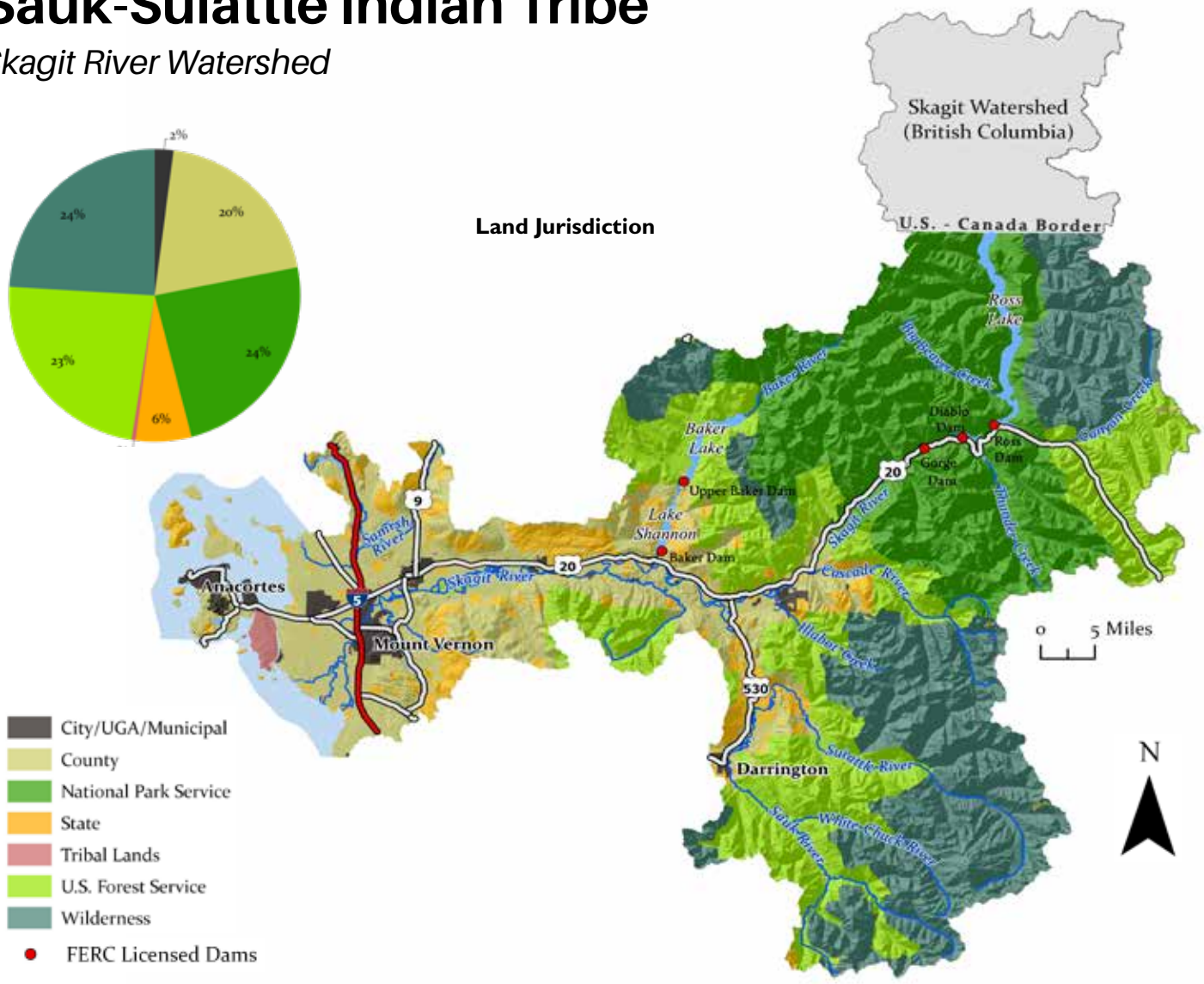
Sauk-Suiattle Indian Tribe

The Sauk-Suiattle Indian Tribe, known traditionally as the Sah-ku-mehu, have made their homeland in the Skagit, Sauk, Suiattle and Cascade river watersheds since time immemorial. They have lived as hunters, gatherers and fishers throughout this region. The tribe had an important village at Sauk Prairie in the Sauk River valley, near the confluence of the Sauk and Suiattle rivers. The tribe's current reservation is also near that confluence, just north of Darrington, Wash.

Following the United States Homestead Act, the tribe became a landless people, but continued to live in scattered groups close to the traditional homelands. Though many tribal members left the area or joined neighboring tribes, Sauk-Suiattle maintained its tribal government, social structure, identity and hope for the future. Tribal membership numbered around 4,000 before the 1855 Treaty of Point Elliott. By 1924, numbers had dwindled to 18 members. Residents of the Sauk-Suiattle Indian Reservation today are the surviving descendants of the original peoples who lived in this special valley. Current membership of the tribe is around 310 individuals.

Sauk-Suiattle Indian Tribe

Skagit River Watershed



The Skagit River flows from a 3,100-square-mile watershed that originates in British Columbia and flows south into Washington state before continuing westward through Skagit County and into Puget Sound. It has the largest watershed in Puget Sound and provides 30% of the sound's freshwater input.[1] The Skagit has an estimated 396 glaciers in the watershed, making up one of the largest areas of glacial cover in the United States outside of Alaska.[2] The Baker River, Sauk River, White Chuck River and Cascade River all flow from glaciers within the Skagit River watershed.

The Skagit River watershed has been home to the Sauk-Suiattle Indian Tribe, the Upper Skagit Indian Tribe and the Swinomish Indian Tribal Community since time immemorial. All three tribes have their reservations in the watershed and all have entered into a treaty with the U.S. guaranteeing them the right to fish at their usual and accustomed places forever.

Since European settlement, land use in the watershed has been dominated by natural resources extraction. The foothills and mountains have been used for wood products, mining and outdoor recreation. The river valleys, delta and coastal areas have been used for agriculture, industry, commerce and residential development. As of 2019, the U.S. Census Bureau estimated 129,205 residents lived in Skagit County, a 25% increase in population since the year 2000.[3,4]

The upper Skagit River watershed is primarily within national forest and the North Cascades National Park. The lower watershed mainly comprises state forest, private forest, agriculture, rural residential and urban residential/commercial/industrial lands. There are five Federal Energy Regulatory Commission (FERC) licensed dams in the Skagit River watershed: the lower and upper Baker River dams, and the Gorge, Diablo and Ross dams.

The Skagit River is home to all five species of Pacific salmon, as well as steelhead trout. It has the healthiest and largest runs of wild Chinook and Pink salmon in Puget Sound.[5] Even so, the last 150 years of human population growth and associated land use has resulted in declines in Chinook, a near collapse of Chum and declines in other salmonid productivity. The Skagit Chinook Recovery Plan (2005) provides a strategy for both protection and targeted restoration. It will take federal, tribal, state and local leadership to provide a consistent yet adaptive plan to control the future impacts of land use in the watershed.

Map Data Sources: DOD 2023[6], SSHIAP 2004[7], WADNR 2024a[8], WADNR 2024b[9], WAECY 2018c[10], WAECY 2018d[11], WAECY 2023[12], WAECY 2021[13], WAECY 2024[14], WADOT 2018[15], WADOT 2023[16], USFWS 2024[17]

Chapter Summary

The Sauk-Suiattle Indian Tribe's watershed is the Skagit River, including its largest tributary, the Sauk River, and in turn the Sauk's largest tributary, the Suiattle River. People of the Sauk-Suiattle have hunted, gathered, fished and lived throughout this watershed since time immemorial. Salmon have always been central to their life in the watershed, and the health of salmon are inextricably linked to the health of the watershed and to the health of the tribe.

The state of the Sauk-Suiattle Indian Tribe's watershed is similar to many of its neighboring rivers throughout Puget Sound. With myriad concerns from a lack of adequate buffers to rapid human population growth driving increased contamination from stormwater, to agricultural runoff … the list is long. But the overriding issue that will increasingly subsume all others is global warming.

Any assessment of the health of the Skagit River watershed must put the list of problems in this broader context. The earth is heating up at an unprecedented rate, and the ecosystems, tribal cultures and societal economies that developed over millennia are going to have to adjust extremely rapidly if we are to mitigate the impacts of this warmer world. The Skagit River watershed is the largest glaciated watershed in the lower 48 states, but its glaciers could melt completely by 2100 unless global carbon emissions are dramatically reduced.

The primary limiting factors for salmon recovery are the quantity and quality of habitat where salmon begin and end their lives in the watersheds. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

For this report, the Sauk-Suiattle Indian Tribe has focused on portions of their watershed that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Culvert Barriers Blocking Fish Passage Across Multiple Jurisdictions in the Skagit Watershed

A recent, comprehensive inventory of culverts on anadromous fish-bearing streams in the Skagit watershed documented 931 culverts. Of these, 556 culverts are fish-passage blockages and 91 culverts are unknown but may be fish-passage blockages. Over 74% of the blocking and unknown culverts are either privately owned (291 culverts, 45%) or county owned (194 culverts, 30%). The remaining 162 culverts (about 25%) are spread across other public ownerships.

Forest Road Maintenance and Abandonment Plans are Complete, Landsliding Greatly Reduced

Efforts to upgrade and decommission forest roads and new regulations designed to reduce logging on unstable slopes above streams have led to greatly reduced forestry-related landsliding in the Skagit River watershed. Because excess sediment supply from forestry activities has been a leading cause of habitat degradation in the Pacific Northwest, these results are good news for salmon recovery. Increased winter precipitation and summer wildfire activity due to climate change, however, may lead to future increases in landsliding despite past regulatory successes, suggesting an uncertain future for sediment supply impacts to salmon streams.

Sauk River Floodplain Forest is Relatively Healthy and Important to Protect

In 2021, Sauk River floodplain and tributary riparian areas were an estimated 88% forested. It is estimated that 104 acres of forest cover was lost in the Sauk River floodplain between 2011 and 2021. Almost 97% (101 acres) of that loss is attributed to natural processes, considered a healthy function of the floodplain ecosystem.

Increasing Water Quality Impairment Threatens Salmon Habitat in the Skagit River Watershed

From 2012 to 2018, water quality decreased in the Skagit River watershed.

High Stream Temperatures Impair Salmon-bearing Waters in the Sauk River Watershed

Stream temperature monitoring in the Sauk River watershed shows that waters are often too warm for juvenile salmonids. Of 30 streams with at least three years of monitoring data, only three streams had no days of temperatures harmful to salmon, while 11 streams had temperatures exceeding water quality standards between 30 and 60 days annually on average, and 11 streams had temperatures exceeding water quality standards between 60 and 90 days annually on average.

Measurable But Insufficient Floodplain Restoration Occurring in the Skagit River System

Between 2001 and 2019, a total of 24 structures or channel crossings were removed from the floodplain, natural processes were restored in 59-hectares of non-channel and channel area, and 2.7 kilometers of road/levee and channel lining riprap was removed. Still, floodplain restoration progress has been slower than desired, with only a 10% increase in the Freshwater Rearing Index over the past 25 years. The Skagit Chinook Recovery Plan calls for a 31% increase in freshwater rearing capacity over 50 years, highlighting the need to accelerate restoration efforts. Thus, while measurable gains have been made, they are not on track to achieve recovery during the 50-year target.

Long-term Commitment to Knotweed Monitoring and Treatment has Greatly Reduced its Presence in the Sauk River

Knotweed has been significantly reduced through treatment in the Sauk River watershed since 2014.

Projected Climate Impacts to Precipitation are a Threat to Salmon in the Sauk River

Precipitation is shifting from snow to rain in the Sauk River watershed. The Sauk River watershed hydrology is historically 71% dominated by snow. Based on climate forecasts, the watershed will be only 42% snow dominated by the 2080s, a loss of 29%. Climate change is projected to also increase the size of the river's 20-year, 50-year and 100-year floods by 63%, 57% and 51% respectively.

Glacial Recession Threatens Fish in the Skagit River Watershed

Since 1959, glacier area in the Skagit River watershed has decreased between 30 and 35 square kilometers (about -19%). At current consumption rates, this loss of glacial cover equals the elimination of an estimated 100 years of cold freshwater supply for Skagit County.

Chinook Salmon are Spawning Later with Warming River Temperatures

Over the last six decades, natural-origin Skagit River Chinook salmon have been spawning later by up to 0.52 days per year. Meanwhile, egg take for hatchery propagation has moved earlier by 0.58 days per year. Mean August river temperatures have risen over the period of record, as expected given climate predictions, suggesting that Chinook salmon spawn timing trends may be expressing plastic or adaptive responses to warming water and/or related factors.

Conclusion

The Skagit River and its tributaries are already manifesting the early signs of a warming climate. Tidal marsh in the delta is impacted by sea level rise, and the lower Skagit River tributaries are exhibiting summer stream temperatures that are harmful or even lethal to juvenile salmon. Upstream, Skagit watershed glaciers lost 50% of their area during the 20th century, and if the current rate of carbon emissions continues unabated, the glacial area could be reduced by half again by 2050—and gone by 2100.

A review of key environmental indicators shows steady progress on some fronts: forest road improvements, floodplain forest cover, riparian planting success, and a reduction of the invasive plant Japanese knotweed. On the other hand, there are still too many barrier culverts, water quality has decreased, stream temperatures are too high, and climate change is impacting Chinook salmon, stream flows and the stability of the glaciers.

Recovery of the Skagit River watershed and its salmon requires continued restoration progress and a greater commitment from federal, state and local government regulators to implement the environmental laws in place to conserve and protect critical salmon habitat and tribal treaty resources throughout the watershed. People have to be held accountable to protect, conserve and improve fish habitat in their land-use decisions, and federal, state and local governments all have a role in that. Existing land-use and water laws that are meant to protect critical areas and fish habitat need to be implemented. Implementation includes education and voluntary action, but it also needs to include enforcement when those laws are broken. The future of tribal treaty rights in the Skagit River basin depends on it.

Recovery Efforts Show Signs of Improvement But Still Lagging in Key Indicators

At the 20-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Skagit River basin shows progress for forest road improvements and estuary restoration. But degradation has occurred with the continued reduction of glaciers, along with concerns about riparian forest sustainability and barrier culverts. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address these issues, implement actions to restore and protect habitat, and monitor and enforce compliance with existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trends for these key environmental indicators shows improvements where restoration is occurring, and concern or declines where losses are ongoing, such as continued glacier recession:

Tribal Indicator	Status	Habitat Trend
Barrier Culverts	A recent inventory of culverts on anadromous fish-bearing streams in the Skagit River watershed documented 931 culverts. Of these, 556 culverts are fish-passage blockages and 91 culverts are unknown but may be fish-passage blockages. Over 74% of the blocking and unknown culverts are either privately owned (291 culverts, 45%) or county owned (194 culverts, 30%). The remaining 162 culverts (about 25%) are spread across other public ownerships.	Declining
RMAP	Efforts to upgrade and decommission forest roads and new regulations designed to reduce logging on unstable slopes above streams have led to greatly reduced forestry-related landsliding in the Skagit River watershed.	Improving
Floodplain Forest Cover	In 2021, Sauk River floodplain and tributary riparian areas were an estimated 88% forested. It is estimated that 104 acres of forest cover was lost in the floodplain between 2011 and 2021. Almost 97% (101 acres) of that loss is attributed to natural processes, considered a healthy reflection of the floodplain ecosystem.	Improving
Water Quality	From 2012 to 2018, water quality decreased in the Skagit River watershed.	Declining
Stream Temperatures	Of 30 streams with at least three years of monitoring data, only three streams had no days of temperatures harmful to salmon, while 11 streams had temperatures exceeding water quality standards between 30 and 60 days annually on average, and 11 streams had temperatures exceeding water quality standards between 60 and 90 days annually on average.	Declining
Riparian Planting	Since the 2020 State of Our Watersheds Report, riparian planting has accelerated along the Skagit and Sauk rivers and their tributaries.	Improving
Invasive Species - Knotweed	Knotweed has been significantly reduced through treatment in the Sauk River watershed since 2014.	Improving
Climate Impacts - Precipitation	The Sauk River watershed hydrology is historically 71% dominated by snow. Based on climate forecasts, the watershed will only be 42% snow dominated by the 2080s, a loss of 29%. Climate change is also projected to increase the size of the river's 20-year, 50-year and 100-year floods by 63%, 57% and 51% respectively.	Declining
Glacial Recession	Since 1959, glacier area in the Skagit River watershed has decreased between 30 and 35 square kilometers, or about -19%. At current consumption rates, this loss of glacial cover in the watershed equals the elimination of an estimated 100 years of cold freshwater supply for Skagit County.	Declining
Stream Temperature Impact to Chinook Salmon Spawning Timing	Over the last six decades, natural-origin Chinook salmon have been spawning later by up to 0.52 days per year. Meanwhile, egg take for hatchery propagation has moved earlier by 0.58 days per year.	Concerns

The Sauk-Suiattle Indian Tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

Climate scientists have warned that deep reductions in global carbon emissions need to be implemented by 2030 to limit warming to a level that could avoid the more catastrophic impacts predicted by climate models.[1] The early impacts of global warming are already being felt throughout the Skagit River watershed: melting glaciers in the headwaters; warming water temperatures in lower Skagit tributaries and even some of the larger upstream tributaries, such as the Sauk River; changes in timing, frequency and intensity of floods; lower pH levels in the ocean causing brittle shells for oysters and other shellfish; huge areas of warm water in the ocean further depleting cold-water fish species such as salmon; and dead zones in Puget Sound with low levels of dissolved oxygen.

Riparian ecosystems throughout the lower Skagit River and its tributaries are feeling pressure from rapid human development. As Skagit County's human population expects a 30% increase by 2036,[2] the opportunity arises to incorporate novel, sustainable development practices to address the needs of riparian ecosystems as well as human population growth. For example, encouraging cities to adopt mixed-use development and zoning can provide for population growth as well as cold-water fish species by establishing interspersed green areas, promoting walkable communities (thus decreasing the dependence on motor vehicles), supporting local retailers, and offering residents a sense of place and connection with their environment.

Upstream, as the glaciers disappear, so too will 8-12% of the Skagit River's summer flows.[3] This will require more conservative management of flows from the three Seattle City Light dams and the two Puget Sound Energy dams to make sure salmon redds are not left high and dry during late summer and early fall spawning on the Skagit River. This is especially important as terms are being negotiated for a new license for the Seattle City Light dams. Also important to keep in mind is that the reservoirs will have less glacial melt to work with, yet more human development downstream will place increasing demands for water and electricity. And the Skagit's main tributary, the Sauk River, has no dams on it—meaning once the glaciers are gone, those flows and colder inputs will be lost during the summer months. Outreach and education about water conservation methods, as well as eliminating financial barriers to effective household water conservation, is absolutely essential, as is exploring and incentivizing alternative ways of collecting and storing water to meet human development needs.

Simultaneous to these locally scaled efforts, a wholesale transformation of the regional, national and global economies is going to have to be advocated for and implemented as quickly as possible. A shift away from fossil fuels and other sources of carbon emissions must be made, replaced by renewable energy.

Washington state government is to be commended for many of its efforts in recent years to make this shift. The state's cap and invest program is a model for the nation, and even other countries, to see if regulators can use economic incentives to drive down carbon emissions at an industrial level. Initial results from the early years of this program are very encouraging, which is important because other states and nations are watching to see if they could implement something similar. The state is making commendable efforts to put the funding generated by this program and other funding sources to good use. Washington state also has initiated a wide range of other projects designed to expedite the transition away from fossil fuels, such as a new hydrogen power plant, arrays for solar and wind-generated electricity, and the electrification of ferries and motor pools.

The Sauk-Suiattle Indian Tribe has helped lead by example as well, using some of its state climate funds to convert some of its motor pool to electric cars for all of its departments. Tribal, local, state and national governments must show the leadership necessary to make this happen so that the locally scaled impacts of a rapidly warming climate can be mitigated in time to make a difference. The federal government's drastic policy shift against such efforts could not be timed much worse, but it should also be noted that some large renewable energy projects have succeeded in politically conservative states such as Texas and others.

All such efforts should be encouraged moving forward. For example, regarding the melting of the glaciers in the Skagit River watershed, if carbon emissions are greatly reduced in time, climate models suggest that the higher elevation glaciers could be saved. The same logic would apply to sea level rise, ocean acidification, the changing hydrologic cycle and other problems associated with global warming.

Scott Morris

Solar panels and electric-vehicle charging stations installed at the Sauk-Suiattle Indian Tribe's Natural Resources Department building, along with the new Ford Lighting 150. Most departments at the tribe have new electric vehicles and charging stations, and some of the tribal buildings are getting solar panels.

Skagit Climate Science Consortium

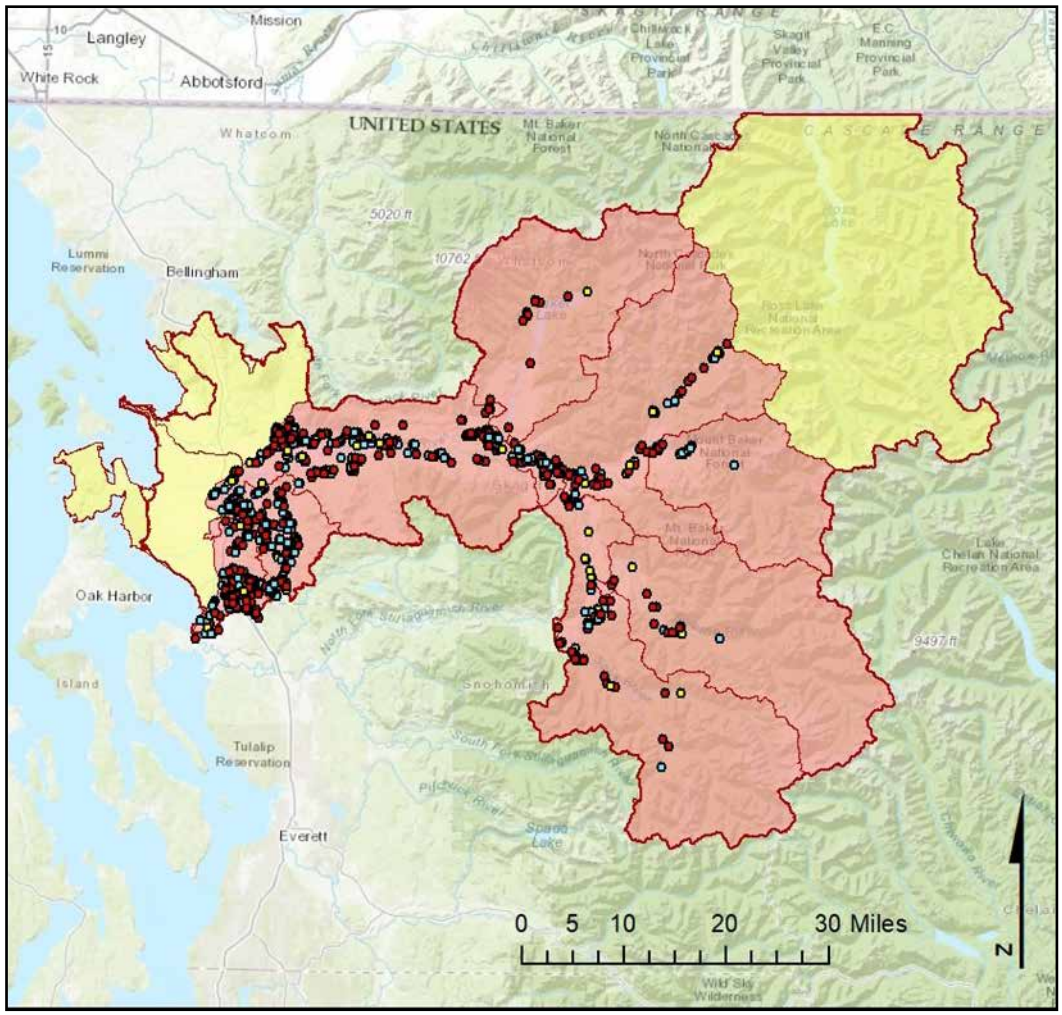
Ice loss at the Easton Glacier on Mount Baker since approximately 1900.

Culvert Barriers Blocking Fish Passage Across Multiple Jurisdictions in the Skagit Watershed

A recent comprehensive inventory of culverts on anadromous fish-bearing streams in the Skagit watershed documented 931 culverts. Of these, 556 culverts are fish-passage blockages and 91 culverts are unknown but may be fish-passage blockages. About 75% of the blocking and unknown culverts are either privately owned (291 culverts, 45%) or county owned (194 culverts, 30%). The remaining 162 culverts (about 25%) are spread across other public ownerships.

Culverts make up more than 87% of known fish-passage barriers in the Skagit River watershed. Ongoing work on a comprehensive survey that was initiated in 2020 by a working group comprised of the Skagit River System Cooperative, Upper Skagit Indian Tribe, Skagit County, Skagit Fisheries Enhancement Group and Snohomish County updated barrier statuses, identified previously unmapped barriers and refined mapping of streams likely to be accessible by anadromous fish species. The survey focused on anadromous fish-bearing streams within a selected survey area, which excludes the Samish River watershed, the Skagit estuary, Fidalgo Island and the portion of the Skagit watershed upstream of the Gorge Dam at Newhalem due to complicating factors in those areas.

The survey identified 647 culverts within the study area that were known barriers and unknown but potential barriers.[1] These barriers are to be considered as a group from which land managers and restoration planners in the Skagit River watershed can strategically locate projects to open fish passage. The project also created a GIS tool to enable land managers and restoration planners to estimate habitat gains from candidate barrier correction projects and identify whether upstream and downstream barriers are present on the same stream system.[2] This allows for project prioritization and strategic planning of multi-culvert removal in locations where upstream and/or downstream culverts are also blocking salmon habitat.



Map of all known culverts in the project study area (n = 931); passable (n = 284, blue,) barrier culverts (n = 556, red) and unknown barrier status (n = 91, yellow).

Since 2020, a total of 43 barrier correction projects have been completed, funded or begun by working group members as a direct result of the inventory done in the watershed. Additionally, per the terms of the state culvert injunction, 10 barrier correction projects have been completed in the watershed by the Washington State Department of Transportation since 2020, and 15 others have been funded for design or construction, with completion anticipated by 2027.

The Skagit Chinook Recovery Plan[3] recommends that each governmental entity identify each culvert on their lands or under their jurisdiction that are barriers to Chinook salmon. With the information now available from this barrier survey, it is even more possible for the culvert barrier owner, regardless of jurisdiction, to take responsibility for fixing their blockage to fish passage, as is required through current Washington state statute.

Map Data Sources: Crowley et al. 2024[4]

Forest Road Maintenance and Abandonment Plans are Complete, Landsliding Greatly Reduced

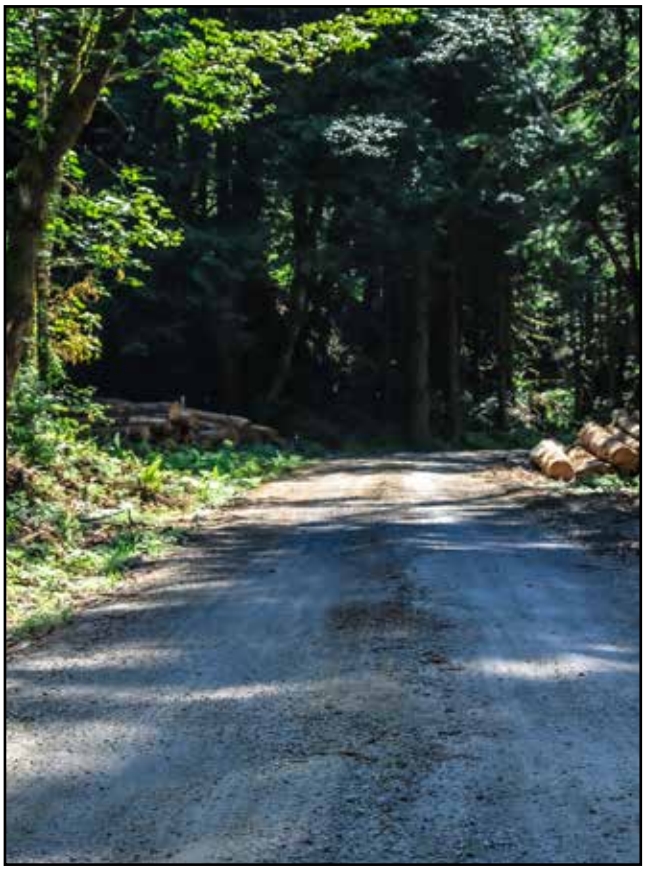
Efforts to upgrade and decommission forest roads and new regulations designed to reduce logging on unstable slopes above streams have greatly reduced forestry-related landsliding in the Skagit River watershed. Because excess sediment supply from forestry activities has been a leading cause of habitat degradation in the Pacific Northwest, these results are good news for salmon recovery. Increased winter precipitation and summer wildfire activity due to climate change, however, may lead to future increases in landslides despite past regulatory successes, suggesting an uncertain future for sediment supply impacts to salmon streams.

Excess sediment supply from landsliding triggered by timber harvest and road building has widened and simplified stream channels, smothered incubating salmon eggs, removed riparian vegetation and filled important pool habitat, among other impacts. Previous tribal State of Our Watersheds reports documented successes of the Road Maintenance and Abandonment Plan (RMAP) process, which required all roads on state and private timber lands to be brought up to modern engineering standards or decommissioned between 2001 and 2021, a major goal of the Skagit Chinook Recovery Plan.

Similarly, the Forests and Fish Report (FFR) regulations enacted in 2001 for state and private timber lands encouraged ongoing harvest but required landowners to avoid unstable slopes when designing forestry operations. On U.S. Forest Service lands, the 1994 Northwest Forest Plan (NWFP) curtailed most logging in federal forests and jump-started an effort to decommission the most problematic federal roads.

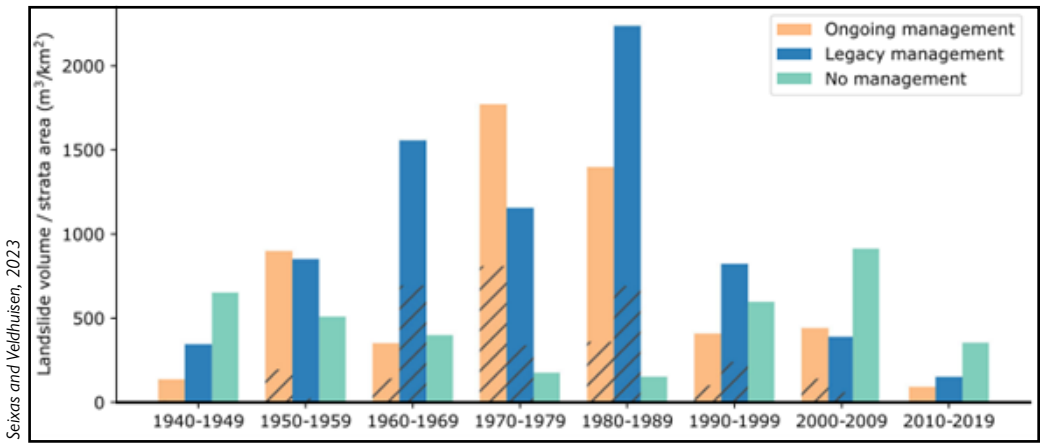
An extensive monitoring effort[1] to document trends in shallow landsliding in nine Skagit River tributary basins has demonstrated that the differing approaches in federal and state/private ownerships have both paid off: landslide sediment yield was reduced by about 75% on state/private forests and about 85% on federal forests on a per-acre, per-year basis following the implementation of the FFR and NWFP regulations (see figure). Landsliding in unlogged forests increased over the same period likely due to climatic influences.

Despite great progress due to forest land-use and regulatory changes, predicted increases in winter storm and wildfire frequency and severity suggest a risky future for sediment supply impacts to salmon habitats. Future research should better assess these risks and make predictions for where and when the impacts will be most acute, to inform restoration and habitat protection planning.



Washington Department of Natural Resources

Changes in forest road management have benefits for salmon recovery.



Seixas and Veldhuisen, 2023

Decadal landslide sediment yield trends in three land-use strata representing state and private timberlands (Ongoing management, orange), federal forests (Legacy management, blue), and unlogged forests (No management, teal). The hatch pattern represents forest road failures.[2]

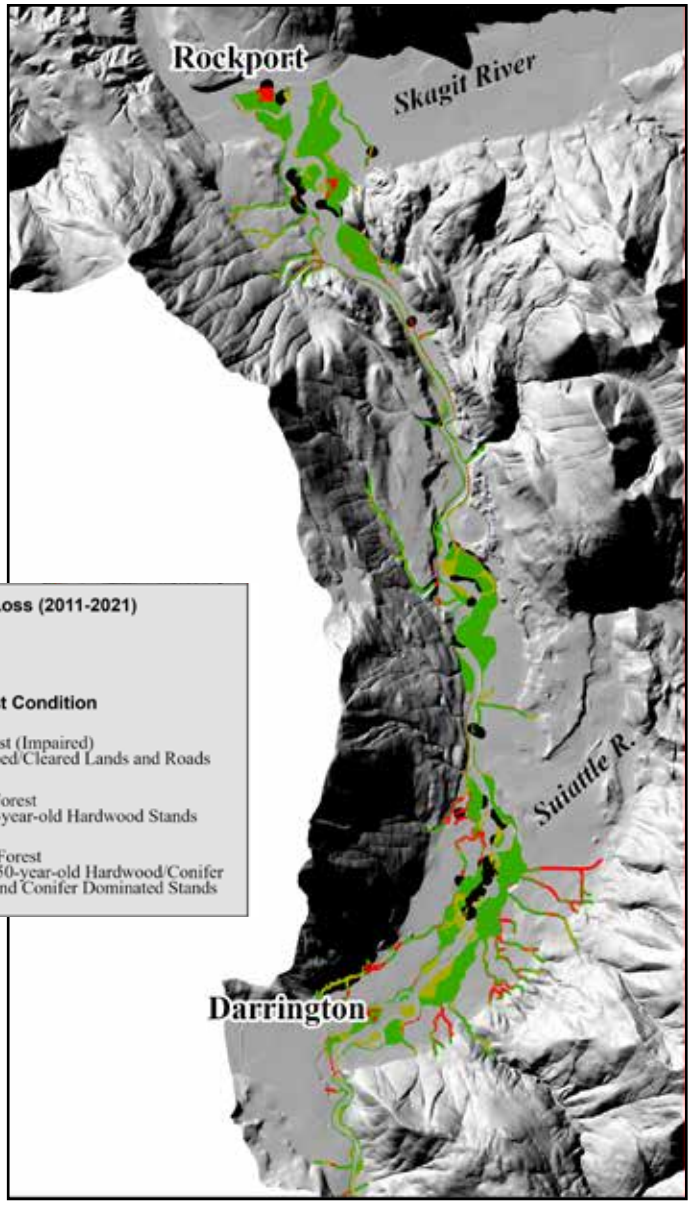
Sauk River Floodplain Forest is Relatively Healthy and Important to Protect

In 2021, Sauk River floodplain riparian areas were an estimated 88% forested. It is estimated that 104 acres of forest cover was lost in the Sauk River floodplain between 2011 and 2021. Almost 97% (101 acres) of loss is attributed to natural processes, considered a healthy function of the floodplain ecosystem.[1,2]

The Skagit Chinook Recovery Plan recognizes that riparian forests provide shade, nutrients, large woody debris and stream bank stability for spawning and rearing Chinook. The plan strongly recommends protecting riparian forests that are healthy and restoring those that are impaired.[3] The Sauk River remains one of healthiest floodplain ecosystems in the Skagit River watershed, but even so, the lower reaches of the Sauk feature younger, smaller trees that indicate a riparian zone still in a state of recovery from past human disturbances.[4]

Continued protection of riparian areas in the Sauk River floodplain will require an end to agricultural practices exemptions from the Shoreline Management Act (SMA), and the development of alternative mechanisms to agricultural practices that provide protection equivalent to the SMA. Additionally, the small forestland owners' exemption from the riparian protections of the Forests and Fish Agreement is not consistent with the original agreement and should be removed to consistently protect riparian resources across all lands regulated through the agreement.[5]

Sauk Floodplain Riparian Forest Change, 2011 to 2021



Status and change of riparian area in the Sauk River floodplain between 2011 and 2021.[10,11]

Sauk River Floodplain Riparian Forest Area	Non-forested Riparian Area (Acres)	
	2011	*2021*
40 m channel migration zone buffer	119	123
40 m tributary buffer	290	294
Active Sauk River channel migration zone (2009)	103	193
Island within active channel	5	12
Total	518	622

Map Data Sources: Ramsden K. 2010[6], WDFW. 2022[7], SSHIAP 2004[8], WADNR 2014c[9]

Increasing Water Quality Impairment Threatens Salmon Habitat in the Skagit River Watershed

From 2012 to 2018, water quality decreased in the Skagit River watershed.

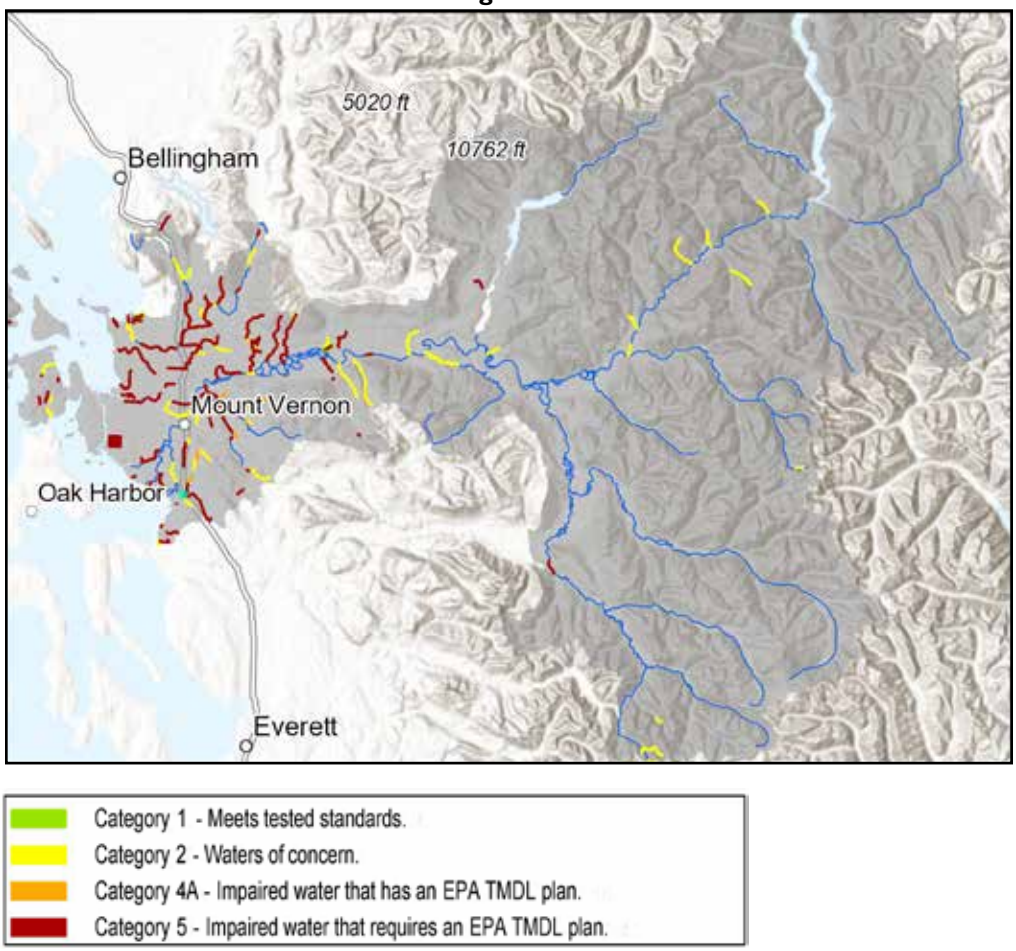
The 2018 Washington Department of Ecology Water Quality Assessment and listings report to the U.S. EPA is the first update since 2012. In it, temperature impaired streams that need a water improvement plan increased from 34.63 listed miles to 70.11 listed miles, and temperature impaired streams with a water improvement plan remained the same, at 23.18 miles. Dissolved-oxygen impaired streams that need a water improvement plan increased from 67.54 listed miles to 83.62 listed miles.[1]

Pacific salmon require cold, well-oxygenated water across all life stages. High stream temperatures and low dissolved-oxygen levels are lethal to salmon at certain thresholds and sub-lethal to salmon at lower thresholds.[2] Low levels of dissolved oxygen also can hinder embryo incubation, which can result in weaker fry that are more susceptible to predation and that don't feed or swim as well.

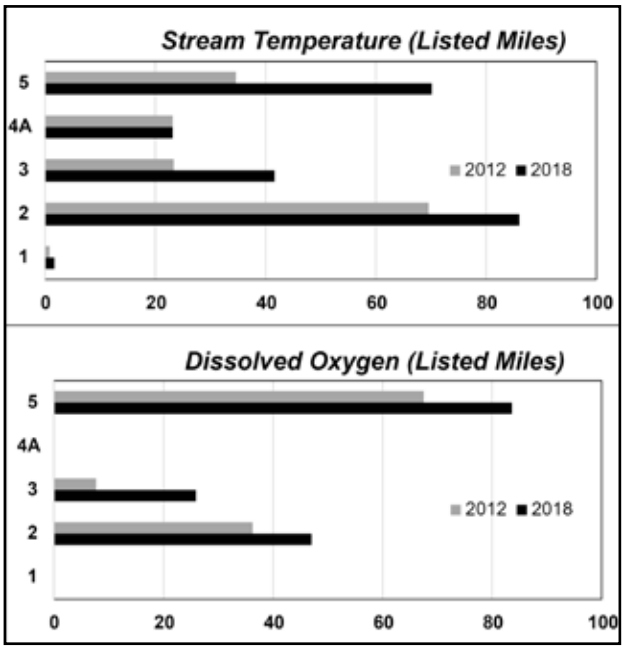
Stream temperature and dissolved oxygen impairments are largely caused by nonpoint source pollution. The Clean Water Act provides limited authority to address nonpoint source pollution, so a lot of the TMDL (total maximum daily load) measures recommended for impaired waters are voluntary. They encourage landowners to take action to decrease pollution. Dating back to 2013, the Government Accounting Office reported on the challenges of nonpoint source pollution control measures and recommended that Congress consider revising the Clean Water Act's voluntary approach to cleaning up such pollution. As of the end of 2023, Congress had not taken action on these recommendations.[3]

Under Washington state law and affirmed by the state Supreme Court, Ecology has some authority to regulate nonpoint source pollution, but the agency still relies largely on non-effective voluntary measures.

Temperature- and Dissolved Oxygen-Impaired Streams in the Skagit Watershed



From the 2012 Water Quality Assessment to the 2018 Water Quality Assessment, changes in stream miles impaired for water temperature and for dissolved oxygen.[1]

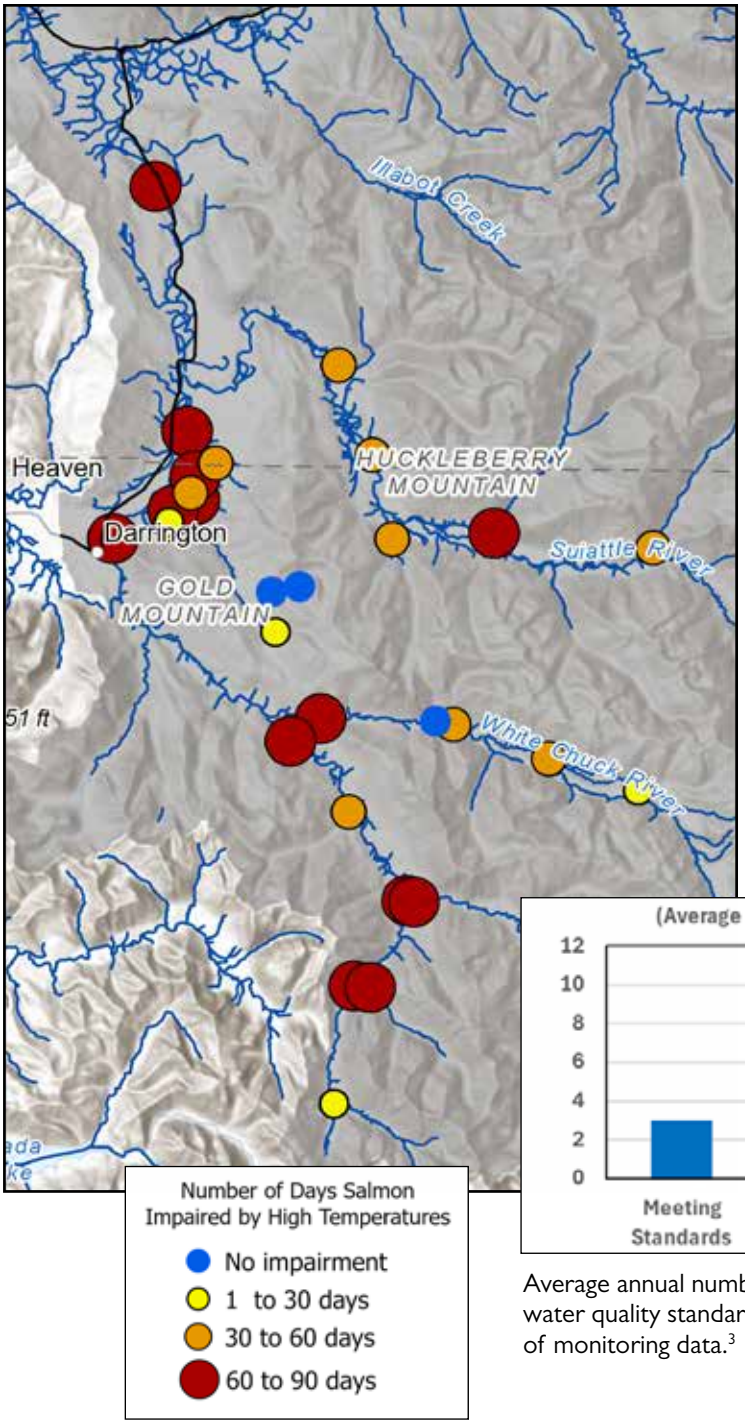


Map Data Sources: WAECY 2022[1]

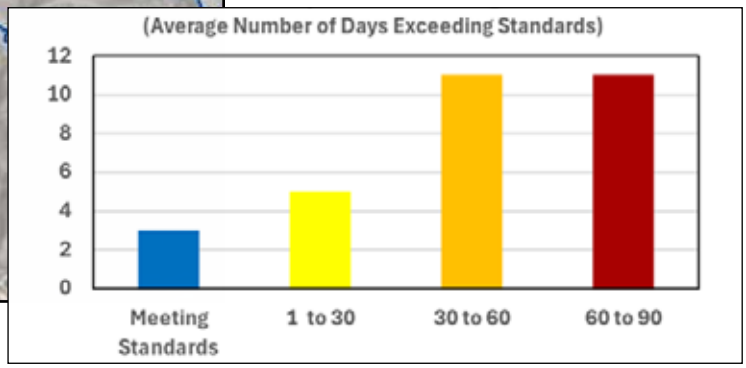
High Stream Temperatures Impair Salmon-bearing Waters in the Sauk River Watershed

Stream temperature monitoring in the Sauk River watershed shows that waters are often too warm for juvenile salmonids. Of 30 streams with at least three years of monitoring data, only three streams had no days of temperatures harmful to salmon, while11 streams had temperatures exceeding water quality standards between 30 and 60 days annually on average, and 11 streams had temperatures exceeding water quality standards between 60 and 90 days annually on average.

Stream Temperature Monitoring Locations



High stream temperatures were identified as a limiting factor for Chinook survival and recovery in the 2005 Skagit Chinook Recovery Plan and for steelhead recovery in the 2019 Puget Sound Steelhead Recovery Plan.[1,2] The Washington Department of Ecology has relied entirely on voluntary programs to recover the water quality of important salmon streams and has been mostly unwilling to create a regulatory framework for enforcing water quality standards for temperature in salmon streams—and so compliance with salmon stream temperature regulations continues to be treated as optional. Sole reliance on voluntary efforts has been and will continue to be insufficient to meet water quality standards or the needs of Chinook and steelhead recovery in a timely manner.

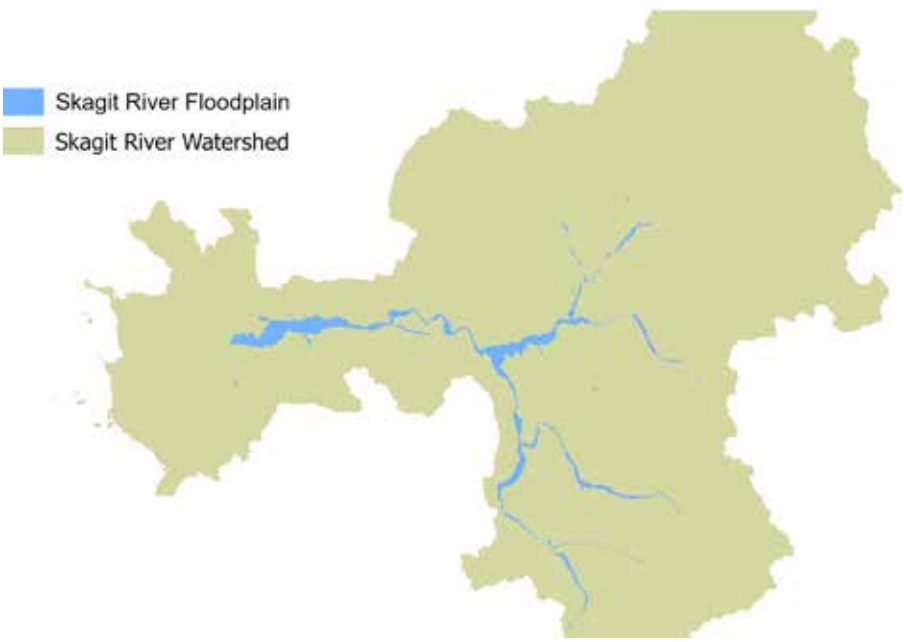


Average annual number of days stream monitoring sites exceed water quality standards for high temperature, based on 10-20 years of monitoring data.[3]

Map Data Sources: SSIT 2024[4]

Measurable But Insufficient Floodplain Restoration Occurring in the Skagit River System

Between 2001 and 2019, a total of 24 structures or channel crossings were removed from the floodplain, natural processes were restored in 59 hectares of non-channel and channel area, and 2.7 kilometers of road/levee and channel-lining riprap was removed.[1] However, this progress is too small to keep pace with recovery plan targets.



The Skagit River watershed is the largest in the Puget Sound.

SRSC

A newly restored channel in lower Hansen Creek during a high flow event in 2024.

Map Data Sources: SRSC & WADFW 2005[7]

Off-channel and side-channel habitats in the Skagit River floodplain provide critical rearing areas for juvenile Chinook salmon, supporting both migrating parr and yearling life histories. However, over the past century, floodplain habitat has declined by approximately 35% due to channelization and hydromodifications such as roads, levees and riprap bank protection.[2] This loss has significantly reduced the capacity of the floodplain to support juvenile Chinook.[3]

Achieving Chinook salmon recovery goals in the Skagit watershed requires a net gain in floodplain habitat to boost juvenile productivity. Since the 2020 State of Our Watersheds Report, several restoration projects have been implemented to address this need, including efforts at lower Hansen Creek, Pressentin Slough, Illabot Creek, Lower Day Slough and Barnaby Slough. These projects aim to improve habitat connectivity and restore natural floodplain processes across off-channel areas, side channels, mainstem edges and Chinook-bearing tributaries.

Using orthophotography from the Washington Department of Natural Resources and the U.S. Department of Agriculture's National Agriculture Imagery Program (1998, 2006 and 2015), the Skagit River System Cooperative (SRSC) classified the floodplain into various habitat types.[4] These classifications were then used to develop a Freshwater Rearing Index for juvenile Chinook salmon, which quantifies changes in rearing habitat based on known associations between habitat type and juvenile salmon density.

Since the 1999 listing of Puget Sound Chinook under the Endangered Species Act, Skagit River floodplain rearing habitat has increased due to both restoration efforts and natural processes such as channel migration. However, progress has been slower than desired, with only a 10% increase in the Freshwater Rearing Index over the past 25 years.[5] The Skagit Chinook Recovery Plan calls for a 31% increase in freshwater rearing capacity over 50 years,[6] highlighting the need to accelerate restoration efforts. Thus, while measurable gains have been made, they are not on track to achieve recovery during the 50-year target.

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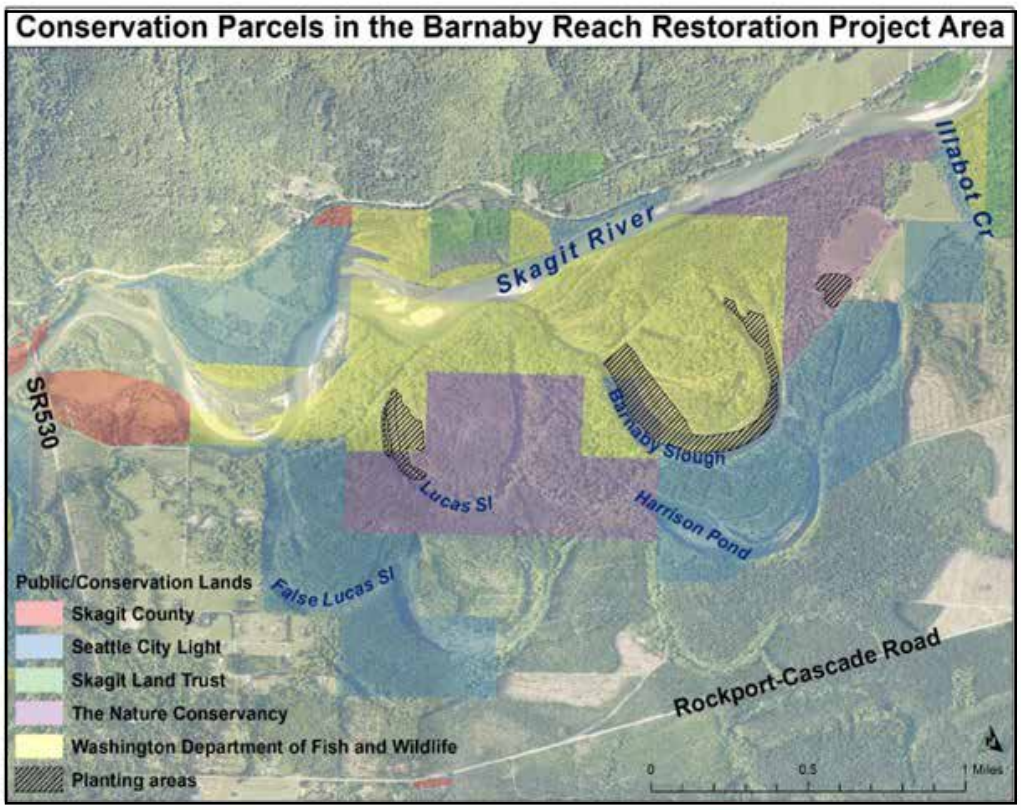
Spotlight: Barnaby Restoration Project

The Barnaby Reach lies on the left bank of the Skagit River east of the Sauk River confluence. Much of the land is in conservation status, owned by the Washington Department of Fish and Wildlife, The Nature Conservancy and Seattle City Light (see figure). In 2021, the Skagit River System Cooperative (SRSC) completed the Barnaby Reach Restoration Project to reestablished floodplain processes, improve fish habitat and restore fish passage by removing barriers and infrastructure associated with a derelict hatchery facility.

After construction, SRSC began to plant native vegetation in large swaths of invasive reed canarygrass to the north of the slough. The hydrology and soils present at the site were well suited for scrub-shrub and forested wetlands—which lower water temperatures by creating shade and provide woody debris—but due to deforestation, soil compaction and invasive species domination, the desired plant species were unable to colonize the site.

To overcome these challenges, the planting crew used an innovative technique that involves installing tall, dense willow stakes. More than 5,000 of the 6-foot-tall live stakes were installed per acre at 3 feet apart and 1.5 feet into the ground, leaving 4.5 feet above ground. Within the first year, the stakes were tall enough to outcompete the reed canarygrass for light. Within five years, the planting density will begin to shade and weaken the reed canarygrass. Since 2023, SRSC has installed 33,200 willows across nearly 8 acres. So far, the plantings have been very successful.



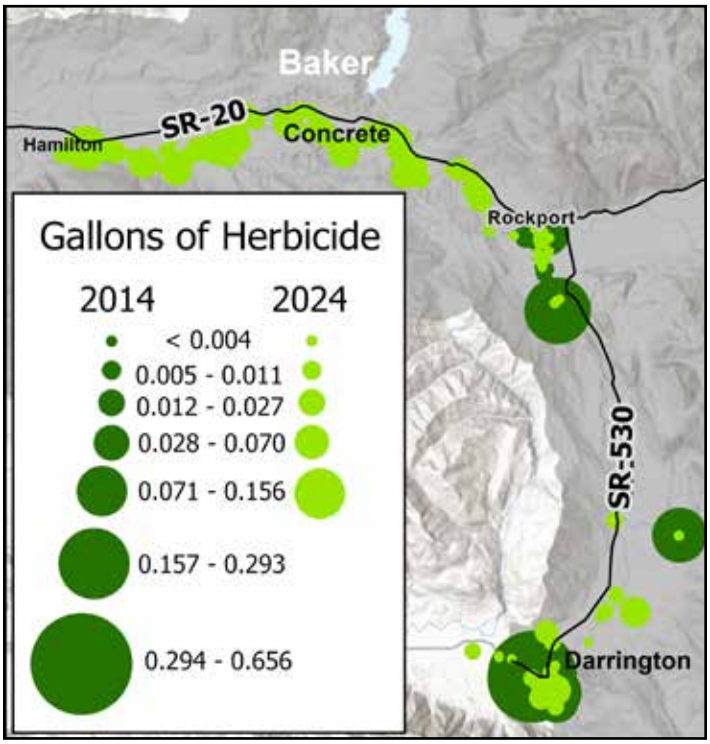
SRSC

Natural Systems Design

Barnaby Slough after the removal of Dike A.

Long-term Knotweed Treatment has Greatly Reduced its Presence in the Sauk River

Knotweed has been significantly reduced through treatment in the Sauk River watershed since 2014.



Comparing the amount of herbicide applied to invasive knotweed during the past 10 years between Darrington and Rockport along the Sauk River floodplain demonstrates the effectiveness of persistent summer treatments. In 2014, 2.4 gallons of herbicide were applied. In 2024, only 0.3 gallons were required for that same reach.[3]

Knotweed in the Sauk and Skagit river floodplains is bad for salmon habitat. Knotweed's aggressive growth reduces the establishment of native woody species, which are ultimately crucial for creating large woody debris that forms deep scour pools essential for salmon. Additionally, knotweed stands decrease shade, leading to higher water temperatures and lower oxygen levels, which are detrimental to salmon and other aquatic life. The brittle root systems of knotweed also contribute to increased soil erosion, negatively impacting salmon spawning habitats by smothering eggs with excess silt.

Over the last decade, the Sauk-Suiattle Indian Tribe and its partners have made significant progress in reducing a knotweed infestation in the Sauk River. A top-down approach has proven effective, as treating upstream areas first prevents downstream re-establishment caused by natural river processes that redistribute viable fragments. The number of treated upstream patches has been steadily decreasing, as shown on the map by the drastic reduction of herbicide being applied. This indicates successful management and reduction of knotweed infestations.

The most effective method of treatment is a 1% herbicide to 99% water mixture. In 2014, 2.4 gallons of herbicide were applied along the mainstem Sauk River in the roughly 25 miles from Darrington to Rockport. In 2024, only 0.3 gallons were applied along that same reach.[1] The decrease in herbicide application is a direct measure of the decrease in number of knotweed stems and area covered in knotweed. With reduced knotweed found in the Sauk River and increased funding for treatment, work was extended down the Skagit River in 2018, covering 28 more river miles and treating hundreds of additional patches.[2]

In all, the Sauk-Suiattle Tribe and partners including the Skagit Fisheries Enhancement Group and Skagit County are now surveying and treating invasive knotweed in almost 90 river miles of floodplain in the Sauk and Skagit watersheds. Including areas covered by partnering agencies, the treatment area now starts in the upper reaches of the Skagit and Sauk rivers and spans downstream to Hamilton, WA. This ongoing effort not only helps restore native vegetation but also improves habitat conditions for salmon, supporting their recovery and long-term sustainability.

A 4-acre patch of knotweed discovered in the Sauk River watershed by monitoring crews in 2012.

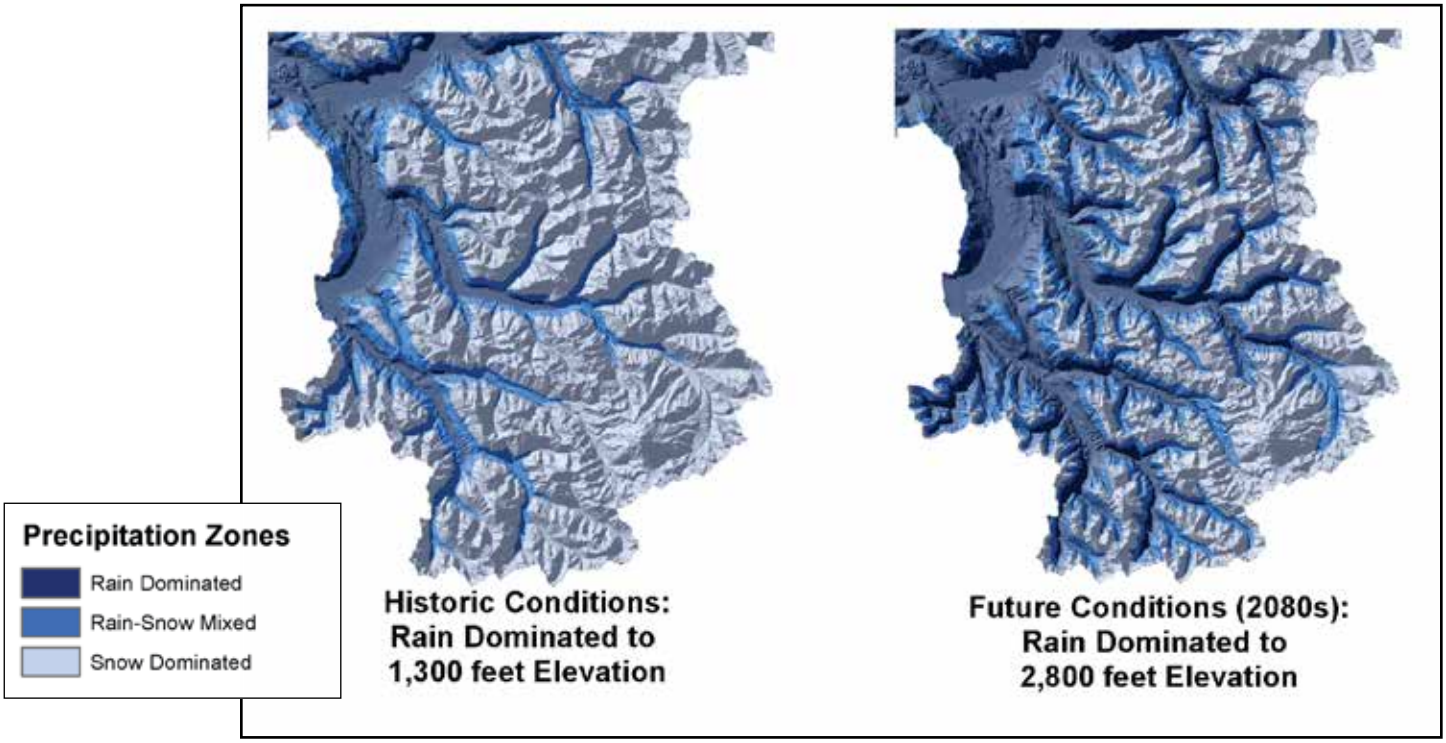
Right: The same 4-acre area in 2016, replanted with native vegetation after knotweed treatment.

Sauk-Suiattle Natural Resources Department

Map Data Sources: Morris, et.al. 2025[3]

Projected Climate Impacts to Precipitation are a Threat to Salmon in the Sauk River

Precipitation is shifting from snow to rain in the Sauk River watershed. The Sauk River watershed hydrology is historically 71% dominated by snow. Based on climate forecasts, the watershed will only be 42% snow dominated by the 2080, a loss of 29%.[1,2,3] Climate change also is projected to increase the size of the river's 20-year, 50-year and 100-year floods by 63%, 57% and 51% respectively.[4,5]



The precipitation zones in the Sauk River watershed are projected to transition from snowfall dominated to rainfall dominated.

Typically, it snows more than rains during winter in the Sauk River watershed, though as air temperatures increase it is projected that there will be an increase in the area that receives rain as opposed to snow. Climate models also predict there will be an increase in this area's winter precipitation overall, driven in part by changes in the frequency and magnitude of extreme precipitation events. Therefore, the watershed will see an increase in winter rainfall from all these changes.

The shifts in local precipitation types and quantities undermines instream salmon habitat. Increasing winter rainfall can exacerbate sedimentation that may bury or suffocate salmon redds during spawning and decrease the amount of cold water available from spring snowmelt, which can compound with warming summer stream temperatures to jeopardize salmon populations during rearing. As local salmon and trout populations are adversely affected, there will be less high-quality fish for Sauk-Suiattle tribal members to harvest to exercise their treaty rights and ways of life.

	Rainfall Dominated	Transient Snow Zone	Snowfall Dominated
Historical	12%	17%	71%
2080s*	32%	26%	42%
Projected Change	**+20%**	**+ 9%**	**- 29%**

Projected decrease in winter precipitation falling as snow within the Sauk River watershed as air temperatures increase with the changing climate.[6,7]

Recurrence Interval (yrs)	Historical (cfs)	2080s* (cfs)	Change
20	28,290	46,230	+63%
50	34,560	54,160	+57%
100	39,960	60,270	+51%

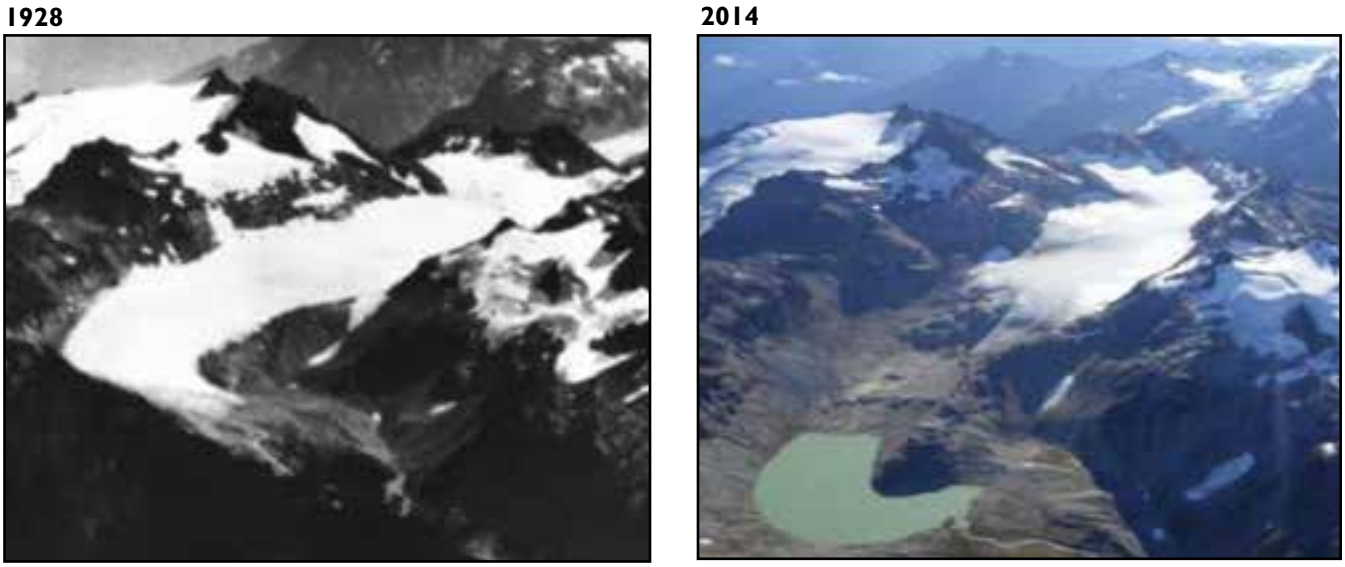
Projected increase in flood statistics for the Sauk River near USGS Gauge: 12189500.[8]

Map Data Sources: Natural Systems Design 2014[9]

Glacial Recession Threatens Fish in the Skagit River Watershed

Since 1959, glacier area in the Skagit River watershed has decreased between 30 and 35 square kilometers (about -19%).[1] At current consumption rates, this loss of glacial cover in the watershed equals the elimination of an estimated 100 years of cold freshwater supply for Skagit County.[2]

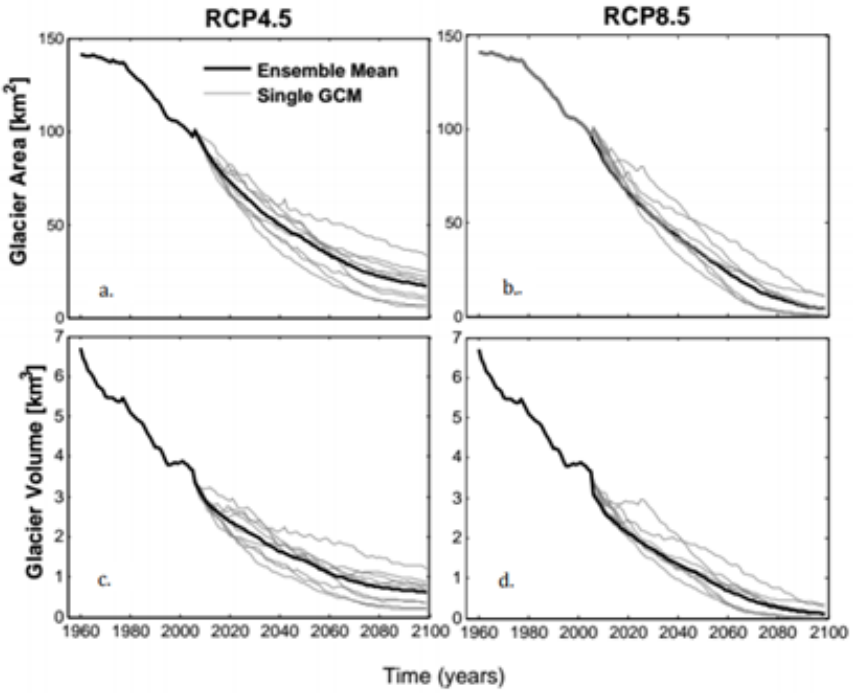
The Skagit River watershed has the most glacial cover in the contiguous United States, but that cover has been decreasing rapidly since the middle of the 20th century.[3] Skagit River salmon are cold-water fish that depend on the input of glacial water to their natal streams. Less glacial water means lower summer flows with higher summer stream temperatures.[4] Those lower, warmer streamflows threaten all freshwater life stages of salmon, including migration timing, spawning survival and rearing capacity.



U.S. Geological Survey

This time series of the South Cascade Glacier in the Skagit watershed illustrates an extensive recession of glacial area.[6]

Climate modeling using representative concentration pathways (RCP) predicts that no reduction in current greenhouse gas emissions (RCP 8.5) will result in the disappearance of all glacier coverage in the Skagit River watershed by the end of this century. More hopefully, the same climate modeling predicts that a decrease in emissions (RCP 4.5) by 2040 may result in retaining some high-elevation glacier area within the watershed.[5]

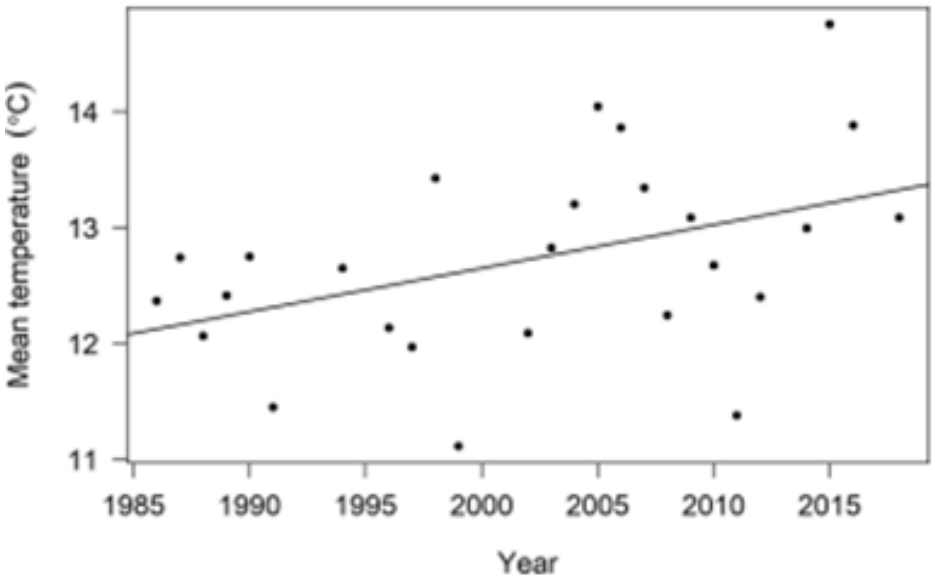


Some High-Elevation Glaciers Remain by 2100

Glaciers Entirely Gone by 2100

Chinook Salmon are Spawning Later With Warming River Temperatures

Over the last six decades, natural-origin Chinook salmon have been spawning later by up to 0.52 days per year. Meanwhile, egg take for hatchery propagation has moved earlier by 0.58 days per year. Mean August river temperatures have risen over the period of record as expected given climate predictions, suggesting that Chinook spawn timing trends may be expressing plastic or adaptive responses to warming water and/or related factors.[1]



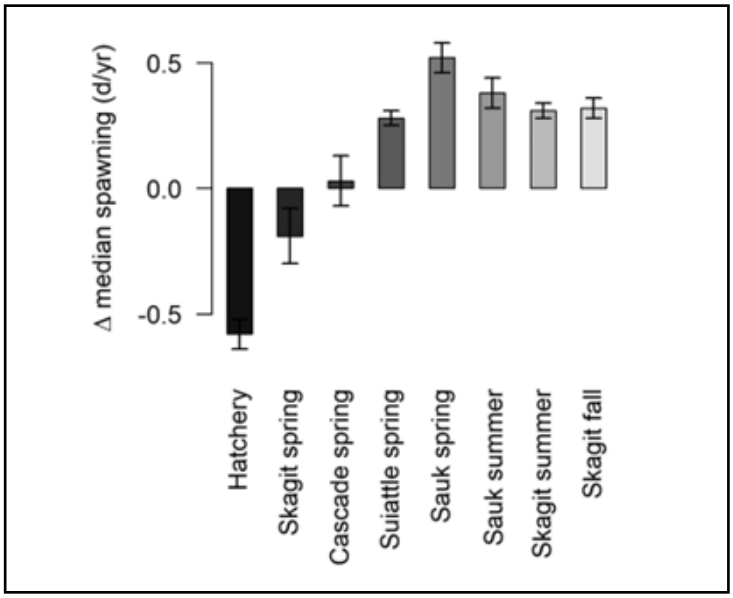
Mean of daily August maximum temperatures for the mainstem Skagit River at Marblemount (river kilometer 127).

Median timing of reproduction in Pacific Salmon populations is generally consistent among years, reflecting long-term patterns of natural selection from characteristics of the local environment. However, altered selection from factors related to climate change or human intervention might shift timing over generations, with implications for the population's persistence.

The SRSC modeled median timing of redd counts as an index of spawning timing by natural-origin Chinook salmon in the Skagit River system. Five of six natural-origin populations showed progressively later spawning over time.

Sauk River spring Chinook salmon demonstrated the fastest rate of change (0.52 days per year) and Suiattle River spring Chinook salmon the slowest (0.28 days per year).[2] Several temperature and timing factors relevant to Cascade River Chinook salmon cannot be disentangled from current data: South Cascade cold glacial meltwater input and the relationship to Marblemount Hatchery-origin fish.

Across populations, however, the picture that emerges is that Chinook salmon are spawning later with warming water temperatures, which may have implications for juvenile emergence timing in the spring and other ecological relationships important for the recovery of the species.



Bars depict the rate of change and standard error of median spawning in days per year over the period of record for naturally reproducing populations of Skagit River Chinook salmon; "Hatchery" refers to Chinook salmon egg take at the Marblemount Hatchery.[3]

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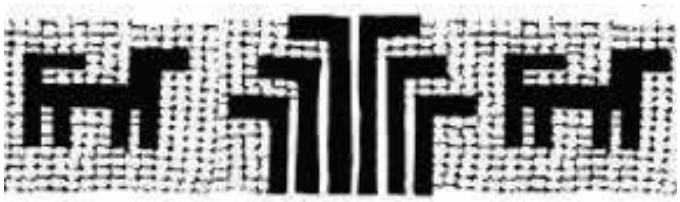
2025 State of Our Watersheds Report

Skokomish-Dosewallips Basin

We have emphasized a Skokomish River whole watershed approach and strategy in our Chinook Recovery Plan, with high expectations and aggressive goals and objectives. Habitat recovery is a fundamental component of the plan. With the support of local stakeholders and the technical and funding assistance of our federal and state partners, we have implemented and completed significant components of the habitat restoration plan. We are grateful for all those who have contributed to the effort. There does remain a lot of work to be done but we are committed to the restoration and enhancement of the Skokomish watershed resources that are vital to the health of our community.

– Joseph Pavel
Director of Natural Resources

Area of Interest



Skokomish Tribe

The Skokomish Indian Tribe is the successor to the Twana people whose aboriginal territory encompasses the entire Hood Canal and tributary watershed basins. There were nine permanent village sites throughout the Hood Canal region, as well as seasonal and temporary encampments, located near streams where they could take advantage of plentiful fish and shellfish resources.

At the signing of the Point No Point Treaty of 1855, the Skokomish Tribe ceded their traditional lands to the U.S. government, and Washington's Gov. Isaac Stevens assured the tribe that they could continue to gather food at the accustomed locations. However, during this period, Euro-Americans began farming the floodplains, cutting the forests, and shellfish and fish resources began to be harvested by settlers.

Today, the region is largely rural and forested, and communities still rely on logging, fishing, shellfish and recreation. Unfortunately, there have been major land-use impacts on treaty-protected resources including salmon habitat from dam construction, floodplain and shoreline development, and roads and logging.

The Skokomish Tribe, as natural resources co-manager, is actively engaged in the protection, maintenance, recovery and enhancement of resources throughout Hood Canal. Tribal programs include fish, shellfish, hatchery, wildlife, water quality, habitat and enforcement programs. Resource management and habitat restoration are key to maintaining tribal cultural, subsistence, and economic well-being.

Skokomish Indian Tribe

Hood Canal Watershed

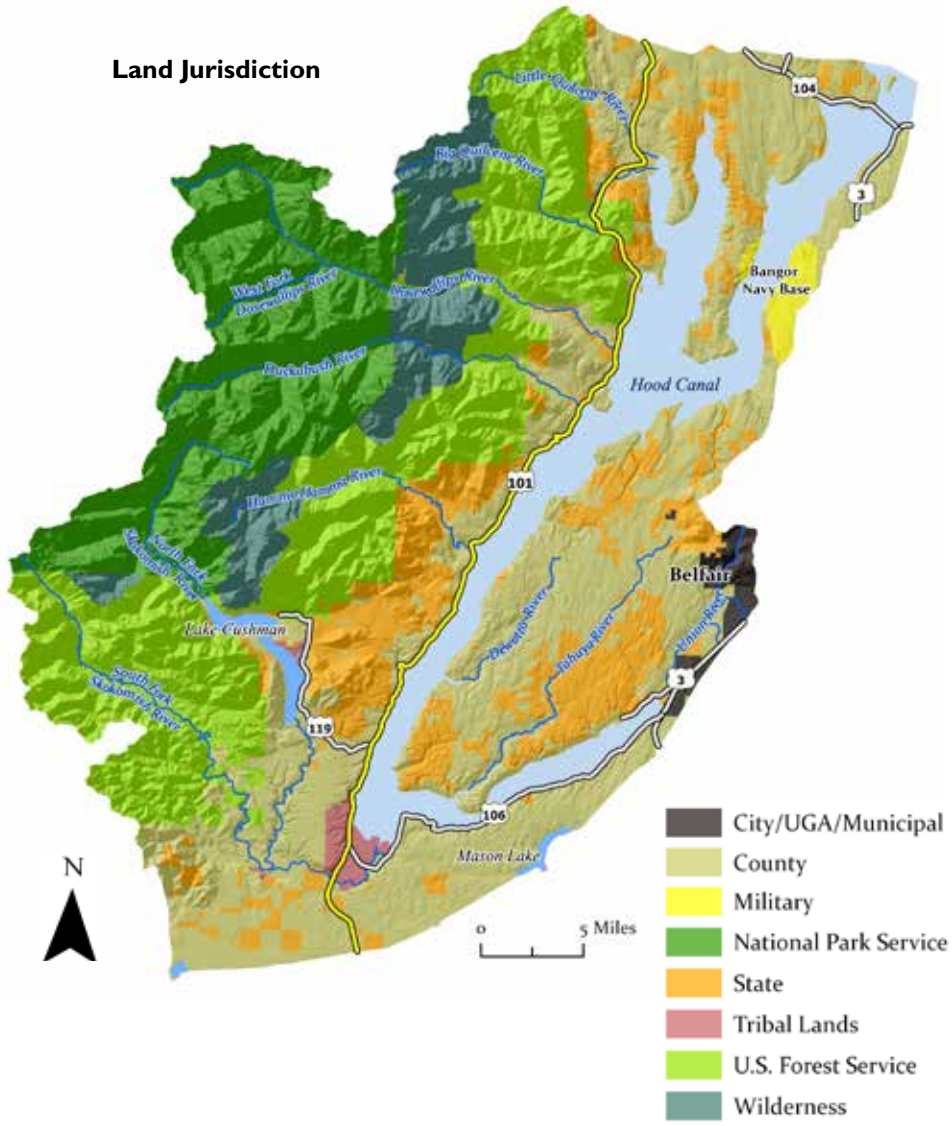
Hood Canal is a natural, glacier-carved fjord separating the Olympic and Kitsap peninsulas. It stretches 68 miles from the northern tip of the Kitsap peninsula to Lynch Cove, forming an L-shape that remains narrow, ranging from 1.5 to 2 miles across. The canal includes portions of Mason, Jefferson and Kitsap counties as well as the Skokomish and Port Gamble S'Klallam tribal reservations. Major rivers entering Hood Canal from the steep eastern slopes of the Olympic Mountains on the west side include the Skokomish, Dosewallips and Big Quilcene. Precipitation is variable—Quilcene receives only 16 inches per year, while 90 inches fall annually at Skokomish.[1]

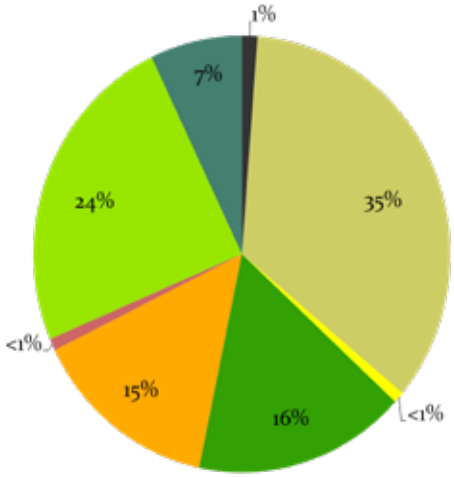
The average depth of Hood Canal is 177 feet, with a maximum depth of 600 feet, and the circulation is poor, especially in the southern portion. Water from the Strait of Juan de Fuca mixes poorly due to an underwater sill south of the Hood Canal Bridge, and fresh water entering the canal often forms a layer at the surface. Algal blooms reduce dissolved oxygen, providing a poor habitat for marine species. However, fisheries and aquaculture are economically important to the region, and the canal is famous for its oysters and other shellfish.[2]

The principal watersheds—Skokomish, Hamma Hamma, Duckabush and Dosewallips—currently support listed Hood Canal summer Chum, steelhead and Puget Sound Chinook. Sizable portions of these major watersheds are contained within the Olympic National Park or U.S. Forest Service ownership. The U.S. Forest Service lands were subject to excess resource extraction which caused extreme habitat damage and alterations. Since 1994, these lands have been managed under the U.S. Northwest Forest Plan and are now protected for the long-term health of forests, wildlife and waterways.

At treaty time, the Skokomish River supported large fish runs including all species of Pacific salmon and steelhead. This broad range of species (Chinook, Coho, Chum, Sockeye, Pink and steelhead) and fish runs returned to the Skokomish River during almost every month of the year. The estuarine and nearshore habitats of Hood Canal provide a critical migration corridor for juvenile salmon of all species.

Today, the region is largely rural and forested, with communities relying on logging, fishing, shellfish and recreation. Major land-use impacts on salmon habitat include activities such as dam construction, floodplain and shoreline development, and roads and logging, especially in steep forested terrain.





Map Data Sources: DOD 2023[3], SSHIAP 2004[4], WADNR 2024a[5], WADNR 2024b[6], WAECY 2018c[7], WAECY 2021[8], WAECY 2024[9], WADOT 2018[10], WADOT 2023[11], USFWS 2024[12]

Chapter Summary

The Twana (ancestors of the Skokomish people) were the first inhabitants of the south Hood Canal region, with villages and fishing camps located near streams where they could take advantage of plentiful fish and shellfish resources. The Skokomish Tribe are leaders in the region's salmon recovery effort. No other people know these watersheds as well as the tribes and none has a greater stake in their future. The tribes believe that if salmon are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org.*

For this report, the Skokomish Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Shoreline Armoring Continues to Impact Forage Fish Spawning Habitat and Endangered Chinook Salmon in Hood Canal

Since 2019, there have been an estimated 44 hydraulic permits accepted by WDFW to either replace or repair existing shoreline armoring in Hood Canal. In 2017, a bulkhead was replaced without the proper permits, causing permanent environmental damage and killing endangered Chinook salmon. In 2024, property owners were ordered to pay a $250,000 fine for the illegal bulkhead replacement.

Shellfish Restoration and Harvesting Opportunities Increase in Hood Canal

The Skokomish Indian Tribe has been working with partners to reestablish the native Olympia oyster near the mouth of the Skokomish River. Efforts by the tribe and others to improve water quality near Hoodsport has also led to a mile of shellfish beach to be declared safe for harvesting for the first time in 45 years.

Impervious Surface and Population Increase Slightly

Impervious surfaces in the Hood Canal watershed increased slightly by 0.05% from 2011-2021, and there was a slight increase in population between 2020-2023. Although there has not been significant change, continued population growth in the watershed could lead to a more rapid increase in development and impervious surfaces in the future.

Fish Barrier Culverts Continue to Impede Fish Passage

There are 1,105 barrier culverts which are owned by the state, cities and counties, as well as private corporations and individuals in the Skokomish Area of Interest. Most of the barriers are owned by Jefferson, Kitsap or Mason counties (455 barriers).

Forest Cover Conditions Improve

From 2011 to 2021, the Hood Canal watershed saw an increase of approximately 4,494 acres of forest cover, a 0.55% gain. Forest practice applications are still occurring, but the regrowth of forests is surpassing the amount of timber harvested.

Water Wells Increase Along Rivers Draining into Hood Canal Despite Low Flows Impacting Salmon

Along Hood Canal, 5,874 water wells were installed between 1980-2019. Between 2020-2024, an additional 283 water wells were added, a 4.8% increase.

Skokomish Estuary Monitoring Shows Native Vegetation and Salmon Using Restored Habitat

The Skokomish Tribe began restoring the estuary in 2007 and since then almost 1,000 acres have been reintroduced to tidal influence. The tribe has been monitoring the area year-round from 2011-2020, and now every other year, at 15 sites throughout the estuary and in reference marshes. The first full year of sampling showed 20 fish species, including Chinook, Chum and Coho salmon, using both the large and small tidal channels of the estuary and native vegetation flourishing where conditions permit.

Agricultural Land Riparian Management Continues

Skokomish River channel and floodplain restoration efforts continue through riparian habitat restoration and watershed planning. One of these projects is on an old agricultural farm and was completed in 2021 with a 2,500-foot-long and 12-foot-wide overflow channel that was dug through the farm to alleviate the flooding. Floodplain roughness mounds with woody debris were constructed using fill from the channel and placed in a wetland complex. A riparian buffer on each side of the overflow channel was planted with more than 8,000 native shrubs and trees.

Skokomish River Mile 5 Floodplain Reconnection Project

In 2023, an instream and floodplain reconnection project was conducted at the Skokomish River Mile 5. This project is located a short distance downstream of the Highway 101 bridge. Eight engineered logjams were installed, including one large apex jam placed directly within the Skokomish River and seven smaller deflector logjams placed along the south bank downstream of the apex jam. In addition, a 2,000-foot-long side channel connecting the Skokomish River with Purdy Creek was excavated to provide flood conveyance and flood storage capacity in undeveloped areas away from infrastructure.

Conclusion

There have been a number of successes in the Skokomish watershed in recent years, including an increasing amount of forest cover, and improving water quality—which lead to an opening of shellfish beach to harvest for the first time in 45 years—and continued success with local restoration projects to improve habitat.

Impervious surface growth in the Hood Canal watershed from 2011-2021 was negligible. Shoreline armoring is still increasing, which is not meeting the Puget Sound Partnership's goal of the having the amount of armoring removed exceed the amount constructed.

Hood Canal has experienced substantial population growth, especially along the shoreline over the past several decades, bringing an increased demand for water. From 1980-2019, the Hood Canal watershed saw 5,874 new water wells and between 2020-2024, an additional 283 water wells, which represents a 4.8% increase.

Today, the Skokomish watershed is the most complete estuary restoration project in Puget Sound. In 2018, spring Chinook salmon returned to the watershed to spawn for the first time in nearly a century, after having been reintroduced to the river by the tribe in 2016.

People need to be held accountable to protect, conserve and improve fish habitat in their land-use decisions, and federal, state and local governments all have a role in that. Land use and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented. Implementation includes education and voluntary action, but it also needs to include enforcement when those laws are broken. The future of tribal treaty rights in the Skokomish watershed depends on it.

Recovery Efforts Improving but More Actions are Needed

At the 20-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Skokomish-Dosewallips Basin area shows that priority concerns continue to be around the degradation of marine shoreline habitat conditions, barrier culverts, population growth, a slight increase in impervious surface and the associated increase in water wells.

There have been improvements to the watershed's forest cover and marine water quality, represented by the net gain of shellfish harvest acres.

In general, there is a shortage of staff at all levels (federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat, and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trends for these key environmental indicators shows an improvement in forest cover, nearshore water quality leading to more shellfish harvest areas being re-opened and restoration efforts:

Tribal Indicator	Status	Habitat Trend
Shoreline Armoring	Since 2019, there have been an estimated 44 hydraulic permits accepted by WDFW to either replace or repair existing shoreline armoring in Hood Canal. There was also an illegal repair project that has resulted in permanent environmental damage and the killing of endangered Chinook salmon.	Declining
Habitat Restoration - Shellfish	The Skokomish Indian Tribe has been working with partners to reestablish the native Olympia oyster near the mouth of the Skokomish River. Efforts by the tribe and others to improve water quality near Hoodsport have also led to a mile of shellfish beach to be declared safe for harvesting for the first time in 45 years.	Improving
Impervious Surface - Population Density	Impervious surfaces have slightly increased (0.05%) from 2011 to 2021 and there was a slight increase in population between 2020-2023.	Declining
Barrier Culverts	There are 1,105 barrier culverts which are owned by the state, cities and counties, as well as private corporations and individuals in the Skokomish Area of Interest. Most of the barriers are owned by Jefferson, Kitsap or Mason counties (455 barriers).	Declining
Forest Cover	From 2011 to 2021, the Hood Canal watershed saw an increase of approximately 4,494 acres of forest cover, a 0.55% gain. Forest practice applications are still occurring, but the regrowth of forests is surpassing the amount of timber harvested.	Improving
Water Wells	Between 1980-2019, 5,874 water wells were installed near Hood Canal and between 2020-2024, an additional 283 water wells were added, that is a 4.8% increase in water wells.	Declining
Restoration	The two habitat improvement projects completed at Skokomish River Mile 5 (the Farm in 2021 and the LWD/side channel in 2023) have exceeded the expectations of project partners. Additional floodplain reconnection and habitat improvement projects continue to be developed throughout the watershed.	Improving

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring areas that are degraded, and conducting research to understand the different species and the habitats they occupy.

Looking Ahead

Examples of issues and opportunities that may affect the future of watershed health in Hood Canal include management of the following:

- Water quality monitoring and remediation will continue to be focused activities of the Skokomish Tribe. Septic system failures are an ongoing threat to water quality and resource health. The tribe has been successful at identifying and correcting failing systems, increasing the acreage of clean beaches, and availability of safe shellfish products. The increasing number of septic system installations and the ongoing burden of maintaining the functionality of existing systems is an ongoing threat to any progress made.
- Long-term weather pattern effects have contributed to increasing threats of harmful algal blooms, which contribute to hypoxic conditions in Hood Canal, and beach closures with prohibitions on shellfish harvest due to harmful algal toxins in shellfish. The tribe continues to monitor these conditions, contributing to the body of information needed to mitigate and adapt to fluctuating climate conditions.
- Animal manure and pet waste also contribute to the fouling of waters and the tribe continues to strive for the control of these inputs and the maintenance of water quality. The tribe looks to their partners at the Washington Department of Ecology and the county departments of Health to be vigilant in enforcing the existing standards and improving water quality protection standards and capabilities.
- The Skokomish Tribe will continue to conduct an active habitat maintenance, protection, and restoration program. The tribe has accomplished a tremendous amount of active instream, floodplain and riparian restoration projects throughout the Skokomish River Basin and currently has significant projects in the planning and implementation phases. The Mason Conservation District (MCD) has been building off the U.S. Army Corps of Engineers General Investigation study to provide an updated watershed assessment and project prioritization. The Skokomish Tribe will continue to work with MCD to design, fund and implement conservation and restoration projects in the basin while keeping riparian vegetation recovery efforts as a focus in our watershed.
- The Skokomish Tribe works with the city of Tacoma and other partners (WDFW, NOAA Fisheries, USFWS, BIA, WDOE, USFS and NPS) to implement the conditions of a settlement between the parties which also include the issuance of a FERC license to operate hydroelectric facilities. The conditions include a program to reintroduce spring Chinook and Sockeye in the Skokomish River. The North Fork Skokomish River habitat restoration planning, design and funding also are included in the conditions. The tribe is working with Tacoma Power on planning and design of the North Fork restoration and looks forward to the implementation of these projects in the near future.
- The Skokomish Tribe continues to develop and implement the Chinook Recovery Plan with WDFW, city of Tacoma and NOAA Fisheries, and the Summer Chum Recovery Plan with HCCC, WDFW, HCSEG and NOAA fisheries. The tribe is looking ahead to recovery of these species in the watershed, as well as maintaining and enhancing existing resources. These efforts require an ongoing commitment of funding. Education, communication and outreach are necessary to achieve the required level of commitment.

Shoreline Armoring Continues to Impact Forage Fish Spawning Habitat and Endangered Chinook Salmon in Hood Canal

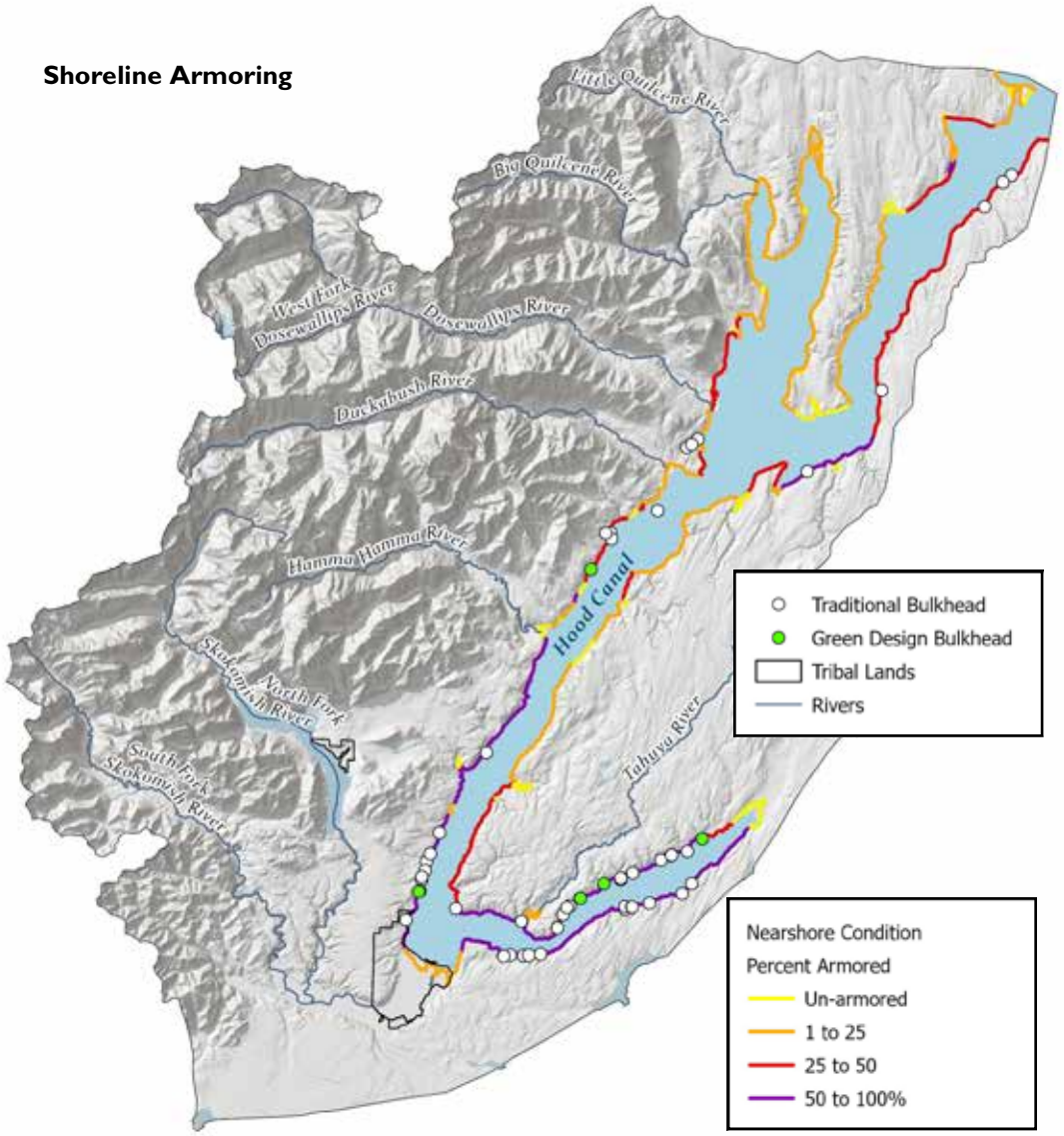
Since 2019, there have been an estimated 44 hydraulic permits accepted by WDFW to either replace or repair existing shoreline armoring in Hood Canal. In 2017, a bulkhead was replaced without the proper permits, causing permanent environmental damage and killing endangered Chinook salmon. In 2024, property owners were ordered to pay a $250,000 fine for the illegal bulkhead replacement.

Shoreline armoring impacts ecosystem processes, structure, and function in the nearshore environment. Armoring can block sediment supply, reduce the abundance of large woody debris on beaches, and cause the direct loss of forage fish spawning habitat. Shoreline armoring can also alter juvenile salmon distribution and movement patterns.[1]

Since 2019, there have been an estimated 44 hydraulic permits accepted by WDFW that either replace or repair existing armoring in Hood Canal. Of those, only five had green design elements, such as replacing the bulkhead further upland to provide a net gain of beach habitat or using grated decking that allows light to penetrate through, which decreases juvenile salmon predation.[2,3,4]

The Hood Canal Coordinating Council (HCCC) provides an In-Lieu Fee (ILF) Program which gives an alternate mitigation option for authorized, unavoidable impacts to freshwater and marine aquatic resources and may offer some permit applicants an option to purchase mitigation credits from HCCC to fully satisfy mitigation obligations for their proposed projects. Landowners or developers can implement their own mitigation projects or voluntarily use the ILF Program.[5]

If landowners or developers do not go through the permitting process to repair or replace existing bulkheads, the consequences can be costly to not only the property owners, but the nearshore environment. In 2017, a bulkhead was replaced without the required permits and the construction projects discharged concrete and other fill material in Hood Canal, permanently and negatively changing the patterns of tidal water flow and circulation along the shoreline. Property owners admitted to the death of endangered Chinook salmon during construction of the bulkhead, and in January 2024, the U.S. District Court for the Western District of Washington ordered them to pay a $250,000 penalty and provide $33,492 to the HCCC as mitigation for their illegal bulkhead replacement work.[6]



Map Data Sources: WDFW 2023[2], CGS 2020[3], SSHIAP 2004[7], USGS 2018[8], WADOT 2018[9]

Shellfish Restoration and Harvesting Opportunities Increase in Hood Canal

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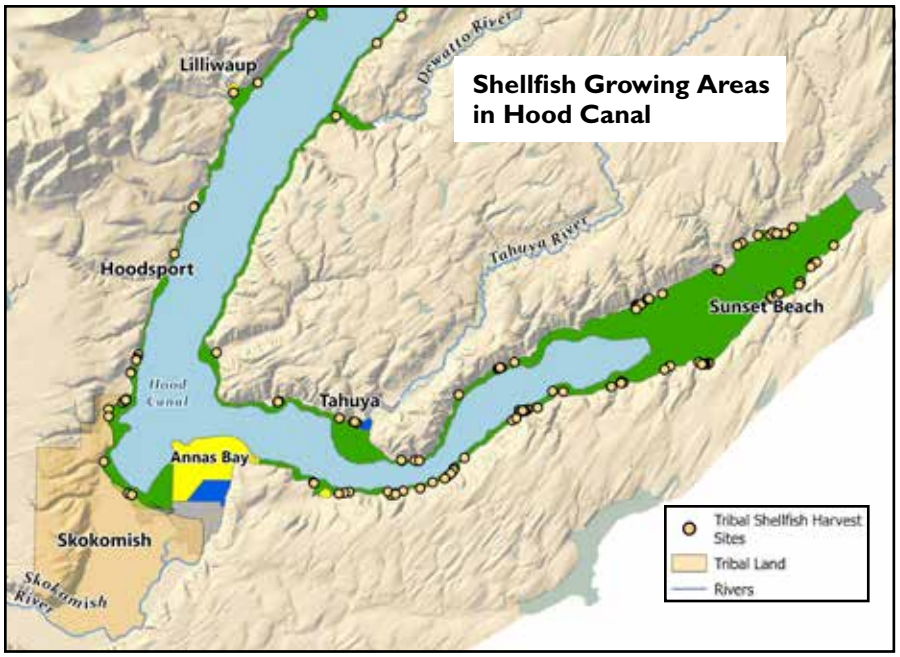
Tiffany Royal, NWIFC

A bag of adult Olympia oysters.



In Hood Canal, shellfish harvesting holds great cultural, economic and subsistence value to the Skokomish Tribe. The tribe has been working with the Natural Resource Conservation Service and Puget Sound Restoration Fund to restore the Skokomish tidelands near the mouth of the Skokomish River. In 2021, the tribe partnered with The Nature Conservancy and Pew Charitable Trusts to participate in a national oyster restoration program, Supporting Oyster Aquaculture and Restoration (SOAR). The goal of SOAR is to support local growers by purchasing native oysters to be used in nearby restoration projects that benefit shellfish habitat and water quality.[1]

Olympia oysters were received from Set and Drift, a Hood Canal shellfish farm. The oysters were spread on the tribe's tidelands to see how they respond in terms of spawning and growth.

The native oyster is important to the tribe as a traditional food source, but pollution and overharvest since the late 1880s nearly destroyed the population. Efforts to restore Olympia oysters will not only provide harvestable quantities of subsistence food to the tribe but will also reestablish an important species to Puget Sound intertidal habitats. The oysters are prey for crabs, juvenile salmon, seasonal birds and small marine life.[1]

Shellfish harvesting opportunities recently increased in southern Hood Canal after a mile of shellfish beach near Hoodsport was opened and declared safe for harvesting. After four years of improving water quality, the Washington Department of Health upgraded 66 acres of tidelands from Prohibited to Approved status in 2021. Cleanup efforts involved tracking down sources of pollution, which included eight failing septic systems that were either repaired or replaced. The Skokomish Tribe pushed for the cleanup project to take place and assisted with water quality sampling.

Other partners included Mason County Public Health, who found the sources of pollution, and the Hood Canal Coordinating Council, who provided funding through the Hood Canal Regional Pollution Identification and Correction Program. Tribal members are happy to have a new area to harvest shellfish located close to the Skokomish Reservation with easy access by land and by boat.[2]

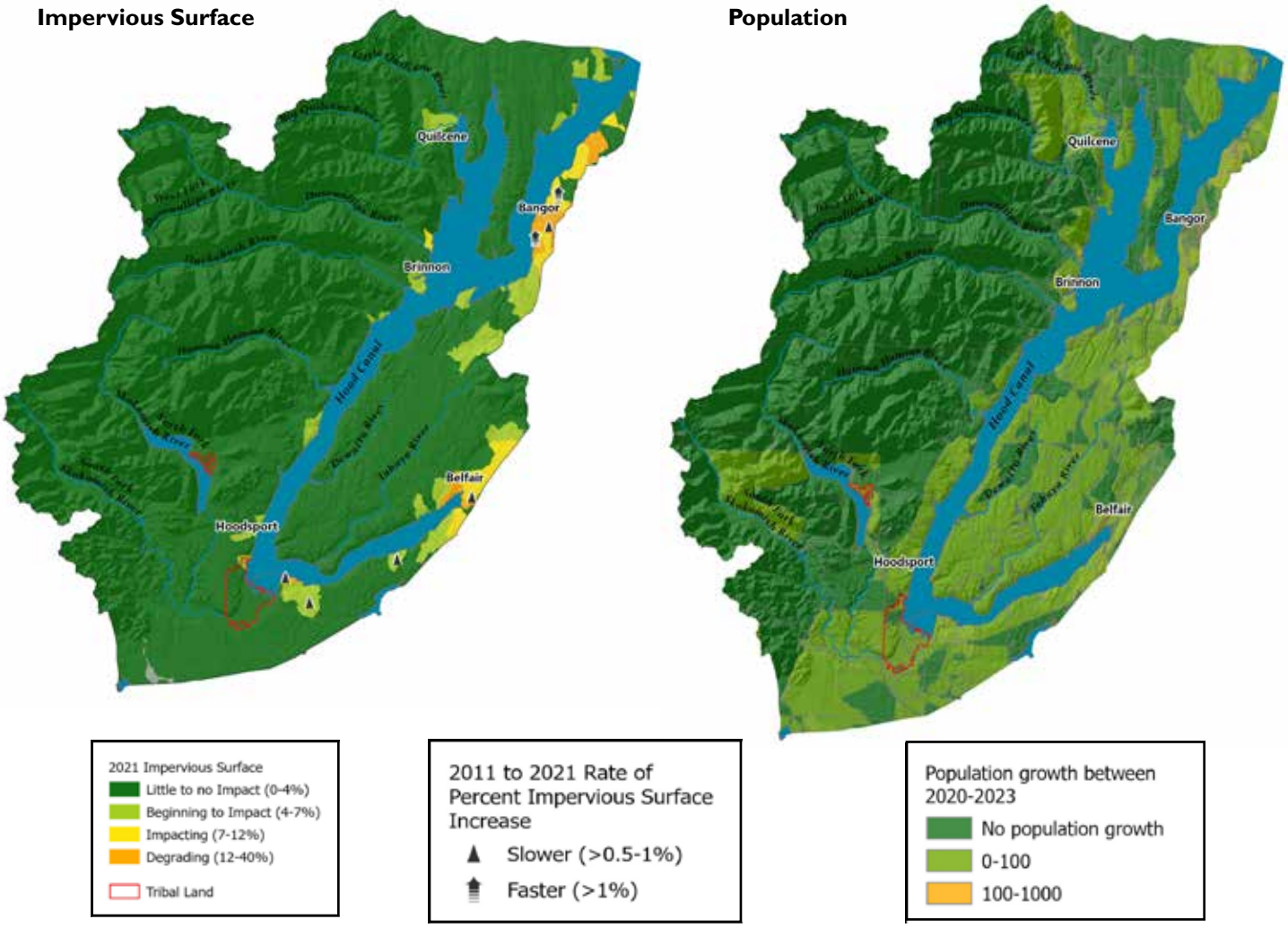
Julian Sammons, Skokomish Tribe

Skokomish Tribal members harvest shellfish at the newly approved beach near Hoodsport.

Map Data Sources: WADOHa 2025[3], WADOHb 2025[4], SSHIAP 2004[5], USGS 2018[6]

Impervious Surface and Population Increase Slightly

Impervious surfaces in the Hood Canal watershed increased slightly by 0.05% from 2011-2021, and there was a slight increase in population between 2020-2023. Although there has not been significant change, continued population growth in the watershed could lead to a more rapid increase in development and impervious surfaces in the future.



The Hood Canal watershed's rivers, streams and nearshore environment provide important habitat for Chinook, Chum, Coho and Pink salmon, steelhead and cutthroat trout. Habitat quality has diminished due to multiple causes including land clearing for agriculture and residences, large-scale logging, stream modifications, shoreline development, and water impairment from nonpoint source pollutants.[1,2]

Impervious surfaces prevent the infiltration of water, which reduces groundwater recharge and base flow. Nonpoint source pollutants including pathogens, nutrients, toxic contaminants and sediment collect on impervious surfaces, and during rainfall events, the stormwater containing these pollutants flows directly into waterways, causing harm to aquatic ecosystems. Increasing development results in increases in impervious surfaces such as roads, parking lots and rooftops.[3,4]

Impervious surfaces in the Hood Canal watershed increased slightly by 0.05% from 2011-2021,[5,6] and there was a slight increase in population between 2020-2023.[7] Although there has not been significant change, continued population growth in the watershed could lead to a more rapid increase in development and impervious surfaces in the future.

The Skokomish Chinook Recovery Plan states that habitat must be accessible and exist in sufficient quality and quantity for all salmonid life stages.[2] How state and local governments manage urban/rural growth as more people move into the Hood Canal watershed will have a direct impact on salmon and steelhead habitat.

Map Data Sources: NLCD 2011[5], NLCD 2021[6], WAOFM 2023[7], SSHIAP 2004[8], WADOT 2018[9], SWIFD 2019[10], WAECY 2017[11]

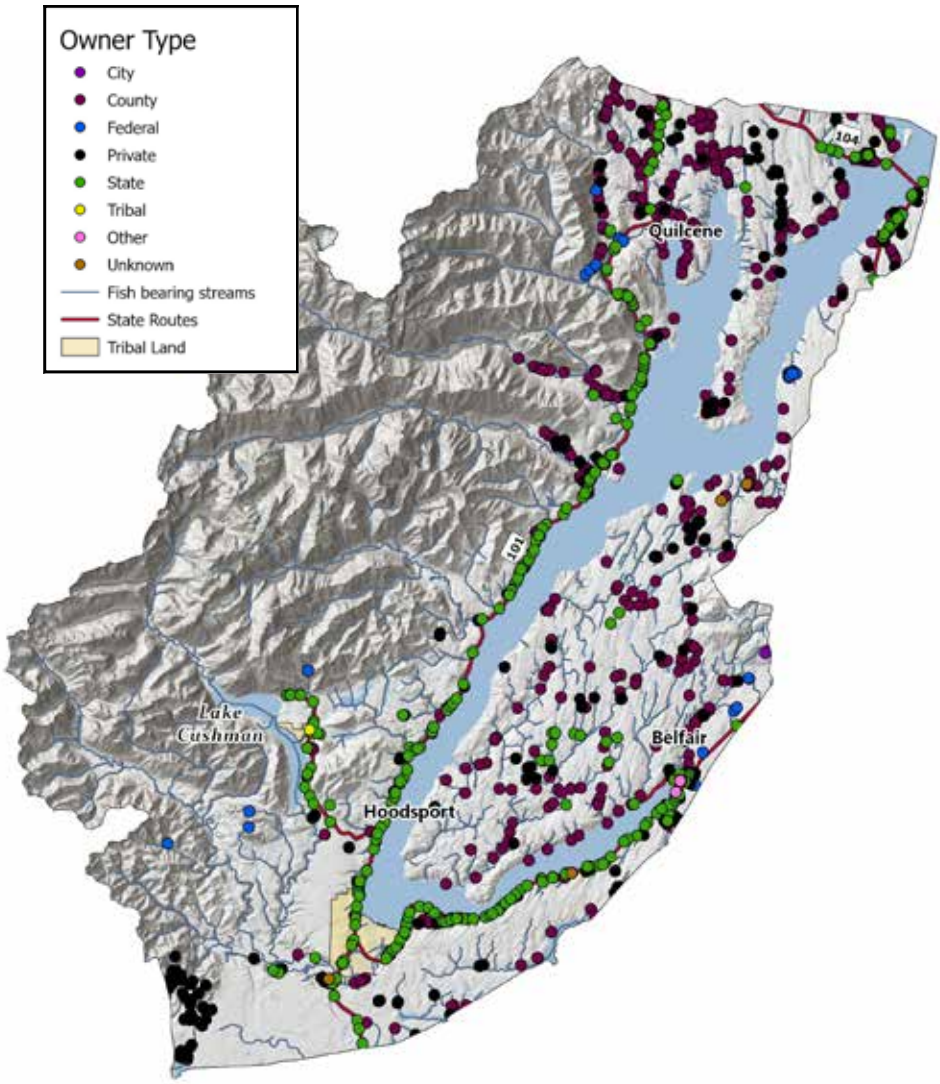
Fish Barrier Culverts Continue to Impede Fish Passage

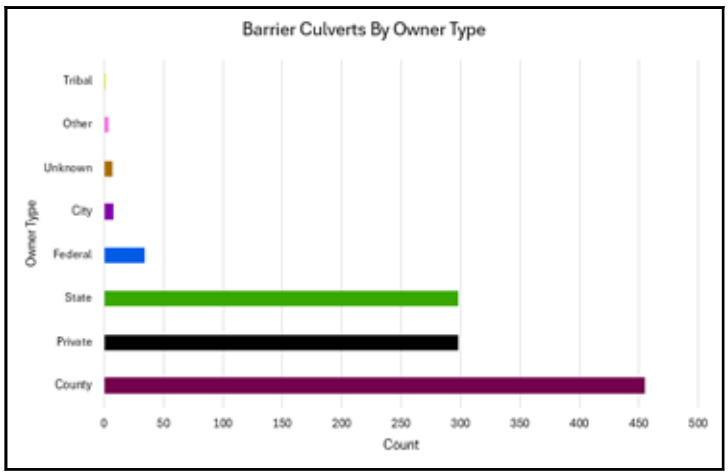
There are 1,105 barrier culverts owned by the state, cities and counties, as well as private corporations and individuals in the Skokomish Area of Interest. Most of the barriers are owned by Jefferson, Kitsap or Mason counties (455 barriers).

Culverts (tunnels that carry a stream under a road) can be barriers to fish migration when they are too small or steep or are perched too high to allow fish to pass. When fish can't reach suitable habitat to feed, migrate or spawn, populations decline. Reduced fish populations affect the entire ecosystem. Juvenile salmon are important prey for other species, and adults who spawn and die provide nutrients to river ecosystems. Reduced populations affect commercial and recreational fisheries, impacting local economies as well as tribal communities.[1]

Washington state is under a court injunction to replace the barrier culverts opening 90% of potential habitat by 2030.[2] In addition to culverts identified by the culvert injunction, there are 1,105 barrier culverts that are owned by the state, cities and counties, as well as private corporations and individuals in the Skokomish Area of Interest. Private ownership accounts for 298 (27%) of the culverts while local governments, the federal government and Washington state own 463 (42%), 34 (3.1%) and 298 (27%) culverts, respectively. About 1% of barrier culverts fall outside of these ownerships.[3] Over half of these barrier culverts are owned by small landowners and local governments who are going to need significant resources to remove these impediments to fish passage and improve fish habitat.

Skokomish Park at Lake Cushman, formerly known as Camp Cushman, was included in lands returned to the tribe as part of a settlement with Tacoma Power in 2009.[4] The park is located at the mouth of Big Creek, which at one time had a culvert placed in it by the Washington Department of Natural Resources. The culvert is in the design process of being removed in collaboration with the tribe and the Washington State Department of Transportation.





Map Data Sources: WDFW 2025[3], WADOT 2018[5], WADOT 2010[6], SWIFD 2024[7], WADOT 2024[8], SSHIAP 2004[9]

Forest Cover Conditions Improve

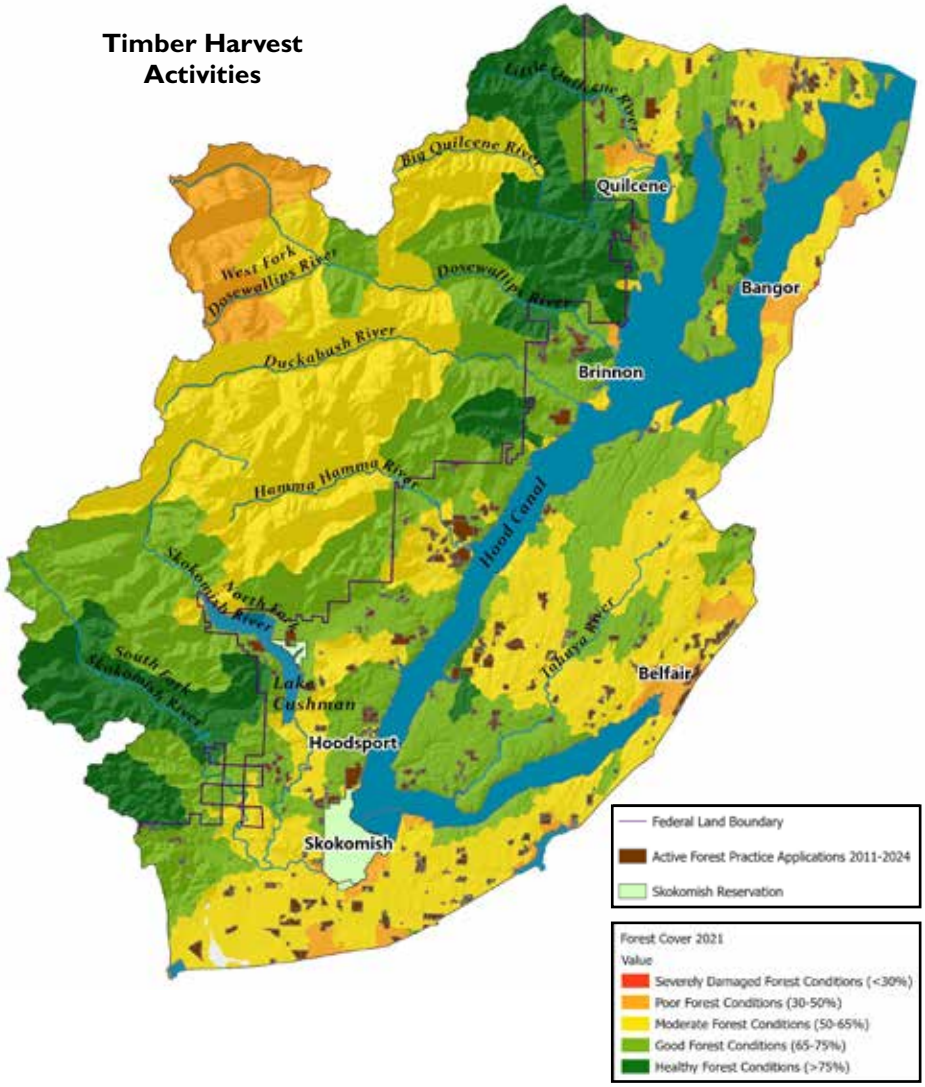
From 2011 to 2021, the Hood Canal watershed saw an increase of approximately 4,494 acres of forest cover, a 0.55% gain.[1,2] Forest practice applications are still occurring, but the regrowth of forests is surpassing the amount of timber harvested.

The Skokomish Tribe is taking steps to maintain and protect its own forestlands. The tribe has earned the Forest Stewardship Council certification through the Northwest Natural Resource Group (NNRG) for its 2,086-acre forest at the south end of Hood Canal in Mason County.

Forest Stewardship Council certification is a market-based, voluntary system for ensuring that wood products come from well-managed forests. This makes the Skokomish Tribe the first tribe in Washington state to gain certification of a well-managed forest.[3]

The tribe hired NNRG to help steward its forests in 2014 and develop a management plan for its forest holdings. Those forests include more than 1,500 acres on the reservation and about 500 acres at Skokomish Park by the shores of Lake Cushman. The forest management plan aims to develop the characteristics of a more mature, diverse and robust stand that will provide a wide array of ecological benefits, including a variety of understory vegetation species and wildlife habitat. The plan is also intended to generate a sustainable return of high value timber products.[3]

The first certified harvest of Skokomish Park happened in 2019. The neglected forest floor was opened using a "thin from below" strategy, in which smaller-diameter trees are removed to create more light, nutrients and room for other trees and understory to flourish. This will lead to more species diversity in plants and encourage more browsers and grazers to inhabit the forest.[4]



Tiffany Royal, NWIFC

Construction crews work on one of the logjams in the South Fork of the Skokomish River.

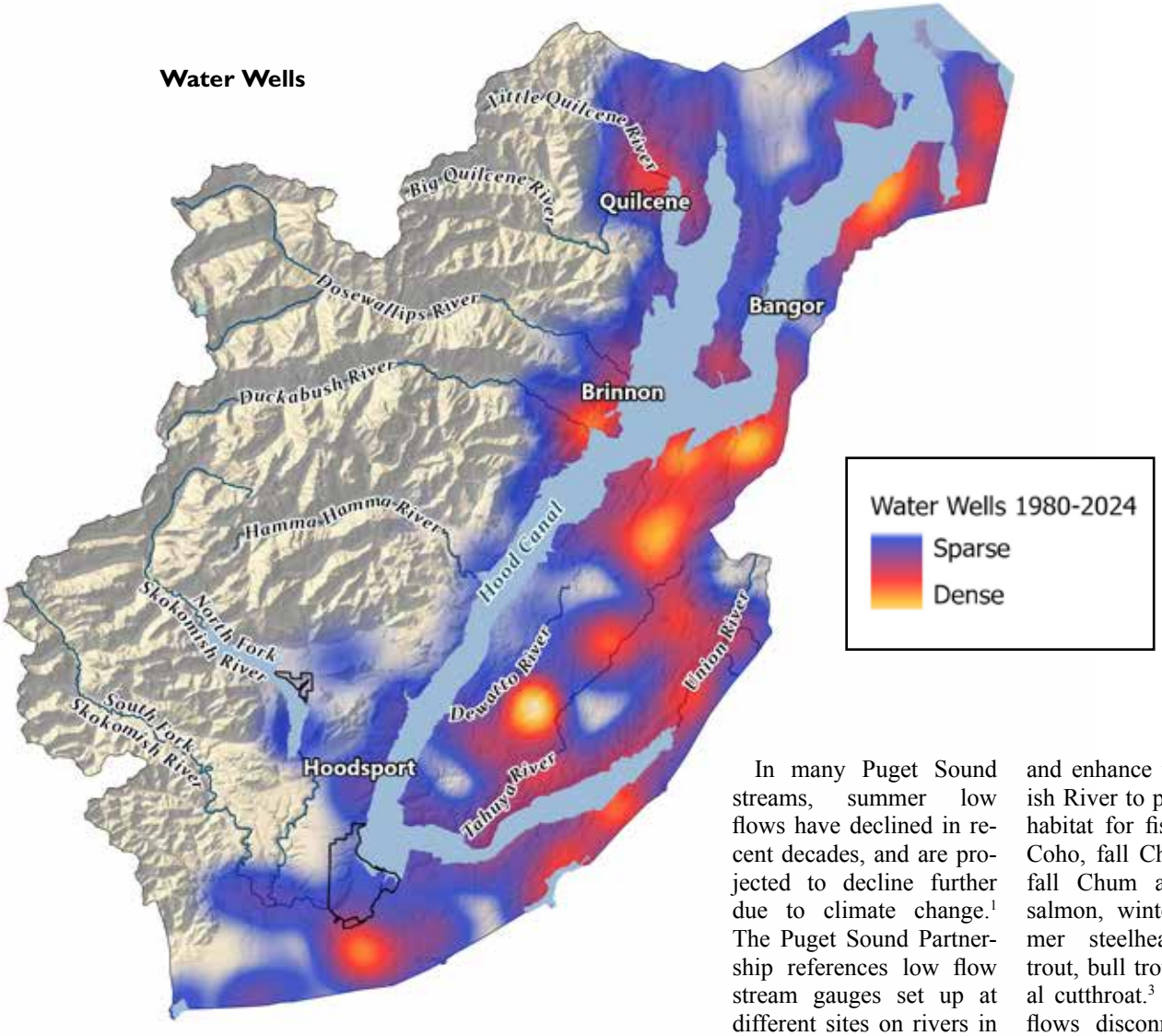
The forest surrounding the South Fork of the Skokomish River has a history of extensive logging and associated road construction. By the mid-1990s, the South Fork was one of the most intensely harvested watersheds in the state, with 60% of the National Forest land clearcut and roads built at a density of over 3.6 miles of road per square mile of forest. These activities, combined with other alterations in the watershed, led to sediment buildup in streams and a simplification of the river channel.[5]

Since 2010, the Skokomish Tribe and its partners, Mason Conservation District and the U.S. Forest Service, started adding woody debris to improve salmon habitat within 15 miles of the upper South Fork of the Skokomish River. In 2022, more than 1,000 logs were placed strategically within the floodplain and stream channel to facilitate the development of pools and riffles, leading to more productive fish habitat.[6]

Map Data Sources: NLCD 2011[1], NLCD 2021[2], ESRI 2024[7], WADNR 2020[8], WAECY 2017[9], SSHIAP 2004[10], WADOT 2018[11], WADOT 2010[12], WAECY 2018[13]

Water Wells Increase Along Rivers Draining into Hood Canal Despite Low Flows Impacting Salmon

Along Hood Canal, 5,874 water wells were installed between 1980-2019. Between 2020-2024, an additional 283 water wells were added, a 4.8% increase.



In many Puget Sound streams, summer low flows have declined in recent decades, and are projected to decline further due to climate change.[1] The Puget Sound Partnership references low flow stream gauges set up at different sites on rivers in Puget Sound, including two rivers that drain into Hood Canal. Between 2018-2021, the North Fork Skokomish River near Hoodsport and the Duckabush River near Brinnon both experienced mean daily flow that was below normal more than 50% of the year.[2]

The Skokomish Tribe has been working to restore and enhance the Skokomish River to provide better habitat for fish, including Coho, fall Chinook, Pink, fall Chum and Sockeye salmon, winter and summer steelhead, rainbow trout, bull trout and coastal cutthroat.[3] Summer low flows disconnect streams from their floodplains, forcing fish who make it upstream to build their redds in the main channel of the river where they are more vulnerable to scour during peak winter flows. Juvenile salmon who are forced out of off-channel habitat are more exposed to predation, concentrated pollutants in the water, and increased temperatures.[4]

(Continued next page)

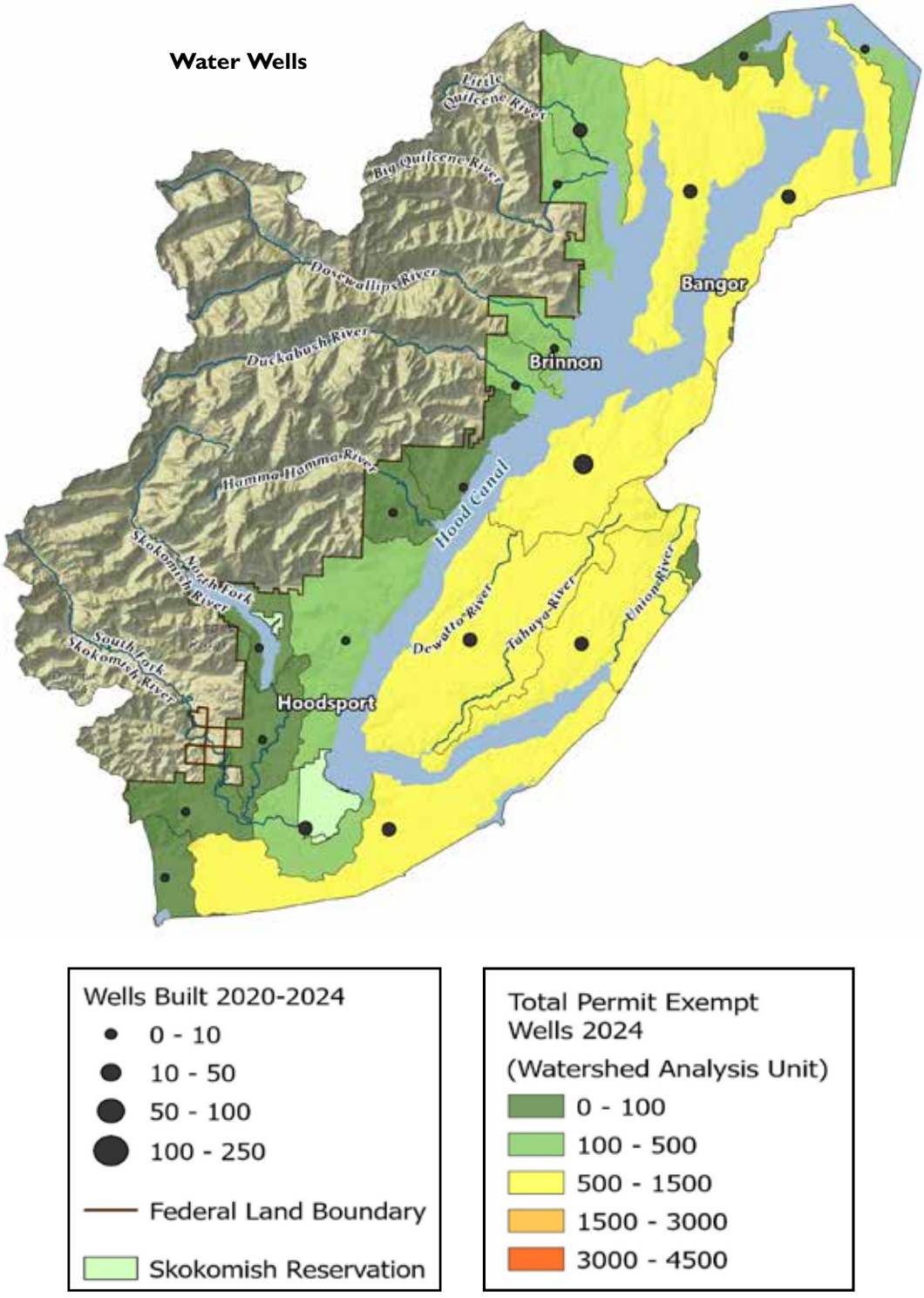
Map Data Sources: WAECY 2024[5], SSHIAP 2004[7], WADOT 2018[8], WADOT 2010[9], SWIFD 2019[10]

(Continued from previous page)

Along Hood Canal, 5,874 water wells were installed between 1980-2019. Between 2020-2024, an additional 283 water wells were added, a 4.8% increase.[5] Most of the new wells are located near the Dewatto, Tahuya, Union, Quilcene and Skokomish rivers. With these rivers already experiencing below average flows and summer low flows getting lower and lasting longer each year, the increase in water wells will inevitably impact salmon as decreased flows reduce available instream habitat, increase temperatures and limit fish passage.

The Skokomish Area of Interest includes portions of Water Resource Inventory Area (WRIA) 14, 15, 16 & 17. Watershed plans for WRIA 16 & 17 were previously adopted by planning units in 2006 and 2011, respectively. Watershed planning groups have worked on WRIA 14 & 15 management plans since 2018. These planning groups were not able to come to a consensus, and after technical review by the Salmon Recovery Funding Board, the Washington Department of Ecology adopted these plans in December 2024 and is initiating rulemaking, under the Streamflow Restoration Law.

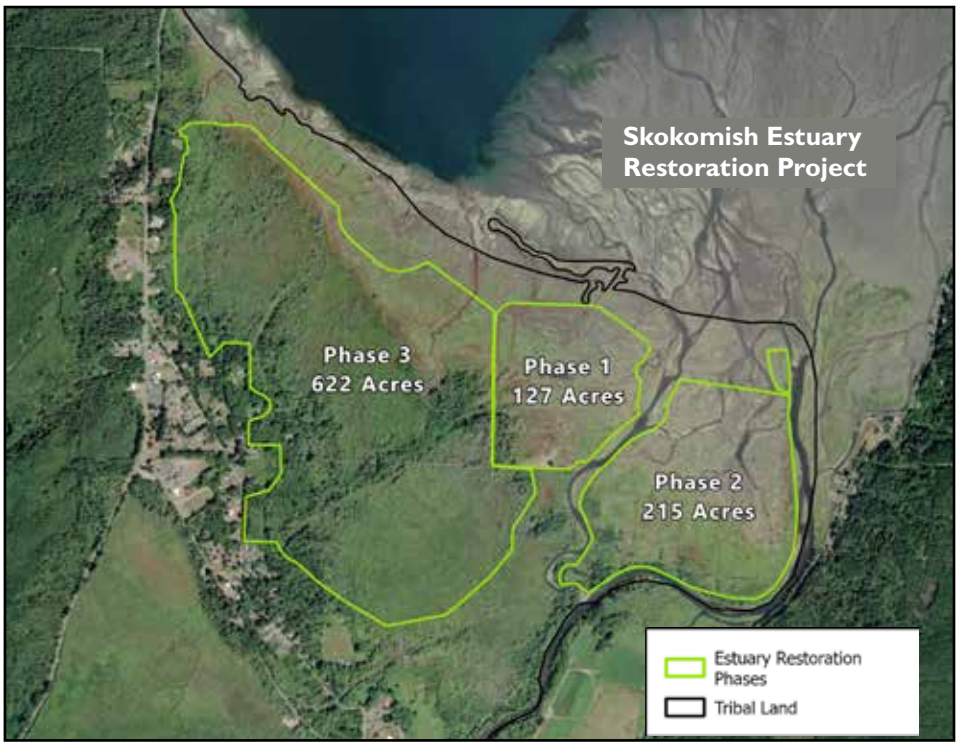
For example, the WRIA 15 plan projects 5,215 new permit-exempt wells to be installed between 2018-2038. Of the seven subbasins in WRIA 15 that were analyzed, roughly two fall within the Skokomish Area of Interest. The North Hood Canal and South Hood Canal subbasins are projected to install 1,782 permit-exempt wells between 2018-2038. The estimated impact of these wells on rivers and streams is 245.3 acre-feet per year (a volume equal to about 121 Olympic sized swimming pools).[6]



Map Data Sources: WAECY 2024[5], SSHIAP 2004[7], WADOT 2018[8], WADOT 2010[9], SWIFD 2019[10], WAECY 2017[11], ESRI 2024[12]

Skokomish Estuary Monitoring Shows Native Vegetation and Salmon Using Restored Habitat

The Skokomish Indian Tribe has worked with multiple partners, particularly Hood Canal Coordinating Council, Mason Conservation District and Tacoma Power, in a multi-phased effort to restore the Skokomish River estuary to its historic and natural form and function. Project funding, $12.4 million, was provided from multiple sources, including the National Marine Fisheries Service, Puget Sound Nearshore and Estuary Restoration Program, U.S. Fish and Wildlife Service, Pacific Salmon Recovery Fund, U.S. Army Corps of Engineers and others. The estuary has not been completely restored to conditions that existed prior to development; however, the restoration has been comprehensive and will facilitate ongoing recovery of the estuary toward undisturbed conditions. This was a phased project: Phase 1 dike removal occurred in 2007 and Phase 2 dike removal in 2010. Both dike removal phases included removal of tide gates, roads, culverts, and restoration of historic channel networks. Rootwads were installed to support habitat in the channels, and new salmon-friendly bridges and larger culverts reconnected freshwater wetlands to the estuary.[1]



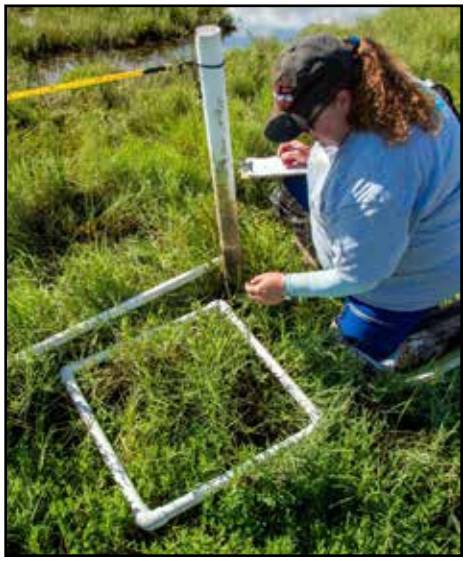
Map Data Sources: Belleveau 2018[5], WADOT 2018[6]

After Phase 1 was completed and the river and the tide had access to the salt marsh, native salt marsh vegetation came in right away and channels started forming on their own.[2] The first full year of sampling showed 20 fish species, including Chinook, Chum and Coho salmon, using both the large and small tidal channels of the estuary.[3] In 2016, Phase 3 (final phase) of the restoration was completed, however the estuary will take several decades to fully recover on its own.

The tribe has been monitoring the area year-round from 2011-2020, and now every other year at 15 sites throughout the estuary and in reference marshes. There are 3 plots per site where salinity levels in the soil are measured, as well as plants present and how the estuary has increased or decreased in elevation according to the height of the sediment. Continued monitoring will help biologists determine salt marsh plant species tolerance of varying levels of salinity and tidal inundation and where different vegetation communities are likely to settle.[4] Monitoring also includes eight monitoring locations that record data on water depth, salinity and temperature. These parameters can help biologists and planners understand impacts associated with sea level rise such as inland migration and coastal squeeze. The tribe will continue monitoring and restoring the floodplain in the valley, as well as continuing restoration efforts in the forested upper watershed of the Skokomish River.[2]

Tiffany Royal, NWIFC

Skokomish tribal staff monitor vegetation growth and sediment deposits in the Skokomish estuary.



Tiffany Royal, NWIFC

Skokomish habitat manager Lisa Belleveau notes the types of vegetation present at a monitoring site in the Skokomish estuary in 2024.

Agricultural Land Riparian Management Continues

Skokomish River channel and floodplain restoration efforts continue through riparian habitat restoration and watershed planning.

The Skokomish River is the largest river that flows into Hood Canal. Since the Euro-American colonization of the Pacific Northwest, the river and surrounding land have been transformed to suit timber, hydropower and agricultural uses.[1]

Critical salmon habitat has been degrading for many years, prompting the Skokomish Tribe and Mason County in 2003 to request a General Investigation by the U.S. Army Corps of Engineers (USACE). The investigation was completed in 2015, and determined the Skokomish ecosystem will continue to degrade unless restoration actions are taken, and that it is of national interest to develop and implement five federal ecosystem restoration projects for the Skokomish River: the Skokomish South Fork large woody debris installation, confluence levee removal, river mile 9 levee setback, grange levee setback, and side channel reconnection.

Since the completion of the General Investigation, USACE has not been able to complete these projects and the tribe along with the Mason Conservation District are taking up the responsibility to move these critical projects forward. These projects will aim to manage excessive sedimentation, restore year-round fish passage into critical spawning grounds, and reconnect 161 acres of floodplain.[2,3]

These projects join several other Skokomish channel and floodplain restoration projects that will improve the physical habitat conditions within the stream channel and the surrounding floodplain.[4]

One of these projects is on an old agricultural farm. More than 100 acres of the farm was purchased by the tribe in 2011. The farm regularly floods during significant rain events as the Skokomish River cuts through the property, sending fish into the flooded hayfields. Work was done in 2021 to redirect the water with a 2,500-foot-long and 12-foot-wide overflow channel that was dug through the farm to alleviate the flooding. Floodplain roughness mounds with woody debris were constructed using fill from the channel and placed in a wetland complex on the other end of the channel. A 75-foot riparian buffer on each side of the overflow channel was planted with more than 8,000 native shrubs and trees. The primary goal of the project is to restore salmon habitat and create a functional floodplain while minimizing landscape disturbance. It is part of a comprehensive strategy to restore riverine, wetland, and floodplain habitat in the Skokomish River watershed.[5]

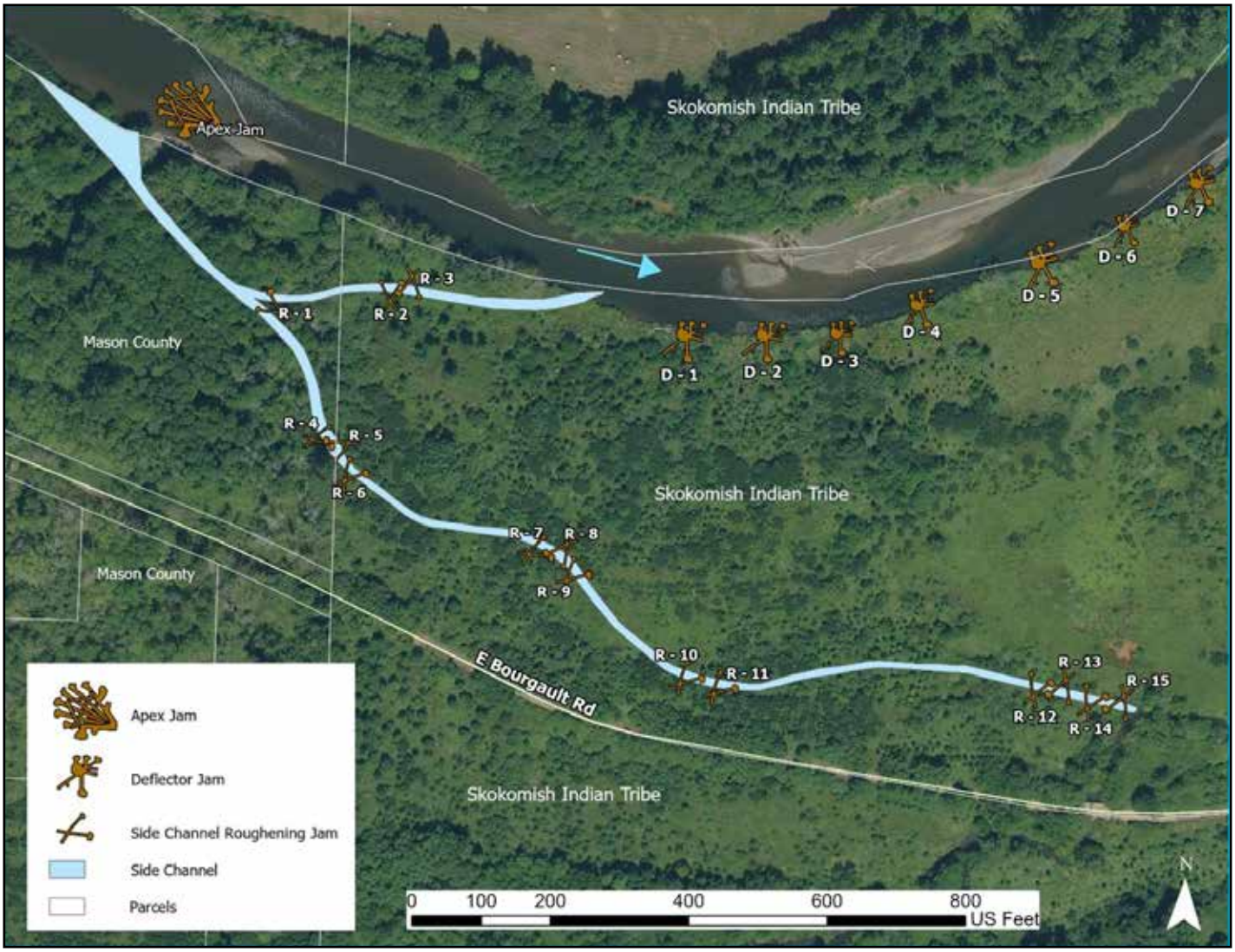
Skokomish Tribe staff walk along the overflow channel that cuts through River Mile 5 Farm.

Tiffany Royal, NWIFC (2)

Skokomish Tribe staff plant native vegetation behind a mound supported by a logjam on River Mile 5 Farm.

Map Data Sources: SSHIAP 2004[6], WADOT 2018[7], WAECY 2018[8]

Skokomish River Mile 5 Floodplain Reconnection Project



Alex Papiez, Skokomish Tribe

Project Design

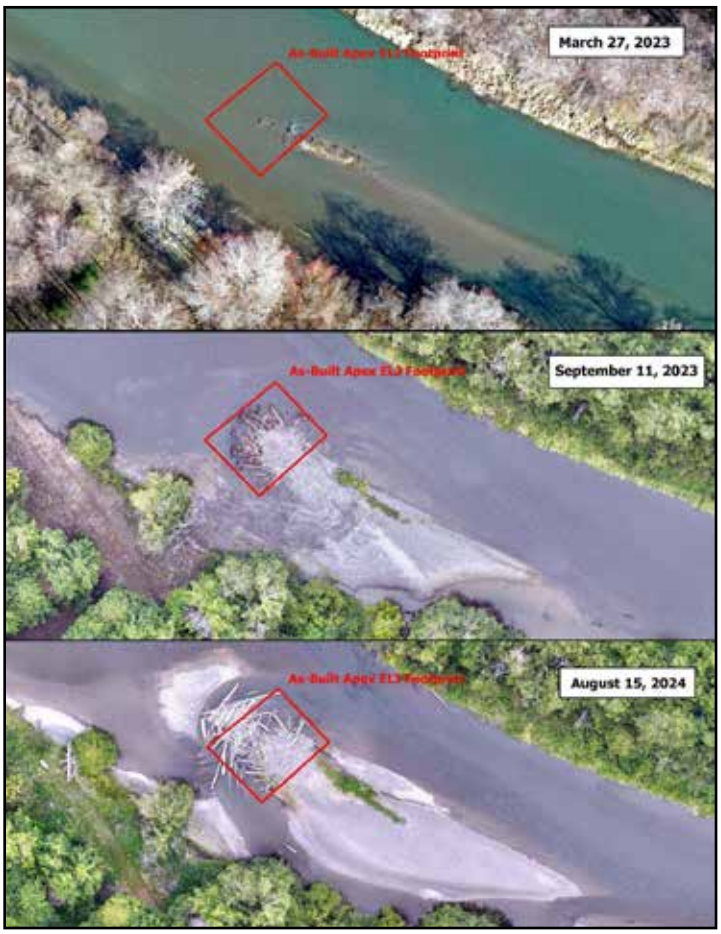
In 2023, the Skokomish Tribe, in collaboration with Mason Conservation District, conducted an instream and floodplain reconnection project at the Skokomish River Mile 5.

This project is located a short distance downstream of the Highway 101 bridge. Eight engineered logjams were installed, including one large apex jam placed directly within the Skokomish River and seven smaller deflector logjams placed along the south bank downstream of the apex jam. In addition, a 2,000-foot-long side channel connecting the Skokomish River with Purdy Creek, was excavated to provide flood conveyance and flood storage capacity in undeveloped areas away from infrastructure.

The primary goal of this effort is to increase the variety and frequency of key habitats for Skokomish Chinook, Coho, steelhead and Chum salmon. The project design proposed increases in stable accumulations of large wood in the channel, channel complexity, the number and depth of pools in the mainstem channel, floodplain and side channel connectivity, and encourage sediment accumulation on gravel bars and formation of vegetated islands. These changes will give salmon greater opportunities to spawn, feed, rest and hide, and increase the survivability of adult and juvenile Skokomish salmon.

The pre- and post-images of the apex logjam show that in one year, it accumulated additional wood, already formed a gravel bar, which hopefully will become vegetated over time, and created a deep pool for salmon to rest, feed and hide. Each of the seven deflector jams downstream of the apex jam have also already created deep pools for refugia.[1,2]

"We felt that this was a prime opportunity to implement this style of restoration project and have it be highly effective and have a substantial beneficial outcome that could enhance survivability of fish, both juvenile and adult," said Joseph Pavel, the Skokomish Tribe's natural resources director. "It'll provide unique habitat features and ecological functions that are well served for the life history of salmon in the Skokomish River."[3]



Drone images of the River Mile 5 apex logjam, from top: before, just after installation and one-year after.

Alex Papiez, Skokomish Tribe

A school of Chinook salmon head upstream near the installation of a new logjam on the Skokomish River.

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Impervious Surface and Population Increase Slightly

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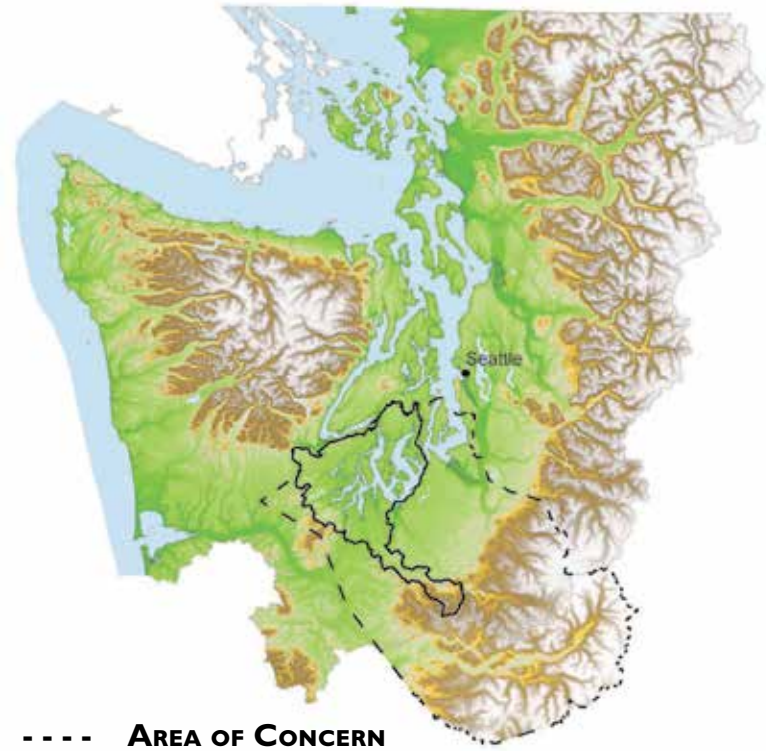
2025 State of Our Watersheds Report
Headwaters of the Salish Sea

We are descendants of the maritime people who lived along the shores and watersheds of the seven southernmost inlets of Puget Sound. We are the "People of the Water." We are of the bays, inlets, rivers, lakes and streams. Our Squaxin Island Tribal history spans many thousands of years. We are the Noo-Seh-Chatl of Henderson Inlet, Steh Chass of Budd Inlet, Squi-Aitl of Eld Inlet, Sawamish/T'Peeksin of Totten Inlet, Sa-Heh-Wa-Mish of Hammersley Inlet, Squawksin of Case Inlet and S'Hotle-Ma-Mish of Carr Inlet. Our culture is still very much connected to this aquatic environment.

– Andy Whitener
Natural Resources Director



- - - - Area of Concern

——— Area of Interest

Squaxin Island Tribe

We are the Noo-Seh-Chatl of Henderson Inlet, Steh Chass of Budd Inlet, Squi-Aitl of Eld Inlet, Sawamish/T'Peeksin of Totten Inlet, Sa-Heh-Wa-Mish of Hammersley Inlet, Squawksin of Case Inlet and S'Hotle-Ma-Mish of Carr Inlet.

The ancestral lands ceded to the federal government in the 1854 Treaty of Medicine Creek included 4,000 square miles. Only one small island, 4.5 miles long and .5 mile wide, was reserved as the main area for all of our people to live.

Our people gradually left the island to take up permanent residence near their original homes. Although there are no year-round residents on Squaxin Island today, it is looked upon as the bond that unites our past, present and future generations. Squaxin Island is used for fishing, hunting, shellfish gathering, camping and other activities.

Tribal headquarters are now located in Kamilche, between Little Skookum and Totten inlets, where hundreds of acres of land have been purchased and a thriving community has been established.

Squaxin Island Tribe

Headwaters of the Salish Sea

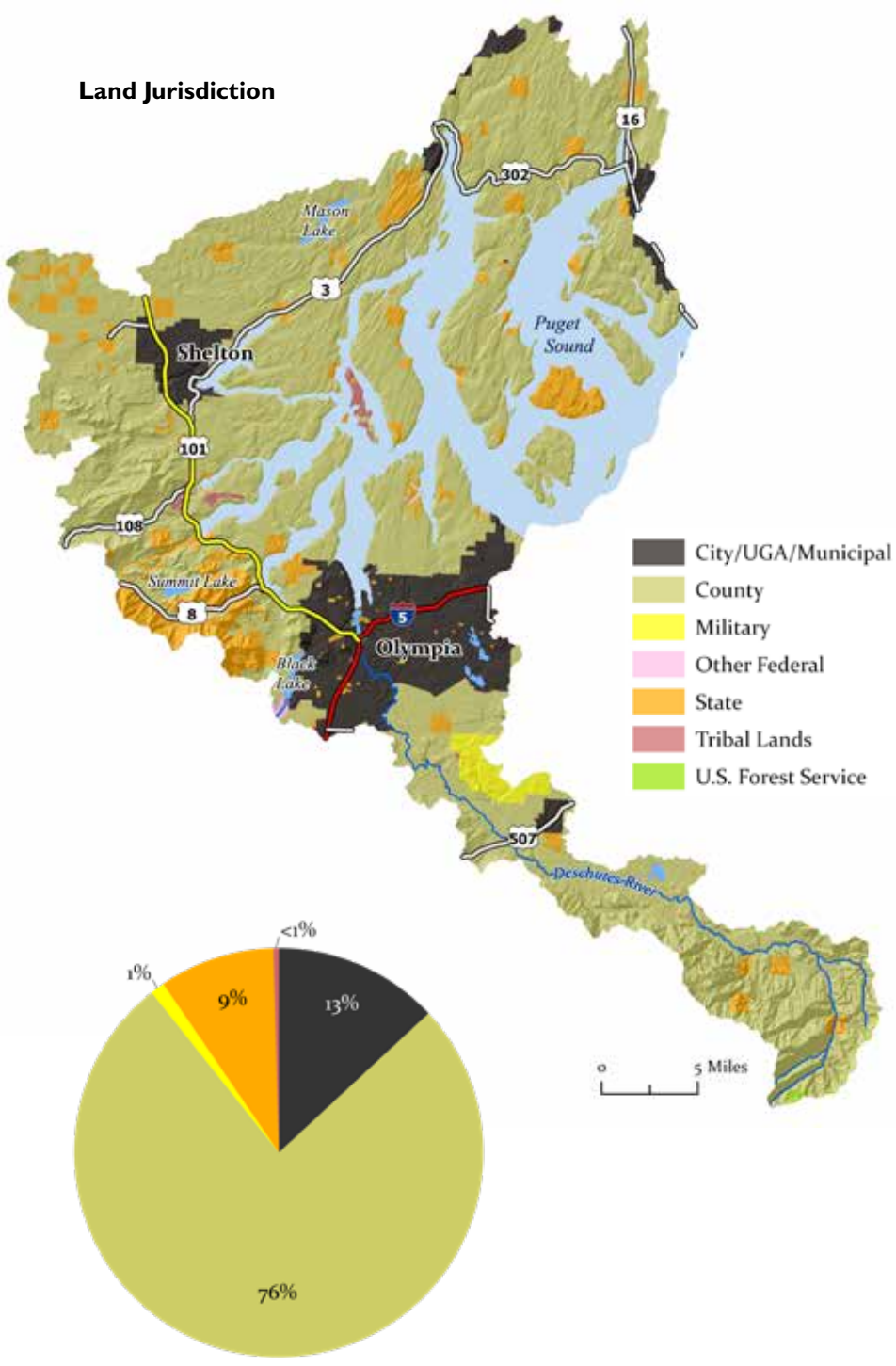
The Squaxin Island Tribe's Area of Focus is the headwaters of the Salish Sea, which includes the marine waters south of the Tacoma Narrows and all freshwater rivers and streams flowing into it.

The topography is generally low relief and composed of glacial till and outwash deposits from the Vashon Stade, which ended about 11,000 years ago. This geology has resulted in a landscape abundant in low gradient streams with many lakes and wetlands, especially in the headwaters. Nearer the marine waters, these independent streams typically cut down several aquifers in a "canyon reach" where there is significant influx of groundwater resulting in a substantial downstream cooling of water temperatures, especially notable in the summer.

The independent streams are well suited for Coho, Chum and coastal cutthroat. In recent times, anadromous salmonids could not pass Tumwater Falls at the lower end of the Deschutes River. In 1952, a fish ladder was installed to allow passage, and a run of Coho has become naturalized, although recent numbers are depressed.[1]

The stream deltas empty into numerous biologically productive inlets that provide a diversity of estuarine and marine habitats for juvenile and migrating salmonids. A tremendous amount of marine shoreline and diversity of habitats support rearing and migrating salmonids in the region. Juvenile salmon from elsewhere in the Salish Sea, like the Puyallup River, frequently visit South Sound before heading to the open ocean.

Since the arrival of Euro-Americans, the late-serial coniferous forests that once dominated the region have been logged and the landscape is today primarily early and mid-serial forest. Predominant land use within the basin is gradually shifting from being undeveloped or under commercial timber production to small-scale agricultural, residential and urban uses. The major threats to salmon habitat include land-use impacts on hydrology, instream and riparian habitat, and the marine shoreline.



Map Data Sources: DOD 2023[2], SSHIAP 2004[3], WADNR 2024a[4], WADNR 2024b[5], WAECY 2018c[6], WAECY 2021[7], WAECY 2024[8], WADOT 2018[9], WADOT 2023[10], USFWS 2024[11]

Chapter Summary

We are the Noo-Seh-Chatl of Henderson Inlet, Steh Chass of Budd Inlet, Squi-Aitl of Eld Inlet, Sawamish/T'Peeksin of Totten Inlet, Sa-Heh-Wa-Mish of Hammersley Inlet, Squawksin of Case Inlet and S'Hotle-Ma-Mish of Carr Inlet. The Squaxin Island Tribe are descendants of the maritime people who lived and prospered along the shores of the southernmost inlets of the Salish Sea for untold centuries. Because of our strong cultural connection with the water, we are also known as the People of the Water. The Squaxin Island Tribe are leaders in the region's salmon recovery effort. No other people know these watersheds as well as the tribes and none has a greater stake in their future. The tribes believe that if salmon are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

For this report, the Squaxin Island Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Poor Ocean Conditions Threaten Marine Life in South Puget Sound

Effects of warm ocean temperatures, high nitrogen levels and low dissolved oxygen levels are noticeable, particularly in the shallow waters of the Squaxin Island Tribe's traditional fishing waters in South Puget Sound. The Squaxin Island Tribe's culture is still very much connected to the aquatic environment. Changes need to be made to address stressors to salmon, shellfish and other aquatic organisms in South Puget Sound.

Efforts Underway to Restore Rapidly Declining Kelp Forest along Southern Squaxin Island

Chronic stressors such as water quality degradation, rising ocean temperatures, competition with invasive species and grazing are causing rapid declines in kelp in Puget Sound. The Squaxin Island Tribe and partners are working to restore bull kelp beds before they disappear altogether.

Sea Level Rise Threatens Shellfish Beds and Important Infrastructure on Squaxin Island

A study completed by the Squaxin Island Tribe and the Climate Impacts Group found that sea level rise is projected to dramatically increase the frequency of inundation during storm surge events. Many of the sites surveyed by the tribe are currently at risk of flooding or will be in the future due to sea level rise. These include culturally significant sites to the tribe.

Marine Mammal Predation Threatens Salmon Returns

Dramatic increases in harbor seal and sea lion populations have led to increased predation on salmon at juvenile and adult life stages. The Squaxin Island Tribe is concerned with low survival rates of juvenile Coho salmon and contributes to ongoing research with the Salish Sea Marine Survival Project.

Upland and Riparian Forest Cover Conditions Slightly Decrease

Forest cover decreased slightly by 0.84% from 2011-2021 in the Squaxin Area of Interest, a loss of approximately 5,173 acres.

Impervious Surface Continues to Increase Outside of Cities and UGAs

Between 2011 and 2021, impervious surfaces increased by approximately 1,082 acres (0.18%) outside of cities and Urban Growth Areas in the Squaxin Area of Interest.

Water Quality Remains Impaired in the Kennedy-Goldsborough Watershed

The Washington Department of Ecology 2018 Water Quality Assessment and listings report to the U.S. EPA is the first update released since 2012. In the Kennedy-Goldsborough watershed, temperature impaired streams that need a water improvement plan increased slightly from 21.25 listed miles to 21.85 listed miles, and dissolved oxygen impaired streams remained the same at 8.46 listed miles. None of the temperature or dissolved oxygen impaired streams improved from the 2012 assessment to the 2018 assessment.

Summer Low Streamflows Increase Alongside Water Well Installations

Between 1980-2019 there were 9,520 water wells installed in the southern Kitsap Watershed and the Kennedy-Goldsborough Watershed near Shelton, Wash. Between 2020-2024, an additional 508 water wells were installed—a 5.3% increase. In the Deschutes Watershed, 4,353 water wells were installed between 1980-2019, and 158 water wells were added between 2020-2023—a 3.6% increase.

Fish Barrier Culverts Continue to Impede Fish Passage

There are 1,688 barrier culverts that are owned by the state, cities and counties, as well as private corporations and individuals in the Squaxin Island Area of Interest. Most of the barriers are owned by Kitsap, Mason, Pierce or Thurston counties (726 barriers).

Reasonable Use Exemptions Impact Wetland and Stream Buffers

Cumulative losses of stream and wetland buffers through the allowances of reasonable use exemptions threaten salmon recovery.

Shellfish Restoration is an Encouraging Step Forward Despite the Need for Water Quality Improvements near Squaxin Island

The Squaxin Island Tribe has been working with partners to reestablish the native Olympia oyster with the goal of having a robust, self-sustaining bed on Squaxin Island. These efforts are encouraging, however, elsewhere within the tribe's Area of Interest, poor water quality, rising water temperatures and sea level rise threaten shellfish habitat.

Conclusion

The Squaxin Island watersheds have seen habitat impacts with the decrease in forest cover and the increase in impervious surface, water wells and the improper use of the 'Reasonable Use Exemptions' by local governments. Concerns continue when considering the impacts of decreasing ocean conditions, sea level rise and the increase in marine mammal populations.

Between 2011-2021, there was an increase of about 1,082 acres (.84%) of impervious surface in the Squaxin Area of Interest. This is only a slight increase but the concern is that runoff will inevitably impact our waterways as population and impervious surfaces continue to increase. Even though restoration is occurring, it is not enough to keep up with the impacts of a growing population and their land-use decisions. Land use and water laws that are in place and meant to protect critical areas and fish habitat need to be implemented. Implementation includes education and voluntary actions, but it also needs to include enforcement when those laws are broken. The future of treaty rights in the Squaxin Island watersheds depend on it.

Recovery Efforts Lagging

At the 20-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Squaxin Island Tribe's area shows that priority issues continue to be degradation of water quantity and quality, degradation of floodplain and riparian processes, and degradation of marine shoreline habitat conditions. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trend for these key environmental indicators shows an upgrade in shellfish growing areas but a steady loss in habitat status:

Ocean Conditions	Effects of warm ocean temperatures, high nitrogen levels, and low dissolved oxygen levels are noticeable, particularly in the shallow waters of the Squaxin Island Tribe's traditional fishing waters in South Puget Sound.	**Concerns**
Sea Level Rise	A study completed by the Squaxin Island Tribe and the Climate Impacts Group found that sea level rise is projected to dramatically increase the frequency of inundation during storm surge events. Many of the sites surveyed by the Tribe are currently at risk of flooding or will be in the future due to sea level rise. These include culturally significant sites to the tribe.	**Concerns**
Marine Mammals	Dramatic increases in harbor seal and sea lion populations have led to increased predation on salmon at juvenile and adult life stages. The Squaxin Island Tribe is concerned with low survival rates of juvenile Coho salmon and contributes to ongoing research with the Salish Sea Marine Survival Project.	**Concerns**
Forest Cover	Forest cover decreased slightly by 0.84% from 2011-2021 in the Squaxin Area of Interest, a loss of approximately 5,173 acres.	**Declining**
Impervious Surface	Between 2011 and 2021, impervious surfaces increased by approximately 1,082 acres (0.18%) outside of cities and Urban Growth Areas in the Squaxin Area of Interest.	**Declining**
Water Quality	In the Kennedy-Goldsborough watershed, temperature impaired streams that need a water improvement plan increased slightly from 21.25 listed miles to 21.85 listed miles, and dissolved oxygen impaired streams remained the same at 8.46 listed miles. None of the temperature or dissolved oxygen impaired streams improved from the 2012 assessment to the 2018 assessment.	**Declining**
Water Wells	Between 1980-2019 there were 9,520 water wells installed in the southern Kitsap Watershed and the Kennedy-Goldsborough Watershed near Shelton. Between 2020-2024, an additional 508 water wells were installed – a 5.3% increase. In the Deschutes Watershed 4,353 water wells were installed between 1980-2019, and 158 water wells were added between 2020-2023 – a 3.6% increase.	**Declining**
Barrier Culverts	There are 1,688 barrier culverts that are owned by the state, cities and counties, as well as private corporations and individuals in the Squaxin Island Area of Interest. Most of the barriers are owned by Kitsap, Mason, Pierce or Thurston counties (726 barriers).	**Declining**
Reasonable Use Exemptions	Cumulative losses of stream and wetland buffers through the allowances of reasonable use exemptions threaten salmon recovery.	**Declining**
Restoration - Shellfish	The Squaxin Island Tribe has been working with partners to reestablish the native Olympia oyster with the goal of having a robust, self-sustaining bed on Squaxin Island. These efforts are encouraging, however, elsewhere within the tribe's area of interest, poor water quality, rising water temperatures, and sea level rise threaten shellfish habitat.	**Concerns**

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the different organisms and the habitats they occupy.

Looking Ahead

The Squaxin Island Tribe will work toward the cleanup of toxins in the environment so that all people can safely consume fish and shellfish. We will advocate for timber harvest practices that preserve the function of riparian forests and support stream health. Additionally, we recognize the increasing impact of marine mammals on salmon populations, along with poor ocean conditions and climate-driven changes that contribute to kelp decline. These and other stressors, including exemptions such as the "reasonable use" doctrine, continue to challenge salmon and shellfish recovery and overall ecosystem health.

We will pursue the removal of fish-blocking culverts and the restoration of natural sediment supply to improve fish passage. We will also support land-use planning that minimizes the impacts of development on groundwater and surface water resources. As climate change and sea level rise bring new threats to coastal and freshwater systems, proactive conservation and thoughtful land management will be essential to maintaining ecosystem resilience.

Poor Ocean Conditions Threaten Marine Life in South Puget Sound

Noctiluca algal bloom at Saltwater State Park, Des Moines, Wash.

Ocean acidification can hinder shell development in species such as Pacific oysters.

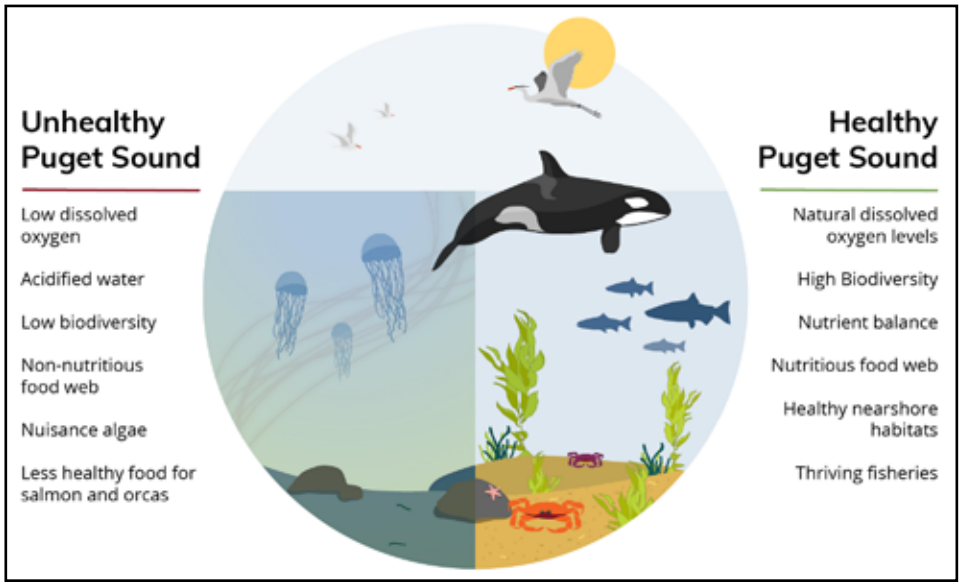
Effects of warm ocean temperatures, high nitrogen levels and low dissolved oxygen levels are noticeable, particularly in the shallow waters of the Squaxin Island Tribe's traditional fishing waters in South Puget Sound. Impacts of these stressors can be seen in salmon and shellfish and are only expected to increase due to climate change.[1]

As salmon migrate out of South Puget Sound, they face several challenges due to changing ocean conditions. Warm ocean waters favor plankton that are smaller and less nutrient rich than cold water plankton species. When warm water conditions dominate, salmon eat less nutrient rich forage fish and have a lower probability of marine survival.[1]

Ocean acidification is occurring alongside warmer ocean temperatures and lower levels of dissolved oxygen. Hypoxia (low dissolved oxygen) can lead to fish kills in areas where water levels drop too low or too quickly. Changing ocean chemistry leaves each level of the marine food web susceptible to changes in reproduction, growth and species distribution.[1]

Nitrogen rich surface waters fuel algal blooms, and when algal cells die and decompose, it contributes to lower dissolved oxygen concentrations in bottom waters, stressing marine organisms.[2] In Puget Sound, nitrogen pollution from humans comes from wastewater treatment plants (~70%) and watershed runoff such as nitrogen-rich fertilizer (~30%).[3] In 2021, the Washington Department of Ecology announced the Puget Sound Nutrient General Permit. The permit would apply to 58 municipal wastewater treatment plants, of which 27 facilities contribute 99% of the nutrient load. The amount of time before improvements are seen as well as the cost of retrofitting facilities are among the concerns surrounding the Nutrient General Permit.[3,4]

The Squaxin Island Tribe's culture is still very much connected to the aquatic environment. Changes need to be made to address stressors to salmon, shellfish and other aquatic organisms in South Puget Sound.



Washington Department of Ecology

Efforts Underway to Restore Rapidly Declining Kelp Forest along Southern Squaxin Island

Chronic stressors such as water quality degradation, rising ocean temperatures, competition with invasive species and grazing are causing rapid declines in kelp in Puget Sound. The Squaxin Island Tribe and partners are working to restore bull kelp beds before they disappear altogether.

Florian Graner [5]

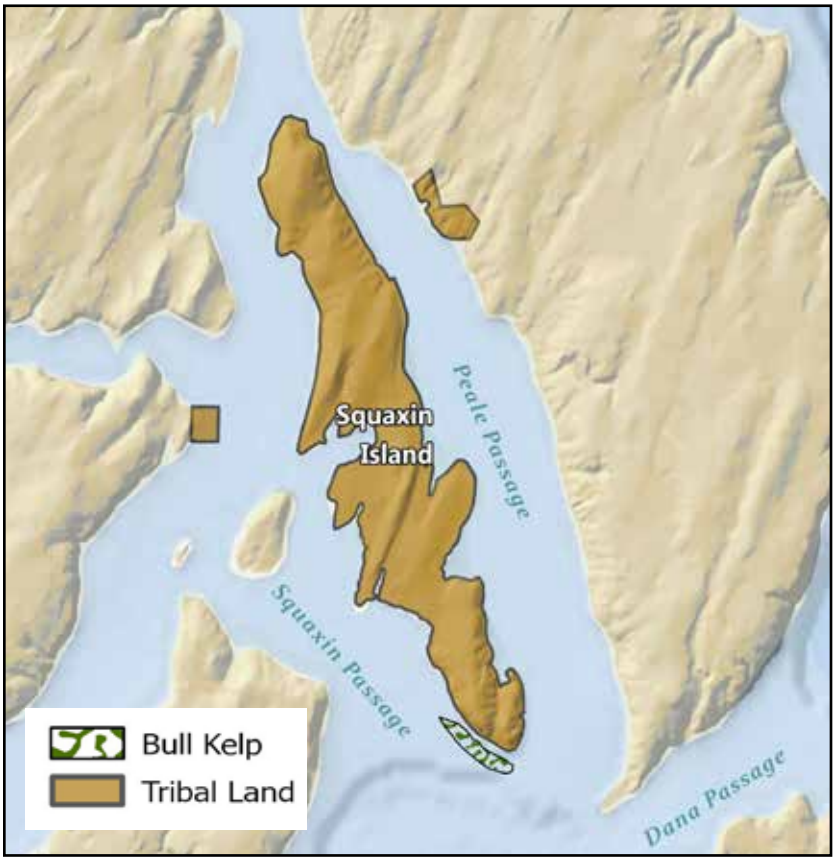
Harbor seals swim in bull kelp beds near Edmonds, Wash.

A bull kelp forest along the southern tip of Squaxin Island shrunk significantly following the marine heatwave between 2013 and 2017, known more commonly as "the blob." The population has plummeted from thousands of plants to fewer than 100.[1]

In Puget Sound, the annual bull kelp is the only species of kelp that forms floating canopies on the water's surface. Kelp forests provide a safe place for young fish to mature and habitat for invertebrate species which support young salmon, rockfish and other forage fish. Kelp is resilient in general, however, chronic stressors like warming ocean temperatures associated with climate change pose a serious threat to kelp growth and survival.[2,3]

Bull kelp is an important part of the Squaxin Island Tribe's culture, providing food and a habitat for other resources the tribe utilizes. To save the diminishing kelp along Squaxin Island, the tribe partnered with the Puget Sound Restoration Fund (PSRF), who has been building a kelp seed bank in partnership with Filipe Alberto at the University of Wisconsin-Milwaukee and NOAA. Bull kelp seed was strung and anchored in a new kelp bed at Squaxin Island in March 2023.[1]

In July 2024, the Washington Department of Natural Resources and Squaxin Island Tribe announced their formal partnership to steward the health and conservation of the Squaxin Island Kelp Bed. As the last major kelp bed in South Puget Sound, the Squaxin Island Kelp Bed will be the first priority habitat under the Statewide Kelp and Eelgrass Health and Conservation Plan.[4]



Trevor Pyle, NWIFC [1]

Brian Allen (left) with PSRF and Helen Berry with the Washington Department of Natural Resources, inspect bull kelp seed, which the Squaxin Island Tribe and partners strung underwater to restore bull kelp beds.

Map Data Sources: SSHIAP 2004[6], WADOT 2018[7], SSHIAP 2023[8]

Sea Level Rise Threatens Shellfish Beds and Important Infrastructure on Squaxin Island

A study completed by the Squaxin Island Tribe and the Climate Impacts Group found that sea level rise is projected to dramatically increase the frequency of inundation during storm surge events. Many of the sites surveyed by the tribe are currently at risk of flooding or will be in the future due to sea level rise. These include culturally significant sites to the tribe.

The Intergovernmental Panel on Climate Change (IPCC) 2023 synthesis report states that sea level rise will continue for millennia, but how fast and how much depends on future emissions. Unavoidable sea level rise will cause losses of coastal ecosystems and ecosystem services, groundwater salinization, flooding and damage to coastal infrastructure. These cascade into risks to settlements, livelihoods, food and water security and cultural values.[1]

Squaxin Island is centered near the entrances to seven inlets in southern Puget Sound. The Squaxin Island Tribe is concerned about climate change impacts on salmon resources in Totten and Little Skookum Inlets, home to numerous salmon-bearing streams. The tribe's headquarters, many residences, and other important infrastructure are located at relatively low elevations near Little Skookum Inlet and could be at risk of flooding due to sea level rise. Squaxin Island is known for its clams, which are important for celebrations, feasts, and funerals.[2,3] Using Light Detection and Ranging (LIDAR) technology, the tribe produced a detailed digital elevation map of Squaxin Island and model predicted sea levels and shellfish and forage fish habitats. The tribe estimates that a third of the shellfish habitat on the island is going to disappear. This will be a major loss to the tribe and everyone who depends on shellfish harvesting in the region.[4]

More recently, the Squaxin Island Tribe procured funding for a study and collaborated with the Climate Impacts Group to release a report titled "Future Sea Level, Streamflow and Stream Temperature Projections for the Squaxin Island Tribe." The study found that sea level rise is projected to dramatically increase the frequency of inundation during storm surge events. Although many of the elevations surveyed by the Squaxin Island Tribe are beyond the reach of sea level extremes, many others are either currently at risk of flooding or will be at risk in the future due to sea level rise. Analysis from the study confirms that even small amounts of sea level rise can lead to large changes in the frequency of flooding. This means that a sea level rise of just 14 inches, which all studies agree is highly likely over the coming decades, would result in a 50-fold increase in the frequency of today's 100-year coastal flood event.[5]

Of the study sites that were found to be impacted by sea level rise, a few were highlighted by the tribe in a StoryMap (see the QR code above). The Port Blakely lower picnic shelter currently experiences inundation of the shelter floor 15 days per year, which is likely to increase to 27 days by 2050 and 69 days by 2100. At a streamflow monitoring station on Skookum Creek at Highway 101, days per year of inundation are predicted to double from 121 to 238 days by 2100. At the Collier House (a culturally significant site), the septic system drain field and septic tank are already partially inundated by king tides. The king tide on December 27, 2022, reached about 18.6 feet above Mean Lower Low Water (MLLW). Currently, that level is expected to happen every 40 years. By 2050, there is a 50% chance that it will happen every 4 years.[3]

Although current decision makers may live past the 2050 benchmark, they won't live past the 2100 benchmark. Their kids and grandkids will though, so special attention must be paid to sea level rise predictions that will affect the next generation.

Study sites that are projected to be impacted by sea level rise.

Squaxin Island Tribe

Map Data Sources: Penn & Marbet, 2024[3], SWIFD 2024[6], WADOT 2018[7], WADOT 2010[8]

Marine Mammal Predation Threatens Salmon Returns

Dramatic increases in harbor seal and sea lion populations have led to increased predation on salmon at juvenile and adult life stages. The Squaxin Island Tribe is concerned with low survival rates of juvenile Coho salmon and contributes to ongoing research with the Salish Sea Marine Survival Project.

Puget Sound Partnership

Juvenile Coho salmon.

The Marine Mammal Protection Act (MMPA) is a federal law passed in 1972 to protect marine mammal population declines due to human activities. Its protections have stopped the decline of many populations and led to the recovery of several, such as humpback whales, gray whales and gray seals.[1] In Washington state marine waters, the MMPA has been successful at rebuilding the abundances of harbor seals, California sea lions and Steller sea lions. However, since 1970, predation on Chinook salmon runs within Puget Sound has increased approximately ninefold in terms of numbers and doubled in terms of biomass. Large increases in harbor seal predation on smolts coupled with predation on adult salmon by seals and sea lions has impacted salmon recovery efforts in the region.[2] In a report prepared for the Washington Department of Fish and Wildlife, evidence taken together supports the hypothesis that current populations of pinnipeds are a contributing factor in the decline and depression of salmon populations in Washington state waters.[3]

The Squaxin Island Tribe completed a multi-year study which involved fitting wild and hatchery Coho salmon with acoustic tags to track their migration throughout Puget Sound. Only six of the 175 tagged Coho could be found beyond the Tacoma Narrows Bridge.[4] Possible causes could include a lack of food for the young fish or an overabundance of predators like harbor seals.[5] In 2016, the tribe released juvenile Coho near Vashon Island and Point No Point to determine whether they can survive at a higher rate than fish released from net pens near Olympia.[4] Research is ongoing and contributes to the Salish Sea Marine Survival Project. A synthesis of findings of the Salish Sea Marine Survival Project was published in 2021, which states that the Synthesis Committee believes there is substantial evidence supporting the assertion that increased seal abundance has reduced the marine survival of Chinook, Coho and steelhead.[6]

Juvenile Coho salmon path starting from Olympia and migrating out of Puget Sound (one scenario).

The Marine Mammal Center

Pacific harbor seals

Map Data Sources: WADOT 2018[7], WADOT 2010[8]

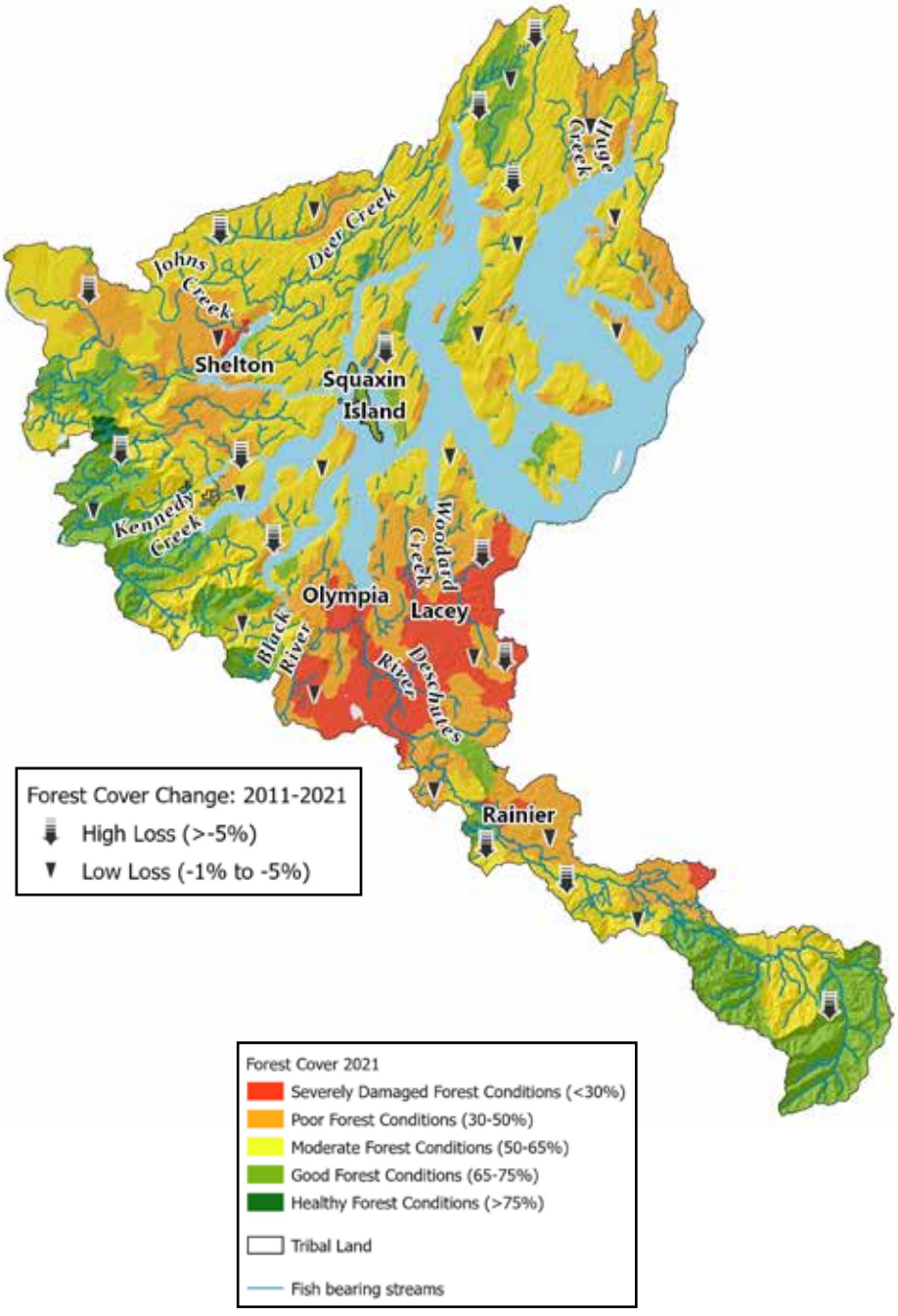
Upland and Riparian Forest Cover Conditions Slightly Decrease

Forest cover decreased slightly by 0.84% from 2011-2021 in the Squaxin Area of Interest, a loss of approximately 5,173 acres.

Riparian ecosystems perform important functions that affect salmon and other aquatic and terrestrial wildlife. Riparian forests reduce flooding; provide nutrients, food and shade to streams; and contribute large woody debris to river systems. Native riparian vegetation protects streams from erosion, temperature extremes and pollutants. This results in cold, clear water that is essential for Pacific salmon survival.[1]

Riparian forest buffers are an agroforestry practice that involves planting trees, shrubs or perennial plants between agricultural lands and waterways like rivers and streams. A wide variety of state and federal programs support the installation of riparian forest buffers on public and private lands. Riparian forest buffers can deliver a number of benefits including filtering nutrients, pesticides and animal waste from agricultural land runoff; stabilizing eroding banks; providing shade, shelter and food for fish and other aquatic organisms; sequestering carbon; and protecting cropland and downstream communities from flood damage.[2,3]

Forest cover decreased slightly by 0.84% from 2011-2021 in the Squaxin Area of Interest, a loss of approximately 5,173 acres.[4,5] Future population growth and development could lead to even more forest cover loss in parts of Mason & Thurston counties. Conserving and restoring riparian forest habitat is essential to salmon recovery, especially with climate change impacting summer low flows and instream temperatures.[6] Restoration may include adding riparian forest buffers along streams in agricultural, suburban and urban settings or more widespread watershed-scale restoration efforts that recreate ecologically functional floodplains. Large-scale restoration efforts connect floodplains to rivers and promote healthy salmon populations and climate resiliency within watersheds.[7,8]



Map Data Sources: NLCD 2011[4], NLCD 2021[5], WAECY 2017[9], SSHIAP 2004[10], WADOT 2018[11], WADOT 2010[12], SWIFD 2024[13], WAECY 2018[14]

Impervious Surface Continues to Increase Outside of Cities and UGAs

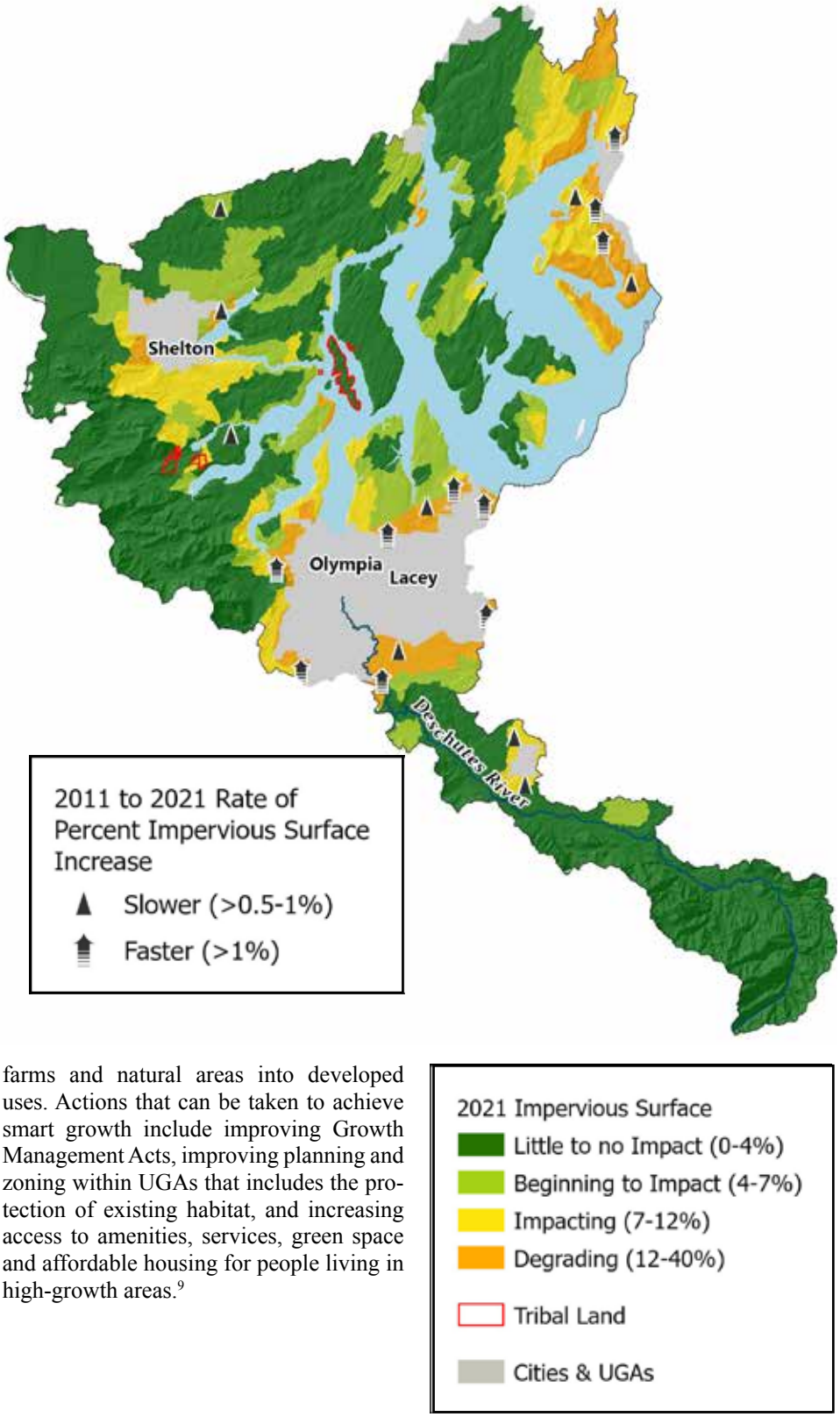
Between 2011 and 2021, impervious surfaces increased by approximately 1,082 acres (0.18%) outside of cities and Urban Growth Areas in the Squaxin Area of Interest.

Impervious surfaces prevent the infiltration of water, which reduces groundwater recharge and base flow. Non-point source pollutants including pathogens, nutrients, toxic contaminants and sediment collect on impervious surfaces, and during rainfall events the stormwater containing these pollutants flows directly into waterways, causing harm to aquatic ecosystems. Increasing urbanization and development results in increases in impervious surfaces such as roads, parking lots and rooftops.[1,2]

Impervious surfaces increased in Thurston County (which includes the cities Olympia and Lacey) from 5.5% to 6.5% between 2001-2021. Forests still cover over 40% of the county's area, however, forested land cover declined by more than 41,000 acres between 1992 and 2016 due to logging, development and other factors.[3] Natural hydrologic regimes are disrupted, leading to severely degraded and often unrecoverable fish and wildlife habitat in areas with greater than 10% impervious surfaces and less than 65% forest cover.[4,5]

Outside of cities and UGAs within the Squaxin Area of Interest, impervious surface increased by approximately 1,082 acres (0.18%) between 2011 and 2021.[6,7] The Deschutes River, a groundwater-fed system, is being impacted by decreased forest cover and increased impervious surfaces near the Urban Growth Areas for Olympia and Lacey. Salmon populations in this system are affected when pollutants flow directly into the river during heavy rainfall events, and when impervious surfaces inhibit groundwater recharge, leading to lower flows in the summer months.[8]

The Puget Sound Partnership's Vital Signs measure ecosystem health and progress toward Puget Sound recovery goals. In their 2022-2026 action agenda, a strategy to meet the habitat recovery goals is smart growth. This strategy focuses on protecting ecologically important lands by channeling population growth into urban growth areas and reducing the conversion of forests, farms and natural areas into developed uses. Actions that can be taken to achieve smart growth include improving Growth Management Acts, improving planning and zoning within UGAs that includes the protection of existing habitat, and increasing access to amenities, services, green space and affordable housing for people living in high-growth areas.[9]



Map Data Sources: NLCD 2011[6], NLCD 2021[7], SSHIAP 2004[10], WADOT 2018[11], WADOT 2010[12], SWIFD 2019[13], WAECY 2021[14], WAECY 2017[15]

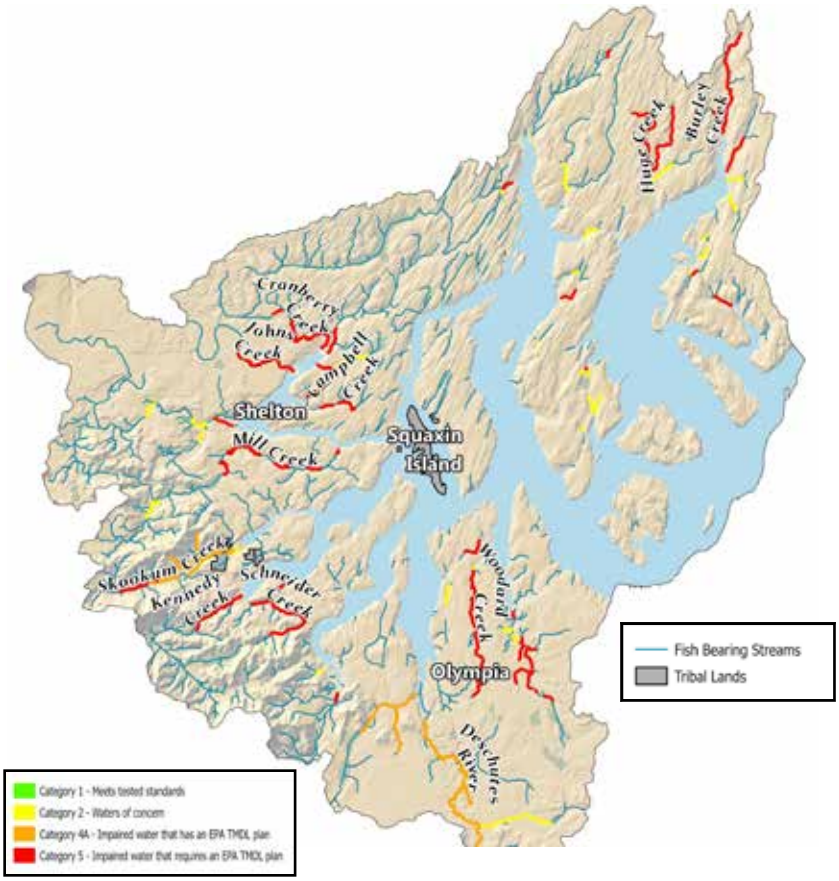
Water Quality Remains Impaired in the Kennedy-Goldsborough Watershed

The Washington Department of Ecology 2018 Water Quality Assessment and listings report to the U.S. EPA is the first update released since 2012. In the Kennedy-Goldsborough watershed, temperature impaired streams that need a water improvement plan increased slightly from 21.25 listed miles to 21.85 listed miles, and dissolved oxygen impaired streams remained the same at 8.46 listed miles. None of the temperature or dissolved oxygen impaired streams improved from the 2012 assessment to the 2018 assessment.

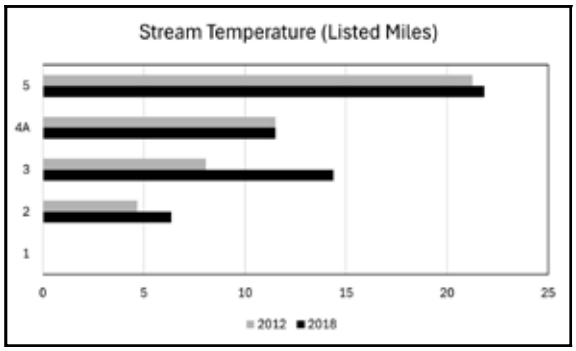
Stream temperatures in many western Washington locations regularly exceed optimal temperatures for fish in all life phases, particularly during the summer. Less water increases water temperatures, reducing dissolved oxygen and leaving salmon with greater susceptibility to diseases, parasites and the effects of toxic chemicals in the water.[1]

The Washington Department of Ecology has listed several temperature and dissolved oxygen impaired streams near Shelton, Wash. that require an EPA TMDL plan. In the U.S. under Section 303(d) of the Clean Water Act, states are responsible for developing Total Maximum Daily Loads (TMDLs) and submitting them to the EPA for approval. A TMDL is the calculation of the maximum amount of a pollutant allowed to enter a waterbody so that the waterbody will meet and continue to meet water quality standards for that pollutant.[2]

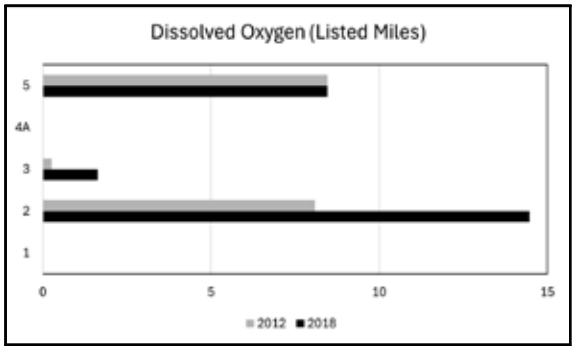
The most up-to-date water quality assessment by Ecology is for the year 2018.[3] As shown in the map, listed temperature and dissolved oxygen impaired streams include Johns Creek, Cranberry Creek, Campbell Creek, Mill Creek, Kennedy Creek and Skookum Creek. Between the latest water quality assessment released in 2018 and the previous assessment from 2012, temperature impaired streams that need a water improvement plan increased slightly from 21.25 listed miles to 21.85 listed miles, and dissolved oxygen impaired streams remained the same at 8.46 listed miles. None of the temperature or dissolved oxygen impaired streams improved from the 2012 assessment to the 2018 assessment.



Temperature and dissolved oxygen impaired waters are spread throughout the Kennedy-Goldsborough watersheds.



Listed miles of impaired temperature streams for Section 305(b) categories in 2012 and 2018 in the Kennedy-Goldsborough watershed.[3]



Listed miles of dissolved oxygen impaired streams for Section 305(b) categories in 2012 and 2018 in the Kennedy-Goldsborough watershed.[3]

Map Data Sources: WAECY 2022[4], SSHIAP 2004[5], WADOT 2018[6], WADOT 2010[7], SWIFD 2024[8]

Summer Low Streamflows Increase Alongside Water Well Installations

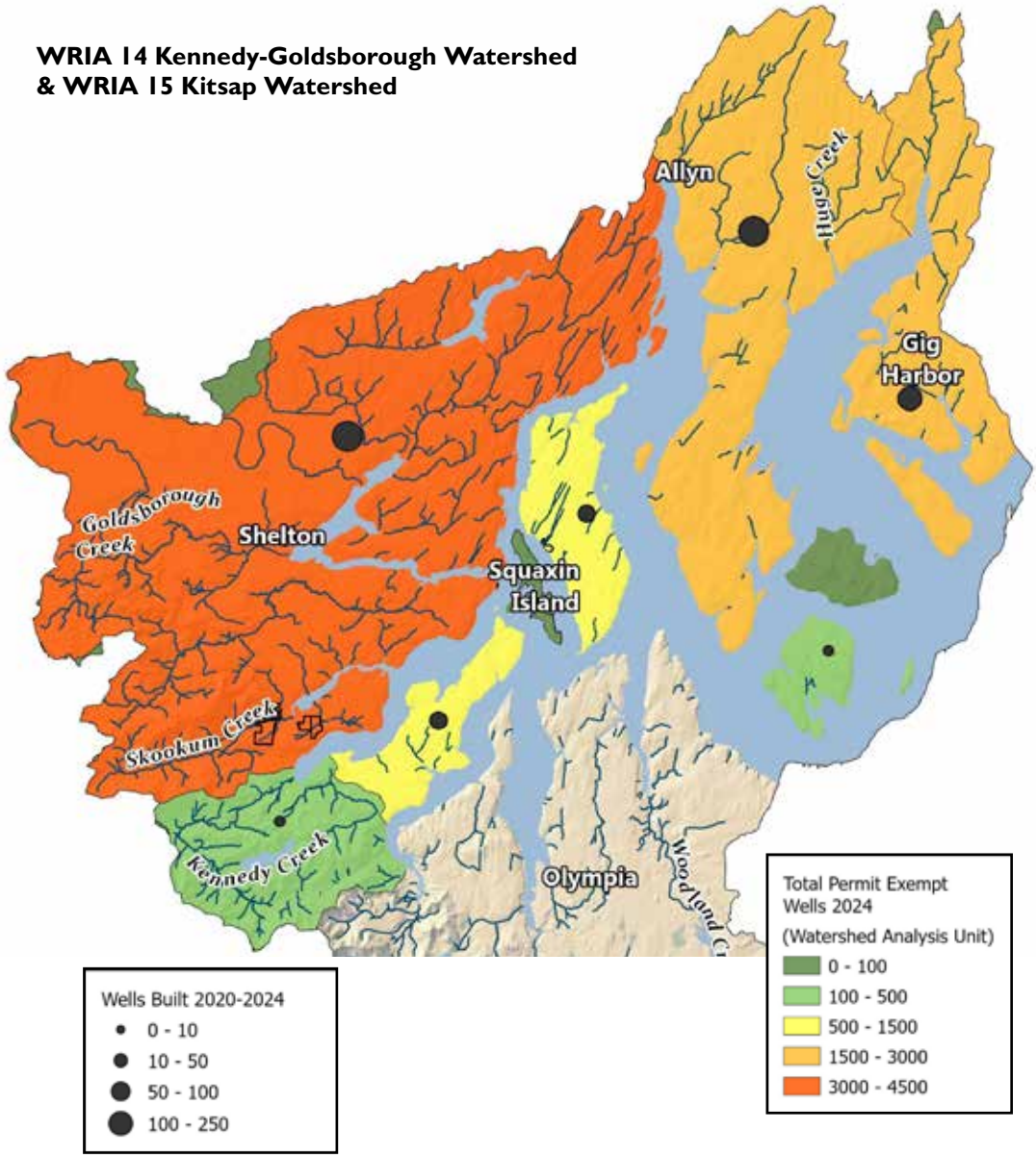
Between 1980-2019,, there were 9,520 water wells installed in the southern Kitsap Watershed and the Kennedy-Goldsborough Watershed near Shelton, Wash. Between 2020-2024, an additional 508 water wells were installed—a 5.3% increase. In the Deschutes Watershed, 4,353 water wells were installed between 1980-2019, and 158 water wells were added between 2020-2023—a 3.6% increase.

In many Puget Sound streams, summer low flows have declined in recent decades, and are projected to decline further due to climate change.[1] The Puget Sound Partnership compiles low flow stream gages set up by the USGS at different sites on rivers in Puget Sound, including two sites in the Squaxin Island area of interest. In 2020, Huge Creek experienced mean daily flow that was below normal more than 50% of the year, and between 2018-2021, the Deschutes River near Rainier experienced mean daily flow that was below normal more than 50% of the year.[2]

Summer low flow conditions result in reduced fish passage and reduced access to off-channel habitat for salmon. During spawning season, fish are forced to build their redds in the main channel, where they are more likely to get washed out during winter peak flows. Low flows can also reduce the survival of juvenile salmon by exposing them to more predation.[3]

The Squaxin Island Area of Interest includes portions of Water Resource Inventory Area (WRIA) 13, 14 and 15. Between 1980-2019, there were 9,520 water wells installed in the Kennedy-Goldsborough Watershed (WRIA 14) and the southern Kitsap Watershed (WRIA 15). Between 2020-2024, an additional 508 water wells were installed—a 5.3% increase.[4]

After technical review by the Salmon Recovery Funding Board, the Washington Department of Ecology adopted the Watershed Restoration and Enhancement Plans for WRIA 14 and 15 in December 2024 and is initiating rulemaking under the Streamflow Restoration Law.



For example, the WRIA 14 plan projects 4,294 new permit-exempt wells to be installed between 2018-2038. The largest number of these wells are likely to be installed in the Oakland Bay subbasin near the city of Shelton. The estimated impact of these wells on rivers and streams is 760 acre-feet per year (a volume equal to about 375 Olympic sized swimming pools). The plan identified eight different projects/actions that Ecology finds will offset impacts to instream flows that would be caused by the new permit-exempt wells.[5]

(Continued on next page)

Map Data Sources: WAECY 2024[4], SSHIAP 2004[8], WADOT 2018[9], WADOT 2010[10], SWIFD 2024[11], WAECY 2017[12]

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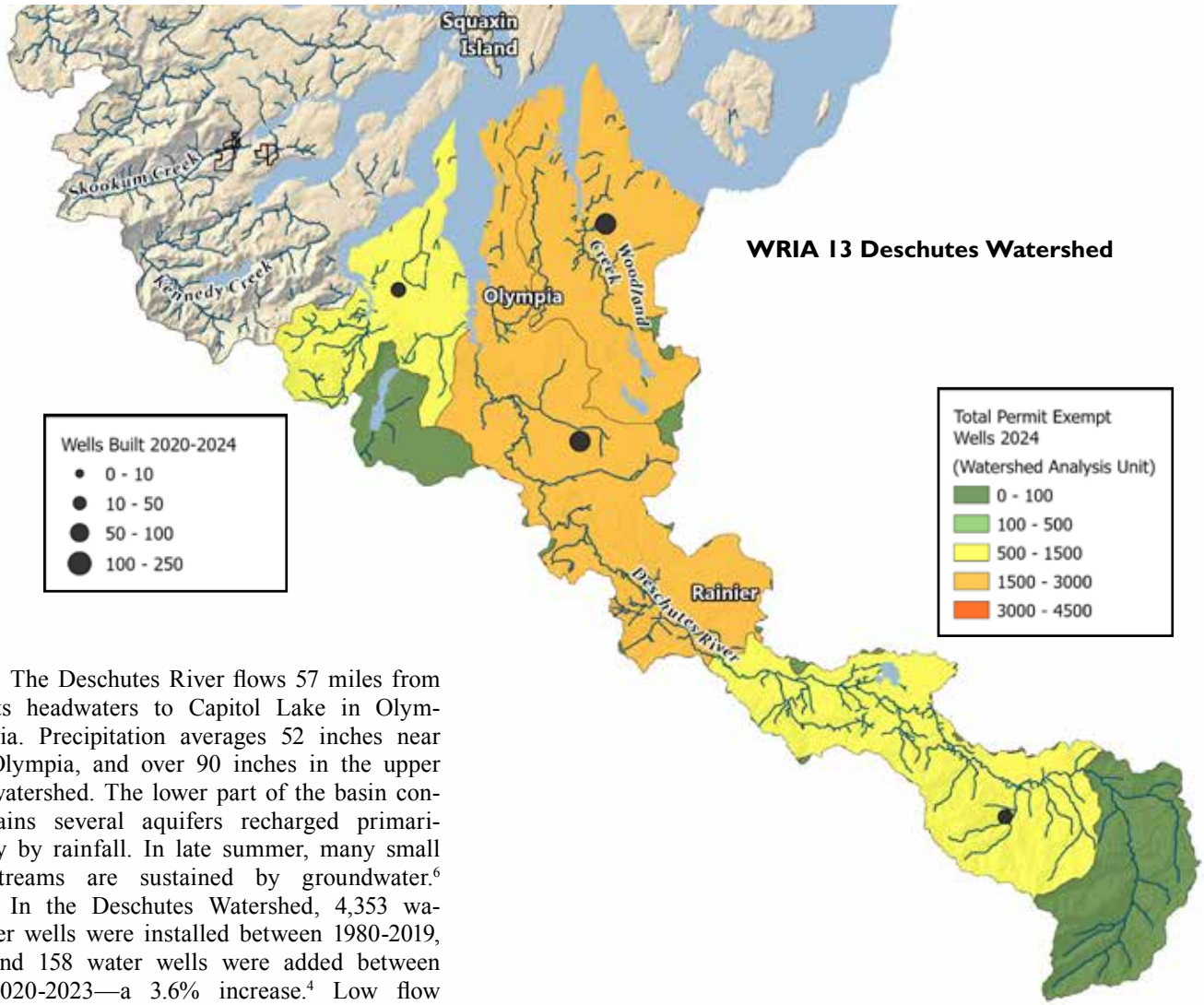


The Deschutes River flows 57 miles from its headwaters to Capitol Lake in Olympia. Precipitation averages 52 inches near Olympia, and over 90 inches in the upper watershed. The lower part of the basin contains several aquifers recharged primarily by rainfall. In late summer, many small streams are sustained by groundwater.[6]

In the Deschutes Watershed, 4,353 water wells were installed between 1980-2019, and 158 water wells were added between 2020-2023—a 3.6% increase.[4] Low flow declines due to climate change alongside increased water well usage is concerning, especially during summer low flows when salmon are vulnerable at all life stages.

After technical review by the Salmon Recovery Funding Board, Ecology adopted the Watershed Restoration and Enhancement Plan for WRIA 13 in December 2024 and is initiating rulemaking under the Streamflow Restoration Law.

The WRIA 13 plan projects 2,616 new permit-exempt wells to be installed between 2018-2038. The estimated impact of these wells on rivers and streams is 434 acre-feet per year (a volume equal to about 215 Olympic sized swimming pools). The plan identified six different projects/actions that Ecology finds will offset impacts to instream flows that would be caused by the new permit-exempt wells.[7]

Capitol Land Trust

The Deschutes River in Thurston County.

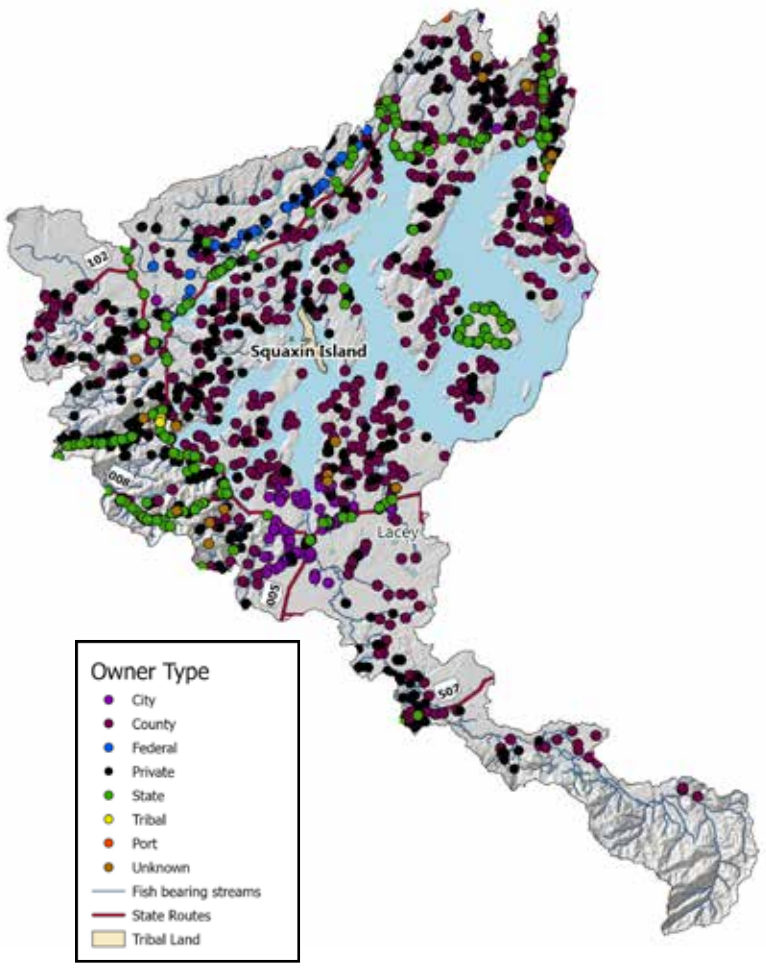
Map Data Sources: WAECY 2024[4], SSHIAP 2004[8], WADOT 2018[9], WADOT 2010[10], SWIFD 2024[11], WAECY 2017[12]

Fish Barrier Culverts Continue to Impede Fish Passage

There are 1,688 barrier culverts owned by the state, cities and counties, as well as private corporations and individuals in the Squaxin Island Area of Interest. Most of the barriers are owned by Kitsap, Mason, Pierce or Thurston counties (726 barriers).

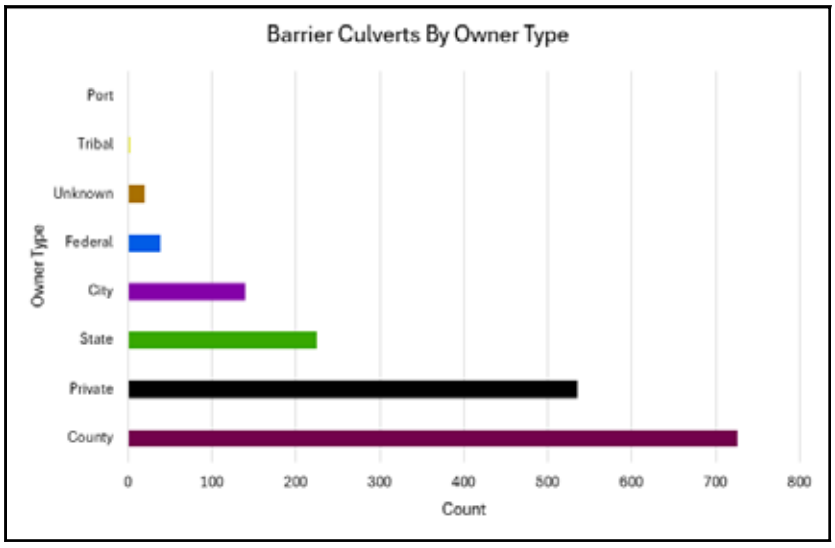
Fish passage is the ability of fish or other aquatic species to move through an aquatic system among all habitats necessary to complete their life cycle. An undersized or improperly placed culvert can impede or totally block fish and aquatic species from passing. Salmon depend on connected streams to move freely to feed, migrate, and reproduce. By removing obsolete and dangerous infrastructure, fish passage projects eliminate public safety hazards, improve climate resilience, reconnect habitat, and restore river ecosystems.[1]

Washington state is under a court injunction to replace the barrier culverts opening 90% of potential habitat by 2030.[2] In addition to culverts identified by the Culvert Case Injunction, there are 1,688 barrier culverts that are owned by the state, cities and counties, as well as private corporations and individuals in the Squaxin Area of Interest. Private ownership accounts for 535 (31.7%) of the culverts while local governments, the federal government, and Washington state own 866 (51.3%), 39 (2.3%) and 225 (13.3%) culverts, respectively. About 1.4% of barrier culverts fall outside of these ownerships.[3] Over 80% of these barrier culverts are owned by small landowners and local governments who are going to need significant resources to remove these impediments to fish passage and improve fish habitat.



A culvert replacement before and after on a tributary to the Black River in Thurston County. Funded by The DNR Family Forest Fish Passage Program, which helps private forestland owners replace fish barrier culverts.

WDNR (2)



Map Data Sources: WDFW 2025[3], SSHIAP 2004[4], WADOT 2018[5], WADOT 2010[6], SWIFD 2024[7], WADOT 2024[8]

Reasonable Use Exemptions Impact Wetland and Stream Buffers

Cumulative losses of stream and wetland buffers through the allowances of reasonable use exemptions threaten salmon recovery.

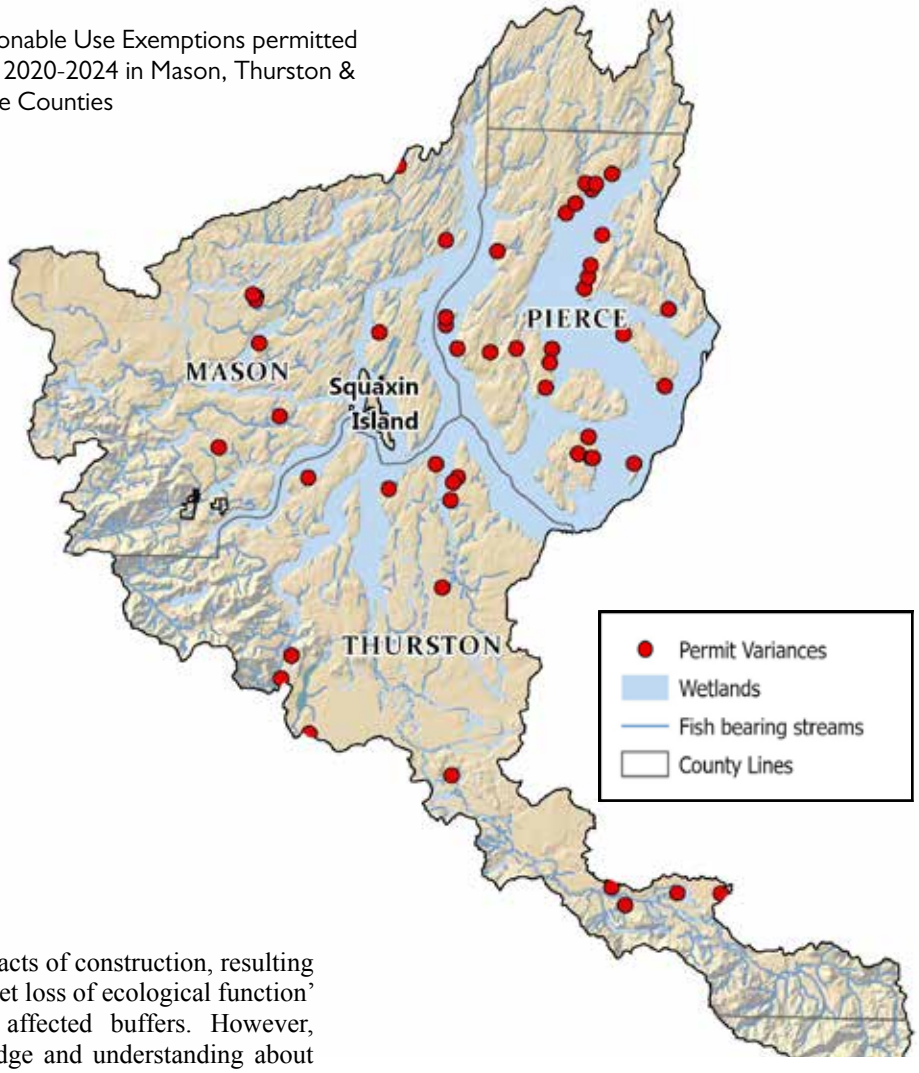
In Washington state, the Growth Management Act requires cities and counties to adopt regulations protecting "critical areas" to preserve the natural environment, wildlife habitats, and sources of fresh drinking water. Cities and counties must limit development in five types of critical areas: wetlands, fish and wildlife habitat conservation areas, areas with a critical recharging effect on aquifers used for potable water, frequently flooded areas, and geologically hazardous areas.[1]

Wetlands provide numerous beneficial services for people, fish and wildlife. Some of these services include improving water quality, providing fish and wildlife habitat, storing floodwater, and maintaining surface water flow during dry periods. Wetlands also store carbon within their plant communities and soil instead of releasing it into the atmosphere as carbon dioxide, helping to moderate global climate conditions.[2]

Property owners in Washington state may apply for reasonable use exemptions to carry out a use or activity which is prohibited by a County Critical Areas Ordinance. Pierce County approved 29 shoreline exemptions between 2020-2024 within the Squaxin Area of Interest.[3] These exemptions involve constructing or extending single-family residences within Aquatic, Natural or Conservancy shoreline designations. For these designations, shoreline development should generally be avoided to preserve shoreline ecological functions.[4]

Similarly, Thurston County granted 16 exemptions and Mason County granted 10 exemptions between 2020-2024 within the Squaxin Area of Interest. These exemptions involve constructing or extending single-family residences within wetland and/or stream buffers.[5,6] Many of these exemptions require mitigation (e.g. planting native plants) to offset the impacts of construction, resulting in 'no net loss of ecological function' of the affected buffers. However, knowledge and understanding about wetland ecosystem complexities is still developing. A degraded wetland can lose its capacity to remove excess sediments, nutrients and other pollutants and may release carbon as it is disturbed instead of storing it.[7] The time required to revert a degraded wetland back into a carbon sink is largely unknown. The conservation and protection of wetlands should be prioritized as these ecosystems provide numerous beneficial services and already play a key role in climate change mitigation. Cumulative losses of stream and wetland buffers through the allowances of reasonable use exemptions are also detrimental to salmon recovery.[8]

Reasonable Use Exemptions permitted from 2020-2024 in Mason, Thurston & Pierce Counties



Capitol Land Trust

Johns Creek side channel creates wetland habitat.

Map Data Sources: Pierce Cty[3], Thurston Cty[5], Mason Cty 2024[6], SSHIAP 2004[9], WADOT 2018[10], SWIFD 2024[11], USFWS 2024[12]

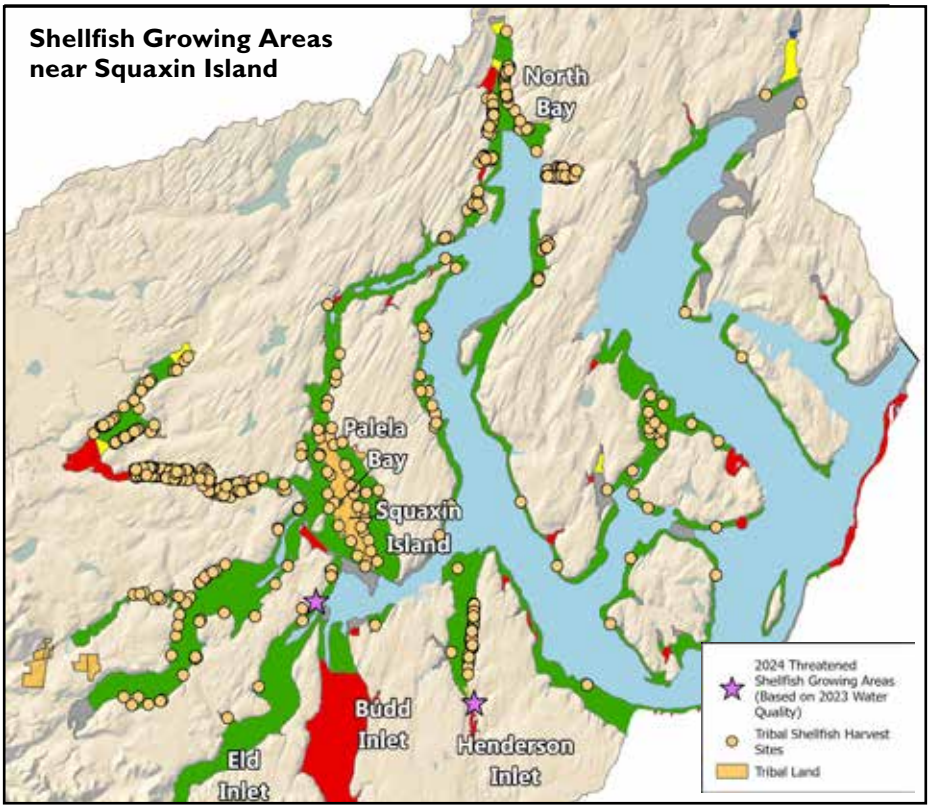
Shellfish Restoration is an Encouraging Step Forward Despite the Need for Water Quality Improvements near Squaxin Island

The Squaxin Island Tribe has been working with partners to reestablish the native Olympia oyster with the goal of having a robust, self-sustaining bed on Squaxin Island. These efforts are encouraging. However, elsewhere within the tribe's Area of Interest, poor water quality, rising water temperatures and sea level rise threaten shellfish habitat.

The Squaxin Island Tribe has relied on shellfish culturally and economically for millennia. The Olympia oyster was shared at many tribal gatherings for hundreds of years before heavy siltation in Eld Inlet nearly eliminated the oyster from South Puget Sound. The tribe has spent several decades working to restore Olympia oysters with the goal of having a robust, self-sustaining bed on Squaxin Island. In 2021, the tribe partnered with The Nature Conservancy and Pew Charitable Trusts to participate in a national oyster restoration program, Supporting Oyster Aquaculture and Restoration (SOAR). The goal of SOAR is to support local growers by purchasing native oysters to be used in nearby restoration projects that benefit shellfish habitat and water quality. Olympia oysters were nursed at Chelsea Farms on Eld Inlet and in April, staff spread about 71,000 adult oysters in Palela Bay and an additional site.[1]

The Annual Shellfish Growing Area Review for 2023 released by the Washington Department of Health (DOH) lists some sites of concern within Squaxin Island's Area of Interest. Several water quality stations are under 'threatened' status. These include one station in Eld Inlet and two stations in Henderson Inlet.[2] Threatened status is assigned in growing areas when a water sampling station has fecal coliform levels that do not meet water quality standards (90th percentile is between 30 and 43 fc/100mL).[3]

Mason County, Mason Conservation District and Thurston County have received funds through the National Estuary Program for pollution identification and correction, and technical assistance and outreach.[3] These efforts will hopefully reverse the downward water quality trend of these sites, however there are still concerns for shellfish populations moving forward. The tribe recognizes that rising temperatures due to climate change and sea level rise also threaten shellfish habitat. If trends are not reversed, harvestable populations of shellfish may not be available for tribal members and future generations.[4]



Map Data Sources: Swason, Trevor, et al 2024[3], SSHIAP 2004[5], WADOHa 2025[6], WADOHb 2025[7]

NWIFC

Olympia oysters are transferred from Chelsea Farms to the Squaxin Island Tribe for restoration.

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Poor Ocean Conditions Threaten Marine Life in South Puget Sound

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Sea Level Rise Threatens Shellfish Beds and Important Infrastructure on Squaxin Island

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Marine Mammal Predation Threatens Salmon Returns

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2025 State of Our Watersheds Report
Stillaguamish River Basin

We have an obligation to our resources and future generations to prioritize restoration and recovery work—even if it means we won't live long enough to witness those benefits directly. We cannot continue to sacrifice tomorrow's culture and sustainability for today's ease of access and convenience. The work that we're doing will inevitably save salmon and preserve the vitality of our culture, while allowing all of us to enjoy the benefits of a more resilient landscape, clean water, and long-term economic stability.

– Kadi Bizyayeva
Fisheries Director

Salmon Warrior

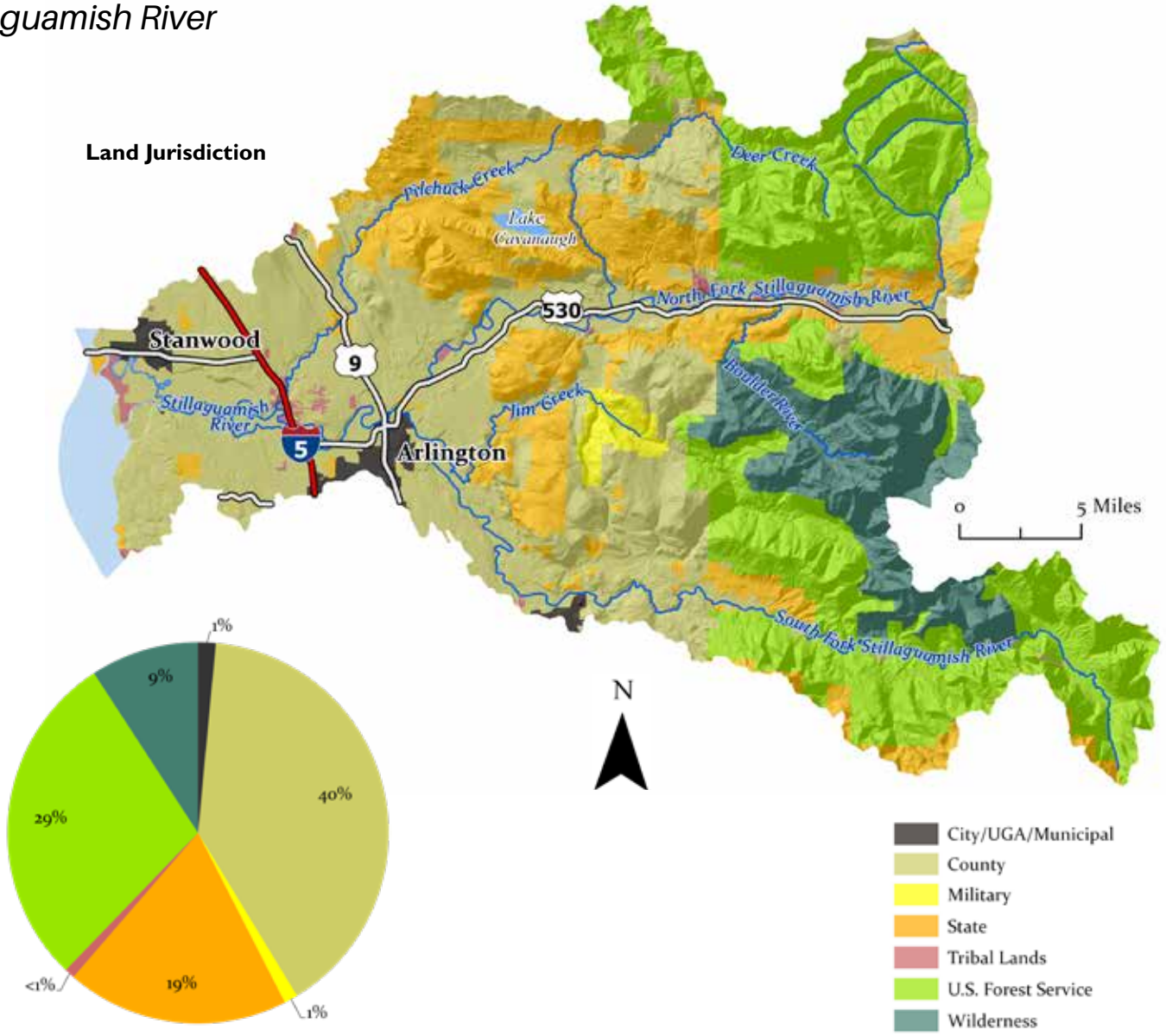
Area of Interest

Stillaguamish Tribe

The Stillaguamish Tribe is composed of descendants of the *Stoluck-wa-mish* River Tribe. In 1855 the population resided on the main branch of the river, as well as the North and South forks. The name Stillaguamish, under various spellings, has been used since around 1850 to refer to those Indians who lived along the Stillaguamish River and camped along its tributaries. They were a party to the Treaty of Point Elliott of Jan. 22, 1855. No separate reservation was established for the *Stoluck-wa-mish* Indians. Some moved to the Tulalip Reservation, but the majority remained in the aboriginal area along the Stillaguamish River. Tribal headquarters are located in Arlington, Wash.

Stillaguamish Tribe

Stillaguamish River



At 694 square miles, the Stillaguamish River is the fifth largest drainage basin in the Puget Sound region, and includes portions of both Skagit and Snohomish counties. The basin extends to the headwaters of its two major forks in the North Cascade Mountains.

The two major forks of the Stillaguamish are the North Fork, which drains approximately 284 square miles, and the South Fork, which drains approximately 255 square miles. The Stillaguamish supports both wild and hatchery stocks of anadromous salmonids and trout. These include Chinook, Coho, Pink, Chum and Sockeye salmon, and steelhead and cutthroat trout.

The Stillaguamish River basin is within the ancestral home of the *stulǝgʷabš* (People of the River), whose descendants are the Stillaguamish Tribe of present. Traditionally, people of the Stillaguamish fished, hunted and gathered their food, medicines, clothes and building materials from within the watershed's boundary and throughout the region as part of common Coast Salish seasonal subsistence activities. Many of these traditions are still carried forward today.

Since European settlement, land-use patterns in the watershed have continued to be shaped by its physical geography, even while that settlement greatly altered the natural processes and habitats that had supported the tribe since time immemorial. The foothills and mountains are now mainly used for wood products and outdoor recreation. The more fertile and developable lowlands are now primarily used for agriculture and rural residential development. Most of the basin's human population is centered in and around the towns of Granite Falls, Stanwood, Arlington and Darrington.

The last 150 years of colonization has left the natural ecology of the Stillaguamish watershed stressed and depleted. The future of the watershed will require significantly better protection of existing natural resources, and a greater commitment to actively restoring, as well as changing, land-use behavior within the landscape. As the original environmental scientists and natural resource managers in this watershed, the Stillaguamish Tribe is committed to this effort.

Map Data Sources: DOD 2023[1], SSHIAP 2004[2], WADNR 2024a[3], WADNR 2024b[4], WAECY 2018c[5], WAECY 2021[6], WAECY 2024[7], WADOT 2018[8], WADOT 2023[9], USFWS 2024[10]

Chapter Summary

The Stillaguamish Tribe are descendants of the *Stoluck-wa-mish* River Tribe. They have fished, hunted, gathered and handcrafted along the rivers and tributaries of the Stillaguamish River watershed since time immemorial. No one is more connected to the Stillaguamish River watershed, its water, plants, fish and animals than the Stillaguamish Tribe. At the heart of that connection is salmon which has always been a primary source of life for the tribe.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

For this report, the Stillaguamish Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Shoreline Armoring Threatens Erosional Drift Cells Critical to the Ecology of Port Susan Bay

More than 13.75 miles of nearshore marine shoreline is armored in Port Susan Bay. Over the past 10 years there has been very little new armoring added to previously unarmored shoreline, but there have been an estimated 50 hydraulic permits accepted by WDFW that either replace or repair existing armoring and very little existing armoring has been removed.

Progress Is Being Made Toward Estuary Restoration Targets for Stillaguamish Salmon Recovery

The Stillaguamish Salmon Recovery Plan's 10-year target for estuary habitat restoration is 548 acres. From 2014 through 2019, 330 acres of estuary habitat were restored, bringing the total restored to 480 acres. In addition, 250 estuary acres were acquired during this time for future restoration. Since 2020, the tribe has secured a contract to restore 230 acres by 2026, purchased an additional 400 acres for future restoration, and is in an ongoing negotiation to see an additional 50 acres of tidal wetland restoration.

Nonpoint Source Pollution and Wastewater Treatment Prohibit Commercial Shellfish Harvest in Parts of Port Susan and South Skagit

In 2024, over 1,600 acres of commercial shellfish area at the mouth of the Stillaguamish was "Unclassified" for shellfish harvesting due to lack of commercial or tribal interest in harvesting there. The 302 acres prohibited in Port Susan and South Skagit Bays in 2016 remain prohibited in 2024.

Population Change in the Stillaguamish Watershed (2000 to 2023)

The population within the Stillaguamish watershed has increased by nearly 20,000 people, a 46% increase, since 2000. Over 60% of new residents moved into Arlington, Stanwood, Granite Falls and their associated Urban Growth Areas. But the watershed's population remains rurally dispersed, with over 60% of residents still living outside of cities, towns and Urban Growth Areas.

Forestland Conversion Slows

As of 2022, approximately 1,787 acres of land had been converted from forest practices to nonforest practices through the WADNR Class IV-General permit. Most of the conversion, 1,411 acres, occurred between 1997 and 2007. Snohomish County's current 20-year Future Land Use plan proposed an estimated 7,221 acres of land currently zoned in forestland to be rezoned and converted out of forest practice activities and into rural residential and Urban Growth Area land uses.

Washington State's Program Continues to Impact Small Tributary Flows

Between 2005 and 2022, there have been 1,086 wells added to the groundwater reserve watersheds established through the Instream Resources Protection and Water Resources Program. Washington Department of Ecology estimated that the 1,086 wells were withdrawing 190,575 gallons of water per day from the groundwater reserve watersheds.

Floodplain Restoration and Acquisition Are Moving Forward

Restoration toward salmon recovery continues in the Stillaguamish River Floodplain. Of a targeted 30 acres of floodplain area, 22.66 acres have been restored, 0.24 miles of a targeted 4.1 miles of bank armoring has been removed, and 367 acres of a targeted 400 acres of riparian forest has been planted. At the same time, 0.43 miles of additional bank armoring has been discovered, and based on a 2021 high-resolution mapping of tree canopy by NOAA-CCAP, the percent riparian forest cover in the Stillaguamish River floodplain is 28%.

Increasing Water Quality Impairment Threatens Salmon Habitat

The 2018 Washington Department of Ecology Water Quality Assessment and listings report to the U.S. EPA is the first update since 2012. In it, temperature-impaired streams that need a water improvement plan increased from 4.85 listed miles to 50.78 listed miles, and dissolved oxygen-impaired streams increased from 6.59 listed miles to 23.62 listed miles. Only 0.28 miles of previous temperature-impaired streams improved from impairment, and none of the previous dissolved oxygen-impaired streams improved.

Climate Change Threatens Mountain Goat Populations in the North Cascades

Monitoring of mountain goat populations since 2012 has found sharply declining rates of survival in Washington state. The Darrington west area population is estimated to have declined from 235 goats in 2015 to 8 goats in 2024. The Mount Baker population declined from 346 goats in 2019 to 164 goats in 2021. A recent study into environmental impacts on mountain goat survival looked at the 324 mountain goats spread across seven separate monitoring activities between 2002 and 2022. Of the 324 goats monitored only 122 goats survived, and survival decline increased between 2012 and 2022.

Conclusion

The Stillaguamish Watershed Chinook Salmon Recovery Plan's stated goal is to maintain and restore natural ecosystem conditions that sustain salmon productivity. While habitat improvement is a major component of the recovery strategy, it is recognized that without protecting existing habitat function, restoration activities cannot reverse the decline of Chinook populations within the watershed. In this regard, conclusions on the state of the watershed in 2025 are mixed.

There is a clear strategy for estuary and floodplain restoration in place, and it is resulting in the acquisition and restoration of critical salmon habitats in these areas. However, restoration in these areas is expensive, and funding remains a challenge. As well, this type of restoration requires willing landowners, and finding willing landowners is also a challenge. Restoration and acquisition continue, but these two factors greatly affect the pace at which it occurs.

The legacy of European colonization of the landscape remains largely unchanged. Floodplain riparian forest cover is in poor condition, too much of the marine nearshore remains armored, and nonpoint pollution continues to threaten shellfish harvest. People continue to move into the watershed, either reinforcing development patterns of the past, or bringing new development to previously undeveloped areas. Changing this legacy of land use is a long, slow and very contentious process. It requires adherence to the laws and regulations of federal, state and local governments. Implementation of those laws, which happens locally, is often left to volunteerism on the part of the landowner. Politically, this is most palatable, but it has proven inadequate for the needs of salmon habitat recovery. Moving forward, as more people move into the watershed, better enforcement of the regulatory framework will become even more necessary.

Recovery Efforts Lagging

At the 20-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Stillaguamish basin shows that priority issues continue to be degradation of water quantity and quality, degradation of floodplain and riparian processes, and degradation of marine shoreline habitat conditions. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress.

Review of the trend for these key environmental indicators shows an improvement occurring with the restoration of habitat but a steady loss in habitat status:

Tribal Indicator	Status	Habitat Trend
Armoring	Over 13.75 miles of nearshore marine shoreline is armored in Port Susan Bay. Over the past 10 years there has been very little new armoring added to previously unarmored shoreline, but there have been an estimated 50 hydraulic permits accepted by WDFW that either replace or repair existing armoring and very little existing armoring has been removed.	Declining
Restoration - Estuary	Stillaguamish Salmon Recovery Plan's 10-year target for estuary habitat restoration is 548 acres. From 2014 through 2019, 330 acres of estuary habitat were restored bringing the total restored to 480 acres. In addition, 250 estuary acres were acquired during this time for future restoration. Since 2020, the tribe has secured a contract to restore 230 acres by 2026, purchased an additional 400 acres for future restoration, and is in an ongoing negotiation to see an additional 50 acres of tidal wetland restoration.	Improving
Shellfish	In 2024, over 1,600 acres of commercial shellfish area at the mouth of the Stillaguamish was "Unclassified" for shellfish harvesting due to lack of commercial or tribal interest in harvesting there. The 302 acres prohibited in Port Susan and South Skagit Bays in 2016 remain prohibited in 2024.	Declining
Population	The population within the Stillaguamish watershed has increased by nearly 20,000 people, a 46% increase, since 2000. Over 60% of new residents moved into Arlington, Stanwood, Granite Falls and their associated Urban Growth Areas. But the watershed's population remains rurally dispersed, with over 60% of residents still living outside of cities, towns and Urban Growth Areas.	Concerns
Land Conversion	As of 2022, approximately 1,787 acres of land had been converted from forest practices to nonforest practices through the WADNR Class IV-General permit.	Declining
Wells	Between 2005 and 2022, there have been 1,086 wells added to the groundwater reserve watersheds established through the Instream Resources Protection and Water Resources Program.	Declining
Restoration - Floodplain	22.66 acres of a targeted 30 acres of floodplain area have been restored, 0.24 miles of a targeted 4.1 miles of bank armoring has been removed, 367 acres of a targeted 400 acres of riparian forest has been planted	Improving
Water Quality	Temperature impaired streams that need a water improvement plan increased from 4.85 listed miles to 50.78 listed miles, and dissolved oxygen impaired streams increased from 6.59 listed miles to 23.62 listed miles.	Declining
Climate Change - Wildlife	Monitoring of mountain goat populations since 2012 has found sharply declining rates of survival in Washington state.	Declining

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

To counteract the continued pressures on salmon habitat in the Stillaguamish, the tribe has been working with other watershed stakeholders to acquire and restore a corridor of lands along the main salmon-bearing waters of the Stillaguamish. Concurrently, the tribe has been closely involved with local, state, and federal agencies to ensure that existing habitats are protected from both permitted and unpermitted land-use activities. This work is ongoing at the time of publication and will continue for decades.

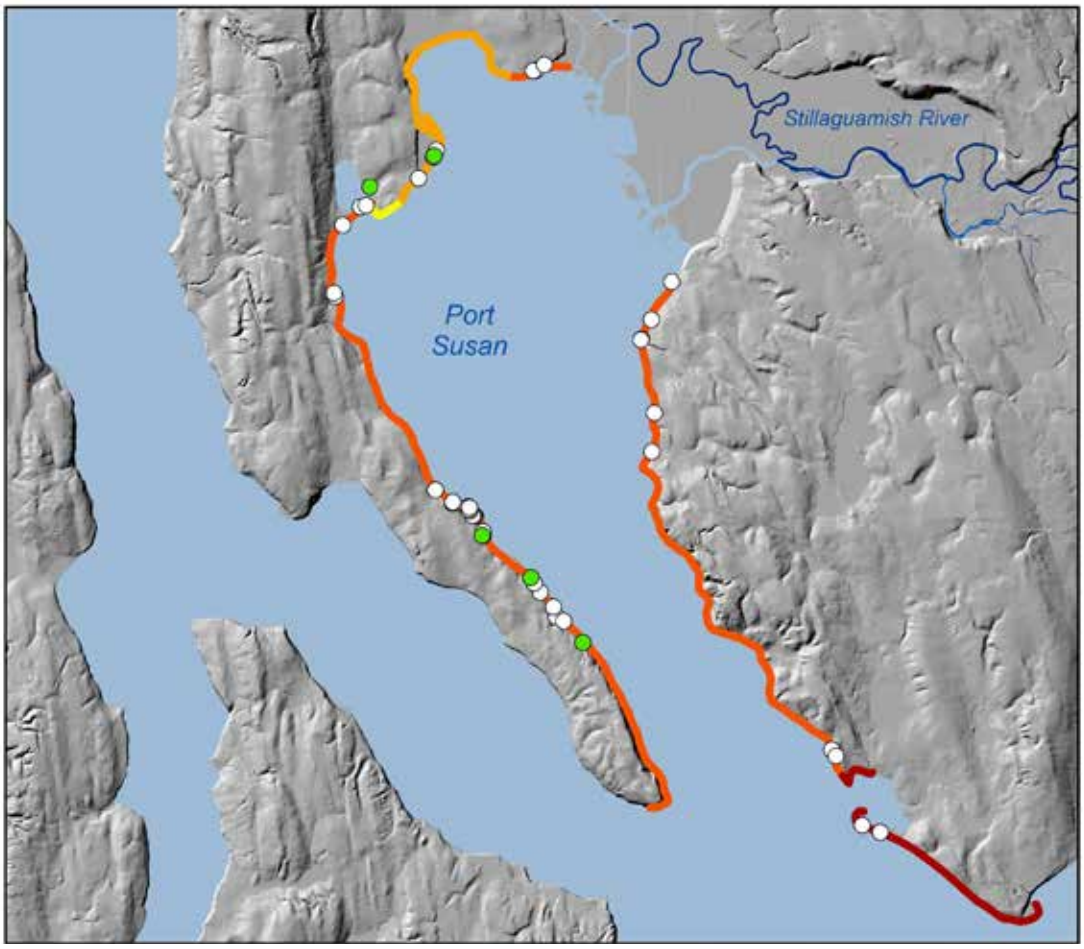
Over time, these efforts will link quality habitats from the tidewater to the mountains and provide locations for the ambitious floodplain and estuary projects needed to meet recovery goals. The tribe plans to complete the purchase of several hundred acres of riparian lands in the next five years, while working to restore lands it already owns. The ongoing restoration work includes engineered logjams, riparian planting, bank armoring removal and the restoration of tidal influence to diked lands in the estuary. A sustained effort across thousands of acres is needed if we are to bring back harvestable populations of salmon to the Stillaguamish Tribe's nets.

Shoreline Armoring Threatens Erosional Drift Cells Critical to the Ecology of Port Susan Bay

More than 13.75 miles of nearshore marine shoreline is armored in Port Susan Bay.[1] Over the past 10 years there has been very little new armoring added to previously unarmored shoreline, but there have been an estimated 50 hydraulic permits accepted by WDFW that either replace or repair existing armoring and very little existing armoring has been removed.[2]

The greatest impact to forage fish habitat on erosional drift cells is shoreline armoring, as it interrupts erosion, distribution and accretion of sediment.[3] Impacts to forage fish are felt directly by federally listed Puget Sound Chinook salmon, as they feed on forage fish. Forage fish spawning beaches are protected through the State's Hydraulic Code Rules, the State's Growth Management Act (GMA), and State's Priority Habitats and Species (PHS) Program, yet these habitats remain vulnerable to shoreline armoring and modification.[4]

The WDFW Estuary and Salmon Restoration Program (ESRP) has completed Beach Strategies, a multiphase project that resulted in a set of science-based tools that can be used by recovery practitioners to strategize nearshore restoration and protection from armoring.[5] WDFW is the agency responsible for protecting the shorelines of Washington state through Hydraulic Permitting. While Beach Strategies shoreline restoration and protection prioritization is intended as guidance for recovery practitioners, WDFW has a unique opportunity to also use Beach Strategies prioritization in Hydraulic Permitting. If an armoring replacement or repair application is within a high or moderate Beach Strategies priority area, green design or soft shore armoring should be a requirement.

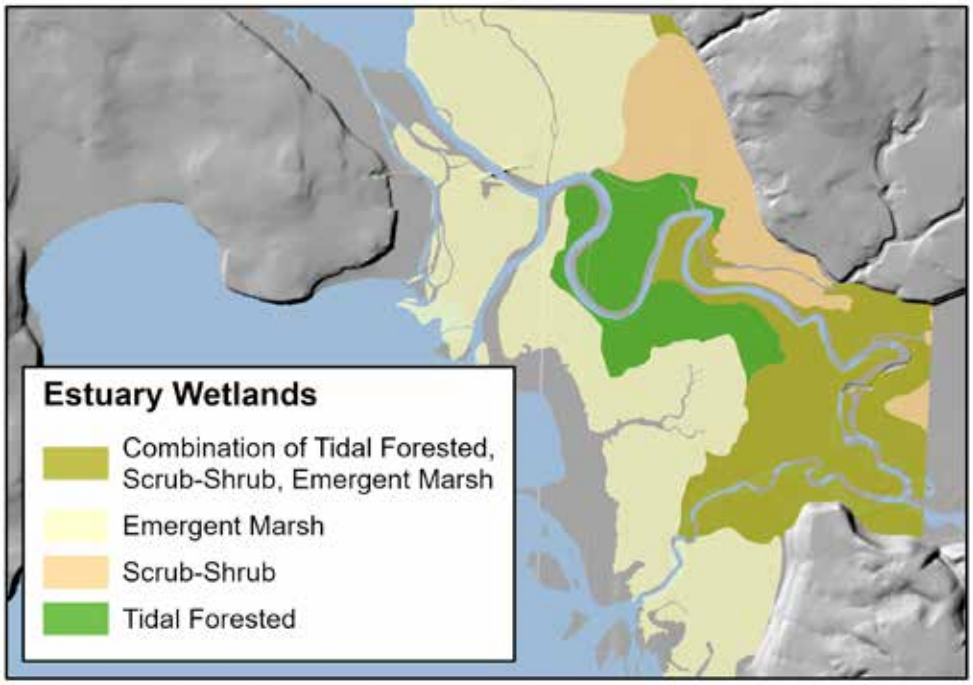


Close to 14 miles of the 34 miles of erosional drift cells in Port Susan Bay are already armored or modified. Of the estimated 50 nearshore armoring replacement or repair permits since 2015, only 5 have been for green design or soft shore projects.

Map Data Sources: CGS 2020[6], WDFW 2023[2]

Progress Is Being Made Toward Estuary Restoration Targets for Stillaguamish Salmon Recovery

The Stillaguamish Salmon Recovery Plan's 10-year target for estuary habitat restoration is 548 acres.[1] From 2014 through 2019, 330 acres of estuary habitat were restored, bringing the total restored to 480 acres.[2] In addition, 250 estuary acres were acquired during this time for future restoration.[3] Since 2020, the tribe has secured a contract to restore 230 acres by 2026, purchased an additional 400 acres for future restoration, and is in an ongoing negotiation to see an additional 50 acres of tidal wetland restoration.[4]



Historic wetland conditions in the Stillaguamish River estuary

Current mapping shows that there has been a 99% loss of tidal scrub-shrub wetland, a 96% loss of tidal forested wetland in the Stillaguamish watershed, and a 57% loss of emergent marsh wetland. Updated targets for properly functioning conditions call for restoration of the 80% of historic estuarine wetland habitat or 4,039 acres, to be composed of these three wetland types. Over 50% of that restoration, 2,191 acres, is targeted for 11 to 50 years of the recovery plan.[6]

Over 92% of the land in the Chinook Recovery Plan's Estuary Priority Area is zoned Agriculture, which means every future restoration opportunity in the estuary has a good potential of being scrutinized by the Agricultural Advisory Board and the local Farm Bureau. Regional help from the Puget Sound Partnership and NOAA Fisheries remains necessary to reconcile salmon habitat restoration with agricultural land conservation.[7,8]

Final estuary restoration targets approved by Stillaguamish Watershed Council in 2014[10]

Estuary Acres	Estimated Historic Acreage	PFC * (80% of historic)	Needed to meet PFC (PFC minus Current Ac.)	10-Year Target	11 to 50-Year Target
Emergent Marsh	2878	2302	1052	210	842
Scrub-Shrub	1120	896	887	177	710
Tidal Forested	1050	840	800	160	640
Total	**5048**	**4039**	**2739**	**548**	**2191**

*PFC: Properly Functioning Condition (based on 80% of historic)

Map Data Sources: Griffith & Fuller 2012[1], WWU 2014[9]

Nonpoint Source Pollution and Wastewater Treatment Prohibit Commercial Shellfish Harvest in Parts of Port Susan and South Skagit Bays

In 2024, over 1,600 acres of commercial shellfish area at the mouth of the Stillaguamish was "Unclassified' for shellfish harvesting due to lack of commercial or tribal interest in harvesting there.[1] The 302 acres prohibited in Port Susan and South Skagit Bays in 2016 remain prohibited in 2024.[2]

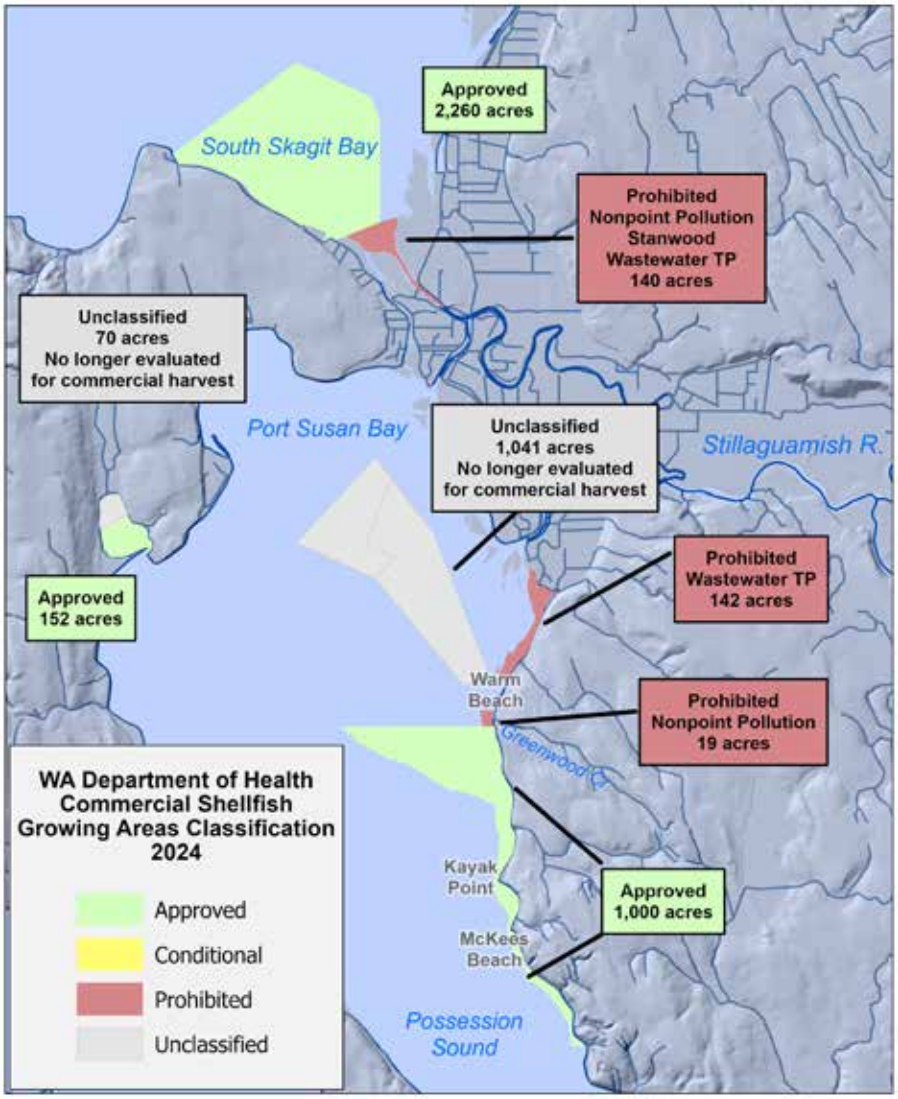
Fecal coliform counts in Port Susan and South Skagit Bays are currently high enough to require the Washington Department of Health to prohibit commercial shellfish harvest on over 302 acres between the two areas.[3] Nonpoint source fecal coliform pollution from the Stillaguamish River is degrading water quality in both Port Susan Bay, and South Skagit Bay has been a management challenge since late 1980s, when access to 18,000 acres of commercial shellfish harvesting in both bays was closed due to high counts of fecal coliform.[4]

In 1993, the South Skagit Bay commercial harvest area was reopened for 2,280 acres, in 2006 that area was reduced to 1,344 acres and in 2009 re-expanded to 2,200 acres. In 2010, 1,800 acres of commercial shellfish acres in Port Susan were approved for commercial shellfish harvest.[5] The current approved status of 152 acres in Port Susan Bay reflects a degrading trend since 2010.

On a positive note, in 2014 approximately 1,000 acres of previously unclassified commercial shellfish harvest areas of McKees Beach and Warm Beach in Possession Sound were approved upon a study encouraged by the Stillaguamish Tribe, and these areas remain open.[6,7]

The cooperative effort involving the Stillaguamish Tribe, and state and county agencies to clean up Stillaguamish River water quality has not wavered. A return to an "Approved" rating will require continued vigilance in all of the areas of nonpoint source pollution control, as onsite septic, livestock and pet pollution remain persistent nonpoint pollution sources.

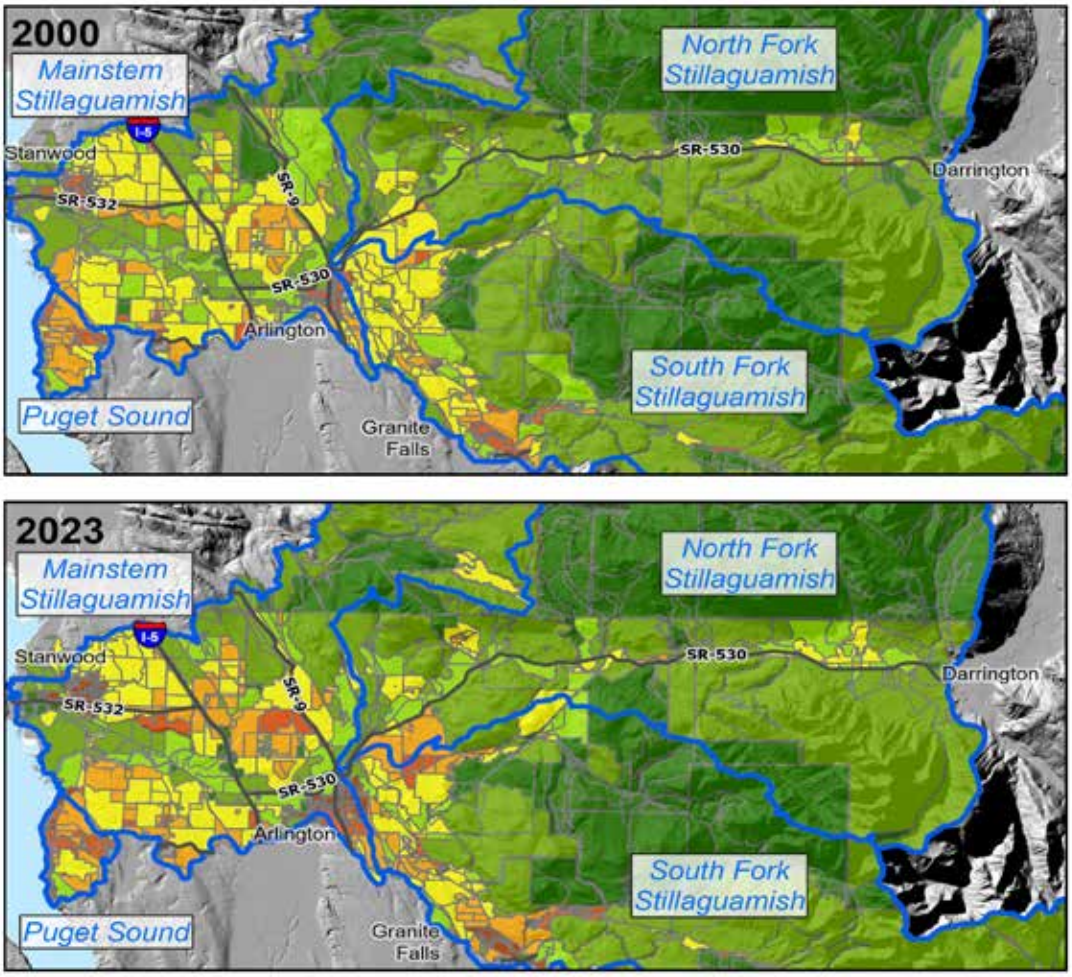
Current Status of Commercial Shellfish Growing Areas in Port Susan Bay and South Skagit Bay to McKees Beach in Possession Sound



Map Data Sources: WADOH 2023[8], SSHIAP 2004[9], USGS 2018[10]

Population Change in the Stillaguamish Watershed (2000 to 2023)

The population within the Stillaguamish watershed has increased by nearly 20,000 people, a 46% increase, since 2000. Over 60% of new residents moved into Arlington, Stanwood, Granite Falls and their associated Urban Growth Areas. But the watershed's population remains rurally dispersed, with over 60% of residents still living outside of cities, towns and Urban Growth Areas.



The Stillaguamish watershed is divided into 3 sub-watersheds: the lower mainstem and the upper North Fork and South Fork.

Over the past 20 plus years, the water resource and water quality impacts from population growth have been centered in the lower mainstem sub-watershed, where over 74% of the population growth during this period has occurred.

This complicates salmon recovery efforts, as the salmon stocks of the Stillaguamish watershed are faced not only with the water quality and habitat impacts of agriculture in the lower mainstem, and industrial forestry in the upper North and South Forks, but also with the increasing impacts of urbanization in the lower extent of their habitat.

Since 2000, population growth has been centered in the mainstem sub-watershed of the Stillaguamish watershed.[2,3,5]

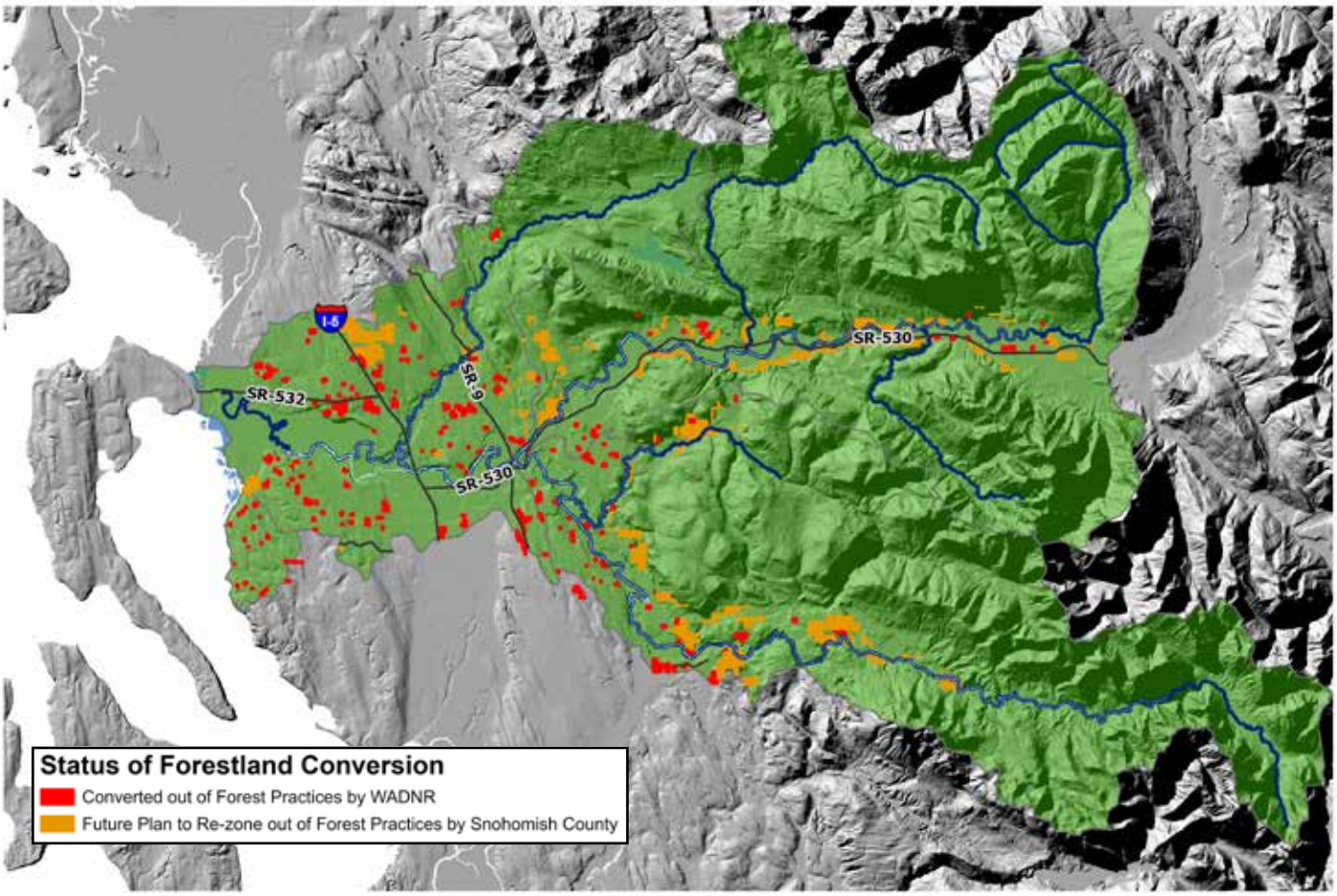
Population Change in the Stillaguamish Watershed (2000 to 2023)[1,2,3,4]

Distance from UGA	Estimated Population in 2000	Estimated Population in 2010	Estimated Population in 2023	Percent Change in Population from 2000 to 2023
Inside UGA	13,290	19,764	24,732	86%
0 to 1 mile from UGA	4,505	4,907	5,633	25%
1 to 5 miles from UGA	19,664	22,160	25,030	27%
5 to 10 miles from UGA	3,728	3,929	4,646	25%
>10 miles from UGA	296	296	479	62%
Total Population	**41,483**	**51,056**	**60,520**	**46%**

Map Data Sources: OFM 2023[1], OFM 2000[2], USCB 2010[3], USGS 2014[4], WAECY 2023[5]

Forestland Conversion Slows

As of 2022, approximately 1,787 acres of land had been converted from forest practices to nonforest practices through the WADNR Class IV-General permit. Most of the conversion, 1,411 acres, occurred between 1997 and 2007.[1] Snohomish County's current 20-year Future Land Use plan proposed an estimated 7,221 acres of land currently zoned in forestland to be rezoned and converted out of forest practice activities and into rural residential and Urban Growth Area land uses.[2]



Conversion out of forest practices and planned rezoning out of forest practices occurs almost exclusively in the Rural Residential Zone and could result in continued rural sprawl in the Stillaguamish watershed.

Since 1997, an estimated 1,787 acres of forestland has been converted out of forest practices in the Stillaguamish River watershed.[3] Evidence suggests the primary motivation for conversion out of forest practices is residential development. To this point, over 582 acres or 33% of forestland conversion since 2000 occurred from 2005 through 2007, coinciding with the region's housing boom. Additionally, 83% of all forestland conversion since 2000 has occurred on Rural Residential or Urban Growth Area parcels, strongly suggesting that the majority of forestland conversion is for residential or commercial property development.[4,5,6]

According to Snohomish County's current 20-year vision of preferred future land-use patterns, an additional 7,221 acres of forestland will be converted out of forest practices. Over 97% of the forestland rezoning is proposed to occur in rural residential land outside of Urban Growth Areas.[7]

Snohomish County was required through the Growth Management Act to update their 20-year Future Land Use Plan by December 2024.[8] Once land is converted out of working forests, the potential for permanent tree clearing and the expansion of impervious surfaces increases. The residential landscape can be more polluting and less protected than the forestland landscape.

Map Data Sources: WADNR 2024[1], Snohomish County 2024[8], Skagit County 2024[10],

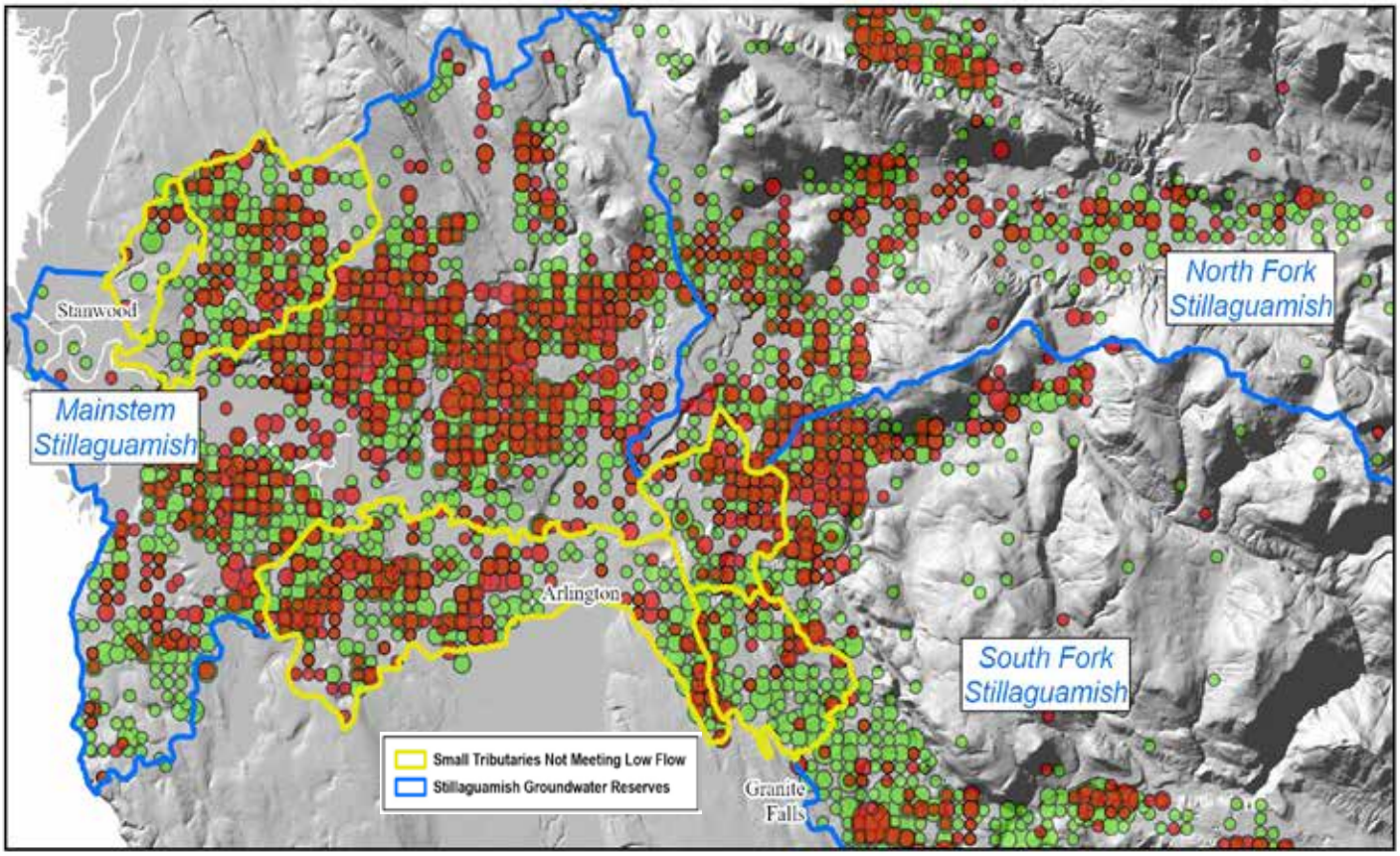
Washington State Ecology's Groundwater Reserve Continues to Impact Small Tributary Flows

Between 2005 and 2022, there have been 1,086 wells added to the groundwater reserve watersheds established through the Instream Resources Protection and Water Resources Program. Washington Department of Ecology estimated that the 1,086 wells were withdrawing 190,575 gallons of water per day from the groundwater reserve watersheds.[1]

In 2005, Washington Department of Ecology established the Instream Resources and Water Resource Program to account for and protect instream flows in the Stillaguamish watershed. Groundwater reservations were established for three sub-basins, the mainstem Stillaguamish, the North Fork Stillaguamish and the South Fork Stillaguamish.[2] At the sub-basin scale, there is still well over 90% of water in the reserve available for exempt well development.[3]

The 2005 Ecology Instream Resources and Water Resource Program does not account for groundwater withdrawal in any of the tributary basins of the mainstem, North Fork or South Fork Stillaguamish groundwater reserve sub-basins. This leaves small tributaries vulnerable to over withdrawals of groundwater and impacts to their instream flows.

For example, in 1999, five separate small tributaries within the three large sub-basins of the Stillaguamish watershed were found to be over-consuming groundwater at a rate of 5% or more of groundwater recharge per year.[4] While those five tributaries collectively amount to less than 7% of total Stillaguamish watershed area, more than 20% of all permit-exempt wells installed since 2005 are within the watersheds of those tributaries.[5]

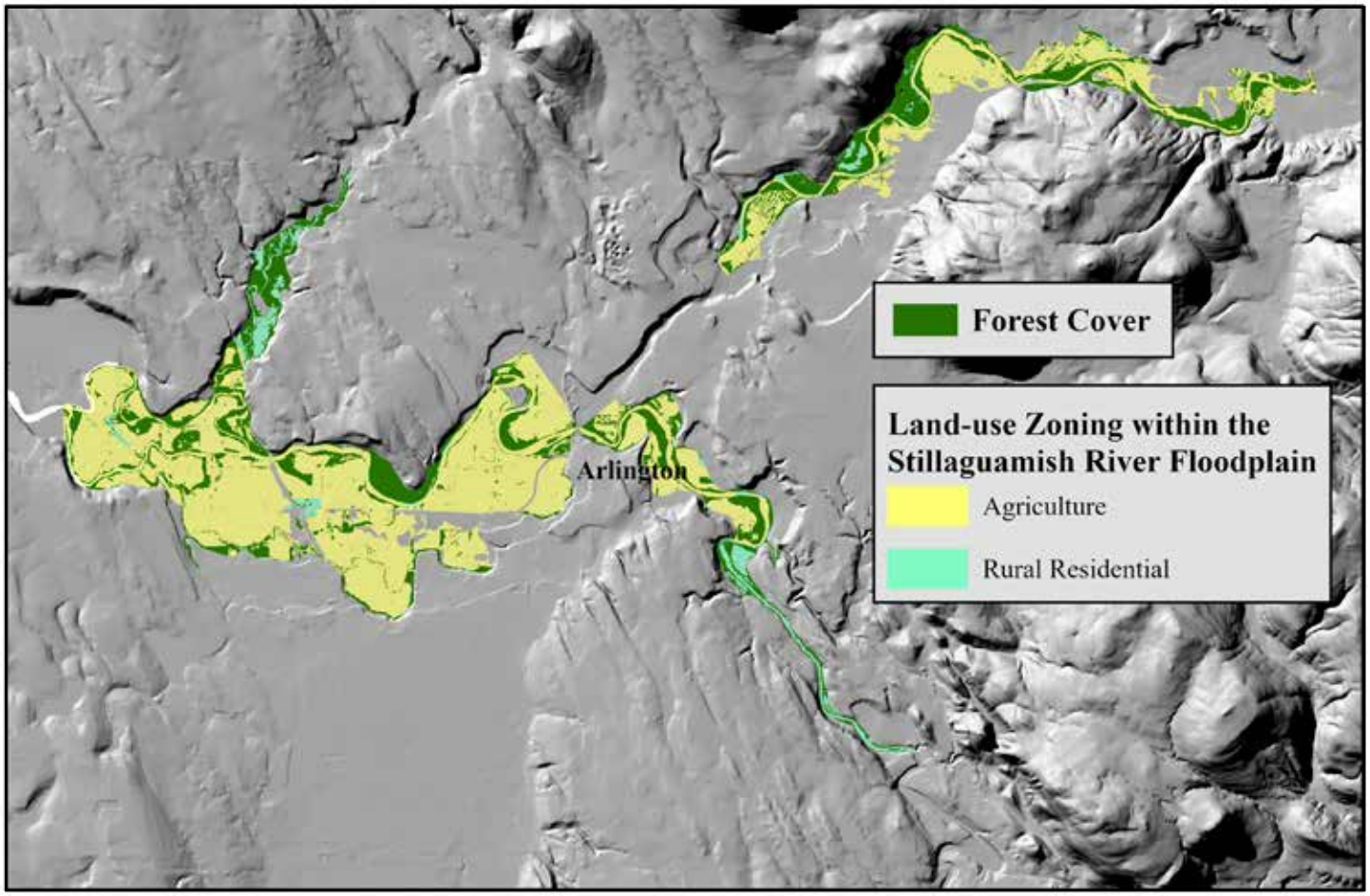


The large sub-basins of the 2005 Stillaguamish River (WRIA 05) state-instituted groundwater reserve for permit-exempt wells do not account for groundwater impacts to smaller watersheds within WRIA 05.[6,7]

Map Data Sources: USGS 2014,[6] WAECY 2023[7]

Floodplain Restoration and Acquisition Are Moving Forward

Restoration toward salmon recovery continues in the Stillaguamish River floodplain. 22.66 of a targeted 30 acres of floodplain area have been restored, 0.24 miles of a targeted 4.1 miles of bank armoring has been removed, 367 acres of a targeted 400 acres of riparian forest has been planted.[1,2,3,4] At the same time, 0.43 miles of additional bank armoring has been discovered and based on a 2021 high-resolution mapping of tree canopy by NOAA-CCAP, the percent riparian forest cover in the Stillaguamish River floodplain is at 28%.[5]



Riparian forest cover remains just over a third of the 80% cover considered a long-term Properly Functioning Condition (PFC) in the Stillaguamish Salmon Recovery Plan.[9] Largely due to maintained forest clearing on agricultural and rural residential lands, which combined, are over 98% of the total floodplain area.

Draining and clearing of the Stillaguamish River floodplain began in the 1860s. Since that time, the floodplain has been deliberately managed in a state of permanent ecological disturbance. This resulted in the long-term absence of mature riparian vegetation throughout the floodplain coupled with the straightening and armoring of floodplain channels and huge deficits to habitat area and quality.[6]

The Stillaguamish Watershed Council (SWC) recognizes that Chinook salmon recovery will not occur without the restoration of floodplain habitat. They also recognize that asking landowners to voluntarily protect their floodplain parcels is not the most effective restoration strategy.

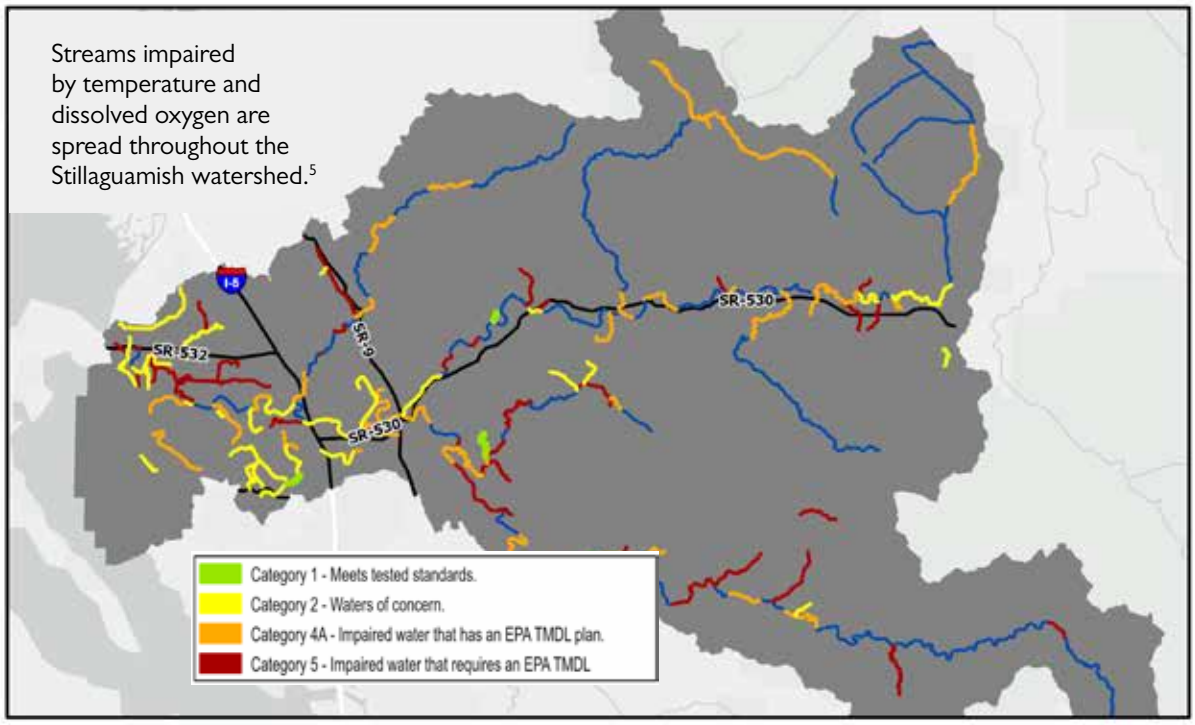
As a result, SWC has formulated a floodplain acquisition strategy to identify floodplain parcels that are of the highest priority in restoring the Stillaguamish floodplain corridor critical to Chinook salmon recovery.[7]

Acquisition strategy and restoration progress continues to be made. Through 2020, 2,111 acres of floodplain had been acquired and/or put into conservation easement.[8] Currently, about a mile of armoring in the floodplain is planned to be removed by 2026, and an additional 400 acres of planned floodplain restoration will be completed by 2030. Since 2020, about 64 acres of additional riparian area have been restored as well.

Map Data Sources: NOAA 2023[5], Stillaguamish Implementation Review Committee 2005[10], Snohomish County 2010[11], SSHIAP 2004[12], WAECY 2018b[13]

Increasing Water Quality Impairment Threatens Salmon Habitat

The 2018 Washington Department of Ecology Water Quality Assessment and listings report to the U.S. EPA is the first update since 2012. In it, temperature-impaired streams that need a water improvement plan increased from 4.85 listed miles to 50.78 listed miles, and dissolved oxygen-impaired streams increased from 6.59 listed miles to 23.62 listed miles.[1] Additionally, only 0.28 miles of previous temperature-impaired streams improved from impairment, and none of the previous dissolved oxygen-impaired streams improved.[2]



Pacific salmon require cold, well-oxygenated water across all life stages. Exceedingly high stream temperatures are lethal to salmon at certain thresholds and sub-lethal to salmon at lower thresholds.

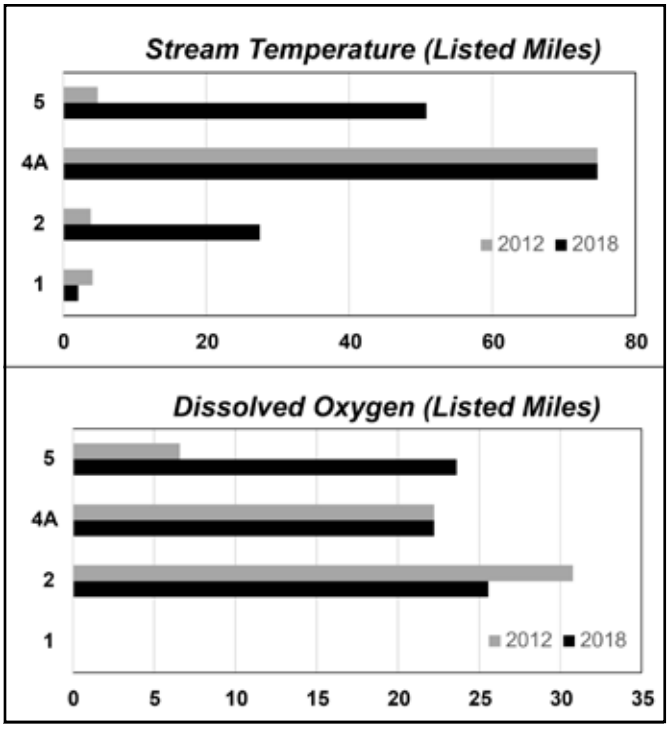
Low levels of dissolved oxygen can hinder embryo incubation, which can result in weaker fry that are more susceptible to predation and that don't feed or swim as well. At the extreme end, low dissolved oxygen can be lethal to salmon.[3]

Stream temperature and dissolved oxygen impairments are largely caused by nonpoint source pollution. The Clean Water Act provides limited authority to address nonpoint source pollution, so a lot of the Total Maximum Daily Load (TMDL) measures recommended for impaired waters are voluntary. They require the landowner to take voluntary action to decrease pollution.

Dating back to 2013, the Government Accounting Office reported on the challenges of nonpoint source pollution control and recommended that Congress consider revising the Clean Water Act's voluntary approach to cleaning up such pollution. As of the end of 2023, Congress had not taken action on these recommendations.[4]

Under Washington state law and affirmed by the State Supreme Court, Ecology has some authority to regulate nonpoint source pollution, but as stated, they still rely largely on non-effective voluntary measures.

Map Data Sources: WAECY 2022[1]

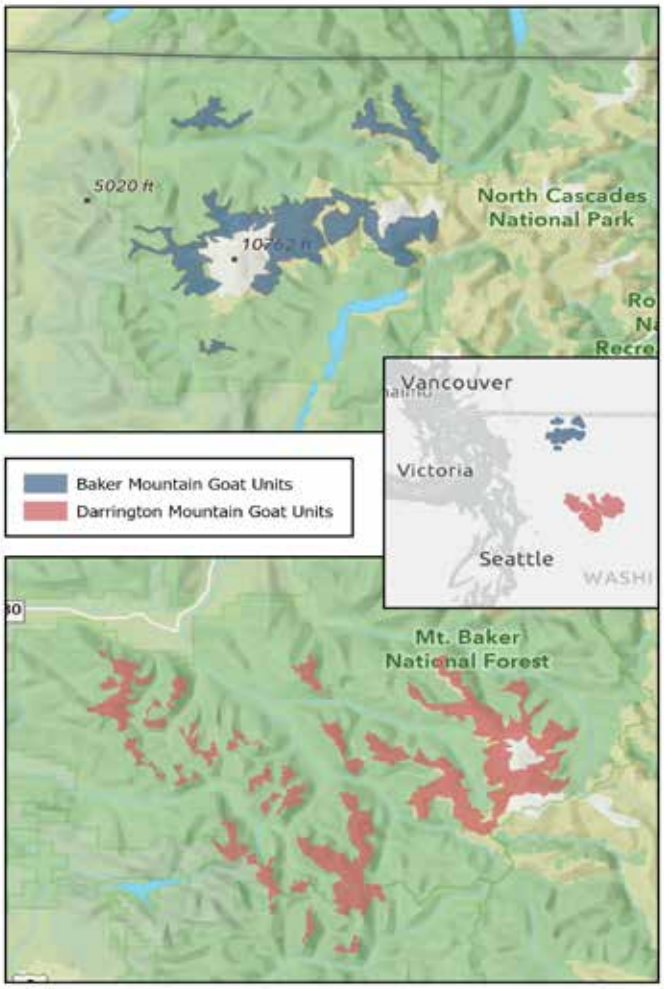


From the 2012 Ecology Water Quality Assessment to the 2018 Ecology Water Quality Assessment, stream miles impaired for temperature increased by 946% and stream miles impaired for dissolved oxygen increased by 258%.[1]

Climate Change Threatens Mountain Goat Populations in the North Cascades

Monitoring of mountain goat populations since 2012 has found sharply declining rates of survival in Washington state. The Darrington west area population is estimated to have declined from 235 goats in 2015 to 8 goats in 2024.[1] The Mount Baker population declined from 346 goats in 2019 to 164 goats in 2021.[2] A recent study into environmental impacts on mountain goat survival looked at the 324 mountain goats spread across seven separate monitoring activities between 2002 and 2022. Of the 324 goats monitored, only 122 goats survived, and survival decline increased between 2012 and 2022.[3]

Northwest Treaty Tribes



Map Data Sources: WDFW 2024[8]

After seeing low survival of mountain goats translocated from Olympic National Park to the Cascade Mountains, as well as declines in native resident mountain goats starting around 2017, researchers started looking into what environmental impacts might be a factor.

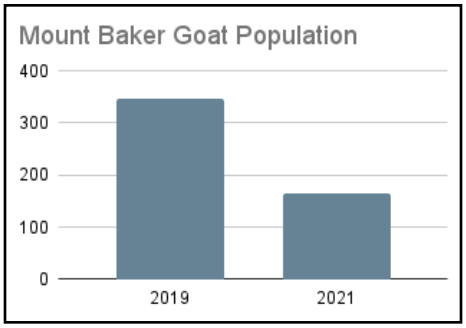
The impacts found to relate to the decline in mountain goat survival were: higher mean winter snow depth, intensity of the previous year's drought and higher mean daily temperatures in the previous year's month of May.

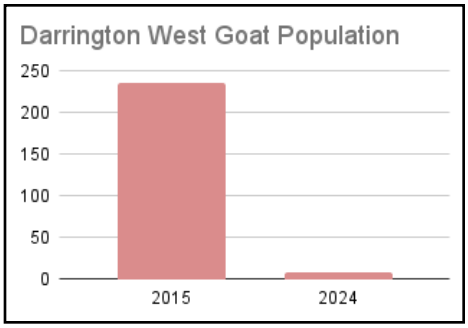
Deeper snow in winter may make it harder for mountain goats to safely travel in their mountain habitats. Deep snow also decreases areas of winter forage during winter months.

Successive seasons of low snow depth associated with year-round drought and/or rapid snow melt during high temperatures in May appear to affect goats' ability to thermoregulate in the summer.[4] These factors also decrease the nutritional value of forage species and may be leaving mountain goats malnourished (at an energy deficit) in the long term.[5]

Climate change will likely increase future drought conditions in western Washington and increase the vulnerability of the already vulnerable regional mountain goat populations.[6]

The Stillaguamish Tribe considers the long-term persistence of mountain goats on the landscape essential to protecting tribal treaty rights. They are committed to mountain goats research and monitoring as essential for the best management towards survival of mountain goats within the Point Elliott Treaty ceded area.[7]





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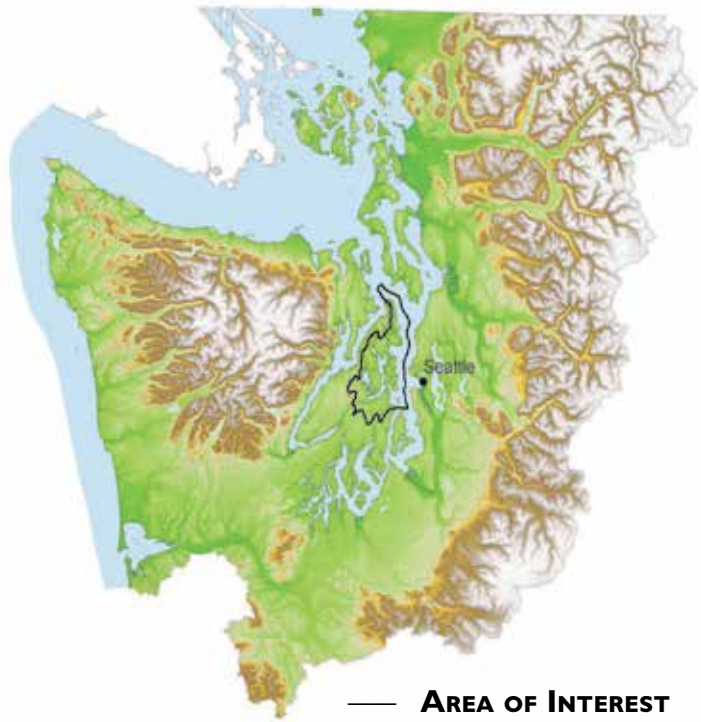
2025 State of Our Watersheds Report
Kitsap Basin

Respect for the land and waters, the abundant natural resources, and a deep understanding of the delicate supportive relationships of the natural systems were central themes in all Northwest Indian cultures. It is still true to this day for the Suquamish people. The tribe continues to be a good steward, managing, honoring and enhancing the resources, and guarding habitat and wildlife. Despite encroachments, the Suquamish people are still committed to steadfastly protecting areas and resources of cultural and traditional significance.

– Rob Purser
Fisheries Director



— **Area of Interest**

Suquamish Tribe

Since time immemorial, the Suquamish Indian Tribe of the Port Madison Reservation has inhabited the shores of Puget Sound. The Suquamish are a Coast Salish people, who speak Lushootseed, and in 1855 signed the Treaty of Point Elliott in which they reserved the right to continue to hunt, fish and gather as they have always done.

The Port Madison Reservation was set aside for the Suquamish people on lands that encompassed their largest village site on the shores of Agate Pass, in what is now known as Suquamish, Kitsap County, Washington. The tribe can legally harvest treaty-reserved fish and other resources in its adjudicated usual and accustomed (U&A) grounds and stations which includes the marine waters of Puget Sound from the northern tip of Vashon Island to the Fraser River in Canada, including Haro and Rosario straits, and the streams draining into the western side of Puget Sound and Hood Canal. The tribe's on-reservation fisheries occur in and around Kitsap County's marine shorelines.

Cumulative impacts to salmonid habitat continue because of residential and commercial land use development, including clearing of vegetation and removal of native soil, groundwater extraction, and encroachment into riparian corridors, floodplains and marine shorelines. The loss of forest cover and increased impervious surfaces negatively impact streamflows, water quality and temperature, and the ecological health of watersheds. These land use impacts will likely be amplified by climate change in the coming decades.

Suquamish Tribe

Portion of East Kitsap Area

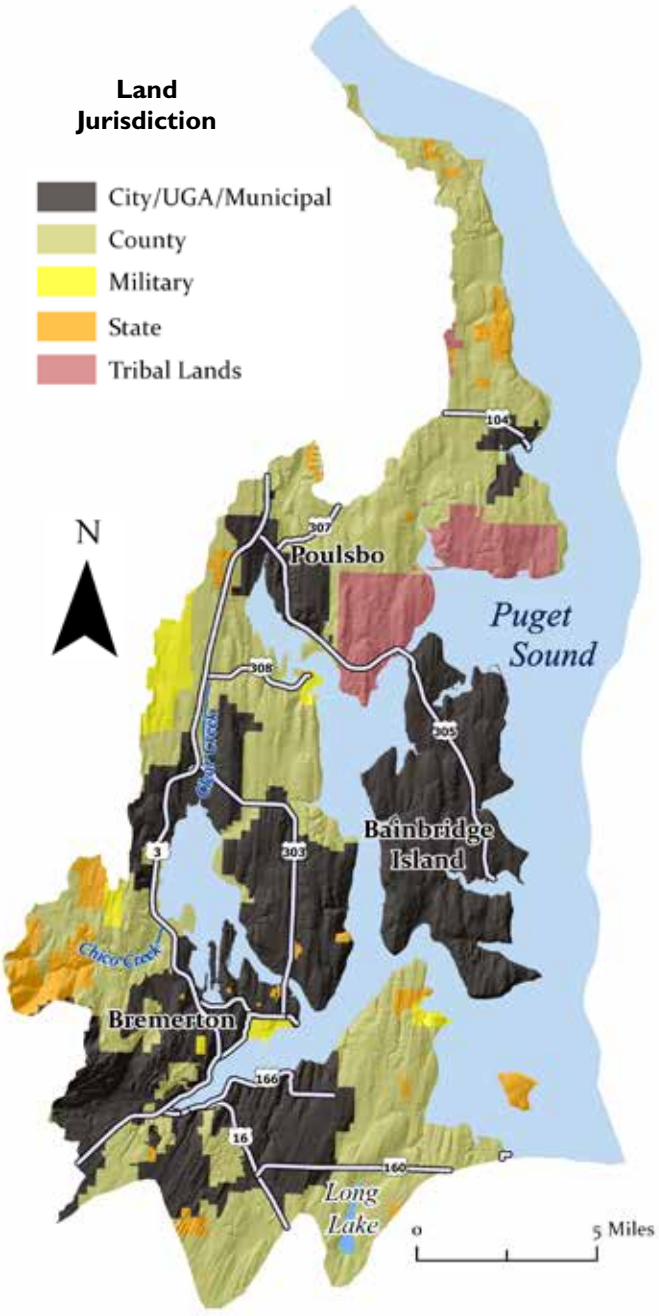
The entire Kitsap Peninsula (including the East Kitsap area) is 400 square miles in size, with 360 miles of marine shoreline, which accounts for nearly half of the nearshore habitat in south and central Puget Sound and is vital for threatened Chinook, as well as for Chum, Coho, steelhead and cutthroat trout from watersheds throughout Puget Sound.[1]

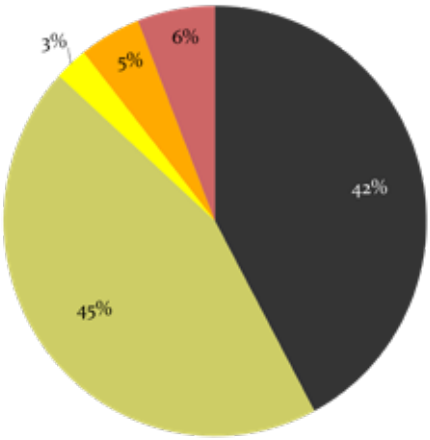
This report focuses on the East Kitsap area, a small portion of the tribe's extensive U&A and home to the Port Madison Indian Reservation. The shorelines of East Kitsap area form the eastern portion of Kitsap County, including the cities of Bainbridge Island, Poulsbo, Bremerton and Port Orchard, all of which contain many streams that flow to central or southern Puget Sound. These unique Kitsap Peninsula lowland streams provide ideal spawning and rearing habitat for multiple species of salmonids. Lacking snowpack, streamflows are dependent on rainfall and groundwater contribution. Most all of them originate from lakes, springs or headwater wetlands.[2]

The U.S. Navy owns most of the federal land in the East Kitsap area, and some of these lands contain valuable habitat. These Navy installations occupy significant stretches of developed shoreline and nearshore marine areas (e.g., Puget Sound Naval Shipyard in Bremerton, Jackson Park, Keyport and Manchester) and present significant challenges to protecting and restoring habitat. Navy operations have left a legacy of contamination in the East Kitsap area, in upland, nearshore and sub-tidal marine waters. Although the Navy's internally developed Integrated Natural Resource Management Plans provide environmental guidance, they do not ensure the protection of treaty-reserved rights and resources or consistency with state and local land use and other environmental laws designed to protect habitat. West Sound Partners for Ecosystem Recovery (WSPER) serves as the lead entity for salmon recovery and local integrating organization for Puget Sound ecosystem recovery.

Through WSPER, the Suquamish Tribe works with other tribal and local governments to implement salmon recovery. For example, the tribe led a collaborative effort with local governments and other salmon recovery partners in developing the East Kitsap Demographically Independent Population Steelhead Recovery Plan (EK DIP Plan) to guide local recovery of steelhead as part of Puget Sound steelhead recovery.[3] WSPER recognizes the critical role played by the nearshore and marine areas in providing support for salmon species originating from all portions of Puget Sound.[4]

Completed in 2020, the EK DIP Plan emphasizes strategies to protect and restore watershed processes that ensure adequate cool clean water for Steelhead, including protection and restoration of wetlands and both riparian and upland forest conditions, opening access to stream habitats through removal of fish passage barriers, and reconnecting floodplains. The plan calls for property acquisitions and easements to protect key habitats and improved land use regulatory protections and compliance where needed. The plan identifies critical data gaps in monitoring steelhead population and habitat trends in the East Kitsap area. The overall goal is to protect, restore and enhance watershed natural processes and habitat in order to contribute to Puget Sound-wide salmon recovery.





Map Data Sources: DOD 2023[5], SSHIAP 2004[6], WADNR 2024a[7], WADNR 2024b[8], WAECY 2018c[9], WAECY 2021[10], WAECY 2024[11], WADOT 2018[12], WADOT 2023[13], USFWS 2024[14]

Chapter Summary

The Suquamish Tribe has inhabited the Kitsap Peninsula and surrounding areas since time immemorial. They are party to the Point Elliott Treaty of 1855, when tribes ceded their traditional lands to the U.S. government. The Suquamish Tribe are leaders in the region's salmon recovery effort. No other people know these watersheds as well as the tribes and none has a greater stake in their future. The tribes believe that if salmon are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the watersheds, prey availability and poor early marine survival.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribes' Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling and 1994 Rafeedie decision upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, protection of habitat and established the tribes as co-managers of the fisheries resource.

The goal of this report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org.*

For this report, the Suquamish Tribe has focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing a metric for assessing changes in salmon habitat. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Shoreline Armoring Continues to Impact Forage Fish Spawning Habitat in East Kitsap County

Shorelines with significant armoring (50-100%) account for 97% of armoring in East Kitsap County.[1] Forage fish spawning locations have been documented, with 71% of sand lance and 90% of surf smelt spawning locations occurring along shorelines with significant armoring.[2]

Shellfish Harvests Threatened and Cockle Restoration Taking Longer than Expected

Poor water quality threatens bivalve shellfish harvests and efforts to restore cockle populations have slowed after the discovery of cockle cancer was found in samples.

Eelgrass and Kelp Restoration Show Promise

Eelgrass has declined in many areas and bull kelp has disappeared where it once flourished, but recent restoration projects show promise for improving nearshore habitat. Bull kelp was planted at Jefferson Head near the Suquamish Tribe's Doe Kag Wats estuary, and in 2020, the kelp reached the surface for the first time in almost three decades.

Impervious Surfaces and Population Continue to Increase

From 2020-2023, population growth in East Kitsap was mostly confined to Urban Growth Areas within Kitsap County, however the county is still not in compliance with its adopted urban/rural growth target. From 2011-2021, impervious surfaces increased slightly (0.52%) with 982 acres added to roughly the same areas, concentrated mainly within the Blackjack Creek, Gorst Creek and Clear Creek watersheds.

Stormwater Runoff Connected to Pre-Spawning Mortality

A compound derived from tire wear, 6PPD-quinone, has been shown in studies to cause mortality in 100% of adult coho salmon. In East Kitsap County, there are 655 stormwater discharge locations on state-maintained highways, and predictions have been made for areas where heavy traffic will contribute to high pre-spawning mortality rates in Coho salmon.

Increase in Water Wells puts Pressure on Groundwater Supply, Contributing to Inadequate Water Flow for Salmon and Steelhead

In East Kitsap 5,011 water wells were installed between 1980-2019. Between 2020-2024, an additional 183 water wells were added, a 3.7% increase.

Upland and Riparian Forest Cover Conditions Slightly Decrease

Forest cover in the East Kitsap area decreased by 2.22% between 2011-2021, a loss of approximately 4,230 acres.

Culverts Continue to Impede Fish Passage

There are 1,083 known barrier culverts that are owned by the state, cities and counties, as well as private corporations and individuals in the East Kitsap area. Most of the barriers are privately owned (343 barriers) or owned by Kitsap County (326 barriers).

Barrier Removal and Restoration Successful in Priority East Kitsap Watersheds

Multiple culvert removal and habitat restoration projects have been completed or are near completion in East Kitsap. Additional habitat and restoration projects have been completed in Chico, Curley, Blackjack and Gorst watersheds. Of the culvert projects completed, the State Route 3 project (completed in 2024) that replaced two eight-foot square culverts with a 240-foot bridge (200-foot hydraulic opening) was most notable.

Watershed Restoration and Salmon Recovery Planning

The Suquamish Tribe is an active participant in salmon forums. Tribal representatives participate in the Puget Sound Partnership Salmon Recovery Council as well as participate in the West Sound

Partners for Ecosystem Recovery (WSPER). WSPER serves as both the salmon recovery lead entity and the Local Integrating Organization for ecosystem recovery in the North Central Action Area. Participants include Kitsap County, Pierce County, cities of Bremerton, Poulsbo, Port Orchard, Bainbridge Island and Gig Harbor, the Suquamish, the Port Gamble S'Klallam and the Squaxin Island tribes, Department of Fish and Wildlife, and various enhancement groups, conservation districts and environmental groups. WSPER has a Salmon Recovery and Conservation Plan that was completed in 2005 and is currently going through an update scheduled to be released in 2025.

Climate Change

The Suquamish Tribe's water temperature data was used in a study to assess the impacts of climate change on water temperatures in various watersheds throughout Kitsap County. Results show that stream temperatures will increase in the coming decades and solutions need to be implemented to protect salmon, such as riparian habitat protection and restoration, and allowing for beavers to help form more complex aquatic habitats, store water and increase groundwater/surface water exchange.

Conclusion

The East Kitsap area has seen some successes in habitat restoration in recent years but some key habitat indicators have not improved or have worsened. Tribal leadership have concerns with the increase in population and the impacts that come from it. The loss of riparian and aquatic habitat are major factors contributing to the decline of salmon stocks in the Salish Sea. Since the last State of Our Watersheds Report in 2020, there have been slight changes to key indicators, but overall habitat conditions are not improving.

Even though restoration is occurring, it is not enough to keep up with the impacts of a growing population and land use decisions. Currently land use and water laws that are in place need to be enforced.

In addition to regulatory protection, salmon recovery must also include education and voluntary actions that support habitat protection and restoration.

Recovery Efforts Improving but Key Indicators Still Lagging

At the 20-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Kitsap basin planning area shows that priority issues continue to be degradation of water quantity and quality, floodplain and riparian processes, marine shoreline habitat conditions, and fish habitat blockages from culverts and other human-made structures. In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations.

In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress. Although habitat degradation continues, there are some positive developments that the tribe hopes gain traction.

Suquamish Tribe

Review of the trends for these key environmental indicators shows a positive trend when looking at the continued efforts in the restoration of the Chico Creek watershed and eelgrass and kelp restoration. Overall, the trends of these key environmental indicators show a continued decline in habitat status.

Tribal Indicator	Status	Habitat Trend
Shoreline Modifications	In East Kitsap County, forage fish spawning locations have been documented, with 71% of sand lance and 90% of surf smelt spawning locations occurring along shorelines with significant armoring (50-100%).	**Declining**
Shellfish	Poor water quality threatens bivalve shellfish harvests. Efforts to restore cockle populations have slowed after the discovery of cockle cancer was found in samples.	**Declining**
Eelgrass and Kelp Restoration	Eelgrass has declined in many areas and bull kelp has disappeared where it once flourished, but recent restoration projects show promise for improving nearshore habitat. Bull kelp was planted near the Suquamish Tribe's estuary Doe Kag Wats, and in 2020, the kelp reached the surface for the first time in almost three decades.	**Concerns**
Impervious Surface / Population Growth	From 2020-2023, population growth in East Kitsap was mostly confined to Urban Growth Areas within Kitsap County, however the county is still not in compliance with its adopted urban/rural growth target. From 2011-2021, impervious surfaces increased slightly (0.52%) with 982 acres added to roughly the same areas, concentrated mainly within the Blackjack Creek, Gorst Creek and Clear Creek watersheds.	**Declining**
Water Quality - 6PPDQ Impacts	A compound derived from tire wear, 6PPD-quinone, has been shown in studies to cause mortality in 100% of adult Coho salmon. In East Kitsap County, there are 655 stormwater discharge locations on state-maintained highways, and predictions have been made for areas where heavy traffic will contribute to high pre-spawning mortality rates in Coho salmon.	**Concerns**
Water Wells	In East Kitsap, 5,011 water wells were installed between 1980-2019. Between 2020-2024, an additional 183 water wells were added, a 3.7% increase.	**Declining**
Forest Cover	Forest cover in the East Kitsap area decreased by 2.22% between 2011-2021, a loss of approximately 4,230 acres.	**Declining**
Barrier Culverts	There are 1,083 known barrier culverts that are owned by the state, cities and counties, as well as private corporations and individuals in the East Kitsap area. Most of the barriers are privately owned (343 barriers) or owned by Kitsap County (326 barriers).	**Declining**
Barrier Removal / Restoration	Multiple culvert removal and habitat restoration projects have been completed or are near completion in East Kitsap. Additional habitat and restoration projects have been completed in Chico, Curley, Blackjack and Gorst watersheds. Of the culvert projects completed, the State Route 3 project (completed in 2024) that replaced two eight-foot square culverts with a 240-foot bridge (200-foot hydraulic opening) was most notable.	**Improving**
Climate Change	The Suquamish Tribe's water temperature data was used in a study to assess the impacts of climate change on salmonids in the Chico Creek watershed. Results show that stream temperatures will increase in the coming decades and solutions need to be implemented to protect salmon, such as riparian habitat restoration and beaver recolonization.	**Concerns**

The Suquamish Tribe continues to work toward the protection and restoration of healthy and functional watersheds, streams, nearshore and estuarine habitat.

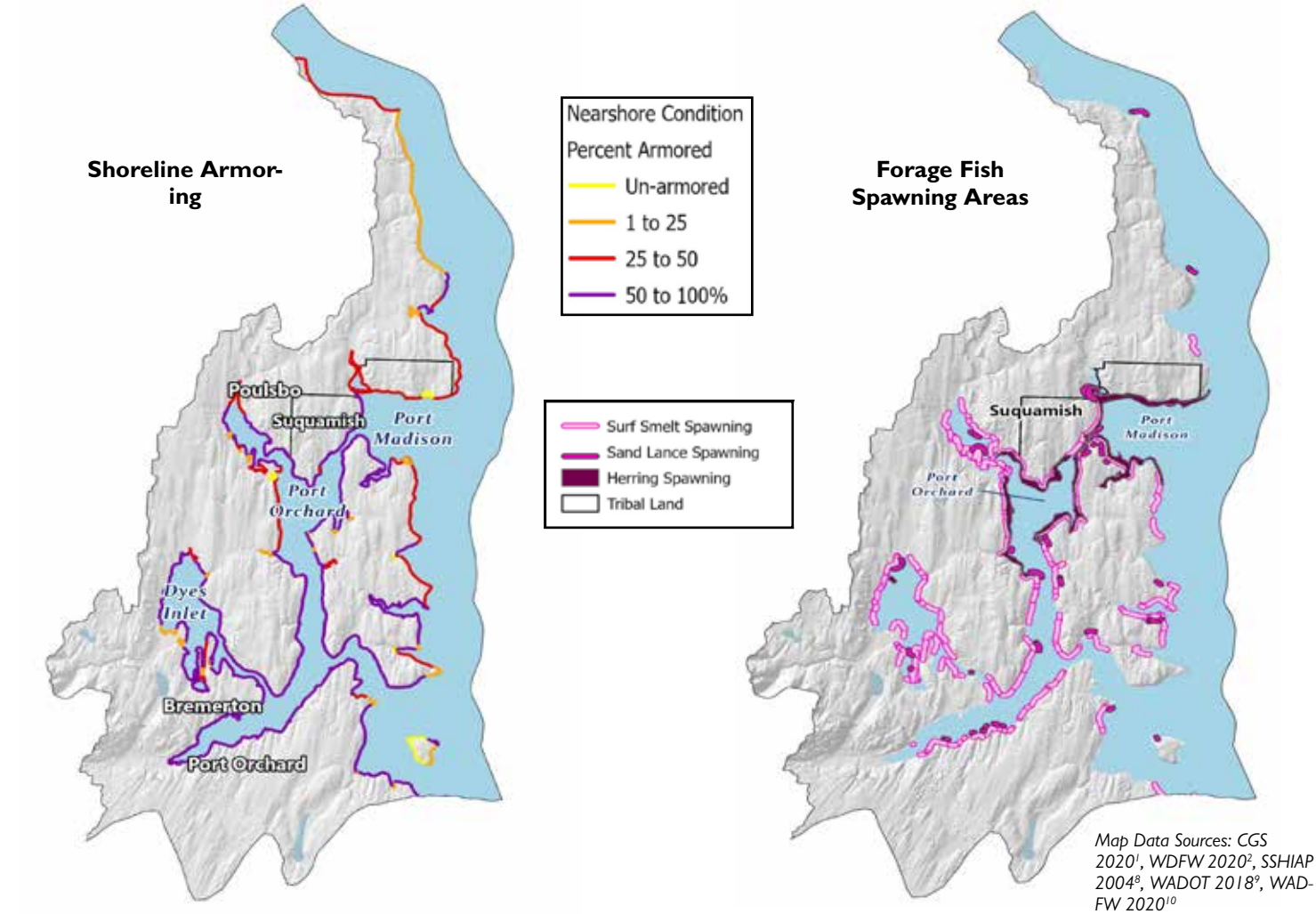
Looking Ahead

The Suquamish Tribe's activities in the near future (2025-2030) will emphasize, but are not limited to, the following:

- Continue working with Kitsap County and Department of Health to upgrade shellfish growing area classifications in the East Kitsap area, including but not limited to Chico Bay/Dyes Inlet, Liberty Bay, Ostrich Bay, Oyster Bay, Foulweather Bluff, Lynwood Center and Sinclair Inlet;
- Continue tracking water pollution sources at Richmond Beach in order to meet the criteria to classify and re-open beaches to shellfish harvest;
- Restoration of depressed native oyster, sea cucumber and cockle populations;
- Conducting actions to prevent further habitat and water quality degradation through review of land use plans, development project permits and water quality permits;
- Completed baseline forage fish surveys in partnership with the state Department of Fish and Wildlife, expanding in 2021-2022 to include acoustic and trawl surveys for herring in the Port Orchard/Port Madison waters and other parts of Puget Sound;
- Participation in Superfund and other contaminated site cleanup activities; including DOD sites, Lower Duwamish/East Waterway, Port Gamble Bay, Port Blakely Harbor, Pier 91 and Bremerton Gasworks in Bremerton;
- To facilitate the exchange of climate change and technology knowledge, the tribe now has a climate change program;
- Tribe is working with WWU/NWIFC on riparian assessment in East Kitsap watersheds, focused on modeling shade and large wood functions, to inform prioritization of riparian habitat protection and restoration actions. The tribe also is working with Kitsap County in mapping and assessing floodplain connectivity and ecological conditions in the county to help prioritize habitat restoration and protection actions in floodplains for evaluating salmon recovery progress and identification of habitat conservation and restoration priorities.
- Tribe is beginning several restoration design projects, including working with city of Bremerton on Gorst Creek, with Great Peninsula Conservancy on Cowling Creek and Clear Creek (Petersen Farm), and with Kitsap County on lower Chico Creek (Erlands Point Park).
- Tribe is starting a project with Shore Friendly Kitsap program and a willing landowner on a design for removal of an old bulkhead and restoration of shoreline adjacent to tribal property.
- Continue and expand on pre- and post-restoration effectiveness monitoring at Rose Point Embayment Estuary and Finn Creek Estuary.
- Tribe anticipates a partnership with King County and the Tulalip Tribes on a study that will assess landscape scale and habitat characteristics that determine juvenile Chinook and other salmon use of "non-natal" habitats, including about 15 study sites in the East Kitsap area.
- Continue working with BNSF and the Tulalip Tribes on culvert replacement projects on the BNSF rail line.
- Tribe is working with salmon recovery partners in developing an East Kitsap Steelhead Monitoring Plan that will recommend implementation of monitoring steelhead populations and tracking progress toward recovery. The tribe anticipates starting some form of steelhead monitoring, in collaboration with recovery partners, during the next five years.
- Tribe is considering expanding the use of environmental DNA (eDNA) for monitoring steelhead population distributions, and other watershed protection and restoration projects.

Shoreline Armoring Continues to Impact Forage Fish Spawning Habitat in East Kitsap County

Shorelines with significant armoring (50-100%) account for 97% of armoring in East Kitsap County.[1] Forage fish spawning locations have been documented, with 71% of sand lance and 90% of surf smelt spawning locations occurring along shorelines with significant armoring.[2]



Map Data Sources: CGS 2020[1], WDFW 2020[2], SSHIAP 2004[8], WADOT 2018[9], WADFW 2020[10]

Shoreline armoring impacts ecosystem processes, structure and function in the nearshore environment. Armoring can block sediment supply, reduce the abundance of large woody debris on beaches, and cause the direct loss of forage fish spawning habitat.[3]

The three most common forage fish species in the Puget Sound basin are surf smelt, Pacific sand lance and Pacific herring. Surf smelt and Pacific sand lance lay their eggs in sand and gravel on intertidal beaches, while Pacific herring spawn on marine vegetation such as eelgrass in shallow subtidal and low intertidal areas.[4]

Many activities, harmful to fish and shellfish both directly and indirectly, continue to occur with some permitted under current rules (single family residence exemptions). In addition, lack of enforcement and tracking of cumulative impacts continue to negatively affect shoreline health and processes.

As a result of climate change, sea level rise and warming ocean temperatures are projected to impact nearshore areas. Erosion, extreme storm events, rising sea levels and increasing temperatures will affect nearshore habitat for shellfish, eelgrass and forage fish.[5] As water levels rise, eelgrass will need to grow closer to the shore, as it cannot survive in depths greater than 10 meters deep. If shoreline armoring is present, shellfish and eelgrass growing areas will potentially become constricted. This could result in a loss of spawning and rearing habitat for forage fish and juvenile salmon.[5]

The Suquamish Tribe recently partnered with the Washington Department of Fish and Wildlife to conduct acoustic trawl surveys for Pacific herring around East Kitsap County, including the waters off Port Orchard and Port Madison.[6] Previous acoustic trawl surveys happened every year for decades until funding ran out in 2010. Renewed efforts to collect data on herring populations will inform salmon recovery, as healthy forage fish populations provide a high energy food source for salmon and may help reduce predation on juvenile salmon because other fish, marine mammals and birds consume forage fish too. Herring also has been important traditionally to Puget Sound tribes as sustenance during the late winter and spring before adult salmon return, and surf smelt have been harvested by the Suquamish Tribe for consumption since time immemorial.[7]

Shellfish Harvests Threatened and Cockle Restoration Taking Longer than Expected

Poor water quality threatens bivalve shellfish harvests and efforts to restore cockle populations have slowed after the discovery of cockle cancer was found in samples.

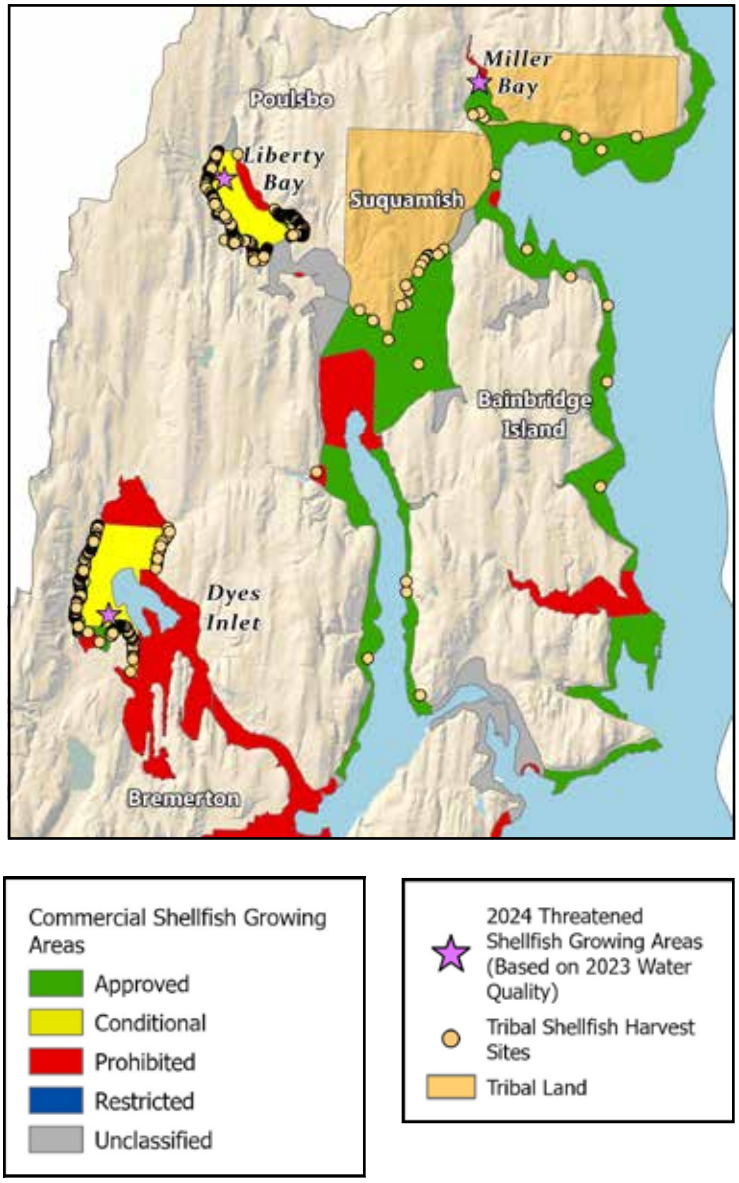
Shellfish harvesting is a traditional activity that the Suquamish Tribe has engaged in for thousands of years. In the tribe's Area of Interest, population growth in cities like Bremerton have affected water quality in intertidal zones where bivalve shellfish are harvested.[1] The Washington Department of Health routinely checks marine water quality sampling stations and determines whether harvesting areas are Approved, Conditionally Approved, Prohibited or Restricted based on sample results.[2]

Dyes Inlet and Liberty Bay are important shellfish grounds to the tribe and both experienced closures the past few years which have limited shellfish harvests. Harvesting was prohibited in Dyes Inlet until 2003 when the city of Bremerton upgraded its sewer system. Since then, parts of Dyes Inlet have been Approved or Conditionally Approved for human consumption.[3] In the 2024 Annual Growing Area Evaluation for Kitsap County, five water quality monitoring stations were listed as threatened, including one in Dyes Inlet, one in Miller Bay and three in Liberty Bay. The water quality stations were assigned a 'threatened' status due to fecal coliform levels between 30 and 43 fc/100ml; 43 being the threshold limit for an area to remain open.[4]

The tribe also started a restoration program to bring back traditional foods to tribal diets, however, a viral cancer which affects cockles has been found in samples, slowing the tribe's restoration efforts until the disease is better understood. Traditionally, the tribe would have clam bakes which included cockles, a bulbous clam found in eelgrass beds. Fewer and fewer cockles had been harvested by the tribe by 2016, when they contacted the Puget Sound Restoration Fund (PSRF) to voice their concerns about the clam's disappearance. PSRF and NOAA worked with the tribe to produce cockles in a hatchery setting, where there has been success with rearing cockle juveniles. However, in 2018 a rare cancer was discovered after a sample of cockles went through a health screening. The tribe and PSRF reached out to the Pacific Northwest Research Institute who found that the cancer transmits like a virus among cockles but does not affect other species. The cancer can spread quickly enough to kill an entire population.[5]

Cockles on the Pacific Coast and soft-shell clams on the Atlantic Coast are now being studied thanks to a grant from the National Science Foundation's Division of Ocean Sciences. The five-year study will help determine how the disease transfers from one population to another and how it progresses within individuals. The cancer has been found in samples from Semiahmoo, Agate Pass, Penn Cove and Sequim Bay. It has not been found in samples from Hood Canal or South Sound. The tribe had hoped to help seed cockles to restore local populations, so understanding this disease will help inform management decisions moving forward.[6]

Teaching the next generation how to gather traditional foods is a practice that is vital to tribal members and having healthy populations of harvestable shellfish is the goal for the future. The tribe is focused on improving coastal habitat and water quality along intertidal zones in Kitsap County by addressing pollution problems, researching ocean acidification, restoring bull kelp beds and conducting eelgrass surveys.[1] Efforts to restore local populations of shellfish will hopefully ensure that traditional foods are a part of tribal diets for many generations to come.



Map Data Sources: WADOHa 2025[7], WADOHb 2025[8], SSHIAP 2004[9], WADOT 2018[10], WADOT 2010[11]

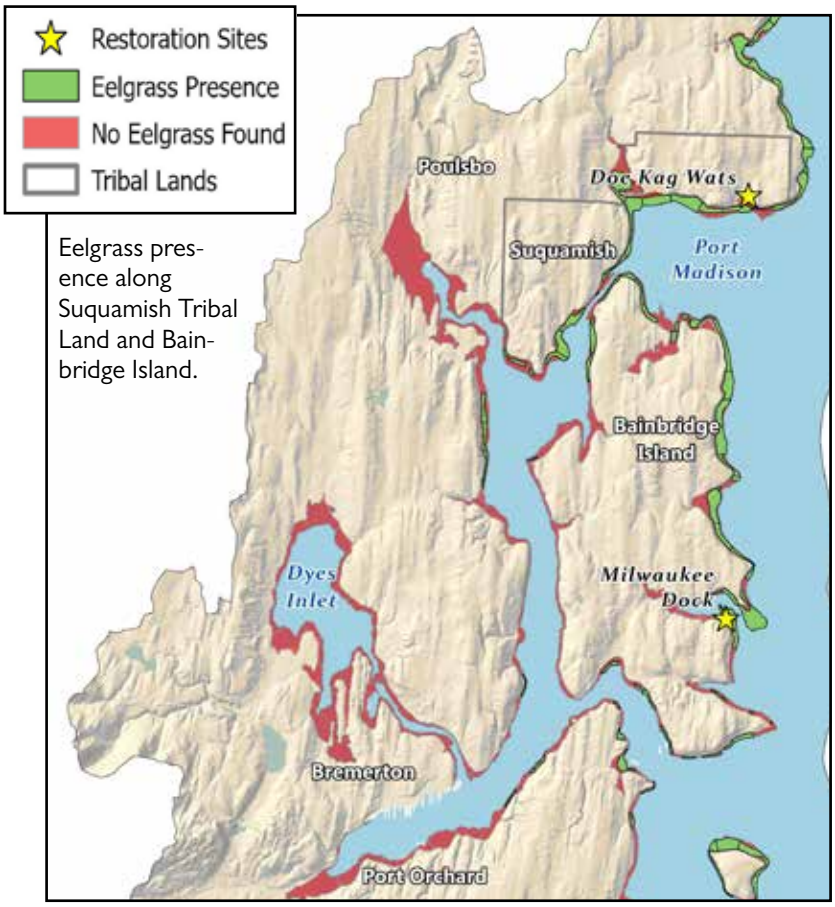
Eelgrass and Kelp Restoration Show Promise

Eelgrass has declined in many areas and bull kelp has disappeared where it once flourished, but recent restoration projects show promise for improving nearshore habitat. Bull kelp was planted at Jefferson Head near the Suquamish Tribe's Doe Kag Wats estuary, and in 2020, the kelp reached the surface for the first time in almost three decades.

Eelgrass is an essential plant in the ocean which helps stabilize shorelines, absorbs carbon, improves water quality and provides shelter and foraging areas for rockfish, salmon and Dungeness crab. Eelgrass is found in shallow nearshore areas, but is disappearing due to pollution, dredging, development, sea level rise and other impacts.[1]

In 2014, the Suquamish Tribe signed an interagency agreement with the Washington Department of Natural Resources (DNR) to collect baseline eelgrass area and depth distribution data within their usual and accustomed fishing area, including 62 sample sites along eastern Kitsap Peninsula and Bainbridge Island, using methods standardized by DNR's Submerged Vegetation Monitoring Program. Additional areas and sites were added in subsequent years. The monitoring occurred between 2014-2020 and found eelgrass beds along most of the shorelines of the Central Basin of Puget Sound. Eelgrass beds were sparse or absent in Port Orchard, Dyes Inlet and Liberty Bay portions of East Kitsap. Between 2018-2020, 35 sites were revisited along Kitsap shorelines that had been surveyed in earlier years. One site had no eelgrass, 4 sites showed eelgrass declines, and 30 had no significant change in eelgrass.[2]

Near Pritchard Park on Bainbridge Island, the Milwaukee Dock historically served the Wyckoff creosote plant, with navigation channels leaving two large depressions too deep for eelgrass to establish. The Milwaukee dock has since been removed, and the site was a prime candidate for restoration because the eelgrass beds surrounding the deep depressions are robust. The tribe partnered with Puget Sound Partnership, among others, to complete the Milwaukee Dock eelgrass restoration project in 2017, which converted about 3 acres of deep unvegetated habitat into a shallow eelgrass meadow.[3, 4]



Eelgrass presence along Suquamish Tribal Land and Bainbridge Island.

Like eelgrass, kelp forms a key part of the Puget Sound ecosystem. Kelp gives fish, invertebrates and other species a place to live, and floating species such as bull kelp form a canopy on the water's surface. Kelp forests allow young salmon, rockfish and forage fish to mature in safety.[5] Near Doe Kag Wats, an estuary property owned by the tribe, kelp once grew in thick rafts. In 2018, the Puget Sound Restoration Fund, in partnership with the tribe, started replanting kelp at Doe Kag Wats. In 2020, kelp reached the surface for the first time in almost three decades.[6,7]

The tribe is now working with DNR on mapping canopy kelp forests in Central Puget Sound, including some locations in East Kitsap, using drone-based imagery. This mapping will provide a baseline for tracking changes to these kelp forests.

Aaron Barna [8]

Eelgrass (*Zostera marina L.*)

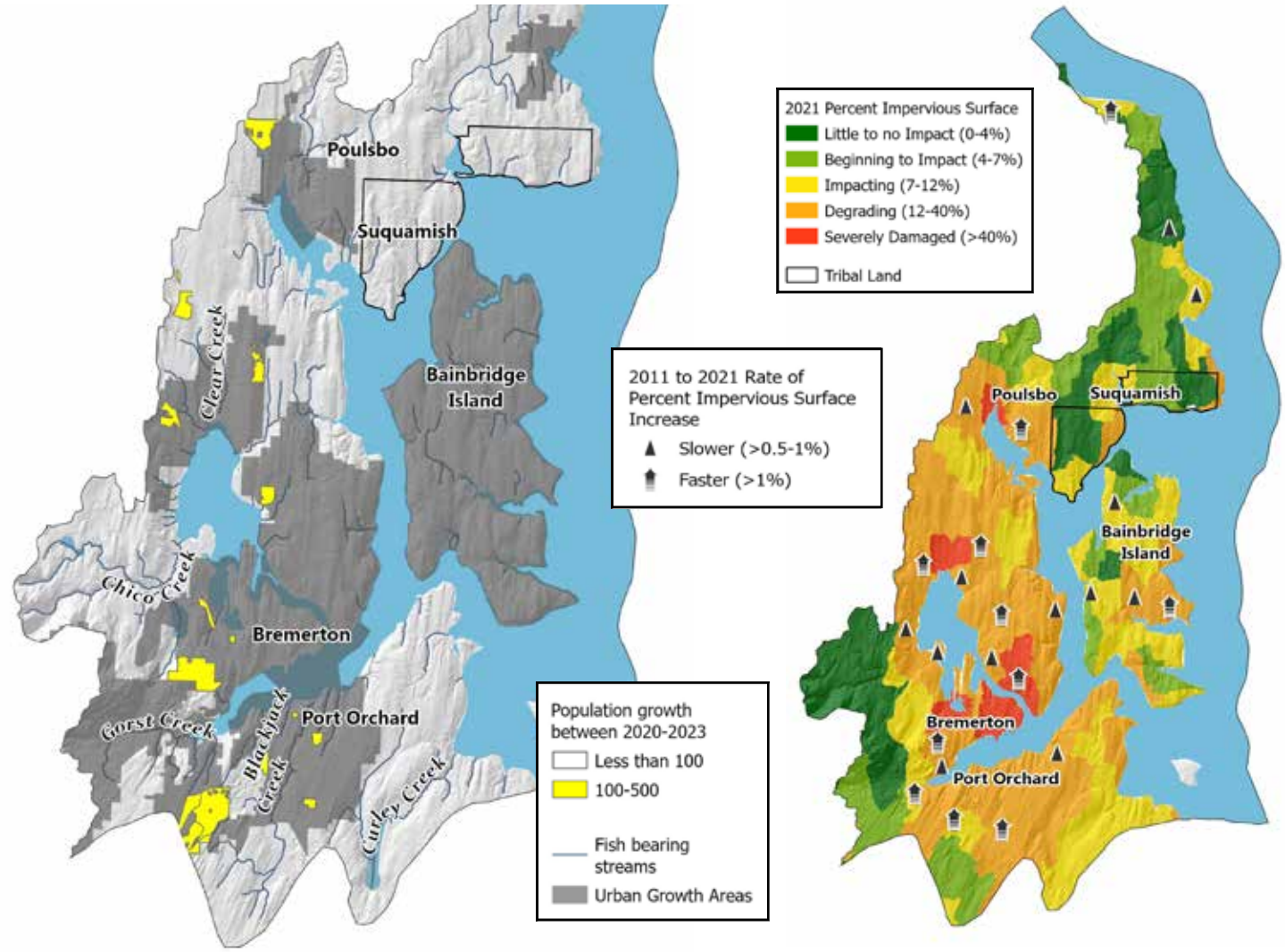
Thomas Mumford [8]

Kelp beds near the San Juan Islands, Washington.

Map Data Sources: SSHIAP 2004[9], WADOT 2018[10], WADOT 2010[11], WADNR 2020[12]

Impervious Surfaces and Population Continue to Increase

From 2020-2023, population growth in East Kitsap was mostly confined to Urban Growth Areas within Kitsap County, however the county is still not in compliance with its adopted urban/rural growth target. From 2011-2021, impervious surfaces increased slightly (0.52%) with 982 acres added to roughly the same areas, concentrated mainly within the Blackjack Creek, Gorst Creek and Clear Creek watersheds.



Impervious surfaces prevent the infiltration of water, which reduces groundwater recharge and base flow for streams. Non-point source pollutants including pathogens, nutrients, toxic contaminants and sediment collect on impervious surfaces, and during rainfall events the stormwater containing these pollutants can flow directly into waterways, causing harm to aquatic ecosystems. Increasing urbanization and development results in increases in impervious surfaces such as roads, parking lots and rooftops.[1,2]

The central Puget Sound region is expected to grow by 1.5 million people by 2050[3], and local, state and federal governments are challenged to keep up with the needs of a growing population without degrading habitat beyond repair.

The Kitsap County Comprehensive Plan update was completed in December of 2024, and the Year of the Rural will be completed in 2025. These two documents will plan for growth for the next 10 years. The goal is to update these plans based on new priorities, new state requirements, best available science and public input. In reviewing and updating the plan, Kitsap County staff incorporated regional planning goals and policies (Puget Sound Regional Council's VISION 2050) which included climate change as a new element to the plan.[4]

From 2020-2023, population growth in East Kitsap was mostly confined to Urban Growth Areas (UGAs) within Kitsap County, however the county is still not in compliance with its adopted urban/rural growth target.[4] From 2011-2021, impervious surfaces increased slightly (0.52%) with 982 acres added to roughly the same areas, concentrated mainly within the Blackjack Creek, Gorst Creek and Clear Creek watersheds.[9,10,11,12] By design, population growth should fall within a county's urban/rural growth target. However, when habitat degradation occurs within these areas there is often an imbalance in funding for restoration projects in urban versus rural areas. Urban projects tend to be more expensive due to infrastructure constraints, but keeping up with completing these projects is vital to achieve adequate stream health within UGAs.

Map Data Sources: SSHIAP 2004[5], WADOT 2018[6], WADOT 2010[7], SWIFD 2024[8], NLCD 2011[9], NLCD 2021[10], WAECY 2017[11], WAOFM 2023[12], WAECY 2021[13]

Stormwater Runoff Connected to Pre-Spawning Mortality

A compound derived from tire wear, 6PPD-quinone, has been shown in studies to cause mortality in 100% of adult Coho salmon. In East Kitsap County, there are 655 stormwater discharge locations on state-maintained highways, and predictions have been made for areas where heavy traffic will contribute to high pre-spawning mortality rates in Coho salmon.

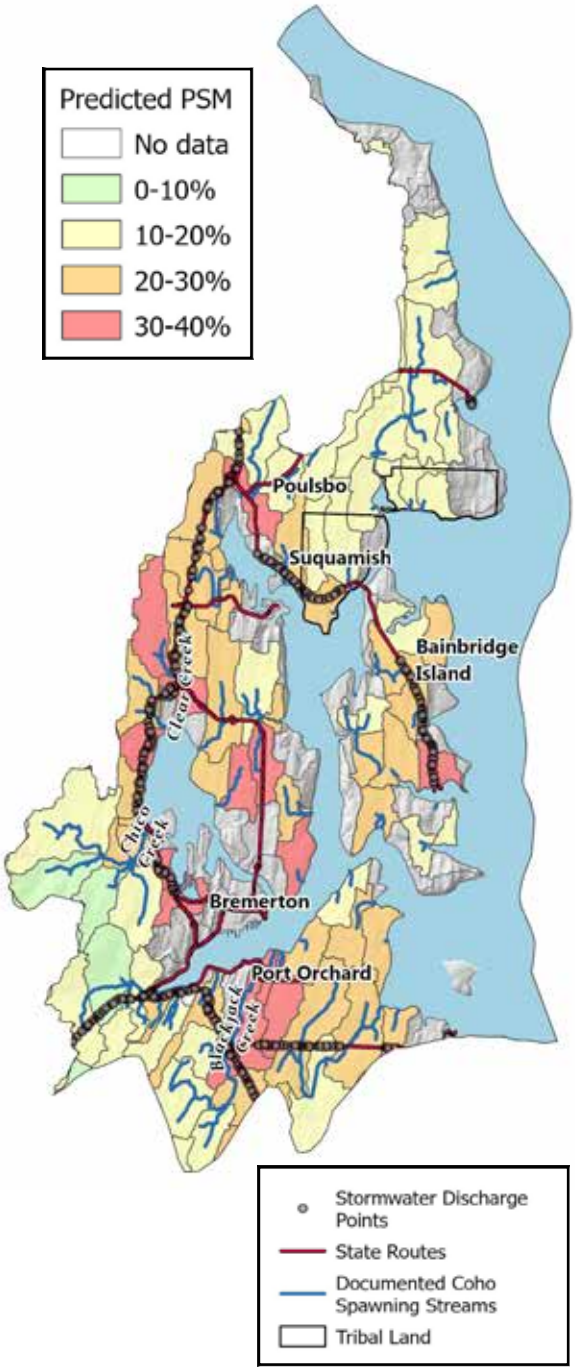
Adult Coho salmon returning from the ocean to spawn in urban basins of the Puget Sound region have been prematurely dying at high rates for more than 20 years. A compound derived from tire wear, 6PPD-quinone (6PPDQ), has been found to negatively impact fish, particularly Coho salmon. When coho salmon are returning to streams to spawn where 6PPDQ is present, they often experience pre-spawning mortality (PSM) and die before they get a chance to spawn.[1] Affected fish become disoriented and show surface swimming, gaping, loss of equilibrium and death on a timescale of a few hours.[2]

In 2017, NOAA's Northwest Fisheries Science Center used computer models to predict PSM rates throughout Puget Sound. Their modeling supports the conclusion that Coho in more urbanized watersheds are vulnerable to nonpoint source pollution regardless of the timing, intensity and frequency of storms. Green stormwater infrastructure will be essential for reducing the high rates of Coho losses in subbasins that are currently urban or suburban. It will also prevent mortality in rural and forested subbasins where Coho runs are presently healthy but vulnerable to future development pressures.[2]

The EPA has been pressured to prohibit the manufacturing, processing and use of 6PPD in tires.[3] In response, the EPA has developed a draft laboratory method for detecting 6PPDQ in surface water and stormwater and has announced $12 million in new Puget Sound stormwater funding aimed at reducing toxins through road retrofit planning, stormwater parks and finding and fixing toxic hotspots.[4] On the state level, the Washington State Department of Ecology has drafted a plan for the monitoring of 6PPDQ in salmon bearing streams.[5] The Washington State Department of Transportation (WSDOT) is using current best management practices that reduce or eliminate other pollutants and may have the same effect on 6PPDQ. Plants, soils and compost are often components of these types of best management practices, referred to as green stormwater infrastructure. WSDOT is utilizing Move Ahead Washington funding to enhance stormwater treatment from existing roads and infrastructure, with an emphasis on green infrastructure retrofits. Retrofit projects will be prioritized based on benefits to salmon recovery and ecosystem health, reducing toxic pollution, addressing health disparities and cost effectiveness.[6]

Kitsap County Public Works

Whispering Firs Stormwater Park captures and prevents toxic metals, oils and bacteria from polluting nearby Clear Creek. Future installations of stormwater infrastructure will need to prioritize 6PPDQ removal in areas where Coho pre-spawning mortality is the highest.



Stormwater discharge points along state-maintained highways in East Kitsap County. Streams with documented Coho presence are also shown, as well as areas where pre-spawning mortality (PSM) is predicted to be the highest.

Map Data Sources: SSHIAP 2004[7], SWIFD 2024[8], WADOT 2018[9], WADOT 2010[10], WADOT 2024[11], WADOT 2023[12], PSM Predictions 2017[13]

Increase in Water Wells puts Pressure on Groundwater Supply, Contributing to Inadequate Water Flow for Salmon and Steelhead

In East Kitsap, 5,011 water wells were installed between 1980-2019. Between 2020-2024, an additional 183 water wells were added, a 3.7% increase.

East Kitsap is a low-elevation part of Puget Sound which relies on groundwater aquifers and wetlands to provide adequate water flow throughout the year. Summer low flows in areas without snowmelt (such as the Kitsap Peninsula), have had a declining trend, with low flows getting lower each year for longer periods of time.[1] Lower water levels can disconnect streams from their floodplains, reducing fish access to off-channel habitat. Low flows cause significant problems for juvenile steelhead that rear in streams throughout the summer, exposing them to increased predation, concentrated pollutants and higher in-stream temperatures due to a lack of flow and a lack of cold water refugia.[2,3]

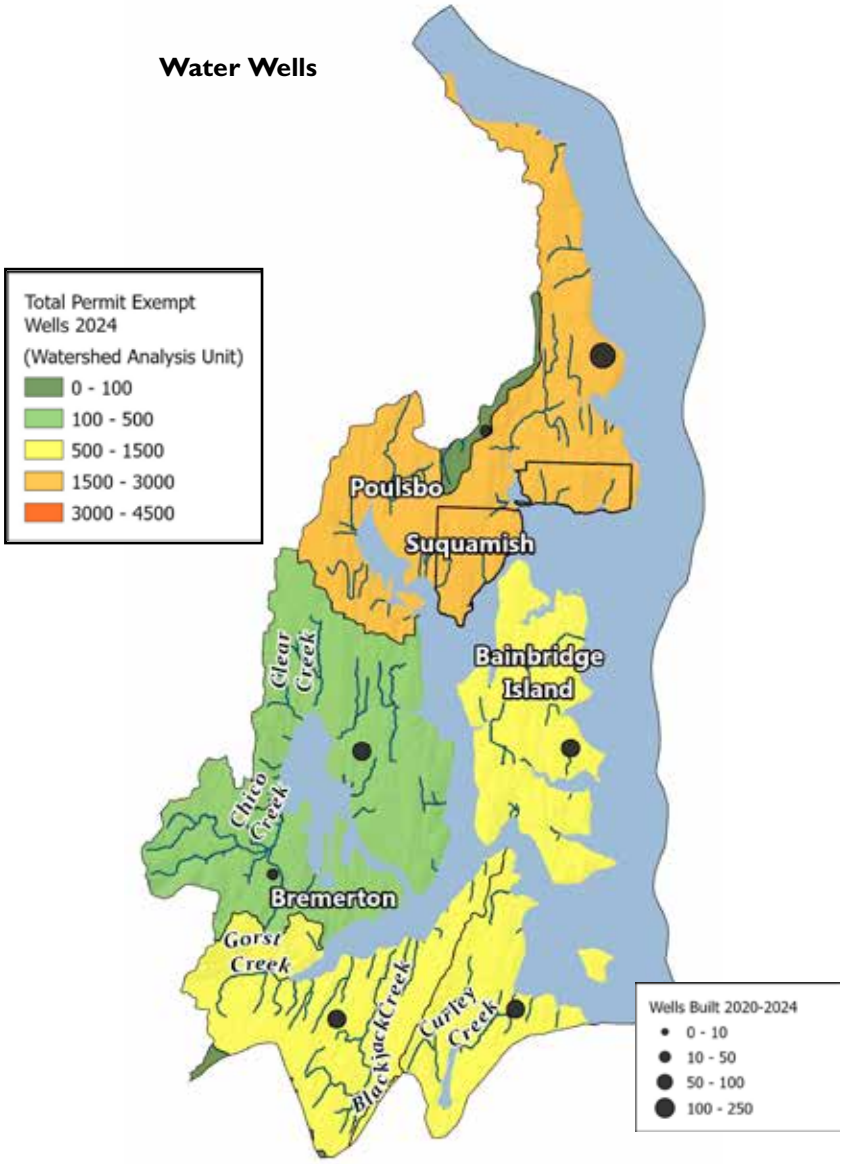
The East Kitsap Demographically Independent Population (DIP) Steelhead Recovery Plan was completed in 2020. One of the primary ecosystem pressures the recovery plan identifies is groundwater withdrawals and altered flows.

There are several types of wells that are permitted by the Washington State Department of Ecology. In East Kitsap, 5,011 water wells were installed between 1980-2019. Between 2020-2024, an additional 183 water wells were added, a 3.7% increase.[4]

In the summer months, juveniles are vulnerable to high stream temperatures, and adults returning to spawn in the early fall also are vulnerable when flows remain low.[5] New water wells put further pressure on finite groundwater resources which will inevitably impact salmon, especially during the summer months and into early fall before rainfall can replenish groundwater and flows.

The East Kitsap area falls within Water Resource Inventory Area (WRIA) 15. Despite hard work and commitment, the WRIA 15 Watershed Restoration and Enhancement Committee did not locally approve their watershed plan and submit to Ecology for review before the June 30, 2021 adoption deadline. After technical review by the Salmon Recovery Funding Board, Ecology adopted the plan in December 2024 and is initiating rulemaking under the Streamflow Restoration Law.

For example, the WRIA 15 plan projects 5,215 new permit-exempt wells to be installed between 2018-2038. The plan identified 15 different projects/actions that Ecology finds will offset impacts to instream flows that would be caused by the new permit-exempt wells. Of the seven subbasins in WRIA 15 that were analyzed, roughly two fall within the East Kitsap area. The Bainbridge Island and West Sound subbasins are projected to install 1,474 permit-exempt wells between 2018-2038. The consumptive use estimate of these wells on rivers and streams is 202.9 acre-feet per year (a volume equal to about 100 Olympic-sized swimming pools). Ecology's consumptive use estimate uses growth projection and incorporates an indoor use assumption as well as an outdoor use based on estimates for irrigation.[6]



Map Credits: WAECY[4], SWIFD 2024[5], SSHIAP 2004[7], WADOT 2018[8], WADOT 2010[9], WAECY 2017[10]

Upland and Riparian Forest Cover Conditions Slightly Decrease

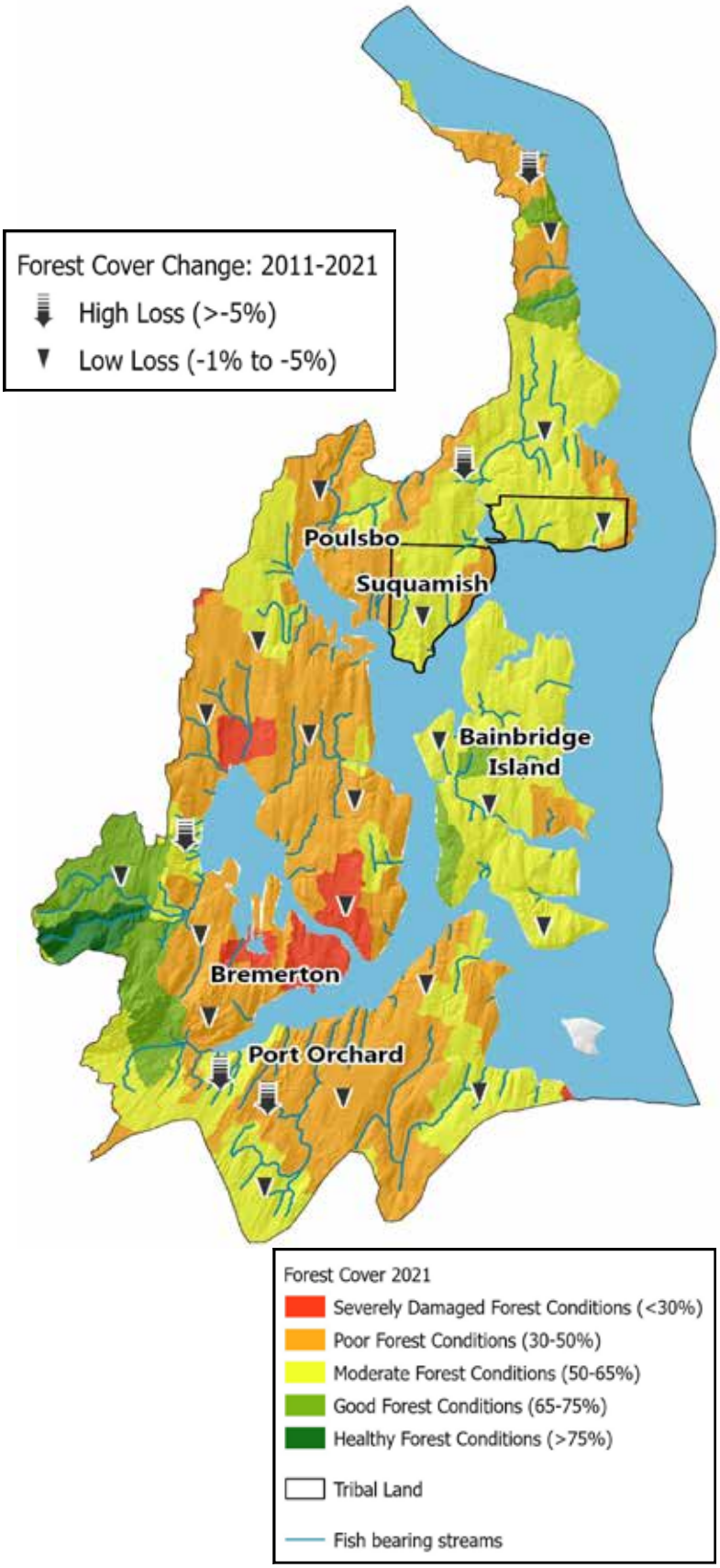
Forest cover in the East Kitsap area decreased by 2.22% between 2011-2021, a loss of approximately 4,230 acres.

Riparian vegetation and upland forests support important habitat for many species including salmon. Vegetation along shorelines plays an important role in filtering nonpoint source pollution, and shading on beaches helps protect surf smelt eggs. Riparian buffers and upland forest cover stabilizes stream banks, provides shade, removes pollutants, and contributes nutrients and woody debris to streams and rivers.[1]

Kitsap County's Critical Areas Ordinance (CAO) develops regulations to protect the functions and values of critical areas such as wetlands, fish and wildlife habitat conservation areas, frequently flooded areas, and geologically hazardous areas. The CAO was last updated in June 2023 and set buffer requirements for streams, lakes, shorelines and wetlands based on several site-specific factors within the critical areas of Kitsap County. Stream buffer widths range from 50-150 feet, the buffer width for all lakes is 100 feet, and wetland buffer widths range from 25-300 feet. Protecting and restoring riparian buffers is encouraged due to their many benefits to aquatic ecosystems.[2] However, there are administrative buffer reductions, reasonable use exemptions and variances that erode the protections that have been put into place and allow for continual impacts to critical areas and their buffers.

The Kitsap Natural Resource Asset Management Program also is underway and is a collaborative effort between Kitsap County, the Suquamish Tribe, Port Gamble S'Klallam Tribe and Washington Environmental Council. The program identifies natural resources as an asset and aims to develop methods to inventory, manage and prioritize natural resource assets and ecosystem services in Kitsap County. The goal is to incorporate the natural resource asset management program into county policies, plans and processes to identify where natural assets can be enhanced, maintained or restored. The program is currently being developed using grant funding from the Environmental Protection Agency and National Estuary Program.[1,3]

Forest cover in the East Kitsap area decreased by 2.22% between 2011-2021, a loss of approximately 4,230 acres.[4,5] Future population increases and development will likely cause this trend to continue, and efforts such as the CAO and Kitsap Natural Resource Asset Management Program could help to ensure that critical habitat is protected or restored. In addition, the Suquamish Tribe is currently working with the Northwest Indian Fisheries Commission and Western Washington University in mapping riparian forests in East Kitsap, specifically modeling how shade and large woody debris inputs to streams are affected, and identifying where riparian habitat protection and restoration would likely yield the greatest benefits.



Map Data Sources: NLCD 2011[4], NLCD 2021[5], WAECY 2017[6], SSHIAP 2004[7], WADOT 2018[8], WADOT 2010[9], SWIFD 2024[10]

Culverts Continue to Impede Fish Passage

There are 1,083 known barrier culverts that are owned by the state, cities and counties, as well as private corporations and individuals in the East Kitsap area. Most of the barriers are privately owned (343 barriers) or owned by Kitsap County (326 barriers).

Fish passage is the ability of fish or other aquatic species to move through an aquatic system among all habitats necessary to complete their life cycle.

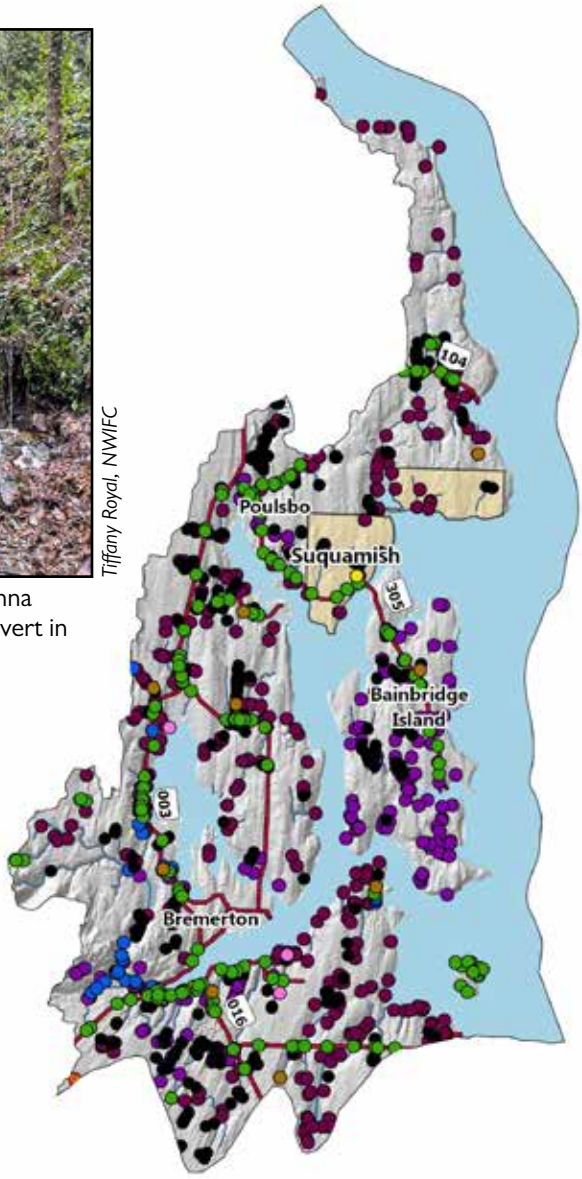
An undersized or improperly placed culvert can impede or totally block species from passing. Salmonids and other aquatic species depend on connected streams to move freely to feed, migrate and reproduce. By removing obsolete and dangerous infrastructure, fish passage projects eliminate public safety hazards, improve climate resilience, reconnect habitat and restore river ecosystems.[1]

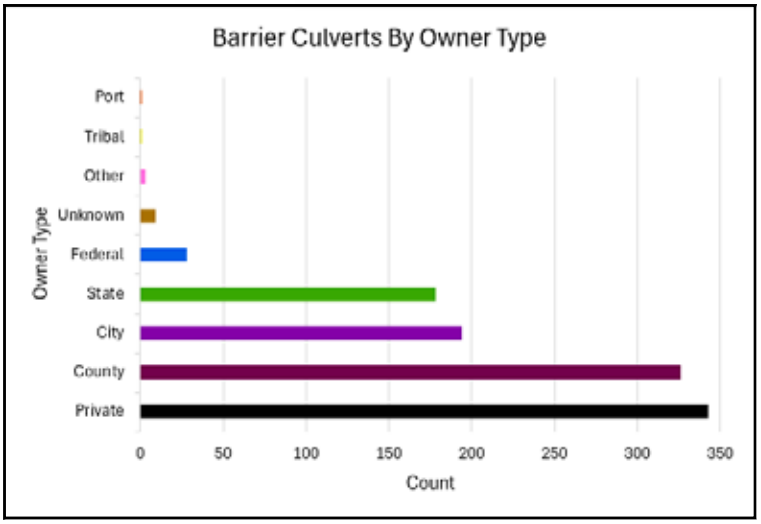
The state of Washington is under a court injunction to replace state-owned culverts with the worst impacts on fish habitat by 2030.[2] In addition to culverts identified by the Culvert Case, there are 1,083 barrier culverts that are owned by the state, cities and counties, as well as private corporations and individuals in the East Kitsap area. Private ownership accounts for 343 (31.7%) of the culverts while local governments, the federal government and the state own 520 (48%), 28 (2.6%) and 178 (16.4%) culverts, respectively. Approximately 1.3% of barrier culverts fall outside of these ownerships including port, tribal and other.[3] More than three-fourths of these barrier culverts are owned by small landowners and local governments who need to prioritize fish passage by removing these impediments and improving fish habitat. However, doing so will require significant resources.

Since September 2022, Suquamish Tribe biologists have been using Washington Department of Fish and Wildlife methods to assess county and privately owned culverts and other stream-crossing structures to determine whether they are fish-passable. The tribe is focusing on streams across East Kitsap's many watersheds. Through the assessment, barriers are assessed and then will be prioritized for removal. In general, a barrier is a higher priority if there is a significant gain of quality habitat for salmon to access upon barrier removal.[4]

Tiffany Royal, NWIFC

Suquamish field biologist Hanna Brush assesses a perched culvert in Poulsbo.[4]





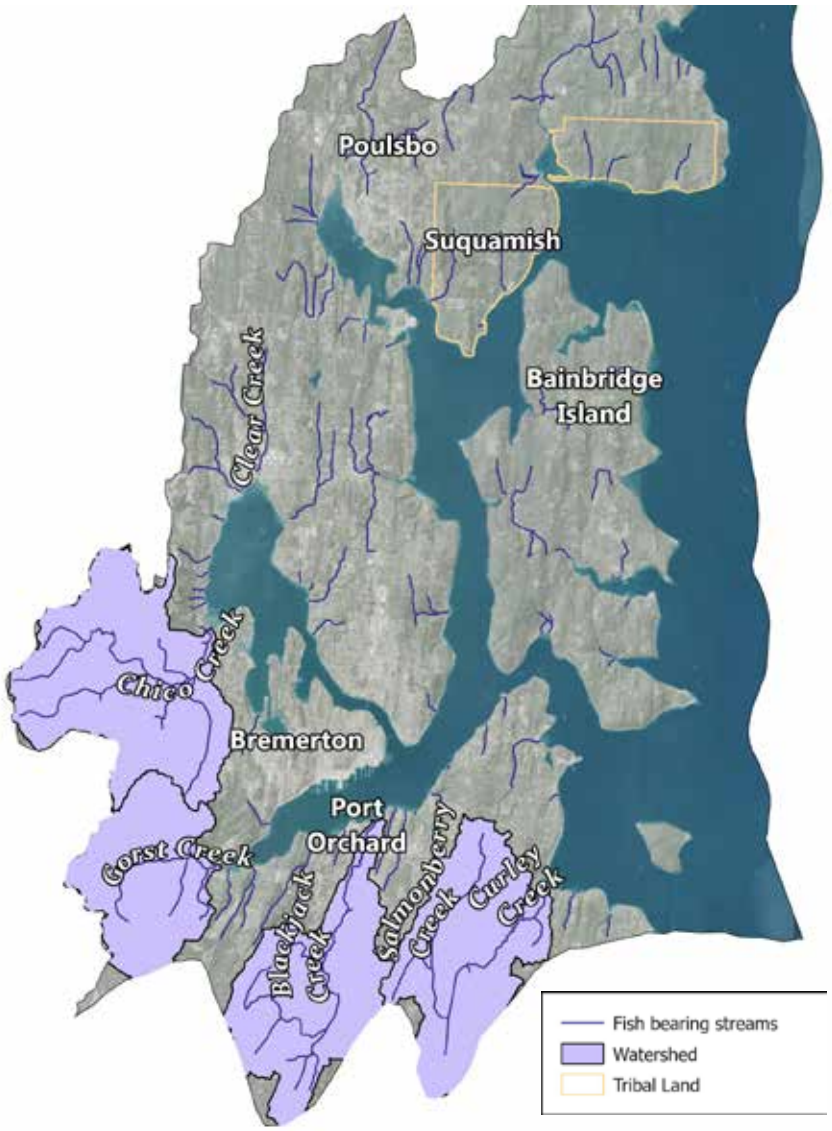
Map Data Sources: WDFW 2025[3], SSHIAP 2004[5], WADOT 2018[6], WADOT 2010[7], SWIFD 2024[8], WADOT 2024[9]

Barrier Removal and Restoration Successful in Priority East Kitsap Watersheds

Multiple culvert removal and habitat restoration projects have been completed or are near completion in East Kitsap. Additional habitat and restoration projects have been completed in Chico, Curley, Blackjack and Gorst watersheds. Of the culvert projects completed, the State Route 3 project (completed in 2024) that replaced two eight-foot square culverts with a 240-foot bridge (200-foot hydraulic opening) was most notable.

The mouth of Chico Creek is known to the Suquamish as the "Place of Chum Salmon." It is one of the most productive salmon streams on the Kitsap Peninsula, with an average of 30,000 fish (mostly Chum salmon but also Coho, steelhead and cutthroat trout) spawning in the watershed each year.[1] Salmon runs were abundant in Chico Creek in the early 1900s but declined in the latter half of the century as a result of habitat impacts including, but not limited to, culvert installations, stream channelization, riparian degradation and loss of large wood material.[2] The Suquamish Tribe led the development of the Chico Creek Watershed Assessment (completed in 2014), which identifies strategies and actions focused on improved fish passage, and riparian, floodplain and in-stream habitat restoration.[3]

In 2014, Suquamish partnered with county, state and federal agencies to remove two large box culverts under Kitty Hawk Drive in the Chico Creek estuary.[4] In 2020, with funding from Kitsap County and the Brian Abbott Fish Barrier Removal Board, the Golf Club Hill Road culvert was removed. The 36-foot triple-box culvert was replaced with a 140-foot-long single-span bridge.[5] From 2021-2024, a significant fish passage barrier was removed on the Chico Creek mainstem under State Route 3.[6] Two 8-foot-wide box culverts were replaced with a 240-foot bridge with a 200-foot-wide clear span opening that restores natural stream processes and tidal exchange. Three smaller barriers on a nearby tributary also were removed (two completely and one replaced with a bridge) as a part of this project in addition to the restoration of riparian habitat.[2]



Chico Creek: Golf Club Hill Road triple-box Culvert

Tiffany Royal, NWIFC

Excavators removing the triple-box culvert under the new bridge for Golf Club Hill Road.

The tribe has also been active in identifying projects and partnering with other entities in implementing habitat protection and restoration actions in other East Kitsap watersheds, including but not limited to Curley Creek. In 2017, the tribe and salmon recovery partners completed a watershed assessment[7] that guides salmon recovery efforts for Curley Creek and its main tributary Salmonberry Creek, both of which provide critical habitat for summer and fall Chum, Coho, fall Chinook, steelhead and cutthroat trout. The Great Peninsula Conservancy has already acquired 177 acres of habitat within the Curley Creek Watershed and is partnering with the tribe and other partners to implement the recommendations in this assessment, including protecting and restoring riparian habitat corridors, protecting and enhancing instream flows, reconnecting floodplains, and restoring channel complexity and fish passage.[8]

Map Data Sources: NSD 2014[3], NSD 2017[7], SSHIAP 2004[9], WADOT 2018[10], WADOT 2010[11], SWIFD 2024[12], Kitsap Cty 2025[13]

Watershed Restoration and Salmon Recovery Planning

Recovery plans and strategies for Kitsap County have been developed by West Sound Partners for Ecosystem Recovery (WSPER), of which the Suquamish Tribe is a partner. WSPER has a Salmon Recovery and Conservation Plan that was completed in 2005 and is currently going through an update scheduled to be released in 2025. Several watershed assessments and restoration plans have been developed by the tribe for the Chico Creek (2014), Blackjack Creek (2017), and Curley Creek (2017) watersheds. The goals of each plan include developing priorities, strategies and actions that will protect and restore watershed, riparian, floodplain and stream processes, and habitat conditions for salmonids.[1]

In addition to the individual watershed restoration plans, the tribe led the effort to develop the East Kitsap Demographically Independent Population (EK DIP) Steelhead Recovery Plan, which was completed in 2020. This plan describes the current understanding of steelhead in the East Kitsap geography, including the habitats that steelhead rely on. The plan includes a set of strategies to protect and restore the most important habitats to support recovery within the next 50 years.[1] The tribe is now developing a detailed steelhead monitoring plan, to be completed by end of 2025, that will identify an approach and methods for monitoring steelhead population status and trends in East Kitsap watersheds.

The Mid Sound Fisheries Enhancement Group, a restoration partner with the tribe, is working to restore the Rose Point Estuary on private property in northern Kitsap County. The tribe is currently monitoring physical and biological (including fish use) changes resulting from the restoration actions at Rose Point. The restoration work occurred in summer 2024 and included removing a 770-foot-long creosote bulkhead and replacing a partial fish passage barrier on a salmon-bearing creek with a bridge that has reconnected the creek with its historic estuary. Doe Kag Wats, a larger estuary nearby on property owned by the tribe, serves as the reference site where monitoring also is occurring.

Observations began at both the Rose Point Estuary restoration and the Doe Kag Wats reference sites in 2023 and will likely continue through 2027. The results should indicate whether the restoration effort at Rose Point is working to re-establish habitat and connectivity that supports juvenile salmon. The overall goal in restoring tidal connectivity at Rose Point and other locations is to provide estuarine habitats along the East Kitsap shoreline so that juvenile salmon have several places to rest, feed and avoid predators. These estuaries serve as a place of refuge for salmon as they make their way to Admiralty Inlet, the Strait of Juan de Fuca and the ocean.[2]

Tiffany Royal, NWIFC

Suquamish Tribe biologists Theo Suver, Hanna Brush and Steve Todd use a fyke net to collect data about fish that use Doe Kag Wats.

Map Data Sources: SSHIAP 2004[3], WADOT 2018[4], WADOT 2010[5], SWIFD 2024[6]

Climate Change

The Suquamish Tribe's water temperature data was used in a study to assess the impacts of climate change on salmonids in the Chico Creek watershed. Results show that stream temperatures will increase in the coming decades and solutions need to be implemented to protect salmon, such as riparian habitat restoration and beaver recolonization.

Tiffany Royal, NWIFC

Suquamish Tribe salmon recovery biologist Steve Todd checks the water temperature on Wildcat Creek in 2021.[1]

For the past 20 years, the Suquamish Tribe has been monitoring water temperatures in the Chico Creek watershed, plus more than 25 other salmon streams in Kitsap County, to understand stream temperature patterns through the warmest and driest months and how they compare with the state's water quality standards. The data was used in a 2021 study with the University of Washington Climate Impacts Group that aimed to provide projections of future streamflows and water temperatures for use in assessing the impacts of climate change on salmonids in the Chico Creek watershed.[1]

The Chico Creek study found that warmer air temperatures in the coming decades will increase stream temperatures in all monitored locations, leading to more summer days when temperatures exceed the state's water quality standard, putting more stress on stream biota such as salmon and steelhead, cutthroat trout, lamprey and freshwater mussels. A similar pattern of warming stream temperatures in more recent years is shown in many of the streams the tribe is monitoring across East Kitsap. A projection into the future of warming air temperatures indicates that many of these streams will exceed the state's water quality standards far more frequently than today. The state's standard for summer salmonid habitat is 16C/60.8F, measured by the seven-day average of daily maximum temperatures.[2]

"If we are to recover and protect salmon for future generations, we need to use the best science available to understand how climate and land use changes are likely to impact our watersheds," said Steve Todd, Suquamish Tribe salmon recovery biologist.[1] One focus will be to identify where protection and restoration of riparian vegetation is likely to be the most effective given future development patterns and a warmer climate. Another option is to look at the role of beavers as an ally in restoration and mitigating climate change impacts to watersheds.

Beavers

Beavers provide ecosystem services which help to reduce flooding and drought and build resilience to climate change in riparian habitats.[3] Damming of small streams by beavers allows sediment to be deposited and nutrients to be stored; increased lateral connectivity restores and reconnects floodplains; and increased water storage extends wetlands and promotes rich plant and invertebrate life.[4] A study which relocated beavers in the Skykomish River watershed found that ponds constructed by relocated beavers caused stream cooling and increased surface and groundwater storage during summer low-flow conditions.[5] In Kitsap County watersheds, a priority should be to work with salmon recovery partners and landowners to protect beavers and allow them to persist, which could provide significant benefits to the restoration of riparian habitats and salmon populations facing climate change.

Kari Neumeyer, NWIFC

A beaver finds its bearings after being relocated by Tulalip Tribes wildlife staff in the Skykomish watershed.[6]

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Suquamish Tribe: Portion of East Kitsap Area

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Shoreline Armoring Continues to Impact Forage Fish Spawning Habitat in East Kitsap County

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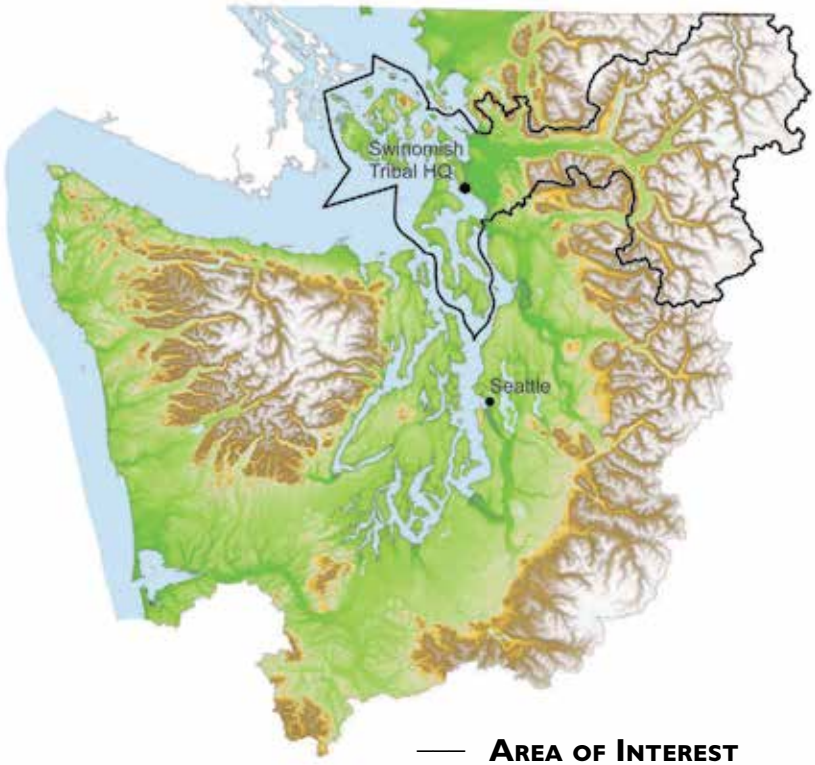
2025 State of Our Watersheds Report
Skagit River Basin

SWINOMISH INDIAN TRIBAL COMMUNITY

As people of the salmon, these fish are the core of our treaty right, and have been an essential first food since time immemorial. Unless we restore some of the damage to our river floodplains and estuary habitat from the past 150 years, we cannot recover our salmon or shellfish or preserve our cultural lifeways. We need everyone who has benefited from the conversion of salmon habitat to make a commitment to support our recovery efforts.

– Tandy Wilbur
Fisheries Manager



Area of Interest

Katie Bassford

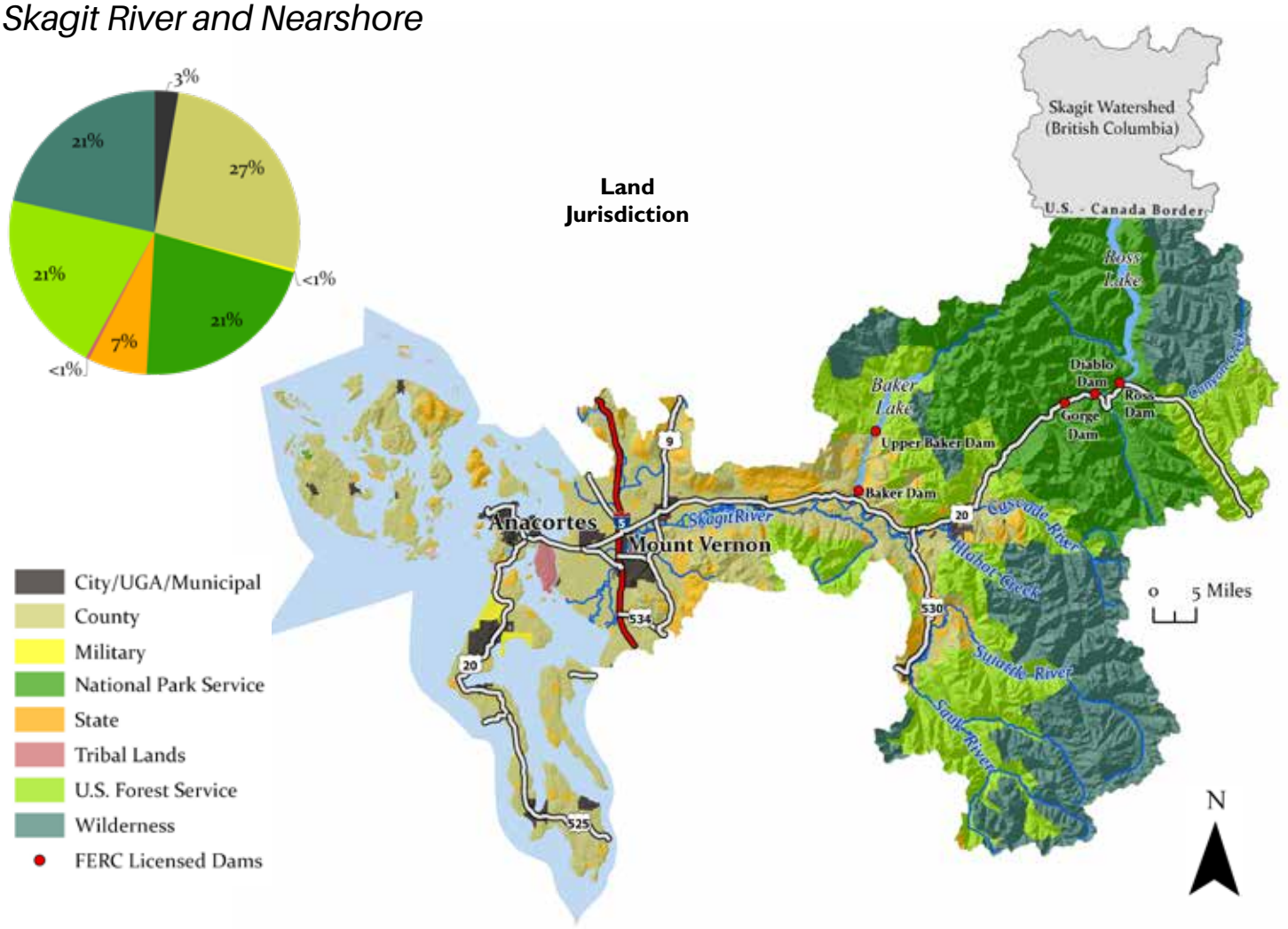
Swinomish Indian Tribal Community

The Swinomish Indian Tribal Community is made up of Coast Salish people descended from groups and bands originating from the Skagit and Samish river valleys, surrounding coastal areas, and numerous islands including around Whidbey, Camano and the San Juans. The Swinomish Reservation on the southeast end of Fidalgo Island is surrounded by 27 miles of saltwater shoreline. It is bounded on the west by Skagit Bay, the east by Swinomish Channel and the north by Padilla Bay. The reservation is about 15 square miles and includes about 7,450 acres of uplands and 2,900 acres of tidelands.

Katie Bassford

Swinomish Indian Tribal Community

Skagit River and Nearshore



The Skagit River flows from a 3,100-square-mile watershed that originates in British Columbia and flows south into Washington state before continuing westward through Skagit County and into Puget Sound. It has the largest watershed in Puget Sound and provides 30% of the sound's freshwater input.[1] There are an estimated 396 glaciers in the watershed, making up one of the largest areas of glacial cover in the United States outside of Alaska.[2] The Baker River, Sauk River and Cascade River all flow from glaciers within the Skagit River watershed.

Swinomish is an adjudicated successor to certain tribes and bands that signed the 1855 Treaty of Point Elliott, including the Kikiallus, Lower Skagit, aboriginal Samish, and aboriginal Swinomish. The tribe's usual and accustomed fishing areas (U&A) extend throughout the Skagit River and its tributaries, the Samish River and its tributaries, and marine areas of the northern Salish Sea. In addition, the Swinomish Tribe has religious, subsistence and cultural interests in the entire Skagit River system and beyond.

Since European settlement, land use in the watershed has been dominated by natural resources extraction. The foothills and mountains have been used for wood products, mining and outdoor recreation. The river valleys, deltas and coastal areas have been converted for agriculture, industry, commerce and residential development. As of 2019, the U.S. Census Bureau estimated 129,205 residents lived in Skagit County, a 25% increase in population since the year 2000.[3,4]

The upper Skagit River watershed is primarily within national forest and the North Cascades National Park. The lower watershed is composed of state forest, private forest, agriculture, rural residential and urban uses. There are five Federal Energy Regulatory Commission (FERC) licensed dams in the Skagit River watershed: the lower and upper Baker River dams, and the Gorge, Diablo and Ross dams.

The Skagit River is home to all five species of Pacific salmon, as well as steelhead trout. It has the healthiest and largest runs of wild Chinook and Pink salmon in the Puget Sound.[5] Even so, the last 150 years of human population growth, intensive agriculture and development have resulted in declines of Chinook, a near collapse of Chum and declines in other salmonid productivity. The Skagit Chinook Recovery Plan (2005) provides a strategy for both protection and targeted restoration. It will take federal, tribal, state and local leadership to provide a consistent yet adaptive plan to control the future impacts of land use in the watershed.

Map Data Sources: DOD 2023[6], SSHIAP 2004[7], WADNR 2024a[8], WADNR 2024b[9], WAECY 2018c[10], WAECY 2018d[11], WAECY 2023[12], WAECY 2021[13], WAECY 2024[14], WADOT 2018[15], WADOT 2023[16], USFWS 2024[17]

Chapter Summary

For thousands of years, the people of the Swinomish Indian Tribal Community maintained a culture centered on abundant saltwater resources that included salmon, shellfish and marine mammals, as well as upland resources such as cedar, camas, berries and wild game. Since European settlement began in the middle of the 19th century, the landscape was changed to support cities, residences and agriculture. The natural estuaries, large floodplains and riparian-lined tributaries needed for healthy populations of salmon, shellfish and all the resources the Swinomish people relied upon historically was disregarded and destroyed. That pattern of substantial habitat destruction and artificial manipulation continues today, and with a growing human population, the degrading impact on salmon habitat has intensified.

The primary limiting factors to salmon recovery are the quantity and quality of habitat where salmon begin and end their lives in the watersheds. The treaty tribes believe the salmon recovery effort should focus on those waters, and Swinomish has taken a leadership role for decades to protect and restore the habitat that salmon need to recover.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

For this report, the Swinomish Indian Tribal Community has focused on portions of their watersheds that are of greatest concern because of continued habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Skagit Estuary Restoration Too Slow

From 1999 to 2019, net tidal marsh habitat gain—naturally and through restoration—was only 44 hectares. Since 2020, only 10-13 acres of new estuary habitat projected have been completed. Hundreds of acres of estuary restoration are in the permitting and planning stages, mostly due to Swinomish and the Washington Department of Fish and Wildlife (WDFW). These future gains will help counter the negative progradation rates, erosion and sea level rise that will cause some reduction of habitat. The 44-hectare gain from 2000-2019 combined with the 10-13 acres gained since 2020 falls far short of the 1,114.6 hectares of new habitat outlined as a goal in the 2005 Skagit Chinook Recovery Plan.

Swinomish is leading by example and currently has multiple estuary habitat projects in the works on its reservation. There is a need for additional private landowner willingness to restore former estuary habitat from its conversion decades ago to intensive agriculture. Additionally, climate warming and sea level rise pose new challenges to meeting salmon recovery goals in the Skagit River system.

Nearshore Armoring Continues to Impact the Intertidal Zone

There are 226 miles of shoreline along Samish and Skagit bays. The WDFW's Beach Strategies project showed that 136 miles (59%) is modified including nearshore bulkheads, tidal barriers and overwater structures in the marine nearshore and intertidal areas. In 2008, published data for that same region showed 113 miles of modified shoreline. It is assumed that most of the increase is due to improved data, including for areas not previously surveyed.

Forest Road Maintenance and Abandonment Plans are Complete, Landsliding Greatly Reduced

Efforts to upgrade and decommission forest roads and new regulations designed to reduce logging on unstable slopes above streams have led to greatly reduced forestry-related landsliding in the Skagit River watershed. Because excess sediment supply from forestry activities has been a major cause of habitat degradation in the Pacific Northwest, these results are good news for salmon recovery. Increased winter precipitation and summer wildfire activity due to climate change, however, may lead to future increases in landslides despite past regulatory successes, suggesting an uncertain future for sediment supply impacts to salmon streams.

Culvert Barriers Blocking Fish Passage Across Multiple Jurisdictions in the Skagit Watershed

A recent comprehensive inventory of culverts on anadromous fish-bearing streams in the Skagit watershed documented 931 culverts. Of these, 556 culverts are fish-passage blockages and 91 culverts are unknown but may be fish-passage blockages. Over 74% of the blocking and unknown culverts are either privately owned (291 culverts, 45%) or county owned (194 culverts, 30%). The remaining 162 culverts (25%) are spread across other public ownerships.

High Stream Temperatures Due to Lack of Riparian Habitat Remain a Limiting Factor for Skagit River Chinook, Steelhead Recovery

The Washington Department of Ecology failed to meet its goal of 100% riparian planting by 2020, and the agency has taken no steps since then to redress this significant adverse impact to Skagit basin water quality and salmon health and recovery. Since 2020, less than 3% of temperature impaired salmon streams have been planted with riparian habitat.

The state's riparian planting strategy remains opportunistic and voluntary, with no commitment to try and meet the 100% planting goal that was missed in 2020. Since 2020, the acreage planted on public lands and lands purchased for salmon habitat conservation contained over six times as much area as the acreage planted on private lands (a combined 459.8 versus 75.7 acres). The majority of plantings that took place on private property were not on 303(d) listed streams that are legally impaired for temperature pollution and have TMDLs (total maximum daily loads) they need to meet.

Measurable But Insufficient Floodplain Restoration Occurring in the Skagit River System

Between 2001 and 2019, a total of 24 structures or channel crossings were removed from the floodplain, natural processes were restored in 59 hectares of non-channel and channel habitat area, and 2.7 kilometers of road/levee and channel-lining riprap was removed. This floodplain restoration progress has been slower than desired, with only a 10% increase in the Freshwater Rearing Index over the past 25 years. The Skagit Chinook Recovery Plan calls for a 31% increase in freshwater rearing capacity over 50 years, highlighting the need to accelerate restoration efforts. Thus, while measurable gains have been made, they are not on track to achieve recovery during the 50-year target.

Swinomish Prioritizes Habitat Protection to Recover Wild Chinook in the Skagit Basin

According to the Skagit Chinook Recovery Plan, successful habitat protection depends upon public recognition of its importance and an unambiguous regulatory framework that ensures that the habitat needs of the fisheries resource is fully protected. Unfortunately, many exemptions exist for ongoing and new land uses, and the state is largely unwilling to ensure through enforcement that there is sufficient cold, clean water in all of our salmon streams.

Chinook Salmon are Spawning Later with Warming River Temperatures

Over the last six decades, natural-origin Chinook salmon have been spawning later by up to 0.52 days per year. Meanwhile, egg take for hatchery propagation has moved earlier by 0.58 days per year. Mean August river temperatures have risen over the period of record, as expected given climate predictions, suggesting that natural-origin Chinook salmon spawn timing trends may be expressing plastic or adaptive responses to warming water and/or related factors.

Emergency Repairs at McGlinn Island Jetty Show Need for a Long-term Solution to Protect Salmon

The U.S. Army Corps of Engineers' McGlinn Island Jetty substantially blocks access for juvenile Chinook and other salmon species to rearing habitats along and north of the Swinomish Channel, and in the spring of 2023 was discovered to be injuring and killing these fish. The 2005 Skagit Chinook Recovery Plan identifies the McGlinn Island Jetty as a limiting factor, impeding juvenile Chinook salmon access to Swinomish Channel and Padilla Bay.

In May 2023, the Army Corps undertook emergency repairs to reduce fish entrapment by filling large holes along the east end of the jetty near McGlinn Island. The tribe continues to monitor this work and evaluate its effectiveness. Field surveys in 2024 documented more stranded and dying fish along various parts of the jetty.

In addition, a technical modeling group formed with representatives from the Army Corps, Swinomish Tribe, Skagit River System Cooperative, NOAA, U.S. Fish and Wildlife Service, and expert consultants has identified a number of conceptual approaches for restoring fish passage across the jetty between Goat and McGlinn islands. Concepts include one or more major jetty breaches of about 350 feet wide, as well as possible breaches across the McGlinn Causeway north of McGlinn Island and marsh development along the jetty.

Conclusion

Restoration of salmon habitat continues to occur in the Skagit River's freshwater and intertidal environments, but not at a pace that science has shown is needed. The rapidly changing and warming climate, as well as continued discovery of habitat impairments, is causing Swinomish to redouble its habitat protection efforts, especially through policy approaches. To achieve salmon recovery by 2055 as the Skagit Chinook Recovery Plan proposed, the habitat restoration schedule needs to significantly accelerate. While Swinomish will continue to lead by example in restoring every part of its small reservation—even within its economic development areas—it needs local governments, special purpose districts and private landowners to similarly commit and take action, including by carrying out legally-required habitat mitigation.

While it does not carry the net positive impact of restoration, mitigation of habitat impairing actions is supposed to at least partially offset the negative impacts to habitat of infrastructure development and maintenance within the Skagit River system. Monitoring of required mitigation actions has shown marginal success. It is essential that increased oversight occurs to ensure that mitigation is sufficient and successful in the future.

Enforcement of the regulatory framework that is in place to protect salmon habitat continues to be greatly lacking in the Skagit River system. There continues to be a reliance on volunteerism toward compliance with environmental laws and regulations, and the result is much less habitat being protected and/or restored than needs to be. Salmon habitat is in critical condition in many areas within the Skagit River system, and the urgency of regulation enforcement is needed to move quickly out of that critical condition.

Restoration Efforts Not on Pace to Achieve Recovery Goals

At the 20-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Skagit basin reveals very concerning results with a lack of sufficient progress toward the plan's habitat restoration goals and objectives. Priority issues continue to be increasing restoration of estuary habitat, expanding floodplain and side/off channel habitats, improving water quality, repairing fish-passage barriers, and preventing new shoreline armoring that interrupts and destroys nearshore habitats and functions. The only bright spot has been efforts to upgrade and decommission forest roads and the advancement of regulations to reduce logging on unstable slopes above streams. There has been progress in two other indicators for restoration of floodplains and riparian plantings, but overall the progress is not on track to achieve Chinook recovery targets,particularly along temperature impaired salmon streams. The state's ongoing failure to take necessary action to achieve the riparian habitat restoration called for in the 2004 stream temperature total maximum daily load (TMDL) for the lower Skagit River is especially alarming.

Stepping back and looking at the big picture, there is an enormous shortage of staff at the federal level as a result of recent large-scale, forced downsizing. State budget cuts and a steady rotation of staff through positions serving the Skagit basin impact the ability to gain forward momentum. Skagit County lacks staff with expertise in fish biology and continues to pass policies and plans that impede salmon recovery, making progress all the more difficult. Skagit County land-use policies generally fail to support the adequate restoration and protection of habitat needed for salmon recovery, in part by requiring a cumbersome hearing examiner process before salmon habitat restoration projects can proceed. In addition, funding shortfalls for large-scale projects contribute to the slow pace of progress. These serious challenges need to be addressed so that the tribe and agency partners have the resources necessary to address the issues, implement the actions needed to restore and protect habitat, and monitor and enforce compliance of existing regulations.

A 20-year review of the trends for these key environmental indicators shows meaningful progress towards only one goal of the Skagit Chinook Recovery Plan. The majority of trends are declining, meaning that progress towards Recovery Plan goals is substantially failing and unlikely to achieve Chinook recovery by 2055.

Tribal Indicator	Status	Habitat Trend
Estuary Habitat	From 2000 to 2019, net tidal marsh habitat gain—naturally and through restoration—was only 44 hectares. Since 2020, two restoration projects have resulted in 10-13 acres of habitat. These small habitat gains fall far short of the 1,114.6 hectares of new habitat outlined as a goal in the Skagit Chinook Recovery Plan.	**Declining**
Armoring	There are 136 miles of modified shoreline in the Skagit and Samish river intertidal areas, and over 106 miles of the modified shoreline is entirely armored.	**Declining**
RMAP	Efforts to upgrade and decommission forest roads and new regulations designed to reduce logging on unstable slopes above streams have led to greatly reduced forestry-related landsliding in the Skagit watershed.	**Improving**
Barrier Culverts	A recent inventory of culverts on anadromous fish-bearing streams in the Skagit watershed documented 931 culverts. Of these, 556 culverts are fish-passage blockages and 91 culverts are unknown but may be fish-passage blockages. About 75% of the blocking and unknown culverts are either privately owned (291 culverts, 45%) or county owned (194 culverts, 30%).	**Declining**
Voluntary Measures Fall Short	The Washington Department of Ecology failed to meet its goal of 100% riparian planting by 2020, and it has taken no steps since then to redress this significant adverse impact to Skagit basin water quality and salmon.	**Declining**
Stream Temperatures	Over the last six decades, natural-origin Chinook salmon have been spawning later by up to 0.52 days per year. Meanwhile, egg take for hatchery propagation has moved earlier by 0.58 days per year.	**Declining**
Restoration - Floodplain	Between 2001 and 2019, a total of 24 structures or channel crossings were removed from the floodplain, natural processes were restored in 59 hectares of non-channel and channel habitat area, and 2.7 kilometers of road/levee and channel-lining riprap was removed.	**Concerns**
Restoration - Riparian Planting	The acreage planted on public lands and lands purchased for salmon habitat conservation contains over six times as much area as the acreage planted on private lands (a combined 459.8 versus 75.7 acres).	**Concerns**
Habitat Protection	Too many exemptions exist for ongoing and new land uses, and Skagit County and the state have been largely unwilling to ensure through enforcement that there is sufficient cold, clean water in all of our salmon streams, or that adequate riparian habitat remains intact. County land-use policies generally fail to support the adequate restoration and protection of habitat needed for salmon recovery.	**Declining**

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river floodplain habitat, restoring those areas that are degraded and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

The Swinomish Tribe has continued to prioritize habitat restoration and protection efforts throughout the Skagit River watershed to recover all six species of Pacific salmonids (five types of salmon and anadromous steelhead) for current and future generations. Best available science is clear that without making significant strides to expeditiously restore additional estuary, floodplain and riparian habitat, Chinook recovery will continue to stall.

The many exemptions that exist for ongoing land uses undermine habitat protection efforts. Large-scale dike, levee and tidegate setbacks are needed on private lands, but have been too slow to move forward. The state has been unwilling to ensure that there is sufficient cold, clean water in all of our salmon streams. Taken together, the pace of salmon recovery is far behind schedule in meeting Skagit Chinook Recovery Plan goals. Recent proposals by federal agencies with a trust responsibility to treaty tribes purport to dismantle the spirit and letter of environmental protection laws, a shocking and potentially catastrophic move in the wrong direction for treaty resources.

The state needs to revise its outdated regulatory framework for land use and shoreline management that has failed to protect and restore enough salmon habitat necessary to achieve recovery goals for Chinook, steelhead and other wild Skagit River salmonids. Climate change will continue to exacerbate many of the long-standing recovery challenges in the Skagit basin, especially without adequate riparian habitat. The tribe is committed to working with our state co-managers and federal trustees to redouble efforts to enforce existing habitat protection laws, create and implement innovative new programs that restore full function to our unique watershed, and continue to do the hard work necessary to achieve salmon recovery goals for current and future generations.

Skagit Estuary Restoration Too Slow

From 1999 to 2019, net tidal footprint gain—naturally and through restoration—was only 44 hectares. Since 2020, two restoration projects have resulted in approximately 10-13 acres of habitat. These small habitat gains fall far short of the 1,114.6 hectares of new habitat outlined as a goal in the 2005 Skagit Chinook Recovery Plan.

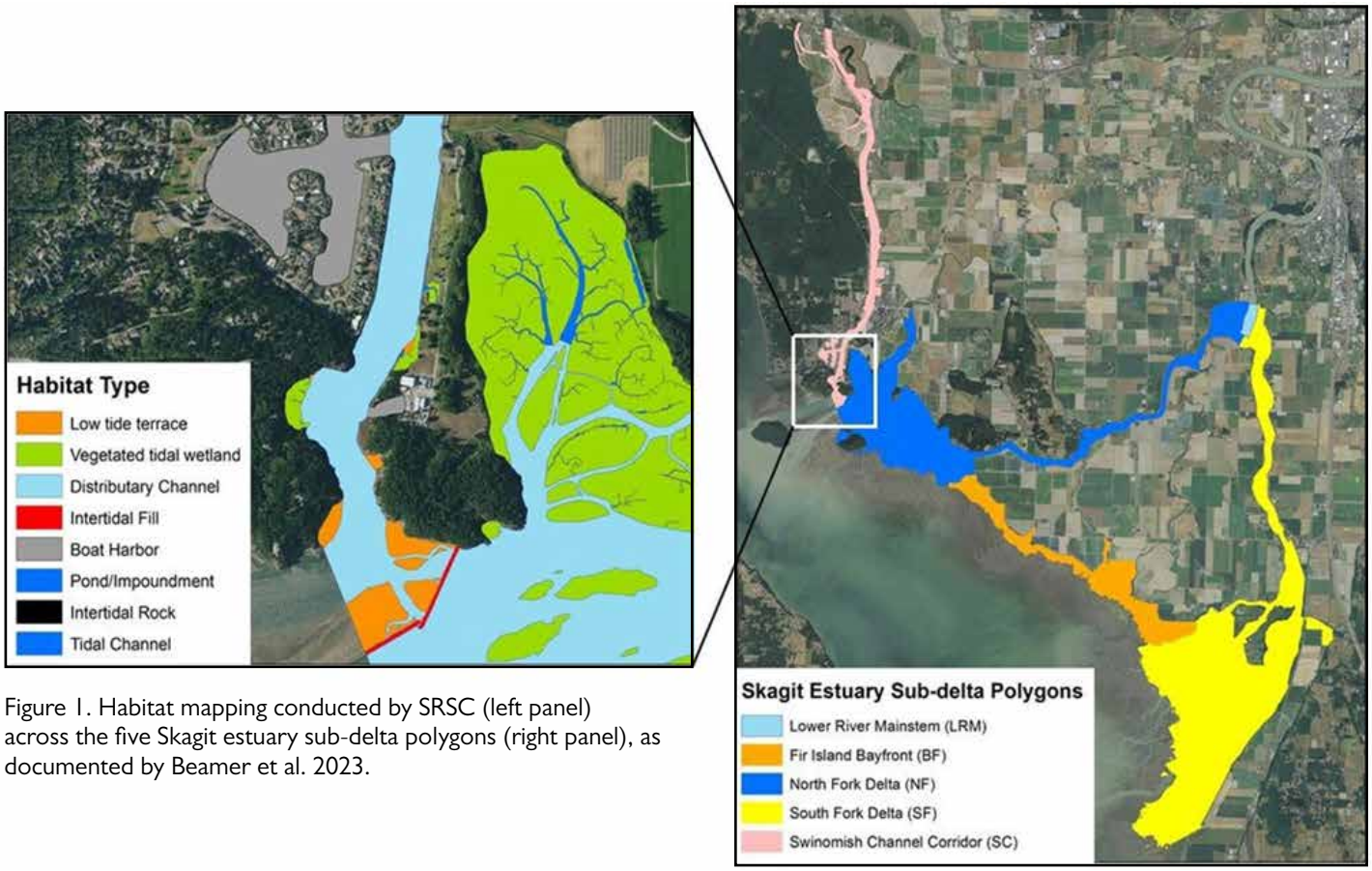


Figure 1. Habitat mapping conducted by SRSC (left panel) across the five Skagit estuary sub-delta polygons (right panel), as documented by Beamer et al. 2023.

Achieving the recovery plan goals requires, in part, a net increase in tidal marsh habitat, which boosts salmon productivity. While restoration efforts can create more habitat for salmon, increasing human development pressures can cause habitat loss. Natural processes also contribute to both habitat gains and losses.

To monitor change over time, the Skagit River System Cooperative (SRSC) mapped estuarine habitats during 2000, 2004, 2013 and 2019 within the vegetated tidal delta (Figure 1). Changes in habitat were attributed to either natural processes or human activity.

A major avulsion of the North Fork Skagit River reoriented a significant distributary channel, and sensitive marshes experienced erosion. Since 2020, three adaptive management projects at previous restoration sites have seen limited increases in fish habitat at two of the sites, and two other projects may have resulted in declines in fish habitat.

During this period, both natural habitat gains and losses were observed. The North Fork Skagit River avulsion led to positive progradation rates, increasing salmon habitat in the area. However, these gains were partially offset by negative progradation rates in the South Fork area and the bay front. Negative progradation in these areas is likely attributable to a combination of insufficient sediment supply due to upstream levees and dikes, erosion from more frequent and severe storms, and sea level rise. In addition, at least two tide gates were replaced in the Skagit basin without any of the required estuary habitat mitigation being performed prior to their replacement.

Restoration and mitigation in the Skagit delta are needed to contribute to the Skagit Chinook Recovery Plan's goal to restore tidal habitat area that increases juvenile salmon rearing capacity, conveyance of fish and sediment, and diversity within the vegetation. Since the 2020 State of Our Watersheds Report, the pace of restoration has still been too slow. However, Swinomish is leading by example and currently has multiple estuary habitat projects in the works on its reservation. There is a need for additional private landowner willingness to restore former estuary habitat from its conversion decades ago to intensive agriculture. Additionally, climate warming and sea level rise pose new challenges to meeting salmon recovery goals in the Skagit River system.[1]

Recent best science from two decades of Skagit estuary stud-

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ies confirms again that Chinook salmon respond positively to new estuary habitat being available. A recent study from the Skagit Intensively Monitored Watershed found that delta restoration led to lower juvenile densities overall and greater juvenile densities when conspecific abundances were high. These and other findings suggest that greater nursery habitat capacity in the Skagit delta allowed salmon to spread out and could accommodate higher salmon numbers when juvenile outmigrations were particularly high. The findings also suggest that estuary restoration promoted the use of Skagit delta habitats by smaller fish while alleviating the effects of competition on growth.

The findings further suggest that estuary habitat restoration in the Skagit delta appeared to alleviate density-dependent constraints on juvenile Chinook rearing and growth, which is particularly significant for the smallest, most vulnerable salmon that presumably benefit most from growth before entering nearshore waters. The study concludes that the findings provide empirical support for restoring estuaries in human-stressed landscapes to rehabilitate nursery habitat functions for Chinook salmon and potentially other species and life stages.

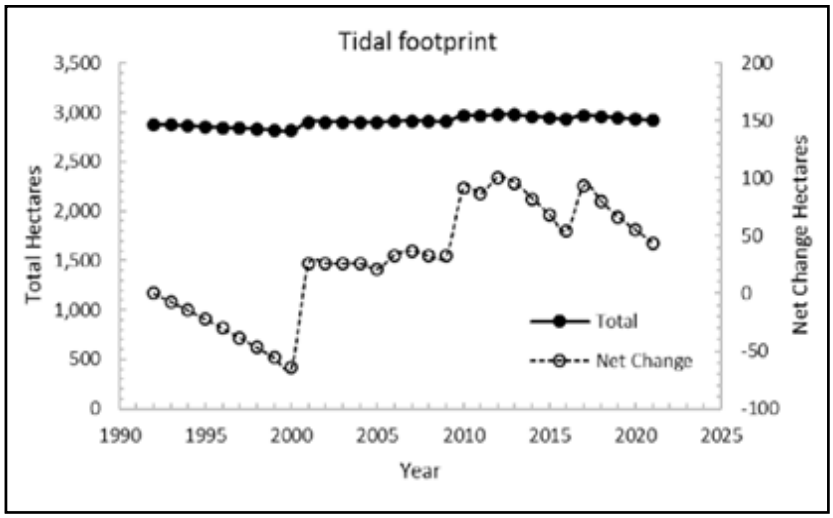


Figure 2. Total and net changes in tidal footprint taken from Beamer et al. 2023.

Project Example: Pocket Estuary Restoration at Similk Bay

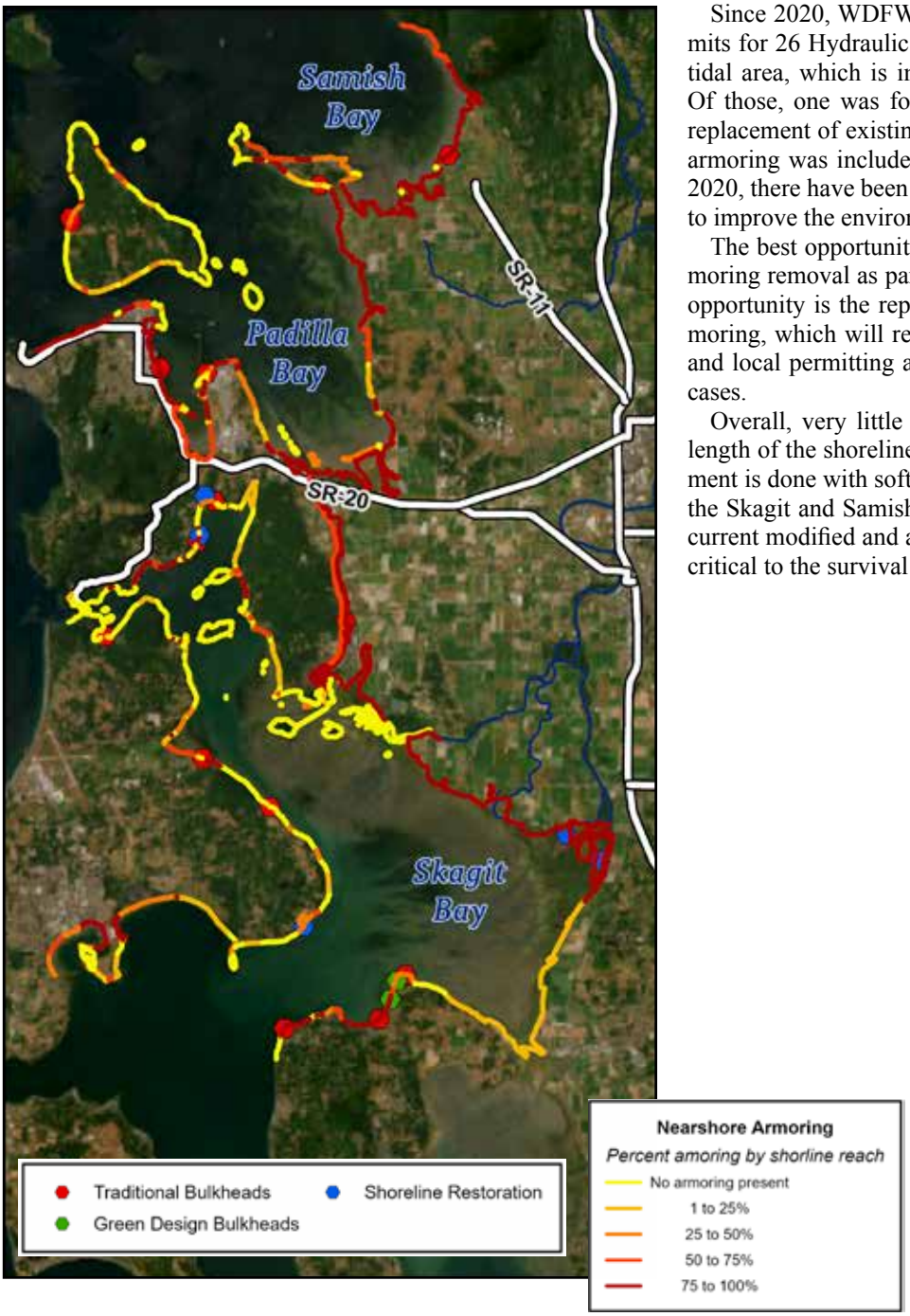
Skagit River System Cooperative

Phase 1 restoration at Similk Bay is complete.

Nearshore Armoring Continues to Impact the Intertidal Zone

The Washington Department of Fish and Wildlife's (WDFW) Beach Strategies project data and Skagit County's dike and levee data shows 136 miles of modified shoreline in Skagit and Samish river intertidal areas. Based on these data, over 106 miles of the modified shoreline is entirely armored. In 2008, published data for that same region showed 113 miles of modified shoreline.[1,2] It is assumed that most of the increase is due to improved data, including for areas not previously surveyed.

Skagit and Samish River Marine Nearshore Projects 2020 through 2024: WDFW HPA Permitted



Since 2020, WDFW has issued marine shoreline armoring permits for 26 Hydraulic Project Approvals (HPAs) within the intertidal area, which is important habitat for Skagit River Chinook. Of those, one was for new armoring and 25 were for repair or replacement of existing armoring. More ecologically suitable soft armoring was included in just two of the 25 repairs.[3] Also since 2020, there have been four nearshore restoration projects intended to improve the environmental condition of the shoreline.

The best opportunity for improving the shoreline is through armoring removal as part of nearshore restoration projects. Another opportunity is the repair or replacement of existing shoreline armoring, which will require continued coordination between state and local permitting agencies to prioritize soft armoring in those cases.

Overall, very little shoreline restoration occurs relative to the length of the shoreline, and almost no armoring repair or replacement is done with soft armoring. As a result, the nearshore area of the Skagit and Samish river intertidal regions will continue in its current modified and armored state, negatively impacting habitats critical to the survival of Skagit and Samish river salmonids.

Map Data Sources: WDFW 2023[4], WDFW 2024[5], SSHIAP 2004[6], Skagit County 2022[7]

Forest Road Maintenance and Abandonment Plans are Complete, Landsliding Greatly Reduced

Efforts to upgrade and decommission forest roads and new regulations designed to reduce logging on unstable slopes above streams have greatly reduced forestry-related landsliding in the Skagit River watershed. Because excess sediment supply from forestry activities has been a leading cause of habitat degradation in the Pacific Northwest, these results are good news for salmon recovery. Increased winter precipitation and summer wildfire activity due to climate change, however, may lead to future increases in landslides despite past regulatory successes, suggesting an uncertain future for sediment supply impacts to salmon streams.

Excess sediment supply from landsliding triggered by timber harvest and road building has widened and simplified stream channels, smothered incubating salmon eggs, removed riparian vegetation and filled important pool habitat, among other impacts. Previous tribal State of Our Watersheds reports documented successes of the Road Maintenance and Abandonment Plan (RMAP) process, which required all roads on state and private timber lands to be brought up to modern engineering standards or decommissioned between 2001 and 2021, a major goal of the Skagit Chinook Recovery Plan.

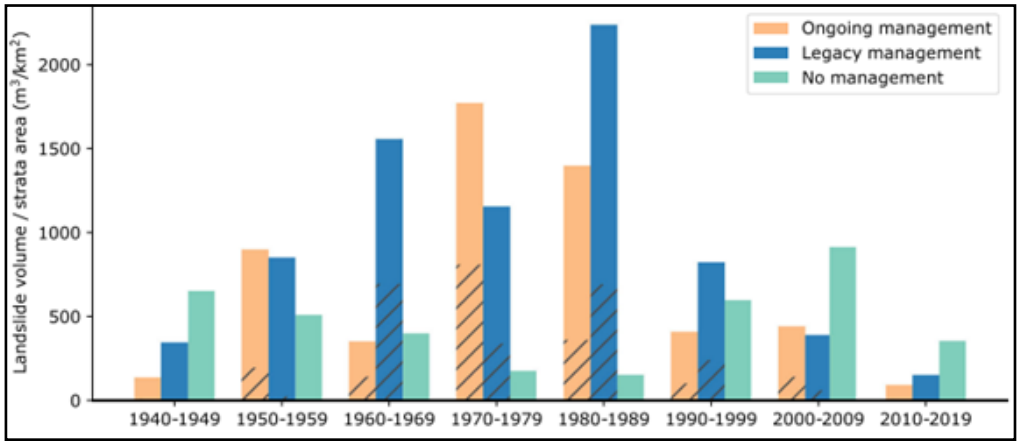
Similarly, the Forests and Fish Report (FFR) regulations enacted in 2001 for state and private timber lands encouraged ongoing harvest but required landowners to avoid unstable slopes when designing forestry operations. On U.S. Forest Service lands, the 1994 Northwest Forest Plan (NWFP) curtailed most logging in federal forests and jump-started an effort to decommission the most problematic federal roads.

An extensive monitoring effort[1] to document trends in shallow landsliding in nine Skagit River tributary basins has demonstrated that the differing approaches in federal and state/private ownerships have both paid off: landslide sediment yield was reduced by about 75% on state/private forests and about 85% on federal forests on a per-acre, per-year basis following the implementation of the FFR and NWFP regulations (see figure). Landsliding in unlogged forests increased over the same period likely due to climatic influences.

Washington Department of Natural Resources

Changes in forest road management have benefits for salmon recovery.

Despite great progress due to forest land-use and regulatory changes, predicted increases in winter storm and wildfire frequency and severity suggest a risky future for sediment supply impacts to salmon habitats. Future research should better assess these risks and make predictions for where and when the impacts will be most acute, to inform restoration and habitat protection planning.



Seixas and Veldhuisen, 2023

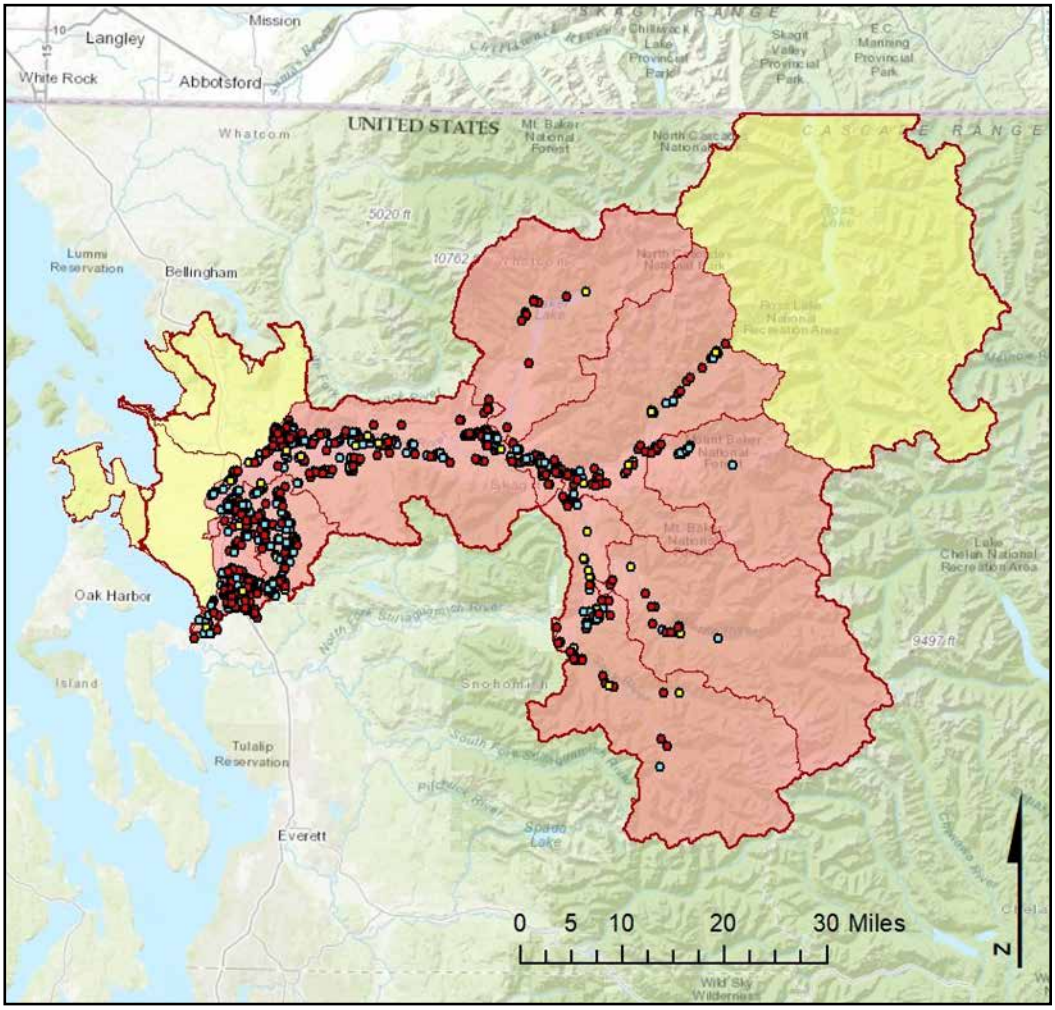
Decadal landslide sediment yield trends in three land-use strata representing state and private timberlands (Ongoing management, orange), federal forests (Legacy management, blue), and unlogged forests (No management, teal). The hatch pattern represents forest road failures.[2]

Culvert Barriers Blocking Fish Passage Across Multiple Jurisdictions in the Skagit Watershed

A recent comprehensive inventory of culverts on anadromous fish-bearing streams in the Skagit watershed documented 931 culverts. Of these, 556 culverts are fish-passage blockages and 91 culverts are unknown but may be fish-passage blockages. About 75% of the blocking and unknown culverts are either privately owned (291 culverts, 45%) or county owned (194 culverts, 30%). The remaining 162 culverts (about 25%) are spread across other public ownerships.

Culverts make up more than 87% of known fish-passage barriers in the Skagit River watershed. Ongoing work on a comprehensive survey that was initiated in 2020 by a working group comprised of the Skagit River System Cooperative, Upper Skagit Indian Tribe, Skagit County, Skagit Fisheries Enhancement Group and Snohomish County updated barrier statuses, identified previously unmapped barriers and refined mapping of streams likely to be accessible by anadromous fish species. The survey focused on anadromous fish-bearing streams within a selected survey area, which excludes the Samish River watershed, the Skagit estuary, Fidalgo Island and the portion of the Skagit watershed upstream of the Gorge Dam at Newhalem due to complicating factors in those areas.

The survey identified 647 culverts within the study area that were known barriers and unknown but potential barriers.[1] These barriers are to be considered as a group from which land managers and restoration planners in the Skagit River watershed can strategically locate projects to open fish passage. The project also created a GIS tool to enable land managers and restoration planners to estimate habitat gains from candidate barrier correction projects and identify whether upstream and downstream barriers are present on the same stream system.[2] This allows for project prioritization and strategic planning of multi-culvert removal in locations where upstream and/or downstream culverts are also blocking salmon habitat.



Map of all known culverts in the project study area (n = 931); passable (n = 284, blue,) barrier culverts (n = 556, red) and unknown barrier status (n = 91, yellow).

Since 2020, a total of 43 barrier correction projects have been completed, funded or begun by working group members as a direct result of the inventory done in the watershed. Additionally, per the terms of the state culvert injunction, 10 barrier correction projects have been completed in the watershed by the Washington State Department of Transportation since 2020, and 15 others have been funded for design or construction, with completion anticipated by 2027.

The Skagit Chinook Recovery Plan[3] recommends that each governmental entity identify each culvert on their lands or under their jurisdiction that are barriers to Chinook salmon. With the information now available from this barrier survey, it is even more possible for the culvert barrier owner, regardless of jurisdiction, to take responsibility for fixing their blockage to fish passage, as is required through current Washington state statute.

Map Data Sources: Crowley et al. 2024[1]

High Stream Temperatures Due to Lack of Riparian Habitat Remain a Limiting Factor for Skagit River Chinook, Steelhead Recovery

The Washington Department of Ecology failed to meet its goal of 100% riparian planting by 2020, and the agency has taken no steps since then to redress this significant adverse impact to Skagit basin water quality and salmon health and recovery. Since 2020, less than 3% of temperature impaired salmon streams have been planted with riparian habitat.

Reliance on Voluntary Measures Fails to Achieve Meaningful Implementation of 2004 Lower Skagit Stream Temperature TMDL

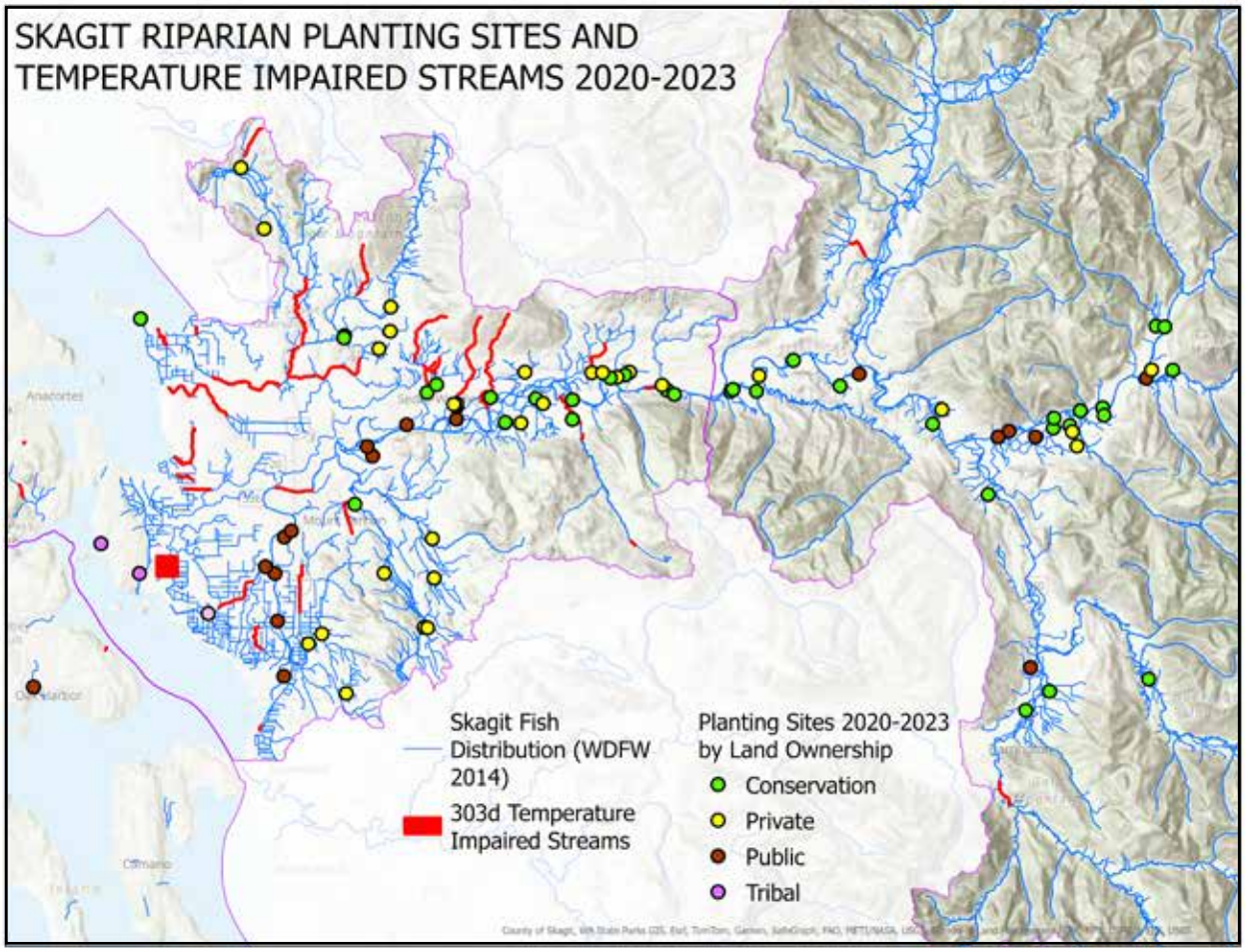


Figure 1. Location of planting areas in relation to temperature-impaired streams, classified as 303(d) under the Clean Water Act, in the Skagit River basin.

High stream temperatures were identified as a limiting factor for Chinook survival in the 2005 Skagit Chinook Recovery Plan and for steelhead survival in the 2019 Puget Sound Steelhead Recovery Plan.[2,3] Yet Ecology has relied entirely on voluntary programs to recover the water quality of the affected salmon streams. For over two decades, Swinomish has pointed out the gross insufficiency of this approach, noting that voluntary programs are a part of the solution but alone would never be adequate to reach water quality standards and restore degraded habitat within sufficient time for salmon recovery.

The consequence of Ecology's persistent failure to address this temperature pollution crisis is that it makes nearly impossible the 2080 goal of temperature compliance for the nine impaired lower Skagit River tributaries, as well as the habitat recovery needed for Endangered Species Act-listed Chinook and steelhead. It also makes it far less likely that lower Skagit River salmon streams can achieve the level of climate resiliency needed as temperatures warm and summers become longer and drier.

Local efforts to restore riparian vegetation are ongoing, with some progress throughout the Skagit watershed as a result of trib-

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Map Data Sources: WAECY 2022[4], SWC 2024[5], WDFW 2024[6]

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Ownership	Temperature Polluted Areas	Other Areas	Total
Conservation	46.8	171.4	218.2
Private	13.7	62.0	75.7
Public	0.0	241.6	241.6
Tribal	0.0	0.6	0.6
Total	60.5	475.6	536.1

Figure 2. Planting acreages in the Skagit River basin by ownership.

al, conservation district and local nonprofit leadership and partnerships. But the state's riparian planting strategy remains opportunistic and voluntary, with no commitment to try and meet the 100% planting goal that was missed in 2020. This is an urgent issue about which Swinomish and its treaty tribe partners have been sounding the alarm for over two decades, and it is far past time for regulatory action. The state's response has been to create a riparian roundtable where all interests can come together to discuss the issue. Yet after years of meetings, no solutions have been agreed to that would solve the problem.

From 2020 to 2023, riparian implementers (including Skagit River System Cooperative, Skagit Fisheries Enhancement Group, Skagit Land Trust, the Skagit County Natural Resource Division and the Conservation Reserve Enhancement Program) planted 536.1 acres along the mainstem Skagit River and its tributaries: 60.5 acres along temperature-polluted streams and 475.6 acres along streams not listed as temperature polluted (Figure 1; Figure 2). A previous Skagit River System Cooperative analysis showed that over 2,200 acres of riparian habitat needs to be restored along temperature impaired salmon streams. Thus less than 3% of the impaired streams were planted.

Over the past four years, the area planted on public lands and lands purchased for salmon habitat conservation combined contained over six times as much area as was planted on private lands (a combined 459.8 versus 75.7 acres). The majority of plantings on private property also were not on streams that are legally impaired for temperature pollution and have limits called total maximum daily loads (TMDLs) they need to meet. There is neither a plan for nor a clear date by which,the lower Skagit River temperature TMDL will be fully implemented or water quality achieved.

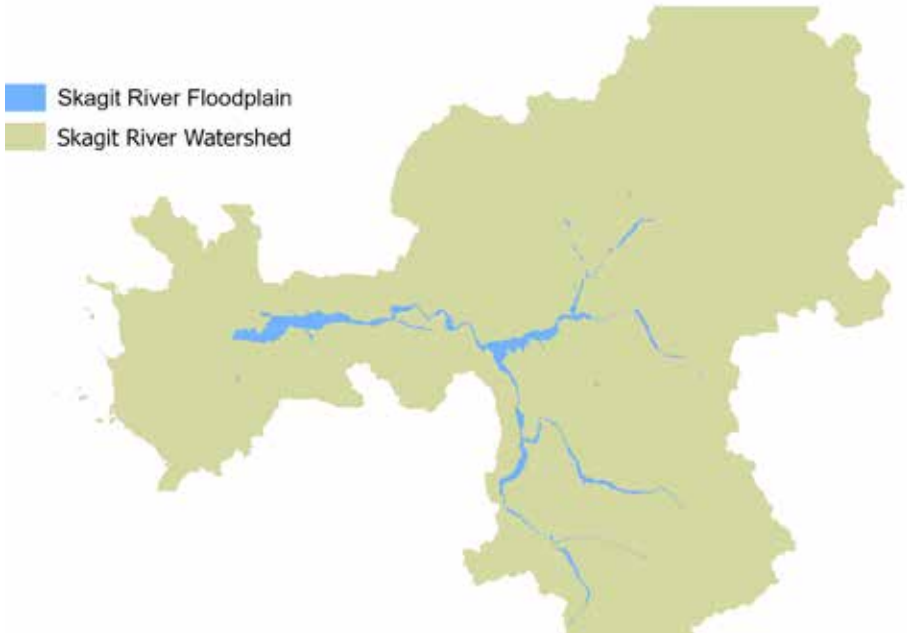
The real problem remains that the pace of restoration on private lands has been far too slow, largely because Ecology has been unwilling to enforce the water quality standards for temperature in salmon streams found in state law under WAC 173-201A. Compliance with stream temperature regulations continues to be treated as optional, which is contrary to the law and the best available science. The state's sole reliance on voluntary efforts has been and will continue to be insufficient to meet water quality standards for salmon streams or the needs of Skagit Chinook or steelhead recovery in a timely manner. Swinomish will continue to work to hold state and federal agencies accountable for their egregious lack of action to ensure salmon streams have the riparian habitat they need to achieve and maintain adequate temperatures for salmon recovery.

Brenda Clifton

Swinomish tribal member Phillip McCoy, Sr. planting trees at the Skagit Land Trust's Utopia site along the Skagit River.

Measurable But Insufficient Floodplain Restoration Occurring in the Skagit River System

Between 2001 and 2019, a total of 24 structures or channel crossings were removed from the floodplain, natural processes were restored in 59 hectares of non-channel and channel area, and 2.7 kilometers of road/levee and channel-lining riprap was removed.[1] However, this progress is too small to keep pace with recovery plan targets.



The Skagit River watershed is the largest in the Puget Sound.

SRSC

A newly restored channel in lower Hansen Creek during a high flow event in 2024.

Off-channel and side-channel habitats in the Skagit River floodplain provide critical rearing areas for juvenile Chinook salmon, supporting both migrating parr and yearling life histories. However, over the past century, floodplain habitat has declined by approximately 35% due to channelization and hydromodifications such as roads, levees and riprap bank protection.[2] This loss has significantly reduced the capacity of the floodplain to support juvenile Chinook.[3]

Achieving Chinook salmon recovery goals in the Skagit watershed requires a net gain in floodplain habitat to boost juvenile productivity. Since the 2020 State of Our Watersheds Report, several restoration projects have been implemented to address this need, including efforts at lower Hansen Creek, Pressentin Slough, Illabot Creek, Lower Day Slough and Barnaby Slough. These projects aim to improve habitat connectivity and restore natural floodplain processes across off-channel areas, side channels, mainstem edges and Chinook-bearing tributaries.

Using orthophotography from the Washington Department of Natural Resources and the U.S. Department of Agriculture's National Agriculture Imagery Program (1998, 2006 and 2015), the Skagit River System Cooperative (SRSC) classified the floodplain into various habitat types.[4] These classifications were then used to develop a Freshwater Rearing Index for juvenile Chinook salmon, which quantifies changes in rearing habitat based on known associations between habitat type and juvenile salmon density.

Since the 1999 listing of Puget Sound Chinook under the Endangered Species Act, Skagit River floodplain rearing habitat has increased due to both restoration efforts and natural processes such as channel migration. However, progress has been slower than desired, with only a 10% increase in the Freshwater Rearing Index over the past 25 years.[5] The Skagit Chinook Recovery Plan calls for a 31% increase in freshwater rearing capacity over 50 years,[6] highlighting the need to accelerate restoration efforts. Thus, while measurable gains have been made, they are not on track to achieve recovery during the 50-year target.

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Map Data Sources: SRSC & WADFW 2005[7]

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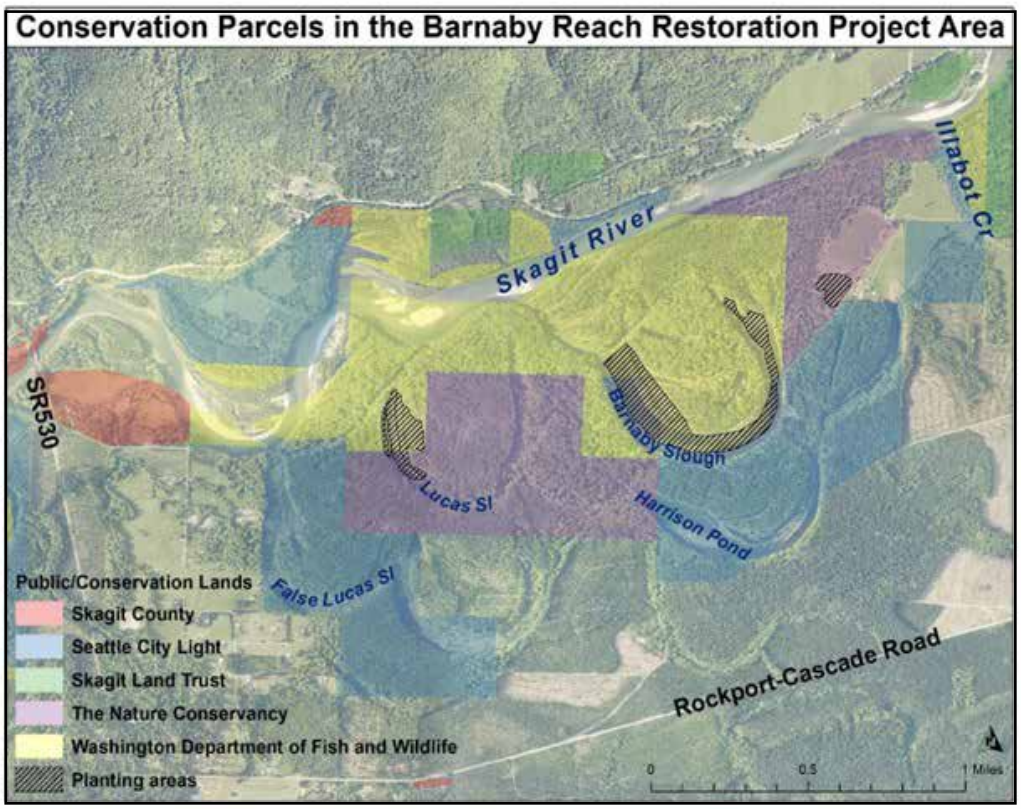
Spotlight: Barnaby Restoration Project

The Barnaby Reach lies on the left bank of the Skagit River east of the Sauk River confluence. Much of the land is in conservation status, owned by the Washington Department of Fish and Wildlife, The Nature Conservancy and Seattle City Light (see figure). In 2021, the Skagit River System Cooperative (SRSC) completed the Barnaby Reach Restoration Project to reestablished floodplain processes, improve fish habitat and restore fish passage by removing barriers and infrastructure associated with a derelict hatchery facility.

After construction, SRSC began to plant native vegetation in large swaths of invasive reed canary grass to the north of the slough. The hydrology and soils present at the site were well suited for scrub-shrub and forested wetlands—which lower water temperatures by creating shade and provide woody debris—but due to deforestation, soil compaction and invasive species domination, the desired plant species were unable to colonize the site.

To overcome these challenges, the planting crew used an innovative technique that involves installing tall, dense willow stakes. More than 5,000 of the 6-foot-tall live stakes were installed per acre at 3 feet apart and 1.5 feet into the ground, leaving 4.5 feet above ground. Within the first year, the stakes were tall enough to outcompete the reed canarygrass for light. Within five years, the planting density will begin to shade and weaken the reed canarygrass. Since 2023, SRSC has installed 33,200 willows across nearly 8 acres. So far, the plantings have been very successful.



SRSC

Natural Systems Design

Barnaby Slough after the removal of Dike A.

Swinomish Prioritizes Habitat Protection to Recover Wild Chinook in the Skagit Basin

According to the Skagit Chinook Recovery Plan, successful habitat protection depends upon public recognition of its importance, an unambiguous regulatory framework that ensures that the habitat needs of the fisheries resource are fully protected, and consistent enforcement of regulations.[1] Unfortunately, many exemptions exist for ongoing and new land uses, and counties and state agencies are largely unwilling or unable to enforce habitat protection laws.

Successes in Habitat Protection

Activities of the Governor's Southern Resident Orca Recovery Task Force elevated the needs of salmon and orca in the public eye. Some enhancements to the regulatory framework for habitat protection are underway. The Washington Department of Ecology is working to integrate new rules regarding climate change and channel migration zones, and possibly riparian management, into state Shoreline Management Act requirements. The U.S. Army Corps of Engineers revised regional general conditions for Nationwide Permits that authorize shoreline armoring, reducing access to streamlined permitting through the spring of 2026. Federal agencies are using the Puget Sound Nearshore Conservation Calculator to increase consistency and rigor in determining adequate mitigation requirements for nearshore projects.

For permitted activities, there have been some victories in protecting critical salmon habitat. Several high-impact proposals for shoreline armor or riparian buffer reductions have been denied by local county or municipal governments, thanks in part to the close attention of Swinomish Environmental Policy and Skagit River System Cooperative (SRSC) staff, as well as the prudent application of local rules and regulations by county or municipal planning staff. Unfortunately, often these denials have been overturned when shoreline property owners bring attorneys in to argue their case on appeal, resulting in loss of and encroachment on habitat.

It is clear to Swinomish that there is an urgent need for broader consideration of climate change in the regulatory framework and continued engagement with local and state agencies on individual project proposals to ensure more consistent and increased habitat protection, without which Chinook recovery will continue to stall.

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SRSC

Residential bulkheads across the Skagit basin are deteriorating due to age and the exacerbated effects of climate change, causing homeowners to either seek permits for repair or replacement, or to conduct the work without permits. These structures have adverse impacts on nearshore habitat.

SRSC

WDFW biologists and engineers, along with SRSC staff, inspect site conditions at a large residential bulkhead near Anacortes. This bulkhead has degraded, and the homeowner is seeking permits to replace it, which will have adverse impacts on nearshore habitat for the life of the new structure.

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Failures in Habitat Protection

Despite some improvements in habitat protection, retaining existing intact habitat continues to be a time-consuming, uphill battle. Unpermitted shoreline armor is widespread. These projects, implemented without technical review, fail to consider ways to avoid or minimize adverse impacts to habitat. Construction without permits also sets an example for neighbors who may see sidestepping permits as a cost- and time-saving strategy.

Of the shoreline armor installed in San Juan County between 2009 and 2019, 74% had no permit and no associated enforcement action by local or state authorities. Just 9% of the 108 new structures installed were fully permitted prior to construction.[2] In Island County, 95% of new shoreline armor constructed between 2016 and 2023 had no record of being permitted.[3] These types of findings suggest that shoreline armor continues to be added without permits and without the necessary habitat mitigation, which is reducing the quantity, quality and function of nearshore habitats.

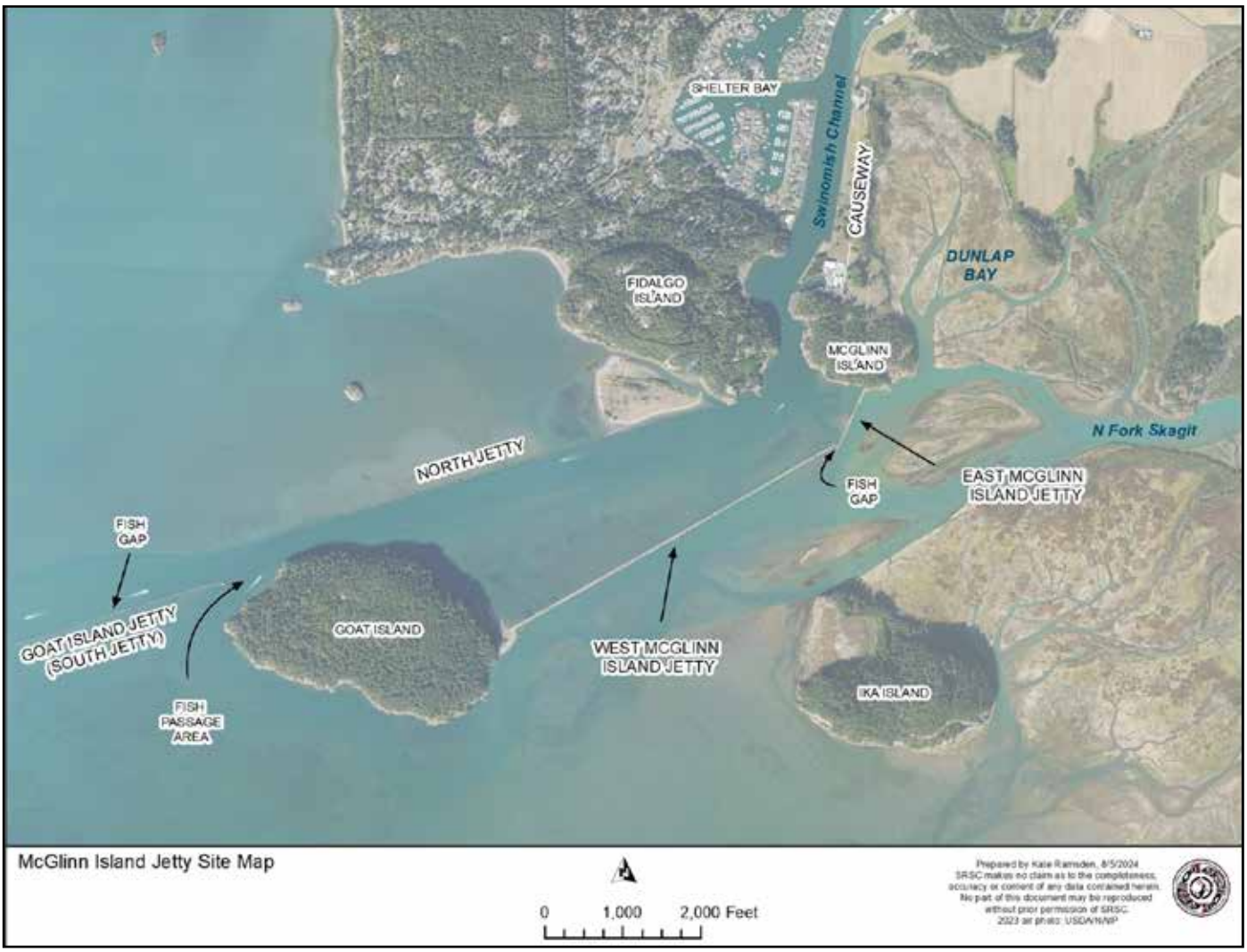
Many of the tools tribal staff rely upon to ensure successful habitat protection within the existing regulatory framework fail to serve their purpose. For example, it is known that No Net Loss policies are not working or are not going far enough to protect natural resources.[4] WDFW has considered a new framework focused on Net Ecological Gain, yet that process has been slow and appears to be headed toward still unacceptably little improvement for habitat protections.

SRSC

Curtis Clement, biologist for the Upper Skagit Indian Tribe, estimates the age of a felled mature cedar, one of almost 1,000 trees harvested illegally within an 18-acre area of the Skagit River floodway.

Emergency Repairs at McGlinn Island Jetty Show Need for a Long-term Solution to Protect Salmon

The U.S. Army Corps of Engineers' McGlinn Island Jetty substantially blocks access for juvenile Chinook and other salmon species to rearing habitats along and north of the Swinomish Channel, and in the spring of 2023 was discovered to be injuring and killing these fish. The 2005 Skagit Chinook Recovery Plan identifies the McGlinn Island Jetty as a limiting factor, impeding juvenile Chinook salmon access to Swinomish Channel and Padilla Bay. Conceptual approaches for restoring fish passage across the jetty include one or more breaches.



Skagit River System Cooperative

The Swinomish Channel (historically called Swinomish Slough) was a significant migratory corridor for Skagit River Chinook salmon, particularly juvenile fish seeking rearing habitat at the north end of the channel and in Padilla Bay. Historic accounts of the waterway span generations of Swinomish Indian Tribal Community families, describing both juvenile and adult salmon moving along the corridor. The area was a culturally important fishing ground for the Swinomish people. Even today, the channel, which runs along the eastern side of the Swinomish Reservation, is central to cultural events, ceremonies and festivals including the Swinomish Blessing of the Fleet each spring and a welcoming of neighboring tribes to Swinomish homelands during the annual Canoe Journey each summer.

A series of actions were undertaken by Congress and the U.S. Army Corps of Engineers between 1892 and 1937 to improve the navigability of the Swinomish Channel for marine commerce. These actions changed the waterway from a highly complex saltmarsh wetland with many channels to a simplified navigation pathway. The conversion has provided benefits to agriculture, transportation, recreation and maritime commerce. However, these benefits have been at the expense of the estuary ecosystem and the salmon that depend

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upon it, as well as the tribal populations and economies that depended on the salmon.

The Skagit Chinook Recovery Plan identifies the Army Corps' McGlinn Island Jetty as a key limiting factor because it impedes juvenile salmon access to the Swinomish Channel and Padilla Bay, as well as to the Swinomish Tribe's Smokehouse Flats property, where a project to restore more than 250 acres of saltmarsh is underway. Extremely limited fish passage occurs through a narrow 10-foot breach in the jetty known as the "fish gap." Fish that do not make their way through the fish gap attempt the long journey around Goat Island and back into the Swinomish Channel. Most fish that follow this route are not able to safely return to the shoreline.

Perhaps more concerning, dead Chum salmon and Endangered Species Act-listed Chinook salmon were observed along portions of the McGlinn Island Jetty in April 2023 during a group outing by staff from the Swinomish Tribe, NOAA's Northwest Fisheries Science Center, the Washington Department of Fish and Wildlife, the Army Corps and the Skagit River System Cooperative (SRSC). The dead, fry-sized juvenile salmon seemed to be associated with areas where the deteriorating jetty was leaking water. Fish were observed to be moving with the current and getting entrapped by debris racked along the jetty. In the following months, surveyors identified several dozen dead fish across seven species. Field surveys in 2024 continued to document stranded and dying fish along various parts of the jetty.

In May and June 2023, the Army Corps undertook emergency repairs to try and reduce fish entrapment by filling large holes along the east end of the jetty. Swinomish, SRSC and other agency staff continue to monitor this work and evaluate its effectiveness. It appears at best to be a temporary fix. Dye tests were performed in 2023 and 2024 to identify major leakage areas. Additional areas of leakage were on track to be treated in 2025. Meanwhile, Swinomish and SRSC initiated a data collection program to track water levels and velocity in the jetty.

Swinomish and SRSC have also been working with the Army Corps to identify fish-friendly projects that would improve habitat connectivity and could be incorporated into jetty maintenance. A technical modeling group that includes representatives from Swinomish, SRSC, the Army Corps, NOAA, the U.S. Fish and Wildlife Service and expert consultants has identified a number of conceptual approaches for restoring fish passage across the jetty between Goat and McGlinn islands. Concepts include at least one large jetty breach about 350 feet wide, as well as other possible breaches across the McGlinn Causeway north of McGlinn Island and marsh development along the jetty.

The Swinomish Tribe is excited by the possibility to restore some of the historic connectivity between the north fork of the Skagit River and the Swinomish Channel, knowing that these type of ecological restoration projects will directly benefit Chinook salmon recovery while supporting the Army Corps' need to maintain the channel as a public waterway.

Skagit River System Cooperative

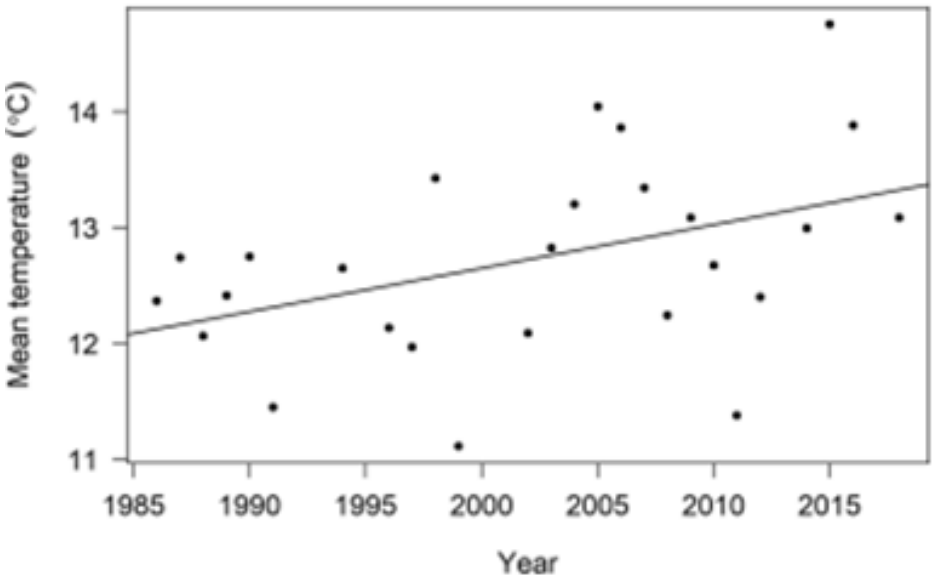
Holes in the McGlinn Island Jetty were leaving fish entrained to die.

Skagit River System Cooperative

Emergency action was taken to fill large holes along the east end of the jetty near McGlinn Island.

Chinook Salmon are Spawning Later With Warming River Temperatures

Over the last six decades, natural-origin Chinook salmon have been spawning later by up to 0.52 days per year. Meanwhile, egg take for hatchery propagation has moved earlier by 0.58 days per year. Mean August river temperatures have risen over the period of record as expected given climate predictions, suggesting that Chinook spawn timing trends may be expressing plastic or adaptive responses to warming water and/or related factors.[1]



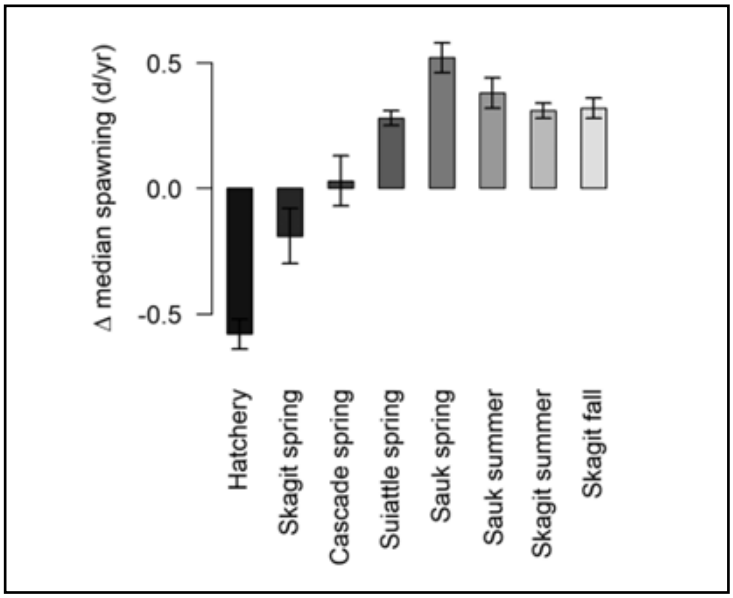
Mean of daily August maximum temperatures for the mainstem Skagit River at Marblemount (river kilometer 127).

Median timing of reproduction in Pacific Salmon populations is generally consistent among years, reflecting long-term patterns of natural selection from characteristics of the local environment. However, altered selection from factors related to climate change or human intervention might shift timing over generations, with implications for the population's persistence.

The SRSC modeled median timing of redd counts as an index of spawning timing by natural-origin Chinook salmon in the Skagit River system. Five of six natural-origin populations showed progressively later spawning over time.

Sauk River spring Chinook salmon demonstrated the fastest rate of change (0.52 days per year) and Suiattle River spring Chinook salmon the slowest (0.28 days per year).[2] Several temperature and timing factors relevant to Cascade River Chinook salmon cannot be disentangled from current data: South Cascade cold glacial meltwater input and the relationship to Marblemount Hatchery-origin fish.

Across populations, however, the picture that emerges is that Chinook salmon are spawning later with warming water temperatures, which may have implications for juvenile emergence timing in the spring and other ecological relationships important for the recovery of the species.



Bars depict the rate of change and standard error of median spawning in days per year over the period of record for naturally reproducing populations of Skagit River Chinook salmon; "Hatchery" refers to Chinook salmon egg take at the Marblemount Hatchery.[3]

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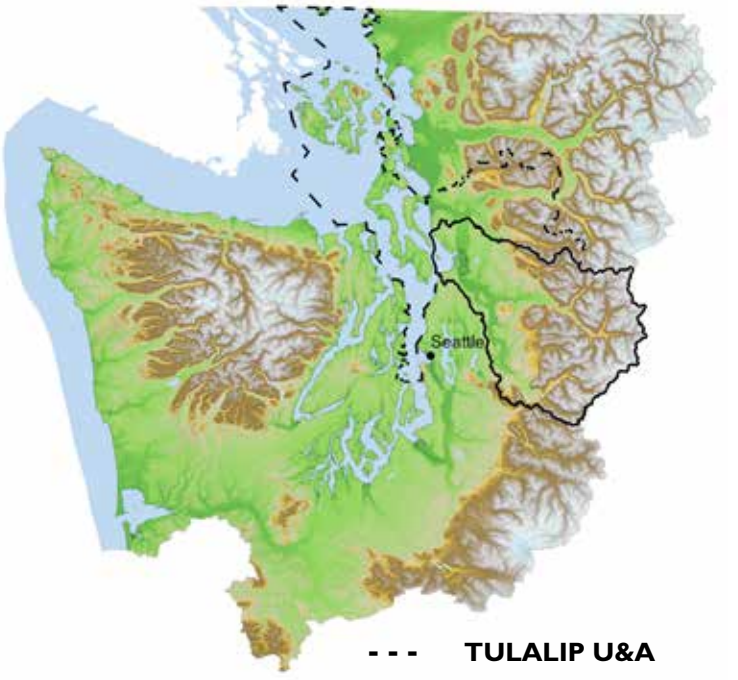
2025 State of Our Watersheds Report
Snohomish River Basin

Salmon has always been an important resource for our people, sustaining us since time immemorial. Tulalip has a long tradition of protecting salmon and shellfish. It's our responsibility to continue to preserve and enhance our natural resources, and we're committed to ensuring the survival of the salmon population. With collective effort and dedication, we can build a sustainable future for our communities and our environment.

– Teri Gobin
Tulalip Tribes Chair

Lindsey Watkins Tulalip Tribes



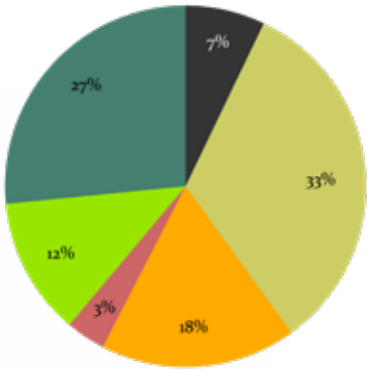
The Tulalip Tribes' areas of concern and areas of interest are far reaching beyond the adjudicated U&A areas and areas ceded through the Treaty of Point Elliott. This chapter largely focuses on the Snohomish River Basin.

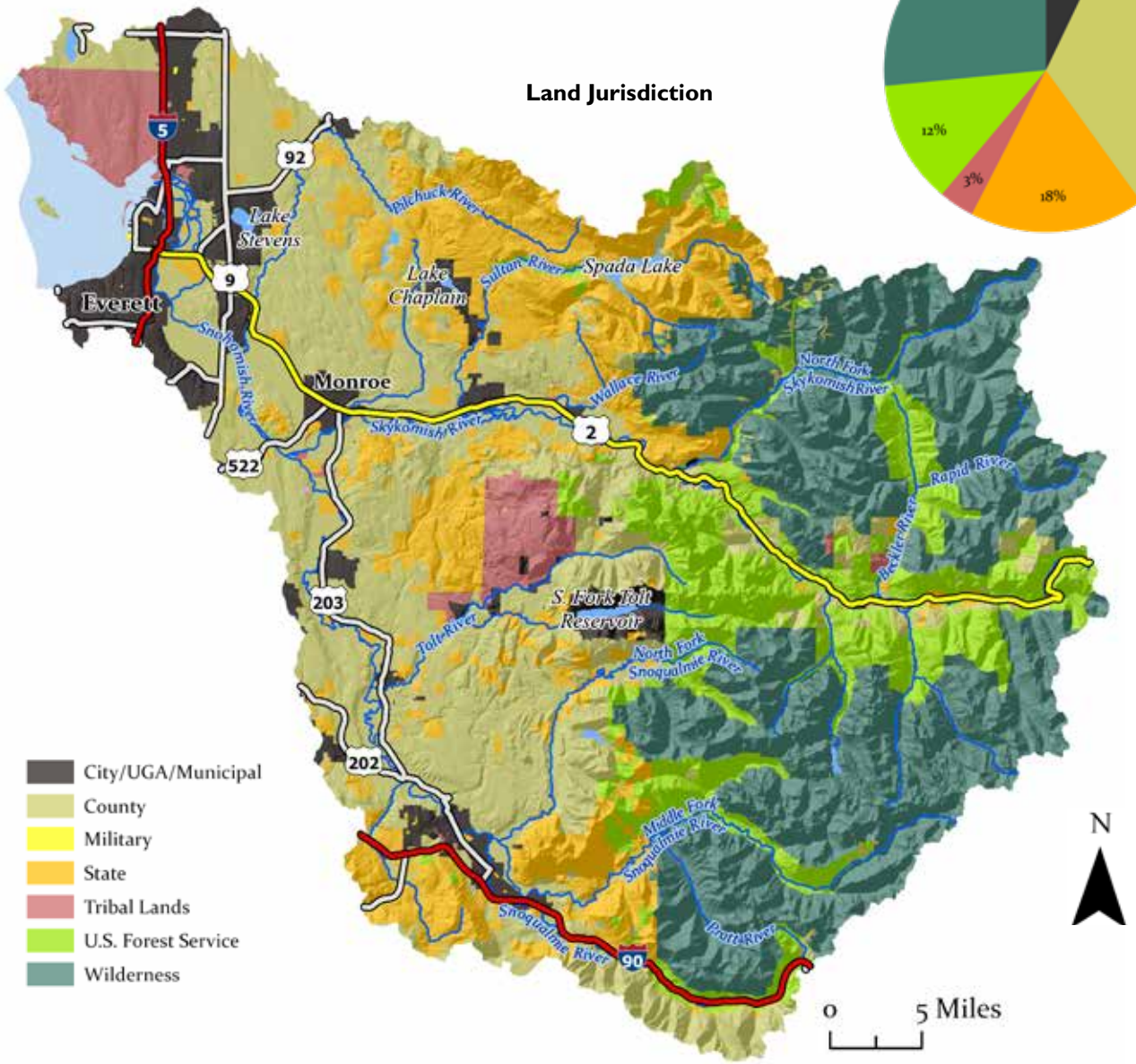
Tulalip Tribes

The Tulalip Tribes are a federally recognized Indian tribe, successors in interest to the Snohomish, Snoqualmie, Skykomish and other allied tribes and bands signatory to the Treaty of Point Elliott. Through the 1855 Treaty of Point Elliott, the Tulalip Tribes reserved the right to fish in their Usual and Accustomed grounds and stations, as well as hunt and gather on all open and unclaimed lands. The Tulalip Indian Reservation is located just north of the mouth of the Snohomish River. This report will focus on the Snohomish River basin and surrounding marine waters, which is only a portion of the area where the Tulalip Tribes work, manage and exercise treaty-reserved rights.

Tulalip Tribes

Snohomish River Basin





At 1,856 square miles, the Snohomish River is the second largest drainage basin in Puget Sound. It is the convergence of two major rivers: the Skykomish River and the Snoqualmie River. These rivers flow steeply from their headwaters in the North Cascades before descending onto the flat low-elevation Puget Sound trough.[1]

The Tulalip Indian Reservation is located just north of north of Everett, Wash., the mouth of Snohomish River and west of Marysville, Wash.

Post-treaty land use in the watershed by non-native immigrants has been largely based on physical geography. The foothills and mountains have mainly been used for timber production and other forms of resource extraction, as well as outdoor recreation. The lowlands have been primarily used for agriculture and rural residential development. Most of the urban and industrial land use has concentrated around the delta of the Snohomish River in the cities of Everett and Marysville. The Snohomish River system supports anadromous stocks of Coho, Chinook, Chum, Pink and Sockeye salmon, and steelhead, cutthroat and bull trout.[2]

The basin is also a major source of municipal water for the cities of Everett and Seattle, along with surrounding areas.[3]

Since 1990, human population is estimated to have grown from ~465,000 to over 847,000.[4] The last 150 years of human expansion has left the natural ecology of the Snohomish watershed in a stressed and depleted state. The future protection, conservation and restoration of the watershed will require a better understanding of the current state of the watershed's natural resources and physical processes and a greater long-term commitment to actively restoring, conserving and protecting resources into the future.

Map Data Sources: DOD 2023[5], SSHIAP 2004[6], WADNR 2024a[7], WADNR 2024b[8], WAECY 2018c[9], WAECY 2021[10], WAECY 2024[11], WADOT 2018[12], WADOT 2023[13], USFWS 2024[14]

Chapter Summary

Since time immemorial, the Tulalip Tribes have exercised fishing, hunting and gathering in what is now known as the Snohomish River Basin and are leaders in the region's salmon recovery effort. No other people or entity know these watersheds as well as the tribes and none have a greater stake in Tulalip's future. The tribes believe that if salmon are to survive, real gains in habitat protection and restoration must be achieved.

The primary limiting factors to salmon recovery are the quantity and quality of habitat in the marine waters and watersheds where salmon begin and end their lives. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribes' Usual and Accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

For this report, the Tulalip Tribes have focused on portions of their watersheds that are of greatest concern because of habitat loss and degradation, including those nearshore areas and local marine waters in proximity to the mouth of the Snohomish River. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Snohomish is Meeting its First 10-Year Estuary Recovery Goal Despite Funding Challenges

The Snohomish River Basin Salmon Conservation Plan had a 10-year goal to restore 1,237 acres of tidal marsh and blind channel habitat by 2015. Projects and planned work include the 415-acre Spencer Island Project, which includes 80 acres restored in 1994, and planned restoration for the remaining 335 acres in 2026, the Tulalip Tribes' 354-acre Qwuloolt Restoration Project completed in August of 2015, the 378-acre Smith Island project completed in the spring of 2018, and the 353-acre Blue Heron Slough project completed in 2022. All will contribute to the Snohomish estuary exceeding the 10-year restoration targets set in the Snohomish River Salmon Recovery Plan, albeit 7 years later than planned.

Fish Passage Barriers Continue to Block Anadromous Salmon from Upstream Habitat in the Snohomish Watershed

In the Snohomish River watershed, an estimated 1,876 inventoried barriers are blocking or impeding fish from accessing more than 400 miles of upstream habitat. This increases the number of known barriers by 786 since 2019.

Increasing Water Quality Impairment Threatens Salmon Habitat

From 2012 to 2018, water quality has decreased in the Snohomish River watershed.

Forest Cover Loss Continues in the Lowlands of the Snohomish River Basin

From 2011 to 2021, there was an estimated 1,989 acres net loss of forest cover in the lowlands of the Snohomish River basin. Over 90% of that loss occurred in areas zoned for Rural Residential land use, while in areas zoned for Agricultural land use, there was a 247-acre increase in forest cover.

Climate Change Impacting Streamflow in the Snohomish River Watershed

A comparison of mean daily mean streamflow in the Snohomish River between 1964-1993 and 1993-2023 shows a shift in streamflow timing over the course of the water year. Daily streamflow is becoming higher from October through January and lower from June through August. This corresponds with the climate change impacts of rising air temperature, more annual precipitation as rain and less as snow in the winter, and less overall precipitation in the summer.

Conclusion

There have been a number of successes in Snohomish River basin restoration since the 2020 State of the Watershed Report, such as the estuary habitat improvements at the Blue Heron Slough site. At the same time, the incremental decline in habitat conditions across the watershed has continued. Fish passage is blocked in too many streams by barrier culverts, water quality and forest cover have decreased, and climate change is impacting streamflows.

Restoration is not enough to keep up with the impacts of a growing population and their land use in the watershed. People must be held accountable to protect, conserve and improve fish habitat in land-use decisions, and federal, state and local governments all have a role in that.

Land-use regulations and water laws need to be implemented to protect critical areas and fish habitat. Implementation includes education and voluntary action, but it also needs to include enforcement backstop when those laws are broken. The future of tribal treaty rights in the Snohomish River basin depends on it.

Recovery Efforts Show Signs of Improvement But Still Lagging in Key Indicators

At the 20-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Snohomish basin shows an improvement in the restoration efforts, but degradation in water quality, forest cover, fish passage barriers and changes in streamflow, which can have negative habitat implications.

In general, there is a shortage of staff and funding at all levels (e.g., federal, state, tribal, county) needed to address the issues and implement actions to restore and protect habitat, and to monitor and enforce compliance of existing regulations. In addition, the longer time frames to implement large-scale projects and the lag time in ecological system recovery contribute to the slow pace of progress.

Review of the trend for these key environmental indicators shows improvement from the restoration efforts and a steady loss for others in habitat status:

Tribal Indicator	Status	Habitat Trend
Restoration - Estuary	The Snohomish River Basin Salmon Conservation Plan had a 10-year goal to restore 1,237 acres of tidal marsh and blind channel habitat by 2015. Work completed through 2022 has exceeded the 10-year restoration targets.	**Improving**
Barrier Culverts	In the Snohomish River watershed, an estimated 1,876 inventoried barriers are blocking or impeding fish from accessing more than 400 miles of upstream habitat. This is an increase of 786 inventoried barriers since 2019.	**Declining**
Water Quality	From 2012 to 2018, the water quality has decreased in the Snohomish River Watershed.	**Declining**
Forest Cover	From 2011 to 2021, there was an estimated 1,989 acres net loss of forest cover in the lowlands of the Snohomish River basin. Over 90% of that loss occurred in areas zoned for Rural Residential land use, while in areas zoned for Agricultural land use there was a 247-acre increase in forest cover.	**Declining**
Climate Change - Stream Flows	Daily streamflow is becoming higher from October through January and lower from June through August. This corresponds with the climate change impacts of rising air temperature, more annual precipitation as rain and less as snow in the winter, and less overall precipitation in the summer.	**Concerns**

The Tulalip Tribes continue to lead efforts, collaboration, funding and implementation of projects to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Looking Ahead

For over a decade since Chinook salmon were listed in Puget Sound, reductions in harvest and hatchery production of Snohomish River Chinook salmon have come at a great cost to the Tulalip Tribes. Meanwhile, significant public funds and volunteer hours have been spent restoring lost habitat according to a comprehensive recovery plan developed cooperatively by many watershed partners throughout the basin, and significant strides have been made.

Nearshore culvert replacement projects are scheduled between Everett and the Snohomish County line, which will provide much-needed nonnatal rearing for juvenile salmon and sediment that historically came from the adjacent feeder bluffs now impounded by the railroad. The tribes have achieved 1,237 acres of estuary restoration under the restoration plan, with additional estuary projects in planning stages that encompass roughly the same amount of additional acreage.

With the development of an acquisition strategy, funding has been secured to increase restoration activities within floodplains on the Skykomish, Snoqualmie and Pilchuck rivers. The tribes are continuing to develop a culvert inventory that is comprehensive and assesses all culverts within the Snohomish basin.

Projects also are being planned to offset the impacts of permit-exempt wells. Floodplain projects including riparian forest restoration are being planned in collaboration with other parties and agencies to increase riparian restoration to meet Salmon Recovery Plan goals.

Even with these much-needed gains through restoration, recent trends and this document demonstrate that net loss and degradation of key habitats continue. Unless appropriate habitat protection measures are taken immediately such that a net gain is seen in habitat, salmon recovery goals will never be reached.

Despite the degradation it has suffered, the Snohomish watershed retains the potential to once again be a strong salmon producer that will positively impact the Tulalip Tribes and its membership with the benefits reserved in the Treaty of Point Elliott.

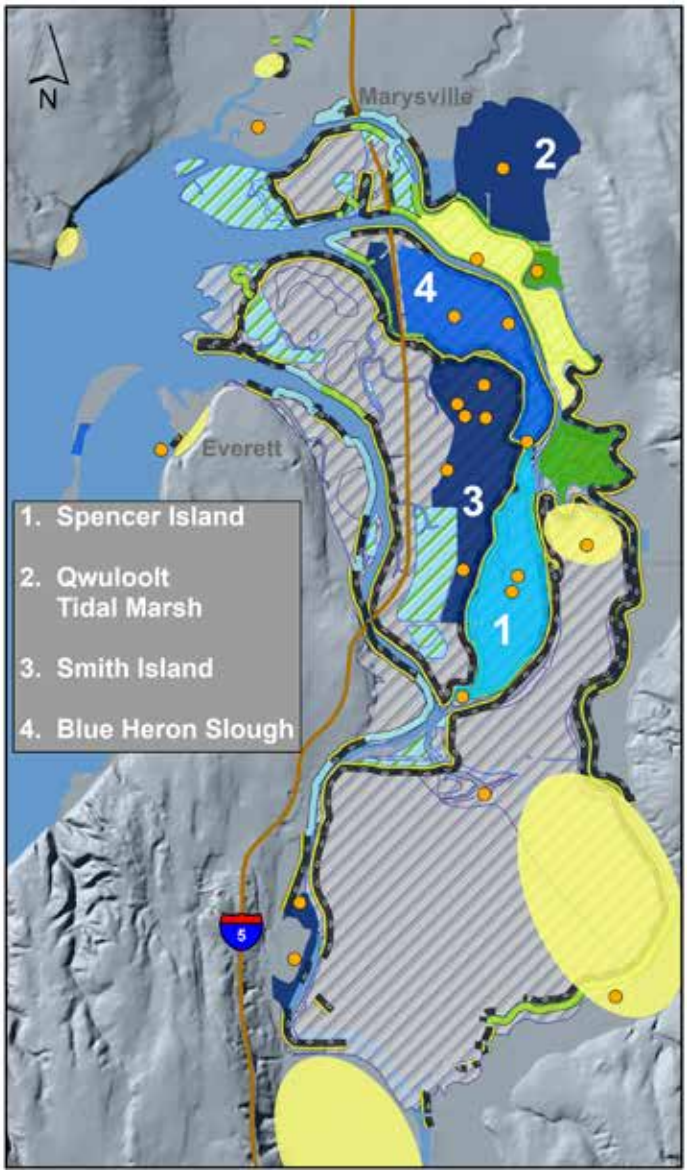
Habitat quantity and quality is a primary concern and restoration of degraded and disconnected habitat—along with continued monitoring of early marine survival to understand its impact on tribal resources—are the greatest needs and the principal actions that need to be taken to recover salmon in the Snohomish basin. The Tulalip Tribes remain ready and willing to work with all watershed partners toward the goal of recovering salmon to maintain its status as the icon of the Pacific Northwest. It takes all partners to work in collaboration, but this will not happen without a meaningful commitment to protect the habitat necessary to sustain them.

The Tulalip Tribes are a leading force in the Snohomish basin and are committed to full ecosystem recovery through collaboration with watershed partners. The tribes will continue to push for solutions as they are a permanent fixture in the basin. The Snohomish system is imminently recoverable. Though there has been significant alteration, much of the change is reversible.

An excellent example is the completed Qwuloolt restoration project, which revitalized 354 acres of estuary that was diked and thought to be lost, and improved salmon accessibility to 16 miles of stream habitat; and the removal of a dam on the Pilchuck that no longer served its purpose, which improved access to 37 miles of river and stream habitat. The last 150 years of human expansion has left the natural ecology of the Snohomish watershed in a stressed and depleted state, but the tribes believe strongly in the resilience of the watershed. If areas are reopened and the watershed processes remain largely intact, treaty-reserved salmon resources are recoverable.

Snohomish is Meeting its First 10-year Estuary Recovery Goal Despite Funding Challenges

The Snohomish River Basin Salmon Conservation Plan had a 10-year goal to restore 1,237 acres of tidal marsh and blind channel habitat by 2015.[1] Projects and planned work, including the 400-acre Spencer Island Project completed in 2009, the Tulalip Tribes' 354-acre Qwuloot Restoration Project completed in August of 2015, the 326-acre Smith Island project completed in the Spring of 2016, and the 353-acre Blue Heron Slough project completed in 2022, have the Snohomish estuary exceeding the 10-year restoration targets set in the Snohomish River Salmon Recovery Plan.[2]



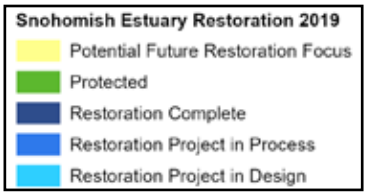
Wetlands of the Snohomish estuary in 1860 were 80-85% more extensive than in 2001.[6] Restoration efforts are slowly bringing some of that lost wetland habitat back. Large projects like Spencer Island, Qwuloolt Estuary and Smith Island helped exceed the10-year restoration target.[7]

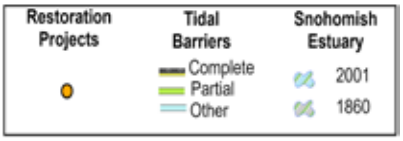
From 1860 to 1950, the clearing and draining of the Snohomish estuary resulted in 80-85% loss of historic estuarine wetland habitat.[3] The loss in habitat area has resulted in a potential loss of 1 million to 1.6 million Chinook smolts annually, leaving the estuary a frequent bottleneck to Chinook production.[4] While reaching the 10-year goal for estuary restoration increases current estuary habitat to 30% of historic totals, it is still far from the 80% habitat restoration desired by the Tulalip Tribes.

Moving beyond the 10-year goal, funding continues to be the key factor limiting estuary restoration projects, with a typically high cost per acre to restore at ~$40K+ per acre.[5] There has been positive news on this front over the last two years as $100 million has been secured for restoration implementation and design.

NOAA

Completed in 2022, 353 acres of tidal wetland habitat was restored and opened in Blue Heron Slough.[8]





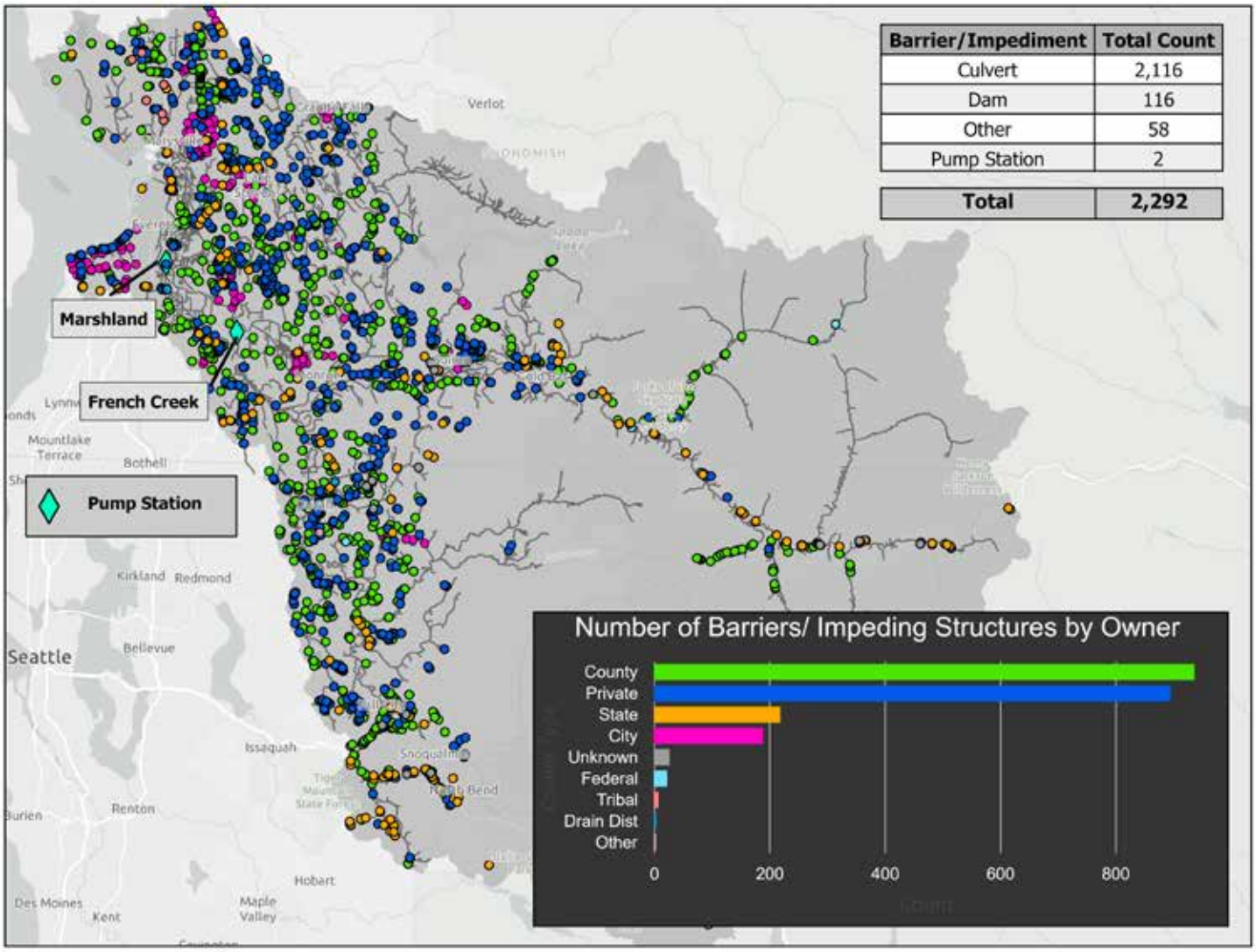
Map Data Sources: HAAS, A. and B. Collins, 2001,[5] HWS 2019[6]

Fish Passage Barriers Continue to Block Anadromous Salmon from Upstream Habitat in the Snohomish Watershed

In the Snohomish River watershed, an estimated 1,876 inventoried barriers are blocking or impeding fish from accessing more than 400 miles of upstream habitat.[1,2] This is an increase of known barriers to 786 since 2019.[3]

Based on survey records through the end of 2024, approximately 2,292 potential barriers are known to exist in the basin,[4] and more than 1,876 barriers of the 2,292 potential barriers are surveyed as at least partial blockages to fish distribution. With continued culvert inventory in the watershed, more barrier impact to salmon and steelhead passage is being discovered. The total impact of culverts on anadromous fish will not be known until culvert inventories are complete.

While culverts are the primary physical barrier impeding habitat in the Snohomish River watershed, pump stations at the Everett Marshland and French Creek are blocking stream and wetland habitat. The removal of the French Creek pump station would open access to more than 50 miles and upwards of 115 miles of floodplain side-channel and tributary habitat and potential access to floodplain wetlands for anadromous fish.[5,6,7] Additionally, removal of the Marshland watershed pump station with accompanied restoration could provide anadromous fish access to between 400 and 500 acres of floodplain wetland habitat.[8]



Culverts, dams and pump stations block or impede access to anadromous salmon habitat throughout the Snohomish River watershed.[9,10,11]

Culverts make up the majority of manmade barriers or impediments to anadromous salmon migration in the Snohomish River watershed.[12,13]

Map Data Sources: WDFW 2024[9], SWIFD 2024[10], WAECY 2017[11]

Increasing Water Quality Impairment Threatens Salmon Habitat

From 2012 to 2018, water quality has decreased in the Snohomish River watershed.

The 2018 Washington Department of Ecology Water Quality Assessment and Listings report to the U.S. Environmental Protection Agency is the first update since 2012. In it, temperature-impaired streams that need a water improvement plan increased from 29.66 listed miles to 44.85 listed miles, and temperature-impaired streams with a water improvement plan increased from 66.46 miles to 95.09 miles. Dissolved oxygen-impaired streams that need a water improvement plan increased from 26.04 listed miles to 29.75 listed miles, and dissolved oxygen-impaired streams with a water improvement plan increased from 21.81 listed miles to 54.57 listed miles.[1]

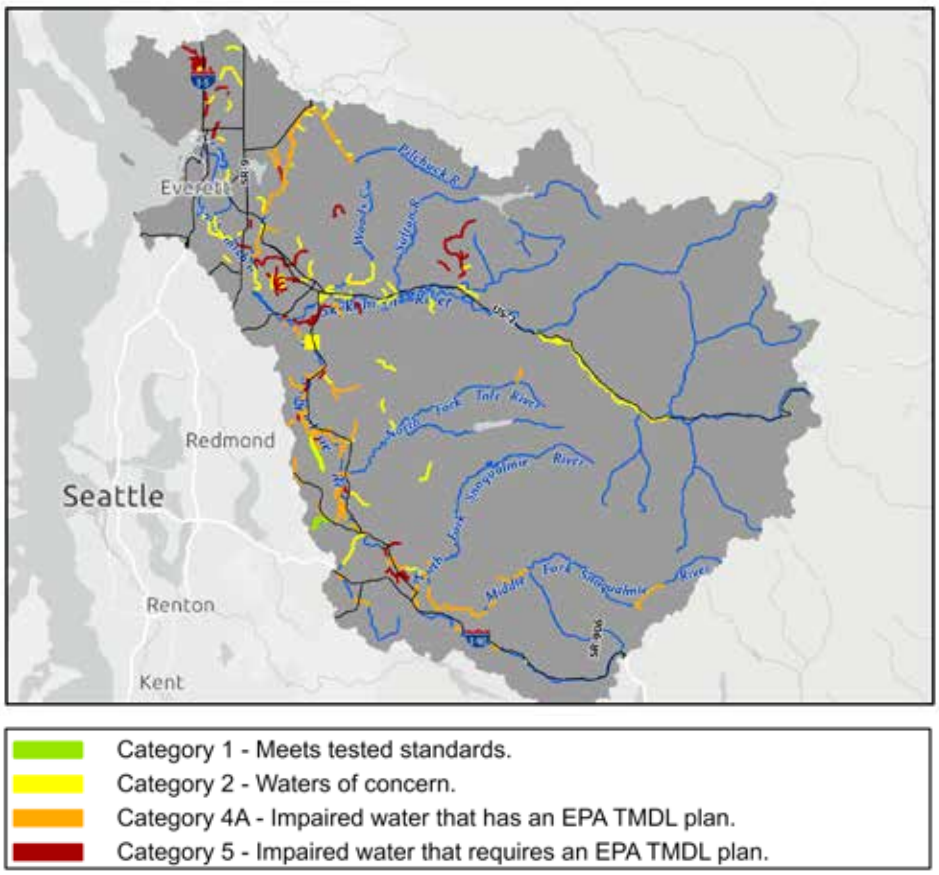
Pacific salmon require cold, well-oxygenated water across all life stages. High stream temperatures are lethal to salmon at certain thresholds and sublethal to salmon at lower thresholds. Low levels of dissolved oxygen can hinder embryo incubation, which can result in weaker fry that are more susceptible to predation and that don't feed or swim as well. At the extreme end, low dissolved oxygen can be lethal to salmon.[2]

Stream temperature and dissolved oxygen impairments are largely caused by nonpoint source pollution. The Clean Water Act provides limited authority to address nonpoint source pollution. Many recommended TMDL measures are voluntary, requiring willingness of the landowner to take action to decrease pollution.

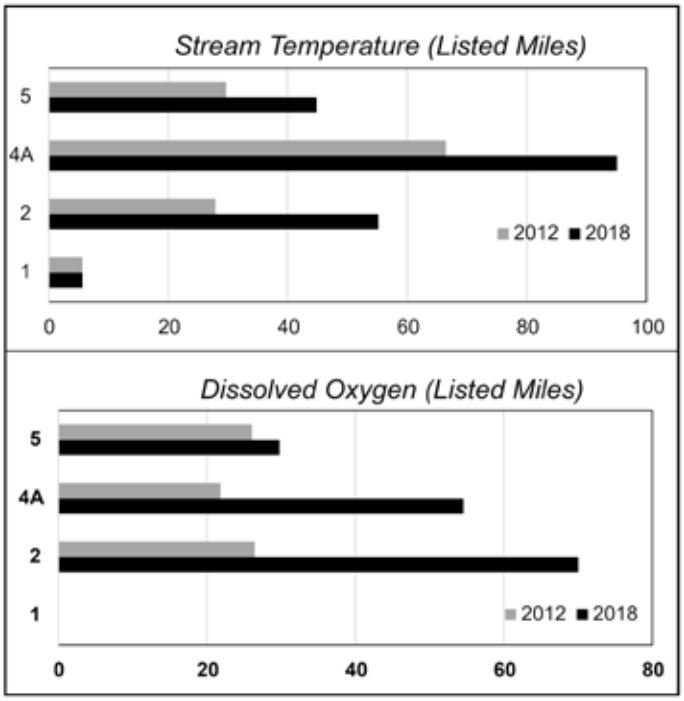
Dating back to 2013, the Government Accounting Office reported on the challenges of nonpoint source pollution control measures and recommended that Congress consider revising the Clean Water Act's voluntary approach to cleaning up such pollution. As of the end of 2023, Congress had not acted on these recommendations.[3]

Under Washington state law and affirmed by the State Supreme Court, Ecology has some authority to regulate nonpoint source pollution, but as stated, they still rely largely on ineffective voluntary measures.

Stream temperature- and dissolved oxygen-impaired water are spread throughout the Snohomish River watershed[4]



From Ecology's 2012 Water Quality Assessment to its 2018 Water Quality Assessment, stream miles impaired for stream temperature and for dissolved oxygen.[5]



Map Data Sources: WAECY 2022[4]

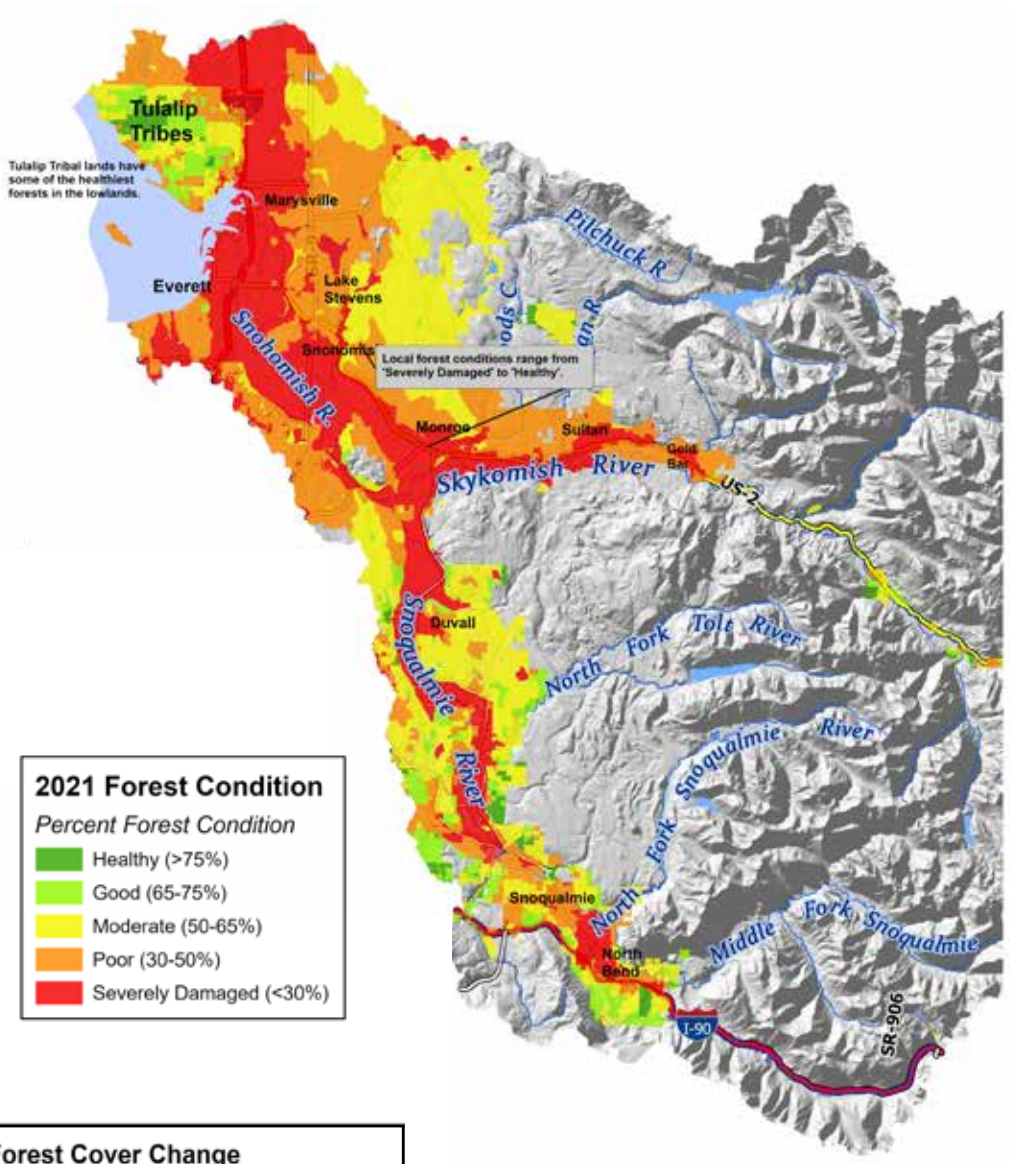
Forest Cover Loss Continues in the Lowlands of the Snohomish River Basin

From 2011 to 2021, there was an estimated 1,989 acres net loss of forest cover in the lowlands of the Snohomish River basin. Over 90% of that loss occurred in areas zoned for Rural Residential land use, while in areas zoned for Agricultural land use there was a 247-acre increase in forest cover.[1,2,3,4]

The desired forest cover in the Snohomish River watershed is mature canopy of conifer and deciduous trees that covers at least 65% of non-urban sub-basins in the watershed.[5] Forest cover at this level provides a healthy environment for water and biota. As forest cover drops below 50% in a sub-basin because of forest clearing and development, water quality is more likely to decrease and biota is more likely to show negative impacts.[6,7]

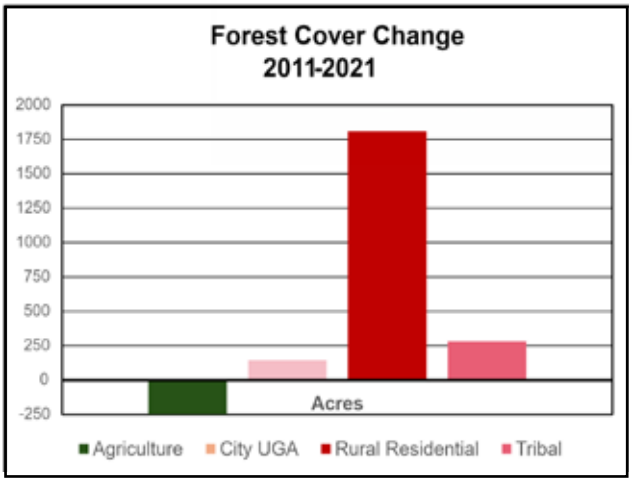
The lowlands of the Snohomish River watershed have 40% forest cover, and forest cover in this area has hovered around 40% for nearly 30 years.

Between 2011 and 2021, land development associated with a growing population resulted in continued forest cover loss in the inhabited lowlands of the Snohomish River basin. The majority of lowland forest cover loss between 2011 and 2021 was in Rural Residential areas, which remain just over 50% forested. While there was a little forest cover gain in Agriculture zoned areas, forest cover in those areas remained the lowest in the lowlands at 15%. Forest cover in cities experienced slight losses and remains low at 28%. Forest cover in tribal areas remains the highest of the lowland jurisdictions at 55%.[8,9,10,11]



2021 forest cover by primary land use areas within the inhabited lowlands of the Snohomish River watershed.

Acres of forest cover loss by land use in the inhabited lowlands of the Snohomish River watershed, 2011 to 2021.[17,18,19,20]



Map Data Sources: NLCD 2021[12], Snohomish County 2020[13], SSHIAP 2019[14], King County 2020[15], SSHIAP 2004[16]

Climate Change Impacting Streamflow in the Snohomish River Watershed

A comparison of mean daily mean streamflow in the Snohomish River between 1964-1993 and 1993-2023 shows a shift in streamflow timing over the course of the water year. Daily streamflow is becoming higher from October through January and lower from June through August (Figure 1).[1] This corresponds with the climate change impacts of rising air temperature, more annual precipitation as rain and less as snow in the winter, and less overall precipitation in the summer.

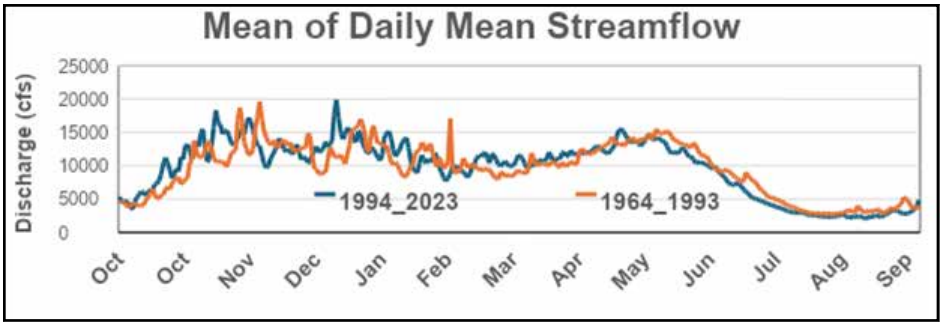


Figure 1. A comparison of two periods of mean of mean daily flow (cfs) measured at the USGS 12150800 gauging station of the Snohomish River at Monroe, Wash. The two periods are 1964-1993 and 1994-2023.[2]

Changes in streamflow are critical to salmon survival and production because they result in changes to water quality and quantity and impact salmon habitat and nutrient availability.

Higher flow in the fall and winter potentially decreases usable spawning habitat area due to higher velocities, impacted spawning gravels and redd scours.

Lower flow in the summer means less usable rearing habitat, and higher water temperatures that can be lethal to anadromous salmon, which has been considered a limiting factor within the Snohomish basin.

Changes in the Snohomish River watershed reflect changes throughout Washington state, and by the 2080s, it is expected that winter streamflows in the state will increase by 23-34% and summer streamflows in the state will decrease by 34-44%.[3]

With this continued change in streamflow affecting salmon across their freshwater life cycle, it is critical to work to restore floodplain connectivity to slow down winter flow and create more usable spawning habitat, forested wetlands to store flow for summer and riparian forest cover to keep flows cool in the summer.

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3 WARCO. 2022. State of the Salmon in Watersheds Executive Summary. Washington State Recreation and Conservation Office, Governor's Salmon Recovery Office. Olympia, WA.

2025 State of Our Watersheds Report
Skagit River Watershed

Curtis Clement

A pre-contact CMT (culturally modified tree) with ancient stone tool marks was found in the vicinity of the ancestral Upper Skagit village of S.blaliu^{w} in the Baker River valley during an old growth survey by the Washington Department of Natural Resources.

The sacred Skagit River is named after the people who resided in cedar longhouses along its banks since time immemorial. The Skagit River historically provided our people with year-round abundant runs of all six species of Pacific salmonids while it was relatively untouched or changed by the outside world. The Upper Skagit people would make nets, traps and spears out of cedar, ironwood and other available materials to catch salmon at ancestral fishing sites that were used for thousands of years. These survival skills and deep connection to the fishing culture were passed down from generation to generation by elders sharing their traditional knowledge of fishing, hunting and gathering. The tribe signed the 1855 Treaty of Point Elliott with the United States, forever reserving the right to fish, hunt and gather in the tribe's usual and accustomed areas. Today, after over 150 years of continual habitat loss and degradation due to floodplain development, untenable land-use practices and hydropower effects, the tribe's treaty-reserved rights have been severely diminished and rely on mostly hatchery-derived salmon runs.

– Scott Schuyler
Natural Resources Director & Policy Coordinator

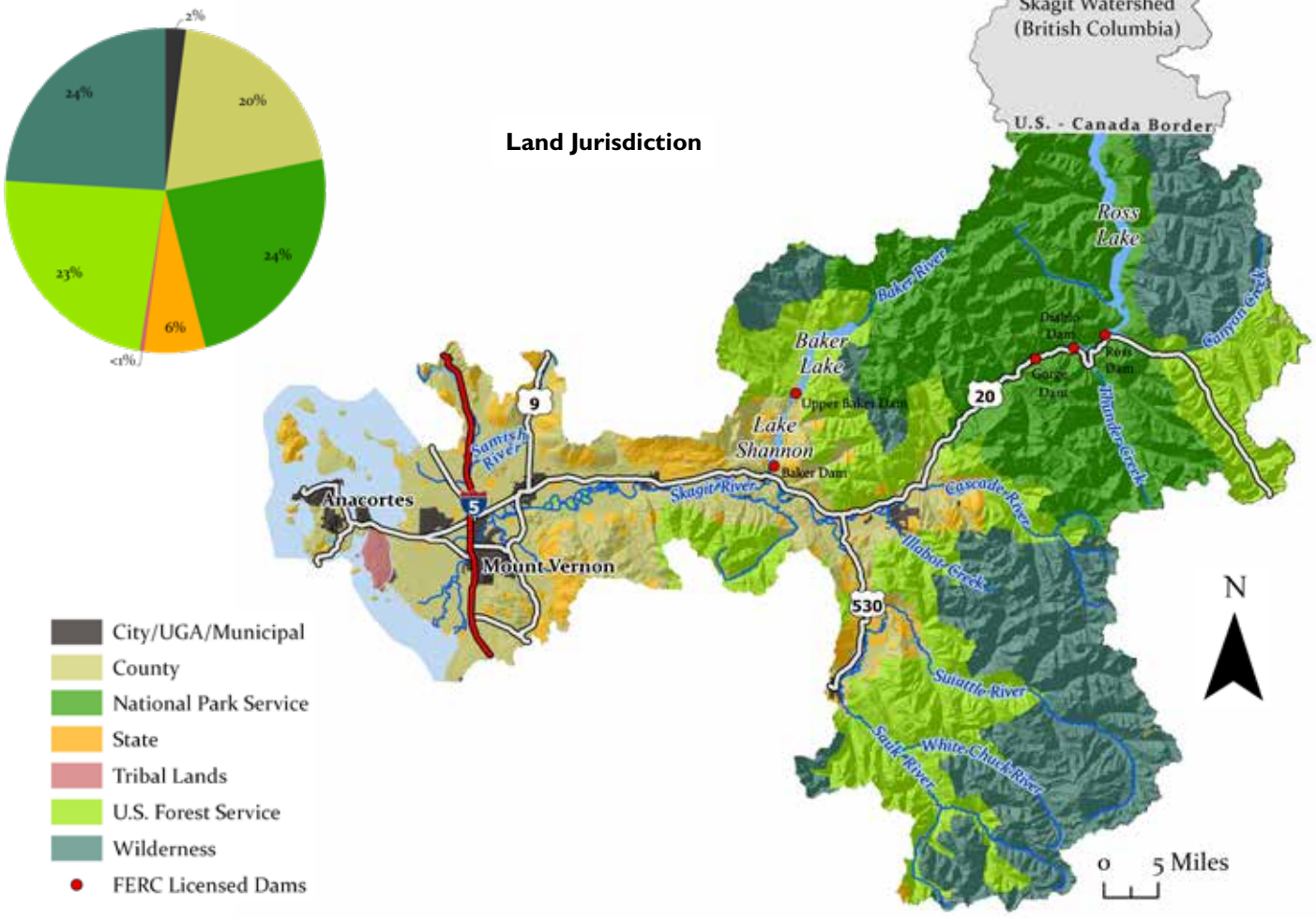
— **Area of Interest**

Upper Skagit Indian Tribe

Upper Skagit was not granted a reservation at treaty time like some tribes and many Upper Skagit tribal members refused to relocate to these newly formed reservations. This act of defiance, along with their continued resistance to encroachment after treaty signing, forever preserved Upper Skagit identity and culture. Upper Skagit participated in the treaty fishing court case after decades of tribal fishers being harassed, arrested and jailed for simply fishing the Skagit River as their ancestors did.

Upper Skagit Indian Tribe

Skagit River Watershed



The Skagit River flows from a 3,100-square-mile watershed that originates in British Columbia and flows south into Washington state before continuing westward through Skagit County and into Puget Sound. It has the largest watershed in Puget Sound and provides 30% of the sound's freshwater input.[1] There are an estimated 396 glaciers in the watershed, making up one of the largest areas of glacial cover in the United States outside of Alaska.[2] The Baker River, Sauk River and Cascade River all flow from glaciers within the Skagit River watershed.

The Skagit River watershed has been home to the Upper Skagit Indian Tribe, the Sauk-Suiattle Indian Tribe and the Swinomish Indian Tribal Community since time immemorial. All three tribes have their reservations in the watershed and all have entered into a treaty with the U.S. guaranteeing them the right to fish at their usual and accustomed places forever. These usual and accustomed areas include some or all of the Skagit River watershed, depending on the tribe.

Since European settlement, land use in the watershed has been dominated by natural resources extraction. The foothills and mountains have been used for wood products, mining and outdoor recreation. The river valleys, delta and coastal areas have been used for agriculture, industry, commerce and residential development. As of 2019, the U.S. Census Bureau estimated 129,205 residents lived in Skagit County, a 25% increase in population since 2000.[3,4]

The upper watershed is primarily within national forest and North Cascades National Park. The lower watershed mainly comprises of state forest, private forest, agriculture, rural residential, and urban residential/commercial/industrial lands.

There are five Federal Energy Regulatory Commission (FERC) licensed hydroelectric dams in the Skagit River watershed: the lower and upper Baker River dams, and the Gorge, Diablo and Ross dams.

The Skagit River is home to all five species of Pacific salmon, as well as steelhead trout. It has the healthiest and largest runs of wild Chinook and Pink salmon in the Puget Sound.[5] Even so, the last 150 years of human population growth and associated land use has resulted in declines in Chinook, a near collapse of Chum, and declines in other salmonid productivity. The Skagit Chinook Recovery Plan (2005) provides a strategy for both protection and targeted restoration. It will take federal, tribal, state and local leadership to provide a consistent yet adaptive plan to control the future impacts of land use in the watershed.

Map Data Sources: DOD 2023[6], SSHIAP 2004[7], WADNR 2024a[8], WADNR 2024b[9], WAECY 2018c[10], WAECY 2018d[11], WAECY 2023[12], WAECY 2021[13], WAECY 2024[14], WADOT 2018[15], WADOT 2023[16], USFWS 2024[17]

Chapter Summary

Upper Skagit was one of the original tribes to participate in the treaty fishing court case *U.S. v. Washington*, as many tribal members were continually arrested in the 1960s and '70s and thrown in jail for fishing. Since the days of the court case, Upper Skagit tribal members have continued to fish the Skagit River on or near their historical villages from present day Mount Vernon to Newhalem. In recent years, however, the salmon have not been returning to the Skagit River in numbers that can sustain Upper Skagit tribal harvest, and the tribe has been forced to fish less and less to protect the salmon that remain. This is at a great cost to the Upper Skagit culture, as a younger generation is not being allowed on the river to learn the lessons of their elders.

Recovery of the fish populations isn't happening fast enough, because while harvest is being restricted, habitat continues to be managed in a degraded state. Since European settlement began in the middle of the 19th century, the landscape of the watershed has been prioritized to support cities, residences and agriculture, and not to support the natural estuaries, large floodplains and riparian-lined tributaries needed for healthy populations of salmon. That pattern continues today, and with a growing human population, the degrading impact on salmon habitat has intensified.

The primary limiting factors for salmon recovery are the quantity and quality of habitat where salmon begin and end their lives in the watersheds. The treaty tribes believe the salmon recovery effort should focus on those waters.

The State of Our Watersheds Report examines key indicators of habitat quality and quantity across the watersheds in the tribe's usual and accustomed fishing areas as defined by *U.S. v. Washington* (Boldt decision). The 1974 ruling upheld tribal treaty-reserved rights, including the right to half of the harvestable salmon returning to Washington waters every year, and established the tribes as co-managers of the salmon resource.

The goal of the State of Our Watersheds Report is to provide tribes with a basic assessment of the health of their watersheds and to gauge progress toward salmon recovery. This report is part of the Treaty Rights at Risk initiative begun by the tribes in 2011 as a call to action for the federal government to exercise its trust responsibility to the tribes and lead a more coordinated and effective salmon recovery effort. More information is available at *treatyrightsatrisk.org*.

For this report, the Upper Skagit Indian Tribe has focused on portions of the watershed that are of greatest concern because of habitat loss and degradation. It is important to note that the State of Our Watersheds Report is a living document that will be updated as new data become available, providing both a metric for assessing changes in salmon habitat and a method for monitoring those changes. The report also will be used to quantify the progress made with the region's salmon recovery plans.

Principal Findings

Skagit Hydropower Projects: Restoring Fish Passage and Mitigating Over a Century of Harm

Seattle City Light is currently undergoing FERC relicensing for its Skagit Hydroelectric Project. Since construction in 1915, the dams have severely altered the Skagit River watershed, including blocking ecological functions and isolating over 140 miles of pristine cold-water tributary habitat. It is imperative that upstream and downstream fish passage be restored at all three of the Skagit Project dams. At the time of publishing, it remains uncertain whether Seattle will achieve timely and successful fish passage at its three Skagit dams.

Increasing Water Quality Impairment Threatens Salmon Habitat in the Skagit River Watershed

From 2012 to 2018, water quality decreased in the Skagit River watershed.

Culvert Barriers Blocking Fish Passage Across Multiple Jurisdictions in the Skagit Watershed

A recent, comprehensive inventory of culverts on anadromous fish-bearing streams in the Skagit River watershed documented 931 culverts. Of these, 556 culverts are fish-passage blockages and 91 culverts are unknown but may be fish-passage blockages. Over 74% of the blocking and unknown culverts are either privately owned (291 culverts, 45%) or county owned (194 culverts, 30%). The remaining 162 culverts (about 25%) are spread across other public ownerships.

Habitat Remains Impaired in the Middle Skagit River Floodplain

As of 2015, 35% of floodplain was isolated or impaired. Exacerbating the impairment caused by habitat access issues, the middle Skagit floodplain remains in a state of managed deforestation; under 50% of the floodplain currently has forest cover.

Floodplain Restoration is Critical to Counter the Increased Variability in Winter Flows' Impacts on Chinook Productivity

A recent study found that half of 60 rivers researched in the Pacific Northwest have experienced increased variability in October – January (winter) streamflows since 1950. The same study found that the increased variability in winter freshwater flows had a more negative effect on Chinook productivity than any of the other climate signals researched.

Protecting and Restoring the Middle Skagit River Floodplain is Critical to Chinook Recovery

According to the Skagit Watershed Council Riparian Database, 472 acres of riparian trees were planted throughout the Skagit River watershed between 2020 and 2023. Of that, 83 acres were planted in the middle Skagit floodplain. That brings the total of riparian planting in the middle Skagit floodplain since 2006 to 687 acres.

Samish Bay Remains Conditionally Closed to Commercial Shellfish Harvest

Since 2011, there has been no change in the conditionally approved status of over 4,000 acres of commercial shellfish growing area in Samish Bay, which continues to be periodically closed for harvest due to pollution. Between 2015 and 2020, additional testing led to an increase of approved commercial growing area to the north of Samish Bay of 526 acres and in Padilla Bay of 151 acres, but there has been no additional progress since.

Nearshore Armoring Continues to Impact the Intertidal Zone

There are 226 miles of shoreline along Samish and Skagit bays. The Washington Department of Fish and Wildlife's Beach Strategies project revealed that 133 miles (59%) is modified, including nearshore bulkheads, tidal barriers and overwater structures in the marine nearshore and intertidal areas.

Tidal Habitat Restoration is Too Slow

From 2000 to 2019, overall tidal marsh habitat gain, either naturally or through active restoration, was only 44 hectares. Since 2020, no restoration efforts have resulted in a measurable increase in habitat, and negative progradation rates, erosion and sea level rise are likely causing further reductions in habitat. The 44-hectare habitat gain falls far short of the 1,114.6 hectares of habitat outlined as a goal in the Skagit Chinook Recovery Plan.

Conclusion

The needs of salmon have been understood by the treaty tribes since time immemorial. For more than two decades, local planners have recognized these needs as well. Salmon habitat research, planning, restoration, monitoring and adaptive management have all been occurring for over 20 years, and still the habitat remains critically degraded in many instances. The tribe's highest priority is restoring fish access above Seattle's three dams. Additionally, more riparian vegetation is needed, more water quality protections are needed, more water is needed, more floodplain habitat is needed and more tidally influenced estuary habitat is needed.

All of the education, cooperation, volunteering and work that is done to protect and restore salmon is very important and needs to be acknowledged, but the treaty rights of the tribe and the legal habitat protections of the salmon also need to be enforced according to the regulatory framework already in place. Without that, the salmon won't be able to recover and the tribe won't be able to fish.

Recovery Efforts Show Signs of Improvement But Still Lagging in Key Indicators

At the 20-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Skagit River basin shows an improvement in restoration efforts. Restoring passage above Seattle's three dams is a necessity. Degradation of water quality and shoreline habitat conditions continue.

In general, there is a shortage of staff at all levels (e.g., federal, state, tribal, county) needed to address these issues and implement actions to restore and protect habitat and to monitor and enforce compliance of existing regulations. Funding shortfalls for large-scale projects are contributing to the slow pace of progress. There is a need for well-funded, incentive-based programs to get more private landowners involved in salmonid recovery.

Review of the trend for these key environmental indicators shows a steady loss in habitat conditions:

Tribal Indicator	Status	Habitat Trend
Estuary Habitat	From 2000 to 2019, net tidal marsh habitat gain—naturally and through restoration—was only 44 hectares. Since 2020, two restoration projects have resulted in 10-13 acres of habitat. These small habitat gains fall far short of the 1,114.6 hectares of new habitat outlined as a goal in the Skagit Chinook Recovery Plan.	**Declining**
Armoring	There are 136 miles of modified shoreline in the Skagit and Samish river intertidal areas, and over 106 miles of the modified shoreline is entirely armored.	**Declining**
RMAP	Efforts to upgrade and decommission forest roads and new regulations designed to reduce logging on unstable slopes above streams have led to greatly reduced forestry-related landsliding in the Skagit watershed.	**Improving**
Barrier Culverts	A recent inventory of culverts on anadromous fish-bearing streams in the Skagit watershed documented 931 culverts. Of these, 556 culverts are fish-passage blockages and 91 culverts are unknown but may be fish-passage blockages. About 75% of the blocking and unknown culverts are either privately owned (291 culverts, 45%) or county owned (194 culverts, 30%).	**Declining**
Voluntary Measures Fall Short	The Washington Department of Ecology failed to meet its goal of 100% riparian planting by 2020, and it has taken no steps since then to redress this significant adverse impact to Skagit basin water quality and salmon.	**Declining**
Stream Temperatures	Over the last six decades, natural-origin Chinook salmon have been spawning later by up to 0.52 days per year. Meanwhile, egg take for hatchery propagation has moved earlier by 0.58 days per year.	**Declining**
Restoration - Floodplain	Between 2001 and 2019, a total of 24 structures or channel crossings were removed from the floodplain, natural processes were restored in 59 hectares of non-channel and channel habitat area, and 2.7 kilometers of road/levee and channel-lining riprap was removed.	**Concerns**
Restoration - Riparian Planting	The acreage planted on public lands and lands purchased for salmon habitat conservation contains over six times as much area as the acreage planted on private lands (a combined 459.8 versus 75.7 acres).	**Concerns**
Habitat Protection	Too many exemptions exist for ongoing and new land uses, and Skagit County and the state have been largely unwilling to ensure through enforcement that there is sufficient cold, clean water in all of our salmon streams, or that adequate riparian habitat remains intact. County land-use policies generally fail to support the adequate restoration and protection of habitat needed for salmon recovery.	**Declining**

The tribe continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat, restoring those areas that are degraded, and conducting research to understand the organisms and the habitats they occupy.

Tribal youth and volunteers from The Salmon School collect eDNA samples from Hansen Creek in 2025.

Looking Ahead

Since time immemorial, the salmon runs of the Skagit River basin have sustained the culture of the people residing there. Today, fragments of the historic salmon habitat remain, allowing these people's cultural fishing identity to continue. But that identity and habitat is under constant threat due to human population growth, climate change, a mismatch of regulatory frameworks, and a lack of political and social will for reversing the large-scale habitat loss that occurred over the previous century. The consequence has been the loss of historic salmon runs.

New partnerships are forming to protect what is left and restore some elements of what has been lost. Habitat trends indicate that renewed efforts to build partnerships, land-use regulation reform and expanded funding for restoration activities are necessary to achieve the agreed-upon recovery goals. A successful program must include local coordinating bodies that provide a forum for tribal leadership across all the Hs of salmon recovery: Habitat, Hydropower, Hatcheries and Harvest. New and revitalized efforts must expand financial support for salmon recovery while also improving the political and social will that is needed. This will require local governments and tribes working together, business leaders and developers supporting smart growth, and climate-resilient infrastructure projects.

Over the next few years, the tribe will be focusing on several salmon recovery, restoration and management areas. Priority management objectives for the Skagit Hydropower Project will focus on aligning the new license with ecosystem and salmon recovery, including restoring fish passage above all three of Seattle's dams. Following decades of slow progress, the tribe is seeking new approaches to increase fishing opportunity. For example, the depressed Sauk summer Chinook population reduces tribal fishing due to lack of a directed fishery and through bycatch constraints that reduce other fishing opportunities. Addressing the fish passage blockage that has existed at Seattle's dams since 1915 provides the greatest feasible opportunity to recover salmon and increase tribal harvest.

Habitat restoration and protection actions that increase natural floodplain processes and target habitat productivity for all salmonids will continue to be a tribal priority. The tribe will continue addressing fish-passage barriers across the watershed by supporting implementation of the culvert injunction and identifying projects on local and private lands. For example, the tribe has partnered with Skagit County and Drainage District 21 to restore the East Fork Nookachamps Creek watershed. This important watershed suffers from high water temperatures, low summer streamflows, impaired fluvial processes, and isolated or degraded aquatic habitats. Efforts are underway to restore natural sediment and hydrogeologic processes, reconnect stream and floodplain habitats, alleviate recurring flood impacts to public and private property, and support progress of the Lower Skagit Tributaries Temperature Implementation Strategy (Washington Department of Ecology, March 2020). Through our engagement efforts, over 3,000 feet of stream length have been planted with trees and shrubs in the lowlands of this watershed.

The tribe is interested in planning for long-term climatic shifts and improving forest practices in important watersheds. The need to increase summer streamflow in small tributaries is evident and the tribe is pursuing methods to sustain flows in spite of drought and climate change. Some initial planning and scoping of an engineered solution known as Managed Aquifer Recharge has been conducted and shows potential along the Skagit River corridor and some tributaries.

In support of these various habitat and hydropower projects, the tribe will also maintain effective management strategies for harvest and hatcheries that support both treaty rights and salmon recovery. The tribe's terminal harvest strategies do not compete with the need for expanding the prey base for orca recovery, and can be managed effectively around stocks of concern. Hatcheries will be operated with the newest scientific principles, ensuring Skagit River hatchery programs address genetic and ecological interactions with native fish and inform conservation goals. Surplus fish can be used to provide needed nutrients to human communities and to watersheds that have been isolated from this significant nutrient supply.

Scott Schuyler

A majestic cultural old growth cedar which has stood as a sentinel marking an ancient Upper Skagit fishing site lays felled in the Skagit River after it was purposely vandalized by an unknown arsonist. Unfortunately, attempts by Upper Skagit and National Park Service staff failed to save this precious tree.

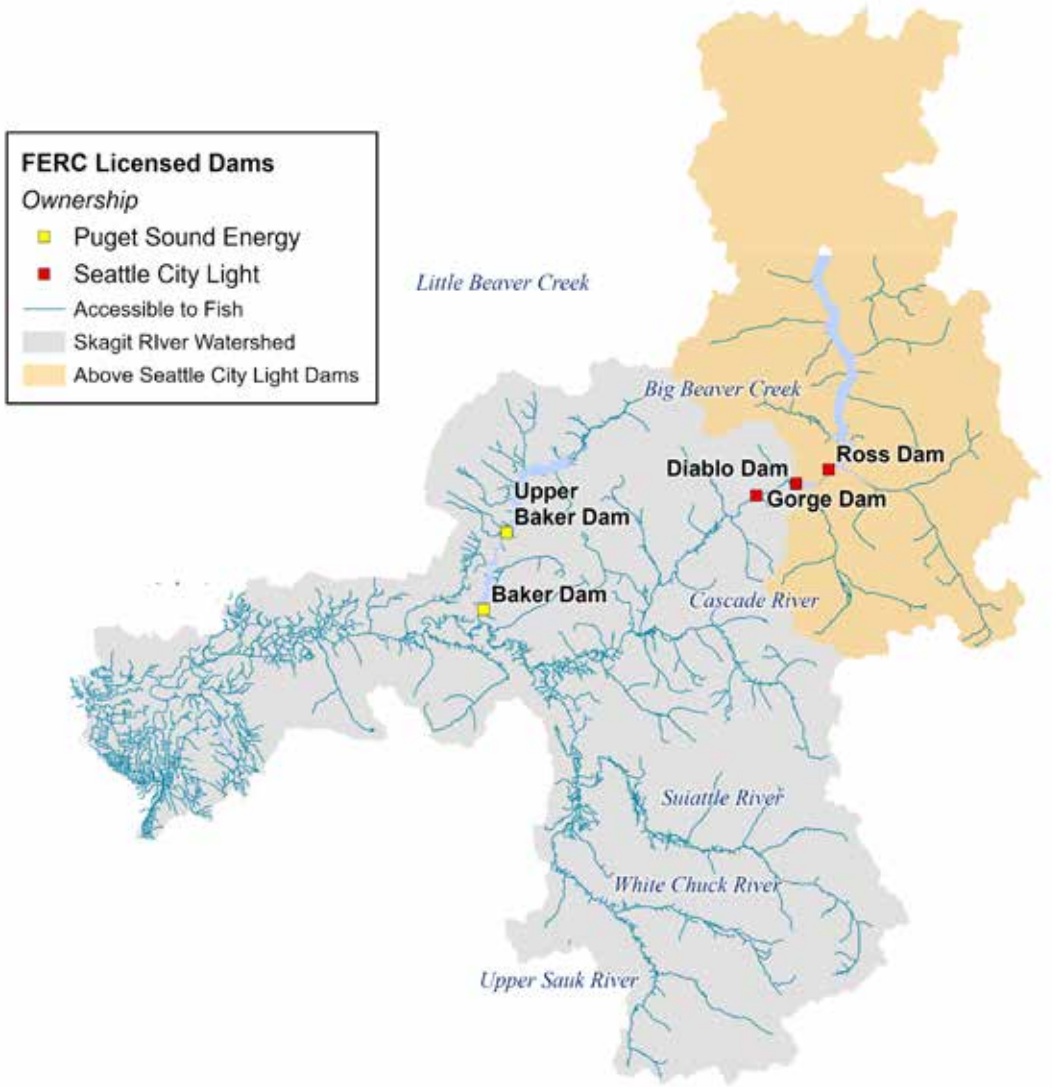
Skagit Hydropower Projects: Restoring Fish Passage and Mitigating Over a Century of Harm

Seattle City Light is currently undergoing relicensing for its Skagit Hydroelectric Project. Since construction in 1915, the dams have severely altered the Skagit River watershed, including blocking ecological functions and isolating over 140 miles of pristine cold-water tributary habitat. It is imperative that upstream and downstream fish passage be restored at all three of the Skagit Project dams. At the time of publishing, it remains uncertain whether Seattle will achieve timely and successful fish passage at its three Skagit dams.

The Skagit Hydroelectric Project, consisting of the Gorge, Diablo and Ross dams, is owned by the city of Seattle, through its Seattle City Light department (SCL). For over 100 years, the Project has blocked movement for anadromous and resident fish to approximately 40% of the Skagit River watershed.

In 1915, Seattle began construction of Gorge Dam on the Skagit River near the town of Newhalem. Construction continued through the 1950s with Diablo Dam and Ross Dam, inundating lands along more than 30 miles of river within the historical homeland of the Upper Skagit Indian Tribe and isolating over 140 miles of pristine cold-water tributary habitat. No officials from Seattle or the state or federal government consulted with the tribe. Meanwhile, Seattle's dams damaged Upper Skagit tribal village sites and traditional cultural properties, inundating a vast area of its ancestral homeland.

The Project falls under the jurisdiction of the Federal Energy Regulatory Commission (FERC) and SCL has applied for a new operating license. The Upper Skagit, working with other tribes, federal and state agencies, local governments and non-governmental organizations, has invested significant funds and staff time over nearly a decade participating in the Project relicensing. This investment indicates how strongly the Project has impacted the tribe. SCL's existing FERC license expired on April 30, 2025. The tribe and other License Participants (i.e., those formally engaged in the FERC process) are pursuing settlement with SCL, though one or more annual licenses may be necessary to reach a comprehensive agreement. Following license issuance, the tribe will continue to expend significant resources and maintain a leading voice as the details of license implementation are worked out.



In negotiating with SCL, the tribe seeks to address the unmitigated wrongs that were committed starting in 1915 and continuing through the present. A primary interest of the tribe is restoring anadromous fish access upstream of the three dams. Fish passage offers the greatest opportunity in the Skagit basin for recovery since Chinook salmon and steelhead trout were listed under the federal Endangered Species Act (ESA).[2] The tribe also seeks an ecosystem-scale program to restore riverine habitats that have been degraded by Project construction and ongoing operations, as well as to maximize the value of reservoir habitats upstream of the dams. Fish passage and restoration of the riverine ecosystem would

(Continued on next page)

Map Data Sources: USGS 2018[3], WAECY 2017[4], WAECY 2018[5], WDFW 2024[6]

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provide meaningful increases to tribal harvest opportunity and the exercise of treaty-reserved rights.

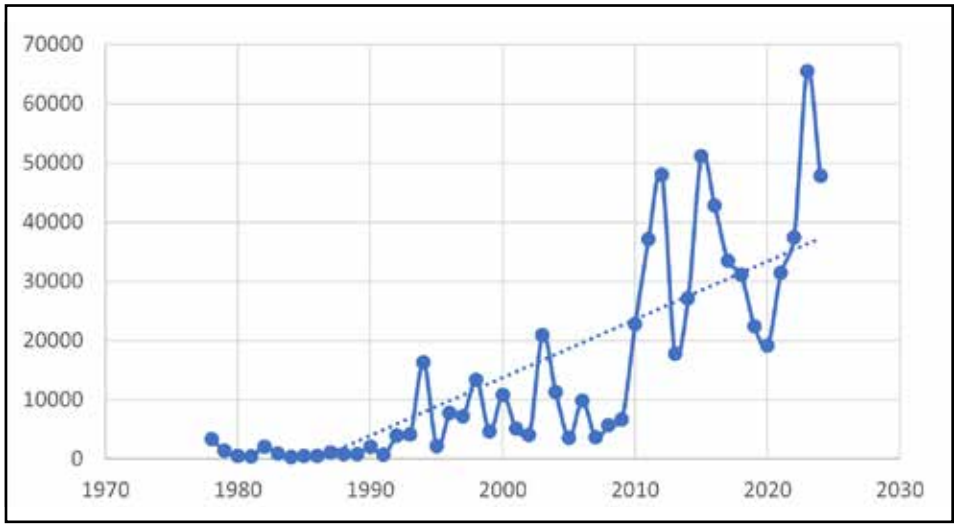
A large amount of currently unutilized fish habitat exists upstream of the dams, where impacts from other human development have been limited and habitat conditions associated with high fish productivity prevail. Studies conducted by SCL under the FERC relicensing documented a minimum of 143 miles of stream habitat that will be accessible to anadromous fish when passage above the dams is restored. This certainly underestimates the length of smaller tributaries that will be used by anadromous fish. Several tributaries are high elevation, with large drainage areas and wide channels that will provide large amounts of habitat for spawning and rearing fish. The high elevation of stream drainages and abundance of glaciers in the headwaters will maintain water quality and quantity in the face of changing climate patterns, making fish passage a wise long-term strategy for salmon recovery in the watershed. Additionally, over 30 miles of reservoir habitat will provide further opportunities to increase the productivity of salmon and steelhead populations. The highly successful Sockeye program at the Baker River Hydroelectric Project provides an in-basin example of the benefit of restoring passage.

Three miles of the Skagit River downstream of Gorge Dam are dewatered due to Project operations. This loss of river is an indescribable harm to the cultural well-being of the Upper Skagit Indian Tribe. The tribe is prioritizing rewatering of the Skagit bypass reach for its cultural well-being and for the health of the Skagit River.

Upper Skagit Indian Tribe, 2024

A 3-mile section of the Skagit River is dewatered by Seattle City Light hydropower operations at Gorge Dam.

Baker River Sockeye Terminal Run Size



An increase in terminal run sizes of Baker River Sockeye over time shows the benefit of restored fish passage above Puget Sound Energy's Baker River Hydroelectric Project.

Drainage Area Descriptions	Drainage Area (Sq Mi.)	Anadromous Fish Habitat (Mi)
Upstream of Skagit Hydroelectric Project dams	765	143
Cascade River Spring Chinook ESA population	172	36
Suiattle River Spring Chinook ESA population	343	105
Upper Sauk River (including White Chuck R.) Spring Chinook ESA population	239	66

Drainage area and stream length potentially accessible to anadromous fish above the Skagit Hydroelectric Project compared to select tributary drainages downstream of the Skagit Hydroelectric Project that support independent populations of ESA-listed Chinook salmon.[7,8]

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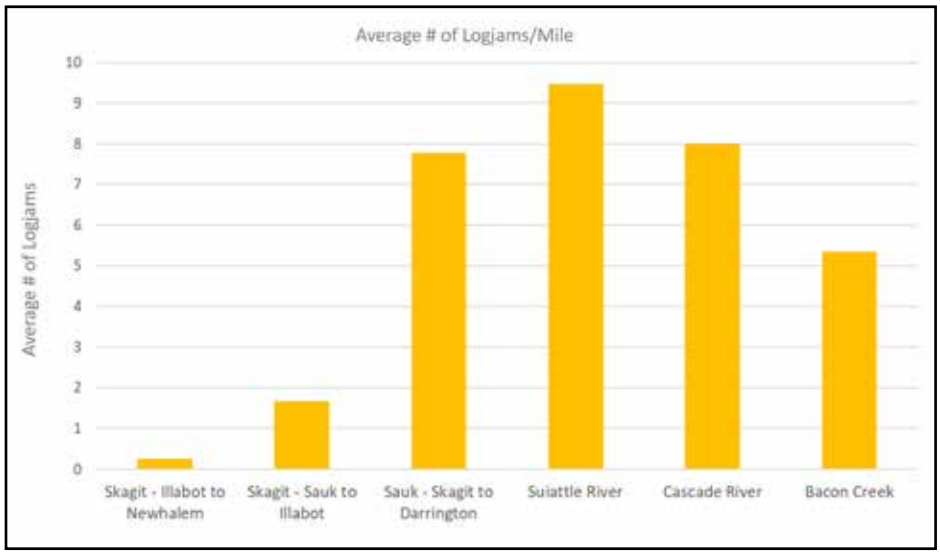
The Skagit Hydroelectric Project has severely degraded riverine habitats downstream of Gorge Dam by managing flows and sequestering sediment and wood. The result is severe reductions in the natural processes that create habitats used by fish. The relative lack of large logjams in low gradient reaches of the managed Skagit compared to unmanaged tributaries is stark. By interrupting the flow of sediment, the dams impede formation of channel and floodplain habitats. Flow management exacerbates these impacts by reducing the capacity of the Skagit River to mobilize the sediment and wood that remains downstream of the dams. The combination of these impacts has simplified riverine habitat, arrested channel evolution and effectively disconnected highly productive floodplain habitats. Furthermore, flood control has decreased the 1% annual chance exceedance flood by 24%.[1] Although flood control provides welcome protection for economic development, it also increases the extent and intensity of floodplain impairment and habitat forming processes, thereby degrading important habitats, including those designated as critical under the ESA.[2]

Project impacts extend to the transmission line corridor, which crosses tributaries and channel migration zones along the Skagit and Sauk rivers. SCL clears the corridor of native vegetation, hardens stream banks to prevent natural channel migration into transmission towers, and maintains access roads that impede fish passage and stream processes. There is no mechanism under the current FERC license to hold SCL accountable.

While the dams remain in place, it will not be feasible to fully address the extensive impacts to riverine ecosystem function. The tribe is seeking a substantial investment from the city of Seattle to mitigate current known impacts to the extent possible. Potential actions include floodplain restoration, riparian planting, installation of engineered logjams, gravel augmentation and changes to flow management that increase habitat-forming processes. SCL has requested a 50-year FERC license. Now is the tribe's best opportunity to put lasting safeguards in place.



Logjams counted in 2005 as reported in Skagit Yearling Phase I per mile of river in the managed Skagit River above the Sauk River confluence and in the unmanaged major tributaries. (Note: Illabot to Newhalem and Sauk to Illabot are reaches below the Seattle City Light dams.)

Where the Bacon Creek alluvial fan extends into the Skagit River, sediment buildup is created by insufficient mainstem flows and may seasonally impact fish access into the tributary. A transmission line corridor passes directly over the alluvial fan, requiring vegetation clearing and bank hardening to protect transmission line towers.

Increasing Water Quality Impairment Threatens Salmon Habitat in the Skagit River Watershed

From 2012 to 2018, water quality decreased in the Skagit River watershed.

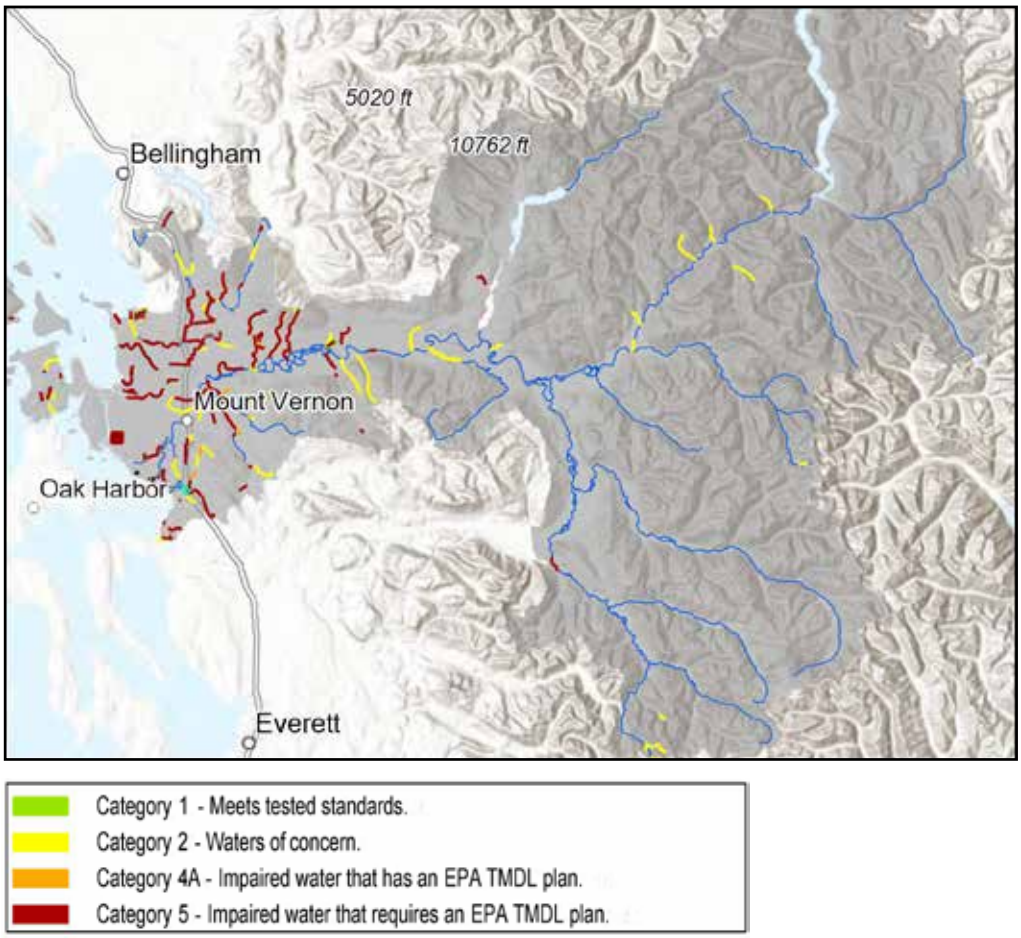
The 2018 Washington Department of Ecology Water Quality Assessment and listings report to the U.S. EPA is the first update since 2012. In it, temperature impaired streams that need a water improvement plan increased from 34.63 listed miles to 70.11 listed miles, and temperature impaired streams with a water improvement plan remained the same, at 23.18 miles. Dissolved-oxygen impaired streams that need a water improvement plan increased from 67.54 listed miles to 83.62 listed miles.[1]

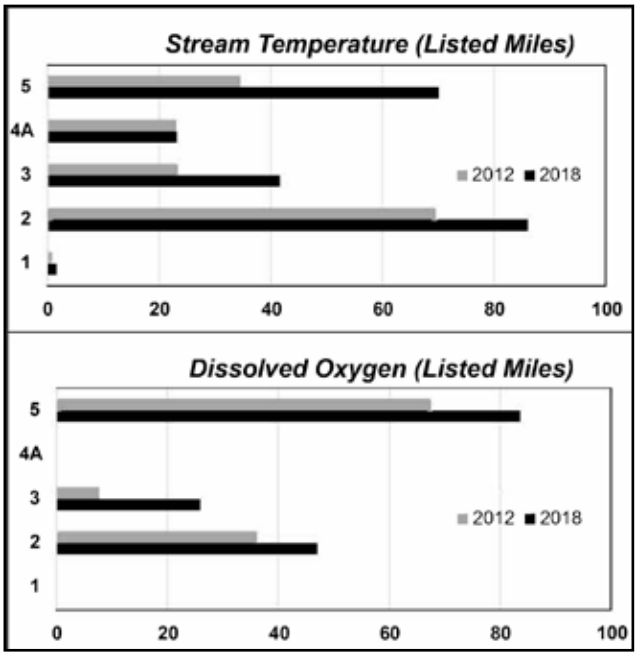
Pacific salmon require cold, well-oxygenated water across all life stages. High stream temperatures and low dissolved-oxygen levels are lethal to salmon at certain thresholds and sub-lethal to salmon at lower thresholds.[2] Low levels of dissolved oxygen also can hinder embryo incubation, which can result in weaker fry that are more susceptible to predation and that don't feed or swim as well.

Stream temperature and dissolved oxygen impairments are largely caused by nonpoint source pollution. The Clean Water Act provides limited authority to address nonpoint source pollution, so a lot of the TMDL (total maximum daily load) measures recommended for impaired waters are voluntary. They encourage landowners to take action to decrease pollution. Dating back to 2013, the Government Accounting Office reported on the challenges of nonpoint source pollution control measures and recommended that Congress consider revising the Clean Water Act's voluntary approach to cleaning up such pollution. As of the end of 2023, Congress had not taken action on these recommendations.[3]

Under Washington state law and affirmed by the state Supreme Court, Ecology has some authority to regulate nonpoint source pollution, but the agency still relies largely on non-effective voluntary measures.

Impaired Streams Within the Skagit Watershed





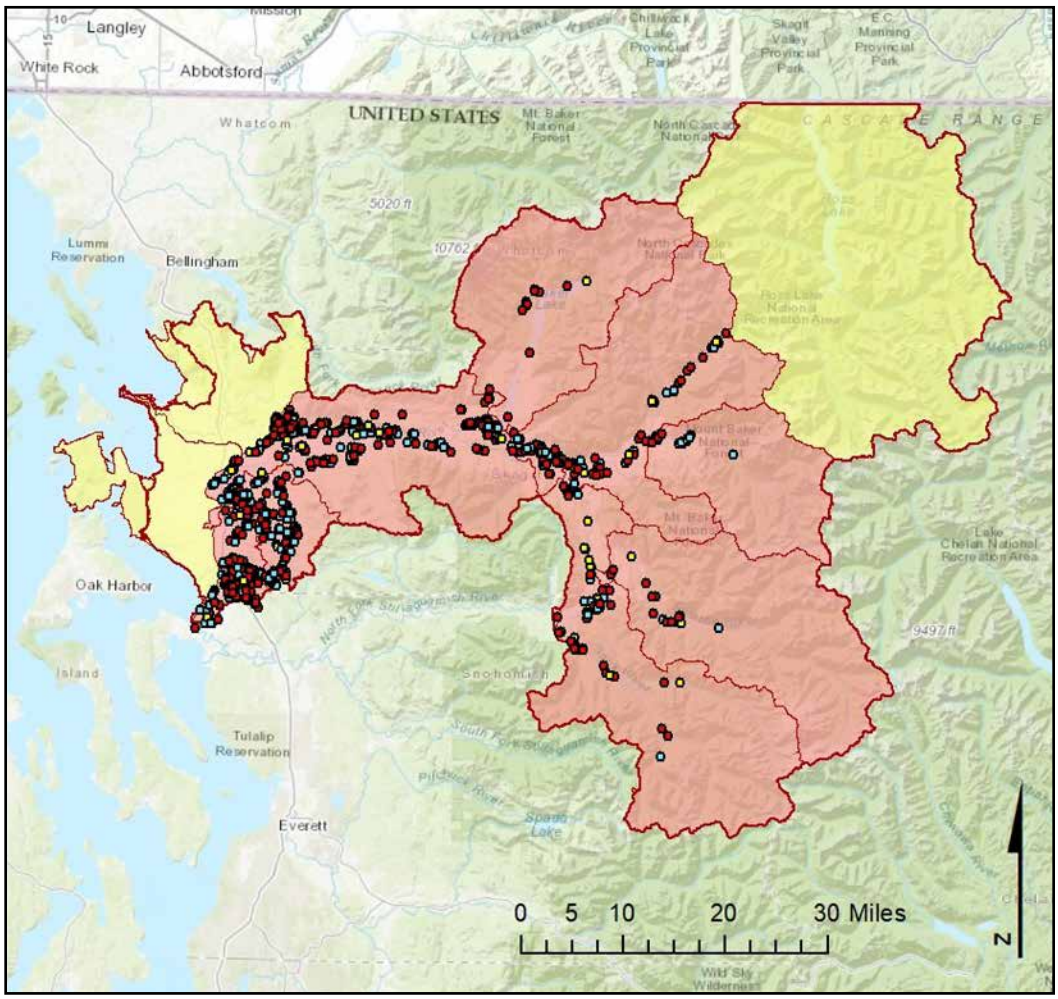
From the 2012 Water Quality Assessment to the 2018 Water Quality Assessment, changes in stream miles impaired for water temperature and for dissolved oxygen.[1]

Map Data Sources: WAECY 2022[1]

Culvert Barriers Blocking Fish Passage Across Multiple Jurisdictions in the Skagit Watershed

A recent comprehensive inventory of culverts on anadromous fish-bearing streams in the Skagit watershed documented 931 culverts. Of these, 556 culverts are fish-passage blockages and 91 culverts are unknown but may be fish-passage blockages. About 75% of the blocking and unknown culverts are either privately owned (291 culverts, 45%) or county owned (194 culverts, 30%). The remaining 162 culverts (about 25%) are spread across other public ownerships.

Culverts make up more than 87% of known fish-passage barriers in the Skagit River watershed. Ongoing work on a comprehensive survey that was initiated in 2020 by a working group comprised of the Skagit River System Cooperative, Upper Skagit Indian Tribe, Skagit County, Skagit Fisheries Enhancement Group and Snohomish County updated barrier statuses, identified previously unmapped barriers and refined mapping of streams likely to be accessible by anadromous fish species. The survey focused on anadromous fish-bearing streams within a selected survey area, which excludes the Samish River watershed, the Skagit estuary, Fidalgo Island and the portion of the Skagit watershed upstream of the Gorge Dam at Newhalem due to complicating factors in those areas.



Map of all known culverts in the project study area (n = 931); passable (n = 284, blue,) barrier culverts (n = 556, red) and unknown barrier status (n = 91, yellow).

The survey identified 647 culverts within the study area that were known barriers and unknown but potential barriers.[1] These barriers are to be considered as a group from which land managers and restoration planners in the Skagit River watershed can strategically locate projects to open fish passage. The project also created a GIS tool to enable land managers and restoration planners to estimate habitat gains from candidate barrier correction projects and identify whether upstream and downstream barriers are present on the same stream system.[2] This allows for project prioritization and strategic planning of multi-culvert removal in locations where upstream and/or downstream culverts are also blocking salmon habitat.

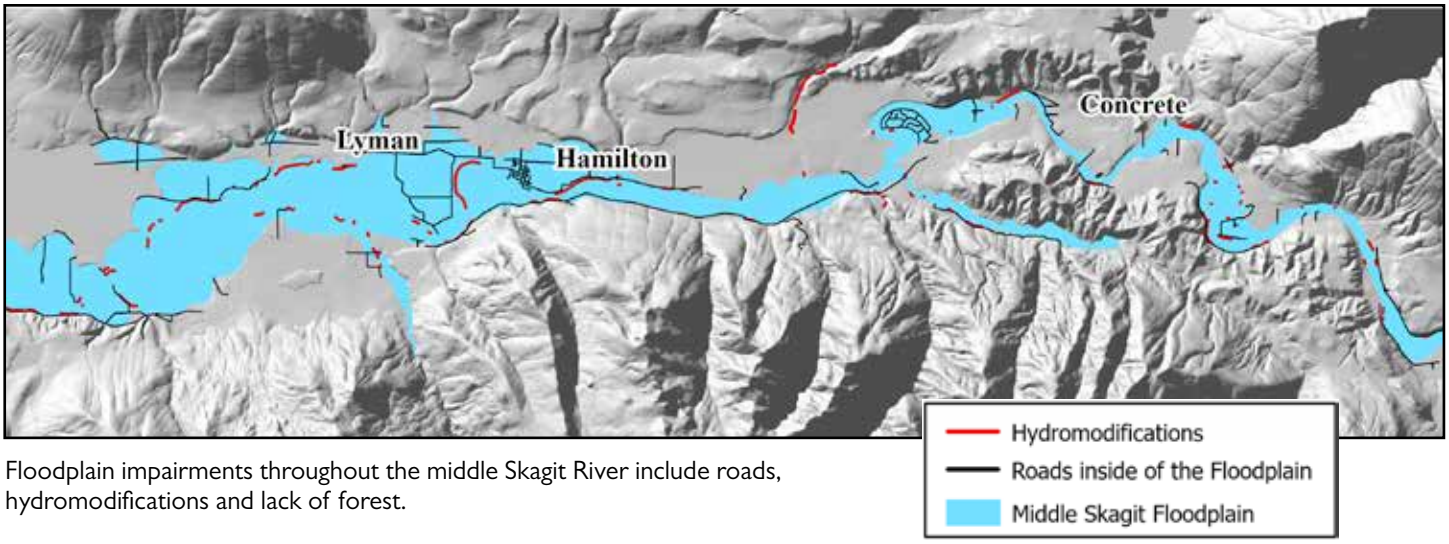
Since 2020, a total of 43 barrier correction projects have been completed, funded or begun by working group members as a direct result of the inventory done in the watershed. Additionally, per the terms of the state culvert injunction, 10 barrier correction projects have been completed in the watershed by the Washington State Department of Transportation since 2020, and 15 others have been funded for design or construction, with completion anticipated by 2027.

The Skagit Chinook Recovery Plan[3] recommends that each governmental entity identify each culvert on their lands or under their jurisdiction that are barriers to Chinook salmon. With the information now available from this barrier survey, it is even more possible for the culvert barrier owner, regardless of jurisdiction, to take responsibility for fixing their blockage to fish passage, as is required through current Washington state statute.

Map Data Sources: Crowley et al. 2024[1]

Habitat Remains Impaired in the Middle Skagit River Floodplain

As of 2015, 35% of floodplain in the middle Skagit River is isolated or impaired, which reduces the quantity and quality of salmon rearing habitat.[1,2] Exacerbating the impairment caused by floodplain disconnections a state of managed deforestation, with forest cover across less than 50% of the floodplain.[3]



Floodplain impairments throughout the middle Skagit River include roads, hydromodifications and lack of forest.

Skagit River floodplain restoration is a habitat target in the Skagit Chinook Recovery Plan. Floodplain habitat is not only critical for the freshwater rearing of juvenile Chinook, it is also important for the availability of complex mainstem edge habitat, backwaters and off-channel habitat essential for the foraging and refugia of all freshwater life history phases.[4] These floodplain habitats can be degraded or eliminated by hydromodifications (e.g., bank armor, levees), timber theft from riparian areas, roads, houses, fills and any other structures that limit lateral channel migration and the formation of backwaters and off-channel habitat. For this reason, restoring natural floodplain processes by removing or relocating floodplain modifications and/or reconnecting historic floodplain channels is critical to salmon recovery.[5]

Continued floodplain disconnection and habitat impairment is one reason the middle Skagit River remains a bottleneck for Chinook production.[6] Additionally, the middle Skagit floodplain is managed largely in a deforested state to support public and private infrastructure, residential property and agricultural land use. State roads, county roads, public utilities and other public infrastructure are present throughout the middle Skagit floodplain and protected from the type of floodplain channel migration which is needed to improve salmon rearing habitat. While public infrastructure and residential and agricultural land use remain inside of the floodplain and are prioritized over salmon habitat, restoration opportunities will remain limited and progress toward recovery will be slow.

Cockreham Island, impaired in the middle Skagit floodplain, remains largely deforested and disconnected from natural river processes behind a hydromodified bank.

Map Data Sources: NOAA 2023[3], USIT 2015[7], Smith et al. 2011[8], WADNR 2014[9], ESRI 2025[10]

Floodplain Restoration is Critical to Counter the Increased Variability in Winter Flows Impacts on Chinook Productivity

A recent study found that half of 60 rivers researched in the Pacific Northwest have experienced increased variability in October – January (winter) streamflows since 1950.[1] The same study found that the increased variability in winter flows had a more negative effect on Chinook productivity than any of the other climate signals researched.[2,3]

Northwest Treaty Tribes

Skagit Eagle Watchers

A multi-channeled section of the Skagit River floodplain provides the space necessary to carry increasingly variable winter flows without disrupting incubating Chinook salmon, giving them a better chance to survive.[10]

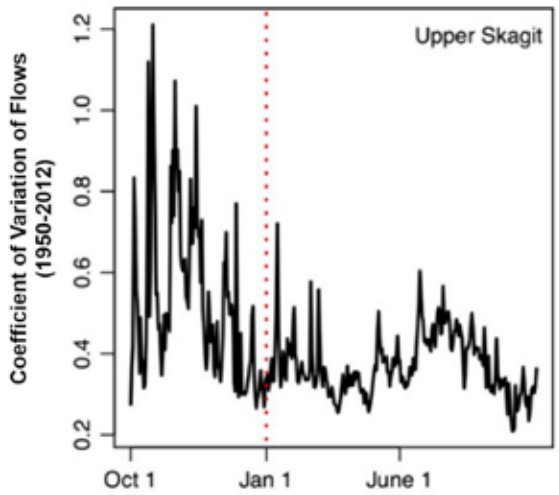
By the 2080s, the Skagit River is projected to have only one rain-driven peak flow season in the winter, as opposed to its current two-peak flow seasons—rain-driven in the winter and snow melt-driven in the summer due to climate change.[4] The large increase in winter flows coupled with the decrease in summer flows creates a larger variation in freshwater flows overall during the water year (October through September). The study of historical stream gauge records for multiple rivers in the Pacific Northwest, including the Skagit River system, has shown that a greater variability in winter stream flows has already occurred across decades.[5]

Increasing variability of winter streamflows may be having a more negative impact on Chinook salmon because the winter season coincides with their incubation period, and Chinook are vulnerable to mortality during that time.[6,7] Climate change is expected to increase winter streamflow variability. If the effects of this are left unmitigated, Chinook recovery may be in jeopardy.

It is unlikely that management actions to slow climate change will decrease the variability of winter flows in the Skagit River system. A more effective approach will be to focus on protection and restoration actions that buffer Chinook salmon from that increasing flow variability.[8] Floodplain restoration is critical to this approach. Reconnection of floodplain channel networks to provide more storage and off-channel habitats and restoration of lateral connectivity of floodplain aquifers will buffer against increasing winter streamflow variability.[9]

Seattle Aquarium

A recently hatched Chinook salmon.[11]

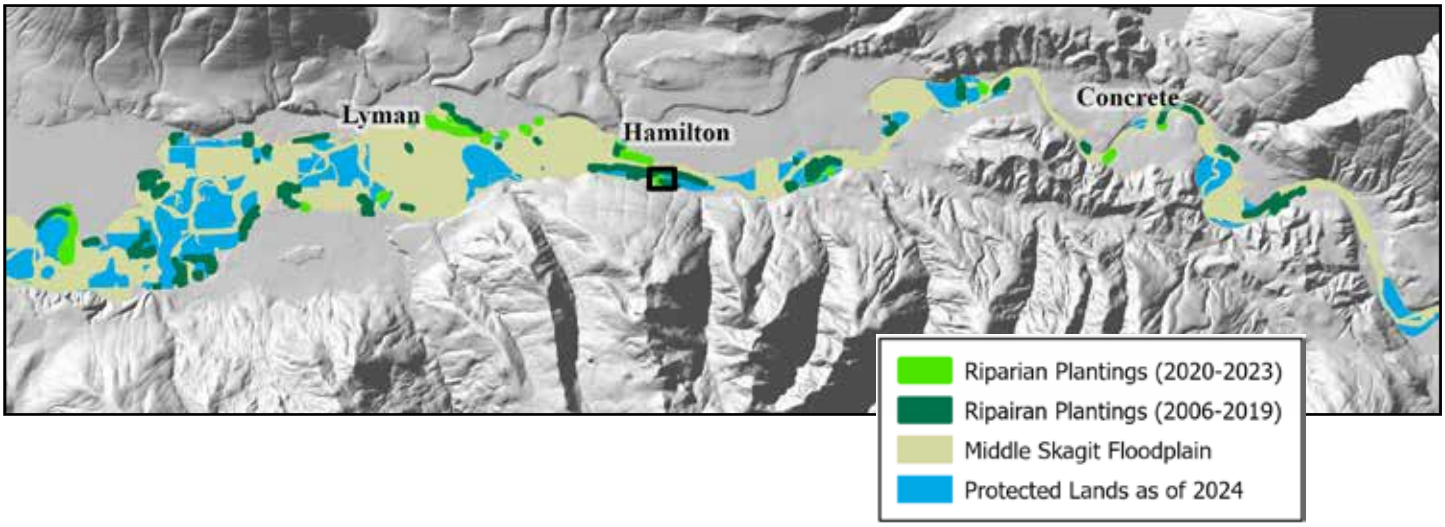


Coefficient of variation for each day of the water year calculated across 1951-2012. This shows the high variability of freshwater flows in the upper Skagit River during the winter months (October-January).[12]

Protecting and Restoring the Middle Skagit River Floodplain is Critical to Chinook Recovery

According to the Skagit Watershed Council Riparian Database, 472 acres of riparian trees were planted throughout the Skagit River watershed between 2020 and 2023. Of that, 83 acres were planted in the middle Skagit floodplain.[1] This brings the total of riparian planting in the middle Skagit floodplain since 2006 to 687 acres.[2,3]

Protected Lands and Riparian Restoration Plantings in the Middle Skagit River Floodplain



The tribes, all levels of government, non-governmental organizations and private citizens are working to restore the middle Skagit River floodplain wherever opportunity presents itself. This has resulted in 5,023 acres of protected lands and 687 acres of riparian plantings.[4,5] Protected lands provide the necessary space for the Skagit River to migrate and create new off-channel habitats. The riparian plantings will provide naturally recruited large woody debris and shade for mainstem edge, floodplain tributary and off-channel rearing habitats for anadromous salmon.

Most of the middle Skagit River floodplain—10,896 acres[6]—remains in unprotected private lands that are being maintained and cleared for infrastructure, agriculture and other forms of human development. Additionally, 55% of the floodplain's land area is already cleared of native forest.[7] Riparian restoration and negotiation of floodplain lands into protected status must continue with the same coordinated energy both have received up to this point. Looking for opportunities to move infrastructure and development out of the floodplain entirely needs to be considered in long-term strategic planning as well, and acted upon any time the option is available.

A 2023 riparian planting along lower Marrietta Creek in the middle Skagit floodplain south of Hamilton, Wash.[12]

Map Data Sources: SRSC 2005[7], SWC 2019a[8], SWC 2019b[9], SWC 2024a[10], SWC 2024b[11]

Samish Bay Remains Conditionally Closed to Commercial Shellfish Harvest

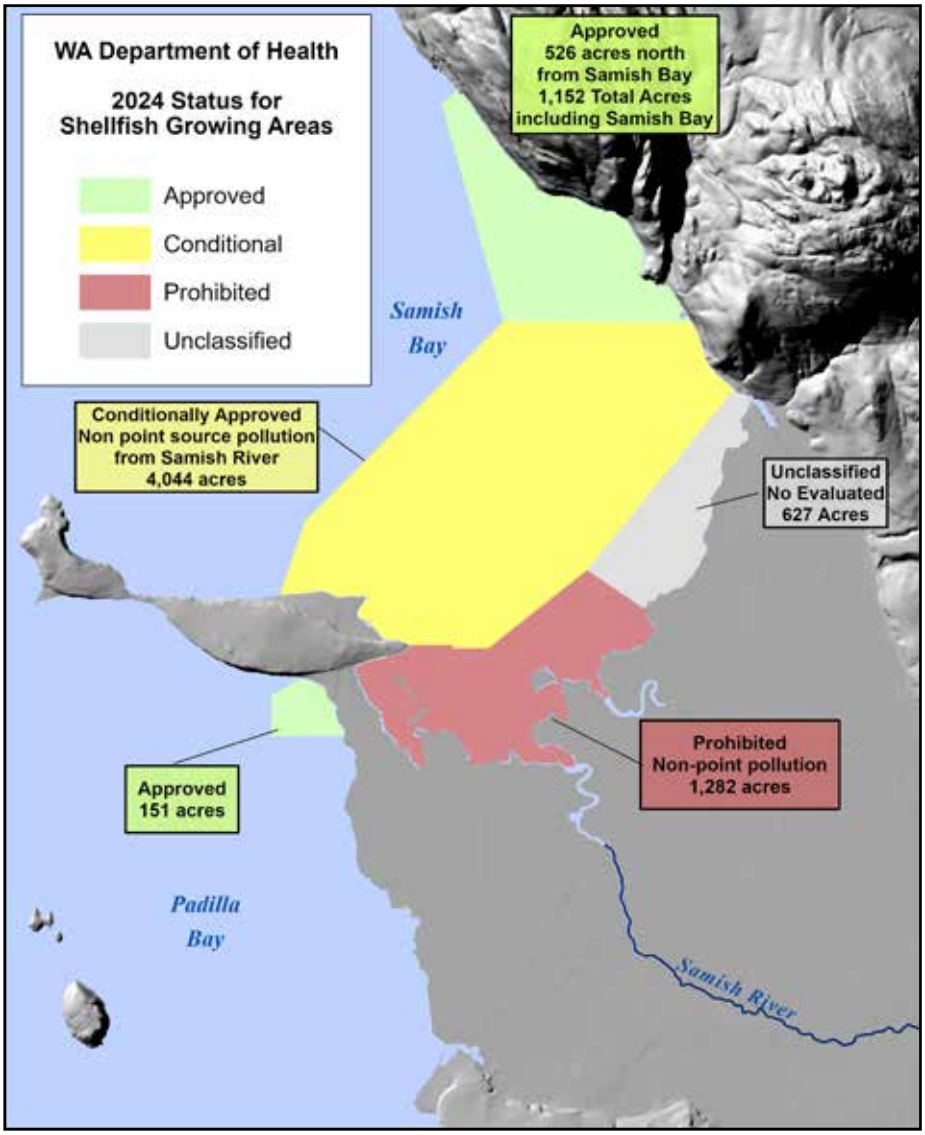
Since 2011, there has been no change in the conditionally approved status of over 4,000 acres of commercial shellfish growing area in Samish Bay, which continues to be periodically closed for harvest due to pollution.[1] Between 2015 and 2020, additional testing led to an increase of approved commercial growing area to the north of Samish Bay (526 acres) and in Padilla Bay (151 acres), but there has been no additional progress since.[2]

Samish Bay is important for shellfish resources, both economically and ecologically. User groups include shellfish growers, recreationists, and members of five different tribes including the Upper Skagit who have treaty-reserved rights to collect fish and shellfish from the bay. The ability to exercise these rights remains in jeopardy by fecal pollution runoff throughout the entire Samish River watershed.

Since 2010, Clean Samish Initiative partners have implemented a Pollution Identification and Correction program and have been working with farmers and residents of the watershed to find and fix sources of fecal bacteria pollution. The team has used everything from windshield surveys and water quality sampling to sewage-sniffing dogs and DNA tracing to identify where the problem is coming from and try to fix it. While the Clean Samish Initiative has been well coordinated and has resulted in some successes, it has not been cleaning up Samish Bay quickly enough, and a majority of the shellfish harvesting area remains periodically closed.

Gaining approved status in 526 acres north of Samish Bay and 151 acres in Padilla Bay between 2015 and 2020 was a positive development for tribal shellfish harvesting opportunities. However, the continued periodic closures in over 4,000 acres within Samish Bay, combined with the unchanged status of other unclassified and prohibited areas in the bay, impede the Upper Skagit Indian Tribe's ability to exercise treaty rights and provide resources to tribal members. Future economic development plans of establishing a tribal shellfish aquaculture business are uncertain due to lack of tangible success in addressing point and nonpoint pollution in the watershed.

Samish Bay and Padilla Bay Commercial Shellfish Growing Areas

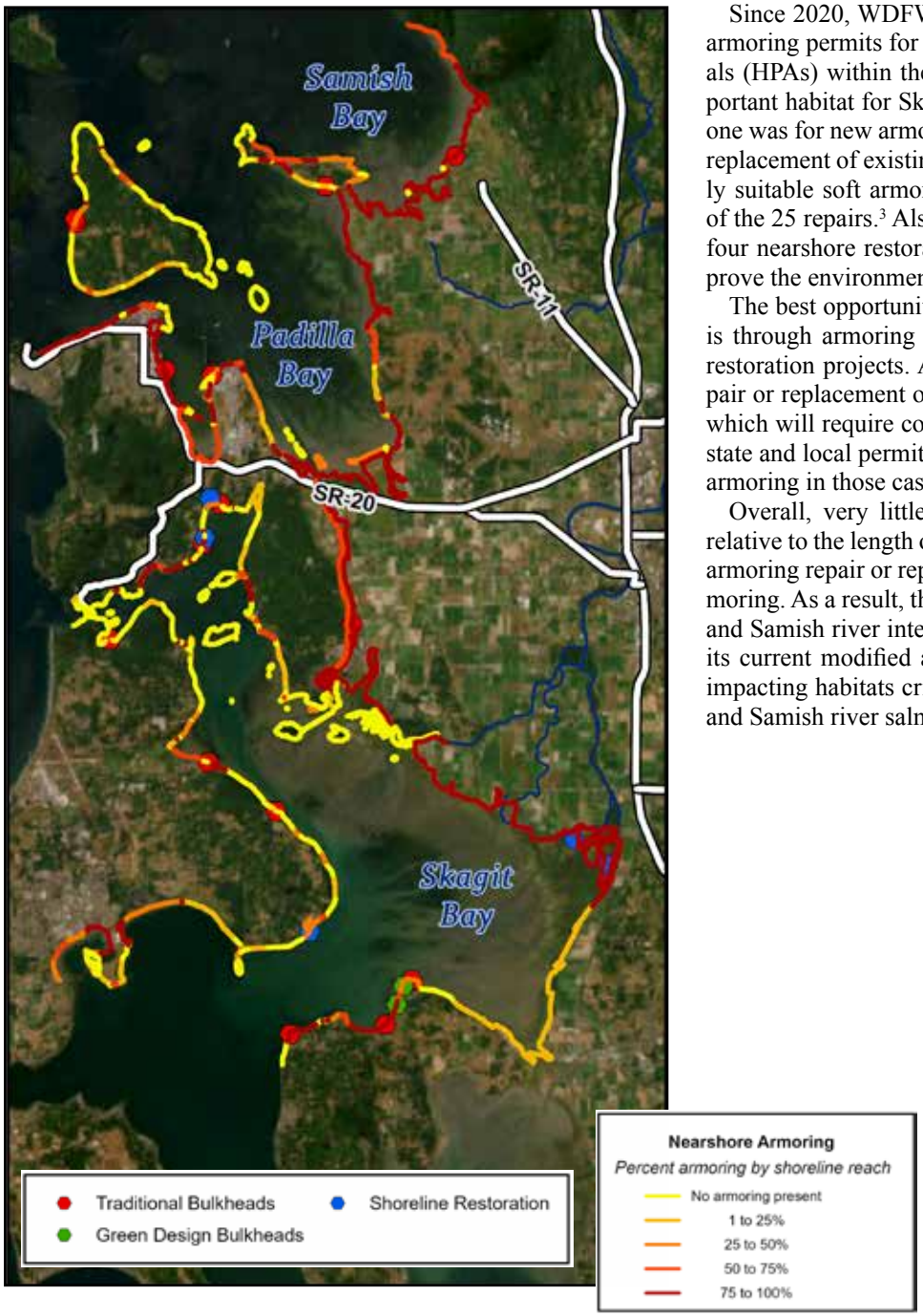


Map Data Sources: WADOH 2024[2], SSHIAP 2004[3], USGS 2018[4]

Nearshore Armoring Continues to Impact the Intertidal Zone

The Washington Department of Fish and Wildlife's (WDFW) Beach Strategies project data and Skagit County's dike and levee data shows 136 miles of modified shoreline in Skagit and Samish river intertidal areas. Based on these data, over 106 miles of the modified shoreline is entirely armored. In 2008, published data for that same region showed 113 miles of modified shoreline.[1,2] It is assumed that most of the increase is due to improved data, including for areas not previously surveyed.

Skagit and Samish River Marine Nearshore Projects 2020 through 2024: WDFW HPA Permitted



Since 2020, WDFW has issued marine shoreline armoring permits for 26 Hydraulic Project Approvals (HPAs) within the intertidal area, which is important habitat for Skagit River Chinook. Of those, one was for new armoring and 25 were for repair or replacement of existing armoring. More ecologically suitable soft armoring was included in just two of the 25 repairs.[3] Also since 2020, there have been four nearshore restoration projects intended to improve the environmental condition of the shoreline.

The best opportunity for improving the shoreline is through armoring removal as part of nearshore restoration projects. Another opportunity is the repair or replacement of existing shoreline armoring, which will require continued coordination between state and local permitting agencies to prioritize soft armoring in those cases

Overall, very little shoreline restoration occurs relative to the length of the shoreline, and almost no armoring repair or replacement is done with soft armoring. As a result, the nearshore area of the Skagit and Samish river intertidal regions will continue in its current modified and armored state, negatively impacting habitats critical to the survival of Skagit and Samish river salmonids.

Map Data Sources: WDFW 2023[1], WDFW 2024[3], SSHIAP 2004[4], Skagit County 2022[5]

Tidal Habitat Restoration is Too Slow

From 2000 to 2019, net tidal marsh habitat gain, naturally and through restoration, was only 44 hectares. Since 2020, no restoration efforts have resulted in a measurable increase in habitat, and negative progradation rates, erosion and sea level rise likely caused further reductions in habitat. This outcome falls far short of the 1,114.6 hectares of new habitat outlined as a recovery goal in the Skagit Chinook Recovery Plan.

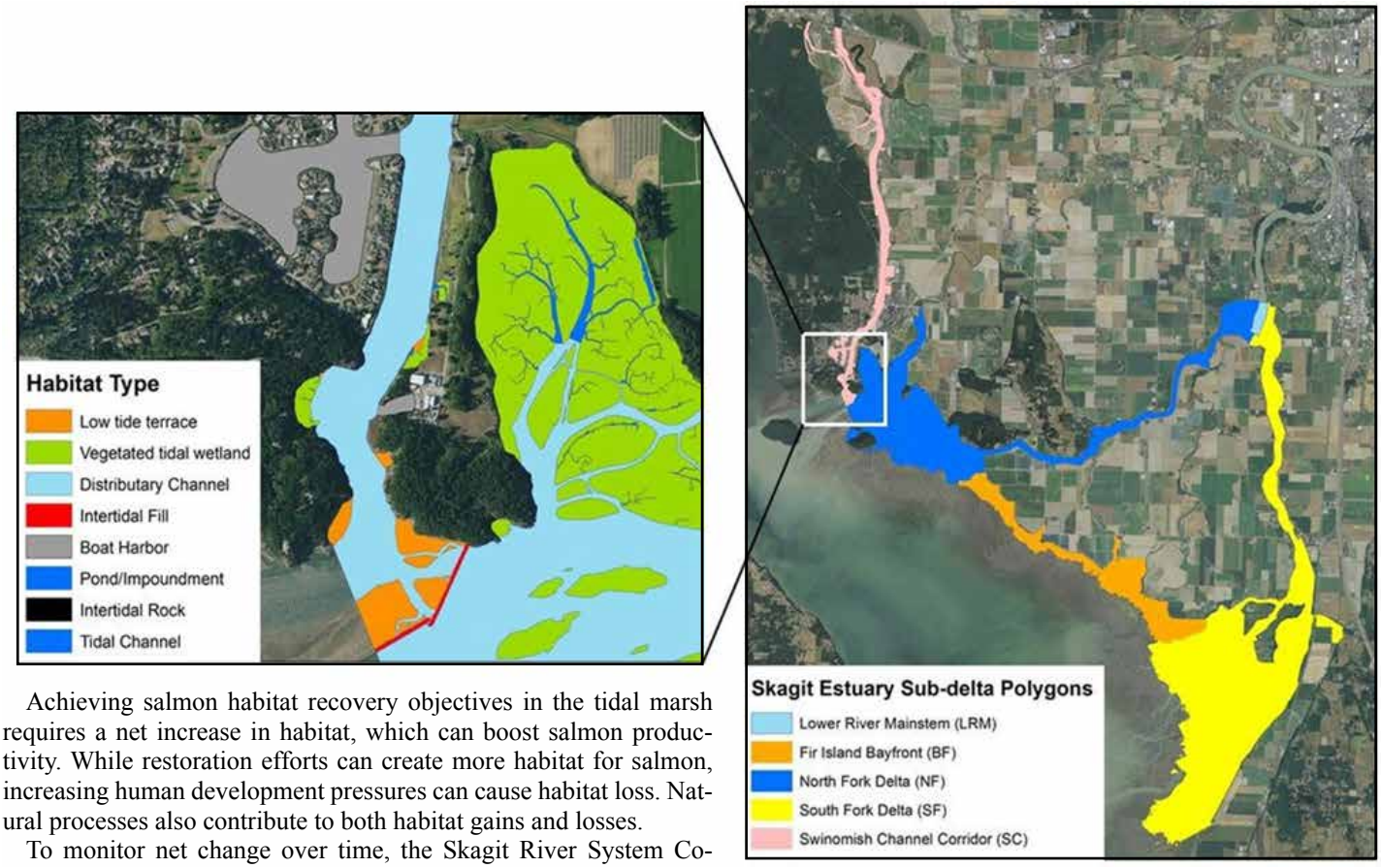


Figure 1. Example of the habitat mapping conducted by SRSC (left panel) across the five Skagit estuary sub-delta polygons (right panel) taken from Beamer et al. 2023.

Achieving salmon habitat recovery objectives in the tidal marsh requires a net increase in habitat, which can boost salmon productivity. While restoration efforts can create more habitat for salmon, increasing human development pressures can cause habitat loss. Natural processes also contribute to both habitat gains and losses.

To monitor net change over time, the Skagit River System Cooperative (SRSC) has mapped estuarine habitats (2000, 2004, 2013 and 2019) within the vegetated tidal delta (Figure 1). Changes were attributed to either natural processes or human activity. During this period, restoration occurred at 10 sites, a major avulsion of the North Fork Skagit River reoriented a significant distributary and sensitive marshes experienced erosion.

From 2000 to 2019, 255 hectares of tidal delta marsh were restored (Figure 2). However, since 2020, no restoration efforts have resulted in a measurable increase in habitat. The North Fork Skagit River avulsion led to positive progradation rates, increasing habitat in the North Fork area. However, these gains were offset by negative progradation rates in the South Fork area and the bay front. Negative progradation in these areas might be attributed to insufficient sediment supply due to upstream levees and dikes, erosion from more frequent and severe storms, and sea level rise. In addition, at least two tide gates were replaced without any estuary habitat mitigation being performed.

The changes in Skagit delta habitat are driven by both natural processes and restoration efforts, which contribute to the Skagit Chinook Recovery Plan's goal to restore tidal habitat area, landscape connectivity and estuarine wetland diversity within the vegetated tidal delta. Since the 2020 State of Our Watersheds Report, no new restoration projects have been undertaken, and slight habitat losses have occurred due to natural causes, resulting in no significant positive trend in this indicator.

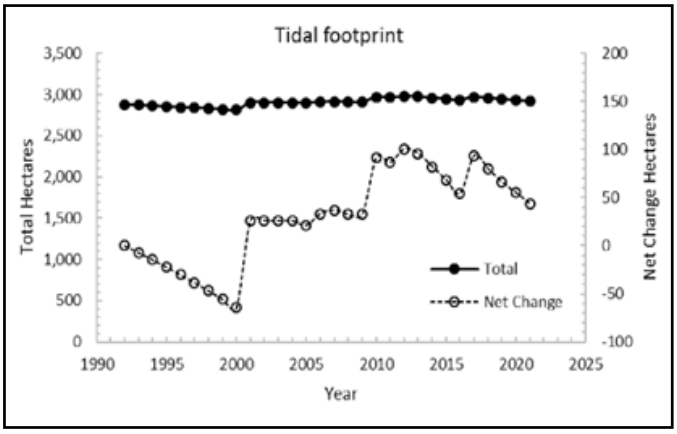


Figure 2. Total and net changes in tidal footprint taken from Beamer et al. 2023.

Information presented here is summarized from Beamer, E.M., Seixas, G., Veldhuisen, C., Hood, G. and Ramsden, K., 2023. Habitat status and trends results to evaluate life stage and population responses of Skagit River Chinook Salmon to recovery actions. Skagit River System Cooperative, Burlington, WA. pp. 53. www.skagitcoop.org

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Nisqually (James Slape Jr., David Troutt, Christopher Ellings, Hannah Whidden, Katie Anderson, Margaret Homerding, George Walters, Steven Borrego)

Nooksack (Rosemary LaClair, Treva Coe, Maggie Taylor, Mike Maudlin, Ned Currence)

Port Gamble S'Klallam (Randy Harder, Roma Call, Benjamin Harrison, Courtney Hart, Hans Daubenberger, Julianna Sullivan, Josh Carter, Marla Powers)

Puyallup (Fred Dillon, Russ Ladley, Char Naylor, Angela Dillon, Eric Marks, Donivan Campbell, Julian Close, Abigail Borge)

Quileute (Mark Williams, James Roubal, Caroline Walls, Chris Terry, Chris Wagemann, Garrett Rasmussen, Jennifer Hagen, Robert Beck, Sierra Hemmig)

Quinault (Cleve Jackson, Dave Bingaman, Lauren Macfarland, Larry Workman)

Sauk-Suiattle (Michael Wolten, Scott Morris, Arianna Lapke, Joe McConnaughy)

Skokomish (David Herrera, Joseph Pavel, Alena Reynolds, Alex Papiez, Lisa Belleveau, Seth Book)

Squaxin Island (Joseph Peters, Scott Steltzner, Amanda Hsu, Candance Penn, Daniel Kuntz, David Dorland, Erica Marbet, Eric Sparkman, Leila Whitener, Sarah Zaniewski, Will Henderson)

Stillaguamish (Kadi Bizyayeva, Jason Griffith, Franchesca Perez, Jennifer Sevigny, Jody Brown, Robert Roose, Sara Thitipraserth, Scott Rockwell)

Suquamish (Robert A. Purser Jr., Steve Todd, Allison O'Sullivan, Casey Schmidt, Charlie Kratzer, Hanna Brush, Rod Malcom, Theo Suver, Viviane Barry)

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Northwest Indian Fisheries Commission

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SSHIAP Salmon and Steelhead Habitat Inventory and Assessment Program