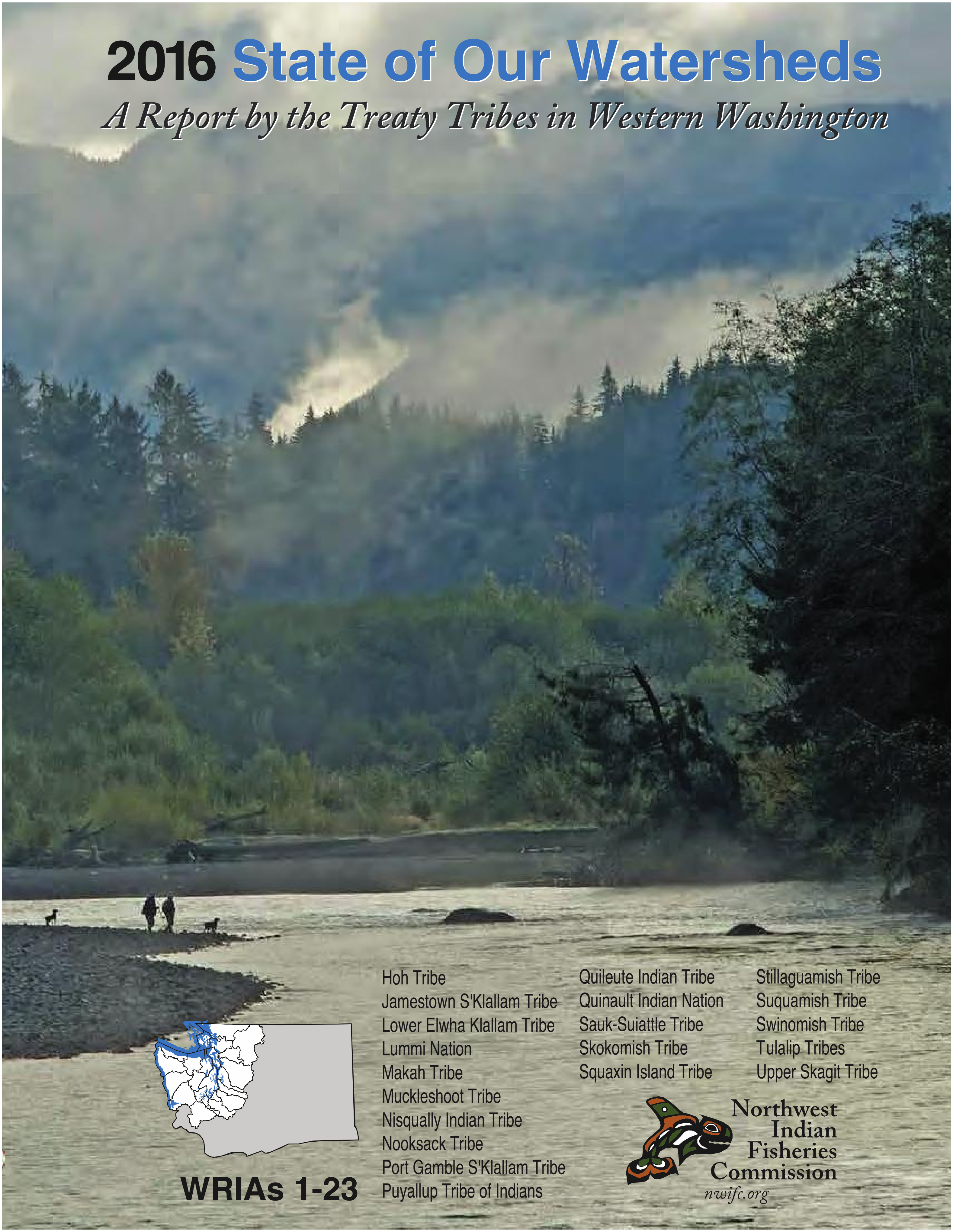

2016 State of Our Watersheds

A Report by the Treaty Tribes in Western Washington

WRIAs 1-23

Hoh Tribe
Jamestown S'Klallam Tribe
Lower Elwha Klallam Tribe
Lummi Nation
Makah Tribe
Muckleshoot Tribe
Nisqually Indian Tribe
Nooksack Tribe
Port Gamble S'Klallam Tribe
Puyallup Tribe of Indians
Quileute Indian Tribe
Quinault Indian Nation
Sauk-Suiattle Tribe
Skokomish Tribe
Squaxin Island Tribe
Stillaguamish Tribe
Suquamish Tribe
Swinomish Tribe
Tulalip Tribes
Upper Skagit Tribe

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2016 State of Our Watersheds

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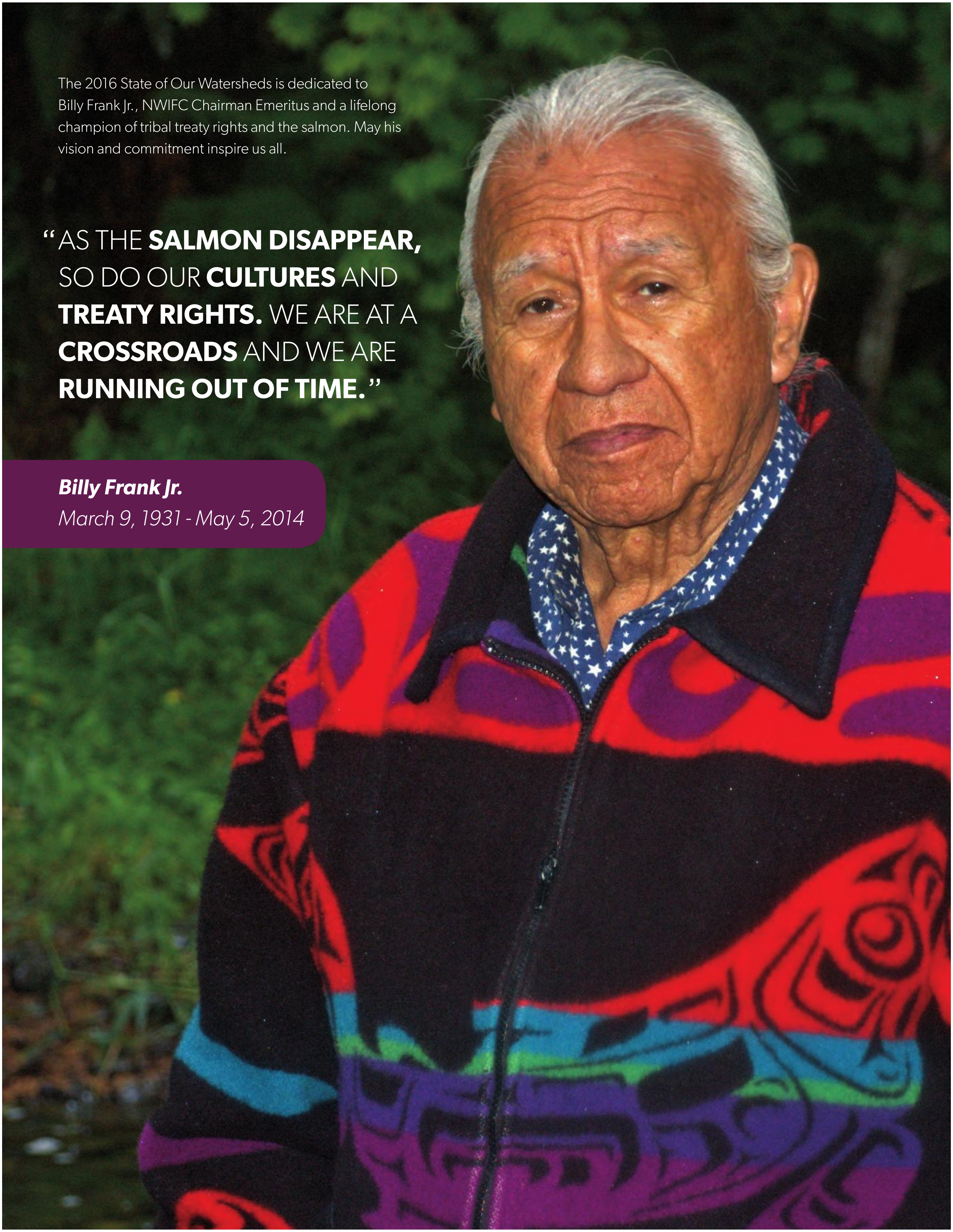


The 2016 State of Our Watersheds is dedicated to Billy Frank Jr., NWIFC Chairman Emeritus and a lifelong champion of tribal treaty rights and the salmon. May his vision and commitment inspire us all.

"AS THE **SALMON DISAPPEAR,** SO DO OUR **CULTURES** AND **TREATY RIGHTS.** WE ARE AT A **CROSSROADS** AND WE ARE **RUNNING OUT OF TIME.**"

Billy Frank Jr.
March 9, 1931 - May 5, 2014

From The Chair

The watersheds of western Washington have always been our home. Our communities, cultures, economies and treaty rights are tied to these places, and always will be.

This State of Our Watersheds Report continues to document environmental conditions and communicate the urgency for action to protect our region's watersheds and their habitats. It is an update of the 2012 State of Our Watersheds Report.

Unfortunately the findings depicted here are grim; we are losing the battle for salmon recovery because we are continuing to lose habitat faster than it can be restored. Unless we can slow, stop and reverse this trend, salmon will continue to disappear along with our treaty rights.

Each of the tribal chapters in this document describes the reality of habitat loss as it affects our communities and treaty-reserved right to harvest fish and shellfish. They document the environmental degradation resulting from increased population growth, polluted stormwater runoff, climate change and other factors. These chapters do not reflect all tribal concerns; instead they are aimed at using a wide range of science and data to mark a point in time and serve as a measuring stick to document salmon habitat trends and progress resolving them.

This report supports the Treaty Rights at Risk initiative that the tribes launched in 2011. Treaty Rights at Risk is a call to action for the federal government to take the lead in implementing a more effective and coordinated salmon recovery effort. As trustee for the tribes, the federal government has both the fiduciary responsibility and the legal authority to protect tribal treaty rights and resources. The State of Our Watersheds Report is intended to help set priorities for action and gauge the effectiveness of our efforts.

Today, tribes share our home and diminishing resources with more than five million people, and more are coming all the time. An additional one million people will bring their needs for water, homes, sanitation, transportation and a host of other necessities over the next 20 years.

These are critical times for the treaty Indian tribes in western Washington. Ongoing loss and damage to salmon habitat is leading to the failure of salmon recovery and the loss of our treaty-reserved rights to half of the harvestable salmon returning annually.

Already, some tribes have lost even the most basic ceremonial and subsistence fisheries that are a cornerstone of our cultures.

Salmon are naturally productive. They will thrive if given clean, cold water, access to and from the sea, and good rearing and spawning habitat.

More than any other factors, the quantity and quality of habitat determines the health of the salmon resource. Good habitat builds resiliency in salmon stocks. But as habitat disappears, so does the salmon's ability to withstand and recover from the impacts of both people and nature.

Closing down salmon fisheries may be necessary, but doesn't create more fish. The best way to do that is to protect and restore more habitat to help salmon populations rebuild and thrive. It will take all of us – working together – to make that happen.

This year's report is dedicated to Billy Frank Jr., who urged all of us in our different roles to tell the truth. This report does that.

Executive Summary

The treaty Indian tribes always have lived throughout the watersheds in western Washington and 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 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 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 *www.treatyrightsatrisk.org*.

In western Washington, the overall rate of habitat degradation has slowed compared to previous years. This may be associated with the 2007-2009 economic downturn, which has slowed new development. As the economy recovers and development increases, the rate of environmental change will likely increase at a more rapid rate too.

For this report, tribes 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:

Degradation of Habitat Outpaces Estuary Restoration

Estuaries in western Washington are losing functional habitat because of population increases in the lower watersheds. For example, since the publication of the 2012 State of Our Watersheds Report, the Stillaguamish Salmon Recovery Plan's 10-year target for estuary habitat restoration has expanded from 315 acres to 548 acres. As of 2013, only 150 acres had been restored toward that target.

The restoration of estuarine habitat is a goal in many of the salmon recovery plans, with identified restoration benchmarks during the first 10-year period. The overall trend for estuary restoration is the continued loss of functional habitat due to the increase in residential and commercial development in the lower watersheds, and the lack of completion of restoration projects. However, some restoration work has made a positive change. For example, about 12% of the 2005 Skagit Chinook Recovery Plan's habitat restoration goal has been met. Since the 2012 State of Our Watersheds Report, Turner Bay and Dugualla Heights have changed from active restoration projects to completed restoration projects.

Degraded Nearshore Habitat Unable to Support Forage Fish

Nearshore areas provide critical rearing and foraging for salmonids. The nearshore has been directly and negatively impacted by human development.

More than 99% of documented forage fish spawning in Whatcom County occurs on erosional drift cells, and 72% (121 of 169 miles) of the erosional drift cell shoreline is already armored or otherwise modified. Since 2011, 350 feet of new marine shoreline armoring has been built in Whatcom County. The trend for this habitat is to continue toward degradation, with basically little to no progress in meeting the restoration goals of the salmon recovery plans.

Large portions of the shoreline have been modified, including armoring that disconnects the critical supply of gravel and sand. These materials replenish beaches and provide spawning habitat for sand lance, surf smelt and Pacific herring. It is anticipated that the habitat conditions will not improve and the shoreline use will not decrease, leading to a trend that continues on a negative path.

Freshwater Shoreline Armoring Continues Unabated

Shoreline armoring contributes to river channel degradation by impeding natural bank erosion and river meandering, disconnecting terrestrial and aquatic ecosystems, and directly impacting salmon habitat.

Since the 2012 State of Our Watersheds Report, there has been an increase in freshwater shoreline modifications. For example, the mainstem of the Hoh River has more than 3.7 miles of riprap between river mile 1 and 37. Since 2012, at least two new riprap projects have been completed and no removal has been completed. These structures contribute to channel degradation by impeding bank erosion and river meandering – the basic forces for most riverine ecological processes and functions.

The Upper Skagit Tribe recently completed its survey of hydromodifications along streambanks within floodplains of the Skagit River watershed. With a focus on Chinook salmon habitat, they surveyed 220 miles of stream and found 32.1 miles of hydromodified bank. There has been no clear evidence of riprap being removed from the middle Skagit River since 2005.

Forest Cover Disappearing

Timber harvest has removed forest cover from throughout all the watersheds, although at a slower rate in some watersheds than the previous 15-year period (1991-2006). This may be due to the economic downturn in 2007-2009 or the time needed for forest stands to mature due to overharvest in previous years.

For example, from 2006-2011, the Makah Area (excluding federal land) saw decreasing forest cover. The biggest reductions were in the Sail River-Frontal Strait of Juan de Fuca watershed, which saw a 10.9% decrease, Big River with a 10.7% decrease, and Upper Hoko River watershed with a 9.6% decrease. Although temporary, the rapid removal of forest in watersheds can have dynamic effects on watershed stability and overall quality of habitat for salmonids. Large clearcuts, inadequate buffers, mass wasting and poorly constructed and/or maintained forest roads all have led to the degradation of salmon habitat. For the overall health of critical salmon habitat, the focus needs to be on ending non-sustainable harvest practices and managing forestlands in a holistic, sustainable manner.

Conversion of forestlands continues to trend negatively for some lowland watershed areas in severely damaged conditions. 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. For example, from 2007 to 2015, approximately 3,167 acres were converted out of forest practices and into non-forestry uses in the Snohomish watershed. This is in addition to more than 3,130 acres that were converted between 1996 and 2006, bringing the total land converted out of forest management to nearly 6,300 acres in 20 years.

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 and forest and river management all have resulted in extremely decreased quantities of instream wood in western Washington. Some tribes are making an effort 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, engineered logjams are consistently being funded, placed and monitored throughout the North, Middle, and South forks of the Nooksack River. This has resulted in an increased density of instream wood since 2005. Although efforts are underway, there are still obstacles to restoring once-functioning river systems by federal, state and local land-use policies. Wood counts in the lower Cedar and Green rivers have less than 5% of expected key piece quantities. Watershed analysis data on LWD in the upper White River (above Mud Mountain Dam) suggest that LWD and key piece quantities are in poor condition as it relates to necessary functions for salmon habitat.

Riparian Forests Not Recovering

Riparian forests are an essential component of healthy fish habitat, providing shade, temperature regulation, streambank stability and food supply. However, riparian buffers along most fish-bearing streams lack necessary vegetation because of poor protection and improper management. The riparian forested buffers along fish-bearing streams continue to decline, except in areas such as the Skokomish watershed, where 26 riparian planting projects are underway (17 active & 9 completed) and 300 riparian acres have been planted in the last five years. Most of these critical riparian lands are found in lower watersheds and many are in agricultural and non-forestry use. For example, in the Skagit watershed, from 2006 to 2011, there had been no change in the status of the delta riparian areas. More than 80% of riparian areas in the Skagit delta were impaired or cleared of trees, and more than 90% of the impaired area was found in agriculturally zoned lands. From 2006 to 2013, Skagit delta agricultural drainages continued to have the worst overall water quality in the Skagit river watershed.

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. The projected population growth 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 needs outweigh the limited gains. Approximately 90% of the Quinault's Area of Interest (excluding the upper Queets and Quinault watersheds) have road densities of more than 3 miles of road for every 1 square mile of land, the level at which streams cease to function properly.

Since 2001, forest landowners have been implementing the Forests and Fish Agreement, including repair and maintenance of their forest roads. All state and large private forest roads are required to be brought up to new forest road standards by 2021 through their Road Maintenance and Abandonment Plans (RMAP). The goal is to minimize impacts from the roads and remove barriers to fish passage. Overall the forest landowners have made good progress in the completion of their RMAPs. In the watersheds analyzed in the SOW Report, about 70% of the obligations have been completed, from 47% completion in the Hoh drainage to 90% completion in the Nooksack. But with only five years remaining (a quarter of the Legislative time period that was agreed to by the forest landowners to complete their RMAP responsibilities), special attention is needed to get the barriers removed and the roads stabilized before the end of 2021.

Impervious Surface Area Impacts Water Quality and Salmonid Habitat

From 2006 to 2011, the amount of impervious surfaces continues to increase around Puget Sound, with a common rate of increase as high as 4%. High population densities lead to large amounts of impervious surfaces, such as roads and other infrastructures, negatively impacting the local watersheds and resulting in loss of salmon habitat. Sensitive stream habitat conditions may be lost when 10% of the watershed is covered by impervious surface area.

In 2011, every urban stream watershed identified in the Snohomish River Salmon Conservation plan was degraded based on impervious surface levels greater than 12%. Additionally, between 2006 and 2011, increases in impervious surface continued to spread from urban stream watersheds into the mainstem and rural stream watersheds to the east.

For example, the lower Snohomish watershed, had 11% impervious surface with an impacted water quality condition in 2006. It increased to 12% impervious surface and was in a degraded water quality condition by 2011.

Fish Barriers Cut Off Vast Amounts of Habitat

Salmon cannot successfully reproduce if they do not have access to spawning habitat. Fish-passage barriers, such as culverts, tide gates and levees still persist in watersheds, impacting a significant number of stream miles. Progress is being made by the state but there are concerns with the lack of proper funding to tackle the larger unfunded barrier projects. Levees are starting to be set back, but more work needs to be done to re-establish the floodplains and estuaries of the watersheds. For example, since 2012, two levee setback projects have been completed in the Puyallup River basin, setting back 1.6 miles of levee, while six levee setback projects are in development, which could set back another 1.5 miles of levees.

Agricultural Lands Remain Degraded

Agricultural lands are still impaired and reflect the practices that began in the late 1800s with the removal of trees and clearing of lowland forests. Diking soon followed, with lower estuaries diked to protect the new farmland and to increase its productivity. Impacts included the loss of stream channels, wetlands, stream buffers, increased sediment, and pollution in the form of runoff from agricultural activities.

The Snohomish River Basin Salmon Conservation Plan recommends at least 65% forested 150-foot riparian buffer on either side of all fish habitat streams. Intense human land use puts continuous stress on lowland riparian resources in the Snohomish River watershed. According to our assessment, along anadromous fish habitat streams flowing through five Snohomish River Basin Chinook Strategy Groups (Mainstem Primary, Mainstem Secondary, Rural Streams Primary, Rural Streams Secondary, and Urban Streams) riparian forest cover was only 49% in 2011, a 1% decrease from 50% in 2006.

Sensitive Floodplains Being Overdeveloped

Floodplains are sensitive lands essential to maintaining hydrologic function of streams while providing off-channel salmon habitat. Flood management of overdeveloped floodplains often results in diking and armoring streams, altering both streamflows and physical habitat. Despite their sensitivity and key role in salmon survival, floodplains continually face development pressures. Floodplain management has had mixed results, with improvements in some watersheds but continued degradation in others.

Population growth is forecast to increase in the next decade and the remaining floodplain habitat is at risk of being converted to non-habitat use. This raises concerns about an increased need for levees, degradation of water quality and riparian forests, and an increase in the amount of impervious surface areas in the lower portions of the watersheds, negatively impacting fish habitat and water quality.

As of 2013, the 10-year floodplain restoration targets for the Stillaguamish Salmon Recovery Plan were not met. Only 22.3 acres of a targeted 30 acres of floodplain area had been restored. Only 0.24 miles of a targeted 4.1 miles of bank armoring had been removed, while 0.43 miles of bank armoring had been added since 2005. Riparian forest cover in the Stillaguamish River floodplain remained at 23%, unchanged since 2006. This is less than a third of the 80% riparian forest cover that is considered a long-term Properly Functioning Condition in the Salmon Recovery Plan.

Rapidly Increasing Permit-Exempt Wells Threaten Water For Fish

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, 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 the 2012 State of Our Watersheds Report, all watersheds have seen an increase in water wells, except in Skagit County. Since October 2013, when the Washington Supreme Court overturned the 2006 Skagit Instream Flow Rule amendment, Skagit County has not issued building permits that rely on permit-exempt wells as their sole water source unless they are adequately mitigated. This has resulted in no new unmitigated exempt well development in Skagit County.

However, there have been between 30 and 40 replacement wells that have been allowed in the basin since that time. It is estimated that the majority of wells are drilled for home construction and are suspected as a potential cause for low flow problems found in many watersheds. The cumulative withdrawal of groundwater associated with the continued proliferation of these wells leads to concerns of associated impacts to instream flows, salmon habitat, public health and senior water rights.

Conclusion

The 2016 State of Our Watersheds Report is filled with examples of a single, repeating trend: key habitat features, such as streamside vegetation, habitat connectivity and streamflows, are imperiled by human activities. This extensive loss and degradation of habitat threatens salmon, tribal cultures and tribal treaty-reserved rights. The principal findings in this report illustrate this alarming trend, but the realities contained within each tribe's watershed review provide the most accurate depiction of habitat.

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 reserved 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 as never before. Some tribes have lost even the most basic ceremonial and subsistence fisheries that are a foundation of tribal life.

The State of Our Watersheds Report is a tool to assess, address and monitor progress toward protecting and enhancing salmon habitat throughout western Washington. The report also serves as a bellwether – both an indicator and warning – that the tide of habitat loss and degradation must be turned 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. This vision of the future is unacceptable to the treaty Indian tribes in western Washington.

2016 Puget Sound Regional Report

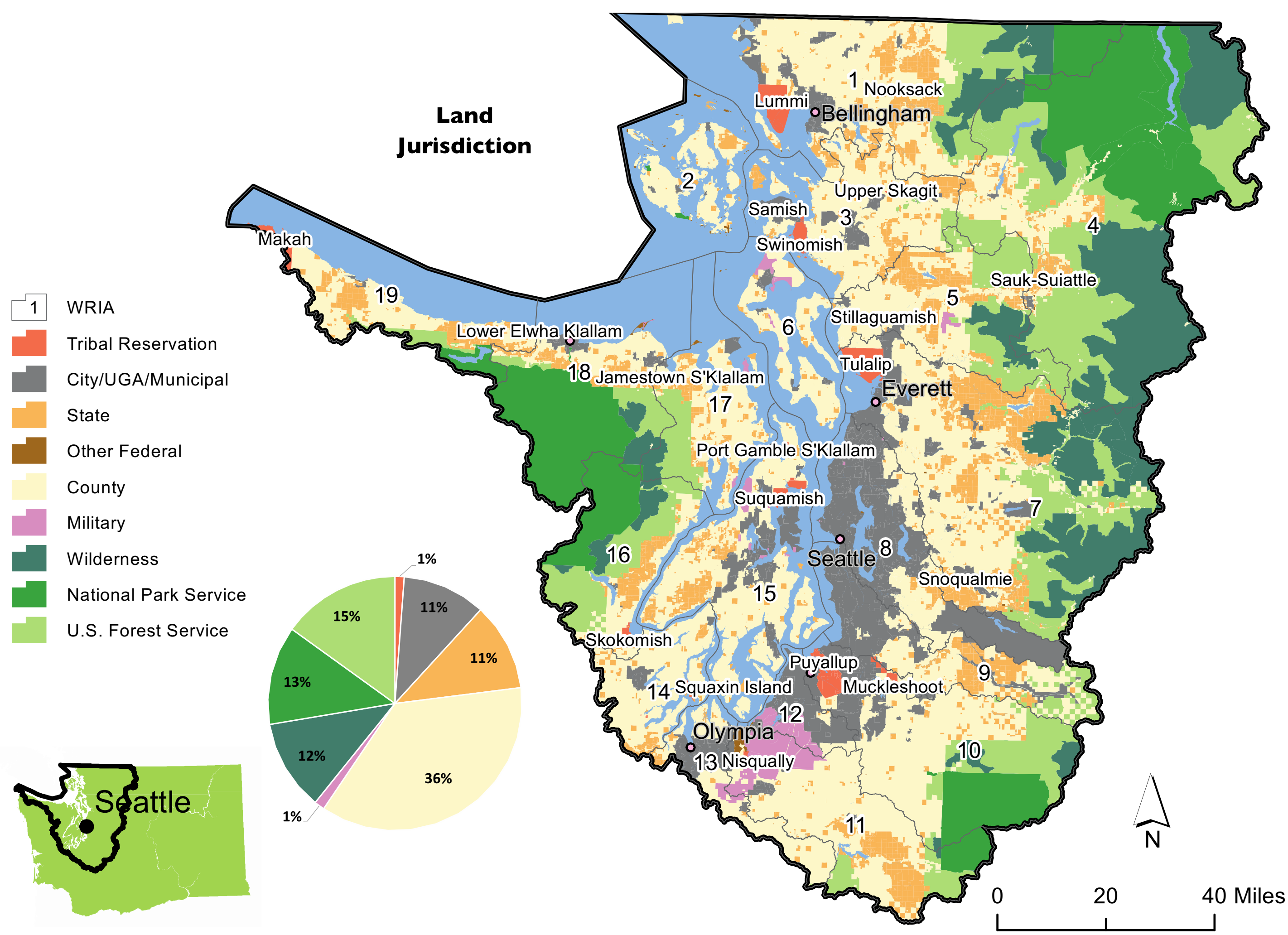
The Puget Sound Region includes the second largest estuary in the United States covering approximately 16,575 square miles, consisting of a complex estuarine system of interconnected marine waterways and basins. The Puget Sound Region has over 20 major river systems, from the Nooksack River along the 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, Washington, 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 1890's. 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, landuse 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.

The Puget Sound Region is home to two-thirds of the state's population, with a projected population increase to six million by 2026.[2] The following pages look at the impacts of growth, its effects on the landscape and salmonids. Conditions such as increased impervious surface area, groundwater extraction, forest cover loss, diminished riparian forest, culvert barriers and nearshore habitat impairment all negatively affect healthy 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 blockage must be mitigated by hatchery production to provide an opportunity for the tribes to exercise their treaty right to harvest salmon. Hatchery production mitigating lost natural production cannot be reduced unless there is a commensurate increase in sustainable natural production, and habitat recovery is required for that.

The Puget Sound Region is home to 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 targeting their recovery needs.



Data Source: USFWS 2014,[3] WADNR 2014a,[4] WADNR 2014b,[5] WADOT 2010,[6] WADOT 2013a,[7] WAECY 1994,[8] WAECY 2000,[9] WAECY 2011a,[10] WAECY 2013[11]

Puget Sound Salmon Recovery Plan

In January 2007, the National Marine Fisheries Service adopted the Puget Sound Salmon Recovery Plan. This plan calls for all leaders at all levels to join together in the effort to protect and manage the salmon and their habitat. The collective overarching goal shared by the contributors of the Puget Sound Salmon Recovery Plan is:

To recover self-sustaining, harvestable salmon runs in a manner that contributes to the overall health of Puget Sound and its watersheds and allows us to enjoy and use this precious resource in concert with our region's economic vitality and prosperity.[1]

Although each watershed has its own salmon recovery plan, there are common types of actions that all watersheds share. The top ten common actions identified in the 2007 plan are:

Protection and restoration of:
- Estuaries,
- Floodplains,
- Riparian Areas,
- Water Quantity (set instream flows, achieve flows, and conduct needed research to design suites of actions aimed at maintaining instream flows at watershed scales),
- Water Quality,
- Fish Access (e.g., dams, diversions, culverts, tide gates),
- Shoreline and Marine Areas (nearshore),

Proper management of:
- Harvest Management,
- Hatchery Management, and

H-Integration:
- The major factors that affect the abundance, productivity, spatial structure and diversity of salmon populations are often lumped into the "H Factors" of harvest, hatcheries and habitat (including hydropower).[2]

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

Technical analysis has identified that a factor limiting salmon production is the loss of habitat-forming processes. Most devastating to the long-term viability of salmon has been the modification of the fundamental natural processes that allow habitat to form, and recovery from disturbances such as floods, landslides, and droughts.[3]

At the 10-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Puget Sound basin shows improvements for water quality and removal of forest road barriers but degradation in water quantity, marine shoreline habitat conditions and impervious surface areas. 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 since the 2012 State of Our Watersheds Report shows a decline for the indicators and a concern for whether the state of Washington will be able to repair the fish barriers per the court order:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Shoreline Modifications / Forage Fish	Since 2008, over twice as much new armoring has been added as being removed. 40% of Puget Sound shorelines have some type of shoreline modification stressor, with 27% of the shoreline armored. Since the habitat is crucial for salmon; protection and restoration of nearshore marine waters is a component of the Puget Sound Salmon Recovery Plan.	**Declining**
Impervious Surface	Excluding federal lands, impervious surface area increased to about 7% in 2011, an increase of 2.6% since 2006. By 2026, the forecast population for Puget Sound will increase by over 750,000 and an increase in impervious surface to over 1,574 square miles at greater than 12% impervious surface area. The Puget Sound Salmon Recovery Plan lists "minimize impervious surfaces" as a key strategy for protecting habitat.	**Declining**
Forestland Cover	Between 2006 and 2011, an additional 153 square miles of forest cover was lost. The projected trend is to see continuing high rates of forest cover loss if protective actions are not taken. Minimizing forest cover removal to reduce long-term impacts is a "key strategy for protecting habitat" component of the Puget Sound Salmon Recovery Plan.	**Declining**
Water Wells	Despite the recent downturn in the economy, well drilling has continued, with a 3% growth since 2009. Most development has occurred in the lower portions of the watersheds and although the growth rate of rural wells has diminished, this has been during a time of economic downturn. As the economy recovers, the rate of new wells will probably increase.	**Declining**
Culverts	During the first two years of implementing the *U.S. v. Washington* Culvert Case Injunction, the state of Washington has corrected 76 fish-blocking culverts. At the current schedule, if additional support is not gained, the corrections of the remaining 800 culverts would be completed in 44 years or the year 2060.	**Concerns**
Riparian Buffers	Diminishing riparian forests in the lowlands of western Washington continue to impair habitats critical to the recovery of the region's anadromous salmon. The number of 6th level HUCs rated for "Properly Functioning" riparian forest cover shrank by 10.5% between 2006 and 2011. For most of Puget Sound in 2011, NMFS identified degraded riparian areas as a limiting factor to the recovery of Chinook salmon.	**Declining**

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 occupy.

Looking Forward

The increasing population of western Washington negatively impacts the landscape both physically and biologically. With population growth comes increased negative effects upon the landscape: 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 negative effects, and current impacts must be mitigated to restore and maintain a healthy landscape for all.

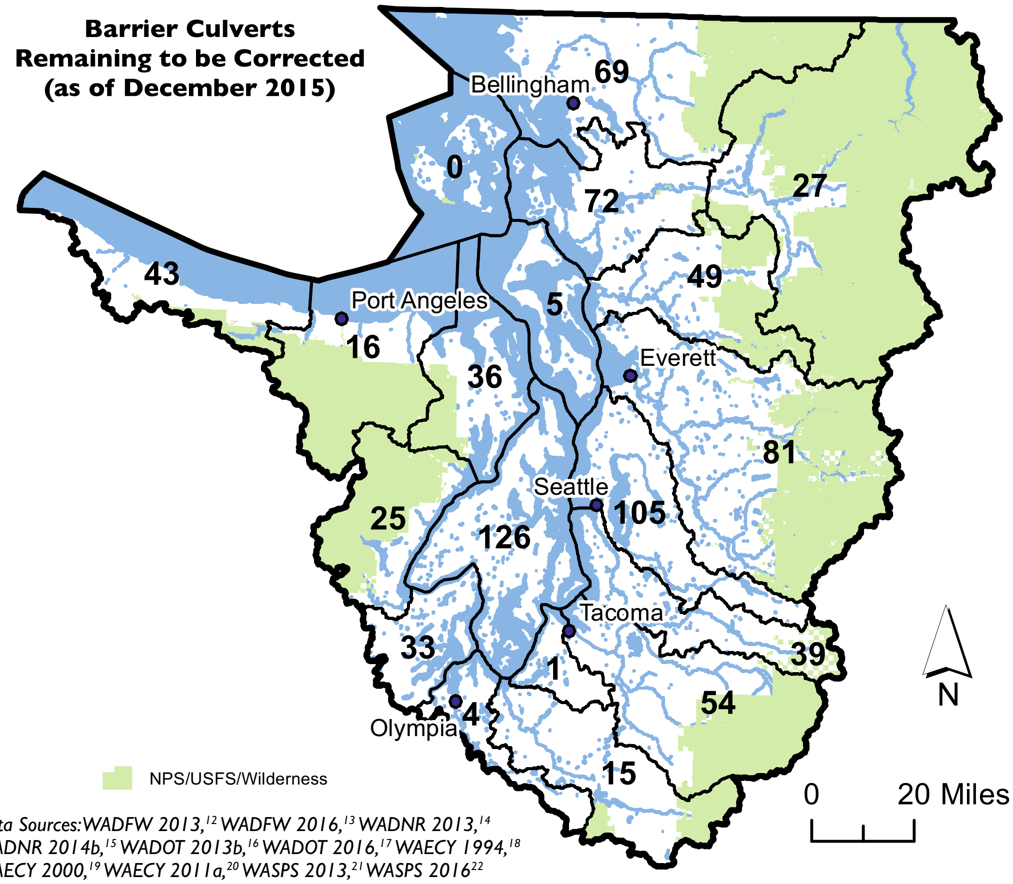
Among these impacts, impervious surfaces restrict groundwater recharge and contribute to increased pollution, both chemical and physical. Surface water withdrawals reduce streamflows and wetland volume downstream. Groundwater withdrawals, if not balanced by recharge, reduce streamflow, wetland volume, 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 are also an impervious surface. 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 that already has 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, terrestrial plants and wildlife, are already experiencing climate change impacts. The tribes currently 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 our changing environment.

Blocking Culverts Impact Salmonid Survival

During the first two years of implementing the U.S. v. Washington *Culvert Case Injunction, the state of Washington has corrected 76 fish-blocking culverts. At the current schedule, if additional support is not gained, the corrections of the remaining 800 culverts would be completed in 44 years or the year 2060.*

Barrier Culverts Remaining to be Corrected (as of December 2015)



Data Sources: WADFW 2013,[12] WADFW 2016,[13] WADNR 2013,[14] WADNR 2014b,[15] WADOT 2013b,[16] WADOT 2016,[17] WAECY 1994,[18] WAECY 2000,[19] WAECY 2011a,[20] WASPS 2013,[21] WASPS 2016[22]

Usable habitat for Puget Sound salmon is a fraction of what it once was, and our ability to recover the salmon populations directly depends on the recovery of habitat.[1]

"Impaired fish access is one of the more significant factors limiting salmonid productivity in many watersheds."[2] In 2013, the U.S. District Court ruled that "the Tribes and their individual members have been harmed economically, socially, educationally, and culturally by the greatly reduced salmon harvests that have resulted from State created or State-maintained fish passage barriers."[3]

The Puget Sound Salmon Recovery Plan states that "the loss of rearing habitat quantity and quality is the primary factor affecting population performance," and that the status quo is unacceptable.[4] Not only do physical barriers limit fish passage and available habitat, they can also damage water quality and disrupt sediment deposition.[5]

Because of this damage, "In 2001, the United States and western Washington Tribes brought an action against the State of Washington for their failure to construct and maintain fish passage on state-owned culverts."[6] In 2007, the court ruled that the right of taking fish, as secured by the treaties, means that the state must "refrain from building or operating culverts…that hinder fish passage."[7]

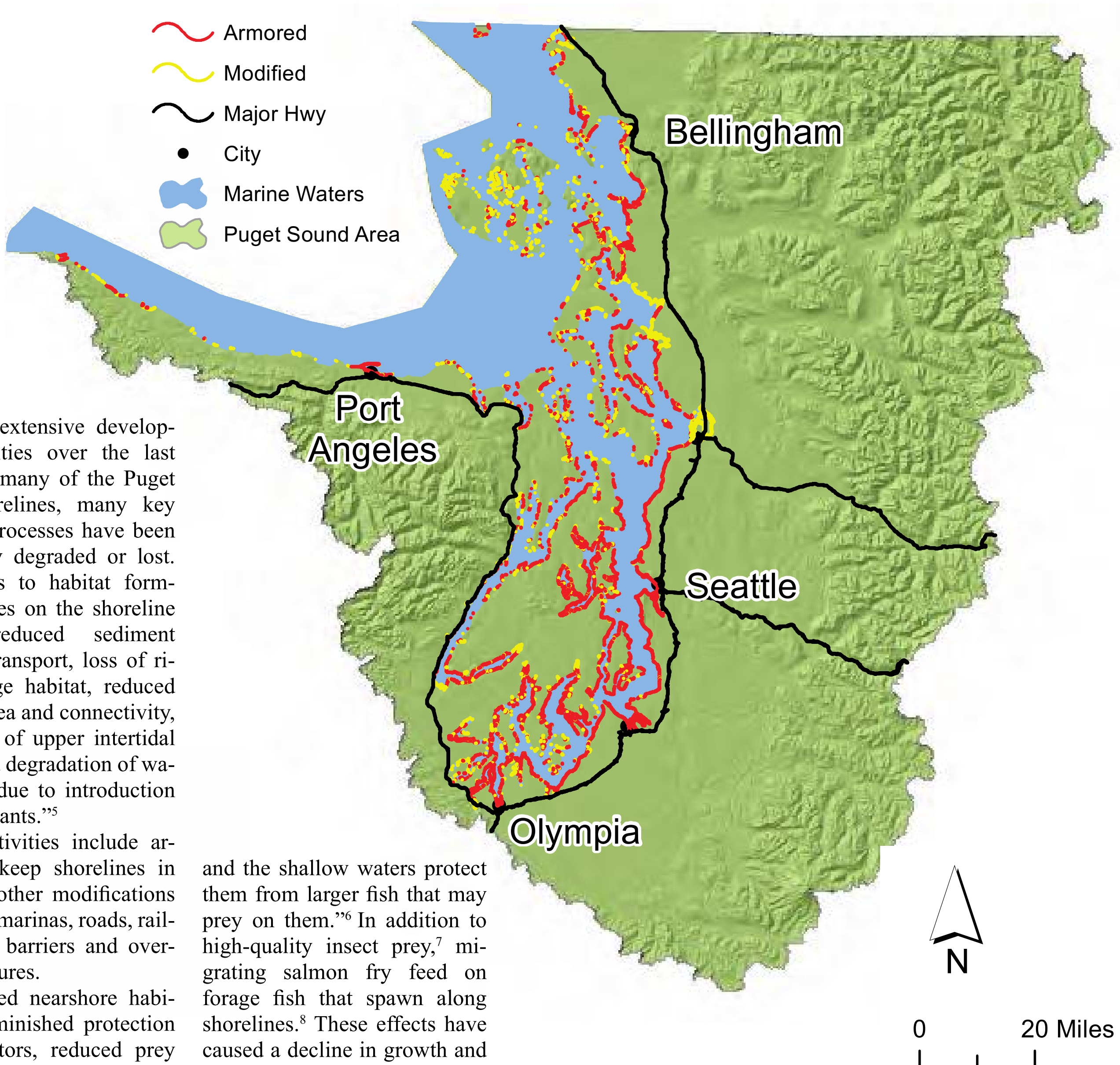
In March 2013, the U.S. District Court granted the permanent injunction requested by the federal government and tribes, holding that the tribes "have suffered irreparable injury in that their Treaty-based right of taking fish has been impermissibly infringed. The construction and operation of culverts that hinder free passage of fish has reduced the quantity and quality of salmon habitat, prevented access to spawning grounds, reduced salmon production in streams in the Case Area, and diminished the number of salmon available for harvest."[8] Multiple state agencies were affected by this ruling. Washington State Parks and the Department of Fish and Wildlife are required by State law to fix their injunction culverts by October 31, 2016.[9] Based on their plans for 2016, which are in line with previous years, they should meet the deadline. Some of Department of Natural Resources' culverts have a longer timeline for correction.[10]

Owner	Original Count	Fixed 2013-15	Add to List	Removed from List	2015 Count	Planned for 2016	Remaining if 2016 planned is fixed
DNR	51	42	5	2	11	11	0
DOT <200	*141*	*2*	*7*	*7*	*139*		*139*
DOT >200	*660*	*19*	*28*	*28*	*641*	*18*	*623*
DOT Unknown	*1*				*1*		*1*
DOT Total	802	21	35	35	781	18	763
Parks	13	9			4	4	*0*
DFW	10	4	3	5	4	4	0

Washington Department of Transportation (DOT) is required to fix culverts that block 200 meters or more of habitat by 2030. Although spending and completing culvert correction has improved, DOT culvert repair funding is less than 12% of where it needs to be to complete repairs by the court appointed deadline.[11] DOT still needs to fix over 600 barrier culverts (>200m of habitat) in the Puget Sound Region region; 18 are planned for 2016.

Shoreline Modifications Continue

Since 2008, over twice as much new armoring is being added as is being removed.[1] 40% of Puget Sound shorelines have some type of shoreline modification stressor,[2] with 27% of the shoreline armored.[3] Since the habitat is crucial for salmon, protection and restoration of nearshore marine waters is a component of the Puget Sound Salmon Recovery Plan.[4]



"Due to extensive development activities over the last century on many of the Puget Sound shorelines, many key nearshore processes have been significantly degraded or lost. Impairments to habitat forming processes on the shoreline include: reduced sediment input and transport, loss of riparian fringe habitat, reduced estuarine area and connectivity, filling over of upper intertidal beaches and degradation of water quality due to introduction of contaminants."[5]

These activities include armoring to keep shorelines in place, and other modifications such as fill, marinas, roads, railroads, tidal barriers and overwater structures.

A modified nearshore habitat with diminished protection from predators, reduced prey abundance and contaminated water is detrimental to achieving salmon recovery goals. Natural shorelines form a migratory pathway for juvenile salmon, which use pocket estuaries "located at the mouths of streams and drainages, where freshwater input helps them to adjust to the change in salinity, insect production is high, and the shallow waters protect them from larger fish that may prey on them."[6] In addition to high-quality insect prey,[7] migrating salmon fry feed on forage fish that spawn along shorelines.[8] These effects have caused a decline in growth and lower survival rates.[9]

Increased restoration of shoreline is needed to mitigate for the additional armoring that has continually been added. Although removal of shoreline armoring has increased since WDFW started tracking it in 2005, until 2014, new armoring was greater than that removed.[10]

Data Sources: ACOE 2008,[11] Carman et al. 2015,[12] PSNERP 2008,[13] WADOT 2010,[14] WADOT 2011,[15] WAECY 1994,[16] WAECY 2000[17]

NOAA, from Encyclopedia of Puget Sound

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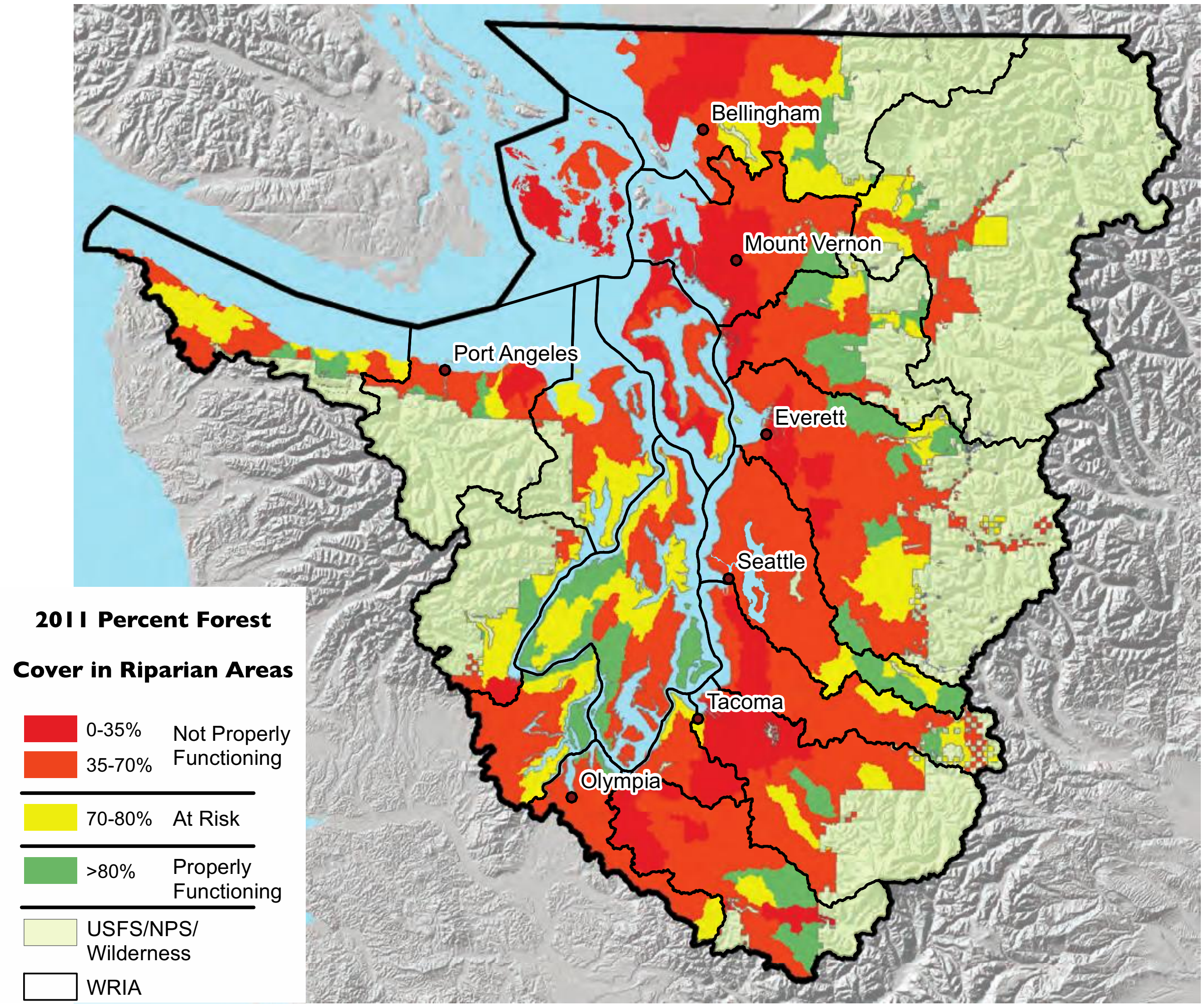
Diminished Riparian Forests

Diminishing riparian forests in the lowlands of western Washington continue to impair habitats critical to the recovery of the region's anadromous salmon. The number of 6th level HUCs rated for "Properly Functioning" riparian forest cover shrank by 10.5% between 2006 and 2011. For most of Puget Sound in 2011, NMFS identified degraded riparian areas as a limiting factor to the recovery of Chinook salmon.[1]



"Since statehood in 1889, Washington has lost an estimated 70% of its estuarine wetlands, 50% of its riparian habitat, and 90% of its old-growth forest."[2]

"Although focusing growth inside UGAs (Urban Growth Areas) is required by GMA (Growth Management Act), the protection of forest cover has not been met by existing regulatory tools. Growth pressures clear land in UGAs, even along riparian corridors and other areas important for salmon habitat."[3]

The Puget Sound area consists of 425 6th level Hydrologic Units (HUCs) from the U.S. side of the Salish Sea out to the mouth of the Strait of Juan de Fuca. 303 of these HUCs are partially or completely outside of USFS/NPS/Wilderness Areas. Of these identified HUCs, only 16.8% are rated "Properly Functioning" riparian forest cover in 2011, down from 18.8% in 2006. NMFS identified degraded riparian areas as a limiting factor important for recovery in their 2011 Implementation Status Assessment Final Report.[4]

The diminished riparian function of most watersheds and marine shoreline results in decreased water quality, temperature regulation, cover, bank stability, LWD recruitment, sedimentation, detrital/nutrient input, and impacts to other biotic and abiotic conditions for salmon and their supporting environment. Human population growth will continue throughout Puget Sound. However, its concomitant effects in riparian areas must be managed to ensure recovery of this vital salmonid habitat limiting factor.

Data Sources: SSHIAP 2004,[5] SWIFD 2014,[6] WADNR 2014b,[7] WADOT 2010,[8] WAECY 2000,[9] WAECY 2006,[10] WAECY 2011b[11]

Forest Cover Loss Continues in Puget Sound Lowlands

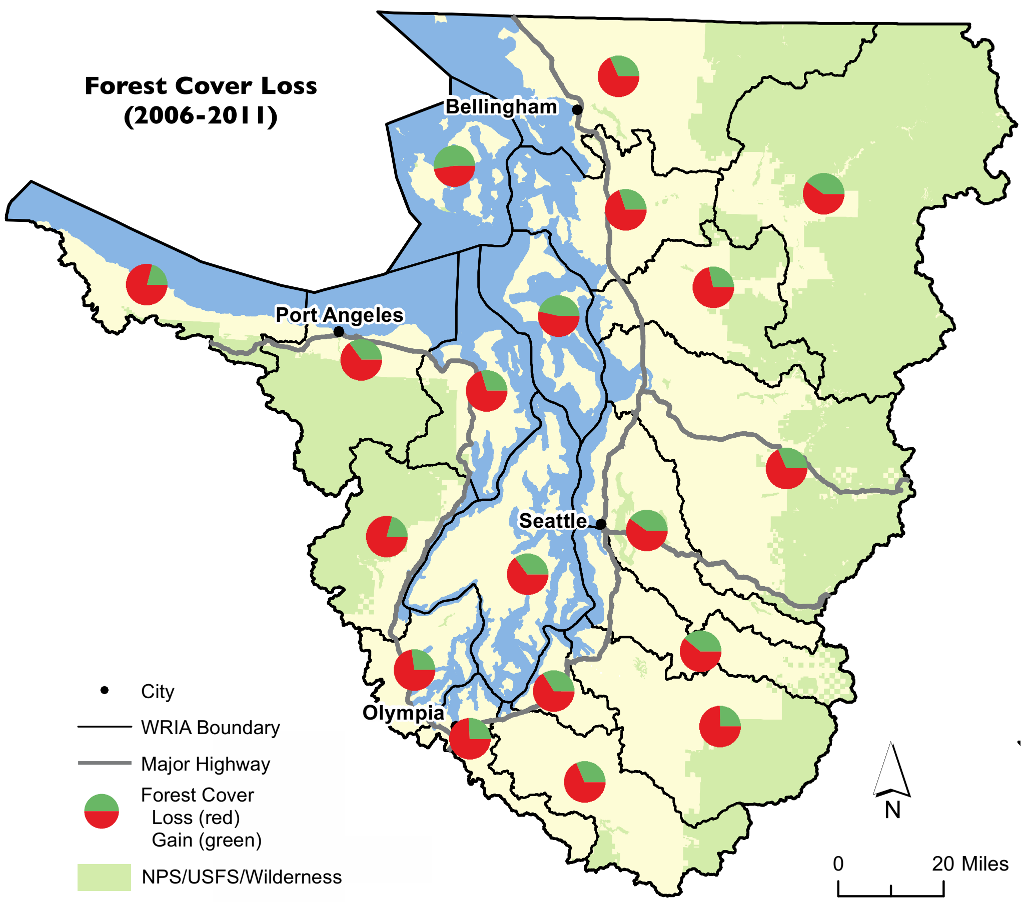
Between 2006 and 2011, an additional 153 square miles of forest cover was lost. The projected trend is to see continuing high rate of forest cover loss if protective actions are not taken. Minimizing forest cover removal to reduce long-term impacts is a "key strategy for protecting habitat" component of the Puget Sound Salmon Recovery Plan.[1]

Within the Puget Sound Area (WRIAs 1-19) and outside of the National Park and Recreation areas, lies an area of approximately 11,950 square miles (excluding the marine waters). There was a decline in forested area between 2006 and 2011, of 153 square miles (net), due to timber harvesting and land conversions. While 378 square miles of forested land cover were lost, 225 square miles were gained through forest growth.

Between 1996 and 2006, 131 square miles of the lost forest cover were zoned for non-forestry uses. Analyzing 2011 forest cover, 163 square miles of the lost forest cover are on land zoned for non-forestry uses. The rate of loss for this five-year cycle (2006-2011) is 249% of the rate for the previous 10-year period (1996-2006). Forestlands converted to non-forestry uses continue to degrade the landscape.

"From 1988-2004, Western Washington forest lands have declined by 25%....These losses (meaning conversion to other uses), were the result of changes in market conditions for wood products, changes in land ownership, impacts from competing land uses and the health of timber stock. Recent research from the University of Washington indicates that nearly one million more acres of private forestland are threatened with conversion. Across all of Washington, the potential risk of conversion is highest in the Puget Sound region....This habitat loss is added to the existing background of land disturbance and development across Puget Sound. The numbers show a disturbing trend of continuing loss despite the State's adoption of some of the most aggressive land management tools in the Nation, including the Shoreline Management Act (SMA), Growth Management Act (GMA), Critical Areas Regulations (CAR) and the Forests and Fish Agreement, which led to changes in the Forest Practices Act to protect Salmon."[2]

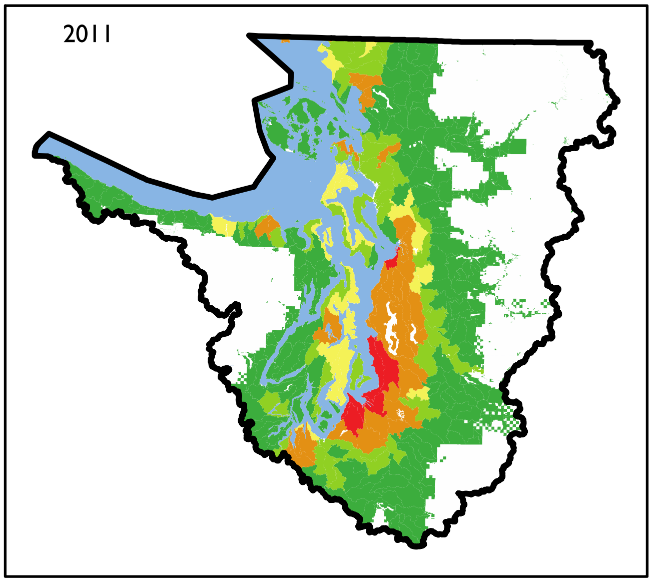
340 acres of forest were removed within the 100-year floodplain of the Skykomish River between 2009 and 2011.

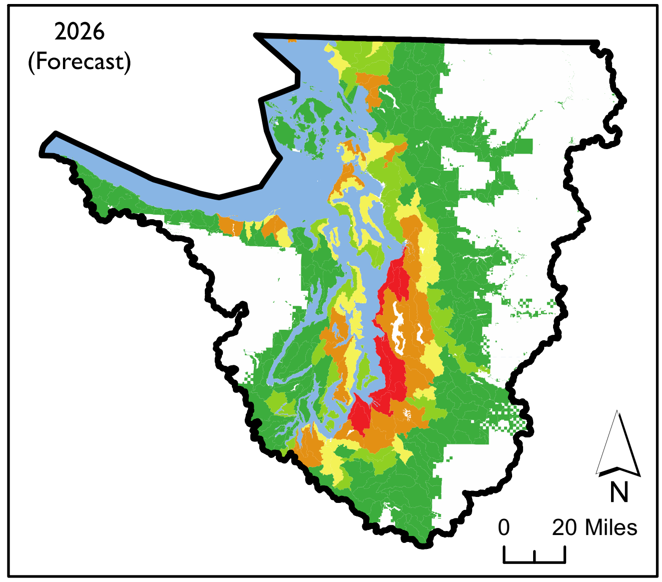


Data Sources: NAIP 2009,[3] NAIP 2011,[4] UW 2012,[5] WADNR 2014b,[6] WADOT 2011,[7] WAECY 2000,[8] WAECY 2006,[9] WAECY 2011a,[10] WAECY 2011b[11]

Impervious Surface Continues to Increase

Excluding federal lands, impervious surface area increased to about 7% in 2011, an increase of 2.6% since 2006. By 2026, the forecast population for Puget Sound will increase by over 750,000 and an increase in impervious surface to over 1,574 square miles. The Puget Sound Salmon Recovery Plan lists "Minimize impervious surfaces" as a key strategy for protecting habitat.[1]





Impervious Surface Categories

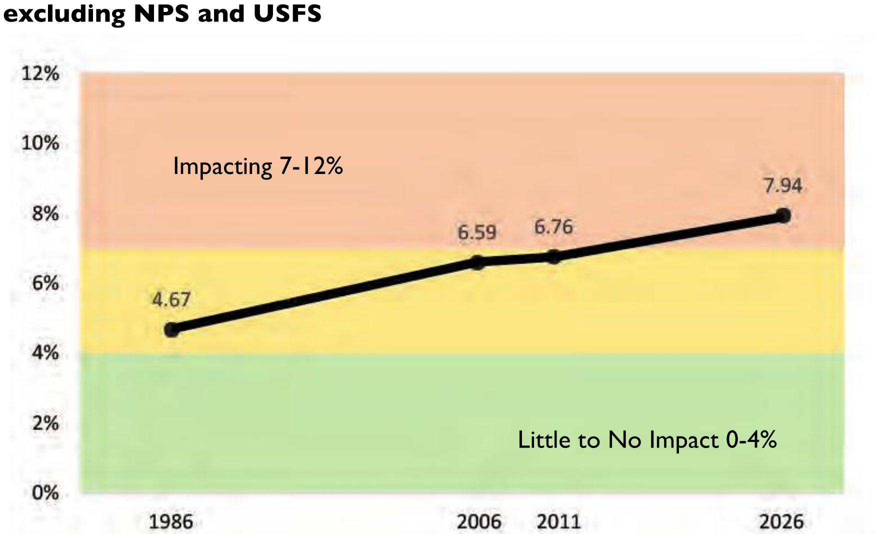
- Little to no Impact (0-4%)
- Beginning to Impact (4-7%)
- Impacting (7-12%)
- Degrading (12-40%)
- Potentially Unrestorable (>40%)
- Waterbodies
- Puget Sound Area Boundary

As impervious surface increases in a watershed, stream temperatures and sediment transport are likely to increase and instream biodiversity decrease by reducing the number of insect and fish species; and contributes to pollutants in stormwater runoff, which can contaminate local aquatic systems.[2] Contaminated runoff poses significant threats to freshwater, estuarine, and marine species, including the Pacific Northwest's salmon and steelhead runs.[3] The addition of impervious surface reduces water infiltration and increases runoff, causing higher peak flows during wet times and lower dry weather flows due to lack of groundwater recharge.[4]

Between 2006 and 2011, the rate of annual impervious surface increase has decreased from the rate between 1986 and 2006. However, this occurred at a time of economic depression, where most of the slowed population increase was in urban areas. The 2026 impervious surface forecast is based upon a continuation of the 2006-2011 behavior. If the population increases much more than forecast, or if an improving economy causes people to regress to 1986-2006 behavior, there is potential for an even greater increased impervious surface level.

The Chinook Recovery Plan leans heavily on local planning, land-use policies, and provisions contained in the local watershed plans to protect federally designated habitat.[5] However, even with critical areas ordinances, planned development areas outside of the designated Urban Growth Areas will continue to contribute to increases in impervious surface area.

Puget Sound Impervious Surface (1986-2026 forecast), excluding NPS and USFS



Data Sources: NLCD 2006,[6] NLCD 2011,[7] USGS 2014,[8] WAECY 1994,[9] WAOFM 2007,[10] WAOFM 2011,[11] WAOFM 2012,[12] WAOFM 2015[13]

Groundwater Withdrawals Impact Surface Flows

Despite the recent downturn in the economy, well drilling has continued, with a 3% growth since 2009. Most development has occurred in the lower portions of the watersheds and although the growth rate of rural wells has diminished, this has been during a time of economic downturn. As the economy recovers, the rate of new wells will probably increase.

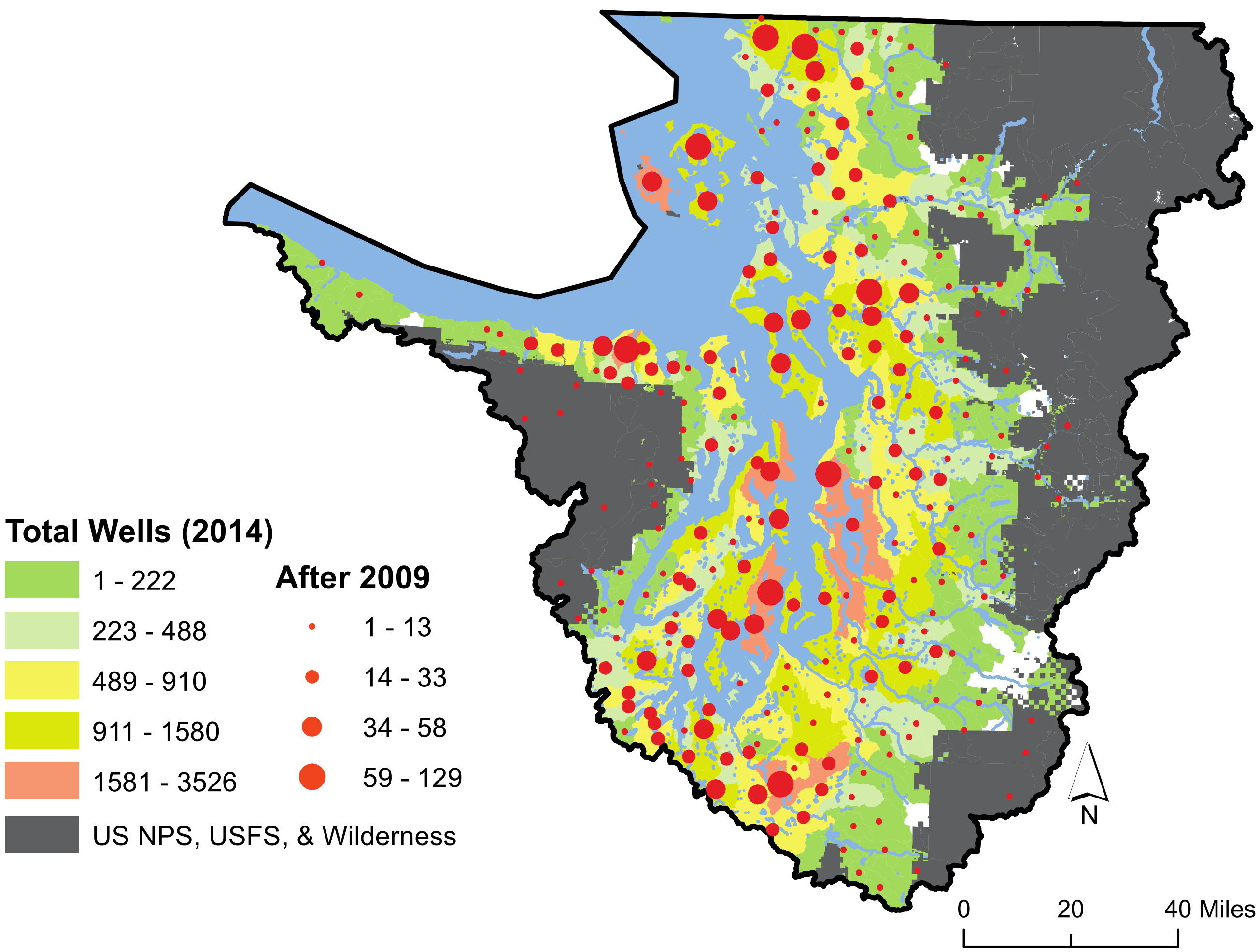
Population growth within the Puget Sound watershed, both in the past and in the near future, will have increased demands on groundwater resources. Washington state instream flow rules allocate river flow for ecological requirements, but state law allows new wells to withdraw 5,000 gallons of groundwater per day without obtaining a permit that would require scientific evidence that water is legally available.[1] Groundwater withdrawals can cumulatively affect streamflows, especially in late summer when flows are naturally low.

An aquifer's natural outflow discharges into lakes, wetlands, streams and seawater through springs and seeps on the land surface and through groundwater. Adequate natural outflow is essential for sustaining base streamflows, maintaining lake levels, providing freshwater inputs to the nearshore, and preventing seawater intrusion.

As development occurs and more groundwater is extracted than is being recharged, the natural outflow from groundwater subsequently decreases. This reduces the amount of freshwater available to lakes, wetlands, streams and the Puget Sound nearshore. Reduced freshwater inputs to the Puget Sound nearshore can have a negative impact on shellfish and out-migrating juvenile salmonids.

The reduced availability of surface water can have a negative impact on all stages of the salmonid life cycle. Water quality (e.g., temperature, flows) is affected by decreased inputs from groundwater. Less groundwater input concentrates pollutants, increases temperature, and diminishes dissolved oxygen. This is detrimental to salmonid migration, spawning and rearing.

Population growth within the Puget Sound watershed will continue to increase demand on water resources. Wells are drilled without regard to aquifer sensitivity and stream recharge needs, which makes it more important that something changes as Puget Sound's freshwater demand increases. Unchecked growth and its associated increase demand for groundwater must be addressed, if implementation of the Puget Sound salmon recovery strategy is to successfully move forward.



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Groundwater Withdrawals Impact Surface Flows

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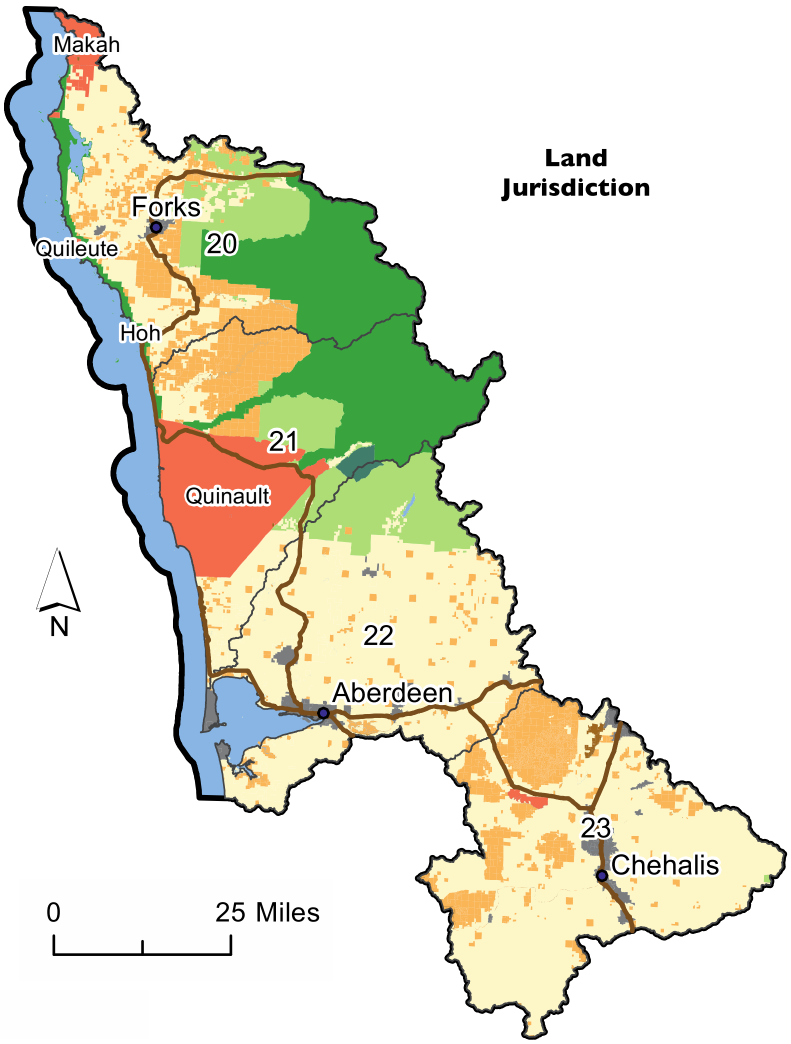
2016 Pacific Coast Regional Report

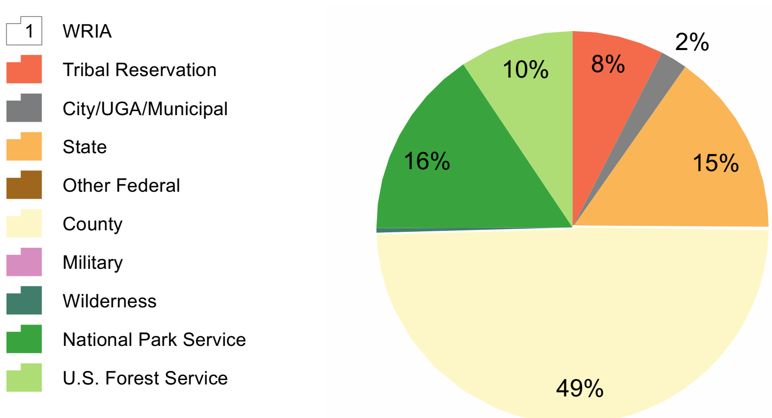


The Pacific Coast Region (PCR) includes WRIAs 20-23, which extend along the Pacific coastline of Washington state. The land area of these WRIAs covers approximately 4,976 square miles and consists of watersheds of the western portion of the Olympic Peninsula, south to the Chehalis River basin. This area is heavily forested with small human population centers, except for parts of the Chehalis River Basin. Economies rely upon timber, agriculture 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 over 200 inches of rain per year, while the upper Chehalis watershed receives just 47 inches of rain falls per year.[1]

The Pacific Coast watersheds are the ancestral and current homelands to the Makah, Quileute, Hoh 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 eight different anadromous fish species: pink, chum, Chinook, coho and sockeye salmon, 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 September 2015 by the USFWS.[3]



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Pacific Coast Region

A review of key environmental indicators reveals a mixed result. There is continued decline in forest cover and an increase in road density, but there are improvements with the removal of fish barriers and treatment of invasive species.

Technical analysis has identified habitat limiting factors for the region's declining salmonid populations as:

- Significantly altered estuary and armored banks;
- Water quality (temperature, flows);
- Loss of hydrologic mature forests;
- Predation by marine mammals;
- Fish-access problems from culvert passage and cedar spalts;
- Increased stream sedimentation;
- Riparian loss or conversion;
- Scoured, incised channels with few spawning gravels;
- Lack of large woody debris; and
- Reduced channel complexity.[1,2,3]

The restoration strategy developed for the PCR consists of maintaining and improving ecosystem productivity and genetic diversity for all salmonid species by protecting highly productive habitats and populations, and restoring impaired habitat and depressed populations. The approach is to prioritize habitat restoration, protection and enhancement activities with regard to the specific habitat conditions of each individual watershed.

Debbie Preston, NWIFC

Hoh River Valley.

Forest Management, Roads, and Invasive Species Threaten Salmonid Habitat

When we evaluate the magnitude of salmon habitat loss and degradation in the PCR with the type and scope of restoration projects being planned and funded, there is little reason for optimism that current trends of habitat loss and degradation can even be curbed, let alone reversed.

Land use in the basins is still dominated by forestry, but loss of vegetation cover has been occurring in the basin with continued loss of lowland forest cover. This trend affects the ecological processes that create and maintain fish habitat by increasing the risk of peak flows, increasing sediment supply, reducing wood recruitment, decreasing water quantity and quality, and raising water temperatures.

As the modern human population continues to grow, it will have a negative impact on the surrounding landscape both physically and biologically, unless we change our approach to protecting our limited natural resources. Developed impervious surfaces, water withdrawals, transportation corridors, pollution (water and air), loss of forest cover, landscape disturbance and global warming are some of the negative effects of the modern population. Since the population will continue to grow in numbers, the challenge is to minimize and mitigate the effects on the environment, while continuing to reverse the negative effects from past development pressures and current resource use.

The watersheds of the Washington coast are experiencing the effects of a changing climate, with continued impacts expected in the future. These changes occur within the context of land and water use that already has 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 the Washington coast leave the member tribes especially vulnerable to the effects of climate change. Critical tribal resources, including salmon, shellfish, terrestrial plants and wildlife, are already experiencing climate change impacts. The tribes currently 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 our changing environment.

Debbie Preston, NWIFC

Logging in the Sol Duc River valley.

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

A review of key environmental indicators for the Pacific Coast Region shows improvements for water quality and removal of forest road barriers, but degradation in water quantity, marine shoreline habitat conditions and impervious surface areas. 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 since the 2012 State of Our Watersheds Report shows improvement for some indicators and a steady loss for others in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Forestland Cover	From 2006-2011, about 6% of the forest cover was removed and the trend is to see more loss if protective actions are not taken. Loss of coniferous forestlands to other uses and its associated negative effects on fisheries and water quality/quantity is a concern repeatedly stated in the recovery, management, and watershed plans for this region.	Declining
Road Density & Crossings	From 2006-2011, road densities not meeting the "properly functioning" level for Pacific Coast watersheds has increased by 18% to 86% of the Pacific Coast watersheds. In addition, the number of road crossings per kilometer is negatively impacting the health of aquatic life in more than 26% of the Pacific Coast watersheds.	Declining
Invasive Species	Since 2012, over 4,700 acres have been treated in the Pacific Coast Region (PCR). Between the WSDA Knotweed Control Program, Washington Department of Recreation and Conservation Office, and matching sponsor costs, over $1,000,000 have been spent in the 2013-2015 biennium in the PCR region.	Improving
Forest Roads	As of the end of 2014, 57% of the RMAPs have been completed within the PCR, which represents an increase of 19% being completed since 2012.	Improving
Culverts	During the first two years of implementing the U.S. v. WA Culvert Case Injunction the State of Washington has corrected 66 fish blocking culverts. 59 of which belonged to WDNR. This leaves 225 barrier culverts to correct, with 89% belonging to WDOT.	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 occupy.

Looking Forward

Although the watersheds within the PCR continue to sustain salmonid species, significant threats to fish habitat remain. Land-use practices, particularly associated with forestry activities and road maintenance, 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 to assure achievement of the goals set in the watershed recovery plans for the PCR.

We are still witnessing the continued loss and fragmentation of habitat through barrier culverts, high road densities and crossings, forest cover removal and extraction of ground water. 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. Upgrading 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.

The tribes are committed to partnering with government and private groups to make improvements to salmon habitat, continued participation in the Lead Entity and Regional Recovery Process, developing strategies for recovery and participating in the efforts to seek grant funding for the PCR.

Blocking Culverts Impacts Salmonid Survival

During the first two years of implementing the U.S. v. Washington Culvert Case Injunction the State of Washington has corrected 66 fish blocking culverts, 59 of which belonged to WDNR. This leaves 225 barrier culverts to correct, with 89% belonging to WDOT.

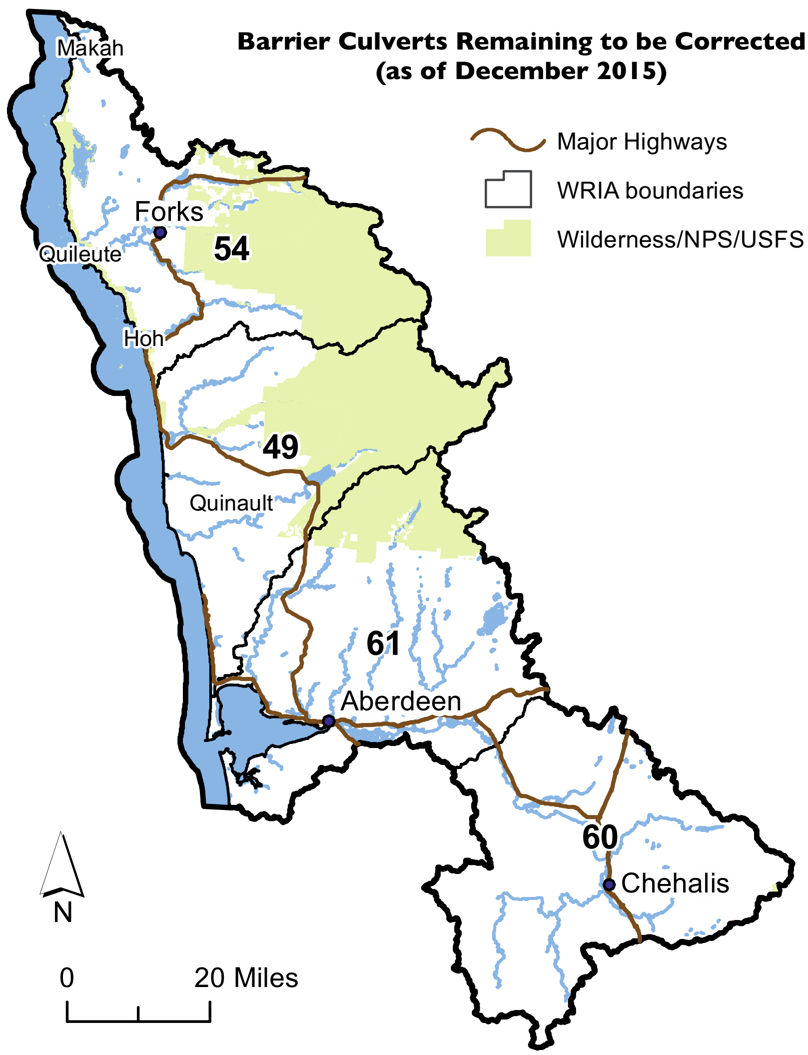
Pacific Coast Region's usable salmon habitat is impacted by barrier culverts and our ability to recover the salmon populations directly depends on the recovery of habitat. "Impaired fish access is one of the more significant factors limiting salmonid productivity in many watersheds."[1] In 2013, the U.S. District Court ruled that "the Tribes and their individual members have been harmed economically, socially, educationally, and culturally by the greatly reduced salmon harvests that have resulted from State created or State-maintained fish passage barriers."[2]

Not only do physical barriers limit fish passage and available habitat, they can also damage water quality and disrupt sediment deposition.[3]

Because of this damage, "In 2001, the United States and western Washington Tribes brought an action against the State of Washington for their failure to construct and maintain fish passage on state-owned culverts."[4] In 2007, the Court ruled that the right of taking fish, as secured by the Treaties, means that the State must "refrain from building or operating culverts… that hinder fish passage."[5]

In March 2013, the U.S. District Court granted the permanent injunction requested by the Federal Government and Tribes, holding that the Tribes "have suffered irreparable injury in that their Treaty-based right of taking fish has been impermissibly infringed. The construction and operation of culverts that hinder free passage of fish has reduced the quantity and quality of salmon habitat, prevented access to spawning grounds, reduced salmon production in streams in the Case Area, and diminished the number of salmon available for harvest."[6]

Multiple State agencies were affected by this ruling. Washington State Parks and the Department of Fish and Wildlife are required by State law to fix their injunction culverts by October 31, 2016.[7] Based on their plans for 2016, which are in-line with previous years, they should meet the deadline. Some of Department of Natural Resources' culverts have a longer timeline for correction.[8]



Washington Department of Transportation (DOT) is required to fix culverts that block 200 meters or more of habitat by 2030. Although spending and completing culvert correction has improved, DOT culvert repair funding is less than 12% of where it needs to be to complete repairs by the court appointed deadline.[9] DOT still needs to fix over 175 barrier culverts (greater than 200m of habitat) in the PCR region; 2 are planned for 2016.

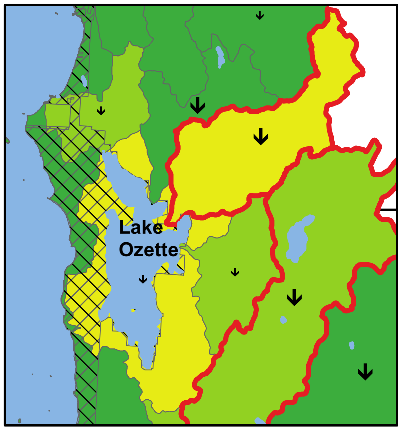
Data Sources: WADFW 2013,[10] WADFW 2016,[11] WADNR 2013,[12] WADNR 2014b,[13] WADOT 2011,[14] WADOT 2013b,[15] WADOT 2016,[16] WAECY 1994,[17] WAECY 2000,[18] WAECY 2011a,[19] WASPS 2013,[20] WASPS 2016[21]

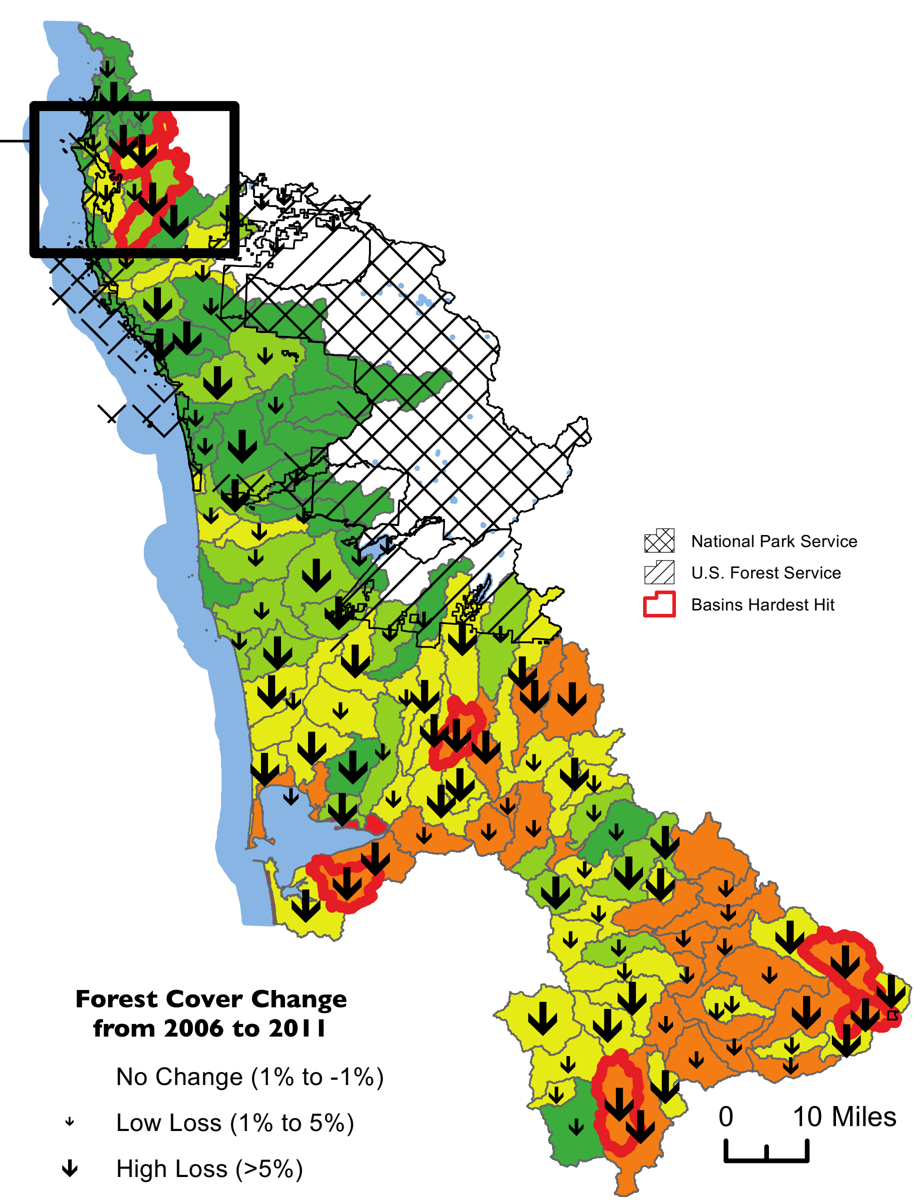
Owner	Original Count	Fixed 2013-15	Add to List	Removed from List	2015 Count	Planned for 2016	Remaining if 2016 planned is fixed
DNR	67	59	14		22	22	0
DOT <200	*26*				*26*	*1*	*25*
DOT >200	*186*		*3*	*14*	*175*	*2*	*173*
DOT Unknown					*0*		*0*
DOT Total	212	0	3	14	201	3	198
Parks	2	2	1		1		1
DFW	9	5	1	4	1		1

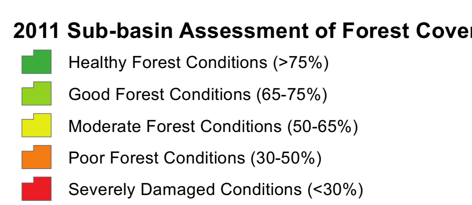
Forest Cover Loss Continues

About 6% of forest cover was removed between 2006 and 2011, and the trend is for more loss if protective actions are not taken. Loss of coniferous forestlands to other uses and the associated negative effects on fisheries and water quality/quantity is a concern repeatedly stated in the recovery, management and watershed plans for this region.

2006-2011 Forest Cover and Change by Basin







Within the Pacific Coast Region (WRIAs 20-23) and outside of the national park areas, is an area of approximately 4,186 square miles (excluding the main waterways). In 2006, 84% of this area was forested, but due to timber harvesting and some land conversions,[1] five years later only 79% of the area is forested, representing a loss of 198 square miles of forest cover.[2] Of the forest cover lost, 24% is on land zoned for non-forestry uses,[3] indicating that the removed forest cover is not planned to be restored.

While over 79% of this region remains forested, most non-park watersheds exhibited a loss in forest cover, with 7 out of 152 basins suffering a greater than 10% loss of forest cover.[4]

Forest cover aids in the reduction of surface runoff and, during wet seasons, the infiltration of precipitation into groundwater. The increase in groundwater and decrease in runoff not only reduces sedimentation, but also moderates peak flows, extends the hydrologic flow duration, and can increase groundwater input into lakes, streams and wetlands. Forest vegetation root mass helps reduce mass wasting events, both in number and size, reducing suspended sediment concentrations. Forest vegetation adjacent to lakes, streams and wetlands provides shade and helps reduce water temperature increases.

The Recovery Plan for Lake Ozette Sockeye Salmon identifies some of the limiting factors to sockeye recovery as high stream temperatures, turbidity, and "alterations in lake level variability from removal of wood at the lake outlet and tributary-inflow hydrologic change, coupled with tributary sedimentation and wood removal (that) have altered groundwater hydraulics, hydrology, and inter-gravel flow along the lake shoreline."[5]

Data Sources: USGS 2014,[6] WADNR 2014b,[7] WADOT 2010,[8] WAECY 2006,[9] WAECY 2011a,[10] WAECY 2011b[11]

AR052749

Road Density and the Number of Road Crossings Have an Impact on Fish Habitat

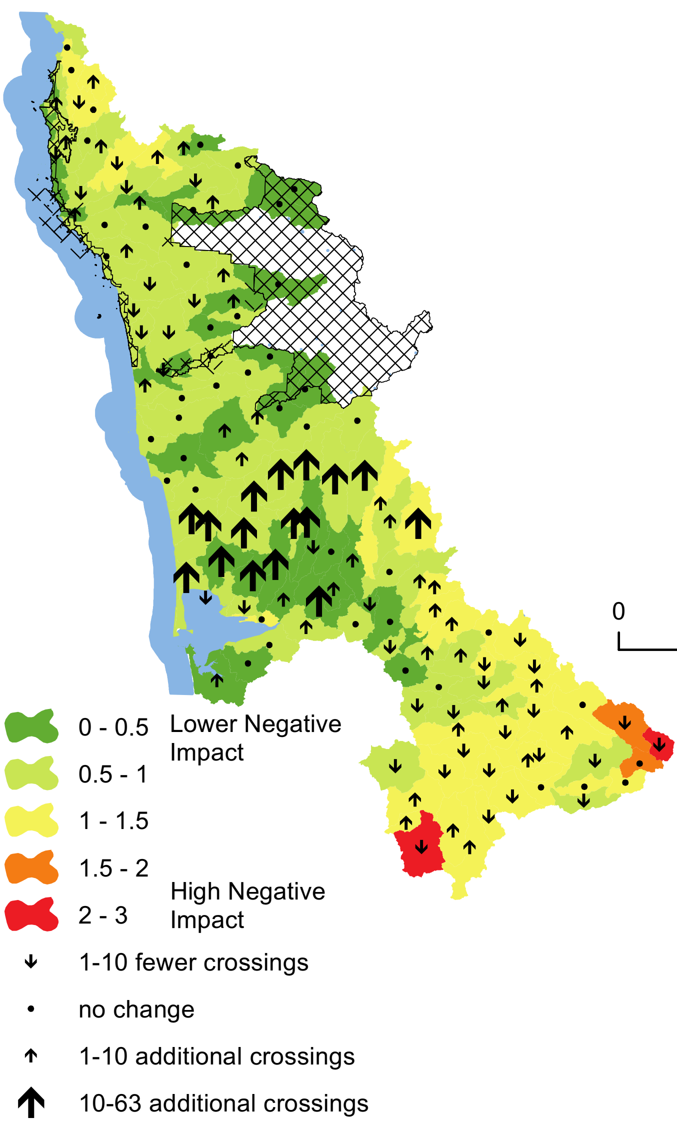
From 2006 to 2011, road densities not meeting the "properly functioning" level for Pacific Coast watersheds have increased by 18% to 86% of Pacific Coast watersheds. In addition, the number of road crossings per kilometer is negatively impacting the health of aquatic life in more than 26% of Pacific Coast watersheds.

According to a NOAA 1996 report, watershed conditions are at risk when there are between 2 and 3 miles of road per square mile, and are considered "not properly functioning" when road miles exceed 3 miles per square mile.[1] "Roads significantly elevate on-site erosion and sediment delivery, disrupt subsurface flows essential to the maintenance of baseflows, and can contribute to increased peak flows. Roads within riparian zones reduce shading and can reduce woody debris throughout the life of the road. These effects degrade habitat by increasing fine sediment levels, reducing pool volumes, increasing channel width and exacerbating seasonal temperature extremes."[2]

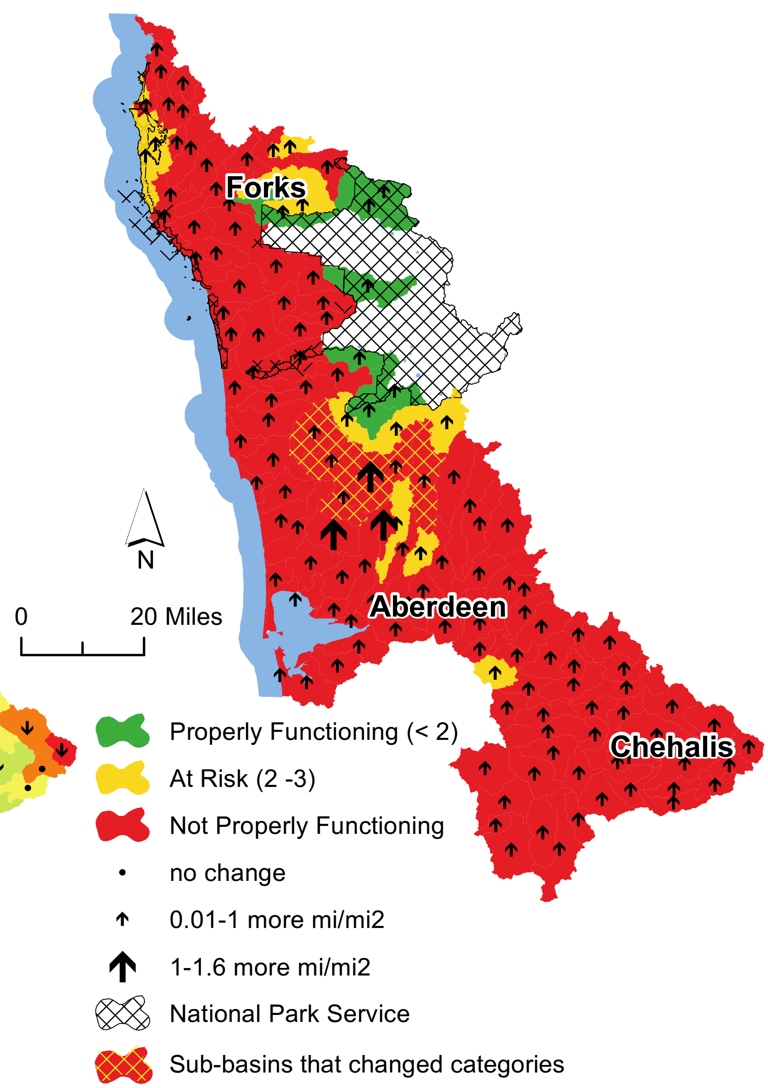
Since 2010, 6 sub-basins have gone from "At Risk" to the "Not Properly Functioning" category, with an increase in the number of road miles per square mile of basin area. All are located north of the city of Aberdeen.

Several Chehalis River, Quillayute River, Ozette Lake and Sooes River sub-basins are trending toward high negative road crossing impacts. These impacts result from having more than one road crossing per kilometer of stream length, with the highest number of road crossings occurring in the headwaters of the Chehalis and Skookumchuck rivers. When averages exceed two road crossings per kilometer of stream length, stream health is significantly more likely to become degraded.[3]

Road Miles per Square Mile of Basin



No. of Road Crossings per Kilometer of Stream Length



Data Sources: UW 2012,[4] WADNR 2014b,[5] WADNR 2014c,[6] WADOT 2010,[7] WAECY 2011a[8]

RMAP Completion a Positive Sign

As of the end of 2014, 57% of the RMAPs have been completed within the PCR, which represents an increase of 19% being completed since 2012.

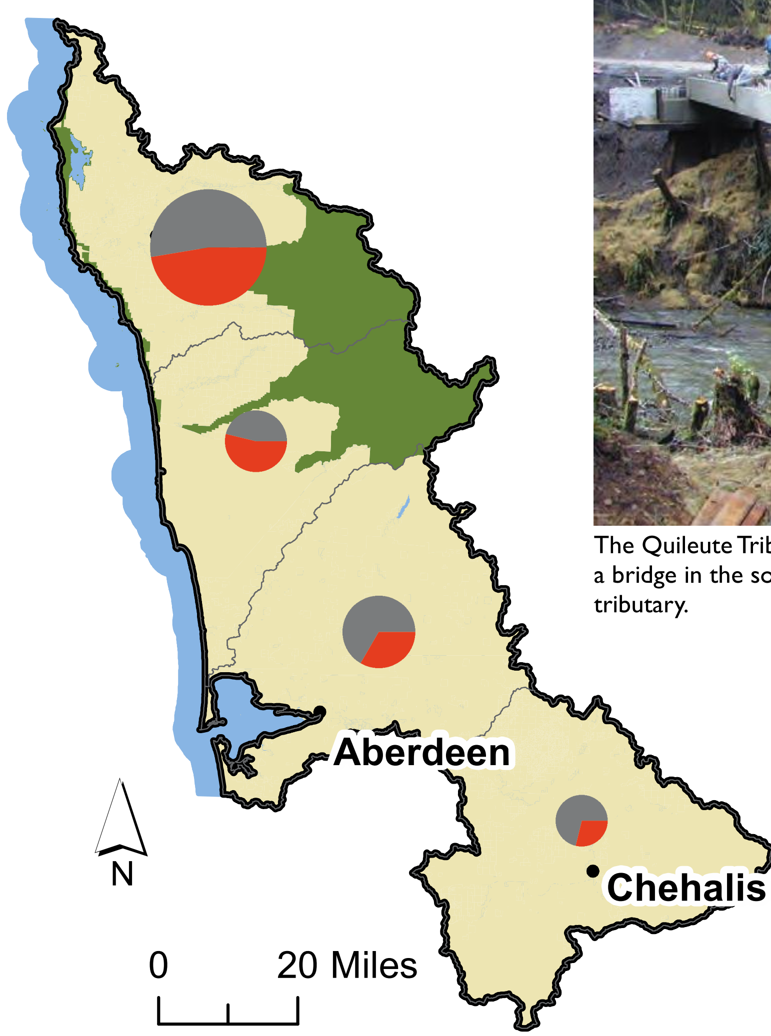
Over 65% of the Pacific Coast Region, outside of the national park, is dedicated to active forest management. Along with the forest management activities comes a high density of forest roads to facilitate commercial timber harvest. Forest roads are known to contribute to stream-channel degradation because, if not properly constructed and maintained, they can be a source of sediments to streams, which degrades fish habitat and water quality.[1,2]

Also, many of the culverts act as fish barriers, denying salmon and steelhead access to needed spawning and rearing habitat. Both the restriction of access and the degradation of salmonid habitat negatively impact salmon recovery and will continue to do so if corrective actions are not taken.

Washington state's forest practices laws require most private forest landowners to prepare and submit a Road Maintenance and Abandonment Plan (RMAP) for their forest roads. To protect water quality and riparian habitat, roads must be constructed and maintained in a manner that will prevent damage to public resources. In the original Forests and Fish Agreement, all forest roads were to be improved and maintained to the standards of the law prior to October 31, 2016. However, due to legislative changes, forest landowners are now able to request an extension of up to five years.

As of the end of 2014, 57% of RMAPs have been completed within the PCR. In the PCR, the state, federal and local governments have met 60% of their RMAP obligations, and private landowners have met 56% of their obligations. There are 1,953 identified culverts remaining to be fixed; 1,698 are scheduled to be completed, 255 are yet to be scheduled for repair. 138 repairs are late. Since 2012, 643 RMAPs have been added and 1,148 fixed.

2014 RMAP Distribution in PCR



Frank Geyer, Quileute Tribe

The Quileute Tribe replaced two corroded and perched culverts with a bridge in the south fork of Maxfield Creek, a lower Bogachiel River tributary.

Data Sources: WAECY 2011a,[3] WADOT 2010,[4] WADNR 2014b,[5] WADNR 2014d[6]

AR052751

PACIFIC COAST

Invasive Plant Treatment Continues

Since 2012, over 4,700 acres have been treated in the Pacific Coast Region. Between the WSDA Knotweed Control Program,[1] Washington Department of Recreation and Conservation Office[2] and matching sponsor costs, over $1 million has been spent in the 2013-2015 biennium in the PCR region.[3]

The knotweed plant is present in all WRIAs of the Pacific Coast Region. Knotweed infestations impact stream environments by replacing streambank-stabilizing native vegetation, increasing the potential for erosion and sediment loads. Loss of native vegetation reduces riparian canopy, increases stream temperatures, and reduces invertebrate populations and recruitment of instream woody debris, all of which negatively impact salmon. A section of knotweed stem or a small portion of root is all that is needed to start a new plant, so it can easily spread downstream.

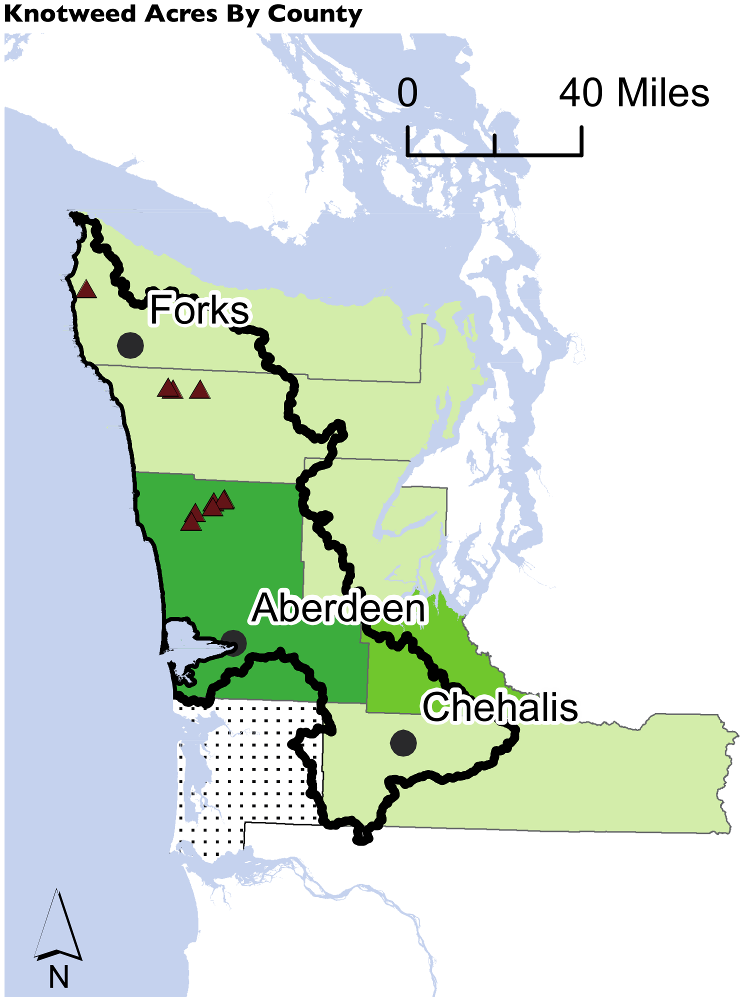
According the WSDA, "These collective impacts of knotweed on keystone species, such as salmon, and on critical riparian functions, can have cascading effects that may result in significant, far-reaching and long-lasting impairment of the ecosystem."[4]

WSDA monitoring "shows a significant decrease in knotweed following a series of annual treatments….Across the state, the knotweed populations that persist in project areas have fewer stems per acre and the knotweed that is present exhibits reduced stem height, stem diameter, and overall vigor….Many native plants, including tree and shrub species, have re-established in areas where they had previously been displaced."[5]

Work is ongoing to identify, treat and monitor this invasive species within the PCR's area. However, it takes three years to treat an infestation site and several more years of monitoring to confirm it is eradicated, since a "small amount of live knotweed present at treatment sites can return to the original infestation level in three seasons.[6]

"WSDA will continue to support knotweed control as program funding allows. The funding outlook in 2015 appears stable. In the past, funding reductions have led to the abandonment of projects and reduced support for ongoing initiatives. In contrast, knotweed projects that have received stable funding have shown a vast decrease in knotweed presence. Stable funding will remain imperative to the success of knotweed control in Washington state."[7]

Knotweed Acres By County



Quileute tribal staff treat knotweed in the Bogachiel River valley.

Knotweed Projects in PRISM

PCR Boundary

Knotweed Acres By County

Unknown

100 - 1000

1000 - 2000

> 2000

Data Sources: PRISM 2015,[8] WAECY 1994,[9] WSDA 2011a,[10] WSDA 2011b,[11] WSDA 2011c,[12] WSDA 2011d[13]

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2016 Pacific Coast Regional Report

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Blocking Culverts Impacts Salmonid Survival

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Road Density and the Number of Road Crossings Have an Impact on Fish Habitat

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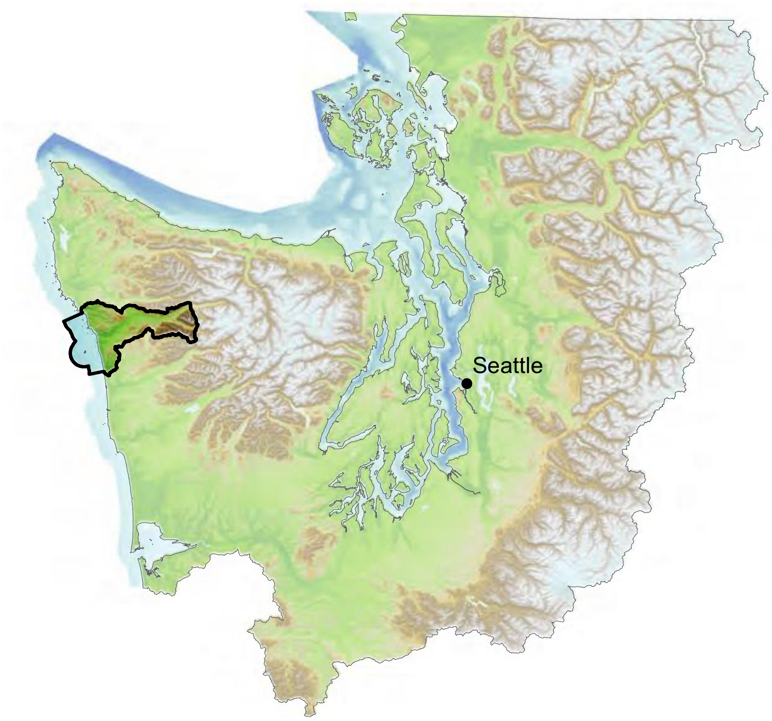
2016 State of Our Watersheds Report
Hoh River Basin

Growing up on the Hoh, I remember hiking upriver with my nets to catch steelhead and camping out. It's good to know that by doing this work, I'm doing something that benefits the Tribe in some way too.

- Richard Sheriff,
Hoh Tribe



Hoh Tribe

Chalá·at: People of the Hoh River

The Hoh River Indians are a federally recognized Tribe located about 28 miles south of Forks and 80 miles north of Aberdeen. The original Hoh Indian Reservation was 443 acres but through property acquisitions, the Tribe now has a total of 908 acres in Trust, which includes 648 acres of productive forestland. The Reservation has approximately one mile of beach front running south from the mouth of the Hoh River toward Ruby Beach. The Hoh Tribe is a river-based fishing community that is dependent on the fish, wildlife, and other natural resources of the Hoh River watershed for their subsistence and commercial economy. Protection of the watershed's functions is therefore key to meeting the cultural and economic needs of the Tribe.

Land Management Limits Salmon Production

The Hoh Tribe's Area of Concern 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, 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 Concern is dominated by state and private forestlands and includes the Hoh Rain Forest, a large temperate area protected from major anthropogenic changes within the Olympic National Park.

The Hoh River basin is one of least developed watersheds on the Washington coast. The basin includes the Hoh Rain Forest, a large temperate area protected within Olympic National Park. Commercial forestry and National Park are the two primary land uses within the watershed. A significant portion of the upper Hoh basin lies within Olympic National Park, but downstream of the park, considerable habitat problems exist.

A limiting factors analysis conducted by the Washington State Conservation Commission identified several factors limiting salmonid production in the basin: fish-access problems from culvert passage and cedar spalts; increased stream sedimentation; altered riparian areas; scoured, incised channels with few spawning gravels; and large woody debris.[1]

A Watershed Plan was developed to address these limiting factors with specific actions and management strategies. The strategies involved:

- Protection of habitat and habitat-forming processes;
- Collection of information where data gaps exist; and
- Restoration projects to reinstate or advance the recovery of habitat, and habitat-protection formation processes that affect the salmonid ecology.[2]

Landscape-Scale Problems Difficult to Address

A review of key environmental indicators for the Hoh basin area shows a reduction in the number of forest practice applications, and the removal of forest road barriers and invasive species, but degradation of water quantity and quantity, degradation of freshwater shoreline habitat conditions, and degradation of floodplain and riparian 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.

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.

Review of the trend for these key environmental indicators since the 2012 State of Our Watersheds Report shows improvement for some indicators and a steady loss for others in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Water Quality	Between 2006 and 2015, all but one of the major salmonid (Chinook, coho and steelhead) tributaries to the Hoh River had summer water temperature values which exceeded the Washington State numeric water quality standards. These exceedances will likely have a significant impact on salmonid surval and production in these watersheds.	**Declining**
Water Quantity - Peak Flows	From 1960, peak flows have shown an increasing trend on the Hoh mainstem. If this trend continues as anticipated under predicted climate change conditions, this may pose a significant impact to salmonid runs.	**Declining**
Water Quantity - Low Flows	From 1960, low flows have shown an decreasing trend on the Hoh mainstem. If this trend continues as anticipated under predicted climate change conditions, this may pose a significant impact to salmonid runs.	**Declining**
Timber Harvest	From 1996 to 2010, 24 square miles (1.7 square miles/year) of forestlands were harvested in the Hoh Tribe's Area of Concern. Since 2010, an additional 1.6 sq miles (2010-2014 0.4 square miles/year) of forestlands have been permitted for harvest which may indicate a slower rate of activity, although Forest Practice Applications do not cover all the activities on the ground. Most of the recent actvity has been in the Goodman Creek watershed and in areas that are predominately private forestlands.	**Concern**
Forest Roads	As of 2014, about 47% of the 764 culverts identified under the Road Maintenace and Abandonment Plans (RMAP) in the Hoh Area of Concern have been repaired, while the other 53% remain to be repaired by 2021.	**Improving**
Road Densities	6 watersheds, representing 72% of the land area, may not be properly functioning because of road density values that exceed 3 miles/square mile.	**Declining**
Shoreline Modifications / Freshwater	The mainstem of the Hoh River has over 3.7 miles of riprap between river miles 1 and 37. Since 2012, there have been at least 4 new riprap projects, and there is no indication that any riprap was removed.	**Declining**
Invasive Species	A multi-year effort initiated in 2002 by the Hoh Tribe to control the invasive knotweed plants along 30 miles of the Hoh River riparian zone has resulted in the eradiction of about 99.5% of the plants. However, other invsaive species such as Scotch broom, herb Robert and Reed canarygrass continue to spread in the watershed.	**Concern**

The Hoh Tribe is concerned that the failure to address climate change issues may negatively impact the natural and cultural resources that tribal members depend on. Also of concern is the continuing and planned increase in military activities in the watershed and their potential impact on human and environmental health. One positive development is the acquisition and protection by Hoh River Trust of 7,000 acres of primarily riparian lands in the watershed.

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

Salmon need cool, clean, highly oxygenated water to survive. Even in an area as rural as the Hoh watershed, land management activities threaten salmon survival and the future of the Hoh people who depend on them culturally and economically.

Elevated stream temperature is one of the cumulative effects of land management activities, which have altered surface water runoff, groundwater recharge, streamside plant communities and in-channel structures such as logjams.

In all likelihood, continued land management activities will preclude many streams from a complete recovery of natural temperature conditions. What salmon need, people need too. To ensure a future for the next seven generations, land management rules already in place need enforcement and those that are not adequate to protect fish need to be adapted to do so.

While the Hoh River basin continues to support native runs of salmonid species, there are significant fish habitat threats, both anthropogenic and natural. Land-use practices particularly associated with forestry activities continue to alter watershed processes, resulting in stream-channel degradation. Streamflow changes and high water temperature values may be the result of forest activities or climate change. The protection and restoration of fish habitat is needed to ensure that the currently declining salmon runs return to a healthy status.

While the Hoh Tribe continues to advocate for increased resource protection, inadequate support from state and federal regulatory agencies is an ongoing hindrance.

In an effort to address rapidly declining habitat conditions and severely impaired riverine processes, the Hoh Tribe is initiating the development of a Hoh watershed restoration plan. This plan will be used, in part, to seek funding for more environmentally compatible alternatives to common infrastructure protection techniques, such as riprap bank armoring.

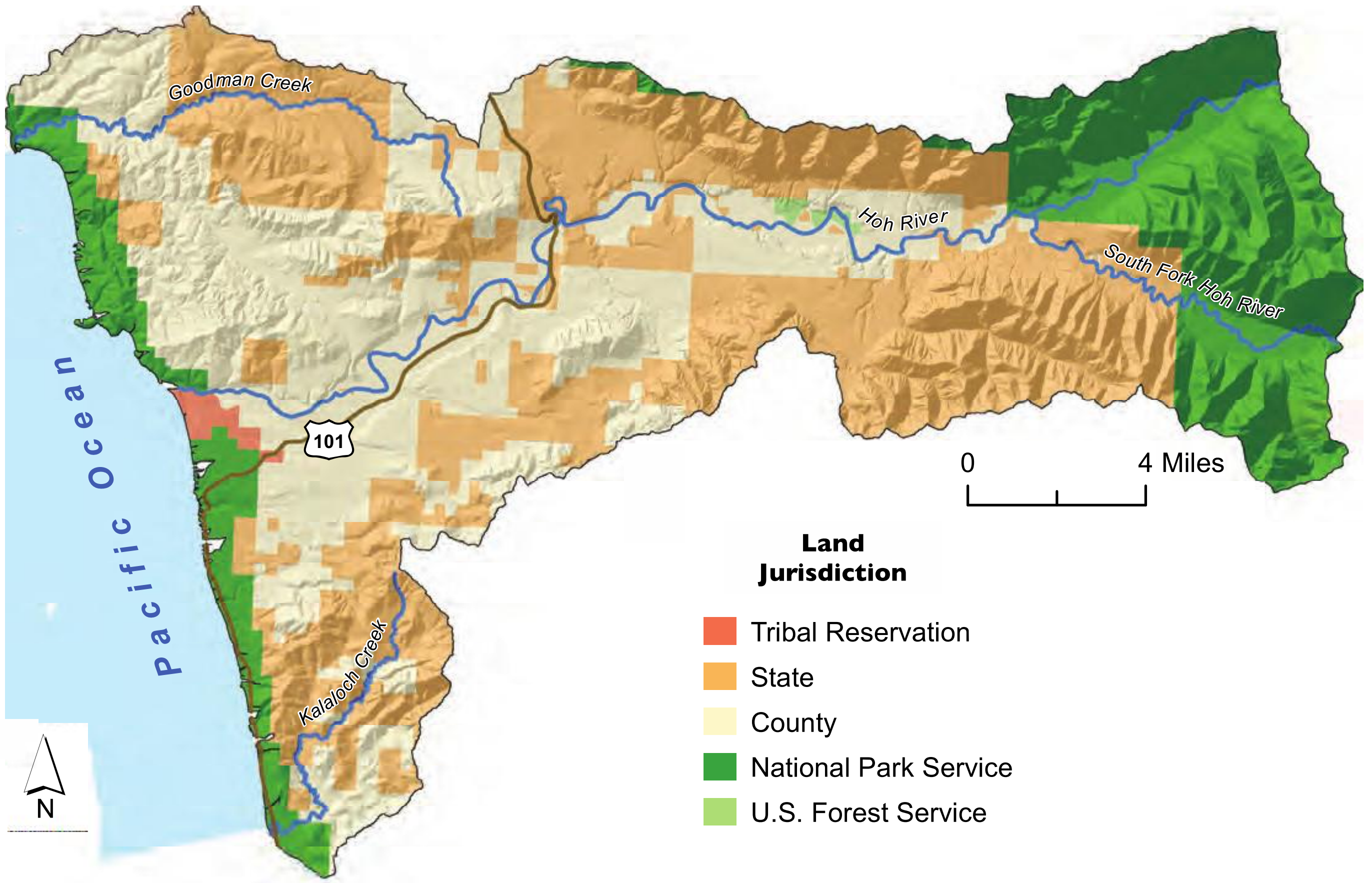
Other efforts include implementation of the Hoh Water Adventure which provides Hoh Tribal members with the opportunity to learn about cultural and natural resources, as well as management concerns and strategies.

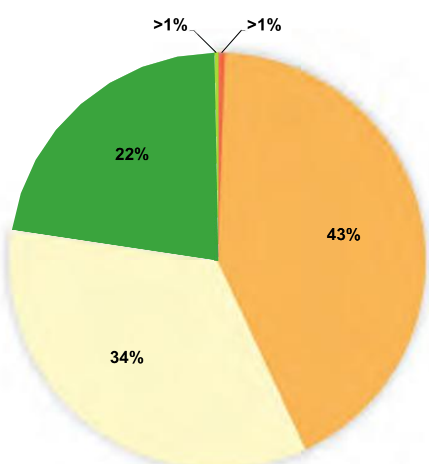
Debbie Preston, NWIFC

Hoh tribal fisheries technician Ruben Hernandez and his daughter Kandace walk along the Hoh River during a summer program designed to connect tribal children to the whole river, not just the part in their village.

Hoh Tribe

Hoh River Watershed and Independent Tributaries





The Hoh Tribe's Area of Concern 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's, which originates at the Hoh Glacier on Mount Olympus. From there, it flows westward through Olympic National Park, 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 Concern is dominated by state and private forestlands and includes the Hoh Rain Forest, a large temperate area protected from major anthropogenic changes within Olympic National Park.

Within the park, the Hoh and South Fork Hoh rivers have some glacial input. The discharges of streams outside the park are rainfall dominated with a mean annual precipitation in the range of 140 to 165 inches, the highest in Washington state. This basin supports all five species of Pacific salmon as well as steelhead and cutthroat trout.[1,2,3] The Hoh River, some adjacent shoreline and tributaries are designated critical habitat for bull trout.[4] There are whitefish, numerous species of lamprey, cottids, stickleback, Olympic mudminnow, and possibly several species of dace that are indigenous to the Hoh Tribe's Area of Concern.[5,6]

Several factors limit salmonid production in the basin downstream of the park.[7] These include fish access problems from 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 includes specific actions and management strategies for addressing these limiting factors.[8]

Data Sources: SSHIAP 2004,[9] WADNR 2014a,[10] WADNR 2014b,[11] WADOT 2012,[12] WADOT 2013,[13] WAECY 1994,[14] WAECY 2011,[15] WAECY 2013a[16]

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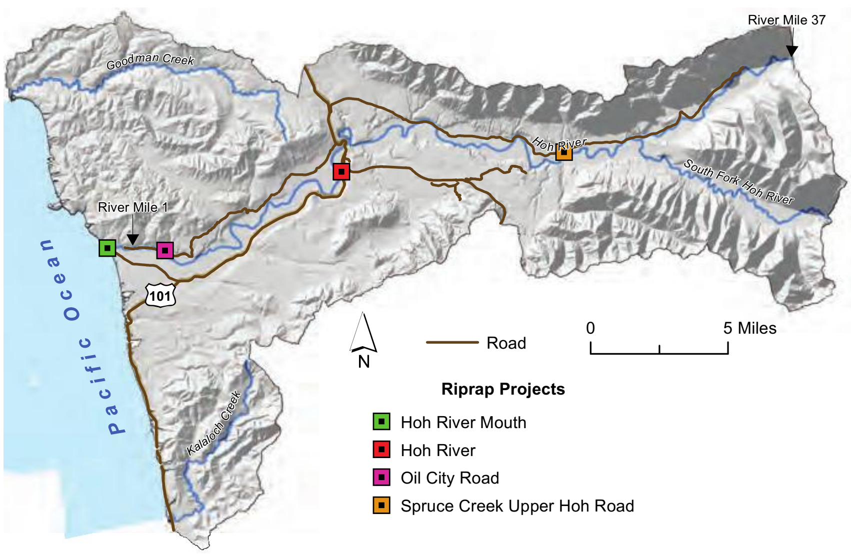
Hoh Tribe

River Bank Riprap

The mainstem Hoh River has over 3.7 miles of riprap between River Mile 1 and 37. Since 2012, there have been at least four new riprap projects as well as extensions and modifications to existing ones. There is no indication that any riprap was removed.

Some river banks in the Hoh Area of Concern have been altered and hardened by the placement of riprap and retaining walls made of rocks and other materials. These are placed to control and minimize streambank erosion but they have a number of negative impacts on the surrounding environment. One of the goals of the WRIA 20 Watershed Management Plan is to restore the natural function of stream channels by reversing stream-channel degradation, increasing floodplain storage and improving aquatic habitat conditions.[1] Some of the degradation of the Hoh River results from river meandering and erosion being halted by rock riprap bank protection. These structures also prevent the recruitment and retention of large woody debris (LWD) in the stream, a problem identified as a factor limiting salmon production.[2]

By 2012, the mainstem Hoh River had over 3.7 miles of riprap between River Mile 1 and 37. Since then, there have been at least four new riprap projects completed, as well as extensions and repairs to existing projects. In the lower Hoh River, wood was placed on a layering of rocks used for riprap on the riverbank. At another site, to protect the lower Oil City Road being threatened by the Hoh River, Jefferson County placed riprap on the road's right of way to avoid getting an emergency Hydraulic Project Approval to do in-channel work. The intention behind the project was that as the river eroded the bank, the riprap would fall into place on the riverbank to stop it from further eroding. That riprap was insufficient to protect the road. The county eventually obtained an emergency hydraulic permit and brought in additional riprap and heavy equipment to protect the section of road being threatened.




Spruce Creek


Hoh River Mouth

Nic Pfeffer-Taggart, Hoh Tribe (2)


Hoh River Project


Oil City Road Project

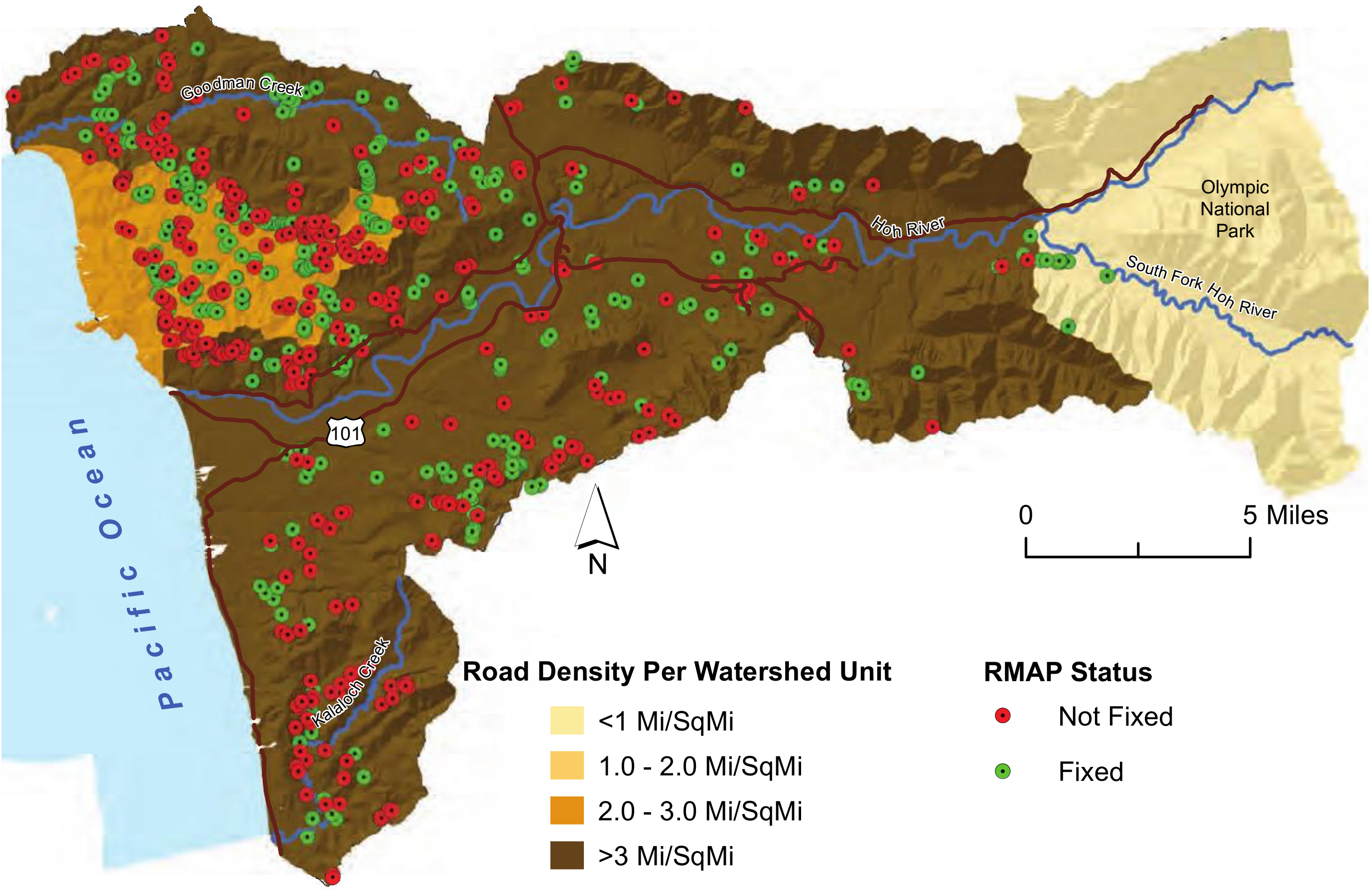
Warren Scarlett, Hoh Tribe (2)

Data Sources: SSHIAP 2004,[3] WADNR 2014c,[4] WADOT 2012,[5] WAECY 2011[6]

AR052759

Impact of Roads

As of 2014, about 47% of the 764 culverts identified under the Road Maintenance and Abandonment Plans (RMAP) in the Hoh Area of Concern have been repaired, while the other 53% remain to be repaired by 2021. Also, six watersheds, representing 72% of the land area, may not be properly functioning because of road density values that exceed 3 miles/square mile.

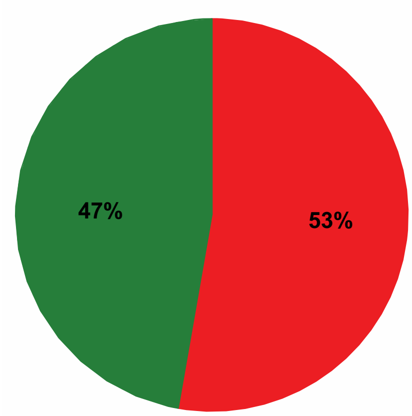


If not properly constructed or maintained, forests roads can be a source of sediments to streams, which degrade fish habitat and water quality.[1] The sediment contribution per unit area from roads is often much greater than all other forest activities combined.[2] Also, many culverts at forest road crossings may constitute fish barriers. One of the goals of the WRIA 20 Watershed Plan is to reverse stream-channel degradation.[3]

In order to reduce the adverse effects of roads, Washington State Forests and Fish Law requires most forest landowners to have a Road Maintenance and Abandonment Plan. The RMAP is a method to evaluate forest roads, identify areas that do not meet forest practices rule standards, and schedule needed upgrades and/or repairs. As of 2014, the RMAP data shows that about 47% of the identified 764 culverts in the Hoh Area of Concern were fixed and another 53% were yet to be repaired. This appears to show that road repairs on both state and private forestlands in this area are on schedule to be completed as mandated by the RMAP program. This will have a positive impact on fish habitat and water quality in the Hoh Area of Concern.

Road density values were over 3 miles/square mile in most watersheds outside Olympic National Park, where the values were less than 1 mile/square mile. A total of six watersheds, representing 72% of the land area, may not be properly functioning because of high road density values. This is the direct result of the network of roads built notably for harvest of timber. Several studies have correlated road density or indices of roads to fish density or measures of fish diversity.[4] Increases in fine sediment in fish spawning habitat were found when road density exceeded 2.5% of the Clearwater watershed.[5]

RMAP Culvert Repair Status



Data Sources: SSHIAP 2004,[6] WADNR 2014c,[7] WADNR 2014d,[8] WAECY 2011[9]

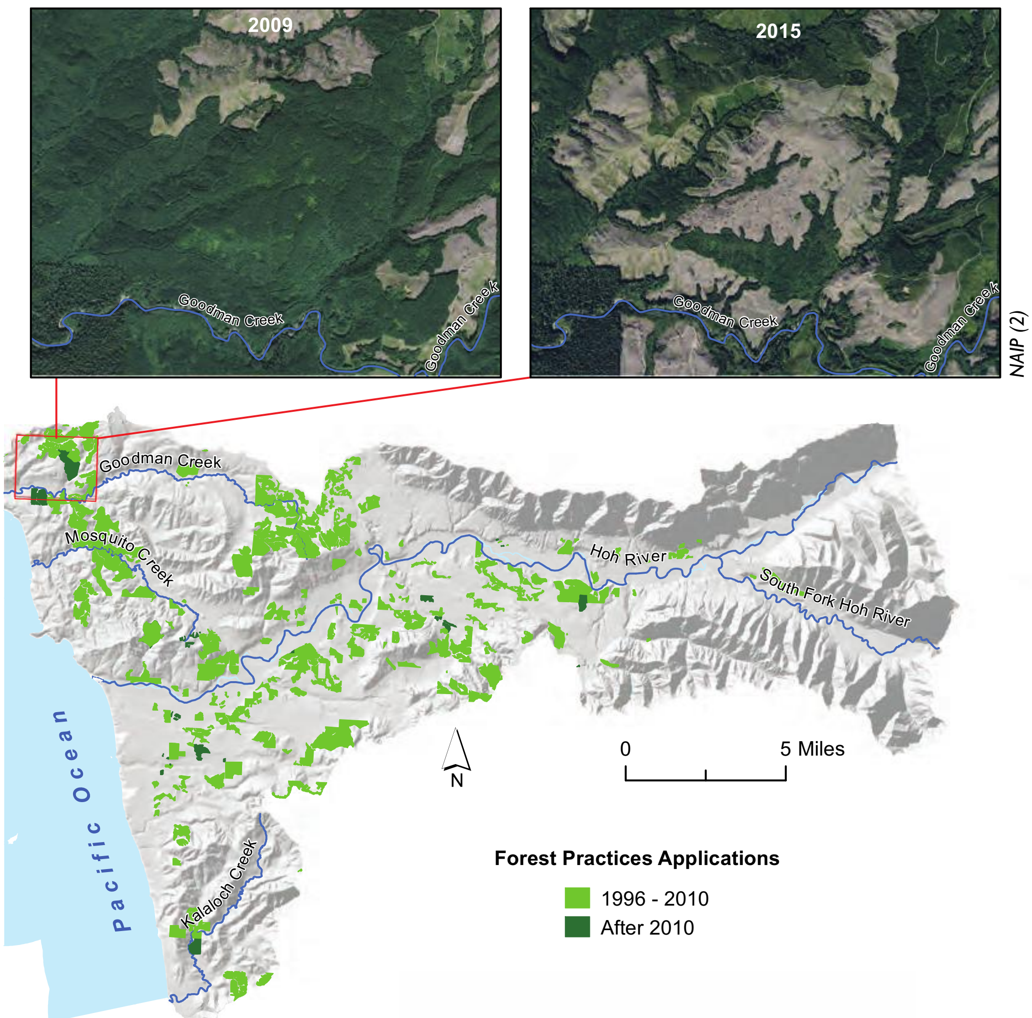
Forest Practice Activities

From 1996 to 2010, 24 square miles of forestlands were harvested in the Hoh Tribe's Area of Concern. Since 2010, an additional 1.6 square miles of forestlands have been permitted for harvest, which may indicate a slower rate of activity, although Forest Practice Applications do not cover all the activities on the ground. Most of the recent activities have been in the Goodman Creek watershed and in areas that are predominantly private forestlands.

Forest practice activities within the Hoh Tribe's Area of Concern directly influence watershed vegetation through creating access to, as well as removal and re-establishment of, forest vegetation. The removal of vegetation has resulted in poor large woody debris and riparian conditions in the basin.[1,2] Debris flows are common and devastating, resulting in scoured, incised channels with few spawning gravels for salmon. The WRIA 20 Watershed Plan recognizes the loss of forest as a watershed threat.[3]

Forest practice applications filed for the purposes of clear-cutting commercial timber products show that between 1996 and 2010, about 24 square miles of forestlands were harvested in this area. Since 2010, an additional 1.6 square miles of forestlands have either been harvested or will soon be harvested, which may indicate a slower rate of activity, although Forest Practice Applications do not necessarily cover all the activities on the ground. A large proportion of the recent forest practice activities have been in the Goodman Creek watershed and in areas that are predominantly private forestlands.

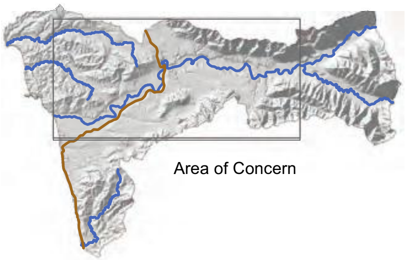
A study in the Hoh watershed revealed that timber harvesting significantly impacts peak and mean daily flow of streamflow at multiple watershed levels.[4] Similarly, reductions in hydrologic maturity with the resultant degradation of floodplain habitat and altered flow regime are significant habitat factors limiting salmonid production in this basin.[5] Aggradation and excessive sedimentation also occur in these watersheds. These conditions may be improved by altering timber harvest rates. The failure to effectively manage these natural resources could have a significant impact on the cultural values attached to them by tribal members.

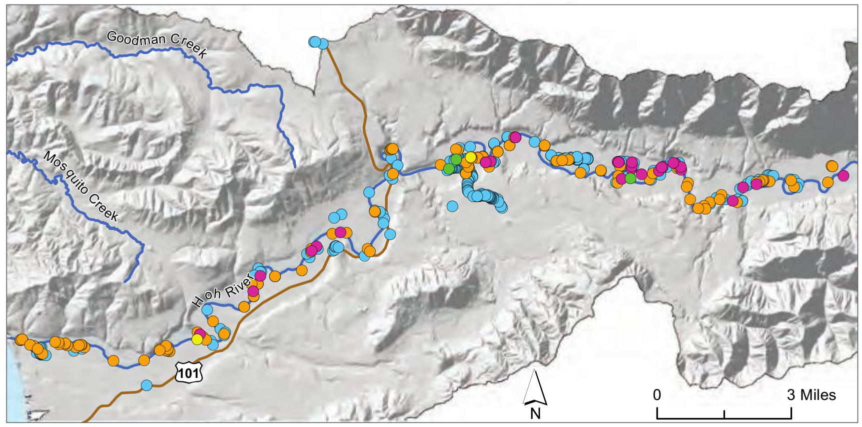


Data Sources: NAIP 2009,[6] NAIP 2015,[7] SSHIAP 2004,[8] WADNR 2011,[9] WAECY 2011[10]

Invasive Species

A multi-year effort initiated in 2002 by the Hoh Tribe to control invasive knotweed plants along 30 miles of the Hoh River riparian zone has resulted in the eradication of about 99.5% of the plants. However, other invasive species like Scotch broom, Herb Robert, and Reed canarygrass continue to spread in the watershed.





Hoh River Invasive Species Distribution 2014

Canada Thistle
Herb Robert
Knotweed
Reed Canarygrass
Scotch Broom

In 2002, a multi-year effort was initiated by the Hoh Tribe to completely eradicate these plants in 29.75 river miles of the active Hoh River channel migration zone and adjacent terraces.[1] The Hoh River's support of relatively healthy wild salmon populations could be threatened by invasive knotweed (*Polygonum spp.*) species found in its riparian zone if treatment does not occur. These plants are a problem because they are known to displace native species and alter riparian 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.[2,3]

Knotweed stem counts show a reduction in the sizes and distribution of the plants.[4] Sites with at least six years of data show that peak numbers were reached in 2003, one year after the project started. Since then, there have been significant stem count drops in all the sites particularly in the Owl Creek and Lindner River bars. It is estimated that by 2011, about 99.5% of the plants had been eradicated on 30 miles of the river and its floodplain. These results show the effectiveness of the control measures.

In a 2014 survey, knotweed made up only 18% of the treated sites, and 65% of the stems were under 3 feet and single-stemmed.[5] Reed canarygrass (Phalaris arundinacea) was more broadly distributed than the previous year, constituting 58% of treated sites. Other species found and treated were Scotch broom (Cytisus scoparius) and herb Robert (Geranium robertianum).

Overall, although significant progress has been made in the control of knotweed in the Hoh River riparian zone, other invasive species like Scotch broom, Herb Robert, and Reed canarygrass continue to spread in other parts of the watershed.

Jill Silver, 10,000 Years Institute

Herb Robert

Data Sources: Silver 2015,[6] SSHIAP 2004,[7] WADOT 2012,[8] WAECY 2011[9]

AR052762

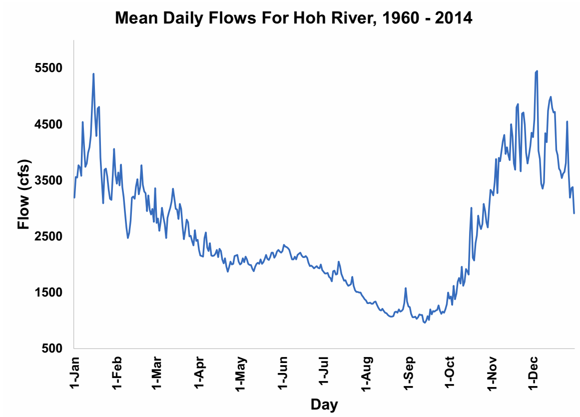
Hoh River Streamflow

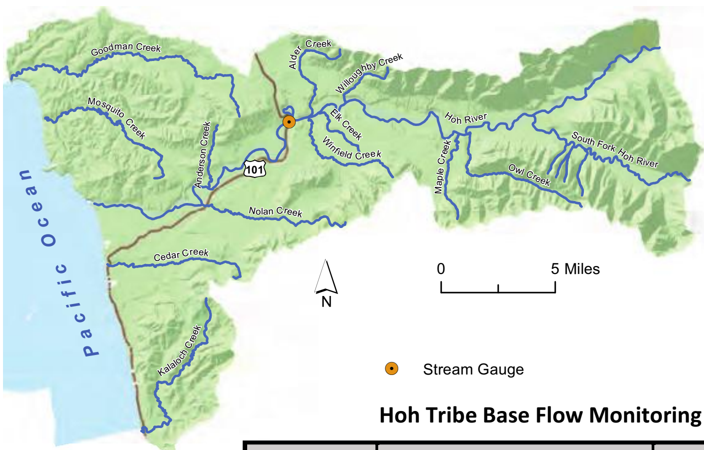
Over the past half-century, the Hoh River peak flow values show an increasing trend while low flows are decreasing. If both trends continue as anticipated under predicted climate change conditions, this poses a significant impact to salmonid runs. In August 2015, base flow measurements were at record lows for tributary streams monitored since 2007 by the Hoh Tribe.

Over half a century of data from the Hoh River gauge at Highway 101 shows that the amount of the river's streamflow is changing. Peak flow values show increased winter streamflow while summer mean low flow values show a decreasing trend at precisely the time when streamflow is needed most and when water temperatures are at their highest. Both trends have been predicted to occur because of climate change and this may indicate that salmon habitat and other aquatic ecosystem functions are not being adequately protected. Low flows and high temperatures mean less suitable habitat for fish as well as impairment of upstream passage of salmon returning to spawn. High flows on the other hand, can scour eggs out of the gravel and create problems for emerging fry.

During a 40-year period, 7-day minimum flow of the Hoh River decreased on average at a rate of about 5 cubic feet per second (cfs) per year.[1] In August 2015, base flow measurements were at record lows for all seven tributary streams monitored since 2007 by the Hoh Tribe.[2]

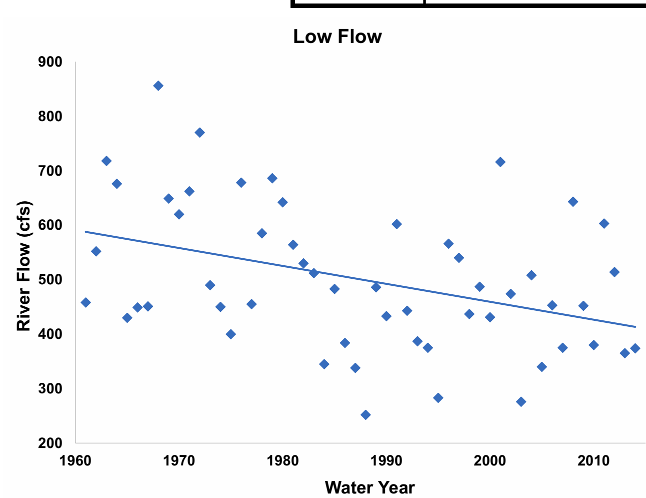
If the low flow trend continues as anticipated under predicted climate change conditions, this may pose a significant challenge to salmonid runs. A recent study found that Chinook salmon populations could be particularly vulnerable to such streamflow changes because spawning fish may show up when rivers are at their lowest levels.[3] The WRIA 20 Watershed Plan recommends that options for maintaining salmonid runs in the face of extended or recurring low flow periods be evaluated for all watersheds.[4]

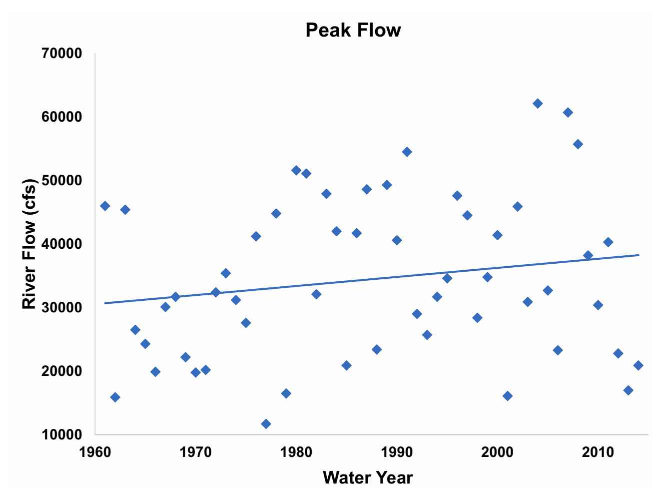




Hoh Tribe Base Flow Monitoring

Creek	Average Lowest Flow (cfs) 2007-20014	Lowest Flow (cfs) August 2015
Anderson	0.67	0.39
Cedar	1.92	0.94
Elk	1.59	1.08
Nolan	1.35	0.61
Owl	7.22	7.87
Willoughby	1.54	0.31
Winfield	3.25	2.81



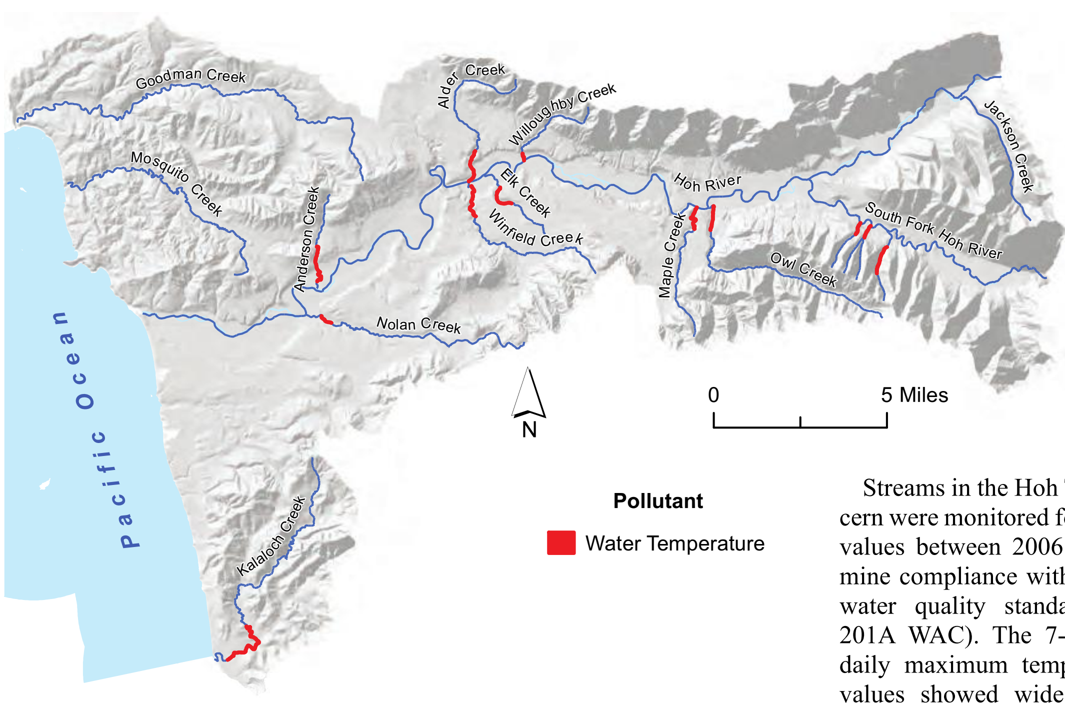


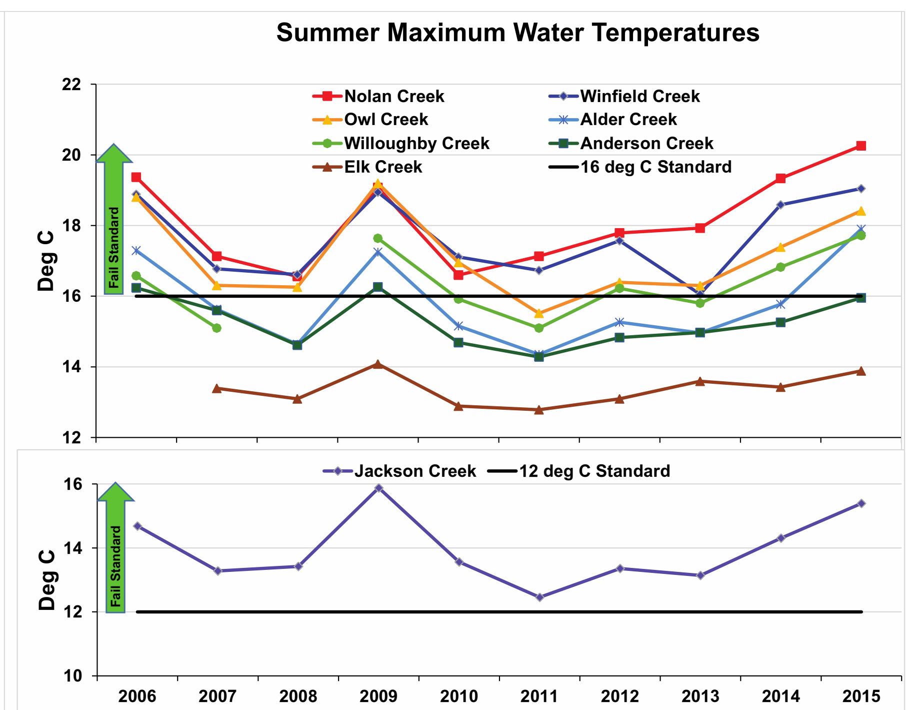
Data Sources: Hoh 2015a,[5] SSHIAP 2004,[6] USGS 2015,[7] WADOT 2012,[8] WAECY 2011[9]

Water Temperature

Between 2006 and 2015, all but one of the major salmonid (coho, Chinook, and steelhead) tributaries to the Hoh River had summer water temperature values which exceeded the Washington state numeric water quality standards. These exceedances will likely have a significant impact on salmonid survival and production in these watersheds.

Impaired Waters for Temperature - 2012





Data Sources: Hoh 2015b,[3] SSHIAP 2004,[4] WAECY 2011,[5] WAECY 2013b[6]

Streams in the Hoh Tribe's Area of Concern were monitored for water temperature values between 2006 and 2015 to determine compliance with Washington state's water quality standards (Chapter 173-201A WAC). The 7-day average of the daily maximum temperature (7-DADM) values showed widespread exceedances and therefore potential violations of the standards.

In all ten years for which data was collected by the Hoh Tribe[1], Jackson Creek had temperature values that exceeded the 12˚C standard for "Char Spawning and Rearing." Similarly, Nolan and Winfield Creeks exceeded the 16º standard for Core Summer Salmonid Habitat in all years while Owl Creek had exceedances in all but one year. Other creeks had varying degrees of failures. The only exception to this general trend was Elk Creek whose relatively intact riparian vegetation may have helped to keep the water temperatures low. In 2012, 12 waterbodies in the Hoh Area of Concern were placed on the 303(d) list for water temperature pollution by the Washington State Department of Ecology.[2]

Generally, these exceedances were highest in 2015, which was also a year of record low flows. These water temperature impairments will likely have a significant impact on fish survival and production in these watersheds since salmonids require cool and well-oxygenated water.

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River Bank Riprap

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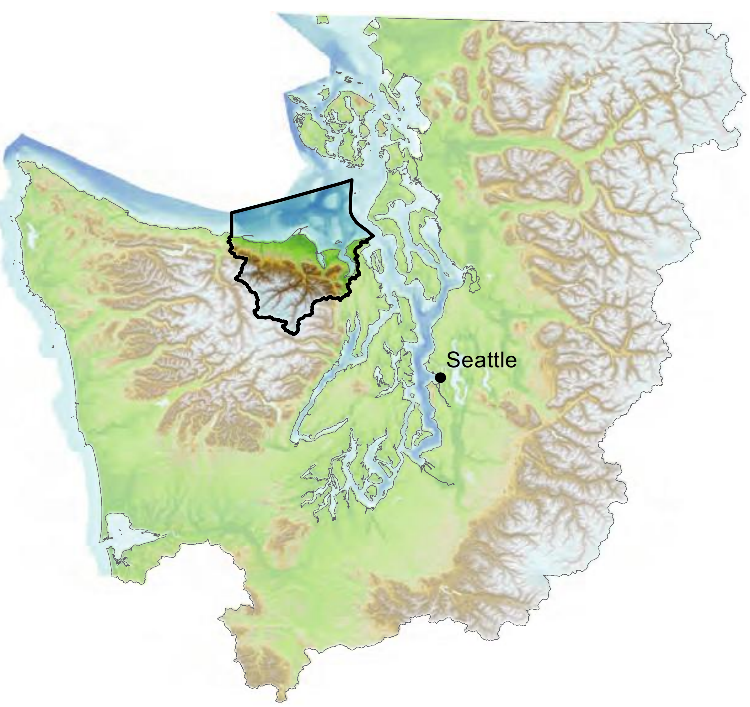
2016 State of Our Watersheds Report
Dungeness – Morse Watersheds

To ensure continued economic growth, promote long-term community vitality and protect sensitive resources and assets, it is essential that we incorporate climate change preparedness into our planning efforts and operations.

– W. Ron Allen
Jamestown S'Klallam Tribe

Jamestown S'Klallam Tribe



The Jamestown S'Klallam Tribe is part of the Klallam Band of Indians that have resided throughout the Strait of Juan de Fuca, Hood Canal and Port Gamble Bay for generations.

Headwaters of the Dungeness basin are in federal lands (Forest Service and National Park) and much of the watershed has remained forested. Commercial forestry is the predominant land use in the upper watershed. The remaining area is a mix of agricultural, rural residential and urban development. This report will focus on portions of the Dungeness Basin and surrounding marine waters, which is only a portion of the area that the Jamestown S'Klallam Tribe works in and manages.

Degradation of Dungeness Basin

The Jamestown S'Klallam Tribe's Focus Area is located in the northeast corner of the Olympic Peninsula and includes portions of WRIAs 17 and 18. These watersheds drain into the Strait of Juan de Fuca and include the Dungeness River, which once supported impressive runs of spring Chinook, summer pink and fall pink salmon.[1] A century of river water withdrawals, riparian forest harvest, and filling and development in the floodplain have made the Dungeness River watershed a ghost of what it used to be.[2] This is the home watershed for the Jamestown S'Klallam Tribe, for which healthy habitat and salmon runs are both culturally and economically vital. Although a large portion of the Focus Area is contained within Olympic National Park and the U.S. Forest Service wilderness area, many of the habitats are heavily impacted by land use, water extractions, infrastructure and other habitat alterations, especially along shorelines and critical environmental areas.

Technical analysis has identified the significant habitat limiting factors for decline of the region's salmonid populations as:

- Estuarine habitat loss and degradation;
- Loss of channel complexity from loss and recruitment of large woody debris;
- Low/impaired instream flows;
- Floodplain and shoreline modifications;
- Sediment aggradation; and
- Loss of littoral drift.[3]

Washington Department of Ecology Coastal Atlas, 2006

A marina environment is a type of armored shoreline in Sequim Bay.

Recovery Plan Includes Protecting Habitat and Fish

The overall salmon recovery strategy for the region seeks to maintain habitat integrity to protect and strengthen wild stocks while restoring habitat for the formerly productive but currently weak wild stocks.

Specific salmon recovery goals and prioritized actions are identified in the North Olympic Peninsula Lead Entity (NOPLE) for Salmon strategy and workplans. NOPLE is the umbrella organization that brings representatives from most of the different stakeholder groups together to coordinate salmon recovery efforts across the North Olympic Peninsula. NOPLE has established priorities for both watershed and nearshore processes to recover ecological function. Priority work is related to hydrologic regime, sediment supply, lower river hydrodynamics, water quality, canopy cover, floodplain restoration and nutrient input.

The identified goals for the NOPLE Recovery Strategy are:

- Achieve fish stocks that are robust to changing conditions, self-sustaining over the long term and capable of supporting harvests (ceremonial, subsistence, recreational and commercial).
- Implement the salmon recovery plans to protect and restore fish habitat.
- Restore and maintain ecosystem function; and
- Integrate efforts toward larger salmon recovery and restoration goal in the entire Puget Sound.[4]

Jamestown S'Klallam Tribe

A box culvert on Siebert Creek under Highway 101 near Sequim.

Recovery Efforts Lagging

At the 10-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Dungeness basin planning area shows that priority issues continue to be degradation of water quantity and quality, degradation of floodplain and riparian processes, degradation of marine shoreline habitat conditions, and habitat blocked to fish access. 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., Siebert Creek culvert replacement, Dungeness River floodplain restoration) contribute to the slow pace of progress.

Review of the status of these key environmental indicators since the 2012 State of Our Watersheds Report shows a steady loss in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Stream Blockage – Culverts	There is concern that a high ranking project (Siebert Creek Hwy 101 Fish Passage Restoration) to remove an undersized culvert blocking 33 miles of fish habitat is not getting attention or being completed.	**Unknown**
Marine Shoreline Modifications/Forage Fish Impacts	Only 63% of marine shorelines remain in a natural condition. Since reported in 2012, modified and armored marine shoreline has increased by 1%. 52% of the marine shoreline documented as sand lance, surf smelt and herring habitat has been negatively impacted and impacts have increased by 1% since reported in 2012. Herring stocks remain in critical status in Discovery Bay.	**Declining**
Forestland Cover	From 2006-2011, the number of sub-watersheds having a moderate, poor or severely damaged forest cover has increased by 3%. 65 of 99 sub-watersheds had an overall loss of forest cover.	**Declining**
Impervious Surface	From 2006-2011, there was a 1% increase in impervious surface. 9% of the sub-watersheds had increases of 2-4%, primarily in UGAs. 12 subwatersheds have 12-40% impervious surface area or seriously degrading watershed health.	**Declining**
Climate Change	Climate change is affecting tribal natural resources and infrastructure. JKST has developed a vulnerability assessment and adaptation plan to prepare for climate change.	**Unknown**

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

As the Tribe looks ahead, the issues and indicators discussed in this report will remain as priorities needing attention and monitoring. The Tribe continues to work on issues pertaining to armoring along all marine shorelines and particularly its effects on herring and forage fish habitat. Other priority issues include the decrease in forest cover and the increase of impervious surface in important habitat areas.

The Jamestown S'Klallam Tribe is on the forefront of addressing tribal 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, they have identified and prioritized areas where the changing climate conditions (i.e., changing precipitation patterns, sea level rise, ocean acidification) will leave their resources, infrastructure, economy and health most vulnerable.[5] Sea level rise models designed for their Focus Area show potential damage and vulnerability to critical beaches, tribal infrastructure, main roads and emergency services. Additional impacts to the Tribe include increased occurrence of shellfish poisoning associated with harmful algal blooms (which warmer conditions may favor) and potentially diminished health and wellness of Tribal members.

One of the main problems in the Dungeness watershed, both for fish and humans, is low streamflows, especially in late summer when the highest demand for irrigation water coincides with peak Chinook spawning. The Tribe has worked for many years with the irrigation community, as well as the Clallam Conservation District and Washington Department of Ecology, to reduce the impacts of irrigation by implementation of water conservation projects and other improved irrigation system efficiencies. Over the past 15 years, the irrigators have reduced their withdrawal by over 45% with the development and implementation of the Water Conservation Plan.[6] Progress has been made, but Dungeness flows are still inadequate for sustaining ESA-listed salmon species. Currently an agreement between the Water Users Association and Washington Department of Ecology (September 2012) details allowed water uses and mitigation activity for irrigation. The agreement binds the irrigators to withdraw no more than 50% of the river flow, while always leaving at least 60 cfs; and to reduce their adjudicated certificates to 93.5 cfs. The Tribe is hopeful that the irrigators will commit to further reductions in irrigation diversions.

In spite of outward appearances, the Sequim/Dungeness watershed is still degraded. Hydrological modifications of the Dungeness River, including a 3-mile-long Army Corps of Engineers levee and five private levees, have caused such significant aggradation in the lower river that flooding is a constant threat. The Jamestown Tribe is working with the Army Corps of Engineers through a tribal Treaty Rights at Risk forum about this very serious


PNPTC

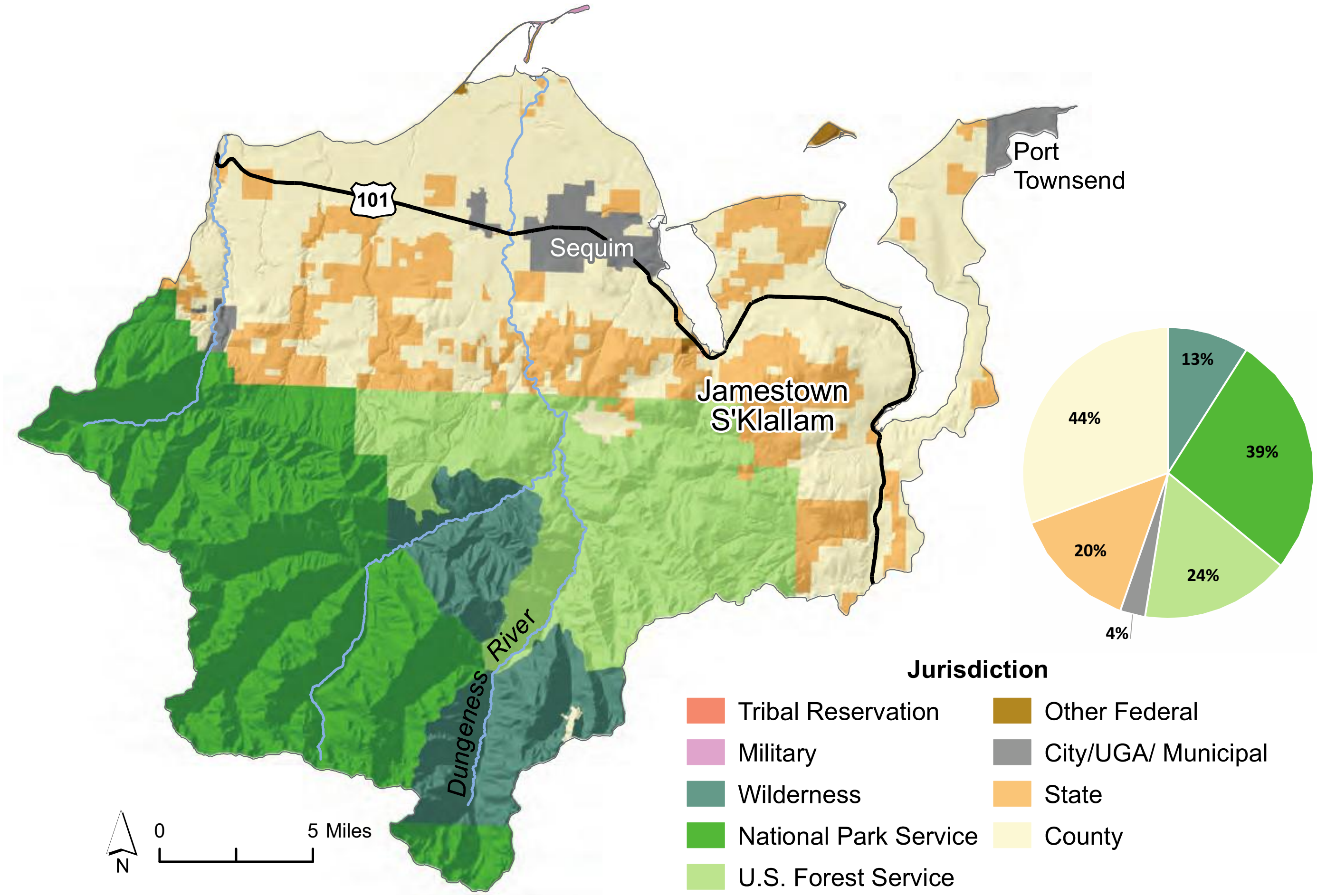
Forest cover at Fort Warden State Park.

concern. The Tribe is hoping to gain continued funding to include floodplain restoration. Funding from the Puget Sound Acquisition and Restoration Fund and the Floodplains by Design initiative has been allocated for restoration efforts in the lower Dungeness River floodplain to restore and improve nearshore, estuary and floodplain conditions, while reducing downstream flood risk. The project funded in 2015 includes plans for levee setbacks and habitat restoration to reconnect 112 acres of floodplain that is expected to be completed within the next five years. The Jamestown Tribe will continue to lead efforts to plan and implement additional habitat restoration on the river.

Within the past 10 years, there has been a proliferation of commercial development and associated increase of impervious surfaces, leading to greater amounts of stormwater runoff. Stormwater runoff impacts fresh and marine waters and is a contributing factor to shellfish harvest area downgrades and salmon fatalities in local streams. Shellfish beds in both Dungeness and Sequim bays are closed to harvest due to either bacterial pollution or toxins associated with algal blooms. Urban and residential growth in the watershed relies almost entirely on groundwater sources that are hydraulically linked with the Dungeness River. Except for the city of Sequim, the entire watershed is served by individual or community septic systems, many of which are likely contributors to marine bacterial pollution.[7] The Tribe will continue to monitor and address impacts to water quality and shellfish.

Habitat is declining despite the assessment of the Puget Sound Chinook Recovery Plan that protecting existing habitat is the most important action needed.[8] Conditions in the Dungeness River floodplain that are harmful to both fish and humans have been described in the Dungeness Flood Control Plan (1990), Dungeness Comprehensive Flood Hazard Management Plan (2009) and several salmon recovery documents. A focused message is needed to foster community will and political support to protect remaining high-quality habitat.

Jamestown S'Klallam Tribe



The Focus Area for the Jamestown S'Klallam Tribe report is in the northeast corner of the Olympic Peninsula and includes portions of WRIA 17 (Quilcene-Snow) and WRIA 18 (Dungeness-Elwha) in the rain shadow of the Olympic Mountains. Its watersheds drain north to the Strait of Juan de Fuca and Admiralty Inlet. These watersheds include the Dungeness River, whose headwaters are located in the Olympic National Park and U.S. Forest Service wilderness areas, as well as several smaller independent drainages.

The topography and precipitation patterns vary dramatically within the Focus Area, from high mountain ridges with 240 inches of annual precipitation to lowland valleys with only 15 inches of annual precipitation. 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 many forage fish and salmonid species, including the ESA-threatened Hood Canal/Eastern Strait summer chum and the Puget Sound Chinook.

Many streams in the Focus Area have natural periods of low flows and may go dry during the summer months when precipitation is sparse. This renders streams particularly vulnerable to human impacts, such as riparian vegetation removal and water extractions. While these streams may not flow year-round, they still provide important spawning habitat for fish populations, including coho and fall chum.

The Klallam were the first 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. After the signing of the Point No Point Treaty of 1855, the S'Klallam tribes ceded their lands to the U.S. 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 and farming the floodplains of the lower Dungeness River. Today the region is largely rural and forested; however, Jefferson and Clallam counties, along with the local cities Port Townsend and Sequim, are rapidly developing.

Data Sources: SSHIAP 2004,[1] USFWS 2014,[2] WADNR 2014a,[3] WADNR 2014b,[4] WADNR 2014c,[5] WADOT 2013,[6] WAECY 1994,[7] WAECY 2011a,[8] WAECY 2013[9]

Nearshore Habitat Loss in the Strait of Juan de Fuca from Morse Creek to Port Townsend

Since reported in 2012,[1] modified and armored marine shoreline has increased by 1% in the Jamestown S'Klallam Tribe's focus area. The Jamestown S'Klallam Tribe relies on healthy habitats for fish and shellfish to sustain their way of life and they are working toward restoring and preserving natural shoreline in this region.

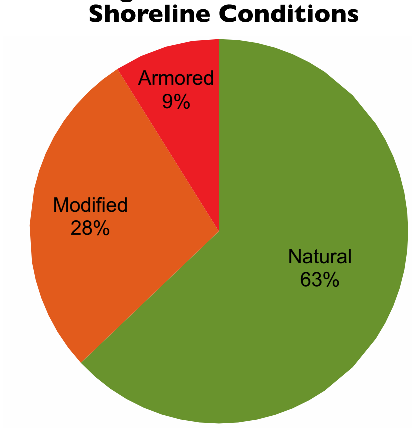
A. Natural Shoreline

B. Modified Shoreline

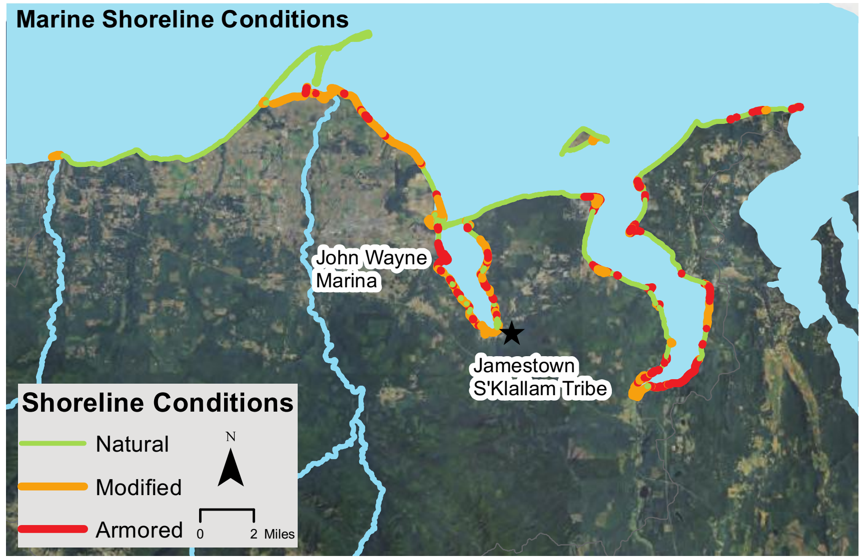
C. Armored Shoreline

Washington Department of Ecology Coastal Atlas, 2006 (3)

Figure 1: Calculated Shoreline Conditions



As of 2012, data collected on shoreline conditions in this focus area shows that 63% is natural, 28% is modified and 9% is armored (Figure 1). New shoreline armoring was permitted in Clallam and Jefferson counties from 2005 through 2014 (Figure 2).

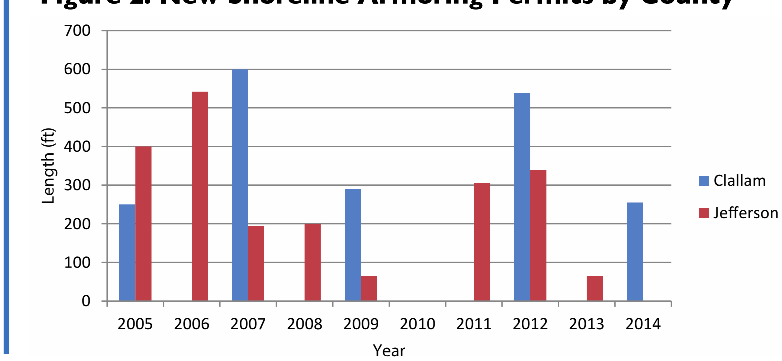


Data Sources: Carman et al. 2015,[8] NAIP 2011,[9] PSNERP 2008,[10] SSHIAP 2012[11]

The Strait of Juan de Fuca contains a rich array of marine habitats that support diverse populations of fish, marine mammals, and other wildlife. The impacts of bulkheads, docks, and other forms of armoring can reduce or eliminate productive beaches and shallow water habitats through filling or by alteration of sediment sources or sediment transport along the nearshore.[2] Furthermore, shoreline armoring associated with a single-family residence, which is exempt under local Shoreline Master Plans, has substantially increased.[3] However, the nearshore coastline adjacent to the Jamestown S'Klallam reservation is largely forested and undeveloped, which is notable compared to the area near the northwestern shore of Sequim Bay (Photo C). This area by Washington Harbor has had a long history of occupancy by the Jamestown S'Klallam Tribe up until the time of non-Indian settlement.[4]

Today habitat function has been lost as a marina, dock, fill, parking lot and launch ramp have severely impacted the shoreline natural processes.[5] The marsh habitat partially isolated by road fill to the south of the marina can likely support juvenile salmon and is of interest for restoration. Shoreline alterations such as jetties and rock walls disrupt the flow of sediment on beaches. Docks and bulkheads cover beaches and reduce the productivity of plants and fish in these areas.[6] The Jamestown S'Klallam Tribe relies on these healthy habitats to sustain their way of life, including fishing and shellfishing, and the Tribe is working toward preserving and restoring habitat in this region. Habitat alteration has been identified in the Action Agenda as a threat and a priority for action in the Puget Sound and Strait of Juan de Fuca.[7]

Figure 2: New Shoreline Armoring Permits by County



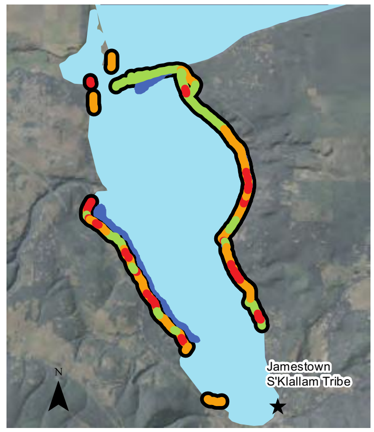
There is an unknown amount of unpermitted armoring that is not included in this graph.

Spawning Conditions for Sand Lance, Surf Smelt and Herring Are Threatened

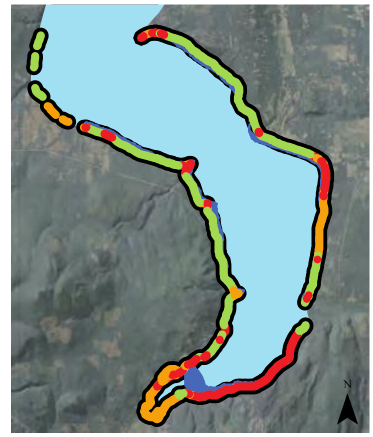
In the Jamestown S'Klallam Tribe's Area of Concern, 52% of the shoreline documented as sand lance, surf smelt and herring habitat has been negatively impacted. Since reported in 2012,[1] modified and armored shoreline has increased by 1%. Armoring and modification interrupts the movement of sand and sediment along the shoreline and could negatively affect spawning habitat. Herring stocks remain in critical status in Discovery Bay.

Forage fishes, such as sand lance and surf smelt, spawn on upper intertidal beaches made of sand and gravel. These fish are small schooling fishes that are important prey for larger predatory fish and wildlife in the marine food web.[2] Sand lance is recognized as being one of the key elements of a juvenile chinook's nearshore diet.[3] In the Strait of Juan de Fuca, the bays have been altered in various ways by human activities, to the detriment of these species. Studies show that development on shorelines negatively affects their spawning sites.[4] This could be one of the main factors contributing to their continued decline. Maintaining abundant herring, surf smelt and sand lance in Puget Sound is a conservation imperative, but current county regulations do not consider cumulative or off-site impacts of armoring the shoreline and do not address likely future conditions such as climate change.[5,6]

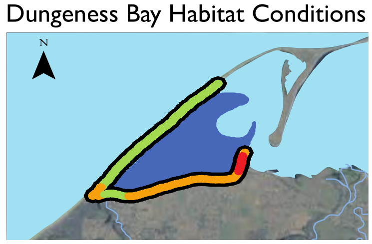
Sequim Bay Habitat Conditions



Discovery Bay Habitat Conditions



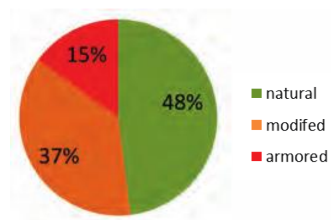
Dungeness Bay Habitat Conditions



Shoreline Conditions Surveyed for Forage Fish and Herring

Natural
Modified
Armored
Herring Spawning Areas
Spawning Areas Surveyed

Figure 1: Fish Habitat Shoreline Conditions



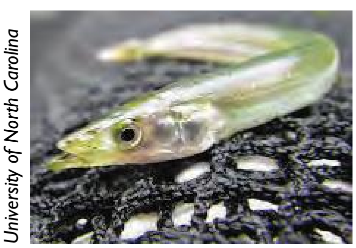
Shoreline conditions in known forage fish spawning areas by percentage area. Of note, not all shorelines have been surveyed.

WDFW

Surf Smelt

University of North Carolina

Herring



USGS

Sand Lance

Pacific herring are a valuable indicator of ecosystem health and they serve as an important bait fish for tribal fishermen. In Discovery Bay, Pacific herring status is critical (Figure 2), which is one step away from disappearance. In Sequim Bay, the status in recent years has fluctuated between moderately healthy and depressed. The estimated herring biomass in Discovery Bay and Sequim Bay combined continues to be low compared to the 1980s.[7]

Figure 2: WDFW Herring Status[8]

Year	Discovery Bay	Sequim Bay
1994	Critical	unknown
1996	Depressed	Healthy
1998	Critical	Healthy
2000	Critical	Healthy
2002	Critical	Moderately Healthy
2004	Critical	Depressed
2006	Critical	Depressed
2008	Critical	Depressed
2010	Critical	Depressed
2012	Critical	Moderately Healthy

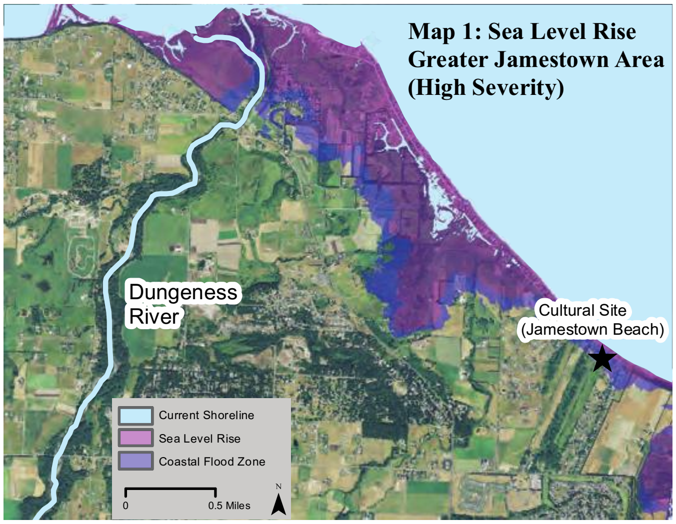
Data Sources: Carman et al. 2015,[9] NAIP 2011,[10] SSHIAP 2004,[11] WADFW 2010[12]

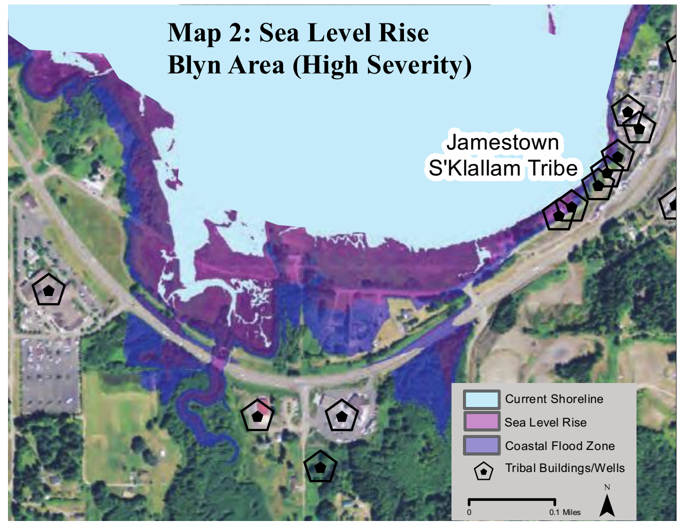
AR052773

Jamestown S'Klallam Tribe

Vulnerability Assessment and Climate Change Adaptation Preparation

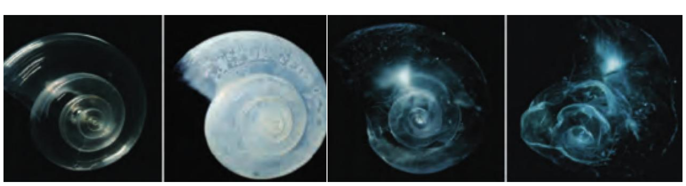
The Jamestown S'Klallam Tribe has prepared a climate adaptation plan to assess vulnerabilities and reduce negative impacts, if possible. Sea level rise models show potential damage and vulnerability to critical beaches, tribal infrastructure, main roads and emergency services.





The Jamestown S'Klallam Tribe is on the forefront of addressing tribal 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, they have identified and prioritized areas where the changing climate conditions (i.e., changing precipitation patterns, sea level rise, ocean acidification) will leave their resources, infrastructure, economy and health most vulnerable.[1]

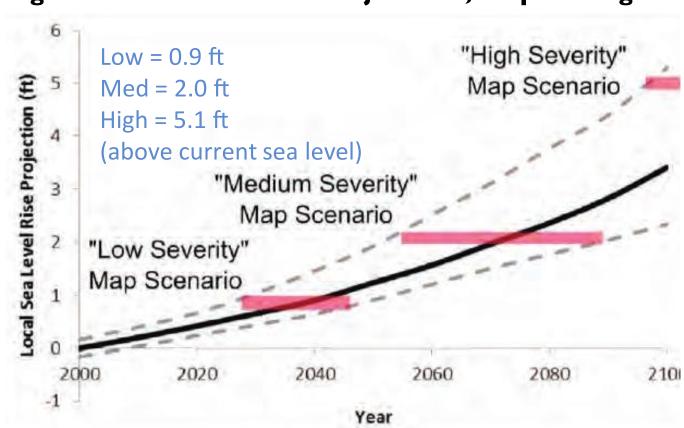
Climate vulnerability depends largely on climate exposure, sensitivity, and adaptive capacity.[2] Vulnerability rankings were determined through an interactive process with Tribal elders, citizens and government. For example, salmon provide the foundation for almost all aspects of tribal cultural life and also serve as economic and nutritional resources for the Tribe. Salmon will be impacted by the change in timing and amount of winter rains and flooding, scouring of egg redds (nests) during high flows, thermal stress from higher water temperature and less water, and therefore habitat availability in the summer. Oysters and clams also are highly vulnerable under expected conditions and are a very high priority for the Tribe. Some of the potential impacts to shellfish include higher water temperatures and ocean acidification. Additional impacts to the Tribe include increased occurrence of shellfish poisoning associated with harmful algal blooms (which warmer conditions may favor), diminished health and wellness of Tribal citizens, economic loss, and flooding of tribal buildings, sacred historical places and infrastructure.[3] The maps above show flood conditions with a sea level rise model under the highest severity scenario (Figure 1).[4] They show the potential inundation of a vital water source, closed roads, an important cultural site at Jamestown Beach (Map 1) and buildings on the tribal campus in Blyn (Map 2) where flood risk is projected to increase by the end of the century.[5]



WAECY[6]

Ocean acidification (decrease in ocean pH) will cause waters to become "corrosive to shell-forming organisms such as oyster larvae, clams, mussels and crabs," posing some serious threats to the shellfish in the Strait of Juan de Fuca.[7] Pictured are the pteropod shells dissolving because of decreasing ocean pH.[8]

Figure 1: Sea Level Rise Projections, Sequim Region



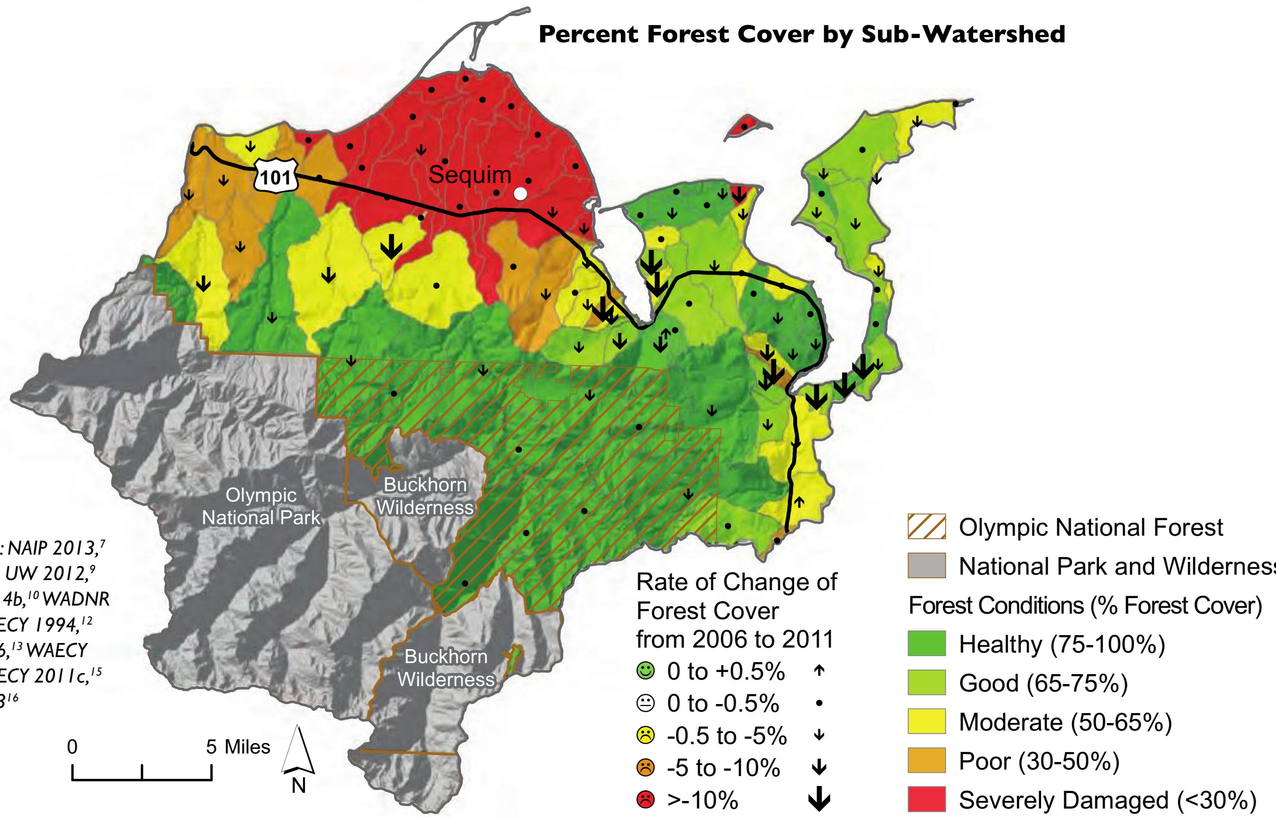
Graph of sea level rise scenarios. This figure was extracted from the Jamestown Climate Vulnerability Assessment and Adaptation Plan.[9]

Data Sources: NAIP 2011,[10] Adaptation International Climate Models[11]

Forested Land Cover Critical for Watershed Health

Land with good to healthy amounts of forest cover is decreasing in the Focus Area outside Olympic National Park and Buckhorn Wilderness. Of the 99 sub-watersheds, those with moderate, poor or severely damaged amounts of forest cover increased from 50 sub-watersheds in 2006 to 53 sub-watersheds in 2011. Sixty-five sub-watersheds had an overall loss of forest cover from 2006 to 2011.

Percent Forest Cover by Sub-Watershed

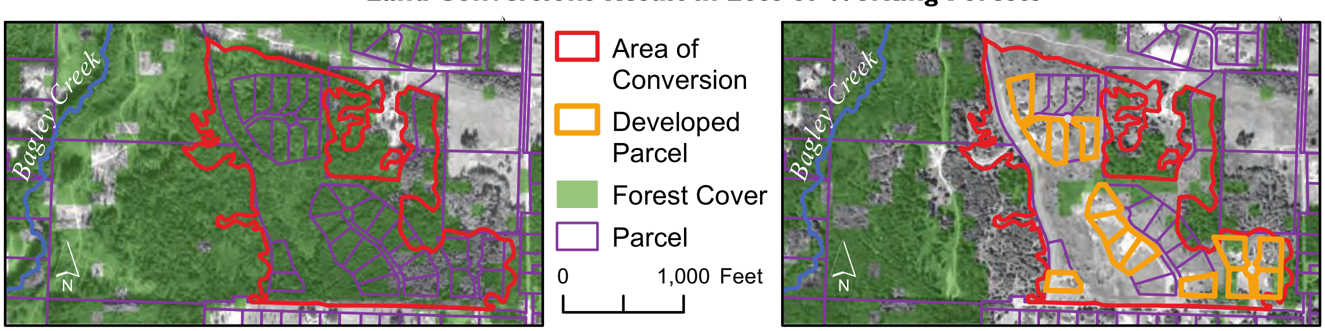


Data Sources: NAIP 2013,[7] NAPP 1994,[8] UW 2012,[9] WADNR 2014b,[10] WADNR 2014c,[11] WAECY 1994,[12] WAECY 2006,[13] WAECY 2011b,[14] WAECY 2011c,[15] WAECY 2013[16]

Forested land cover is a vital component of healthy stream ecosystems at both the watershed and riparian corridor scales.[1] The Hood Canal and Eastern Strait of Juan de Fuca Summer Chum Salmon Recovery Plan states that the "removal and modification of native riparian forests increases water temperatures, reduces stability of floodplain landforms and reduces large woody debris recruitment to stream channels."[2]

Loss of forest cover degrades aquatic ecosystems even when the level of impervious surface is low.[3] The threshold for minimal to severe stream degradation is 65% forest cover;[4] however, any level of disturbance has an impact on stream ecology.[5] Restoring forest cover through vegetation planting in riparian and adjacent areas is vital to salmon habitat restoration efforts in the Dungeness River.[6] While some forest cover is regained through plantings in working forests, much more is lost as forestland is converted and developed. Outside of the Olympic National Park and Buckhorn Wilderness, forest cover decreased in 65 sub-watersheds, resulting in a loss of over 5% forest cover in 16 sub-watersheds and an overall loss of 2% (over 2,600 acres) of forest cover from 2006 to 2011.

Land Conversions Result in Loss of Working Forests



1992 Forest Cover (1994 aerial photo)

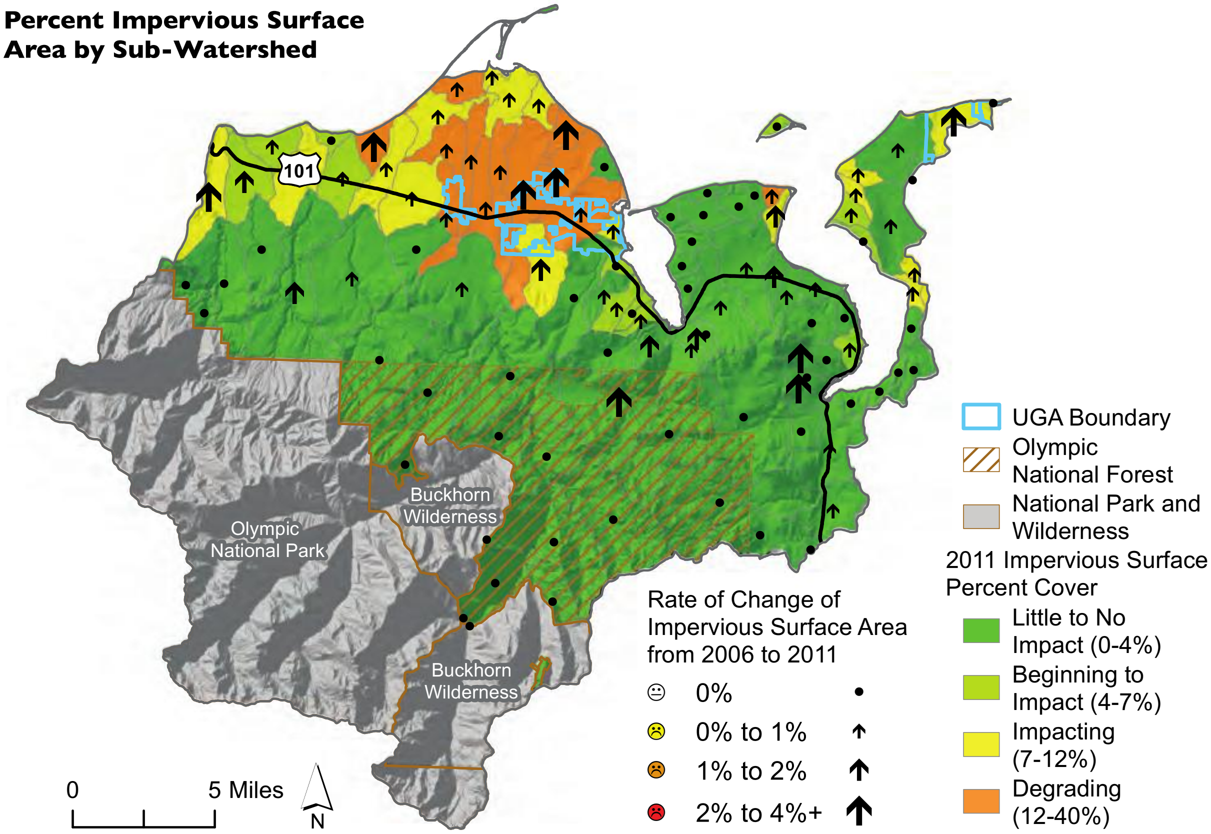
2011 Forest Cover (2013 aerial photo)

Seventy acres of forested land cover was removed by two permitted Forest Practice Application activities between 1999 and 2007 at this site near Bagley Creek. Fourteen new homes were built on the converted land between 2007 and 2014, with room for 14 additional homes.

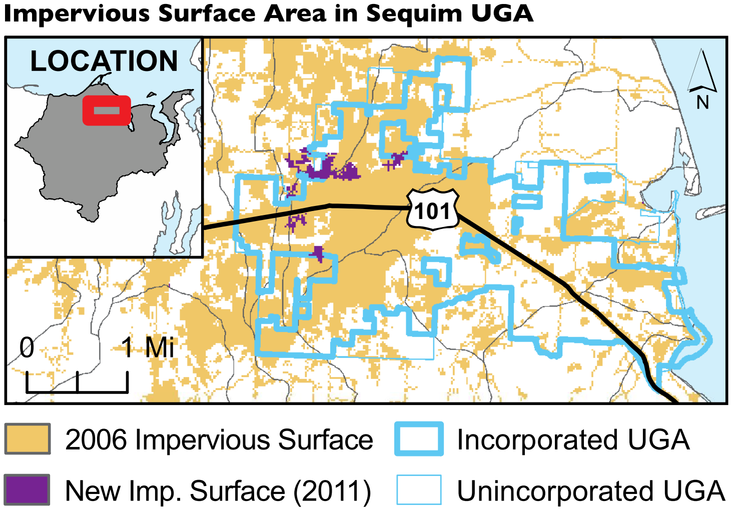
Impervious Surface Negatively Impacts Water Quality

Impervious surface area increased by 1% across the Focus Area from 2006 to 2011. Nine of the 99 sub-watersheds within the Focus Area had increases of 2% to 4% impervious surface area, primarily in Urban Growth Areas (UGAs). Twelve sub-watersheds have degrading watershed health (12-40% impervious surface area).

Percent Impervious Surface Area by Sub-Watershed



Impervious Surface Area in Sequim UGA

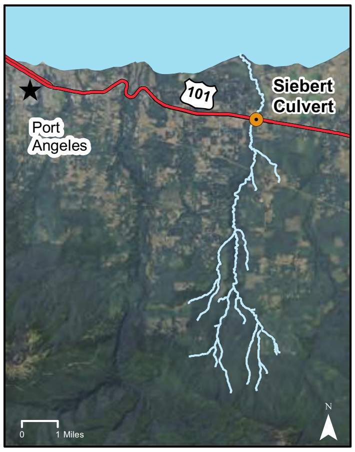


High population densities lead to large amounts of impervious surfaces, negatively impacting the local watersheds and resulting in loss of salmon habitat. The Sequim-Dungeness area is predominantly rural, but any level of human disturbance impacts watershed processes. Impervious surface area is well documented as a coarse measure of human impact on watershed scale hydrology and biology.[1,2,3] Impervious surface area causes increases in stream temperatures, decreases in stream biodiversity, and contributes to pollutants in stormwater runoff, which can contaminate local aquatic systems.[4] 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.[5] Watershed health is beginning to be impacted by impervious surface in 13 sub-watersheds within the Focus Area, is impacted already in 16, and degraded in 12. Each watershed has 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.[6] Impervious surface increased by only 1% between 2006 and 2011 in the Focus Area, however nine sub-watersheds had increases of 2-4%. Over two-thirds of the new areas of impervious surface occurred in UGAs – 55% in the Sequim UGA alone.

Data Sources: NLCD 2006,[7] NLCD 2011,[8] SSHIAP 2004,[9] WADNR 2014b,[10] WADNR 2014c,[11] WAECY 1994,[12] WAECY 2011c,[13] WAECY 2013[14]

Siebert Creek Culvert: A Fish-Passage Barrier

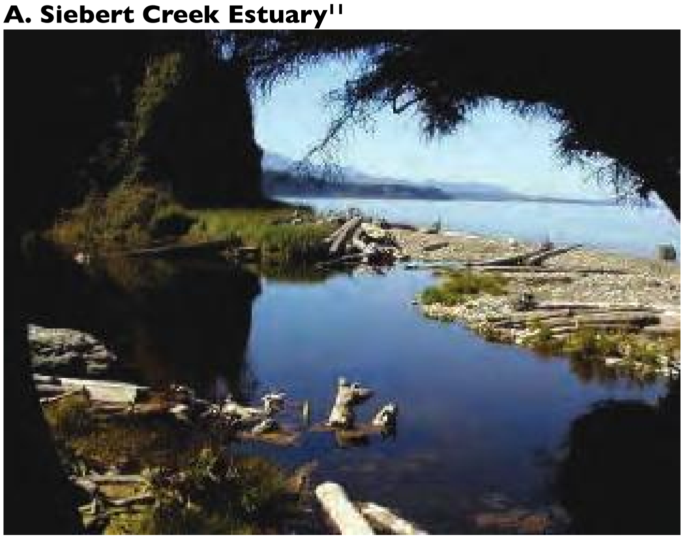
The Jamestown S'Klallam Tribe, as a co-manager of its shared natural resources with Washington state and steward of healthy fish habitat, is concerned about the timely removal of a fish passage barrier on State Highway 101. This barrier is a culvert that blocks over 33 miles of habitat of Siebert Creek, which provides home for ESA-listed steelhead and coho, and may provide habitat for fall chum and chinook.



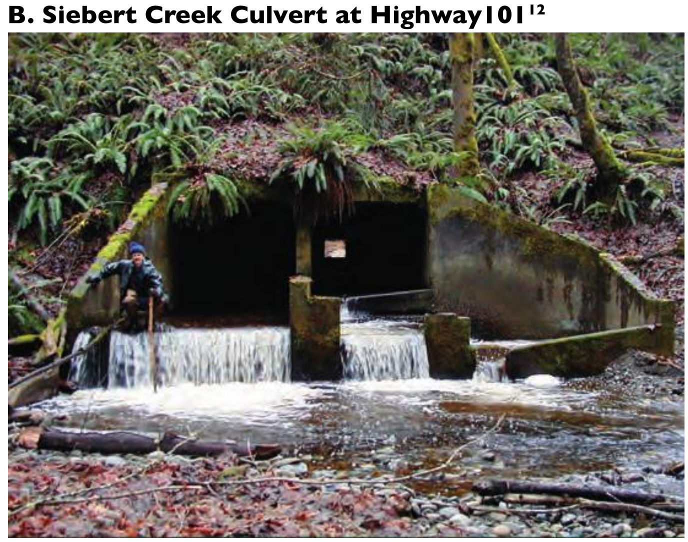
Judge Boldt's 1974 ruling in *U.S. v Washington* (the Boldt decision), upheld the tribal treaty right entitling the treaty tribes of Washington, including the Jamestown S'Klallam Tribe, to half of all harvestable salmon in their Usual and Accustomed treaty fishing areas.[1] More recently, in 2013 *U.S. et al v. State of Washington* (culvert case), the state was ordered to provide fish passage at culverts owned or managed by Washington State Department of Transporation.[2] As a result of this case, Washington state was ordered to fix fish-blocking culverts. Ranked as number 26 on the list, the Siebert Creek/Highway 101 culvert is scheduled for design and repair should funding become available.[3] For the Jamestown S'Klallam Tribe, the Siebert Creek estuary is characterized as prime salmonid habitat and is known as one of the best examples of a functioning, bar-bound estuary in the state of Washington.[4]

This nearshore habitat contains high-quality kelp and eelgrass and provides critical rearing and feeding areas for juvenile salmonids and a diverse assemblage of waterfowl. It also may provide foraging, refuge and rearing habitat for ESA-listed chum and chinook salmon juveniles from the Dungeness River during their seaward migration and is identified as foraging, migration and overwintering habitat for bull trout.[5] The stream historically had fall chum,[6] but currently has healthy habitat for winter steelhead and coho.[7] The Highway 101 box culvert hinders and prevents upstream movement of adults and is a barrier to juveniles going downstream during summer low flows. At times, vertical drops of several feet have been observed at this fishway outlet and the downstream is devoid of pools.[8] Should this barrier be removed, there will be 34 miles of lineal habitat gained, 25 acres of spawning area gained, and 30 acres of rearing habitat gained.[9] In 2004, this culvert was recommended to be replaced with a bridge, supported by the WRIA 18 Watershed Plan, WDFW and the limiting factors analysis,[10] but has yet to be repaired. Although this culvert was initially anticipated to be replaced by 2020, the timeline has been shifted to a later date. Confounding factors indicate that cost and other obstacles will move the start date even later and possibly prevent the completion of this very important, but expensive project.

A. Siebert Creek Estuary[11]



B. Siebert Creek Culvert at Highway101[12]



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Data Sources: NAIP 2011,[13] SSHIAP 2010,[14] WADNR 2014b[15]

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Siebert Creek Culvert: A Fish Passage Barrier

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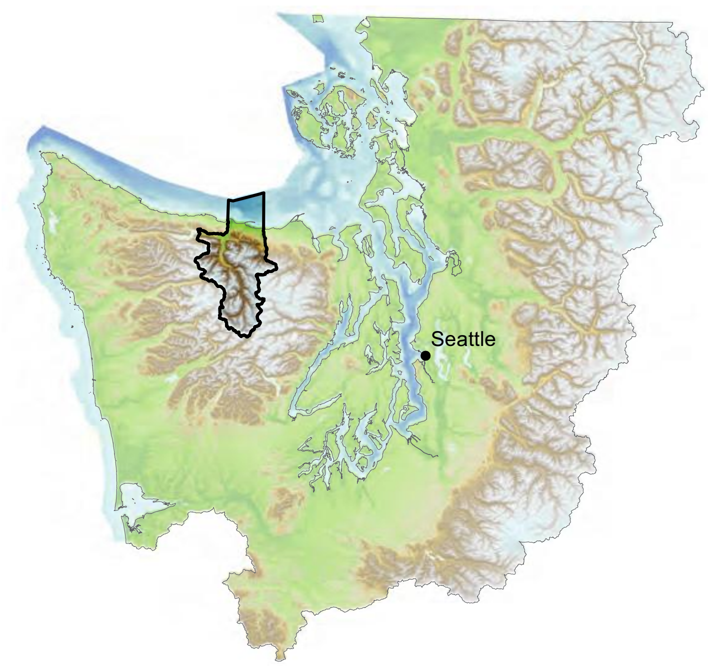
2016 State of Our Watersheds Report
West WRIA 18 – Morse Creek to Elwha River

Dam removal seemed like an elusive target over the years and many citizens were skeptical of the benefits. However in just four years the river has transported over 60% of the stored sediment, resulting in a rebirth of the estuary and the floodplain. Salmon are ascending to historic habitats and the recovery of the ecosystem is about to blossom.

-Mike McHenry
Fisheries Habitat Manager



Lower Elwha Klallam Tribe

The Lower Elwha Klallam Tribe is part of the Klallam Band of Indians that have 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 Dungeness-Elwha Basin (WRIA 18) has 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.

Elwha Basin

The Area of Concern for the Lower Elwha Klallam Tribe (Elwha Tribe) is the western portion of WRIA 18, from the Elwha River watershed to Morse Creek, east of Port Angeles. This area is the ancestral home of the Klallam Indians, the first human inhabitants to the Eastern Strait region, with villages and fishing camps most often associated with stream mouths where they could take advantage of plentiful fish and shellfish resources. Federal lands compose 82% of the Area of Concern and combined with other government-managed lands, mostly by the Washington Department of Natural Resources, only 12% of the area is likely to see future population growth. This land ownership pattern concentrates development in the watershed's lower elevations. Consequently, major land-use impacts on salmon habitat have occurred primarily from floodplain and shoreline development, as well as road construction and past logging practices.

At the 10-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Dungeness-Elwha Basin recovery planning area reveals a continued decline in water quality and quantity, floodplain and riparian processes, and shoreline habitat conditions. Both internal and outside reviews have concluded that recovery efforts are behind the expected pace of implementation.[1]

Funding shortfalls for both large-scale projects and adequate staff capacity are cited as contributing factors for this finding. In addition, progress on many non-capital regulatory and protection actions governed by other entities are also negatively affected by these same funding shortfalls, as it takes staff to engage on these issues.

Technical analysis has identified significant habitat limiting factors for the region's declining salmonid populations as:

- Estuarine habitat loss and degradation;
- Loss of channel complexity from loss of recruitment of large woody debris;
- Floodplain modifications;
- Sediment aggradation; and
- Loss of littoral drift.[2]

Recovery Plan Includes Habitat Restoration

The overall recovery strategy for the region seeks to maintain and improve habitat integrity to protect and strengthen wild stocks while restoring habitat for formerly productive but currently weak wild stocks.

The North Olympic Peninsula Lead Entity (NOPLE) developed a habitat recovery strategy that incorporates specific recovery goals, focused areas and prioritized actions that were developed through various recovery planning processes. NOPLE established priorities for both watershed and nearshore processes. The prioritized processes include hydrologic regimes, sediment supply, lower river hydrodynamics, water quality, canopy cover and nutrient input.

The identified goals for the NOPLE Recovery Plan are:

- Maintain and improve ecosystem productivity and genetic diversity;
- Protect highly productive habitats and populations, and restore impaired habitat and populations with productive potential;
- Utilize the best available science to set regional priorities;
- Recognize socio-political factors in decision-making; and
- Provide direction and focus for project sponsors.[3]

Tiffany Royal, NWIFC

Habitat restoration crew technician Kim Williams plants seedlings in the former Lake Aldwell, as part of the tribe's revegetation restoration efforts.

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

At the 10-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 efforts (Elwha Dam removal), but degradation of water quantity, increase of impervious surface areas and degradation of forestland cover. 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 since the 2012 State of Our Watersheds Report shows improvement for some indicators and a steady loss for others in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Shoreline Modifications / Forage Fish	Washington state's HPA database shows that between 2005 and 2014, Clallam County had 1,933 feet of new shoreline armor, 5,337 feet of replacement armor and no removal of existing armoring. However, within the Lower Elwha Tribe's Area of Interest, the Tribe has removed 2,700 feet of hardened shoreline and is on track to complete the removal of an additional 1,750 feet in 2016.	**Declining**
Impervious Surface	From 2006-2011, most watersheds outside Olympic National Park showed low level (< 1%) of change in impervious surface area.	**Slight Decline**
Timber Harvest	From 2006 to 2011, saw a negative trend in forest cover, with a reduction ranging from 0.1% to 10% on those lands outside of Olympic National Park.	**Declining**
Water Wells	There are 1,003 wells which affect groundwater supply and instream flows in the Lower Elwha Area of Concern. Between 1980 and 2009, 801 wells were completed at a rate of about 27 new wells per year. Since then, 51 new wells have been added at a lower rate of about 10 wells per year.	**Declining**
Floodplain	Morse Creek floodplain has been seriously impaired with 37% (49% downstream of Highway 101) being zoned for development from utility right of ways to single-family homes. Since 2011, a significant meander has been restored and 1,300 feet of habitat added to the formerly channelized reach. Other improvements include the construction of side channels, additions of large wood, removal of dikes and restoration of floodplain forests.	**Improving**
Restoration	Elwha River dams were removed and the ecosystem is being restored, reopening the upper watershed for the first time in 102 years. Port Angeles Harbor Cleanup and Restoration project is underway. The A-Frame site has been restored. Project included the removal of an overwater structure, pilings, two buildings, 1,500 feet of shoreline armoring. Once completed, a total of 2,100 meters of Ediz Hook's shoreline will be restored to a natural condition.	**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

The Lower Elwha Klallam 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. A high priority for the Tribe is the continued restoration of marine shoreline within Port Angeles Harbor, particularly sites located on Ediz Hook, the western lagoon and estuaries of creeks draining into the Harbor. The Tribe will pursue funding opportunities that would assist with the implementation of these activities. The Tribe will also continue its efforts to ensure a timely and effective cleanup of toxic contaminants from Port Angeles Harbor such that future generations may resume subsistence and commercial fishing practices. We hope to see harbor cleanup activities commence by late 2018, in addition to significant restoration efforts associated with Natural Resource Damage compensation. The Tribe will continue to promote restoration actions complementary to dam removal on the Elwha River. This includes restoration of tributary streams and removal of infrastructure in the floodplain and nearshore of the River.

Lower Elwha Klallam Tribe

West WRIA 18 – Morse Creek to Elwha River

The Lower Elwha Klallam Tribe's Area of Concern is the west half of the Dungeness-Elwha Basin (WRIA 18). The basin is located along the northeast portion of the Olympic Peninsula. Its watersheds drain to the Strait of Juan de Fuca. The two principal watersheds are the Dungeness and the Elwha rivers, whose headwaters are in Olympic National Park and U.S. Forest Service wilderness areas. In addition to these two large river systems, a number of smaller independent drainages, such as Morse Creek, also are in the basin.

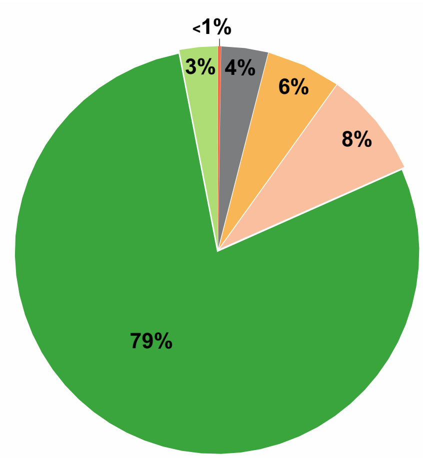
This chapter will focus on an area between Morse Creek drainage, east of Port Angeles, west to the Elwha River. The topography and precipitation patterns vary dramatically, from high mountain ridges with 240 inches of annual precipitation, to lowland valleys with 25 inches of annual precipitation.

ESA-listed Puget Sound Chinook and Hood Canal/Eastern Strait summer chum occur in the basin, along with coho, fall chum, pink salmon and steelhead. Bull trout occur in the Elwha drainages.

The Klallam were the first human inhabitants to the Eastern Strait region, with villages and fishing camps most often associated with stream mouths 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. By this time, Euro-Americans had already begun clearing and farming the floodplains and were soon cutting the old-growth timber along the shorelines.

Though much of the region remains rural and forested, and about 79% of the area is within Olympic National Park, the city of Port Angeles has developed rapidly. The Glines Canyon and Elwha dams along the lower mainstem of the Elwha River blocked all anadromous fish access to the majority of the watershed since the early 1900s. The dams were removed in 2014, opening the upper watershed to salmon for the first time in 102 years.

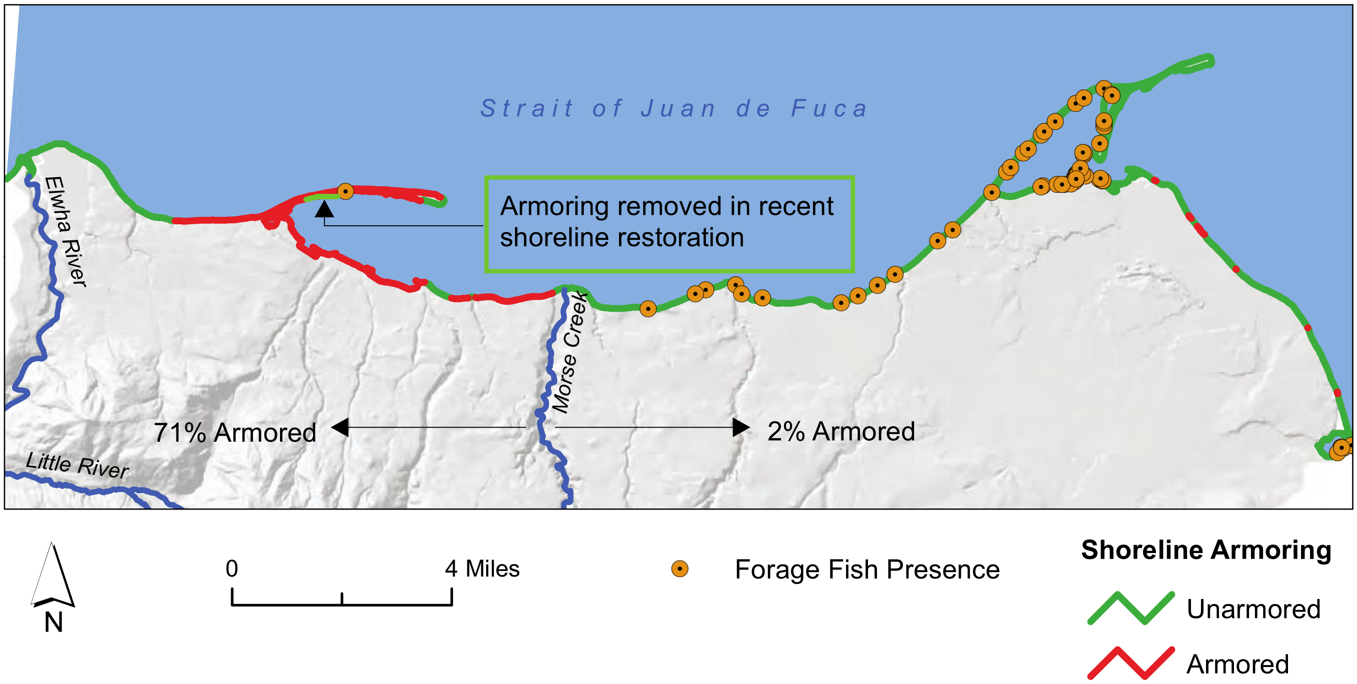
Federal and other government-managed lands compose about 88% of the focus area. That means only 12% of this area is available for the current population and its projected future growth. Rivers, creeks and marine shorelines in this area will be subject to increased development pressures.

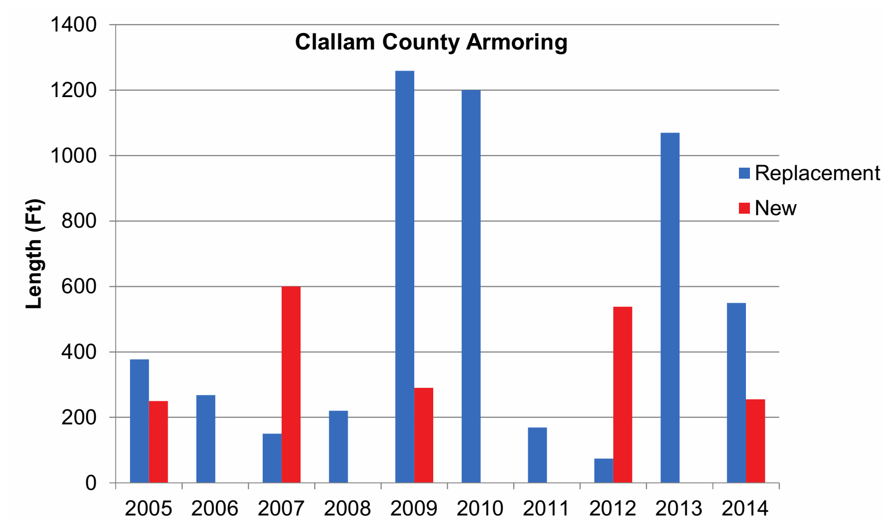


Data Sources: SSHIAP 2004,[1] USFWS 2014,[2] WADNR 2014a,[3] WADNR 2014b,[4] WADOT 2012,[5] WADOT 2013,[6] WAECY 1994,[7] WAECY 2011a,[8] WAECY 2013[9]

Shoreline Armoring and its Impact on Forage Fish Habitat

Washington state's HPA database shows that between 2005 and 2014, Clallam County had 1,933 feet of new shoreline armor, 5,337 feet of replacement armor and no removal of existing armoring. However, within the Lower Elwha Tribe's Area of Interest, the Tribe has removed 2,700 ft of hardened shoreline and is on track to complete the removal of an additional 1,750 feet in 2016.





Armoring involves the use of physical structures to protect marine shorelines in order to stabilize coastal land, prevent erosion, and protect residential and commercial infrastructure.

Shoreline armoring can alter the delivery, transport and accretion of sediments when sediment source bluffs become disconnected from their associated beaches and marine nearshore. This negatively affects the nearshore environment necessary for salmon survival, and severely limits forage fish habitat development and maintenance. According to Entrix, shoreline armoring is widespread, severely degrading shoreline currents, sediment processes, vegetative communities, vertebrate and invertebrate communities (salmonid food sources), and the protective habitat provided by natural shorelines.[1] Sand lance and surf smelt, which make up a major portion of the diets of juvenile Chinook salmon, spawn almost exclusively on sand and gravel beaches, making them especially vulnerable to the degrading effects of shoreline modification and armoring.

About 71% of the marine shoreline in the Lower Elwha Tribe's Area of Concern is armored and this shoreline is almost entirely west of Morse Creek. About 2% of the shoreline outside of the Area of Concern and eastward of Morse Creek is armored. This significant difference in the degree of armoring of the shorelines west and east of Morse Creek may be the reason for the equally significant difference in the distribution of forage fish spawning habitat in both areas. Of the 305 forage fish surveys conducted in WRIA 18 by WDFW (with 82 positive for surf smelt and/or sand lance), only one survey found forage fish west of Morse Creek.

Data available for Clallam County from the Hydraulic Project Approvals (HPA) database[2] was used to identify the general trend in shoreline armoring in this area. Between 2005 and 2014, a total of 26 projects were undertaken, resulting in 1,933 feet of new shoreline armor, 5,337 feet of replacement armor and no removal of existing armoring. However, the Lower Elwha Tribe's Area of Interest, the Tribe has removed 2,700 feet of hardened shoreline and is on track to complete the removal of an additional 1,750 feet in 2016.[3]

Data Sources: Carman et al. 2015,[4] PSNERP 2008,[5] SSHIAP 2004,[6] WADFW 2010,[7] WAECY 2011a,[8] WAECY 2011b[9]

Impervious Surface

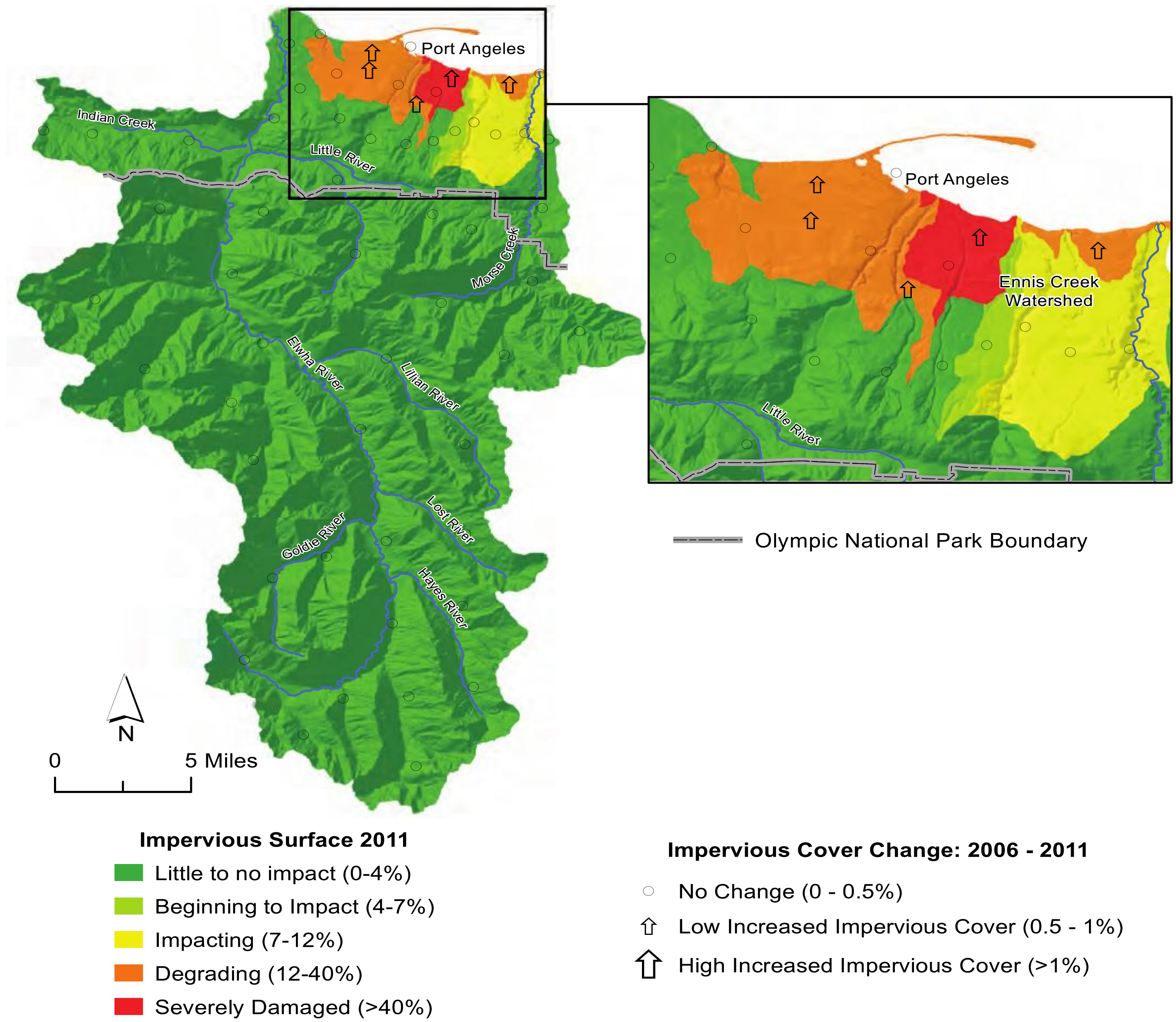
With the exception of the Ennis Creek watershed and around Port Angeles Bay, most of the watersheds in the Lower Elwha Area of Concern currently show little to no impact from impervious surface conditions. Also, between 2006 and 2011, most watersheds outside Olympic National Park showed low or no change in impervious surface conditions with values from 0 to 1% increase.

Based on 2011 data, most of the watershed units in the Lower Elwha Area of Concern currently show little to no impact from impervious surface conditions. These watersheds are mostly in Olympic National Park and Olympic National Forest and are therefore not generally impacted by development pressures.

On the other hand, negative impervious surface conditions prevail in the Ennis Creek watershed and in the tributaries to Port Angeles Harbor. This is likely a result of urbanization which directly increases the percentage of land covered by impervious surfaces and reduces the area available for infiltration. A high percentage of impervious surface leads to increased runoff and higher peak streamflows, increased sediment and pollutant delivery, and decreases in stream biodiversity.[1]

Between 2006 and 2011, most watershed units outside Olympic National Park showed low to no change in impervious surface conditions, with values ranging from 0 to 1% increase. This was likely caused by changes to population, urbanization and road construction during that period. According to estimates by the Washington State Office of Financial Management, the population of WRIA 18 grew by only 1.6% between 2010 and 2014.[2] The reduced rate of increase for impervious surface may be because of this slow population growth and slowdown in economic activities or a combination of these factors.

While the current status of the impervious surface indicator is poor in watersheds around Port Angeles and good in other areas, the general direction or trend outside the Olympic National Park is neutral to negative.



Data Sources: NLCD 2006,[3] NLCD 2011,[4] SSHIAP 2004,[5] WAECY 2011a,[6] WAECY 2011b[7]

Elwha River Fisheries and Ecosystem Restoration

On August 26, 2014, detonation of explosives at the former Glines Canyon Dam site obliterated the final remnants of that structure and re-opened the upper watershed of the Elwha River to salmon for the first time in 102 years. On September 2, one week later, the first Chinook salmon were observed migrating up beyond this site into the more than 40 miles of pristine habitat now available to them within Olympic National Park. This was the culmination of 22 years of planning and 3 years of deconstruction associated with the removal of the 33-meter Elwha Dam (River Mile 4.9) and the 66-meter Glines Canyon Dam (RM 13.6).

Researchers from the Lower Elwha Klallam Tribe and their partners with Olympic National Park, United States Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), University of Washington, SeaGrant, and other entities have been actively monitoring a multitude of biological and physical conditions in the Elwha River watershed to gauge ecosystem response to the removal of the Elwha dams. This work includes water quality monitoring, sediment transport and deposition monitoring, beach and delta topographic studies, numerous studies to assess adult and juvenile salmonid population responses, wildlife population response, estuarine fish and invertebrate studies, vegetation sampling, intertidal sampling and subtidal scuba surveys.

Tribal Monitoring of Wildlife Response

In connection with removal of the Elwha dams, the Lower Elwha Klallam Tribe's wildlife division is collecting baseline data on select species of river-dependent wildlife. Specifically, river otters and American dippers are closely tied to ecosystem health and are expected to be positively impacted by the return of salmon and their associated marine-derived nutrients to the Elwha ecosystem. Our primary objective is to collect information on how otters and dippers use the river to meet their spatial, habitat and dietary needs. To fulfill this objective, the Tribe is capturing and tagging otters and dippers and collecting biological samples to conduct stable-isotope analysis of marine-derived nutrients.

Subtidal SCUBA Surveys

Tribal biologists have been assisting in USGS-led subtidal dive (scuba) surveys along the Elwha nearshore from Freshwater Bay to the base of Ediz Hook since 2011. This study, initiated in 2008, involves monitoring sediment related changes to subtidal habitats that may be associated with the removal of the Elwha dams. The USGS has estimated that, to date, over 4 million cubic yards of sediment has been deposited in the Elwha delta since the removal of the Elwha dams. This represents approximately 15% of the sediment estimated to have been stored behind the Elwha dams.

The dive team identifies algae, macroinvertebrates and fish along 40-meter transects at depths of 20 to 60 feet. In addition, physical characteristics such as grain size, slope and light penetration at the sea floor are recorded. Interestingly, the physical presence of the large sediment plume created by the release of fine sediment from the former Elwha River reservoirs appeared to have a more pronounced effect on habitat during the first two years after dam removal than actual deposition along the sea floor at most study sites. The lack of light penetration through the sediment plume prevented or delayed the regeneration of large, dense kelp forests once observed at most of the subtidal dive sites. As expected, the monitoring sites in closest proximity to the mouth of the river have received the greatest contribution of fine sediment. Of the 15 established Elwha nearshore monitoring sites, all have had some degree of fine sediment deposition from behind the former dams. Five of these subtidal sites have been completely buried resulting in a marked transition from a heavily cobbled to a sandy substrate that is more conducive to bivalves and other soft substrate inhabitants. We have also noted the return of sand lance and smelt, which are important prey items for juvenile salmonids. The site nearest the river mouth is now buried in over 10 meters of fine sediment.

Steve Rubin, USGS

Pre-removal delta with subtidal dive sites

Andy Ritchie, Olympic National Park

Post-removal delta

AR052787

This image was recorded in August 2012, approximately one year after dam removal activities began. It shows the impact of the sediment plume on precluding light penetration and limiting regeneration of kelp formerly found at this site. Note that the bottom substrate surrounding the crab has not yet changed.

Ian Miller, Washington SeaGrant (2)

This image shows the dramatic shift from a coarse, gravelly bottom to a soft, sandy substrate after deposition of bedload from behind the former Elwha River dam. The stems of several former kelp plants (*Pterygophora californica*) can be seen along the transect tape. While this location has been directly impacted by sediment deposition, most of the subtidal dive sites within the study area on each side of the river have only seen impacts associated with the presence of the sediment plume.

While scientific research has dominated early headlines emerging from dam removals on the Elwha, the Tribe has also been conducting comprehensive floodplain restoration actions in the lower river, downstream of Elwha Dam. Prior to dam removal, the 5-mile lower Elwha River reach provided the only available habitat for Pacific salmon following construction of the Elwha Dam in 1913. This habitat became increasingly degraded over time as sediment and wood necessary to support habitat forming processes was blocked by the dam. Habitat was further degraded over time by human activities including floodplain logging, removal of logjams and channelization. Indeed, prior to dam removal, the Lower Elwha had lost almost all of its spawning habitat, had very few side channels for a river of its size, had lost most of its historic estuary and supported limited natural salmon populations. Beginning in the late 1990s, before it was even clear that dam removal would occur, the Tribe began efforts to restore floodplain habitat in the lower river. The restoration strategy involved three tools: 1) the removal of abandoned flood control dikes in the floodplain, 2) the insertion of engineered log jams in the mainstem, 3) addition of free wood in side channels, and 4) floodplain revegetation. Over time and with increasing experience conducting restoration in a large river, the project grew in scale and complexity. While initial restoration actions were focused on simply providing salmon with a refuge while awaiting the possibility of dam removal, later restoration efforts focused on design that would be complementary to dam removal and the expected changes to follow in the lower river. In 2014, both dams had been removed and the Elwha was restored to a free flowing river. A 15-year lower river floodplain restoration effort had resulted in the construction of 50 engineered logjams, the removal of 4 floodplain dikes, 3 side channels loaded with large wood and the planting of 50,000 native trees. All of the restoration work was obtained from competitive grant sources including the Salmon Recovery Funding Board, Bureau of Indian Affairs, Pacific Coast Salmon Recovery Fund and NOAA. The project is one of the largest of its type in the Pacific Northwest.

Ian Miller, Washington SeaGrant

Newly constructed engineered logjams in the lower Elwha River. The structures are designed to split flows, activate new side channels, create pools and sort gravels.

Forest Cover Conditions

Current forest cover conditions are generally good to healthy in most watershed units in the Lower Elwha Area of Concern. Outside Olympic National Park, the overall trend in forest cover between 2006 and 2011 is negative from 0.1% to about 10%.

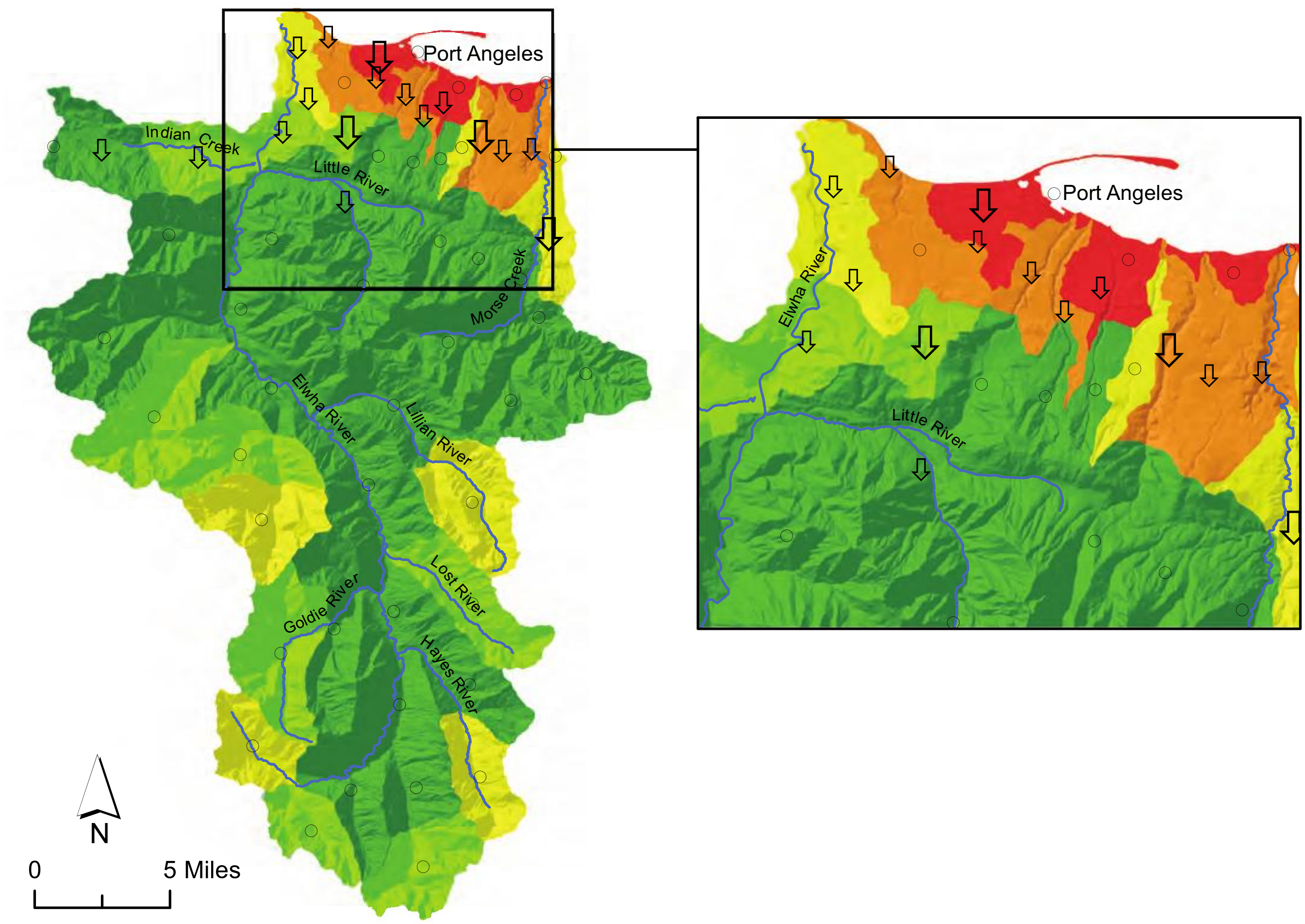
With few exceptions, the 2011 forest cover conditions of most of the watershed units in the Lower Elwha Area of Concern are generally good to healthy. Poor and severely damaged forest conditions exist in watershed units in the urban and suburban areas around Port Angeles.

An analysis of forest cover change between 2006 and 2011 was carried out using two different datasets. The NOAA forest cover data was obtained by analyzing Landsat images according to the Coastal Change Analysis Program (C-CAP) protocol and the WDFW modeled change polygons were derived by analyzing imagery from the National Agricultural Imagery Program (NAIP).

The C-CAP data shows that those watershed units within confines of the Olympic National Park had little to no change in forest cover. This is not unexpected since these units are generally exempt from anthropogenic activities, such as logging and land conversions, that negatively impact forest cover. Outside the park, the overall trend in forest cover change is negative from 0.1% to about 10%.

The WDFW change analysis data indicate that the negative trend outside the park was mostly caused by the replacement of forest cover by new impervious surface or other permanent structures and other human-induced changes such as temporary dirt roads. The other, less important factor was the removal of trees for commercial and non-commercial purposes.

Reduced forest cover can alter watershed processes that are critical to the development and maintenance of good water quality and habitats favorable to salmonids.[1]



Forest Cover 2011

- Healthy Forest Conditions (>75%)
- Good Forest Conditions (65-75%)
- Moderate Forest Conditions (50-65%)
- Poor Forest Conditions (30-50%)
- Severely Damaged Conditions (<30%)

Forest Cover Change: 2006 - 2011

- High Decreased Forest Cover (> -5%)
- Low Decreased Forest Cover (-1% to -5%)
- No Change (1% to -1%)

Data Sources: SSHIAP 2004,[2] WAECY 2006,[3] WAECY 2011a,[4] WAECY 2011b,[5] WAECY 2011c[6]

Lower Elwha Klallam Tribe

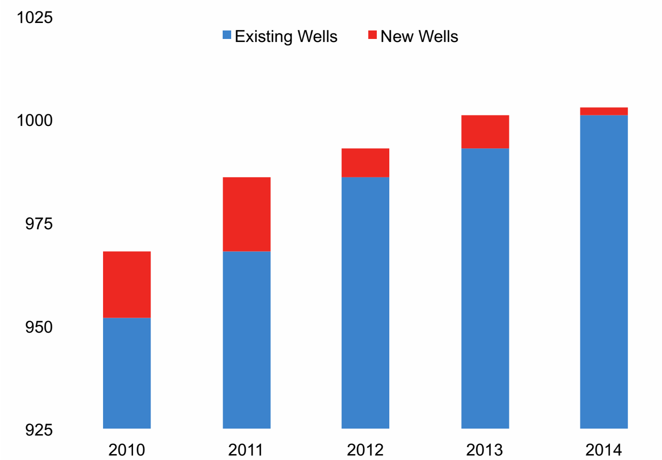
Water Wells

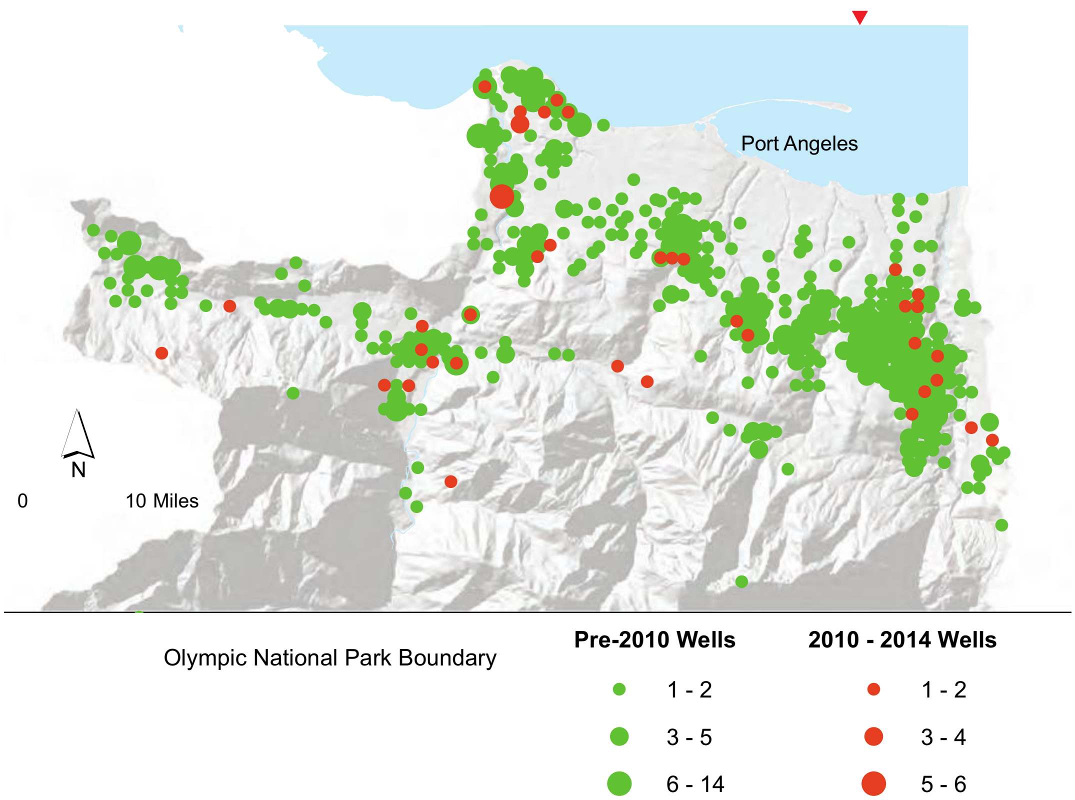
There are 1,003 wells that affect groundwater supply and instream flows in the Lower Elwha Area of Concern. Between 1980 and 2009, 801 wells were completed at a rate of about 27 new wells per year. Since then, 51 wells have been added at a lower rate of about 10 new wells per year.

Permit-exempt wells represent a source of water for many landowners, who under state law are allowed to withdraw water for domestic purposes without obtaining a water right. Water withdrawals through these wells affect groundwater supply. Because of the hydraulic connections between groundwater and surface water, these groundwater withdrawals may reduce instream flows of surface water, and negatively impact water quantity and quality as well freshwater and marine habitat for salmon, shellfish and related species.

There are currently 1,003 wells in this Area of Concern. Most of these wells are concentrated in the smaller developable area north of Olympic National Park. Between 1980 and 2009, 801 wells were completed in the Area of Concern, representing a rate of about 27 new wells per year.

Since 2010, an additional 51 wells have been added, representing a rate of about 10 new wells per year. Although the number of wells has increased since 2010, the rate of increase has slowed. According to estimates by the Washington State Office of Financial Management, the population of WRIA 18 grew by only 1.6% between 2010 and 2014.[1] The reduced rate of increase for wells may be because of this slow population growth, a lesser dependence on wells for their water supply by landowners, or the result of a slowdown in economic activities during that time period or a combination of these factors.





Data sources: SSHIAP 2004,[2] WADNR 2014b,[3] WAECY 2011a,[4] WAECY 2015[5]

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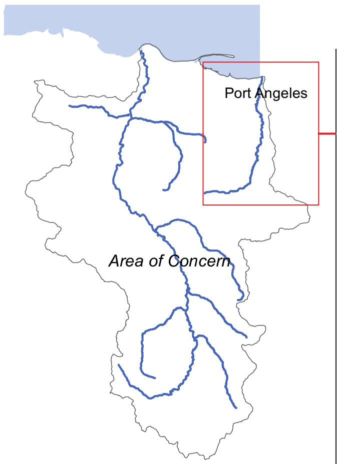
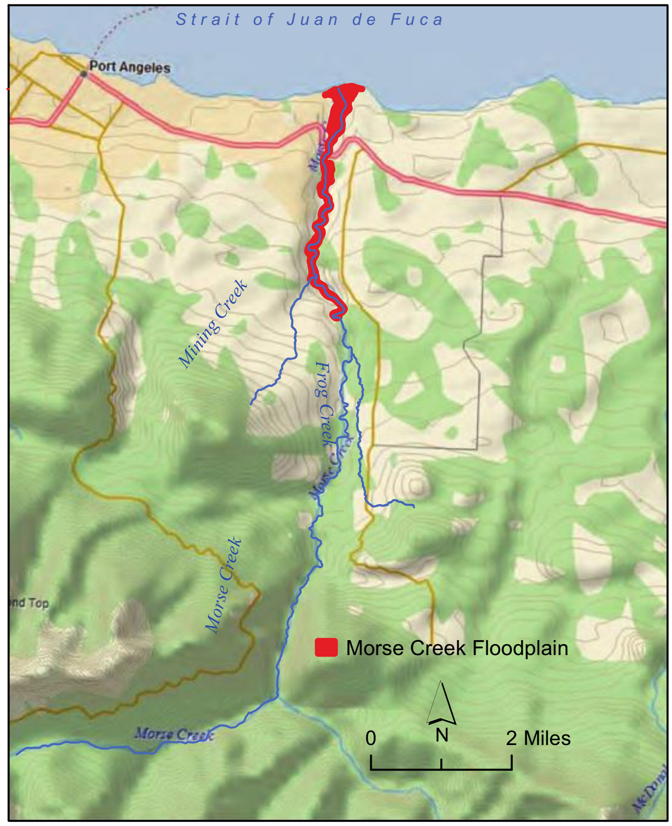
Morse Creek Floodplain Impairment

The once productive Morse Creek floodplain has been severely impaired by channelization, diking and armoring; road and other floodplain constrictions; and riparian vegetation removal. Since 2011, a significant meander has been restored and 1,300 feet of habitat added to the formerly channelized reach. Other improvements include the construction of side channels, additions of large wood, removal of dikes and restoration of floodplain forests.





Data Sources: DeLorme 2015,[8] FEMA 1996,[9] SSHIAP 2004,[10] WAECY 2011a[11]

The Morse Creek floodplain has been seriously impaired with 37% being zoned for development from utility right of ways to single-family homes. Downstream of Highway 101, 49% of the floodplain has been zoned for similar development. The Morse Creek floodplain is severely impaired.[1] Tributary watersheds, platted for urban development "will likely result in additional significant stormwater impacts."[2]

"With the exception of the Elwha and Dungeness rivers, Morse Creek is perhaps historically the most significant salmon stream in the Eastern Strait sub-region."[3] Historically, the lower reaches of Morse Creek were unconfined and meandering with multiple channels. The sediment supply was sufficient to produce a pronounced spit with a secondary tidal creek outlet. "Morse Creek is known to have produced a high diversity of salmon species in greater numbers than would be expected for a stream of its size. Anadromous salmon stocks known to have inhabited Morse Creek include spring/summer Chinook, coho, chum and pink salmon, summer and winter steelhead, and searun cutthroat trout."[4] The diversity of stocks likely resulted from snowmelt hydrology, as Morse Creek drains high elevation landforms in Olympic National Park. Unfortunately, the spring Chinook salmon stock has been extirpated and other stocks including pink, chum, coho and steelhead have declined to extremely low levels.

What was once a wide productive floodplain has been modified to the extent that only the topography is recognizable.

Mike McHenry, Lower Elwha Klallam Tribe

Morse Creek channelized reach through WDFW property prior to restoration, summer 2010.

"The lowest 2 miles of Morse Creek have been most affected by a combination of land development, channelization; diking and armoring; road and other floodplain constrictions; and riparian vegetation removal. Constriction of the channel and floodplain results in greater channel scour during high flow events, as well as in the elimination of escape cover outside the active channel. Below Highway 101, Morse Creek has been diked on both banks (from River Mile 1.2 to its mouth) to facilitate construction of a housing development and associated golf course. This alluvial reach was formerly unconfined and meandering."[5] Today the reach is effectively a rocky flume with almost no pool structure or spawning gravel.

"The Morse Creek estuary, considered to have been an important contributor to the creek's historic productivity, has been largely eliminated by development. The marine nearshore habitat at the mouth of Morse Creek also has been altered by historic railroad construction and armoring within the intertidal area, which has eliminated the shallow nearshore habitat to the west of Morse Creek."[6]

Morse Creek is at risk from potential future development. "Both the Mining Creek and Frog Creek sub-watersheds are platted for future urban development. Both sub-watersheds are located in the rain-on-snow zone in the Morse Creek water-

Mike McHenry, Lower Elwha Tribe (2)

Morse Creek through restored floodplain channel (post-restoration), winter 2011

shed. Even if existing critical area ordinances are enforced, new development will likely result in additional significant stormwater impacts to Morse Creek."[7]

Large-scale floodplain restoration is necessary to restore habitat and fish populations in Morse Creek. The first such project was recently completed south of the 101 bridge crossing on property acquired by Washington Department of Fish and Wildlife for conservation. This parcel of land was historically cleared and used for hay production. Historic aerial photographs show that the channel was relocated by bulldozer along the west side of the river valley. In 2010, the North Olympic Salmon Coalition along with the Lower Elwha Klallam Tribe and Jamestown S'Klallam Tribe, obtained funding from the Salmon Recovery Funding Board to reconnect Morse Creek to its former location. The project restored a significant meander and added 1,300 feet of habitat to the formerly channelized reach. The project also included construction of side channels, additions of large wood, removal of dikes and restoration of floodplain forests. Monitoring has shown a dramatic increase in juvenile fish abundance within the restored reach as compared to an untreated control reach just upstream of the project.

This project demonstrates the type of approach that is necessary to recover Morse Creek habitat and ultimately salmon populations. A similar approach could be developed for the channelized and degraded portions of Morse Creek below Highway 101. Unfortunately, efforts to advance restoration in lower Morse Creek have been resisted by a homeowners association that seems to prefer the maintenance of a straight, channelized river with a golf course that encroaches upon it.

Tiffany Royal, NWIFC

Logjam installation on Morse Creek

"How do we undo historic impacts to the salmon habitat in Morse Creek while preventing future impacts such as stormwater impacts and water withdrawals from other creeks on the peninsula?"

– Russ Hepfer
Lower Elwha Klallam Tribe's Vice-Chairman

Tiffany Royal, NWIFC

NWIFC Commissioner Russ Hepfer tours the completed project in 2012.

"We're taking two steps forward with restoration efforts but are forced to take one step back as we continue to lose habitat faster than we can save it."

– Russ Hepfer
Lower Elwha Klallam Tribe's Vice-Chairman

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Lower Elwha Klallam Tribe

Port Angeles Harbor Cleanup and Restoration

Introduction and Background

Port Angeles Harbor is the largest natural deep water harbor on the west coast of the United States. It is a typical Northwest "working harbor" with uses that include industrial, commercial, municipal, marine trades, recreation, tourism and natural resources. Over a century of industrial activities has exacted a heavy toll on natural systems within the harbor due to contaminants, extensive shoreline armoring and in-water structures. This has resulted in contamination of sediments and fish, heavily degraded shorelines, and the loss of critical nearshore and estuarine habitat used by salmon and their forage fish prey. A fish consumption advisory is currently in effect by the Department of Health as well as a moratorium on commercial fishing in the harbor by the Lower Elwha Klallam Tribe and Washington Department of Fish and Wildlife (WDFW).

The Lower Elwha Klallam Tribe ("Elwha Tribe") is deeply committed to restoring Port Angeles Harbor to a healthy, functioning ecosystem that will allow for the resumption of tribal and public access to fish and shellfish resources. This will require significant efforts: 1) to remove and/or isolate existing contamination from biological pathways (a process often referred to as remediation or cleanup) and 2) to restore degraded nearshore and estuarine habitats along the harbor shoreline (a process referred to as restoration, or NRD after the acronym for "natural resources damages" under such laws as the federal Comprehensive Environmental Response, Compensation and Liability Act, CERCLA or Superfund law). Legal mechanisms exist to promote and enforce these and other efforts, and the Elwha Tribe is optimistic that the cleanup and NRD processes will result in significant improvements to the harbor ecosystem within the next several years.

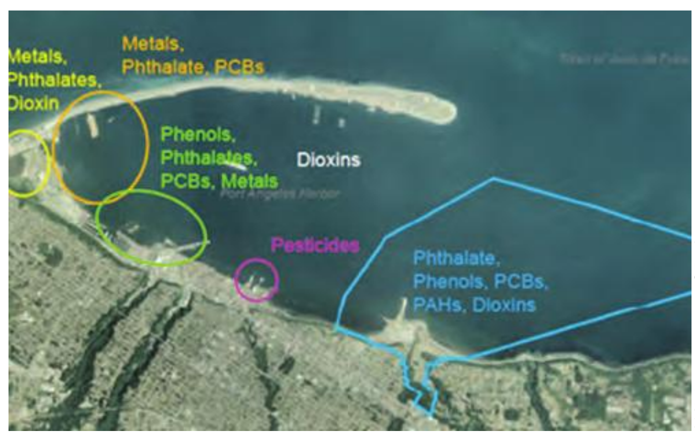
WA Department of Ecology

Aerial view of Port Angeles Harbor.

Elwha Tribe Takes Initial Steps at Restoration of Port Angeles Harbor

The Elwha Tribe has spearheaded multiple shoreline restoration efforts along the interior of Ediz Hook, the spit that created and shelters the harbor. The Tribe partnered with the Washington Department of Natural Resources (WADNR) in 2005 and, later, the city of Port Angeles to restore 1,500 feet of hardened shoreline by removing former log rafting and offloading structures and associated shoreline armoring and replacing with clean beach material and native beach vegetation.

While complicated chemical cleanup processes are ongoing in Port Angeles Harbor, there are also significant habitat impacts that must be dealt with, which have resulted from over a century of industrial uses. Those impacts include shoreline filling, armoring and overwater structures that have encroached on the majority of the harbor's natural shoreline. Indeed, the only remnant natural shorelines remaining in Port Angeles Harbor are located east of the Rayonier Mill site and on the south shore of Ediz Hook. Hardened shorelines affect sediment transport and deposition processes and reduce spawning habitat for forage fish such as sand lance and smelt, favored prey of Pacific salmon. Overwater structures may disrupt salmon migratory corridors and shade bottom habitats including eelgrass, which supports many marine species. On the south shore of Ediz Hook, a historic log dumping structure, known locally as the A-Frame, was abandoned in the 1990s and left derelict. This site included an overwater structure constructed of creosote-treated timber, two buildings, and 1,500 feet of hardened shoreline. In a two-stage cooperative project between the Lower Elwha Klallam Tribe and WADNR, the site was recently restored. WADNR took initial responsibility for removing the overwater structure and buildings. Once removal was completed, the Tribe secured funding from the U.S. Environmental Protection Agency (EPA) to remove contaminated fill and hard armoring, then import clean sand to reconstruct a low slope beach. Based on the success of this project the Elwha Tribe has obtained additional funding to expand restoration efforts on Ediz Hook to the east of the A-Frame site. Once completed, a total of 2,100 meters of Ediz Hook's shoreline will be restored to a natural condition.



WA Department of Ecology

Major chemicals of concern within Port Angeles Harbor.

Model Toxics Control Act (MTCA) Cleanup of Port Angeles Harbor

Matt Beirne, Lower Elwha Klallam Tribe

A-Frame site on the southern shoreline of Ediz Hook as seen in pre-restored condition.

The Lower Elwha Klallam Tribe has been involved in oversight of planning and assessment activities associated with the cleanup of toxic contaminants from upland and marine portions of Port Angeles Harbor since 1999. As a result of a suite of four major agreements involving EPA, the Washington Department of Ecology (Ecology) and the Rayonier Corporation, the cleanup is taking place under Washington's MTCA and administered by Ecology. Under these agreements – where EPA has deferred exercise of its CERCLA Superfund authority subject to conditions that ensure a CERCLA-level cleanup or better – the Elwha Tribe has exercised a unique role with Ecology in the oversight of the cleanup of portions of Port Angeles Harbor attributed to contaminants released from the former ITT Rayonier Pulp Mill. The harbor has been segmented into three cleanup areas based on historic source contributions from industries throughout the harbor. The eastern "Study Area" is attributed to contamination derived primarily from activities at the former Rayonier Pulp Mill, whereas, according to Ecology, the western harbor has a complex array of contaminants from sources most closely associated with the west end of the harbor. The central harbor has a diffuse distribution of dioxins from a variety of sources as well as wood waste and polycyclic aromatic hydrocarbons (PAHs). Other Potentially Liable Parties (PLPs) that have been identified as contributing to contamination in Port Angeles Harbor include the city of Port Angeles, Port of Port Angeles, Nippon Paper, Georgia Pacific, Fiberboard and WADNR as a lessor of public aquatic lands.

The major chemicals of concern within Port Angeles Harbor for cleanup and impacts to natural resources include PCB's, dioxins/furans, PAHs, mercury, phenolics and several other contaminants. Most of the assessment activities (remedial investigation) have been completed and the data is being evaluated (feasibility study) to determine the most appropriate cleanup methods and technologies to use during the cleanup (remediation) phase. Cleanup remedies selected will likely be based on contaminant concentrations and persistence, accessibility, sediment transport patterns, and potential for erosion and resuspension of contaminants. Technological feasibility and cost are also considered during this phase.

Natural Resource Damage Assessment and Restoration

Under the federal CERCLA or Superfund law, the Elwha Tribe has also been participating as an organizing government and leading member of the Port Angeles Harbor Natural Resource Trustee Council. The purpose and function of the Trustee Council is to determine the extent of injuries to natural resources in the harbor and evaluate restoration options that the Potentially Responsible Parties (PRPs, under the terminology of CERCLA) may use to compensate for those injuries. In addition to the Lower Elwha Klallam Tribe, the other members of the Trustee Council are the National Oceanic and Atmospheric Administration (NOAA), the U.S. Fish and Wildlife Service (USFWS), Ecology, the Port Gamble S'Klallam Tribe and the Jamestown S'Klallam Tribe. The Trustee Council has been actively working with Rayonier Corporation since early 2012 to evaluate restoration opportunities to compensate for injuries to natural resources caused by historic releases of contaminants from the former pulp mill. The Trustee Council anticipates engaging with the western harbor PRPs in a similar manner in the near future.

Matt Beirne, Lower Elwha Klallam Tribe

Restored shoreline of Ediz Hook.

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Lower Elwha Klallam Tribe: West WRIA 18 – Morse Creek to Elwha River

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2016 State of Our Watersheds Report
Lummi Watershed

Our elders used to tell us salmon is good medicine. It's part of our schelangen – 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 Puget Sound. The Lummi Nation is a self-governing sovereign nation within the United States and one of the largest tribes in Washington state with more than 5,000 members. The Lummi Nation has the largest fishing fleet of all tribal nations in the United States.

Degraded Habitat Limits Salmon Recovery

Kari Neumeyer, NWIFC

The Lummi Natural Resources Department reconnects tidal channels to restore wetlands that will provide essential rearing habitat for juvenile salmon along Smugglers Slough.

The Nooksack River watershed, which comprises approximately 786 square miles, is the largest drainage in Water Resource Inventory Area (WRIA) 1. Located in northwestern Washington, the watershed encompasses most of northern and western Whatcom County, part of Skagit County, and extends into British Columbia. The Nooksack River watershed has remained largely rural and has one of the higher quality estuaries in Puget Sound.[1]

Since the mid-1800s, salmonid habitat has been severely degraded by forestry and agriculture practices that constitute the primary land uses within the basin. Nearly all of the lower mainstem and delta forests had been converted to agricultural land by the 1930s. Since 1950, land-use conversion has been primarily for commercial, residential, municipal and industrial development.

Water quality and quantity continue to be impacted by forestry and agricultural practices, along with the population growth now being experienced within the watershed. Whatcom County's population was estimated at 212,000 people in 2015, and projected to grow to 273,000 people by 2036,[2,3] which presents a substantial threat to salmon recovery and shellfish habitat protection efforts.

Habitat is Limiting Salmonid Production in WRIA 1

Technical analyses identified seven significant habitat limiting factors for salmonid production from the Nooksack River watershed:

1. Channel instability in the unconfined portions of the three forks and the upper mainstem;
2. Increased sediment loading from natural and human causes, and how that sediment is transported through the system;
3. Loss of habitat diversity associated with the loss of large in-channel wood, disconnection of the channel from the floodplain due to channel incision or flood control, simplification of bank condition through bank hardening, loss of channel sinuosity and associated channel length and habitat quantity through channelization, and debris flows and frequent channel shifting;
4. Bank armoring mostly in the South Fork Nooksack River and mainstem Nooksack River that constrain the river and eliminate side channels where fish rear and could seek refuge during floods;
5. Fish passage barriers that impeded access to upstream habitats;
6. Changes in river flow and temperature due to land-use practices and climate change; and
7. Changes along the marine shoreline in Bellingham Bay and adjacent in nearshore areas.[4]

Steps to Restore Harvestable Populations

The identified goal for WRIA 1 is to recover self-sustaining salmon runs to harvestable levels that will sustainably support fisheries and a culture centered on salmon harvests. In establishing this goal, the WRIA 1 Salmonid Recovery Board acknowledged that this will require protecting existing good habitat and natural stream processes and maintaining critical salmon habitat while restoring degraded salmon habitat. This is to be achieved by guiding the majority of future development into designated urban growth areas and managing rural growth so there are minimal impacts to current habitat conditions.

The overall WRIA 1 habitat recovery approach was structured into seven key strategies:

1. Remove significant barriers to high-quality habitat;
2. Restore habitat in the forks, mainstem and major tributaries;
3. Ensure floodplain management protects and enhances fish habitat;
4. Protect good habitat through local Critical Areas Ordinances and Shoreline Management Programs administered by Whatcom County;
5. Protect and improve instream water flows for fish;
6. Identify priority estuaries and nearshore areas for protection and restoration; and
7. Restore conditions in lowland tributaries and independent tributaries to the Fraser River and Strait of Georgia.[5]

AR052798

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

At the 10-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Nooksack basin shows improvements for barrier removal, mixed results for riparian and floodplain processes, and degradation of water quantity and quality. In general, there is a shortage of agency staff at all levels (e.g., federal, state, tribal, county, cities) 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.

A review of the trend for these key environmental indicators since the 2012 State of Our Watersheds Report shows improvement for some indicators and a steady loss for others in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Water Quality - Shellfish	In September 2014, in order to protect public health and safety, the Lummi Nation, in consultation with the Washington Department of Health, voluntarily closed 335 acres of shellfish growing area in Portage Bay when the National Shellfish Sanitation Program (NSSP) standards were not achieved at several water quality monitoring stations. After poor water quality was measured over the Portage Bay shellfish growing area during November 2014, additional water quality monitoring stations failed to meet the NSSP standards, resulting in the Lummi Nation and the Washington State Department of Health needing to conditionally close a total of 496 acres. The conditional closure classification prohibits shellfish harvest from the affected areas from April 1 through June 30, and from October 1 through December 31. Water quality over the Portage Bay shellfish growing area continued to be degraded during 2015, causing an additional station to fail the NSSP standards and resulting in the conditional closure of 324 additional acres for a total closure area of 820 acres.	**Declining**
Water Wells	Between 2008 and 2014, WAECY estimates that 565 new permit-exempt wells were drilled in Whatcom County (coincident with most of WRIA 1). Approximately 72% of all 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.	**Concerns**
Forest Roads	About 90% (1,277 miles out of 1,426 total miles) of private and state-owned forest roads have been repaired or abandoned in the Upper Nooksack River watershed. About 95% (125 of 132 culverts) on private and state-owned forest roads have been reparied or abandoned.	**Improving**
Floodplain - Wetlands	The WRIA 1 Salmonid Recovery Plan recommends a return to historical wetland conditions in the lower mainstem floodplain of the Nooksack River. 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 within the Nooksack River floodplain, and by 1998 wetlands had been reduced to less than 10% of that historical area. 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, and no further loss between 2006 and 2011.	**Declining**
Restoration - Estuary	The Lummi Nation has been working since the 1990s to improve estuarine habitat in the Nooksack River and Lummi River deltas. The Lummi Nation's Wetland and Habitat Mitigation Bank, which is the first tribal wetland mitigation bank in the United States, became operational in 2012. The mitigation bank is located immediately adjacent to a large restoration project known as the Smugglers Slough Restoration Project. Together, these two projects will permanently protect and restore nearly 3,000 acres of estuarine habitat in the Nooksack and Lummi River deltas.	**Improving**
Large Woody Debris	Engineered logjams are being consistently funded, placed and monitored throughout the North, Middle and South forks of the Nooksack River. This has resulted in an increase in density of instream wood since 2005.	**Improving**

The Lummi Nation continues to work toward the protection and restoration of healthy and functional nearshore, estuarine and river habitat. These efforts include establishing conservation easements to protect these habitat types, restoring those areas that are degraded, and conducting research to better understand the organisms and the habitats they occupy.

Low summer flows on the Nooksack River continue to degrade salmonid spawning and rearing habitat through loss of habitat connectivity, reduced habitat volume, stranding of juveniles and higher stream temperatures. Climate change is predicted to increase the duration and frequency of these low summer instream flows.

The WRIA 1 watershed instream flow rules were adopted in 1985 to "protect and preserve" instream resources from low flow exceedances. One of the primary human causes of salmon-limiting streamflows in the lower Nooksack basin is agricultural irrigation combined with the continued ditching and draining of wetland areas that removes the natural storage of winter precipitation from the landscape. Extensive agricultural drainage activity bypasses storage in the system and moves water off the landscape during the spring months. As a result, water is not in the system during the summer months to maintain instream flows; these conditions are made worse by the large number of irrigation diversions during the summer months.

Looking Ahead

WRIA 1 and Whatcom County have seen great economic progress since the late 19th century, but not without environmental costs. Water quality and quantity continue to decline, the large-scale loss of floodplain forest associated with flood protection for municipalities and agriculture persists, and the quality and quantity of fish and wildlife habitat continue to be degraded. To change these trends will require more than just site-scale restoration of fish and wildlife habitat; it will require a full integration of environmental costs into future land-use and economic planning. For site-scale habitat restoration to succeed, overall watershed health must also be restored – everything is connected.

The regulatory approach within WRIA 1 varies among jurisdictions, but overall the goal is to implement, adapt and enforce compliance of existing regulations for the protection and restoration of salmonid and shellfish habitat. It is recognized that integrating incentives and other non-regulatory approaches within existing regulatory programs may improve compliance (i.e., use incentives to promote protection and restoration, apply penalties to discourage degradation). For this approach to be successful, the accompanying regulatory framework must protect the existing habitat from degradation as improvements in habitat quality and quantity are realized through voluntary effort and directed capital enhancement projects. This is not occurring within WRIA 1 as salmon and shellfish habitat quality and quantity continue to decline due to a general lack of a credible compliance enforcement presence within the watershed. Regulatory reform is required as the current framework clearly is not providing adequate protection.

Implementation of the WRIA 1 Salmonid Recovery Plan is lagging behind the pace originally anticipated during plan development. Restoration work has progressed with numerous 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 the regulatory and incentive programs to protect and restore salmonid habitat and habitat forming processes.

Kari Neumeyer, NWIFC

A Lummi Nation crew plants trees to help enhance riparian habitat along the Nooksack River as part of the first federally backed tribal wetland and habitat mitigation bank.

During 2014 the Lummi Nation launched a water rights settlement initiative composed of five elements: Instream Flow, Fish Habitat Restoration, Water Quality, Water Supply for Out of Stream Uses (tribal and non-tribal), and Accountability. This comprehensive initiative was introduced to key players within WRIA 1 during 2014-2015 and is being further developed in conjunction with the state of Washington and others. Although all of the parties acknowledge that the "devil is in the details," the primary concepts and goals of this initiative have been well received. The Lummi Nation goal is to reach a settlement agreement by July 2017 with the realization that the subsequent court filings to make the agreement permanent and binding would follow.

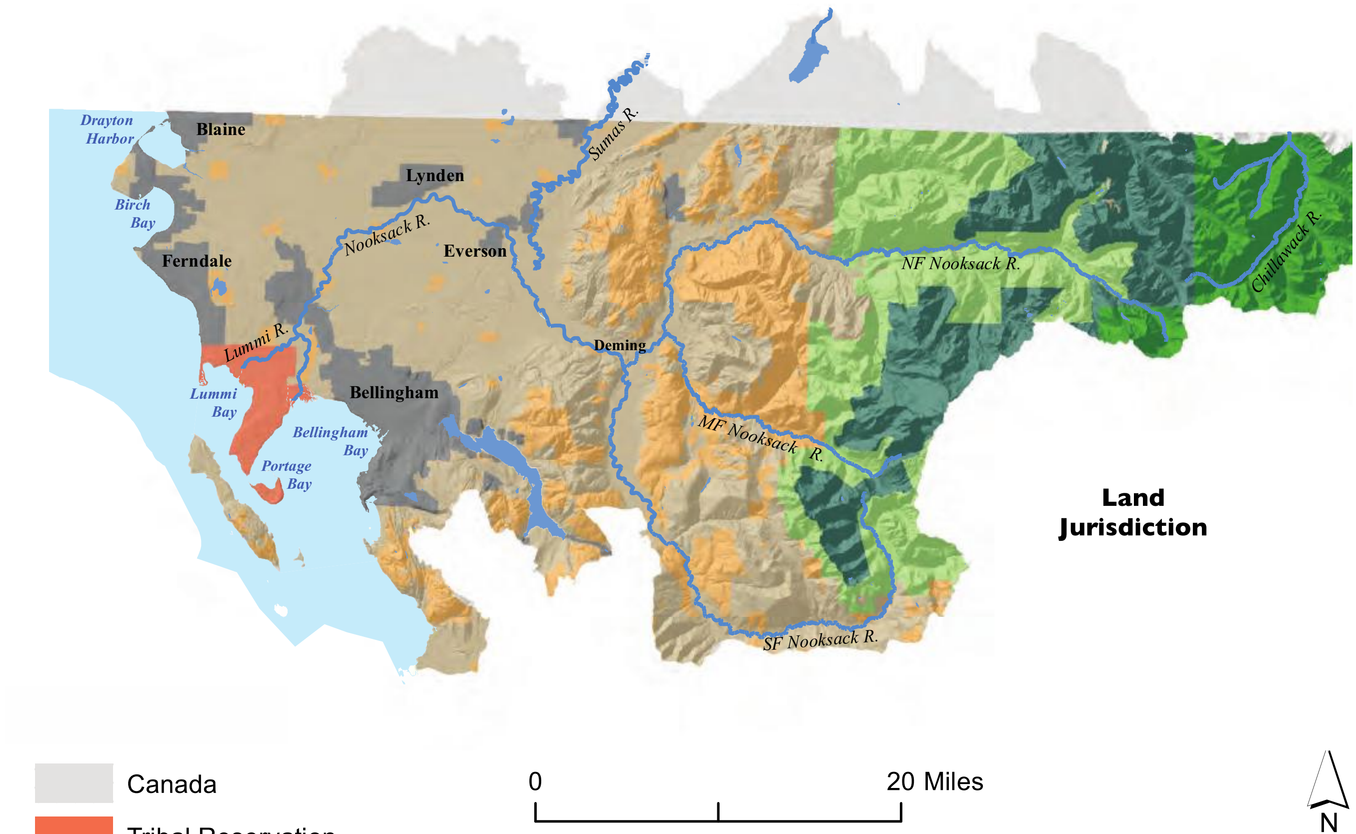
If the Lummi Nation water rights settlement initiative is successful, specific milestones for achieving instream flows, fish habitat restoration, existing water quality standards, and alternative water supply sources for out-of-stream uses will be established. The accountability element of the settlement proposal is intended to provide an economic incentive for the affected parties to perform. If a milestone is not achieved, an economic penalty or fee will be assessed and this penalty will increase based on the extent and duration that a milestone is not achieved.

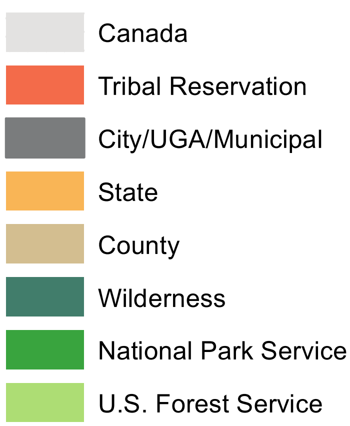
This water rights settlement initiative development effort, along with the continued development and implementation of salmon habitat restoration projects within the Nooksack River watershed, the Lummi Nation Wetland and Habitat Mitigation Bank, the deployment of advanced technologies to better characterize variations in pollutant loading that affect shellfish beds, the continued and enhanced collection and analysis of environmental variables (biological and physical), and the continued engagement in regional and local natural resources management efforts are intended to recover salmon and shellfish to the harvest levels enjoyed by the Lummi Nation as recently as 1985. All of these efforts are part of a broader effort to preserve, promote, and protect the Lummi *Schelangen* ("way of life") into perpetuity.

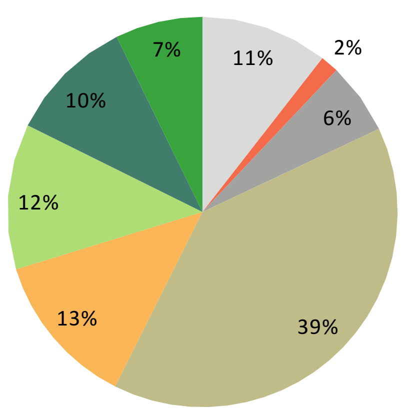
AR052800

Lummi Nation

WRIA 1: Mountains to the Sea







The Lummi are an aboriginal people who have fished, hunted and gathered throughout their Usual and Accustomed grounds and stations and their traditional territories since time immemorial. Living in a region with many resources, the Lummis developed vibrant communities and a rich culture. The Lummi Indian Reservation is located along the marine shorelines of the Salish Sea and includes the deltas and estuaries of the Nooksack and Lummi rivers.

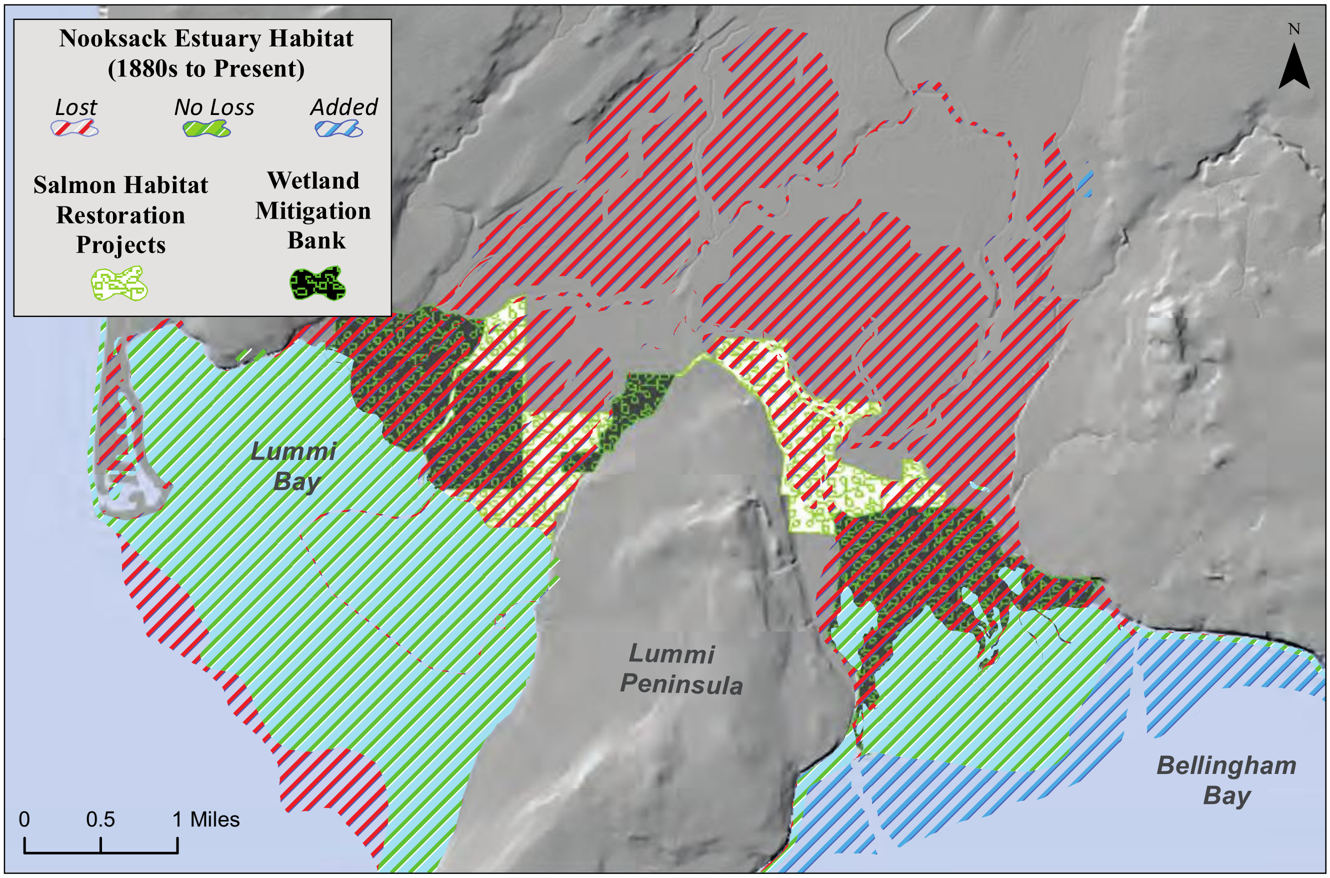
The Nooksack River watershed is 786 square miles, the largest drainage in WRIA 1, and the fourth largest drainage in Puget Sound. The Nooksack River has three main tributaries: the North Fork, Middle Fork and South Fork Nooksack rivers that originate in the steep high-elevation headwaters of the North Cascades and flow westerly descending into the flats of the Puget lowlands. The North and Middle Forks are glacier-dominated 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 the North Fork and South Fork confluence, which marks the upstream extent of the mainstem Nooksack River. The mainstem then flows as a low-gradient, low-elevation river until discharging through the Lummi Indian Reservation and into Bellingham Bay. Historically (prior to 1860), the Nooksack River alternated between flowing into Bellingham Bay and flowing through the Lummi River and into Lummi Bay. The Nooksack River and independent watersheds (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.[1,2]

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. By 1925, nearly all of the lower mainstem and delta forests had been converted to agricultural land.[3,4] Since 1950, land-use conversion has been primarily for commercial, residential, municipal and industrial development.[5]

Data Sources: SSHIAP 2004,[6] WADNR 2014a,[7] WADNR 2014b,[8] WADOT 2013,[9] WAECY 1994,[10] WAECY 2011a,[11] WAECY 2013a[12]

AR052801

Lummi Nation Committed to Protecting and Enhancing Tidal Wetlands in the Nooksack and Lummi River Deltas



While historic tidal wetland areas have been lost in the Lummi River delta, the Nooksack delta area and associated estuary continue to grow. Through a large-scale salmon habitat restoration project and the wetland and habitat mitigation bank, the Lummi Nation is protecting and restoring large tracts of estuarine wetlands.

Over the 1926-1934 period, a sea wall was constructed along Lummi Bay, a levee constructed along the Lummi River and the west side of the Nooksack River, and drainage installed to develop agricultural lands on the Lummi Indian Reservation. This reclamation project significantly reduced historic sub-aerial estuarine habitat.[1] Since then, sediment deposition throughout the Nooksack River delta has expanded historic intertidal estuarine habitat along Bellingham Bay. According to the WRIA 1 Salmonid Recovery Plan, the Nooksack River estuary is presently one of the healthiest and most pristine in Puget Sound. Considering the healthy state of the Nooksack River estuary, the WRIA 1 Salmonid Recovery Plan recommends continued protection and strategic restoration of the estuary.[2]

The Lummi Nation has been working since the 1990s to improve estuarine habitat in the Nooksack River and Lummi River deltas. The Lummi Nation's Wetland and Habitat Mitigation Bank – the first tribal wetland mitigation bank in the United States – became operational in 2012. The mitigation bank is located immediately adjacent to a large salmon habitat restoration project known as the Smugglers Slough Restoration Project. Together, these two projects will permanently protect and restore nearly 3,000 acres of estuarine habitat in the Nooksack and Lummi River deltas.

Lummi Natural Resources

Large woody debris and floodplain forests inside the Lummi Nation Wetland and Habitat Mitigation Bank.

Data Sources: LIBC 2012,[3] PSNERP 2008,[4] SSHIAP 2004[5]

AR052802

Lummi Nation

Fecal Coliform Pollution Forces Partial Closure of Portage Bay Shellfish Growing Area

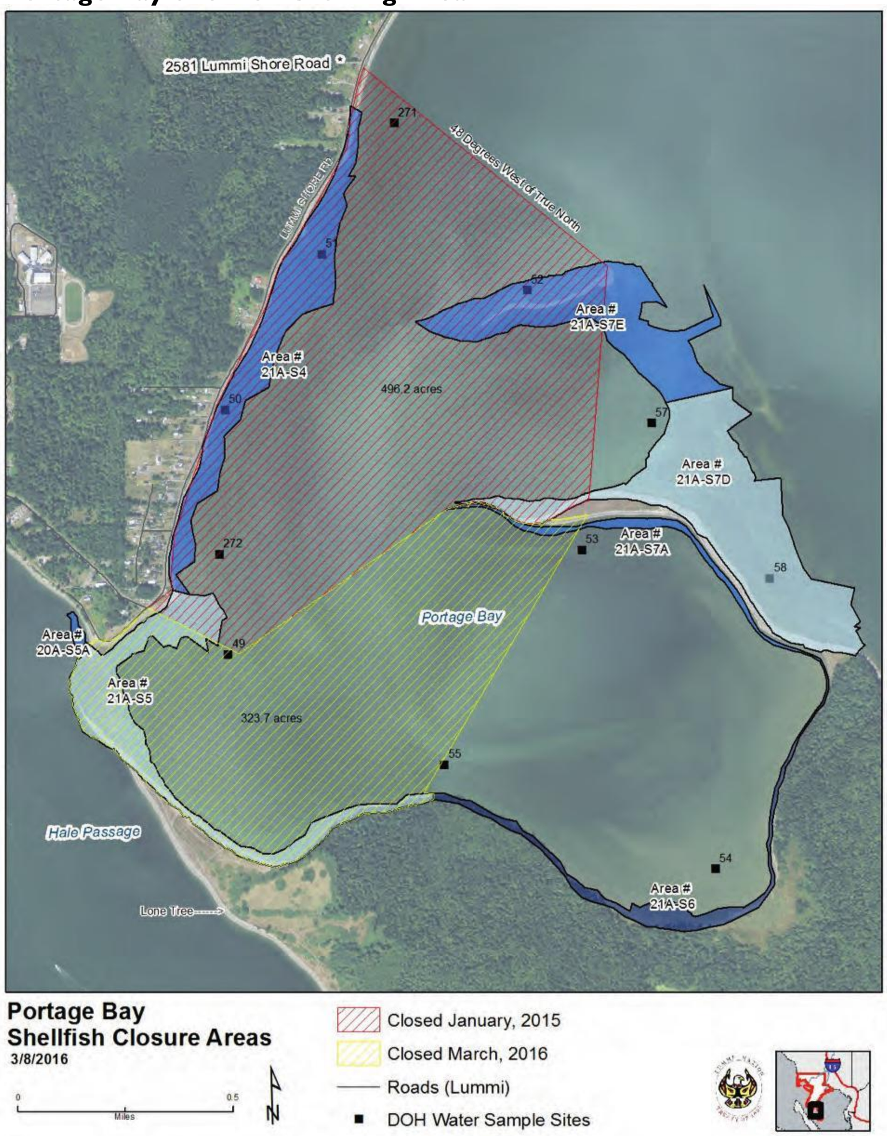
In September 2014, in order to protect public health and safety, the Lummi Nation, in consultation with the Washington Department of Health, voluntarily closed 335 acres of shellfish growing area in Portage Bay when the National Shellfish Sanitation Program (NSSP) standards were not achieved at several water quality monitoring stations.[1] After poor water quality was measured over the Portage Bay shellfish growing area during November 2014, additional water quality monitoring stations failed to meet the NSSP standards, resulting in the Lummi Nation and the Washington State Department of Health needing to conditionally close a total of 496 acres. The conditional closure classification prohibits shellfish harvest from the affected areas from April 1 through June 30, and from October 1 through December 31.[2] Water quality over the Portage Bay shellfish growing area continued to be degraded during 2015, causing an additional station to fail the NSSP standards and resulting in the conditional closure of 324 additional acres for a total closure area of 820 acres.

Manure from dairy farms and non-dairy livestock operations, and waste discharged from municipalities and failing septic systems in the Nooksack River watershed have pushed fecal coliform pollution levels in substantial portions of Portage Bay beyond federally accepted levels for safe shellfish harvest and consumption. The Portage Bay closure has a devastating impact on the livelihoods of over 200 Lummi Nation families who earn a portion of their annual income from the commercial harvest of Portage Bay shellfish. Additionally, the over 5,000 Lummi Nation tribal members who have a treaty right to harvest Portage Bay shellfish for ceremonial and subsistence harvests also are impacted or damaged by this shellfish harvest closure. Degraded water quality in the Nooksack River watershed has substantially reduced the shellfish available for Lummi to harvest and their ability to exercise their treaty rights to harvest shellfish throughout their Usual and Accustomed grounds and stations.

Kari Neumeyer, NWIFC

A Lummi tribal member harvests shellfish in Portage Bay prior to the downgrade of the harvest area.

Portage Bay Shellfish Growing Area



Data Sources: LNR 2016[3]

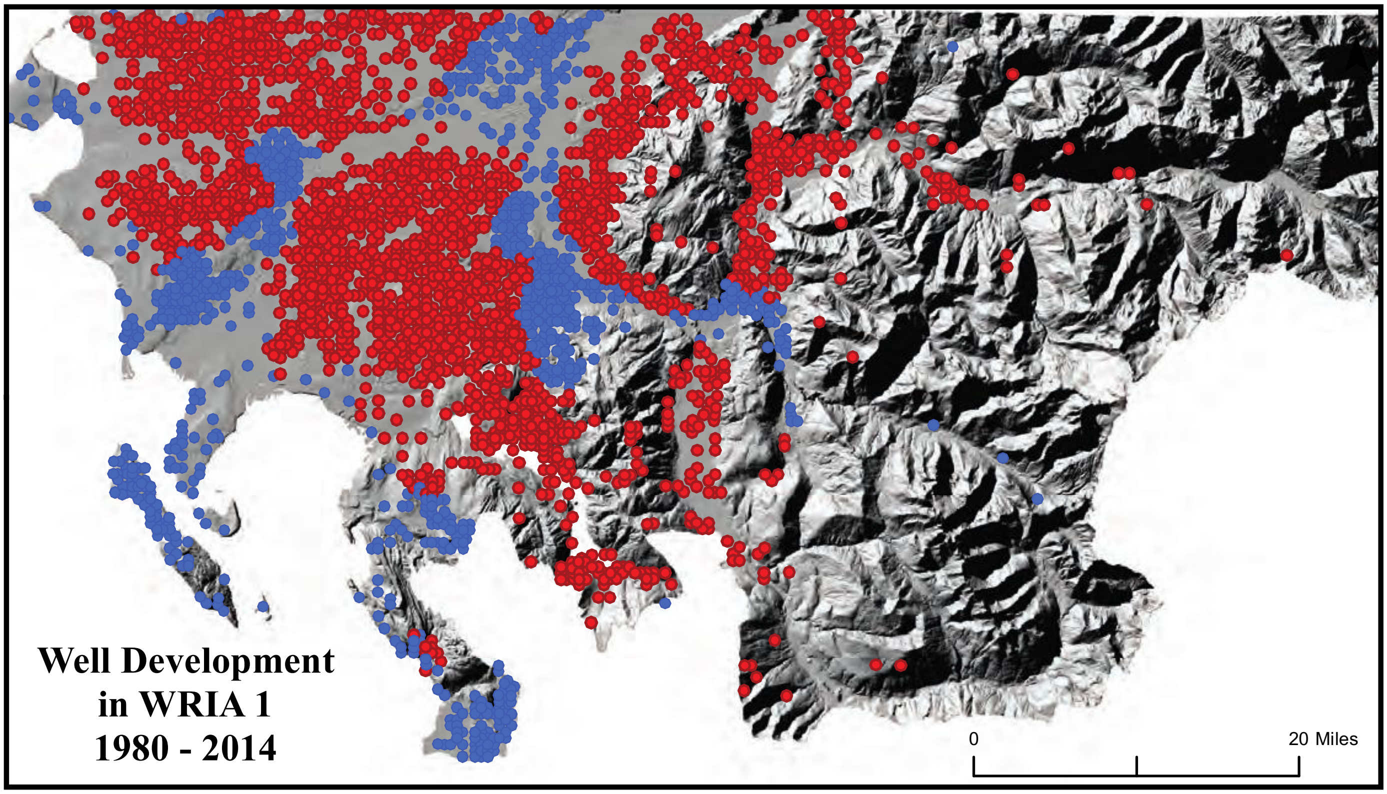
GIS estimate of acres of shellfish growing area in Portage Bay

	WADOH Shellfish Growing Area Status		
	Conditionally Approved	Approved	Unclassified
Portage Bay	820	491	0

AR052803

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

Between 2008 and 2014, Washington State Department of Ecology estimates that 565 new permit-exempt wells were drilled in Whatcom County (coincident with most of WRIA 1).[1] Approximately 72% of all 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.[2]

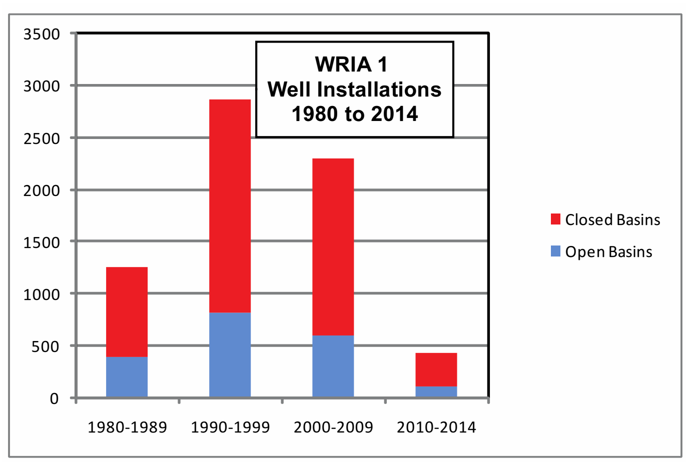


According to the WRIA 1 Salmonid Recovery Plan, not meeting instream low flow limits results in habitat connectivity loss, reduced habitat volume, stranding of juvenile salmon, higher stream temperature and general decrease in water quality.[3] The WRIA 1 watershed instream flow rules were set in 1985 to "protect and preserve" instream resources from low flow exceedance.[4] As displayed in the map above, permit-exempt wells have continued to be developed in WRIA 1 since 1985. While legal under state water law, continued permit-exempt well development in basins that are closed to additional withdrawal under the state 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.

Water Well Installations

- Open Basins
- Closed Basins

The majority of wells developed in WRIA 1 fall inside basins that have been closed to water withdrawal since 1985.[5]

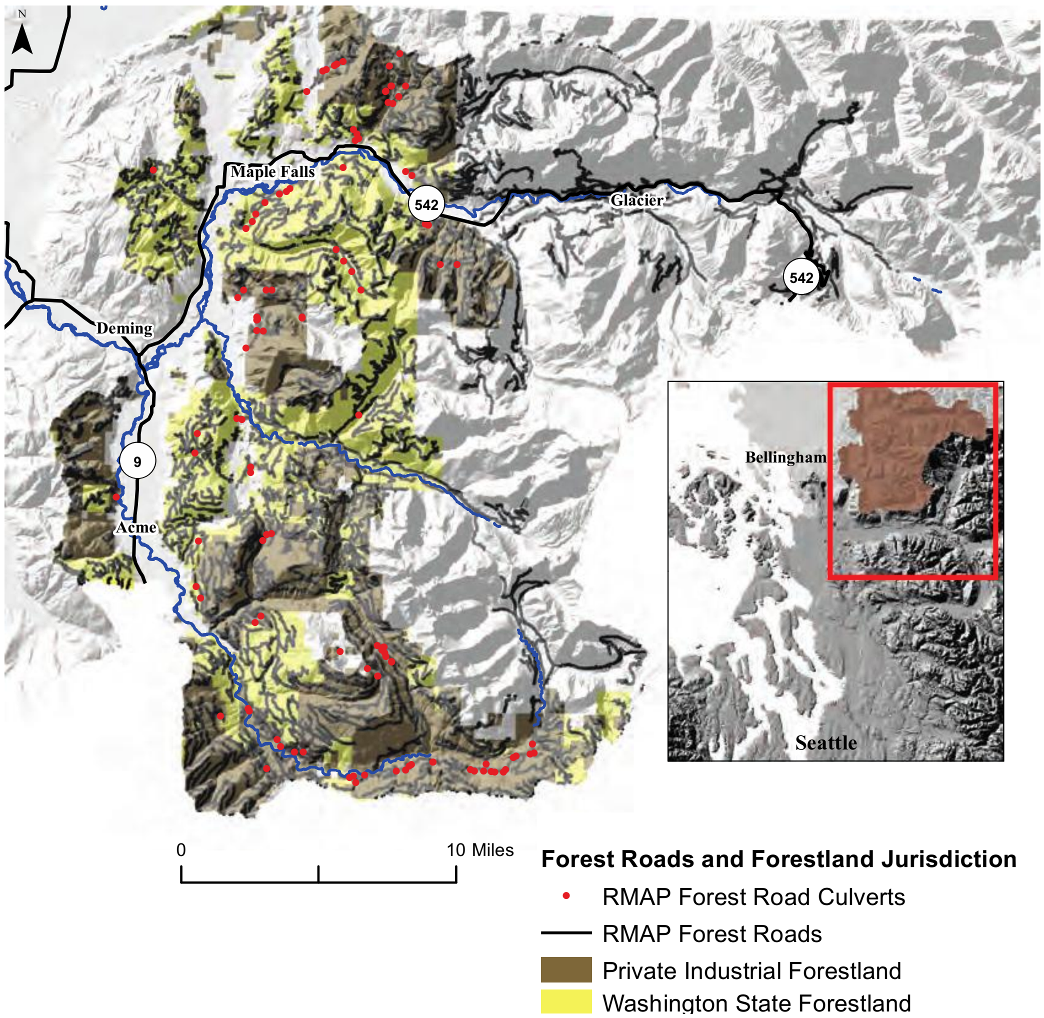


Data Sources: SSHIAP 2004,[6] WAECY 2015b,[7] Whatcom Co. 1998[8]

RMAP Implementation Nearly Complete

The Washington State Forest Road Maintenance and Abandonment Plan (RMAP) implementation has resulted in the repair or abandonment of 90% (1,277 miles out of 1,426 total miles) of private and state-owned forest roads in the Upper Nooksack River watershed.[1] The RMAP implementation has also resulted in the repair or removal of 125 (95%) of 132 culverts on private and state-owned forest roads. The majority of all remaining work is scheduled to be completed by the end of 2016, with the three largest private landowners in the watershed, Weyerhaeuser Corporation, North Cascades Timberlands, and Sierra Pacific Industries all requesting an extension to 2021 to fix the remaining miles of road on their Upper Nooksack River watershed properties.

The majority of forest roads in the Upper Nooksack River watershed are on private industrial and state forestlands and fall under the RMAP mandate. It is expected that RMAP road repairs and abandonment will improve water quality in the upper Nooksack River watershed. Considering the role improved water quality plays in Chinook salmon habitat, the current status of RMAP being almost complete in the Upper Nooksack watershed is good news to salmon recovery. Small forest landowners were not required to develop a RMAP, 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.



RMAP only applies to state and private forestland jurisdictions.

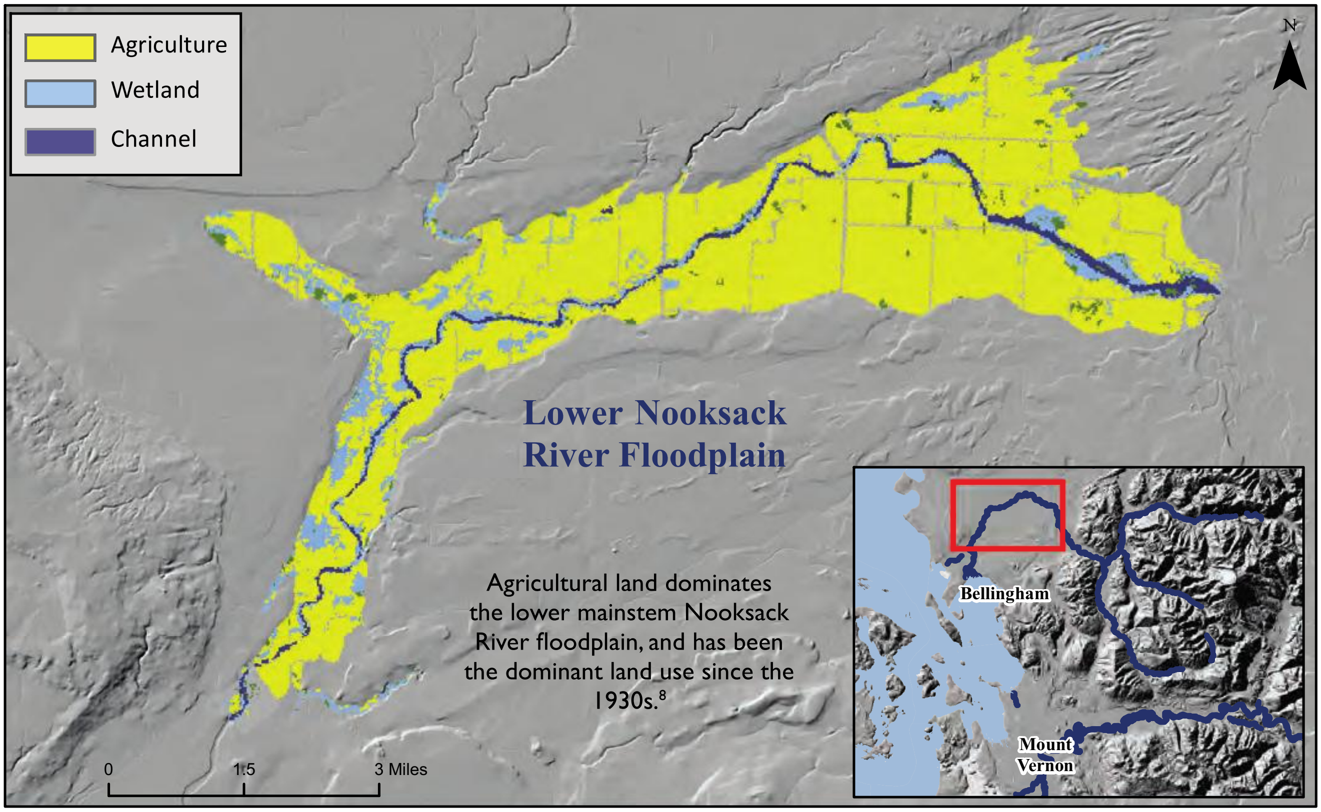
Data Sources: Skagit Co. 2010,[3] SSHIAP 2004,[4] WADNR 2014a,[5] WADNR 2014c,[6] Whatcom Co 2011b[7]

2015 Nooksack River Watershed Road Maintenance and Abandonment Status (RMAP)					
Jurisdiction	*Total Miles of Forest Road*	*Completed Miles*	*Miles Remaining*	*Percent Complete*	*Planned Date for RMAP Completion*
State Lands	459	428	31	93%	10/31/2016
Private Industrial Lands	967	849	118	88%	10/31/2021
Jurisdiction	*Total Number of Culverts*	*Repaired*	*Remaining to be Repaired*	*Percent Repaired*	
State Lands	28	27	1	96%	
Private Industrial Lands	104	98	6	94%	

RMAP status shows that both the state and private forestland owners are approaching completion of road repairs and abandonment as mandated by the RMAP program.[2]

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

The WRIA 1 Salmonid Recovery Plan recommends a return to historical wetland conditions in the lower mainstem floodplain of the Nooksack River.[1] Based on the most recent comprehensive wetland study, in 1880 there were approximately 4,754 acres of wetlands within the Nooksack River floodplain; by 1998, the floodplain wetlands had been reduced to less than 10% of that historical area.[2] 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, and no further loss between 2006 and 2011.[3,4,5]



Agricultural land dominates the lower mainstem Nooksack River floodplain, and has been the dominant land use since the 1930s.[8]

The lower mainstem of the Nooksack River historically meandered through a complex of wetlands and beaver dams. Now, the lower mainstem floodplain is a single threaded river through cropland (raspberries, blueberries, silage corn, potatoes), hay fields and small municipalities. The lower mainstem has suffered the greatest loss of habitat area and function from historical conditions, and the losses have been especially costly for rearing juvenile Chinook salmon. In addition, the productivity of pre-spawning migrant, and over-winter and over-summer rearing life stages are all limited by the loss of historic off-channel wetland habitat in the lower mainstem.[6] While not the most limiting factor to Chinook recovery, all Nooksack stocks of Chinook are affected by conditions in the lower mainstem. Restoration of floodplain wetland conditions in the lower mainstem toward historic conditions remains a long-term goal of the WRIA 1 Salmonid Recovery Plan.[7]

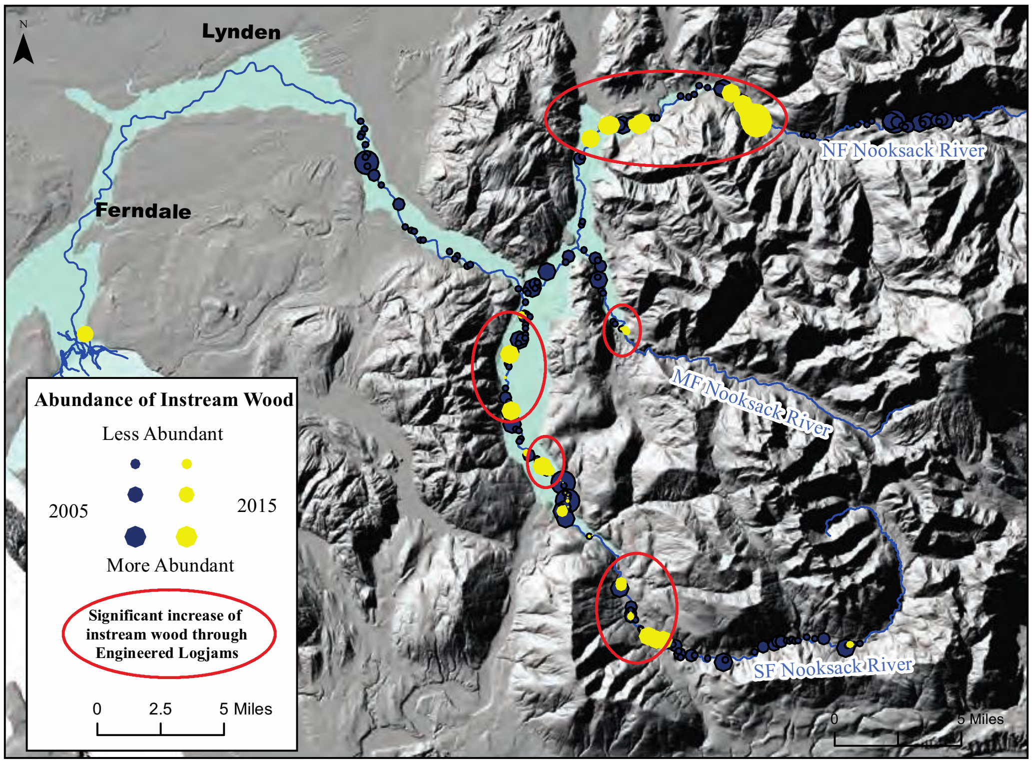
D.Anderson[9]

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

Data Sources: Collins & Sheikh 2002,[10] SSHIAP 2004,[11] WAECY 2011b[12]

Engineered Logjams and Long-Term Commitment Key to Restoring Wood to the Nooksack River

As described in the WRIA 1 Salmonid Recovery Plan, instream wood has a role in channel stability, habitat diversity and overall habitat quantity and quality, all limiting habitat factors to Chinook recovery.[1] At present, there is a two-fold strategy for replenishing instream large woody debris. As a short-term strategy, engineered logjams are being consistently funded, constructed and monitored throughout the North Fork, Middle Fork and South Fork of the Nooksack River by salmon habitat restoration partners. This has resulted in increasing densities of instream wood since 2005.[2] Additionally, the WRIA 1 Salmon Recovery Board (SRB) has set long-term riparian targets for key piece wood recruitment. The draft 2014 revised indicators for the WRIA 1 Salmonid Recovery Plan propose a long-term WRIA 1 SRB target for a "good" or properly functioning riparian condition as a riparian forest that contributes 1.3 to 4 key pieces per 100 meters of stream length.[3]



Archival data suggest that instream wood was historically very abundant in Puget Sound river systems, including the Nooksack River.[4] Settlers' descriptions from the 1800s of logjams 3/4 of a mile long are not uncommon.[5] The combination of land-clearing, riparian forest logging, splash damming and instream wood removal for navigation have all combined to leave the Nooksack River with a relatively low abundance of instream wood.

A notable exception is the Nooksack River delta where large logs have accumulated and a logjam that started to form in 2005 is now over 2/3 of a mile long and completely blocks what was the primary distributary channel of the Nooksack River. These logjams in the Nooksack River delta have substantially impaired navigation in the delta area and as a result, have substantially interfered with the riverine fisheries of the Lummi Nation. The lower mainstem continues to be managed for flood control and navigation. There is little to no accumulation of instream wood between Lynden, Washington, and the delta of the river. The upper mainstem and the forks have a relative abundance of instream wood, but still very low compared to historic levels. The relatively higher levels of wood instream in the upper watershed are in part attributable to the engineering and construction of logjams by the salmon habitat restoration partners. 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.[6]

Lummi Natural Resources Department

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

Data Sources: LNR 2003,[7] NNR 2015,[8] SSHIAP 2004,[9] WAECY 2011a[10]

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2016 State of Our Watersheds Report
Northwest Olympic Peninsula

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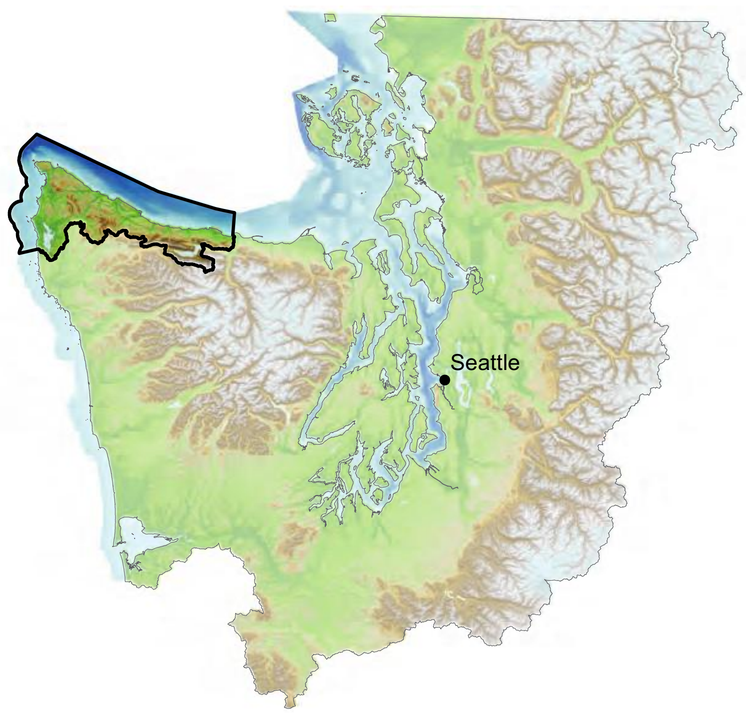
The places- the ocean, the mountain, the fresh water, all the variety of foods, the beach, the land, the animal, the bird, the bug, the tree, the plant give thanks for them. Use what you may need. Take care of them and they will take care of you.



Makah Tribe

Located on the northwest tip of the lower 48 states, the Makah 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 – were located in forests and on beaches. In the early 1800s, these villages were home to between 2,000 and 4,000 Makah. 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 a treaty with the United States retaining their right to whale and hunt, fish and gather as they always had. Today, tribal headquarters are located in Neah Bay, Wash.

Recovering Habitat Means Prioritizing and Restoring

Located on the northwest corner of the Olympic Peninsula, the Makah's Area of Concern 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 or the Pacific Ocean. The largest watersheds are the Sekiu, Hoko, Clallam, Pysht, Tsoo Yess, Ozette and Lyre rivers. Chinook, coho, chum, sockeye and winter steelhead occur in the area's watersheds, with the Ozette sockeye being listed as "threatened" under the Endangered Species Act. Beginning in the late 1800s, the strait region has been heavily logged, with severe consequences to the health of its watersheds and salmon habitat. Today the region is predominantly rural, and industrial forestland management is widespread.

The restoration strategy developed for the Area of Concern consists of maintaining and improving the ecosystem productivity and genetic diversity for all salmonid species by protecting highly productive habitats and populations, and restoring impaired habitat and depressed populations. The approach is to prioritize habitat restoration, protection and enhancement activities with regard to the specific habitat conditions of each individual watershed.

The short-term focus is on habitat restoration activities such as:

- Large woody debris placement;
- Riparian planting;
- Fish-barrier culvert removal;
- Nearshore fill removal; and
- Conservation easements.[1]

Long-term habitat recovery focuses on the restoration and protection of habitat-forming processes. Insufficient time has elapsed to assess the progress toward the goals and objectives of this habitat recovery strategy. Only general conditions and trends can be highlighted.

Debbie Preston, NWIFC

The Waatch River is one of several rivers where the Makah Tribe is removing noxious weeds and creosote pilings as well as restoring habitat.

Sharing Plans and Cooperation Key to Recovery

The Makah Tribe works independently and cooperatively with state and federal agencies to monitor and implement restoration projects. But the Tribe has some concerns about the lack of sufficient commitment by federal and Washington state natural resource agencies to protect, properly manage and recover salmon, since habitat is being damaged and destroyed faster than it can be restored. For the Tribe's treaty-reserved rights to harvest salmon and other natural resources to have meaning, there must be salmon to harvest. There must be real gains in habitat protection and restoration for salmon to survive. And for this to happen, the federal and Washington state governments need to provide leadership and the necessary resources.

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

A review of key environmental indicators for the Makah area shows improvements in the removal of forest road barriers and the installation of large woody debris structures, but degradation of water quantity, road densities and forestland cover. 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 since the 2012 State of Our Watersheds Report shows improvement for some indicators and a steady loss for others in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Water Quantity - Peak Flows	From 1960, peak flows have shown an increasing trend on the Hoko mainstem. If this trend continues as anticipated under predicted climate change conditions, this may pose a significant impact to salmonid runs.	Declining
Water Quantity - Low Flows	From 1960, summer mean low flows have shown an decreasing trend on the Hoko mainstem. If this trend continues as anticipated under predicted climate change conditions, this may pose a significant impact to salmonid runs.	Declining
Water Quality	In the Makah Area of Concern, 32 waterbodies were placed on the 303(d) list for water pollution in 2012. Water temperature was by far the most common pollutant which was in all but two of the waterbodies. The Hoko River was the most impaired waterbody by total length with 11.0 miles impaired by water temperature.	Concerns
Forest Roads	Since 2011, forest landowners have continued to implement their Road Maintenance and Abandonment Plans in the Makah Area of Concern. Almost 53% of the 1,518 culverts have been fixed, leaving about 47% to be repaired by 2021.	Improving
Road Densities	19 watersheds, representing 83% of the land area, may not be properly functioning because of road densities that exceed 3 miles/square mile.	Declining
Forestland Cover	The 2011 forest cover conditions of watersheds in the Makah Area of Concern varied widely but most were in the moderate to healthy categories. However, since 2006, most of the watersheds appear to have been trending toward a reduced forest cover. The highest reductions were in the Sail River-Frontal Strait of Juan De Fuca (10.9%), Big River (10.7%) and Upper Hoko River (9.6%) watersheds.	Declining
Large Woody Debris	The legacy and impacts of historic logging practices that harvested riparian zones is still felt as there is a reduced quantity and quality of large woody debris (LWD) available to being recruited to and retained in many streams in the Makah Tribe's Area of Concern. Since 2012, the Tribe has been working to design and install engineered logjams in 1.3 miles of the mainstem Pysht River and other rivers to improve instream habitat complexity, floodplain connectivity and flood risk attenuation.	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

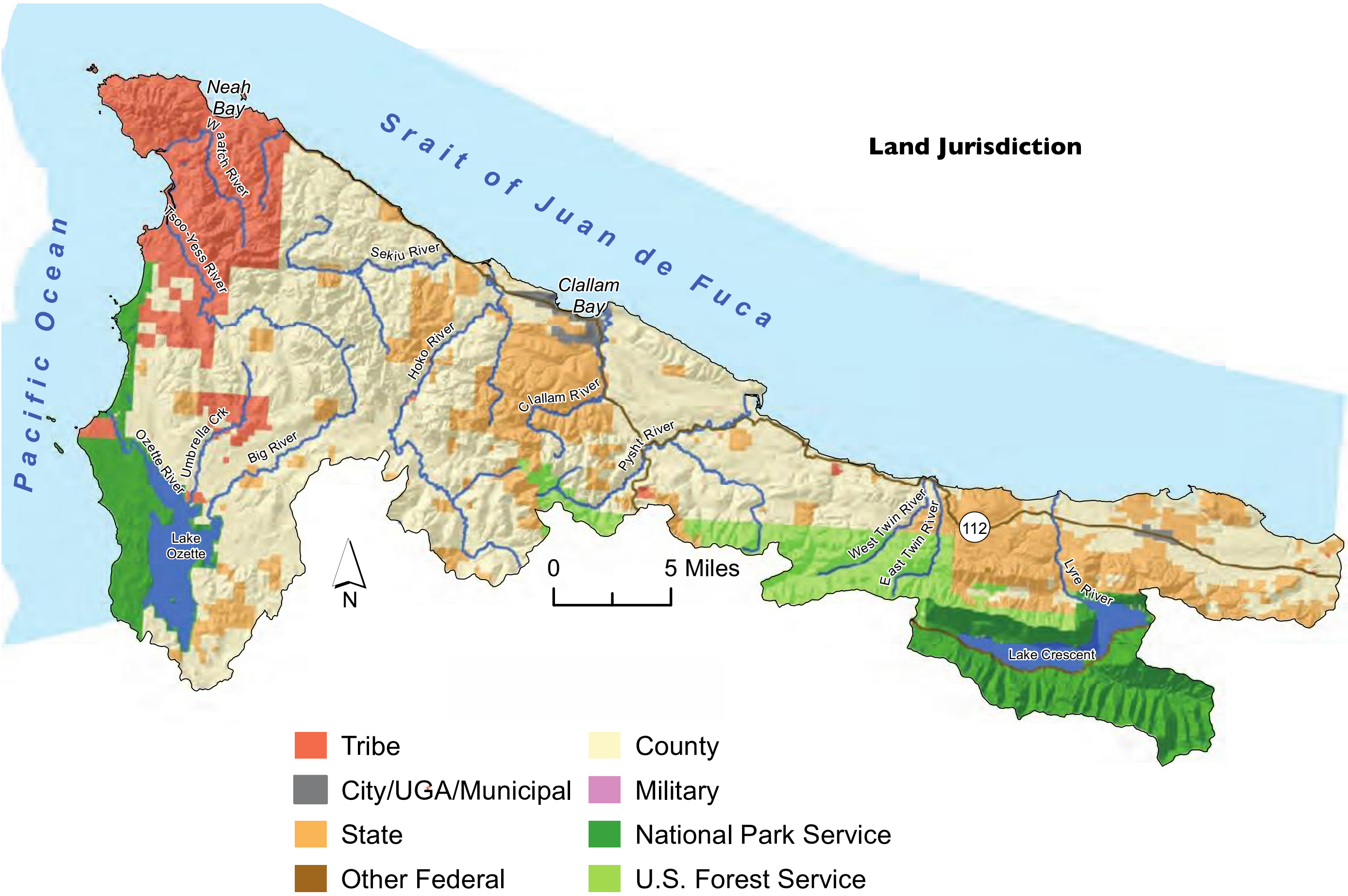
Although the watersheds within the Makah Area of Concern continue to sustain salmonid species, significant threats to fish habitat remain. Land-use practices particularly associated with forestry activities and road maintenance continue to alter watershed processes, resulting in degradation of water quality, water quantity, and stream channel complexity. There is a need for greater communication and cooperation between natural resources managers to assure achievement of the goals set in the watershed recovery plans for the region.

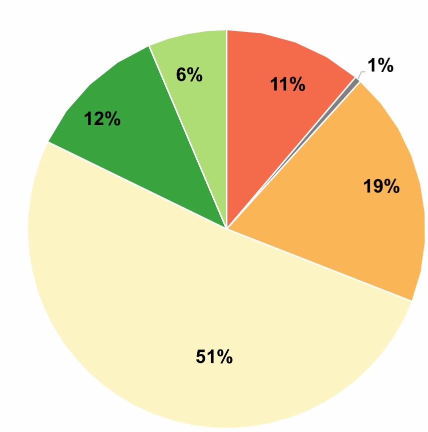
Current habitat conditions and trends speak to the need for continued restoration efforts focused on degraded habitat and increased protection of existing properly functioning habitat. To improve habitat for salmon, significant progress must be made in restoring habitat and stream function with large woody debris placement; riparian planting and fencing; culvert barrier removal; and conservation easements. We are doing our part to buy what land we can in the Area of Concern, but the threat of land transfers to other private ownership could isolate these lands from monitoring as well as collecting important cultural plants. We will need improved communication and cooperation between the myriad of natural resources managers in the area to hold the line, much less improve, fish habitat.

It is troublesome that important repairs to some of these problem road and stream crossings have been delayed with a five-year extension, meaning continued serious harm to these important streams. It is deceptive to think of the Olympic Peninsula as healthy for fish. In concert with climate change, current land-use practices hasten the threat of extinction of the salmon that are a central part of the cultural identity of Makah people.

Makah Tribe

WRIA 19 and portions of WRIA 20





Located on the northwest corner of the Olympic Peninsula, the Makah's Area of Concern 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 or the Pacific Ocean.

The largest watersheds are the Sekiu, Hoko, Clallam, Pysht, Tsoo-Yess, Ozette and Lyre rivers. Easily weathered sedimentary rock, sandstones, and siltstones of the Twin River Formation occur in the western watersheds from and including the Pysht. Streams to the 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 stream channels in the region change quickly to variations in flow and sediment inputs.

Chinook, coho, chum, sockeye and winter steelhead occur in the area's watersheds; the Ozette sockeye is listed as threatened under the Endangered Species Act. Many other salmonid populations are considered critical or depressed from historic levels.[1] Traditionally flourishing off of land and sea, the Makah Tribe had villages and fishing camps most often associated with stream mouths where they could take advantage of plentiful fish and shellfish resources. With the Point No Point and Makah treaties of 1854-55, the tribes agreed to cede their lands to the U.S. government in exchange for retaining their rights to hunt, fish and gather in their usual and accustoms areas. Beginning in the late 1800s, the strait region has been heavily logged, with severe consequences to the health of its watersheds and salmon habitat. Today the region is predominantly rural, and industrial forest land management is widespread.

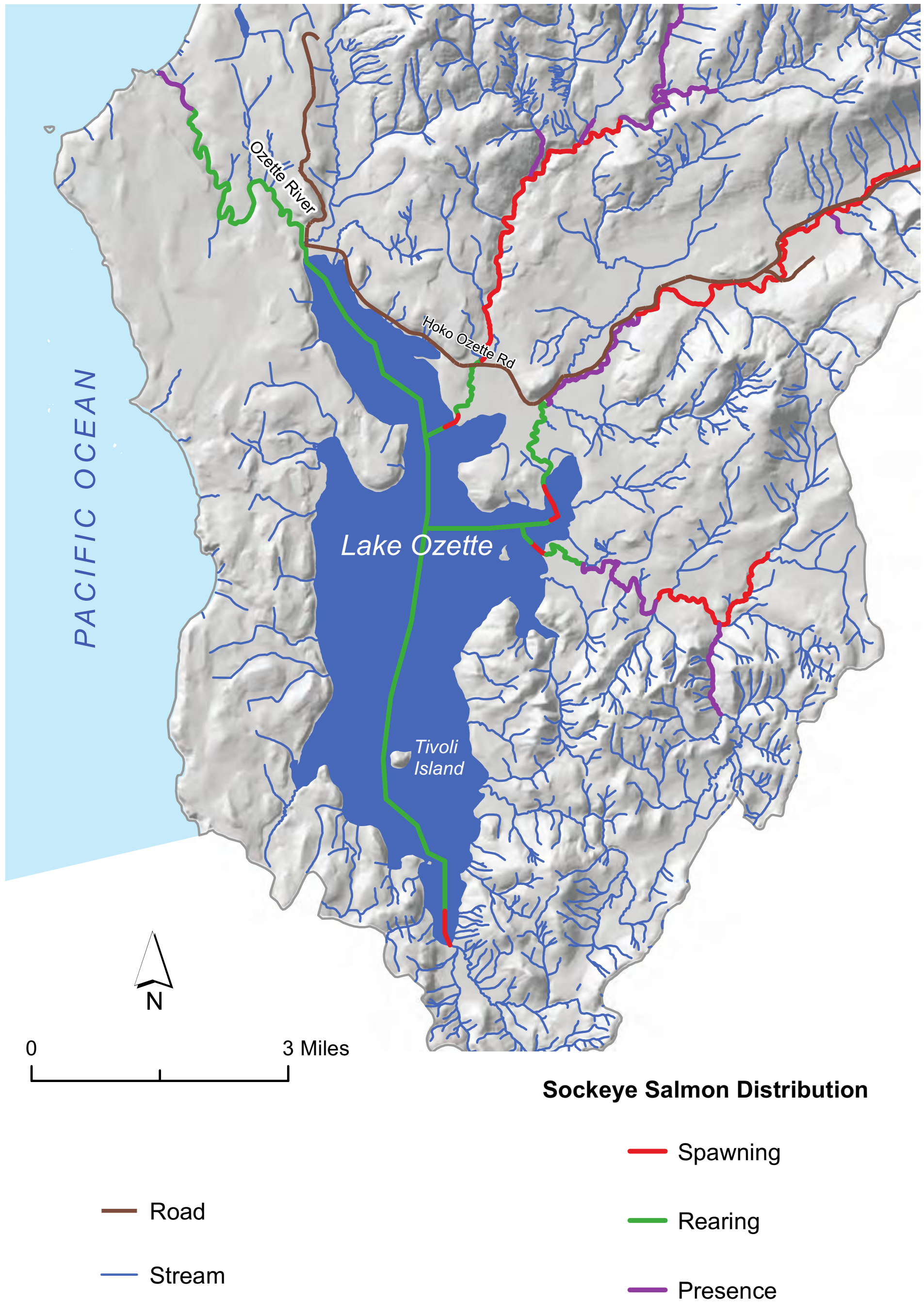
Data Sources: Makah 2016,[2] SSHIAP 2004,[3] USFWS 2014,[4] WADNR 2014a,[5] WADNR 2014b,[6] WADOT 2012,[7] WADOT 2013,[8] WAECY 1994,[9] WAECY 2011a,[10] WAECY 2013[11]

Makah Tribe

Lack of Funding for Co-Manager Response

Co-management refers to the process under which Washington state and the treaty Indian Tribes cooperatively exercise their authority as managers of the salmon resource. The co-management structure was created in 1984, in response to a U.S. Supreme Court decision upholding U.S. District Judge George Boldt's 1974 ruling in *US v. Washington* (the Boldt decision) that the tribes have a treaty right entitling them to half of all harvestable salmon returning to their Usual and Accustomed fishing areas. The Boldt decision also requires the state to maintain the habitat on which salmon depend. The Makah Tribe has some concerns with the lack of sufficient commitment by federal and Washington state natural resources agencies to protect, properly manage and recover salmon as salmon habitat is being damaged and destroyed faster than it can be restored.

One of the biggest contributing factors in the lack of co-manager involvement is that the area is poorly staffed and funded. Frequently, positions remain unfilled when people retire. Therefore you have overloaded staff who have such a large area of coverage that they cannot feasibly review every proposal in detail, especially field review. Some state agencies are better than others, but in a region that takes over 2 hours to travel one-way to a location, this means that there is a large amount of ground that co-managers aren't engaging in. Some state agencies even have to deploy staff from Olympia (some 4.5 hours away) because they won't hire a representative for the area. The area's resources are more vulnerable because of this. It is embarrassing the lack of resources that go into the area in comparison to other regions with ESA-listed salmon species. In addition, state agencies have been cutting their monitoring within the region, therefore increasing the pressure upon the tribes to take up the slack. Only through federal funding grant awards that the Tribe secures have we been able to continue much of the monitoring. Sometimes the Tribe has had to pay the state to operate these monitoring stations.



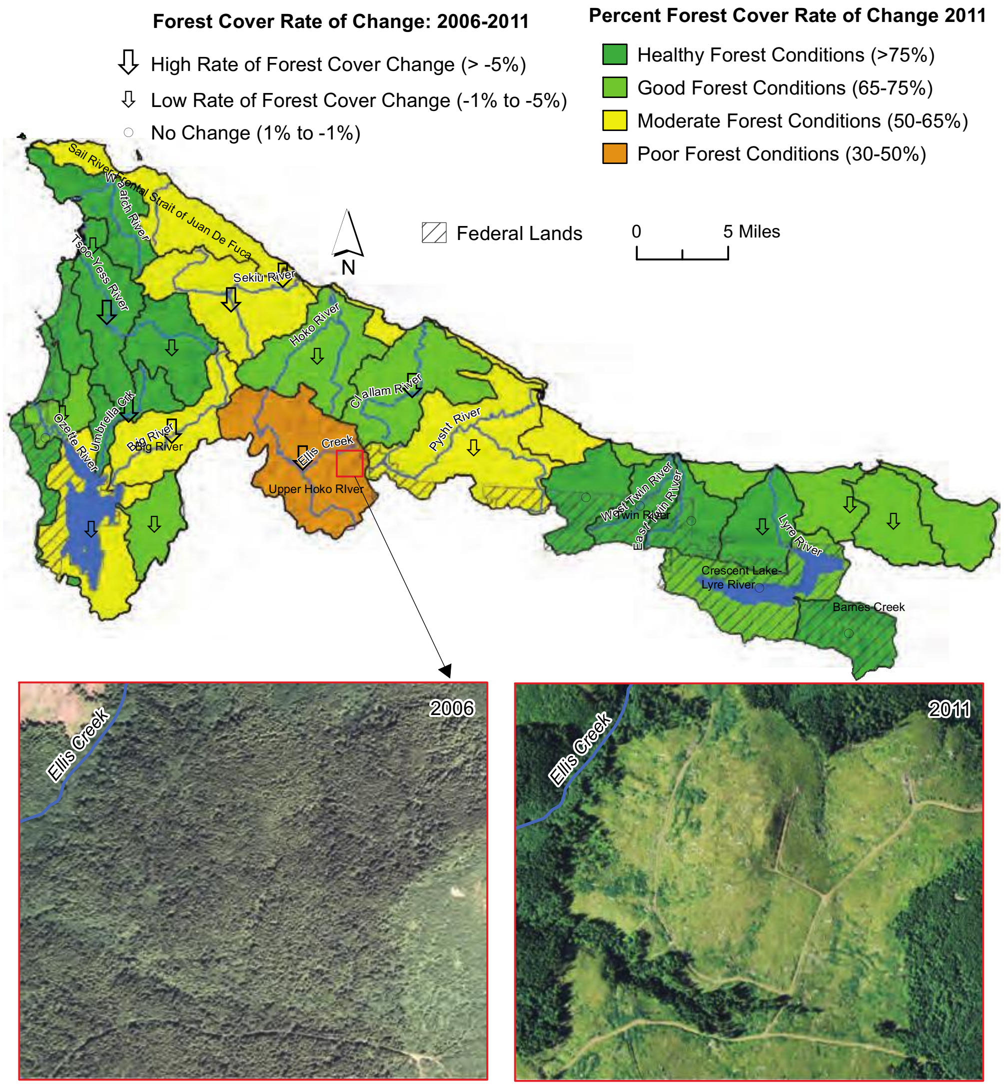
For the Tribe's treaty-reserved rights to harvest salmon and other natural resources to have meaning, there must be salmon to harvest. There must be real gains in habitat protection and restoration for salmon to survive. And for this to happen, the federal and Washington state governments need to provide leadership and the necessary resources.

The recovery of Lake Ozette sockeye provides an excellent example of where the federal and state governments could align their agencies and programs and lead a more coordinated recovery effort. Lake Ozette sockeye were listed as a threatened species under the Endangered Species Act (ESA) in 1999.[1] In an effort to protect and increase the number of spawning sockeye, the Makah Tribe ended its commercial fishery in 1974 and ceased all ceremonial and subsistence fishing in 1982. Even so, sockeye numbers have not rebounded. Developing and implementing a plan to stop the downward trend of the species and return it to a healthy, naturally self-sustaining condition and protect treaty-guaranteed tribal fishing rights requires serious commitment and the provision of ample resources by co-managers.

Data Sources: SSHIAP 2004,[2] SWIFD 2014,[3] WADNR 2014c,[4] WADOT 2012,[5] WAECY 2011a[6]

Forest Cover Conditions

The 2011 forest cover conditions of watersheds in the Makah Area of Concern varied widely but most were in the moderate to healthy categories. However, since 2006, most of the watersheds appear to have been trending toward a reduced rate of forest cover change. The highest reductions were in the Sail River-Frontal Strait of Juan De Fuca (10.9%), Big River (10.7%) and Upper Hoko River (9.6%) watersheds.



Forest cover conditions have a tremendous impact on watershed processes and thus on salmonid habitat. Changes in forest cover can affect the rate of solar radiation reaching the stream surface, the delivery of water, large woody debris (LWD), sediments and nutrients to stream channels, as well as bank and channel stability. When the rate of change increases, it means that the watershed canopy is being removed, typically through logging, faster than it can grow back.

The 2011 forest cover conditions of the different watersheds in the Makah Area of Concern varied widely but most were in the moderate to healthy categories. The main exception was the Upper Hoko River watershed where some poor forest cover conditions exist. The Sekiu River has extensive sedimentation problems, lack of LWD, extensive riparian areas dominated by hardwoods, and the reduced age of the surrounding forests as important habitat limiting factors.[1] Excess sedimentation and a lack of LWD are primary factors that affect channel stability, impact incubating salmon eggs, and therefore limit salmon production in the Hoko River watershed.[2]

An analysis of forest cover rate of change between 2006 and 2011 shows an increase in forest cover loss in most of the watersheds. The highest reductions (of about 10% each) were in the Sail River-Frontal Strait of Juan De Fuca, Big River and Upper Hoko River watersheds. The high rate of loss in Upper Hoko River is particularly significant because of the poor forest conditions in that watershed. Notable exceptions to the general negative trend in forest cover loss were in the Barnes Creek, Crescent Lake-Lyre River and Twin River watersheds where conditions have remained relatively unchanged. While the overall forest cover conditions are generally good, the rate of forest cover change in most of the watersheds appears to be trending negative.

Data Sources: SSHIAP 2004,[3] USGS 2014,[4] WAECY 2006,[5] WAECY 2011a,[6] WAECY 2011b[7]

Large Woody Debris

The legacy and impacts of historic logging practices that harvested riparian zones is still felt as there is a reduced quantity and quality of large woody debris (LWD) available to be recruited to and retained in many streams in the Makah Tribe's Area of Concern. Since 2012, the Tribe has been working to design and install engineered logjams in 1.3 miles of the mainstem Pysht River and other rivers to improve instream habitat complexity, floodplain connectivity and flood risk attenuation.

Healthy stream channels for salmonids requires a steady recruitment and retention of large woody debris to promote channel complexity. Wood helps form pools and other important rearing areas, stores sediment and organic matter, and influences water quality by providing thermal refugia. Biologically, LWD provides cover for fish from predators and refuge from high streamflow, in addition to offering organic processing. The abundance of salmonids is often closely linked to the abundance of LWD.

Lack of LWD was identified as a major salmonid habitat limiting factor for many watersheds including but not limited to the Hoko River, Sekiu River, Pysht River, Nelson Creek, Susie Creek, Salt Creek, Colville Creek, Waatch River, Tsoo Yess River, Ozette River and Big River.[1,2]

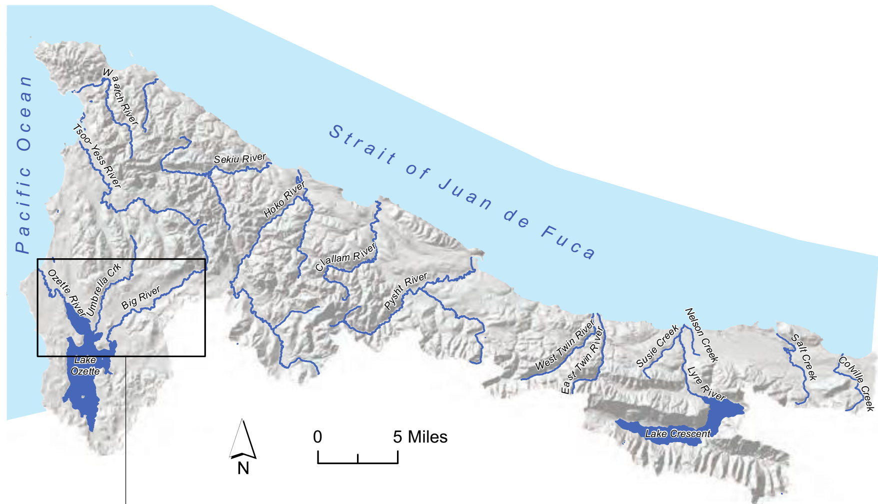
The dominant land use in the low elevation areas of these watersheds is industrial forestry which historically involved the removal of nearly all large tress from riparian zones during logging. As a result, the riparian vegetation was consequently converted from native, old-growth coniferous forests to tree plantations dominated by hardwood like red cedar. The overall trend of the effects from logging have included decreased size, abundance, quality, mobility and species composition, as well as an increased depletion rate of LWD being recruited to streams.[3]

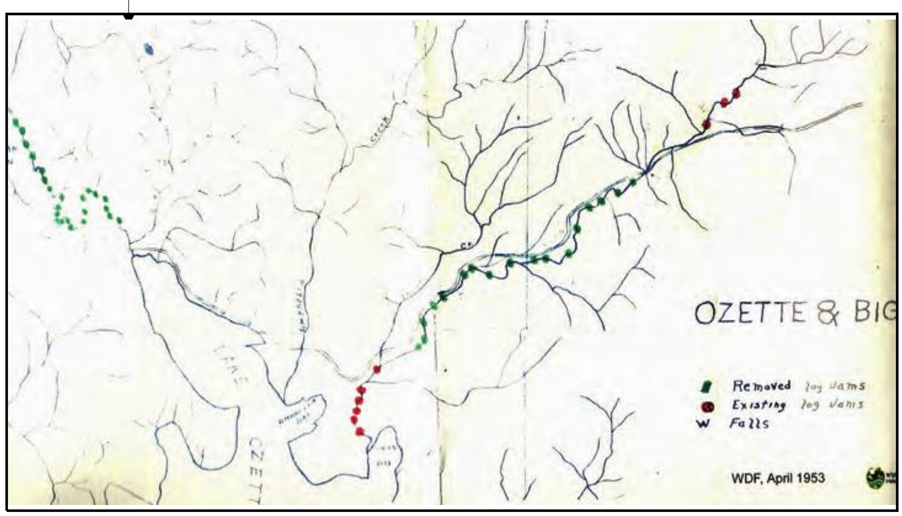
In addition, many of the larger streams and rivers were used to float logs to downstream mills before extensive logging roads were built. Stream reaches were cleared of logjams to allow navigation. Throughout the last century, and particularly in the last 60 or 70 years, LWD was removed in the Ozette River in the belief that it helped fish or would reduce flooding.[4] A total of 26 large jams on the Ozette River were removed in 1952 alone.[5] Similar activities were carried out on the Clallam River,[6] East Twin River[7] and Hoko River.[8]

Placement of LWD has been identified as an important habitat restoration action in the area.[9]

Since 2012, the Makah Tribe has been working to design and install engineered logjams in 1.3 miles of the mainstem Pysht River as well as 0.5 miles of the Hoko River to improve instream habitat complexity, floodplain connectivity and flood risk attenuation.

Data Sources: SSHIAP 2004,[11] WAECY 2011a[12]





Kramer 1953[10]

1953 map depicting removed and existing logjams

Debbie Preston, NWIFC

Large woody debris

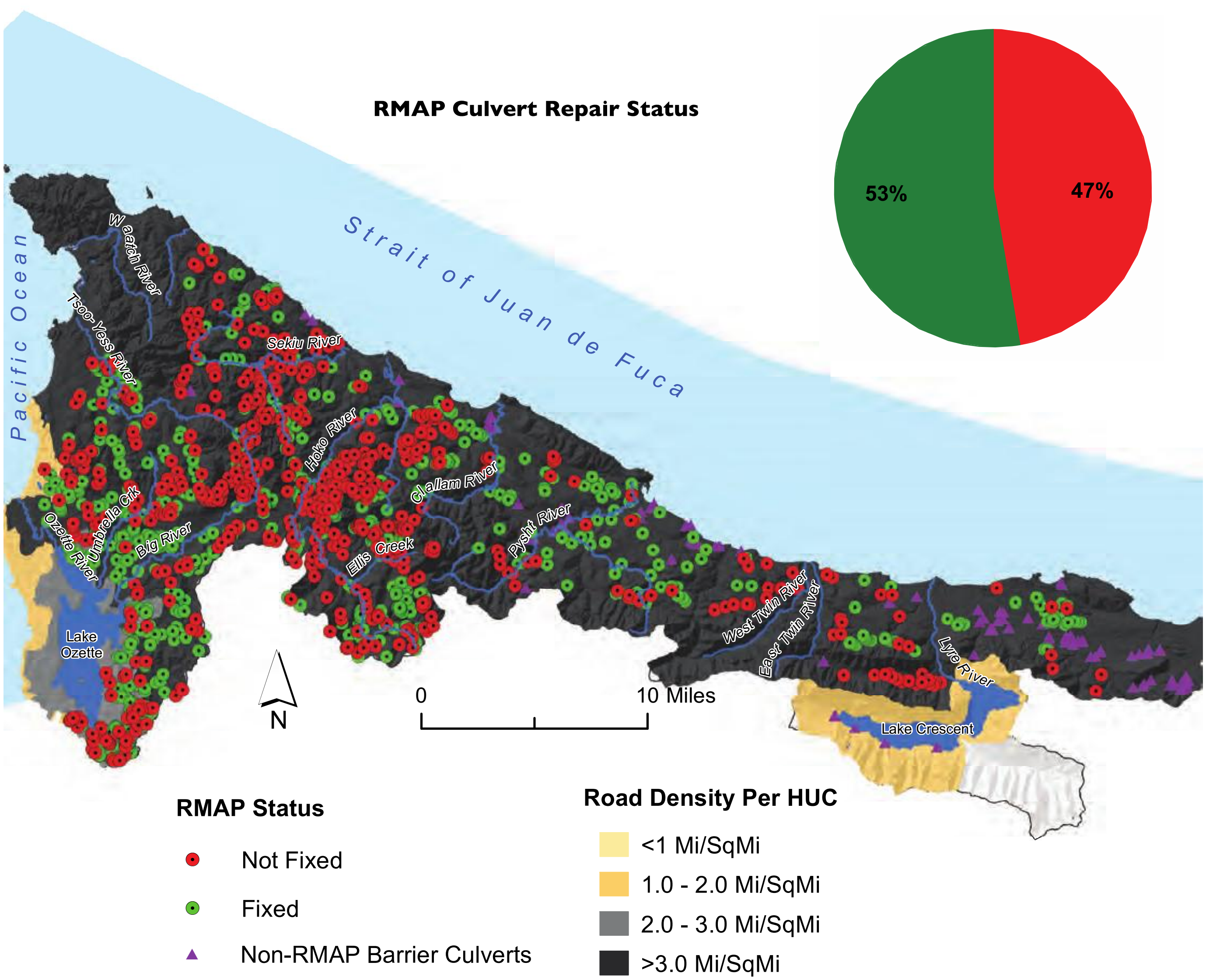
Roads as a Limiting Factor

Since 2011, forest landowners have continued to implement their Road Maintenance and Abandonment Plans (RMAP) in the Makah Area of Concern. Almost 53% of the 1,518 culverts have been fixed, leaving 47% to be repaired by 2021. Also, 19 watersheds, representing 83% of the land area, may not be properly functioning because of road densities that exceed 3 miles/square mile.

Forests roads serve many important functions. If not properly constructed or maintained, they can become a source of sediments to streams which degrade fish habitat and water quality.[1] Furniss et al.[2] concluded that the sediment contribution per unit area from roads is often much greater than all other forest activities combined. Also, many culverts at forest road crossings may constitute fish barriers.

Washington State Forest and Fish law requires most forest landowners to have a Road Maintenance and Abandonment Plan (RMAP), a schedule for any repair work needed to upgrade road systems at stream crossings and address aquatic habitat and fish passage issues. The RMAP data shows that almost 53% of the identified 1518 culverts in the Makah Area of Concern were fixed and 47% are yet to be fixed and remain barriers to fish. This repair rate represents an increase of 16% since 2011, and is a positive trend that should have a positive impact on fish habitat and water quality in the Makah Area of Concern. There are an additional 129 non-RMAP culverts in the Area of Concern.

Cederholm et al.[3] found that fine sediment in salmon spawning gravels increased by 2.6-4.3 times in watersheds with more than 4.1 miles per square mile (mi/sq mi) of land area. The National Marine Fisheries Service guidelines for salmon habitat characterize watersheds with road densities greater than 3 mi/sq mi of watershed area as "not properly functioning".[4] Watersheds were classified as "properly functioning condition" when road densities were less than 2 mi/sq mi and "at risk" when values were 2-3 mi/sq mi. A total of 19 watersheds representing 83% of the land area had road densities above 3 mi/sq mi and this could be a major limiting factor on salmonid production. Extensive sedimentation resulting from high road densities and landslides was reported for many watersheds by Smith.[5]



Data Sources: SSHIAP 2004,[6] WADNR 2014c,[7] WADNR 2014d,[8] WAECY 2011a[9]

MAKAH TRIBE

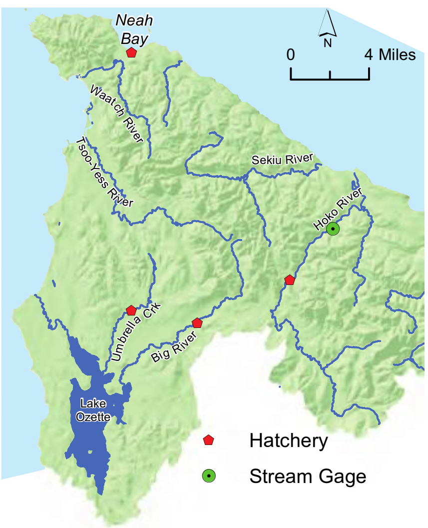
Hoko River Flow

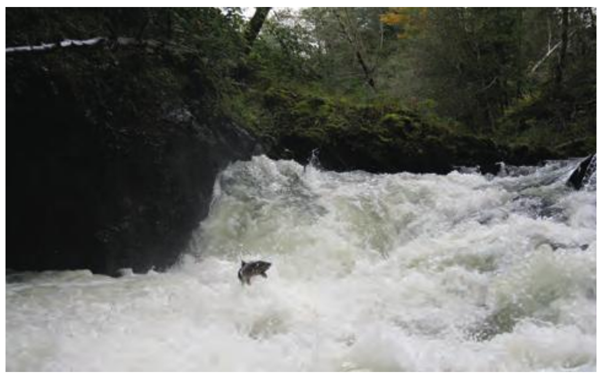
The Hoko River streamflow has experienced a steady and alarming trend. Winter peak flow values show an increasing trend while summer mean low flow values show a decreasing trend. Both trends have been predicted to occur because of climate change and now are a reality in the Hoko. These trends may indicate that salmon habitat and other aquatic ecosystem functions may not be adequately protected under current management regime.

The magnitude, timing and variability of low streamflows and the magnitude and frequency of high streamflows are critical to salmonid survival and production. Because of its low elevation and dependence on precipitation, the Hoko River basin is naturally susceptible to low water flows in the summer and early winter like the other rain dominant watersheds in the region. However, human factors seem to be contributing to the problems of low and peak flows. One of these factors is water withdrawals for municipal water use.[1] Another factor is forestry land-use practices and the alteration of the age and composition of the surrounding forest cover. The relatively younger tree stands are believed to be associated with an increased frequency and severity of peak flows.

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 scour of redds during peak flow events.[2] The timing of these flows can also be a problem for coho salmon.[3]

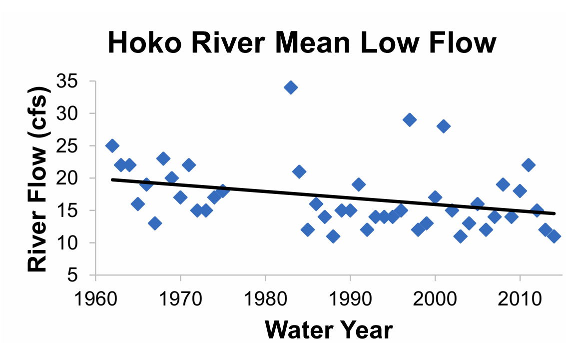
Streamflow data has been collected for the Hoko River by the USGS since 1963, although there were gaps during that period. The data show that over time, winter peak flow values have increased while summer mean low flow values showed a decreasing trend at precisely the time when streamflow is needed the most and when water temperatures are at their highest. Both trends have been predicted to occur because of climate change and now are a reality in the Hoko. These trends may indicate that salmon habitat and other aquatic ecosystem functions may not be adequately protected under current management regime.

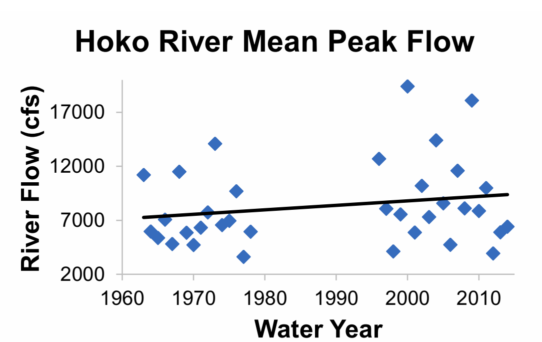




Joe Hinton, Makah Tribe (2)

Both photos were taken looking upstream near River Mile 10 at the base of the Hoko Falls from same general location. The high water picture (top) with the chinook salmon was taken on Oct. 3, 2013, and the low water picture (bottom) was taken Oct. 2, 2014.



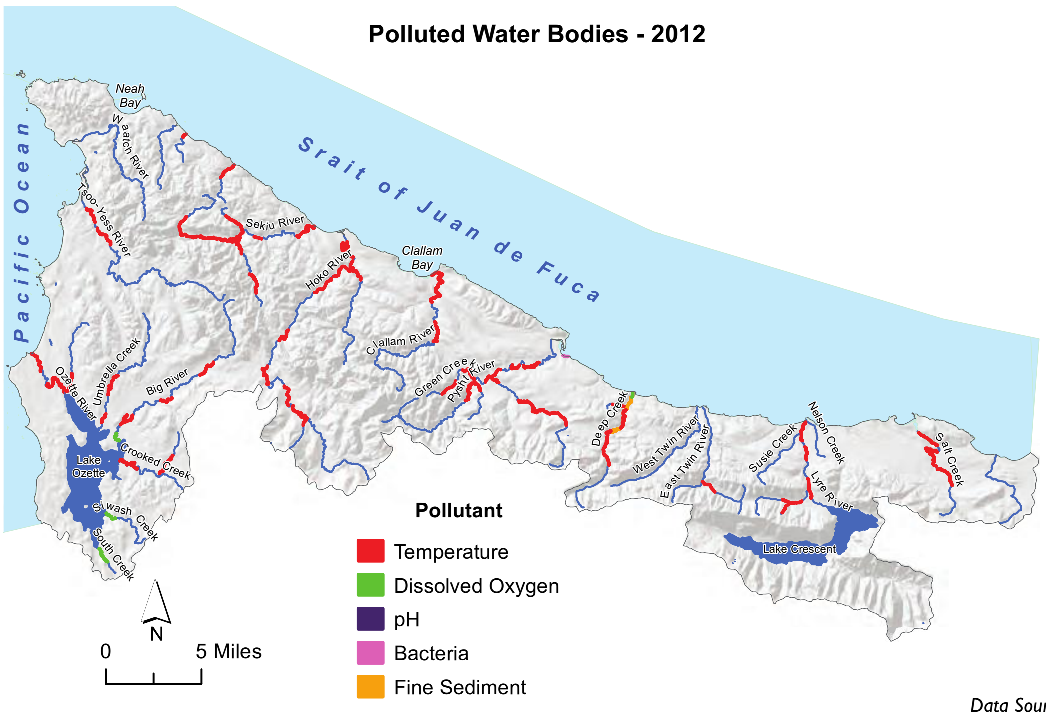


Data Sources: SSHIAP 2004,[4] USGS 2015,[5] WAECY 2011a[6]

MAKAH TRIBE

Water Quality

In the Makah Area of Concern, 32 waterbodies were placed on the 303(d) list for water pollution in 2012. Water temperature was by far the most common pollutant, which was in all but two of the waterbodies. The Hoko River was the most impaired waterbody by total length, with 11.0 miles impaired by water temperature.

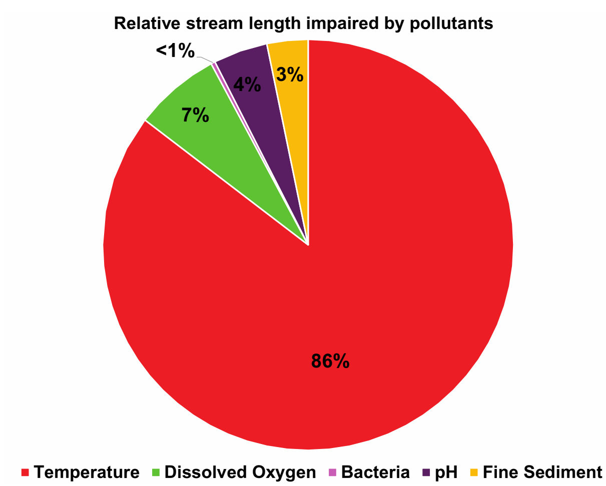


Data Sources: SSHIAP 2004,[2] WAECY 2011a,[3] WAECY 2013[4]

The federal Clean Water Act requires states 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. The 303(d) list comprises those waters that are in the polluted water category, for which beneficial uses such as drinking, recreation, aquatic habitat, and industrial use are not being met.

Water quality requirements for salmonids include cool temperatures, high dissolved oxygen, natural nutrient concentrations, and low level 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.

In the Makah Area of Concern, 32 waterbodies were placed on the 303(d) list for water pollution in 2012, the latest year for which data is available. Water temperature was by far the most common pollutant which was in all but two of the waterbodies. Other pollutants were dissolved oxygen, pH, bacteria, and fine sediment and mercury (Lake Ozette is highest in Washington state). The Hoko River was the most impaired waterbody by total length with 11.0 miles impaired by water temperature. There were many occurrences in which the 7-day mean of daily maximum values (7-DADM) exceeded the temperature criterion of 16˚C for the Hoko River. Deep Creek has 8.8 miles impaired by water temperature, dissolved oxygen, and fine sediment.



Debbie Preston, NWIFC

Coho survey of a tributary of the Hoko River.

AR052819

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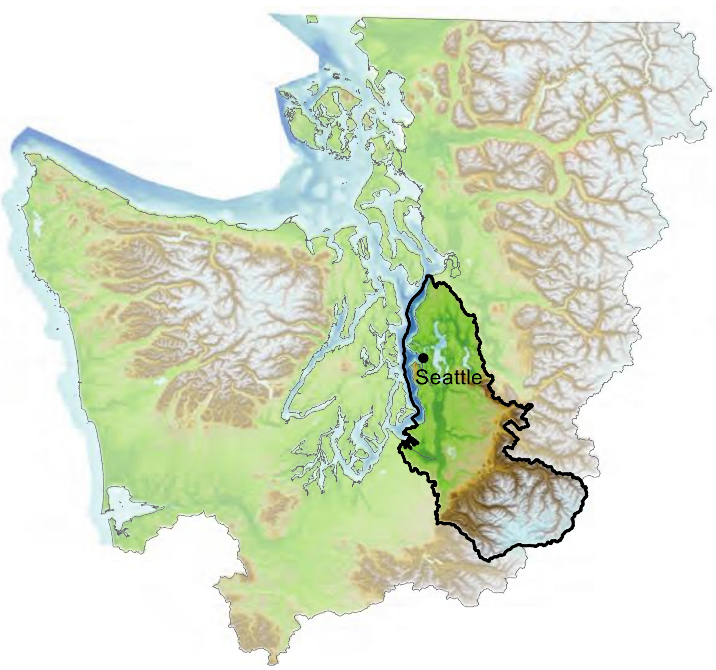
2016 State of Our Watersheds Report
Green-Duwamish River, White-Puyallup River and Lake Washington Basins

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



Areas depicted do not necessarily correspond to Muckleshoot Usual & Accustomed fishing grounds and stations.

Muckleshoot Indian Tribe

The Muckleshoot Indian Tribe is a federally recognized Indian tribe whose membership is composed of descendants of the Duwamish and Upper Puyallup 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 Upper Puyallup ancestors. Today, the United States recognizes the Muckleshoot Tribe as a tribal successor to the Duwamish and Upper Puyallup 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.

Central Puget Sound: A History of Large-Scale Habitat Loss and Degradation

The Green-Duwamish, Puyallup-White and Lake Washington basins in Central Puget Sound continue to support important salmon and steelhead runs despite dramatic habitat alteration and ecosystem decline. However, the abundance and potential production of natural-origin salmon have declined sharply. By the early 1900s, navigation and flood-control projects split apart the former 1,700-square-mile river basin that included the Green, White and Cedar rivers and lakes Washington and Sammamish and their tributaries. The White River was diverted into the Puyallup River. The Black River, the historical outlet of Lake Washington and the Cedar River, was eliminated, and a new outlet was constructed through the Chittenden Ship Canal and Locks.

The Cedar River was diverted into Lake Washington, permanently extinguishing chum and pink salmon runs unable to migrate through the lake. By the 1940s, the Duwamish estuary marsh and tidelands were filled to create Seattle's industrial port, and the Cedar, White and Green rivers were dammed. Streams, wetlands and floodplains were drained, channelized or confined, and the conversion of forest to asphalt began.

Today, the majority of lowland areas are urbanized. Only a small fraction of marine shorelines remain in a natural condition. Now, more than 2 million people live in these basins and that number is growing.

The scarcity of properly functioning freshwater and marine habitat in Central Puget Sound basins means that hatchery fish produced from local broodstock will remain essential for salmon harvest and conservation. In these basins, the Puget Sound Chinook Recovery Plan goal of self-sustaining and harvestable salmon populations is not likely achievable in the foreseeable future. Until enough high-quality habitat is re-established so that much greater numbers of salmon can successfully complete their life cycle, the benefit of hatchery fish to population abundance will outweigh any potential genetic or ecological risks. Without support from hatchery fish, run sizes would dwindle to unfishable "museum" levels or even extinction given the severity of habitat limitations. At the same time, without sufficient habitat and water quality improvement, even hatchery fish may not be sustainable over time.

Muckleshoot Indian Tribe

A Muckleshoot tribal gillnet boat on Elliott Bay underneath the Seattle skyline at sunrise.

Habitat Decline Continues Despite Recovery Plan

Effective habitat protection and restoration efforts are necessary to sustain future salmon runs in these basins regardless of natural or hatchery origin. Local governments in WRIAs 8, 9 and 10 have prepared habitat plans under the Puget Sound Chinook Recovery Plan approved by NMFS in 2005. Significant efforts are being made by the WRIA groups to implement the projects and measures identified in these plans. While some projects are completed, implementation has been limited by funding and other constraints. Even with full funding, however, the ability of these habitat plans to produce a net gain in habitat quality and quantity is uncertain given the impacts of ongoing development and population growth, the small scale of the proposed actions, and a reliance on voluntary measures and inadequate regulatory protection and impact mitigation.

The plans identify restoration projects that, while important, are generally small relative to watershed needs. In many cases, the potential to recover natural habitat processes in restoration projects is constrained by adjacent land use, recreation, flood control, water supply or other conflicts. Despite the efforts by the WRIA groups, habitat continues to be lost and degraded. A status report commissioned by NMFS to track the Puget Sound Recovery Plan implementation found that while salmon plan harvest limits had been followed, habitat for Chinook is still declining in Puget Sound.[1] The status report concluded that habitat degradation is continuing despite the adoption of the Shoreline Management Act, Growth Management Act and Forest Practices Act. Forestland conversion and impervious surface area grew by 2-3% from 2001-2004 and by another 1.3% from 2006-2011. Despite critical areas rules, riparian areas in priority watersheds in the Lake Washington-Cedar-Sammamish Watershed continued to lose forest cover and gain impervious surfaces with a 5.5% gain in rural areas and 10.6% gain inside Urban Growth Boundaries between 2005 and 2009.[2]

The Lake Washington-Cedar-Sammamish Chinook Salmon Conservation Plan (WRIA 8) contains habitat objectives to maintain or restore watershed processes, functional migration corridors and high-quality refuge habitats, land-use and planning recommendations, and public outreach and education.[3] The plan identified 165 high-priority or "Start List" projects for implementation in the first 10 years of the plan. A current update of the "Start List" contains 200 projects.[4] Of these, 48 (or 24%) have been completed in the first 10 years of the plan, and 66 are underway, while organizers report that 38 more are moving toward implementation.

The Green River Salmon Habitat Plan (WRIA 9) established goals to protect and restore physical, chemical and biological processes and freshwater, marine and estuarine habitats; protect and restore habitat connectivity where feasible; and protect and improve water quality and quantity conditions to support healthy salmon populations.[5] The Puget Sound Chinook Recovery Plan 2011 Implementation Status Assessment prepared for NMFS noted that the WRIA 9 planning group has "the disadvantage of attempting to achieve recovery in one of the most highly altered, diked, degraded and urbanized watersheds in Puget Sound."[6] As elsewhere in Central Puget Sound, restoration opportunities in WRIA 9 are challenged by high land costs, conflicting land use and site availability. The scale of the habitat plan restoration projects is generally small. For example, the projects that target estuary transition zone habitat (a high-priority action) would restore a total of fewer than 40 acres, with a long-term goal of just 173 acres. Restoring even the most basic salmon habitat needs in the lower Green River, such as an adequate riparian corridor to address lethal water temperatures, has proved to be a complex challenge given farmland preservation policies, flood control levee maintenance and construction, existing development, and other constraints and conflicts.

Muckleshoot Fisheries Division staff capture and implant tags in adult Chinook to assess migration behaviors and pre-spawn mortality related to high summer temperatures in the Green-Duwamish River caused by a severe riparian shade deficiency along levees and banks.

Pierce County serves as the lead entity for the Puyallup-White WRIA 10 Salmon Habitat Protection and Restoration Plan. Key strategies include levee setbacks, floodplain reconnection, creation of off-channel habitat, restoration of estuary and marine nearshore habitat, and protection and restoration of key tributaries, along with programmatic actions such as a Flood Hazard Reduction Plan and Shoreline Master Plan updates.[7] While some projects have been completed, the WRIA group reports that they are not on pace to meet 10-year goals.[8] Meanwhile, new industrial and commercial warehouse development in the lower White River floodplain is eliminating opportunities for floodplain reconnection.

AR052824

Restoration Progress Slow and New Challenges Emerge

Although only one indicator of habitat conditions, a review of recovery progress and trends at the 10-year mark of the Lake Washington, Green-Duwamish and White River habitat plans indicated mixed results.

Coordination and alignment of the regulatory and programmatic efforts of jurisdictions with the goals and objectives of the recovery plans has not occurred. For example, Shoreline Master Programs governing land use and habitat protection have yet to be updated and made consistent with habitat recovery strategies.[9]

Despite its value to salmon, large woody debris placement in rivers is restricted to accommodate recreation. Progress with restoration efforts has been slow, with less than 100 acres of juvenile Chinook rearing habitat created or underway in the lower Green River and Duwamish Estuary transition zone. This represents less than 2% of the historically available floodplain rearing and intertidal marsh habitat in these areas. Few projects have been able to begin to restore characteristic natural riparian and floodplain habitat processes.

Except for the recent requirement for long-needed fish passage improvements at Mud Mountain Dam, federal agencies are still not adequately meeting their own responsibilities for salmon habitat and need to do more. Examples include:

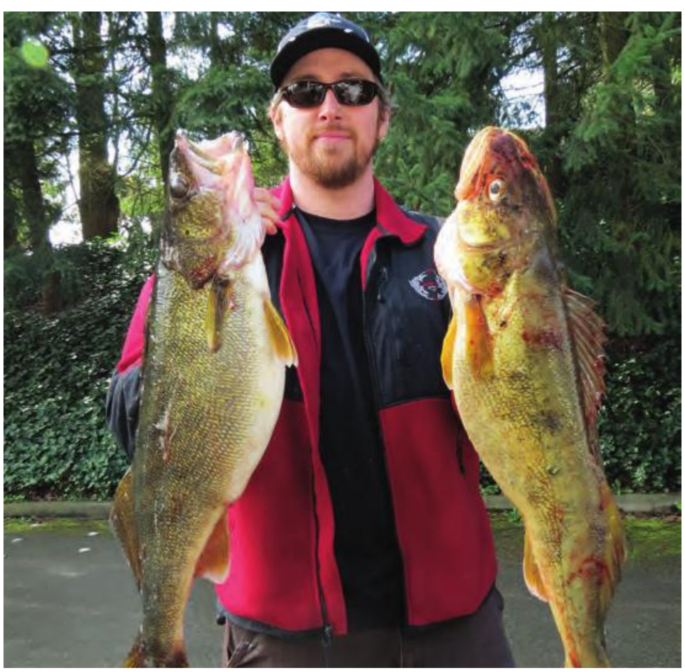
- Continued delays in fish passage improvements at U.S. Army Corps' Howard Hanson Dam, and the Ballard Locks.
- Weak permit terms and conditions for federal actions affecting ESA Critical Habitat, such as the Corps of Engineers' in-place levee repairs under Public Law 84-99 that limit the potential for adequate riparian shade, remove scarce mature trees, and add large quantities of heavy riprap rock along miles of the Green River.

Meanwhile, as fisheries managers, we face new challenges to restore harvestable salmon runs in our watersheds. The highly modified Lake Washington system provides advantageous habitat for many non-indigenous and native fish species that prey on juvenile salmon. These include bass, cutthroat trout, northern pikeminnow – and particularly worrisome – walleye, a large and voracious salmon predator that was recently discovered, with most individuals in breeding condition. One study in the Columbia River basin reported that, on a per-run basis, the mortality attributed to salmon predation by non-indigenous species may be similar to mortality associated with juvenile passage through all of the eight Columbia and Snake rivers' hydropower dams.[10] Preliminary results from a recent tribal study in the Lake Washington basin found that the out-migration survival rate of coho smolts was less than 10 percent. Action is needed now to remove or control walleye before this species becomes established, and to remove other increasingly populous and nonindigenous smallmouth and largemouth bass, especially from locations where salmon juveniles are most vulnerable. Support for predator control actions from state and federal agencies is essential.

Artificial nighttime lighting or light pollution along our waterways is a growing problem. Studies and experiments led by the U.S. Fish and Wildlife Service were conducted in the Lake Washington basin between 1998 and 2014. Sockeye salmon predation mortality was observed to increase as a result of artificial light levels along the lower Cedar River in Renton. Chinook salmon were generally attracted to artificially lit areas and along shadow lines in the lake and in the Lake Washington Ship Canal, along with birds and other predators. While the problem has been known for over a decade, light levels continue to increase.

Muckleshoot Tribe

A ship moves through the U.S. Army Corps of Engineers' Ballard Locks as two smolt passage flumes (foreground) provide the only safe passage to sea for juvenile salmon from the Lake Washington. Fish passage improvements are needed with new equipment and machinery to help reduce smolt mortality associated with navigation at the locks.



Muckleshoot Tribe

Tribal biologist Jesse Nitz displays walleye caught in Lake Washington. An illegally introduced species, walleye were first discovered in the lake in 2014 with some individuals found in breeding condition. Salmon recovery may well depend on control of this invasive salmon predator as well as control of the bass and cutthroat trout that thrive in the lake system's urban shorelines and creeks.

AR052825

Review of the trend for these key environmental indicators since the 2012 State of Our Watersheds Report shows a steady loss in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Water Quality	Approximately 193 miles of stream in WRIAs 8, 9, and 10 are listed as "impaired waters" by the Washington State Department of Ecology 2012 Water Quality Assessment. An additional 42 miles in WRIAs 8 & 9 are assumed to exceed water temperature standards for fish, based on adjacent impairments or other data.	Declining
Coho Pre-Spawn Mortality	Based on NOAA and USFWS models, 269 stream miles or 56% of known coho distribution in the Green-Duwamish and Lake Washington basins are predicted to have a PSM rate of 5% or more, with 141 miles predicted to have 35%-100% PSM.	Declining
Water Wells	From 2010-2014, wells increase by 4.5% (369) in the Lake Washington and Green-Duwamish basins. The Puyallup-White basin saw a 2.6% increase (101) in wells. From 2010-2014, 26 new wells were added to the already existing 1,314 wells in the Soos Creek Basin. Summer-fall flows in Big Soos Creek show a statistically significant decline that coincides with development of municipal and private wells in the subbasin.	Declining
Water Quality - Low Flows	A total of 482 miles of streams in the Lake Washington and Green-Duwamish basins are identified as having low streamflow problems, while in the Puyallup-White basins there are 120 miles of stream with low flow concerns.	Declining
Impervious Surface	From 2006 to 2011, there was a slight increase (1.3%) in impervious surface corresponding to the economic recession. The trend is for a growing human population and more construction activity adding more impervious land cover.	Declining
Shoreline Modifications/Forage Fish Impacts	From 2005 to 2014, shoreline modifications have shown a positive trend in King County, with more armoring being removed than constructed. During this time period, 681 feet of new armoring were constructed, along with the removal of 903 feet. 2.6 miles of armoring were replaced during the same time period. An estimated 82% of Lake Washington's shoreline remains heavily modified with bulkhead and riprap.	Declining
Overwater Structures	Since 2011, Lake Washington and Lake Sammamish have seen an increase of about 60 (1%) new docks, making a total of 4,157 overwater structures.	Declining
Large Woody Debris	Wood counts in the lower Cedar and Green rivers have less than 5% of the expected key piece quantities. Watershed Analysis data on large woody debris (LWD) in the upper White River (above Mud Mountain Dam) suggests the LWD and key piece quantities is in a "poor" condition as it relates to necessary functions for salmon habitat.	Declining

The Tribe continues to work toward the protection and restoration of water quality, streamflows, nearshore, estuarine and river habitat, and to conduct research to understand the organisms and the habitats they occupy.

Looking Ahead

Muckleshoot Tribe

Muckleshoot tribal fishermen land sockeye at Rainier Beach in Seattle in 2006. No tribal or sport sockeye fisheries have been opened since 2006 on account of low abundance. High water temperatures along their migration route led to severe pre-spawn mortality in sockeye returning to the Cedar River in 2014 and 2015, negatively affecting the potential for sockeye fisheries in future years.

Salmon returns and treaty harvest opportunity continue to deteriorate in Central and South Puget Sound. The long-term outlook is challenging given degraded water quality and habitat, a rising human population, and unstable marine conditions and other effects associated with climate change. A dramatic improvement in habitat and water quality is required, along with a new, more flexible approach to salmon recovery to restore harvestable salmon and steelhead populations.

Over the next five years, the Muckleshoot Indian Tribe will work with its co-manager WDFW and others to boost salmon production and survival in our watersheds so that harvest opportunity is restored as soon as possible. A recent tribal study found that fewer than 10% of coho smolts released from the Issaquah Hatchery survived their freshwater migration to Puget Sound. The Lake Washington basin's miles of docks, bulkheads, rip-rap, warm water, and the many native and exotic fish predators favored by those degraded conditions are likely at fault. In the next few years, groups of hatchery fish will be released both at the hatchery and at sites closer to Puget Sound to quantify the survival benefits among release groups that bypass the hazardous shoreline. A program to remove predators at key sites in the Ship Canal and in Lake Washington will be conducted and evaluated. Target predators include introduced smallmouth and

(Continued on next page)

These salmon died because of poor fish passage at the Mud Mountain Barrier Dam on the White River. A new dam and fish trap is scheduled to finally replace the century-old barrier dam and undersized fish trap used to capture and transport fish around the 432-foot-high U.S. Army Corps of Engineers' Mud Mountain flood control dam located five miles upstream. Construction of improved fish passage is required by a NMFS 2014 Biological Opinion but awaits federal funding.

Muckleshoot Tribe

(Continued from previous page)

largemouth bass, and walleye – a recently discovered criminal introduction. Finally, the greatly diminished salmon-producing potential of our watersheds means that natural salmon production alone will not support fisheries; more hatchery supplementation is essential to restore fishing opportunity for tribal members and to fulfill treaty fishing rights. The Tribe has relied on hatcheries for harvest for the past century, and more recently to conserve and rebuild salmon populations. The Tribe will work to expand production where feasible at existing hatchery facilities, develop new rearing and release strategies, and initiate other actions in order to restore treaty fishing opportunity as quickly as possible.

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, a new level of support from state and federal agencies will be demanded regarding permit approvals and mitigation for levee construction and repairs. Reducing lethal temperatures in the Lake Washington Ship Canal and the Sammamish River is another priority. Engineered solutions such as piping cold water from deep layers in Lakes Washington and Sammamish will be evaluated; preliminary modeling by King County shows that such an approach could effectively cool the entire Sammamish River. Contaminants entering Puget Sound from stormwater, wastewater effluent containing hormones and drugs, and other pollutant sources all reduce the survival of juvenile salmon and must be greatly reduced. Long-awaited fish passage improvements must be completed at the U.S. Army Corps' Mud Mountain and Howard Hanson dams, and at the Ballard Locks. 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 development and groundwater withdrawals.

Land-use and coho population analysis has identified a linkage between pre-spawn mortality and stormwater runoff. Adult coho are highly sensitive to toxic pollutants in runoff from urban and residential landscapes, such as copper, pesticides and hydrocarbons. Based on a NOAA model, more than half of the 481 stream miles used by coho salmon in the Muckleshoot Tribe's Area of Concern are predicted to have pre-spawning mortality rates (PSM) of 5% or higher. Of these, 141 miles are predicted to have rates greater than 35%.

Healthy riparian areas require adequate vegetation and large woody debris. The watershed recovery plans call for managing riparian buffers to secure functional stream corridors. The quality and quantity of instream wood in the Green and Cedar rivers (a tributary to Lake Washington) continue to be extremely low compared to natural conditions, due to land use and river management. The amount of existing instream wood in the Green and Cedar Rivers was estimated to be 89% to 95% less than NMFS criteria required for properly functioning conditions for salmon habitat.[11]

The Lake Washington recovery plan recognizes the need to address degraded shorelines in both Lake Washington and Lake Sammamish. Overwater structures and bank modifications disrupt the migration and rearing of Chinook salmon. The shores of Lake Sammamish and Lake Washington are lined with 4,157 docks and piers, and an estimated 82% of Lake Washington has been bulkheaded. Of the 119 miles of marine shoreline in WRIAs 8, 9 and 10, only 5% remains in a natural condition without bulkheads or riprap. Almost 60 miles of the Green-Duwamish and Lake Washington riverbanks are degraded by levees and revetments; which is 49% of the total length of the mainstem river accessible to salmon.

In addition, while many problems have been long known to limit the production of natural and hatchery-origin salmon in our watersheds, lesser known problems have been brought into focus in recent years and deserve greater attention. For example, recent studies by Roger Tabor of USFWS and others have found that artificial night lighting along our urban rivers and lake shorelines modifies the behavior of juvenile salmon and potentially exposes them to increased predation mortality.[12] Another study published in 2014 by NOAA researcher James P. Meador found that Chinook smolts migrating through contaminated estuaries including the Duwamish and Puyallup had a 45% lower average survival rate compared to Chinook moving through less contaminated estuaries. While the study was conducted using data from hatchery releases, the author noted important implications for natural-origin Chinook that spend even more time in estuaries than do hatchery-reared fish.[13]

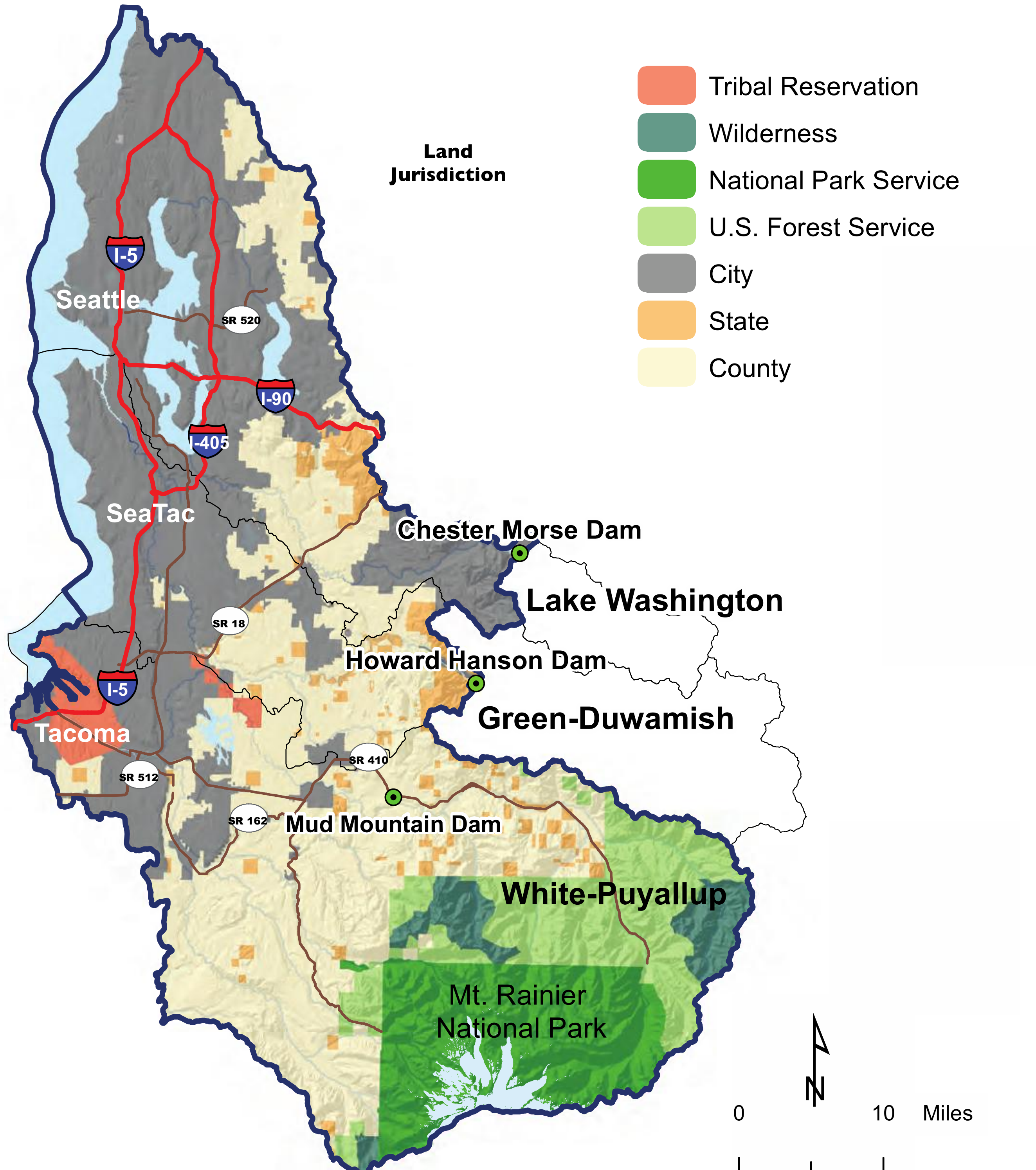
Population growth and development will continue to challenge salmon recovery efforts. Trends indicate that we'll lose critical habitat even as restoration projects are implemented.

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. At the same time, increasing the flexibility for hatchery production and other approaches in urban basins to bypass or substitute for limiting factors must occur if fish abundance is to be restored in the near term in support of treaty harvest rights.

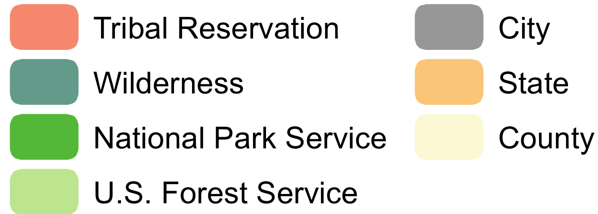
Muckleshoot Indian Tribe

Lake Washington, Green-Duwamish & White-Puyallup River Basins

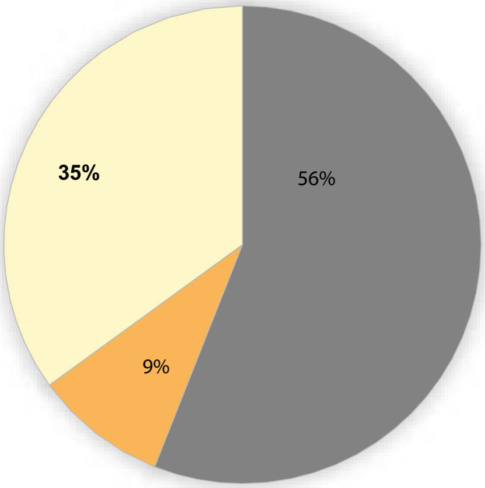
The Muckleshoot Indian Tribe's geographic Area of Focus includes all of WRIAs 8, 9 and 10. In this chapter, the Tribe's focus is on the portions of Lake Washington (WRIA 8) and Green-Duwamish River (WRIA 9) basin that are downstream of the Chester Morse and Howard Hanson dams, and the White-Puyallup River basin (WRIA 10) downstream of Mud Mountain Dam to highlight the status of critical low- and moderate-elevation salmon habitat. Anadromous salmonids in this area include Chinook, coho, sockeye, chum and pink salmon, and steelhead and bull trout.



Areas depicted do not necessarily correspond to Muckleshoot Usual & Accustomed fishing grounds and stations.

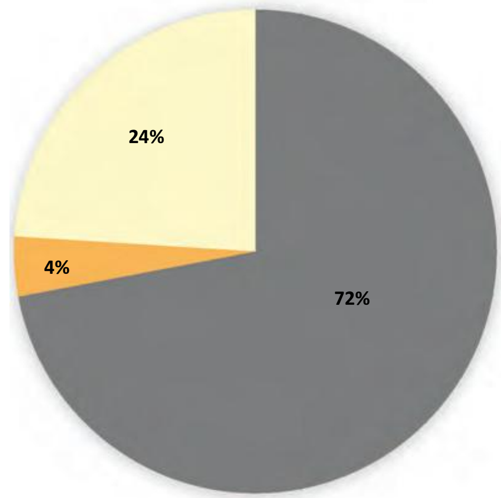


Green-Duwamish downstream of Howard Hanson Dam



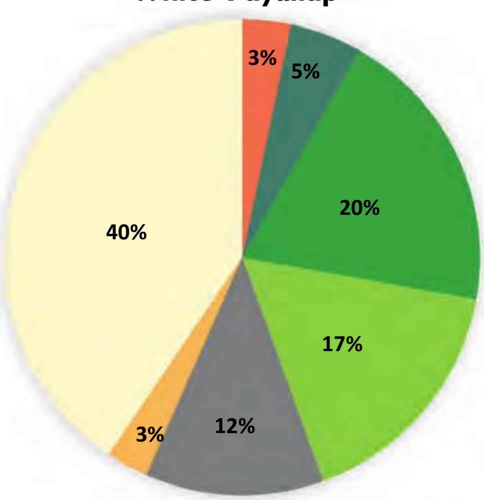
The **Green-Duwamish River** basin was historically 1,736 square miles and included the White and Cedar rivers. The Cedar and White rivers were diverted in the early 1900s, reducing the basin area to 556 square miles. The Green River flow regime is altered by flood control and storage at Howard Hanson Dam and by water withdrawals. The U.S. Army Corps' dam was constructed in the 1960s without fish-passage facilities. Approximately 98% of historic intertidal marsh and flats have been replaced with commercial and industrial development. The basin supports an estimated 596,000 people, and about 30% lies within Urban Growth Area boundaries.[1]

Lake Washington downstream of Chester Morse Reservoir



The 686-square-mile **Lake Washington** basin includes the Cedar and Sammamish rivers and the lakes of Sammamish, Union and Washington. Major alterations include channelization of the Sammamish River, and the construction of the Lake Washington Ship Canal and the Ballard Locks. The basin is heavily urbanized, leading to highly modified stream hydrology and shorelines. With 25 cities and an estimated 1.5 million people, Lake Washington is the most populated basin in Puget Sound with 55% of its land area inside Urban Growth Area boundaries.[2]

White-Puyallup



The **White River** drains 494 square miles and originates on Mount Tacoma (Rainier) glaciers. 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] The U.S. Army Corps' Mud Mountain Dam blocks adult fish migration and the river's flow and sediment regime are heavily altered by flood control activities at the dam. From 1911 until 2004, Puget Sound Energy 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 Tribe required that the diversion meet a minimum instream flow. Hydropower diversion ceased in 2004, and in 2007 an agreement was reached with the Cascade Water Alliance that further limits water diversion to Lake Tapps. The basin includes Commencement Bay, which is highly altered and contaminated with industrial discharges and urban runoff.

Land development along with hydrologic and channel modification have 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 add 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 in order to sustain future salmon populations regardless of hatchery or natural origin.

Data Sources: SSHIAP 2004,[4] USFWS 2014,[5] USGS 2012,[6] WADNR 2014a,[7] WADNR 2014b,[8] WADNR 2014c,[9] WADOT 2013,[10] WAECY 2011a,[11] WAECY 2013a[12]

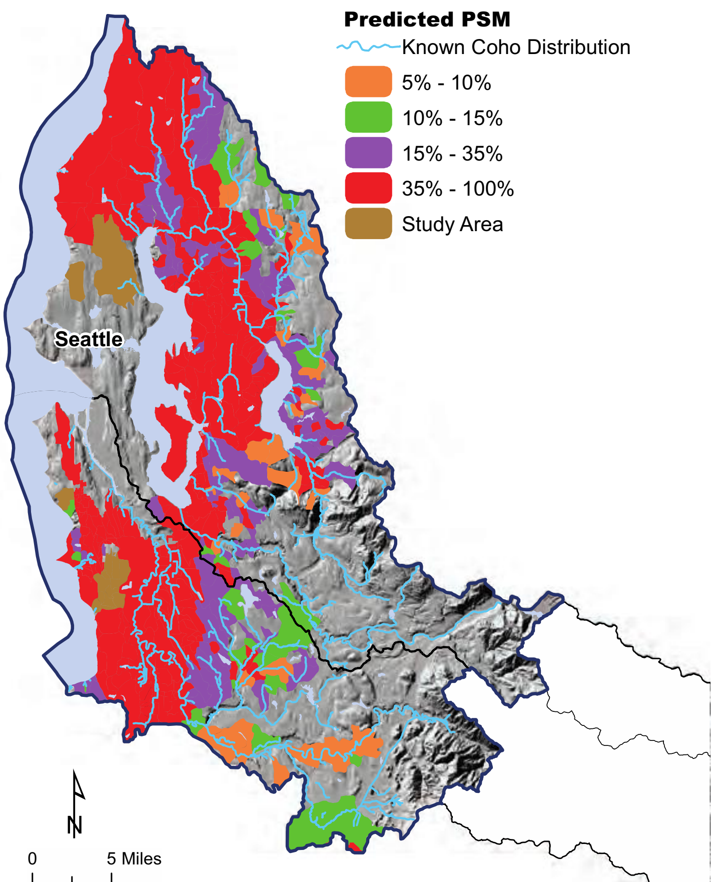
Stormwater Runoff Implicated in Coho Pre-Spawning Mortality (PSM)

Based on NOAA's model, 269 stream miles or 56% of known coho distribution in the Green-Duwamish and Lake Washington basins are predicted to have a PSM rate of 5% or more, with 141 miles or 29% predicted to have 35-100% PSM.

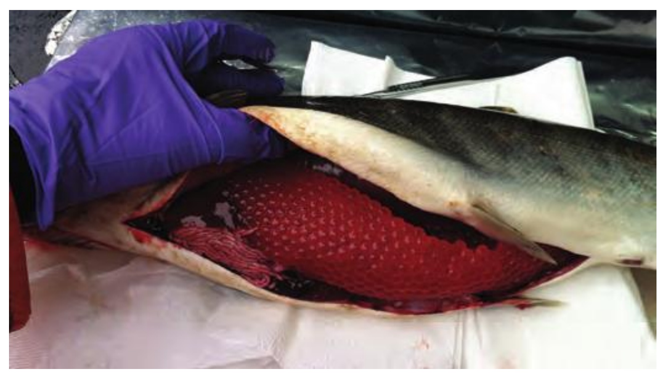
One of the Lake Washington/Cedar/Sammamish Watershed Chinook Salmon Conservation Plan objectives is the protection, maintenance and restoration of water quality and natural hydrology. In addition to adverse effects from peak and low flow changes in urban streams, coho salmon are also affected by elevated pre-spawn mortality (PSM). Scientists are still working to find out the underlying cause of death: what contaminant or mixture of contaminants in stormwater runoff is harmful to salmon. Adult coho salmon have been shown to be highly sensitive to stormwater runoff containing toxic pollutants from urban and residential land uses, such as copper, pesticides and hydrocarbons. NOAA and USFWS researchers have developed a model to predict areas of PSM in Puget Sound using spatial analyses of land-use and coho PSM data.[1] Based on their model, 269 stream miles or 56% of known coho distribution in the Green-Duwamish and Lake Washington basins below the major dams are predicted to have a PSM rate of 5% or more, with 141 miles or 29% predicted to have 35-100% PSM. PSM rates in wild populations of coho salmon are generally less than 1%.[2] These researchers concluded that copper-containing stormwater from urban landscapes can cause sensory deprivation and increase predation mortality of coho juveniles. In a related experiment, deformities and low growth were observed in coho hatchlings incubated in untreated urban creek water compared to treated water from the creek.

The reduced spawning success that results from PSM has detrimental impacts on the persistence of local salmon runs. As human populations grow and urban centers expand into less developed regions, coho salmon in currently unaffected watersheds may also be affected. Therefore, an understanding of the cause of pre-spawn mortality is essential for the protection of salmon populations today and into the future.[3]

Some best practices to improve water quality include techniques such as infiltration swales, low-impact development, adding green roofs, utilizing pervious pavement and establishing rain gardens.[4] Rain gardens and swales typically filter out up to 90% of chemicals and up to 80% of sediments from polluted runoff. They also allow more water to soak into the ground, reducing not only contaminants in local waterways, but also, reducing the amount of flooding that occurs.[5]



Data Sources: Scholz 2009,[8] SSHIAP 2004,[9] SWIFD 2014[10]



Jenifer McIntyre

Adult coho salmon returning to Seattle-area urban streams are dying prior to spawning, as indicated by this female carcass with nearly 100% egg retention. This female returned from the ocean to spawn in Longfellow Creek (West Seattle) in the fall of 2012.

Raindog Designs[7]

8th Ave NW Rain Gardens along the Street of Green: A rain garden is a planted area designed to filter rain water that flows from compacted or impervious areas. Rain gardens do not retain water; they only temporarily collect the water and drain within 12-48 hours.[6]

AR052830

Water Quality Requires Corrective Actions

Approximately 193 miles of stream in WRIAs 8, 9 and 10 are listed as "impaired waters" by the Washington State Department of Ecology 2012 Water Quality Assessment. An additional 42 miles in WRIAs 8 and 9 are assumed to exceed water temperature standards for fish based on adjacent impairments or other data.

Water temperature and dissolved oxygen are known to be significant limiting factors for both juvenile and adult salmon.[1] The Lake Washington Ship Canal, the sole migration route for salmon to and from Lake Washington, routinely reaches temperatures of 21-23+ degrees Celsius by July each year. These high temperatures are believed to have contributed to disease leading to the pre-spawn mortality of approximately 40% of the Cedar River sockeye run in both 2014 and 2015. Summer temperatures in the Lower Green River typically reach 7-day average daily maximums greater than 21˚C. In 2015, July river temperatures reached as high as 24 C. A major cause is poor riparian conditions. Shade levels generally range from zero to 20% of natural system potential.[2]

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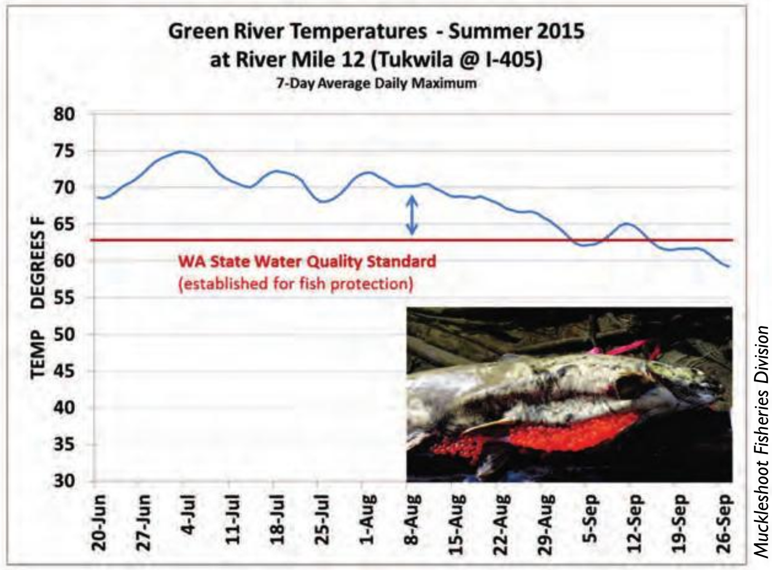
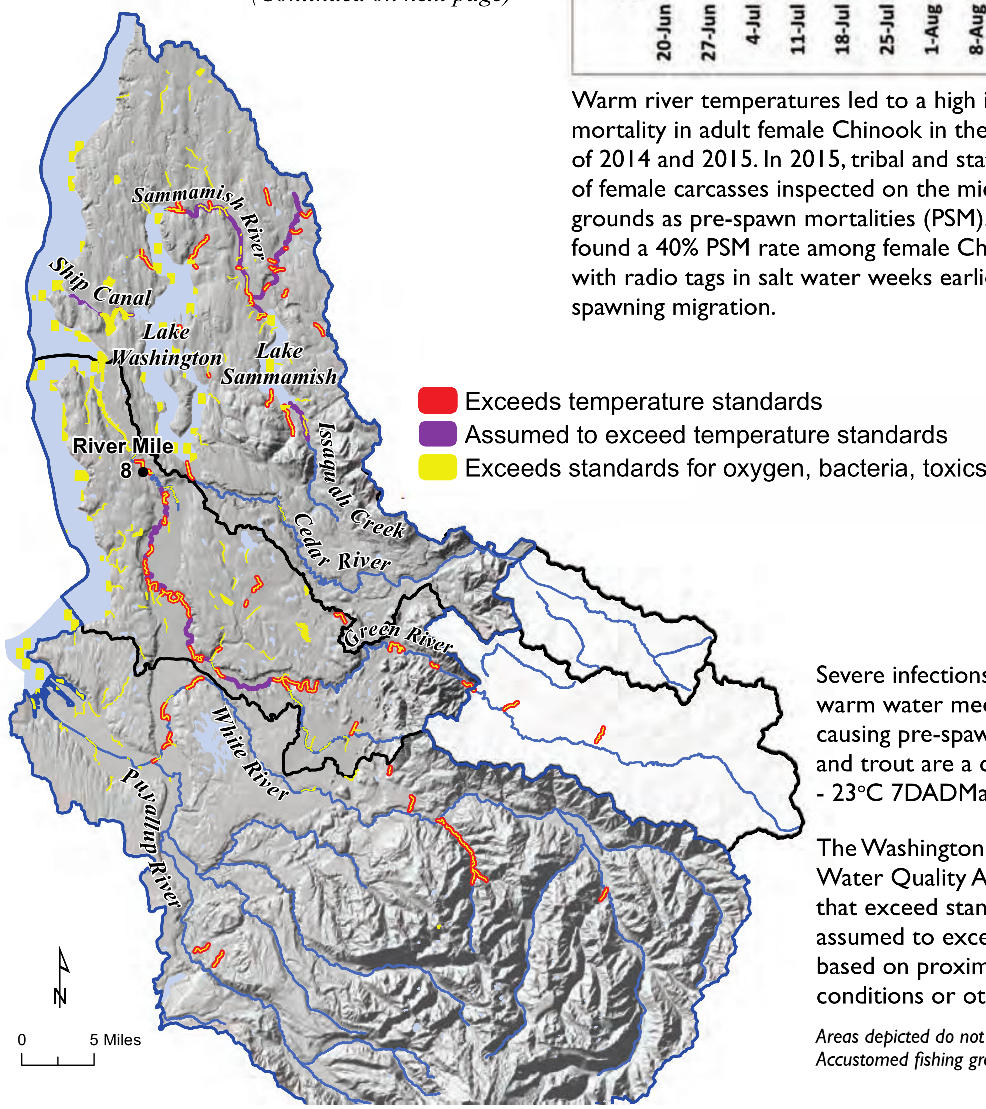


Warm river temperatures led to a high incidence of pre-spawning mortality in adult female Chinook in the Green River during the fall of 2014 and 2015. In 2015, tribal and state surveys identified 16% of female carcasses inspected on the middle Green River spawning grounds as pre-spawn mortalities (PSM). In 2014 and 2015, the tribe found a 40% PSM rate among female Chinook captured and outfitted with radio tags in salt water weeks earlier as they began their final spawning migration.

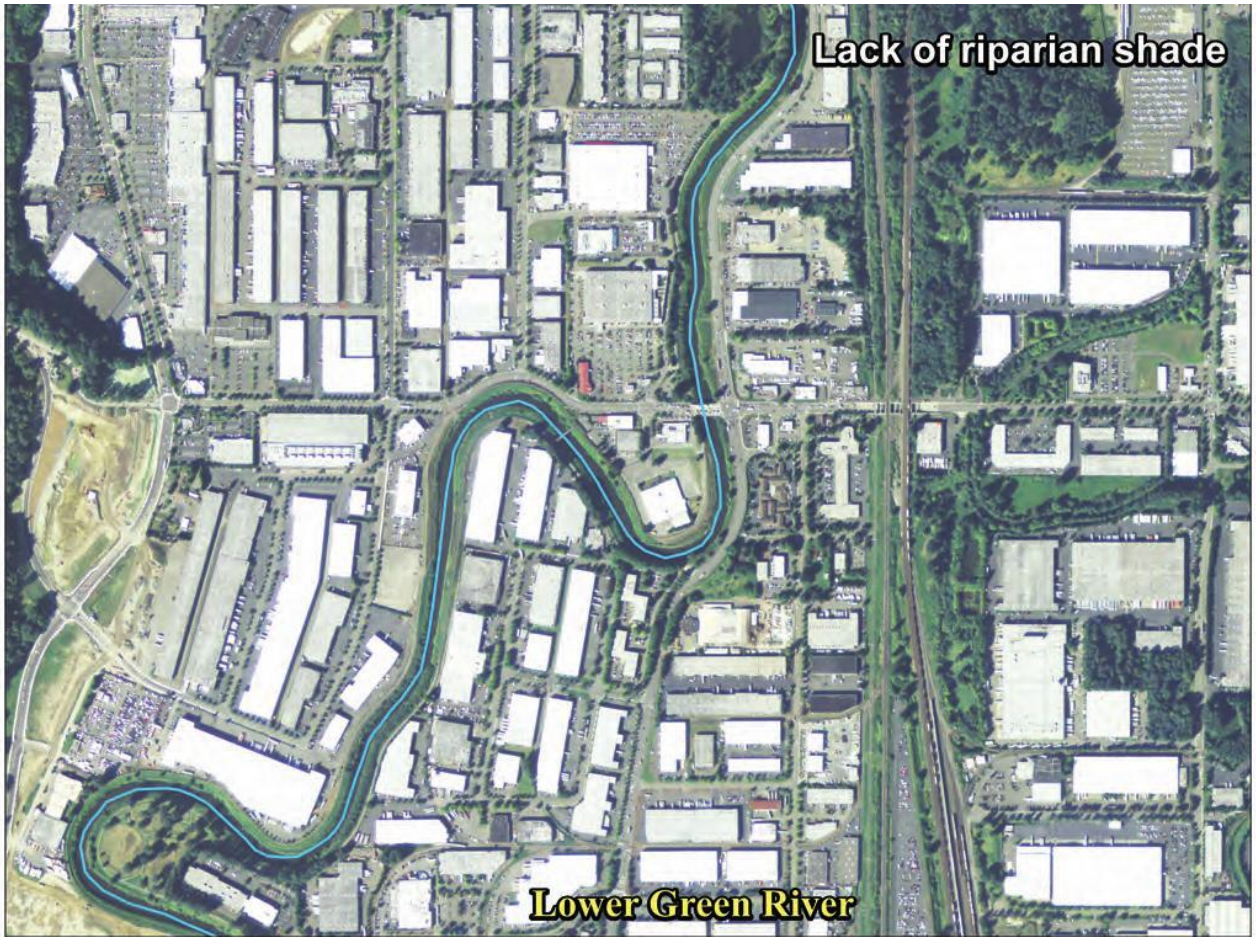


Severe infections and catastrophic outbreaks of warm water mediated bacterial and parasitic diseases causing pre-spawning mortality in migrating salmon and trout are a concern at river temperatures of 18.6 - 23°C 7DADMax.[3]

The Washington Department of Ecology's 2012 Water Quality Assessment identifies river reaches that exceed standards for fish.[4] Additional areas are assumed to exceed temperature standards for fish based on proximity to impaired reaches with similar conditions or other data sets.

Areas depicted do not necessarily correspond to Muckleshoot Usual & Accustomed fishing grounds and stations.

Data Sources: NAIP 2013,[8] SSHIAP 2004,[9] USGS 2014,[10] WAECY 2013b[11]



The lower Green River between Auburn and Tukwila has severe shade deficits along each side of the river, elevating water temperatures to levels known to cause disease outbreaks and pre-spawning mortality in migrating salmon and trout.

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Despite a severe shade deficiency, near-lethal water temperatures and an agreed salmon recovery strategy to "establish and enforce riparian buffers along rivers (and) streams," more than 600 trees have been removed from the lower Green River since 2005 to comply with U.S. Army Corps' maintenance policies for federally subsidized levees.[5] New flood protection facilities have been constructed or repaired in locations that lack space for adequate riparian buffers. Between 2005 and 2009, riparian forests declined by 1.5% in rural areas and by 3.4% in urban growth areas in Lake Washington's high-priority sub-basins.[6]

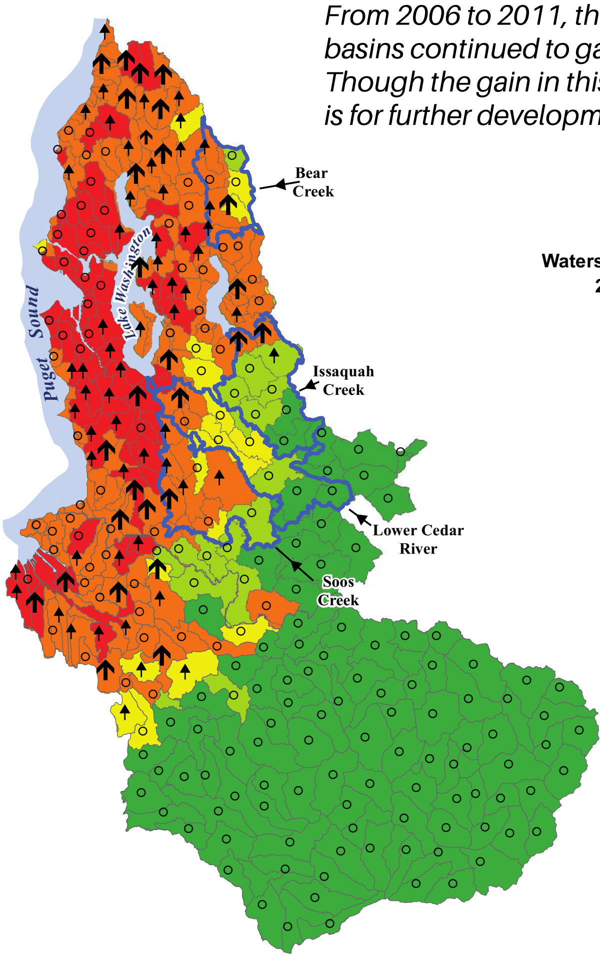
In late 2012, King County Flood Control District initiated a Green River System Wide Improvement Framework (SWIF) planning process to address flood control levee deficiencies in the lower Green River.[7] The SWIF promised to be a 30-year corridor improvement plan to rebuild 16 to 25 miles of levees in a manner that would significantly restore riparian and fish habitat conditions while increasing the level of flood protection. After three years of planning, the Flood Control District decided to scale back the scope of the SWIF and instead rebuild less than 2 miles of levee without assurance of adequate riparian buffer widths in urban levee segments. In this scaled-back interim SWIF, the Flood Control District will continue federally funded levee repairs as needed. Without more effective regulatory permit conditions by NMFS and others, the interim SWIF approach is likely to perpetuate poor riparian, instream and water temperature conditions in the lower river. In 2015, the District initiated a riparian restoration grant program aptly called "Re-green the Green" to help address water temperatures using a voluntary grant approach and conservation easements. Yet water quality modeling indicates that even the most urban leveed areas along the lower river will require 100-foot-plus buffer of tall trees with dense canopy cover to approach state temperature standards and restore a river that can sustain salmon including Chinook that migrate upstream in summer. Loss of riparian vegetation, altered streamflows, and pollution from adjacent land uses limit fish production and survival in much of the Green-Duwamish, Lake Washington and White-Puyallup basins. While some efforts by local jurisdictions have been made, more action is needed to improve water quality and avoid further degradation.

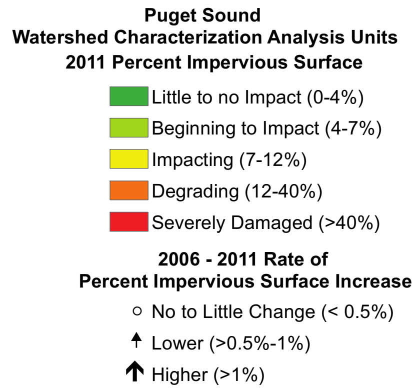
Green River Levee Project

Muckleshoot Indian Tribe

Impervious Surface Continues to Increase

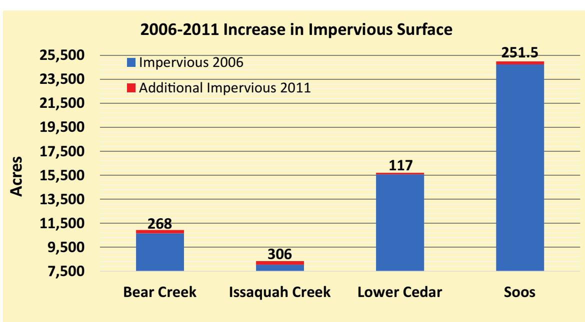
From 2006 to 2011, the Lake Washington, Green-Duwamish and Puyallup-White basins continued to gain impervious surface area despite the economic recession. Though the gain in this time period was small, 1.3% of combined basin area, the trend is for further development and more impervious land cover.





Impervious surfaces are land areas covered with roads, parking lots, rooftops, compacted soils and other surfaces that prevent water from soaking into the ground. Impervious area in a watershed is a general predictor of biological and hydrological conditions.[1] Studies in western Washington have found that when impervious surfaces reach 10-20% of a watershed, stream stability decreases, flooding and bed scour increase, large wood decreases, gravel and water quality decrease, macro-invertebrate diversity decreases, and loss of aquatic system functioning is likely irreversible.[2] Impairment can begin as low as 7 to 12% imperviousness.[3]

The Green/Duwamish and Central Puget Sound watersheds are among the most densely populated and developed in the state, resulting in many sub-watershed areas having high amounts of impervious surface areas. The detrimental effect of stormwater runoff from impervious surfaces on salmon habitat is well documented; this nonpoint source pollution is among the least regulated. Salmonid populations are adversely affected by increased peak flows that scour out salmon redds and displace fry; increased low flows resulting from reduced infiltration and groundwater recharge; by the contaminants carried by water running across impervious surfaces; and by sedimentation and habitat simplification caused by excessive runoff. Salmon survival is critically linked to landscape cover and the management of surface water and stormwater runoff. Stormwater discharges from impervious surfaces also are the primary way in which pollutants are conveyed to the marine waters of Puget Sound.[4]



Protection of existing marine and freshwater habitats is essential for salmon recovery in Puget Sound. Protection means the conservation of habitat and the functions it provides through passive actions (e.g. habitat acquisition) and the application of land-use regulatory measures. Adequate protection of salmon habitat in Puget Sound continues to be an issue in all watersheds. Our reviews noted that the continued degradation of habitat is a concern throughout the region.[5] The Salmon Recovery Plan for WRIA 8 and 9 list Bear Creek, Issaquah Creek, the lower Cedar River and Soos Creek as Tier 1 streams. All of these basins had an increase in impervious surface from 2006-2011.

An example of impervious surface near a salmon-bearing stream in Soos Creek, Green-Diamond River basin.

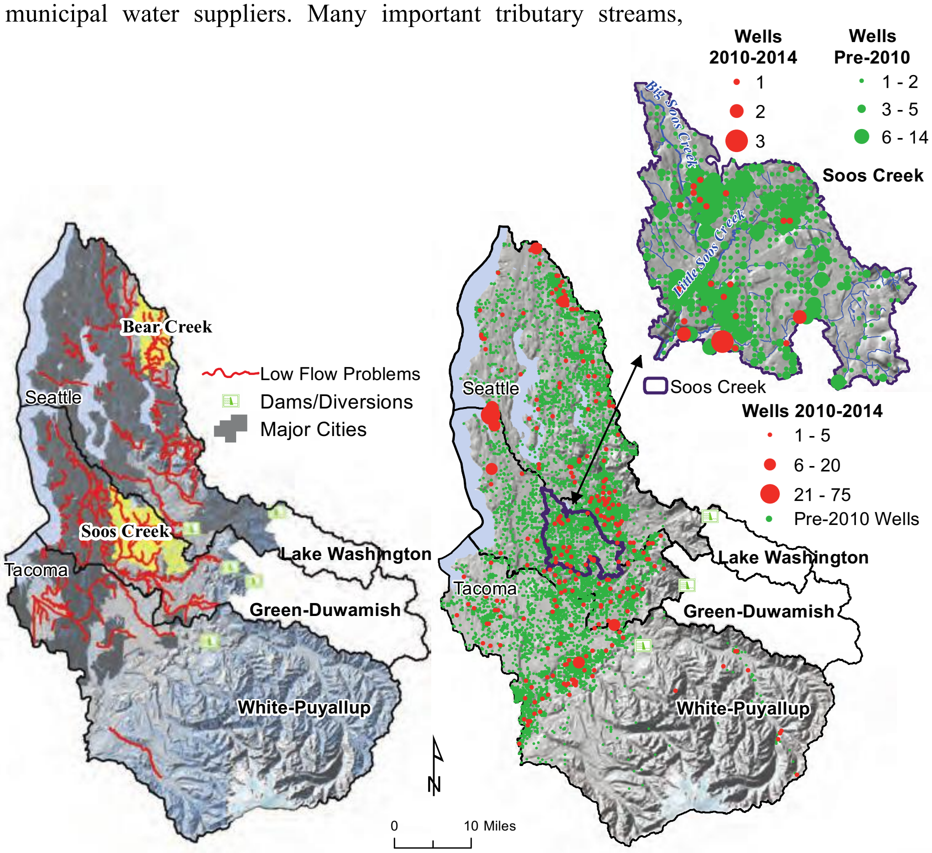
Data Sources: NAIP 2013,[6] NLCD 2006,[7] NLCD 2011,[8] SSHIAP 2004,[9] USGS 2014,[10] WADNR 2006,[11] WAECY 2000,[12] WAECY 2011a,[13] WAECY 2011b[14]

Muckleshoot Indian Tribe

Summer-Fall Flows Decreasing as Water Resource Development Continues

From 2010-2014, 369 new wells (4.5% increase) were added to the already existing 8,227 wells in the Lake Washington and Green-Duwamish basins, while the Puyallup-White basin saw an increase of 101 new wells (2.6%) to the already existing 3,881.[1] A total of 482 miles of streams in the Lake Washington and Green-Duwamish basins are identified as having low streamflow problems,[2] while in the Puyallup-White basin there are 120 miles of low flow concerns.

Low streamflows are one of many factors that contribute to low productivity and abundance of Chinook and other salmon. Low flows reduce the available habitat for rearing, migration and spawning, and contribute to warm water temperatures. Instream flows in the Cedar, Green and White river mainstems have been protected and restored through tribal settlement agreements with municipal water suppliers. Many important tributary streams, however, currently lack protection and restoration and are in need of streamflow. Greater enforcement of water rights laws, a halt in the proliferation of wells, and greater use of conservation, source exchange, and aquifer recharge strategies are critically needed for salmon habitat and to protect the water rights of state and tribal fish hatcheries.

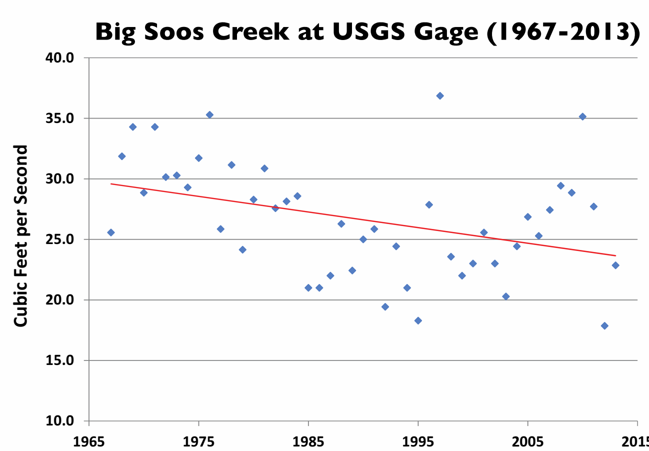


The 2005 Lake Washington and Green-Duwamish Salmon Conservation Plans call for the maintenance of adequate streamflows. Ground and surface water extractions are estimated to be 37% of the current summer low flows in the Green-Duwamish River basin.[3] Summer low flows in the Bear Creek drainage have been reduced by 39%.[4] Private and municipal well extractions in the Soos Creek sub-basin were estimated to equal 52% of the current summer low flow,[5] reducing habitat for Chinook, coho and steelhead.

Over 8,500 wells currently exist in the Lake Washington and Green-Duwamish basins, in addition to two large municipal water diversion dams. The number of wells drilled continues to rise as land development proceeds with an increase of 369 wells from 2010-2014.

Areas depicted do not necessarily correspond to Muckleshoot Usual & Accustomed fishing grounds and stations.

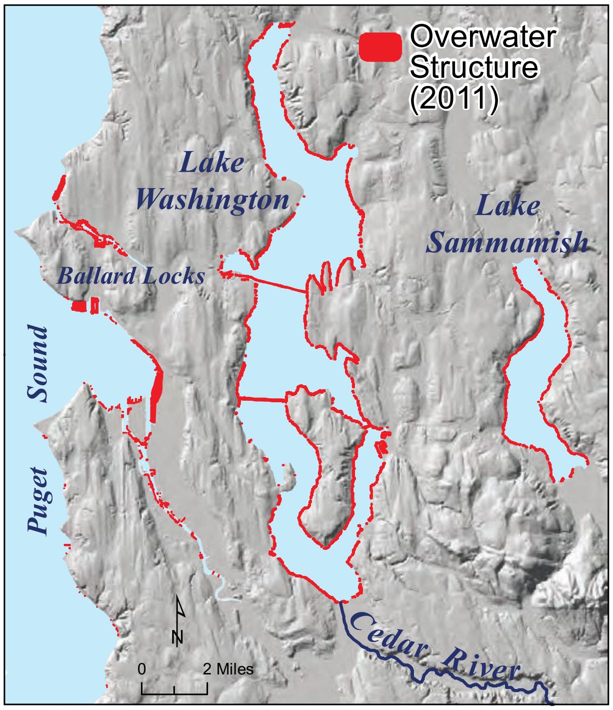
Summer-Fall flows in Big Soos Creek show a statistically significant decline that coincides with development of municipal and private wells in the sub-basin. From 2010-2014, 26 new wells were added to the already existing 1,314 in the Soos Creek Basin.



Data Sources: King Co. 2014,[6] MIT 2014,[7] SSHIAP 2004,[8] USGS 2012,[9] USGS 2014,[10] WADNR 2014b,[11] WAECY 2000,[12] WAECY 2013a,[13] WAECY 2015[14]

Overwater Structures Impact Lakeshore Habitat in Lake Washington

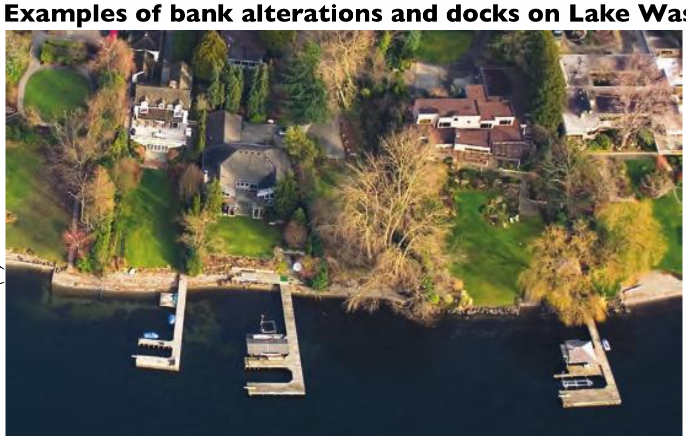
Since 2011, Lake Washington and Lake Sammamish have seen an increase of approximately 60 new docks,[1] adding to the 4,097 docks and piers already built. An estimated 82% of Lake Washington's shoreline remains heavily modified with bulkhead and riprap.



Overwater structures and bank alterations on Lake Washington and Lake Sammamish interfere with the rearing and migration of juvenile Chinook salmon. Docks, piers and bulkheads provide ideal habitat for ambush predators such as smallmouth bass and cutthroat trout, and are avoided by rearing Chinook. Extensive armoring reduces the amount of gentle sloping shorelines that small juvenile Chinook salmon use from January to May.[2] Migrating Chinook smolts are also observed to avoid these structures, moving into deeper water where they are more vulnerable to off-shore predators.[3] The perimeter around docks and piers in Lake Washington nearly doubles the natural shoreline length to 163 miles. This longer swimming distance exposes out-migrating Chinook to increased predation, and may delay saltwater entry until midsummer when fish-passage efficiency at the Ballard Locks drops due to warm water temperatures.

The Salmon Recovery Plan calls for a reduction in the number and coverage of overwater structures in the Lake Washington basin.[4] According to the Habitat Work Schedule, unfortunately no docks have been removed.[5] The overwhelming prevalence of these artificial shoreline structures means that far fewer of the juvenile salmon produced in either Lake Washington's streams or at its two salmon hatcheries ever make it to Puget Sound. Given the lack of progress in re-naturalizing the lake shoreline, alternative approaches that can bypass lethal hazards to salmon migration are warranted, such as trucking or barging hatchery fish as on the Columbia River. The Tribe will be testing this approach over the next few years.

Examples of bank alterations and docks on Lake Washington

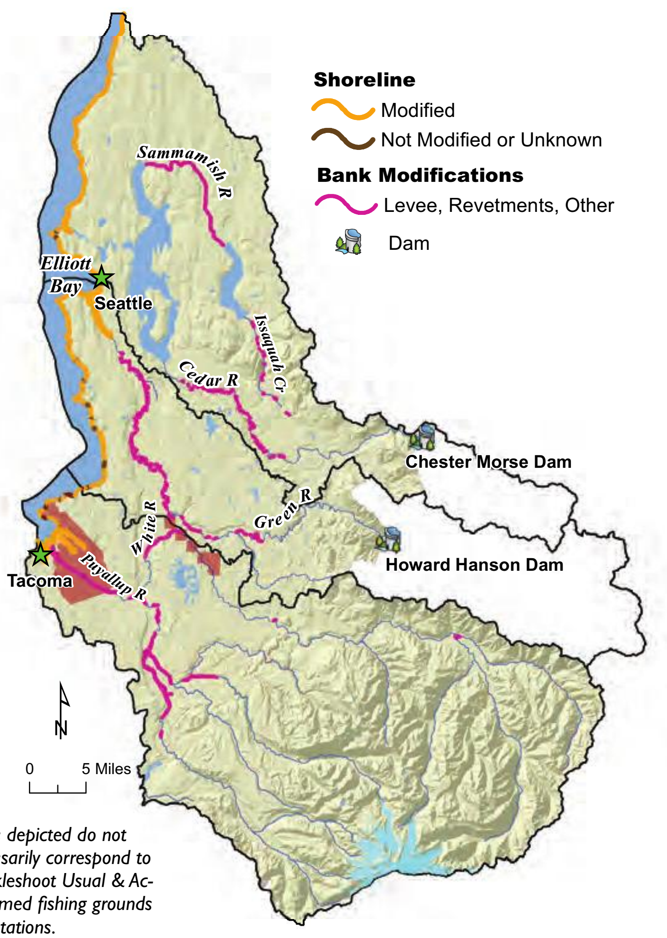


WAECY Coastal Atlas (2)

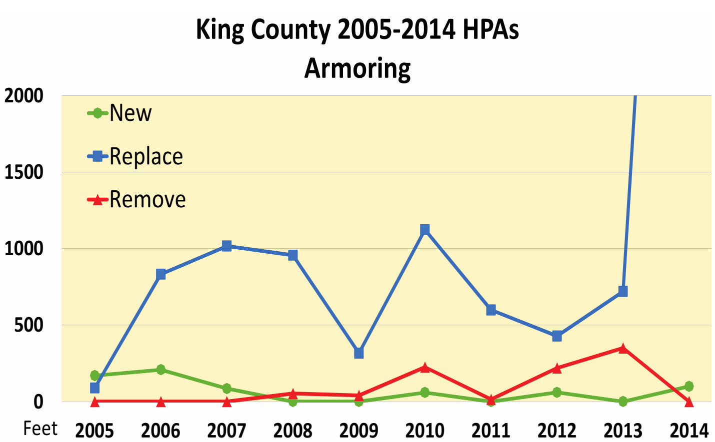
Data Sources: NAIP 2013,[6] SSHIAP 2004,[7] WADNR 2007,[8] WAECY 1994,[9] WAECY 2011a[10]

Riverbank and Shoreline Modifications Limit Fish Habitat in Fresh and Marine Waters

From 2005 to 2014, marine shoreline conditions in King County have changed very little. During this time period, 903 feet of armoring was removed, while 681 feet of new armoring was constructed. 2.6 miles of armoring was replaced.[1] Meanwhile, a total of 115 miles of artificial shoreline continue to negatively affect nearshore habitat for salmon.



Areas depicted do not necessarily correspond to Muckleshoot Usual & Accustomed fishing grounds and stations.

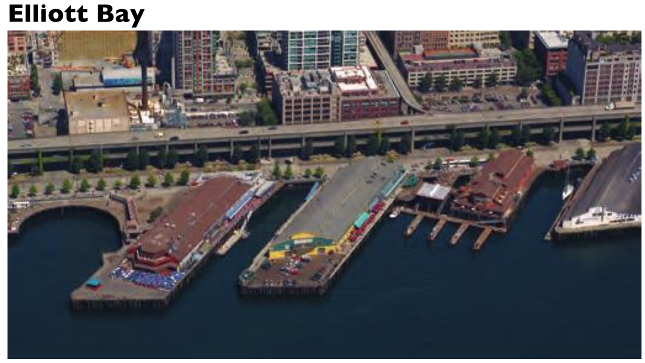


Data Sources: ACOE 2011,[3] Carman et al 2015,[4] King Co. 2014,[5] PSNERP 2008,[6] SSHIAP 2004,[7] SSHIAP 2008,[8] USGS 2012,[9] USGS 2014,[10] WADOT 2010,[11] WADOT 2013,[12] WAECY 2000[13]

Salmon produced in Lake Washington, Green-Duwamish and White-Puyallup basins lack natural nearshore habitat for juvenile rearing, transitioning to salt water, and migration to the Pacific Ocean. Extensive development along marine shorelines has resulted in loss of productive marine aquatic habitat and vegetation. Bulkheads and seawalls have filled shallow water habitats, resulting in reduced rearing area, food supply and cover from predators, and has isolated the aquatic environment from natural sediment sources such as feeder bluffs that sustain beach habitats.

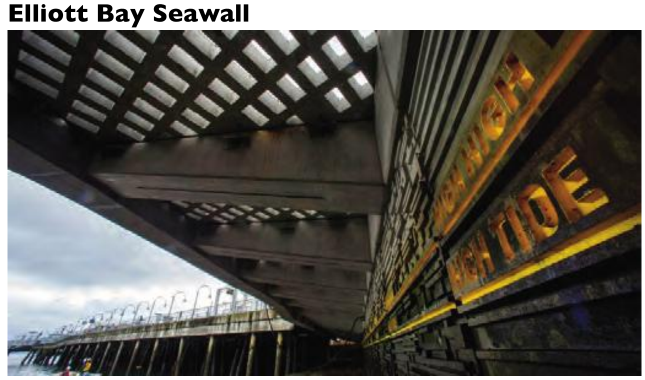
In Elliott Bay, approximately 90% of the central waterfront is covered with piers and other overwater structures, resulting in stark contrasts between light and dark areas. Juvenile salmon hesitate to swim under the waterfront piers due to the lack of light. Juvenile salmon can't see well in the dark, so to avoid swimming blindly, juveniles swim around these structures into deeper waters where they face food competition from larger fish and predation.[2] However, Seattle is getting a new Elliott Bay seawall, and a small part of this big job is to give migrating juvenile salmon a safer route to the sea. Construction on the new wall started in early 2014. Workers have completed the first section of the wall, including a migratory corridor for juvenile salmon that will eventually run the entire length of the downtown waterfront.

Elliott Bay



WAECY Coastal Atlas

Elliott Bay Seawall



Seattle Times

The new wall's face along the Seattle waterfront is studded with grooves and shelves to promote growth of algae and invertebrates that supply food for juvenile salmon.

AR052836

Light Pollution and Salmon – A Growing Concern

Light pollution is one of the most rapidly increasing types of environmental degradation. Its levels have been growing exponentially over nocturnal lighting levels provided by starlight and moonlight.[1] Excessive outdoor artificial night lighting, or light pollution, is harmful to local ecosystems and its inhabitants. Since all living things have evolved according to a day/night cycle, it takes little light to upset nighttime cycles and alter natural rhythms. Many insects, migratory birds, sea turtles, bats, nocturnal rodents, snakes, fish, aquatic invertebrates and even plants are affected by night lighting.[2]

Artificial nighttime lighting can modify the behavior of various aquatic organisms, including salmonids. Affected behaviors may include foraging, predator avoidance, reproduction and migration. Often fish are attracted to artificial light and their behavior may more resemble daytime behavior than nighttime behavior. In urban areas, high-intensity artificial lights are common near rivers, lakes and streams. This lighting comes from street lights, parking lots, industrial and residential buildings, bridges and other urban structures. High-intensity artificial lighting can penetrate the entire water column in shallow water. Thus, fish species that utilize shallow water in urban areas, such as juvenile Chinook, may be most susceptible to the effects of artificial night lighting.[3]

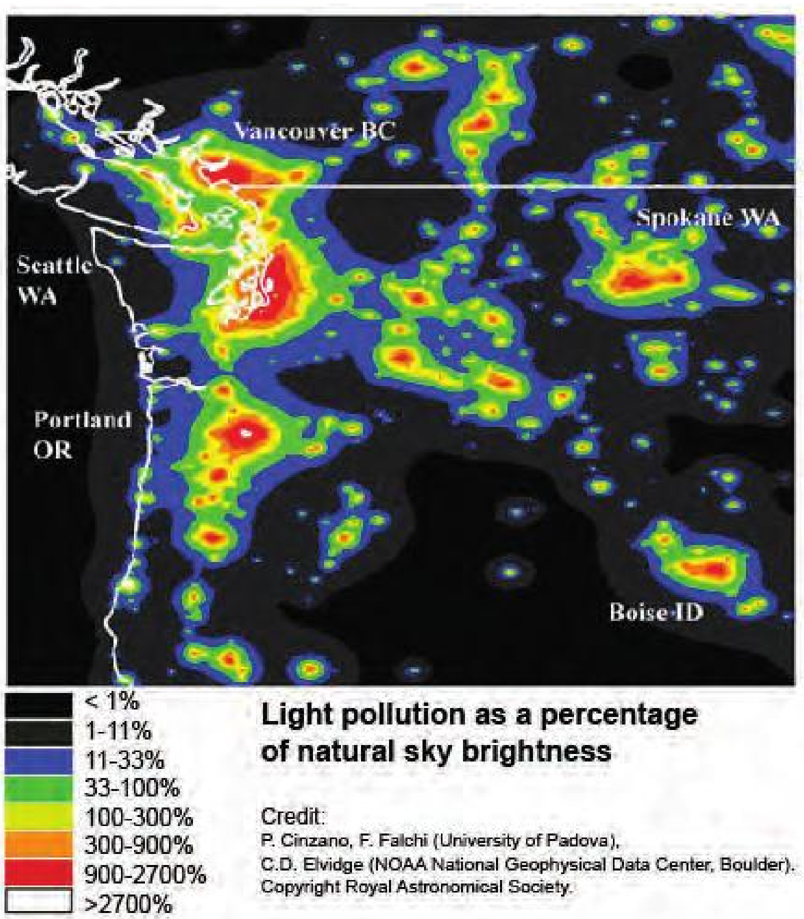
Many researchers consider light pollution to be one of the fastest growing and most pervasive forms of environmental pollution. A growing body of research suggests that light pollution can have lasting adverse effects on both human and wildlife health. Research on insects, turtles, birds, fish, reptiles and other wildlife species shows that light pollution can alter behaviors, foraging areas and breeding cycles – not just in urban centers but in rural areas as well.[4]

The urban regions of the Pacific Northwest are awash in nighttime illumination, much of which shines needlessly skyward. The I-5 corridor, from Vancouver, British Columbia, south to Eugene, Oregon – a stretch of over 400 miles – is a single, nearly unbroken swath of light pollution.[5]

Artificial lighting studies and experiments led by the U.S. Fish and Wildlife Service were conducted in Lake Washington (2014) and Lake Sammamish (2015), in the Lake Washington Ship Canal (2007 and 2008) in the Cedar River (2004). Fish usage "hot spots" were found in brightly lit areas and along shadow lines created by artificial lighting. Chinook salmon were generally attracted to artificially lit areas. Artificial lighting may attract juvenile salmonids and expose them to increased rates of predation from visual predators such as cutthroat trout, smallmouth bass, and northern pikeminnow. Birds such as mergansers and herons are also present, and have been observed anecdotally foraging in artificially lit areas.

Artificial nighttime lighting is extensive in urban areas and is often necessary for human safety. However, there is a need to minimize the effects from lighting by such measures as eliminating unnecessary lights near water, dimming or reducing output, relocating or re-aiming lights, lowering lamp heights, shielding lamps or using designs that reduce the intensity of light reaching water surfaces, reducing "on" hours, or using motion sensors. Further research on different types of lighting and their effects on fish attraction and predation may yield additional benefits.[6]

(Continued on next page)



Big Sky Astronomy Club[7]

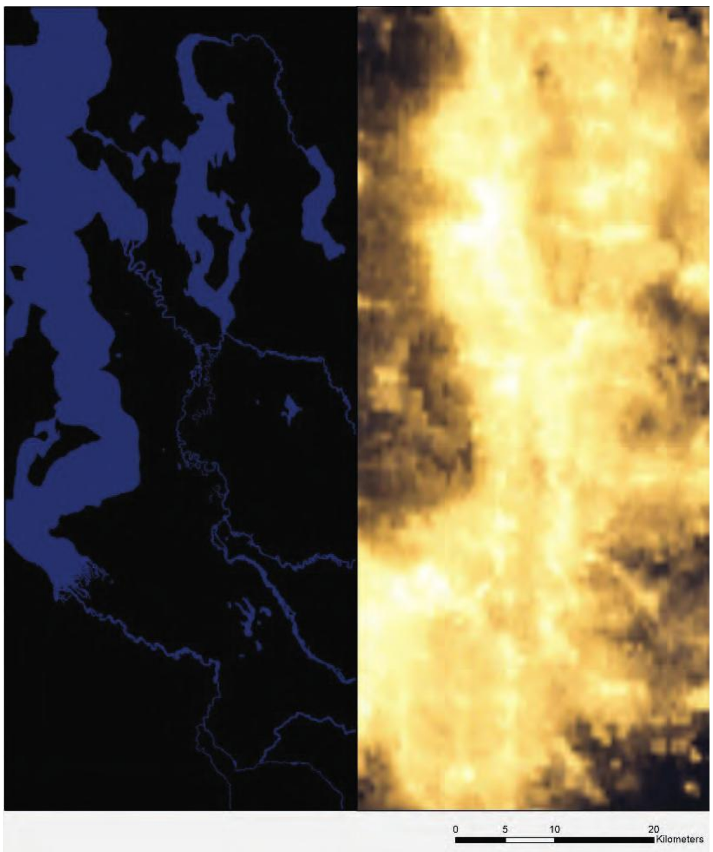
Muckleshoot Indian Tribe

Light Pollution and Salmon – A Growing Concern

(Continued from previous page)

Simple changes in lighting design and installation yield immediate changes in the amount of light spilled into the atmosphere and, often, immediate energy savings. Between 2000-2011, a number of cities and counties passed some form of "dark sky" outdoor lighting ordinances. Examples include: Island and King counties, Redmond, Tumwater, Goldendale, Bothell and Bainbridge Island.

However, these ordinances alone are not sufficient. It is critically important that local, state and federal governments ensure that environmental assessments and permit reviews include the effects of artificial lighting on aquatic habitat, and that initiatives to retrofit and reduce artificial night lighting are undertaken especially along urban lakes and streams.



The left panel shows historical stream channels and shorelines extending from Commencement Bay and the lower White River north to the Seattle city limits and lakes Washington and Sammamish, while the right panel is a NASA 2012 satellite image of the same area at night with intense artificial lighting.

Hiimniko / Flickr bit.ly/1Q3zXDe

This photo taken from Queen Anne Hill shows urban sky glow evident in the night sky over Seattle.

Streams Lack Large Wood and Natural Habitat Features

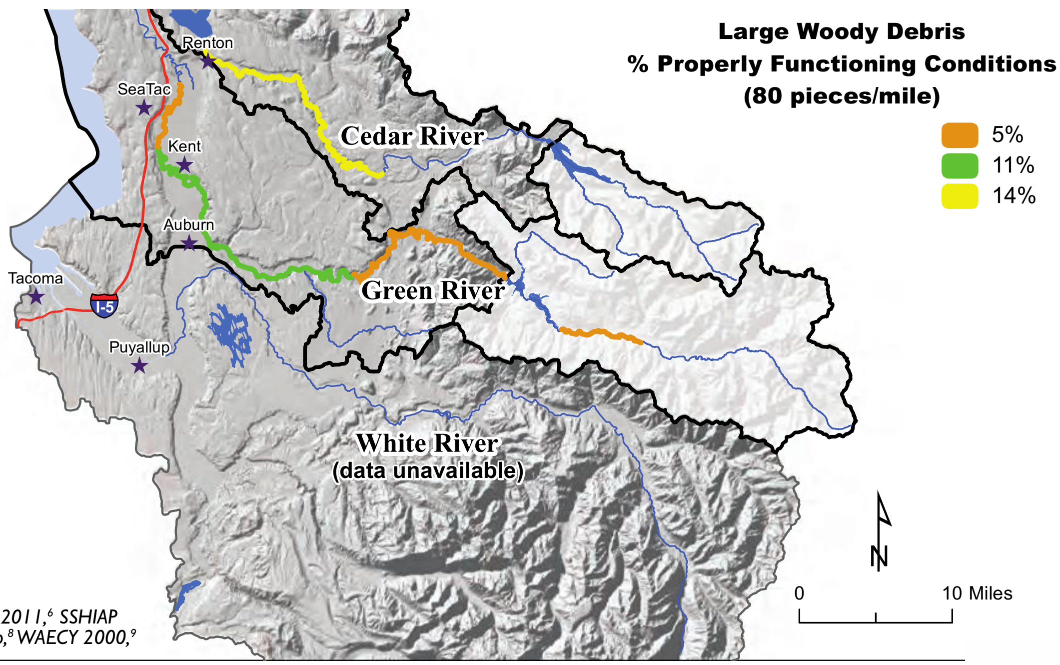
Wood counts in the lower Cedar and Green rivers have less than 5% of the expected key piece quantities.[1]

Large woody debris (LWD) creates pools, provides hiding cover, and interacts with flowing water to produce complex stream habitats used by salmon and steelhead at all life stages. Estimates of LWD in the Green and Cedar rivers meeting NMFS size and frequency criteria are 89% to 95% below the levels necessary for "properly functioning conditions" for salmon habitat.[2] Comparing the wood loads in these rivers to estimated historic conditions[3] and expected natural wood loads to which salmon have adapted,[4] these rivers have a mere fraction of the wood they once contained. A study by King County of the presence and distribution of large wood in the Cedar River estimated 11,500 pieces of large wood on the Cedar River in 2010, and the vast majority of these were categorized as small logs and branches. Only 145 key pieces (wood pieces large enough to aid in the formation of a logjam) were counted for at an average of 6.5 per river mile. Watershed Analysis data on large woody debris (LWD) in the upper White River (above Mud Mountain Dam) suggests the LWD and key piece quantities is in a poor condition as it relates to necessary functions for salmon habitat.[5]

Lake Washington, White-Puyallup and Green-Duwamish salmon habitat plans call for a focus of action to restore sources of LWD, install LWD to restore pool habitat and to protect existing LWD. However, the potential to restore large woody debris to improve salmon habitat in the Green-Duwamish and Lake Washington basins is restricted by land use and also by policies that address river recreation safety. The Cedar, Green and Sammamish rivers are all designated by King County as Recreational Waterways where wood placement for restoration or mitigation purposes is restricted, and the removal, lopping or repositioning of artificially placed or naturally recruited wood deemed hazardous to boaters commonly occurs.

For more information, see: *www.kingcounty.gov/environment/watersheds/general-information/large-wood.aspx*

As a result, much of these channels are simplified and lack the necessary habitat to produce salmon naturally.



Data Sources: King Co. 2011,[6] SSHIAP 2004,[7] WADNR 2014b,[8] WAECY 2000,[9] WAECY 2011a[10]

When large woody debris levels are low, fish habitat productivity is diminished.

Riparian areas function properly when adequate vegetation, landform and large woody debris are present.

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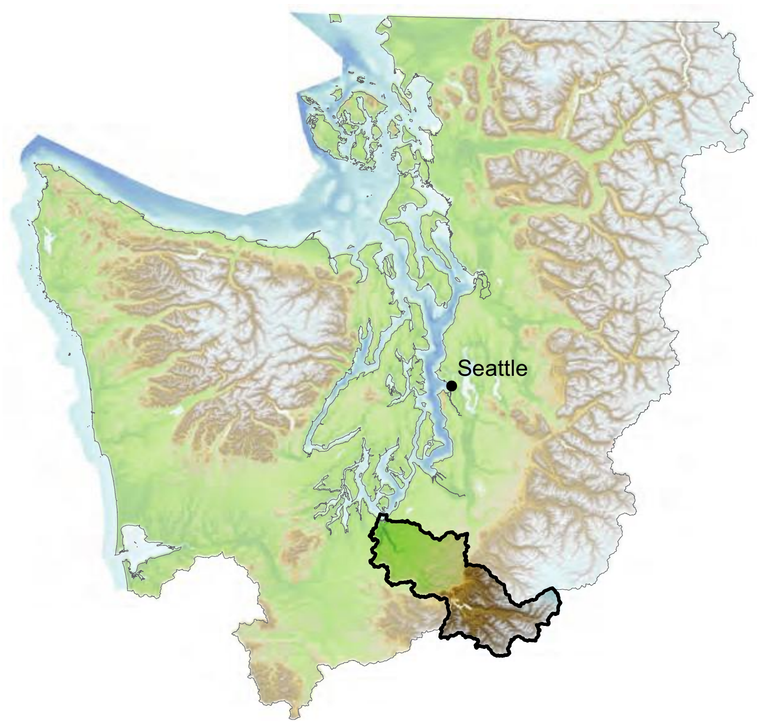
2016 State of Our Watersheds Report
Nisqually River Watershed

We have to have hope. I think of the destruction of our fisheries, each time we see them wear away. We have to have hope; salmon are too much a part of us.

– **Georgiana Kautz,**
Nisqually Tribe



Nisqually Indian Tribe

The Nisqually people have lived in the 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 Nisqually Tribe is the prime steward of the Nisqually River fisheries resources, and operate two fish hatcheries: one on Clear Creek and one on Kalama Creek. In the 1855 Treaty of Medicine Creek, the Nisqually Tribe reserved their right to fish, hunt and gather in their traditional areas. Because of that agreement, the federal government is obligated to protect those treaty-reserved resources. This report will focus on the Nisqually River basin and surrounding marine waters.

Future of the Nisqually River Watershed

The Nisqually River basin is one of the least developed watersheds in south Puget Sound and also has the largest underdeveloped delta in Puget Sound. The watershed encompasses a broad range of land uses and jurisdictions: rural communities; national and state parks and forests; public and private timberlands; municipal hydropower dams and reservoirs; farmlands; the Nisqually Indian Reservation; Fort Lewis Military Reservation and the Nisqually National Wildlife Refuge.

It is the only Puget Sound watershed with its headwaters in a national park and its estuary in a national wildlife refuge. Development has largely occurred in the lower reaches and elevations of the watershed. Habitat degradation was identified as one of the primary reasons for the decline of Nisqually Chinook, stemming from hydroelectric dams, forest practices, agricultural development and urbanization.[1]

There has been tremendous work performed in the Nisqually River watershed to protect existing habitat, recover damaged habitat, mitigate harmful conditions and plan for future progress. Much of this success has been through the work, leadership, coordination and support of the Nisqually Indian Tribe and the Nisqually River Council, their members and parent organizations. Reliable and sufficient funding has been the greatest restriction inhibiting further progress within this watershed.

Nisqually River Salmon Recovery Plan

The Nisqually Chinook Recovery Plan adopted a habitat strategy to protect, enhance and restore prioritized habitat in the basin. Recovery actions were prioritized to:

- Protect and secure habitat that supports the existing core population;
- Enhance that habitat; and
- Restore habitat associated with secondary or lost population segments.[2]

Based on these priorities and an analysis of current productivity within each stream reach of the watershed, restoration and preservation priorities were focused on the estuary and nearshore marine environments and within the freshwater habitats, the mainstem, as well as the Mashel and Ohop sub-basins.[3]

WA Department of Ecology Coastal Atlas

Example of shoreline modifications in the Nisqually Watershed.

Consequently, the habitat actions identified for the Nisqually watershed within the Puget Sound Salmon Recovery Plan were:

- Restore estuary and nearshore marine environments;
- Restore and preserve the Nisqually River mainstem;
- Restore and preserve the Ohop Creek and the Mashel River sub-basins;
- Protect and restore key mainstem tributaries; and
- Evaluate the effects of water well withdrawals.[4]

Population Growth & Groundwater Demands

At the 10-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 degradation of marine shoreline habitat conditions remains a priority issue for the survival of the juveniles 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 since the 2012 State of Our Watersheds Report shows an improvement from restoration activities but a steady loss in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Shoreline Modifications / Forage Fish	From 2005 to 2014, 329 hydraulic project approvals were issued in Pierce and Thurston counties, resulting in an additional 1.5 miles of armored shoreline and the removal of 0.3 miles of armoring, resulting in a net increase of 1.2 miles.	Declining
Water Wells	The number of water wells in the Nisqually watershed continued to grow during 2010-2014 by 300 (3.2%) additional new wells. Most growth, 256 of the 300 wells (85%), occurred in the middle portion of the watershed, bordered by the towns of Eatonville, Roy and Yelm.	Declining
Impervious Surface	From 2006 to 2011, the lower and middle extents of the Nisqually watershed continued to see an increase (0.8%) in impervious surface. Though the increase in this time period is slight, the trend shows impervious surface will continue to increase as people move into the watershed.	Declining
Population Growth	The middle portion of the watershed, bordered by the towns of Eatonville, Roy and Yelm saw an estimated population increase of almost 6% during 2010-2014 and the area's population growth is estimated to be over 5% in 2020. Population growth leading to a high percentage of urban or rural-residential use is an identified concern in this watershed's Chinook recovery plan.	Concern
Restoration	Over 900 acres of the Nisqually Delta estuary has been restored, representing the largest estuary restoration projoect in the Pacific Northwest and one of the most significant advances to date towards the recovery of Puget Sound. More resources will be needed for additional studies in order for mangers to develop plans for addressing substantial impacts to the habitat forming processes in the Delta. Our work to date provides a solid base of information to build upon.	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.

Making Progress with Restoration and Protection

Along with other local restoration efforts, 22 miles of the historic Nisqually delta system have been restored, increasing salt-marsh habitat in southern Puget Sound by over 50 percent. Since 2009, scientists have closely monitored changes to the ecosystem using aerial photographs, permanent land-based panoramic photographs, sediment gauges, vegetation transects, bird and fish counts, and tidal gauges. Results indicate that the historical delta ecosystem is returning and that the dike removal has increased the area's salmon population. Studies indicate that juvenile salmon have benefited from the dike removal. Continued monitoring will allow managers and scientists to detect subtle changes within the delta as the system acclimates to tidal flows.[5]

Construction has officially concluded in the latest phase of the Ohop Valley Restoration Project. The old ditch has been removed and the newly created channel is flowing with water. Ohop Creek is one of two major tributaries to the Nisqually River. The new channel was constructed to recreate a sinuous stream that connected to its floodplain. The floodplain, now replanted with native vegetation, will create 80 acres of a healthy riparian habitat that provides temperature control to the creek and increases bank stabilization. Additionally, the project removed old buildings and removed invasive plants.


K.Turner - USGS

Beach seine pull at the Nisqually delta monitoring site.

Looking Ahead

Nisqually River Council

Ohop Valley Restoration Project.

Future projects, investigations, and research efforts by the Nisqually Tribe:

- Work on crafting a long term management plan for the delta.
- Develop plans for addressing substantial impacts to the habitat forming processes in the delta.
- 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.
- The Nisqually Indian Tribe and the Washington State Department of Transportation are looking at design alternatives, cost estimates, permitting issues, and impacts on transportation to moving to a less impactful crossing of I-5 through the delta.

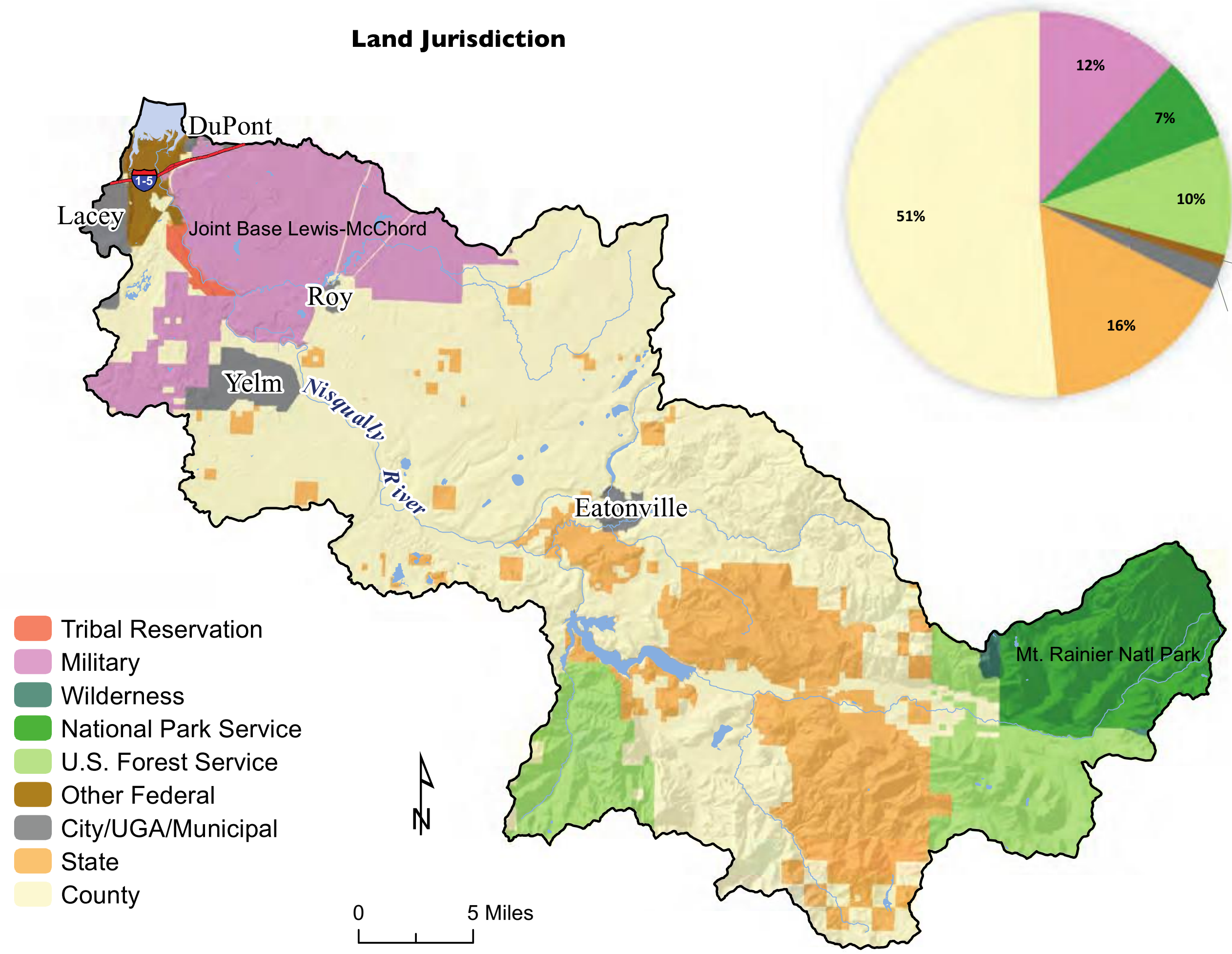
Nisqually Indian Tribe

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 Nisqually National Wildlife Refuge.

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. 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.

Five urban centers currently have boundaries within the Nisqually watershed (Lacey, DuPont, Eatonville, Roy and Yelm) comprising 8.9 square miles. The planned Urban Growth Areas (UGA) within the watershed adds the potential of another 14.2 square miles of use, for a total of 23.1 square miles or an increase of 160%. Based upon the Office of Financial Management (WAOFM) population forecasts, the watershed population could increase by as much as another 46,000 by 2026.[1]



Data Sources: SSHIAP 2004,[2] USFWS 2014,[3] WADNR 2014a,[4] WADNR 2014b,[5] WADOT 2013,[6] WAECY 1994,[7] WAECY 2011,[8] WAECY 2013[9]

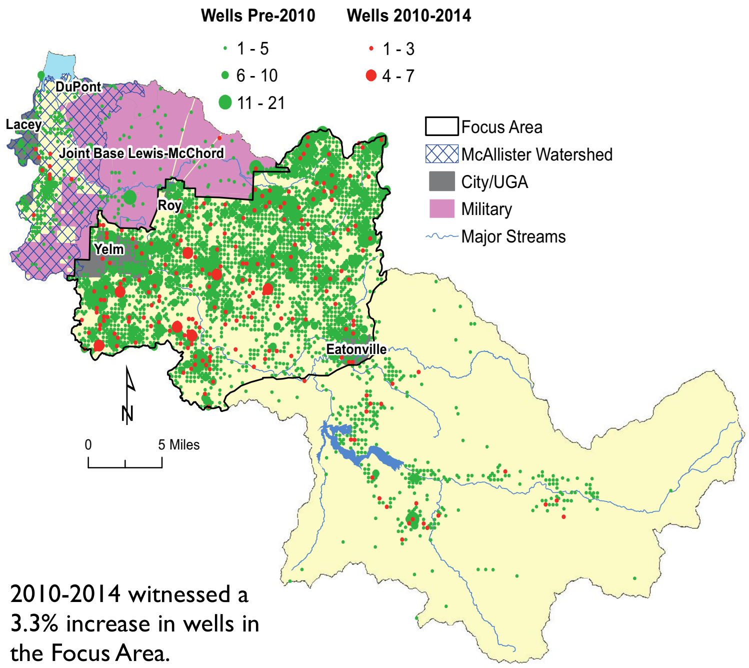
Population Growth Increases Demand for Wells

The number of water wells in the Nisqually watershed continued to grow during 2010-2014 by 300 (3.2%) additional new wells. Most growth, 256 of the 300 wells (85%), occurred in the middle portion of the watershed, bordered by the towns of Eatonville, Roy and Yelm. This area saw an estimated population increase of almost 6% during 2010-2014 and the area's population growth is estimated to be over 5% in 2020.

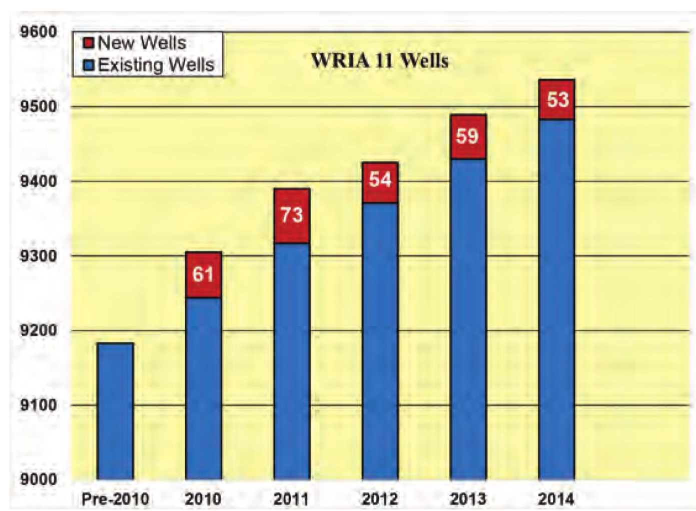
Most land in the upper extent of the Nisqually watershed is restricted from rural growth: it is either steep (slope over 30%), National Park, National Forest, state-owned or private forestland. A large block of land in the lower extent of the watershed consists of Joint Base Lewis-McChord (JBLM) and the Nisqually Indian Reservation. Between the upper and lower extents is a focus area of 230 square miles with mostly flat to gently sloping land, three urban areas (Eatonville, Roy and Yelm) and 87% of the watershed's water wells. This middle focus area of the watershed has seen the majority of water well growth in the past and in the last four years saw an increase of 85%. This area controls some of the most important and productive freshwater stream reaches for salmon in the Nisqually watershed. Unchecked growth and its associated increase in groundwater demand will reduce aquifer volume and thus the outflow to the streams, wetlands, lakes and saltwater nearshore vital to salmon.

Unmanaged population growth within the Nisqually watershed will have an increase demand on groundwater resources. Surface and groundwater withdrawals in WRIA 11 tributaries for irrigation and domestic use will continue to grow and will impact instream flows during adult salmon upstream migration and spawning. Unmanaged growth in the middle extent of the watershed may also lead to a decrease in summer flows thus reducing rearing area for fish residing year-round in the watershed.

In May 2008, the city of Olympia and the Nisqually Indian Tribe entered into a historic agreement – the first such agreement between a tribe and a municipality in the country – to jointly develop a new regional water source at McAllister Wellfield. The city is actively developing a new water source that will replace McAllister Springs as the city's primary supply of drinking water. The new water source will be significantly more protected, more productive, and will meet water supply needs for generations. For years, the city has been working closely with other agencies and municipalities to plan for development of the McAllister Wellfield. Construction began on August 13, 2012.[1]



2010-2014 witnessed a 3.3% increase in wells in the Focus Area.



Population Change

Jurisdiction	2010 Population Census	2014 Population Estimate	Percent Increase
Yelm	6,848	7,915	16%
Eatonville	2,758	2,840	3%
Roy	793	805	2%
Unincorporated Thurston County	135,123	138,160	2%
Unincorporated Pierce County	366,738	381,970	4%

From 2010-2014 the population of Yelm grew by 16%, Dupont grew by 12% and Lacey increased by 7%.[2] Population growth leading to a high percentage of urban or rural-residential use is an identified concern in this watershed's Chinook recovery plan.

Data Sources: WADNR 2014b,[3] WADOT 2013,[4] WAECY 2000,[5] WAECY 2011,[6] WAECY 2013,[7] WAECY 2015,[8] WAOFM 2014[9]

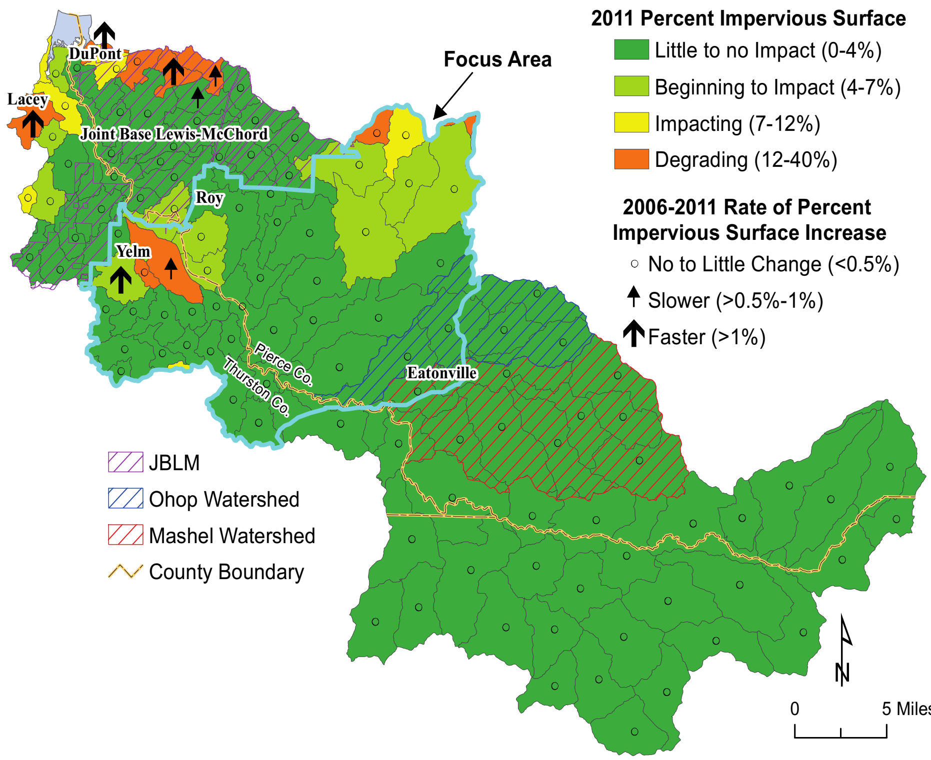
NISQUALLY INDIAN TRIBE

Increased Population Growth and Impervious Surface in the Lower Nisqually Watershed

From 2006 to 2011, the lower and middle extents of the Nisqually watershed continued to see an increase (0.8%) in impervious surface. Though the increase in this time period is slight, the trend shows impervious surface will continue to increase as people move into the watershed.[1]

As the population continues to increase, so will the impervious surface area, causing a disruption of both the ground and surface water ecology. This disruption will negatively impact the ecosystems dependent upon the proper function of the hydrologic cycle. Tributary watersheds important for Chinook (Mashel and Ohop) are mostly managed for forest products in the upper portions of their drainage areas. There is a concern that in the future human population growth in the Mashel River and Ohop Creek may result in portions of these watersheds being converted to urban or rural-residential use.[2]

Impervious surfaces cause increased stream temperatures and decreased stream biodiversity – as evidenced by reduced numbers of insect and fish species – and contribute to pollutants in stormwater runoff, which can contaminate local aquatic systems.[3] Currently, the Nisqually watershed is in relatively good condition, but as population continues to grow within the watershed, the impervious surface will likewise increase. Without proper management and resource protection, the forecast is for impervious surfaces to have grown to an impacting level within 15 years.



Example of Build-out in the Lower Nisqually Watershed


2006


2011

From 2010-2014 the population of Yelm grew by 16%, Eatonville 3%, Roy 2% and both unincorporated Pierce and Thurston County grew by 4 and 2% respectively. Population growth leading to a high percentage of urban or rural-residential use is an identified concern in the Nisqually River Watersheds Chinook recovery plan.

Population Change

Jurisdiction	2010 Population Census	2014 Population Estimate	Percent Increase
Yelm	6,848	7,915	16%
Eatonville	2,758	2,840	3%
Roy	793	805	2%
Unincorporated Thurston County	135,123	138,160	2%
Unincorporated Pierce County	366,738	381,970	4%

Data Sources: NAIP 2006,[4] NAIP 2011,[5] NLCD 2006,[6] NLCD 2011,[7] WADNR,[8] WADNR 2006,[9] WADOT 2010,[10] WAECY 2011b,[11] WAOFM 2014[12]

Nisqually Indian Tribe

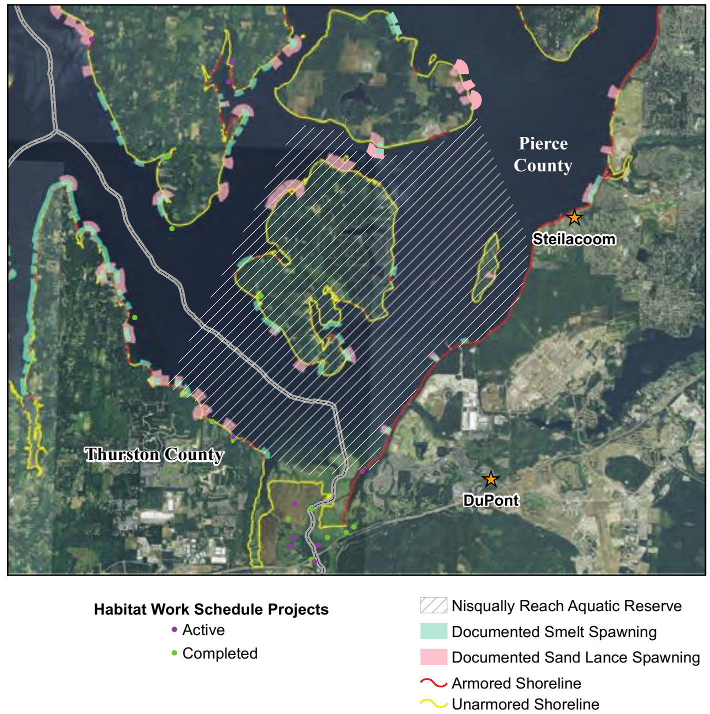
Nearshore Impairment Near Nisqually Delta

From 2005-2014, 329 Hydraulic Project Approvals (HPAs) were issued in Pierce and Thurston counties resulting in an additional 1.5 miles of armored shoreline and the removal of 0.3 miles of armoring, resulting in a net increase of 1.2 miles.[1]

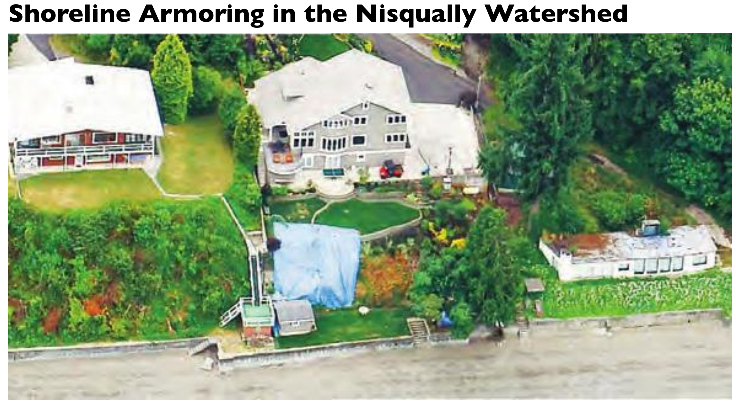
Construction of bulkheads and other types of hard shoreline armoring, groins, and docks reduce the amount of suitable habitat for juvenile salmon rearing and forage fish spawning. Armoring also affects salmon by reducing prey density, increasing predation and changing migration patterns that cause a decline in growth and lower survival rates.[2] Shoreline modification also starves the beach of new sediment that is crucial to maintain a healthy and diverse ecosystem.[3]

Two species of forage fish – sand lance and surf smelt – use the beaches along the edge of the Nisqually Reach Aquatic Reserve as spawning grounds. Surf smelt spawning sites are heavily impacted by shoreline modifications, such as boat ramps, seawalls and culverts. Sand lance spawn on sandy beaches, depositing microscopic eggs in the upper intertidal zone just below the log line.[4]

The Nisqually Salmon Recovery Plan 3-Year Work Plan prioritizes protection and restoration of the nearshore habitat in the Nisqually watershed. The area with the least amount of restoration progress is the Puget Sound nearshore, and modeling continues to indicate that this nearshore habitat is critical to the survival and abundance of fish. This habitat falls outside of the Nisqually watershed/lead entity's designated area, but the Nisqually Work Plan still chose to list specific projects and initiatives in their plan to indicate the great importance of this work in order to recover Nisqually Chinook. The success of this part of their plan is dependent on the success of Puget Sound as a region and of the individual watershed leads that are accountable for this habitat to protect and restore these areas.[5]



Shoreline Armoring in the Nisqually Watershed



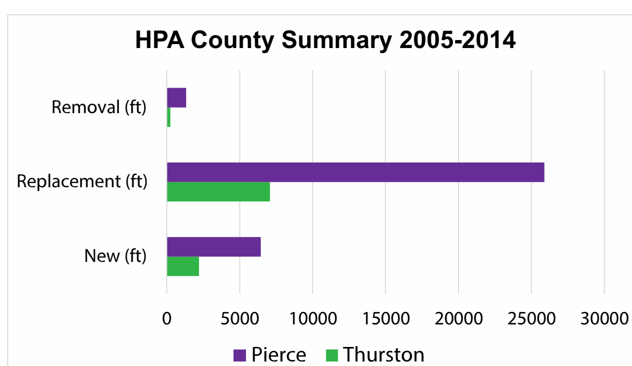
WA Dept. Ecology Coastal Atlas

Surf Smelt

Sand Lance

USGS (2)

Forage fish are an important food source for salmon.



Data Sources: Carman et al. 2015,[6] HWS 2015,[7] NAIP 2013,[8] PSNERP 2008,[9] WADFW 2015,[10] WADNR,[11] WADOT 2010[12]

Nisqually Delta Restoration Efforts

The return of tidal inundation to over 750 acres of the U.S. Fish and Wildlife Service Nisqually National Wildlife Refuge (NWR) in fall of 2009 was the crowning moment in the effort to protect and restore the Nisqually delta. The Nisqually NWR project complemented three earlier restoration projects completed by the Nisqually Indian Tribe on tribal property. Over 900 acres of the estuary has been restored, representing the largest estuary restoration project in the Pacific Northwest and one of the most significant advances to date toward the recovery of Puget Sound. However, it remains uncertain how the delta will respond to this new inundation in light of many altered physical processes (e.g., river flow control, reduced sediment inputs) and the 100-year history of subsidence and freshwater peat development since initial diking. The Nisqually delta restoration projects were decades and many millions of dollars in the making. Thus, the need for project monitoring and research as the magnitude of the Nisqually delta restoration project makes its potential contribution to restoration science unprecedented in Puget Sound.

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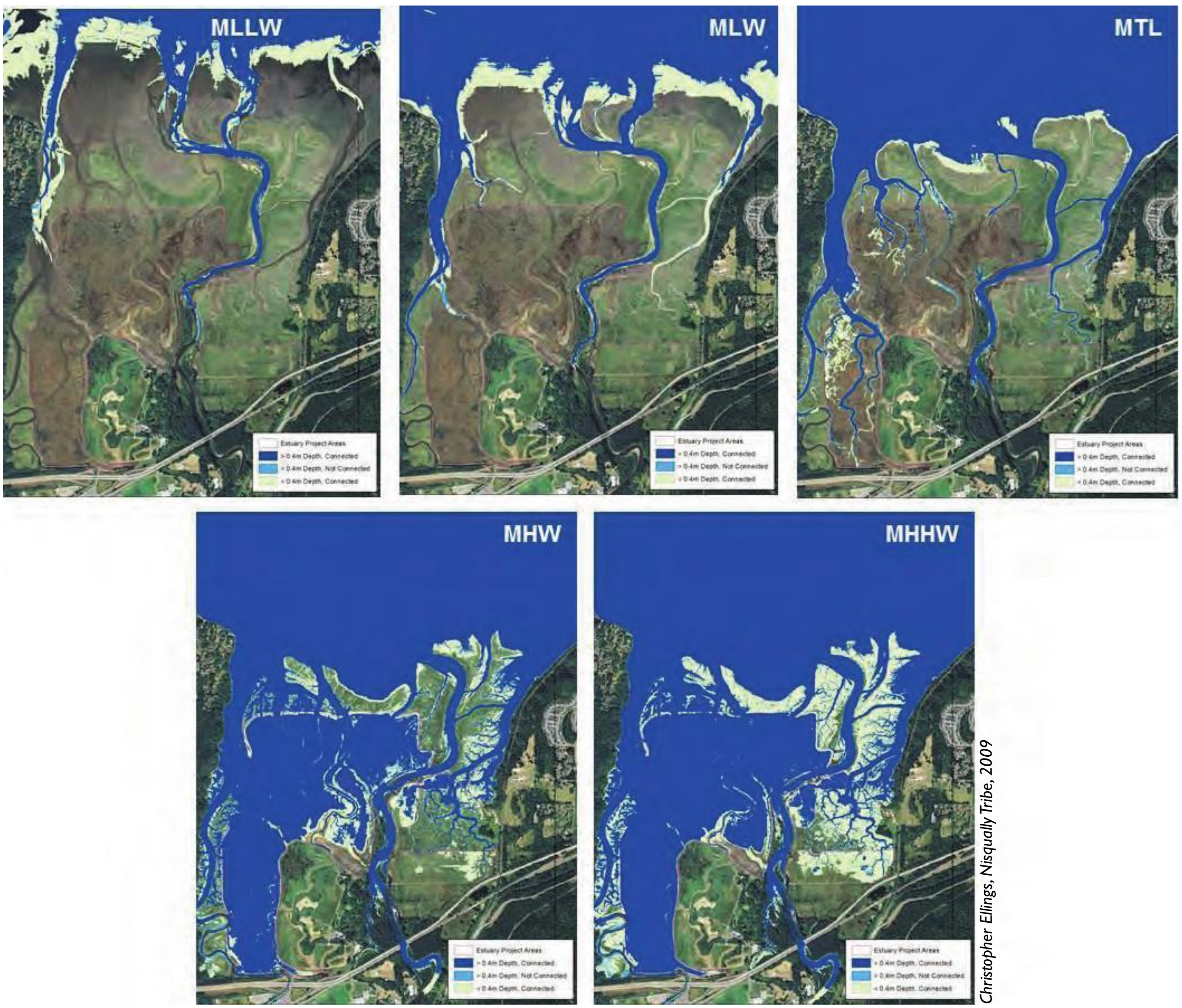


Christopher Ellings, Nisqually Tribe, 2009

Maps show results of habitat connectivity modeling at select water levels as the tides inundate the restored Nisqually delta.

Nisqually Indian Tribe

(Continued from previous page)

The cutting-edge research conducted by the Nisqually Indian Tribe, three U.S. Geological Survey partners and others focused on assessing the effectiveness of the delta projects at restoring estuarine processes, habitats and ultimately the capacity of the delta in support of Chinook salmon and other fishes. Restoration effectiveness information from this project will support the implementation of Puget Sound estuary restoration efforts by tribes and others. An additional outcome of the project is the advancement of adaptive management indicators for management of the Nisqually delta by the Nisqually Indian Tribe and Nisqually National Wildlife Refuge.

The Nisqually Fall Chinook stock is one of the 27 stocks in the Puget Sound evolutionarily significant unit listed as threatened under the federal Endangered Species Act.[1] Our efforts have explored some of the process/structure/function linkages presented by the Puget Sound Nearshore Ecosystem Restoration Project (PSNERP)[2,3] to ultimately determine the success of the Nisqually delta restoration effort. These linkages are: 1) sediment delivery to the delta via the Nisqually River; 2) hydrodynamics affecting sediment transport and estuarine mixing; 3) geomorphic change; 4) vegetation community colonization and succession; 5) insect, benthic and neustonic invertebrate community response; 6) Chinook salmon functional response to process and structure changes as expressed by their distribution and relative abundance, feeding ecology, estuarine and delta residence time and growth, and their life history diversity.

In order to better understand the ecosystem response of their combined efforts in the estuary, the Nisqually Indian Tribe and USFWS Billy Frank Jr. Nisqually National Wildlife Refuge must utilize the results of our monitoring efforts and follow up research to craft a long-term management plan for the delta. Results thus far have generated the following key insights that must be considered:

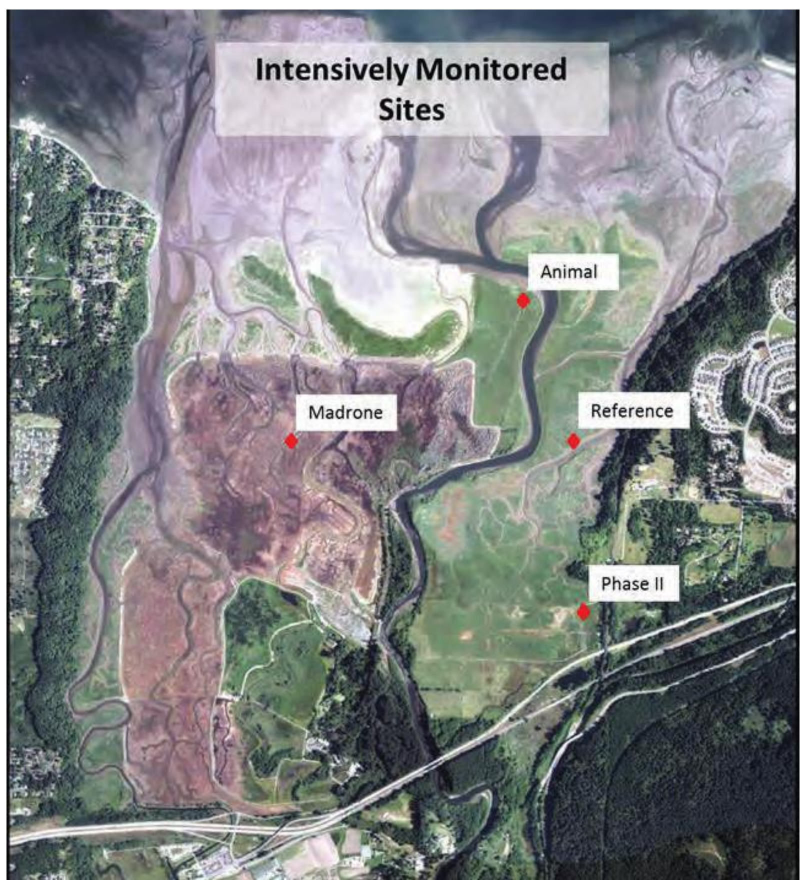
1. Juvenile Chinook rely heavily on all habitat components of the Nisqually delta and Nisqually reach nearshore for rearing, including the tidally influenced freshwater area around I-5. An area truncated by the I-5 bridge and flood control dikes.

2. Juvenile Chinook respond rapidly and positively to delta restoration, even when the restored site lacks mature estuarine habitat characteristics like salt-marsh vegetation.

(Continued on next page)

2009 EPA Tribal Implementation Grant report, Nisqually Tribe

Beach seine pull at the Nisqually delta monitoring site.



Nisqually Delta Restoration Project

Intensively monitored sites in the Nisqually delta.

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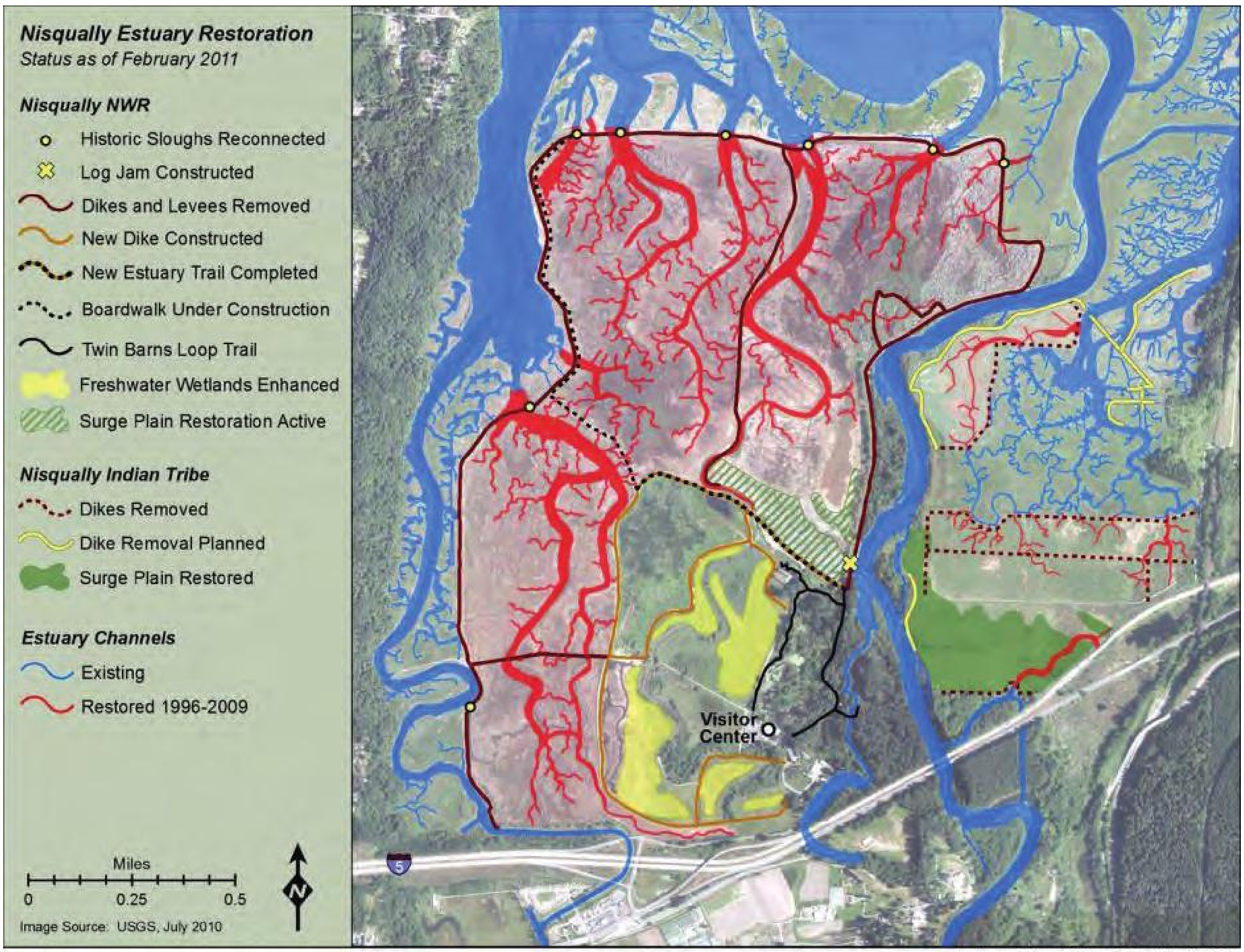
3. Upstream land use can significantly alter the habitat-forming processes of a delta. In the Nisqually, hydropower operations have dramatically reduced sediment supply to the delta. The near-term habitat development of the restoration area, as well as the long-term viability of the delta is threatened by this constriction. Climate change induced sea level rise will drastically reduce delta structure and function if habitat-forming processes are not restored or enhanced.

4. Upstream flood control, floodplain development, and the I-5 causeway exacerbate the impact of reduced sediment supply caused by hydropower development. Sediment routing to the delta from the Nisqually River relies heavily on tidal forcing via tidal channels, so much of the riverine sediment is lost offshore. The lack of distributary channels upstream of I-5 impairs the efficient distribution of sediment. Additionally, the I-5 causeway may inhibit the upstream retreat of estuarine habitats as sea level rises.[4]

More resources will be needed for additional studies in order for managers to develop plans for addressing substantial impacts to the habitat-forming processes in the delta. Work to date provides a solid base of information to build upon. Future studies should expand existing hydrodynamic models to included areas upstream of I-5 and use the model to run sediment supply restoration scenarios. Habitat structure and fish utilization information generated during this project can be used to estimate the impact of various scenarios on vegetation, invertebrates and ultimately Chinook salmon.



Cartography by: J.Cutler, Nisqually Indian Tribe

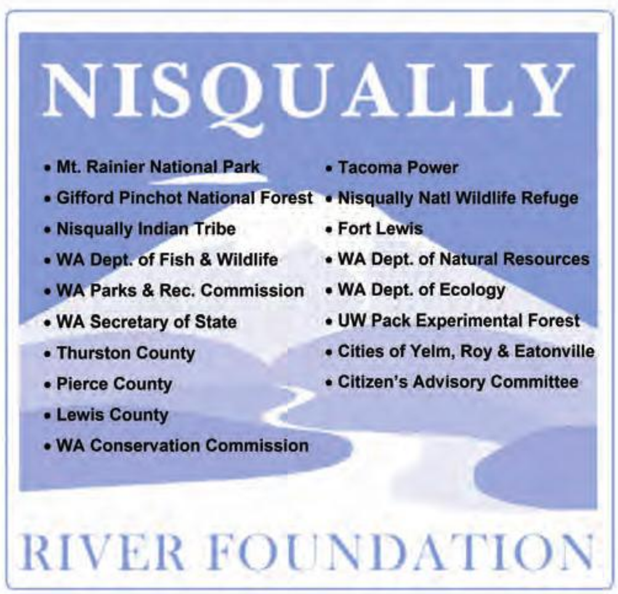
Success Story of the Nisqually River Council

The Nisqually River watershed has long been recognized for the unique relationships and commitment to collaborative and inclusive decision making. At the center of this effort has been the Nisqually River Council. It has served as the central organizing body for the watershed since its formation in 1987 and is the oldest watershed council west of the Mississippi River. It is a place where ideas are shared, concerns aired, trust is established, and a community is built.

The Nisqually River Council arose from a desire to provide locally based and controlled management of a watershed. At the request of a group of local leaders, including the Nisqually Indian Tribe, the Washington State Legislature created the Nisqually Task Force in 1985. Its mission was simple – create a management plan for the watershed that was broadly supported by the communities and interests in the watershed. The result was the 1987 Nisqually River Management Plan, which established the Nisqually River Council as its implementing body and a long list of desired outcomes and projects.

The Council has been incredible successful in honoring the commitment of the dedicated citizens that created the management plan in completing well over 80% of the plan elements. Perhaps the most important accomplishment of the Council has been the fostering of a watershed community, instilling a sense of uniqueness, ownership and stewardship throughout the basin. Through its outreach efforts, its Nisqually River Education program, the creation of the Nisqually Land Trust, and its desire to be inclusive and innovative, the Council has firmly established the Nisqually as the "center of the universe."

The Council has continued its good work and evolved to address current issues, resulting in a significant update to its guiding document through the Nisqually Watershed Stewardship Plan in 2006. This introspective review produced a plan that is based on the principles of sustainability and expands the Council scope to consider actions and strategies to improve local economies and community health, as well as continue its work in environmental stewardship throughout the entire basin. The Council is poised to continue its mission to create a unique place for future generations.



Nisqually River Council Slideshare

Nisqually River Council

Nisqually River Council Current Projects[1]

- Establishment of the Nisqually Community Forest to protect forestland and salmon habitat, while providing resources for local communities.
- Adapting to climate change through the development of an adaptation plan and a three-year education project.
- Forming the Nisqually River Water Trail to increase non-motorized boat access to the lower Nisqually River.
- Celebrating the five-year monitoring results of the Nisqually Delta Restoration Project through educational tools
- Reducing stormwater runoff and improving water quality through low impact development in Eatonville.
- Placing value on the natural benefits, or ecosystem services, of the Nisqually Watershed by protecting old-growth forests that purify Olympia's drinking water.

Interstate 5 Crossing through the Nisqually Delta

The Nisqually Indian Tribe, in close cooperation with myriad partners, has made significant progress toward the full restoration of the Nisqually Estuary. This work has focused on restoring as much of the historic habitat and associated ecosystem functions as possible. Key to this work has been the cutting-edge research and monitoring work that has revealed much in the way of responses from multiple plant, fish, insect and wildlife species.

This monitoring work is revealing that many of the critical habitat features, physical and chemical, are at significant risk of diminished ecosystem value. Sediment transport, formation and location of various habitat features, vegetation communities and associated biota, and the location and magnitude of salinity transition zones are all being substantially influenced by two major factors: climate change and the Interstate 5 crossing of the delta.

Climate change is resulting in sea level rise, disruptions of the historic hydrograph, and significant alteration of sediment transport – all of which impact the ability of the estuary to naturally recreate lost habitats and services. The I-5 crossing compounds and magnifies the impacts. The current dike and fill configuration of the highway has disconnected the delta and prevents natural adaptation to sea level changes. It also serves to greatly reduce the flood capacity for the lower valley as well as negatively impact sediment transport to the newly restored estuary.

The Nisqually Indian Tribe has formed a partnership with the Washington State Department of Transportation (WSDOT) to look at design alternatives, cost estimates, permitting issues, and impacts on transportation associated with moving to a less impactful crossing of I-5 through the delta. Possibilities being considered range from creating an elevated causeway across the entire crossing to strategically placed elevated structures potentially phased over time. The commitment from WSDOT is to work closely with the Tribe and come to agreement on an approach to solve our mutual concerns in the summer of 2016, then continue the partnership in securing funds for implementation.

Nisqually River I-5 Crossing.

Data Sources: NAIP 2013[1]

AR052854

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Interstate 5 Crossing through the Nisqually Delta

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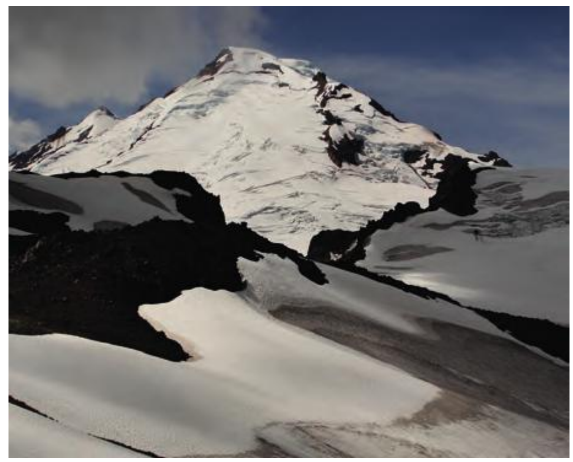
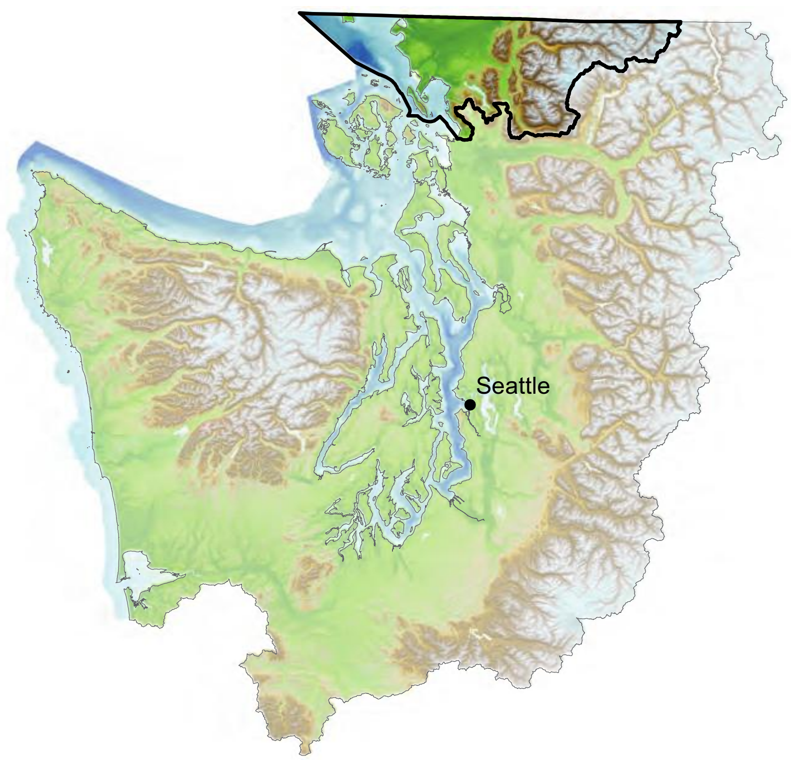
2016 State of Our Watersheds Report
Nooksack River Basin

The Nooksack Indian Tribe has a long history of natural resources management and salmon recovery efforts. Yet, over the last 20 years, there continues to be a decline in our fisheries due to poor habitat conditions throughout our watershed. We need to take immediate action toward salmon recovery because abundances of salmon are low and habitat conditions continue to be in a degraded state. We must prevent further degradation and lay the building blocks for natural habitat to enable recovery of native salmon stocks.

– Bob Kelly
Nooksack Indian Tribe





WRIA 1 and Western Washington

Nooksack Indian Tribe

The Nooksack Indian Tribe is a recognized tribe under the Point Elliott Treaty of 1855 and has about 2,000 enrolled members. Traditionally, the Nooksack people occupied the watershed of the Nooksack River from the high mountain area 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 these 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 Nooksack people.[1]

Salmon Productivity Diminished by Land Use

The Nooksack basin has remained largely rural. The upper watershed, including the North, Middle and South Forks of the Nooksack River, is mostly rural and dominated by forestlands. The mainstem below the confluence of the three forks is primarily agricultural with small towns and cities including Deming, Sumas, Nooksack, Everson, Lynden, Blaine and Ferndale. Bellingham is the largest city in the watershed and is located on the shore of Bellingham Bay, southeast of the Nooksack River delta. The Nooksack River delta is one of the higher quality estuaries in Puget Sound.

Salmon habitat has been severely degraded by the legacy of forestry and agriculture practices that constitute the primary land uses within the upper basin. While land-use practices have improved, water quality and quantity continue to be challenged by these activities along with the population growth being experienced within the lower portion of the watershed.

Whatcom County's population was estimated at 212,000 people in 2015, and projected to grow to 273,000 people by 2036,[2,3] which presents one of the largest threats to water quality, water quantity, salmon habitat and salmon recovery efforts.

Technical analysis identified seven significant habitat limiting factors for salmon production:

1. Channel instability in the upper and middle portions of the North, Middle and South Forks;
2. Increased sediment from natural and human causes, and its movement through the system;
3. Loss of logs and other wood from the channel that create pools and rearing habitat for salmon;
4. Bank armoring, flood control structures, and transportation facilities;
5. Fish-passage blockages;
6. Changes in streamflow and temperature;
7. Changes along the marine shoreline in Bellingham Bay and adjacent nearshore areas;[4]

Kari Neumeyer, NWIFC

The Nooksack Tribe has installed a series of 60 logjams along Wildcat Reach on the North Fork Nooksack River.

While not originally listed in the Puget Sound Shared Strategy as one of the seven significant habitat limiting factors for salmon production, climate change has also been identified as a limiting factor for future salmon production.

Recovery Plan Lags Behind Intended Pace

The protection and restoration strategy pursued for the Nooksack basin seeks to protect existing fish habitat and restore damaged habitat and habitat-forming processes.

Local governments committed to address the threat of projected human population growth by guiding growth into designated urban areas and managing rural development to minimize impacts to current habitat conditions. Specifically, the Water Resource Inventory Area (WRIA) 1 Salmon Recovery Board structured the overall habitat recovery approach into seven key strategies:

1. Remove significant barriers to high-quality habitat;
2. Restore habitat in the forks, mainstem and major tributaries;
3. Ensure floodplain management protects and enhances fish habitat;
4. Protect good habitat through local critical areas ordinances and shoreline management programs;
5. Protect and improve instream water flows for fish;
6. Protect and restore estuaries and nearshore areas; and
7. Restore conditions in lowland tributaries and independent tributaries to the Fraser River and Strait of Georgia.[5]

Implementation of the WRIA 1 Salmonid Recovery Plan is lagging behind the pace originally anticipated during plan development. The Middle Fork Nooksack River dam, a significant barrier to high-quality habitat, remains in place. Integrating salmon recovery needs into floodplain management planning has been lagging. Implementation of local critical ordinances and shoreline management programs has not fully aligned with best available science on habitat protection. Instream flows for salmon remain deficient and over-appropriated. Restoration work has progressed with numerous capital projects focused on restoring Chinook habitat. However, WRIA 1 has faced significant funding shortages for restoration projects, limiting implementation progress.

There still remains one shoreline management plan in WRIA 1 in the process of being updated, and action still needs to occur on regulatory gaps such as exemptions for construction of single-family residences and agriculture. Effectiveness monitoring still needs to occur on all shoreline management plans within WRIA 1.

At the 10-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Nooksack basin shows improvements for shellfish growing area's water quality and removal of forest road barriers. Priority issues continue to be degradation of South Fork Nooksack water quantity, floodplain forest conditions, stream barriers and 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 since the 2012 State of Our Watersheds Report shows improvement for some indicators and a steady loss for others in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Water Quality - Temperature	There are over 22 sites and 32 miles of stream listed as 303(d) in the South Fork Nooksack TMDL for stream temperature. Climate modeling results show that climate change will have a significant impact on future rising water temperature in the South Fork Nooksack River (projected to rise by 2.81 to 6.32 degrees Celsius by 2080). This could substantially impact fish and reduce the amount and quality of preferred salmon habitat in the watershed. Similar trends in stream temperature in the Middle Fork and North Fork Nooksack rivers are expected. Stream temperature modeling has not been accomplished in those rivers, but has in the South Fork Nooksack River.	Declining
Water Quality - Shellfish	As of December 2014, Drayton Harbor shellfish growing areas remained prohibited and conditionally approved, but marginally improving water quality over a 5-year period (low fecal coliform counts) in West Drayton Harbor resulted in excluding February 2014 from the previous conditional closure period of November through February. As of December 2014, the annual status report for Birch Bay shows approved areas in Birch Bay improving and prohibited areas remaining closed. As such, fecal pollution in the lower Nooksack River basin, Drayton Harbor, and Birch Bay continue to be a major impediment to Tribal shellfish gathering. The Tribe has been a major contributor of the fecal coliform monitoring data in the Drayton Harbor watershed.	Concerns
Floodplain	There is no trend of continued permanent removal of floodplain forest between 2009 and 2011. The problem remains the poor to fair status of floodplain forest that is the result of maintained forest clearing within the Nooksack floodplain since the late 19th century. The Nooksack River riparian zone is 50% forested (2013) and right at the WRIA 1 Chinook Recovery Plan threshold between poor and fair forest condition. A total of 2,269 acres of the Nooksack floodplain forest needs to be restored to reach the preferred "good" condition of 70% forest cover for the Nooksack River riparian zone.	Declining
Stream Blockages - Culverts	The total number of barrier culverts increased by 99 through surveys conducted between 2010 and 2014. A total of 604 fish barrier culverts have been identified in the WRIA 01 watershed through 2014.	Declining
Forest Roads	Completed 90% (1,277 out of 1,426 miles) of private and state-owned forest road repairs or abandonment and 95% (125 out of 132) of the culverts have been repaired or abandoned on private and state-owned forest roads.	Improving
Shoreline Modifications / Forage Fish	72% (121 of the 169 miles) of erosional drift cell shoreline in Whatcom County is either modified or armored. Since 2011, 350 feet of new marine shoreline armoring has been added in Whatcom County.	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

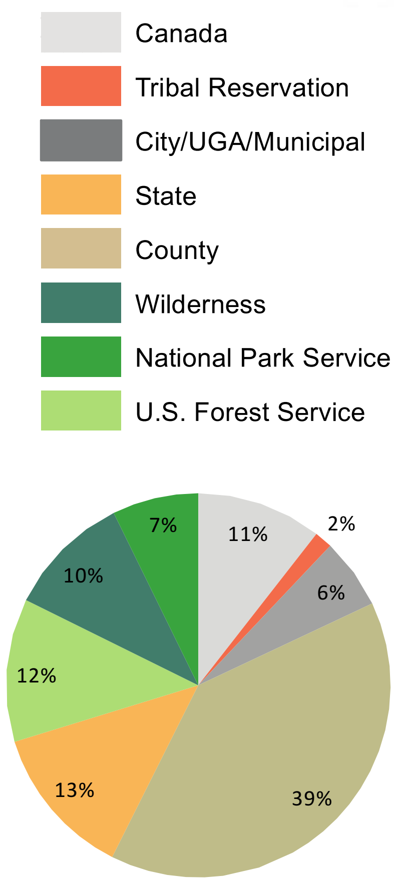
The regulatory approach within WRIA 1 is employing a "No Net Loss" strategy of ecological function from baseline conditions. Salmon recovery, however, will require strong voluntary restoration efforts to successfully recover a degraded watershed and estuarine conditions.

Unfortunately, water quality and quantity conditions within the Nooksack River watershed are continuing to decline. Available funds for restoration and enhancement activities to address past habitat and water quality degradation are limiting and not keeping pace with development pressure. Additional funding will be required to meet the challenge of rising stream temperatures and changing precipitation patterns likely resulting from future climate change. Regulatory reform is required as the current framework clearly is not providing adequate protection.

To meet the expected challenges, the Nooksack Tribe is taking the lead on adapting climate science into planning and action. We continue to assess the impact of climate change on our natural and cultural resources and integrate the findings into local planning. We are making every effort to speed the implementation of our salmon recovery plan as a means of offsetting some of the expected changes in climate. The Tribe's continued climate change studies support salmon recovery and restoration effectiveness and planning; and provide valuable information on sediment loading and transport, altered river hydrology and stream temperature that can be used by many stakeholders including flood control, water supply and instream flow negotiations. The Tribe has taken the lead on securing grant funding from the BIA, EPA, ATNI, NPLCC, Ecology and NWIFC to implement the preparation of a watershed conservation plan that addresses current legacy impacts (flow, temperature, sediment, riparian function) as well as climate change impacts. This planning process acts on the recommendations of the temperature TMDL and the climate change pilot research project currently in the final stages of completion for the South Fork Nooksack River. The planning efforts will focus on watershed-wide services and functions in general and specifically riparian protection and restoration on agricultural lands adjacent to the South Fork Nooksack River. These efforts serve as a pilot that can be applied to the Middle Fork and North Fork Nooksack rivers as well as the lower mainstem Nooksack and other rivers that discharge into Puget Sound. Further, the Tribe has engaged the Stillaguamish Indian Tribe in a climate change information exchange collaboration aimed at assisting each Tribe with climate change vulnerability assessment and adaptation planning.

Nooksack Indian Tribe

WRIA 1: Mountains



Data Sources: USFWS 2014,[6] WADNR 2014a,[7] WADNR 2014b,[8] WADOT 2013,[9] WAECY 1994,[10] WAECY 2011,[11] WAECY 2013a[12]

The Nooksack River watershed is 832 square miles, the largest drainage in WRIA 1, and the fourth largest drainage in Puget Sound. It has three main forks: the North, Middle and South Fork Nooksack rivers that originate in the steep high-elevation headwaters of the North Cascades and flow westerly descending into the flats of the Puget Sound lowlands. The North and Middle Forks are glacial rivers and originate from Mount Baker. In contrast, the South Fork originates on the rain- and snowmelt-dominated low to middle elevation portion of the overall watershed. Even though there are no active glaciers in the South Fork watershed, the river flows through a previously glaciated landscape with ample glacier-derived till and morainal deposits. The Middle Fork flows into the North Fork upstream of the North Fork confluence with the South Fork to form the mainstem Nooksack River just above Deming. The mainstem then flows as a low-gradient, low-elevation river through agricultural lands 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. Further, there is evidence that the Nooksack River flowed into the Fraser River to the north in southern British Columbia through the alluvial flats where the cities of Sumas and Abbotsford are located.

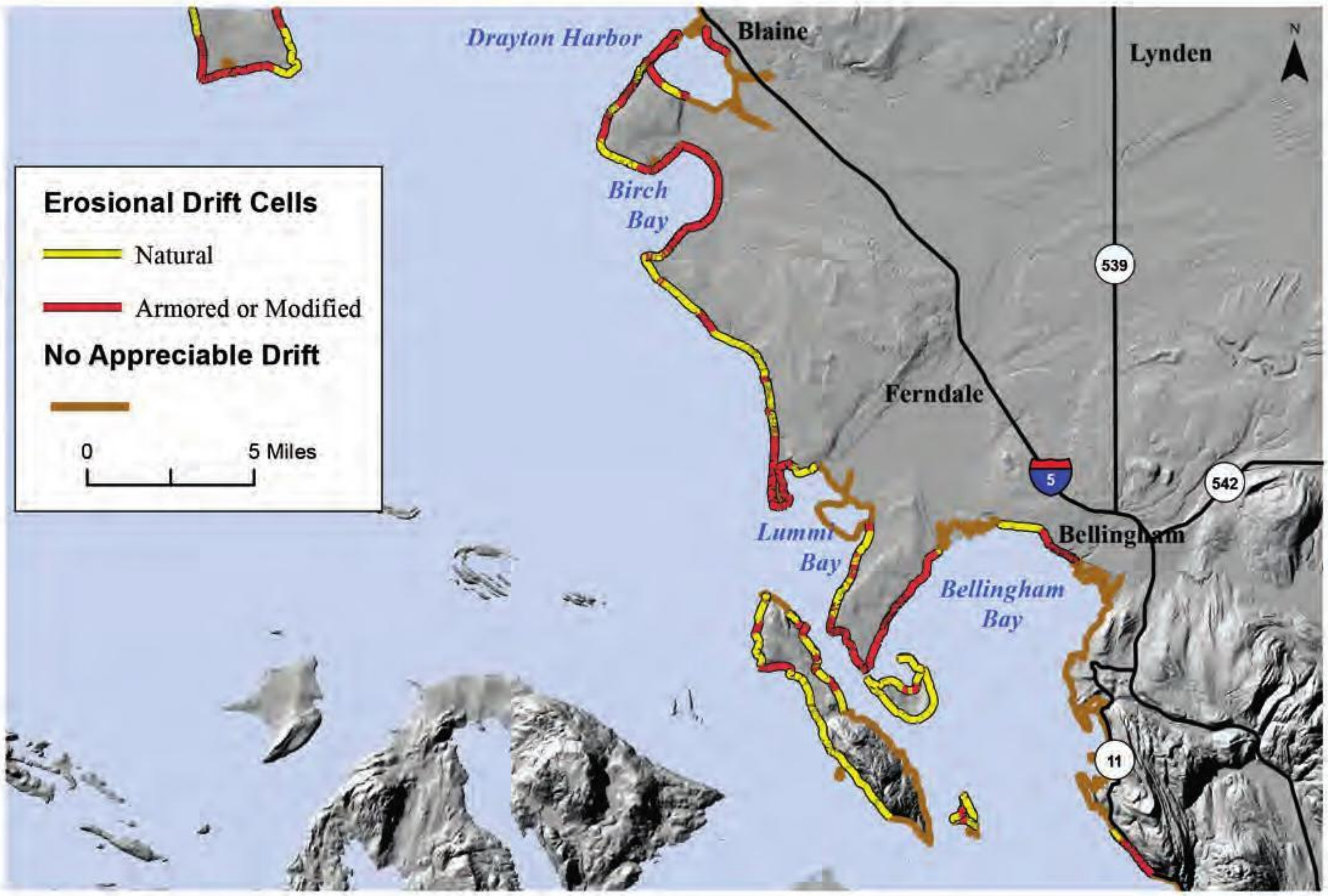
Euro-Americans began settling the area in the 1850s primarily for the logging resources, with some arriving for opportunities in prairie farming and mining. Lowland clearing for agriculture began in earnest by the 1890s. By 1925, nearly all of the lower mainstem and delta forests had been converted to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

While the Nooksack Tribe's ancestral home extends beyond the boundaries of the Nooksack watershed into watersheds adjacent, the Nooksack basin is central to the ancestral home as well as present home of the Nooksack Tribe. The Nooksack Tribe's reservation is located along the Nooksack River in the town of Deming, downstream from the confluence of the South and North Fork Nooksack rivers; trust lands extend upstream to the lower reaches of the forks and downstream towards Everson, as well as to the Sumas watershed.

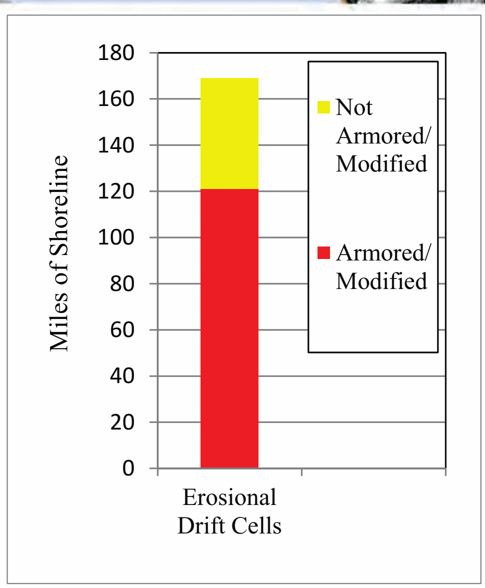
The Nooksack River and independent watersheds (WRIA 1) have five species of anadromous salmon: pink, chum, Chinook, coho and sockeye; and three of anadromous trout: steelhead, cutthroat and bull trout.[4,5]

Shoreline Armoring Threatens Forage Fish Habitat in Whatcom County

There are an estimated 169 miles of erosional drift cell shoreline in Whatcom County, and over 121 miles (72%) is either modified or armored.[1,2] Since 2011, 350 feet of new marine shoreline armoring has been added in Whatcom County.[3]



99% of documented forage fish spawning in Whatcom County occurs along erosional drift cells, and 72% of the shoreline of these drift cells are already armored or otherwise modified.[6,7,8]



Forage fish spawn almost exclusively on erosional drift cells. Their spawning habitats are sustained by sediment erosion from coastal bluffs depositing or accreting along the shoreline in the direction of net-shore drift that is controlled by prevailing Puget Sound winds and currents.[4] The greatest impact to forage fish habitat on erosional drift cells is shoreline armoring, as it interrupts erosion, distribution and accretion of sediment.[5] 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, Growth Management Act (GMA), and Priority Habitats and Species (PHS) Program, yet these habitats remain vulnerable to shoreline armoring and modification. Considering the critical ecological role of erosional drift cells for forage fish spawning and the equally critical role forage fish have in Puget Sound Chinook salmon ecology, no more armoring can be allowed along them, and every opportunity to remove armoring must be taken.

Data Source: PSNERP 2008,[9] SSHIAP 2004,[10] WADFW 2015,[11] WADOT 2012,[12] WAECY 2013c[13]

Shellfish Conditions Improve in Birch Bay and Drayton Harbor But Most of Area Still Closed

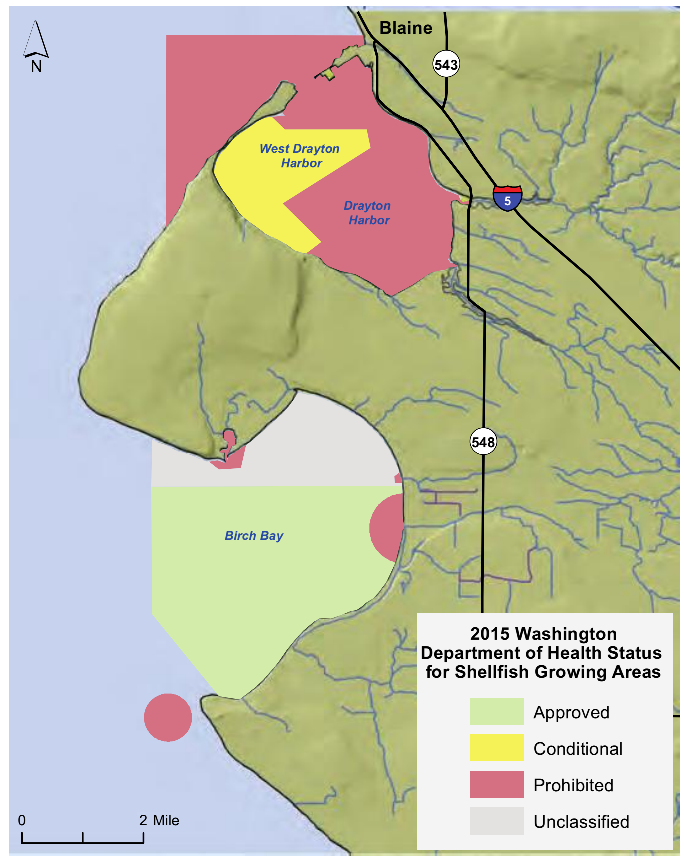
As of December 2014, Drayton Harbor shellfish growing areas remained prohibited and conditionally approved, but improving water quality over a five-year period (low fecal coliform counts) in West Drayton Harbor resulted in excluding February 2014 from the previous conditional closure period of November through February. As of December 2014, the annual status report for Birch Bay shows approved areas in Birch Bay improving and prohibited areas remaining closed.[1] Currently, the Tribe collects a large portion of the fecal coliform monitoring data that supports closures and conditional closures.

The Nooksack Indian Tribe and the tribes of western Washington have treaty rights dating back to the 1855 Treaty of Point Elliott, guaranteeing them continued commercial, ceremonial and subsistence harvest of shellfish in their Usual and Accustomed areas. Increased harvest pressure and degraded water quality have substantially reduced the shellfish available for Nooksack to harvest and their ability to exercise the Treaty Rights guaranteeing them a sustainable shellfish harvest. While the status and trend of the shellfish growing areas in Drayton Harbor and Birch Bay appear to be marginally improving in the short term, the majority of shellfish growing area between the two waterbodies remains either prohibited to shellfish harvest or only conditionally approved. For the Nooksack Tribe to fully exercise their treaty, much more of the Drayton Harbor and Birch Bay shellfish growing areas need to be cleaned up and opened for shellfish harvest.

Drayton Harbor

Washington State Department of Ecology[2]

Drayton Harbor and Birch Bay Shellfish Growing Areas



2014 GIS estimate of acres of shellfish growing area in Drayton Harbor and Birch Bay

	Shellfish Growing Area Status			
	Prohibited	Conditionally Approved	Approved	Unclassified
Birch Bay	311	0	2794	983
Drayton Harbor	2916	810	0	0

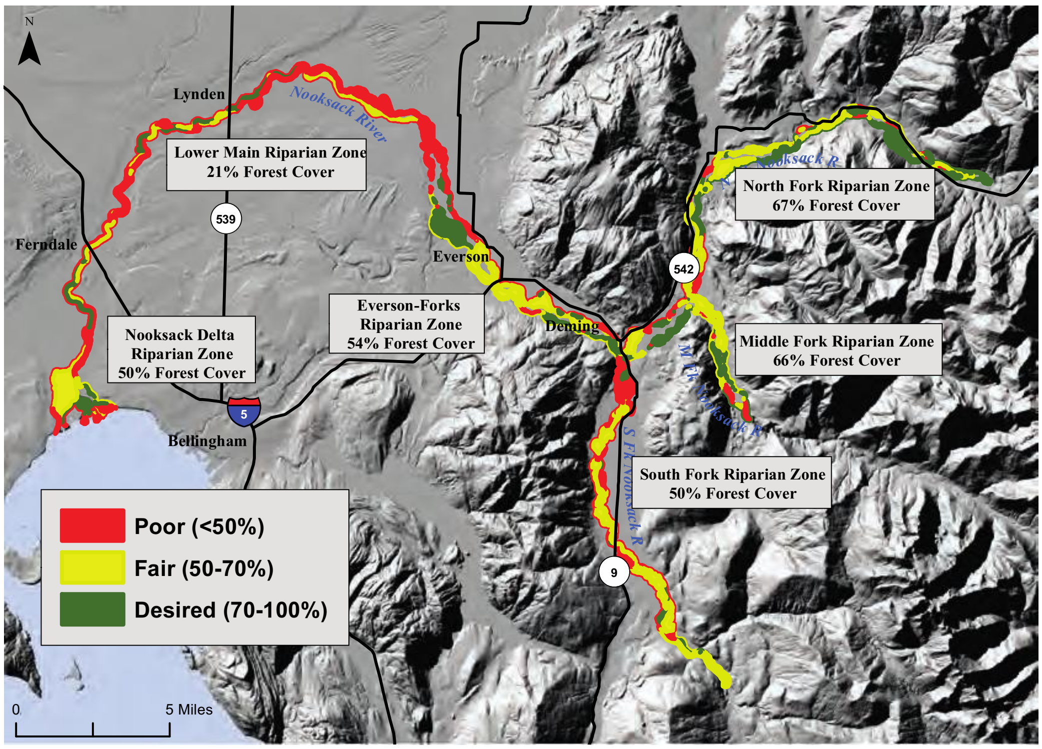
Data sources: SSHIAP 2004,[3] USGS 2014,[4] WADOH 2014,[5] WADOH 2015b,[6] WADOT 2012[7]

AR052862

Restoration Needed in Nooksack Floodplain to Reach Long-Term Chinook Recovery Targets

The Nooksack River riparian zone was 50% forested in 2013, and right at the WRIA 1 Chinook Recovery Plan threshold between poor and fair forest condition.[1] A total of 2,269 acres of Nooksack floodplain forest needs to be restored to reach the preferred "good" condition of 70% forest cover for the historic channel migration zone: 1859-2009 (Nooksack River riparian zone). There is no trend of continued permanent removal of forest between 2009 and 2011.[2] The problem remains the poor to fair status of forest that is the result of maintained forest clearing within the Nooksack riparian zone since the late 19th century.

The WRIA 1 Chinook Recovery Plan targets greater than 70% riparian forest cover for the Nooksack River floodplain. Forest cover from mature trees is critical to Chinook habitat because it provides shade to regulate stream temperatures, large woody debris to help form pools and cover, and root structure to help stabilize stream banks.[3] While the Nooksack River riparian zone is poor to fairly functional overall, most of the poor forest condition is associated with agricultural land in the lower floodplain between the town of Everson and the delta. The forks' floodplains on the other hand, have all reached a near-term Chinook recovery target of fair condition. However, the three forks to varying degrees still suffer from temperature and sediment exceedances that impact salmon and salmon recovery.[4] The South Fork Nooksack riparian zone is at the 50% cut line between fair and poor, but the Middle and North Fork riparian zone both have over 65% forest cover and are very close to preferred "good" future condition.



Poor forest conditions in the Nooksack River riparian zone are primarily focused in the lower mainstem.[5]

Land Use and Zoning Type	Forest Acres	Non-Forest Acres	Non-Forest Acres Needing Reforestation to Reach 70% Forest Cover
Agriculture	2,061	3,477	1,816
Rural Forest	1,339	750	123
Rural Residential	748	678	250
State Trust Land	732	318	3
Private Forestland	712	230	0
Urban Growth Area	41	143	88
Recreation and Open Space	30	80	47
Federal Forestland	33	6	0
Total	**5,696**	**5,683**	**2,269**

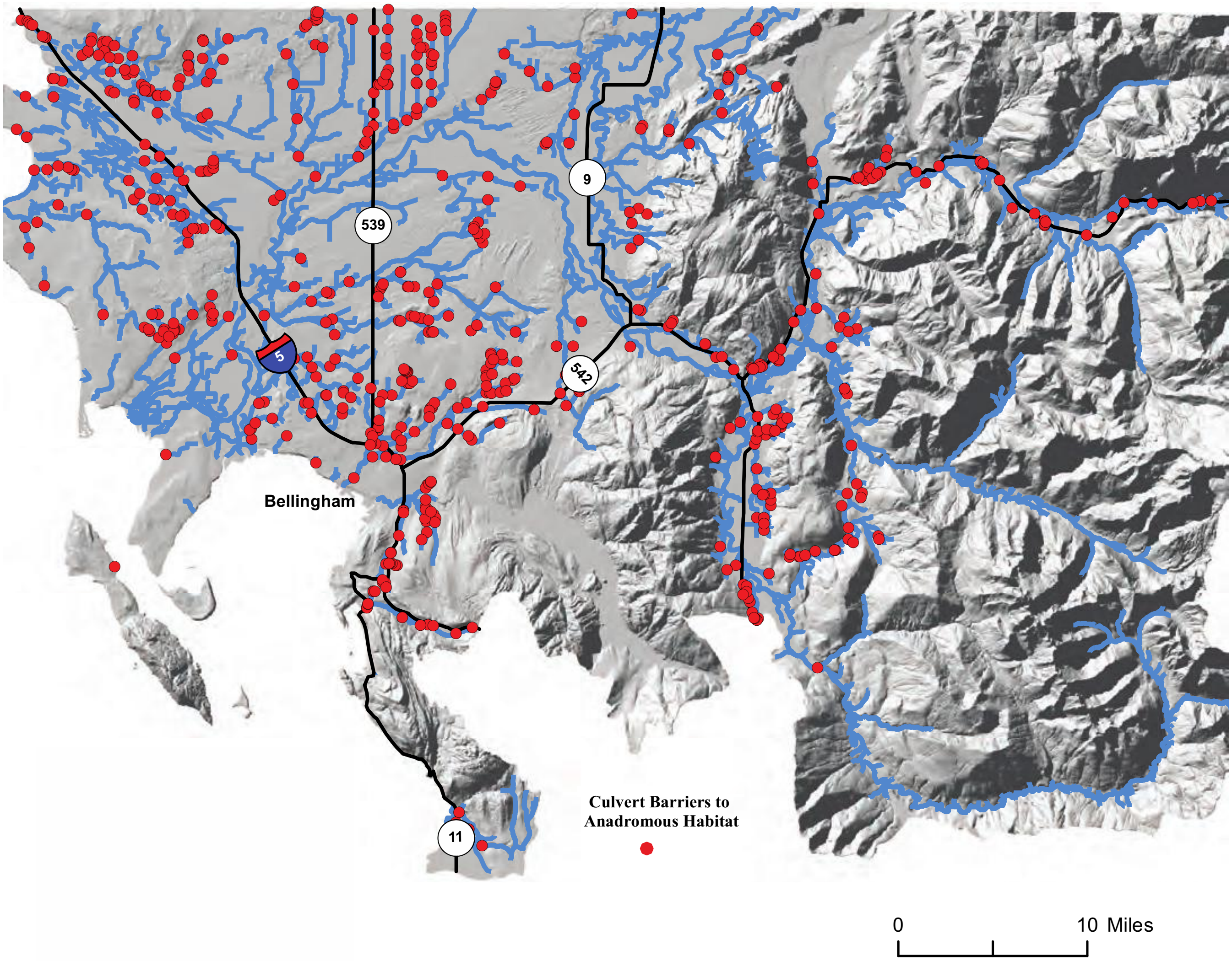
Most of the non-forested acres within the Nooksack River riparian zone that can be reforested to meet greater than 70% forest cover are in the lower mainstem riparian zone and zoned for agriculture.[6]

Data Source: SSHIAP 2004,[7] WADOT 2012,[8] Whatcom Co. 2011,[9] WRIA 1 SRB 2014[10]

Anadromous Barrier Culverts Have Increased

A total of 604 fish barrier culverts have been identified in the WRIA 1 area through 2014. 99 of those culverts have been identified through survey between 2010 and 2014.

Barrier Culverts within the WRIA 1 Watersheds



Through 2010, there were an estimated 505 culverts at least partially blocking anadromous migration in the WRIA 1 watersheds, and through 2014 this number had increased to 604 culverts. Currently in the WRIA 1 watersheds 54% of all barrier culverts are under government jurisdiction. For culvert repair to be meaningful to the recovery of Chinook salmon, governments need to commit to an accelerated schedule of culvert repair.[1]

Estimated Barrier Culverts on Anadromous Streams in the WRIA 01 Watersheds

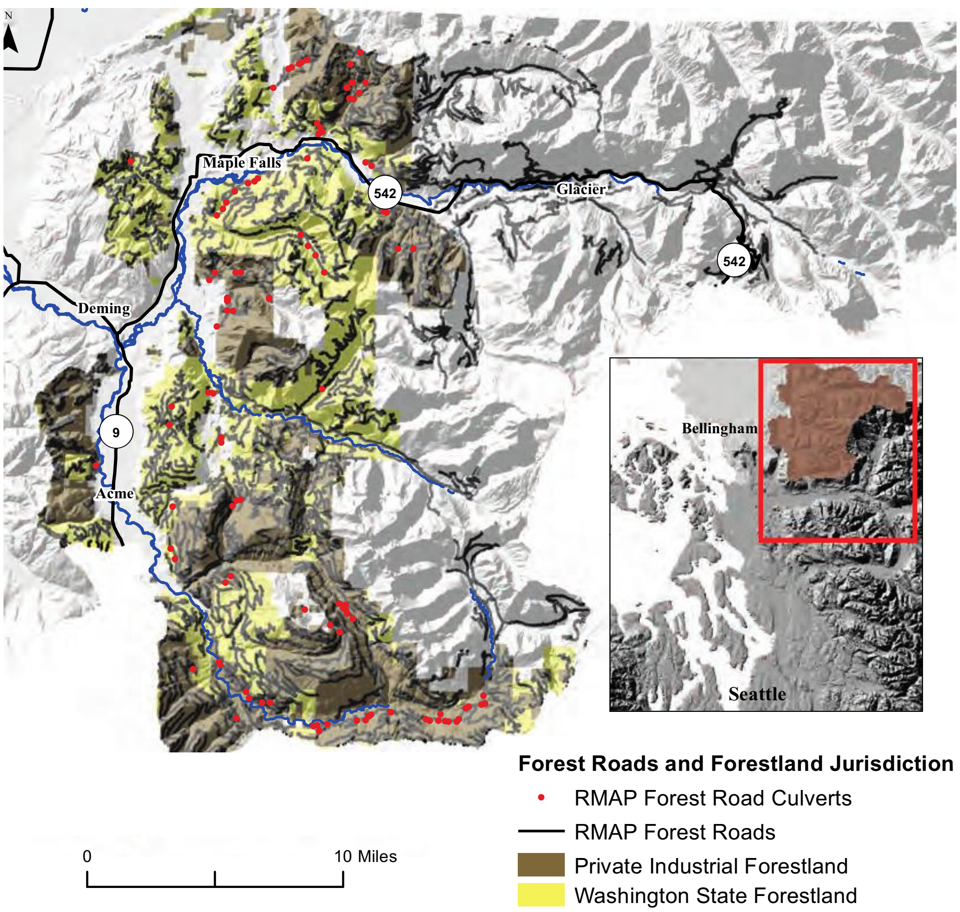
Owner	*Surveyed through 2010*	*Surveyed 2010 - 2014*	*Total Barrier Culverts in 2014*
City	25	38	63
County	179	11	190
Other	1	0	1
Private	224	36	260
State	71	14	85
Unknown	5	0	5
Total	**505**	**99**	604

As of 2014, an estimated 604 culverts remained barriers to anadromous habitat in the WRIA 1 watersheds.[2,3]

Data Sources: SSHIAP 2004,[4] SWIFD 2014,[5] WADFW 2014,[6] WADOT 2012[7]

Forest Road Maintenance, Abandonment Nearly Complete in Upper Nooksack Watershed

The Washington State Forest Road Maintenance and Abandonment Plan (RMAP) has led to the repair or abandonment of 90% (1,277 miles out of 1,426 total miles) of private and state-owned forest roads in the Upper Nooksack River watershed.[1] RMAP has also resulted in the repair or removal of 125 (95%) of 132 culverts on private and state-owned forest roads. The majority of all remaining work is scheduled to be completed by 2016, with the three largest private landowners in the watershed, Weyerhaeuser Corporation, North Cascades Timberlands and Sierra Pacific Industries, all requesting an extension to 2021 to fix the remaining miles of road on their Upper Nooksack watershed property. Small forest landowners were not required to develop a RMAP, 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.



No human alteration of the river's landscape has a greater and more far-reaching effect on aquatic habitat than roads.[2] The majority of forest roads in the Upper Nooksack basin are on private industrial and state lands and fall under the RMAP mandate. It is expected that RMAP road repairs and abandonment will improve water quality in the upper Nooksack River watershed. Considering the role improved water quality plays in Chinook habitat, the current status of RMAP being almost complete in the Upper Nooksack watershed is good news to salmon recovery. Small forest landowners were not required to develop a RMAP, 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.

RMAP only applies to state and private forestland jurisdictions.

Data Sources: Skagit Co. 2010,[4] SSHIAP 2004,[5] WADNR 2014a,[6] WADNR 2014c,[7] WADOT 2012,[8] Whatcom Co. 2011[9]

RMAP status shows that both the state and private forest landowners are approaching completion of road repairs and abandonment as mandated by the RMAP program.[3]

2015 Nooksack River Watershed Road Maintenance and Abandonment Status (RMAP)					
Jurisdiction	*Total Miles of Forest Road*	*Completed Miles*	*Miles Remaining*	*Percent Complete*	*Planned Date for RMAP Completion*
State Lands	459	428	31	93%	10/31/2016
Private Industrial Lands	967	849	118	88%	10/31/2021
Jurisdiction	*Total Number of Culverts*	*Repaired*	*Remaining to be Repaired*	*Percent Repaired*	
State Lands	28	27	1	96%	
Private Industrial Lands	104	98	6	94%	

Climate Change, Higher Flows, Lower Flows, More Salmon Habitat Will Be Lost

In the South Fork Nooksack river watershed, climate change projections show a transition from snow in the mountains to a mix of snow and rain, with snow melt occurring earlier in the year.[1] This means an increase in winter river flows and a decrease in summer river flows, and increased habitat stress for salmonids year-round.

Higher peak flows in the winter and lower base flows in the summer and more sediment loading and transport would mean more salmonid egg scour and loss during winter spawning, and higher water temperatures and less available habitat for summer rearing. For salmon recovery, this would mean even more salmon habitat protection, conservation and restoration than is currently being planned for will be needed to sustainably recover the species. Additional restoration focus will be needed including reconnecting floodplains, floodplain protection and restoration, and other upper watershed actions that protect and restore watershed functions that relate to poor water quality.

Photo 1

Weather Underground

Photo 2

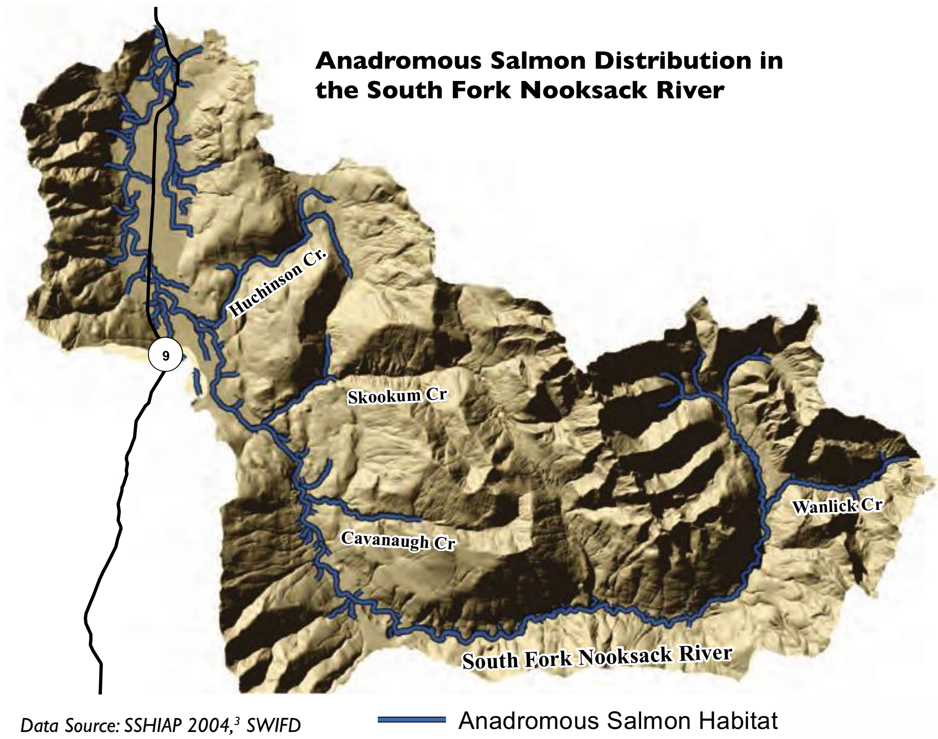
Seattle City Light

Photos 1 and 2: Higher Peak Flows during incubation result in lower salmon survival rates, as salmon eggs are scoured from their redds before they have an opportunity to hatch.

Photo 3

WA Department of Ecology

Anadromous Salmon Distribution in the South Fork Nooksack River



Data Source: SSHIAP 2004,[3] SWIFD 2014,[4] WADOT 2012[5]

Current Conditions and Potential Future Conditions for the South Fork Nooksack River under Climate Change

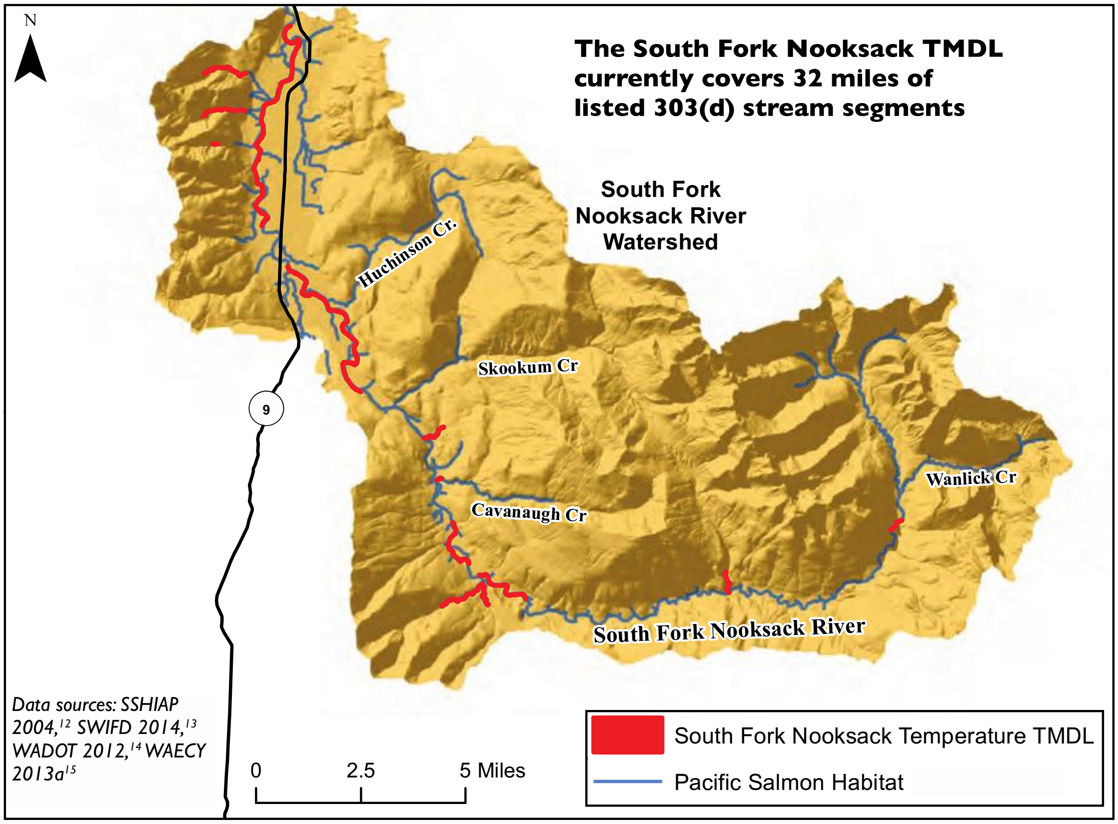
Physical Parameters	Current Conditions	Future Conditions with Climate Change	
timeframe	variable	2040	2080
Mean annual flow (cfs)	1032 [1]	+2.5% [2]	+6.2% [2]
Mean low flow (cfs)	102 [3]	-23% [4]	-34% [4]
Mean high flow (cfs)	1,970 [1]	+12% [5]	+11% [5]

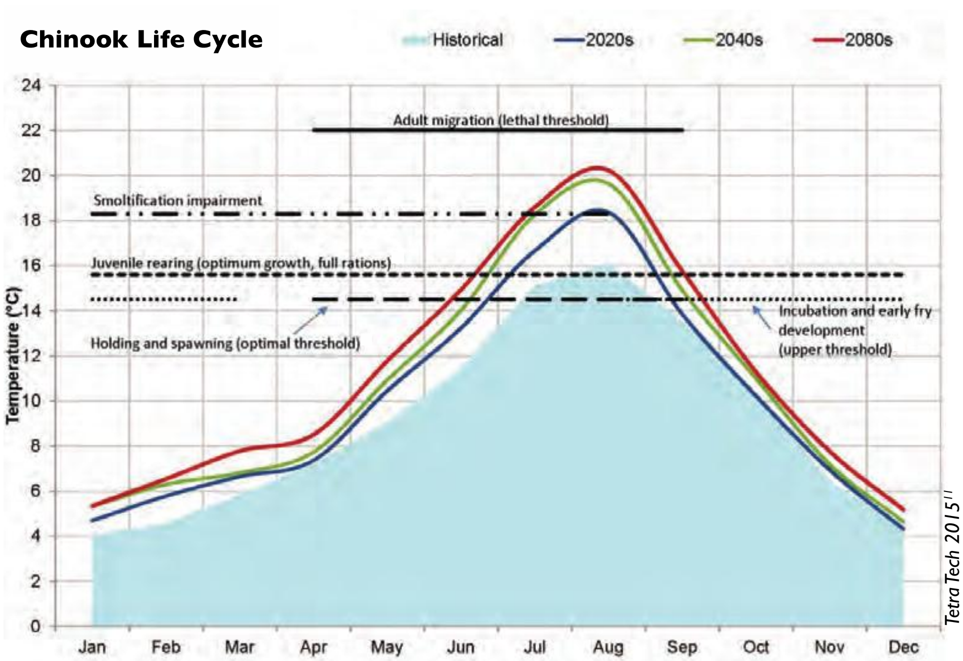
Table Sources:[2] [1] Value based on Department of Ecology data from gauging station 01F070 at Potter Road bridge from WY 2004- WY 2010 (DOE QAPP, publication number 12-03-126). High flow value indicates the 90th percentile flow. [2] Total annual streamflow projections for Washington State, relative to the 1917-2006 time period, under moderate future impacts (the 2007 International Panel on Climate Change A1B scenario) (DOE, 2013; Elsner et al, 2010). [3] 7-day average low flow with a 2-year recurrence interval (7Q2) estimated by Curran and Olsen (2009).The 7Q10 recurrence interval was 75.8 cfs (Tetra Tech, 2013). By 2040 the 7Q2 will be close the present day 7Q10 and by 2080 the 7Q2 will be greater that the 7Q10 today. [4] Average change in summer low flows for Washington state relative to 1917-2006 (Snover et al, 2013). [5] The Variable Infiltration Capacity (VIC) hydrologic model's 25-year projected increased flood magnitude under the medium-impact scenario CCSM2 climate model (pg. 54, Tetra Tech, 2013).

Photo 3: Lower low flows result in shallower water and less wetted area in the river. All of these directly reduce salmon's habitat for summer rearing.

Climate Change Forecasts a Warming Trend for Stream Temperatures in South Fork Nooksack

Currently, there are over 22 sites and 32 miles of stream listed as 303(d) in the South Fork Nooksack TMDL for stream temperature.[1] Climate modeling results show that climate change will have a significant impact on future rising water temperature in the South Fork Nooksack River (projected to rise by 2.81 to 6.32°C by 2080).[2] This could substantially impact fish and reduce the amount and quality of preferred salmon habitat in the watershed.





Chinook life cycle temperature requirements compared with current and forecast South Fork Nooksack River monthly average water temperature under the medium impact climate scenario.

Growing evidence shows that climate change will exacerbate rising stream temperatures. This is especially troubling for the spawning and incubation of the South Fork Spring Chinook, a Puget Sound stock that is currently in critical condition. To plan for the challenge of climate change to habitat restoration and salmon recovery in the South Fork Nooksack, the Nooksack Tribe has partnered with the Washington State Department of Ecology and the U.S. EPA in a TMDL pilot project designed to consider climate change impacts into the South Fork Nooksack Stream Temperature TMDL and in Pacific Salmon Endangered Species Act recovery actions.[3]

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Climate trends over the last 100 years suggest an approximate increase in average air temperature of approximately one to 1.5˚C. Recent studies suggest that this could translate into increases in stream temperature of as much as 0.6˚C.[4] Warmer stream temperatures related to increased air temperatures have further impacted water temperature increases due to land management, primarily removal of riparian shading. Further, there are indications that the hydrograph of the Nooksack River watershed has changed as well, with increased peak flows during the late fall through early spring and reduced flows during the winter.[5] Continued climate change into the future will further increase winter peak flows, and decrease summer flows with associated increases in stream temperature. These climate change impacts further challenge restoration effectiveness and salmon recovery success.

According to the Climate Impacts Group at the University of Washington, average annual air temperatures could increase 5.5˚F by 2070 under a high greenhouse gas scenario.[6] This potential increase in air temperature could, in general, translate to an increase in water temperature as high as 4.5˚F by the 2080s.

The Tribe has developed and implemented a comprehensive climate change project that investigates the impacts of climate change on glacier behavior and ablation, changes in the Nooksack River hydrograph, stream temperatures, and sediment loading and transport. The Tribe collects data on the glaciers of Mount Baker, stream temperature, streamflow and sediment transport at many stations throughout the upper watershed to provide a baseline against which climate change impacts can be measured. The results of this work will be applied to salmon recovery and restoration planning. Furthermore, the data developed by the Tribe will be used to plan for climate change impacts on water supply, flood management and instream flow negotiations.[7]

Recent hydrologic modeling for climate change has been accomplished by Western Washington University under contract with the Tribe.[8] By applying the Distributed Hydrology Soils Vegetation Model (DHSVM) for various climate change projections, they suggest that the North Fork Nooksack River could experience a 77% decrease in streamflow in July (by 2075, 8.5 RCP) and a 253% increase in January. Similarly, the Middle Fork could experience a 65% decrease and a 127% increase, respectively. And the South Fork Nooksack River could experience a 76% decrease and a 112% increase, respectively. The mainstem Nooksack River at North Cedarville could experience a 119% increase and a 72% decrease in flows, respectively. These changes would likely be the result of the transition from snow-dominated watersheds to mostly rainfall and rain- and snow-dominated watersheds, with atmospheric warming and subsequent changes in the area and depth of snow accumulation, snow melt rates and timing.

The Tribe was fundamental to focus the South Fork Nooksack River temperature Total Maximum Daily Load (TMDL) project on realistic natural conditions, climate change and upland watershed processes. The South Fork TMDL is the first such project to explicitly address climate change and take a more realistic view of natural conditions assumed in the TMDL. As a result, the Tribe substantially contributed to EPA Office of Research and Development (EPA-ORD) climate change pilot research project focused on the South Fork Nooksack River.[9] The objective of the pilot research project was to include climate change in ESA recovery actions and CWA compliance.

Tetra Tech, Inc., under contract with EPA-ORD, modeled stream temperatures in the South Fork Nooksack River.[10] They suggest that August stream temperatures could increase from historical levels of 16˚C to 20.5˚C by 2080. Existing temperatures in the South Fork currently impact holding and spawning, incubation and early fry, rearing, and smoltification. Stream temperatures by 2080 could approach lethal levels for salmonids.

Increasing air temperature, increasing winter flows, decreasing summer flows, and increasing sediment loading and transport with continued climate change will add to existing legacy impacts further threatening salmon survival and recovery. in the Nooksack River watershed.

Kari Neumeyer, NWIFC

Runoff from the Sholes Glacier is the headwaters of Wells Creek, a tributary to the Nooksack River. Nooksack Tribe natural resources staff are monitoring the Sholes Glacier on Mount Baker to learn what effects climate change could have on the Nooksack River. Record high temperatures and drought in 2015 resulted in drastic differences from previous years in exposed ice, retained snowpack, runoff and sediment loads from the glaciers. These conditions could impede the Nooksack Indian Tribe's future ability to harvest sustainable populations of salmon for ceremonial, cultural, subsistence and commercial uses.

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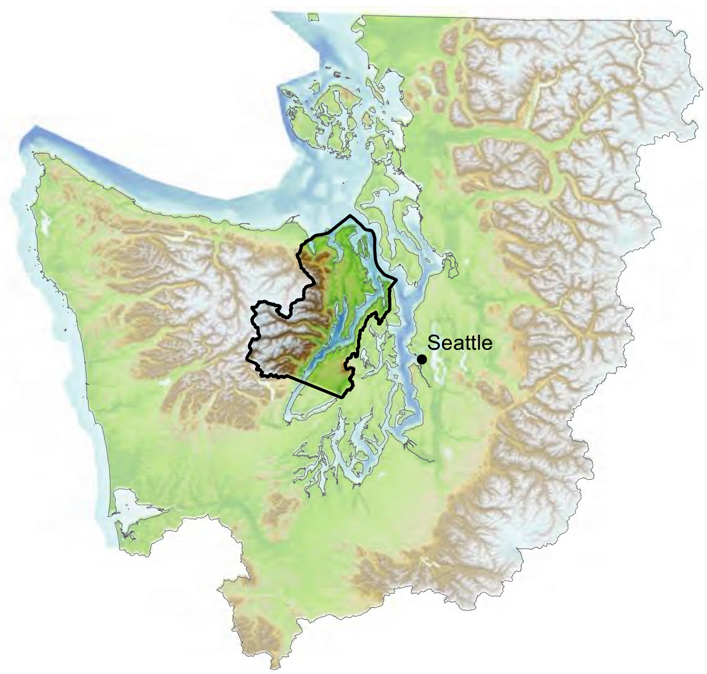
2016 State of Our Watersheds Report
Olympic & Kitsap Peninsulas

We are in the middle of challenging times. Our natural resources are facing many threats – a multitude of ESA listings and decreasing populations for subsistence and commercial salmon species, and increasing shoreline development and human population growth. In addition, we're dealing with new threats, such as climate change and ocean acidification. We are struggling to manage, conserve, enhance and protect our declining and threatened salmon populations. Restoration and recovery efforts are more important than ever before as we realize the realities we face of new threats and a critical need for immediate action.

– Paul McCollum
Natural Resources Director



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 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.

Degradation of WRIA 17 and Northern Hood Canal

The Port Gamble S'Klallam Tribe's Focus Area for this report encompasses the northeast corner of the Olympic Peninsula in the rain shadow of the Olympic Mountains, and 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 Hood Canal and eastern Strait of Juan de Fuca are home to salmonids and shellfish, which are culturally and economically important resources to the Port Gamble S'Klallam Tribe. 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 (the Boldt decision), in the 1994 ruling by Judge Rafeedie affirming tribal shellfish harvest, and several other court cases. Although considerable portions of the Tribe's Focus Area are contained within Olympic National Park or U.S. Forest Service wilderness, much of the upland, shoreline and floodplain areas are heavily impacted by land use, development, roads and historic logging.

Technical analyses have identified the significant habitat limiting factors for decline of the region's salmonid populations as:

- Estuarine habitat loss and degradation;
- Loss of channel complexity from loss and recruitment of large woody debris;
- Scouring from high water flows in the winter months and low flows in the summer months;
- Floodplain modifications and loss of wetlands; and
- Sediment aggradation.[1]

Landowners Critical to Recovery Efforts

The recovery strategy pursued for the Focus Area has been the protection and restoration of shoreline and estuary habitat. Landowner involvement and incentives for good stewardship were seen as critical components of this effort as most of the land adjacent to these critical areas is privately owned.

The existing regulatory protection tools have been viewed as adequate for recovery "if watershed development occurs as expected and current regulations are maintained or improved and adequately implemented."[2] Development pressure is testing this assumption.

Washington Coastal Atlas, 2006

An example of modified shoreline in northern Hood Canal.

Recovery Efforts Lagging

At the 10-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the WRIA 17 and northern Hood Canal area shows degrading water quantity and quality, increasing impervious surface areas and degrading marine shoreline habitat conditions remain priority issues, while some improvements are occurring with restoration efforts. 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 since the 2012 State of Our Watersheds report shows a steady loss in habitat but improvement in restoration efforts:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Water Quality	Fish kill event was observed in 2015, as fatally low dissolved oxygen levels affected Hood Canal.	Declining
Shoreline Modifications/Forage Fish Impacts	2004-2014 saw an increase of new armoring in all four counties in this region. About 45% of shoreline has been modified or armored. Survey data from 1970 to 2012 shows about 41% of inventoried sand lance and surf smelt spawning habitat has been modified and of that 11% has been armored. From 1970 to 2012, Port Gamble Bay herring stocks decreased from a status of healthy to depressed, showing potential relationships between fish decline and shoreline armoring and climate change. By 2014, about 50% of the herring spawning areas inventoried were either modified or armored.	Declining
Water Wells	Water well logs increased nearly 185% in the Focus Area between 1980 and 2014. From 2011-2014, an increase of 164 wells, over 50 (30%) were installed in watersheds that are closed to new withdrawals.	Declining
Impervious Surface	From 2006-2011, impervious surface increased by 1%. 36 of 328 sub-watersheds had impacted (7-12% impervious surface) habitat conditions in 2011. Over 140 subwatersheds had increases in impervious surfaces.	Declining
Restoration	Long-awaited cleanup and restoration of Port Gamble Bay commenced in the fall of 2015. The project will remove 70,000 cubic yards of contaminated sediment and wood waste and over 6,000 creosote pilings.	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

Tiffany Royal, NWIFC

Habitat biologist Hans Daubenberger prepares the hydroacoustic equipment for launch in Port Gamble Bay.

The Port Gamble Tribe's priorities center around the protection of Hood Canal and Port Gamble Bay and the resources they provide for current and future generations. Many of their future efforts are intended to enhance and protect existing resources, such as beach seeding and enhancement through a shellfish nursery floating upweller system in Port Gamble Bay and protecting the Hood Canal from impacts of stormwater pollution.

Greater focus and effort is required in conservation measures and restoration activities to offset negative habitat trends. Enhancement and restoration efforts in the Focus Area are not on pace to achieve the identified 10-year goals due to the lack of funding, staff capacity and landowner expectations.[3] 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.[4] Obviously, 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 as a result of implementation of new land-use regulations.

Climate change is emerging as a key priority for the Port Gamble S'Klallam Tribe. More science is needed to better determine the potential impacts of climate change including sea level change, ocean acidification and changes in temperature. 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 three generations and address the management challenges it presents to ensure that fishable and harvestable resources are sustained.

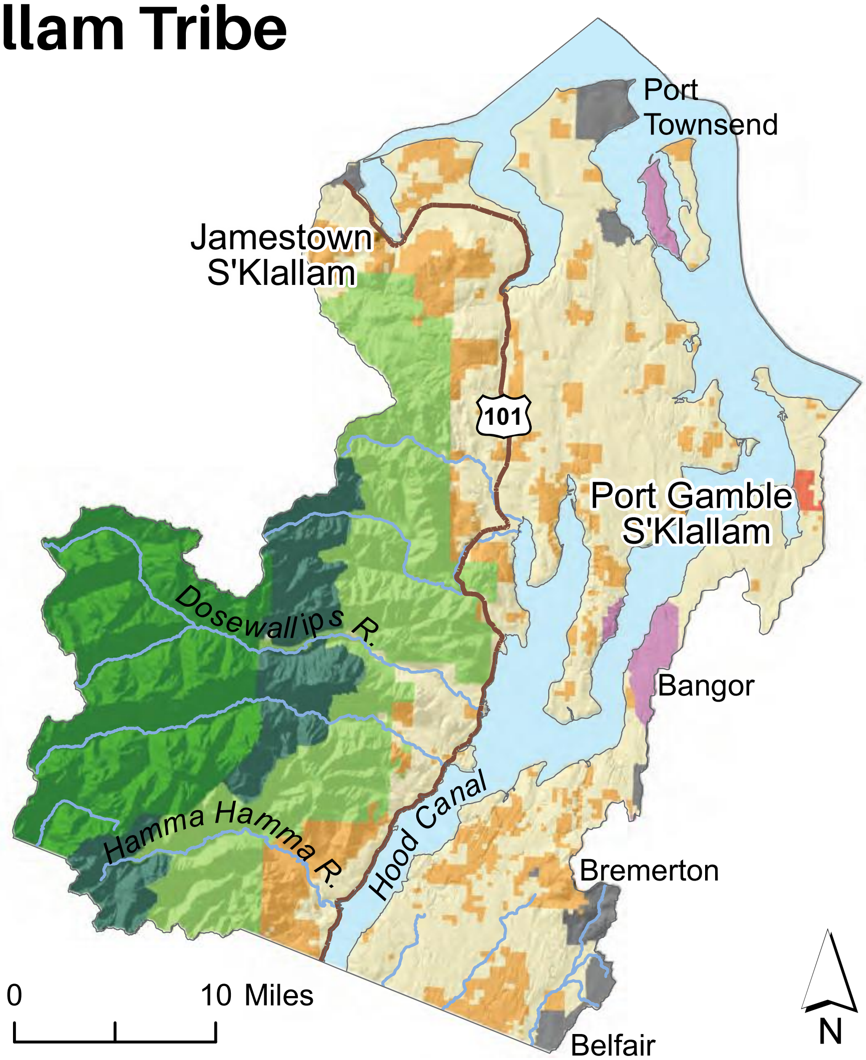
The Port Gamble S'Klallam Tribe is trying to secure healthy and sustainable salmon populations, as well as access to them, for future generations with very limited resources. Another concern is with the population and availability of cockles, which are an important subsistence fishery for the Tribe.

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. The Tribe is looking at associated limiting and/or constraining factors with juvenile salmon and forage fish relating to their nearshore habitat use, dependence and impacts from the large areas of altered shorelines.

The Port Gamble S'Klallam Tribe is involved in many projects to further understand and protect the resources within their Focus 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 they 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 any associated effects on human health.

Port Gamble S'Klallam Tribe



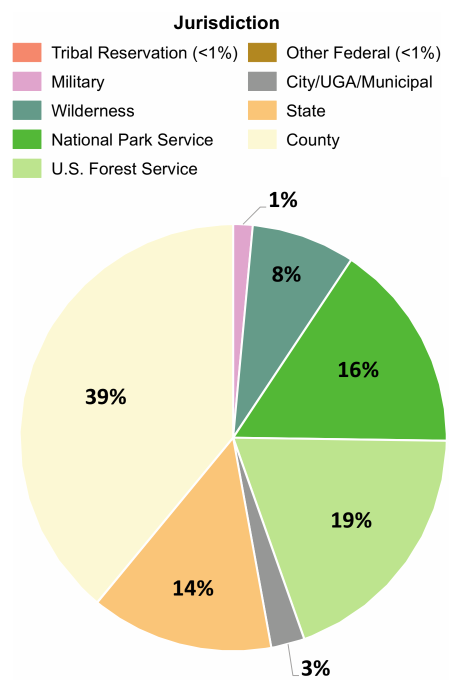
The Focus Area for the Port Gamble S'Klallam Tribe encompasses the northeast corner of the Olympic Peninsula in the rain shadow of the Olympic Mountains, south to the Hamma Hamma watershed. The area includes many smaller watersheds that drain the low elevation terrain of the Kitsap Peninsula and the steep eastern slopes of the Olympic Mountains into Hood Canal, Admiralty Inlet and the Strait of Juan de Fuca. The Focus Area is made up of portions of four counties: Kitsap, Jefferson, Clallam and Mason.

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 Hood Canal/Eastern Strait summer chum and Puget Sound Chinook, both listed as threatened under the Endangered Species Act.

Many streams in the Focus Area 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 riparian vegetation removal and water extractions. While these streams may not flow year-round, they provide important spawning habitat for fish populations, including coho and fall chum.

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 U.S. 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. Sizable portions of Water Resource Inventory Areas (WRIAs) 16 and 17 are contained within 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 early to mid-seral forest, though semi-rural residential and urban development encompasses an increasing portion of the landscape.

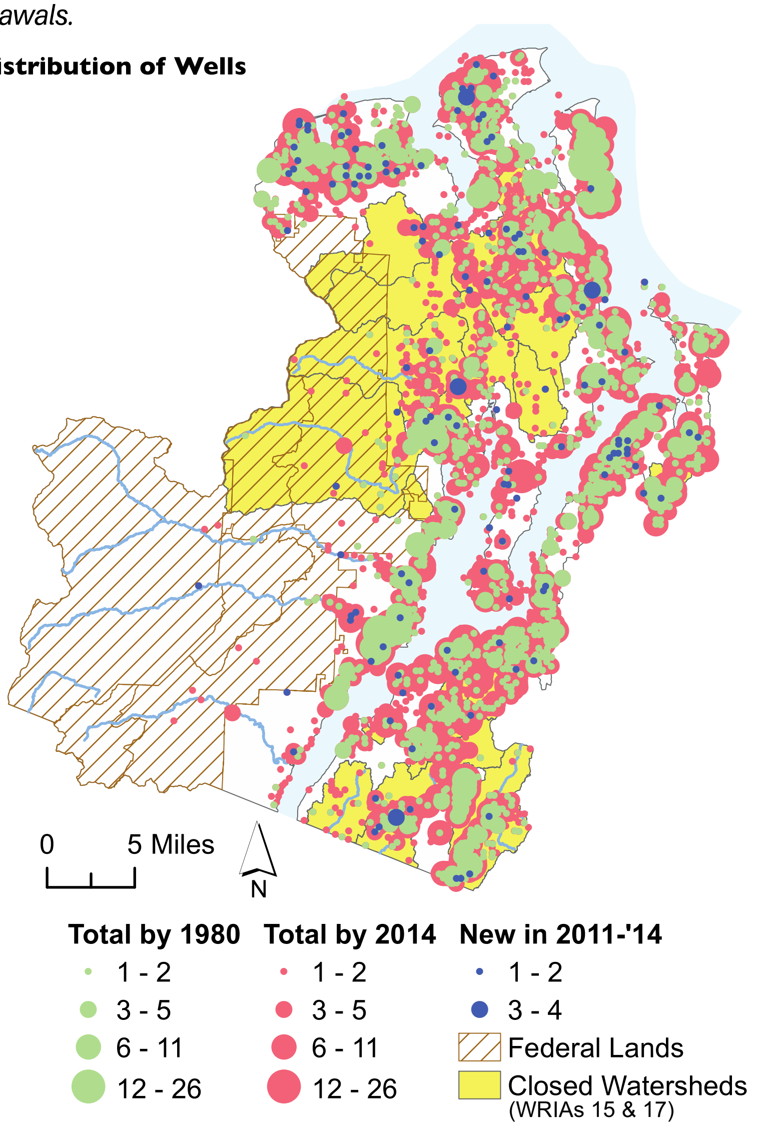


Data Sources: SSHIAP 2004,[1] USFWS 2014,[2] WADNR 2014a,[3] WADNR 2014b,[4] WADNR 2014c,[5] WADOT 2013,[6] WAECY 1994,[7] WAECY 2011a,[8] WAECY 2013[9]

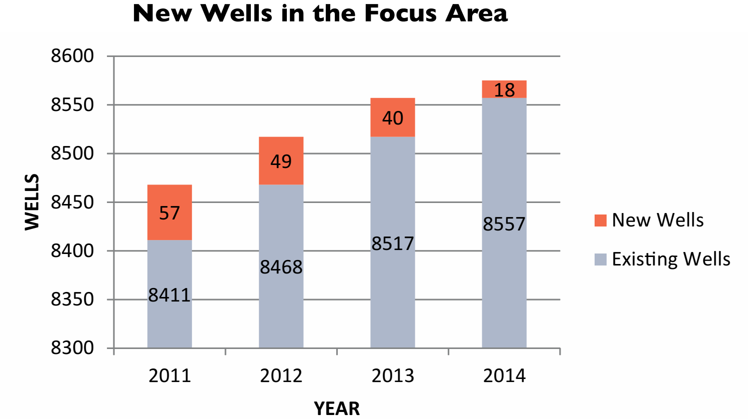
Water Extractions Impact Surface Flow and Fish Usage

The number of well logs has increased by 185% in the Focus Area from 1980 to 2014; 164 new wells were added in 2011-2014 alone. Of those 164 wells, over 50 were installed in watersheds that are closed to new water withdrawals.

Distribution of Wells



New Wells in the Focus Area



New wells were added each year from 2011 to 2014, and more may be added as the economy improves and population increases.

The watersheds within the Focus Area receive 15-100 inches of precipitation per year, primarily in the winter months.[1,2,3] Little precipitation falls during the dry summer months when water needs are greatest, causing streams to draw on groundwater sources. "Groundwater and surface water are one resource": changes to one will impact the other.[4]

Salmonid species, including summer chum and steelhead, require adequate streamflows to access suitable spawning habitats and to maintain appropriate water temperatures and stream substrate.[5] The summer low flow period is expected to get longer and stream temperatures to increase due to climate change,[6] amplifying the effects of groundwater extractions on freshwater salmon habitats. The Focus Area experienced periods of extreme drought during the summer of 2015,[7] resulting in record low streamflows.[8]

Well logs within the Focus Area increased 185% from 1980 to 2014, with 164 new wells in 2011-2014 alone. Seventeen of the streams within WRIAs 15 and 17 are closed to new surface and groundwater uses at least part of the year.[9,10] However, over 50 of the 164 new wells since 2011 were installed in watersheds closed to new water withdrawals. The number of new wells will likely increase with the upturn of the economy and the resulting development.

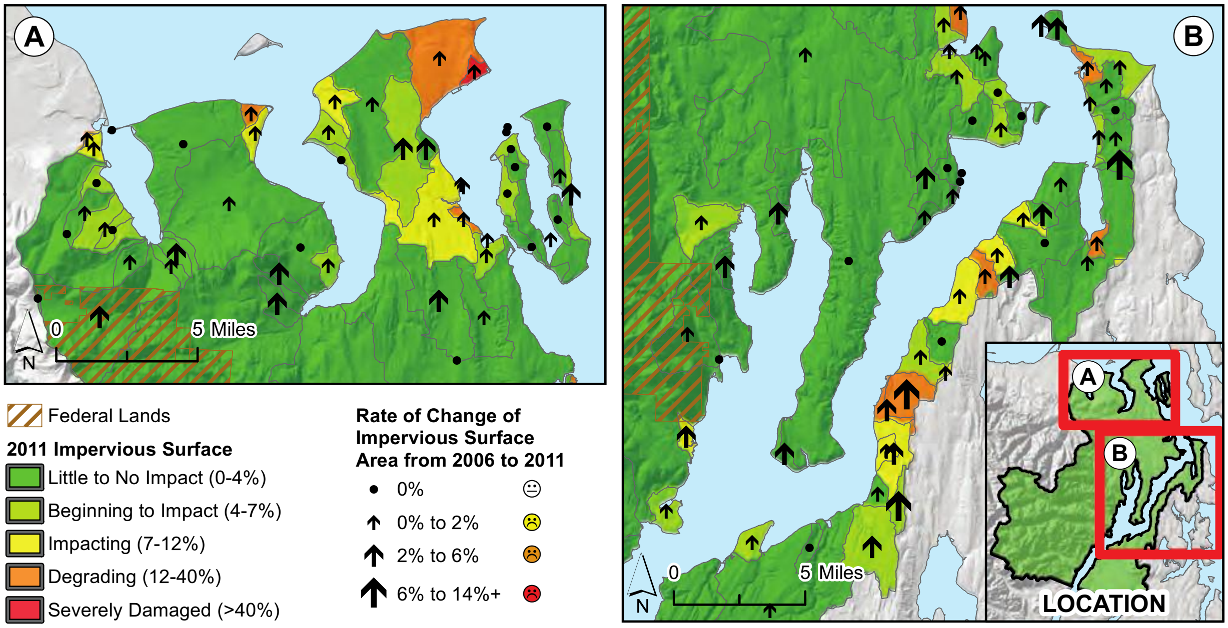
The Department of Ecology's instream flow rules are designed to protect instream resources by mandating minimum water levels for streams.[11] However, many of the instream flow rules are inadequate for protecting salmonid species and ensuring their ability to produce in the wild, a primary goal in the evaluation of instream flow rules.[12] Tribes have attempted to update instream flow rules for important salmon-bearing streams through the Department of Ecology with little success, occasionally resorting to legal action.[13]

Conservation of freshwater resources for instream and human uses is one of the five primary objectives in Puget Sound Partnership's Action Agenda.[14] Water withdrawals and diversions are listed as one of the high pressures on the local ecosystem within the Hood Canal Action Area.[15]

Data Sources: SSHIAP 2008,[16] WADNR 2014c,[17] WAECY 1994,[18] WAECY 2011a,[19] WAECY 2015[20]

Population Density and Impervious Surface Impact Water Quality

The total impervious surface area increased by 1% from 2006 to 2011. Thirty-six of the 328 sub-watersheds had impacted habitat conditions from impervious surfaces in 2011 and over 140 had increases of impervious surface area from 2006 to 2011. The areas with the highest population densities had the most impervious surfaces.

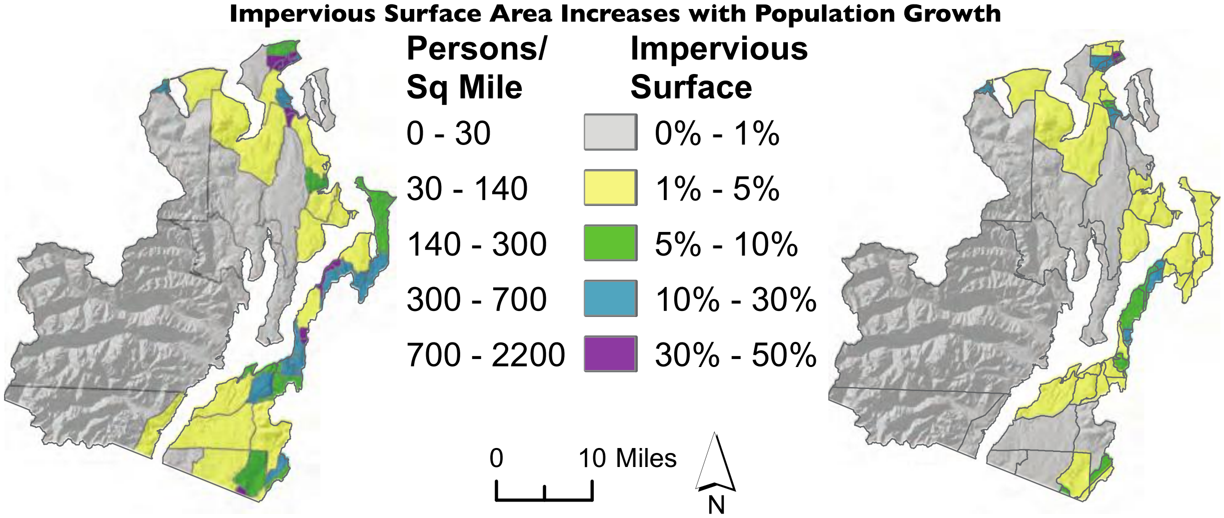


Any level of human disturbance has an impact on watershed processes. Impervious surface area is well documented as a coarse measure of human impact on watershed-scale hydrology and biology.[1,2,3] The Hood Canal and Strait of Juan de Fuca Summer Chum Recovery Plan describes thresholds of 10% impervious 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.[5] Many species within the watersheds show signs of stress and population decline well before the 10% impervious surface area threshold is reached.[6]

Impervious surface area causes increases in stream temperatures, decreases in stream biodiversity, and contributes to pollutants in point and nonpoint sources of stormwater runoff, which can contaminate local aquatic systems[7] and lead to shellfish area closures. Aquatic and marine organisms respond immediately to these changing habitat elements, resulting in fatalities,[8] impaired physiological functions, or migration to more hospitable areas.[9]

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 2015 and 2040; over half of those people are projected to be in Kitsap County.[10]

Impervious Surface Area Increases with Population Growth



Data Sources: NLCD 2006,[11] NLCD 2011,[12] SSHIAP 2004,[13] WADNR 2014c,[14] WAECY 1994,[15] WAECY 2011b,[16] WAOFM 2014[17]

High Juvenile Fish Densities Found Within Port Gamble Bay

Port Gamble Bay had the highest estimated fish densities in Hood Canal during the survey seasons of 2011 and 2012, likely linked to its ideal environment for eelgrass and high densities of larval forage fish.

The Port Gamble S'Klallam Tribe conducted hydroacoustic surveys, surface trawls and beach seining during the summers of 2011-2014 in nearshore habitats of Hood Canal and Eastern Strait of Juan de Fuca.

"Single targets" (individual non-schooling fish) were extracted from the hydroacoustic data for analysis. Pairing the hydroacoustic surveys with surface trawls and beach seining allowed for species composition of the single targets to be determined based on size class distribution.

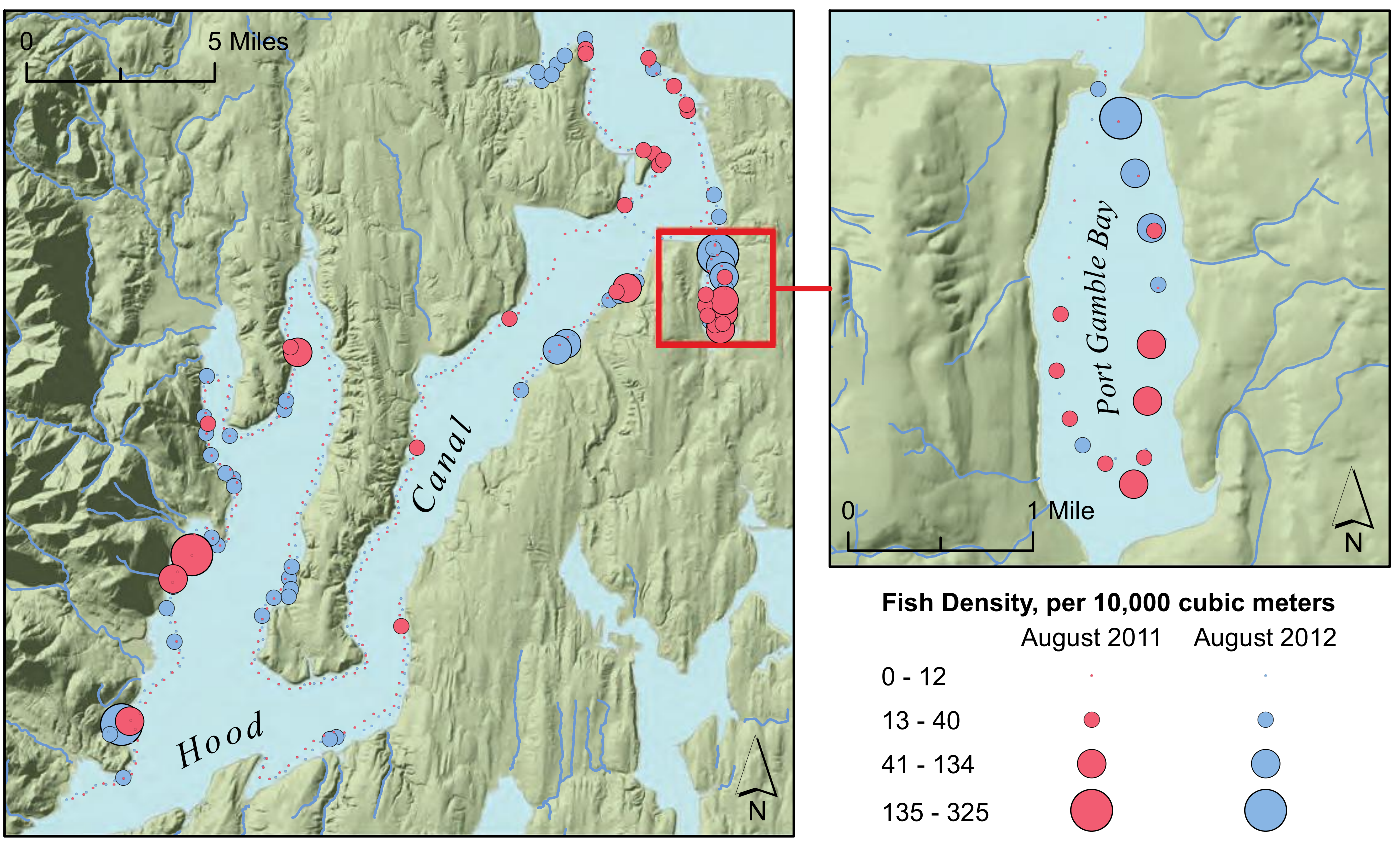
Port Gamble Bay had the highest estimated fish density rankings in 2011 and 2012.[1] Port Gamble Bay is a spawning area for forage fish including herring, surf smelt and sand lance. The larval forage fish are prey for juvenile Chinook and may explain the high densities of single target detections. The unique geomorphology of Port Gamble Bay within Hood Canal may also be a factor of the high densities: the relatively shallow bay creates a productive aquatic environment ideal for eelgrass and attached macroalgae.

The Dosewallips and the Duckabush River deltas did not have high densities of single target detections. These results were surprising considering the rivers' large populations of salmonid species, including Chinook, fall chum and summer chum. This may be attributed to the rivers' large, shallow alluvial fans that are dewatered during low tide events.

Results of this study will inform the Hood Canal Coordinating Council's Salmon Habitat Recovery Strategy to help prioritize and rank restoration and conservation actions within the marine nearshore environment.[2]

H. Daubenberger (2)

Left: Juvenile Chinook caught in a surface trawl. Above: PGST research crew members Janet Aubin and Julianna Sullivan record measurements of fish caught during a surface trawl.

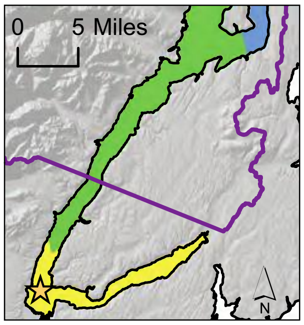


Data Sources: PGST 2013,[3] SSHIAP 2004,[4] WAECY 1994[5]

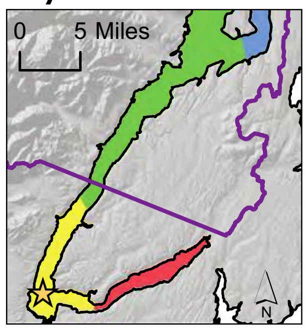
Low Dissolved Oxygen Causes Fish Kills in Hood Canal

Four fish kill events were observed between 2006 and 2015 as fatally low dissolved oxygen levels affected large portions of the water column in Hood Canal. Dissolved oxygen levels continue to be a key planning issue for the Mid-Hood Canal Chinook Recovery Plan.[1]

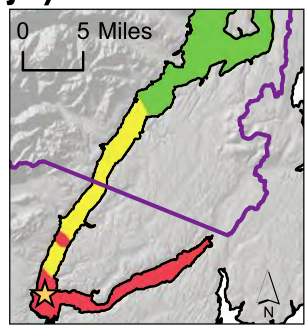
March 2006



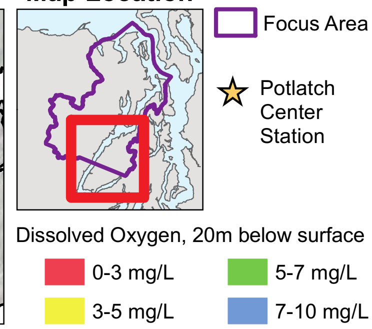
May 2006



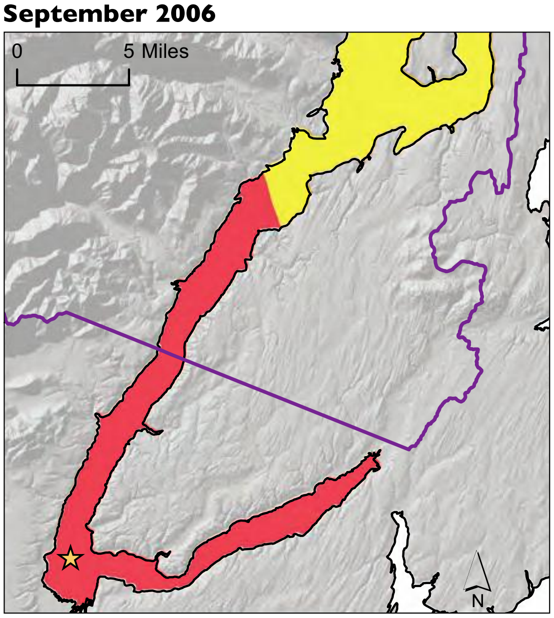
July 2006



Map Location



September 2006



This map series models the levels of DO at 20 meters below the water surface throughout Hood Canal that led up to the fish kill event of September 2006.

Hypoxia as a result of chronic low dissolved oxygen (DO) has a detrimental impact on marine species, changing their usual activity patterns and species distribution. Predation may increase as the fish leave the hypoxic waters for areas with more oxygen where they may be vulnerable to new predators, including birds and mammals that are not affected by hypoxia.[2]

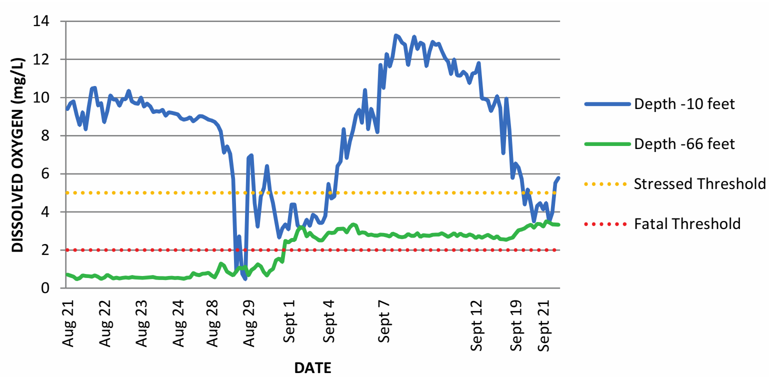
Many fish species experience stress at DO concentrations below 3-5 milligrams per liter (mg/L) and may be severely stressed and die at concentrations of 1-2 mg/L.[3] There were 17 days in 2011 that had DO levels of 5 mg/L or less at 20 meters below the surface in Hood Canal, nine of which had DO levels of 3 mg/L or less.[4] As a consequence of low DO, salmonids in Hood Canal may not be able to find food and quality habitat, resulting in reduced growth and increased mortalities.[5]

It is estimated that humans are responsible for less than 1% of the nitrogen input into Hood Canal. The natural fluctuations of DO have been linked to climate, but they may increase in severity as development increases. A review of Hood Canal best available science recommends a series of actions to improve the estimates of human influence on DO levels within Hood Canal, including modeling and continued monitoring.[6]

August 2015 Hood Canal Fish Kill

A fish kill occurred in lower Hood Canal in late August 2015 when southerly winds brought hypoxic water to the surface. The low oxygen levels associated with this fish kill are the worst conditions that have been measured. However, the fish kill events from 2003, 2006 and 2010 were worse than the 2015 event.[7] Hood Canal is a system that is very susceptible to periodic fish kills; additional oxygen depressions from human nitrogen loading increase that risk.[8]

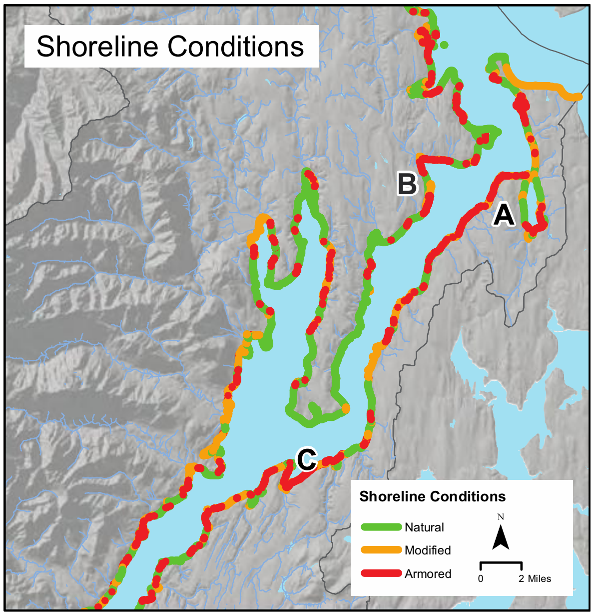
Hoodsport Buoy Dissolved Oxygen Levels
August 21, 2015 – September 21, 2015



Data Sources: HCDOP 2006,[9] NANOOS 2015,[10] SSHIAP 2004,[11] WAECY 1994[12]

Nearshore Habitat Loss in Hood Canal and Strait of Juan de Fuca

About 45% of the marine shoreline in the Port Gamble S'Klallam Tribe's Focus Area has been modified or armored. A closer look at Port Gamble Bay's shoreline shows about 74% being altered through anthropogenic means. From 2004 to 2014, there was a net increase of 19,663 feet in armoring in all four counties in this region.[1]



A. Natural Shoreline

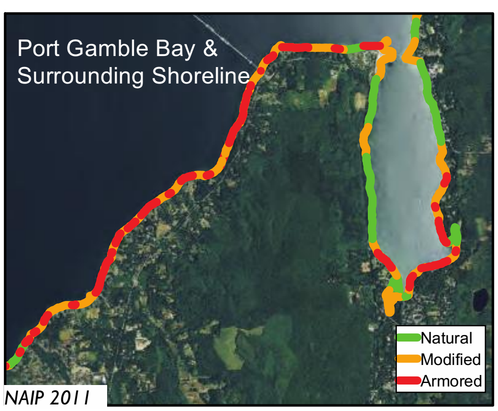
No portion of Hood Canal has been altered more than southern Hood Canal. In contrast, Point Julia, home to the Port Gamble S'Klallam Tribe, has the most frequently used and most heavily accessed spit complex on Hood Canal and maintains natural functions and values.[2]

B. Modified Shoreline

C. Armored Shoreline

Washington Coastal Atlas, 2006 (3)

The Action Agenda has identified habitat alteration as a priority threat in the Puget Sound region.[3] Shoreline alterations such as jetties and rockwalls interrupt the flow of sand on beaches. Docks and bulkheads cover beaches so that plant life and fish species are not productive in these areas.[4] Data collected on shoreline conditions in the Port Gamble Tribe's Focus Area shows that 55% is natural, 32% is modified and 13% is armored (Figure 1). However, when focusing on the area around Port Gamble Bay, a known productive area for salmonids and forage fish, it is noted that 74% of the area is either modified or armored (Figure 2). 2008 PSNERP data was used to calculate this area, but funding has been cut to continue this type of essential monitoring. The Port Gamble Bay area and surrounding shoreline has a significant amount of forested area upland of the bay that is not developed. Sediment source beaches make up 50% of this area, of which 70% is either modified or armored.[5] Shorelines in the reservation section of the drift cell are little changed and have significant wooded bluffs contributing sediment supply to the spit at Point Julia as well as providing large wood structure in the nearshore and overhanging shade for out-migrating salmon.[6] This regional Focus Area is made up of four different county jurisdictions: Clallam, Jefferson, Mason and Kitsap. Data available from the Hydraulic Project Approval (HPA) database shows that shoreline armoring is increasing for each of these counties.[7] From 2005 to 2014, there has been a net increase of 3.7 miles (19,663 feet) in shoreline armoring in Clallam, Jefferson, Kitsap and Mason counties (Figure 3).[8]



NAIP 2011

Figure 1

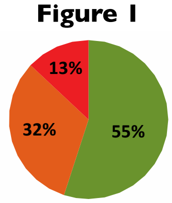


Figure 2

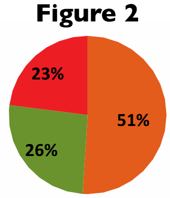
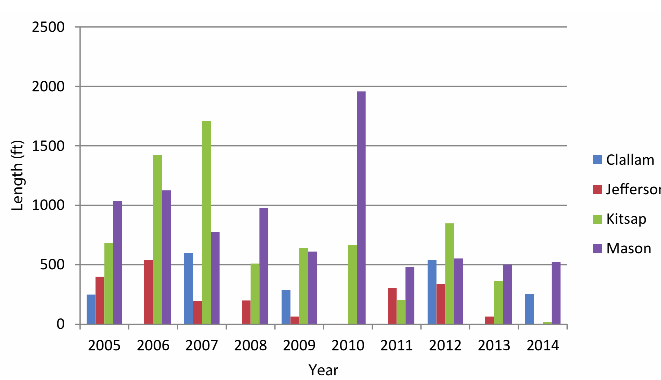


Figure 3: New Shoreline Permits by County



There is an unknown amount of unpermitted armoring that is not included in graph above.

Data Sources: Carmen et al. 2015,[9] NAIP 2011,[10] PSNERP 2008,[11] SSHIAP 2004,[12] SSHIAP 2012,[13] USGS 2014[14]

Sand Lance and Surf Smelt Spawning Habitat Conditions

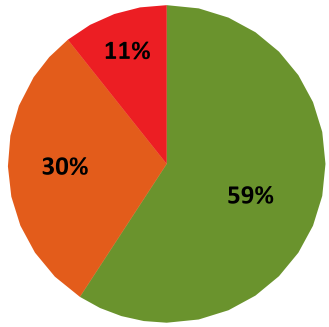
Survey data from 1970 to 2012 shows that approximately 41% of inventoried sand lance and surf smelt spawning habitat in the Port Gamble Tribe Focus Area has been modified, and of that 11% has been armored. Armoring and modification interrupts the movement of gravel and sand to these beaches and could negatively affect spawning habitat as a consequence. Climate change could exacerbate these conditions.

Surf smelt and Pacific sand lance are key part of the Puget Sound food web.[1] These forage fishes are small schooling fishes that are key prey items for larger predatory fish and wildlife, such as salmonids.[2] Sand lance is recognized as being one of the key elements of a juvenile Chinook's nearshore diet.[3] A very large portion of the shoreline in this Focus Area has been altered in various ways by human activities, to the possible detriment of the species. Sand lance and surf smelt spawn on upper intertidal beaches consisting of sand and gravel. Shoreline modification and development can negatively affect spawning sites.[4] Additionally, sea level is expected to rise substantially in this century, which will likely profoundly affect the structure and function of the Puget Sound ecosystem.[5] Maintaining abundant surf smelt and sand lance in Puget Sound is a conservation imperative, but current regulations do not consider cumulative or off-site impacts of armoring, cannot prohibit armoring in most cases,[6] and do not address likely future conditions such as climate change.[7] Cumulative distribution functions of catch per unit effort indicate that historically dominant forage fishes (Pacific herring and surf smelt) have declined in Central and South Puget Sound.[8] The results of this study suggest that some Puget Sound sub-basins have reduced capacity to support forage fish that were highly abundant historically, and these patterns are consistent with other historic studies.[9,10] The studies referenced above suggest the possible linkage between anthropogenic activities and development, as well as changing climate conditions on the abundance of forage fish in Puget Sound.

PNPTC, 2014

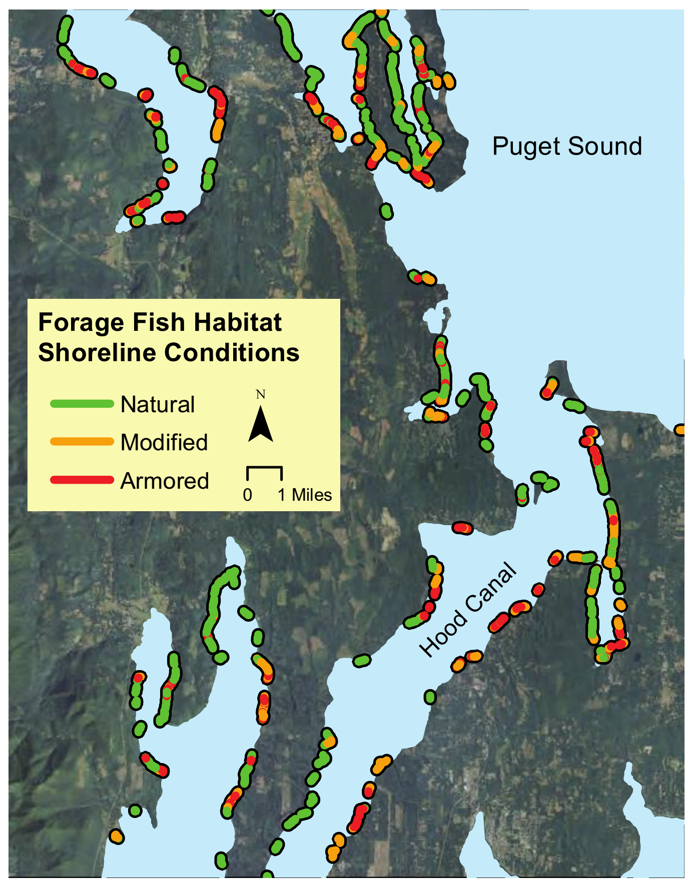
Armoring and modification impacts nearshore spawning habitats for forage fish in Hood Canal.

Pacific Sand Lance and Surf Smelt Habitat Shoreline Conditions



WADFW

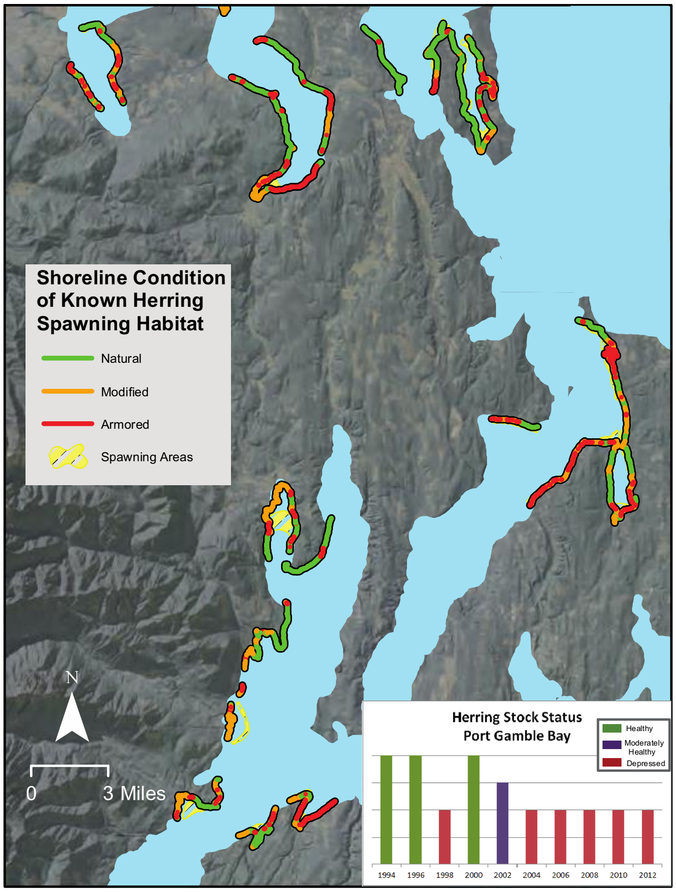
This pie chart reveals the proportion of armoring and modification in known forage fish spawning areas along shorelines, which can affect the natural sediment dynamics of spawning beaches and potentially impact the habitat for these fish. Of note, not all beaches were surveyed for forage fish.

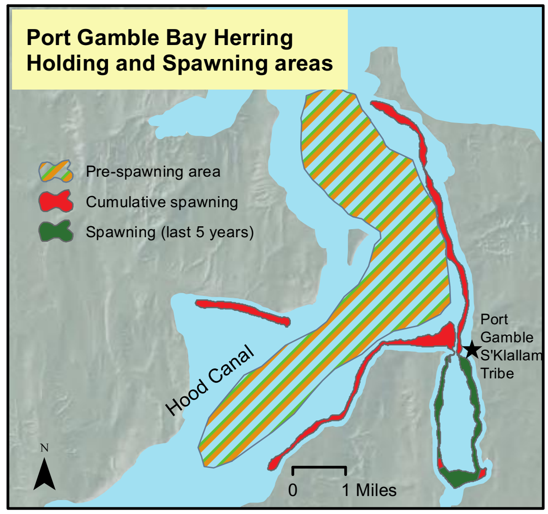


Data Sources: NAIP 2011,[11] PSNERP 2008,[12] SSHIAP 2008,[13] WADFW 2010[14]

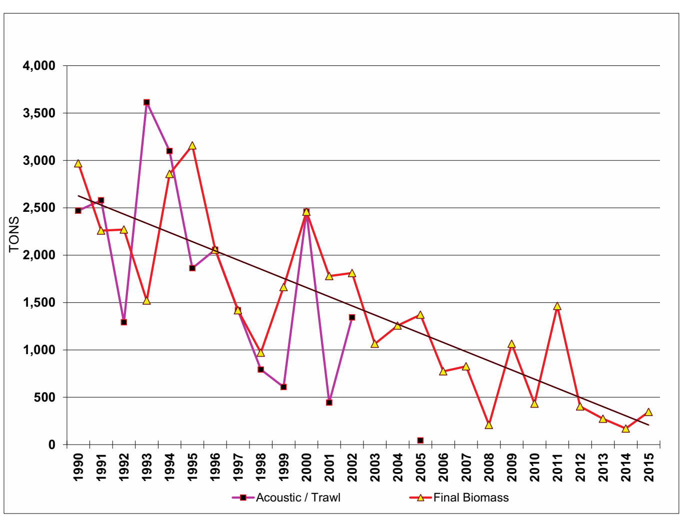
Pacific Herring Spawning Habitat Conditions: Regionally and in Port Gamble Bay

From 1970 to 2012, Port Gamble Bay herring stocks have decreased from a status of healthy to depressed, showing potential relationships between fish decline, shoreline armoring and climate change.[1] By 2014, approximately 50% of the herring spawning areas inventoried were either modified or armored. Historical evidence shows Port Gamble Bay having one of the largest Pacific herring stocks in Puget Sound. However, considerable spawning habitat has been lost due to shoreline alterations.[2]





Port Gamble Herring Stock, Spawning & Recruitment 1990 to 2015



The Port Gamble herring stock has been considered one of the larger stocks in Puget Sound since quantitative survey effort began in the late 1970s.[3] Pacific herring, a vital forage fish of the marine ecosystem, are an indicator of the overall health of the marine environment. Herring were included in the 1974 Boldt decision, which defined Native American fishing rights. Herring are generally known for preferring nearshore areas containing vegetation and bay inlets. Inventoried known spawning areas along the shoreline show that 49% of the shoreline remains natural, 35% is modified, and 16% is armored. Research indicates that priority habitat for herring lies in sheltered bays.[4]

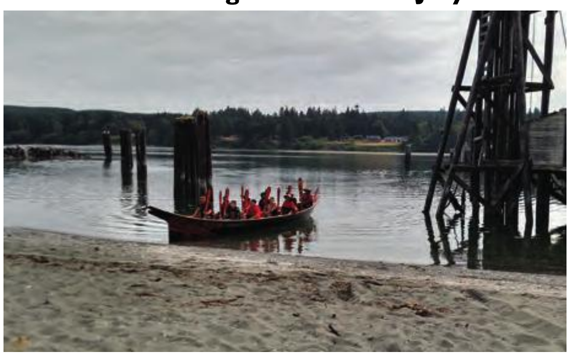
Approximately 10% of shorelines in the Puget Sound are selected by herring in sheltered bays, such as Port Gamble and Quilcene Bays.[5] The Spawning and Recruitment graph shows stock decline levels from 1990 to 2015 in Port Gamble Bay. The WDFW Port Gamble stock status has declined from healthy to depressed.[6] The concern is that development and other anthropogenic impacts within these bays will continue to remove healthy habitat for herring, especially with the unknown consequences of climate change.[7] Also, because of high contaminant levels from the old mill site on Port Gamble Bay, a recent study shows that Pacific herring embryos survived significantly better outside the Port Gamble Bay than inside.[8] The Port Gamble Tribe is hopeful that the Port Gamble Cleanup and Restoration, including removal of creosote piles, will help restore the herring population.[9]

Data Sources: NAIP 2011,[10] PSNERP 2008,[11] SSHIAP 2004,[12] SSHIAP 2008,[13] Stick et al. 2014,[14] WADFW 2010[15]

Port Gamble Bay: Long-Awaited Cleanup and Restoration

Port Gamble Bay

S'Klallam Blessing at Mill Site - July 2015



PNPTC

The Port Gamble S'Klallam performed a blessing ceremony of Port Gamble Bay and the old Port Gamble mill site in July 2015, as work started to remove thousands of creosote pilings and overwater structures from the former industrial site. Approximately 70,000 cubic yards of contaminated sediment and wood waste will be removed.

Pope Resources entered into a consent decree with the Washington Department of Ecology to clean up Port Gamble Bay from contamination from the former saw mill site. The cleanup area will include removing 70,000 cubic yards of contaminated sediment and wood waste and over 6,000 creosote pilings. Port Gamble Bay is an ancestral home and very important fishing area for the Port Gamble S'Klallam Tribe. Area tribes have been supporting this long-awaited action. Port Gamble Bay is home to ESA-listed Puget Sound Chinook, Puget Sound steelhead, Hood Canal summer chum and bull trout,[1] and other species such as coho, fall chum, herring and other forage fish, oysters, crabs and clams.[2] Port Gamble Bay is an abundant shellfish, crab and finfish harvest area, containing approximately 28% of the approved commercial harvest area within Kitsap County.[3] But historic and current uses of the Bay and watershed – including the former saw mill, the town of Port Gamble, and other developments – have taken their toll.

Port Gamble Bay is part of the Tribe's ancestral history, with archeology from Point Julia indicating that people have been using and living along the bay's shore for well over 1,000 years. With the signing of the Point No Point Treaty of 1855,[4] the S'Klallam Tribes retained the right to fish, hunt and gather in their Usual and Accustomed areas.[5] These treaty-reserved rights were affirmed by Judge Boldt in the *U.S. v. Washington* ruling (the Boldt decision), in the 1994 ruling by Judge Rafeedie affirming tribal shellfish harvest, and several other court cases. The cleanup and restoration of the Bay is essential for tribes to exercise their treaty-reserved rights.

Just 470 feet across the bay from the Port Gamble Reservation, the Port Gamble saw mill operated from 1853 to 1995. During that time, pollutants from wood waste and creosote pilings were released into the bay. These pollutants include cadmium, petroleum hydrocarbons, carcinogenic polycyclic aromatic hydrocarbons (cPAHs) and dioxins/furans. The mill closed in 1995 and has since been used for log sorting/chipping, materials handling and as a marine research facility. The bay cleanup will take about two years, with the first year focusing on the southern portion of the former mill. The second year will focus on creosote piling removal and cleanup on the area north of the mill site. Substantial improvement to the bay will result once this cleanup is complete. As a broader effort, the Port Gamble S'Klallam Tribe has been working on a cleanup of debris and removal of derelict gear and vessels on the bay next to their reservation. In 2015, the Washington Department of Ecology and the Port Gamble S'Klallam Tribe removed and disposed of an old pier, pilings and a boat launch.[6] The Tribe is looking into more restoration opportunities to protect the bay from development.[7]

For the tribe, Port Gamble Bay is not just a bay; it is the home of the tribe's ancestral village. They eat shellfish and salmon collected in the bay. Gathering goods there is very important to tribal identity and livelihood. After many years of work between the Department of Ecology and Pope Resources, with the support of local tribes, the cleanup of the bay and mill site is scheduled, starting in the fall of 2015, to remove approximately 70,000 cubic yards of contaminated sediment and wood waste, a derelict vessel, and 6000 creosote pilings along with overwater structures.[8] It will be the biggest creosote piling removal in Washington state history.[9]

Former Mill Site at Port Gamble

Washington Department of Ecology

Data sources: NAIP 2013,[10] WADNR 2014b[11]

AR052882

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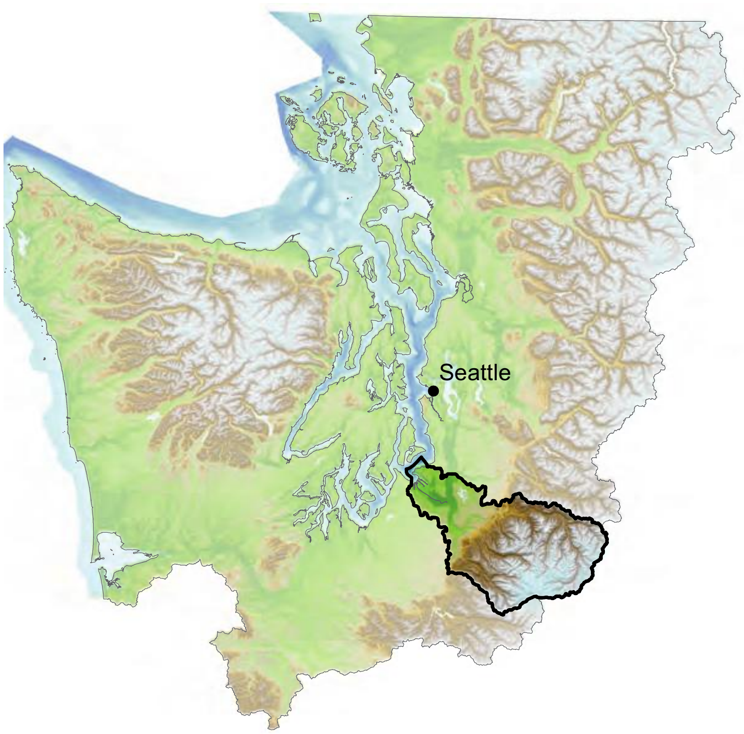
2016 State of Our Watersheds Report

Puyallup River Basin

It's the tribes that are putting the fish back in the waters. It's our people doing that to make sure our livelihood will carry on, that our children will have this opportunity to get into a boat and go fishing so they can eat what they need.

– **Nancy Shippentower-Games**
Puyallup Tribe of Indians



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. This development 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.

History of the 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 flows to Commencement Bay at the Port of Tacoma, the third largest port in the western United States. The Puyallup Basin has been substantially altered from its historic condition and is currently contained within a revetment and levee system throughout its lower 26 miles.

The Puyallup River is the only river in the state where early flood protection measures included formation of a concrete channel. Intense timber harvest and forest road density within unstable drainages has led to high sediment input, frequent slope failures and channel instability. Economic activity within the watershed is largely industry, marine shipping, military base operations, lumber mills, urban development, commercial forestry, energy production and agriculture.

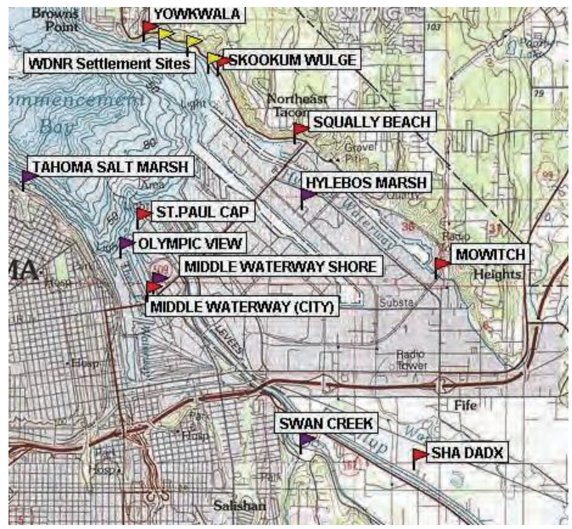
The identified leading factors for decline are loss of fish access to spawning and rearing habitat, lack of estuarine and nearshore habitat, impaired riparian functions and conditions, loss of floodplain processes and off-channel habitat, sediment transport, flow regime alteration and water quality.

Habitat recovery planning has involved many forums including CERCLA/RCRA/NRDA issues in the industrial tideflats/POT area since 1980, various planning efforts under WAC 40-12 (nonpoint rule), as well as more recent processes; one conducted within the Shared Strategy Process and the other by the fishery co-managers. As part of the Puget Sound Shared Strategy process, Pierce County developed a habitat recovery plan using EDT modeling with the participation of the Puyallup Tribe and Washington Department of Fish and Wildlife. White River and Puyallup River Chinook Recovery Plans had already been developed by the co-managers in earlier watershed recovery planning processes. Efforts are ongoing between the co-managers and Pierce County to integrate these respective plans within an all-H context.

Three key strategic habitat protection and restoration priorities were identified in the Shared Strategy process for the Puyallup watershed:

- Restoration of estuary habitat and floodplain connectivity in the lower Puyallup, lower White and lower Carbon rivers;
- Increased protection and restoration of tributaries that have relatively high productivity, including South Prairie Creek, Boise Creek, Greenwater River, Huckleberry Creek and the Clearwater River; and
- Changes in flow management for Mud Mountain Dam PSE bypass, removal and amelioration of migration barriers associated with the Electron Dam.[1]

Example of channelization of the Puyallup River.



Restoration Sites in Commencement Bay.

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

At the 10-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Puyallup basin planning area shows improvements for water quality and removal of forest road barriers, but degradation for water quantity, marine shoreline habitat conditions and impervious surface areas. Each remains a priority issue. 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 since the 2012 State of Our Watersheds Report shows improvement for some indicators and a steady loss for others in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Water Quality	In 2013, the Puyallup basin saw a slight improvement in its water quality and aquatic habitat conditions. Grade went from C to C+.	Improving
Water Quality - Flows	Since 1926, the Puyallup River stream flows have shown a continuous decline especially during critical flow periods despite the establishment of instream flows in 1980. The decline is due to groundwater withdrawals and land-use changes.	Declining
Shoreline Modifications/Forage Fish Impacts	From 2005-2014, 270 HPAs were issued, resulting in an additional 1.2 miles of armored shoreline, while 0.25 miles were removed, resulting in a net increase of about 1 mile of armored shoreline.	Declining
Water Wells	From 2010-2014, the Puyallup River basin saw an increase of 2.6% in water wells, keeping at the same pace as 2010 (20 new wells per year). Since 1926, the Puyallup River stream flows has shown a continuous decline especially during critical flow periods, despite the establishment of instream flows in 1980.	Declining
Impervious Surface	The Puyallup River basin continued to see an increase in impervious surface (1.2%) from 2006 to 2011. Clarks Creek basin saw an increase in impervious surface in all of its watershed analysis units, while South Prairie basin still remains mostly undeveloped.	Declining
Forest Roads	About 81% of the RMAPs have be repaired or abandoned.	Improving
Restoration	Since 2012, two levee setback projects have been completed in the Puyallup River basin, setting back 1.6 miles of levee, while 6 levee setback projects are in development, which could setback another 1.5 miles of levee.	Improving
	South Fork Road Floodplain Restoration Project (2,000-foot side channel, 1,100-foot backwater channel, engineered logjams). Since 2012, two levee setback projects have been completed, setting back 1.6 miles of levee. A 6.7-acre project site located in the City of Tacoma along the lower, tidal section of Hylebos Creek was completed. Restoration inlcuded removing structure, material, non-native vegetation, excavating the site to re-establish the tridal marsh and mudflats, and planting a vegetative buffer.	

Looking Ahead

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: restoration of instream flows, enforcement of TMDLs (or other mechanisms in its place to improve water quality), absence of TMDLs for water quality parameters that adversely affect fish, stormwater cleanup, absence of water resource management prescriptions in temperature TMDLs, and absence of continuous monitoring or monitoring for toxics/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, and 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 H's (habitat, harvest and hatcheries). The greatest challenge remains securing the funding necessary for the large, multi-year restoration projects required to conduct levee setbacks and estuarine habitat creation.

Tacoma Weekly

Puyallup Tribal members bring a canoe ashore during the Tribal Canoe Journey.

Future Tribal Actions and Restoration Efforts:

Puyallup Tribe's goals for the future include:

1. The Puyallup Tribe is set to begin out-migrant monitoring on the White River in 2016. An 8-foot screw trap will begin fishing in Sumner near river mile 3.0 in January. This action will address a long-standing data vacuum and will provide answers to questions concerning survival rates of smolts through Mud Mountain Dam, out-migration timing, spawner/recruit ratios, growth rates, etc.

2. The Puyallup Tribal Fisheries will begin operating a wild steelhead acclimation pond at 28 Mile Creek on the Greenwater River in 2016. Although the Tribe currently operates five similar facilities, this is the first to be dedicated to steelhead recovery. This new acclimation pond will allow the Tribe to move steelhead recovery program fish out of the Diru Creek Hatchery and get the fish acclimated to an area that provides a great deal of presently underutilized rearing and spawning habitat.

3. The Clarks Creek Channel and Bank Stabilization project will be constructed in the Maplewood Spring ravine. This project is designed to lessen the contribution and transport of sediment to downstream reaches using a variety of soft earth technologies.

4. The Tribe will continue to work with the Army Corps and other agencies to design a replacement fish trap facility that will improve adult survival and enhance data collection for stock assessment needs. The soonest we will see a new facility is 2020.

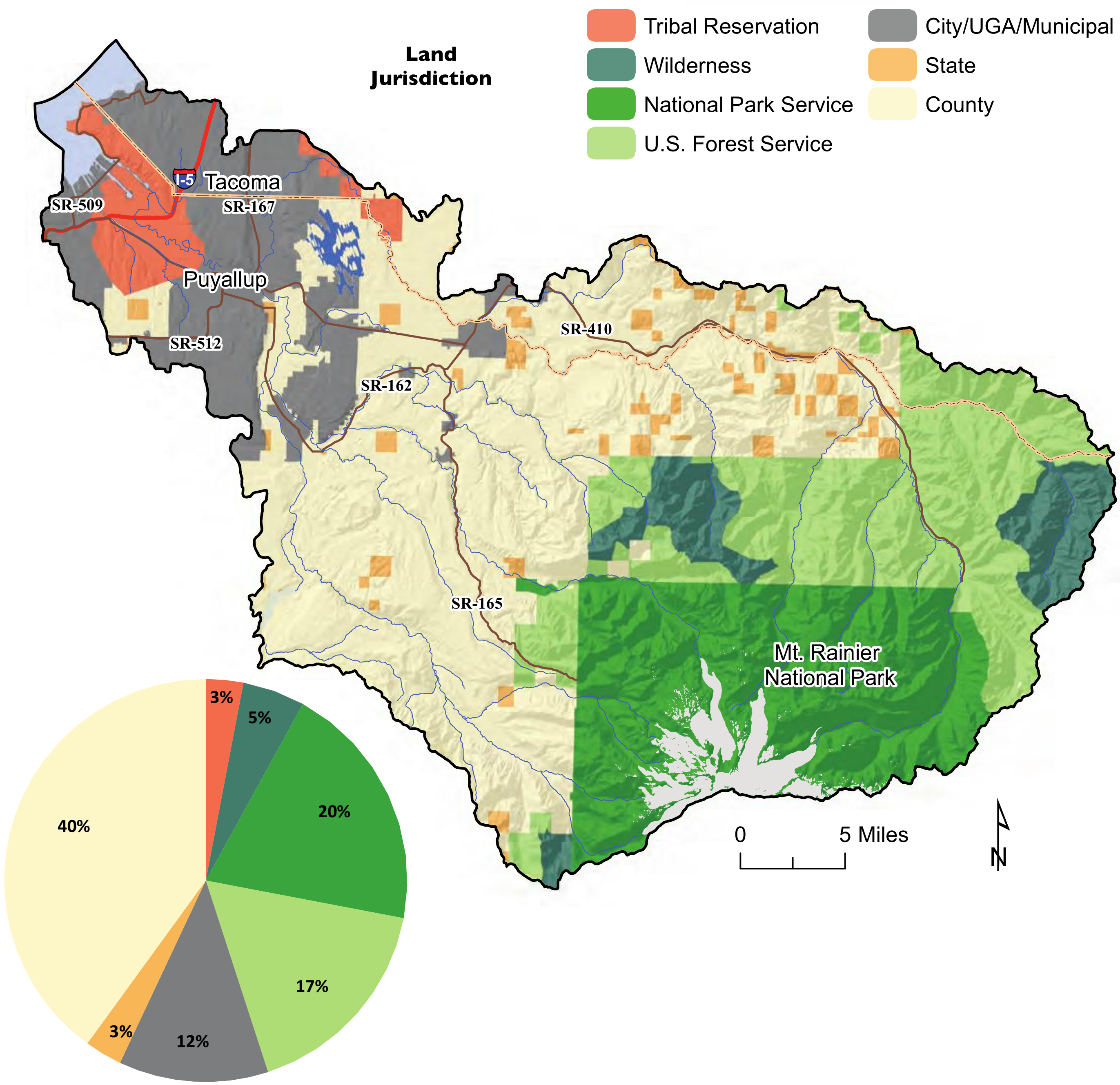
5. At Electron Dam, the Tribe will continue to work with the new project owner Electron Hydro to improve existing infrastructure that will lead to better survival rates and reduced diversion of fish into the power generation flume.

The Tribe will continue to work with its partners to improve both mainstem and riparian habitat conditions of South Prairie Creek. Both physical channel design changes and property acquisition are approaches currently being used.

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 over 4,300 miles of river and streams. The Puyallup basin has been substantially altered from its historic condition and is currently contained within a revetment and levee system throughout its lower 26 miles.[1] 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.[2]



Data Sources: SSHIAP 2004,[3] WADNR,[4] WADNR 2014a,[5] WADNR 2014b,[6] WADNR 2014c,[7] WADOT 2013,[8] WAECY 1994,[9] WAECY 2011,[10] WAECY 2013a[11]

Habitat Restoration and Preservation Continues in WRIA 10

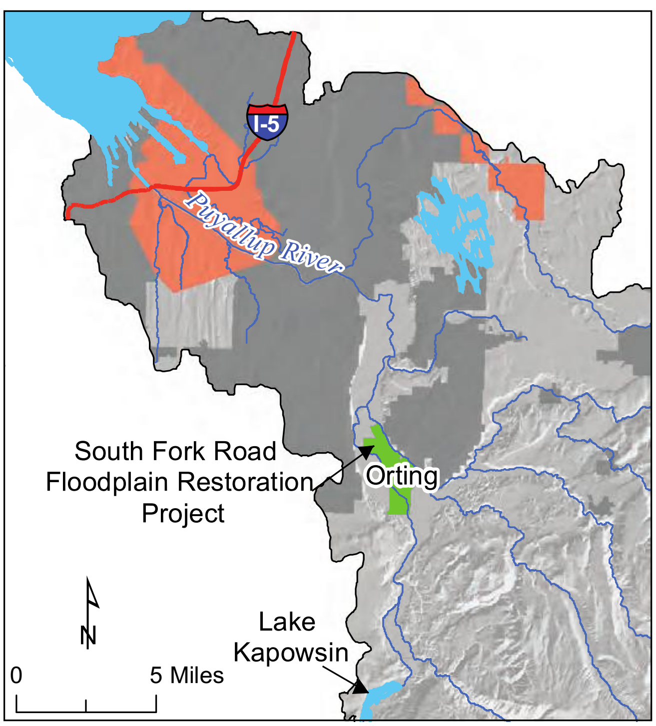
South Fork Road Floodplain Restoration Project

A very substantial restoration project is underway in WRIA 10 that will reconnect part of the Puyallup River to its historic floodplain, producing valuable, high quality salmon habitat. Pierce County is reconnecting part of the historic Puyallup River floodplain by building a side channel near South Fork Road and 145th Street East, north of the city of Orting and west of SR 162. Construction on the side channel's second segment (Phase 2A) was completed in summer 2014. The final phase of the project will complete the side channel's second segment and connect the segments together and to the Puyallup River (anticipated in 2015). The South Fork Road Floodplain Restoration project currently has a 2,000-foot side channel and a 1,100-foot backwater channel. In addition to constructing these channels, crews built engineered logjams in the channels, constructed a perimeter access road and planted native plants.[1] The final phase of this project is anticipated to be completed in 2015.

Engineered logjam.

Pierce County South Fork Floodplain Restoration Project (2)

Completed South Fork Phase I Channel.



Tribal Reservation
City/UGA

Created by the Electron mud flow off Mount Rainier 500 years ago, Lake Kapowsin is a unique example of the Earth's natural forces at work. The 512-acre lake is nearly undeveloped and covers an ancient cedar forest of old-growth trees.[2] The lake is important habitat for fish and other water-dependent species.

Lake Kapowsin WA DNR

Because of its rarity and value, the Washington Department of Natural Resources is proposing to make Lake Kapowsin Washington's first freshwater aquatic reserve.

Data Sources: SSHIAP 2004,[3] WADOT 2013,[4] WAECY 2011,[5] WAECY 2013a,[6] WADNR 2014b[7]

Puyallup Tribe of Indians

Levees and Revetments

Since 2012, two levee setback projects have been completed in the Puyallup River basin, setting back 1.6 miles of levee, while six levee setback projects are in some stage of development (feasibility, design, permitting) which could set back another 1.5 miles of levee.[1]

Of the 303 miles of known fish distribution in the Puyallup basin, 48 miles are contained within a levee and revetment system. Of these 48 miles, 36 are covered by U.S. Army Corps of Engineers Disaster Operations Public Law 84-99 Flood Control and Coastal Emergency Act (PL 84-90). Once a levee segment falls under PL84-99 jurisdiction, any repair work or maintenance that is deemed emergency is exempt from consultation, temporal closures associated with fish windows, mitigation, and compliance with WDFW's Integrated Streambank Protection Guidelines. Channelization and levees have reduced river processes that form pools, side channels and other habitat features used by salmonids. The construction of the revetments and levees and their maintenance has decreased the contribution of prey organisms to the river by precluding functioning riparian vegetation habitats. Additionally, they have precluded the recruitment of small and large wood from areas most likely to contribute this material.

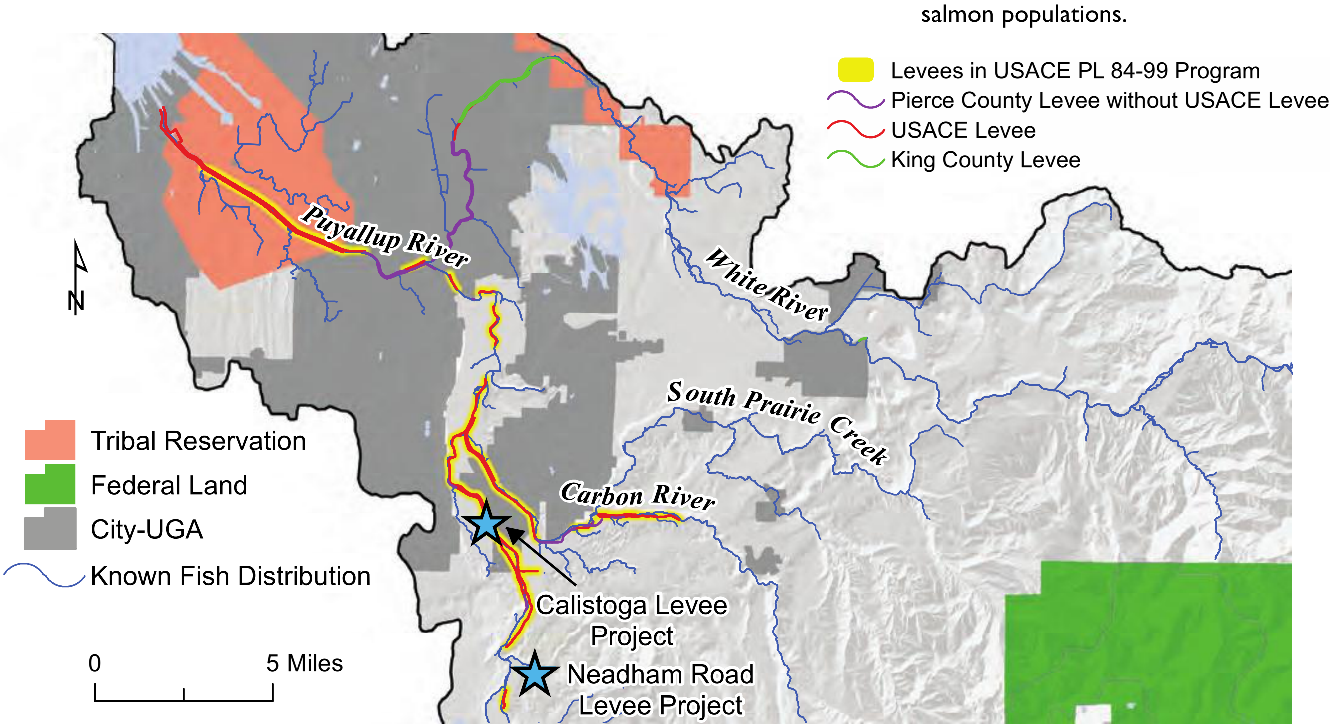
To improve the habitat conditions, the Puyallup Tribe and Pierce County have completed two levee setback projects and have six in development. Levee setbacks and estuarine habitat creation are the most beneficial types of actions needed for recovery of Chinook in WRIA 10 and will be a high priority.[2] The Calistoga and Neadham Road levee projects were two completed recently offering new habitat opportunities to local salmon populations.

Keith Eldrige, KOMO News

Calistoga Levee Project: This project will open up an approximately 1.5-mile-long corridor reconnecting the Puyallup River to a large portion of its historic floodplain while helping to reduce flooding and provide off-channel habitat for a range of fish species at various life stages.

Pierce County

Neadham Road Levee Project: This project on the Puyallup River included the installation of 650 lineal feet of setback levee and three engineered logjams offering new habitat opportunities to local salmon populations.



Data Sources: HWS 2015,[3] King Co. 2014,[4] Pierce Co. 2008,[5] SSHIAP 2004,[6] SWIFD 2014,[7] USACE 2008,[8] WADNR 2014b,[9] WADOT 2013,[10] WAECY 2011,[11] WAECY 2013a[12]

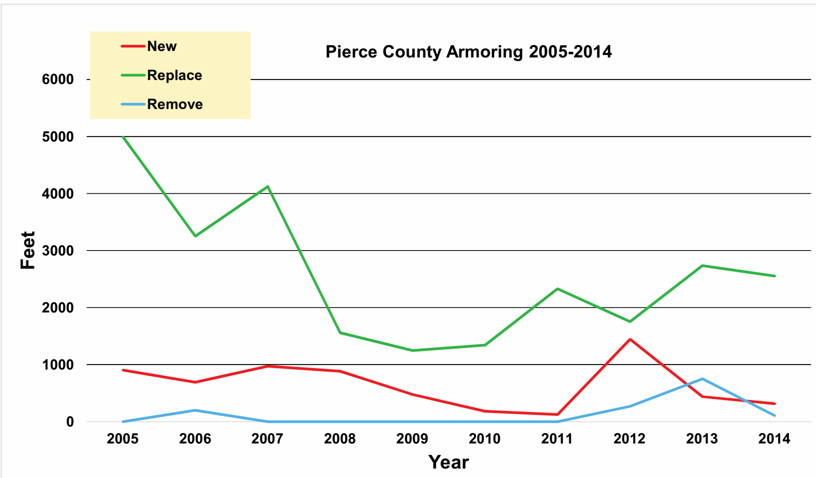
Puyallup Tribe of Indians

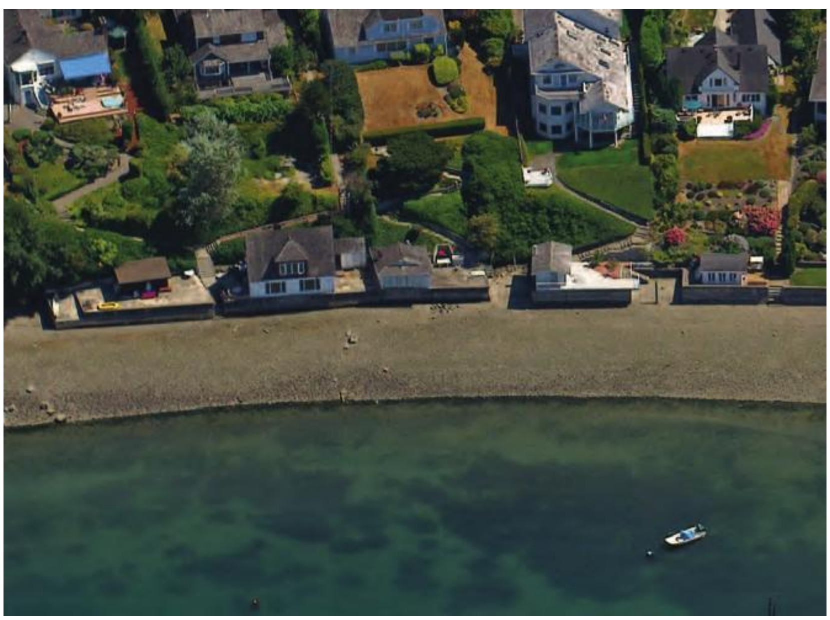
Nearshore and Estuary Habitat Lacking

From 2005-2014 in Pierce County, 270 Hydraulic Project Approvals (HPAs) were issued resulting in an additional 1.2-plus miles of armored shoreline, while 0.25 miles were removed, resulting in a net increase of about one mile.[1]

Of the 36 miles of marine shorelines in the Puyallup River basin, about 7% are undeveloped and free of bulkheads, riprap or other structures. Out of more than 5,900 acres of estuary habitats that historically existed at the head of Commencement Bay, only about 3% remain due to dredging, filling and activities associated with development.[2]

Nearshore and estuarine habitats provide food and refuge for juvenile salmon as they prepare for their journey to the ocean, but flood control projects, Port of Tacoma activities and urbanization have resulted in severely degraded conditions and have significantly reduced the amount of functioning habitat. Contaminated sediments, which have further limited the nearshore and estuarine habitat, have resulted in additional reductions in Chinook productivity.




Washington Department of Ecology Coastal Atlas

Example of Shoreline Modifications in WRIA 10.


NOAA Commencement Bay NRDA

Hylebos Creek Restoration Project: This 6.7-acre project site is located in the city of Tacoma along the lower, tidal section of Hylebos Creek. Restoration activities included restoring the estuarine salt marsh complex by creating intertidal channels and a vegetated buffer.[3] This property was later transferred to the Puyallup Tribe of Indians.


NOAA Commencement Bay NRDA

Hauff Property Nearshore Restoration Project: Despite the large amount of development along the marine shoreline in the Puyallup basin, a 6.7 acre project site located in the city of Tacoma along the lower, tidal section of Hylebos Creek was completed. Restoration activities include cleaning up the site by removing structures and materials, removing the non-native vegetation, excavating the site to re-establish the tidal marsh and mudflats, and planting a vegetative buffer.

Data Sources: Carman et al. 2015,[4] NAIP 2013[5]

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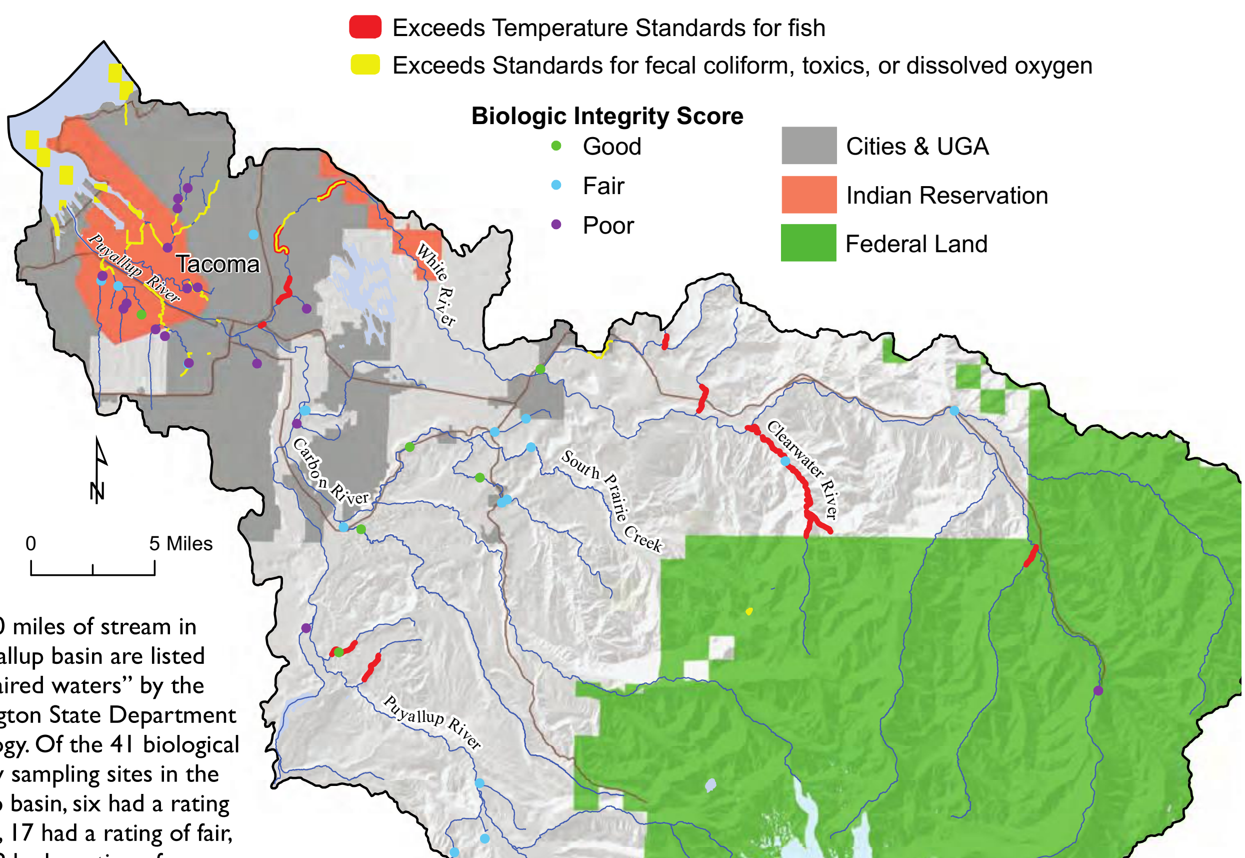
Water Quality Shows Slight Improvement

In 2013 the Puyallup basin saw a slight improvement in its water quality and aquatic habitat conditions. The average grade for Pierce County streams in 2013 was C+, up a little from the 2010 score of C, on a scale of A-F, with the water quality and aquatic habitat conditions still considered "fair."[1] The 41 biological integrity sampling sites in the Puyallup Basin show the "good" category changing from 0 to 6, the "fair" category changing from 19 to 17, and the "poor" category changing from 22 to 18.[2]

Since the mid-1990s, university scientists, water resource managers, and volunteers have used the multi-metric Benthic Index of Biotic Integrity (B-IBI) to evaluate the biological condition of Pacific Northwest streams with benthic macroinvertebrates.[3] Benthic macroinvertebrates are particularly well suited for biomonitoring: they are diverse and abundant, sensitive to human disturbance, and are excellent indicators of stream condition because they are key components of the aquatic food web, often long-lived, and not migratory or artificially stocked.[4] The loss of biological integrity within salmon spawning grounds equates to a loss of salmon. If a stream's biological condition is degraded (as reflected by the condition of the benthic macroinvertebrate population), it is safe to conclude that the stream will not support healthy salmon or other fish populations. The decline of healthy salmon spawning and rearing habitat has been identified as one major cause of the decline of wild salmon populations. Of the 41 sampling sites in the Puyallup basin, none had a rating of excellent and only six had a rating of good.

Point and nonpoint source pollution due to industrial and commercial activities, residential development and agriculture adversely impacts water quality. Many of the streams in this basin suffer from combinations of high fecal coliform levels, low dissolved oxygen levels and other water quality impacts.

Puyallup staff collects macroinvertebrates in Clarks Creek.



Over 60 miles of stream in the Puyallup basin are listed as "impaired waters" by the Washington State Department of Ecology. Of the 41 biological integrity sampling sites in the Puyallup basin, six had a rating of good, 17 had a rating of fair, while 18 had a rating of poor.

Data Sources: HWS 2015,[5] Pierce Co. 2013,[6] SSHIAP 2004,[7] USGS 2014,[8] WADNR 2014b,[9] WADNR 2014c,[10] WADOT 2013,[11] WAECY 2011,[12] WAECY 2013a,[13] WAECY 2013b[14]

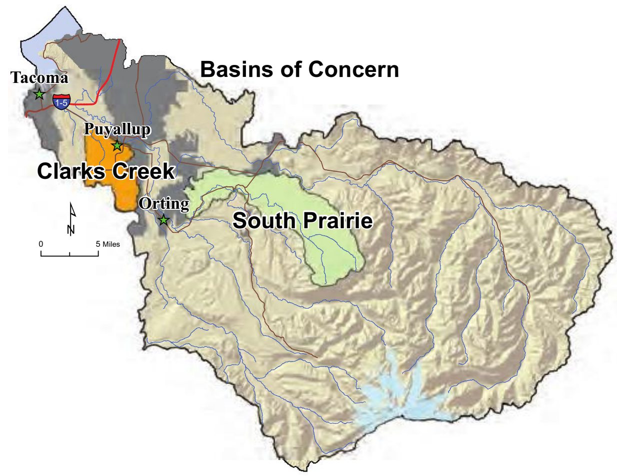
Impervious Surface and Population Continues to Increase

The Puyallup River basin continued to see an increase in impervious surface (1.2%) from 2006 through 2011. Clarks Creek basin saw an increase in impervious surface in all of its watershed analysis units, while South Prairie basin still remains mostly undeveloped.

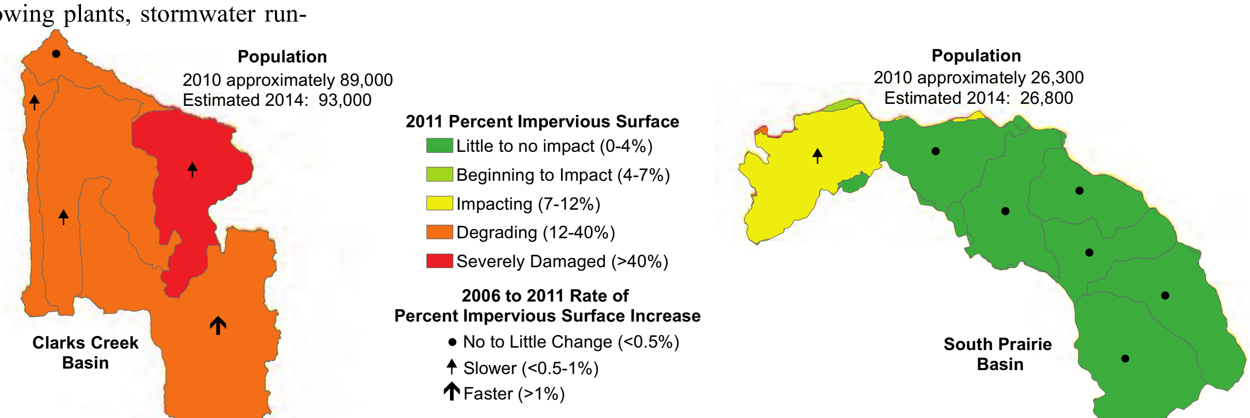
The Puyallup River basin has an estimated 2014 population of 424,001 (up 4,341 from 2010) in incorporated communities and unincorporated Pierce and King counties.[1] It includes the state's third largest city, Tacoma, with a population estimate of almost 200,900 for 2014. Increased population pressure and development, with the conversion of forested areas to impervious surfaces, is the major factor affecting water quality in the region.[2] Greater numbers of people in the region result in greater volumes of waste water, more septic systems and more sources of nutrients entering surface waters. As a result of development, once-forested land has been replaced with buildings, roads and lawns.

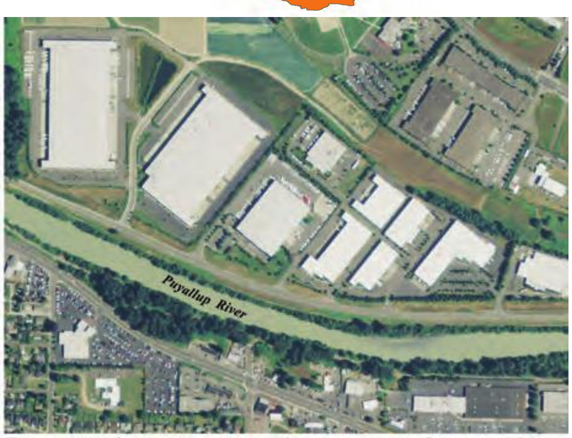
Clarks Creek supports the highest salmon spawning densities of any incorporated area in the watershed. Clarks Creek provides critical habitat for Chinook salmon. Within the creek can also be found coho, chum, cutthroat, and steelhead salmon. Over-growing plants, stormwater run-off pollution, fecal coliform and low levels of dissolved oxygen all plague Clarks Creek. The health of this creek and its sustainability are in jeopardy. Clarks Creek basin saw an increase in impervious surface in all of its watershed analysis units from 2006-2011 and remains degraded or severely damaged.

South Prairie Creek, a major tributary of the Carbon River, is considered one of the most productive reaches used by Chinook for spawning habitat that is available for natural salmonid production in the basin. South Prairie Creek is temperature impaired and has not seen water temperatures improve since a TMDL was completed in 2003. The South Prairie Creek mainstem is identified as a high priority for protection, meaning that further degradation would have a large negative effect on Chinook performance in that system. South Prairie basin still remains undeveloped with mostly little to no impact of impervious surface.



Incremental degradation is most rapid during the first stages of urbanization (0% < impervious surface < 10% in a watershed). Any watershed with less than 5% impervious surface will have high-quality habitat to consider for preservation.[3]





Example of impervious surface near the Puyallup River.

Impervious surfaces prevent rainfall from infiltrating into the soil and groundwater, and increase the volume and rate at which water runs off the surface into wetlands, streams, lakes and Puget Sound. The greater volume of runoff increases the frequency of flooding, erodes channel banks and streambeds, increases sediment movement, increases the amount of pollutants carried into water bodies and damages aquatic life. By reducing the amount of water that infiltrates, impervious surfaces can decrease aquifer recharge and reduce summer baseflow to streams. Reduced summer baseflow in streams can result in warmer temperatures that are harmful to fish and other aquatic life. Also, low streamflows and shallow water can form barriers to fish movement and migration. In addition to impacts from increased peak flows and volumes associated with new impervious surface areas, water quality can be affected if the new impervious surfaces are significant sources of pollutants. Runoff from pollutant-generating impervious surfaces can affect the quality of drinking water supplies, as well as negatively affect aquatic life in surface waters.

Data Sources: NAIP 2013,[4] NLCD 2006,[5] NLCD 2011,[6] WADNR 2006,[7] WADNR 2014c,[8] WAECY 2011,[9] WAOFM 2014[10]

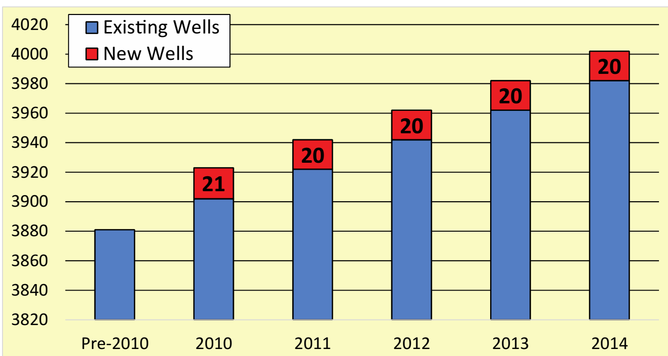
Low Flows Continue to Decline

The Puyallup River basin saw an increase of 101 wells (2.6%) from 2010 to 2014, keeping at the same pace as 2010 (20 new wells per year). Since 1926, the Puyallup River streamflows have shown a continuous decline especially during critical flow periods, despite the establishment of instream flows in 1980.

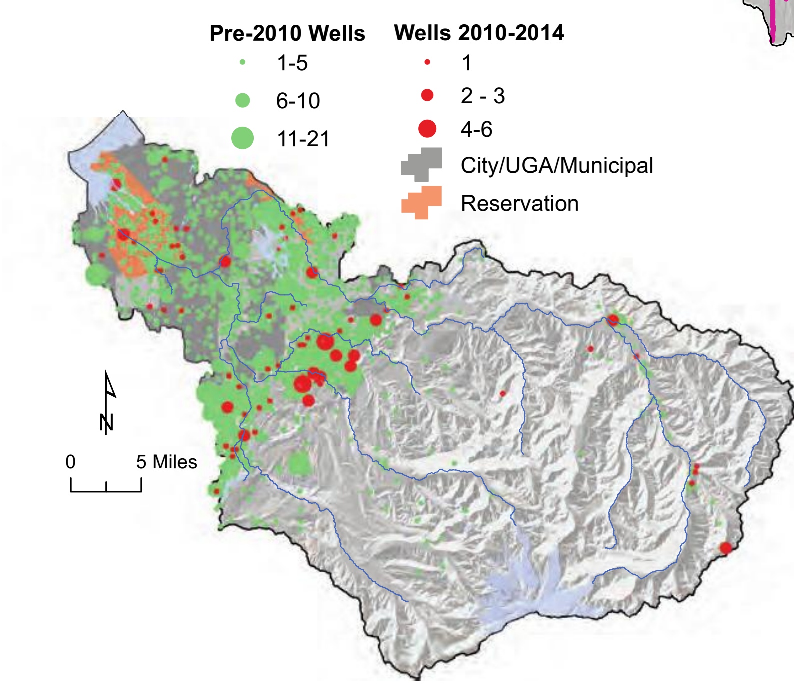
Instream flow rules, which allocate specific flow and timing regimes in rivers and river systems, are meant to legally account for the ecological requirements that may not have been considered previously. The Washington Department of Ecology and Department of Fish and Wildlife have developed instream flow rules to "protect and preserve instream resources" that include fish and fish habitats, water quality, wildlife, aesthetics and recreation.[1] A watershed assessment in 1995 conducted by Ecology indicated there has been a decrease in low flows over the last 20 years, despite above average precipitation and prohibitions on new surface water withdrawals. Low water flows were identified as a priority issue for salmon in WRIA 10.[2]

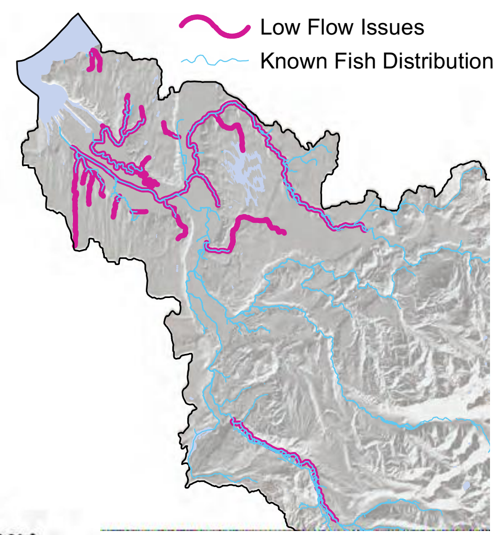
Water well withdrawals can have a cumulative effect on streamflows, especially in late summer. Summer low flows have declined continuously since at least 1980 in spite of the closure for new surface water withdrawals, the establishment of minimum instream flow requirements and above average precipitations. The 1980 Ecology regulation prohibited all new surface water withdrawals from the White River, Hylebos and Wapato creeks, and many tributaries to the Puyallup River. Nevertheless, flows in the Puyallup River have continued a long decline.

The impacts of low flows can reduce the amount of habitat available for spawning and rearing, eliminate access to valuable habitats, dewater incubating eggs, affect the timing and success of both juvenile and adult migrations, reduce food sources by reducing invertebrate populations and increase stressors by degrading water quality (increasing temperatures and reducing dissolved oxygen).[3]



The number of wells from 2010-2014 continued to grow at the same pace as 2010.





The Puyallup basin contains more than 3,983 wells and 120 miles of stream with low flow issues.

Data Sources: SSHIAP 2004,[4] SWIFD 2014,[5] USGS 2014,[6] WADNR 2014b,[7] WADOT 2013,[8] WAECY 2011,[9] WAECY 2013a,[10] WAECY 2015[11]

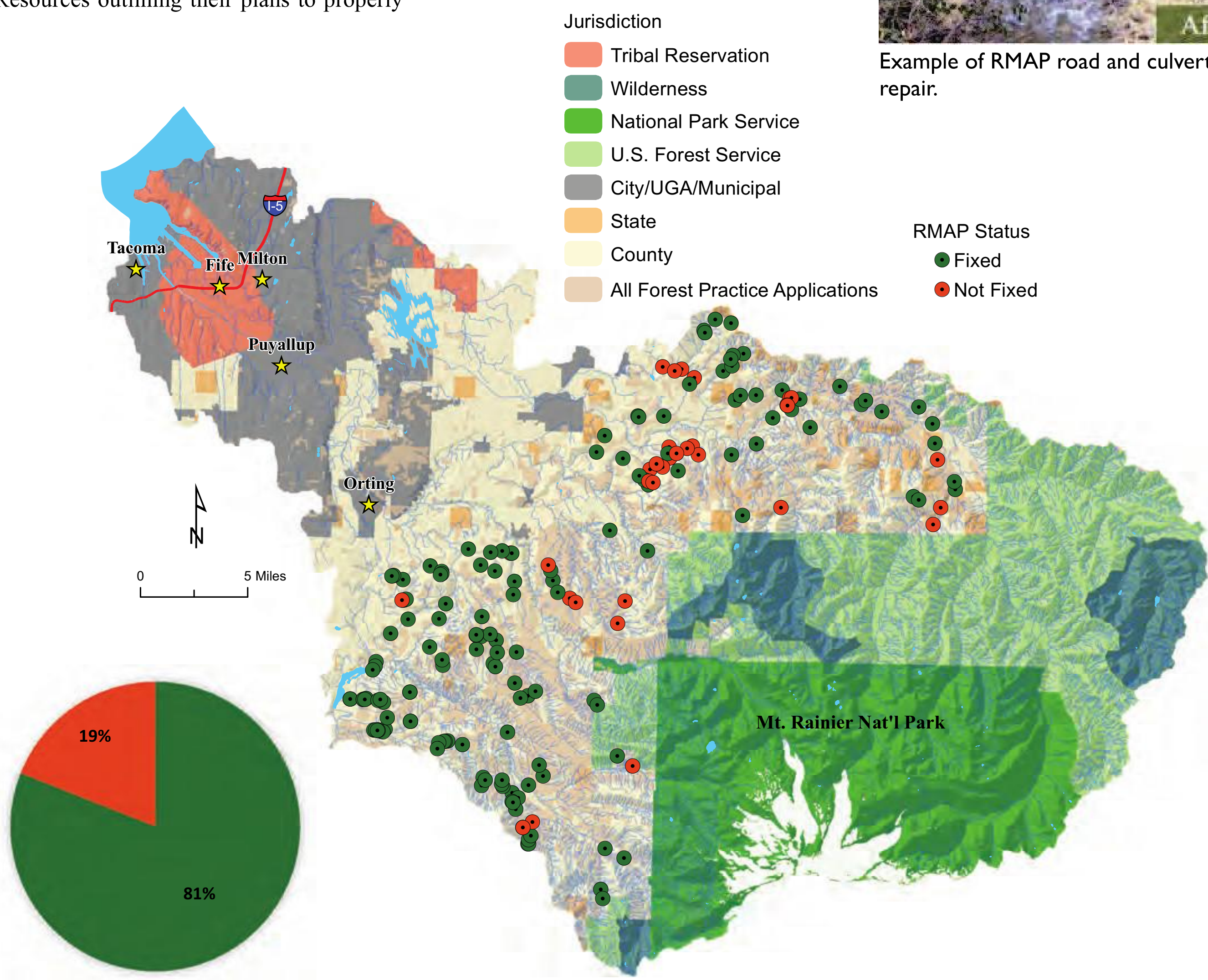
RMAPs Making Huge Progress

The Forests and Fish Law requires that all state and private forest roads be brought up to new forest roads standards by 2021 through RMAPs. Currently, in WRIA 10, about 81% of the RMAPs are repaired.[1]

Forest landowners are required to improve their forest roads to protect public resources, including water, and fish and wildlife habitat. Improved road maintenance and construction practices reduce or eliminate runoff and fine sediment being delivered into streams, which can degrade water quality and fish habitat. Statewide, as of June 2013, with both small and large landowners, 254 RMAPs and more than 10,000 RMAP checklists have been completed for large and small landowners respectively, covering more than 57,000 miles of forest road. The results are more than 3,800 miles of fish habitat has been opened by removing or replacing nearly 5,600 stream blockages.[2]

Forest landowners, both industrial and non-industrial, are required to submit their own RMAP to the Department of Natural Resources outlining their plans to properly abandon or stabilize existing forest roads no longer in use, and improve standards on how new roads are to be built. "Work must show progress over time, and be prioritized by the 'worst first' to give the most benefits to public resources early in the period."[3] Culverts and bridges are now being enlarged, new road techniques are being used, and old culverts and stream passages that pose a risk of failure are being re-engineered to withstand a 100-year flood. Other practices include building roads across streams at a perpendicular angle, not one that is parallel to the stream. This minimizes the area of road surface that can contribute sediment to streams. "New cross-drain techniques will divert runoff from ditches onto the forest floor, and sediment traps are used to stop sediment before it reaches a stream."[4]

Example of RMAP road and culvert repair.



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RMAPs Making Huge Progress

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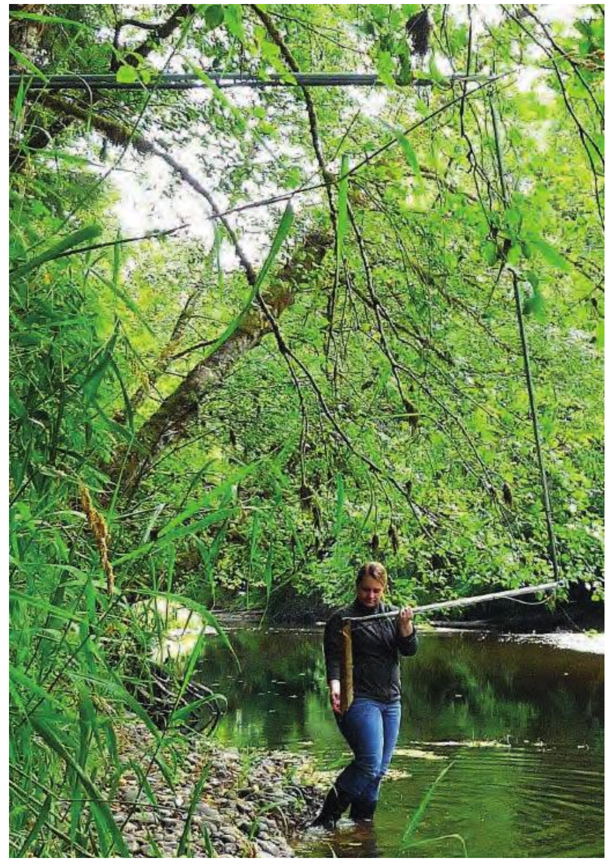
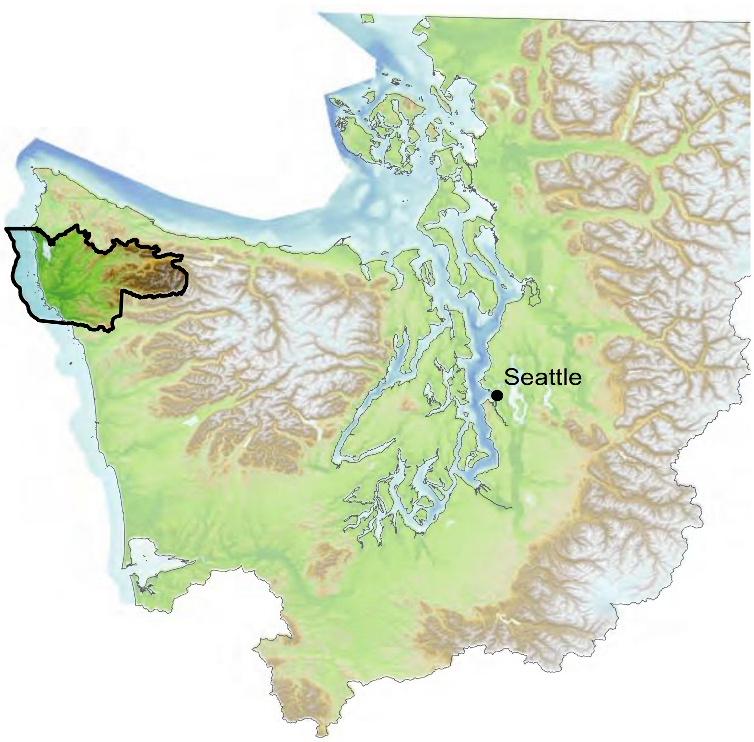
2016 State of Our Watersheds Report
Quillayute River Basin



Habitat projects are vital to restoring the salmon fishery. We have successfully partnered on projects in the past but we need many more into the future.

- Mel Moon,
Natural Resources Director
Quileute Tribe



Quileute Tribe

The Quileute Tribe is located in La Push, on the shores of the Pacific Ocean, where tribal members have lived and hunted for thousands of years. 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 rain forests. 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.

Large Watershed Has Significant Subbasins

The Quileute Tribe's Area of Concern includes the northern portion of WRIA 20, from Lake Ozette to the Goodman Creek Watershed. The largest basin in the area is the Quillayute, with four major sub-basins: the Dickey, Sol Duc, Calawah and Bogachiel rivers. This part of the coastal region is a temperate rainforest with abundant waterfall and an annual rainfall that can reach 140 inches. The Quillayute River flows westerly from the confluence of the Sol Duc and Bogachiel rivers, and enters the Pacific Ocean at La Push, the ancestral home of the Quileute Tribe. The Dickey's confluence is at river mile 1 of the Quillayute. A number of smaller independent streams, such as Cedar Creek and Goodman Creek, drain into the Pacific Ocean.

The area supports Chinook, coho, sockeye, chum, and pink salmon, as well as steelhead and cutthroat trout. The Tribe does not manage the chum and pink salmon that are infrequently found in the area, nor the cutthroat trout. All the fisheries are co-managed with the state of Washington, and the Quileute Tribe has a shared Usual and Accustomed area with the Makah Tribe in the Lake Ozette basin. The Lake Ozette sockeye is listed as threatened under the Endangered Species Act.

The area is heavily forested with relatively infrequent impervious cover caused by development and small population centers. A part of the Quillayute and Ozette basins lies in Olympic National Park, which has been protected from timber harvest and other major human impacts. Those lands outside the park include Olympic National Forest, state forests and private timberland and city of Forks.

Limiting factors for salmonid production identified within part of WRIA 20:

- A significantly altered estuary and armored banks;
- Increased sedimentation and water flow;
- Reduced levels of large woody debris;
- Loss of maturity; and
- Predation by marine mammals.[1]

Debbie Preston, NWIFC

Lake Creek chinook and coho surveys in the Quillayute River Watershed.

Quillayute Watershed Salmon Recovery Plan

The development of the WRIA 20 Watershed Plan included many of the same parties as the original watershed analyses, with the addition of interested members of the public. Adopted in 2008, it sought (as one part of four statutory goals regarding streams) to protect fish habitat by recommending compliance with existing riparian protection regulations and through public education.[2]

The plan values the presence of stable salmon stocks, recognizes the need to protect commercially viable populations from pressure of reduced water supply, and establishes the objective to improve the abundance of healthy stocks, as well as restore those stocks already experiencing reduced populations. The overarching habitat goal was to maintain the viability of anadromous salmonid runs in all streams in WRIA 20. The approach focuses on establishment of instream flow rules, basin hydrology, water quality and sediment transport, stream channel complexity, riparian areas, noxious weed control, fish passage, and access. This group tried to include broad endorsement of water quality monitoring. However, that remains a subject for individual discussion with each landowner as to access. Further, no funding exists to pursue instream flow rules at present.

Since 1999, Quileute has been a part of local Lead Entities (LE), a state program for salmon habitat restoration/recovery, first with North Olympic Peninsula LE, and when the west end was severed from it, the new North Pacific Coast LE, which began in 2007. Each year the LE updates its restoration strategy and prioritized project list, relying on participants for local information. For every year, the restoration strategy is to maintain and improve ecosystem productivity and genetic diversity for all WRIA 20 salmonid species, by protecting highly productive habitat and populations, and restoring impacted habitat and populations with the potential to recover. Progress toward these goals has lagged through limited available restoration funding and delays in regulation implementation. Both the Washington Department of Ecology and U.S. Environmental Protection Agency articulated the belief that implementation of the Forest Practices Rules under Forests and Fish Report should:

Tami Pokorny, Jefferson County Water Quality

North Pacific Coast Lead Entity group field trip.

- Significantly advance forest practices in Washington state;
- Improve water quality in the short term; and
- Allow water quality standards to be met in the long-term.[3]

However, in 2011, full implementation of this regulatory package was delayed by the Washington State Forest Practices Board extending the deadline for Road Maintenance and Abandonment Plan (RMAP) implementation until 2021, which extended the presence of the fish-blocking structures in salmon-bearing streams for an additional five years.

AR052902

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

A review of key environmental indicators for the Quillayute basin shows that priority issues continue to be degradation of water quantity and quality, degradation of floodplain and riparian processes, degradation of forest cover and high road densities. There have been improvements in the repair or abandonment of forest roads and the successful treatment of invasive species. 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 trend for these key environmental indicators since the 2012 State of Our Watersheds Report shows an improvement for some indicators and a steady loss for others in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Water Quantity - Peak Flows	From 1975, peak flows have shown an increasing trend on the Calawah mainstem. If this trend continues as anticipated under predicted climate change conditions, this may pose a significant impact to salmonid runs.	Declining
Water Quantity - Low Flows	From 1975, mean low flows have shown a decreasing trend on the Calawah mainstem. If this trend continues as anticipated under predicted climate change conditions, this may pose a significant impact to salmonid runs.	Declining
Forest Roads	About 54% of the 1,528 RMAP forestland culverts have been repaired or abandoned.	Improving
Road Densities	Fifteen watersheds representing 68% of the land area may not be properly functioning due to road densities that exceed 3 mi/sq mile threshold.	Declining
Timber Harvest	Between 2011-2015, 1.4% private and 0.3% state owned forestlands were permitted for harvest. Average rate of harvest was 1.1 sq mi/yr down from the average rate of harvest of 4.4 sq mi/yr (1996-2010).	Improving
Forestland Cover	Between 2006-2011, state and private forestlands saw a negative forest cover trend, with the highest losses in the West Fork Dickey (12.1% decrease) and lower Bogachiel River (9.9% decrease).	Declining
Invasive Species	Since 2003, successful treatment has reduced knotweed densities in the Dickey, Calawah, Sol Duc, and Bogachiel watersheds. In 2014, the Quileute Tribe treated 7.63 miles and 13 miles in the Dickey River and Bogachiel River watersheds respectively. In recent years, there has also been treatment in the Quillayute Mainstem. Clallam County has partnered to treat the Sol Duc and Olympic National Park to treat the Quillayute.	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.

Debbie Preston, NWIFC

A cooperative state-tribal sandbagging effort on the Sol Duc River during the low flows of 2015 helped fish reach spawning grounds.

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. The current regulatory framework clearly has not provided 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 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), developing strategies for recovery and participating in the grant process.

The greatest need is continued funding, since habitat restoration is an ongoing process (e.g., culvert, bridge and road maintenance, and weed control). Funding also is needed for staff programs to monitor, assess and develop plans for needed 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 please visit *www.quileutenation.org/natural-resources*.

In February of 2012, Congress approved additional lands to become part of the Quileute Reservation, approximately doubling reservation size. This was to provide for the Move to Higher Ground, designed for tsunami protection. These lands (except for one small fee parcel converted to trust status), come from Olympic National Park and are largely undeveloped. A portion is wetlands.

Over the next five years, the Tribe, while continuing to focus on maintenance of stream monitoring and salmon habitat restoration throughout WRIA 20, will be expanding concerns to assure the Move to Higher Ground occurs in a manner that will continue to protect our natural resources. We are exploring flood control and culvert projects for the new lands, in cooperation with state and federal agencies. We are also working on climate change concerns through existing federal grants from EPA and BIA and insofar as watershed management interfaces with climate (e.g., flooding, new precipitation cycles, low flows, changes in invasive species or habitat for native species), we will need to address such issues.

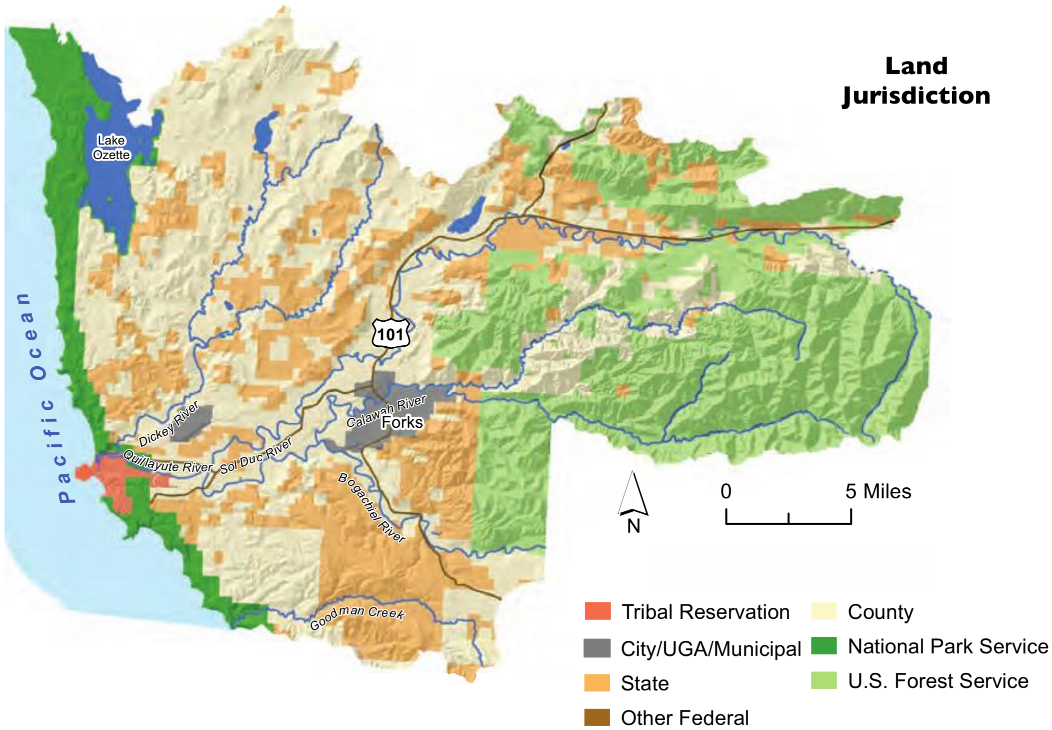
Debbie Preston, NWIFC

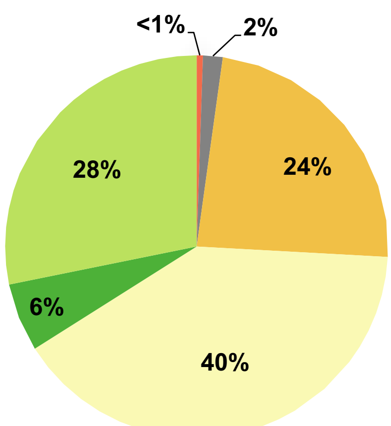
Eradication of the invasive knotweed in the Quillayute River watershed has been an multi-year effort by the Quileute Tribe involving crews spraying and injecting the plant with herbicide to kill it. Knotweed replaces important habitat components for fish and spreads easily requiring years of follow-up effort in watersheds.

AR052904

Quileute Tribe

Lake Ozette, Quillayute River and Goodman Creek





The Quileute Tribe's Area of Concern includes the northern portion of WRIA 20, from Lake Ozette to the Goodman Creek watershed. 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 enters 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; these are referred to as the "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 1 mile up from the mouth. 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 has been protected from timber harvest and other major human impacts. 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, although chum and pink salmon are infrequent.[1,2] Chum, pink salmon and cutthroat trout are not managed by the Quileute Tribe.

All 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. With the Endangered Species Act listing of Lake Ozette sockeye as threatened in 1999, the National Marine Fisheries Service spearheaded a steering committee made up of co-managers and other stakeholders to develop a Recovery Plan.[3] The plan has extensive discussions of limiting factors, threats and recovery recommendations. This process was funded by the federal government. Very limited funding is available now for facilitation of an Implementation Steering Committee. For the present, recovery projects will need to be funded on an individual basis, largely by competitive grants.

A watershed management plan was also prepared that provides specific guidance and recommendations on water resources management and a detailed implementation plan was developed to guide the actions needed to protect, preserve, and/or restore the natural resources in WRIA 20.[4]

Data Sources: Quileute 2015,[5] SSHIAP 2004,[6] USFWS 2014,[7] WADNR 2014a,[8] WADNR 2014b,[9] WADOT 2012,[10] WADOT 2013,[11] WAECY 1994,[12] WAECY 2011a,[13] WAECY 2013[14]

Quileute Tribe

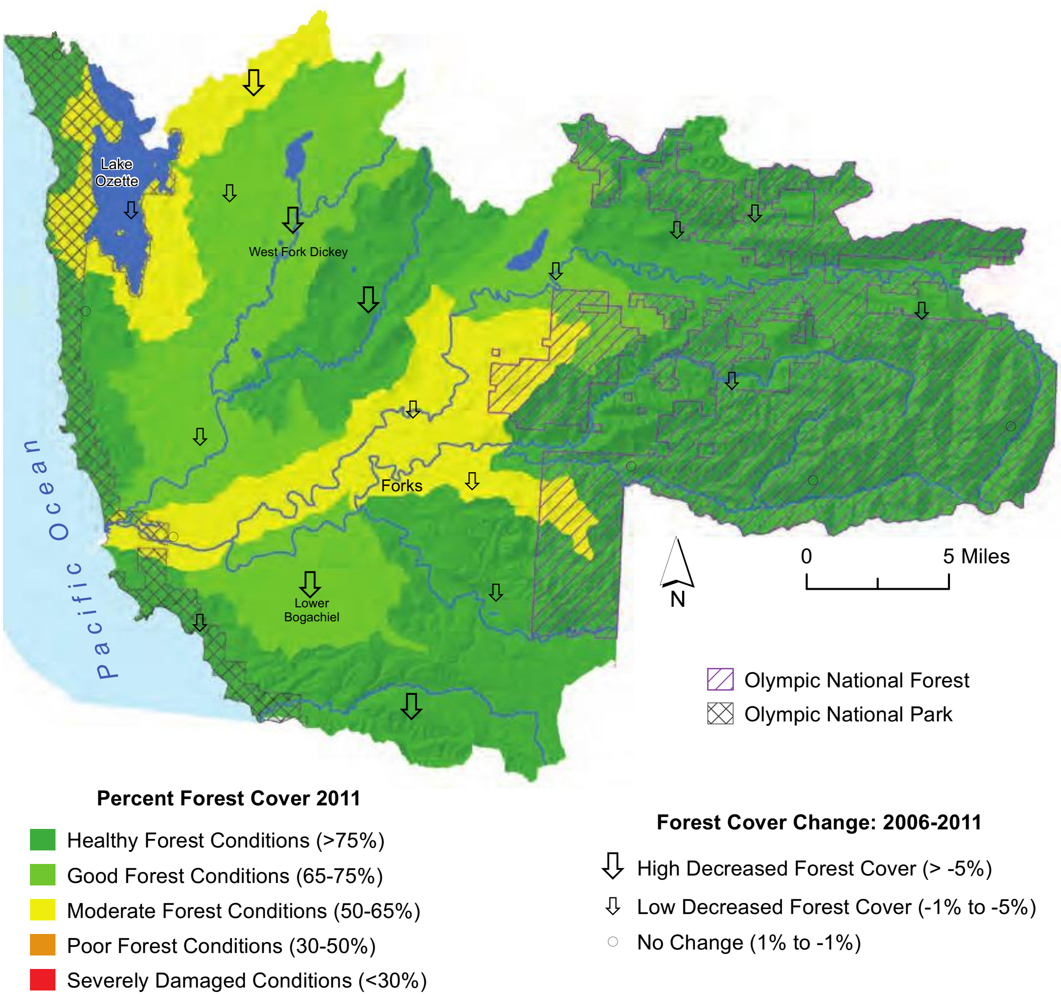
Loss of Forest Cover Impacts Fish Habitat

Current forest cover conditions are generally good to healthy in most watershed units in the Quileute Area of Concern. Between 2006 and 2011, watersheds within Olympic National Park and U.S. Forest Service lands had little (<1%) or no change in forest cover conditions while within the state and private lands, the overall trend is negative. Watersheds with the highest losses were West Fork Dickey (with a 12.1% change) and Lower Bogachiel River (9.9%).

Healthy forest cover conditions are vital for the maintenance of proper watershed processes and thus salmonid habitat. A major goal of the WRIA 20 watershed plan “is the maintenance of forest cover to benefit fish habitat, water quantity and water quality, and to provide additional ecosystem services such as carbon sequestration.”[1]

The 2011 forest cover conditions of most of the watershed units in the Quileute Area of Concern were generally good to healthy, but moderate forest cover conditions do exist in the northwest part of the area near Lake Ozette, as well as in the central region near the city of Forks. However, the Forks area is historically a prairie and much of it was not covered by forest. These areas were mostly outside Olympic National Forest and Olympic National Park.

Between 2006 and 2011, watersheds within Olympic National Park and U.S. Forest Service lands had little (less than 1%) or no change in forest cover conditions, while within the state and private lands, the overall trend in forest cover is negative. Watersheds with the highest losses were West Fork Dickey (with a 12.1% change) and lower Bogachiel River (9.9%). Since these areas are in private forestlands, it is likely that these changes were caused by timber harvesting. No watersheds showed any gains in forest cover, making the net change in forest cover of the different watersheds either neutral or negative. While the overall forest conditions are good to healthy, the general trend for most watersheds outside the park and Forest Service lands appears to be negative. However, it is important to note that except for the National Park, this area (especially private and state ownership) is under continuous harvest and replanting, so figures do change over time.



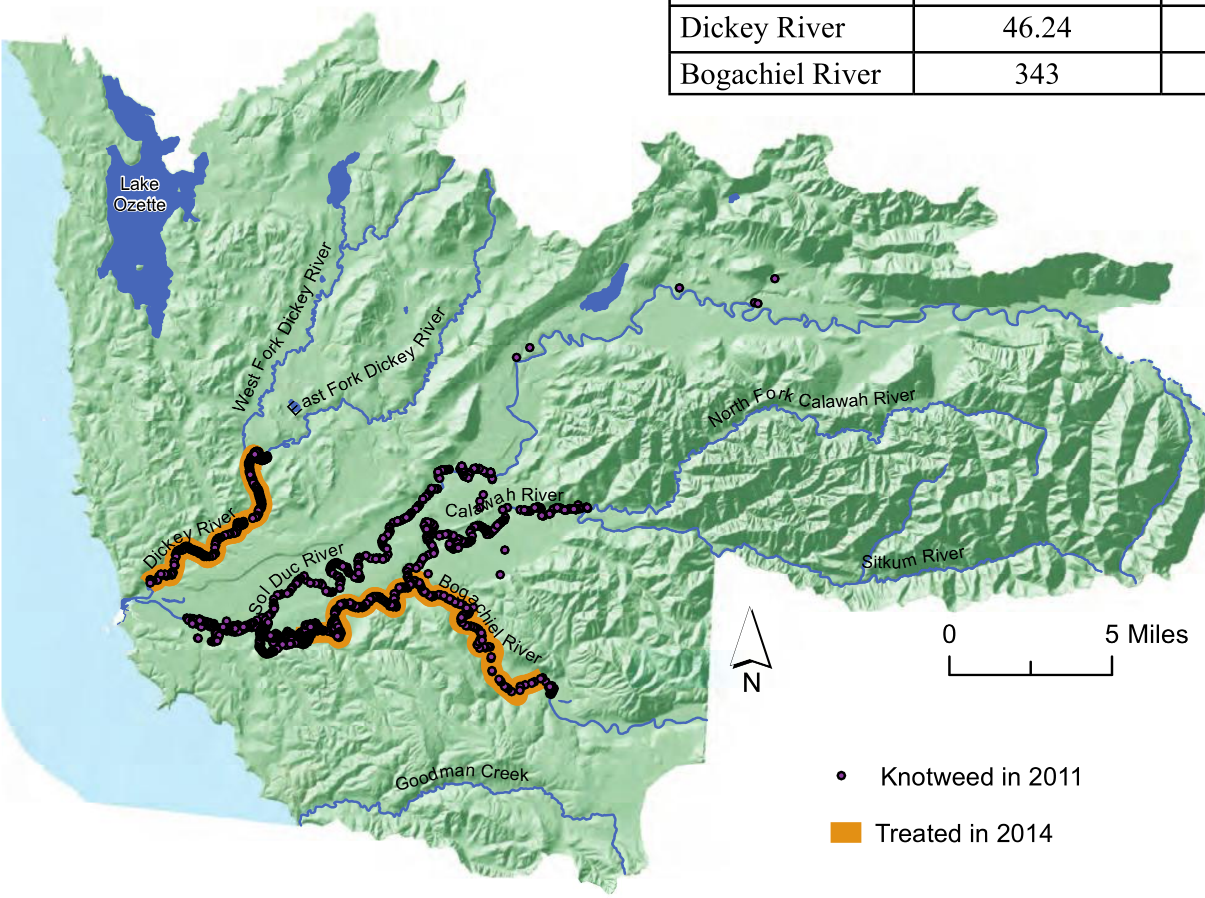
Data Sources: SSHIAP 2004,[2] USGS 2014,[3] WADNR 2014b,[4] WAECY 2006,[5] WAECY 2011a,[6] WAECY 2011b[7]

Invasive Knotweed Management

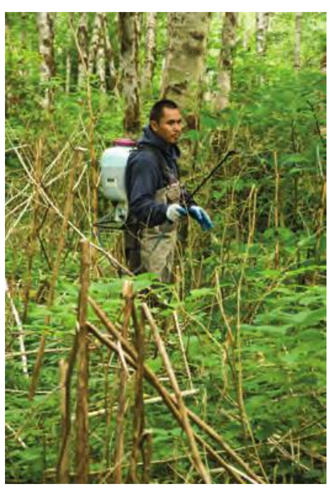
The Quileute Tribe continues to make efforts to reduce invasive knotweed densities in the Dickey, Calawah, Sol Duc and Bogachiel watersheds, and the Quillayute mainstem, a process that began in 2003. In 2014, the Quileute Tribe treated 7.63 miles and 13 miles in the Dickey River and Bogachiel River watersheds respectively. Clallam County has treated much of the Sol Duc .

Knotweed Control by Quileute Tribe in 2014

Watershed	Acres Searched	Miles Treated
Dickey River	46.24	7.63
Bogachiel River	343	13



Quileute Tribe



Debbie Preston, NWIFC

Quileute tribal staff controlling knotweed.

Invasive knotweed (*Polygonum spp.*) plants are known to displace native species and alter riparian vegetative communities.[1] They can cause long-term changes to the structure and functioning of the riparian forests, negatively impacting watershed health and adjacent fish habitat. These plants have been widely distributed in the riparian zone of the Quillayute watershed.[2] Its removal and control continues to be listed as a "Top Priority" salmon restoration project by the Quileute Tribe.

Since 2003, the Tribe has embarked on a multi-year effort to eradicate these plants. The program has resulted in the largely successful removal of these plants in the Dickey system.[3] The efforts in the Calawah, Sol Duc and Bogachiel are also largely successfully completed.[4] Because rhizomes sometimes regenerate plants, a few years of retreatment is essential.

These efforts have resulted in a drastic reduction of the densities of these plants, so that it now takes only a fraction of the time it previously took to treat and control them.[5] The Tribe continues to monitor these systems for re-infestation, while expanding work into the Quillayute mainstem.

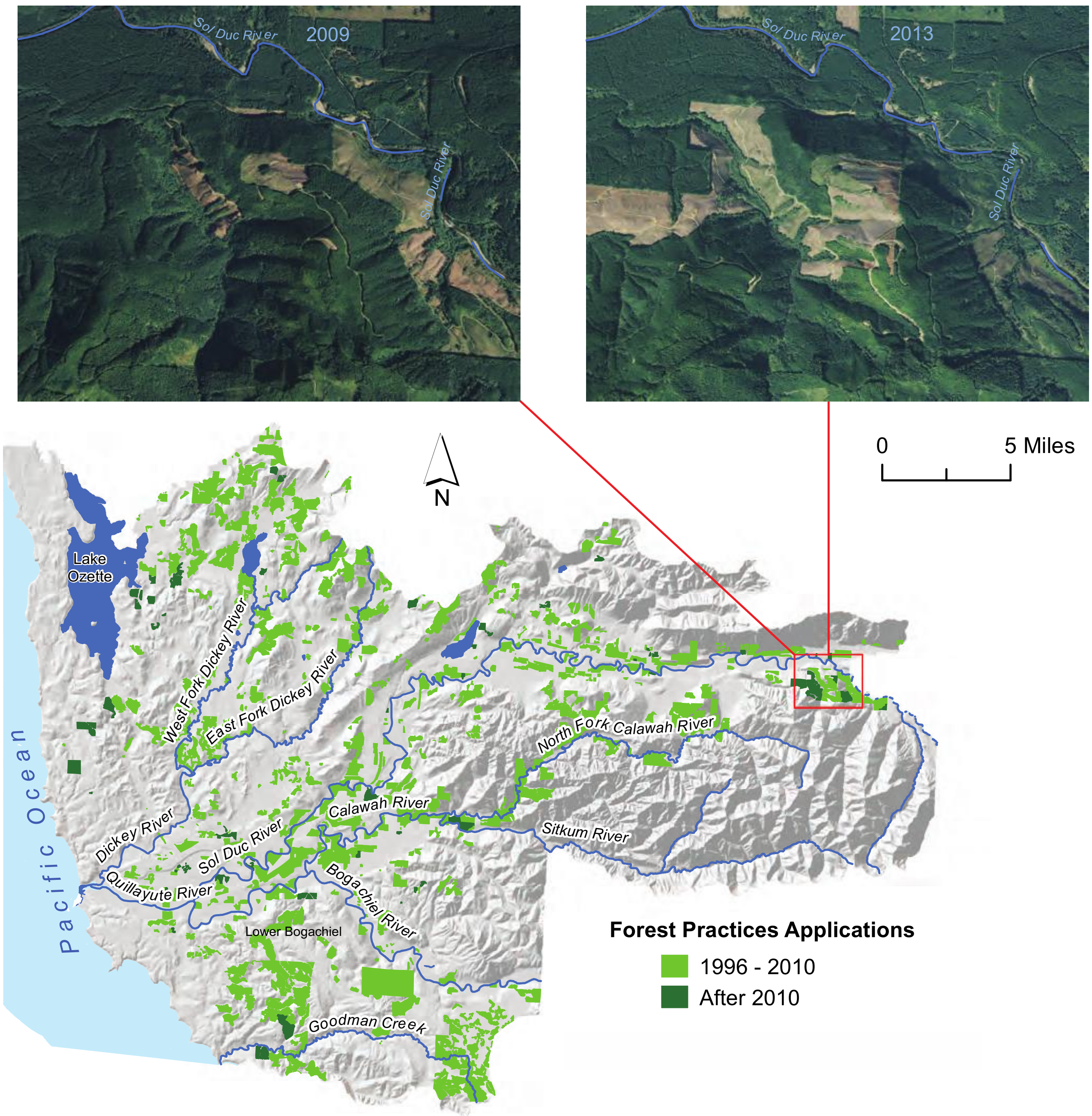
Data Sources: Quileute 2011,[6] Quileute 2015,[7] SSHIAP 2004,[8] WAECY 2011a[9]

Forest Practice Activities

Since 2011, 1.4% of private and 0.3% of state-owned forestlands have been permitted for harvesting in the Quileute Tribe's Area of Concern. Between 1996 and 2010, the rate was 20.1% and 8.9% respectively. The average rate of harvest was 4.4 square miles/year (from 1996 to 2010) and 1.1 square miles/year (since 2011), which may indicate a trend toward a slower rate of harvest activity.

Forests in the Quileute Tribe's Management Area of Concern have been relied upon for many important resources, including timber. However, the removal of vegetation from commercial timber harvesting negatively impacts riparian function, results in poor large woody material recruitment in streams and alters the flow regime. These are factors limiting salmon production in the area.[1] Forest practice applications filed for the purposes of cutting or removal of commercial timber products in the Area of Concern show that between 1996 and 2010, about 20.1% of private and 8.9% of state-owned forestlands were permitted for harvesting. Since 2011, about 1.4% and 0.3% of private and state-owned forestlands respectively were permitted for harvesting. From 1996 to 2010, the average rate of harvest was 4.4 square miles/year and since 2011, it has been 1.1 square miles/year. This may indicate a trend toward a slower rate of harvest activity.

Most of the recent forest practice activities seem to be concentrated in the Lower Sol Duc, Dickey and Goodman Creek watersheds, which are predominantly private forestlands.



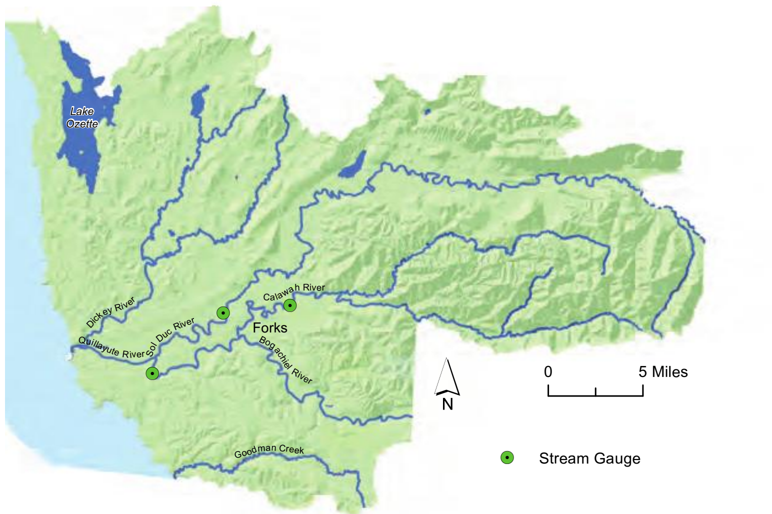
Data Sources: NAIP 2009,[2] NAIP 2013,[3] SSHIAP 2004,[4] WADNR 2011,[5] WAECY 2011a[6]

Streamflow

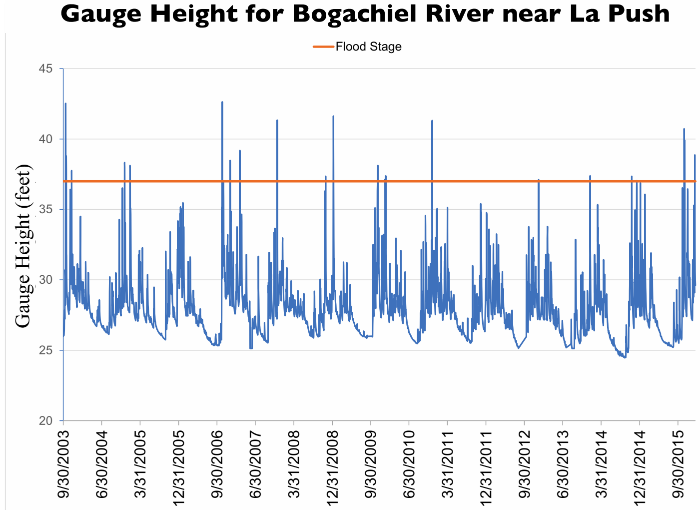
Since 2010, streamflows for the Calawah River have followed the same overall trends as the previous 35 years – increasing peak flows and decreasing low flows. Both trends could threaten salmon habitat and other aquatic ecosystem functions. For instance, in the summer of 2015, streamflows in this Area of Concern were so low that fish had difficulty reaching spawning grounds.

The ability of river systems to provide adequate water for fish is critical for fish migration survival and productivity. Protection of instream flows is a key goal of the WRIA 20 detailed implementation plan.[1] However, to date there are no instream flow rules in place and no funds from the state or others to initiate them.[2] The Quileute Tribe works with the Department of Ecology to continue operation of the monitoring gauge on the Sol Duc River, which supports stocks of coho, Chinook and sockeye salmon, as well as native runs of steelhead and cutthroat trout. The variation in streamflow timing and magnitude shown for the Sol Duc is typical for streams in this basin, with peak flows in the winter months and low flows in the summer months. The Tribe also operates a gauge on the Bogachiel River, which is used to track flooding and its impacts on road access from La Push to Forks. In addition, tribal staff monitors water flow levels with a handheld device while monitoring for water quality.

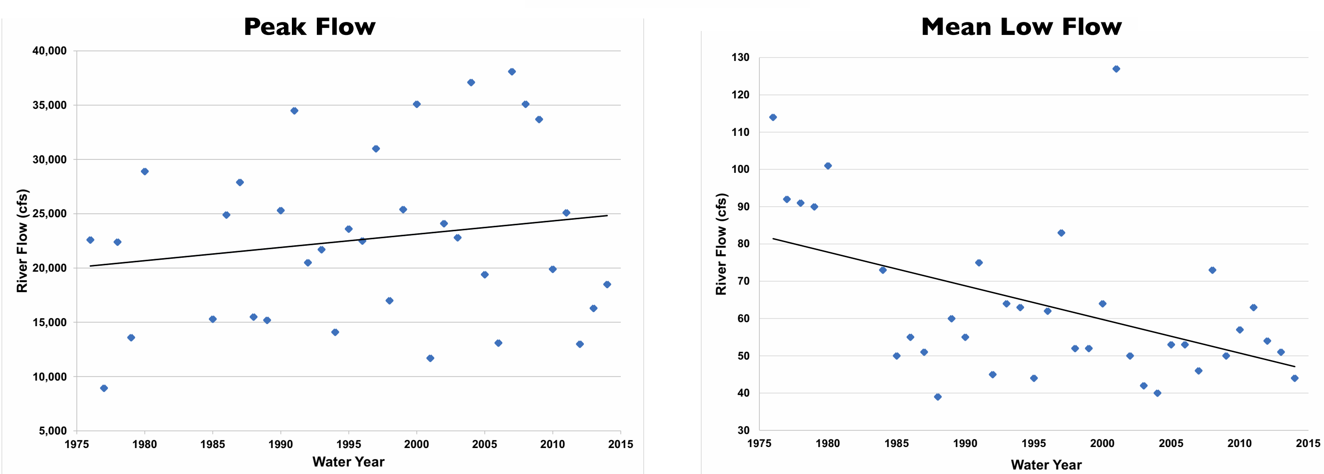
Since 2010, streamflows for the Calawah River have followed the same overall trends as the previous 35 years – increasing peak flows and decreasing low flows. Such a scenario is predicted to occur as a result of climate change, and both trends could threaten salmon habitat and other aquatic ecosystem functions.[3] Increased peak flows may also be the result of removal of vegetation.[4,5] They cause the scouring of streambeds, channel incision (and subsequent disconnection from floodplain), and downstream transport of wood, resulting in simplified stream channels and greater instability. The trend of increasing peak flows has been shown to make streams less productive.[6] Many studies in the Pacific Northwest have documented the relationship between low streamflows and poor salmonid survival.[7,8] The reduction in streamflows may result in less fish habitat because of dry streambeds or pools become cut off from the main channel and strand fish. In the summer of 2015, streamflows in this Area of Concern were so low that fish had difficulty reaching spawning grounds.



Gauge Height for Bogachiel River near La Push



Calawah River Flows



Data Sources: SSHIAP 2004,[9] USGS 2015,[10] USGS 2016,[11] WAECY 2011a,[12] WAECY 2015[13]

Impact of Roads on Fish Habitat

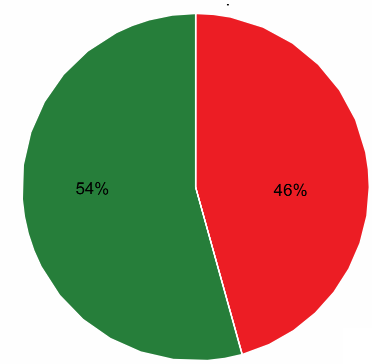
About 54% of the 1,528 Road Maintenance and Abandonment Plan (RMAP) forestland culverts in the Quileute Area of Concern have been fixed, leaving about 46% to be repaired by 2021. Also 15 watersheds representing 68% of the land area may not be properly functioning due to road densities that exceed the 3 miles/square mile threshold.

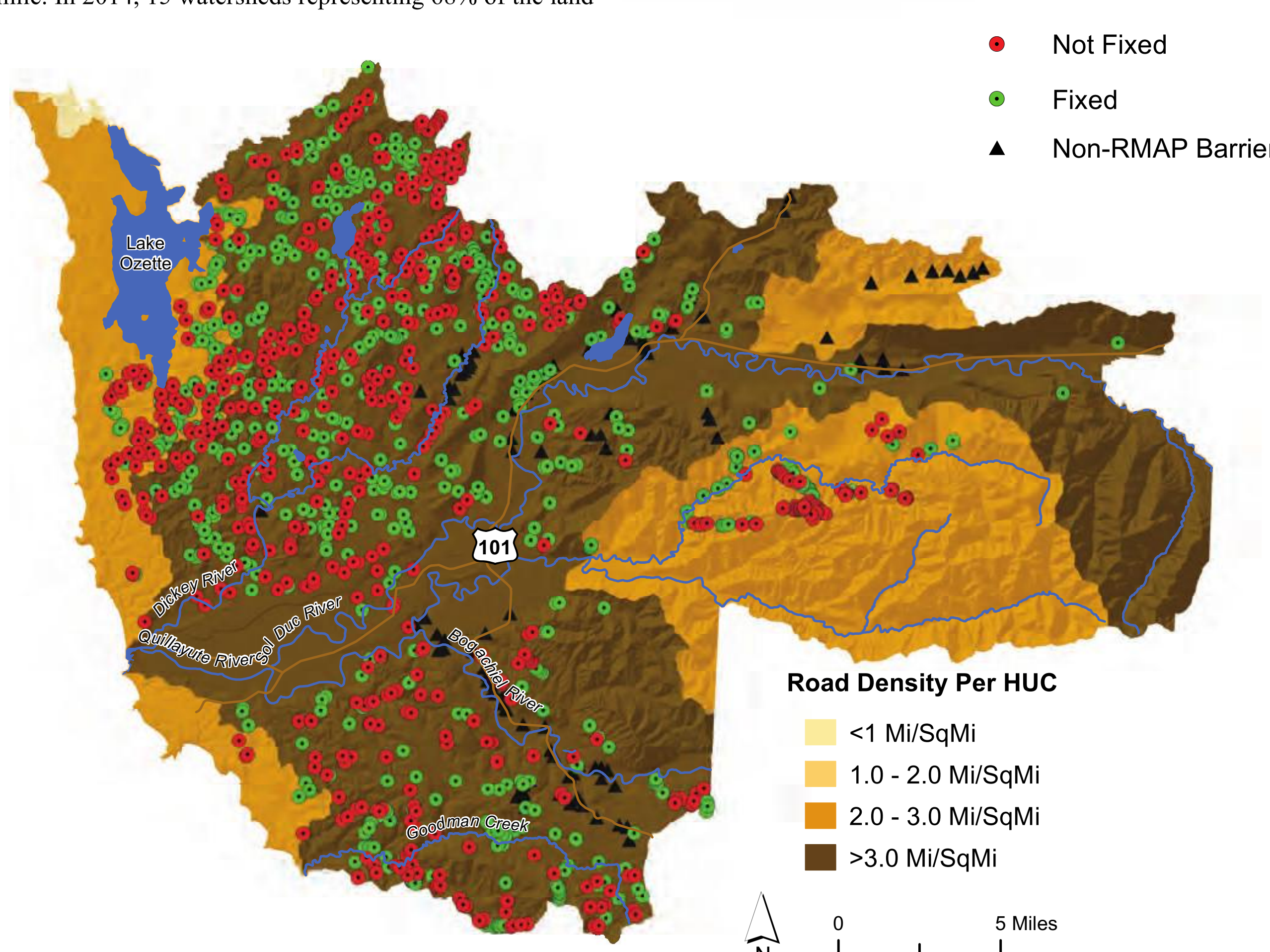
Roads are a vital component of the human use of forested watersheds, but they can affect fish habitats by increasing erosion and sediment loading, and by changing channel morphology. If not properly constructed or maintained, culverts at road crossings may become fish barriers. The WRIA 20 Detailed Implementation Plan recommends restoring fish populations by working to remove fish passage barriers.[1]

The Washington State Forests and Fish Law requires most forest landowners to have a RMAP for their ownership, which includes a schedule for any repair work needed to improve road systems at stream crossings and address aquatic habitat and fish-passage issues. The RMAP data shows that about 54% of the identified 1,528 culverts in the Quileute Area of Concern have been fixed and the remaining 46% were yet to be repaired and remain barriers to fish, as of December 2014. In addition, there were 121 non-RMAP fish barriers in the area.

The National Marine Fisheries Service defined watersheds with road densities greater than 3 miles/square mile of watershed area as "not properly functioning" for salmon habitat.[2] Watersheds were classified as "properly functioning" when road densities were less than 2 miles/square mile and "at risk" when values were 2-3 miles/square mile. In 2014, 15 watersheds representing 68% of the land area in the Quileute Area of Concern still have road densities that placed them in the "not properly functioning" category and this could have an impact on stream hydrology, fish habitat and salmonid production. The highest density of over 5 miles/square mile was in the Crooked Creek watershed near Ozette Lake. Other high density watersheds were the West Fork and East Fork Dickey River, as well as the Bockman Creek-Sol Duc River watersheds.

RMAP Culvert Repair Status





Data Sources: SSHIAP 2004,[3] WADNR 2014c,[4] WADNR 2014d,[5] WADOT 2012,[6] WAECY 2011a[7]

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Citations

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Impact of Roads on Fish Habitat

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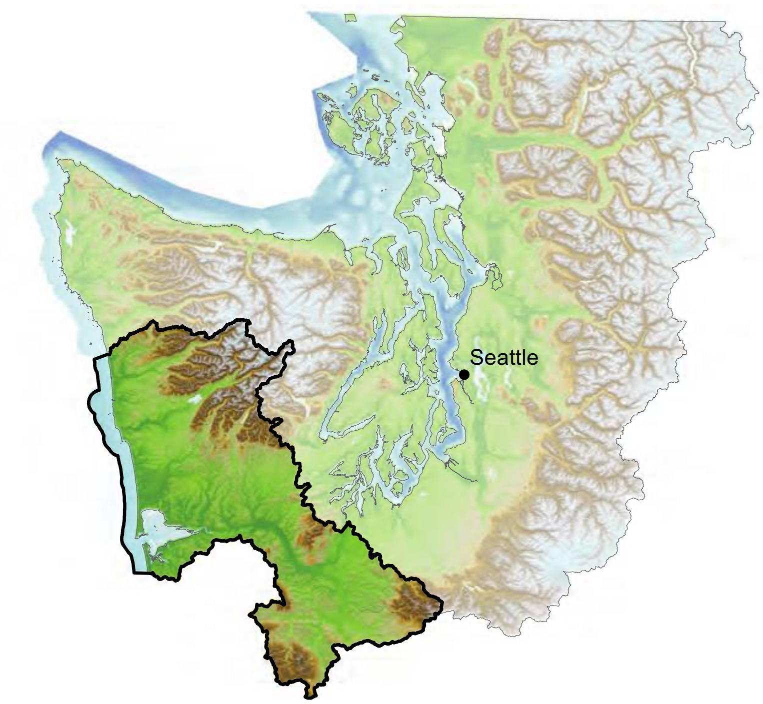
2016 State of Our Watersheds Report
Queets – Chehalis Basins

The evidence is abundantly clear. We know how to manage our fish. We understand sustainability. The problems fish are facing are not of our making. But we are definitely a big part of the solution, with the work we do in habitat restoration and protection, good management and education.

– **Fawn Sharp, President**
Quinault Indian Nation



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, Washington.

Queets – Quinault – Chehalis Basins

Debbie Preston, NWIFC

A tree planting crew seeds Sitka spruce as part of the Quinault Indian Nation's work to restore native vegetation to the upper Quinault river valley floodplain to help improve production of blueback (sockeye) salmon. Crews planted 12,000 spruce seedlings at about 170 trees per acre, similar to the densities in naturally developing forests of the Hoh and Queets river bottoms.

The Quinault Indian Nation's Area of Interest for this report covers three Water Resource Inventory Areas (WRIAs) including the Queets-Quinault basin (WRIA 21) and Chehalis basin (WRIAs 22 and 23). WRIA 21 contains the tributaries to the Pacific Ocean from Kalaloch Creek in the north to near Grays Harbor in the south. 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 that head at the foothills of this range. All these streams provide suitable spawning and rearing habitat for salmon.[1] The Lower Chehalis (WRIA 22) comprises mainly the lower portion of the Chehalis River drainage, with 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 three WRIAs in this report support Chinook, chum and coho salmon, as well as steelhead and cutthroat trout, and char. WRIA 21 also supports sockeye salmon. The Queets, Quinault and Chehalis basins have known bull trout use but in the Chehalis, the documented use is limited to foraging. Bull trout were listed as threatened under the federal Endangered Species Act in 1999. The salmon and steelhead runs in the Chehalis basin are significantly degraded from their historic levels. Modeling of salmon populations by the Governor's Chehalis Basin Workgroup shows spring-run Chinook populations reduced by 78%, Fall-run Chinook by 45%, coho by 69%, and steelhead by 44%.[2]

The majority of the area is forestland owned by corporations and government and includes the Capitol State Forest and Quinault Indian Reservation, as well as portions of Olympic National Forest, Gifford Pinchot National Forest and Olympic National Park. Although salmonids in this area have fared better than in Puget Sound,[3] several habitat factors limit salmonid production in the basin. These include 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.

Recovery Efforts Lagging

A review of key environmental indicators for the Queets to Chehalis basins area shows that priority concerns continue to be degradation of water quantity and quality, degradation of floodplain and riparian processes, loss of forest cover conditions and habitat blocked to fish access. Improvement has been observed in forest roads (RMAPs). 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 since the 2012 State of Our Watersheds report shows an improvement for one indicator and a steady loss for others in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Water Quality	Between 2011 and 2013, there were widespread water temperature impairments in the Queets River watershed that exceeded Washington State numeric water quality standards. These violations, likely caused by forest practices activities and glacier loss, will have an impact on salmonid production in the watershed.	Declining
Water Quantity - Peak Flows	Peak flows have shown an increasing trend for both the Queets River and Chehalis River.	Declining
Water Quantity - Low Flows	Low flows on the Chehalis River have experienced an increasing trend.	Concerns
	Low flows on the Queets River have experienced a decreasing trend.	Declining
Forest Roads	About 61% of the RMAP culverts have been repaired and 39% are scheduled to be completed by 2021.	Improving
Road Densities & Crossings	Approximately 90% of the Quinault Area of Interest had road densities of greater than three miles/square mile, the level at which streams cease to function properly. Road crossings were highest in the East Fork Satsop River and Black River watersheds with values of greater than one per mile of stream. The Chehalis Basin Salmon Habitat Restoration and Preservation Strategy (2010 Update) calls for a reduction of sediment loading by reducing road densities in the basin.	Declining
Forestland Cover	Between 2006 and 2011, there was an overall negative trend (1- 14%) in forest cover conditions in watersheds on State and Private forestlands.	Declining
Water Wells	Between 1980-2009, 9,991 wells were completed at a rate of about 344 new wells per year. Between 2009-2014, 580 wells have been added at a lower rate of about 116 wells per year.	Declining
Impervious Surface	From 2006 to 2011 watersheds in the Chehalis River basin showed deteriorating impervious surface conditions with increases ranging from 1% to over 5%. Areas near the cities of Aberdeen, Centralia, and Chehalis have impervious surface conditions that were impacting (7-12%) or degrading (12-40%). Rest of area have impervious surface area 0-4%.	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

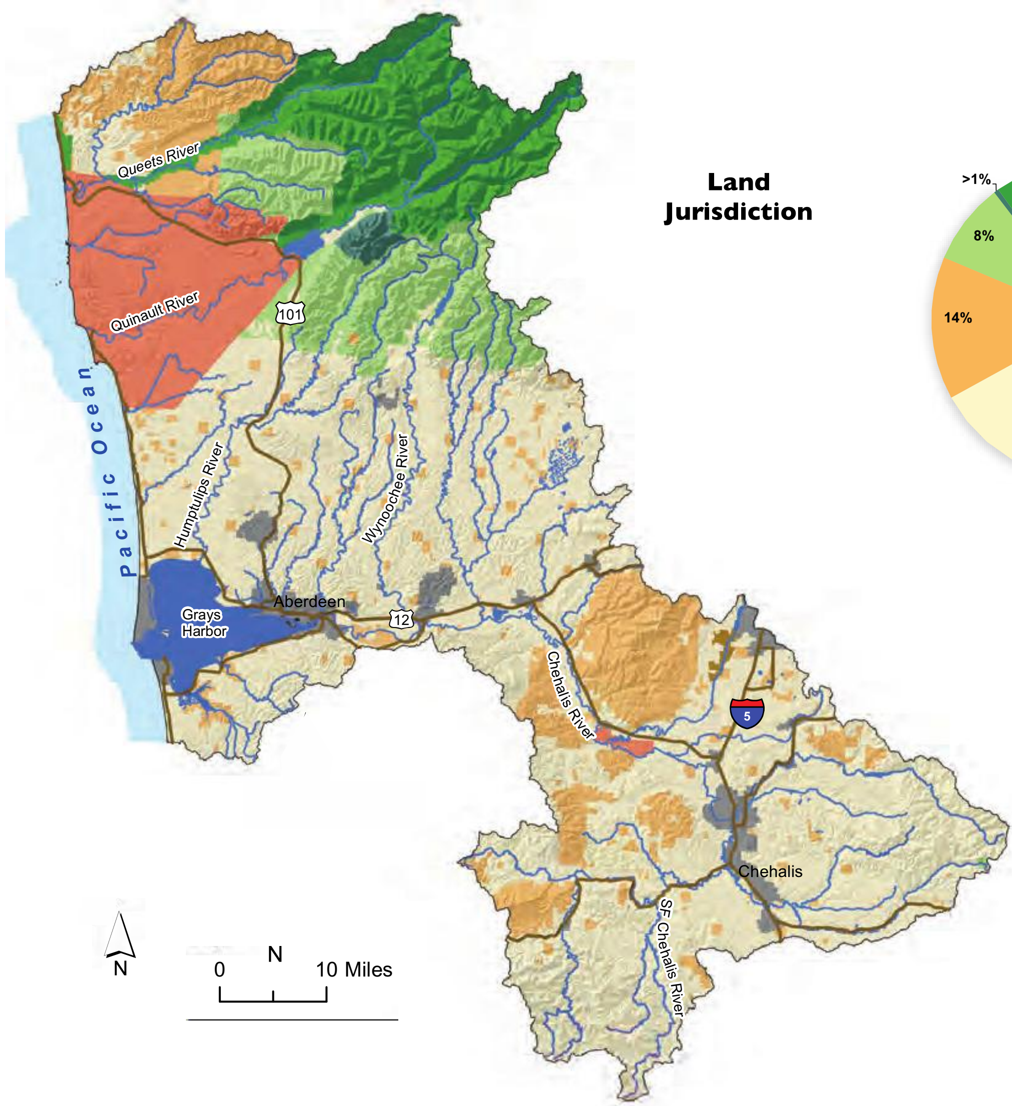
Pressure from population growth, agricultural practices and timberland use within the Chehalis River basin will continue to present challenges to salmon conservation and recovery efforts. Land-use management and forest practice regulations continue to allow the further degradation of floodplain and riparian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

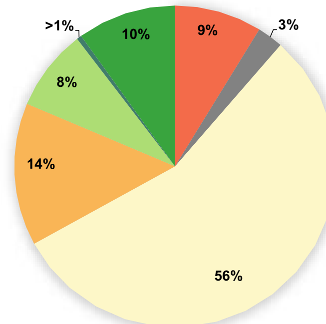
Current trends indicate that land-use regulation reform is required and continued funding of habitat restoration activities is necessary in order to achieve salmon recovery goals. The Chehalis Basin Salmon Habitat Restoration and Preservation Strategy for WRIA 22 and 23 relies almost exclusively on restoration to address limiting factors within the basin.

However, we are still witnessing the continued loss and fragmentation of habitat through barrier culverts, high road densities and crossing, forest cover removal and wells. The lack of progress on the protection of existing habitat remains the biggest impediment to salmon recovery.

Quinault Indian Nation

The Queets, Quinault, and Chehalis Watersheds





The Quinault Indian Nation's Area of Interest 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. WRIA 21 contains the tributaries to the Pacific Ocean from Kalaloch Creek in the north to near Grays Harbor in the south. 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 that start at the foothills of this range. All these streams provide suitable spawning and rearing habitat for salmon.[1]

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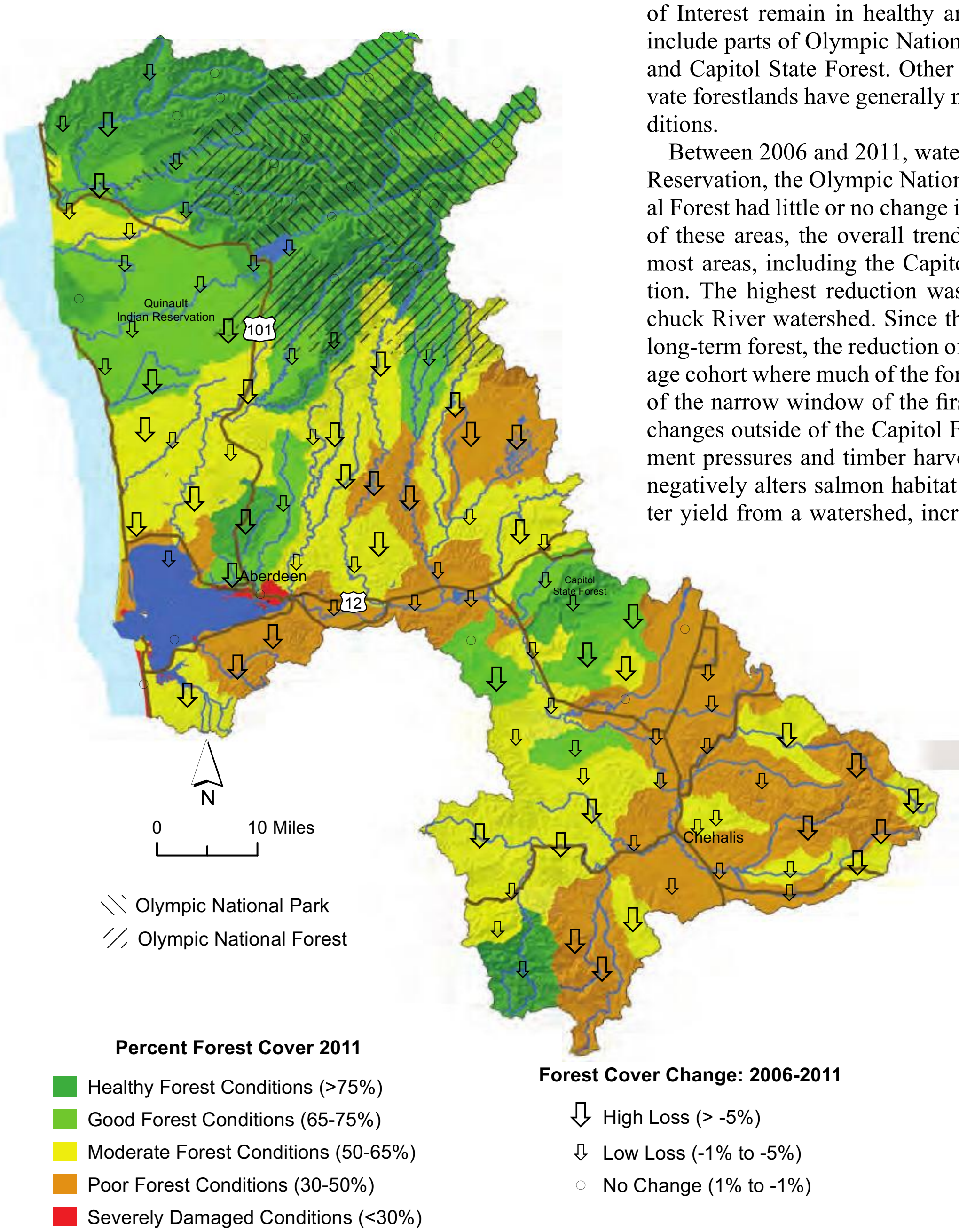
Data Sources: SSHIAP 2004,[7] USFWS 2014,[8] WADNR 2014a,[9] WADNR 2014b,[10] WADOT 2012,[11] WADOT 2013,[12] WAECY 1994,[13] WAECY 2011a,[14] WAECY 2013[15]

Forest Cover Conditions

A total of 47 watersheds (representing 42% of the land area) within the Quinault Tribe's Area of Interest are in healthy and good forest conditions with over 65% forest cover. Other areas which are predominantly private forestlands are in moderate (<65%) to poor (<50%) forest cover conditions. Between 2006 and 2011, there was an overall negative trend in forest cover in watersheds outside the Tribal Reservation, Park and Forest Service lands, with a forest cover loss of up to 14.3%.



Forest cover conditions impact the ecological processes that create and maintain fish habitat. Large sections of the Quinault Area of Interest remain in healthy and good forest conditions. These include parts of Olympic National Forest, Olympic National Park and Capitol State Forest. Other areas that are predominantly private forestlands have generally moderate to poor forest cover conditions.

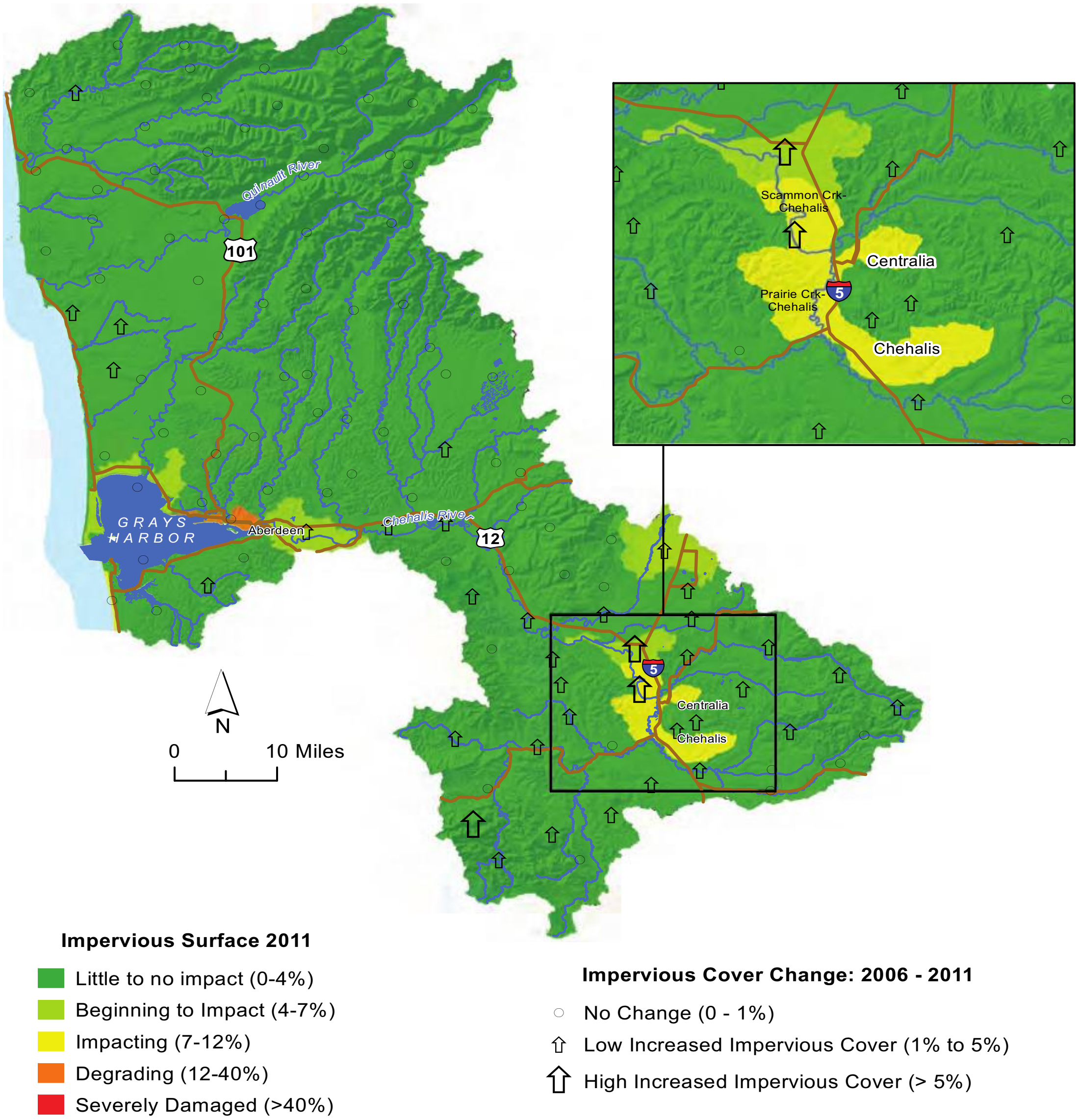
Between 2006 and 2011, watersheds within the Quinault Indian Reservation, the Olympic National Park, and the Olympic National Forest had little or no change in forest cover conditions. Outside of these areas, the overall trend in forest cover is negative with most areas, including the Capitol State Forest, showing a reduction. The highest reduction was 14.3% in the Upper Skookumchuck River watershed. Since the Capitol Forest is managed as a long-term forest, the reduction of forest cover there may reflect the age cohort where much of the forest is merchantable age as a result of the narrow window of the first harvest. On the other hand, the changes outside of the Capitol Forest most likely reflect development pressures and timber harvesting. 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 overall negative trend in forest cover makes it critical to protect and preserve those watersheds with good or better forest conditions. 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 adopted the restoration and preservation of properly functioning riparian areas as an important strategy for addressing this limiting factor.[4]

Data Sources: SSHIAP 2004,[5] USGS 2014,[6] WADOT 2012,[7] WAECY 2006,[8] WAECY 2011a,[9] WAECY 2011b[10]

Impervious Surface

A total of 103 watersheds (representing 92% of the land area) in the Quinault Area of Interest currently have impervious surface levels of 0-4%, showing little to no impact from those conditions. However, areas near Aberdeen, Chehalis and Centralia had impervious surface conditions that were impacting (7-12%) or degrading (12-40%). Between 2006 and 2011, watersheds in the southern half of the area showed deteriorating impervious surface conditions with increases from 1% to 11.4%.



Imperviousness, an indicator of urbanization, negatively impacts fish habitat by increased erosion, stream channel destabilization, loss of pool habitat, excessive sedimentation and scour, and large woody debris reduction. A high percentage of impervious surface also leads to higher peak streamflows, increased sediment and pollutant delivery, and decreases in stream biodiversity.[1]

Based on 2011 data, most of the watershed units in the Quinault Area of Interest have impervious surface levels of 0-4%, showing little to no impact from impervious surface conditions. This is an indication that urbanization is not a major limiting factor in this area. Exceptions to this are a few watersheds near Aberdeen as well as Chehalis and Centralia where impervious surface conditions were impacting (7-12%) or degrading (12-40%).

Between 2006 and 2011, there was little or no change in impervious conditions in watersheds in the upper half of this Area of Interest. In the lower half of the area, there is a general negative trend in many watersheds. The Scammon Creek-Chehalis River and Prairie Creek-Chehalis watersheds near Chehalis and Centralia in the Interstate 5 corridor had the highest increase (over 5%) in impervious surface levels. This is particularly significant because these watersheds already had impervious surface values that were impacting fish habitat. These conditions are likely caused by population changes and urbanization in the Chehalis/Centralia area.

While the current status of the impervious surface indicator is good in most watersheds, the general direction in the southern half of the Area of Interest is negative.

Data Sources: NLCD 2006,[2] NLCD 2011,[3] SSHIAP 2004,[4] USGS 2014,[5] WAECY 2011a[6]

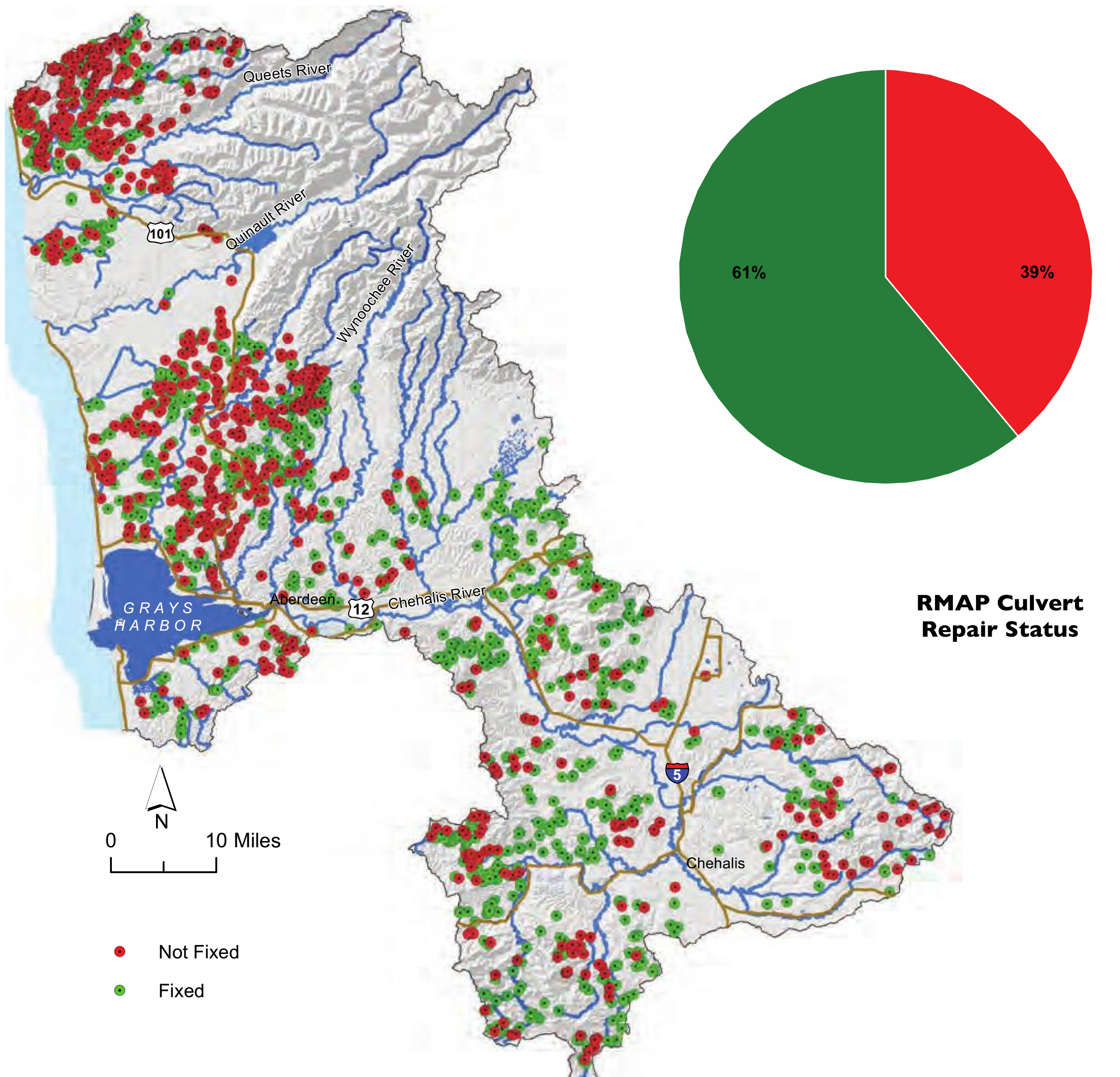
Impact of Culverts on Habitat

Under the Road Maintenance and Abandonment Plan (RMAP), about 61% of the identified 2,439 culverts in the Quinault Area of Interest have been fixed, but another 39% were yet to be repaired, and create barriers to fish passage. Overall, the RMAP program appears to be working.

Roads are an important component of the human use of forested systems. If not properly constructed or maintained, forests roads can be a source of sediments to streams that degrade fish habitat and water quality.[1] Furniss et al. concluded that the sediment contribution per unit area from roads is often much greater than all other forest activities combined.[2] Also, many culverts at forest road crossings may constitute fish barriers. The Chehalis Basin Salmon Habitat Restoration and Preservation Strategy identified the replacing of dysfunctional culverts as a very high priority because they eliminate access by wild salmonids to upstream habitat.[3]

In order to reduce the adverse effects of roads, Washington State Forests and Fish Law requires most forest landowners to have a Road Maintenance and Abandonment Plan (RMAP), a schedule for any repair work needed to upgrade road systems at stream crossings, and address aquatic habitat and fish passage issues. RMAP's are only required in forestlands and there is no process in place to consistently inventory or repair blocking culverts outside of forestlands. Also, since the law exempts small forest landowners, the RMAP culvert numbers here are likely understated.

The RMAP data shows that about 61% of the identified 2,439 culverts in the Quinault Area of Interest have been fixed, but another 39% were yet to be repaired and create barriers to fish passage. Overall, the RMAP program appears to be working. This should have a positive impact on fish habitat and water quality in the Quinault Area of Interest.



RMAP Culvert Repair Status

Data Sources: SSHIAP 2004,[4] WADNR 2014c,[5] WADOT 2012,[6] WAECY 2011a[7]

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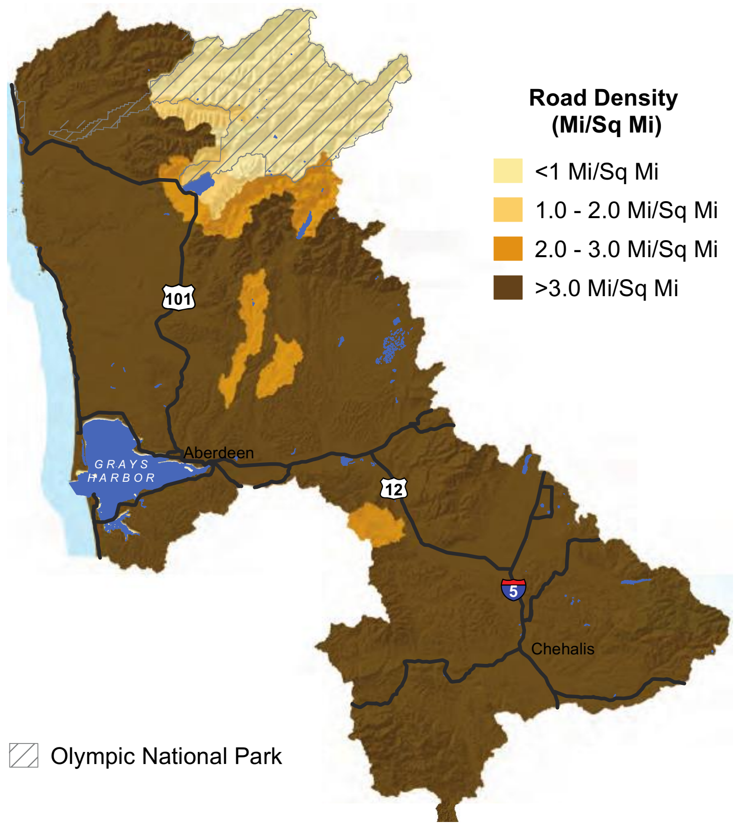
The Impact of Road Densities and Crossings

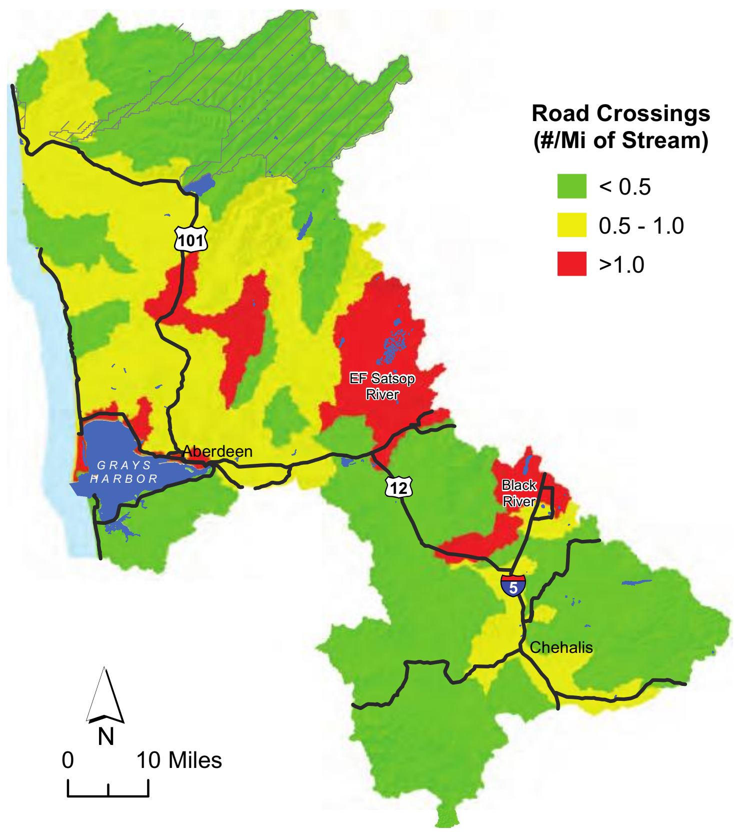
Approximately 90% of the Quinault Area of Interest had road densities of greater than 3 miles/square mile, the level at which streams cease to function properly. Road crossings were highest in the East Fork Satsop River and Black River watersheds with values of greater than 1 per mile of stream.

Roads can adversely affect stream ecosystems through multiple pathways. Due to increased imperviousness, roads indirectly bring about increased erosion rates in watersheds,[1] leading to altered stream discharge patterns, mass wasting, and increased sediment delivery to streams. Elevated fine sediment levels, identified as a limiting factor by the Chehalis Basin Salmon Habitat Restoration and Preservation Strategy, decrease the quality of spawning gravels.[2]

Road density values were over 2 miles/square mile in most watersheds outside Olympic National Park where the values were less than 1 mile/square mile. This is the direct result of the network of roads built notably for harvest of timber. Several studies have correlated road density or indices of roads to fish density and diversity.[3] Cederholm et al. found increases in fine sediment in fish-spawning habitat when road density exceeded 2.5% of the total basin area in the Clearwater watershed.[4] 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] A vast majority of watersheds in the Quinault Area of Interest had road densities that exceeded this value.

At road crossings, roads can directly impact stream ecosystems, for example by altering stream geomorphology. Road crossings were highest in the East Fork Satsop River and Black River watersheds (near the I-5 corridor) with values of over 1 per mile of stream. Crossings were lowest in watersheds within the National Park.





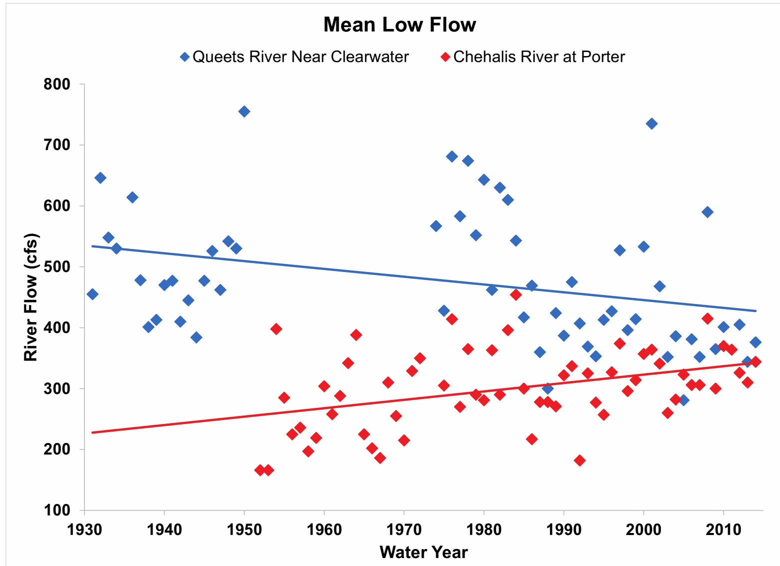
Data Sources: SSHIAP 2004,[6] USGS 2014,[7] WADNR 2014c,[8] WADNR 2014d,[9] WADOT 2012,[10] WAECY 2011a[11]

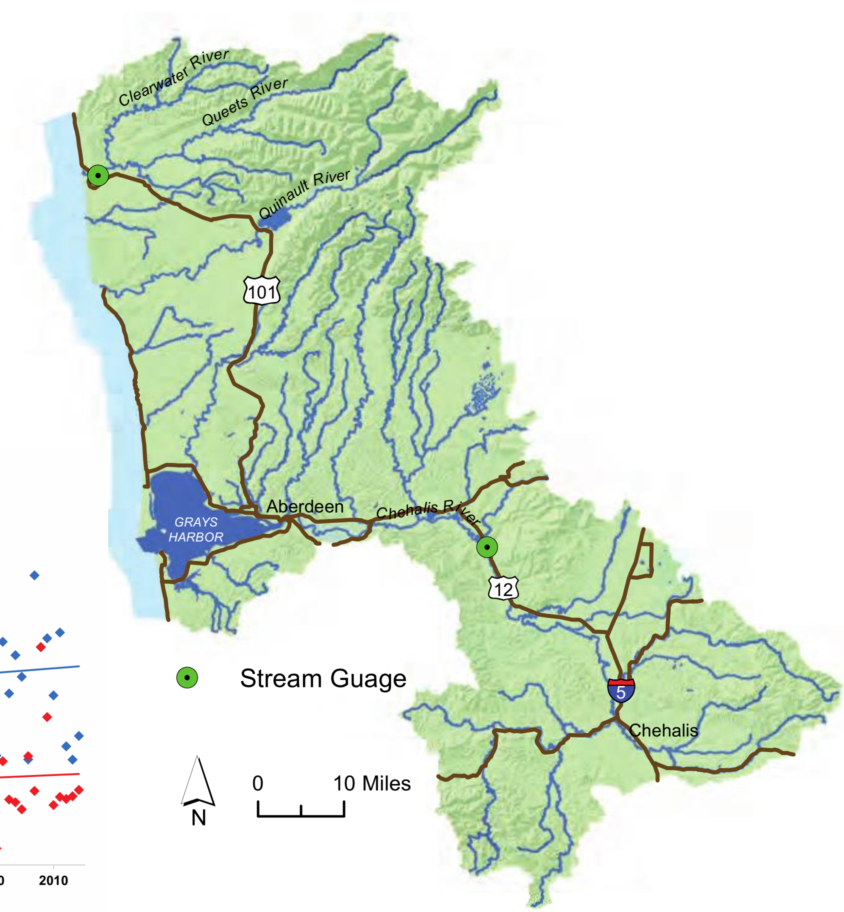
Streamflow

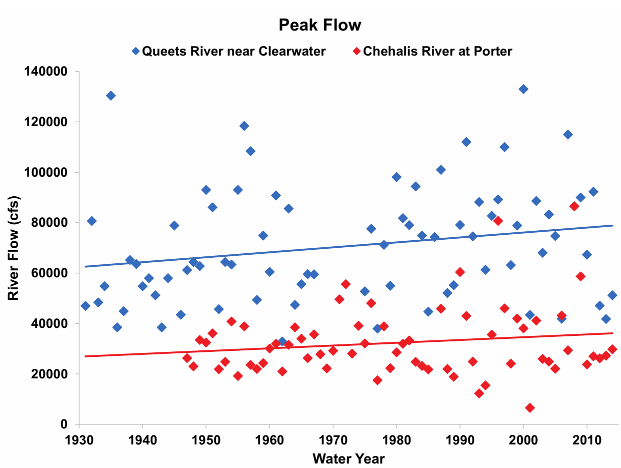
Peak flows for the glacier-fed Queets River show an increasing trend over time, while mean low flows show a decreasing trend. In the rain-dominated Chehalis River, both peak flows and mean low flows are increasing. If these trends continue as a result of climate change, the altered streamflows may have a significant impact on salmon populations.

Streamflow data are important in determining the instream resources available for fish survival and productivity. 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. The lower summer flows in the Chehalis were likely the result of 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 for the glacier-fed Queets River show an increasing trend over time while mean low flows show a decreasing trend. This means that in the days of lowest flow, it was carrying less water than before. One major concern is the loss of glaciers and spring snow melt to refill the groundwater and replenish the surface flows. The system changing to a rain-dominated system may have a significant impact on the fisheries. In the rain-dominated Chehalis River, both peak flows and mean low flows show an increasing trend, meaning that in the days of lowest flows, it was carrying more water. If these trends continue as a result of climate change, the altered streamflows (as well as warming summertime stream temperatures) will likely reduce the reproductive success of salmon populations.[2]







Data Sources: SSHIAP 2004,[3] USGS 2015a,[4] USGS 2015b,[5] WADOT 2012,[6] WAECY 2011a[7]

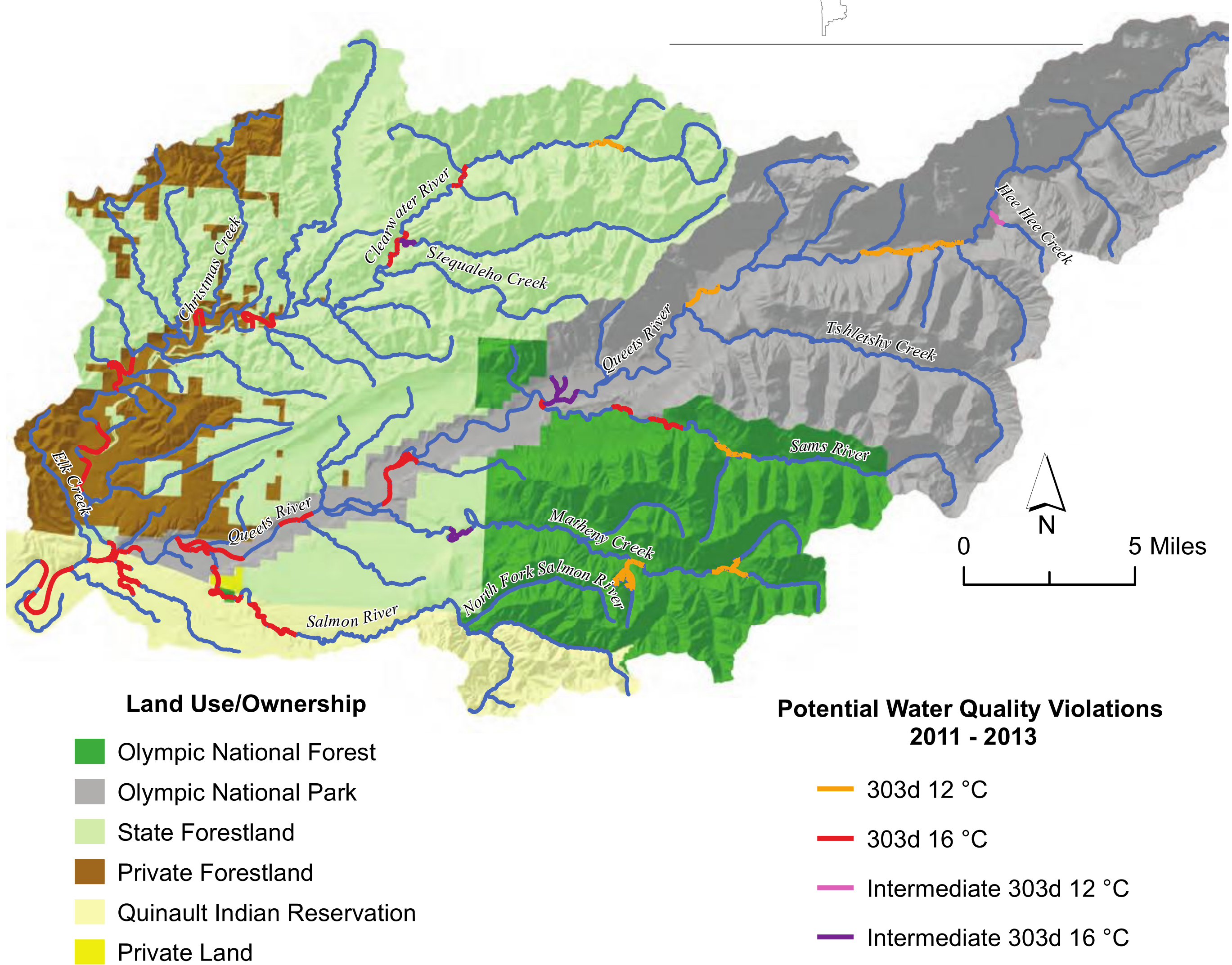
Queets River Watershed Water Temperature

Between 2011 and 2013, there were widespread water temperature impairments in the Queets River watershed that exceeded Washington state numeric water quality standards. These violations, likely caused by forest practice activities and glacier loss, will have an impact on salmonid production in the watershed.

Water temperature monitoring throughout the Queets River watershed was carried out between 2011 and 2013 to determine compliance with water quality standards for surface waters of the State of Washington.[1] The temperature values were used to determine compliance for stream reaches with designated uses of "Char Spawning and Rearing" (7-DADM or 7-day average of the daily maximum temperatures of 12ºC) and "Core Summer Salmonid Habitat" (7-DADM of 16ºC).

Data analysis shows that 43 of 87 thermistors (49.4%) placed in this watershed in 2011 failed either the 12ºC or 16ºC criteria by at least 0.4ºC. Another seven thermistors had 7-DADM values within the units' accuracy specifications (+/- 0.3ºC), for a total of 50 potential violations. In 2012, 40 of 58 units (68.9%) exceeded the standards. Another six thermistors had values within the units' accuracy specifications, for a total of 56 potential violations. In 2013, 60 of 87 thermistors (68.9%) failed the standards. Another three thermistors had values within the units' accuracy specifications, for a total of 63 potential violations.

These potential violations are likely caused by forest practice activities and glacier loss. Insufficient accumulation of snow in the glacier during winter results in low spring flow of glacier water to cool surface waters in warmer summer months. Salmonid fish in general and bull trout in particular require cool and well-oxygenated water, and these widespread water temperature impairments will have an impact on fish production in the Queets River watershed.



Data Sources: Quinault 2013,[2] SSHIAP 2004,[3] WADNR 2014a,[4] WADNR 2014b,[5] WADOT 2013,[6] WAECY 2000,[6] WAECY 2011a[7]

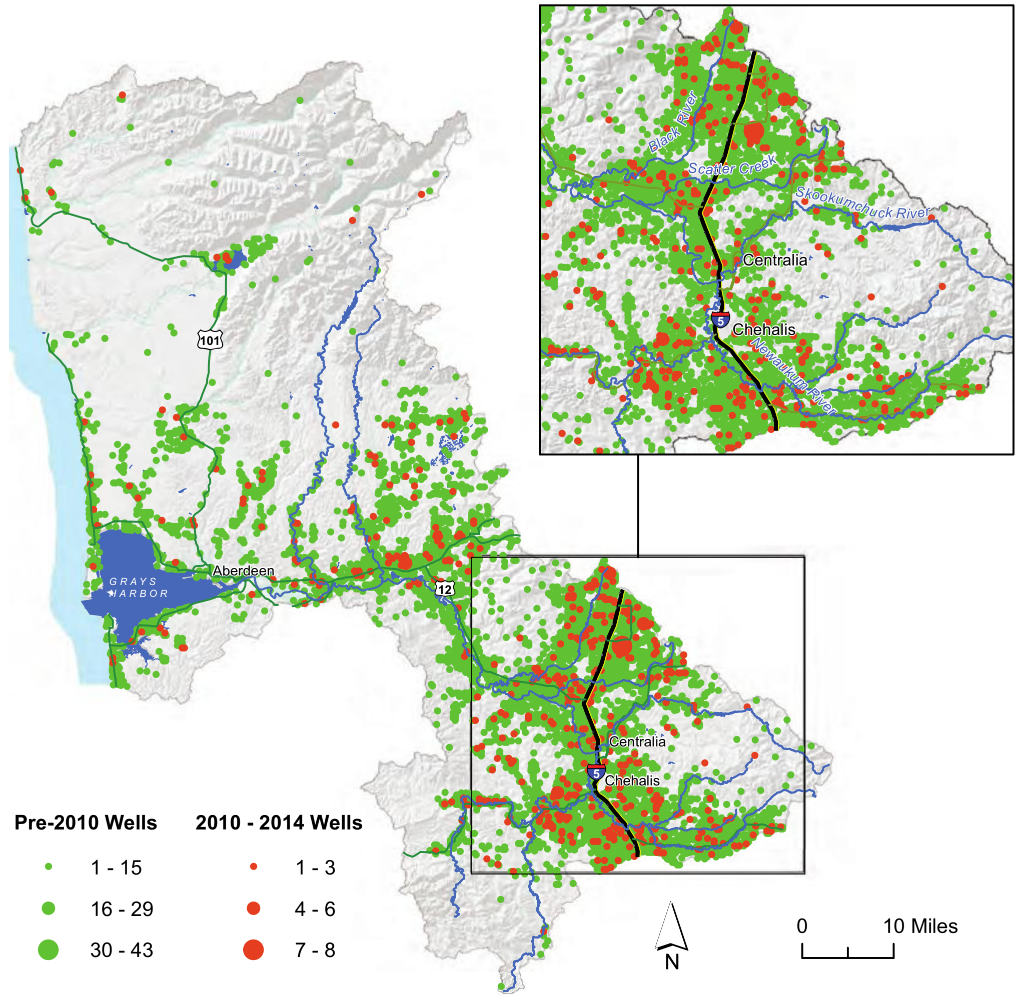
Quinault Indian Nation

Water Wells

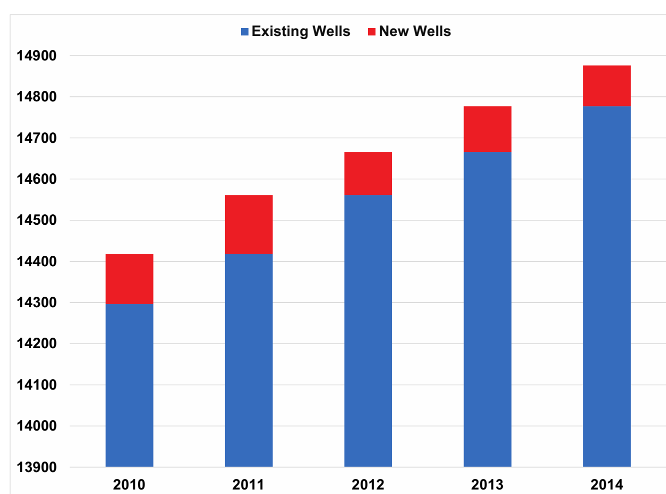
Currently, there are 14,876 water wells that may affect groundwater supply and instream flows in the Quinault Area of Interest. Between 1980 and 2009, 9,991 wells were completed in this Area of Interest, at a rate of about 344 new wells per year. Since 2009, 580 wells have been added at a lower rate of about 116 new wells per year.

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 identified low summertime flows in some sub-basins as a problem.[1] An earlier assessment found that in many streams and rivers, minimum streamflows are not met on many days from July through October.[2] 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]

There are currently 14,876 wells in the Quinault Area of Interest. The majority of wells are in the higher population areas of 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 2009, 9,991 wells were completed in the Quinault Area of Interest at a rate of about 344 new wells per year. Between 2010 and 2014, an additional 580 wells were added at a rate of about 116 new wells per year. Although the total number of wells has increased since 2010, the rate of increase has slowed compared to the pre-2010 period. The reduced rate of increase for wells may be the result of a slower population growth, a lesser dependence on wells for their water supply by landowners, the result of a slowdown in economic activities during that time period, or a combination of these factors.



Many streams in the Chehalis basin, including Scatter Creek, as well as Black, Skookumchuck and Newaukum rivers, are closed to further consumptive appropriations in the summer.[4] The impact of wells is expected to be greater in those areas where streamflows already do not meet regulatory minimums.



Data Sources: SSHIAP 2004,[5] WADOT 2012,[6] WAECY 2011a,[7] WAECY 2015[8]

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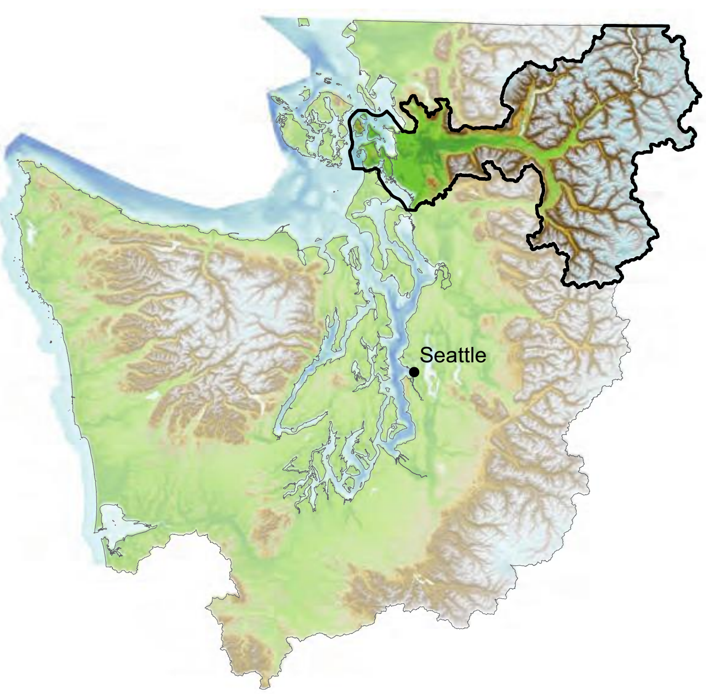
2016 State of Our Watersheds Report
Skagit River Watershed

The Sauk-Suiattle Indian Tribe has acquired 500-plus acres of lands for program or project development. These lands are surrounded by natural flowing rivers, mountains, an abundance of trees, nature and clean refreshing air. Our goal is to ensure the future for our people looking forward seven generations. We must protect our salmon habitat and restore the salmon habitat we lost. The past years have shown a slow recovery, but more must be done to restore the salmon runs that are so important to our tribal culture and way of life.

– Norma A. Joseph, Chairman
Sauk-Suiattle Indian Tribe



Sauk-Suiattle Indian Tribe

The Sauk-Suiattle Indian people have lived under the gaze of Whitehorse Mountain for many generations. They lived as hunters, gatherers and fishermen in the region of Sauk Prairie near the present-day town of Darrington, Washington. In the early days, they were known as the Sah-ku-me-hu. Sauk-Suiattle homelands encompassed the entire drainage area of the Skagit, Sauk, Suiattle and Cascade rivers. The Tribe had an important village at Sauk Prairie near the confluence of the Sauk and Suiattle rivers. Following the U.S. 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 Point Elliott Treaty. By 1924, numbers had dwindled to 18 members. Residents of the Sauk-Suiattle Indian Reservation are the surviving descendants of the original peoples who lived in this special valley. Current membership numbers around 200 individuals.

Wild and Scenic Rivers Part of Federal Lands

The Skagit, Sauk, Suiattle and Cascade basins remain among the healthiest within Puget Sound. The Skagit, Sauk, Suiattle and Cascade rivers are designated as "Wild and Scenic," and the Sauk is one of the largest undammed river systems remaining in the Pacific Northwest.

The upper portion of these watersheds is primarily under control of the federal government, located within the Mount Baker-Snoqualmie National Forest and North Cascades National Park. The middle and lower sections of the watershed are largely held as forestland, either in state or private ownership. The delta reaches are predominantly held in agricultural land.

The forestry practices that constitute the primary land use within the basins over the last 150 years have resulted in the degradation of salmon habitat. Spawning and rearing habitat is being degraded by fine sediment from surface erosion and mass wasting due to timber harvest and access roads.

Current habitat limiting factors identified by the Skagit Recovery Plan include:

- Juvenile holding and rearing capacity;
- High water temperature;
- Loss of delta habitat, pocket estuaries and connectivity;
- Degraded riparian areas;
- Illegal habitat degradation;
- Illegal fishing or poaching;
- Sedimentation and mass wasting;
- Flooding;
- Current hydroelectric operations;
- Hydromodifications;
- Water withdrawals; and
- Seeding levels.[1]

Kari Neumeyer, NWIFC

Sauk-Suiattle Tribe's natural resources department collects broodstock for a new chum salmon enhancement program on the Sauk River.

In addition, the impacts of climate warming are now understood to be of fundamental significance to conservation and recovery of native fishes. As average temperatures climb, rates of glacial recession are increasing at the same time winter rains replace snowfall throughout mid-elevation areas. In sum, these phenomena will drive wholesale change in hydrology, sediment transport and water temperature regimes – threatening a number of fish species and life history types.

Restoration Plan Implemented Slower than Hoped

The habitat protection and restoration strategy pursued for the Skagit, Sauk, Suiattle and Cascade basins seeks to protect existing fish habitat and restore damaged habitat and habitat-forming processes. Specifically, restoration and protection efforts have focused on forest road maintenance, floodplain protection and water quality issues. Priorities have focused on the largest scale possible.

The protection strategy focuses on:

- Streamflows;
- Basin hydrology;
- Water quality;
- Sediment quality and transport;
- Stream-channel complexity;
- Riparian areas and wetlands;
- Tidal delta area and nearshore; and
- Fish passage and access.[2]

The restoration strategy focuses on fish production and weighs restoration actions by the degree to which they restore landscape conditions in the basin and thus contribute to the long-term recovery.

Tidal and Nearshore Habitat Restoration Prioritized

In 2010, the Skagit Watershed Council updated its restoration actions to provide a more strategic focus to restoration and recovery efforts.[3]

Three guiding principles were adopted:
1. Restore processes that form and sustain salmon habitats.
2. Protect functioning processes and habitat from degradation.
3. Focus protection and restoration on the most biologically important areas.

Adoption of these principles also prioritized restoration to three areas:
1. Estuary and riverine tidal habitat;
2. Shallow nearshore habitat, including pocket estuaries; and
3. Sediment- and hydrology-impaired watersheds.

Eric Mickelson, SRSC

The Skagit River System Cooperative, the natural resources extension of the Swinomish and Sauk-Suiattle (SRSC) removed a portion of Similk Bay Road and a non-functioning tide gate that isolated about 8 acres of estuary in Turners Bay, about seven miles from the Skagit River delta.

Implementation of the Skagit Chinook Recovery Plan is lagging behind the pace originally anticipated during plan development in 2006. Restoration work has progressed with numerous capital projects focused on restoring fish habitat and passage.

However, WRIAs 3&4 have faced significant funding shortages for restoration projects, limiting implementation progress. Progress also has lagged on implementing the regulatory and incentive programs to protect and restore salmon habitat and habitat-forming processes.

Numerous shoreline management plans are still in the process of being updated and action on regulatory gaps such as agriculture buffers and FEMA's Flood Insurance Program still need to occur. A major element of the 2006 Skagit Recovery Plan's habitat protection and restoration strategy for the Skagit, Sauk, Suiattle and Cascade basins relies on revisions to state and national environmental regulatory programs that have proven difficult to adjust to address the needs of the salmon resources in the Northwest.

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

At the 10-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Skagit basin area shows improvements for estuary restoration, removal of forest road barriers and ongoing restoration efforts. But degradation has occurred with riparian buffers and no trend in the recovery of forest conditions within the Sauk River floodplain. 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 since the 2012 State of Our Watersheds Report shows improvements in most indicators, and no trend for a couple of indicators and a declining trend for the riparian buffer habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Riparian Buffers	From 2006 to 2011, riparian acres were more impaired and had less forest cover. There was a reduction in all zoning categories, except industry, and the lower Skagit is failing to meet its primary temperature TMDL management recommendation.	Declining
Floodplain	The Sauk River floodplain riparian areas were just over 90% forested in 2009, and they are just under 90% forested in 2011. It is estimated that 38 acres of forest cover was lost between 2009 and 2011. Only 13% or about 5 acres was attributed to human land use and considered impairment of floodplain riparian areas.	No Trend
Estuary	Through 2015, 6 pocket estuaries have been restored, totaling 33.6 acres. Total smolt production projections show a potential increase of over 48,000 smolts, 33% of Chinook recovery target. The change since the 2012 report reflects the completion of Turner Bay and Dugualla Heights restoration projects.	Improving
	About 12% of the 2005 Skagit Chinook Recovery Plan's habitat restoration goals for the estuary have been met. At present, estuary restoration is on track to realize the recovery plan's habitat goal in 50 years. Skagit Intensively Monitored Watershed investigators have found decreases in juvenile Chinook densities where restoration has increased habitat capacity.	
Forest Roads	Completed 80% of road and 86% of culvert repair or abandonment on private and state-owned forest roads in the Skagit Watershed.	Improving
Roads	Monte Cristo Mine Cleanup site has made the historic old Monte Cristo road that originated at Barlow Pass redundant. The old road, under the jurisdiction of Snohomish County, has been closed, but not decommissioned or put to bed.	No Trend
Restoration	Sauk-Suiattle Indian Tribe has purchased over 250 acres of floodplain habitat to contribute to the Sauk-Suiattle Conservation Area in the last 5 years.	Improving
	Monte Cristo Mine Cleanup received $11 million award for cleanup. Concerns still exist about the decommissioning of the old access road.	Improving
	Since 1996, 129 restoration projects have been completed or remain active in the Skagit Watershed Council's (SWC) target areas. 57 of those projects have come since 2010, with the majority (38 projects) falling in the SWC Tier 1 target area, the Skagit River delta and Skagit and Sauk River floodplains.	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

The regulatory approach within WRIAs 3&4 is employing a strategy that seeks to ensure that there will be no loss of productivity and the current habitat conditions for the fish not worsen. With this strategy, the regulatory framework must protect the existing habitat as improvements in habitat quality and quantity are realized through voluntary effort and directed capital enhancement projects.

However, progress within the Skagit, Sauk, Suiattle and Cascade basins is not keeping pace with the goals of the Recovery Plan. Available funds for enhancement activities are lacking, and projected costs within the three-year work plans are consistently exceeding original projections.

When facing the reality of the recovery process, regulatory reform is required as the current framework clearly has not provided adequate protection of the water quality and riparian habitat within the basin. For example, many exemptions that originate in the State Shoreline Management Act (RCW 90.58) and that have been adopted into the Skagit Shoreline Management Plan (SMP) constitute the vast majority of shoreline permits where impacts to shoreline ecology are most prevalent. Just considering agricultural zoning exemptions, 39% of all Skagit SMP acres are unprotected through an exemption from SMP regulation.

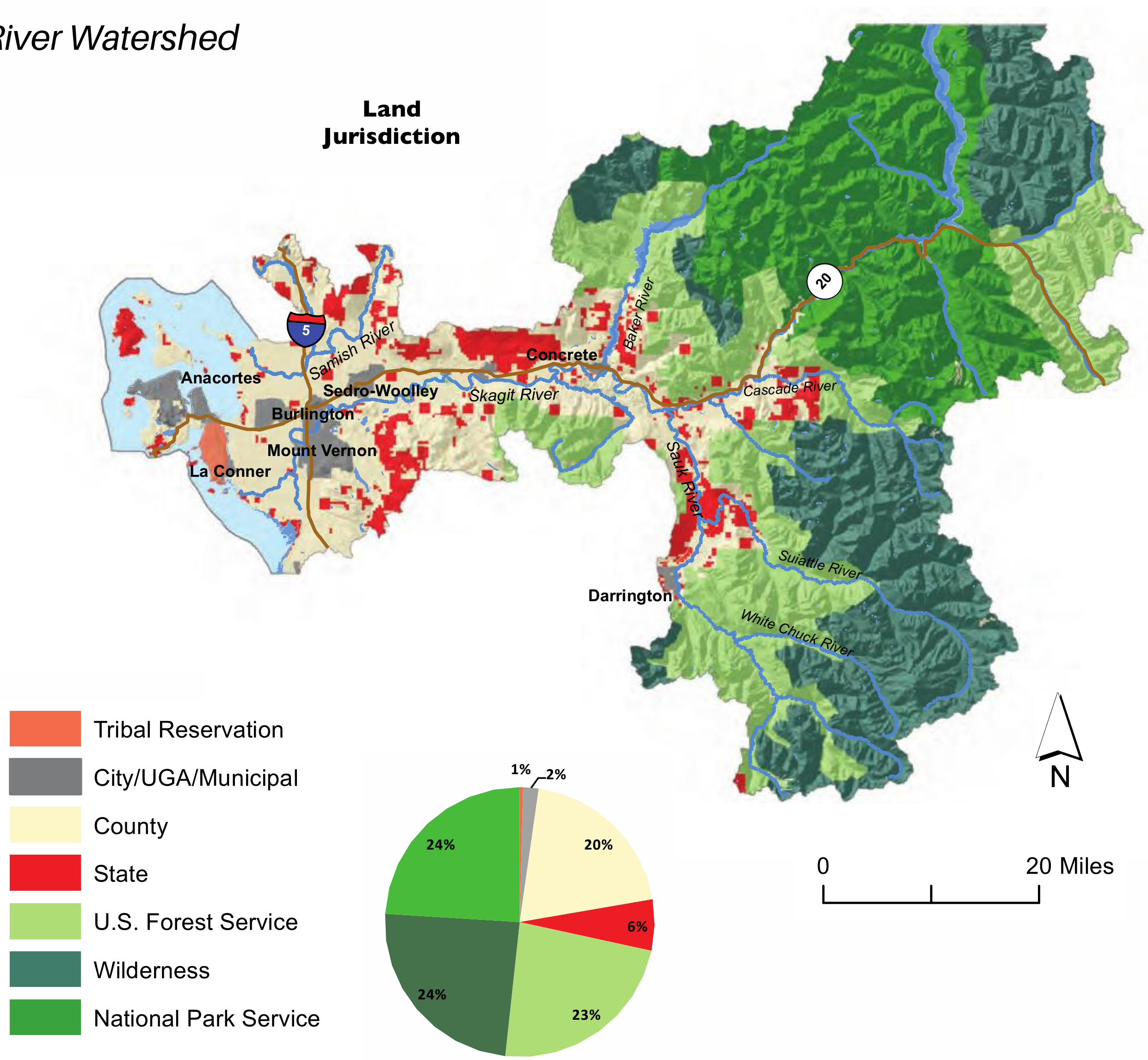
Given the alarming declining trends in recent returns of Chinook, chum and coho salmon in the Skagit River watershed, the Tribe will continue to push for accelerated recovery efforts of riparian forests, estuary habitat and off-channel floodplain habitat. The ongoing Superfund cleanup of the historic Monte Cristo Mining Area in the Sauk River headwaters will continue to be monitored by the Tribe's water quality program, including the as-yet unfunded decommissioning of the old road.

Models of future climate change paint a bleak picture for the continuing presence of healthy salmon runs in the Skagit, Sauk, Suiattle and Cascade basins. Both air and water temperatures are expected to reach new highs and remain there. Snow and ice melt contributions to glacially dominated river systems are predicted to decline, while increasing rain-on-snow events and high-flow fall floods will provide additional challenges to the survival of salmonids within their historic range.

Adaptation strategies for the purpose of climate change mitigation, a relatively new and innovative approach, are continuing to be developed and explored for many different ecosystems. The Sauk-Suiattle Indian Tribe will continue to advance and support the application of these strategies and efforts, as they will bolster the natural environment against the harsh reality of climate change, increasing the resilience of traditional natural resources and preserving them for continued use in the future.

Sauk-Suiattle Indian Tribe

Skagit River Watershed



With a 3,100-square-mile watershed, the Skagit River is the largest in the Puget Sound and the third largest on the West Coast of the continental United States. It provides 30% of the Puget Sound's freshwater input. The Skagit River originates in British Columbia, and flows south into Washington state before continuing westward through Skagit County and into the sound. The upper half of the watershed is primarily within the National Forest and the North Cascades National Park, and the lower half mainly comprises private forest, agriculture, rural residential, and urban residential lands. The Baker River, Sauk River and the Cascade River all flow within the Skagit River watershed.

The Sauk-Suiattle Indian Tribe's homeland extends across the Skagit River watershed, which includes the Sauk, Suiattle and Cascade River watersheds. The Tribe fishes, hunts and gathers food and medicines throughout this entire area. The Tribe's reservation is located near the confluence of the Sauk and Suiattle Rivers, just north of Darrington.

Since European settlement, land use in the watershed has been dominated by natural resources. The foothills and mountains have been mainly used for wood products, mining and outdoor recreation. The river valleys, the delta and the coastal areas have been used for agriculture, industry, commerce and residential development. Population is projected to increase to an estimated 162,000 people by 2040.[1]

The Skagit River is home to all six species of Pacific salmon, including steelhead. It has the healthiest and largest runs of wild Chinook and pink salmon in the Puget Sound.[2]

The last 150 years of human land use has resulted in declines in Chinook productivity, yet the Skagit River watershed remains one of the healthiest in the Puget Sound. The Skagit Chinook Recovery Plan 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.

Data Sources: SSHIAP 2004,[3] USFWS 2014,[4] WADNR 2014a,[5] WADNR 2014b,[6] WADOT 2012,[7] WADOT 2013,[8] WAECY 1994,[9] WAECY 2011a,[10] WAECY 2013[11]

Skagit Estuary Restoration on Track to Meet 50-year Chinook Recovery Goals

About 12% of the 2005 Skagit Chinook Recovery Plan's habitat restoration goals for the estuary have been met.[1] At present, estuary restoration is on track to realize the Recovery Plan's habitat goal in 50 years.[2] Skagit Intensively Monitored Watershed (IMW) investigators have found improvement through decreases in juvenile Chinook densities where restoration has increased habitat capacity.[3]

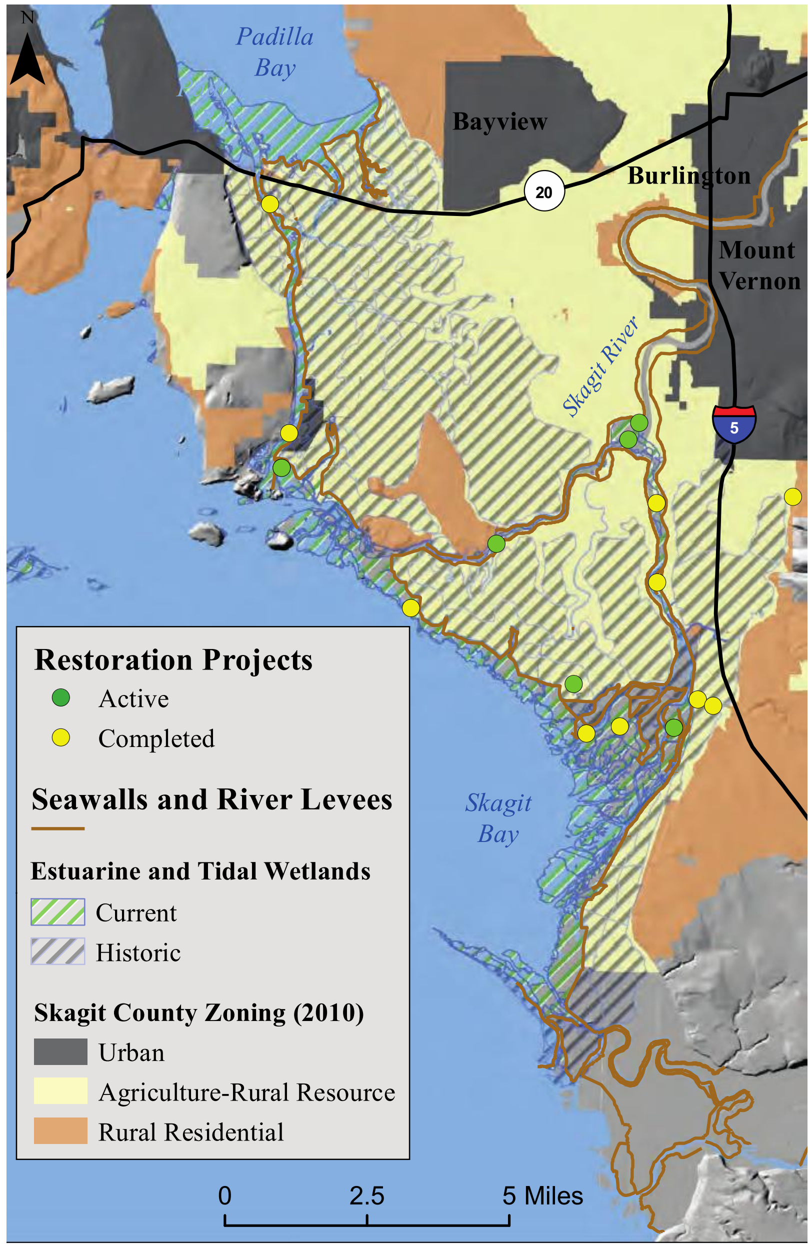
Diking, dredging, filling, clearing and developing the Skagit delta over the last 150 years has reduced tidal wetland area from 28,375 acres to 7,705 acres.[4] This has resulted in an estimated 88% loss of juvenile Chinook rearing habitat in the delta, leading to an overpopulation of existing habitat.

Since the 2012 State of Our Watersheds Report, the Fisher Slough tidal marsh restoration was completed, a series of small marsh sites along the Swinomish Channel were created by the removal of dredge spoils, and tidal inundation at WDFW's Milltown Island in the South Fork was expanded. Additionally, there is progress on three tidal delta projects on WDFW land (Fir Island Farms, Cottonwood Island and Deepwater Slough Phase 2).[5]

Based on current restoration status, the 50-year habitat restoration goal is reachable. However, many of the remaining identified delta restoration projects involve privately owned agricultural land, which will make keeping pace with the 50-year restoration target very difficult.

Washington Restoration and Conservation Office

Skagit River Delta



Over 70% of historic estuarine and tidal wetlands in the Skagit delta fall on lands that are currently zoned in agriculture,[6,7] a complicating factor for future estuary and tidal wetland restoration opportunites.[8]

Data sources: Collins & Sheikh 2005,[9] HWS 2015,[10] Skagit Co. 2010,[11] SSHIAP 2004,[12] WAECY 2014[13]

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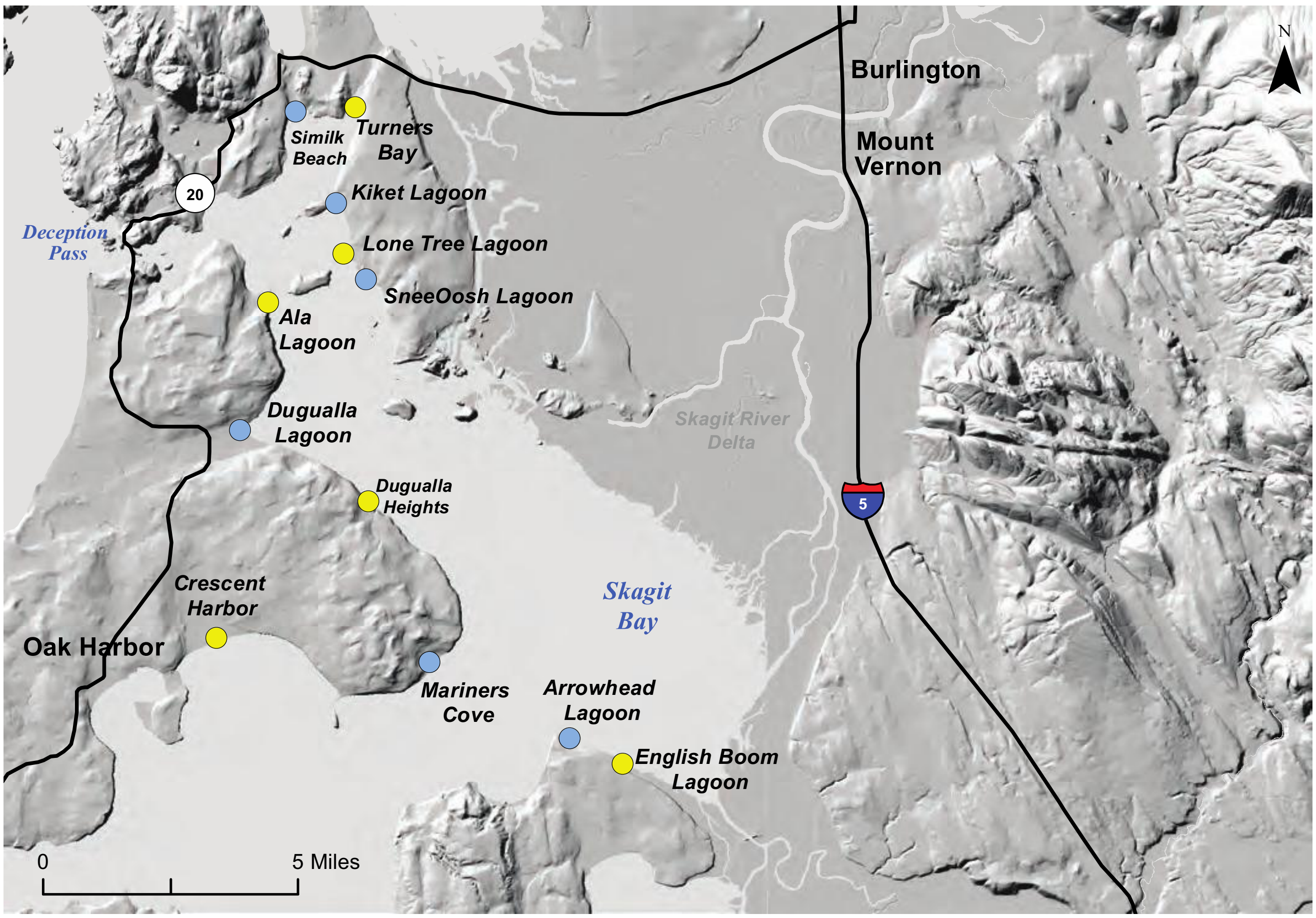
Whidbey Basin Pocket Estuaries

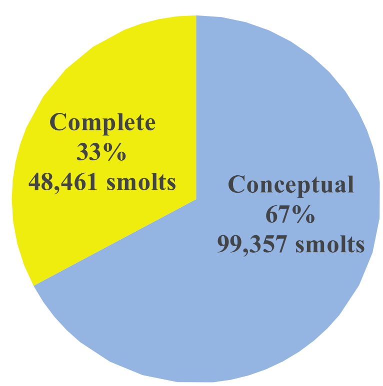
Restoration Underway and Initial Targets Have Been Met

The Skagit Chinook Recovery Plan prioritized the restoration of 12 pocket estuaries totaling 76.8 acres of usable habitat area, all of which is within a day's swimming distance for Skagit River juvenile Chinook. Through 2015, pocket estuary restoration has been completed at six sites totaling 33.6 acres. These restored pocket estuaries are estimated to increase Chinook smolt production by over 48,000 smolts. The change in status since the 2012 State of Our Watersheds Report reflects Turner Bay and Dugualla Heights both going from active restoration projects to completed restoration projects.[1,2]



There are 12 prioritized pocket estuary restoration projects in the Whidbey basin, six of which have been completed and six of which are conceptual.

For the Whidbey basin, modeling and field surveys have led researchers to conclude that over two-thirds of historic pocket estuaries have been completely lost to juvenile salmon use, and the remaining one-third has been reduced in size by approximately 50%. This suggests an approximately 80% net reduction in pocket estuary area. The 12 pocket estuaries within a day's swimming time of the Skagit River delta have experienced an 86% net reduction.[3] Restoration of these sites are expected to result in the production of over 147,000 additional smolts. Over 63% of the increased production, or over 93,000 smolts will come from the completed restoration of the Dugualla Lagoon project.[4]



Whidbey basin pocket estuary restoration has resulted in the additional production of an estimated 48,641 Chinook smolts.

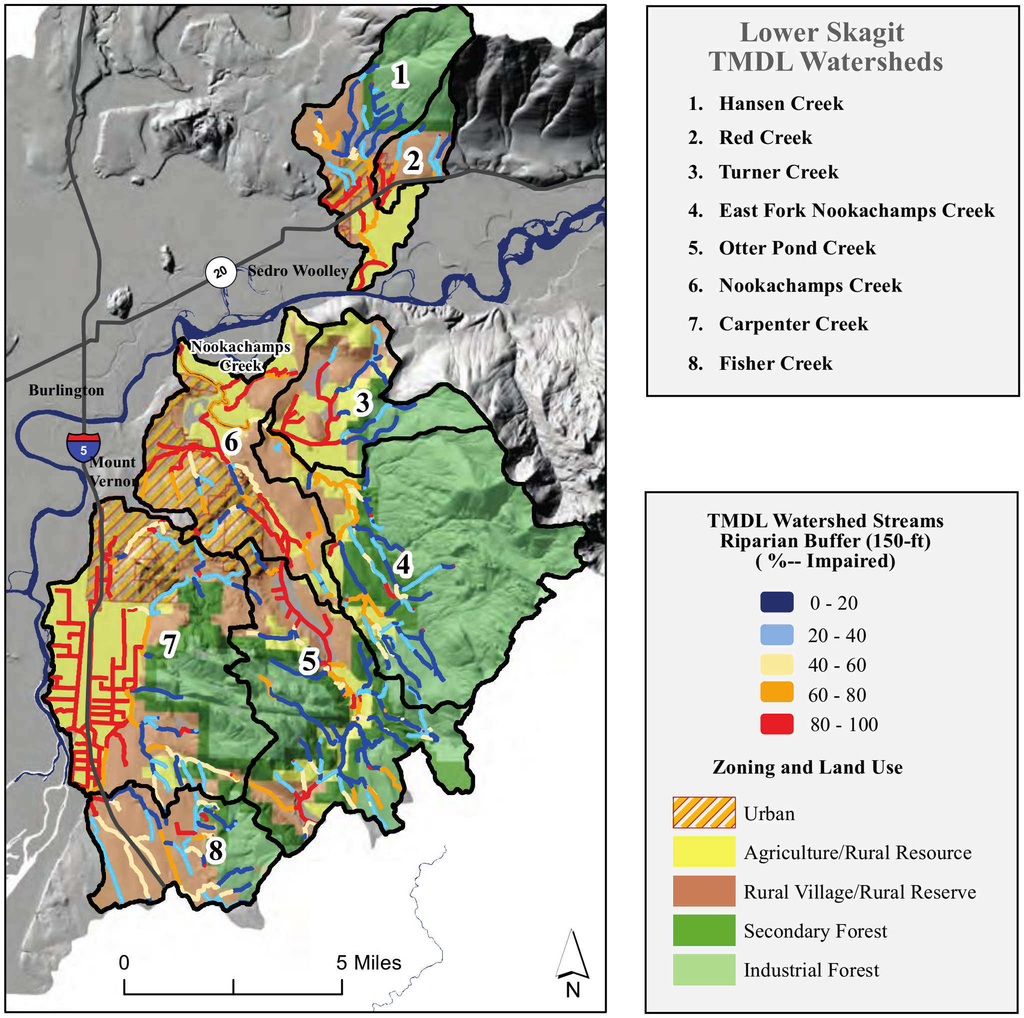
Data Sources: HWS 2015,[5] SSHIAP 2004,[6] SRSC &WDFW 2005,[7] SRSC & WDFW 2012,[8] WADOT 2012[9]

Lower Skagit Watersheds Not Meeting Stream Temperature TMDL Recommendations

In 2011, over 51% of riparian acreage along fish-bearing streams within the 2008 Lower Skagit Temperature TMDL watersheds was non-forested and impaired.[1,2] When compared to 2006 NOAA-CCAP forest cover dataset, riparian forests within the TMDL watersheds were more impaired and less forested.[3] This suggests that the lower Skagit is failing to meet the primary management recommendation of the temperature TMDL: riparian reforestation.

High stream temperatures impact Chinook salmon at all life stages, especially during juvenile rearing.[4] The Lower Skagit Temperature TMDL remains in place for eight tributaries in the lower Skagit watershed as they are out of state compliance with Washington state water quality standards. The Lower Skagit TMDL recommends restoration of riparian tree shading of streams as the primary mechanism for lowering stream temperatures into compliance.

The state's TMDL plan for reducing stream temperature is voluntary and includes a combination of financial incentives, outreach and technical training, and communication.[5] It is expected that with these measures in place, streams will be in temperature compliance by 2080.[6] The present trend suggests that streams will not be compliance by 2080.



Land-use practices in the Lower Skagit Temperature TMDL watersheds continue to impair riparian condition.

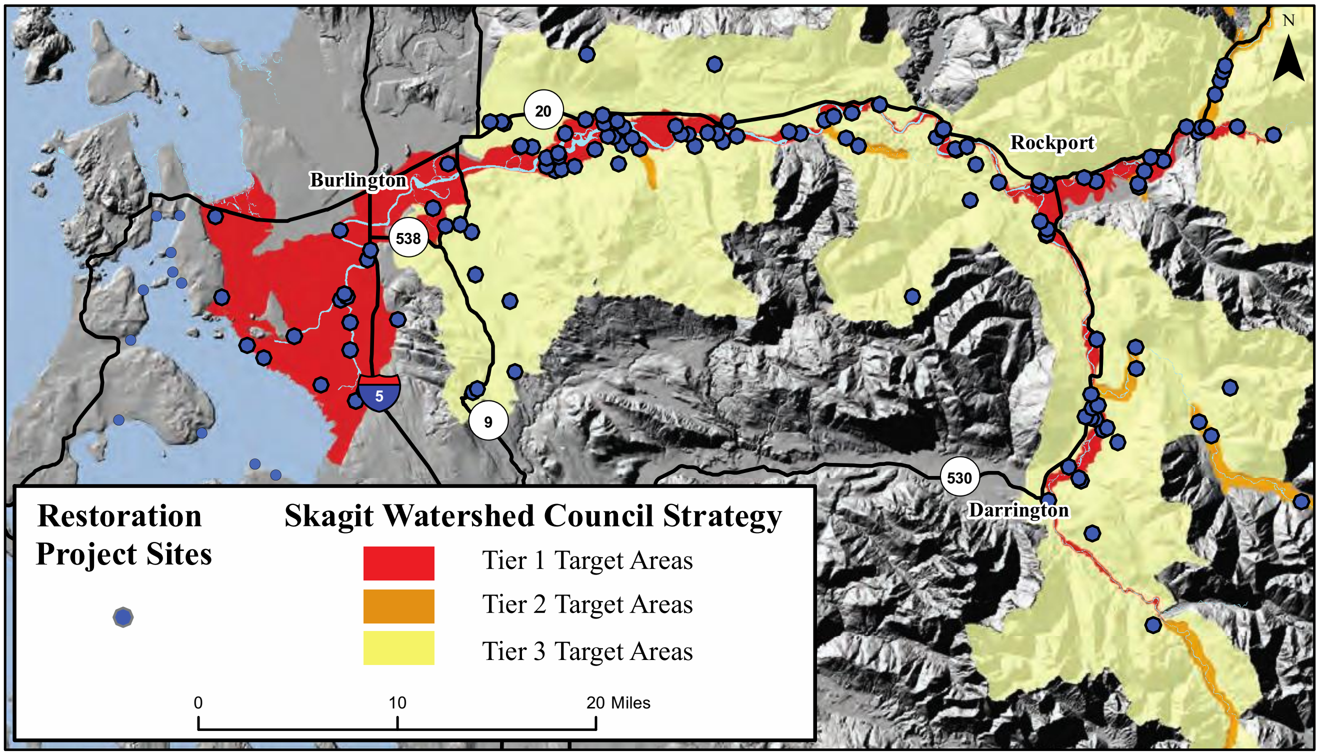
In the lower Skagit TMDL watersheds riparian forests continued to become more impaired between 2006 and 2011.

Zoning Category	Riparian Acres (150-ft buffer)	2006 Impaired Riparian Acres (Non-forested in 150-ft buffer)	2011 Impaired Riparian Acres (Non-forested in 150-ft buffer)	Riparian Buffer % Impaired (Non-forested)	Riparian Impairment Trend 2006-2011
Urban	881	564	571	65%	More Impaired
Agriculture/Rural Resource	2,555	1,928	1,946	76%	More Impaired
Rural Residential	1,944	848	850	44%	More Impaired
Secondary Forest	1,028	210	219	21%	More Impaired
Industrial Forest	847	127	127	15%	No Change

Data sources: Skagit Co. 2010,[7] SSHIAP 2004,[8] WAECY 2011a,[9] WAECY 2011b,[10] WAECY 2014[11]

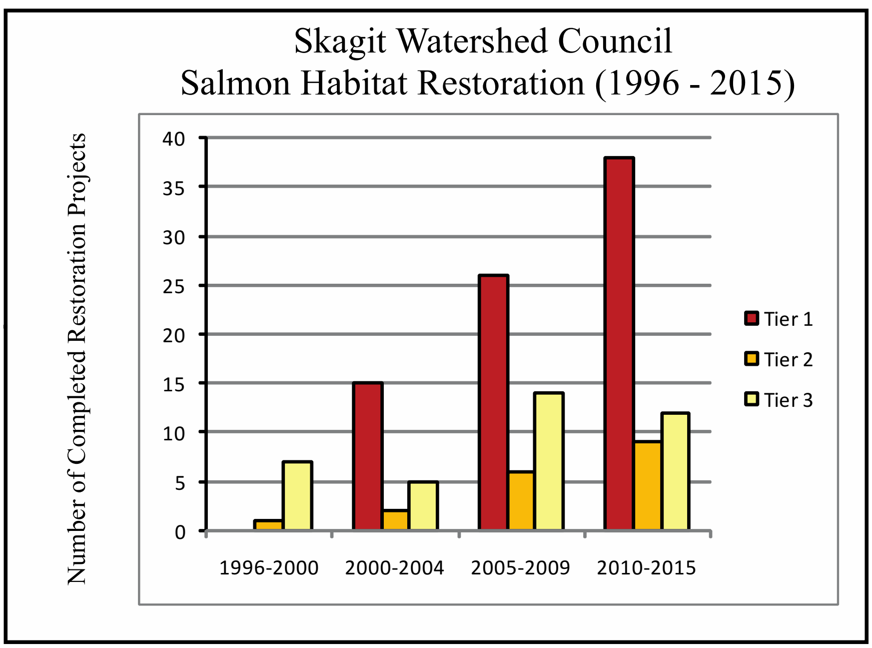
Skagit River Restoration Focuses on Habitat Bringing Greatest Benefit to Chinook

Since 1996, 129 restoration projects have been completed or remain active in the Skagit Watershed Council's (SWC) target areas.[1] Fifty-seven of those projects have come since 2010, with the majority, 38 projects, falling in the SWC Tier 1 target area, the Skagit River delta, and Skagit and Sauk River floodplains.[2,3,4]



Restoration projects are occurring throughout the Skagit River watershed, with the majority of restoration projects occurring in the Skagit delta and the Skagit and Sauk River floodplains.

The SWC Tier 1 target areas for habitat restoration support mixed use of multiple stocks, and they include tidal and non-tidal habitats of the Skagit river delta, as well as Skagit and Sauk river floodplain mainstem, tributary and side-channel habitats.[5] Tier 2 target areas for restoration include pocket estuaries and floodplains of streams and rivers that support single populations of salmon. Tier 3 target areas include watersheds that have impaired sediment supply or peak flows. Increases in the number of Tier 1 and Tier 2 restoration projects, combined with decreases in Tier 3 restoration projects since the 2005 Skagit Chinook Recovery Plan, suggests that the Skagit Watershed Council's target area restoration strategy is being implemented successfully.



Number of restoration sites from 1996 to 2015 by SWC target areas (Tiers 1-3).

Data sources: Beechie et al. 2010,[6] HWS 2015,[7] Ramsden 2010,[8] SSHIAP 2004,[9] WADOT 2012[10]

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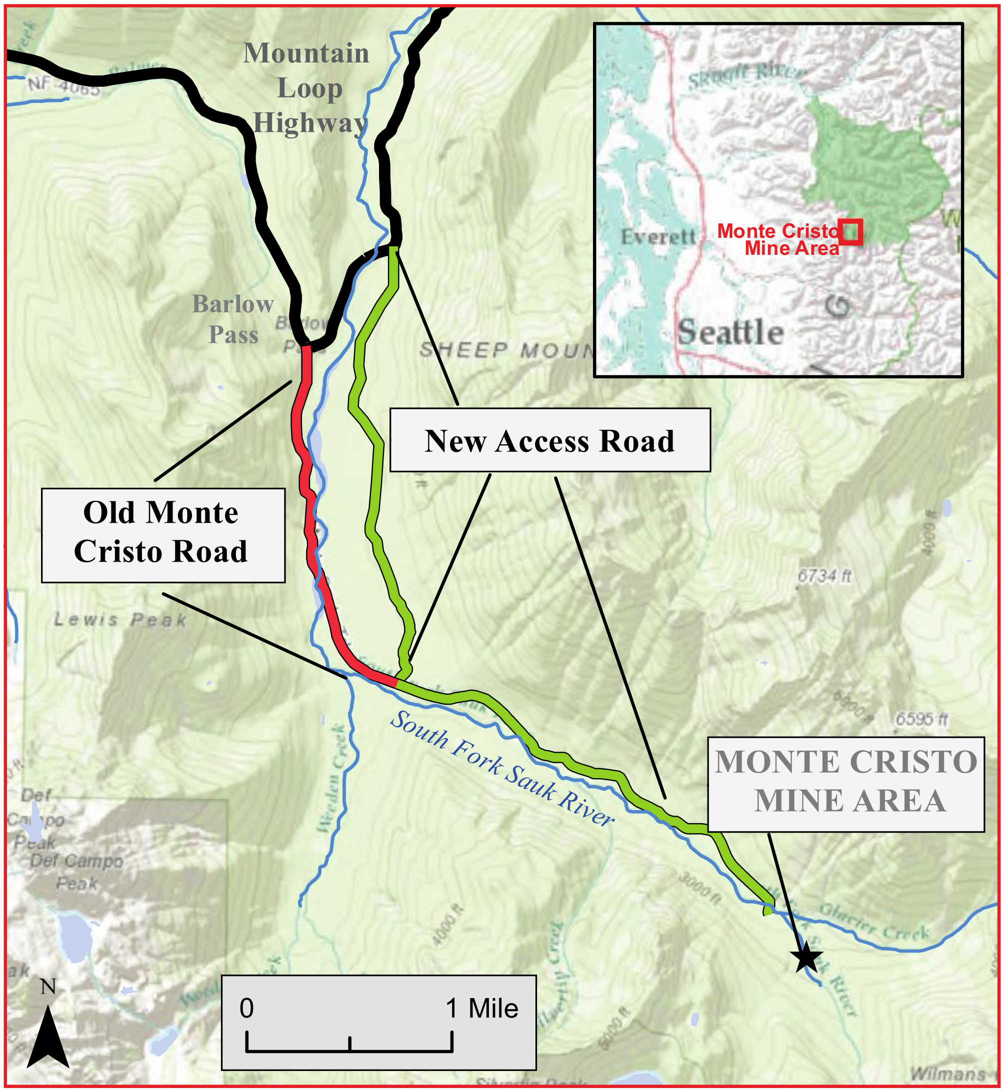
Old County Road to Monte Cristo Mining Area Causes Problems for South Fork Sauk River

In 2009 the U.S. Forest Service and Washington Department of Ecology were awarded $11 million dollars as part of an ASARCO bankruptcy agreement, to fund the Monte Cristo Mining Area (MCMA) cleanup in the upper South Fork Sauk River watershed.[1,2] The mine is close to the South Fork Sauk River, and legacy sediments pose downstream risks to human and ecological health from exposure to high levels of hazardous substances, particularly arsenic. Of concern in the South Fork Sauk River are the water quality impacts to bull trout and steelhead, as both spawn in the area and both are federally listed as "threatened" under the Endangered Species Act.

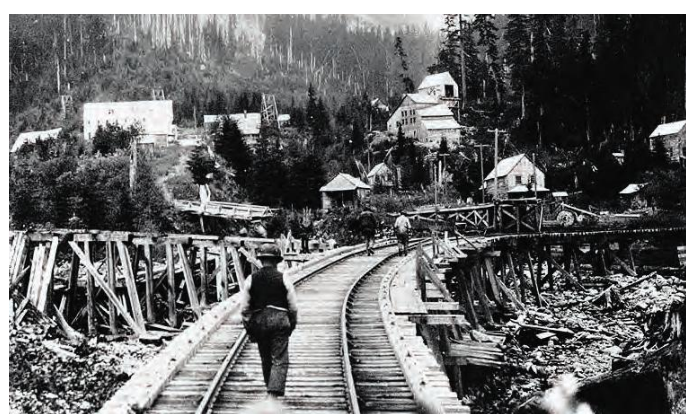
On the positive side, the funded work is progressing. A new access road for the site was completed the summer of 2014. USFS conducted three Removal Actions in summer 2015: construction of the contaminated materials storage site, removal of remote site material by helicopter, and removal of road-accessed materials by truck. As part of the USFS-implemented Removal Action, Washington State Department of Ecology (WAECY) had a public comment period for plan review in May and June of 2015, and also worked with the private property owners to obtain access to some of the Removal Area sites.

Barlow Pass to the Monte Cristo Mine Area



Data sources: CES 2010,[3] CES 2013,[4] Esri 2015[5]

While the cleanup is a step in the right direction, roads to and from the mining area continue to pose a threat to Tribal fishery interests. The new access road to the Monte Cristo Mine Area cleanup site has made the historic old Monte Cristo road that originated at Barlow Pass redundant. The old road, under the jurisdiction of Snohomish County, has been closed, but not decommissioned or put to bed. The old county road has a large landslide and a bridge that presents chronic, costly problems for the South Fork Sauk River and Tribal fishery interests. The Sauk-Suiattle Tribe would like USFS and WAECY to emphasize to Snohomish County that the old road be decommissioned. If it is not put to bed by the county, the South Fork Sauk would then have roads on either side of it, a condition that the Tribe finds unacceptable.



Museum of History and Industry, Seattle, WA

Boston Mining Company, Monte Cristo Mine, 1912

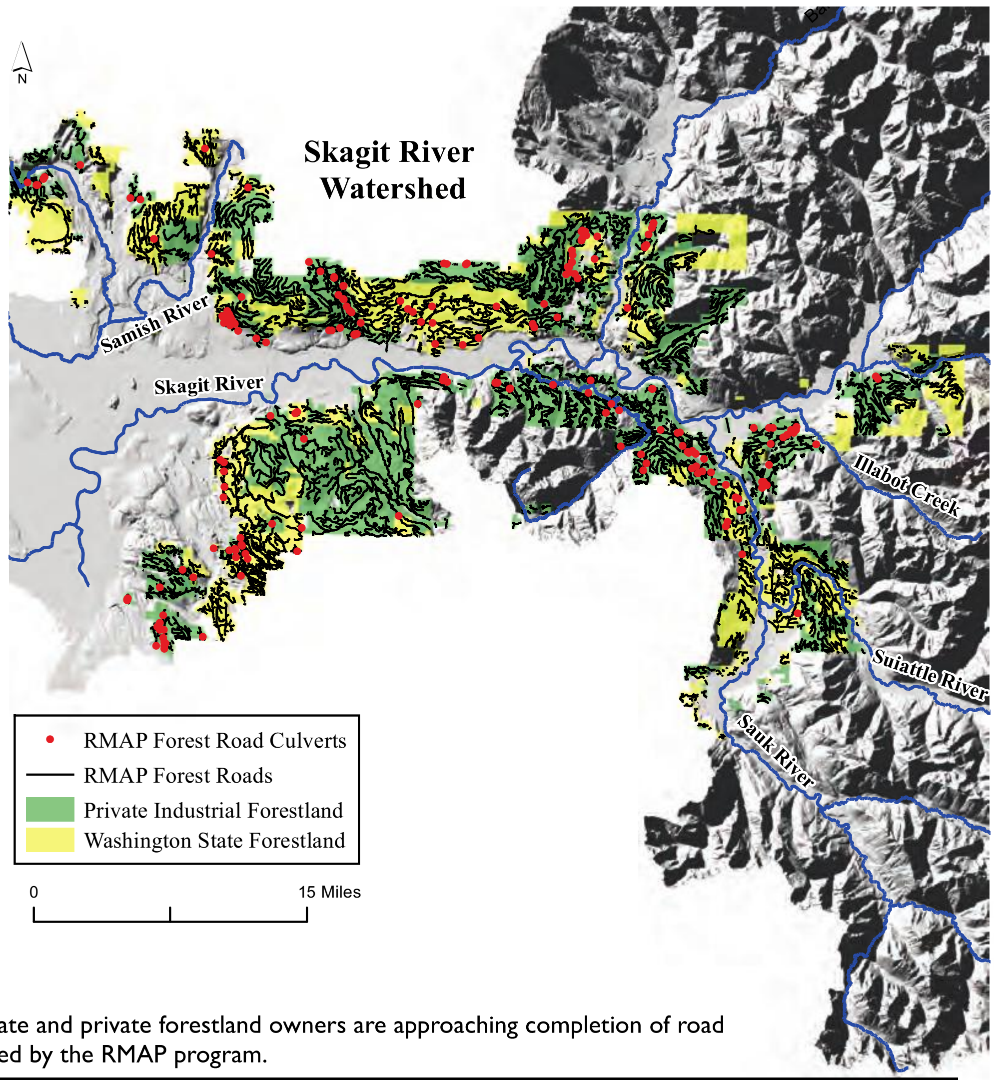
RMAPs Almost Complete in Skagit and Samish Watershed

The Washington State Forest Road Maintenance and Abandonment Plan (RMAP) has led to the repair or abandonment of 80% (1,331 miles out of 1,662 total miles) of private and state-owned forest roads in the Skagit River watershed.[1] Within the Sauk Suiattle and Cascade watersheds of the Skagit, an estimated 69% (around 90 of 130 miles) of road have been either abandoned or repaired. RMAP has also resulted in the repair or removal of 179 of 209 culverts on private and state-owned forest roads within the Skagit, and 38 of 44 culverts within the Sauk, Suiattle, and Cascade watersheds. The majority of all remaining work is scheduled to be completed by 2021, as both Weyerhaeuser Corp. and Sierra Pacific are seeking a 2021 extension. Together they have over 300 miles of forest road that still needs to be brought up to RMAP standards or abandoned.

No alteration of the human landscape has a greater and more far-reaching effect on aquatic habitat than roads.[2] Over 1,600 miles of forest roads in the Skagit basin are on private industrial and state lands and fall under the RMAP mandate. It is expected that RMAP road repairs and abandonment will improve water quality in the upper Skagit and Samish River watersheds. Considering the role improved water quality plays in Chinook habitat, 80% of RMAP roads brought up to standard or abandoned is good news to salmon recovery in the Skagit and Samish river watersheds.

Data Sources: Mostovetsky 2015,[3] Skagit Co. 2010,[4] SSHIAP 2004,[5] WADNR 2014a,[6] WADNR 2014c,[7] WAECY 2011a[8]

RMAP only applies to state and private forestland jurisdictions.



RMAP status shows that both the state and private forestland owners are approaching completion of road repairs and abandonment as mandated by the RMAP program.

2015 Samish and Skagit River watershed Road Maintenance and Abandonment Status (RMAP) from Annual Reports					
Jurisdiction	*Total Miles of Forest Road*	*Completed Miles*	*Miles Remaining*	*Percent Complete*	*Planned Date for RMAP Completion*
State Lands	574	543	31	95%	10/31/2016
Private Industrial Lands	1088	788	300	72%	10/31/2021
Jurisdiction	*Total Number of Culverts*	*Repaired*	*Remaining to be Repaired*	*Percent Repaired*	
State Lands	35	30	5	86%	
Private Industrial Lands	174	149	25	86%	

Sauk River Floodplain Forest Relatively Healthy

The Sauk River floodplain riparian areas were just over 90% forested in 2009, and they were just under 90% forested in 2011. It is estimated that 38 acres of forest cover was lost between 2009 and 2011. Almost 87%, or 33 acres, of loss is attributed to natural processes considered a healthy reflection of the floodplain ecosystem. Only 13% or approximately 5 acres of forest cover loss is attributed to human land use and considered increased impairment of floodplain riparian areas.[1,2]

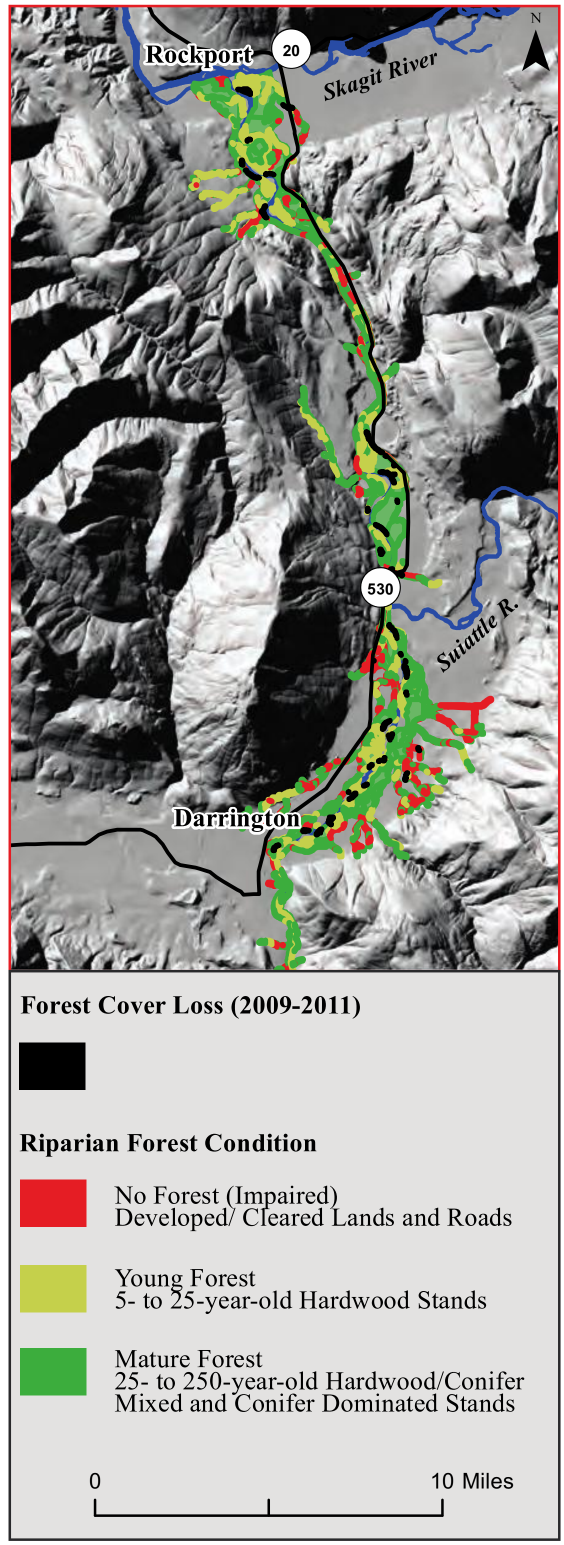
The Skagit Chinook Recovery Plan recognizes that riparian forests provide shade, nutrients, large woody debris and streambank stability for spawning and rearing Chinook. The plan strongly recommends protecting riparian forests that are healthy and restoring those that are impaired.[3] The Sauk River remains one of healthiest floodplain ecosystems in the Skagit River watershed. Continued protection of riparian areas in the Sauk River floodplain will require an end to agriculture practices exemptions from the Shoreline Management Act (SMA), or the development of alternative mechanisms to agricultural practices that provide protection equivalent to the SMA. Additionally, the small forest landowner's 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 Forests and Fish Agreement.[4]

Status and change of non-forested riparian area in the Sauk River floodplain between 2009 and 2011

Sauk River Floodplain Riparian Forest Area	Total Impaired Acres		Percent Impaired Acres	
	2009	*2011*	*2009*	*2011*
40 m channel migration zone buffer	112	119	15%	16%
40 m tributary buffer	288	290	22%	22%
Active Sauk River channel migration zone (2009)	80	103	3%	4%
Island within active channel	0	5	0%	3%
Total	480	518	10%	10%

Data sources: Pearce 2013,[5] Ramsden 2010,[6] SSHIAP 2004,[7] WADOT 2012,[8] WAECY 2011a[9]

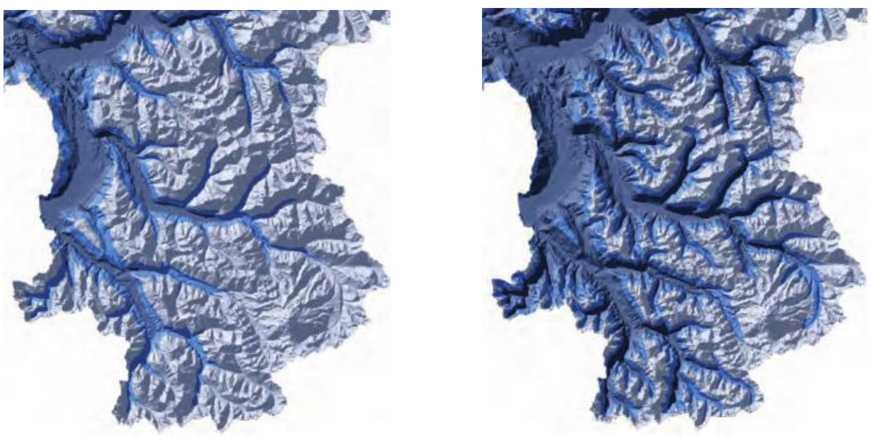
Sauk River floodplain riparian forest condition and change, 2009 to 2011



Climate Change, Higher Flows, Lower Flows, and Sauk River Salmon Under Increased Habitat Stress

In the Sauk River watershed, climate change projections show that the area dominated by rainfall rather than snow in the winter will increase by 20% by the 2080s, as a result of the expected increase in average annual air temperature by 5.3˚F.[1,2,3] The transition from snow-dominated to rain-dominated areas within the watershed will mean less storage of winter precipitation as snowpack and higher runoff into rivers in the winter. For Sauk River summer flow, earlier snowmelt could mean a 35% decrease in June streamflow by 2080. Freezing levels moving to higher elevations in the winter could mean a 73% increase in January streamflow by 2080.[4] For salmon, this changing hydrology would mean increased habitat stress year-round.

Historic and Predicted Future Precipitation Conditions for the Sauk River watershed.[5]



**Historic Conditions:
Rain Dominated to
1,300 feet Elevation**

**Future Conditions (2080s):
Rain Dominated to
2,800 feet Elevation**

Precipitation Zones

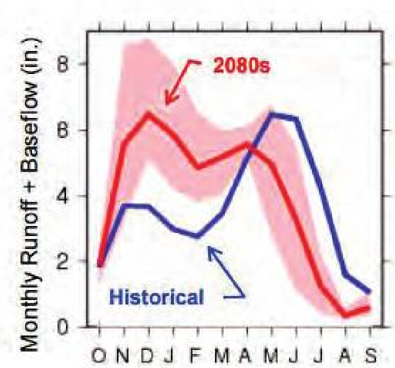
- Rain Dominated
- Rain-Snow Mixed
- Snow Dominated

0 20 Miles

	Rainfall Dominated	Transient Snow Zone	Snowfall Dominated
Historical	12%	17%	71%
2080s*	32%	26%	42%
Projected Change	**+20%**	**+ 9%**	**- 29%**

Projections of future climate show increasing rain-dominated zones and decreasing snow-dominated zones in the Sauk River watershed.[6,7,8] Transient snow zones, where winter precipitation falls as snow then melts during rain-on-snow events, also are projected to increase.

Higher peak flows in the winter and lower base flows in the summer would mean more salmonid egg scour and loss during winter spawning, and higher water temperatures and less available habitat for summer rearing. Considering how important connected off-channel floodplain habitat is for winter refuge from peak flows, and for summer refuge from low flows and high stream temperature, predicted climate change means that protection of the relatively intact Sauk and Suiattle river floodplains are even more critical to salmon recovery efforts in the Skagit River basin.



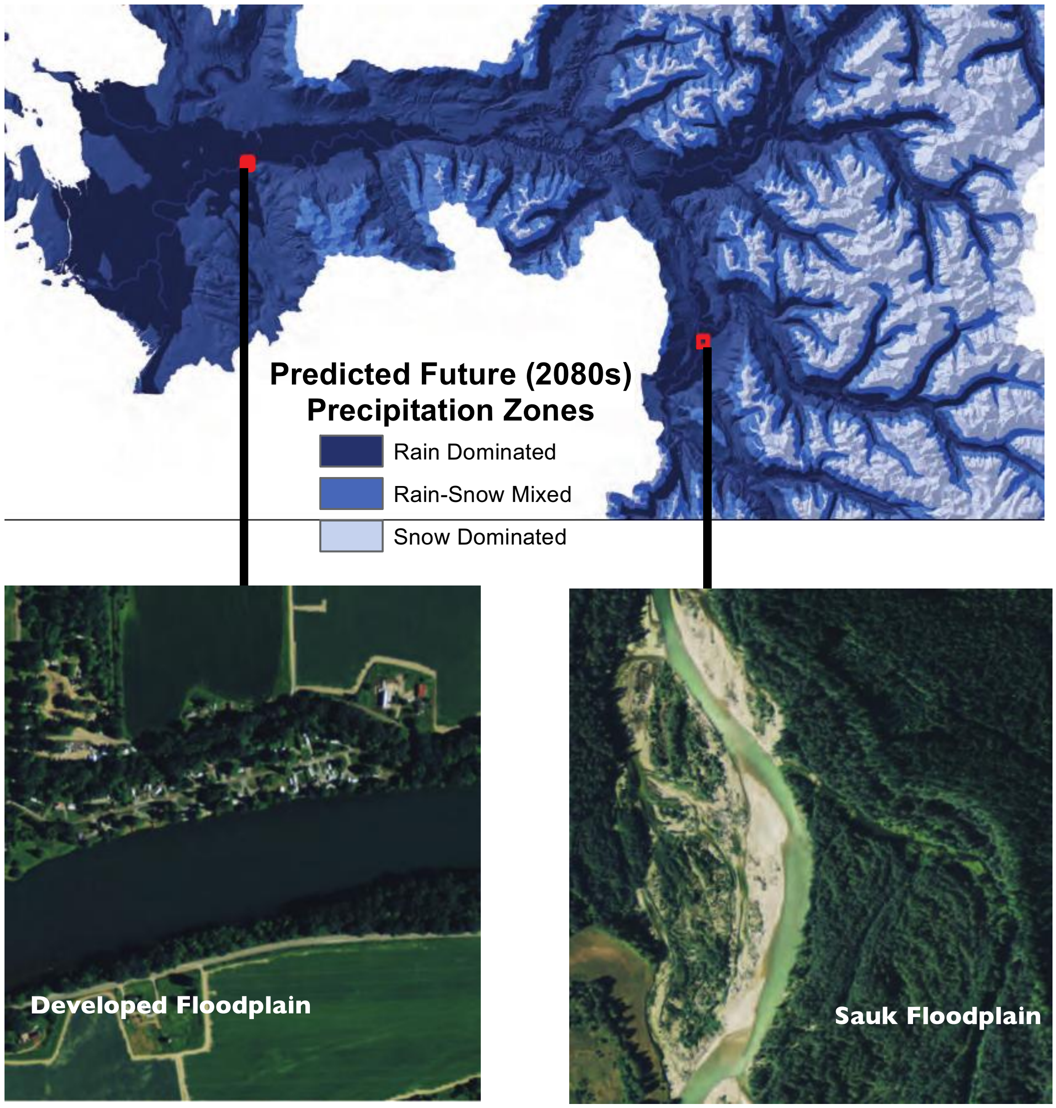
Models of future climate show changes to the annual hydrograph, with increasing flow in the winter and decreasing flow in the summer as more precipitation falls as rain rather than snow.[9,10]

Predicted Climate Impacts Highlight Importance of Off-Channel Floodplain Refuge Habitat

The Sauk-Suiattle Tribe joined Seattle City Light, The Nature Conservancy, and federal, state and local governments in protecting floodplain resources through conservation acquisition. The Sauk-Suiattle Tribe has purchased over 250 acres of floodplain habitat to contribute to the Sauk-Suiattle Conservation Area in the last five years, which makes the Sauk-Suiattle Indian Tribe fully committed to habitat protection in the Sauk River floodplain, as recommended in the Skagit Chinook Recovery Plan. An estimated 20-25% of protected land in the Sauk River floodplain is in the Sauk-Suiattle Conservation Area.[1] This is second only to Seattle City Light, which has acquired 46% of protected land in the floodplain.[2]

The predicted climate change impact of more rain and less snow would mean increasing winter flows and decreasing summer flows, putting stress on anadromous salmon during both seasons.[3] Under such conditions, refuge habitat within the floodplain but off the main channel is critical to salmon survival. The Sauk River floodplain has some of the best remaining floodplain refuge habitat in the Skagit River watershed. Protection of remaining floodplain habitat through conservation purchase is an increasingly important piece of salmon recovery and sustainability.

Predicted climate change would mean more annual precipitation falling as rain, higher winter and lower summer flows.[4]



Human development in the lower Skagit River reaches has resulted in a loss of wetted off-channel floodplain habitat to agriculture as well as commercial and residential development.

The Sauk River floodplain remains relatively undeveloped and relatively rich in off-channel habitat. Protection of this and any such floodplain area in the Skagit River system is critical in light of climate change.

Data sources: Abbe 2014,[5] Esri 2015[6]

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Skagit Estuary Restoration on Track to Meet 50-year Chinook Recovery Goals

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Climate Change, Higher Flows, Lower Flows, and Sauk River Salmon Under Increased Habitat Stress

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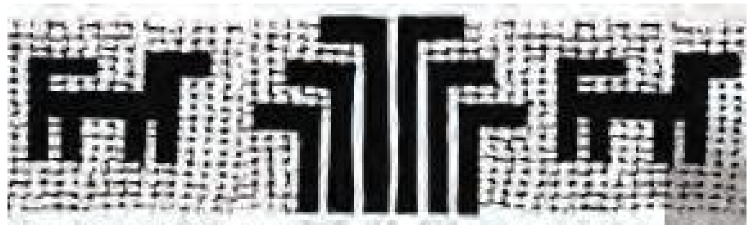
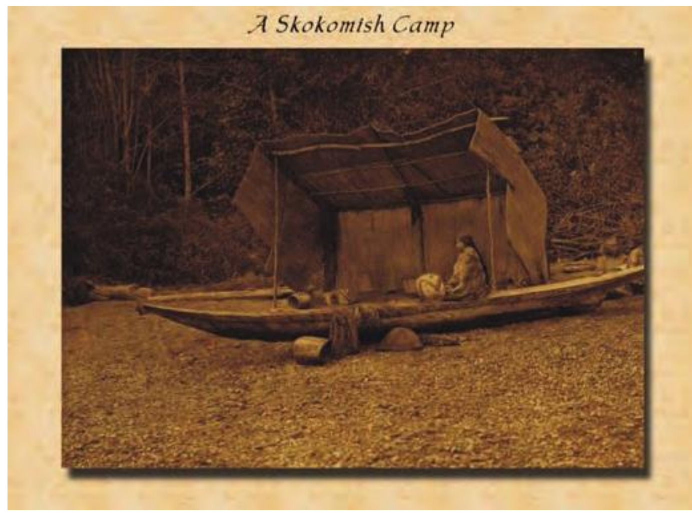
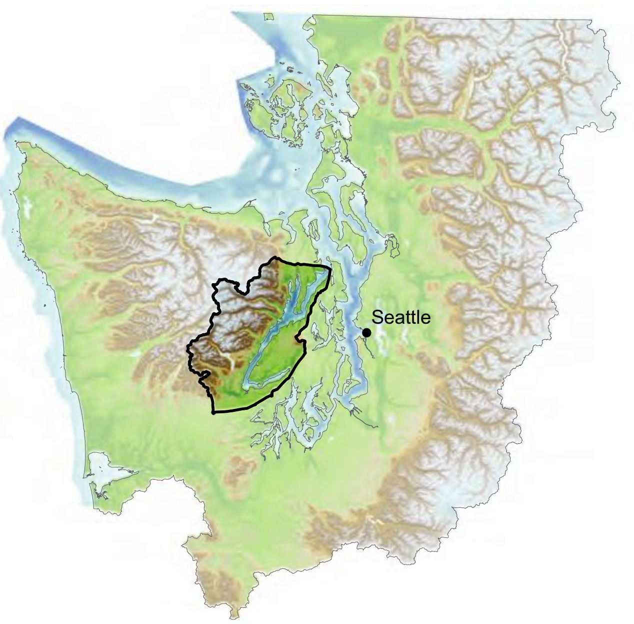
2016 State of Our Watersheds Report
Skokomish-Dosewallips Basin



The Skokomish Tribe is wholly devoted to restoring the Skokomish watershed and its resources – not just for the next five years, not just for another 40 years, but forever. We must continue healing the environment that we depend upon for survival. The health and well-being of the Skokomish watershed is vital to the Skokomish tribal culture, tradition, subsistence and economy.

– Joseph Pavel
Skokomish Tribe





Skokomish Tribe

The Twana (ancestors of the Skokomish people) were the first human 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.

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 I. 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, communities still rely on logging, fishing, shellfish and recreation. Unfortunately, there have been major land-use impacts on Treaty-protected resources including salmon habitat. Dam construction, floodplain and shoreline development, and roads and logging have had their impacts.

The Hood Canal Watershed: Home of the Skokomish Tribe

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. The Skokomish Reservation is located near the Big Bend of southern Hood Canal at the mouth of the Skokomish River. Major rivers entering Hood Canal from the steep eastern slopes of the Olympic Mountains include the Skokomish, Dosewallips and Big Quilcene rivers.

Historically, the economy of the Hood Canal region relied largely on shellfish harvesting, commercial fisheries, commercial forestry, tourism and agriculture. Unfortunately, habitat quality, which sustains the economic activities of Hood Canal, has diminished due to multiple causes including: roads and land development, stream modifications, shoreline development, and water pollution from sediment, nutrients and pathogens.

Roughly 48% of the Hood Canal watershed land area is under federal jurisdiction in Olympic National Park, Olympic National Forest or designated wilderness areas. This has led to the concentration of land use, and development pressure on a remaining 50% of non-federal land, which is in either a forest or rural land-use classification, making it a potential target for future development pressures.

Even without future development, the region has concerns regarding viable fisheries populations, which are the lifeblood of the Skokomish Tribal economy. The Puget Sound Salmon Recovery Plan identified significant habitat limiting factors for the decline of the region's salmonid populations.

Flickr user Lana_aka_BADGRL

Hood Canal, looking toward the Olympic Mountains.

The plan's technical analysis has identified the following habitat limiting factors:

- Estuarine habitat loss and degradation;
- Loss of channel complexity from large woody debris;
- Scouring from high water flows;
- Floodplain modifications and loss of wetlands; and
- Sediment aggradation.[1]

Implementing a Conservation & Recovery Plan

There is a plan to protect habitat and a restoration strategy pursued for Hood Canal, approved by the National Marine Fisheries Service and supported by the watershed-based Council of Governments with the Hood Canal Coordinating Council as lead entity. The plan focuses on habitat stewardship and restoration projects. Restoration actions were organized by limiting factors within each watershed. The existing regulatory protection tools were viewed as adequate for recovery, "if watershed development occurs as expected and current regulations are maintained or improved and adequately implemented."[2] However, growth has continued.

Still, restoration within the drainages of Hood Canal has proceeded under the recovery plans for each watershed. Work has focused on restoring stream connectivity, bed stabilization, riparian replanting, placement of logjams, invasive plant species removal and road decommissioning. Several projects have been implemented throughout Hood Canal to initiate habitat restoration in estuarine and nearshore areas surrounding the rivers and other major streams. A major project under way is the restoration of the Skokomish River estuary. The Skokomish Tribe instigated this project in 2007, working with federal, state and county collaborators as well as Tacoma Power to remove dikes and culverts from the Skokomish estuary. This project has been an important success in restoring habitat in the estuary. In addition, large woody debris was placed in the estuary for habitat enhancement and areas have been revegetated with native plants. As of the printing of this report, the Skokomish Tribe and its partners have restored 1,000 acres of habitat for salmon and wildlife.

Tiffany Royal, NWIFC

Dirt is moved and land is surveyed for the proper placement of a box culvert in the Skokomish estuary.

Recovery Efforts Lagging

At the 10-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 degradation of water quantity and quality, degradation of floodplain and riparian processes, degradation of marine shoreline habitat conditions, and an increase in impervious surface. 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 since the 2012 State of Our Watersheds Report shows an improvement in restoration efforts but a steady loss in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Impervious Surface	From 2006-2011, there was a < 1% increase in impervious surface. 39% of the impervious surface occurs within 1 mile of Hood Canal.	Declining
Shoreline Modifications / Forage Fish	From 2005 to 2014, Mason County had 202 hydraulic project approvals issued, resulting in an additional 1.6 miles of armored shoreline. This was the greatest amount in any Puget Sound County, while 714 feet of armoring were removed, resulting in a net increase of about 1.5 miles of armored shoreline.	Declining
Water Wells	From 2010-2014, water wells were increased by 4%. Of these 256 new wells, 112 (44%) were within 1 mile of Hood Canal shoreline.	Declining
Timber Harvest	From 2006 to 2011 the Hood Canal Watershed experienced a 3.4% decrease in forest cover. In addition, from 2008 to present 37 square miles have been or have the potential of being harvested within the Skokomish Tribe's Area of Focus.	Declining
Restoration	Twenty-six (17 active & 9 completed) riparian planting projects have be implemented on agricultural buffers in the Hood Canal watershed. In Skokomish watershed, 300 riparian acres have been planted in the last 5 yrs by the Mason Conservation District. The tribe has built the Potlatch Waste Water Treatment Plant which is owned and operates. The plant will help alleviate the many problems of on-site septic systems in the Hood Canal Watershed.	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

Examples of issues and opportunities that may affect the future of watershed health in Hood Canal include management of the following:

- Water quantity and quality monitoring;
- Water conservation;
- Water supply and use;
- Septic system;
- Animal manure and pet waste;
- Stormwater;
- Habitat;
- Funding;
- Education, communication, and outreach; and
- Enforcement.[3]

The four pressures that carried a "very high" rating as priorities in the Hood Canal Integrated Watershed Plan are the following:

- Commercial and residential development;
- Transportation and service corridors;
- Climate change and ocean acidification; and
- Wastewater discharges and stormwater runoff.[4]

Skokomish Indian Tribe

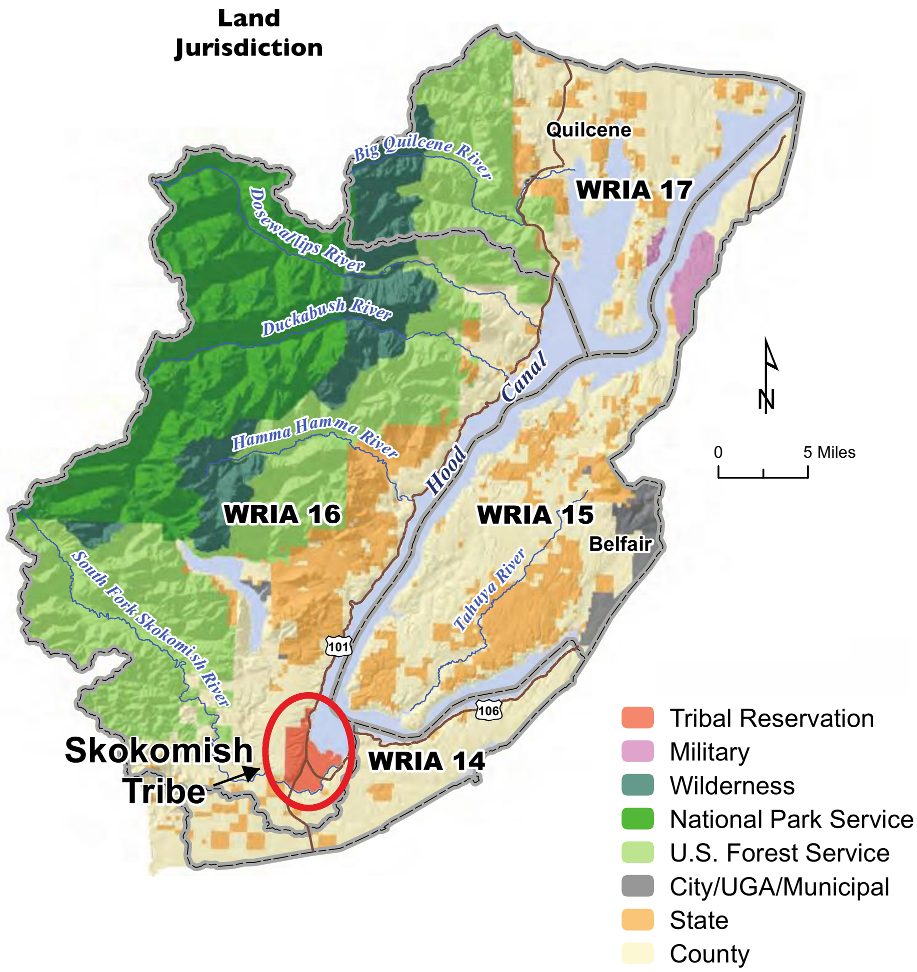
Hood Canal Watershed

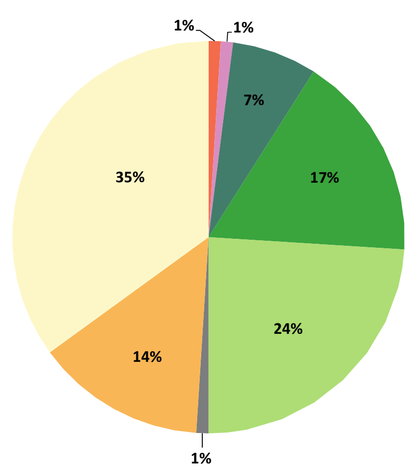
Hood Canal is a natural, glacier-carved fjord separating the Olympic and Kitsap peninsulas. It stretches 68 miles from the northern tip of the Kitsap peninsula to Lynch Cove, forming an L-shape that remains narrow, ranging from 1.5 to 2 miles across. The Canal includes portions of Mason, Jefferson and 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. 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 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 such activities as: dam construction, floodplain and shoreline development, roads and logging, especially in steep forested terrain.





Data Sources: SSHIAP 2004,[2] USFWS 2014,[3] WADNR 2014a,[4] WADNR 2014b,[5] WADNR 2014c,[6] WADOT 2013,[7] WAECY 1994,[8] WAECY 2000,[9] WAECY 2011a,[10] WAECY 2013[11]

Skokomish Tribe

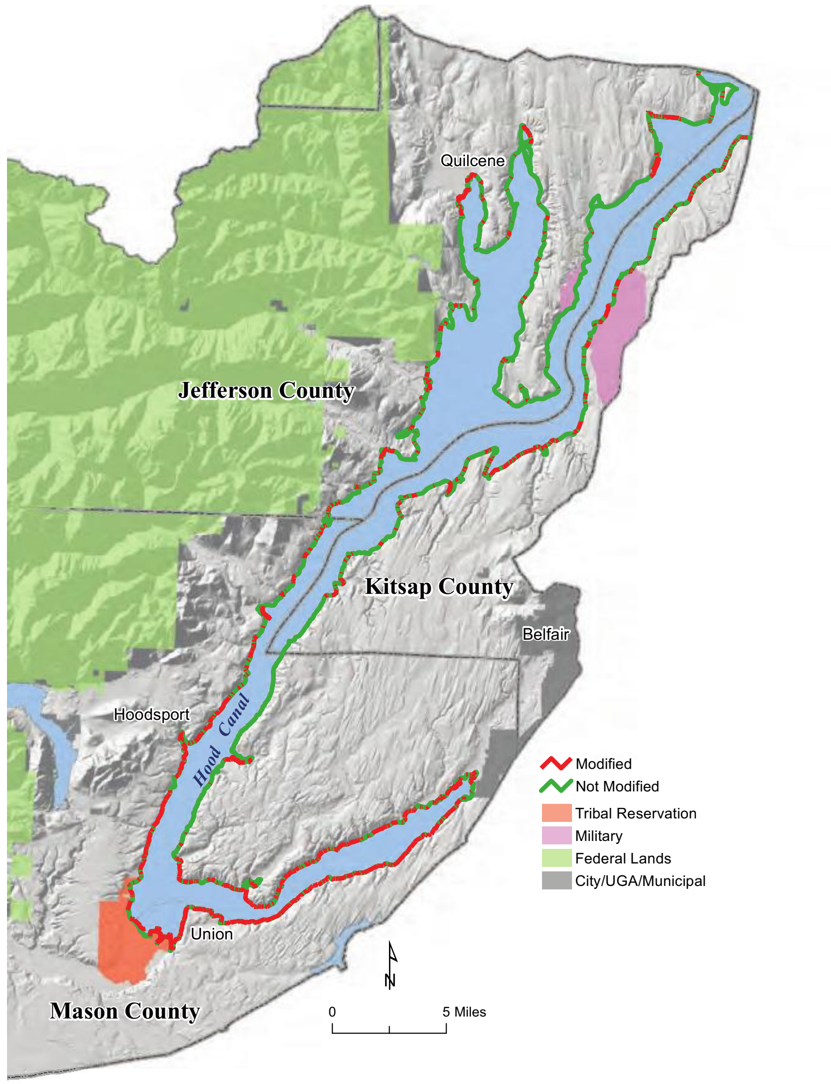
Shoreline Modifications Threaten Nearshore Habitat

From 2005-2014 in Mason County, 202 Hydraulic Project Approvals (HPAs) were issued resulting in an additional 1.6 miles of armored shoreline, the greatest amount in any Puget Sound county, while 714 feet of armoring were removed, resulting in a net increase of about 1.5 miles of armored shoreline.[1]

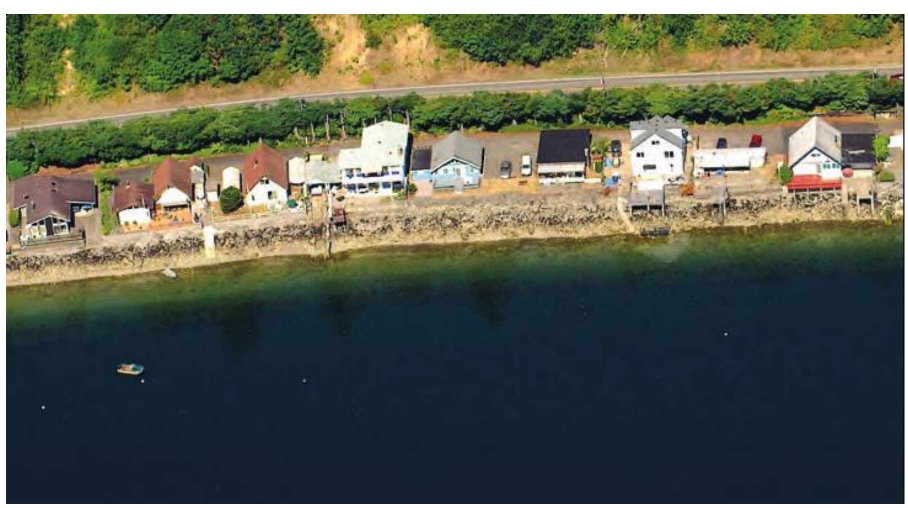
The nearshore habitat, which provides critical rearing and foraging for salmonids continues to be directly and negatively impacted. Shoreline development such as bulkheads, fill, roads, highways, docks and piers can affect habitat that salmon rely upon for migration, rearing and refuge. Estuarine, salt marsh, eelgrass and shallow water nearshore habitats are critical to all species of juvenile salmonids as they enter the marine environment.

The Hood Canal Coordinating Council Salmon Habitat Recovery Strategy has identified habitat in the nearshore marine waters as a high priority.[2] The intent is to protect and restore what is presently documented as the Chinook and chum habitat, and the watershed processes that support and maintain that habitat. The Mid-Hood Canal Chinook Recovery Planning Chapter identified the key to recovery of productive, sustainable natural Chinook is the habitat in the watersheds and estuaries.[3]

One of the objectives of the Skokomish Chinook Recovery Plan is to "protect from further degradation the structural elements that contribute to nearshore habitat forming processes and associated key habitats."[4] A recovery plan framework objective is "to restore nearshore habitat, the estuary, and associated floodplain habitat and function."[5] Needless to say, with over 35% of the shoreline being in a modified condition, continued, focused efforts will be necessary to reach these objectives.



Mason County HPA Summary 2005 - 2014	
No. of Shoreline Projects	202
New Armoring (ft)	8,545
Replacement Armoring (ft)	11,875
Removal Armoring (ft)	714



Example of shoreline armoring in the Hood Canal Watershed.

Data Sources: Carman et al. 2015,[6] PSNERP 2010,[7] USFWS 2014,[8] WADNR,[9] WADNR 2014c,[10] WADOT 2013,[11] WAECY 2011a,[12] WAECY 2013[13]

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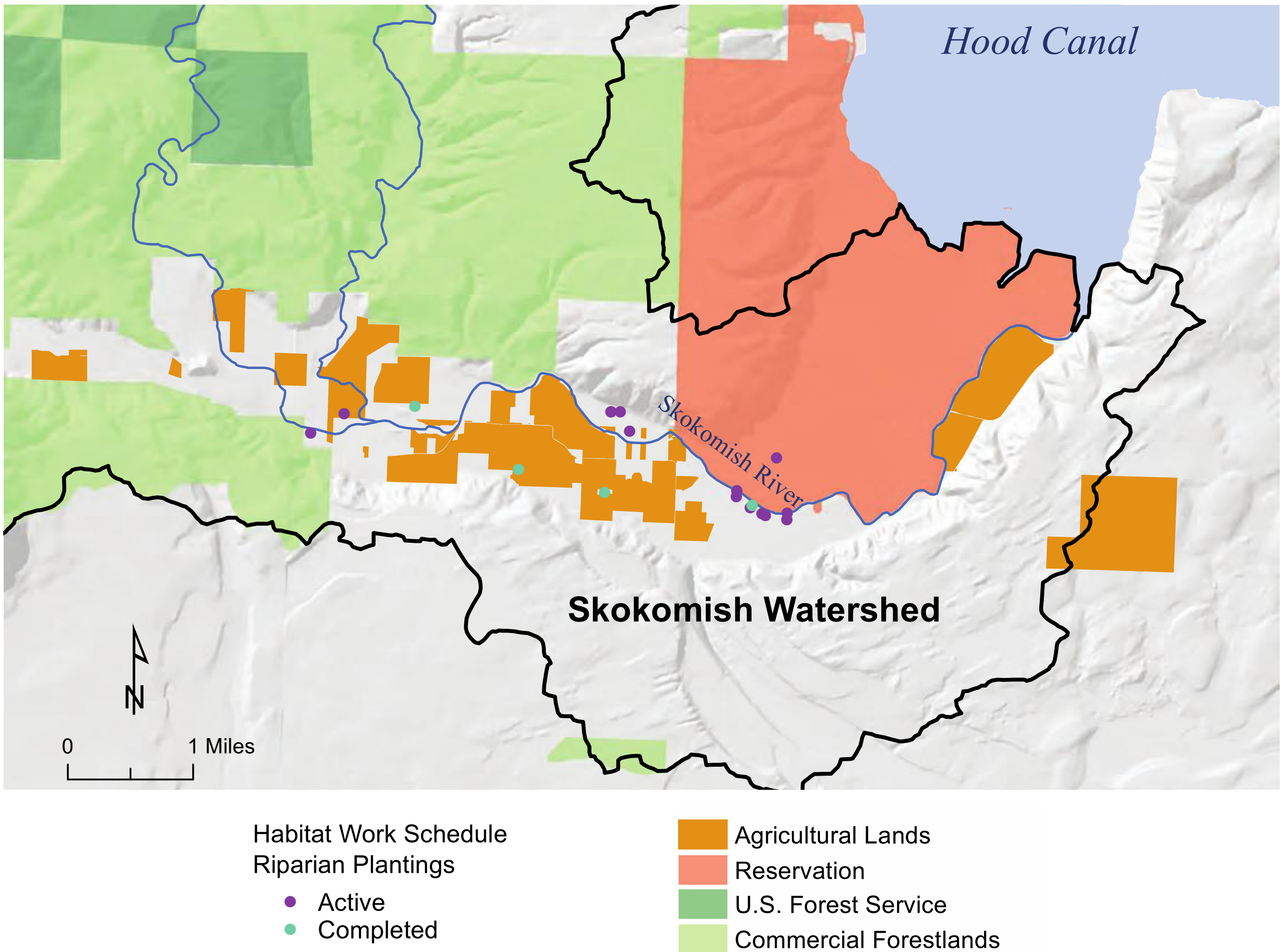
Agricultural Land Riparian Management Making Progress

The Habitat Work Schedule currently shows 17 active and 9 completed riparian planting projects on agricultural buffers in the Hood Canal Watershed through 2013. In the Skokomish Watershed, 300 riparian acres have been planted in the last five years by the Mason Conservation District.



The Skokomish River is a good example where agriculture activities, such as dike construction, channelization, erosional degradation and large wood removal have contributed to habitat problems. Many of these practices have caused excessive sediment loads and unstable streambeds and streambanks that have had significant impacts on the fate of salmon.[1]

Ninety-five percent of the agricultural lands of WRIA 16 are located in the Skokomish watershed. The Skokomish watershed has a long history of negative impacts caused by the lack of proper management of these agricultural lands, including lack of stream buffers, erosional sediment impacts, wetland loss and fecal contamination from cattle being allowed to enter streams. One of the limiting factors for Chinook recovery is the modifications to the floodplain and loss of freshwater wetlands.

Even though buffers on agricultural lands can help mitigate a number of impacts, managing floodplain riparian areas where agriculture is practiced in the Pacific Northwest is a continuing issue.[2] Large riparian setbacks are seen as an intrusion into private property owners' rights and mitigations for impacts are problematic.

Riparian buffers are widely considered to be a good land stewardship practice because of their ability to reduce agriculture-related nonpoint pollution. The performance and effectiveness of buffers is highly variable and site specific. Studies indicate that buffers of 15-30 meters (50-100 feet) provide adequate protection to aquatic resources under most circumstances, but disproportionately wider buffers are needed to obtain greater function.[3]

The Mason Conservation District continues to make progress in riparian restoration throughout Mason County. In the past five years, the Mason Conservation District has implemented over 300 acres of riparian planting in the Skokomish Valley alone.[4]

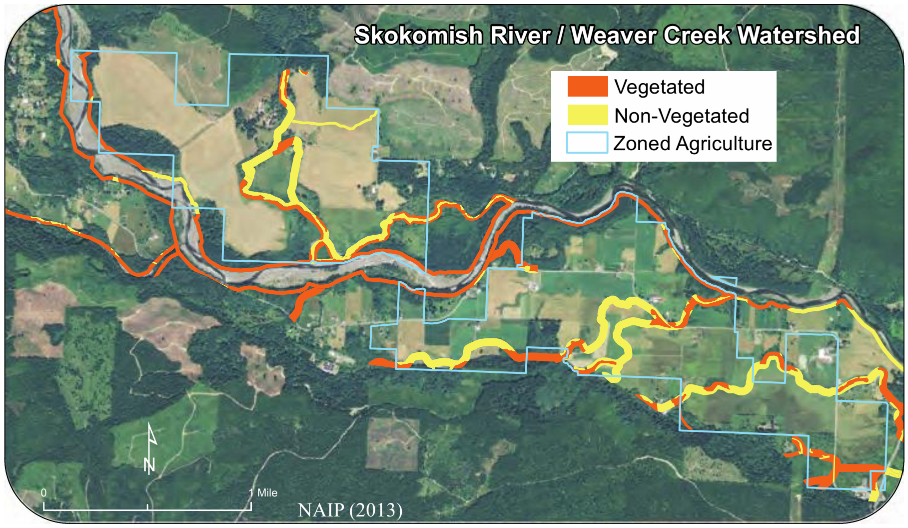
(Continued on next page)

Data Sources: HWS 2015,[7] Mason Co. 2015,[8] NAIP 2013,[9] SSHIAP 2014,[10] USFWS 2014,[11] USGS 2014,[12] WADNR 2006,[13] WADNR 2014c[14]

Agricultural Land Riparian Management Making Progress

(Continued from previous page)

Skokomish Farms has partnered with the Mason Conservation District and others to plant almost 90 acres of riparian and floodplain habitats, install more than 2.5 miles of livestock exclusion fencing, and provide off-stream watering facilities to livestock.[5] Mason County bought out nine acres of flooded pasturelands and partnered with the Mason Conservation District. The property, located north of Shelton along Highway 101, includes two tracts along Weaver Creek and one tract along the Skokomish River. The acreage was planted with a mixture of native evergreen trees and bushes. Riparian buffers were installed as part of a Washington State Conservation Reserve Enhancement Program (CREP) contract. The 180-foot-wide riparian buffers have already begun to provide wildlife habitat. Nests have been found and the fast-growing alder trees are beginning to shade the water.[6]



Example of agricultural riparian buffer conditions on the Lower Skokomish River and tributaries.

A newly planted CREP riparian buffer established to reduce the impacts of flooding, provides wildlife habitat and enhances salmon habitat along the Skokomish River.

A Skokomish WRIA 16 Agricultural Land Riparian Buffer Analysis pilot project by NWIFC SSHIAP was completed in the summer of 2014. The purpose of the project was to evaluate the vegetated condition of the riparian buffers found on the agricultural lands within the floodplains of the Skokomish, Dosewallips and Hamma Hamma watersheds. The analysis assessed the current conditions using NHD hydrography, 2013 NAIP imagery, and the NMFS/Ecology 319 Option 2 Buffer limits. See the chart below and map above for the results.

Miles of Vegetated Riparian Buffer:

Watershed	Total Miles	Vegetated Miles	Percent Vegetated	Non-Vegetated Miles	Percent Non-Vegetated
Dosewallips	5.62	4.64	83%	0.98	17%
Hamma Hamma	2.41	1.51	63%	0.9	37%
Skokomish Estuary	4.71	1.86	39%	2.85	61%
Skokomish	28.47	17.52	62%	10.95	38%
TOTAL:	**41.21**	**25.53**	**62%**	**15.68**	**38%**

Skokomish Tribe

Impervious Surface Unchanged

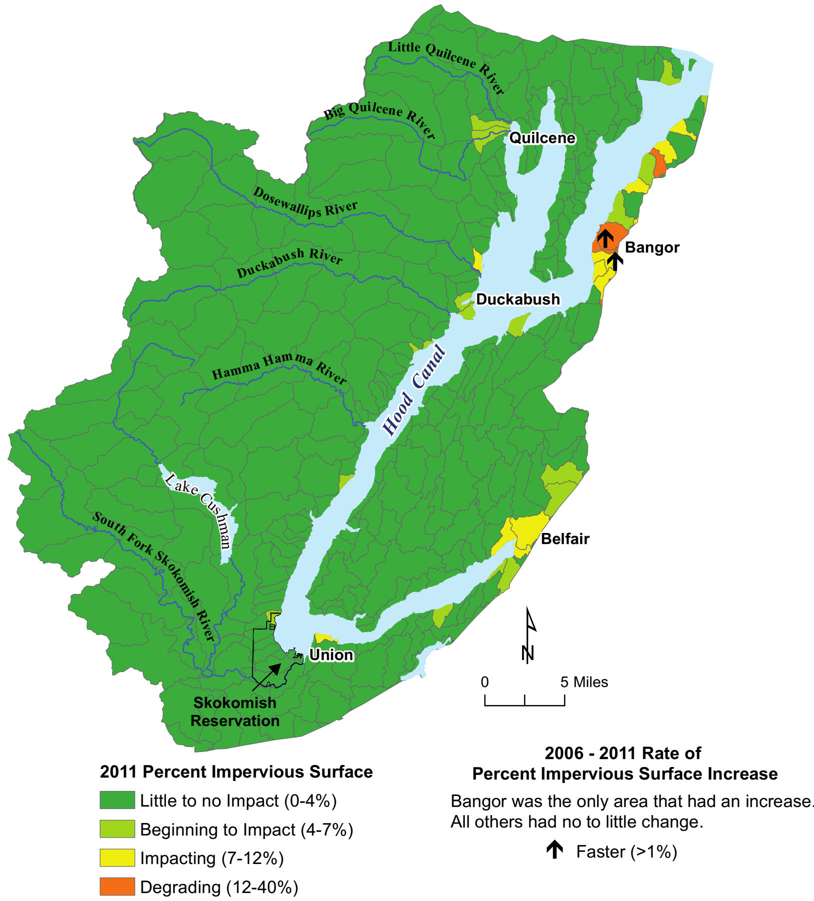
Impervious surface in the Hood Canal watershed increased by less than 1% between 2006 and 2011, with most occurring in the Bangor area.[1] Thirty-nine percent of the impervious surface in the watershed occurs within one mile of the Hood Canal shoreline.

The Hood Canal watershed's rivers, streams and nearshore environment provide important habitat for Chinook, chum, coho, and pink salmon, steelhead and cutthroat trout, and associated aquatic species. Habitat quality has diminished due to multiple causes including roads and land development, stream modifications, shoreline development and water pollution from sediment, nutrients and pathogens.[2]

Percent of impervious surface has been recognized as a key indicator of impacts to watersheds due to urbanization.[3] The frequency and intensity of peak flows and the volume of stormwater runoff all increase when natural cover is removed from developing areas and then converted to impervious surfaces, such as pavement, homes, buildings and non-native landscapes like lawns that reduce surface perviousness relative to natural forest cover.[4]

Development is a direct result of population growth, which in turn leads to increased impervious surfaces. Although the cities/towns in the Hood Canal watershed are small compared to more urbanized areas, they all showed an increase in population from 2010-2014. Belfair's population increased by 3.5%, Quilcene by 16.6%, and Union by 0.8%.[5]

One of the four goals of the Skokomish Chinook Recovery Plan identifies the need to protect the ecological processes, functions and forms of the Skokomish watershed from ongoing land and water uses, specifically the protection of water quality from further degradation from nonpoint and point pollution sources.[6] How the state and local governments manage urban/rural sprawl as more people move into the area will have a direct impact on the quality of salmon and steelhead habitat.



The Skokomish Tribe is working to reduce development that causes impervious surfaces and has implemented non-impervious surface walkways along Reservation Road.

New Skokomish Housing Development and Wastewater Treatment Plant planning and development has worked to reduce impervious surfaces.

2006

2011

Data Sources: NAIP 2006,[7] NAIP 2011,[8] NLCD 2006,[9] NLCD 2011,[10] WADOT 2013,[11] WADNR 2014c,[12] WAECY 2011a,[13] WAECY 2013[14]

Cumulative Impacts of Timber Harvest Operations

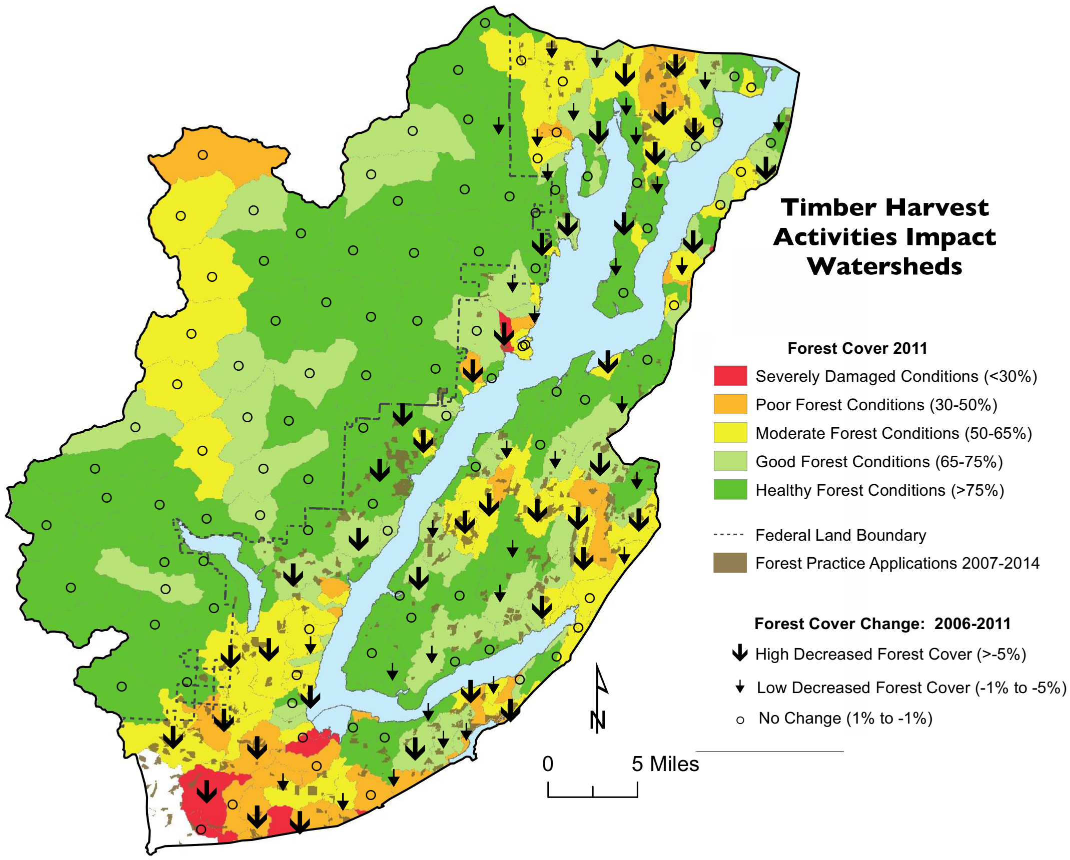
From 2006 to 2011, the Hood Canal watershed experienced a 3.4% decrease in forest cover.[1,2] In addition, from 2008 to present, 37 square miles have been or have the potential of being harvested within the Skokomish Tribe's Area of Focus.

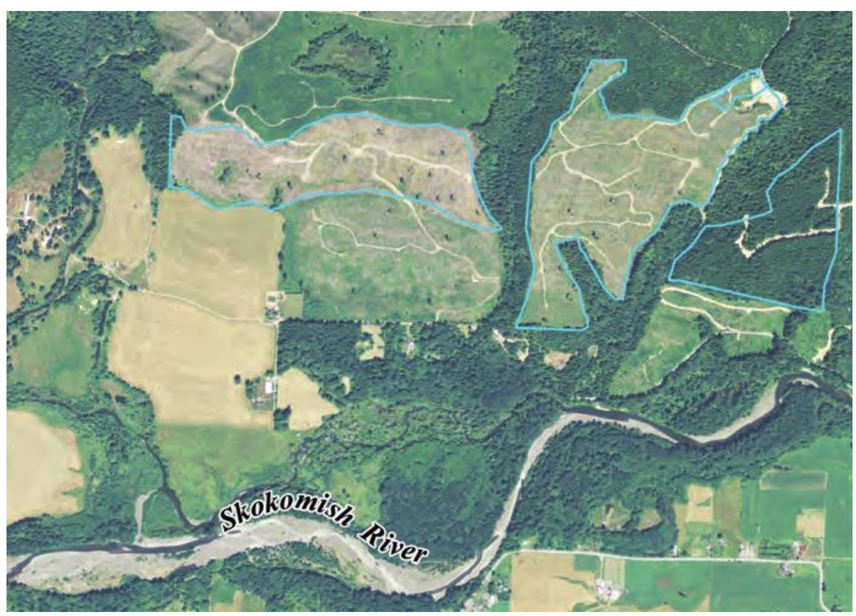
Timber harvest on non-federal land is present in all watersheds, with a significant amount occurring in the Skokomish and Toandos peninsulas. Large clear-cuts, inadequate buffers, mass wasting, and poorly constructed or maintained forest roads and culverts have all led to the degradation of salmon habitat in the Hood Canal watershed. Riparian degradation in the lower Dosewallips, McDonald Creek, lower Lilliwaup River, Skokomish River and lower Duckabush River has been attributed to forest practices.[3]

In the lower watershed, a significant amount of the anadromous fish habitat is on private lands. The lower river and estuaries are the most impacted by development and past logging practices in each of the three watersheds included in the Mid-Hood Canal Chinook Recovery Plan.[4]

In the Skokomish watershed, an additional 2,428 acres (3.8 square miles) of non-federal commercial forestlands were, or had the potential to be, harvested from 2008 to 2014. This, in combination with the USFS harvest of about 58,000 acres prior to 1995 in the upper watershed, places this watershed in need of aggressive restoration. These high rates of harvest are one of the main causes of aggradation and flooding seen in the lower river.

Significant habitat limiting factors which have prevented increased productivity of Chinook include the following: the estuarine habitat loss, channel complexity and overall channel conditions, high water flows in the winter months, floodplain wetlands, and logging roads in the upper watersheds.[5]





Three FPAs near the Skokomish River are depicted above, two of which show continued forest loss.

Data Sources: NAIP 2013,[6] USFWS 2014,[7] WADNR 2006,[8] WADNR 2011,[9] WADNR 2014c,[10] WAECY 2006,[11] WAECY 2011b[12]

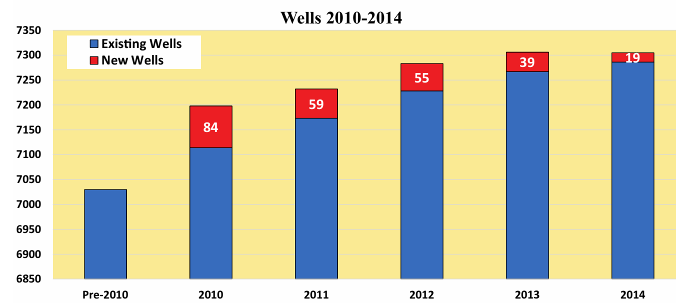
Water Wells Potentially Impact Surface Flows

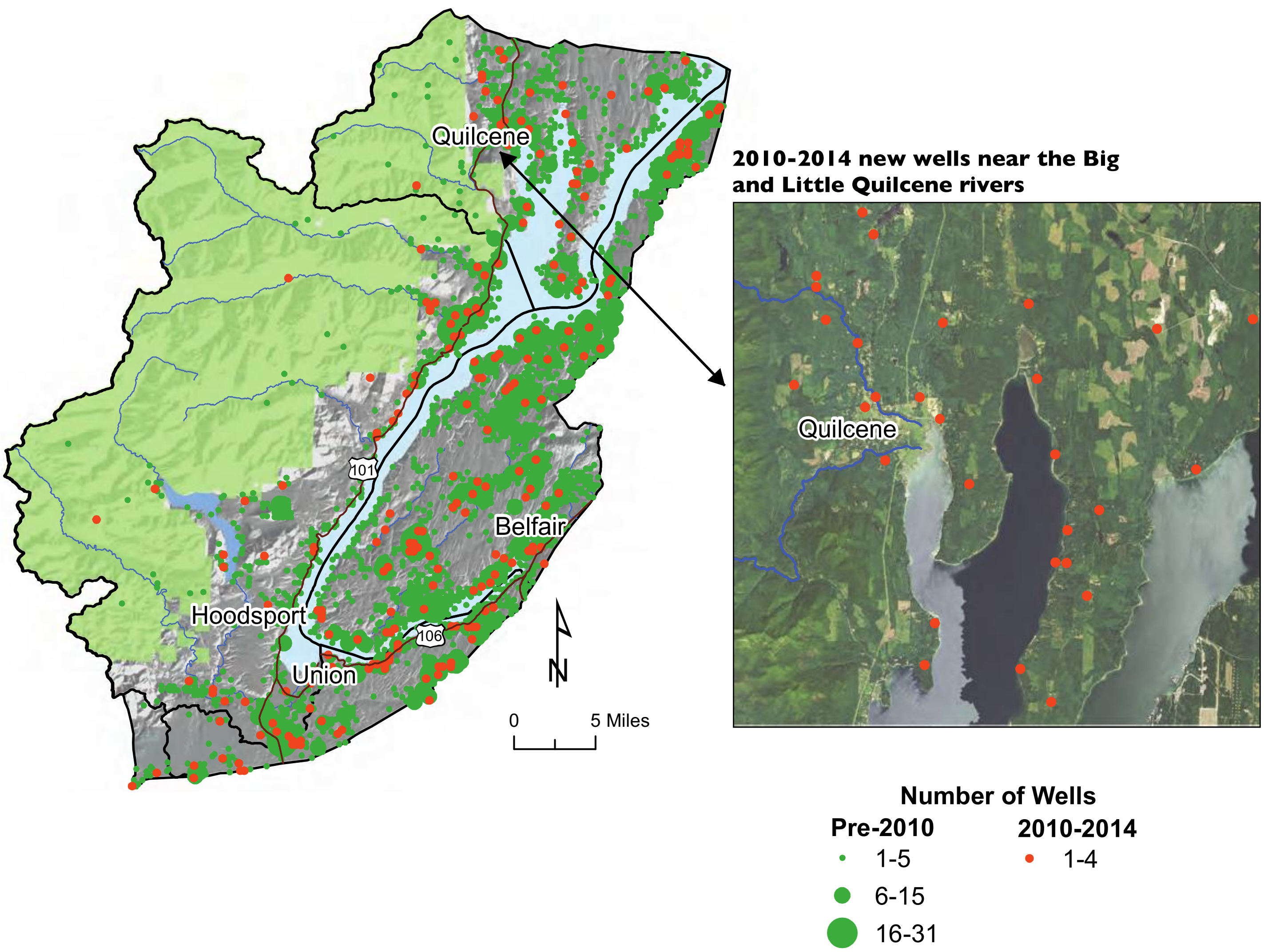
The Hood Canal watershed has seen a 4% growth in the number of water wells from 2010-2014. Of these 256 new wells, 112 (44%) were within one mile of the Hood Canal shoreline.

Hood Canal has experienced substantial population growth, especially along the shoreline, over the past several decades,[1] bringing an increased demand for water. Currently there are over 7,200 water wells in the Hood Canal Watershed.[2] Of the approximately 256 new wells (from 2010-2014), 112 are found within one mile of the Hood Canal shoreline. Recent tests have indicated that increased pumping from aquifers in this area would likely lead to saltwater intrusion from Hood Canal into those aquifers.[3]

Late summer streamflow in most of Washington's rivers and streams is dependent on groundwater draining into the streambed. During the drier summer months when flows are typically the lowest of the year, groundwater flowing into the stream is frequently providing almost all of the streamflow. Groundwater also provides a source of cooler water which is critical to fish reproduction and survival. Use and consumption of groundwater typically results in decreases in streamflow.[4] Streamflow affects fish habitat in many ways, including: the amount and distribution of spawning and rearing habitat; the risk of damaging incubating eggs or larval fish by scour or desiccation; risk of stranding fish in low flows; and the biophysical factors that form and maintain stream channels.[5]

The cumulative withdrawal of groundwater associated with the recent proliferation of water wells has led to concerns of instream flow, salmon habitat, public health and senior water right impact.[6] The Action Agenda in Hood Canal identifies the pressures from water withdrawals as ranking "high".[7]





Data Sources: NAIP 2013,[8] SSHIAP 2004,[9] USFWS 2014,[10] WADNR 2014b,[11] WADNR 2014d,[12] WAECY 2011a,[13] WAECY 2015[14]

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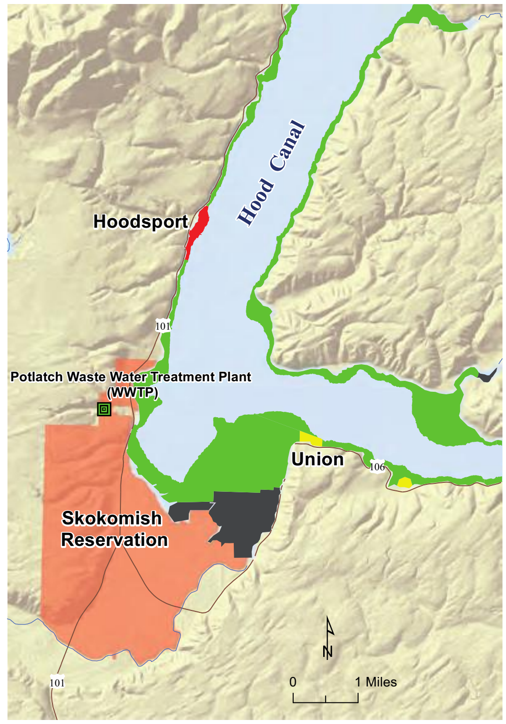
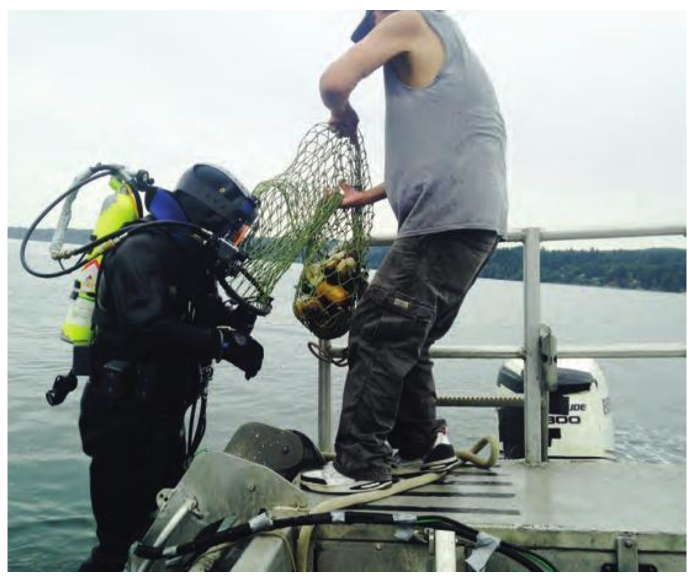
Taking Action on Water Quality in the Hood Canal Watershed

The Skokomish Indian Tribe is working with multiple agencies to classify a one-mile stretch of beach near Hoodsport as open to shellfish harvesting. The Tribe has built the Potlatch Waste Water Treatment Plant (WWTP), which is owned and operated 100% by the Skokomish Indian Tribe. This plant will help alleviate the many problems of on-site septic systems in the Hood Canal watershed.

The Skokomish Tribe wants more shellfish harvesting areas opened for everyone in Hood Canal and is working with local agencies to make sure that happens. There are areas near Hoodsport that the Tribe would like to see open for harvest because the resource is plentiful.[1] It's a multi-agency and multi-year effort between the Tribe, Mason County Health Department, the state Department of Health (DOH), Hood Canal Coordinating Council and Washington State University (WSU) to classify a one-mile stretch of beach near Hoodsport as safe for harvest. Working together, these partners will achieve the goal of improving the water quality of Hood Canal and improving natural resources for all. The Tribe and the County and state health departments are collecting and analyzing water samples from the area during a three-year period, starting in fall 2014, which is a regulatory requirement for an area to be considered as safe for harvest. Once the area is opened, the Tribe will seed it with shellfish so more of the resource is available in the future. In addition, WSU will be conducting surveys of landowners to better understand how to work with them to address water quality problems. The DOH also is conducting a survey of all the potential sources of pollution in the area and the Tribe will continue its pollution monitoring and control work into the future.[2]



Data Sources: SSHIAP 2004,[3] USGS 2014,[4] WADNR 2014b,[5] WADOH 2014,[6] WADOT 2013[7]



Skokomish Indian Tribe

The Skokomish Tribe has been monitoring geoduck and intertidal species of shellfish for biotoxins throughout the canal.

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T.iffany Royal, NWIFC

Seth Book, Skokomish Tribe water quality biologist, uses a refractometer to measure the salinity of a water sample from Hood Canal.

During FY14, the Tribe completed the construction of the Potlatch Wastewater Treatment Plant (WWTP) a membrane bioreactor (MBR) plant for the Potlatch area of Hood Canal. This system hooked up the *t3ba'das* housing development, Potlatch State Park facilities, and residential and commercial sites along U.S. Hwy 101, including the Tacoma Power House facilities, residences, Saltwater Park and the Waterfront at Potlatch Resort. Residences and businesses on both sides of U.S. 101 are eligible to be connected to this system. Wastewater from these homes and businesses are collected and pumped (through a force main) that follows U.S. Highway 101 to the WWTP plant.

In FY 15-16, the WWTP MBR facility will expand from the Potlach area to the Lucky Dog Casino, hooking up additional homes, the casino, and Twin Totem gas station. Existing septic tanks will be properly abandoned. A primary objective of this project is to avoid any underground flow of untreated sewage pollutants into Hood Canal. An MBR uses membranes to filter out suspended solids, including harmful microorganisms such as viruses and bacteria. The resulting effluent can be safely returned to groundwater or recycled. The system capacity is 55,000 gallons per day.

(Continued next page)

Completed Potlatch Wastewater Treatment Plant


Skokomish Natural Resources 2015

Skokomish MBR Plant Tie-Ins 2015-2016

Skokomish Natural Resources 2015

Skokomish Tribe

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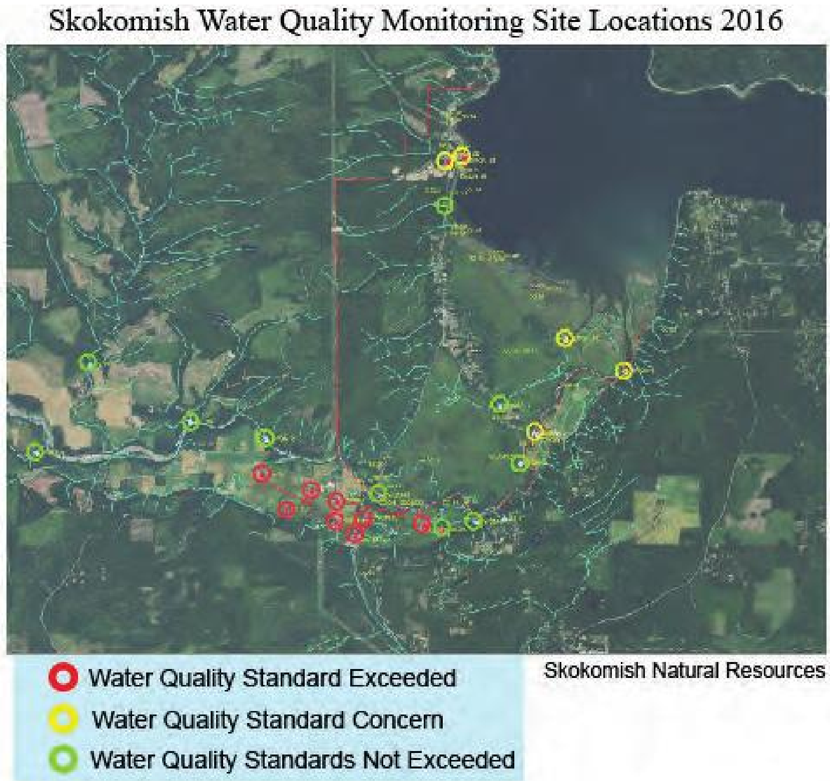


Skokomish Natural Resources

The Skokomish Water Quality Monitoring program surveys continued to give the Tribe the ability to gather baseline water quality data, as well as alert state and federal agencies to exceedances in water quality standards. The Skokomish water quality staff is working with the Washington State Department of Ecology on the Skokomish River Total Maximum Daily Load (TMDL) compliance for Weaver and Hunter creeks.

Skokomish staff is continuing to communicate Skokomish Tribe's water quality concerns to Ecology for action regarding cattle access to streams in the Skokomish system. As shown, agricultural land in the mid-Skokomish Valley, which is associated with cattle grazing, consistently have high fecal contamination, which jeopardizes shellfish growing areas in Hood Canal.

The Skokomish Tribe reached a milestone in 2013 with the certification of its water quality lab for total phosphorus by the Washington State Department of Ecology. Since then, the Skokomish Natural Resources Department has continued to improve the lab, including receiving conditional certification for nitrate and ammonia. The lab facilities were expanded in 2015 to another 180 square feet to accommodate a gas chromatograph/mass spectrometer (GC/MS) and a high pressure liquid gas chromatograph (HPLC) purchased in 2013. To enhance the lab capacity further, the Natural Resources Department advertised for a lab chemist to run the specialized sampling equipment. In 2015 the Tribe hired Ph.D. scientist Sang Seon Yun to do sophisticated analysis for hydrocarbons, pesticide, herbicides contamination, as well as toxic algal monitoring of Hood Canal waters as an indicator of the effects of climate change. In the future, fish tissue may be analyzed in support of Fish Consumption Rate water quality standards. The Tribe will continue analyze for nutrients in its Skokomish water quality monitoring program.

Skokomish Natural Resources

The Skokomish Tribe's water quality lab.

Skokomish Estuary Restoration Nearly Finished

The Skokomish River has the largest estuary and intertidal delta in the Hood Canal basin. The Skokomish Estuary project in southern Hood Canal is sponsored by the Skokomish Tribe with the goal to restore historic and natural estuarine form and function, as well as improve water quality issues and habitat for fish, shellfish and shore birds.

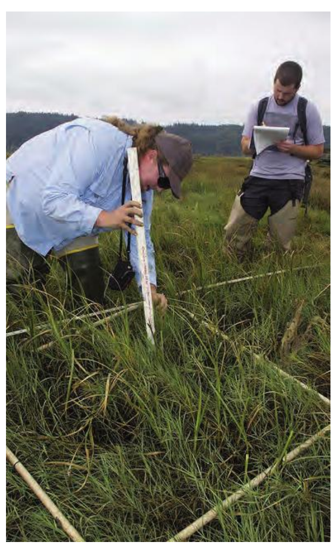
Phase 1, completed in 2007, was the main shore, and included removal of dikes and culverts and the installation of large woody debris. A boardwalk was constructed for access to the Tacoma powerlines and Tribal shellfish harvesting. Recolonization of salt marsh vegetation has taken well to the restored area in the last five years.

Phase 2, completed in 2010, included restoring Nalley Island to its historic state as a natural estuary. Work included building a temporary bridge for construction crews to remove interior dikes and soils.

Currently in the third and final phase, the Tribe is reconnecting historic tidal channels that were blocked or filled in over time, allowing the tidelands to flow properly. The latest phase of the Skokomish Estuary restoration effort is the largest to date: 600 acres of forested wetlands are going to be reconnected to 400 acres of Skokomish tidelands. Doing that will re-establish the forested wetland-to-salt marsh connection that's been missing for 70 years. In addition, fish-blocking culverts and tide gates are being removed or replaced with larger culverts and bridges.[1] With just a few more earth-moving projects left, the Skokomish Tribe will be nearing the end of the restoration of its 1,000-acre estuary. In 2016, small fish-blocking culverts will be replaced with bridges on Skokomish Flats Road, the primary access road to the estuary.

"After this phase, the estuary will be pretty much restored to nearly like it was before it was diked," said Alex Gouley, the Tribe's habitat program manager. "Then it will just be letting nature take over fully."[2]

As soon as the habitat returns, so do the fish. The Skokomish Tribe has solid data showing how salmon are using the Skokomish tidelands after a year of monitoring the 400-acre restored estuary. While the tribe monitors the estuary year-round, the first full year of sampling (December 2011 to November 2012) showed 20 fish species, including Chinook, chum and coho salmon, using both the large and small tidal channels in the restored areas of the estuary.[3] Every August, since 2011, when everything is in full bloom, Tribal staff visit 14 sites throughout the estuary that are in phase 1 and 2, looking at sediment, plant types, sizes and growth. The tribe has found pickleweed, salt grass, sedges, rushes, sea arrow grass and Puget Sound gumweed.[4]



Tiffany Royal, NWIFC (3)

Top: Aerial view of Annas Bay. Middle: Skokomish habitat program manager Alex Gouley observes a historic tidal channel functioning again. Bottom left: Habitat staff survey vegetation in the estuary. Bottom right: Fisheries staff use a seine to collect and count salmon and other fish in the estuary.

Data Sources: NAIP 2015[5]

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2016 State of Our Watersheds Report
Headwaters of the Salish Sea

The Squaxin Island Tribe is descended from maritime people who have lived and prospered along the shores of the southernmost inlets of Puget Sound for millennia. These waters have always nourished our culture and community. Their protection and restoration is central to providing abundant salmon and shellfish to sustain our way of life.

– Andy Whitener,
Squaxin Island Tribe

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, four-and-a-half miles long and a half-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 has been purchased and a thriving community has been established.

The Headwaters of the Salish Sea

The Headwaters of the Salish Sea is the Squaxin Island Tribe's Area of Focus, which includes the marine waters south of the Tacoma Narrows and all freshwater rivers and streams flowing into it. A tremendous amount of marine shoreline and diversity of habitats support rearing and migrating salmonids in the region. Smolts from elsewhere in the Salish Sea, like the Puyallup River, frequently visit South Sound before heading to the open ocean. This area is second only to the San Juan Islands for total length of marine nearshore. Its shoreline accounts for nearly half of the nearshore habitat in south and central Puget Sound, and provides vital habitat for salmonid reproduction locally and regionally.

The South Sound Salmon Recovery Plan focused on the nearshore environment to recover salmonid populations. The strategy was to ensure that properly functioning nearshore habitats serve rearing, refuge, feeding, physiological transition and migratory needs of local and regional salmonid populations.

Technical analysis has identified significant limiting factors contributing to the decline of the region's salmonid populations and shellfish harvest opportunities.

From the PSP Action Agenda South Sound Chapter:

- Habitat conversion from historic conditions, including loss of forest cover; reduced instream large woody debris; elevated summer stream water temperatures, loss of wetlands, degradation of topsoil and duff layer, and marine shoreline armoring.
- Disruption of natural hydrologic regimes and loss of natural floodplain function due to land conversion to impervious surfaces, simplification of stream channels and native vegetation removal.
- Extreme sensitivity to toxic, nutrient and pathogen pollution due to poor water circulation in and out of South Sound. Contaminants are transported primarily by stormwater runoff and are leading to acidification, hypoxia and shellfish harvest restrictions in South Sound waters.[1]

Squaxin Island Tribe

Squaxin Island Water Quality Technician taking field measurements.

Recovery Efforts Lagging

At the 10-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 since the 2012 State of Our Watersheds Report shows an upgrade in shellfish growing areas but a steady loss in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Impervious Surface	From 2006-2011, increase of 2% in impervious surface outside of cities and UGAs, accounting for an additional 0.6 square miles.	Declining
Land Conversion	From 2006-2011, increase of 4% in developed lands.	Declining
Shoreline Modifications / Forage Fish	From 2005 to 2014, Pierce, Mason and Thurston counties, had 547 hydraulic project approvals issued, resulting in an additional 3.3 miles of new armored shoreline, while 0.4 miles of armoring were removed, resulting in a net increase of almost 3 miles of armored shoreline. The Puget Sound Action Team shows 48% of the pocket estuaries in south Puget Sound as properly functioning while 52% are not properly functioning or at risk.	Declining
Water Wells	From 2010 to 2014, 259 new wells (4.5% increase) were added to the already existing 5,786 in WRIA 14.	Declining
Water Quantity - Low Flows	Much of Johns Creek continues to exceed the minimum Core Summer Salmonid Habitat water quality standards (not exceeding 16 degree Celsius 7-Day Average Daily Maximum).	Declining
Water Quality - Shellfish	From 2011 to 2014, improved sanitary conditions resulted in an upgrade in shellfish growing area classifications. Adding an additional 1,194 acres for shellfish harvesting or longer harvest periods.	Improving
Forestland Cover	From 2006-2011, decrease of 6% in forest cover	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

Using sound science, the Squaxin Island Tribe will advocate for habitat restoration, better resource management, and land conservation and preservation. We will push for cleanup of toxins in the environment, so that all people can consume fish and shellfish without threats to their health. We will advocate for the highest standards in wastewater management. We will advocate for timber harvest practices that retain the function of riparian forests. We will seek the removal of bulkheads on shorelines and blocking culverts in streams in order to provide sediment supply and fish passage. And we will advocate for land-use planning to minimize impact of development on water resources.

Emmett O'Connell, NWIFC

Squaxin Island tribal elders harvest shellfish on Little Skookum Inlet.

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.

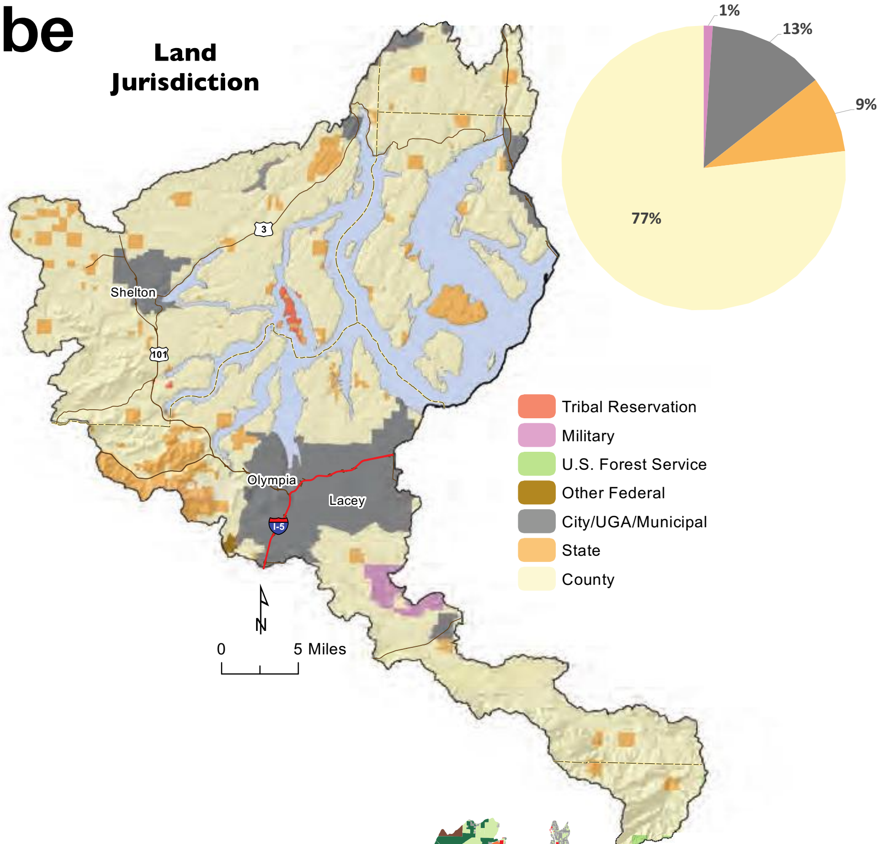
The topography is generally low relief and composed of glacial till and outwash deposits from the Vashon Stade, which ended about 11,000 years ago. This geology has resulted in a landscape abundant in low gradient streams with many lakes and wetlands, especially in the headwaters. Nearer the marine waters, 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.

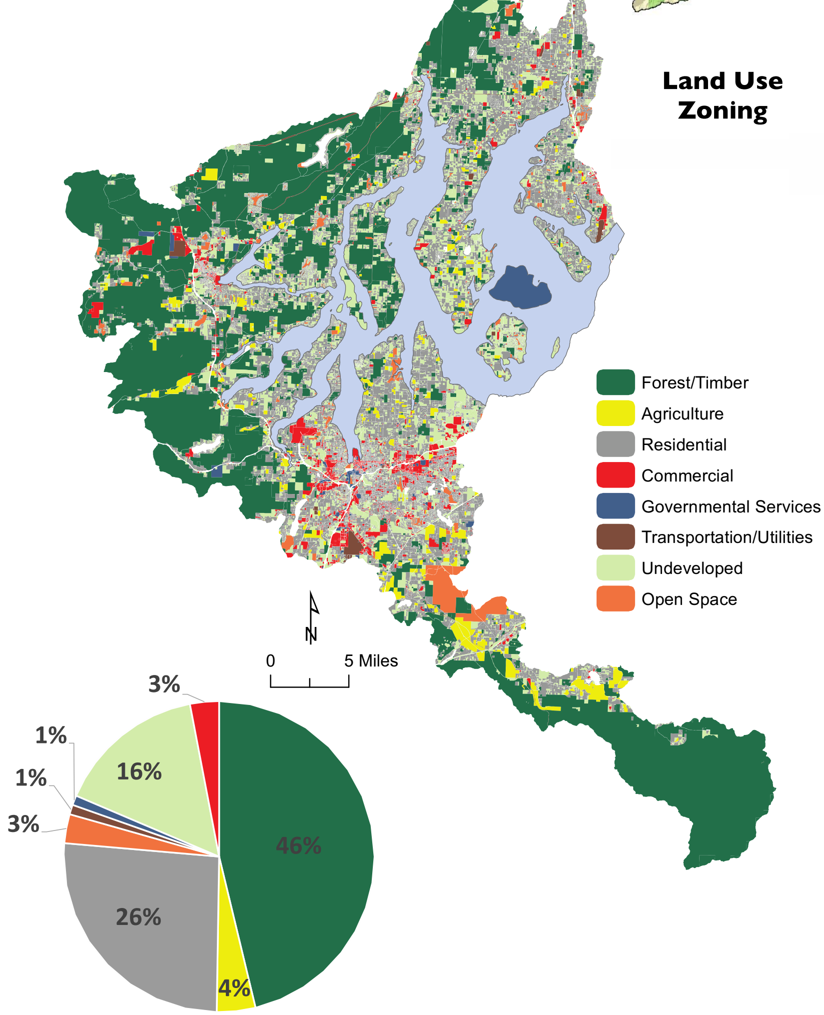
The independent streams are well suited for coho, chum, and coastal cutthroat, but in recent memory anadromous salmonids could not pass Tumwater Falls at the lower end of the Deschutes River. In 1952, a fish ladder was installed to allow fish passage, and a run of coho has become naturalized although recent numbers are dwindling.[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. Smolts 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.

Data sources: SSHIAP 2004,[2] USFWS 2014,[3] WADNR,[4] WADNR 2014a,[5] WADNR 2014b,[6] WADNR 2014c,[7] WADOT 2013,[8] WAECY 1994,[9] WAECY 2010,[10] WAECY 2011a,[11] WAECY 2013[12]



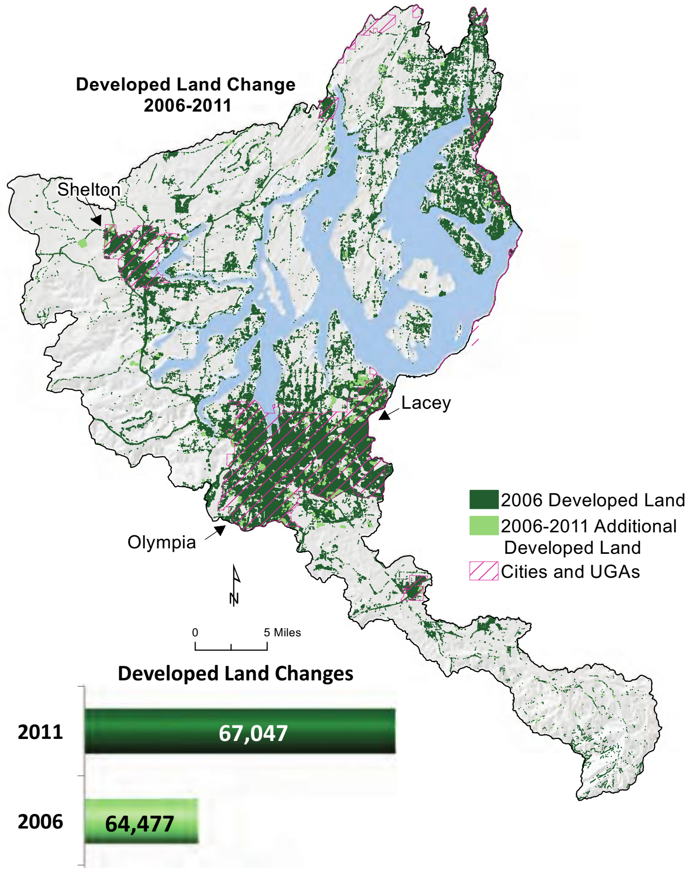


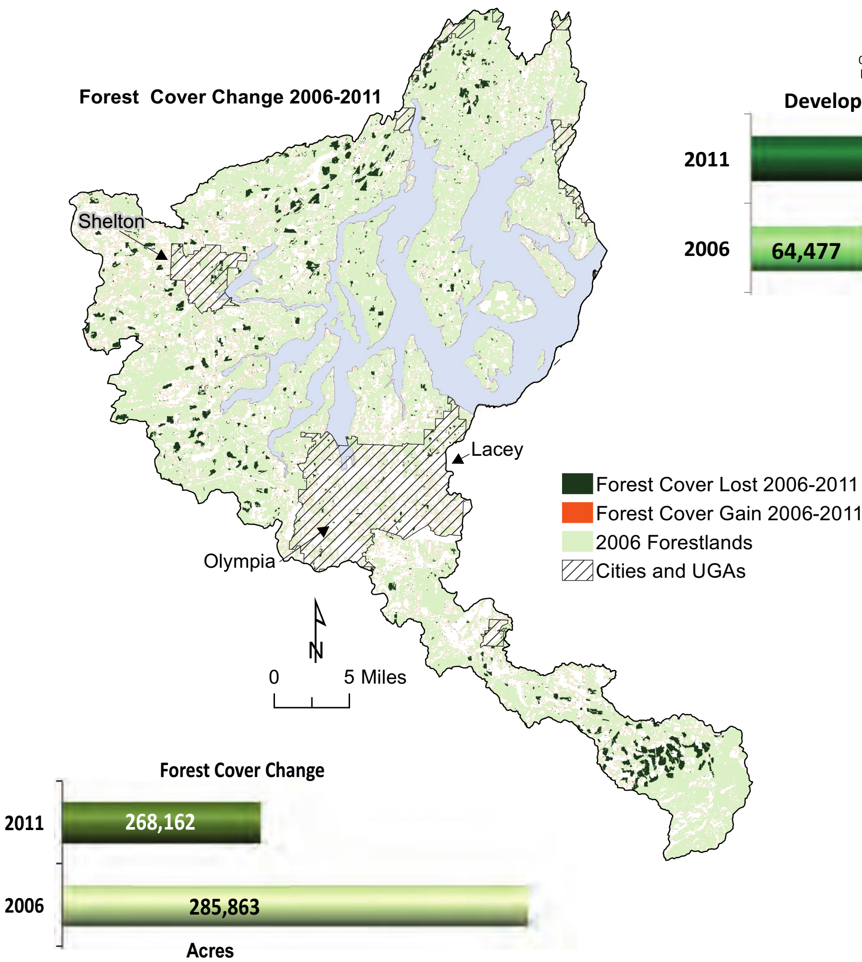
Urban Sprawl – Continued Loss of Forest Cover

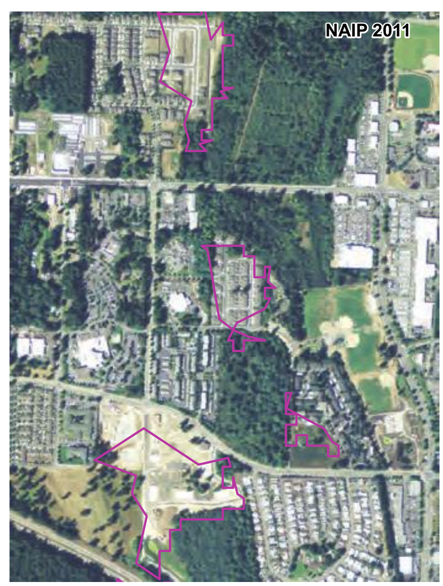
From 2006 to 2011, the Squaxin Area of Focus saw a 4% increase in developed lands and over a 6% decrease in forest cover.[1,2]

Timber harvest, agriculture, and residential and commercial development have substantially altered salmonid habitat throughout South Puget Sound. In the Puget Sound region, forestlands are giving way to cities and urbanized areas at a fairly rapid rate. Research shows that as development increases, impacts to streams and stream health tend to progress. Studies have also shown that watersheds with high forest cover are less likely to have degraded stream health.[3] Data from NOAA-CCAP shows that during the 2006-2011 timeframe there was an increase of 2,570 acres (4%) in developed land and a loss of 18,026 acres (6%) in forest cover.

The PSP's 2013 State of the Sound report message to the Governor, Legislature and the people of Puget Sound states: "Annually, we lose more habitat to development than we gain in our restoration programs," and this is in despite of the ESA listing of Chinook, coho and steelhead.[4]







Forest giving way to urban sprawl in Thurston County. Pink polygons depict areas of lost forest cover conversion to development from 2006 to 2011.

Data sources: NAIP 2011,[5] WAECY 2006,[6] WAECY 2011a,[7] WAECY 2011b,[8] WAECY 2013[9]

Shellfish Growing Areas Show Improvement

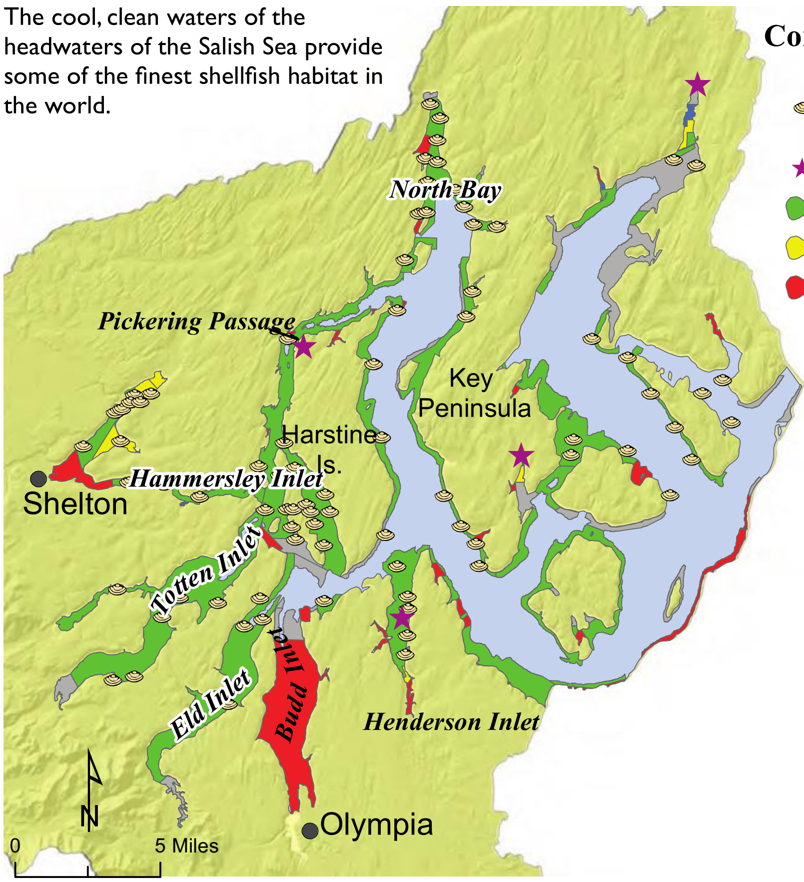
From 2011 to 2014 improved sanitary conditions resulted in net upgrades in classifications of shellfish growing areas within the Squaxin Island Area of Focus allowing for shellfish harvesting or longer harvest periods on an additional 1,194 acres.[1]

Shellfish have been a mainstay for the Squaxin Island people for thousands of years. Their harvest remains vitally important today for subsistence, economic and ceremonial purposes. As shellfish growing areas are upgraded to an approved status within the Squaxin Area of Focus, the Tribe could potentially harvest their treaty share in those expanding areas. In addition to upgraded areas, each year other areas within the Squaxin Area of Focus are being identified and surveyed by the Squaxin Island Shellfish Department. The goal of the department is to maintain treaty harvest rights in this area and provide harvest opportunities for Squaxin Island tribal members.

Four of the five South Sound inlets are classified for commercial shellfish harvesting. Budd Inlet, the most developed of the five inlets, has been closed to shellfish harvesting for decades along with Shelton Harbor in Hammersley Inlet. In contrast, Totten Inlet, the least developed inlet, along with Squaxin Island beaches, closes only at the most extreme of rain events due to potential pathogen pollution in stormwater runoff. Henderson Inlet is more challenging due largely to the scale and complexity of the pollution problems and continued population growth and urbanization around Lacey and Olympia.[2]

Approximately 7,200 acres of shellfish harvesting areas in the Squaxin Island Area of Focus are classified as prohibited due to the proximity of potential pollution sources (wastewater treatment plant or stormwater outfalls) or otherwise poor water quality caused by nonpoint sources of pollution.[3]

The cool, clean waters of the headwaters of the Salish Sea provide some of the finest shellfish habitat in the world.



A Squaxin Island tribal member harvests geoducks in South Puget Sound.

Threats to Treaty Shellfish Harvest:

- Failing septic systems
- Poor livestock management
- Increased stormwater runoff
- Increased harmful algal blooms
- Contaminated sediment
- Decreased submarine groundwater discharge
- Ocean acidification

Reclassification of Intertidal Shellfish Growing Areas 2011-2014

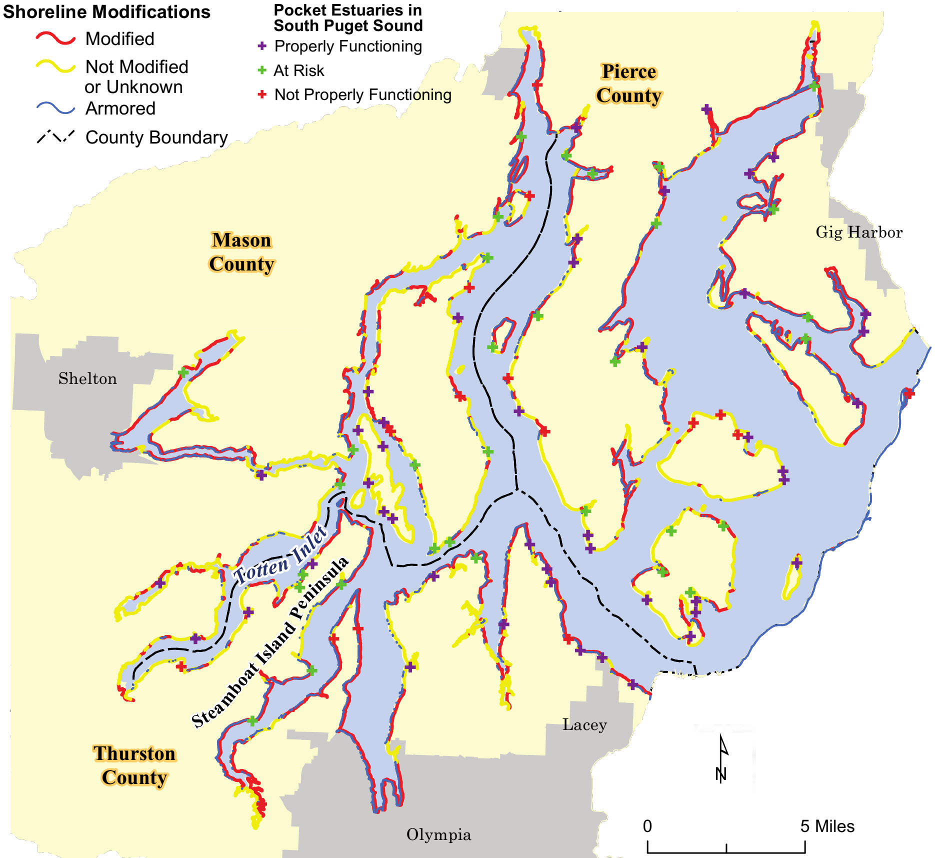
Growing Area	Acres Upgraded	From	To
Pickering Passage	47	Conditional	Approved
Pickering Passage	12	Prohibited	Approved
Vaughn Bay	50	Prohibited	Approved
Henderson Inlet	50	Conditional	Approved
Henderson Inlet	50	Prohibited	Conditional
Oakland Bay	799	Conditional	Approved
Henderson Bay	41	Restricted	Approved
Henderson Bay	15	Prohibited	Approved
Nisqually Reach	19	Prohibited	Approved
Penrose Point	27	Prohibited	Approved
Burley Lagoon	36	Restricted	Conditional
Totten Inlet	48	Unclassified	Approved

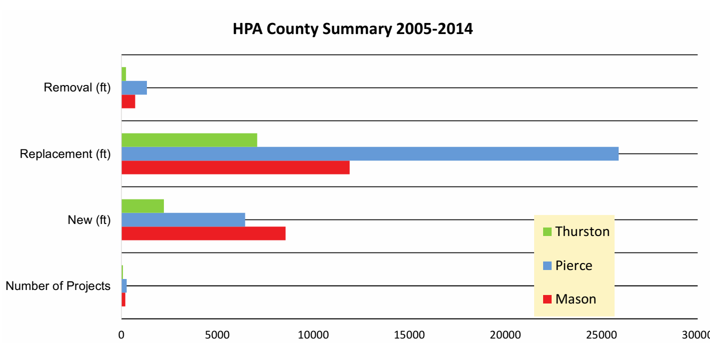
Data sources: Squaxin 2015,[4] WADOH 2014,[5] WADOH 2015,[6] WADOT 2010,[7] WAECY 2011a[8]

Nearshore Marine Shoreline Modifications

From 2005-2014 in Pierce, Mason and Thurston counties, 547 Hydraulic Project Approvals (HPAs) were issued resulting in an additional 3.3 miles of new armored shoreline, while 0.4 miles of armoring were removed resulting in a net increase of almost 3 miles of armored shoreline.[1] The Puget Sound Action Team (PSAT) shows 48% of the pocket estuaries in south Puget Sound as properly functioning while 52% are not properly functioning or at risk.

WAECY Coastal Atlas





Almost 54% of the marine shoreline segments in the Squaxin Island Tribe's Area of Focus contain some type of modification such as bulkheads, riprap or other human-made structures. Thurston County's shoreline is among the most extensively armored in Puget Sound. Between 1984 and 2002, over 25,000 feet of new bulkheads had been added in Thurston County.[2]

HPAs issued by the Washington Department of Fish and Wildlife (WDFW) are required for in-water and shoreline construction activities in Washington state, including shoreline armoring. To identify recent trends in the rate, extent and location of shoreline armoring in Puget Sound, WDFW reviewed all shoreline armoring HPAs in Puget Sound between January 2005 and December 2014.[3] The trend in shoreline armoring in Puget Sound is an important indicator of ecological condition and is used by the Puget Sound Partnership as one of several indicators of the general health of Puget Sound.

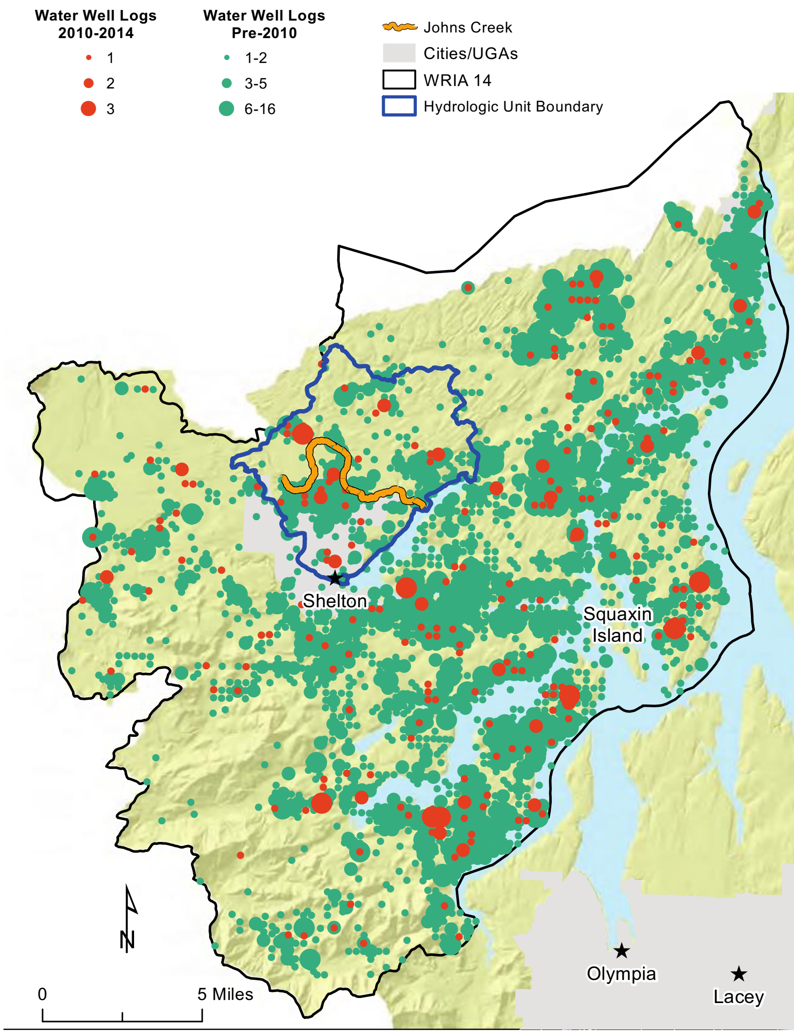
Shoreline armoring alters natural erosion and deposition patterns, increasing substrate size, and altering plant community composition and primary production. Armoring increases erosion rates on beaches, thus converting the beach from a depositional area that accumulates sediment and organic matter to an area that loses these elements on an annual or seasonal basis. Shoreline modifications affect salmon habitat by reducing shallow water areas and nearshore functional benefits. Surf smelt and Pacific sand lance spawn on beaches composed of sand and small gravel, habitat that is lost when wave energy and erosion are increased by shoreline armoring.[4]

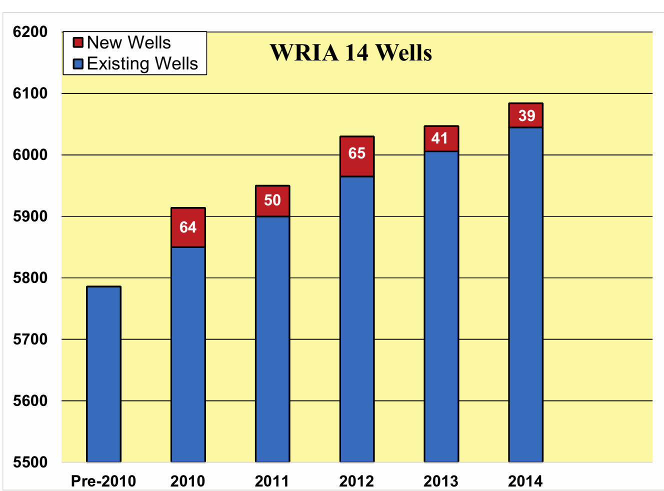
Pocket estuaries are "small-scale estuaries located at the mouths of streams and small rivers and other semi-enclosed embayments within Puget Sound that have a tidal channel structure, intertidal marsh and/or mudflats, eelgrass beds and other features typical of larger estuaries."[5] Pocket estuaries provide juvenile salmonids with a refuge from predators and high wave energy, and a transition to salt water. The rich macroinvertebrate community within pocket estuaries is also critical for foraging and growth. The physical conditions in South Puget Sound lead to some differences between the flora and fauna of southern Puget Sound as compared with other estuaries in Puget Sound. Some species assemblages such as kelp and other algae and invertebrate species are not as diverse as other parts of Puget Sound. Eelgrass, a key habitat of juvenile salmon, is also not found south of the Nisqually Delta.[6]

Data Sources: Carman et al. 2015,[7] PSAT 2005,[8] PSNERP 2008,[9] SSHIAP 2012,[10] USGS 2014,[11] WADNR,[12] WAECY 2011a,[13] WAECY 2013[14]

Low Streamflow and Elevated Water Temperatures

From 2010-2014, 259 new wells (4.5% increase) were added to the already existing 5,786 in WRIA 14. Washington state requires Core Summer Salmonid Habitat not to exceed a 16°C 7-Day Average Daily Max. Much of Johns Creek continues to exceed this threshold.





Johns Creek in Mason County, Washington, is an important producer of coho and chum salmon. In 1984, the Washington State Department of Ecology established an Instream Resources Protection Program for Water Resource Inventory Area 14 (WAC 173-514) to retain sufficient instream flow to protect fish and wildlife, scenic, aesthetic, and other environmental values. This rule closed Johns Creek and its tributaries to all consumptive appropriations annually from September 16 through November 15, and established minimum instream flows for the rest of the year.[1] The stream is also listed on the Ecology 303(d) list of impaired waterbodies for temperature. Sections of this stream exceed water quality standards and are considered too warm. In addition, Johns Creek is also listed as impaired (Category 4C water) for instream flow in Reaches 2 and 3. Category 4C waters are those waters impaired by a non-pollutant. Ecology has initiated a temperature TMDL for Oakland Bay-Hammersley Inlet and associated tributaries, including Johns Creek.[2] Despite these protections, Johns Creek average daily flows are frequently below established instream flow in summer.[3]

Available stream gauge data suggests that all listed streams, for most periods of time since at least the 1980s, fail to meet statutory minimum flows in both winter and summer in WRIA 14.

One cause of these insufficient flows is the dramatic increase in the number of water wells constructed in the last 30 years. State law allows new wells to withdraw groundwater up to 5,000 gallons/day without obtaining a permit that would require scientific evidence that water is legally available.[4] (Wells shown may not be permit-exempt.) Since the 1940s, Mason, Thurston and Kitsap counties have seen some of the greatest increases in wells among Washington counties.[5] Thurston County has the second highest number of wells of any county in the state, and is seeing particular pressure for growth and development in rural areas where permit-exempt wells are used most often.[6] Although the water volume a single exempt well uses is small, the cumulative effect of wells in close proximity can be significant. Exempt groundwater withdrawals don't require a water right permit but they are always subject to state water law.

(Continued on next page)

AR052968

Squaxin Island Tribe

(Continued from previous page)

Permit-exempt wells need to be regulated to protect and eventually restore the minimum instream flows. In the Johns Creek watershed, the number of exempt wells has more than doubled since 1980, while streamflows have often failed to meet statutory minimums since at least 2004.[7]

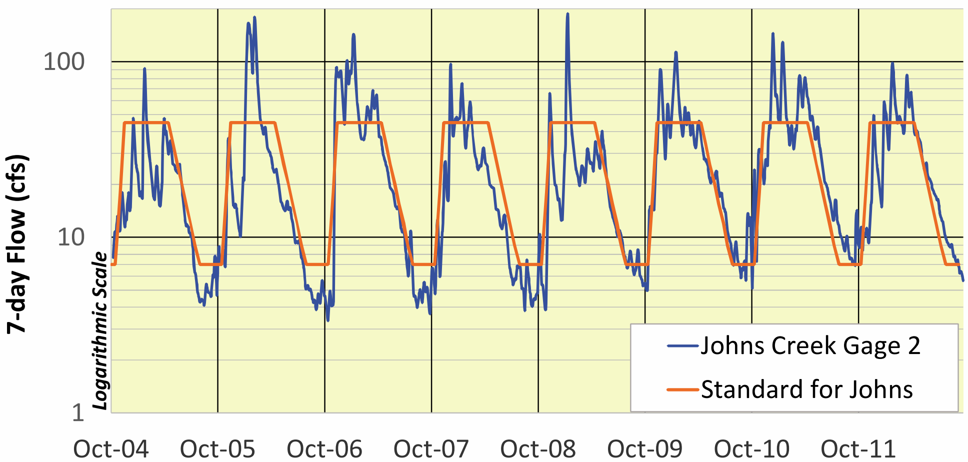
The Johns Creek drainage basin has been extensively modified. Some of the process modifications include:

- Land conversion from pervious to impervious surfaces;
- Logging adjacent to the stream; and
- Channelization and bank armoring.[8]

These modifications play a critical role in increasing stream temperature, which is identified by the South Sound Recovery Plan as a threat to salmon survival.

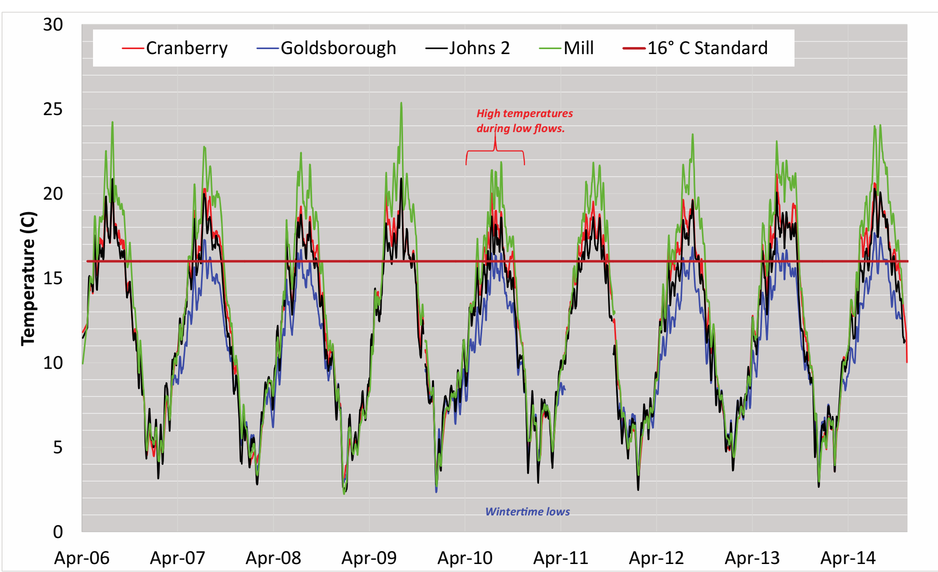
Emmett O'Connell, NWIFC

Joe Puhn, natural resources technician for the Squaxin Island Tribe, takes a velocity measurement on Goldsborough Creek.



Increased drilling intercepts groundwater influx, elevating temperatures and limiting dissolved oxygen; both are severely detrimental to salmonid migration, spawning, and rearing. Washington state requires Core Summer Salmonid Habitat to not exceed a 16°C 7-Day Average Daily Max.

Protecting riparian shade and maintaining groundwater influx keeps stream temperatures cooler. Streams of concern with temperature limits in the Squaxin area include the Deschutes, Woodland, Kennedy, Johns, Goldsborough, Skookum, Mill and Cranberry.



Data Sources: Squaxin 2014,[9] SSHIAP 2004,[10] USGS 2014,[11] WADOT 2010,[12] WAECY 2011a,[13] WAECY 2015[14]

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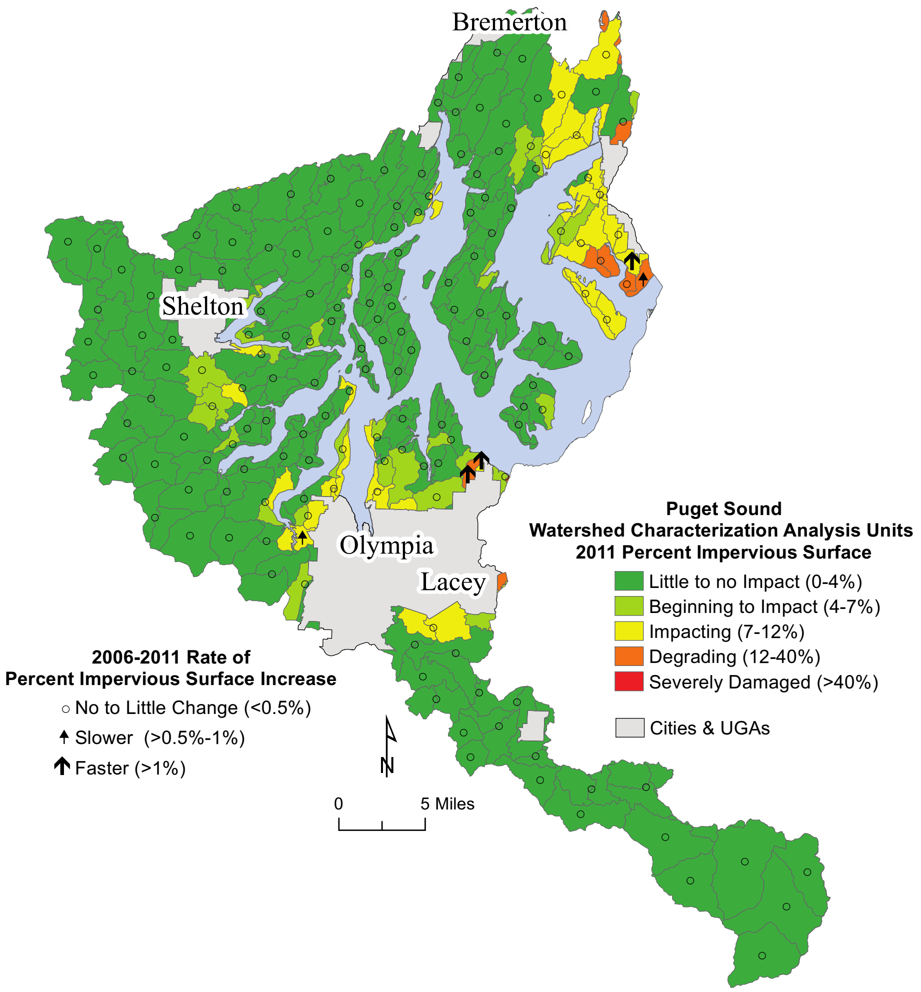
Impervious Surface Increases Outside UGA

From 2006 to 2011, a 2% increase in impervious surface was observed in the total land area outside of cities and Urban Growth Areas, accounting for an additional 0.6 square mile.[1,2]



The Chinook Recovery Plan for South Sound identified an objective to promote land-use practices that prevent stormwater flows. This objective calls for the preservation of native land cover and natural drainage systems, while limiting the area and connectivity of impervious surfaces.[3]

South Sound is one of the fastest growing areas in the state, exceeding the state's growth rate consistently since the 1960s. Much of this growth is clustered around Puget Sound's inlets, or near and around streams that feed into Puget Sound. Research shows that as development increases beyond 10% impervious cover and forest cover drops below 65%, streams and their fisheries are severely degraded, making them expensive or impossible to recover.[4]

The Squaxin Area of Focus has several basins that have less than 10% impervious surface and generally more than 65% forest cover. The best conditions are found in the Skookum Creek and Coulter Creek basins. Other basins with relatively low impervious surface and high forest cover include Rocky, Sherwood, Deer, Campbell, Uncle Johns, Cranberry, Malaney, Johns, Goldsborough, Mill, Kennedy, Schneider, Perry, McLane, and the upper Deschutes. These basins have the best chance for biological recovery and should be prioritized for Puget Sound restoration. Achieving this protection will be key to the survival of salmon and steelhead in the South Sound.

Example of the increase of impervious surface in northwestern Lacey outside of cities and UGA

2006 **2011**

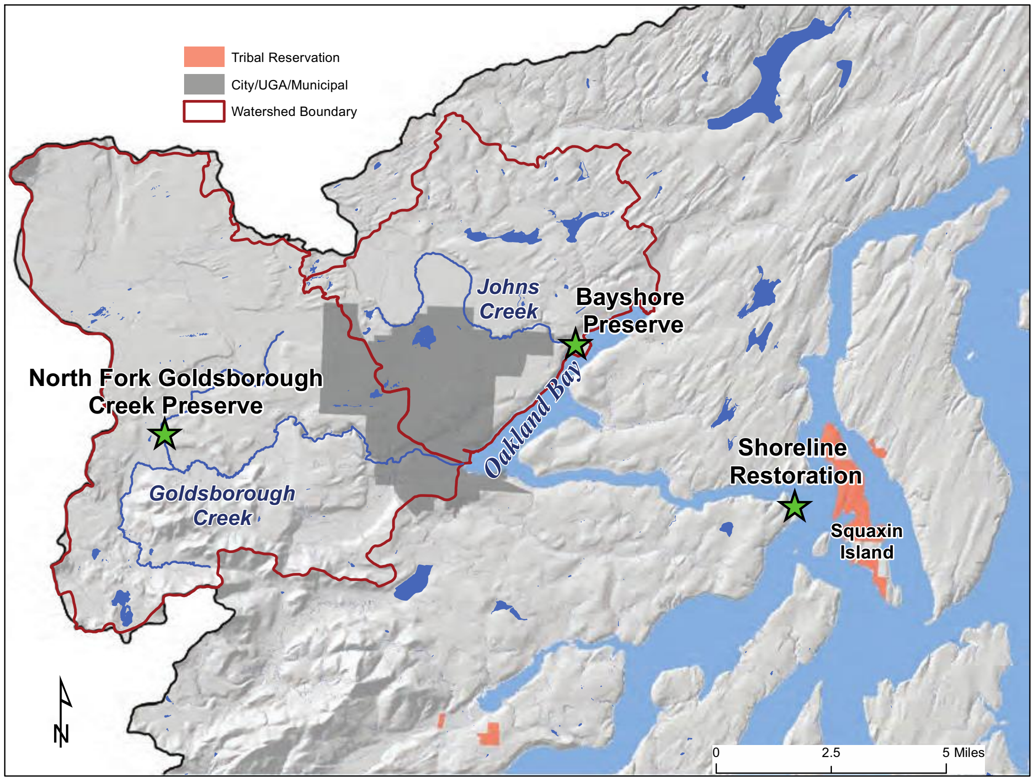
City/UGA

Data sources: NAIP 2006,[5] NAIP 2011,[6] NLCD 2006,[7] NLCD 2011,[8] WAECY 1994,[9] WAECY 2011a,[10] WAECY 2011d,[11] WAECY 2013[12]

Land Conservation and Restoration Efforts to Restore and Protect Habitat

The Squaxin Island Tribe is working with the South Puget Sound Salmon Enhancement Group to restore vital forage fish habitat by removing a 70-foot-long boat basin and a 137-foot-long boat ramp to reconnect a large drift cell along the shoreline. After removing the concrete boat basin and ramp, the Tribe will restore the original slope of the beach, recovering the spawning habitat lost to forage fish. This will allow sediment to naturally move, supplying sediment to beach spawning forage fish and those offshore. In addition to providing more room for forage fish, nearshore habitat also provides important rearing areas for juvenile salmon before they move out to the open ocean.[1]

Squaxin Island Tribe Restoring Vital Shoreline in Puget Sound



Emmett O'Connell, NWIFC

A crew removes a concrete boat basin and ramp.

Data Sources: SSHIAP 2004,[4] USGS 2014,[5] WADNR 2014c,[6] WADOT 2011a,[7] WAECY 2013[8]

AR052971

Purchase of the Bayshore Preserve

The Capital Land Trust and the Squaxin Island Tribe are working to bring back salmon habitat and protect an important shellfish growing area by restoring a former golf course on Oakland Bay. The land trust recently purchased the 74-acre Bayshore Golf Course, which includes the mouth of Johns Creek and over 1,000 feet of Oakland Bay shoreline. The purchase of the Bayshore Preserve was completed in 2014, but much of the groundwork for the purchase was completed in 2013. The former golf course was identified as having among the highest habitat values in southern Puget Sound with more than 4,000 feet of marine shoreline and 27 acres of intact salt-marsh habitat. Preventing development around the bay also protects the most productive shellfish growing area in the state. The majority of the structures have been removed from the site and future restoration work will include the removal of the 1,400-foot supratidal dike; ground grading, sloping and excavation of blocked tidal channels; and removal of invasive plants and re-planting with native species. The state Department of Ecology also helped the land trust buy the surface water rights associated with the golf course. The restoration is part of a larger effort to protect and restore Oakland Bay. The tribe, the land trust and other local partners have protected hundreds of acres of habitat and improved water quality throughout the bay. Oakland Bay is one of the largest commercial shellfish production areas in Puget Sound.

The mouth of Johns Creek was the site of one of the largest longhouses and Squaxin villages.

"We have always thought of this place as special," said Andy Whitener, natural resources director for the tribe. "Our people lived there for thousands of years, subsisting on the fish, shellfish and wildlife that was always available."[2]


WAECY

Bayshore on Oakland Bay


Eric Erler

Bayshore Preserve

Conserving the 145-acre North Fork Goldsborough Creek Preserve

In 2013, Capitol Land Trust and partners conserved the 145-acre North Fork Goldsborough Creek Preserve, as part of the Goldsborough Creek Protection Initiative. The property consists of century-old conifers, shaded pools, winding riparian areas and densely vegetated wetlands – forming the heart of one of the most productive salmon-producing systems remaining in southern Puget Sound: Goldsborough Creek. The North Fork of Goldsborough Creek runs through the center of the property and provides excellent habitat for the fish and wildlife of Mason County, including steelhead, coho, Chinook and chum salmon. Project partners include Green Diamond Resource Company, Squaxin Island Tribe, Washington State Recreation and Conservation Office, the Salmon Recovery Funding Board, Lone Cedar 1 LLC, WRIA 14 Lead Entity and Forterra.[3]


PRISM

North Fork Goldsborough Preserve.

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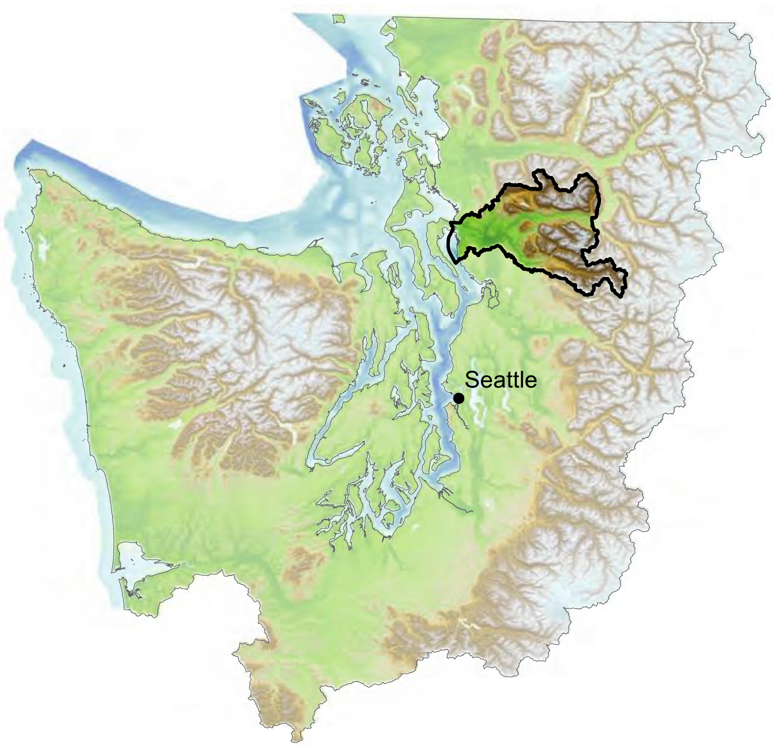
2016 State of Our Watersheds Report
Stillaguamish River Basin

We volunteered not to fish for Chinook and to focus on the recovery of our salmon. But even with the nets out of the river, our fish numbers are not increasing. We work hard to restore habitat and recover Stillaguamish Chinook, but in the meantime, our culture faces extinction. We are a living culture and we must have salmon to harvest.

– **Shawn Yanity**
Stillaguamish Tribe



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 January 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, Washington.

Stillaguamish Watershed Salmon Recovery Plan

The Stillaguamish watershed remains one of the few largely undeveloped rural areas adjacent to major urban centers in Puget Sound. The local economy remains based in natural resources, with forestry the most extensive land use in the watershed.

Streamside land use within the hydrologically connected areas used by anadromous fish comprises 61% forestry, 22% rural, 15% agriculture and 2% urban. Not surprisingly, the leading factors for decline in riparian habitat throughout the watershed have been related to forest practices and conversion of floodplain habitats to agricultural and urban land uses.

The Stillaguamish Watershed Salmon Recovery Plan's stated goal is to maintain and restore natural ecosystem conditions that sustain salmon productivity.

A three-tiered approach was outlined for recovery:

- Prevent further fragmentation of aquatic habitat;
- Improve connectivity between isolated habitat patches; and
- Protect and restore areas and necessary functions surrounding critical salmon habitat from further degradation, and allow for the expansion of existing refugia.[1]

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.

Kari Neumeyer, NWIFC

Stillaguamish Chairman Shawn Yanity, left, and assistant fisheries manager Jeff Tatro paddle a canoe that was carved for the tribe

Results Mixed after Recovery Progress Review

The Stillaguamish Implementation Review Committee (now known as the Stillaguamish Watershed Council, or SWC) adopted a 10-year watershed goal for habitat enhancement projects. These projects reflected the categories and geographical priorities (riparian, estuary, large woody debris, floodplain, sediment and hydrology) that corresponded with the limiting factors for Chinook salmon populations in the Stillaguamish watershed.

The identified project goals are:

- Planting 400 areas of riparian habitat;
- Restoring 195 and creating 120 acres of estuary habitat;
- Installing 51 engineered logjams;
- Restoring 30 acres and removing 4.1 miles of armoring in floodplain habitat;
- Conducting 2 landslide treatments and 106 miles of forest road treatments for sediment control; and
- Acquiring 1,445 acres for conservation protection.[2]

Review of habitat recovery progress and trends at the 10-year mark of the Stillaguamish Watershed Salmon Recovery Plan reveals mixed results:

- 493 of 400 acres of riparian habitat restored;
- 233 of 315 acres of estuary marsh land created or restored;
- 30 of 51 engineered logjams installed;
- Over 5 miles of side-channel floodplain habitat reconnected or restored;
- 1.5 of 2 landslides treatments completed;
- Over 300 miles of forest road treatments (not including state forest roads) and over 105 miles of road storage, decommissioning and/or abandonment (including state forest roads) have been completed; and
- 550 of 1,445 acres of land acquired in priority reaches.

Greater Population Demands Degrade Habitat

The recovery plan envisioned that a variety of protection tools and incentive-based voluntary actions would be drawn upon to protect Chinook salmon habitat. Central to this effort would be development of non-regulatory and programmatic actions to encourage habitat conservation and the integration of salmon recovery goals and objectives with local comprehensive plans and land-use policies. Little to no progress has been made on this protection strategy.

The last 150 years of human expansion and development has depleted natural resources and left degraded the natural ecology of the Stillaguamish River basin. One of the major resource concerns for the Stillaguamish Tribe is the state of salmon within the watershed, and the Tribe has been deeply committed to the Stillaguamish Watershed Salmon Recovery Plan.[3] The Salmon Recovery Plan clearly identifies historic habitat loss and the causes of continued habitat degradation. This report highlights some of the major landscape-level causes for sustained salmon habitat loss throughout the watershed, from the estuary to the headwaters.

Kari Neumeyer, NWIFC

A crew installs an engineered logjam on a former tree farm acquired by the Stillaguamish Tribe.

Recovery Efforts Lagging

At the 10-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 since the 2012 State of Our Watersheds Report shows an upgrade in shellfish growing areas but a steady loss in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Shoreline Modifications / Forage Fish	Since 2005, the counties of Port Susan Bay (Island and Snohomish) have combined for a net increase of 1.1 miles of marine shoreline armoring, which represents 17% of total net increase in marine shoreline armoring for Puget Sound over the same time period. 99% of documented forage fish spawning in Port Susan Bay occurs along erosional drift cells, and 38% of the shoreline of these drift cells are already armored or otherwise modified.	**Declining**
Water Quality - Shellfish	In 2014, over 1,000 acres upgraded from unclassified to approved for commercial shellfish growing. This comes in addition to the 1,800 acres of Port Susan's shellfish area that was upgraded to the State Department of Health's high rating of approved in 2010.	**Improving**
Water Quality - Peak Flows	Long-term increases in rainfall accompanied by decreases in snowfall have likely been driving steady increases in peak flows in the North Fork Stillaguamish River. These increases are confronting each current brood year of spawning North Fork Stillaguamish Chinook with a 50% chance, rather than a historic 10% chance, of being exposed to peak flows that correspond to egg to fry survival rates where the Chinook stock does not replace itself.	**Declining**
Water Wells	In 2009, Ecology reported 666 wells drawing from the reserve and by the end of 2013 the number was 827, a 24% increase. Current unofficial estimates of Ecology data have the number of exempt wells drawing from the reserve at between 900 and 1,000 wells.	**Declining**
Population Growth	As of 2013, there were an estimated 52,000 people living in the Stillaguamish River watershed. Most residents continued to live outside of incorporated towns and Urban Growth Areas (UGA) in 2010 (64%) and continued to do so in 2013 (63%). This data points to a slowing trend of rural population sprawl in the Stillaguamish watershed. Whether this is a reflection of the “Great Recession,” or whether this is due to growth management planning is not understood at this point.	**Declining**
Floodplain	As of 2013, the 10-year floodplain restoration targets for the Salmon Recovery Plan were not being met. Only 22.3 of a targeted 30 acres of floodplain area had been restored, and only 0.24 miles of a targeted 4.1 miles of bank armoring had been removed while 0.43 miles of bank armoring were added since 2005. Riparian forest cover in the Stillaguamish River floodplain remains 23%, unchanged since 2006. This is less than a third of the 80% riparian forest cover considered a long-term Properly Functioning Condition (PFC) in the Salmon Recovery Plan.	**Declining**
Land Conversion	From 2007-2015, about 945 acres were converted out of forest practices and into non-forestry uses. This is in addition to the over 935 acres converted from 1997-2006, bringing the total to 1,882 over the last 20 years. Over the past 20 years, 76% of all conversions occurred almost exclusively in the Rural Residential Zone, outside UGA boundaries.	**Declining**
Restoration - Estuary	Since publication of the 2012 State of Our Watersheds Report, the Stillaguamish Salmon Recovery Plan’s 10-year target for estuary habitat restoration has expanded from 315 to 548 acres. As of 2013, 150 acres or 27% has been restored towards that target.	**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.

Salmon Runs Continue to Decline under Status Quo

The Stillaguamish Watershed Council has concluded that Stillaguamish Chinook cannot be recovered without major changes at the state and federal levels including:

- Adequate instream flows;
- Improved timber harvest regulations and enforcement;
- Improved water quality enforcement and compliance;
- Improved protection and enforcement on agricultural lands; and
- Development regulations that protect critical habitat throughout the floodplain and the estuary.[4]

As David Montgomery points out in his 2003 book, *King of Fish: The Thousand-Year Run of Salmon*, "many share the blame for the decline of salmon in the Pacific Northwest. Not surprisingly, there is no shortage of finger-pointing: Land developers blame the fishing industry. Fishermen blame the timber industry. Loggers blame land developers. Some even blame hungry sea lions and fish-eating birds. And there is a long history of blaming declining salmon populations on Indian fishing. Yet even though there is a broad consensus among scientists regarding the primary factors driving salmon declines, actions to stem known causes remain either mired in institutional, corporate, and societal denial, dissipated by spin-doctoring, or thwarted by political agendas and bureaucratic inertia."[5]

The continued decline of salmon populations (and their habitat) in the Stillaguamish is a reflection of a society operating under the status quo policy direction.

Stillaguamish Tribe

Stillaguamish tribal fishermen harvest salmon.

"With legions of professionals engaged in salmon recovery, it remains rare to hear policy makers or anyone else acknowledge that how we live on the land leads directly (and sometimes indirectly) to the risk of local or regional salmon extinction," Montgomery writes. "We seldom, if ever, hear a public official admit that the decline of salmon has been an implicit, even if inadvertent, policy for over a century. And yet, unless we address the fundamental underlying issues, we may well spend a lot of money and still end up with no fish to show for it."

Looking Ahead

While the Salmon Recovery Plan represents a well-organized, scientifically based plan, and by its own accounting, a largely successful approach to restoration in the Stillaguamish watershed, overall land use of the watershed continues to place a countervailing pressure on the natural ecology of the watershed. The sustained drainage and clearing of the estuary and the floodplain for agriculture, the maintained harvesting intensity of state and private industrial forests, and the growing popularity of the watershed with rural residents are all continuing to limit restoration gains. Through both incentive-based programs and regulation enforcement, people within the watershed will have to make some changes to their natural resource use behaviors if the full benefits of the Salmon Recovery Plan are to be met.

If the trends continue, the status of Stillaguamish salmon will continue to decline precipitously, directly impacting the Stillaguamish Tribe's treaty rights. It is time for elected officials and scientists to have a frank discussion of the true cost of continuing on the current societal pathway. The data presented in the State of Our Watersheds Report indicate that it will lead to the extinction of fisheries (if not populations themselves) as surely as it did for Atlantic salmon in Europe and on the East Coast. Though written in 1861, the words of Charles Dickens in *All the Year Round: A Weekly Journal* should cause us pause in the Stillaguamish today:

"The cry of 'Salmon in Danger!' is now resounding throughout the length and breadth of the land. A few years, a little more over-population, a few more tons of poison, a few fresh poaching devices ... and the salmon will be gone – he will become extinct."

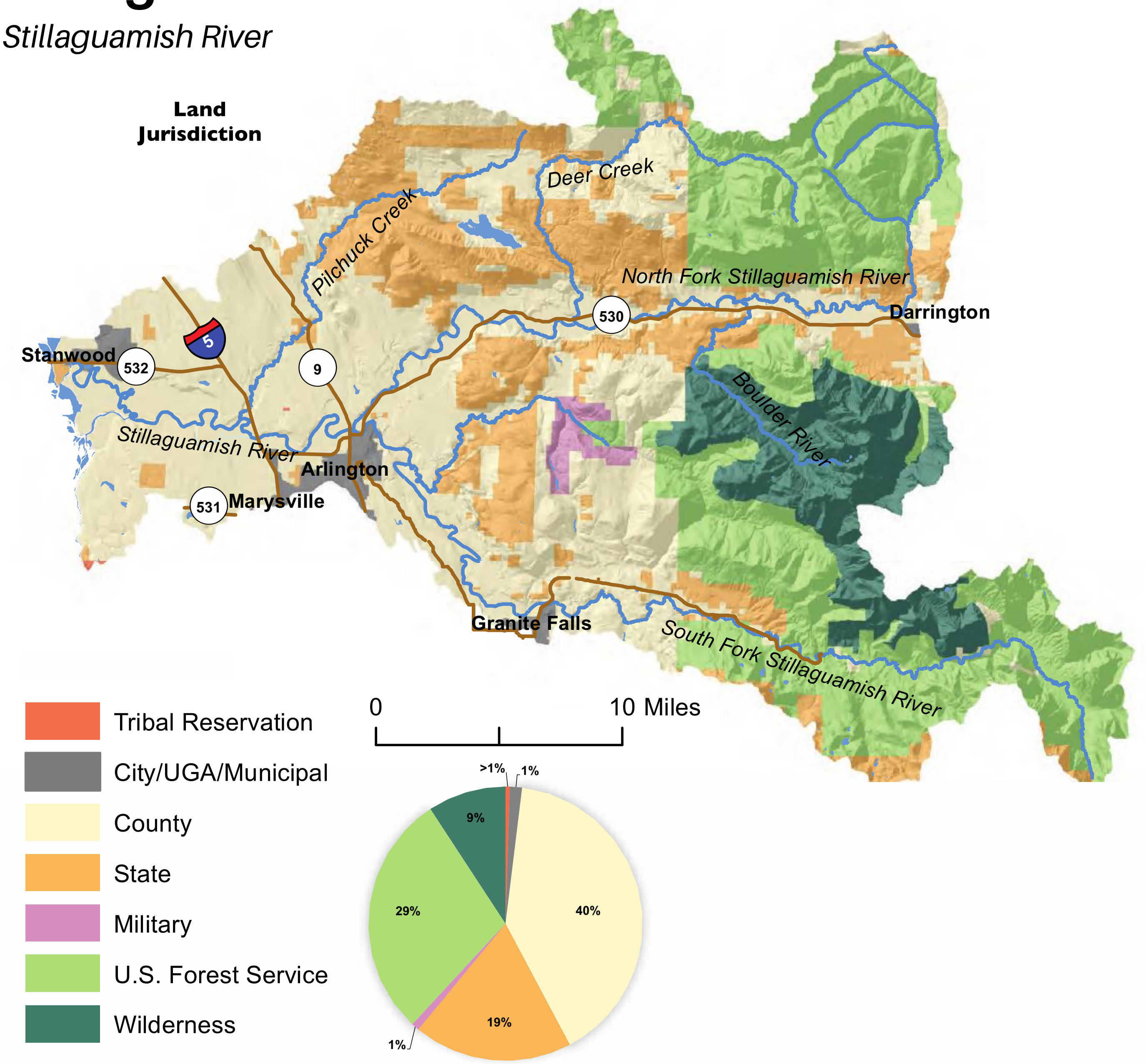
To counteract the continued pressures on salmon habitat in the Stillaguamish, the Tribe has been working with other watershed stakeholders to acquire and restore a corridor of lands along the main salmon bearing waters of the Stillaguamish. Over time these efforts will link quality habitats from the 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 log jams, 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 Tribe's nets.

Kari Neumeyer, NWIFC

An adult Chinook salmon swims in the North Fork Stillaguamish River in summer 2015, when the river experienced record high temperatures and low flows.

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 Stoluck-wa-mish River Tribe, 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 and around the watershed's boundary.

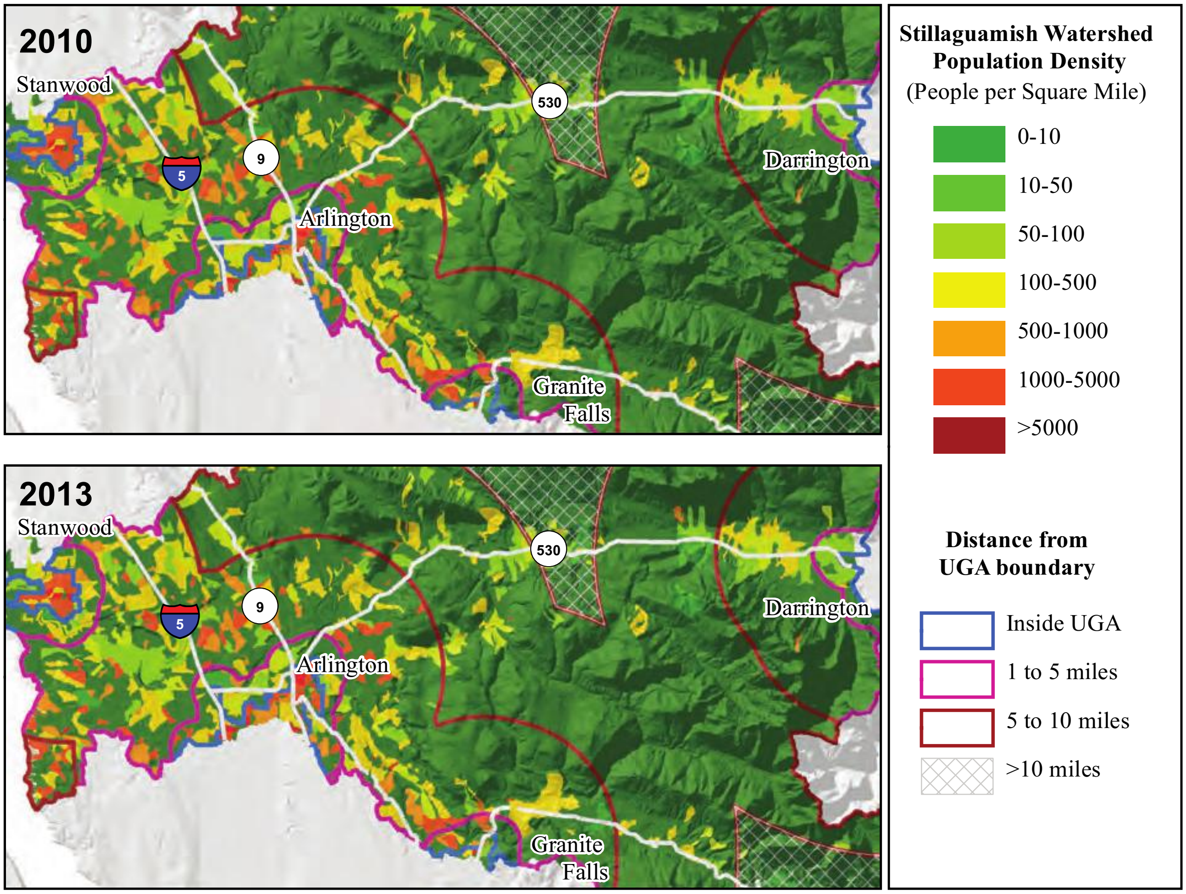
Since European settlement, land use in the watershed has continued to be dominated by physical geography. The foothills and mountains are mainly used for wood products and outdoor recreation. The more fertile and developable lowlands are primarily used for agriculture and rural residential development. 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 human land use 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.

Data Sources: SSHIAP 2004,[1] USFWS 2014,[2] WADNR 2014a,[3] WADNR 2014b,[4] WADOT 2012,[5] WADOT 2013,[6] WAECY 1994,[7] WAECY 2011a,[8] WAECY 2013a[9]

Population Change in the Stillaguamish Watershed 2010 to 2013

As of 2013, there were an estimated 52,000 people living in the Stillaguamish River watershed.[1,2] Most residents of the Stillaguamish continued to live outside of incorporated towns and Urban Growth Areas (UGA) in 2010 (64%) and continued to do so in 2013 (63%). These data point to a slowing trend of rural population sprawl in the Stillaguamish watershed. Whether this is a reflection of the "Great Recession," or whether this is due to growth management planning is not understood at this point.



Population Change in the Stillaguamish Watershed (2010 to 2013)

Distance from UGA	Estimated Population in 2010	Estimated Population in 2013	Percent Change in Population from 2010 to 2013
Inside UGA	18,489	19,447	4.9%
0 to 1 mile from UGA	4,496	4,691	5.1%
1 to 5 miles from UGA	22,633	22,445	-0.8%
5 to 10 miles from UGA	4,168	4.320	3.5%
>10 miles from UGA	309	293	-5.6%

Arlington, Stanwood and Granite Falls all experienced increased population densities and sprawl between 2010 and 2013.

From 1990 to 2010, it is estimated that the Stillaguamish watershed saw an 85% increase in population.[3] From 2010 to 2013, population growth within the UGA boundary and within a mile of the UGA boundary was faster than growth outside of this area. However, even with faster growth rates in and around cities, town and UGAs, an estimated 54% of watershed residents continue to live farther than a mile from incorporated areas.

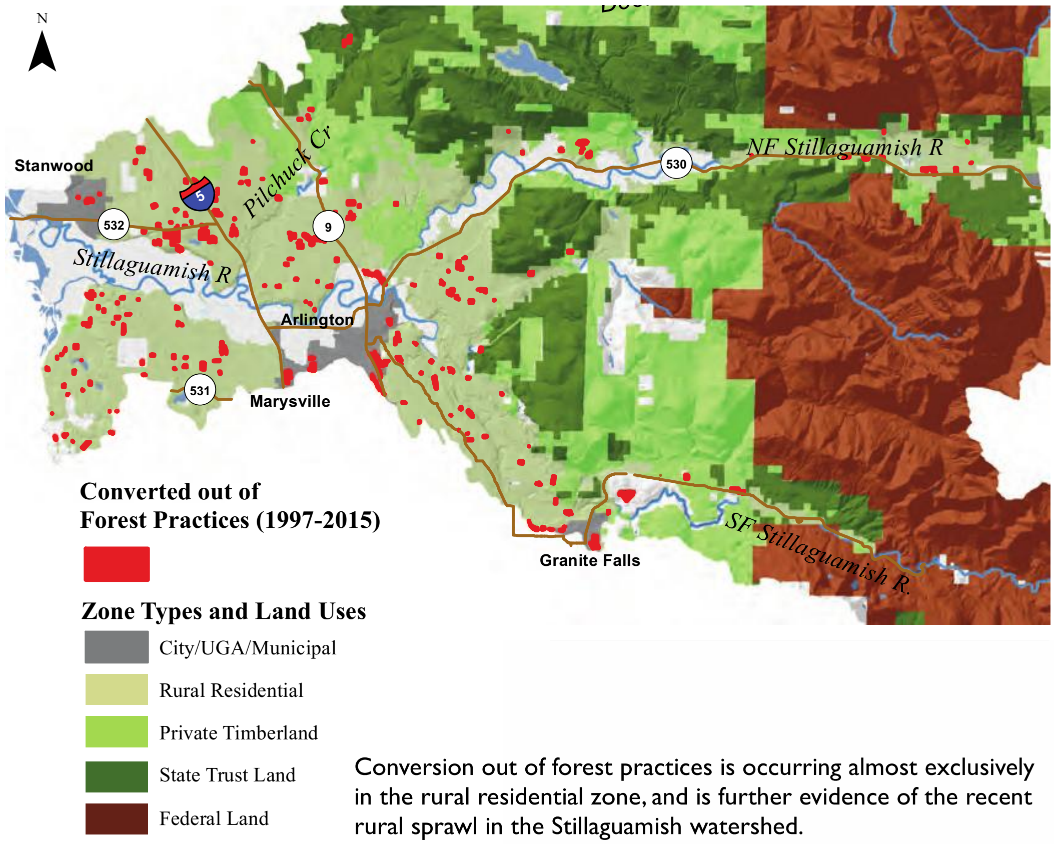
Data Sources: SSHIAP 2004,[4] USCB 2015a,[5] USCB 2015b,[6] WADOT 2012,[7] WAECY 1994,[8] WAECY 2011b,[9] WAECY 2013a[10]

Forestlands at Risk of Rural Residential Sprawl

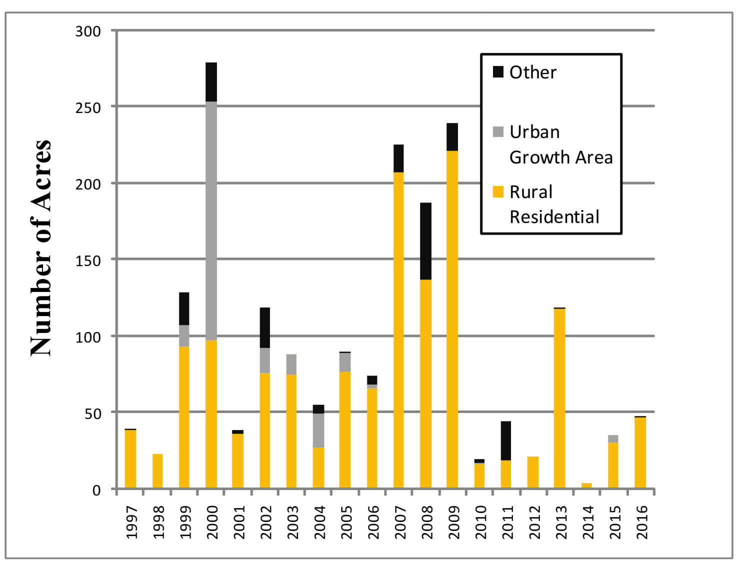
From 2007 to 2015, approximately 945 acres were converted out of forest practices and into non-forestry uses in the Stillaguamish watershed. This is in addition to the over 935 acres converted from 1997 through 2006, bringing the total area converted from forest practices to nearly 1,882 acres over the last 20 years.[1]

Since 1997, nearly 1,882 acres of forestland has been converted out of forest practices in the Stillaguamish River watershed.[2] Evidence suggests the primary motivation for conversion out of forest practices is residential development. To this point, over 650 acres, or 35%, of forestland conversion since 1997 occurred between 2007 and 2009, coinciding with the region's housing boom. Beyond that point, 89% of all forestland conversion since 1997 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.[3,4]

Only 64% of private forestland in the Stillaguamish basin is signed up for the "Designated Forestland Program" meant to incentivize non-conversion of forestland. The 36% of private forestland that is not signed up is considered to be at a 91% risk for permanent conversion to residential land uses.[5] Land in working forests is protected by the Washington State Forests and Fish Law, designed to comply with the Endangered Species Act (ESA) and the Clean Water Act (CWA) to protect native fish and assure clean water compliance.[6] Once land is converted out of working forests, not only do the trees disappear, but so do the fish protection and clean water guarantees of the Forest and Fishs Law. In their place is a residential landscape with greater pollution and less protection.



Conversion out of forest practices is occurring almost exclusively in the rural residential zone, and is further evidence of the recent rural sprawl in the Stillaguamish watershed.



Over the past 20 years, 76% of all conversions out of forest practices have been rural residential parcels outside of Urban Growth Area boundaries.

Data Sources: SSHIAP 2004,[7] UW 2012,[8] WADNR 2014b,[9] WADNR 2015,[10] WADOT 2012,[11] WAECY 2011a,[12] WAECY 2013a[13]

AR052981

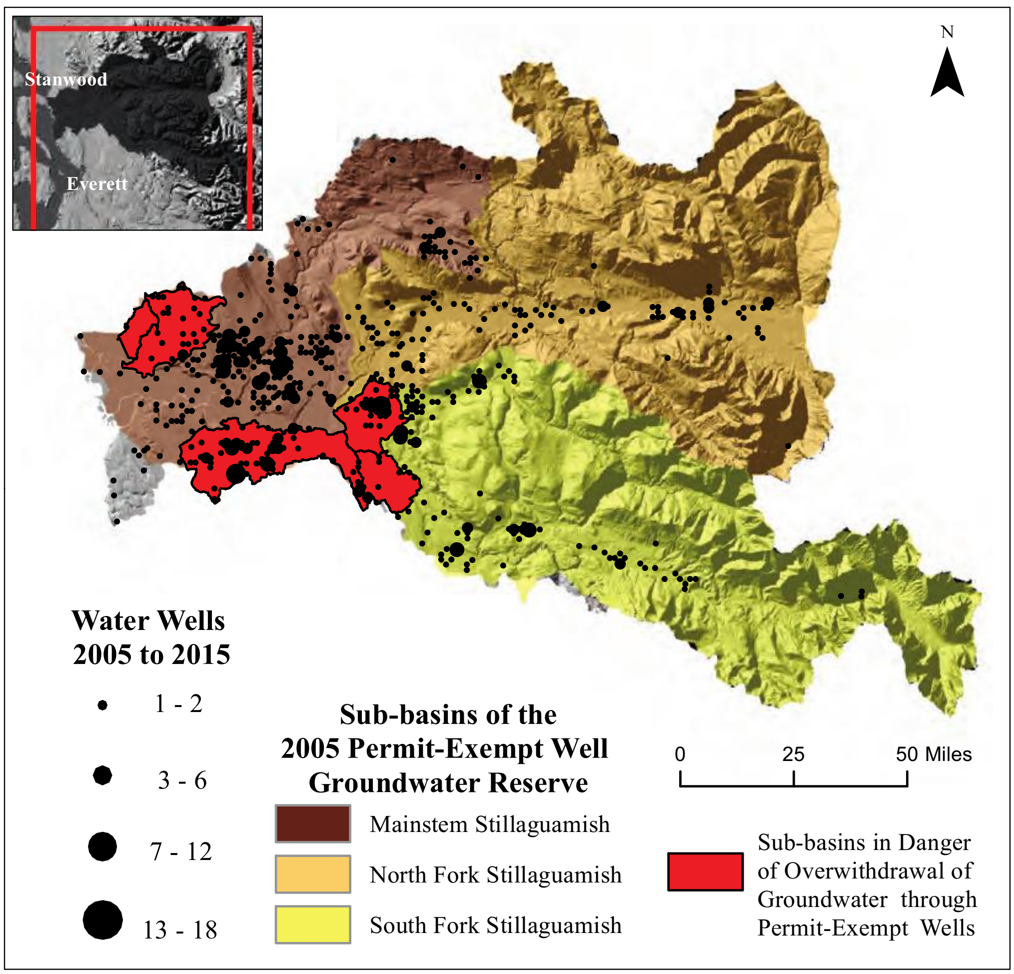
Washington State's 2005 Groundwater Reserves in the Stillaguamish Watershed Fail to Protect Summer Streamflow in Small Tributaries

In 2009, Ecology reported 666 wells drawing from the reserve, and by the end of 2014, the number reported by Ecology was 818, a 19% increase over the time period.

In the 2014 Stillaguamish Water Reservations Report, Washington Department of Ecology reported that 818 wells were withdrawing 143,500 gallons of water per day from the groundwater reserve for permit-exempt wells that was established in 2005. According to Ecology, an additional 50 to 75 exempt wells are drawing from the reserve every year. Accounting for the reserve is done for three sub-basins, the mainstem Stillaguamish, the North Fork Stillaguamish and the South Fork Stillaguamish.[1] At the sub-basin scale, there is still well over 90% of water in the reserve available for exempt well development.[2] Ecology does not account for groundwater impacts to tributaries smaller than the mainstem, the North Fork, and the South Fork sub-basins of the Stillaguamish River. In 1999, five separate small tributaries within those larger Stillaguamish sub-basins were found to be over-consuming groundwater, at a rate of 5% or more of groundwater recharge per year.[3]

The amount of 143,500 gallons per day being drawn from the 818 wells is a conservative estimate of groundwater withdrawal, based on 350 gallons per day for wells with no associated septic and 175 gallons per day for wells with an associated septic. While that may approximate current use from the 818 wells, it must be pointed out that each permit-exempt well can legally withdraw as much as 5,000 gallons per day, so while current usage is estimated at 143,500 gallons per day, through the permit-exempt well program, 4,090,000 gallons per day are actually available to the 818 wells. As the state is using 175 to 350 gallons per day to account for individual permit-exempt well usage, they should consider proposing a 350 gallon per day cap on permit-exempt wells withdrawing from the reserve to protect against unaccounted over-withdrawal in the future.

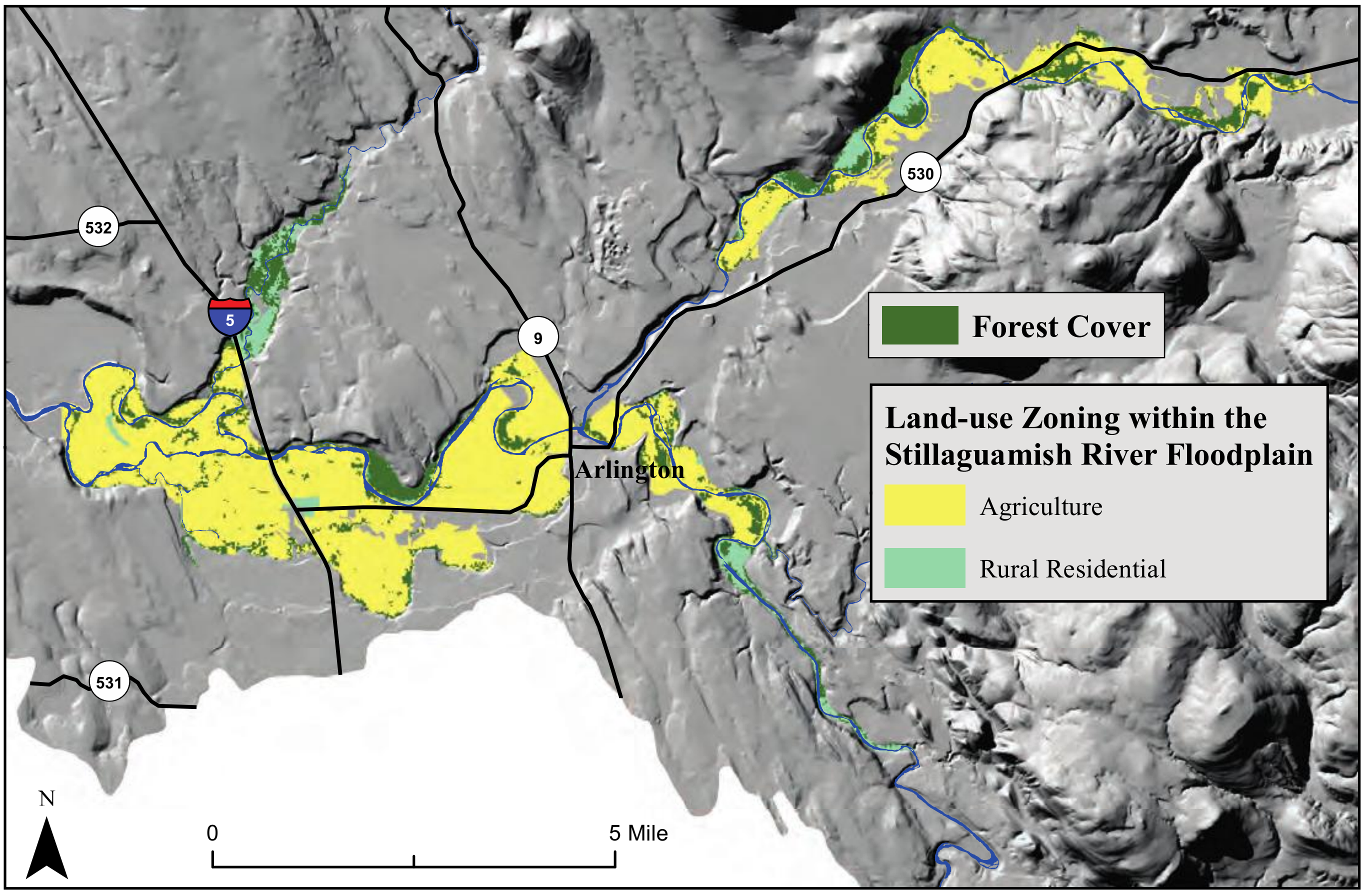
In the large sub-basins of the 2005 Stillaguamish River (WRIA 05), state instituted groundwater reserve for permit-exempt wells do not protect against over-withdrawal of groundwater from small tributary sub-basins.



Data Sources: SSHIAP 2004,[4] USGS 2014,[5] WAECY 2015b[6]

Lack of Riparian Forests along with Bank Armoring Impact Stillaguamish Floodplain

As of 2013, the 10-year floodplain restoration targets for the Salmon Recovery Plan were not being met. Only 22.3 of a targeted 30 acres of floodplain area had been restored, and only 0.24 miles of a targeted 4.1 miles of bank armoring have been removed, while 0.43 miles of bank armoring were added since 2005.[1,2] Riparian forest cover in the Stillaguamish River floodplain remains 23%, unchanged since 2006.[3,4] This is less than a third of the 80% riparian forest cover considered a long-term properly functioning condition (PFC) in the Salmon Recovery Plan.[5]



Only 23% of floodplain riparian forests have any forest cover, largely due to maintained forest clearing on agricultural and rural residential lands,[8] 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 has 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. It also recognizes 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 parcels that are of the highest priority in restoring the Stillaguamish floodplain corridor critical to Chinook salmon recovery.[7]

Data Sources: Snohomish Co. 2010,[9] SSHIAP 2004,[10] WADOT 2012,[11] WAECY 2006,[12] WAECY 2011c[13]

Improved Water Quality Reopens Commercial Shellfish-Growing Areas in Port Susan Bay

In 2014, over 1,000 acres of previously unclassified shellfish growing area in Port Susan were classified as approved for commercial shellfish growing. This acreage comes in addition to the 1,800 acres of Port Susan's shellfish area that was upgraded to the State Department of Health's (DOH) high rating of "approved" in 2010.

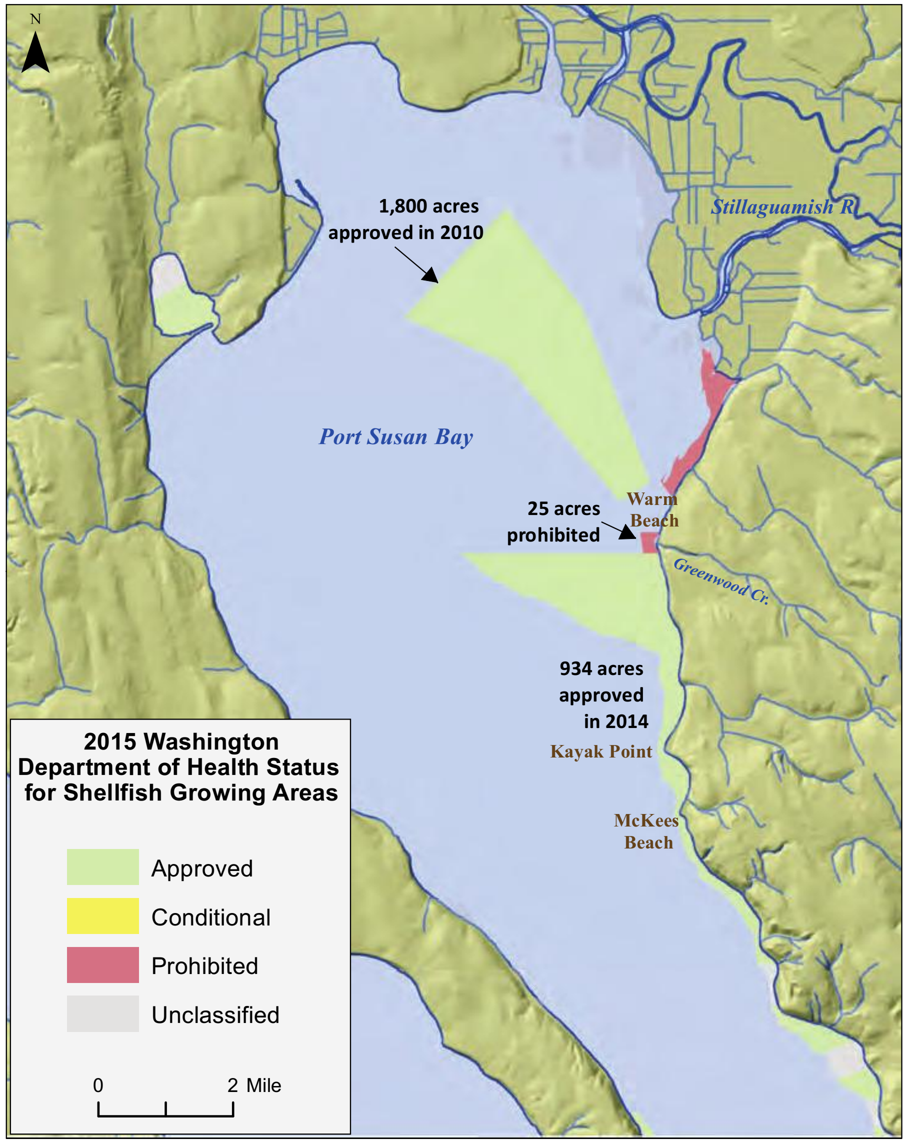
In 2014, 934 acres of previously unclassified shellfish growing area in Port Susan were classified as approved for commercial shellfish growing.[1] Located in northern Port Susan, this area begins just south of Greenwood Creek in Warm Beach, and includes Kayak Point and McKees Beach. An additional 100 acres were also classified as approved in 2014 in the pocket estuary known as Triangle Cove on the west side of Port Susan in Island County. This acreage comes in addition to the 1,800 acres of Port Susan's shellfish area that were upgraded to the State Department of Health's high rating of "approved" in 2010. Not all recent classifications have been positive, as shellfish growing in the 25 acres around the mouth of Greenwood Creek was recently prohibited because bacteria levels exceeded state standards.

Fecal coliform counts were so high in the late 1980s that access to the entire bay was closed. In 1993, Snohomish County formed a Clean Water District (CWD) to "Restore water quality in saltwater tidelands; bringing about the upgrading of conditionally approved, restricted, and prohibited shellfish beds."[2] Efforts of the CWD have resulted in water quality improvements through changes in farming practices, city wastewater management, and updates to rural septic systems in the Stillaguamish watershed. Additionally, the Snohomish Conservation District is developing and implementing more farm plans that are helping to clean up agricultural water quality.

Finally, a cooperative effort involving the Stillaguamish Tribe, state and county agencies has been forming to carry identification of a pollution issue forward to enforcement when necessary. Maintaining the "approved" rating will require continued vigilance in all of these areas, as on-site septic, livestock and pet pollution remain persistent nonpoint pollution sources.[3]

While marine water quality improvements are responsible for the recent upgrades, monitoring by the Stillaguamish Tribe dating back to 1998 and a formal request for a DOH classification review of Port Susan in 2007,[4] were both instrumental in DOH upgrading shellfish areas in Port Susan Bay.

Port Susan Bay shellfish growing area



Data Sources: SSHIAP 2004,[5] USGS 2014,[6] WADOH 2014,[7] WADOH 2015[8]

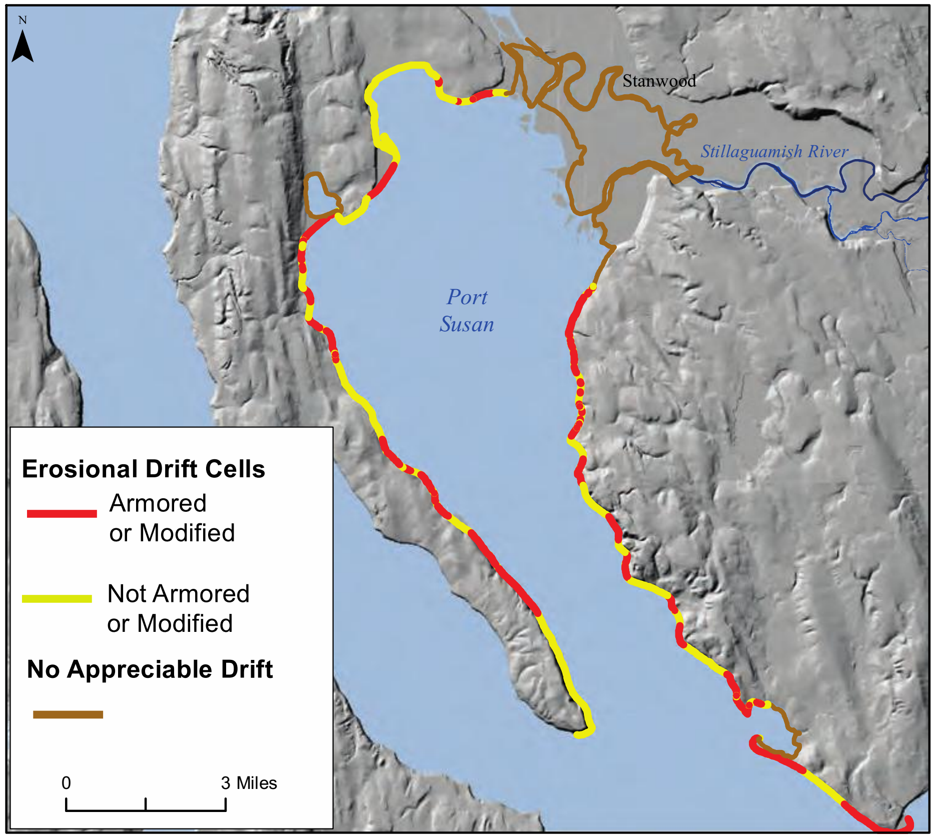
Shoreline Armoring Threatens Forage Fish Habitat Critical to Port Susan Bay Ecology

Since 2005, the counties of Port Susan Bay (Island and Snohomish) have combined for a net increase of 1.1 miles of marine shoreline armoring, which represents 17% of total net increase in marine shoreline armoring for the Puget Sound over the same time period.[1]

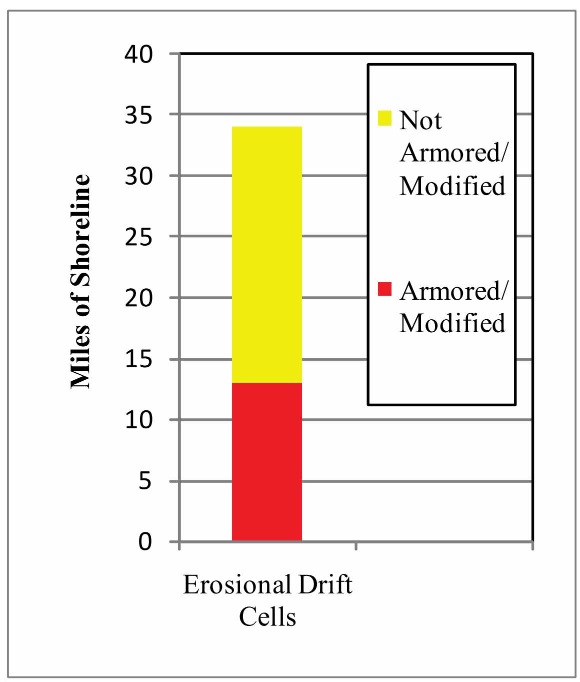
Over 16 miles (99%) of all documented forage fish spawning in Port Susan Bay occurs on erosional drift cell habitat, characterized by feeder bluffs and accretion shoreline beaches. There is only 34 miles (over 50%) of erosional drift cell habitat in Port Susan Bay, and over 13 miles (38%) of that habitat is already modified or armored, leaving Port Susan Bay with only 21 miles of unmodified preferred potential forage fish habitat.[2,3]

Forage fish spawn almost exclusively on erosional drift cells. Their spawning habitats are sustained by sediment erosion from coastal bluffs depositing or accreting along the shoreline in the direction of net-shore drift, which is controlled by prevailing Puget Sound winds and currents.[4] The greatest impact to forage fish habitat on erosional drift cells is shoreline armoring, as it interrupts erosion, distribution and accretion of sediment.[5]

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, Growth Management Act (GMA) and Priority Habitats and Species (PHS) Program, yet these habitats remain vulnerable to shoreline armoring and modification.[6] Considering the critical ecological role of erosional drift cells for forage fish spawning and the equally critical role forage fish have in Puget Sound Chinook salmon ecology, no more armoring can be allowed along them, and every opportunity to remove armoring must be taken.



99% of documented forage fish spawning in Port Susan Bay occurs along erosional drift cells (yellow lines), and 38% of the shoreline of these drift cells (red lines) are already armored or otherwise modified.



13 of the 34 miles of erosional drift cells in Port Susan Bay are already armored or modified.

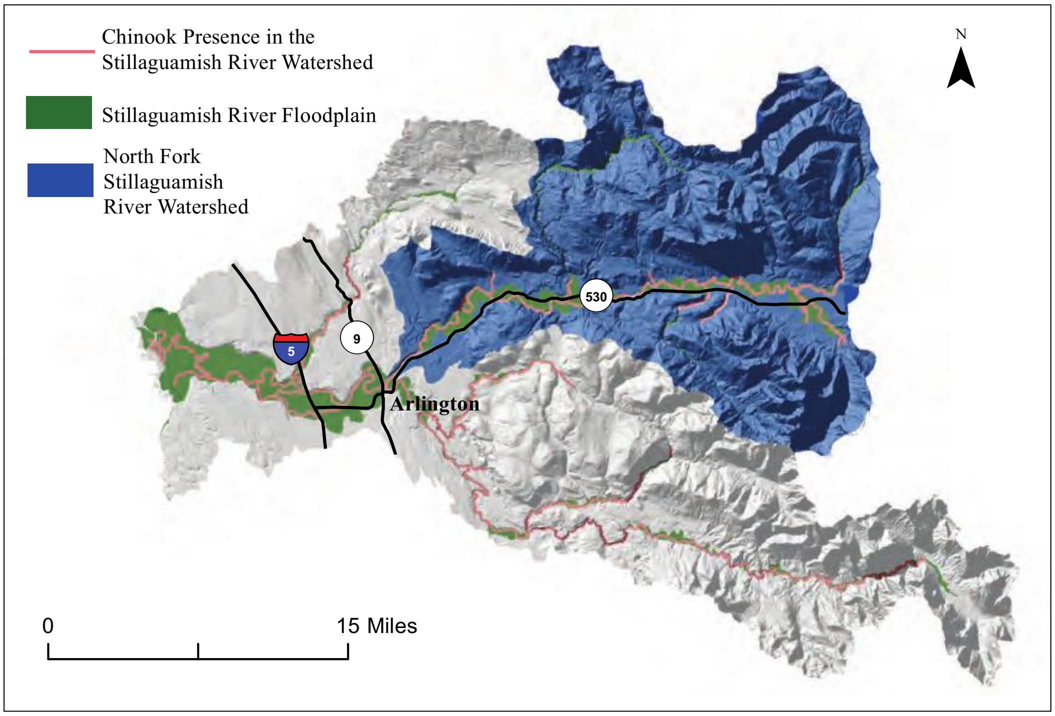
Data Sources: PSNERP 2008,[7] SSHIAP 2004,[8] WADFW 2006,[9] WAECY 2013b[10]

Increases in Annual Precipitation Driving Increased Flooding on North Fork

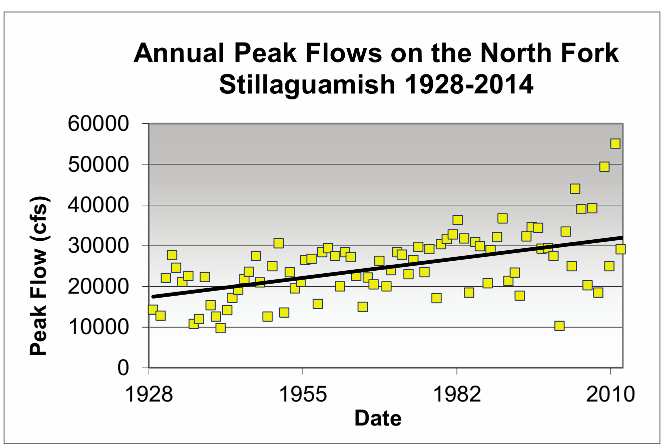
Long-term increases in rainfall accompanied by decreases in snowfall have likely been driving steady increases in peak flows in the North Fork Stillaguamish River.[1] These increases are confronting each current brood year of spawning North Fork Stillaguamish Chinook with a 50% chance, rather than a historic 10% chance, of being exposed to peak flows that correspond to egg-to-fry survival rates where the Chinook stock does not replace itself.[2,3]

In light of the long-term climate patterns driving increased peak flows in the North Fork Stillaguamish River, floodplain restoration to slow down, distribute and store peak flows is critical to North Fork Stillaguamish Chinook survival. The Stillaguamish Watershed Council has proposed a floodplain restoration strategy that protects and restores mature floodplain forests, as well as areas within the floodplain that allow for channel migration and overbank flow. The plan is being implemented to create a connected corridor of floodplain habitat through the North Fork and the South Fork Stillaguamish floodplains.

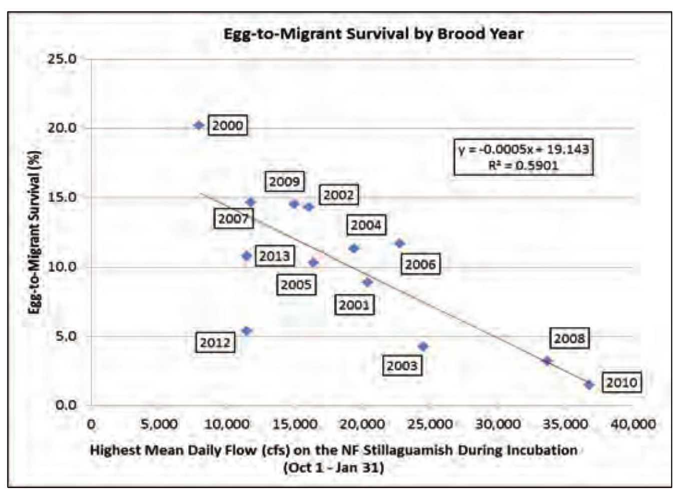
Data Sources: Konrad 2013,[4] SSHIAP 2004,[5] SWIFD 2014,[6] USGS 2014,[7] WADOT 2012[8]



With rainfall increases across the North Fork Stillaguamish watershed resulting in larger and larger peak flow events in North Fork Stillaguamish River, restoration of floodplain habitat is critical to the survival of summer and fall Chinook populations. Approximately 80% of Stillaguamish Chinook spawn in the North Fork and associated tributaries.



Both the variability and magnitude of North Fork Stillaguamish River peak flows have increased over the last 80 to 90 years.



Data collected on the Stillaguamish Tribe's mainstem smolt trap have directly measured the effects of peak flow events on survival of Chinook juveniles. High flows kill eggs in the gravel, and if the trend is for flows is to increase, Chinook survival will decrease.

Historical Understanding Expands Estuary Restoration Targets for Salmon Recovery

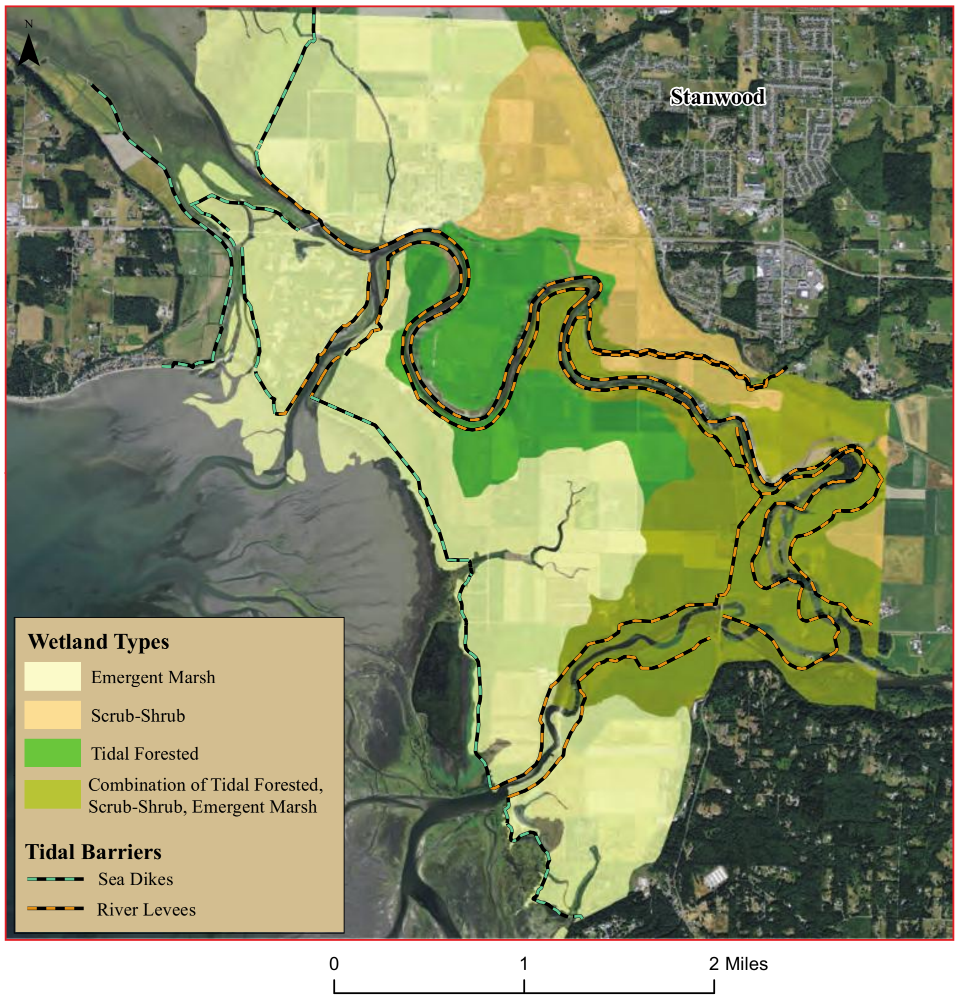
Since publication of the 2012 State of Our Watersheds Report, the Stillaguamish Salmon Recovery Plan's 10-year target for estuary habitat restoration has expanded from 315 to 548 acres.[1] As of 2013, 150 acres were restored toward that target.[2] Recent research has pointed out the historic importance of tidal scrub-shrub and tidal forested wetlands in addition to emergent marsh wetland in tidal areas. As a result, the new targets for the estuary now include scrub-shrub and tidal forested wetland types as part of the restoration strategy.

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.[3] Updated targets for properly functioning conditions (PFC) call for restoration of the 80% of historic estuarine wetland habitat or 4,039 acres, to constitute these three wetland types. Over 50% of that restoration, 2,191 acres, is targeted to be fixed in the 11 to 50 years of the recovery plan.[4]

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 will be necessary to reconcile salmon habitat restoration with agricultural land conservation.[5,6]

Data Sources: Griffith & Fuller 2012,[7] NAIP 2011,[8] WWU 2014[9]

Historic wetland conditions in the Stillaguamish River estuary



Updated final estuary restoration targets approved by Stillaguamish Watershed Council in 2014

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 Function Condition (based on 80% of historic)

AR052987

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Historical Understanding Expands Estuary Restoration Targets for Salmon Recovery

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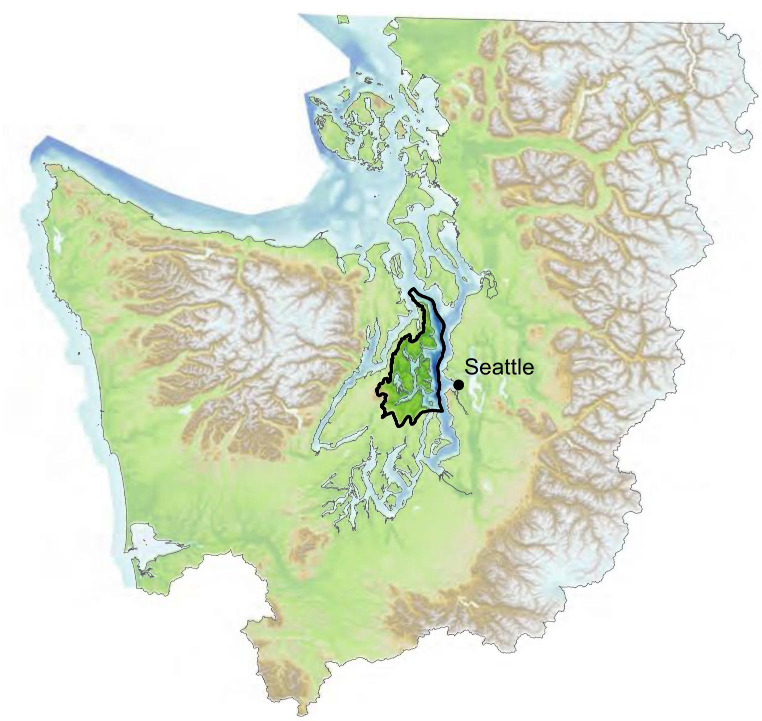
2016 State of Our Watersheds Report

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,**
Suquamish Tribe



Suquamish Tribe

The Suquamish Tribe has inhabited the Kitsap Peninsula since time immemorial. They are party to the Point Elliott Treaty of 1855, when tribes ceded their traditional lands to the U.S. government. This report will focus on the East Kitsap basin and surrounding marine waters, one of many areas within the Suquamish Tribe's adjudicated Usual and Accustomed fishing area. The Kitsap shoreline accounts for nearly half of the nearshore habitat in south and central Puget Sound and provides vital habitat for salmonid production throughout the region. Major land-use impacts on salmon habitat continue to result from floodplain and shoreline development, urban development, road construction and logging practices.

Kitsap Basin and the East Kitsap Recovery Strategy

The Suquamish Tribe's Usual and Accustomed fishing area includes marine waters from the northern tip of Vashon Island to the Fraser River, including but not limited to Haro and Rosario straits, the San Juan Islands, the streams draining into the western side of this portion of Puget Sound, and also Hood Canal. For this report, the Focus Area of the Suquamish Tribe's Usual and Accustomed fishing area is a portion of the East Kitsap basin. The shorelines of East Kitsap form the eastern portion of Kitsap County, including Bainbridge Island, and its streams flow to central or southern Puget Sound. These lowland streams, many of which originate from lakes, springs or headwater wetlands,[1] provide ideal spawning and rearing habitat for juvenile and adult salmonids. The streamflows are dependent on precipitation and groundwater contribution.

The U.S. Navy owns most of the federal land in the East Kitsap Focus Area, some of which contains high quality, functioning habitat. Navy-owned shorelines are among the most impacted by industrial development, habitat loss, and chemical contamination in Kitsap County. This presents significant challenges with respect to ecological protection and restoration, as well as treaty rights and human health. The Navy uses internally developed Integrated Natural Resource Management Plans (INRMPs); however, such plans do not ensure protection of treaty-reserved rights and resources or consistency with state and local land use and other environmental laws designed to protect habitat.

The East Kitsap Recovery Strategy follows the Puget Sound Salmon Recovery Plan with a focus on protection and restoration of the nearshore and watershed-specific recovery plans (e.g., Chico, Curley, Blackjack) that are being developed.

This recovery strategy is consistent with the Open Standards Framework for Conservation and it addresses important treaty rights salmonid populations.

Recovery Efforts Lagging

At the 10-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, degradation of floodplain and riparian processes, degradation of marine shoreline habitat conditions, degradation of fish life 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 we hope gain traction. For example, Kitsap County manages a "Shore Friendly" program that offers financial incentives and other assistance to landowners for removing bulkheads (http://shorefriendlykitsap.com/).

Review of the trend for these key environmental indicators since the 2012 State of Our Watersheds Report shows an improvement in restoration efforts but a steady loss in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Population Growth	The population estimate for Kitsap County shows a growth of 2% since 2010; however, both Port Orchard and Poulsbo are expected to grow by 15% and 6% respectively. High population densities lead to increases in impervious surface area which adversely affect land use, water resources, and fish habitat.	**Declining**
Impervious Surface	From 2006-2011, increase of 3% (2.4 square miles) in impervious surface. 4 drainage units were impacted enough to move their status to a more degraded category.	**Declining**
Shoreline Modifications / Forage Fish	From 2005 to 2014, 237 HPAs were issued in Kitsap County, resulting in an additional 1.3-plus new miles of armored shoreline, while 0.9 miles of armoring were removed, for a net increase of 0.4 miles. Over 80% of these modifications are from riprap and bulkheads. 56% of the marine and freshwater shorelines have been heavily modified, a factor identified by the East Kitsap Recovery Plan as limiting salmon production in the basin.	**Declining**
Water Wells	From 2010-2014, increase of almost 3% in water wells, while the Port Madison Water Resource Area saw a 2.5% increase.	**Declining**
Forestland Cover	From 2006-2011, a decrease of about 2% of the forestland cover. The trend in many watersheds continues toward "moderate" or "poor" conditions. 52% of the riparian zones in the marine and freshwater shorelines have been heavily modified, a factor identified by the East Kitsap Recovery Plan as limiting salmon production in the basin.	**Declining**
Stream Blockages - Culverts	Barrier culverts partially or fully block 78.2 miles of fish habitat in the East Kitsap study area.	**Declining**
Road Densities	94% of the drainage units are impacted by high road densities (>3 miles of road per square mile) while 37% are negatively impacted by stream crossings.	**Declining**
Restoration	Restoration examples include the removal of about 400 feet of Kittyhawk Drive, a box culvert at the mouth of Chico Creek, culvert replacements, and Powel Shoreline Restoration Project (removal of 1,500 feet of shoreline armoring).	**Improving**

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

Climate Change and Ocean Acidification

The Suquamish Tribe is currently assessing vulnerabilities to natural resources, including shellfish, salmonids, and traditional plants and their ecosystems, caused by anthropogenic carbon emissions that result in climate and ocean change. The Tribe plans to develop and implement a climate adaptation strategy to address climate change threats. The Tribe is also taking several near-term actions including improving the tools used to assess biological impacts of ocean acidification and supporting environmental education in K-12 classrooms.

Among the aquatic impacts of increased atmospheric carbon include ocean acidification, warmer waters, and shifts in oceanic current patterns that pose a variety of potential threats to marine ecosystems. The planktonic communities that form the base of the marine food web are thought to be especially vulnerable. To improve the ability to detect these changes, Suquamish is partnering with faculty and students at the University of Washington to develop a low cost zooplankton imaging and computer identification system. The Tribe's recently completed Chico Watershed Protection and Restoration Plan includes strategies and actions for floodplains, riparian corridors, and streams that provide greater resilience to climate change.

The Suquamish Tribe is also supporting environmental education efforts targeting tribal youth, and the broader tribal community, as well as educators outside the Tribe. For example, Suquamish Fisheries runs a web-based collection of curricula on ocean acidification (*OACurriculumCollection.org*), and is active in both student and teacher training in a variety of forums.

Paul Williams

Ocean acidification awareness booth, sponsored by Suquamish Tribe, at the Quinault 2013 Tribal Canoe Journey.

Looking Ahead

Suquamish Tribe activities in the near future will emphasize, but are not limited to, the following:

- Working with entities to upgrade shellfish growing area classifications (in East Kitsap);
- Habitat restoration;
- Developing the Curley Creek and Blackjack Creek watershed assessments that will identify and prioritize salmonid habitat protection and restoration actions;
- Conducting actions to prevent further habitat and water quality degradation through review of land use plans and development project permits;
- Conducting baseline eelgrass and forage fish surveys;
- Participation in the review of response actions at Superfund and other contaminated sites.
- Continuing to support educational programs and curricula regarding climate change and ocean acidification; and
- Assessing climate vulnerabilities to Suquamish natural resources, including salmonids, shellfish, and traditional plants and their ecosystems, and developing and implementing a tribal climate adaptation strategy.

Tiffany Royal, NWIFC

Removal of treated logs from the Suquamish Tribe's Doe Kag Wats estuary.

Suquamish Tribe

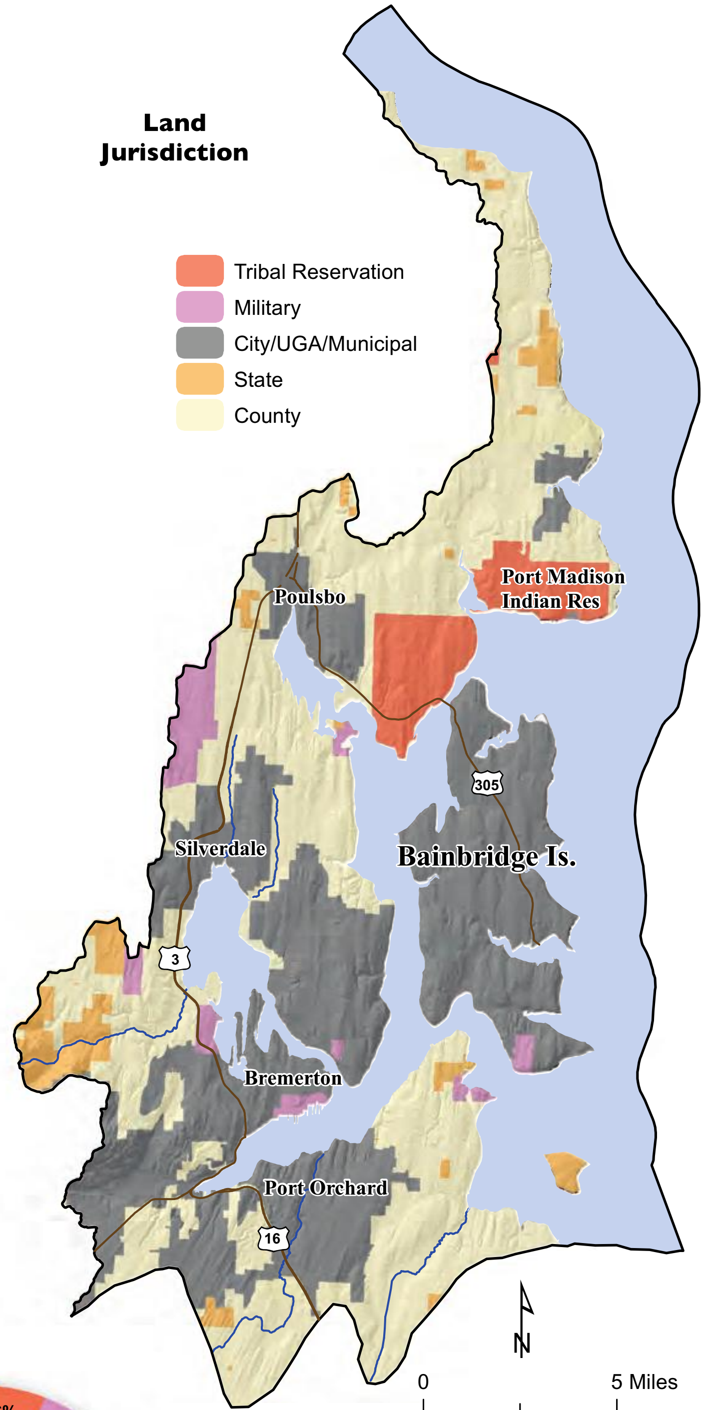
Portion of East Kitsap Basin

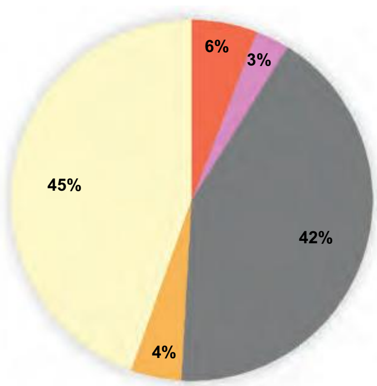
The Suquamish Tribe's Usual and Accustomed fishing area includes marine waters from the northern tip of Vashon Island to the Fraser River, including but not limited to Haro and Rosario straits, the San Juan Islands, the streams draining into the western side of this portion of Puget Sound and also Hood Canal. For this report, the Focus Area of the Suquamish Tribe's Usual and Accustomed fishing area is a portion of the East Kitsap basin (hereinafter "East Kitsap"). The shorelines of East Kitsap form the eastern portion of Kitsap County, including Bainbridge Island, and its streams flow to central or southern Puget Sound. These lowland streams provide ideal spawning and rearing habitat for juvenile and adult salmonids. Many of them originate from lakes, springs, or headwater wetlands.[1] Streamflows are dependent on precipitation and groundwater contribution.

The entire Kitsap Peninsula is 400 square miles in size, surrounded by 360 miles of saltwater shoreline. This shoreline accounts for nearly half of the nearshore habitat in south and central Puget Sound and provides vital habitat for threatened Chinook, as well as for chum, coho, steelhead and cutthroat trout from watersheds throughout those areas.[2]

The U.S. Navy owns most of the federal land in the East Kitsap Focus Area, and some of the military lands in East Kitsap contain valuable habitat. These Navy lands contain military bases that occupy significant stretches of developed shoreline and nearshore marine areas. This presents significant challenges with respect to habitat protection and restoration. Past operations have left a legacy of contaminated sites in the Focus Area, many in the nearshore. Although the Navy uses internally developed Integrated Natural Resource Management Plans (INRMPs) to carry out its military missions, such plans do not ensure protection of treaty-reserved rights and resources or consistency with state and local land use and other environmental laws designed to protect habitat.

East Kitsap salmon recovery has been implemented with the recognition of the critical role played by the nearshore and marine areas in providing support for salmon species originating from all portions of Puget Sound.[3] The overall goal is to protect, restore and enhance the nearshore natural processes and habitat in order to contribute to Puget Sound-wide salmon recovery.





Data Sources: SSHIAP 2004,[4] USFWS 2014,[5] USGS 2014a,[6] WADNR 2014a,[7] WADNR 2014b,[8] WADNR 2014c,[9] WADOT 2013,[10] WAECY 1994,[11] WAECY 2011a,[12] WAECY 2013[13]

AR052995

Land Conversion and Loss of Habitat

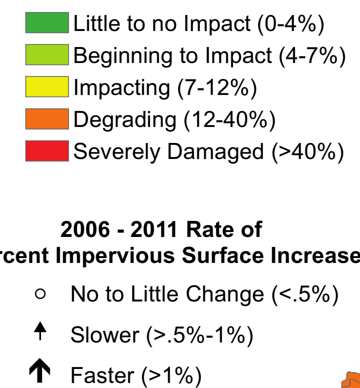
Impervious surface increased by 3% (2.4 square miles) from 2006-2011 in the Suquamish Focus Area. Four drainage units were impacted enough to move their status to a more degraded category.

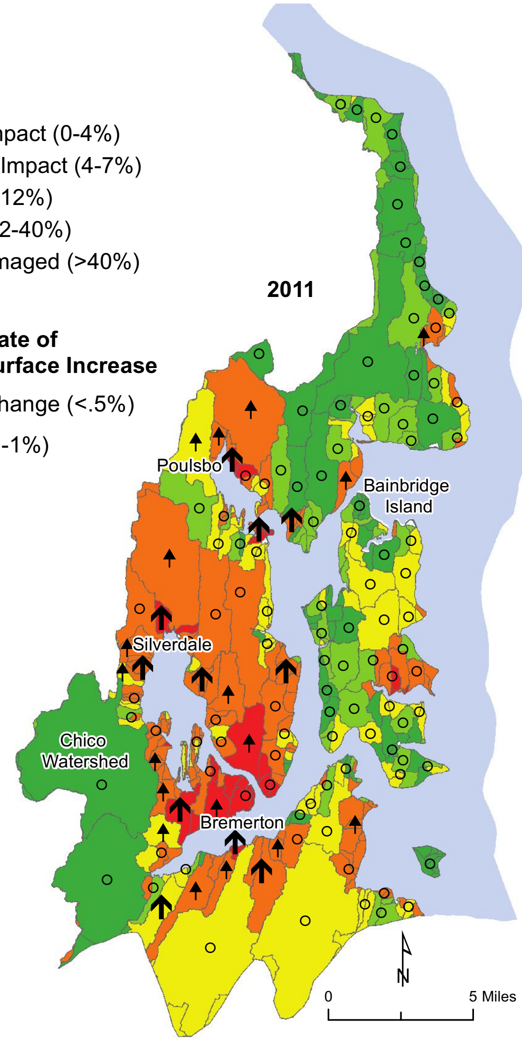
Increases in impervious surfaces associated with development degrade habitat and water quality[1,2] and adversely affect salmon production in East Kitsap.[3] Impervious surface data for the East Kitsap study area shows an increasing trend toward degrading watershed conditions particularly around Poulsbo, Silverdale, Gorst and parts of Bremerton and Port Orchard. Four drainage units in the Suquamish Focus Area had an increase in impervious surface large enough to change categories during the time period of 2006-2011. One noted exception is the Upper Chico watershed, which has remained relatively undeveloped and thus has little impervious surface impact.

The growth and spread of impervious surfaces within urbanizing watersheds pose significant threats to the quality of natural and built environments. These threats include increased stormwater runoff, reduced water quality, higher maximum summer temperatures, degraded and destroyed aquatic and terrestrial habitats, and the diminished aesthetic appeal of streams and landscapes.[4]

About 75% of the toxic chemicals entering Puget Sound are carried by stormwater runoff that flows off paved roads and driveways, rooftops, yards and other developed land.[5] In native Kitsap soils, 10-40% of the precipitation returns to groundwater. In contrast, populated areas with lots of roads and buildings only return about 15% of precipitation to groundwater.[6]

Three ways to help mitigate impervious surfaces are: 1) Protecting aquifer recharge areas from development and impervious surface. 2) Directing future impervious surface areas in areas underlain by bedrock or glacial till, which has less of an impact on hydrology than adding impervious surfaces to permeable soils such as alluvium or glacial outwash.[7] 3) Adding rain gardens to populated areas to encourage the recharge of aquifers by returning more water directly into the ground instead of allowing flow into surface streams or other waterbodies. Rain gardens can slow down stormwater moving off properties, making for less flooding and erosion in streambeds, protecting salmon, and providing more clean water in the ground, lakes and streams.

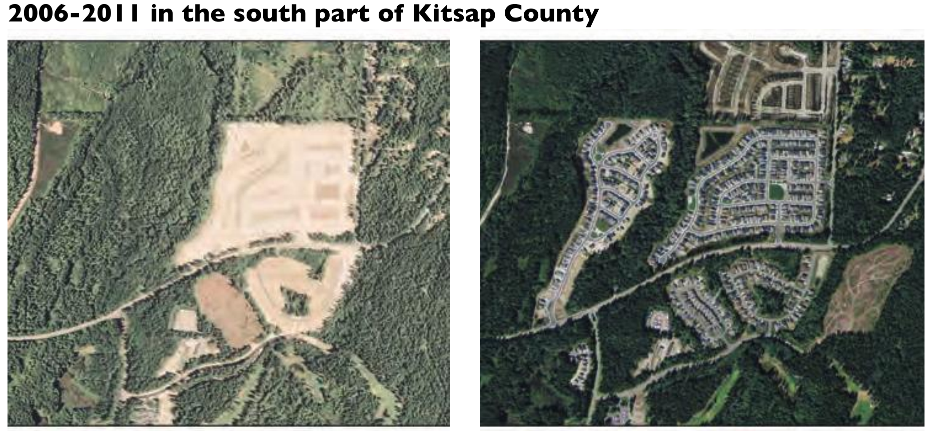




"'Imperviousness,' although an imperfect measure of human influence, is clearly associated with stream-system decline. A wide range of stream conditions, however, can be associated with any given level of imperviousness, particularly at lower levels of development."[8]

"Correlations between watershed development and aquatic-system conditions have been investigated for over two decades. Klein (1979) published the first such study, where he reported a rapid decline in biotic diversity where watershed imperviousness exceeded 10 percent."[9]

Area of increased impervious surface resulting from build-out from 2006-2011 in the south part of Kitsap County

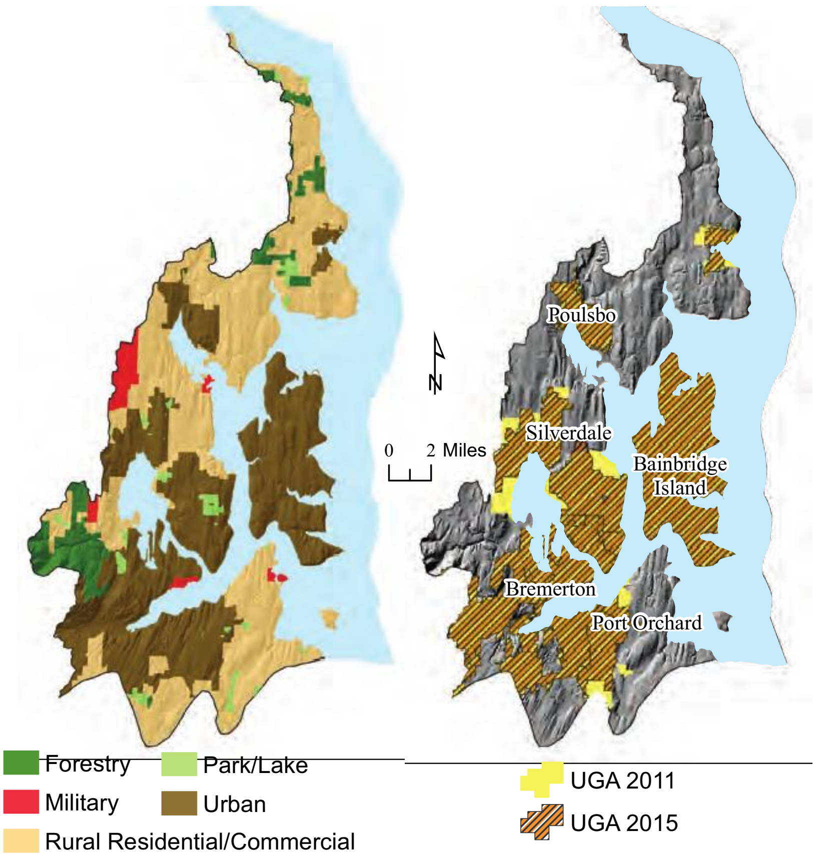


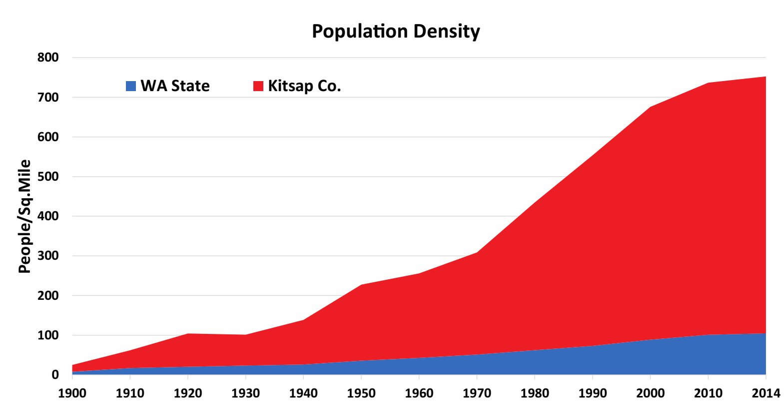
Data Sources: NAIP 2006,[10] NAIP 2011,[11] NLCD 2006,[12] NLCD 2011,[13] USGS 2014a[14]

AR052996

Population Growth and Impact on Habitat

The population estimate for Kitsap County shows a growth of 2% since 2010. However, from 2010 to 2014, both Port Orchard and Poulsbo are expected to grow by 15% and 6% respectively.[1] High population densities lead to increases in impervious surface area, which adversely affect land use, water resources and fish habitat.





Note: Time intervals are 10 years except for the last interval which is four years

Kitsap County is the seventh most populous county of the 39 in Washington state but represents the third most densely populated county due to its small geographic size and proximity to the state's largest employment centers.[2] The county grew by 22% between 1990 and 2000, 8.3% between 2000 and 2010 and 2% from 2010 to 2014.[3] The Washington State Office of Financial Management (OFM) estimated population for 2014 shows Kitsap County population growth slowing to 2%.

The population forecast is the first step in determining where planners will target future growth, as the county and all four cities begin to work on new comprehensive land-use plans, to be completed in 2016. In 2004, the Kitsap Regional Coordinating Council adopted a midrange projection from OFM, which predicted the county's population would reach 332,000 in the year 2025. The latest projections from 2012 place the midrange estimate for 2025 at only 289,000, some 43,000 fewer people than predicted eight years ago. When the comprehensive plan was last updated in 2006, the urban growth areas were sized to accommodate the growth forecast at that time. Urban growth areas were expanded for Poulsbo, Bremerton and Port Orchard, as well as unincorporated urban areas such as Silverdale and Kingston. A major obstacle to the next round of planning is the fact that the 2006 comprehensive plan remains under the shadow of legal actions. Following five years of appeals, the state's Growth Management Hearings Board ruled that the county and its cities had planned for a lower density of housing than was likely to occur in urban areas, which means the county's urban growth areas were sized too large. The county is in the midst of shrinking some or all of its urban growth areas by identifying lands and entire communities with the least urban characteristics. Three alternatives have been developed, each with different lands proposed to be removed from UGAs.[4]

The UGA of the East Kitsap Focus Area has decreased in area by 9.4% since 2011. The Silverdale UGA decreased by 27%, while the Port Orchard UGA decreased by 32%.[5] Areas were removed along Dyes Inlet near Chico because of the presence of critical areas and the desires of area residents. Other areas were removed because of steep slopes, low development potential, and the presence of streams and wetlands.

Development pressures continue to increase along the waterfront and into rural areas. The cumulative impacts resulting from activities such as wells, residential shoreline development, vegetation removal, floodplain development and stormwater runoff remain largely unchecked and unaccountable.

Data Sources: Kitsap Co. 2015,[6] SSHIAP 2004,[7] USGS 2014a,[8] UW 2012,[9] WADNR 2014c,[10] WAECY 2013,[11] WAOFM 2014[12]

Wells Potentially Impact Low Flows

The East Kitsap Focus Area saw an increase of almost 3% in the number of water well logs from 2010-2014. The Port Madison Water Resource Area (PMWRA) saw a 2.5% increase during this same time period.

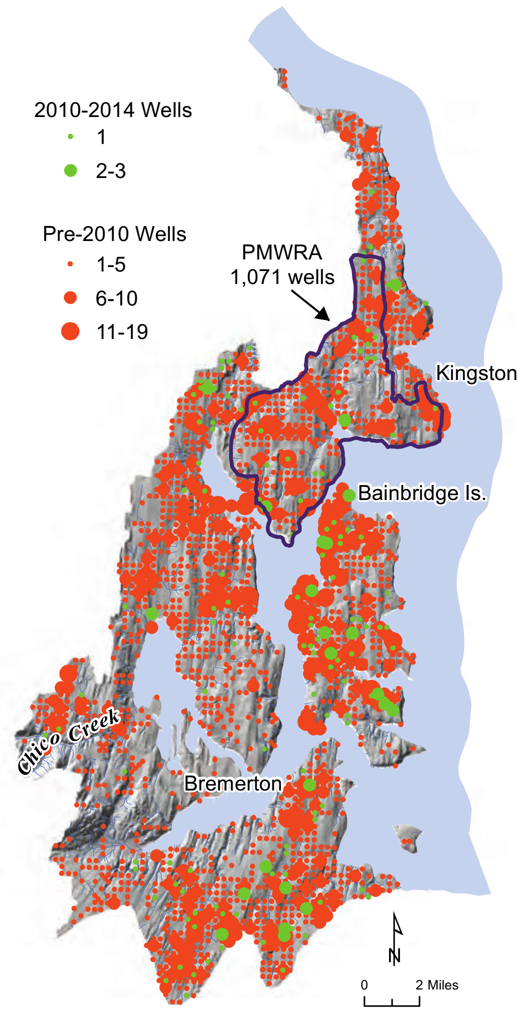
The East Kitsap Salmon Recovery Plan identified the alteration of natural stream hydrology as perhaps one of the largest impacts/threats to salmon habitat in the basin.[1] There are many small streams in the basin that are highly influenced by groundwater and support many fish populations.[2]

Groundwater is the primary source of drinking water for most of the population of the Kitsap Peninsula. As the population grows, generally so does the demand for groundwater. The quantity of usable groundwater likely is limited, however. This area has "issues of limited groundwater recharge because of overlying low-permeability glacial tills,"[3] much less precipitation in the north and east parts of the county, and impervious surfaces as a result of development. There is also a potential for saltwater intrusion near coastal wells; however thus far no widespread or serious problems have been recognized.

A recent water budget calculated for the Kitsap Peninsula showed that during 2012, an above-average year of precipitation, the groundwater system received about 664,610 acre-feet of recharge from precipitation and 22,122 acre-feet of recharge from septic and irrigation return flows. On average across the Kitsap basin, most of this annual recharge (66%) discharged to streams, and only about 4% was withdrawn from wells. The remaining groundwater recharge (30%) left the groundwater system as discharge to Hood Canal and Puget Sound.[4]

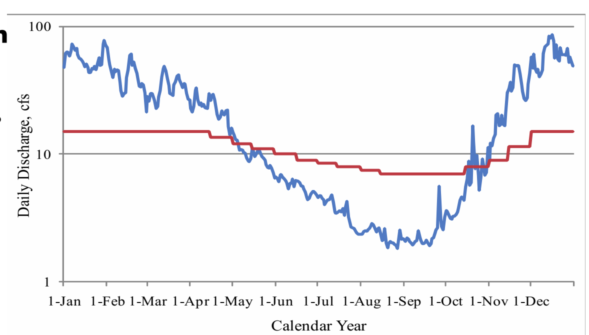
However, some of the water budget components in the north and eastern portions of the basin (including East Kitsap) are likely to show very different relationships. For example, the eastern part of the basin has the least amount of groundwater recharge and the greatest amount of groundwater withdrawals. With a new USGS model soon to be released, we will be able to examine these relationships more closely.

Between 2010 and 2014, there was an increase of about 3% in the number of well logs in East Kitsap Focus Area. In the Port Madison Water Resource Area (PMWRA), the increase was 2.5%. Permit-exempt wells are not subject to the same restrictions and regulations as other water diversions in Washington state. They can contribute to the over-appropriation of groundwater and to the decline of aquifers. The cumulative effect of exempt wells reduces water levels in wetlands, springs, streams and rivers. Across the entire Kitsap Peninsula, if no well withdrawals were occurring at all, the base flows of streams would be between 1-3% higher than current conditions. Many studies in the Pacific Northwest have documented the relationship between low streamflow and poor salmonid survival.[5] Local zoning and development ordinances rarely provide sufficient protection for groundwater and its critical contribution to summer base flows.



Data Sources: SSHIAP 2004,[8] USGS 2014a,[9] WAECY 2015[10]

Flow Hydrograph at Chico Creek Mainstem, 1991-1996, 2001-2009[6]



In Chico Creek, minimum instream flows were not met from June to September in the 13 years that data was available. This watershed has one of the largest salmon runs in Kitsap County. Several species of fish migrate through the Chico Watershed, including chum, and coho salmon, steelhead, and sea-run cutthroat trout. Streamflow is primarily driven by rainfall and groundwater contributions. Grover's Creek in the PMWRA appears to be similarly impacted.[7]

Jim Zimny, Kitsap County

Chico Creek

Suquamish Tribe

Shoreline Modifications Threaten Salmon Rearing and Forage Fish Spawning Habitat

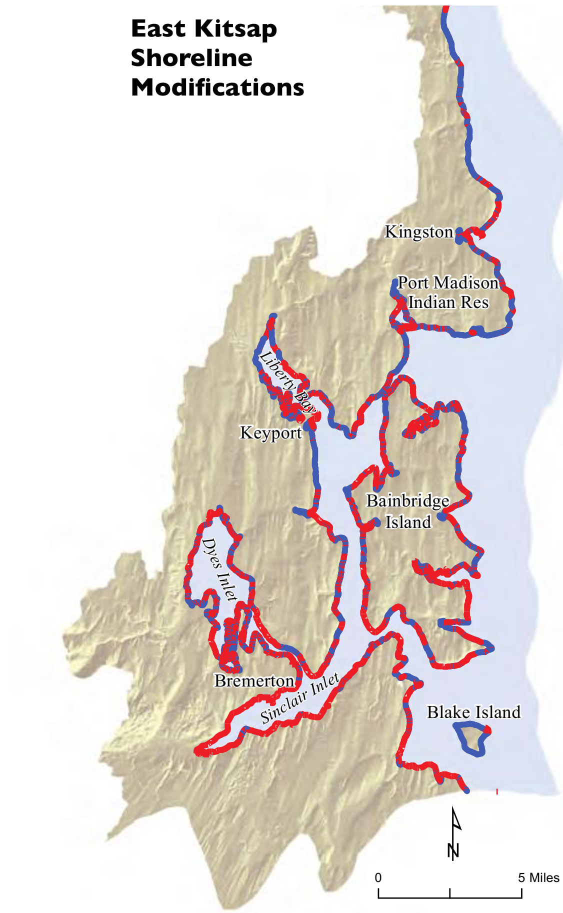
From 2005-2014, 237 Hydraulic Project Approvals (HPAs) were issued in Kitsap County resulting in an additional 1.3-plus miles of armored shoreline, while 0.9 miles of armoring were removed, for a net increase of 0.4 miles.[1] Over 80% of these modifications are from riprap and bulkheads.

Shoreline alterations are pervasive in the East Kitsap study area. About 56% of the entire shoreline has been modified by the presence of fill, armoring, roads or similar structures, changing how the ecosystem functions, and including negatively impacting salmon rearing and forage fish spawning habitat.[2]

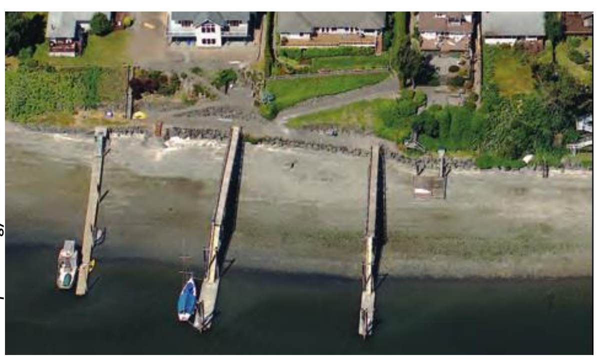
Shoreline development has been identified as a key habitat stressor to Chinook in East Kitsap.[3] Armoring or hardening the shoreline significantly affects sediment supply and distribution and can alter the nearshore food web.

A majority of the shorelines, particularly around Bremerton, Sinclair Inlet, Dyes Inlet, Liberty Bay and Bainbridge Island, are modified by the presence of fill, roads or similar structures in the nearshore. The few exceptions to this ubiquitous shoreline development are most of Blake Island and stretches of shoreline in the Port Madison Indian Reservation, south of Keyport, and north of Kingston. The most common type of modification is riprap, followed by concrete and wooden bulkheads. These are typically built to protect homes and other structures but they change how the ecosystem functions and have a detrimental impact on fish habitat. However, recent data shows that Kitsap County has removed the greatest amount of armoring of any county in Puget Sound. The Powel Shoreline Restoration Project on Bainbridge Island removed over 1,500 lineal feet of shore armor resulting in re-establishment of salt marsh and intertidal vegetation and increasing intertidal habitat on the project property by 163%.[4]

East Kitsap Shoreline Modifications



Data Sources: ACOE 2008,[7] SSHIAP 2004,[8] USGS 2014a[9]

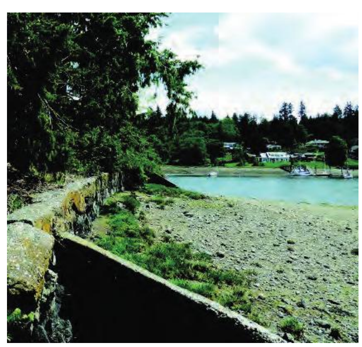


WA Dept. Ecology Coastal Atlas

WADFW

Surf smelt and sand lance

Shoreline residential development in East Kitsap: Throughout Puget Sound, surf smelt and sand lance are important forage fish for Pacific salmon, marine mammals, and seabirds. Since they spawn exclusively on sand and gravel beaches, they are particularly vulnerable to the cumulative negative impacts of a wide variety of shoreline development activities.[5]



Bainbridge Island Land Trust (2)

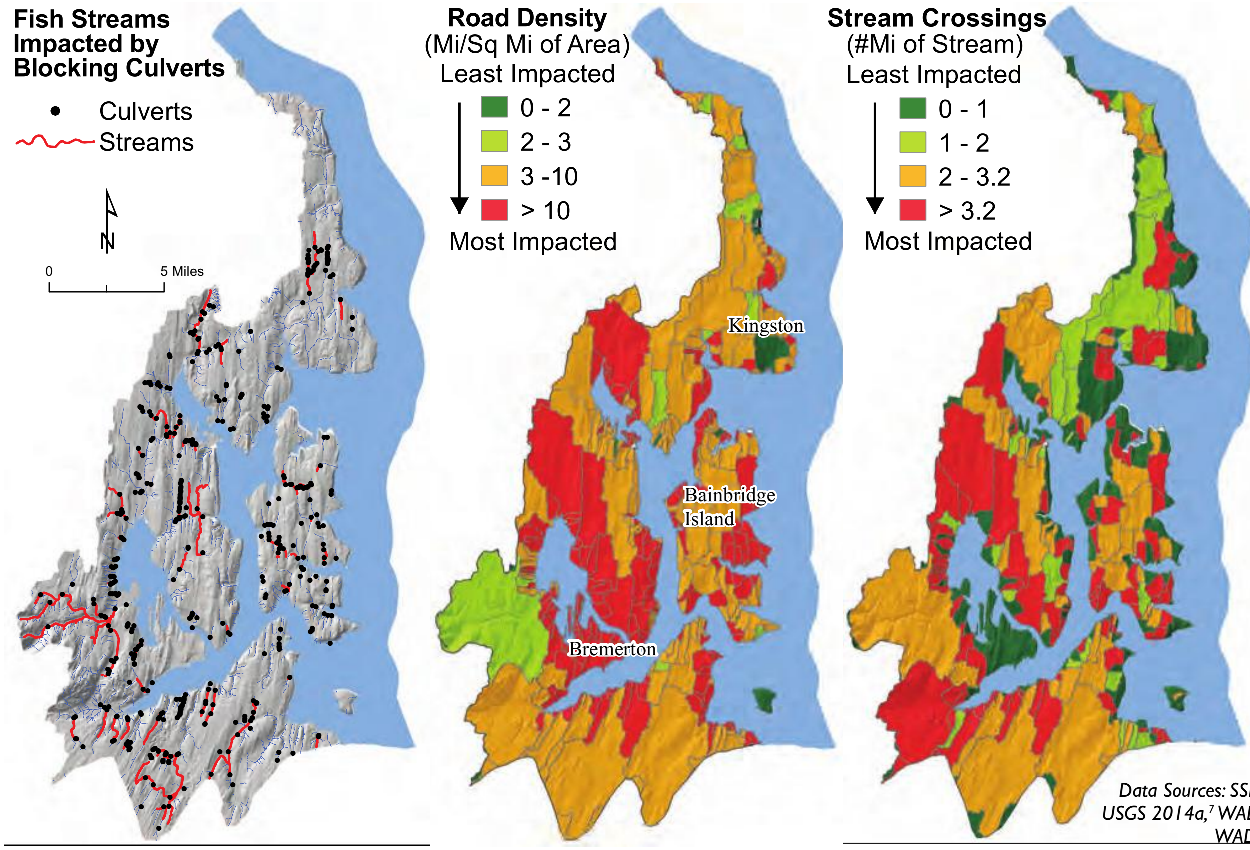
Powel Shoreline Restoration Project – Bainbridge Island: The amount of armoring removed in Kitsap County is more than any county in Puget Sound. The Powel Project is a great example where over 1,500 lineal feet of shore armor were removed along with associated fill, resulting in a 163% increase in intertidal area and salt marsh; 33,000 square feet of riparian area were cleared of invasive plants and replanted with native vegetation.[6]

HPA County Summary 2005 - 2014

County	Number of Projects	New (ft)	Replacement (ft)	Removal (ft)
Kitsap	237	7073	16,728	4689

Impacts of Culverts, Road Density and Stream Crossings

Barrier culverts partially or fully block 78 miles of fish habitat in the East Kitsap study area. Ninety-four percent of the drainage units are impacted by high road densities (>3 miles of road per square mile) while 37% are negatively impacted by stream crossings.



Data Sources: SSHIAP 2004,[6] USGS 2014a,[7] WADFW 2014,[8] WADNR 2014b[9]

Urbanization typically results in the construction of road networks which can be significant stressors to stream health. High road densities require stream crossings, culverts and other structures that constrain stream channels.[1] The removal of fish passage restrictions in streams that provide important salmon habitat was identified as high priority in the East Kitsap Salmon Recovery Plan since they create physical obstructions that impede access to spawning and rearing habitats.[2] Barrier culverts partially or fully block slightly over 78 miles of potential fish habitat in streams of East Kitsap. Recent stream mapping work in East Kitsap suggests that culverts and other man-made obstructions block considerably more habitat than this estimate indicates.[3]

This analysis shows that almost every watershed in the East Kitsap study area is impacted by high road densities and a significant number are also impacted by stream crossings. The proper function 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/square mile.[4] Streams have also been shown to approach poor biological conditions when exceeding 3.2 crossings per mile of stream length.[5]

Habitat Work Schedule

Larry Steagall, Kitsap Sun

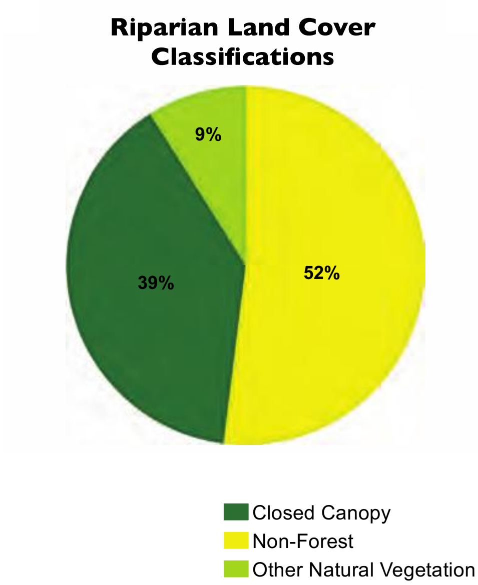
WF Clear Creek Culvert Removal: To improve fish passage and enhance habitat, Kitsap County permanently closed Sunde Road at Clear Creek and removed the culvert in the summer of 2013. In addition to improving fish passage, this project restored instream and riparian habitat and improved water quality.

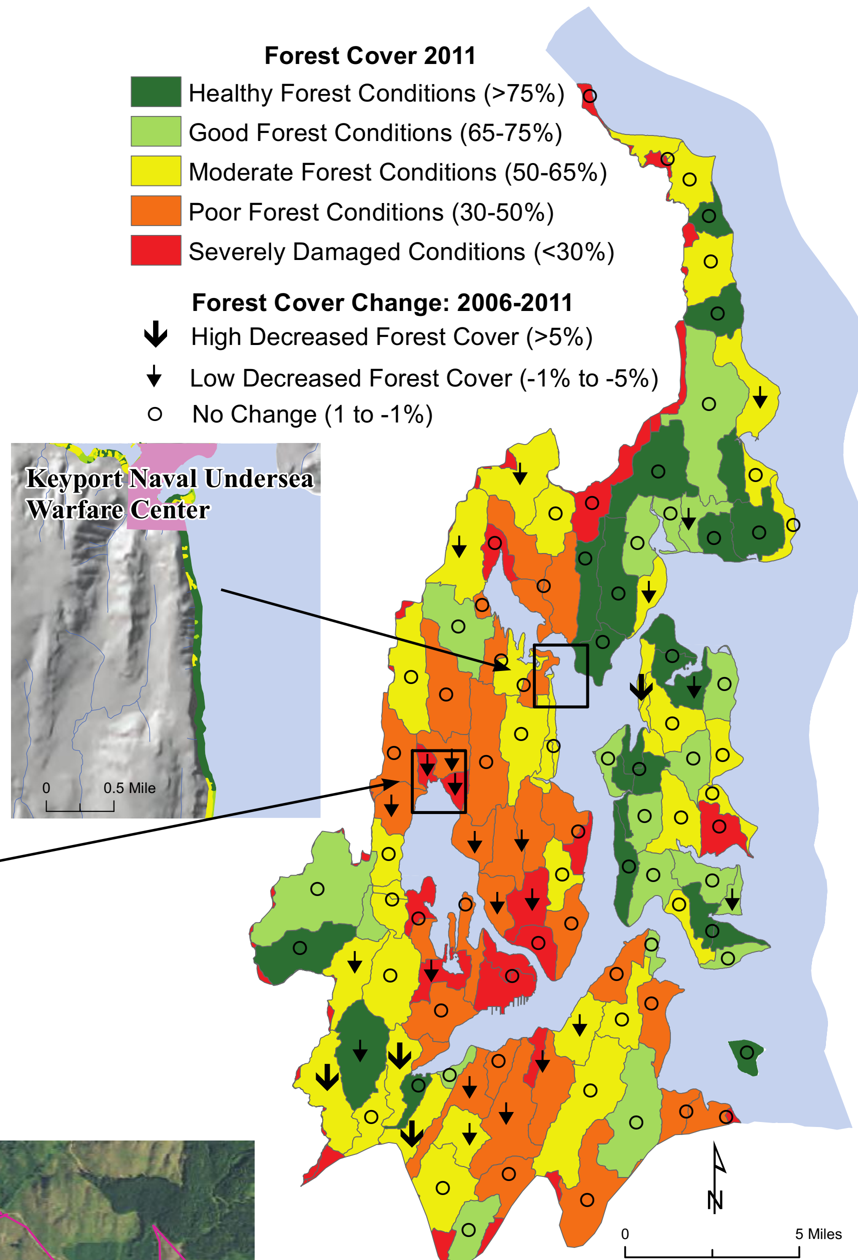
Forest and Riparian Land Cover Conditions

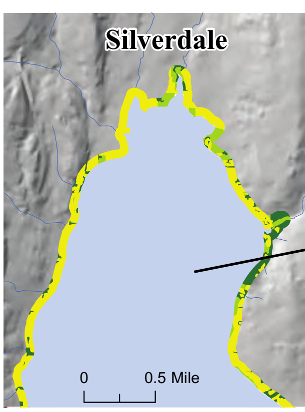
About 2% of the forestland cover was lost in East Kitsap between 2006 and 2011, and the trend in many watersheds continues toward "moderate" or "poor" conditions. Fifty-two percent of the riparian zones in the marine and freshwater shorelines have been heavily modified, a factor identified by the East Kitsap Recovery Plan as limiting salmon production in the basin.[1]

Based on NOAA-CCAP data, 1591 acres (2%) of the forestland cover was lost in East Kitsap between 2006 and 2011. Many watersheds have "moderate" or worse forest conditions. Loss of forest cover typically results in less water retention, increased peak flow and increased water yield from a watershed.[2]

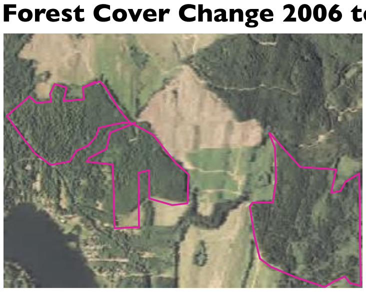
East Kitsap shorelines provide vital habitat for threatened Chinook as well as other salmonids,[3] but the shoreline conditions are in decline. Data from 2011 (PNPTC) shows that 52% of riparian zones in the marine and freshwater shorelines are "non-forest," largely the result of forest clearing and other shoreline modifications. Only 39% have deciduous- and conifer-dominated forests with closed canopies. Riparian forests along streams provide large woody debris, shade, bank stability, wildlife habitat and other ecological functions for salmonids and other biota. Their removal and fragmentation degrades habitat quality.







Forest Cover Change 2006 to 2011



Data Source: NAIP 2006,[4] NAIP 2011,[5] PNPTC 2011,[6] USGS 2014a,[7] WADNR 2011,[8] WAECY 2006,[9] WAECY 2011b[10]

Suquamish Tribe

Chico Creek Estuary Restoration

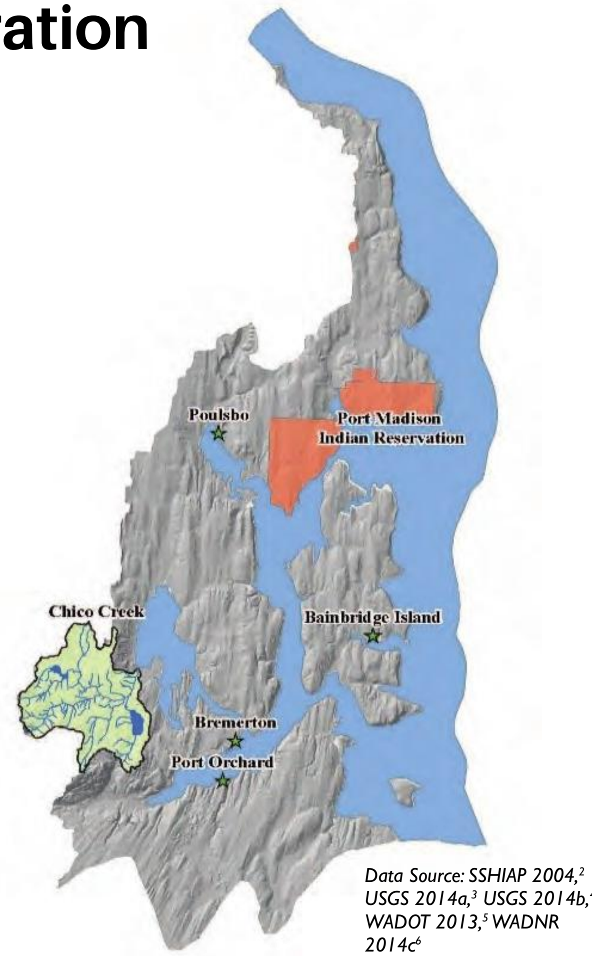
The Suquamish Tribe completed a major salmon restoration project at the mouth of Chico Creek in 2014. The goals of the project were 1) to improve fish passage at the mouth of Chico Creek through the State Route 3 (SR3) culvert; 2) restore stream and marsh habitats and improve channel/estuary connectivity; 3) establish conditions that allow for the replacement of the SR3 culvert with a bridge; 4) maintain utilities and vehicle access to residential properties. A major component of the project was the permanent removal of nearly 400 feet of Kittyhawk Drive and the culvert (both county-owned) at the mouth of Chico Creek.

The Chico Creek estuary is a diverse mix of habitats including stream and nearshore riparian, salt marsh, tidal distributary channels and intertidal gravel beach. The Suquamish Tribe has documented juveniles of five species of Pacific salmon (including listed Chinook salmon and steelhead) rearing within the Chico estuary.

In the early 1960s the State Highway Department built State Route 3 and Kittyhawk Drive on fill as deep as 50 feet, resulting in the loss of approximately 5 acres of channel, floodplain and saltmarsh in the Chico Estuary. Before the restoration project was completed, Chico Creek flowed into the estuary after passing through a 400-foot double box culvert under State Route 3 and a 40-foot double box culvert under Kittyhawk Drive. These culverts impeded fish passage under conditions that are common during the peak adult salmon migration period (in the fall and early winter).

The Washington State Department of Transportation has ranked its SR3 culvert as the second highest priority for replacement in the entire Olympic Region. Removing Kittyhawk Drive and its culvert from the historic Chico estuary was a necessary first step allowing for the future replacement of the SR3 culvert.

Sources of funding to complete the project included Kitsap County Public Works, Washington State Department of Transportation, Estuary Salmon Restoration Program (Washington State Department of Fish and Wildlife), US EPA, and the US Navy.[1]



Data Source: SSHIAP 2004,[2] USGS 2014a,[3] USGS 2014b,[4] WADOT 2013,[5] WADNR 2014c[6]

Suquamish Fisheries

Kittyhawk Drive and culvert at mouth of Chico Creek, prior to removal of the road/culvert and restoration of the estuary.

Suquamish Fisheries

Aerial photo of the Chico Creek estuary following the removal of a section of Kittyhawk Drive and culvert and replanting with native species.

Kitsap Sun Aug 24, 2014

Workers pulverize Kittyhawk culvert.

AR053002

Importance of Eelgrass in Puget Sound

"The importance of eelgrass meadows to salmon and other fish and invertebrates is well documented," said Tom Ostrom, Salmon Recovery Coordinator for the Suquamish Tribe.[1] Two projects illustrate how vital eelgrass beds are to the health of the Puget Sound ecosystem and the emphasis the Tribe places on eelgrass protection and restoration.

Data Source: NAIP 2013[2]

Eelgrass Restoration along Bainbridge Island

In 2013, the Suquamish Tribe and other members of the Elliott Bay Trustee Council began implementing the second phase of an important eelgrass restoration project outside Eagle Harbor on Bainbridge Island. The restoration site occurs at the former location of the Milwaukee Dock, which served the Wyckoff creosote plant for decades and was removed in the early 1990s.

The dock was constructed in a dense subtidal meadow of eelgrass, which was further impacted by navigation channels that left two large depressions too deep for eelgrass to grow and flourish.

Eelgrass is recognized as one of the most valuable ecosystem components in Puget Sound. The restoration project includes filling the two depressions with clean sediment to a more natural depth, and planting eelgrass within these two areas (northern and southern depression areas). When completed, this project will contribute to the Puget Sound Partnership's goal of increasing the amount of eelgrass habitat by 20% over the current baseline by 2020.

Baseline Eelgrass Study in the East Kitsap Nearshore

Suquamish is beginning work with the Washington Department of Natural Resources on an assessment of the status of eelgrass beds along shorelines of the East Kitsap area. This study will be used to establish a baseline of eelgrass distribution in the area (consistent with the Puget Sound Ecosystem Monitoring Program), and provide information for local governments (through their Shoreline Master Programs) and others in prioritizing protection and restoration of eelgrass beds.

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Suquamish Tribe: Portion of East Kitsap Basin

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Land Conversion and Loss of Habitat

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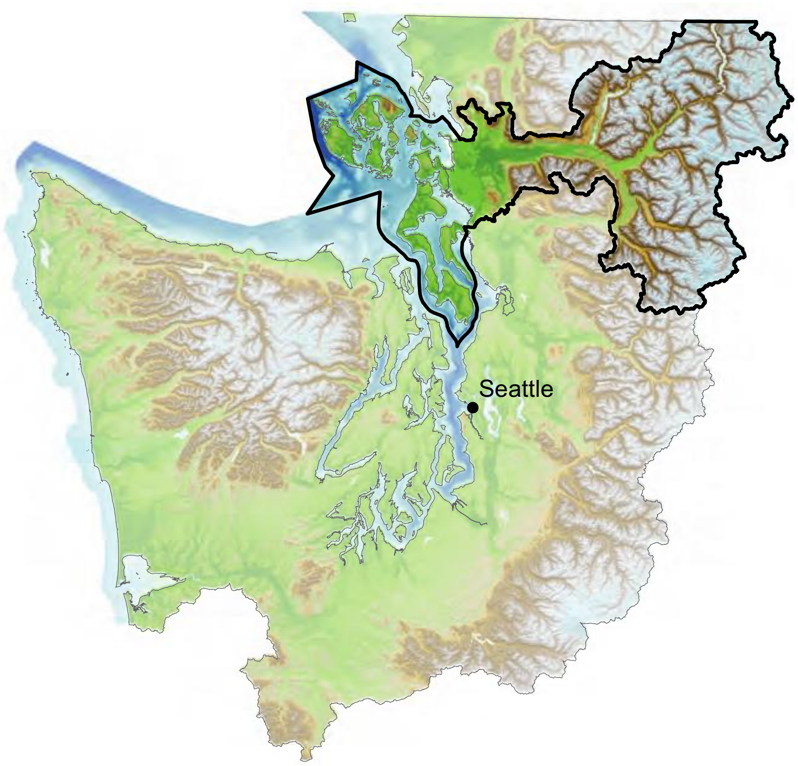
2016 State of Our Watersheds Report
Skagit River Basin

Swinomish Tribal Community

It's hard to tell our fishermen that they can't fish. If we didn't truly believe we could rebuild these salmon runs, we wouldn't be working as hard as we do. It's difficult to recover weak stocks without recovering their habitat at the same time. We are doing a lot of habitat work, as much as we can. We are also monitoring these projects for their benefits to salmon.

– Lorraine Loomis,
Fisheries Manager,
Swinomish Tribe



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, coastal areas surrounding nearby bays and waters, and numerous islands including San Juan, Whidbey and Camano islands. The Swinomish reservation on the southeastern 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 in size and includes 7,450 acres of upland and approximately 2,900 acres of tidelands.

Recovery Plan Seeks to Restore and Protect

The Skagit River remains one of the more pristine watersheds within Puget Sound.

The upper portion of the watershed is primarily under control of the federal government, located within the Mount Baker-Snoqualmie National Forest. Portions of the watershed are in federal wilderness and national parks. The middle section of the watershed is largely held as forestland, either in state or private ownership. The delta reaches are predominantly held in agricultural land.

Human land use over the last 150 years has resulted in the degradation of salmon habitat due to forestry and agricultural practices that constitute the primary land uses within the watershed.

Current limiting factors identified by the Skagit Recovery Plan include:

- Seeding levels,
- Degraded riparian zones,
- Poaching,
- Current hydroelectric operations,
- Sedimentation and mass wasting,
- Flooding,
- High water temperature,
- Hydromodification,
- Water withdrawals,
- Loss of delta habitat and connectivity,
- Loss of pocket estuaries and connectivity, and
- Illegal habitat degradation.[1]

The habitat recovery strategy pursued for the Skagit River sought to protect and restore the system from a process-based and landscape scale. It was recognized that successful recovery depends on the ability to produce an overall gain in the factors that support viable populations. Key strategies and actions focused on habitat protection and restoration.

Kari Neumeyer, NWIFC

The Swinomish Tribe integrated a canoe landing channel into an estuary restoration project along the Swinomish Channel.

The protection strategy focused on:

- Streamflows,
- Basin hydrology,
- Water and sediment quality and sediment transport,
- Stream channel complexity,
- Riparian areas and wetlands,
- Tidal delta area and nearshore, and
- Fish passage and access.

The restoration strategy focuses on fish production and weighs restoration actions by the degree to which they restore landscape conditions in the basin and thus contribute to long-term recovery.

Restoration efforts are focused on spawning areas, rearing in freshwater, tidal delta and nearshore habitat.

Tidal and Nearshore Habitat Restoration Prioritized

In 2010, the Skagit Watershed Council updated its restoration actions to provide a more strategic focus to restoration and recovery efforts.

Three guiding principles were adopted:

1. Restore processes that form and sustain salmon habitats.
2. Protect functioning processes and habitats from degradation.
3. Focus protection and restoration on the most biologically important areas.

Adoption of these principles also prioritized restoration to three areas:

1. Estuary and riverine tidal habitat;
2. Shallow nearshore habitat, including pocket estuaries; and
3. Sediment and hydrology impaired watersheds.[2]

Implementation of the Skagit Chinook Recovery Plan[3] is lagging behind the pace originally anticipated during plan development in 2006. Restoration work has progressed with numerous capital projects focused on restoring fish habitat and passage.

However, WRIAs 3&4 have faced significant funding shortages for restoration projects, limiting implementation progress. Progress also has lagged on implementing the regulatory and incentive programs to protect and restore salmonid habitat and habitat-forming processes.

Numerous shoreline management plans within WRIAs 3&4 are still in the process of being updated and action on regulatory gaps such as agriculture buffers and FEMA's Flood Insurance Program still need to occur. A major element of the 2006 Skagit Chinook Recovery Plan relies on revisions to state and national environmental regulatory programs, which have proven difficult to adjust to address the needs of the salmon resources in the Northwest.[4]

Swinomish environmental director Todd Mitchell observes a self-regulating tide gate installed as part of a tideland restoration.

Kari Neumeyer, NWIFC

Recovery Efforts Show Improvement But Still Lagging in Key Indicators

At the 10-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Skagit basin reveals mixed results in progress toward the recovery plan's goals and objectives. Priority issues continue to be degradation of water quantity and quality, degradation of floodplain and riparian processes, degradation of marine shoreline habitat conditions, and habitat blocked to fish access. There has been progress in two indicators: water wells and restoration. With the water wells indicator, improvement came after the Tribe took the state of Washington to court to stop the over-allocation of the Skagit groundwater supply. 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 since the 2012 State of Our Watersheds Report shows improvement for some indicators and a steady loss for others in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Water Quality	In 2011, over 51% of riparian acreage along fish-bearing streams within the 2008 Lower Skagit Temperature TMDL watersheds were non-forested and impaired. Since 2006, the streams were more impaired and less forested.	Declining
Water Wells	Since October 2013, Skagit County has not issued building permits that rely on permit-exempt wells as their sole water source, unless adequately mitigated for. This has resulted in no new unmitigated exempt well development in Skagit County since that date. There have been between 30 and 40 replacement wells allowed in the basin since that time.	Improving
Shoreline Modifications/Forage Fish Impacts	At present, about 55% of Skagit County's soft shorelines are already hardened by bulkheads or levees. To add further concern, nearly 1 mile of shoreline has been armored in Skagit County since 2005.	Declining
San Juan Island Shoreline Modifications	In the San Juan Islands, over 25 miles of marine shoreline are already either modified or armored. To make matters more critical, between 2005 and 2014, 5,676 feet of new marine shoreline armoring was added in San Juan County, the fifth highest county total in Puget Sound, and 11% of all permitted marine shoreline armoring completed in Puget Sound during that time period.	Declining
Stream Blockages - Culverts	From 2010-2014, the number of barrier culverts increased from 497 to 580, a 17% increase. For every culvert repaired in the Skagit watershed, over 3 new barrier culverts were identified. An additional 107 barrier culverts were surveyed in the Skagit River watershed and only 24 barrier culverts were repaired, resulting in a net increase of 83 addtional barrier culverts.	Declining
Forest Roads	Completed 80% of road and 86% of culvert repair or abandonment on private and state-owned forest roads in the Skagit Watershed.	Improving
Riparian Buffers	From 2006 to 2011, there has been no change in the status of the Skagit delta riparian areas. Over 80% of riparian areas in the Skagit delta were cleared of trees or impaired. Over 90% of that impaired area was found in agriculturally zoned lands. From 2006 to 2013, Skagit delta agricultural drainages continued to have the worst overall water quality in the Skagit River watershed.	Declining
Restoration	Through 2015, 6 pocket estuaries have been restored, totaling 33.6 acres. Total smolt production projections show a potential increase of over 48,000 smolts, 33% of Chinook recovery target. The change since the 2012 report reflects the completion of Turner Bay and Dugualla Heights restoration projects. 12% of the 2005 Skagit Chinook Recovery Plan's habitat restoration goal for the estuary has been met. At present, estuary restoration is on track to realize the Recovery Plan's habitat goal in 50 years.	Improving
	About 12% of the 2005 Skagit Chinook Recovery Plan's habitat restoration goals for the estuary have been met. At present, estuary restoration is on track to realize the recovery plan's habitat goal in 50 years. Skagit Intensively Monitored Watershed (IMW) investigators have found decreases in juvenile Chinook densities where restoration has increased habitat capacity.	

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

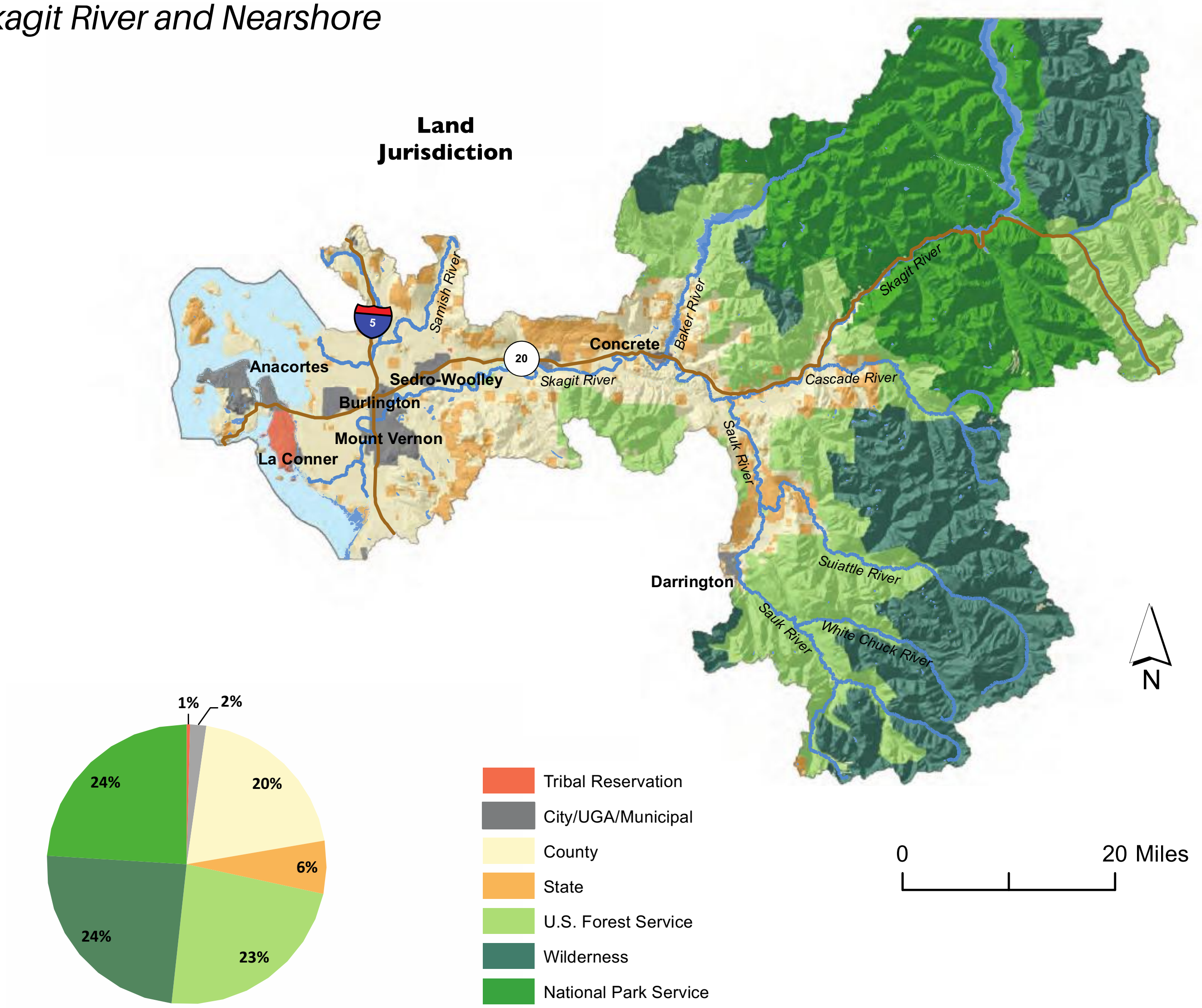
Population growth and associated development within Skagit County will continue to pose challenges to salmon conservation and recovery efforts. Current trends indicate that land-use regulation reform is required and continued funding of habitat restoration activities is necessary in order to achieve the agreed-upon recovery goals.

Restoration and protection work within the Skagit River watershed has not kept pace with the goals of the Recovery Plan. Upgrading 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.

The current state and federal regulatory framework clearly has not provided adequate protection of the instream flow, water quality and riparian habitat within the basin and nearshore areas.

Swinomish Indian Tribal Community

Skagit River and Nearshore



With a 3,100-square-mile watershed, the Skagit River is the largest in the Puget Sound and the third largest on the West Coast of the continental United States. It provides 30% of Puget Sound's freshwater input. The Skagit River originates in British Columbia, and flows south into Washington state before continuing westward through Skagit County and into the sound. The upper half of the watershed is primarily within the National Forest and the North Cascades National Park, and the lower half mainly comprises private forest, agriculture, rural residential and urban residential lands. The Baker River, Sauk River and the Cascade River all flow within the Skagit River watershed.

The Swinomish Indian Tribe lived in the Skagit and Samish River valleys and in the coastal areas surrounding Skagit, Padilla, and Fidalgo Bays since time immemorial. They are Coast Salish people, and their culture has centered around abundant saltwater resources like salmon, shellfish and marine mammals, as well as upland resources, like cedar, berries and wild game. Their homeland remains on Fidalgo Island, where they are surrounded by 27 miles of saltwater shoreline.

Since European settlement, land use in the watershed has been dominated by natural resources. The foothills and mountains have been mainly used for wood products, mining and outdoor recreation. The river valleys, the delta and the coastal areas have been used for agriculture, industry, commerce, and residential development. Population is projected to increase to an estimated 162,000 people by 2040.[1]

The Skagit River is home to all six species of Pacific salmon, including steelhead. It has the healthiest and largest runs of wild Chinook and pink salmon in Puget Sound.[2]

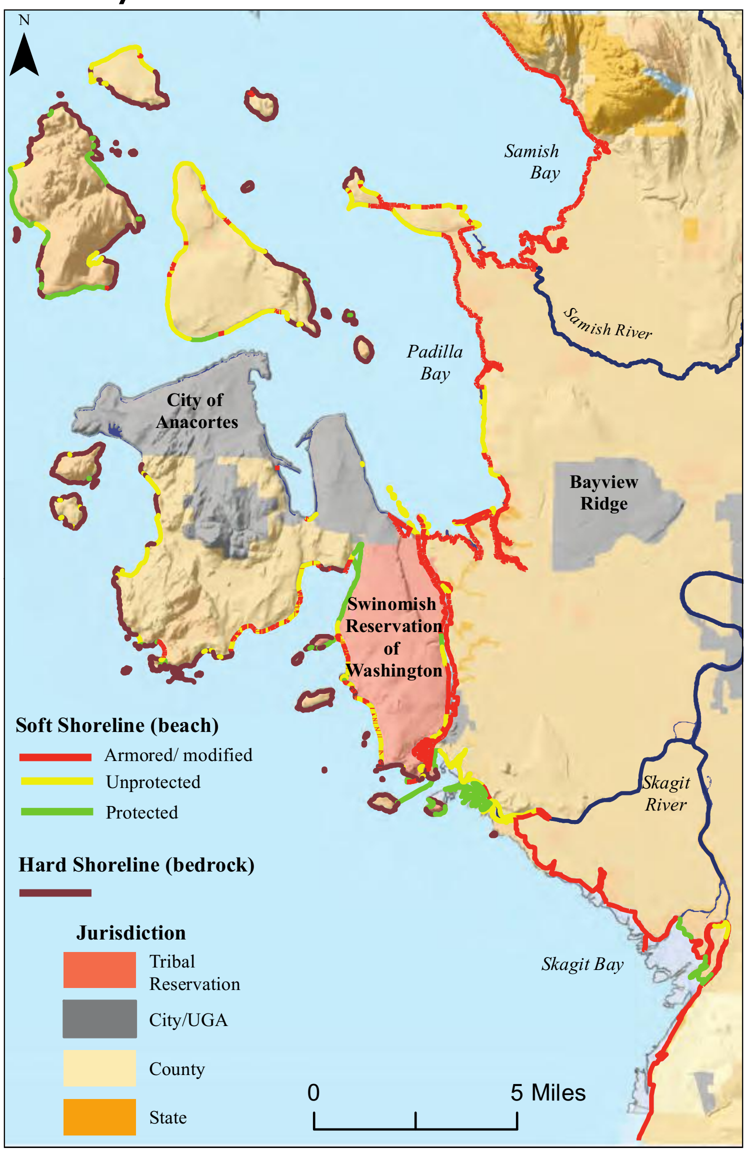
The last 150 years of human land use has resulted in declines in Chinook productivity, yet the Skagit River watershed remains one of the healthiest in Puget Sound. The Skagit Chinook Recovery Plan provides a strategy for both protection and targeted restoration.[3] It will take federal, tribal, state and local leadership to provide a consistent yet adaptive plan to control the future impacts of land use in the watershed.

Data Sources: USFWS 2014,[4] SSHIAP 2004,[5] WADNR 2014a,[6] WADNR 2014b,[7] WADOT 2012,[8] WADOT 2013,[9] WAECY 2011a,[10] WAECY 2013a[11]

Shoreline Management Plan Leaves Shorelines Vulnerable to Future Bulkheads and Levees

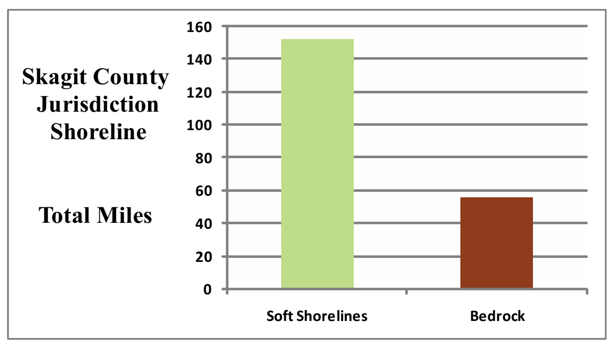
Based on the current Skagit County shoreline management plan, the soft shorelines of the nearshore could be 83% armored under a full build-out scenario. At present, approximately 55% of soft Skagit County shorelines (excluding bedrock areas that have no need for armoring) have bulkheads or levees.[1] In addition to shorelines already armored or modified, current Skagit County zoning would allow 28% of soft shoreline to be bulkheaded under the residential exemption in the Shoreline regulations. This would mean a total of over 83% of all of the soft shoreline in Skagit County's jurisdiction could be armored behind bulkheads and/or levees if the county is fully developed. To add further concern, nearly 1 mile of shoreline has been armored in Skagit County since 2005.[2]

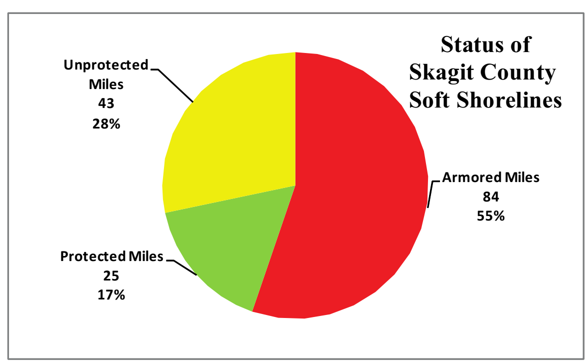
Skagit County jurisdiction of bedrock, soft and artificially hardened marine shoreline



Washington state and Skagit County shoreline codes both allow an exemption from getting a shoreline substantial development permit to build bulkheads that protect single family residences. State law also states that "Local shoreline master programs shall include policies and regulations designed to achieve no net loss...and that exempt development in the aggregate will not cause a net loss of ecological functions of the shoreline."[3] In Skagit County this exemption is allowed for all Skagit shoreline designations except for Aquatic or Natural, (it is prohibited in Aquatic and is conditional in Natural). When considering the exemption for single-family residences and how it is implemented outside Natural designations in Skagit County, a full build-out scenario would make "no net loss" of ecological functions of the shoreline unattainable.[4]

Skagit County zoning designation of armored and unmodified soft shoreline.





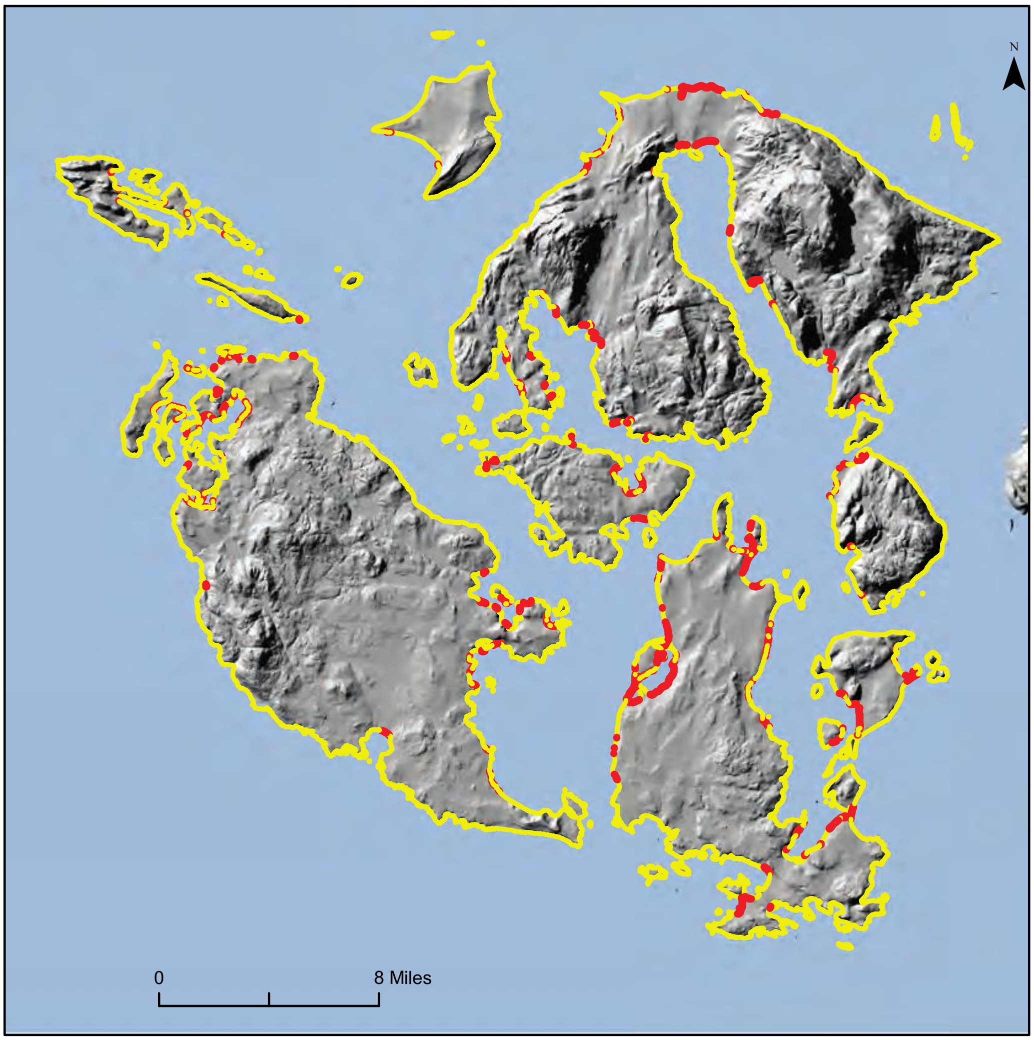
Data Sources: PSNERP 2008,[5] SSHIAP 2004,[6] WADNR 2014a,[7] WADNR 2014b,[8] WADOT 2013,[9] WAECY 2011a,[10] WAECY 2013a[11]

AR053011

Shoreline Armoring Increases Threats to Forage Fish Habitat Critical to Ecology of San Juan County

In the San Juan Islands, over 25 miles of marine shoreline are already either modified or armored.[1] To make matters more critical, between 2005 and 2014, 5,676 feet of new marine shoreline armoring was added in San Juan County, the fifth highest county total in Puget Sound, and 11% of all permitted marine shoreline armoring completed in Puget Sound during that time period.[2] A separate analysis, a 2014 report from Friends of the San Juans that compared San Juan County shoreline armoring permits from 1972 to 1992 with shoreline armoring permits from 1992 to 2009, found that current regulatory protection policies starting in 1993 have not reduced rates or armoring, but that exemptions allowing for new shoreline armoring and repair of existing shoreline armoring have actually increased since 1993.[3]

In the San Juan County Marine Stewardship Area Plan, shoreline modification was identified as a top threat to the county's marine ecosystem.[4] The cumulative impact of human modifications to the shoreline may be far-reaching in terms of both habitat and existing human activities, particularly in the face of anticipated increases in the rate of sea level rise and storm-induced erosion. Forage fish are especially vulnerable to shoreline armoring, as armoring interrupts erosion, distribution and accretion of their spawning sediments.[5] These impacts to forage fish are felt directly by federally listed Puget Sound Chinook salmon that feed on forage fish. Considering the critical ecological role forage fish have in Puget Sound Chinook salmon ecology, no more armoring can be allowed where it might impact their habitat, and every opportunity to remove impactful armoring must be taken.



More than 25 miles of shoreline are armored or modified in San Juan County.[6]

San Juan County Shoreline

Armored or Modified

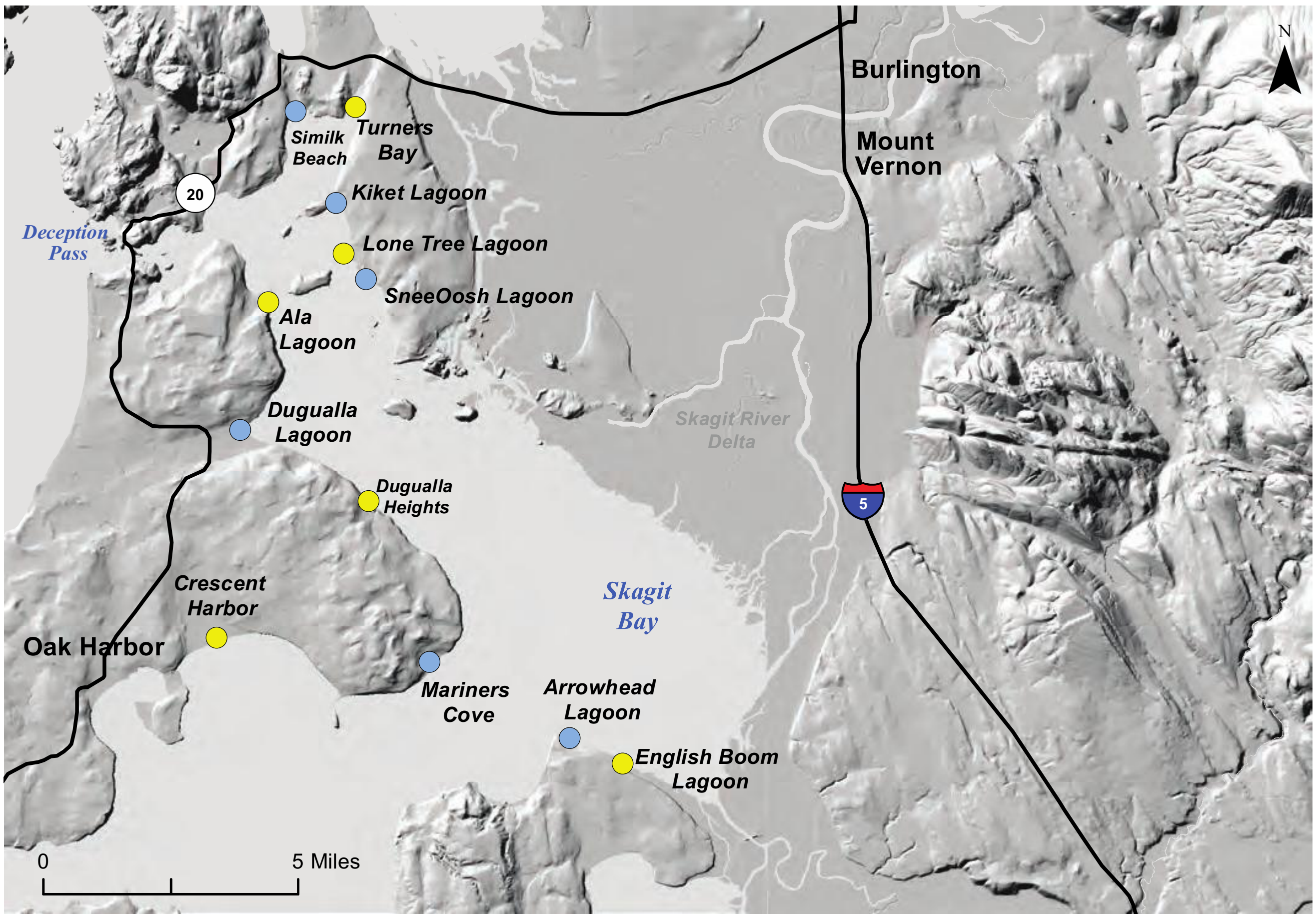
Not Armored or Modified

Data Sources: PSNERP 2008,[7] SSHIAP 2004,[8] WAECY 2013b[9]

Whidbey Basin Pocket Estuaries

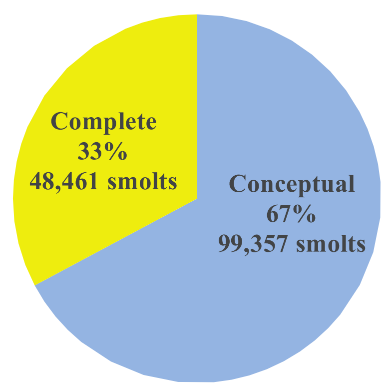
Restoration Underway and Initial Targets Have Been Met

The Skagit Chinook Recovery Plan prioritized the restoration of 12 pocket estuaries totaling 76.8 acres of usable habitat area, all of which is within a day's swimming distance for Skagit River juvenile Chinook. Through 2015, pocket estuary restoration has been completed at six sites totaling 33.6 acres. These restored pocket estuaries are estimated to increase Chinook smolt production by over 48,000 smolts. The change in status since the 2012 State of Our Watersheds Report reflects Turner Bay and Dugualla Heights both going from active restoration projects to completed restoration projects.[1,2]



There are 12 prioritized pocket estuary restoration projects in the Whidbey basin, six of which have been completed and six of which are conceptual.

For the Whidbey basin, modeling and field surveys have led researchers to conclude that over two-thirds of historic pocket estuaries have been completely lost to juvenile salmon use, and the remaining one-third has been reduced in size by approximately 50%. This suggests an approximately 80% net reduction in pocket estuary area. The 12 pocket estuaries within a day's swimming time of the Skagit River delta have experienced an 86% net reduction.[3] Restoration of these sites are expected to result in the production of over 147,000 additional smolts. Over 63% of the increased production, or over 93,000 smolts will come from the completed restoration of the Dugualla Lagoon project.[4]

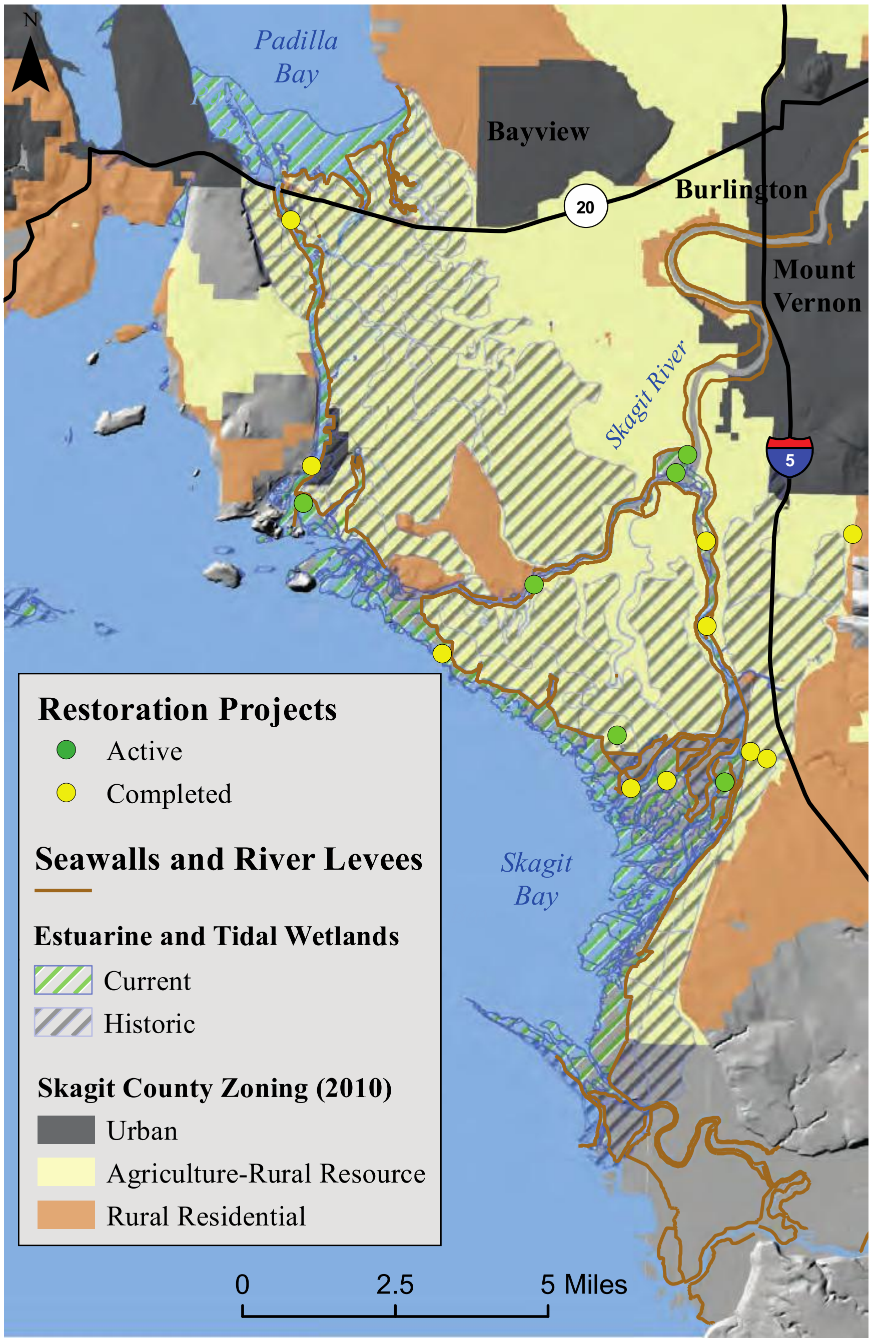


Whidbey basin pocket estuary restoration has resulted in the additional production of an estimated 48,641 Chinook smolts.

Data Sources: HWS 2015,[5] SSHIAP 2004,[6] SRSC & WDFW 2005,[7] SRSC & WDFW 2012,[8] WADOT 2012[9]

Skagit Estuary Restoration on Track to Meet 50-year Chinook Recovery Goals

About 12% of the 2005 Skagit Chinook Recovery Plan's habitat restoration goals for the estuary have been met.[1] At present, estuary restoration is on track to realize the Recovery Plan's habitat goal in 50 years.[2] Skagit Intensively Monitored Watershed (IMW) investigators have found decreases in juvenile Chinook densities where restoration has increased habitat capacity.[3]



Over 70% of historic estuarine and tidal wetlands in the Skagit delta fall on lands that are currently zoned in agriculture,[6,7] a complicating factor for future estuary and tidal wetland restoration opportunites.[8]

Diking, dredging, filling, clearing and developing the Skagit delta over the last 150 years has reduced tidal wetland area from 28,375 acres to 7,705 acres.[4] This has resulted in an estimated 88% loss of juvenile Chinook rearing habitat in the delta, leading to an overpopulation of existing habitat.

Since the 2012 State of the Watershed Report, the Fisher Slough tidal marsh restoration was completed, a series of small marsh sites along the Swinomish Channel were created by the removal of dredge spoils, and tidal inundation at WDFW's Milltown Island in the South Fork was expanded. Additionally, there is progress on three tidal delta projects on WDFW land (Fir Island Farms, Cottonwood Island and Deepwater Slough Phase 2).[5]

Based on current restoration status, the 50-year habitat restoration goal is reachable. However, many of the remaining identified delta restoration projects involve privately owned agricultural land, which will make keeping pace with the 50-year restoration target very difficult.

Washington Recreation and Conservation Office

Skagit River Delta

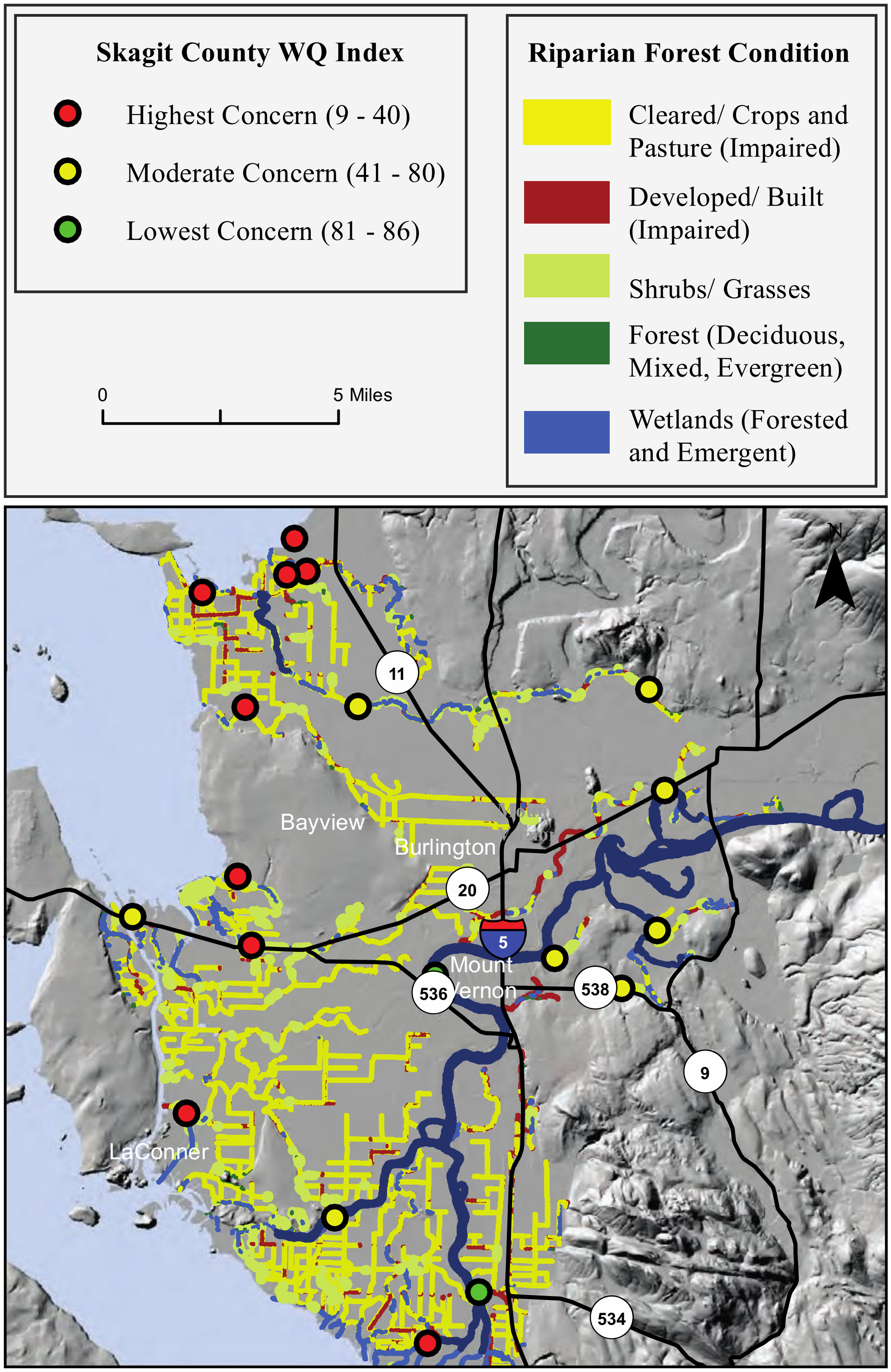
Data sources: Collins & Sheikh 2005,[9] HWS 2015,[10] Skagit Co. 2010,[11] SSHIAP 2004,[12] WAECY 2014a[13]

AR053014

Riparian Forests Remain Impaired on Skagit Delta Agricultural Lands

Prior to 2006, over 80% of riparian areas in the Skagit Delta were cleared of trees or impaired and over 90% of that impaired area was found in agriculturally zoned lands.[1] In 2011, over 80% of riparian areas remained impaired and over 90% of those areas continued to be found on agriculturally zoned land.[2,3] From 2006 to 2013, Skagit delta agricultural drainages continued to have the worst overall water quality in the Skagit River watershed.[4]

Agriculture remains the most productive industry in Skagit County economy. With almost $300 million in production in 2014, reflecting a near $45 million increase in production since 2010, and a near $250 million increase in production since the 1970s.[5] While exemptions from the State Shoreline Management Act, the State Growth Management Act, and the Skagit County Critical Area Ordinance, combined with the Skagit Delta Fish and Tide Gate Initiative, have eased the burden of environmental regulation on agriculture and helped grow the agricultural economy, it has had the opposite effect on the delta's other natural resources. Riparian forest in the delta remains 80% impaired,[6] the delta's water quality is chronically poor,[7] and the delta's habitat preferred by endangered Chinook salmon are around 15% of historic levels.[8] Like agriculture, riparian forests, water quality, and salmon all need protection from the burdens they face, and environmental regulation is meant to provide some of that protection. Environmental regulation/protection should only be eased if evidence suggests it is not needed to protect forests, water and salmon. As it stands now, a more balanced approach towards regulating agricultural practices to provide more protection for the other resources in the delta still seems warranted.



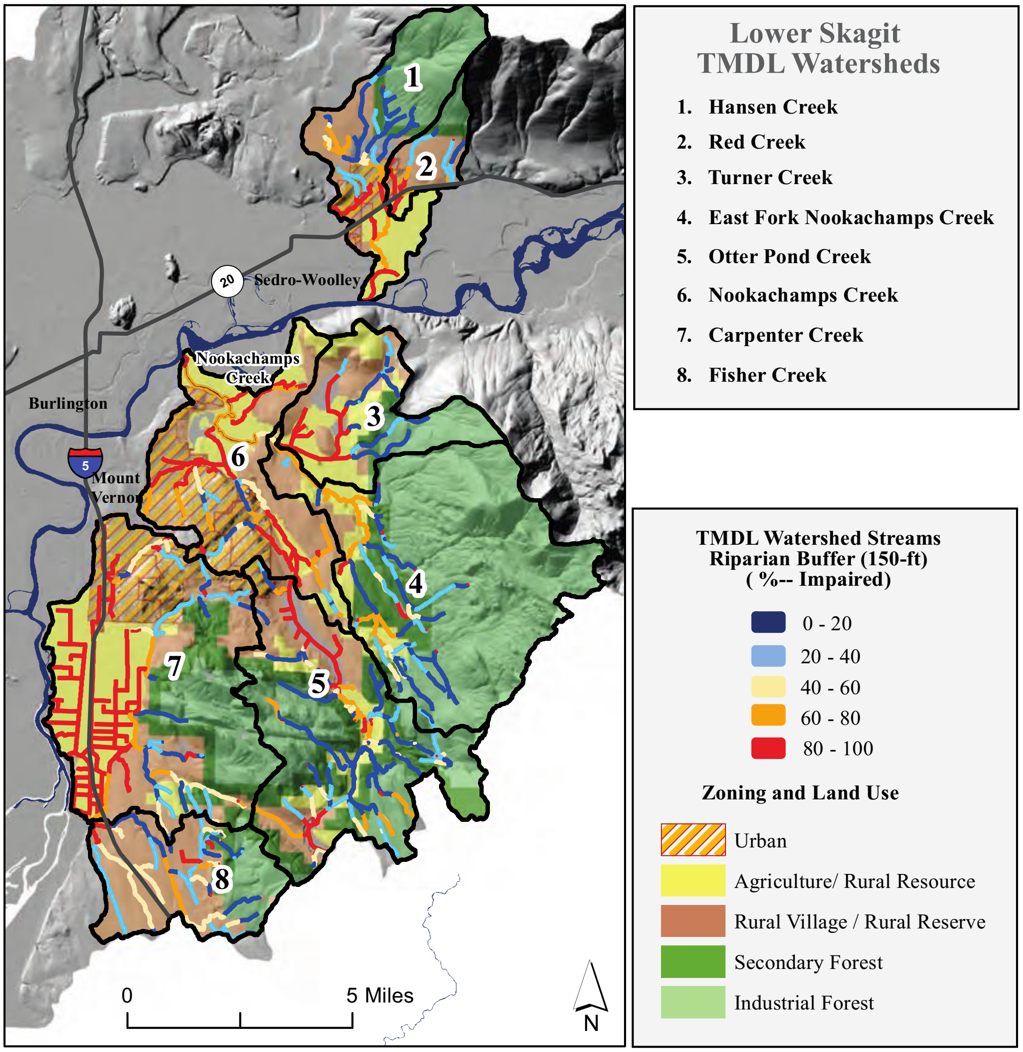
Data Sources: Skagit Co. 2006-2013,[9] SSHIAP 2004,[10] SSHIAP 2010,[11] WADOT 2012,[12] WAECY 2011b[13]

Lower Skagit Watersheds Not Meeting Stream Temperature TMDL Recommendations

In 2011, over 51% of riparian acreage along fish-bearing streams within the 2008 Lower Skagit Temperature TMDL watersheds was non-forested and impaired.[1,2] When compared to 2006 NOAA-CCAP forest cover dataset, riparian forests within the TMDL watersheds were more impaired and less forested.[3] This suggests that the lower Skagit is failing to meet the primary management recommendation of the temperature TMDL: riparian reforestation.

High stream temperatures impact Chinook salmon at all life stages, especially during juvenile rearing.[4] The Lower Skagit Temperature TMDL remains in place for eight tributaries in the lower Skagit watershed as they are out of state compliance with Washington state water quality standards. The Lower Skagit TMDL recommends restoration of riparian tree shading of streams as the primary mechanism for lowering stream temperatures into compliance.

The state's TMDL plan for reducing stream temperature is voluntary and includes a combination of financial incentives, outreach and technical training, and communication.[5] It is expected that with these measures in place, streams will be in temperature compliance by 2080.[6] The present trend suggests that streams will not be compliance by 2080.



Land-use practices in the Lower Skagit Temperature TMDL watersheds continue to impair riparian condition.

Zoning Category	Riparian Acres (150ft-buffer)	2006 Impaired Riparian Acres (Non-forested in 150-ft buffer)	2011 Impaired Riparian Acres (Non-forested in 150-ft buffer)	Riparian Buffer Percent Impaired (Non-forested)	Riparian Impairment Trend 2006-2011
Urban	881	564	571	65%	More Impaired
Agriculture/ Rural Resource	2,555	1,928	1,946	76%	More Impaired
Rural Residential	1,944	848	850	44%	More Impaired
Secondary Forest	1,028	210	219	21%	More Impaired
Industrial Forest	847	127	127	15%	No Change

In the lower Skagit TMDL watersheds, riparian forests continued to become more impaired between 2006 and 2011.

Data Sources: Skagit Co. 2010,[7] SSHIAP 2004,[8] WAECY 2011a,[9] WAECY 2011b,[10] WAECY 2014a[11]

Skagit Basin Closed to Permit-Exempt Well Development

Since October 2013, Skagit County has not issued building permits that rely on permit-exempt wells as their sole water source, unless adequately mitigated for. This has resulted in no new unmitigated exempt well development in Skagit County since that date. There have been between 30 and 40 replacement wells allowed in the basin since that time.

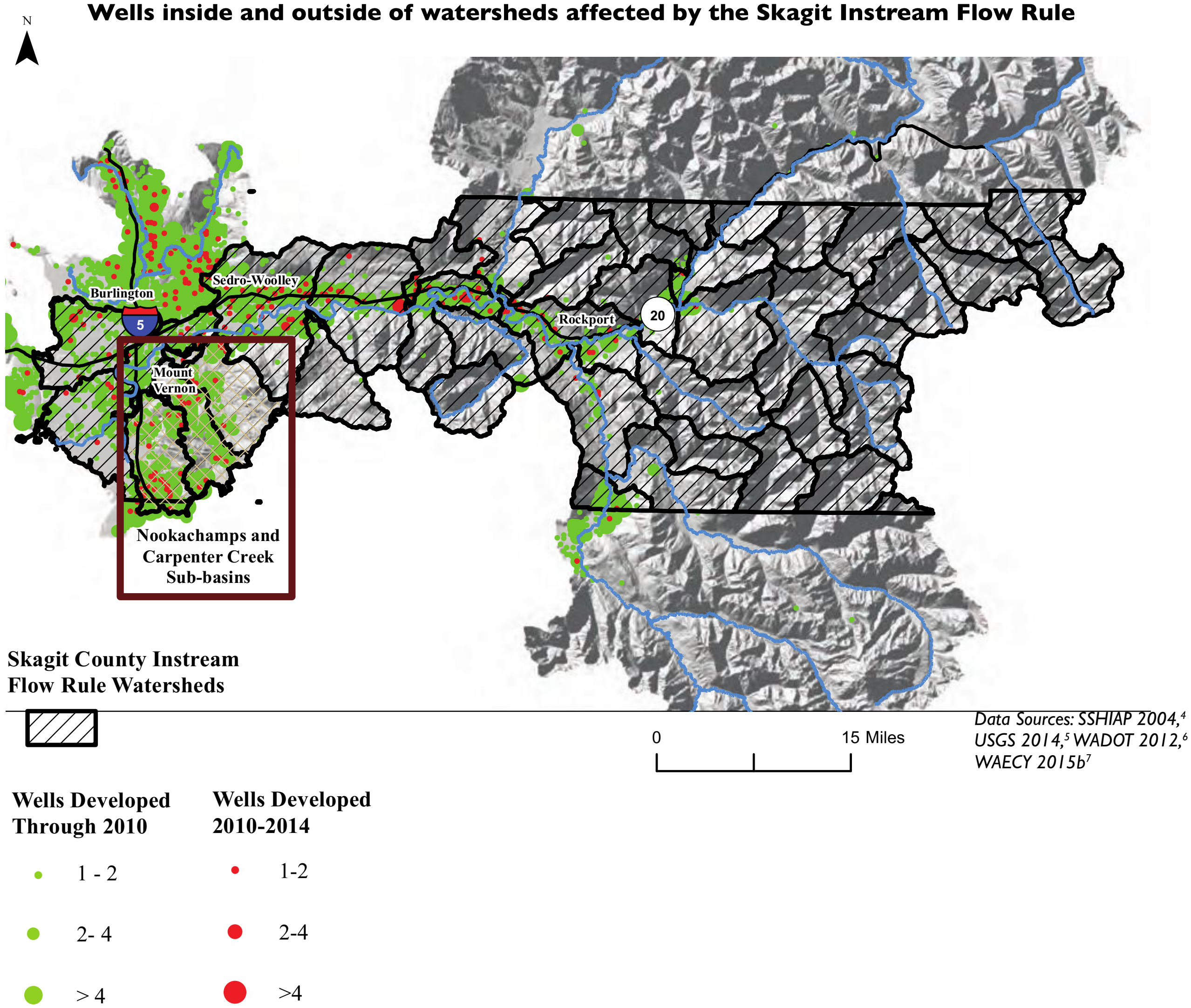
On October 3, 2013, the Washington Supreme Court overturned the 2006 Skagit Instream Flow Rule amendment that provided uninterruptible water supplies through a regulatory tool called water reservations, in its decision in *Swinomish Indian Tribal Community v. Department of Ecology*. The 2006 water reservations provided uninterruptible water supply for well users that started using water after the original rule was adopted in 2001. Ecology estimates that 475 homes and 8 businesses started using water between April 14, 2001 and October 3, 2013.[1]

The Swinomish Tribe has agreed not to challenge Ecology's decision not to interrupt water supply for those home and business owners, and has pledged to find sources of mitigation water for those users that rely on reservation water.[2] To date, no mitigation has been provided. This ruling applies to all sub-basins within the Skagit Instream Flow Rule, including the Nookachamps Creek and Carpenter Creek sub-basins.

Looking from the perspective of Skagit Chinook recovery, low flows in the Skagit River system continue to be a potential threat. However, the establishment of a legal restriction on permit-exempt well development in basins where streamflow reduction is having a direct impact on seasonal low flow is a significant step toward managing the factors of streamflow reduction that are within our control.

Since October 2013, all building permit applicants within the Skagit watershed instream flow rule area have been required to obtain Ecology's approval of proposed water use prior to submitting a permit or subdivision application to Skagit County.[3]

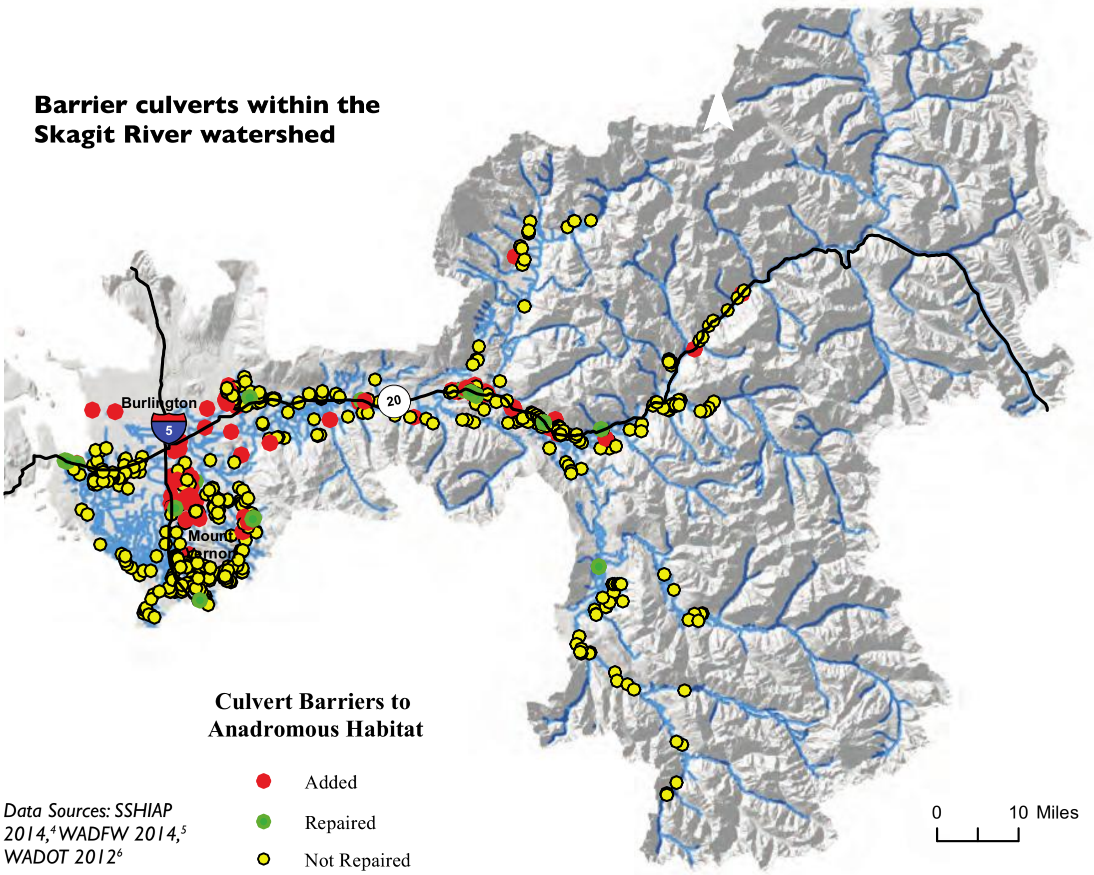
Wells inside and outside of watersheds affected by the Skagit Instream Flow Rule



AR053017

More Anadromous Barrier Culverts Identified in the Skagit Watershed Since 2010

In the Skagit River watershed between 2010 and 2014, an additional 107 barrier culverts were identified and only 24 barrier culverts were repaired. The net gain of 83 barrier culverts clearly indicates that we have yet to turn the corner on getting this issue addressed.



Data Sources: SSHIAP 2014,[4] WADFW 2014,[5] WADOT 2012[6]

Through 2010, there were 497 culverts at least partially blocking anadromous migration in the Skagit River watershed, and through 2014 this number had increased to 580 culverts. The Skagit River Recovery Plan recommends governments be held accountable for repairing culverts under their jurisdiction. Currently in the Skagit watershed 52% of all barrier culverts are under government jurisdiction.[1] For culvert repair to be meaningful to the recovery of Chinook salmon, governments need to commit to an accelerated schedule of culvert repair.

Barrier Culverts on Anadromous Streams in the Skagit River Watershed

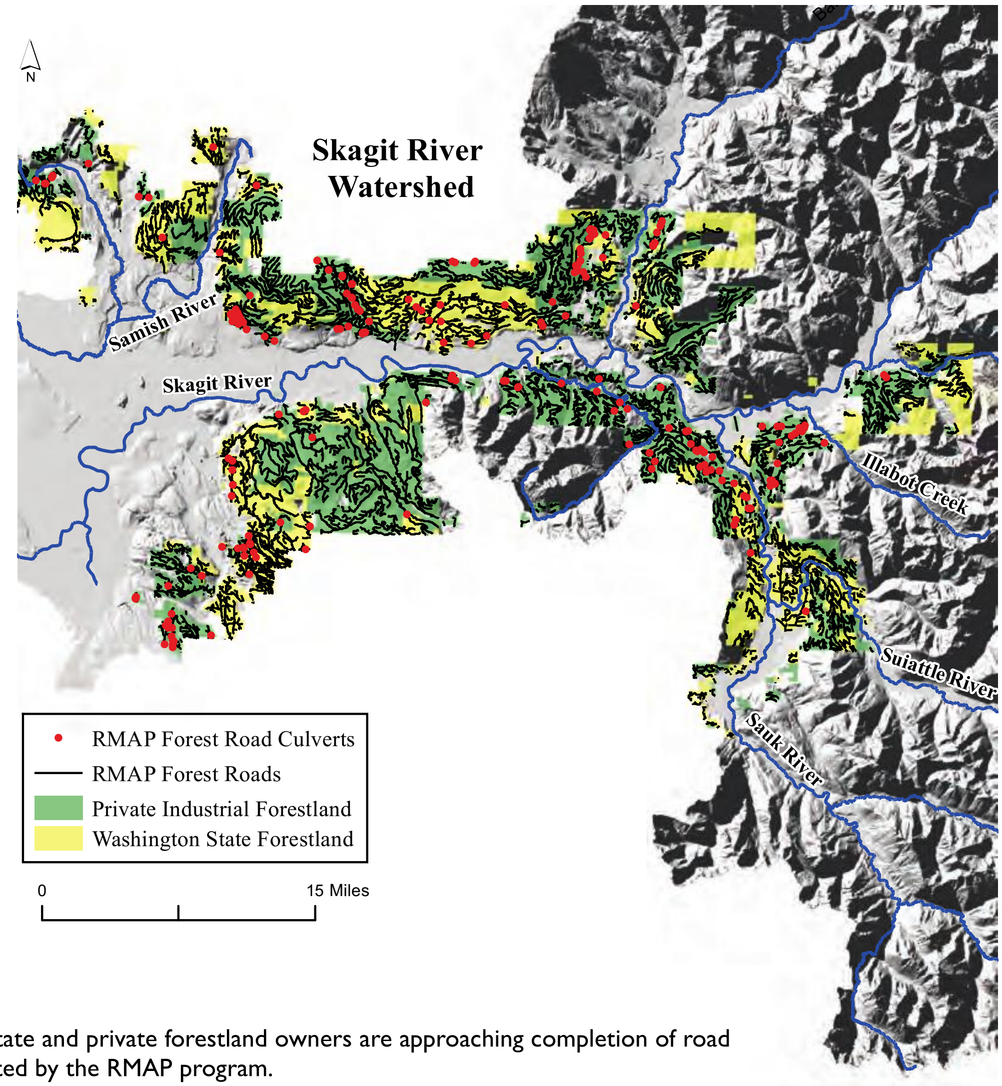
Owner	*Total Barrier Culverts in 2014*	*Barriers Surveyed Through 2010*	*Barrier culverts surveyed between 2010 and 2014*	*Barrier culverts repaired between 2010 and 2014*	*Change in Culvert Barriers (2010 - 2014)*	*Percent Change (2010 - 2014)*
City	28	6	25	3	**22**	**367%**
County	162	153	15	6	**9**	**6%**
Drainage District	3	3	0	0	**0**	**0%**
Federal	28	26	2	0	**2**	**8%**
Other	1	1	0	0	**0**	**0%**
Port	1	1	0	0	**0**	**0%**
Private	261	216	53	8	**45**	**21%**
State	78	74	11	7	**4**	**5%**
Tribal	0	0	0	0	**0**	**0%**
Unknown	18	17	1	0	**1**	**6%**
Total	**580**	**497**	**107**	**24**	**83**	**17%**

As of 2014, an estimated 580 culverts remained barriers in the Skagit River watershed.[2]

RMAPs Almost Complete in Skagit and Samish Watershed

The Washington State Forest Road Maintenance and Abandonment Plan (RMAP) has led to the repair or abandonment of 80% (1,331 miles out of 1,662 total miles) of private and state-owned forest roads in the Skagit River watershed.[1] Within the Sauk, Suiattle and Cascade watersheds of the Skagit, an estimated 69% (around 90 of 130 miles) of road have been either abandoned or repaired. RMAP has also resulted in the repair or removal of 179 of 209 culverts on private and state-owned forest roads within the Skagit, and 38 of 44 culverts within the Sauk, Suiattle, and Cascade watersheds. The majority of all remaining work is scheduled to be completed by 2021, as both Weyerhaeuser Corp. and Sierra Pacific are seeking a 2021 extension. Together they have over 300 miles of forest road that still needs to be brought up to RMAP standards or abandoned.

No alteration of the human landscape has a greater and more far-reaching effect on aquatic habitat than roads.[2] Over 1,600 miles of forest roads in the Skagit basin are on private industrial and state lands and fall under the RMAP mandate. It is expected that RMAP road repairs and abandonment will improve water quality in the upper Skagit and Samish River watersheds. Considering the role improved water quality plays in Chinook habitat, 80% of RMAP roads brought up to standard or abandoned is good news to salmon recovery in the Skagit and Samish river watersheds.



Data Sources: Mostovetsky 2015,[3] Skagit Co. 2010,[4] SSHIAP 2004,[5] WADNR 2014a,[6] WADNR 2014c,[7] WAECY 2011a[8]

RMAP only applies to state and private forestland jurisdictions.

RMAP status shows that both the state and private forestland owners are approaching completion of road repairs and abandonment as mandated by the RMAP program.

2015 Samish and Skagit River watershed Road Maintenance and Abandonment Status (RMAP) from Annual Reports

Jurisdiction	*Total Miles of Forest Road*	*Completed Miles*	*Miles Remaining*	*Percent Complete*	*Planned Date for RMAP Completion*
State Lands	574	543	31	95%	10/31/2016
Private Industrial Lands	1088	788	300	72%	10/31/2021

Jurisdiction	*Total Number of Culverts*	*Repaired*	*Remaining to be Repaired*	*Percent Repaired*
State Lands	35	30	5	86%
Private Industrial Lands	174	149	25	86%

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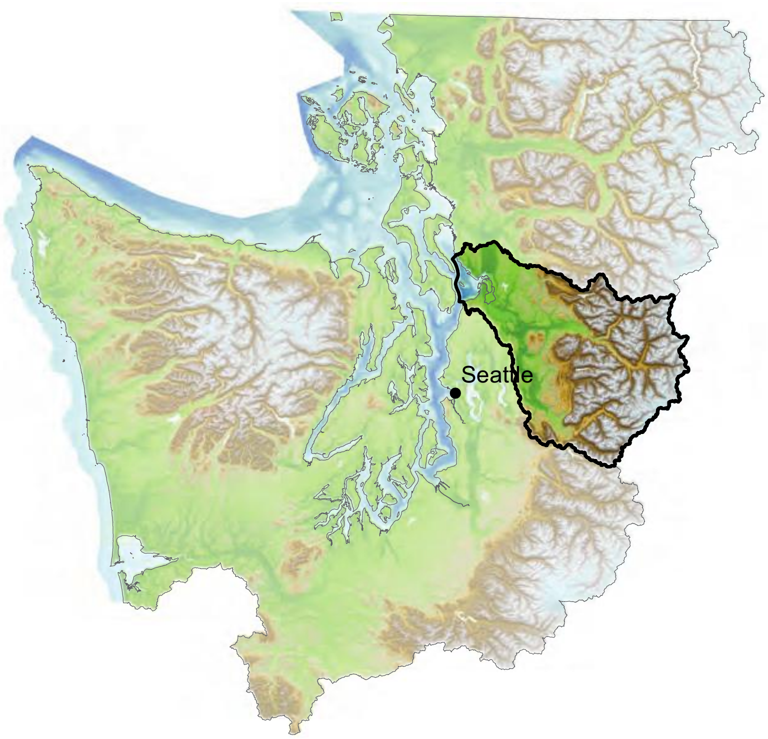
2016 State of Our Watersheds Report
Snohomish River Basin

Salmon was always the only livelihood of our people. That's all the tribes ever lived on. Tribes have been protecting the salmon and shellfish for thousands of years. That's all we want to do – continue to protect and enhance our natural resources. That's how all of the tribes feel, and we're doing our share to bring these resources back. We just have to keep working at it and get everybody to protect the salmon.

– Stan Jones
Tulalip Tribes



Tulalip Tribes

The Tulalip Tribes are successors in interest to the Snohomish, Snoqualmie, Skykomish, and other bands of Indians. The Tulalip Reservation is at the mouth of the Snohomish River north of Everett, but historically, these tribes inhabited the drainages of the rivers that now bear their names, as well as parts of Whidbey and Camano islands and the mainland shore from north of Seattle to the mouth of the Stillaguamish River. At the time of European settlement, members of these tribes traveled throughout Puget Sound and north to the Fraser River and beyond to pursue fishing and trading opportunities. The 1855 Treaty of Point Elliott preserved tribes' right to fish, hunt and gather in their traditional areas. The federal government is obligated to protect those treaty-reserved resources. Today the adjudicated Usual and Accustomed fishing area of the Tulalip Tribes extends 120 miles from the Canadian border south to the north end of Vashon Island. This report will focus on the Snohomish River basin and surrounding marine waters, which is only a portion of the area the Tulalip Tribes work in and manage.

Degradation of the Snohomish River Basin

Kari Neumeyer, NWIFC

A crew works to remove dikes that will restore tidal flow to the Qwuloolt Estuary, which was diked and drained 100 years ago to create farmland, cutting off fish access to valuable salt marsh habitat.

The last 150 years of human expansion and development has depleted natural resources and left degraded the natural ecology of the Snohomish River basin. Over 30% of the feeder bluffs and accretion shoreline beaches along Whidbey basin nearshore are already armored and directly impacting forage fish that are key to juvenile Chinook survival.[1,2] Nearly every feeder bluff along the Snohomish nearshore south from Everett to Mukilteo has been cut off from the shoreline, impounded to protect the Burlington Northern Santa Fe Railroad. The estuary has had 80-85% of its historic wetland habitat cleared and drained, resulting in the potential juvenile Chinook losses of between 1 and 1.6 million per year.[3] Dikes, flow control devices, and agriculture development have decreased the area of side-channel sloughs accessible to juvenile salmonids by 55% since 1884.[4] Around 50% of nearly 1,600 surveyed culverts are combining to block and reduce accessibility of approximately 320 miles of anadromous stream habitat in the basin.[5] Impervious surface area in the basin continues to degrade stream health through spreading residential development and urban sprawl into neighboring rural areas. Riparian forest cover, essential to fish habitat for shade, nutrients and structure, decreased to 49% in 2011 and is now 16% below the desired condition of 65% forested 150-foot riparian buffer on either side of all fish habitat streams.[6] Wells continue to be drilled, even in basins where water withdrawal has not been permitted in over 60 years.[7]

Ineffective Regulatory Framework Limiting Salmon Recovery in the Snohomish Basin

The Snohomish Basin Salmon Conservation Plan adopted five principles to guide recovery planning efforts:

- Emphasize protection and reconnection of habitat;
- Use historical information to guide today's decisions;
- Preserve and restore the natural ecosystem processes;
- Use monitoring and assessment to guide adaptive management; and
- Preserve options for the future.[8]

During the development of this plan, the Snohomish Basin Salmon Recovery Forum used computer modeling of habitat/fish relationships to identify a suite of habitat improvement projects for the Snohomish watershed to be implemented within 10 years. Increased rearing habitat quality and quantity in estuary and mainstem areas was the highest priority for salmon recovery projects, as this was where the modeling showed the greatest opportunity for improvement.

One key assumption of this recovery plan was that restoration of lost habitat in the nearshore, estuary and mainstem areas will not, by itself, produce viable anadromous populations in the long term. The recovery strategy depends critically on a functional regulatory framework – through the Growth Management, Shoreline Management and Forest Practices acts, for example – that minimizes habitat loss while making an overall net gain in habitat through protection and restoration.

Another key assumption was that land-use regulations would be updated to follow the guidance of the salmon recovery plan. As of December 2010, Island and Snohomish counties' Shoreline Master Programs governing land-use activities and habitat protection in the nearshore, estuary and river system had yet to be updated.

Snohomish County updated their Shoreline Master Plan in 2012 and Critical Area Regulations in 2015. Effectiveness of these changes are unknown at this time and will depend on how they are interpreted and implemented by the county.

The state's "no net loss" goal does not result in habitat conditions that lead to recovery, because the benchmark is being established in a watershed that already is in a degraded state, not capable of producing properly functioning conditions from an ecological standpoint.

The State of Our Watersheds Report provides context to the problem that our regulatory framework is not working despite the many existing programs and regulations intended to protect salmon habitat and watershed processes. Regulations across all levels of government, including federal, state, and local, do not meet minimum standards and lack measurable goals. In addition, regulations do not contain consistent language and messaging, and are implemented and enforced differently by individual agencies and local governments in the basin. Consistent policy, harmonized regulations, and programmatic actions based on measurable standards are necessary to protect hydrology and habitat to help achieve the 50-year salmon recovery goals in the Snohomish River basin.

All levels of government need to jointly address regulatory gaps and inconsistencies, and to agree on measurable goals that allow us to monitor gains and losses in habitat condition. We propose convening a Joint Conference for all levels of government to come together to address the barriers and opportunities to regulatory harmonization for salmon and ecosystem recovery.

Restoration Makes Progress, But Not Enough

Habitat recovery milestones were identified for the estuary, nearshore, mainstems and lowland tributaries:

- 1 mile of restored shoreline;
- 1,237 acres of tidal marsh habitat;
- 10.4 miles of restored river edge habitat;
- 256 acres of riparian habitat;
- 41 logjams; and
- 167 acres of off-channel habitat.[9]

Since the recovery plan (Snohomish Basin Salmon Conservation Plan) was adopted in 2005, habitat restoration work has made progress, but the work is not being implemented fast enough to meet the 10-year benchmarks.

The Snohomish basin 3-year workplan for 2014 (the last time implementation metrics were updated in the Snohomish basin) reports that restoration and mitigation projects have completed:

- 0.39 mile of restored shoreline;
- 860.6 acres of estuarine tidal marsh;
- 2.9 miles of restored river edge habitat;
- 240 acres of riparian habitat;
- 6 logjams installed; and
- 43.27 acres of off-channel habitat.

These numbers reflect only what has been reported in the habitat work schedule and likely does not capture all activities to date. Implementation monitoring also does not account for the effectiveness of restoration, and the quality of the restored habitat has not been evaluated.

Coordinating Harvest, Hatcheries, and Habitat

This 10-year restoration plan was just a start. All parties recognized that this work would be effective only in combination with recovery action across all H's: Harvest, Hatcheries and Habitat protection.

The habitat activities specified in the plan complement harvest and hatchery management. Over the past two decades, harvest exploitation rates on Snohomish basin Chinook salmon have been greatly reduced from more than 60% to approximately 20%.

Achieving this has required managers to reduce and restrict fisheries from southeast Alaska to the Washington coast. The Tulalip Tribes have closed nearly all of their large Usual and Accustomed fishing areas to Chinook salmon, opening only a small area in Tulalip Bay to target fish produced at the Bernie Kai-Kai Gobin Hatchery.

Working with their state co-managers, Tulalip also has implemented a number of innovative recommendations for changing hatchery practices to greatly reduce the potential harmful effects of hatchery fish on the productivity of naturally produced Chinook salmon.

Harvest and hatcheries are being managed in ways that will allow Snohomish Chinook salmon to recover, assuming appropriate habitat restoration and protection measures are taken.

Review of habitat recovery progress and trends at the 10-year mark of the Snohomish River Basin Conservation/Recovery Plan is difficult to evaluate given available information. However, preliminary results from satellite based land-use land cover data indicate that roughly 383 acres of forest cover have been lost within 150 feet of a waterbody.[10] These results are corroborated by similar results from the Washington Department of Fish and Wildlife high resolution change analysis data which shows a loss of 343 acres of forest cover within the same area.[11] When compared with the roughly 240 acres of riparian habitat that have been restored, the result is a net loss of riparian habitat since 2006. Stressing the need for more riparian habitat restoration coupled with stricter management of already forested riparian areas.

The Tulalip Tribes expect that this pattern is widespread and we are continuing to lose many types of habitat throughout the basin, despite our recovery efforts.

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

At the 10-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Snohomish basin shows an improvement in restoration efforts, but degradation in water quantity, marine shoreline habitat conditions, and floodplain and 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.

Kari Neumeyer, NWIFC

After the levee was breached, restoring tidal flow to the Qwuloolt Estuary, Tulalip natural resources staff beach seine for fish using the new habitat.

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Review of the trend for these key environmental indicators since the 2012 State of Our Watersheds Report shows improvement for some indicators and a steady loss for others in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Shoreline Modifications / Forage Fish	The Snohomish Salmon Recovery Plan set the 10-year target for 1 mile of restoration along the Snohomish marine nearshore. As of the 2013 three-year workplan, only 0.2 miles of restoration had occurred. Since 2005, the counties of the Whidbey basin (Island, Skagit and Snohomish) have combined for a net increase of 2.1 miles of marine shoreline armoring, which represents 30% of total net increase in marine shoreline armoring for Puget Sound over the same time period. There are 160 miles of erosional drift cells in the Whidbey basin. 67 of 69 miles (98%) of documented forage fish spawning occurs on erosional drift cells, so we assume that the other 93 miles of erosional drift cells are potential forage fish habitat. About 31% of all erosional drift cells have already been armored or modified.	**Declining**
Floodplain	Since the 2012 SOW Report, there has been no change in the status of French Creek and Marshland watershed barriers. The removal of the French Creek pump station would open access to at least 50 miles and upwards of 115 miles of floodplain side-channel and tributary habitat, and potential access to floodplain wetlands for anadromous fish. 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.	**Declining**
Riparian Buffers	The Snohomish River Basin Salmon Conservation Plan recommends at least 65% forested 150-foot riparian buffer on either side of all fish habitat streams. Riparian forest cover was only 49% in 2011, a 1% decrease from 50% in 2006.	**Declining**
Stream Blockages - Culverts	Over 50% of nearly 1,600 inventoried culverts are blocking or impeding fish from accessing upstream habitat. More than 320 miles of anadromous fish habitat is currently upstream of blocking or impeding culverts. Since 2010, the number of inventoried culverts, the percentage of blocking or impeding culverts, and the miles of blocked anadromous habitat have all increased.	**Declining**
Water Wells	An estimated 3,000 wells or 25% of all of the water wells within the Snohomish River basin fall inside of seven tributary watersheds that have been closed to new water rights and permitted withdrawal since the 1950s. This trend has continued, as 98 (33%) of the 298 wells developed since 2010 were completed within those seven closed watersheds.	**Declining**
Forestland Cover	In 2011, with the exception of the Tulalip Indian Reservation, the forest conditions in lowland watershed areas adjacent to the lower Snohomish mainstem and estuary were either in poor or severely damaged condition. From 2006 to 2011, forest cover was either decreasing or staying the same in the Snohomish River watershed. There was no sign of an increasing forest cover in the Snohomish River basin during this period.	**Declining**
Land Conversion	From 2007 to 2015, approximately 3,167 acres were converted out of forest practices and into non-forestry uses in the Snohomish watershed. This is in addition to the over 3,130 acres converted between 1996 and 2006, bringing the total land converted out of forest practices to nearly 6,300 acres in 20 years.	**Declining**
Impervious Surface	From an assessment of 2006 data, the lower Snohomish watershed was found to have 11% impervious surface, conditions that lead to poor water quality conditions. Assessment of 2011 data indicated impervious area continues to increase. In 2011, every Urban Stream watershed identified in the Snohomish River Salmon Conservation plan was degraded, based on impervious surface levels greater than 12%. Additionally, between 2006 and 2011, increases in impervious surface continued to spread from Urban Stream watersheds into the Mainstem and Rural Stream watersheds to the east.	**Declining**
Restoration	The Snohomish River Basin Salmon Conservation Plan has a 10-year goal to restore 1,237 acres of tidal marsh and blind channel habitat by 2015. Projects and planned work, including the 400-acre Spencer Island Project completed in 2009, the Tulalip Tribe's approximately 350-acre Qwuloot Restoration Project completed in August of 2015, and the 326-acre Smith Island project to be completed in spring 2017, the Snohomish estuary is well on its way to meeting the 10-year restoration targets set in the Snohomish River Salmon Recovery Plan.	**Improving**

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 occupy.

Looking Ahead

Kari Neumeyer, NWIFC

Tulalip tribal youth drum during the First Salmon Ceremony.

For over a decade since Chinook salmon were listed in Puget Sound, harvest and hatchery impacts on Snohomish River Chinook salmon have been greatly reduced, at 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. Beach nourishment projects are scheduled between Mukilteo and Everett to provide much-needed sediment that historically came from the adjacent feeder bluffs now impounded by the railroad.[12] The estuary is on track to have restored over 1,000 acres of the Salmon Recovery Plan's 10-year goal of 1,237 acres of tidally influenced habitat.[13] Assessments are underway to determine the feasibility of restoring fish passage and flow into the historically productive Marshland and French Creek areas of the Snohomish River floodplain. As well, riparian forest restoration continues to move forward towards the 10-year goals of the Salmon Recovery Plan.

Yet with these much-needed gains through restoration, recent trends and this document demonstrate that net loss and degradation of key habitats continues. Unless appropriate habitat protection measures are taken immediately such that we start to see a net gain in habitat, our salmon recovery goals will never be reached, and all other recovery actions will have been in vain.

Despite the degradation it has suffered, the Snohomish watershed retains the potential to once again be a strong salmon producer that will provide our people with the benefits they retained when they gave up so much else in the Treaty of Point Elliott. It is the Tribes' position that the reduction in habitat loss and the restoration of degraded and disconnected habitat are the greatest need and are 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 to turn us toward the goal of recovered salmon once again being the icon of the Pacific Northwest. But this will not happen without a meaningful commitment to protection of the habitats necessary to sustain them.

The Tulalip Tribes have a reputation in the Snohomish basin as a leading force, committed to full ecosystem recovery through collaboration with watershed partners.

The Tribes will continue to push for solutions as we are a permanent fixture in the basin. We believe that 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 about 354 acres of estuary that was diked and thought to be lost, and improved salmon accessibility to 16 miles of stream habitat. We believe strongly in the resilience of the system. If areas are reopened and the largely intact watershed processes are able to do their work, the basin will be even more productive for salmon. This restoration, along with the increased protection of at-risk areas, will ensure that Tulalip Tribes will be able to continue the practices that we as a people have been dependent on since salmon arrived in Puget Sound.

The Tulalip Tribes are continuing to work with partners on projects in the Snohomish Estuary, French Creek and Pilchuck River. As well, Tulalip remains fully engaged in the protection of watershed processes like river and streamflow, water quality, and management of the forest landscape.

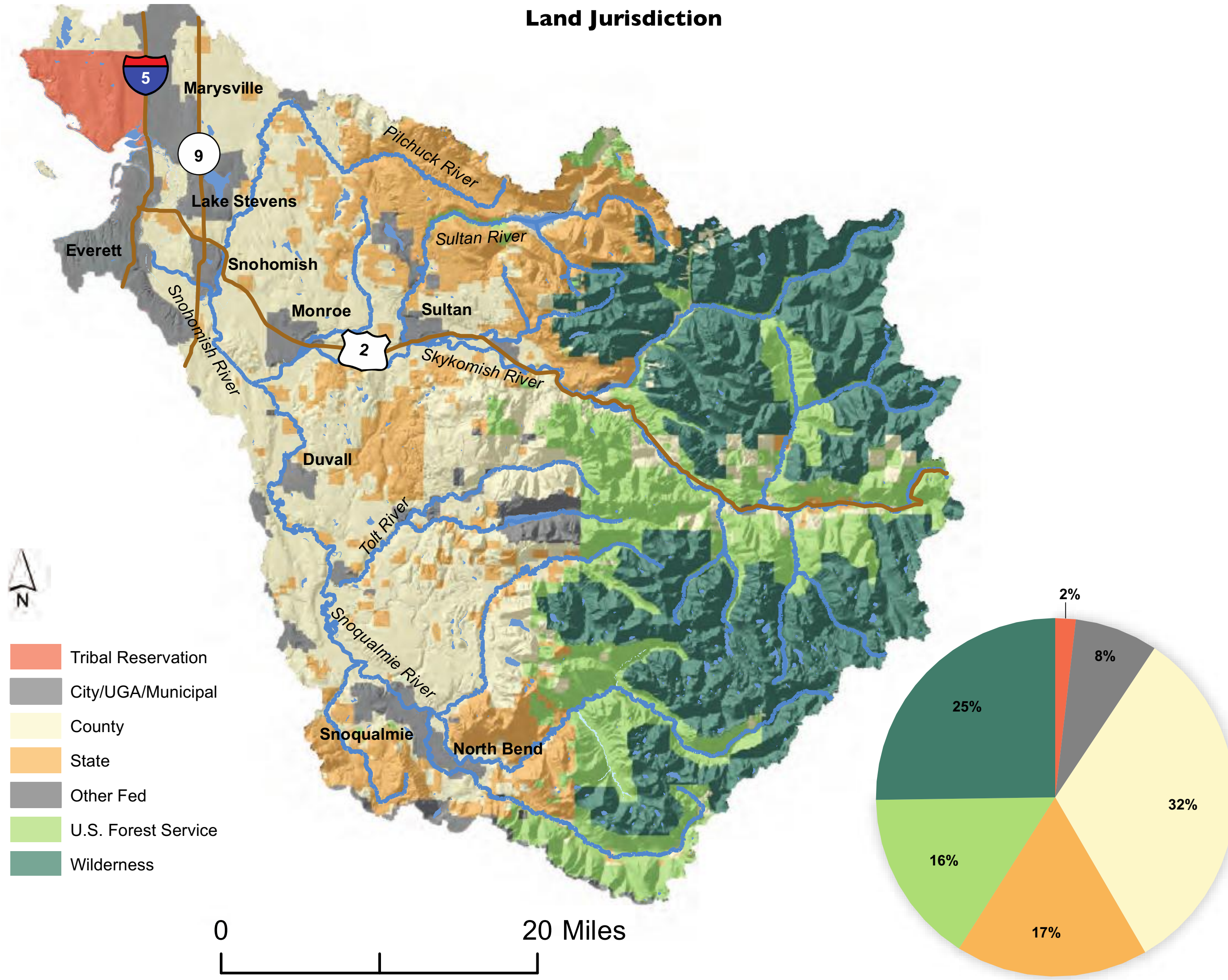
In addition to habitat restoration and the protection of watershed processes, priorities for the next five years include:

- Continuing research of nearshore and Puget Sound conditions as they relate to salmon resources.
- Continuing and improving monitoring to determine trends, and what is working and what is not.
- Shifting the recovery efforts to provide multi-species benefits, addressing other threatened species, such as steelhead.
- A complete accounting for the impacts of climate change on all protection and restoration efforts.
- A Joint Conference for all levels of government to come together to address the barriers and opportunities to regulatory harmonization for salmon and ecosystem recovery.

Salmon recovery goals will be considered successful if the partners reach the prescribed targets and monitor abundance and productivity to determine their impact.

Tulalip Tribes

Snohomish River Basin



At 1,856 square miles, the Snohomish River has 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 on to the flat low-elevation Puget Sound trough.[1]

The Snohomish River basin is within the ancestral home of a number of tribes and bands that later formed the Tulalip Tribes. The present day reservation lands of the Tulalip Tribes are located along the nearshore of the basin just north of Everett, Washington. 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 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, and pink salmon, and steelhead 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 approximately 230,000 to over 380,000.[4] Over 85% of the current population lives in urban and rural residential areas. Population is expected to grow at a 59% rate over the next 30 years.[5] 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 a greater commitment to actively restoring, as well as conserving and protecting resources into the future.

Data Sources: SSHIAP 2004,[6] USFWS 2014,[7] WADNR 2014a,[8] WADNR 2014b,[9] WADOT 2012,[10] WADOT 2013,[11] WAECY 1994,[12] WAECY 2011a,[13] WAECY 2013b[14]

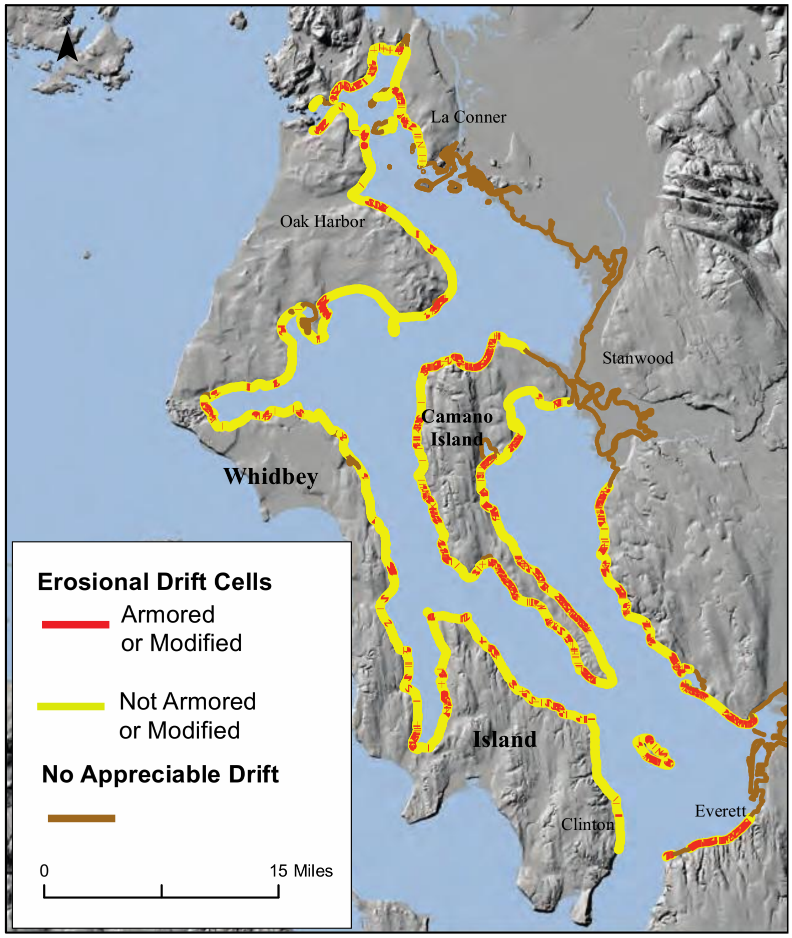
Shoreline Armoring Threatens Forage Fish Habitat Critical to Whidbey Basin Ecology

Since 2005, the counties of the Whidbey basin (Island, Skagit and Snohomish) have combined for a net increase of 2.1 miles of marine shoreline armoring, which represents 30% of total net increase in marine shoreline armoring for Puget Sound over the same time period.

Over 67 miles (98%) of all documented forage fish spawning in the Whidbey basin occurs on 69 miles of erosional drift cell habitat, characterized by feeder bluffs and accretion shoreline beaches. There is only 160 miles (over 50%) of erosional drift cell habitat in the entire Whidbey basin, and over 50 miles (31%) of that habitat is already modified or armored, leaving the Whidbey basin with only 110 miles of unmodified potentially preferred forage fish habitat.[1,2]

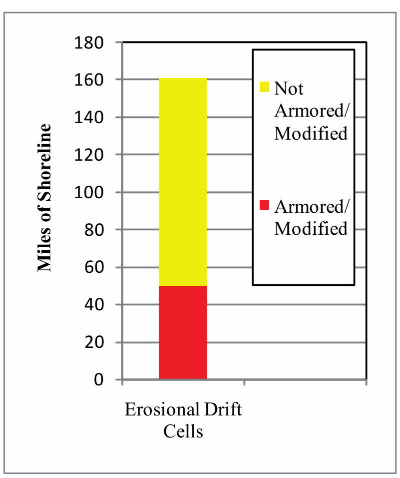
Forage fish spawn almost exclusively on erosional drift cells. Their spawning habitats are sustained by sediment erosion from coastal bluffs depositing or accreting along the shoreline in the direction of net-shore drift, which is controlled by prevailing Puget Sound winds and currents.[3] The greatest impact to forage fish habitat on erosional drift cells is shoreline armoring, as it interrupts erosion, distribution and accretion of sediment.[4] Impacts to forage fish are felt directly by federally listed Puget Sound Chinook salmon, as they feed on forage fish. Considering the critical ecological role of erosional drift cells for forage fish spawning, Skagit County, Island County, Snohomish County and all cities implementing the State's Shoreline Management Act within Whidbey basin must recognize the finite nature of forage fish habitat along erosional drift cells and implement the Shoreline Management Act to its fullest to protect every foot of remaining erosional drift cell against modification and/or armoring.

Data Sources: PSNERP 2008,[5] SSHIAP 2004,[6] WADFW 2006,[7] WAECY 2013a[8]



99% of documented forage fish spawning in Whidbey basin occurs along erosional drift cells (yellow lines), and 31% of the shoreline of these drift cells is already armored or otherwise modified.

There are 160 miles of erosional drift cells in the Whidbey basin. 67 of 69 miles (98%) of documented forage fish spawning occurs on erosional drift cells, so we assume that the other 93 miles of erosional drift cells are potential forage fish habitat. About 31% of all erosional drift cells have already been armored or modified.



Snohomish County Marine Resources Committee

While shoreline armoring protects human development from the waters of Puget Sound, it continues to have a heavy negative impact on forage fish habitat.

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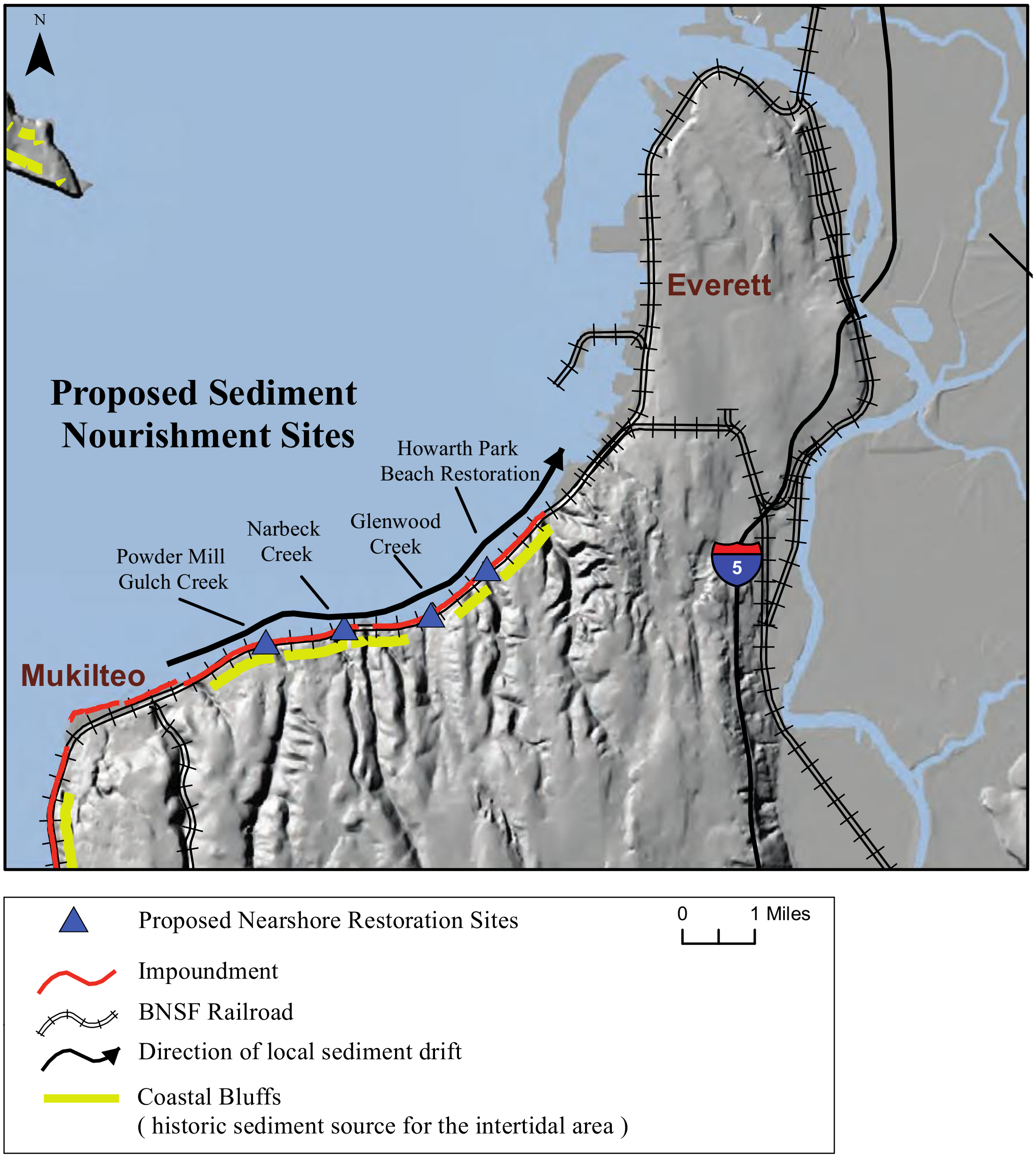
Beach Nourishment Alleviates Railroad Impact

The Snohomish marine nearshore is over 95% armored, modified or artificial, with three-quarters of that impact occurring south of the Snohomish River estuary between Everett and Mukilteo.[1] The Salmon Recovery Plan set the 10-year target for 1 mile of restoration along the Snohomish marine nearshore. As of the 2013 three-year workplan, only 0.2 miles of restoration had occurred.[2]

Historically, beaches of the erosional drift cell extending from Mukilteo to Everett were fed sediment from coastal bluffs that extend along that entire section of shoreline. Since the 1800s, the railroad (now Burlington Northern Santa Fe) has separated the entire Mukilteo to Everett intertidal area from those neighboring bluffs, and left the local beaches starved for sand.[3] Forage fish spawn almost exclusively on the beaches of erosional drift cells. The greatest impact to forage fish habitat on erosional drift cells is shoreline armoring, as it interrupts erosion, distribution and accretion of sediment.[4] Shading also is often identified as a required condition or feature of preferred forage fish beaches.

From Everett to Mukilteo, the railroad not only impairs forage fish, but also the federally listed Puget Sound Chinook that feed on forage fish. Considering this ongoing impact to Puget Sound Chinook, the federal government needs to take action and require that the BNSF Railroad company remove or modify the railroad to permit the unimpeded transport of sediment along the shoreline.

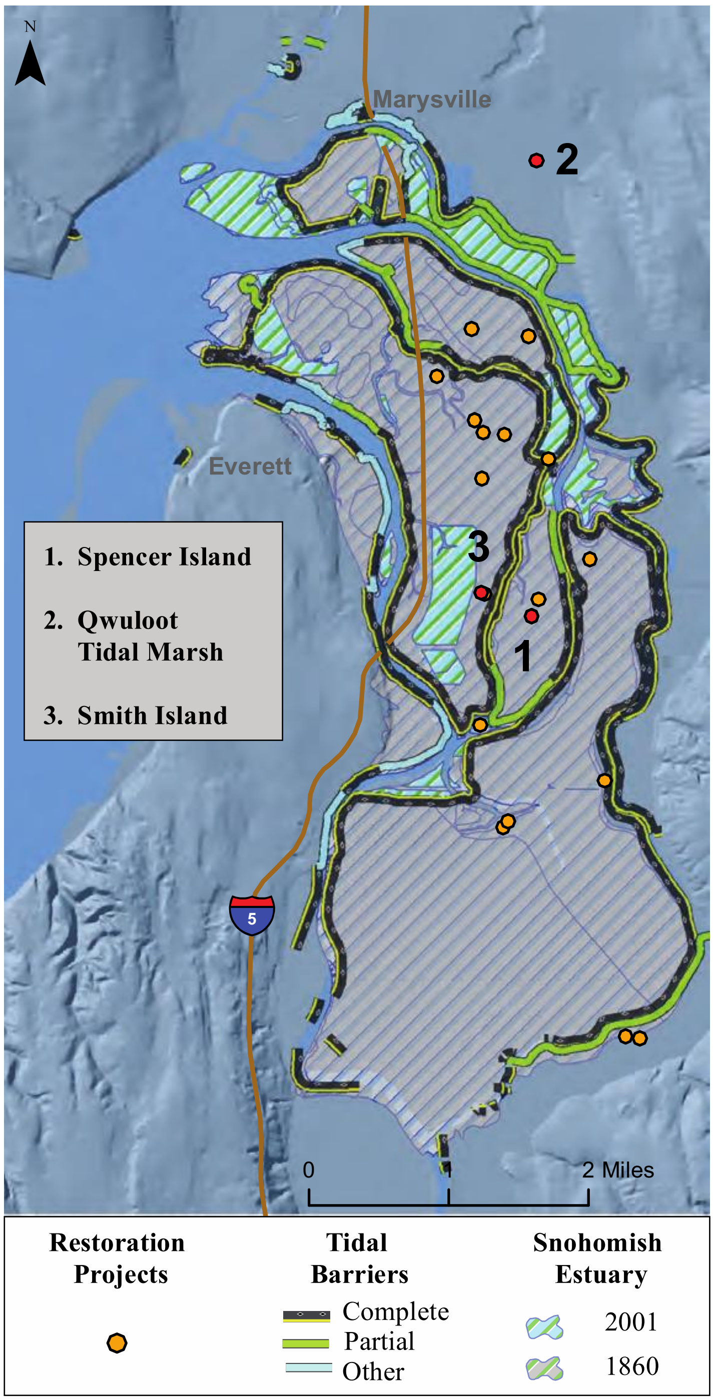


There are currently four planned beach nourishment projects along this impounded stretch of shoreline from Everett to Mukilteo. The proposed sediment nourishment restoration projects do not restore coastal bluffs as the sediment source for the beaches. Instead, dredged material from the Snohomish delta is used to fill the sediment-starved beach sites in need of nourishment. The Snohomish Salmon Recovery Planners calculate that they will be close to meeting their 10-year nearshore restoration target once these four projects are completed.[5,6]

Data Sources: Snohomish Co. 2012,[7] SSHIAP 2004,[8] WADOT 2012[9]

Snohomish Salmon Recovery Meeting 10-year Estuary Recovery Goal, Funding Harder to Get

The Snohomish River Basin Salmon Conservation Plan has 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' approximately 354-acre Qwuloolt Restoration Project completed in August of 2015, and the 326-acre Smith Island project to be completed in 2017, the Snohomish estuary is well on its way to meeting the 10-year restoration targets set in the Snohomish River Salmon Recovery Plan.[2]



Data Sources: HWS 2015,[9] PSNERP 2008,[10] PSRHP 2001,[11] SSHIAP 2004,[12] WADOT 2012[13]

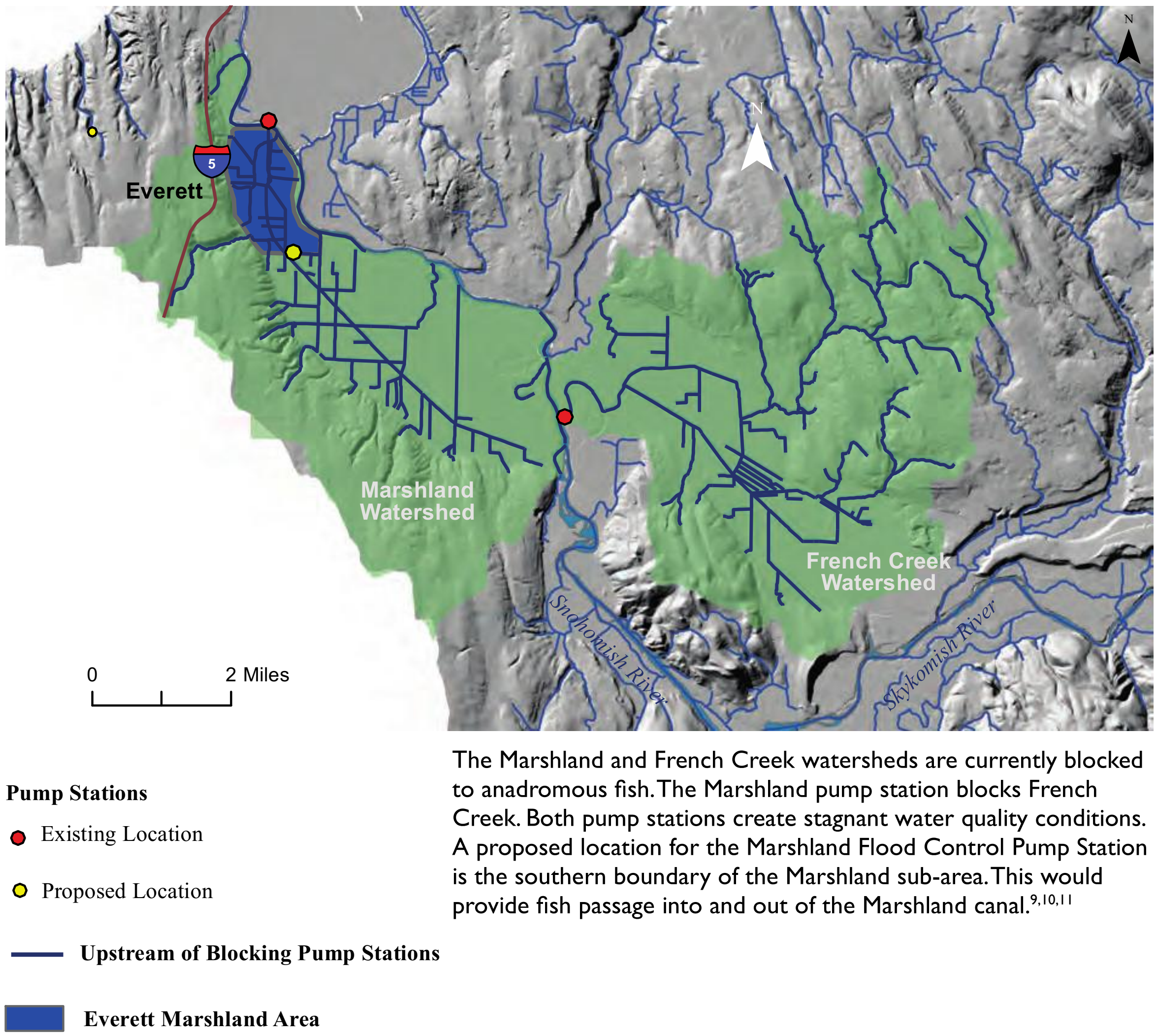
Through the efforts of the Tulalip Tribes in partnership with many agencies, the first tidal flood of the Qwuloot Estuary was restored the afternoon of August 28, 2015.[6]

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 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 will increase 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 high cost of approximately $40,000-plus per acre to restore.[5] The difficulty in advancing these large projects due to political and funding constraints may suggest the need to shift the basin's investment strategy until such issues can be overcome.

Wetlands of the Snohomish estuary in 1860 were 80-85% more extensive than in 2001.[7] Restoration efforts are slowly bringing some of that lost wetland habitat back, and large projects like Spencer Island, Qwuloolt Estuary and Smith Island have the estuary close to meeting its 10-year restoration target.[8]

Fish Access to Marshland and French Creek Key Step in Restoring Floodplain Habitat

The removal of the French Creek pump station would open access to at least 50 miles and upwards of 115 miles of floodplain side-channel and tributary habitat, and potential access to floodplain wetlands for anadromous fish.[1,2,3] 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.[4]



The Marshland and French Creek watersheds are currently blocked to anadromous fish. The Marshland pump station blocks French Creek. Both pump stations create stagnant water quality conditions. A proposed location for the Marshland Flood Control Pump Station is the southern boundary of the Marshland sub-area. This would provide fish passage into and out of the Marshland canal.[9,10,11]

Flood control facilities including dikes and pump stations at the mouths of Marshland and French Creek watersheds are primarily responsible for the approximately 95% loss of Chinook salmon rearing and coho salmon smolt production capacity in the Snohomish River floodplain.[5]

The French Creek pump station has been identified by both the Washington Department of Ecology and the Snohomish Conservation District as a major impediment to fish usage of the French Creek watershed.[6,7]

The Marshland pump station is a key component of the Everett Marshland sub-area plan, and moving it to the south end of the Everett Marshland project area will restore fish access to 400 to 500 acres of wetland habitat within the Snohomish River floodplain.[8]

Both French Creek and the Marshland watersheds have a legacy of water quality issues that will need to be addressed to restore healthy anadromous fish use to those areas. Removal of their fish-blocking pump stations is one integral step in that process.

Data Sources: PSNERP 2014,[12] SSHIAP 2004,[13] SWIFD 2014,[14] WADOT 2012[15]

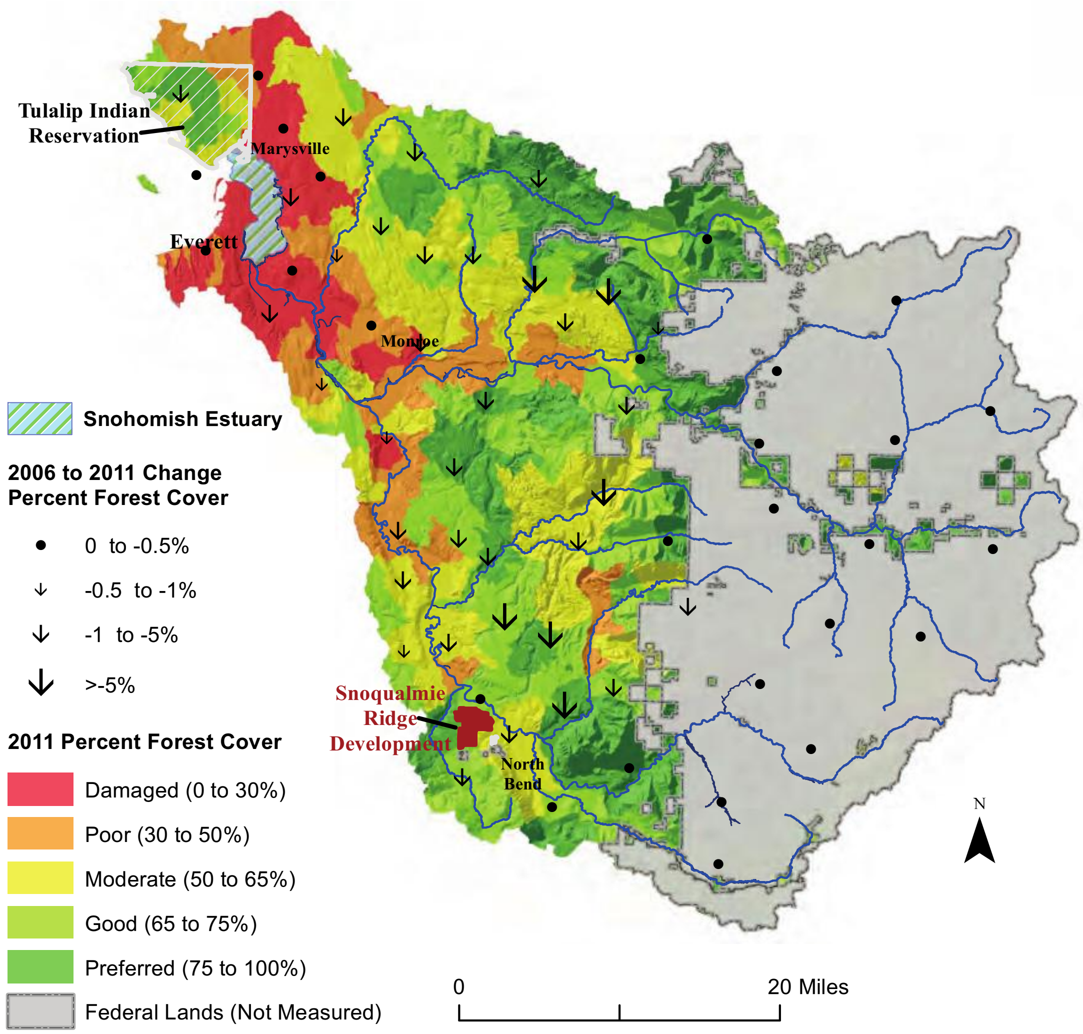
Tulalip Tribes

Forest Cover Conditions Not Improving in the Lower Snohomish River Watershed

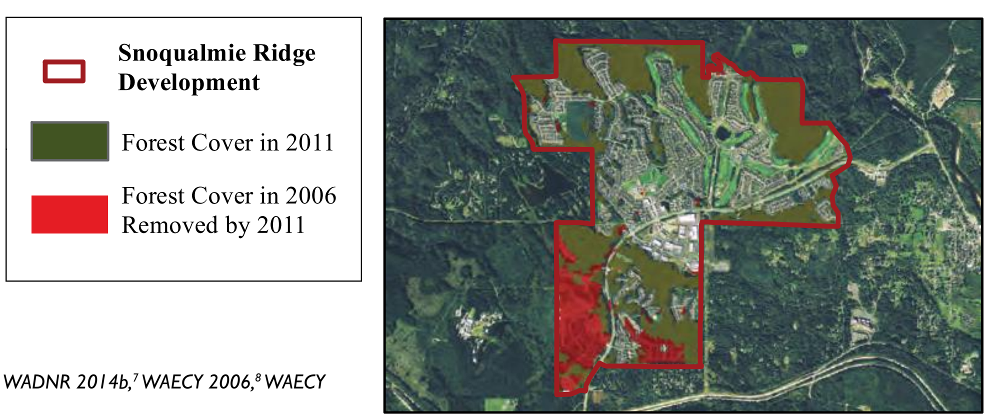
In 2011, with the exception of the Tulalip Indian Reservation, the forest conditions in lowland watershed areas adjacent to the lower Snohomish mainstem and estuary were either in poor or severely damaged condition. From 2006 to 2011, forest cover was either decreasing or staying the same in the Snohomish River watershed.[1,2] There was no sign of an increasing forest cover in the Snohomish River basin during this period.

In 1992, watershed characterized by poor and severely damaged forest cover was already centered on the critical habitat areas of the estuary. By 2006, moderate forest conditions centered on the estuary declined to poor conditions that continued to spread up the lower mainstem. This neutral to downward trend continued from 2006 to 2011. Restoration of forest cover may be slowing the rates of decrease in the lower Snohomish River watershed, but to see future increases in forest cover, especially in the lowlands, will require more deliberate protection, conservation, and restoration of forest cover in urban, agricultural and rural residential areas.

2011 Forest Cover in the Snohomish River watershed



As reported in 2012, in 1992 the Snoqualmie Ridge development was over 70% forested and by 2006 just 40% forested.[3] As an example of the consistency of forest cover loss once an area begins to be developed, the Snoqualmie Ridge development is now only 30% forested based on 2011 forest cover data.[4]



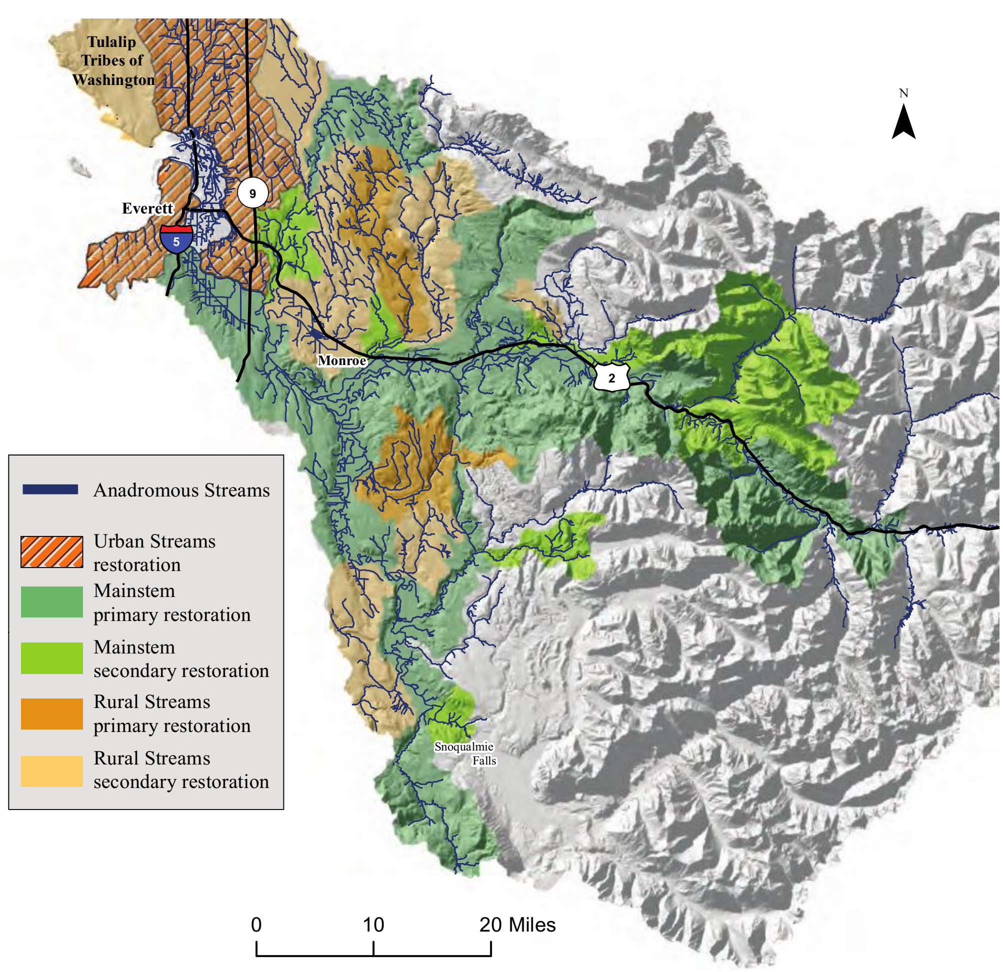
Data Sources: Snohomish Co. 2005,[5] SSHIAP 2004,[6] WADNR 2014b,[7] WAECY 2006,[8] WAECY 2011b,[9] WAECY 2011c[10]

Riparian Forest Cover Continues to Decrease

The Snohomish River Basin Salmon Conservation Plan recommends at least 65% forested 150-foot riparian buffer on either side of all fish habitat streams.[1] Intense human land use puts continuous stress on lowland riparian resources in the Snohomish River watershed. According to our assessment, along anadromous fish habitat streams flowing through five Snohomish River Basin Chinook Strategy Groups (Mainstem Primary, Mainstem Secondary, Rural Streams Primary, Rural Streams Secondary and Urban Streams) riparian forest cover was only 49% in 2011, a 1% decrease from 50% in 2006.[2,3]

The Snohomish River Basin Salmon Conservation 3-Year Work plan from 2014 reports that riparian restoration has occurred in 237 acres of 350 acres planned for restoration by 2015.[4] However, our forest cover assessment raises concerns that not enough riparian restoration has been planned, as the 1% decrease in riparian acreage between 2006 and 2011 is equal to a 383 acres of riparian acreage removed over that time frame. To verify this analysis, we looked at the WDFW High Resolution Change Detection (HRCD) data for 2006 through 2011 and found 343 acres of riparian acreage removed over that time frame. Both datasets suggest riparian forest cover loss is occurring at a higher rate. Better local enforcement of the State Shoreline Management Act (SMA) is needed if riparian restoration is going to outpace riparian forest loss.

Data Sources: Pearce 2013,[6] Snohomish Co. 2005,[7] SSHIAP 2004,[8] SWIFD 2014,[9] WADNR 2014b,[10] WADOT 2012,[11] WAECY 2006,[12] WAECY 2011b[13]



The Snohomish River Basin Salmon Conservation Plan's five Chinook Strategy Groups with riparian restoration goals, evaluated by acres of riparian area restored.

Riparian forest cover loss and riparian forest restoration within 150 feet of low elevation anadromous streams in the five main Snohomish River Basin Salmon Conservation Plan Chinook Strategy Groups. 237 acres of riparian restoration is progress toward the 10-year goals of the plan,[5] but 383 acres of riparian forest cover loss between 2006 and 2011 suggests that the restoration planned is not enough to be effective in the long-term.

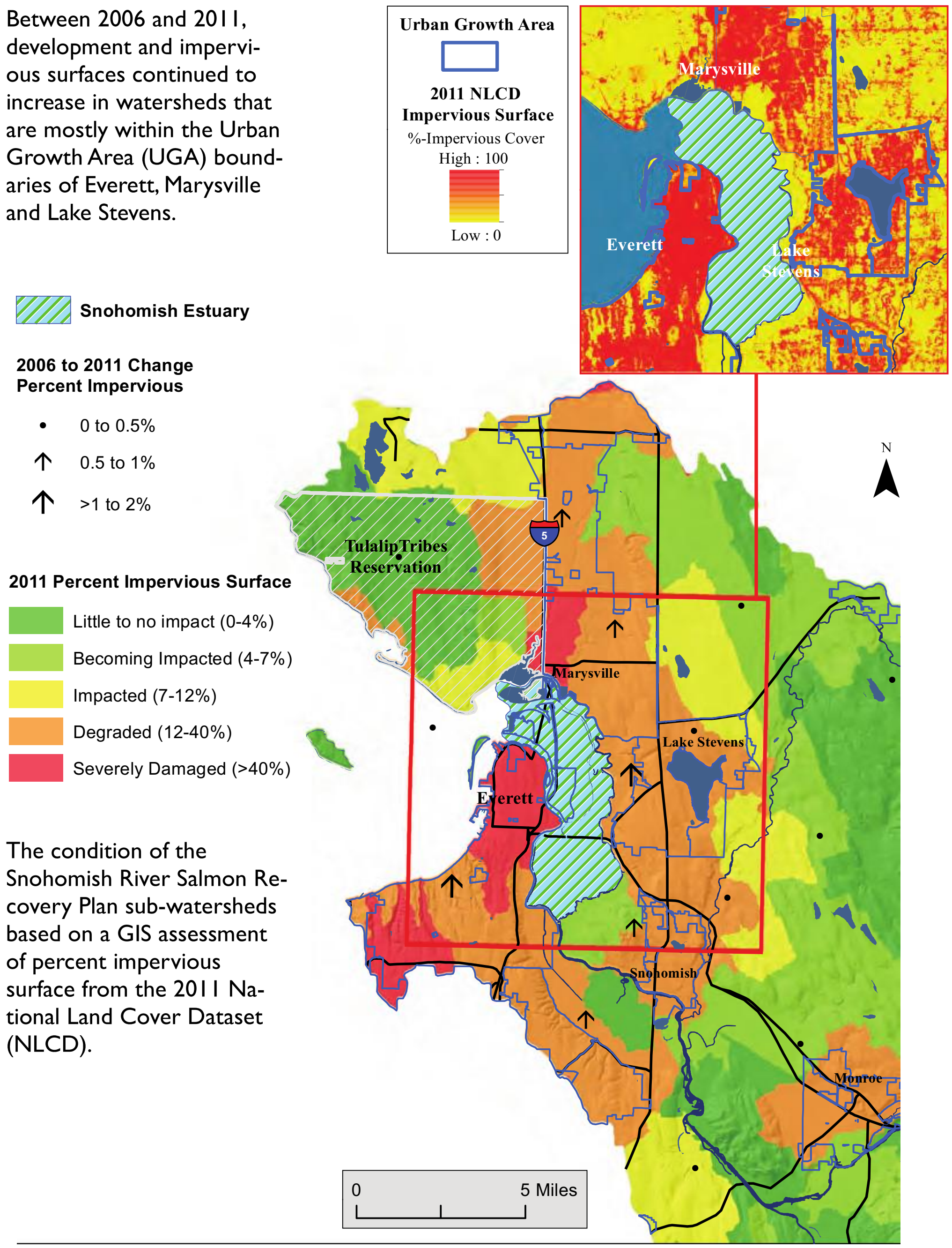
Total Riparian Acres (150-ft buffer of low elevation anadromous streams)	Riparian Forest Cover				Change in Riparian Forest Cover	Snohomish Basin Riparian Habitat Restoration Goal	Restoration Progress	Currently on Target to Meet 10-yr Restoration Goal
	2006		2011		2006 to 2011	2005 to 2015	Through 2014	
	%	Acres	%	Acres	Acres	Acres		
15,809	47%	7,424	45%	7,135	-289	256	191	Yes
4,622	59%	2,709	58%	2,685	-24	6	0	No
3,416	68%	2,323	67%	2,301	-22	13	6	Progressing
8,808	56%	4,937	56%	4,897	-40	0	14	Yes
5,673	34%	1,906	33%	1,898	-8	75	26	Progressing
38,328	50%	19,299	49%	18,915	-383	350	237	Progressing

Impervious Surfaces Continue to Threaten Water Quality

From an assessment of 2006 data, the lower Snohomish watershed was found to have 11% impervious surface, conditions that lead to poor water quality conditions.[1] Assessment of 2011 data indicated impervious area continues to increase.[2] In 2011, every Urban Stream watershed identified in the Snohomish River Salmon Conservation plan was degraded, based on impervious surface levels greater than 12%. Additionally, between 2006 and 2011, increases in impervious surface continued to spread from Urban Stream watersheds into the Mainstem and Rural Stream watersheds to the east.

The Snohomish River Basin Salmon Conservation plan suggests watershed recovery at under 7%, and warns of watershed degradation at 12% impervious surface.[3] The urban, mainstem and rural watersheds of the lower Snohomish River system are continuing to move away from conservation plan targets toward a worsening watershed condition. The intensification of impervious surface in urban watersheds and the spread of impervious surface into both mainstem and rural watersheds are continuations of a 1992 to 2006 trend identified in the 2012 State of Our Watersheds Report.[4]

Between 2006 and 2011, development and impervious surfaces continued to increase in watersheds that are mostly within the Urban Growth Area (UGA) boundaries of Everett, Marysville and Lake Stevens.



The condition of the Snohomish River Salmon Recovery Plan sub-watersheds based on a GIS assessment of percent impervious surface from the 2011 National Land Cover Dataset (NLCD).

Data sources: Snohomish Co. 2005,[5] NLCD 2006,[6] NLCD 2011,[7] SSHIAP 2004,[8] WADNR 2014b,[9] WADOT 2012,[10] WAECY 2011a,[11] WAECY 2013b[12]

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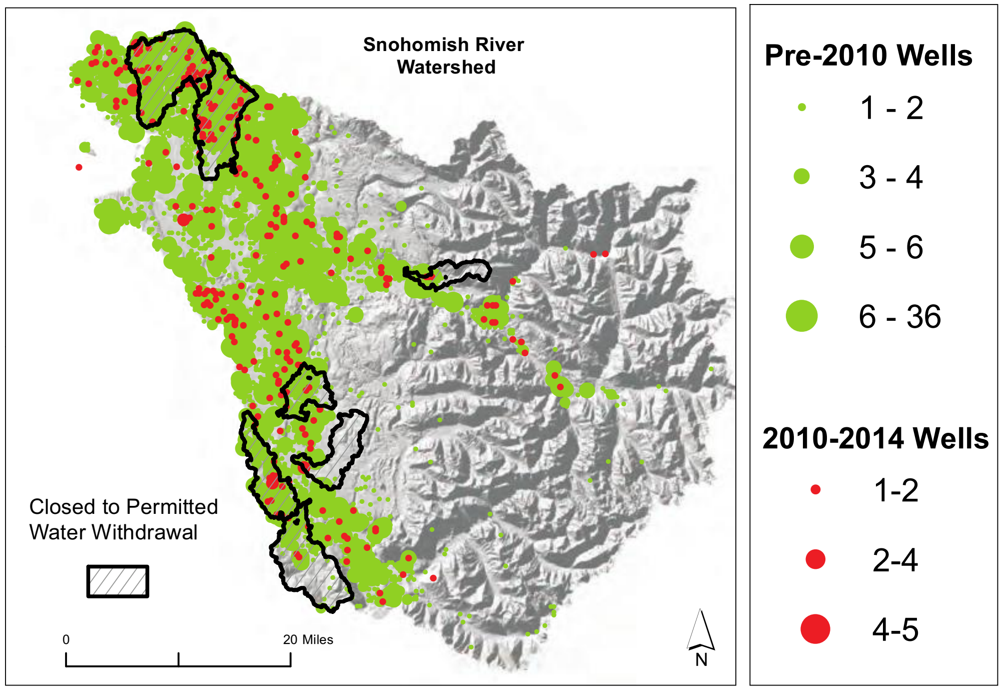
Wells are an Accumulating Problem

An estimated 3,000 wells, or 25% of all of the water wells within the Snohomish River basin, fall inside seven tributary watersheds that have been closed to new water rights and permitted withdrawal since the 1950s. That trend has continued, as 98 (33%) of the 298 wells developed since 2010 were completed within those seven closed watersheds.

Washington Department of Ecology (WAECY) considers permit-exempt wells for use by single-family residences and small hobby farms to result in the usage of small quantities of water. While exempt wells are small withdrawals (not to exceed 5,000 gallons per day), permit exemption has resulted in over 11,000 wells being dug in the Snohomish River basin.

Based on a conservative estimate of recent WAECY Well Log data, 11,613 water wells were completed in the Snohomish River watershed by the end of 2009, and from 2010 through the end of 2014, an additional 298 wells were completed.[1] WAECY estimates that 95% of these wells are small domestic wells that are exempt from needing a water right.[2]

Based on the 11,000-plus wells having been dug in the Snohomish River basin and with the allocation of 5,000 gallons per day per allocation, over 20 billion gallons of water per year is being allocated within the Snohomish River watershed through the exempt well program. Even in the seven basins that have been closed for 60 years to permitted water withdrawal because water is scarce, the permit-exempt well program has allocated over 5 billion gallons of water per year.



Water wells developed prior to 2010, water wells developed between 2010 and 2014, and closed basins in the Snohomish River watershed.[3]

Stream	Date of Closure	Period of Closure
Griffin Creek, Tributary to Snoqualmie River	9/22/53	All year
Harris Creek, Tributary to Snoqualmie River	1/20/44	All year
Little Pilchuck Creek, Tributary to Pilchuck River	5/6/52	All year
May Creek, Tributary to Wallace River	10/13/53	All year
Patterson Creek, Tributary to Snoqualmie River	2/19/52	All year
Quilceda Creek, Tributary to Ebey Slough	6/10/46	All year
Raging River, Tributary to Snoqualmie River	9/20/51	All year
Unnamed Stream (Bodell Creek), Tributary to Pilchuck River	9/6/51	All year

There are a total of eight closed basins in the Snohomish River watershed. The location of Bodell Creek, a tributary to the Pilchuck River, is not well documented, so this assessment only summarizes exempt well impacts for seven of the closed watersheds in the Snohomish River watershed.

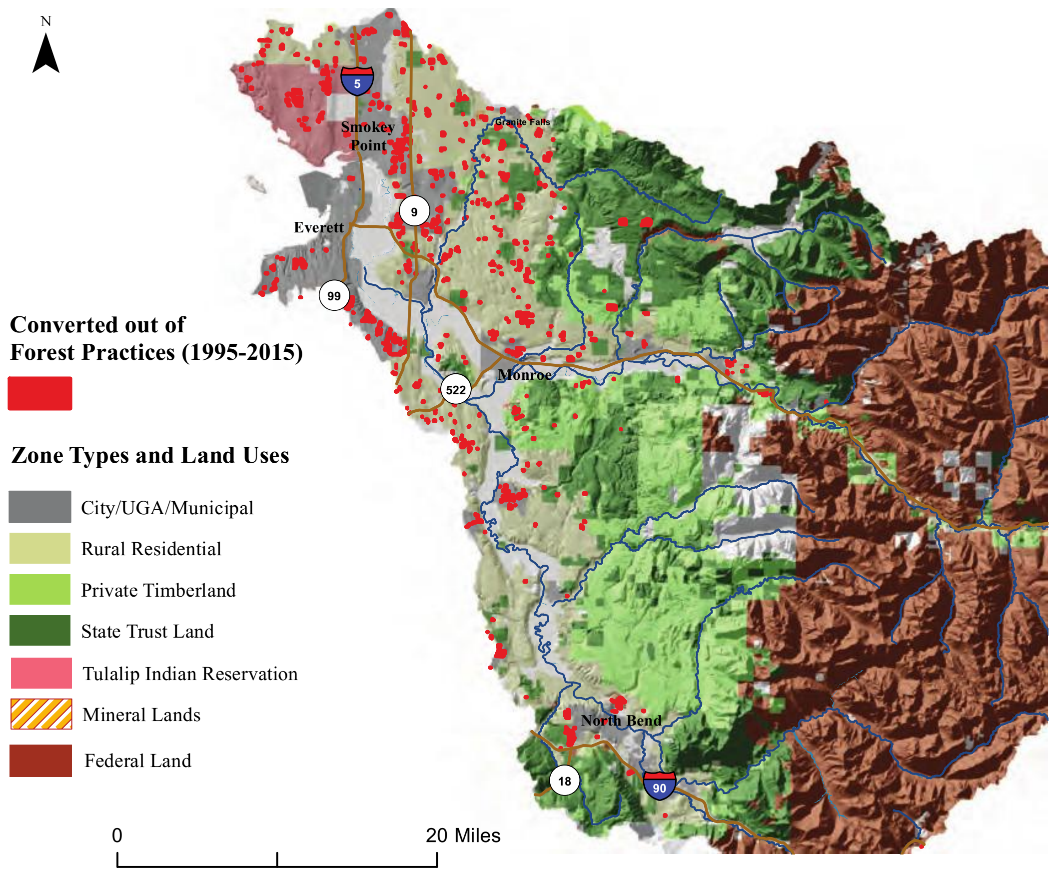
Data Sources: SSHIAP 2004,[4] WAECY 2011c,[5] WAECY 2015a[6]

Forestlands at Risk of Residential Sprawl

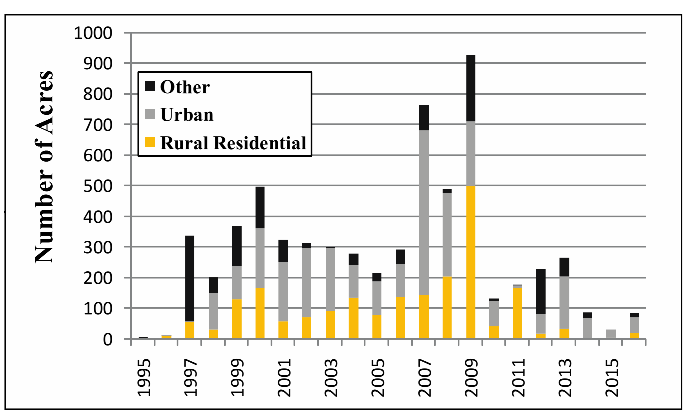
From 2007 to 2015, approximately 3,167 acres were converted out of forest practices and into non-forestry uses in the Snohomish watershed. This is in addition to the over 3,130 acres converted between 1996 and 2006, bringing the total land converted out of forest practices to nearly 6,300 acres in 20 years.

Since 1995, nearly 6,300 acres of forestland has been converted out of forest practices in the Snohomish River watershed.[1] Evidence suggests the primary motivation for conversion out of forest practices is residential development. To this point, over 2,100 acres, or 1/3, of forestland conversion since 1995 occurred between 2007 and 2009, coinciding with the region's housing boom. Beyond that point, 78% of all forestland conversion since 1995 has occurred on Urban Growth Area or Rural Residential parcels, strongly suggesting that the majority of forestland conversion will be for residential or commercial property development.

Only 58% of private forestland in the Snohomish basin is signed up for the "Designated Forestland Program" meant to incentivize non-conversion of forestland. The 42% of private forestland that is not signed up is considered to be at an 87% risk for permanent conversion to residential land uses.[2] Land in working forests is protected by the Washington State Forests and Fish Law, designed to comply with the Endangered Species Act (ESA) and the Clean Water Act (CWA) to protect native fish and assure clean water compliance.[3] Once land is converted out of working forests, not only do the trees disappear, but so do the fish protection and clean water guarantees of the Forests and Fish Law. In their place is a residential landscape with greater pollution and less protection.



Conversion out of forest practices is occurring primarily in the Urban Growth Area and Rural Residential zones,[4,5] and is further evidence of urban to rural sprawl fragmenting forests in the Snohomish watershed.



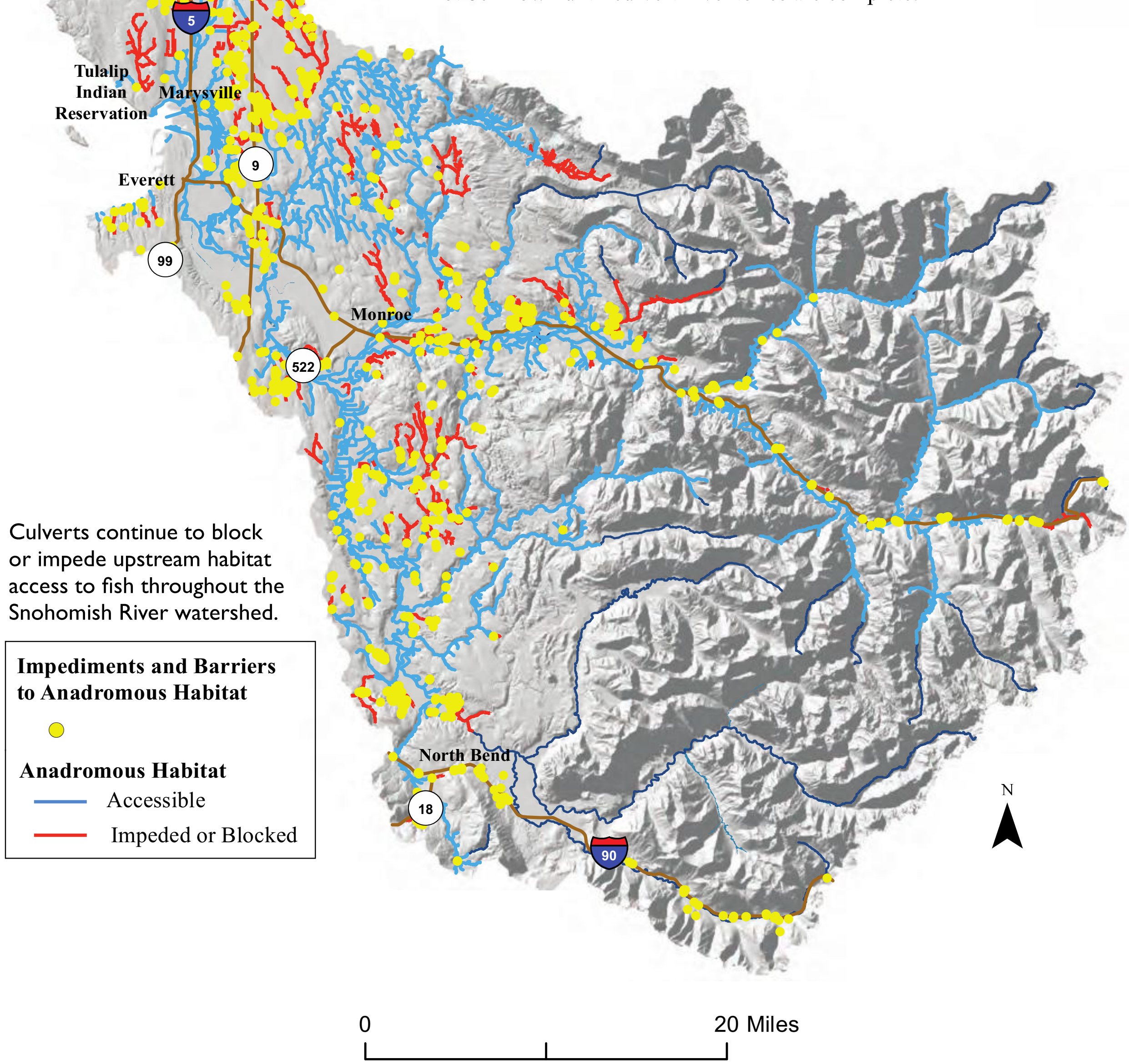
Over the past 20 years, 78% of all conversions out of forest practices have been either within the Urban Growth Area (UGA) boundary or on Rural Residential parcels outside of UGA.[6,7,8]

Data Sources: SSHIAP 2004,[8] UW 2012,[9] WADNR 2011,[10] WADNR 2014b,[11] WADNR 2015,[12] WADOT 2012,[13] WADOT 2013,[14] WAECY 2013b[15]

Culverts Block Anadromous Salmon from Upstream Habitat in Snohomish Watershed

In the Snohomish River watershed, over 50% of nearly 1,600 inventoried culverts are blocking or impeding fish from accessing upstream habitat.[1] More than 320 miles of anadromous fish habitat is currently upstream of blocking or impeding culverts.[2] Since 2010, the number of inventoried culverts, the percentage of blocking or impeding culverts, and the miles of blocked anadromous habitat have all increased.

In the Snohomish Salmon Recovery Plan, it is estimated that there are 7,000 culverts in the Snohomish watershed.[3] Based on survey records, approximately 1,600 culverts are known to exist in the basin.[4] Data on the status of barrier removal and additional barriers is difficult to come by. 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.



Culverts continue to block or impede upstream habitat access to fish throughout the Snohomish River watershed.

Data Sources: SSHIAP 2004,[5] SWIFD 2014,[6] WADFW 2014,[7] WADOT 2012[8]

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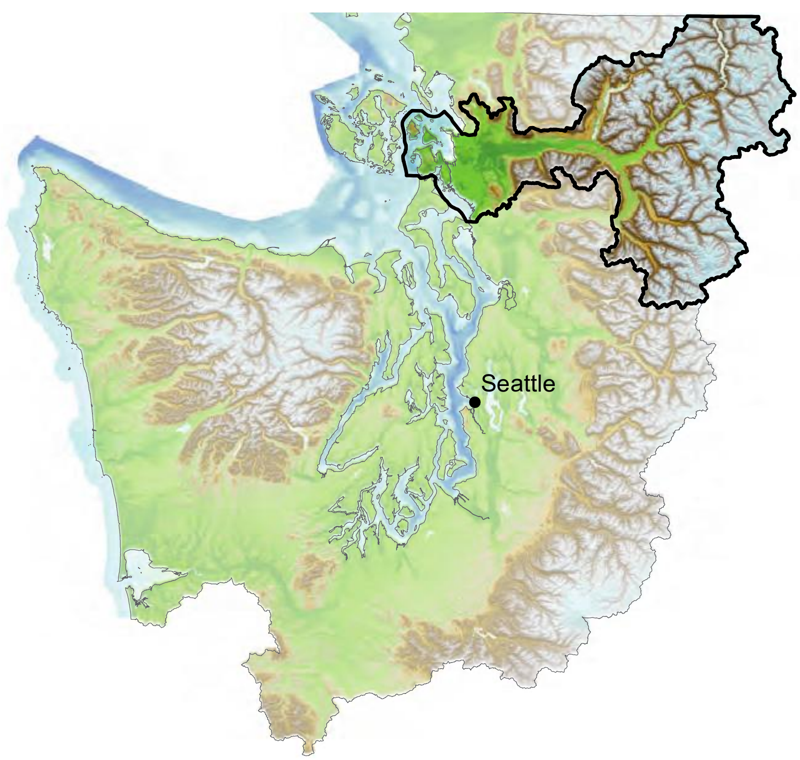
2016 State of Our Watersheds Report
Skagit River Basin

Salmon, shellfish and wildlife make up the cornerstones of our rich fishing and hunter/gatherer history and culture. For thousands of years, our ancestors practiced sustainable management to ensure that the resources would continue to be here for future generations. Today it is a constant struggle to preserve resources for our children and their children, as habitat continues to be degraded or lost, coupled with some of the worst environmental conditions ever seen.

– **Scott Schuyler**
Upper Skagit Tribe



Upper Skagit Indian Tribe

Signatory to the Treaty of Point Elliott, the Upper Skagit Tribe's historical villages were located on Samish and Skagit river watersheds. Upper Skagit was not granted a reservation at treaty time and most Upper Skagits refused to relocate to other tribes' reservations. This act of defiance, along with their continued resistance to encroachment after treaty signing, forever persevered Upper Skagit identity and culture. Although not well known, Upper Skagit also was one of the original tribes to participate in the treaty fishing case, as many Upper Skagit were continually arrested in the 1960s and '70s and thrown in jail for fishing. Today, Upper Skagit Tribal members continue to fish on the Skagit on or near their historical villages from present day Mount Vernon to Newhalem.

Recovery Plan Seeks to Restore and Protect

The land in the upper portion of the Skagit watershed is primarily under the jurisdiction of the federal government, located within the Mount Baker-Snoqualmie National Forest, multiple wilderness designations, and National Park and National Recreational areas. The middle section of the watershed and most of the watershed's floodplains are largely managed as forestlands or rural residential in private, county or state jurisdiction.

The land in the lower watershed or delta is managed by private agricultural users, as well as the only urban area under city jurisdictions within the watershed.

Human land use and resource extraction over the last 150 years have resulted in the degradation of salmon habitat. The continued degradation of productive salmon habitat in modern times largely relates to human infrastructure, and ongoing agriculture and forestry practices within the watershed.

Despite these land use alterations, the Skagit River still remains one of the most productive watersheds within Puget Sound drainage. The Skagit supports all five anadromous salmonids as well as steelhead, cutthroat and bull trout, and is currently the only watershed still managing wild native fisheries. The Skagit supports six native Chinook populations.

The Skagit Chinook Recovery Plan (2005) was developed from a life cycle model that identified the limiting factors for Chinook productivity.

These factors include:

- Loss of floodplain habitats and connectivity;
- Loss of delta habitats and connectivity;
- Loss of pocket estuaries and connectivity;
- Degraded riparian zones;
- Sedimentation and mass wasting;
- Hydromodification;
- Hydroelectric operations;
- Flooding; and
- Water quality impairments.[1]

Upper Skagit Indian Tribe (2)

Photos of Hansen Creek in 2009 (top) and 2015 (below) show the changes following restoration work by the Upper Skagit Tribe to remove parts of a levee and build log jams to restore natural sediment movement and improve salmon habitat.

The habitat recovery strategy for Skagit Chinook populations sought to restore and protect habitat at a landscape level and focused on habitat-forming processes. Salmon productivity depends not on a single habitat or life stage but on all the habitats used by salmon throughout their life. The restoration actions were designed at a scale of independent populations as well as all the Skagit Chinook populations.

The habitat protection strategy for Skagit Chinook populations focused on how best to protect existing habitat from future degradation. These recommendations were largely developed for local and state regulatory agencies for decisions that pertain to land and water uses that may impact Chinook Recovery goals.

This strategy focused on:

- Instream flows;
- Basin hydrology;
- Stream channel complexity;
- Riparian areas and wetlands;
- Estuary and nearshore; and
- Fish passage.[2]

Project Restores Habitat, Function to Floodplain

Legacy land-use impacts on federal lands remain a challenge for salmon habitat restoration and recovery. The Upper Skagit Indian Tribe is leading a collaborative effort to identify a restoration plan for a large alluvial floodplain in the Goodell Creek watershed. The goal of this action would be to increase habitat productivity by reconnecting isolated and lost floodplain habitat, improving hydrology and water quality that would benefit multiple salmonid species including Chinook and steelhead. The majority of the watershed is under the jurisdiction of the North Cascades National Park Service and still provides near-pristine ecological function. However, the alluvial floodplain is managed under the Ross Lake National Recreational Area and is impaired by a century of floodplain occupation and infrastructure. The salmonid habitat impacts are related to loss of channel complexity, channel migration and floodplain processes due to roads, levees and undersized stream crossings.

Lack of Funding Limits Recovery Progress

Implementation of the Skagit Recovery Plan is lagging behind the pace originally anticipated during plan development in 2005. Restoration work has progressed with numerous capital projects focused on restoring fish habitat and passage. However, the Skagit Chinook Recovery Plan has faced significant funding shortages for large-scale restoration projects, as well as the political momentum and focus to maintain Chinook recovery as an achievable political goal. In addition, recovery based on voluntary actions of local and private landowners has slowed, as the obvious and easier projects have been restored. What remains now are large complex projects that will need multiple landowners and broad agency support due to the size and complexity of the remaining project types. Incentives and local leadership are needed to advance these difficult but critical restoration strategies to completion.

A major element of the 2005 Skagit Chinook Recovery Plan relies on revisions to local, state and national environmental regulatory programs to protect salmon habitat and habitat-forming processes. Progress on implementing these regulatory and incentive programs has also lagged behind recovery expectations. Numerous shoreline management plans within WRIAs 3 & 4 are still in the process of being updated, and alignment of all federal regulatory guidelines with Puget Sound salmon recovery is still lacking.

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

At the 10-year mark of the Puget Sound Salmon Recovery Plan, a review of key environmental indicators for the Skagit Basin area shows an improvement in restoration efforts but degradation of water quality, marine and freshwater shoreline habitat conditions, and floodplain and riparian 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 since the 2012 State of Our Watersheds Report shows improvement for some indicators and a steady loss for others in habitat status:

Tribal Indicator	Status	Trend Since SOW 2012 Report
Floodplain	In the Middle Skagit River floodplain, approximately 55% of the land area has been cleared of native forest and is being maintained and cleared for human development. This type of land use is considered an impaired floodplain forest and has not changed in at least the last 20 years. Continued floodplain forest impairment is one reason the Middle Skagit remains a juvenile rearing bottleneck to population production. As long as floodplain forests remain impaired, salmon conservation activities will not fully succeed.	**Declining**
Water Quality - Shellfish	While the Clean Samish Initiative is improving shellfish growing conditions in Samish Bay, as of spring 2015, Samish Bay's downgraded status had not changed, while most of the bay is conditionally approved for shellfish growing. This closure impedes the Tribe's ability to exercise treaty rights, as well as shellfish growers and recreationists alike. Renewed efforts to review Samish Bay's status and address upstream impacts to Samish Bay shellfish growing are needed.	**Declining**
Shoreline Modifications / Forage Fish Impacts	Since 2011, 4,300 feet of new marine shoreline armoring has been added in Island and Skagit counties. This accounts for 23% of all permitted marine shoreline armoring completed in Puget Sound. 193 (38%) of 510 miles of erosional drift cells in the northern Whidbey basin, Padilla and Samish bays have already been armored or modified. 94% of documented forage fish spawning occurs along erosional drift cells.	**Declining**
Shoreline Modifications / Freshwater	The Upper Skagit Tribe recently completed its survey of hydromodifications along streambanks within floodplains of the Skagit River watershed, with a focus on Chinook salmon habitat. They surveyed 220 miles of stream and found 499 structures and 32.1 miles of hydromodified bank along Chinook-bearing waters. There is not clear evidence of riprap being removed from the Middle Skagit River since 2005.	**Declining**
Impervious Surface	Between 2006 and 2011 impervious surfaces increased by 1 to 2% inside of the NPDES Phase II permit area of Anacortes, Mount Vernon, Burlington, Sedro Woolley and Concrete, and outside of the NPDES Phase II permit area in La Conner, and along I-5, State Route 9 and State Route 20.	**Declining**
Restoration	Upper Skagit Tribe has commenced the planning phase of the restoration and protection of the North Cascades National Park Complex to restore prioritized salmonid and floodplain habitat on Goodell Creek, a large Skagit River tributary focusing on levee and road removals and replacing or removal of stream crossings.	**Improving**
Climate Change	Climate change is real, and salmon ranges, timing and productivity are responding to this change. Fishery management needs to adapt more quickly to be effective with novel freshwater and ocean conditions. Upper Skagit Indian Tribe seeks support to improve capacities to detect and predict impacts of climate change on salmon populations. They also seek coordination to improve fisheries management to incorporate these novel conditions and the variability associated with them to ensure treaty rights can be exercised in the future.	**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

Salmon habitat in the Skagit River basin and along the Skagit Whidbey basin nearshore was completely altered during the 20th century. Now a fight is underway to protect what is left and restore some sections of what was lost. Population growth and associated development within the Skagit basin will continue to pose significant challenges to salmon conservation and recovery efforts. Current trends indicate that land-use regulation reform is required and continued funding of habitat restoration activities is necessary in order to achieve the agreed-upon recovery goals.

For the Upper Skagit Indian Tribe, what is needed is an environment that supports increasing the number of returning salmon and a healthy Puget Sound. The watershed is currently home to over 120,000 residents[3] with different perspectives on what is needed for the future of the Skagit River and Puget Sound, including all aquatic flora and fauna that are dependent on a healthy functioning ecosystem. Development and implementation of policy focusing the broad list of pressures and opportunities to salmon recovery is needed at the federal, state and local levels. A successful program must include a local coordinating body that provides a forum for the Tribal perspective and leadership. New alliances must form to help raise the concerns and align focus and energy for salmon recovery, like sport fishing organizations and the tribal fishing communities. In the near term, support must be made for protecting hatcheries as they represent the only viable tool for mitigation against lost habitat and protecting treaty rights.

Kari Neumeyer, NWIFC

Upper Skagit tribal fishermen harvest sockeye salmon near the confluence of the Baker and Skagit rivers. The harvest is an integrated stock of both hatchery and wild-spawned fish.

Over the next few years, the Tribe will be focusing on additional upriver protection and restoration projects, with a focus on rebuilding the three Skagit Spring Chinook populations. These freshwater restoration projects will focus on both spawning and rearing habitats that benefit multiple salmonid species by using a habitat-forming framework. Given the pressures from human occupation and the ever-increasing climate change impacts on natural systems, every effort must be taken now to protect what is still functioning while restoring productivity and resiliency to reach salmon recovery goals and protect treaty rights.

Upper Skagit Indian Tribe (3)

Upper Skagit tribal members practice their treaty rights by harvesting cedar (top left) and teach youth about the importance of their tribe's culture and natural resources.

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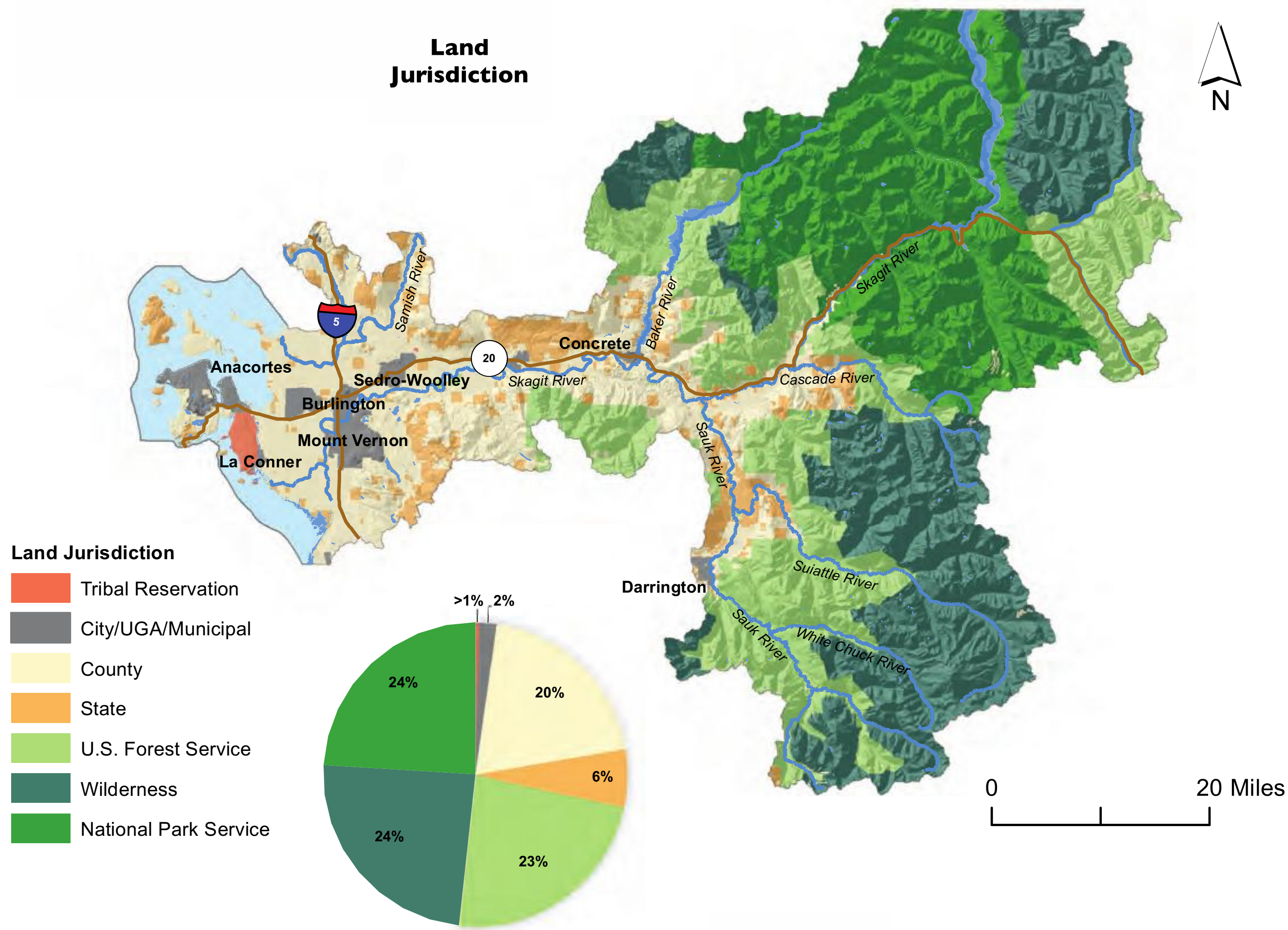
Upper Skagit Indian Tribe



With a 3100-square-mile watershed, the Skagit River is the largest in Puget Sound and the third largest on the West Coast of the continental United States. It provides 30% of Puget Sound's freshwater input. The Skagit River originates in British Columbia, and flows south into Washington state before continuing westward through Skagit County and into the sound. The upper half of the watershed is primarily within the National Forest and the North Cascades National Park, and the lower half mainly comprises private forest, agriculture, rural residential and urban residential lands. The Baker, Sauk and Cascade rivers all flow within the Skagit River watershed.

The Tribe's administrative offices remain in the Skagit watershed east of Sedro-Woolley. Current Upper Skagit membership is 1,860 and is now the largest Tribal community in the Skagit basin. There are over 120,000 residents in the Skagit watershed. Population is projected to increase to an estimated 162,000 people by 2040.[1]

The Upper Skagit Tribe has occupied lands along the Skagit River and throughout the watershed since time immemorial. The watershed once provided them with an abundance of fishing, hunting and gathering opportunities.

Since European settlement, land use in the watershed has been dominated by natural resource extraction. The foothills and mountains have been mainly used for wood products, mining and outdoor recreation. The river valleys, the delta and the coastal areas have been used for agriculture, industry, commerce and residential development. The Skagit River is home to all five species of Pacific salmon, as well as steelhead. It has the healthiest and largest runs of wild Chinook and pink salmon in Puget Sound.[2]

The last 150 years of human land use has resulted in declines in Chinook and other salmonid productivity, yet the Skagit River watershed remains relatively healthy. The Skagit Chinook Recovery Plan 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.

Data Sources: SSHIAP 2004,[3] USFWS 2014,[4] WADNR 2014a,[5] WADNR 2014b,[6] WADNR 2014c,[7] WADOT 2013,[8] WAECY 1994,[9] WAECY 2011a,[10] WAECY 2013a[11]

Fecal Coliform Pollution Threatens Tribal Shellfish Harvest in Samish Bay

The Clean Samish Initiative is improving conditions for shellfish growing and harvest in Samish Bay. However, high counts of fecal coliform bacteria continue to keep most of Samish Bay's commercial shellfish areas either Conditionally Approved (closed during high rain events) or Prohibited (closed year-round) to shellfish growing, leaving only a small section in the north of Samish Bay Approved (open year-round) for shellfish growing.[1]

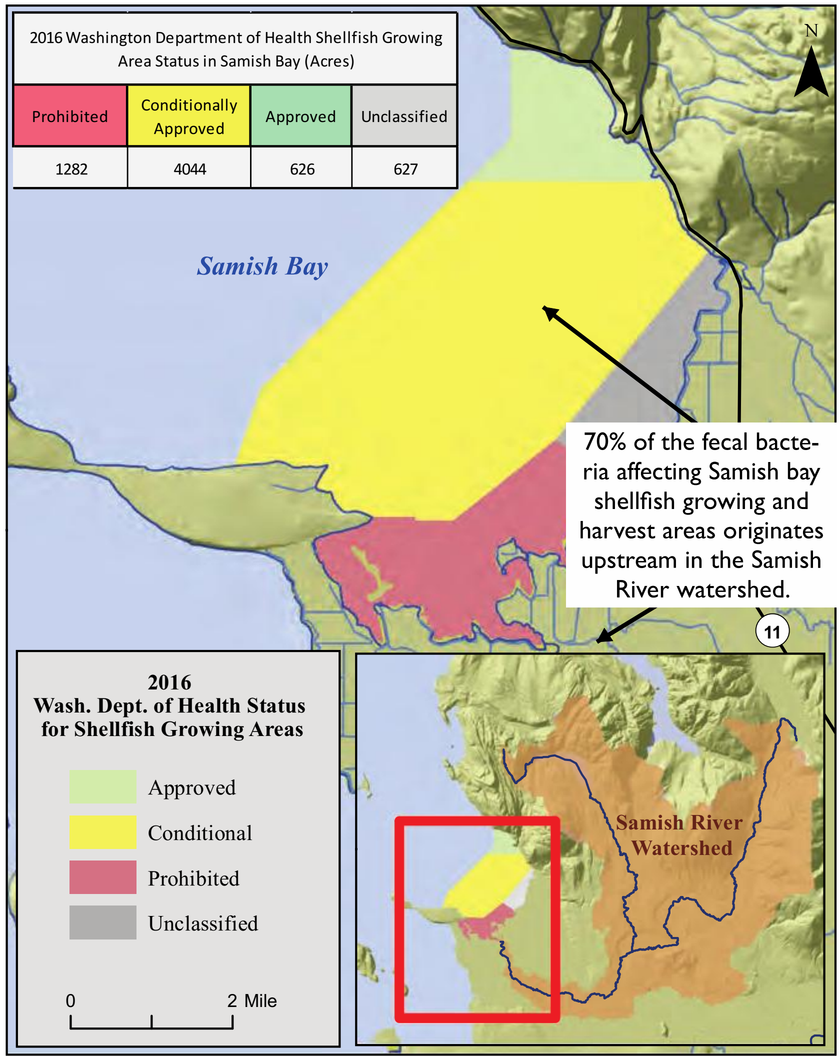
Samish Bay is important for shellfish resources, both economically and ecologically. User groups include shellfish growers, recreationists and members of five different tribes who have reserved rights to collect fish and shellfish from the bay. The ability to exercise this right has been put into jeopardy by fecal pollution runoff through the entire Samish watershed.

The Samish Bay shellfish closures are impeding the Tribe's ability to exercise treaty rights to provide resources to tribal members. Future economic development plans of establishing a shellfish aquaculture business are still uncertain due to lack of tangible success in addressing point and nonpoint pollution in this watershed.

Upper Skagit Indian Tribe

Upper Skagit Tribal member and natural resources technician Larry Peterson and field coordinator Mike Bartlett gather clams for a tribal celebration.

GIS estimate of acres of shellfish growing area in Samish Bay and their January 2016 status



Data Sources: SSHIAP 2004,[2] WADOH 2014,[3] WAECY 2008,[4] WAECY 2011a[5]

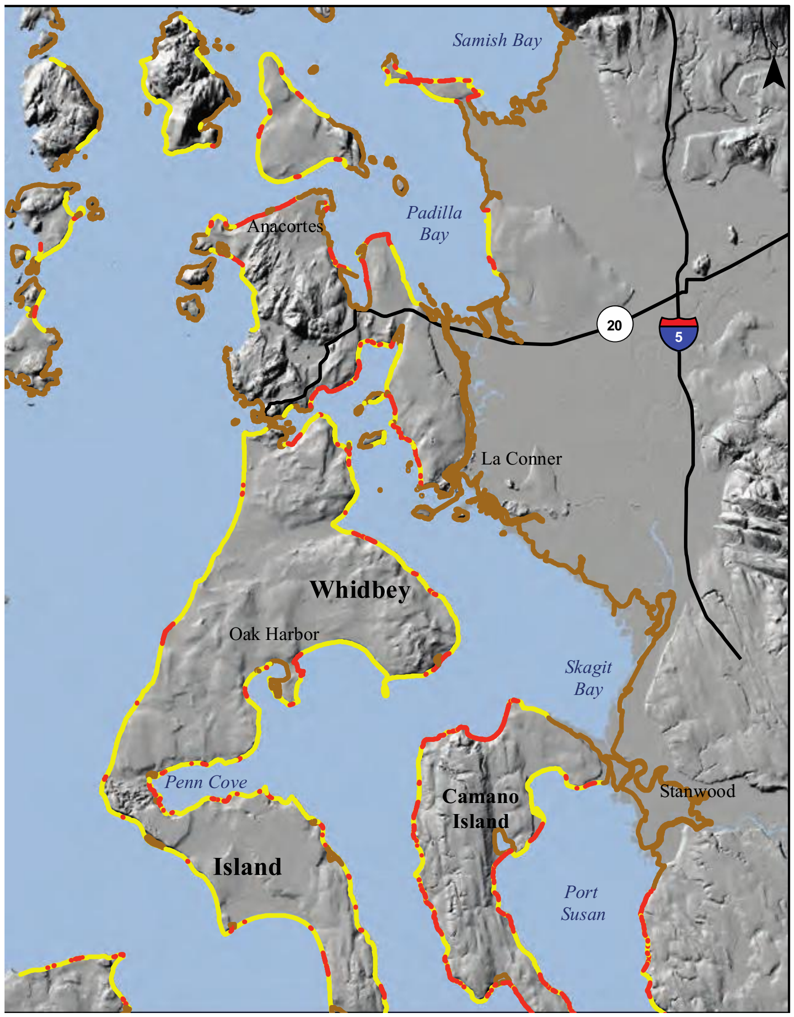
Shoreline Armoring Threatens Forage Fish Habitat in Whidbey Basin, Padilla, Samish Bays

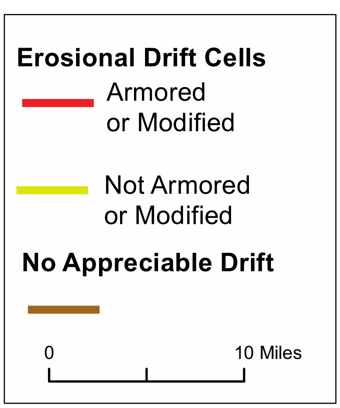
There are an estimated 510 miles of critical forage fish habitat in the northern Whidbey basin, Padilla and Samish bays of Island and Skagit counties. More than 193 miles (38%) is either modified or armored.[1,2] Since 2011, 4,300 feet of new marine shoreline armoring have been added in Island and Skagit counties which accounts for 23% of all permitted marine shoreline armoring in Puget Sound during that time period.[3] Leadership is needed to protect what little forage fish habitat is left.

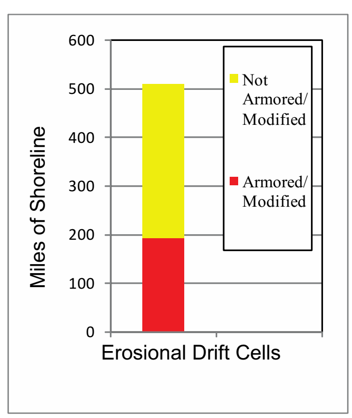
Forage fish spawn almost exclusively on erosional drift cells. Their spawning habitats are sustained by sediment erosion from coastal bluffs depositing or accreting along the shoreline in the direction of net-shore drift which is controlled by prevailing Puget Sound winds and currents.[4] The greatest impact to forage fish habitat on erosional drift cells is shoreline armoring, as it interrupts erosion, distribution and accretion of sediment.[5]

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, Growth Management Act (GMA) and Priority Habitats and Species (PHS) program, yet these habitats remain vulnerable to shoreline armoring and modification. Considering the critical ecological role of erosional drift cells for forage fish spawning, additional regulatory focus must work to stop additional armoring in these critical habitats. Additionally, incentives must be created to support the removal of these impacts.

193 of 510 miles of erosional drift cells in the northern Whidbey basin, Padilla and Samish bays have already been armored or modified.





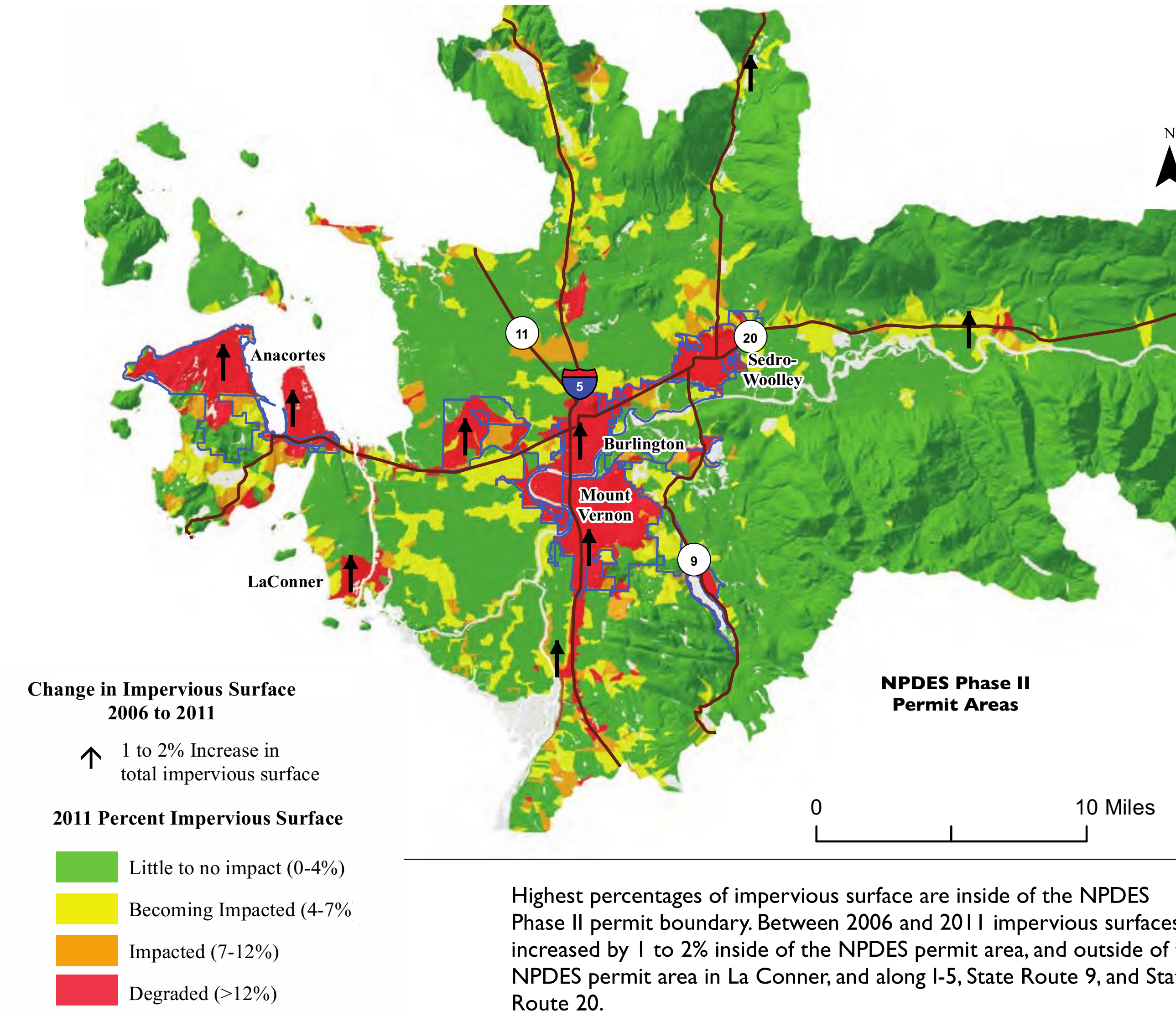


94% of documented forage fish spawning in the northern Whidbey basin, Padilla Bay and Samish Bay occurs along erosional drift cells, and 38% of the shoreline of these drift cells is already armored or otherwise modified.[6]

Data Sources: PSNERP 2008,[7] SSHIAP 2004,[8] WADNR 2014b,[9] WAECY 2011a,[10] WAECY 2013b[11]

Skagit County Provides Less Stormwater Protection Outside of Cities, Towns and Populated Places

Between 2006 and 2011 impervious surfaces increased by 1 to 2% inside of the NPDES Phase II permit area of Anacortes, Mount Vernon, Burlington, Sedro Woolley and Concrete and outside of the NPDES Phase II permit area in La Conner, and along I-5, State Route 9 and State Route 20.[1,2]

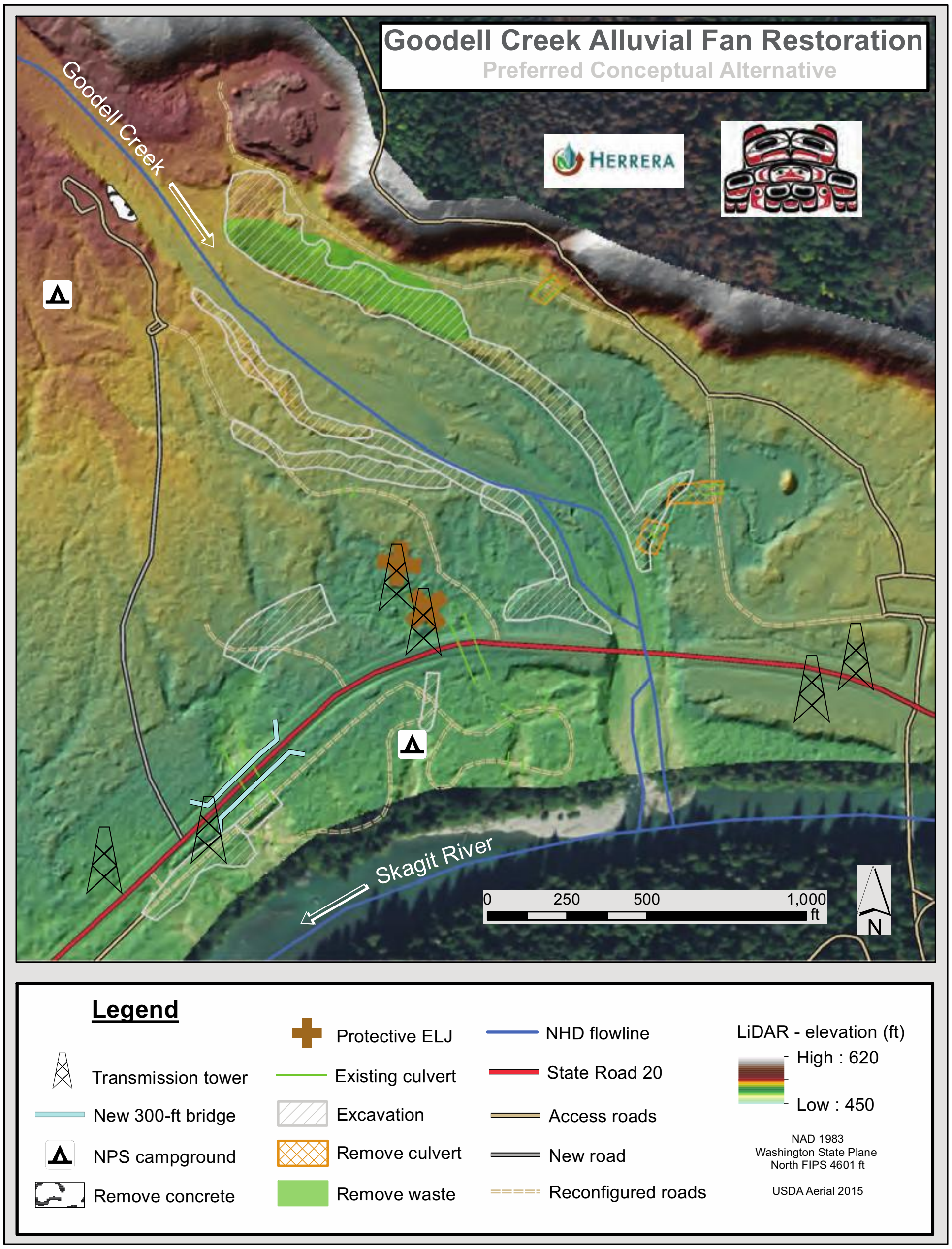


Highest percentages of impervious surface are inside of the NPDES Phase II permit boundary. Between 2006 and 2011 impervious surfaces increased by 1 to 2% inside of the NPDES permit area, and outside of the NPDES permit area in La Conner, and along I-5, State Route 9, and State Route 20.

Increasing percentages of impervious surface potentially increase pollutants to stormwater, which further degrades water quality and salmon habitat. In Skagit County, the requirements for stormwater management are different inside of the National Pollution Discharge Elimination System (NPDES) Phase II permit area than they are outside of that permit area. Inside the permit area, there will be a Low Impact Development (LID) requirement for new development and re-development. Outside of the permit area, LID will be allowed but will not be required.[3] Inside the permit area, the technical basis for stormwater management requirements will be full compliance with the 2012 Stormwater Management Manual for Western Washington. Outside the permit boundary, single-family residences on parcels greater than 1 acre (the vast majority of county development), are only partially required to comply with the manual.[4] Those living outside of the NPDES permit area deserve the same level of water quality protection as those living inside the permit area. Skagit County's current stormwater management plan, which separates those inside the permit area from those outside the permit area, is not providing equal stormwater protection for everyone.

Data Sources: NLCD 2006,[5] NLCD 2011,[6] SSHIAP 2004,[7] WADNR 2014b,[8] WAECY 2012[9]

Federal Land Habitat Restoration Important to Treaty Resource Protection



The Goodell Creek watershed is in the North Cascades National Park, a relatively intact ecological setting. However, the alluvial floodplain at the mouth of Goodell Creek lies within the Ross Lake National Recreational Area, and is restricted by a system of roads and levees, power transmission lines and undersized stream crossings.[1]

To restore natural alluvial fan and floodplain processes, levees need to be removed, service roads need to be re-sited and State Route 20 stream crossings need to be expanded. This action would increase productivity for multiple salmonid species, including threatened Chinook and steelhead, and would promote ecologically diverse life history strategies within these populations. Proper functioning of the high-elevation Goodell watershed will be particularly important as climate change drives increasingly negative impacts to tribal resources.

Even federally owned public trust lands that are protected in national parks, forests, recreational areas and wilderness designations may exhibit a history of ecosystem disturbance. These legacy issues are often overlooked for restoration opportunities, or worse, are deemed to be considered the new baseline for addressing future environmental and fishery-related impacts.

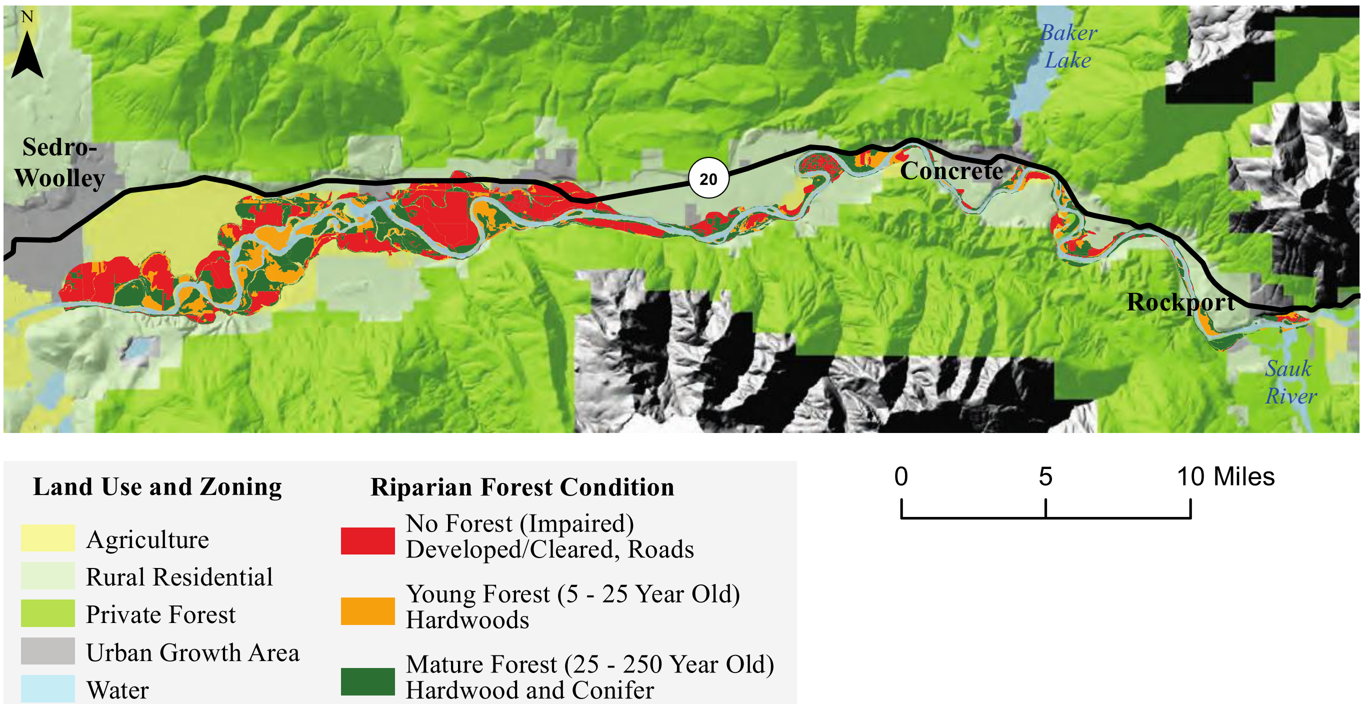
The Tribe has focused on working with federal trustees to identify these legacy issues, and partnerships to support the trust responsibility and treaty rights. Restoration of these lands is an important aspect of treaty resource protection.

The Upper Skagit Indian Tribe recently received SFRB funding for the feasibility planning of the Goodell Creek project. The Tribe is leading the collaborative effort with the National Park Service, Seattle City Light and state Department of Transportation to analyze and discuss the costs and benefits of constructing the restoration project. This planning phase will be crucial to identifying the funding strategy and determining how quickly the project will move ahead toward design and construction.

Land Use Impairs Forests of Floodplain

In the Middle Skagit River floodplain, approximately 55% of the floodplain's land area has been cleared of native forest and is being maintained and cleared for human development.[1] This type of land use is considered an impaired floodplain forest. Based on satellite imagery data, this level of floodplain impairment has not changed in at least the last 20 years.[2] Continued floodplain forest impairment is one reason the Middle Skagit remains a juvenile rearing bottleneck to population production.[3] As long as floodplain forests remain impaired, salmon conservation activities will not fully succeed.

Skagit County land use and forest condition in the Middle Skagit River floodplain



An estimated 73% of the Middle Skagit floodplain is zoned for agriculture.[4] While Skagit County recognizes that the state's Growth Management Act (GMA) requires protection of floodplain areas critical to fish and wildlife habitat, it is primarily focused on allowing ongoing agriculture practices and has focused its efforts on protecting agricultural interests in the county.[5] As a result, Skagit County has opted against mandatory critical area buffers where the floodplain and agriculturally zoned lands overlap, and instead opted for a set of Watercourse Protection Measures for Ongoing Agriculture. In 2011 the county enrolled in the Washington State Voluntary Stewardship Program (VSP), but due to a lack of state funding, has yet to implement this program. If water quality or critical area violations from agricultural practices are reported under this new program, the county can enforce Watercourse Protection Measures. However the program does not seek to monitor activities and only responds to voluntary reports.

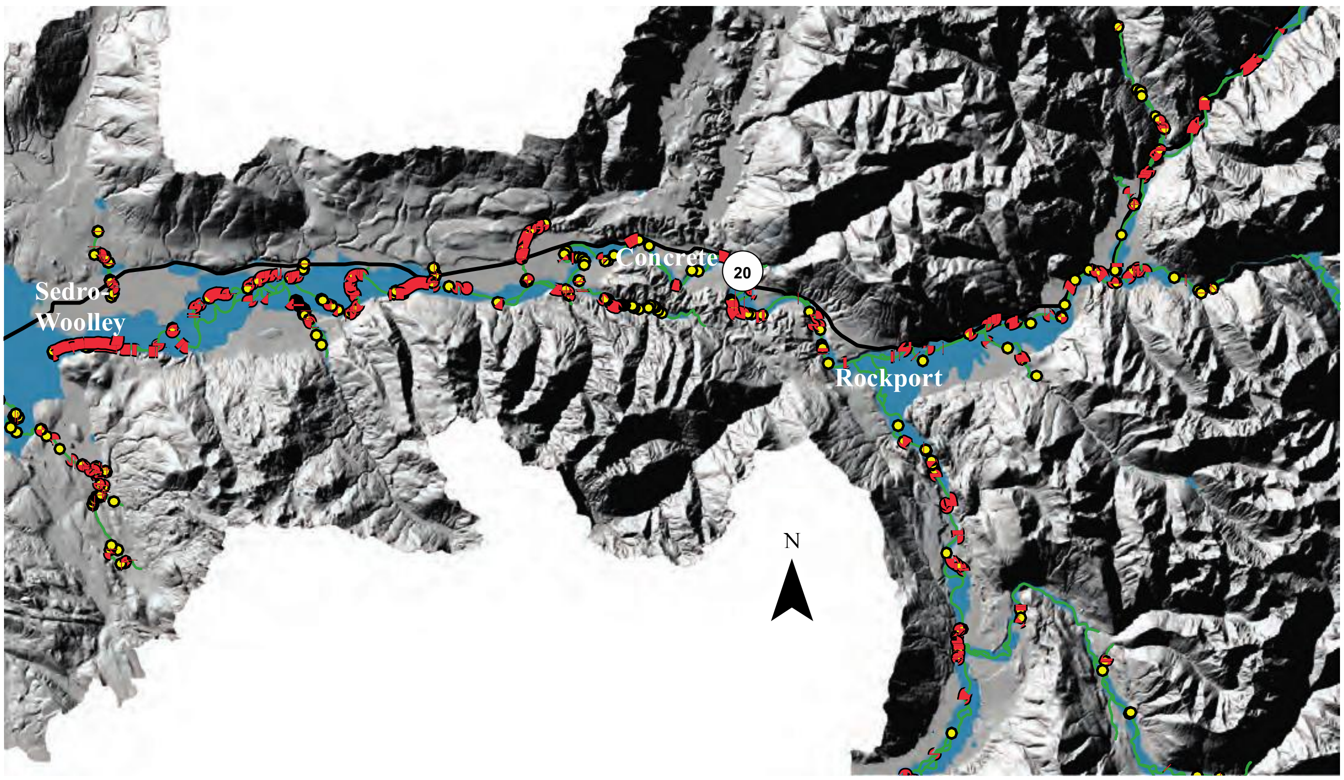
John Scurlock

Aerial view of the Middle Skagit River floodplain.

Data Sources: Skagit Co. 2010,[6] Smith et al. 2011,[7] WAECY 2011b[8]

Shoreline Management Exemption for Existing Residences Leaves the Skagit River Vulnerable

The Upper Skagit Tribe recently completed a survey of hydromodifications along streambanks within floodplains of the Skagit River watershed, with a focus on Chinook salmon habitat. They surveyed 220 miles of stream and found 32.1 miles of hydromodified bank along Chinook-bearing waters.[1] There is not clear evidence of riprap being removed from the Middle Skagit River since 2005.



499 structures and 32.1 miles of armoring have been built upon the streambanks of Chinook-bearing waters within the floodplains of the Skagit River watershed.[4,5]

Shoreline armoring's impact to Chinook salmon is direct; juvenile densities are up to five times lower along armored shore than along natural shore, and they are disconnected from acres of floodplain habitat historically available to them.[2,3] To protect Skagit River's shoreline and floodplain from future armoring, Skagit County is proposing a Rural Conservancy – Skagit River Floodway environmental designation for the middle Skagit River reach. This designation should prohibit construction of residences, other structures and associated shoreline armoring. However, existing residential structures still receive an exemption, both from state and from county shoreline regulations, and may be allowed to armor shoreline for protection. Ongoing agriculture within the Skagit River Floodway may also be able to claim exemption from county SMP shoreline armoring regulations, but the Skagit flood ordinance should prohibit shoreline armoring to protect agricultural land within the Rural Conservancy – Skagit River Floodway.

The Skagit Chinook Recovery Plan calls for removal and/or relocation of dikes and levees wherever possible. Beginning with the Skagit Chinook Recovery Plan and continuing with the Skagit Watershed Council, a strategy for acquiring floodplain parcels and removing riprap has been developed in the Middle Skagit River. Much of the strategy remains conceptual, however, and there is no clear evidence of riprap removal in the middle Skagit River since 2005.

Data Sources: SSHIAP 2004,[6] SRSC 2005,[7] USIT 2015[8]

Climate Change and Fisheries Management: What does the future hold and are we ready to manage it?

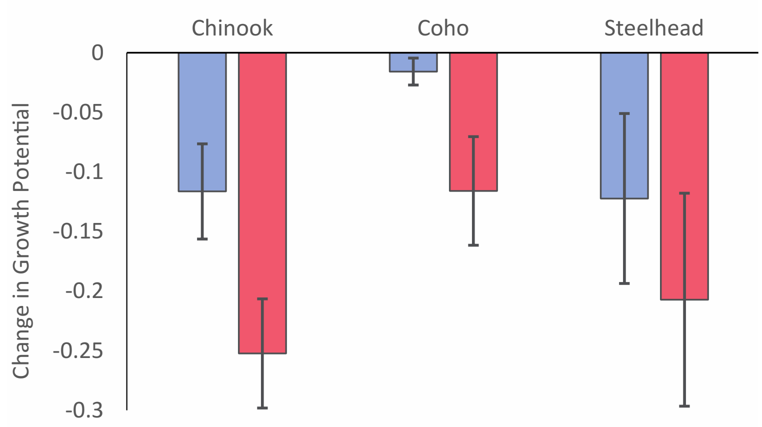
Climate change is real, and salmon ranges, timing and productivity are responding to this change. Fishery management needs to adapt more quickly to be effective with novel freshwater and ocean conditions. USIT seeks support to improve capacities to detect and predict impacts of climate change on salmon populations. They also seek coordination to improve fisheries management to incorporate these novel conditions and the variability associated with them to ensure treaty rights can be exercised in the future.

Climate change has already had dramatic influence on salmon populations and has driven changes in ranges,[1] return timing in adults[2] and productivity.[3] In addition, climate change has been identified in altering evolutionary trajectories of some salmon species.[4] These changes are happening rapidly and dramatically alter the underlying ecology of Pacific salmon management. Conditions in 2015 are an example of how different and how complex these changes can be with novel situations such as the Pacific "blob," an area of extremely warm water off the west coast of North America, and more variation in El Niño events that influence water temperature and precipitation rates in streams and rivers. Fisheries managers have little information regarding the influence of these events on salmon populations and the fisheries that interact with them.

Managers, policy makers and politicians have been slow to accept, understand and assimilate this change that may soon result in a mismatch between real salmon biology and the assumed biology of salmon management. Many underpinnings of salmon management have been established over recent decades, such as population forecasting and fishery exploitation rates. For example, many models used for forecasting and fisheries implementation are built from historical conditions, conditions that may not hold true today or as climate change becomes more of a reality. If the underlying ecology changes as predicted, then the underpinning of salmon management must be vigilant and flexible.

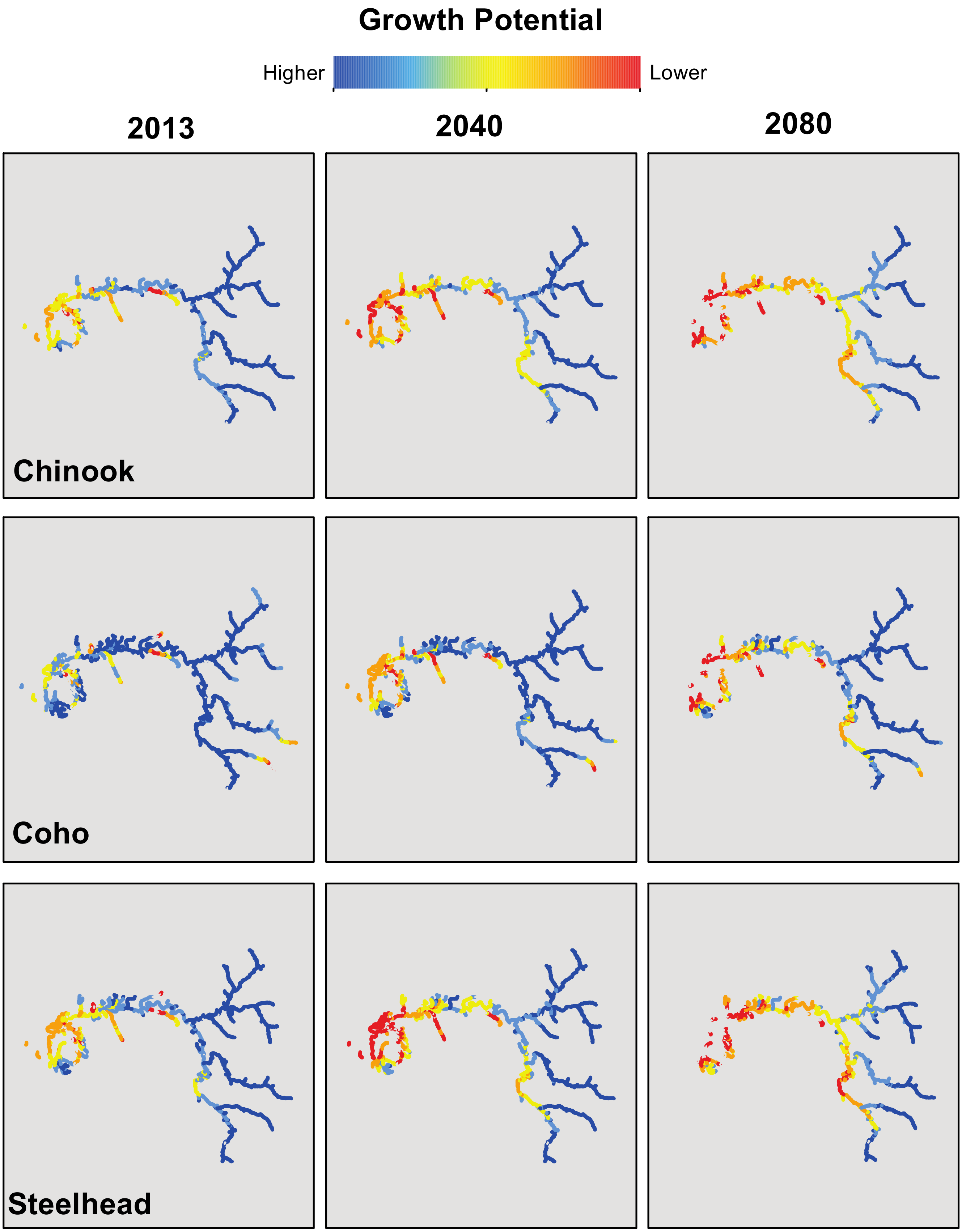
Upper Skagit Indian Tribe is working to understand the impacts of climate change on the salmon populations, to begin thinking about future fisheries management and treaty rights. USIT staff have begun assessing potential climate change impacts on juvenile production for the Chinook, coho and steelhead that Upper Skagit people rely on for cultural and subsistence needs, and a vital economic resource. In our analysis, which utilizes published methods,[5] each species assessed had varied responses to future climate scenarios. Chinook salmon productivity will decrease dramatically over the next 70 years, while coho productivity will decline only slightly. Steelhead will tend to decline but have more variable productivity over the landscape, suggesting that production will be high in isolated reaches, while more of the basin will support little productivity. We should be clear that temperature is only one aspect of climate impacts on salmonid populations and that we are working to develop a broad understanding of these processes. However limited in scope, this analysis shows how juvenile production might change over time and between species that could challenge future fisheries management.

USIT hopes that through extensive analysis of future changes in salmon ecology, co-managers of the Skagit River salmon populations can begin addressing potential changes in monitoring and management to be truly adaptive to changing conditions. We ask for leadership to work with us in addressing these concerns in hopes that these fish will persist and remain harvestable into the future.



Change in growth potential for juvenile Chinook and coho salmon and steelhead from 2013 to 2040 (blue) and 2013 to 2080 (red) in the Skagit River basin. The future loss of growth potential associated with increases in stream temperature varies for each species within the known anadromous zone.

Spatial extent of growth potential for juvenile Chinook, coho salmon and steelhead in 2013, 2040 and 2080 in the Skagit River basin. Future predictions suggest that much of the mainstem Skagit into the Sauk River will have temperatures that will decrease growth potential. The implications of these changes to co-management of the resource, tribal governance and future treaty rights is unknown.



Data Sources: SWIFD 2014,[6] USDA 2016[7]

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Upper Skagit Indian Tribe: Land Jurisdiction

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10 WAECY. 2011a. NHD Major Areas, Streams, and Waterbodies. 1:24000. From U.S. Geological Survey (in cooperation with others) National Hydrography Dataset. Olympia, WA: Washington Department of Ecology.

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Fecal Coliform Pollution Threatens Tribal Shellfish Harvest in Samish Bay

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Shoreline Armoring Threatens Forage Fish Habitat in Whidbey Basin, Padilla, Samish Bays

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Skagit County Provides Less Stormwater Protection Outside of Cities, Towns and Populated Places

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