SOUTH SOUND STRATEGY

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CONTENTS

ACRONYMS

Acronym	Full Name
ACUB	Army Compatible Use Buffer
AHSS	Alliance for a Healthy South Sound
AU	Assessment Unit
BEACH	Beach Environmental Assessment, Communication, and Health Program
B-IBI	Benthic Index of Biotic Integrity
CBSM	Community-Based Social Marketing
C-CAP	Coastal Change Analysis Program
CFS	Cubic Feet per Second
CMP	Conservation Measures Partnership
CNLM	Center for Natural Lands Management
CREP	Conservation Reserve Enhancement Program
CRP	Closure Response Plans
CWA	Clean Water Act
DERT	Deschutes Estuary Restoration Team
DNR	Department of Natural Resources
DOH	Washington Department of Health
ECB	Ecosystem Coordination Board
ECO	Education, Communication, and Outreach Network
ECY	Washington Department of Ecology
EPA	Environmental Protection Agency
GMA	Growth Management Act
HCP	Habitat Conservation Plan
HUC	Hydrologic Unit Codes
JBLM	Joint Base Lewis McChord
LIO	Local Integrating Organization
LWD	Large Woody Debris
MWCI	Marine Water Condition Index
NACWA	National Association of Clean Water Agencies
NEP	National Estuary Program
NGO	Non-Government Organization
NHP	Natural Heritage Program
NOAA	National Atmospheric Association
NPDES	National Pollutant Discharge Elimination System
NPST	Nearshore Project Selection Tool
NREP	Nisqually River Project
NTA	Near Term Action
NWIFC	Northwest Indian Fisheries Commission
O&M	Operation and Maintenance
OSS	Onsite Septic System

PCBs	Polychlorinated Biphenyl
PIC	Pollution Identification Correction Program
PSAR	Puget Sound Acquisition and Restoration Fund
PSNERP	Puget Sound Nearshore Ecosystem Restoration Project
PSP	Puget Sound Partnership
RCO	Washington State Recreation and Conservation Office
RCW	Revised Code of Washington
SMP	Shoreline Management Plan
SPD	Shellfish Protection District
SPSSEG	South Puget Sound Salmon Enhancement Group
SQI	Stream Quality Index
SSEA	South Sound Estuary Association
SSHIAP	Salmon and Steelhead Habitat Inventory and Assessment Project
TCD	Thurston County Conservation District
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WQI	Water Quality Index
WRIA	Water Resource Inventory Area
WSU	Washington State University

TABLES AND FIGURES

I. Executive Summary

The mission of the Alliance for a Healthy South Sound (AHSS) is to support coordinated and collaborative decision-making aimed at restoring and protecting the ecological and socio-economic health of South Puget Sound. AHSS developed the South Sound Strategy (Strategy) in late 2015 and throughout 2016 with funding from the Puget Sound Partnership (PSP). The purpose of the Strategy is to serve as a science-based resource that identifies key South Sound focus areas, attributes associated with these focus areas, pressures affecting those attributes, and strategies for protecting and improving the species and habitats that make South Sound unique. The Strategy provides a framework for decision-makers as they consider what actions to emphasize as part of the broader effort to restore and protect Puget Sound and establishes a set of recovery targets.

Focus areas provide a logical framework for organizing recovery. As the Strategy was developed, the Alliance decided on the following six focus areas: Prairies and Oak Woodlands, Forest and Freshwater Habitats, Marine Nearshore Habitat, Water Quality, Shellfish, and Salmon. Within these focus areas, the AHSS assigned attributes, which are characteristics of ecosystem function. Each attribute can be further defined by existing and regularly updated data that can be spatially mapped within a discreet set of inlet and island groups in the South Puget Sound. To measure progress, several attributes have been assigned numeric recovery targets. The strategy is organized around focus areas and their attributes, and for each, includes a description of the background, baseline conditions, and current strategies, existing programs and actions to address restoration and protection.

Focus Areas

Prairies and Oak Woodlands

South Sound is home to the only remaining location of native prairies and oak woodlands in the Puget Sound region. Key threats to the remaining habitat are the conversation of land to agriculture or urban/suburban development, lack of natural disturbance, spread of invasive species, overgrazing, and habitat fragmentation. To address these threats, strategies focus on direct protection of intact areas, support and implementation of land management plans, implementation of local policies and regulations, and restoration of habitats through work with a variety of partners.

Forest and Freshwater Habitats

Forests and freshwater habitats continue to be impacted by population and development growth in the South Sound. Key threats affecting these habitats include conversion of land to housing and urban areas, roads and railroads, dams, tourism and recreation, spread of invasive species, and habitat fragmentation. These threats can be alleviated through continued work toward direct protection of intact areas, support and implementation of land management plans and policies, incentive programs for protecting and restoring natural areas and open space, supporting sustainable forestry efforts, educating people about the importance of ecosystem functions and services.

Marine Nearshore Habitat

The nearshore is the transitional zone between terrestrial, freshwater, and marine ecosystems. Its physical complexity, high productivity, complex food webs, and diverse habitats and organisms make it a focus of Puget Sound protection efforts. Pressures affecting this habitat include conversion of land for housing and commercial/industrial areas, roads and railroads, dams and marine levees, shoreline alterations and infrastructure, and tourism and recreation areas. Strategies to address these pressures include direct protection of intact areas, support and implementation of land management plans, supporting landowners to protect and restore riparian areas, and education and outreach on the importance of nearshore and marine processes.

Water Quality

Clean freshwater and marine water are vital to people and to fish and wildlife. Water is affected by many factors, both natural and human. Significant threats to water quality in the South Sound include changing land cover and increases in impervious surfaces, pollution from point and nonpoint sources, increasing temperatures, pet waste, recreation, spills, invasive species, and other emerging contaminants. Strategies to address these threats include protecting marine and freshwater shorelines, programs to identify and correct pollution, collecting and treating urban stormwater, concentrating urban growth areas, and providing incentives to keep land in natural land covers.

Shellfish

Shellfish are critical to the culture, economy, recreation and water quality of the South Puget Sound. Shellfish health and productivity are threatened by nonpoint source pollution from things like stormwater runoff, failing on-site sewage systems, sewage treatment plan outfalls, and marinas. Several strategies are intended to protect and restore shellfish beds, including reduction of contamination in stormwater runoff, improvements in maintenance and operation of septic tanks, identification and correction of point-source pollution, and conversion of on-site septic systems to sewer.

Salmon

Salmon are vital to Puget Sound ecosystem processes, recreation, economy, and culture. There are ten species of salmon native to the area and South Puget Sound is a documented feeding ground for stocks from other Puget Sound waters. Salmon recovery work in Puget Sound is a longstanding and well-known process; the South Sound Strategy is intended to reinforce and complement and support existing salmon recovery plans, not replace current processes.

Education and Outreach

Education and outreach are critical to Puget Sound recovery and protection. Without an active and educated citizenry, recovery and protection action can quickly be negated through unintended or intended collective detrimental behavior of individuals on the Puget Sound ecosystem. Given the projected population increase in the Puget Sound region over the short, intermediate, and long term, education and outreach are key to ensuring that gains in environmental health and human well-being in the Puget Sound are durable and sustainable. AHSS encourages organizations to incorporate outreach and education into project design since outreach and education are most effective at the project level. For organizations with limited outreach and education capacity, this may require partnering with outreach and education-focused organizations.

Adaptive Management

AHSS will accomplish adaptive management of the South Sound Strategy primarily through ongoing discussions with the South Sound Technical Team and the AHSS Council. The AHSS Executive Committee will continue to make decisions about changes to South Sound goals or targets in response to advice from the Technical Team and Council. The AHSS anticipates at least one plan review per year; the review may be implemented as a session at the longstanding and well attended South Sound Science Symposium.

The AHSS notes that adaptive management and evolutionary decision making involve a combination of responding to scientific and technical information and interactions with policy makers, project sponsors, and the broader community so the overall South Sound Strategy can continue to reflect what is needed and what can be done.

How to Use the South Sound Strategy

The Alliance will use the South Sound Strategy to facilitate broad conversations about the work needed to protect and restore the South Puget Sound and to inform selection of projects for the AHSS to endorse and advocate. Currently the AHSS (like other LIOs) controls very little project funding; however, the Alliance is hopeful that this will change over time and, as it does, the AHSS anticipates using the Strategy to inform funding decisions.

AHSS encourages and welcomes the opportunity to endorse and advocate for projects that are consistent with the Strategy. The AHSS is particularly interested in projects that accomplish habitat protection and restoration, protection and restoration or shellfish beds, and stormwater reduction and control. All actions proposed for AHSS endorsement should demonstrate a sound scientific and technical basis.

II. Introduction

The South Sound Strategy (Strategy) was developed between late 2015 and fall 2016 by the AHSS, a Local Integrating Organization (LIO) funded through the Puget Sound Partnership (PSP). The Strategy is intended to guide decision making about ecosystem restoration and recovery in South Puget Sound by compiling the most up-to-date, high-quality data on key South Sound ecosystem focus areas, science-based priorities for what work to do where, and basic conceptual models that demonstrate why and how working on key South Sound focus areas will contribute to Puget Sound recovery.

The Strategy is organized around six ecosystem focus areas (e.g., forests) and 18 attributes that further represent those focus areas (e.g., forest cover). The Strategy establishes protection and recovery targets at both a local scale ("Inlet/Island group") and the entire South Sound scale for the six attributes. The Strategy will be revised by updating the existing data on key attributes, filling data gaps as new data sources are developed, and through adaptive management practices.

Vision for the South Sound Strategy

The South Sound Strategy uses high-quality data to describe the ecological processes occurring at the Inlet/Island scale in South Puget Sound, and opportunities to improve these processes. It also describes ongoing natural resource management efforts by South Sound organizations, and provides a framework by which these entities can make practical and opportunistic decisions around future priority preservation and restoration work.

Purpose of the South Sound Strategy

The South Sound Strategy is intended to serve the following purposes:

- Summarize and synthesize current, verifiable knowledge of South Sound ecosystems in a concise and usable format, including: status and trends, key threats and problems, and ongoing work
- Identify and describe overall South Sound recovery focus areas and broad goals
- Identify and describe quantifiable recovery objectives at an inlet/island group scale
- Identify and prioritize recovery strategies and opportunities and needs on an inlet/ island group basis
- Identify key gaps in information and understanding
- Serve as a guiding document for AHSS and partners

South Puget Sound Overview

South Puget Sound is the southern end of the larger Puget Sound fjord estuary complex, separated from central Puget Sound by a narrow, shallow sill associated with the Tacoma Narrows. The figure below shows the South Puget Sound Inlet & Island Group Boundaries.

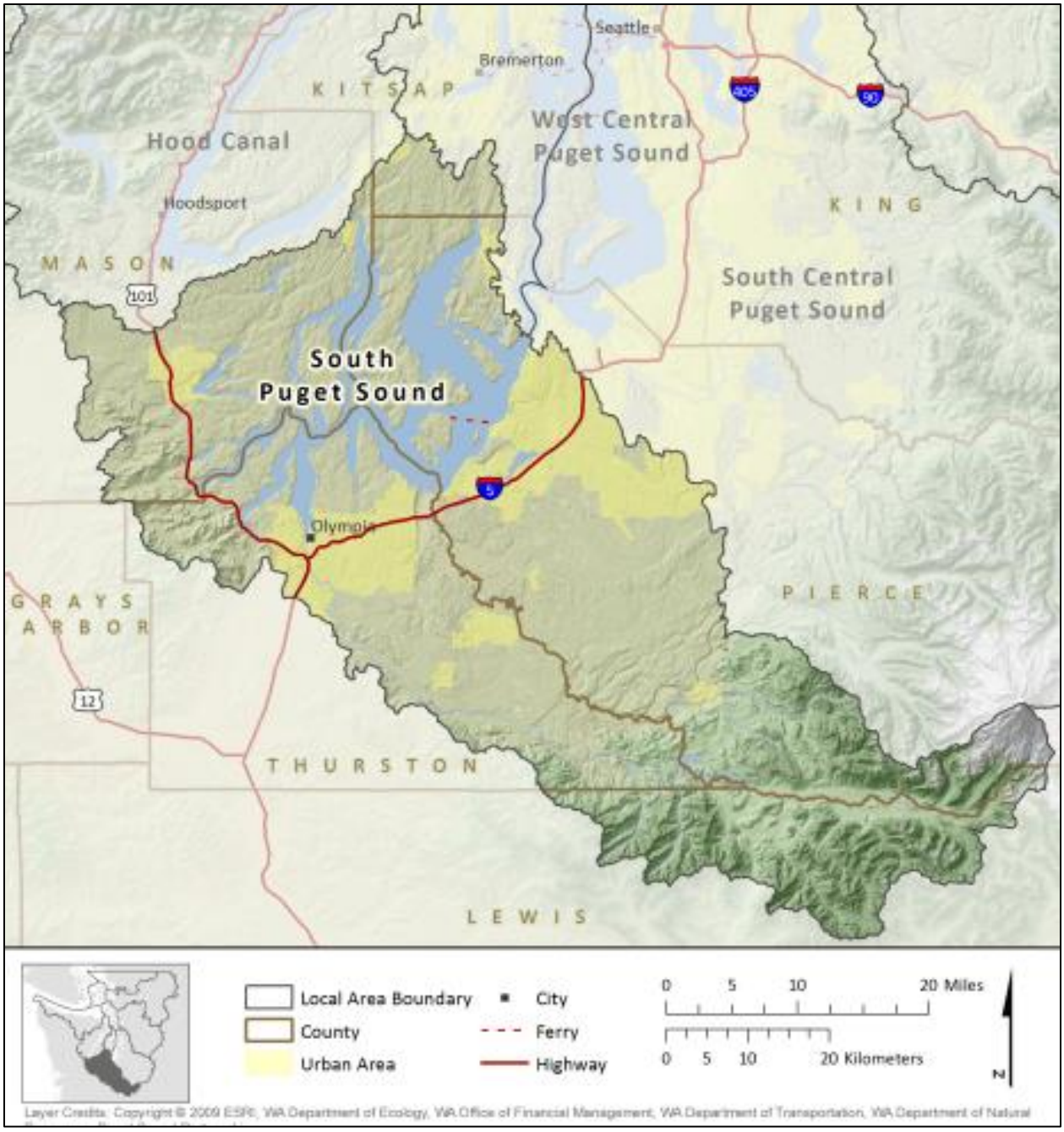


Figure 2.1. South Puget Sound Boundary

The Deschutes River and the Nisqually River are the major river systems in South Puget Sound. In much of the South Sound, steep bluffs bordering Puget Sound are intersected by small, steep ravines that drain the upland areas. There are several estuarine bays and lagoons located along the shorelines where these streams intersect with Puget Sound. When combined, the numerous streams that drain into South Puget Sound rival the biological output of large Puget Sound river systems.

The total surface area of marine waters in South Puget Sound is approximately 152 square miles, and there are nearly 450 miles of shoreline. More than 50% of South Puget Sound is less than 115 feet deep,

and only a very small percentage is deeper than 328 feet. Tidal ranges in South Sound are extensive, with maximum ranges upwards of 20 feet.

Hydrographically, South Puget Sound is very different from the main basin of Puget Sound. Many of the larger-scale physical and chemical processes found in greater Puget Sound are muted or accentuated in the South Sound due to the shallow sill at the Tacoma Narrows. This presents a unique set of conditions for physical, chemical, and biological interactions. Much of the South Sound has slow circulation and sensitivity to nutrients, causing a trend to low dissolved oxygen. In addition, the shallow nature of South Puget Sound provides a greater amount of sandy and intertidal habitat, which makes many of the bays and inlets more productive than the rest of Puget Sound.

Five Watershed Resource Inventory Areas (WRIA) drain into South Puget Sound:

- WRIA 11 – Nisqually
- WRIA 12 – Chambers-Clover
- WRIA 13 – Deschutes
- WRIA 14 – Kennedy-Goldsborough
- WRIA 15 – Kitsap

Of these five WRIA, only the Nisqually, Deschutes, and Kennedy-Goldsborough WRIA drain exclusively into South Puget Sound. WRIA 15-Kitsap shares its drainage with Central Puget Sound north of the Tacoma Narrows and Hood Canal. WRIA 12 - Chambers-Clover also extends north of the Tacoma Narrows to Commencement Bay.

Because of its stable and diverse economy, high quality of life, and relatively lower cost of living, South Puget Sound is among the fastest growing areas in Washington State. Between 2000 and 2010, the populations of Mason and Thurston Counties grew by 22%, the 4th and 6th highest rates of growth, respectively, among Washington State counties during that time; Pierce County grew at 14%. Between 2015 and 2040, the Office of Financial Management projects a population growth rate of 34% for Mason and Thurston Counties, and a growth rate of 25% for Pierce County.

Much of the population in South Sound is clustered in and around the towns and cities of Shelton, Olympia, Lacey, Tumwater, Steilacoom, University Place, Lakewood, Tacoma, DuPont, the community of Allyn, and along shorelines. Land use varies from urban populations to rural and mixed use.

The waters of the South Sound provide some of the finest shellfish habitat in the world and present an array of recreational, commercial, and tribal harvest opportunities. Washington leads the country in production of farmed clams, oysters, and mussels, with an annual economic benefit of over $185 million, and Washington shellfish growers directly and indirectly employ over 2,700 people. The commercial shellfish industry is thriving, demand is expanding in markets worldwide, and clean water is the essential catalyst for continued success. Recreational use of the shorelines for clam digging, swimming, boating, fishing, and beachcombing on state, county, city, and private beaches is popular.

Use of marine waters and nearshore areas by juvenile salmon and trout rates high in South Puget Sound, not only for salmonids coming from freshwater systems in the area, but also during summer when salmon from elsewhere in Puget Sound, and even British Columbia, are known to feed in the rich South Sound.

The AHSS Executive Committee is comprised of representatives from the following organizations:

- Nisqually Indian Tribe
- Mason County
- Pierce County
- Squaxin Island Tribe
- Thurston County

The AHSS Council consists of representatives from the following organizations:

- AHSS Representative to the Ecosystem Coordination Board (ECB) (currently Dan Wryer)
- Capitol Lake Improvement & Protection Association
- Chambers-Clover Creek Watershed Council
- City of Tumwater
- City of Olympia
- City of Lakewood
- Deschutes Estuary Restoration Team
- LOTT Clean Water Alliance
- Mason County
- Mason Conservation District
- Nisqually Indian Tribe
- Nisqually Land Trust
- Nisqually River Council
- Oakland Bay Shellfish Protection Area
- Pierce Conservation District
- Pierce County
- Port of Olympia
- South Puget Sound Salmon Enhancement Group
- Squaxin Island Tribe
- Tacoma-Pierce County Health Department
- Taylor Shellfish
- Thurston County
- Thurston Education, Communication, and Outreach (ECO) Network
- West Sound Watersheds Council
- Wilcox Farms
- WSU Extension

South Puget Sound Near Term Actions

Near Term Actions (NTAs) are activities that are "trackable, measurable, and necessary for Puget Sound recovery…They can be proposed by government agencies and tribes, academic institutions, non-profit organizations, as well as businesses and individuals." Organizations that participate in AHSS proposed several NTAs during the 2014 and 2016 updates to the Action Agenda for Puget Sound. AHSS's NTA proposal and adoption process is described in greater detail on the AHSS website. NTAs that are connected to specific sections of the South Sound Strategy are listed in their corresponding chapters. The list of 2014 and 2016 NTAs is also presented in Appendix B of this document.

South Puget Sound Assessment Units

The Strategy describes status and trend information and establishes protection and recovery targets at a local scale within a defined assessment unit (AU). For the marine nearshore ecosystems, information is summarized at the "Inlet/Island Group" scale and for upland terrestrial and freshwater ecosystems at the sub-watershed scale. Inlet/Island groups are different in their level of intactness and in their key pressures and opportunities for recovery progress. There are nine distinct South Puget Sound inlets and island groups:

- Case Inlet
- Carr Inlet
- Harstine Island Group
- McNeil Island Group
- Hammersley Inlet & Oakland Bay
- Totten & Little Skookum Inlets
- Eld Inlet
- Budd Inlet
- Henderson Inlet

These nine landscape regions are used in the South Puget Sound chapter of Puget Sound Salmon Recovery Plan, which drew from the division used by the State of Washington and the Treaty Tribes for harvest planning and management. The Salmon Recovery Plan notes that the boundaries also reflect a very natural division of the South Puget Sound ecosystem into distinct geographic units that display their own unique characteristics. These boundaries are illustrated in Figure 2.2 below.

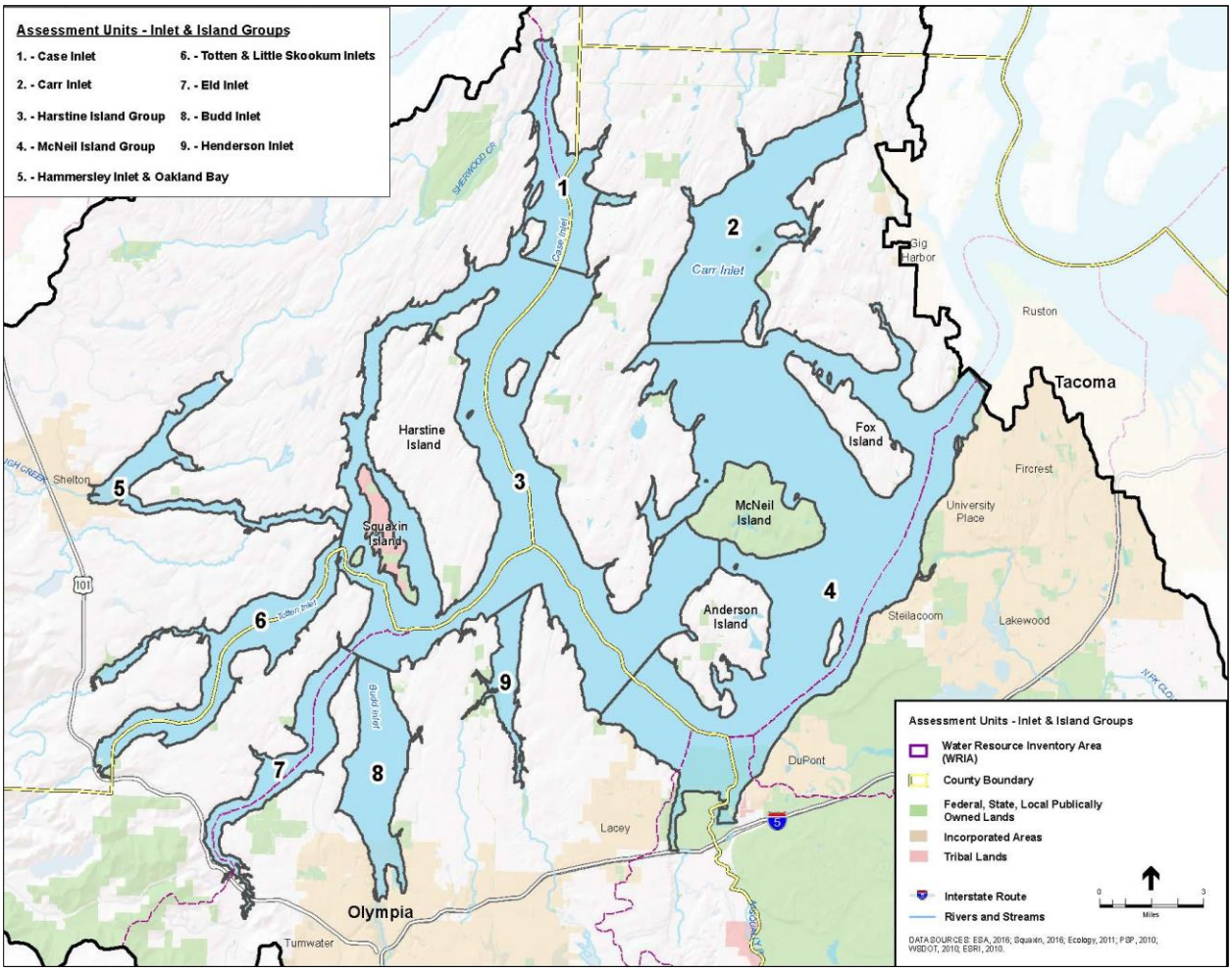


Figure 2.2. South Puget Sound Inlet & Island Group Boundaries

Upland terrestrial and freshwater ecosystems are described by sub-watershed AUs. There are 12 individual upland AUs and each map directly to the adjacent Island/Island Group. The upland AUs are (shown in Figure 2.3):

- Budd Inlet
- Eld Inlet
- Totten & Little Skookum Inlets
- Hammersley Inlet & Oakland Bay
- Harstine Island Group
- Case Inlet
- Carr Inlet
- McNeil Island Group
- Chambers Clover
- Nisqually
- Henderson Inlet
- Deschutes

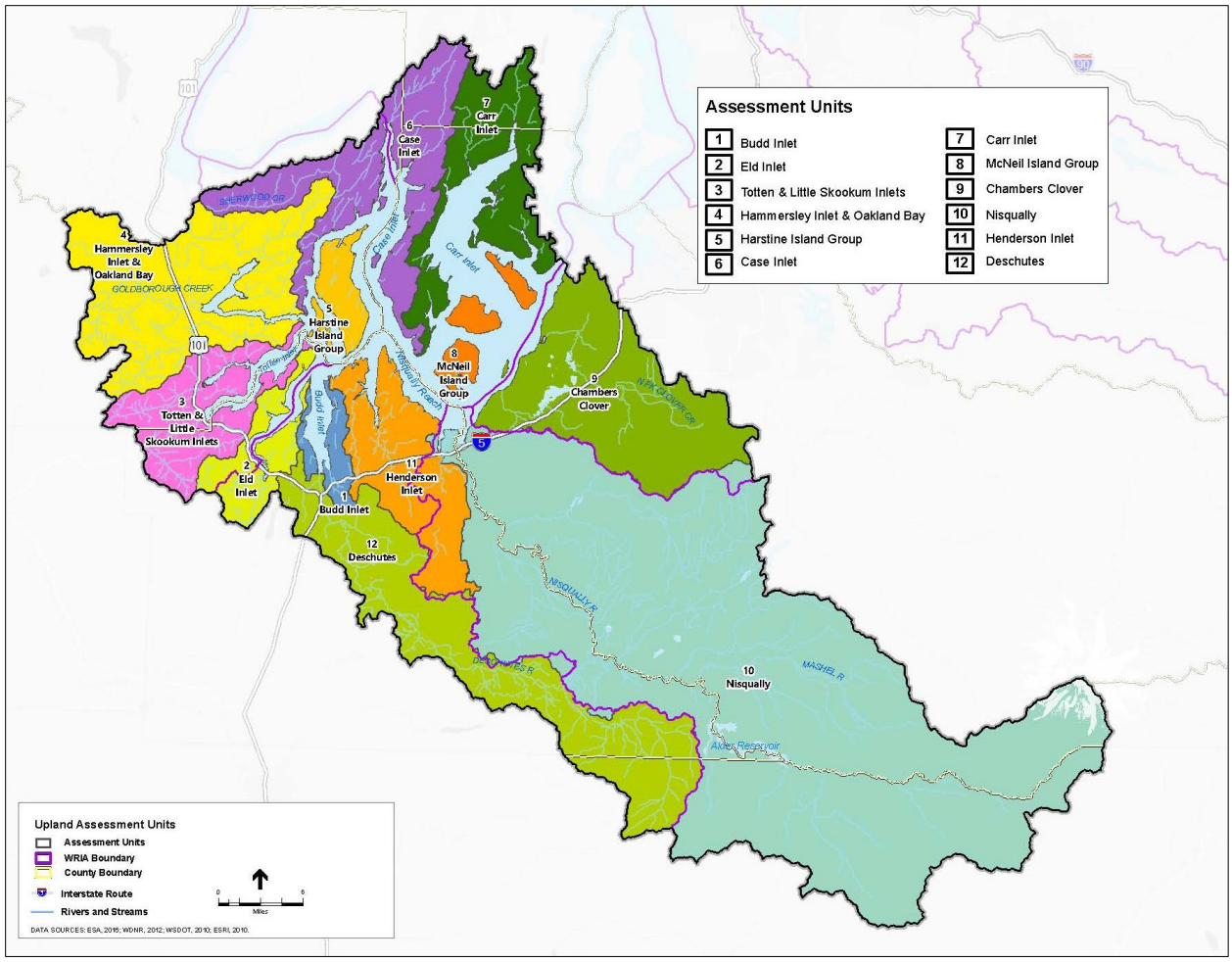


Figure 2.3. South Puget Sound Upland Assessment Unit Boundaries

Each Inlet/Island group is described in more detail in Appendix A.

Relationship to Existing Salmon Recovery Plans

The South Sound Strategy is intended to reinforce and complement existing salmon recovery plans. In the Strategy, the AHSS identifies and discusses focus areas, pressures, attributes, and related targets at a high level and from a broad perspective. These issues are further described - from a salmon-focused perspective - in local recovery plans including:

- Salmon Habitat Protection and Restoration Strategy WRIA-10 and WRIA-12 2012 (link)
- Salmon Habitat and Restoration Plan: WRIA 13, Deschutes 2016 (link)
- WRIA 14 Watershed Management Plan: Kennedy-Goldsborough Watershed 2006 (link)
- WRIA 15 Salmon Habitat Restoration Strategy: East Kitsap Peninsula 2005 (link)
- South Sound 4 year Workplan: "South Sound Chapter" (updated in 2016) (link)
- Nisqually Chinook Stock Management Plan 2011 (link)
- Nisqually Steelhead Recovery Plan 2014 (link)
- Nisqually Watershed Stewardship Plan (link)

Each plan describes salmon stock and watershed health, identifies limiting factors on salmon abundance, distribution, and productivity, and describes strategies and a list of prioritized actions to improve salmon. The AHSS expects that the salmon recovery work and priorities will continue to be a key driver for South Sound protection and recovery and that many of the projects that come forward for AHSS consideration and endorsement will have their origin in the salmon recovery work.

III. South Sound Focus Areas

The AHSS originally identified nine ecosystem focus areas covering a range of important habitats and species to provide a logical framework for organizing recovery planning. For the most part, the focus areas are expressed in terms of a broad directional goal. The AHSS modified and combined these nine to settle on six focus areas covered in the Strategy (due to time and resource limitations, the AHSS decided that the seventh focus area "Human wellbeing" would be addressed at a later date):

- Protection and Restoration of Prairies and Oak Woodlands
- Protection and Restoration of Forests and Freshwater Habitats
- Protection and Restoration of Marine Nearshore Habitat
- Improved Water Quality
- Expansion of Healthy, Productive Shellfish Populations and Harvest
- Increase in Abundance, Distribution, and Productivity of Native Salmon Species and Harvest

They then selected attributes and set targets to create tangible goals for recovery activities within each of the focus areas. Attributes are characteristics that can serve as indicators of the structure and function (i.e., health) of ecosystem focus areas. They can describe the status and trends of ecosystem focus areas (how much do we have and where is it?) and are meant to help understand whether ecosystem health is improving, declining, or staying the same. Recovery activities aimed at specific ecosystem focus areas can be measured and evaluated through these attributes. Each focus area chapter in the South Sound Strategy includes a set of directional strategies to guide improvements. Due to time and resources constraints, for this initial draft of the Strategy human wellbeing strategies and targets are not included. Future versions of the Strategy will include this information, using for example health indicators such as those developed by Tacoma-Pierce County Public Health Department (see 2015 Health Equity Assessment – link).

Focus areas and related strategies are summarized in Table 3.1 below:

TABLE 3.1: FOCUS AREAS AND RELATED STRATEGIES

Focus Area	Strategy
Prairie and Oak Woodlands	Direct protection of intact areas (e.g., through acquisition and transfer/purchase of development rights)
	Support and implement land management plans and regulations. Specifically, county and city growth management and critical area programs that concentrate growth in urban growth areas and protect sensitive prairie and oak woodland habitats
	Support to landowners to help them protect and restore prairie and oak woodland habitats (e.g., through investment in restoration and by incentivizing natural areas and open space, invasive species removal, and native plant establishment)
	Education and outreach about how prairie and oak woodlands support ecosystem functions and services to raise support for prairie and oak woodland protection and restoration efforts

Forest and Freshwater Habitat	Direct protection of intact areas (e.g., through acquisition and transfer/purchase of development rights)
	Support and implement land management plans and regulations, particularly county and city growth management and critical area programs that concentrate growth in urban growth areas and protect freshwater habitats such as lakes, wetlands, and streams
	Support to landowners to help them protect and restore freshwater habitats (e.g., through investment in restoration and by incentivizing natural areas and open space)
	Support for sustainable forestry efforts and sustainable agricultural practices, and for efforts to ensure these practices maintain or improve forest and freshwater habitat quality
	Education and outreach about how forest and freshwater processes support ecosystem functions and services (such as abundant salmon) that are important to people to raise support for forest and freshwater protection and restoration efforts.
Marine and Nearshore Habitat	Direct protection of intact areas (e.g., through acquisition and transfer/purchase of development rights)
	Support and implement land management plans and regulations, particularly local shoreline master programs that concentrate growth in urban growth areas and limit further shoreline alterations
	Support to landowners to help them protect and restore remaining marine riparian and other intact nearshore habitat and protect and restore sediment supplies and transfer particularly by removing or softening shoreline armoring, other alterations, and overwater structures (e.g., through investment in restoration and by incentivizing natural areas and open space)
	Education and outreach about how nearshore processes support ecosystem functions and services (such as abundant salmon) that are important to people to raise support for nearshore protection and restoration efforts
Water Quality	Direct protection of land adjacent to streams and lakes (e.g., through acquisition and transfer/purchase of development rights)
	Support and implement land management plans and regulations, particularly county and city growth management and critical area programs that concentrate growth in urban growth areas, protect sensitive habitats, and limit the amount of new impervious surfaces created, and local shoreline master programs that concentrate growth in urban growth areas and limit further shoreline alterations
	Support and implement stormwater management plans and regulations at a watershed scale
	Support and incentives to landowners to keep land in natural, or nearer to natural land covers, such as forest and agriculture
	Education, outreach, and support to landowners, particularly agricultural and livestock land owners, to help them limit pollutant loads to surface water through best management practices (e.g., through technical and financial assistance from conservation districts)
	Support and implement programs to identify and correct specific sources of pollution (commonly pollution identification and correction programs, or PIC)
	Support and implement programs that ensure septic systems do not create pollution and support and incentives for septic system owners to maintain their systems in good working order, and conversion of septic systems to sewer

	Reducing sources of pollution by choosing less toxic products and materials and encouragement of these choices by county and local governments, businesses, and residents
	Collect and treat urban stormwater to reduce pollutant loading, such as through stormwater retrofit actions and stormwater quality focused street sweeping
	Education and outreach about pollution reduction and how water quality supports ecosystem functions and services (such as shellfish harvest) that are important to people to raise support for water quality protection and restoration efforts
Shellfish Populations and Harvest	AHSS does not have separate, specific strategies for shellfish. The strategies for forests and freshwater, marine nearshore, and water quality all support shellfish protection and recovery by protecting and restoring shellfish habitat. More specific strategies (e.g., related to reintroduction of native shellfish) may be developed in the future.
Salmon	AHSS does not have separate, specific strategies for Salmon. The strategies for forests and freshwater, marine nearshore, and water quality all support salmon protection and recovery by protecting and restoring salmon habitat. In addition, AHSS actively supports local salmon recovery groups and the strategies and actions described in local salmon recovery plans

Because natural processes are the essential building blocks that create the habitats and species groups valued in South Sound, attributes that characterize natural processes are preferred by the AHSS. Ecosystem processes are interactions among physical, chemical, and biological attributes of an ecosystem that lead to an outcome of change in character of the ecosystem and its components (i.e., changes in ecosystem state) (Schlenger et al. 2011). Successful restoration or recovery is ensuring that these physical, ecosystem-forming processes that maintain landscape structure are restored to their natural spatial and temporal scales. The following ecosystem processes are considered important to South Sound recovery and ecosystem process maintenance by the AHSS:

- Sediment input/supply and transport
- Erosion and accretion of sediments
- Tidal hydrology/flow
- Fluvial sources of sediment and freshwater
- Detritus sources (recruitment and retention)
- Local geochemical and ecological processes (nutrient cycling, primary production, food web interactions)

For freshwater systems, life history models such as Ecosystem Diagnostic and Treatment (EDT) methods were used by the Puget Sound Salmon Recovery Plan to link environmental attributes actions and biological performance" (for salmon populations). The environmental attributes defined and used in the method are "those that traditionally appear in the literature to describe the relationship between biological performance and the environment." The AHSS attributes follow a similar chain of logic applied to a broader suite of habitats and species.

The AHSS considered a set of questions to identify and select attributes. These questions inquire about the attribute's relationship to focus areas' process and function, relationship to recovery actions, ability to measure, time/resources to measure, and the general logic for selecting the attribute.

1. What does this attribute convey about the underlying ecosystem process responsible for forming the structure and function of the focus area?
2. How would recovery actions be "shown" by this attribute? What type of recovery actions? (categories in mind included– conservation/protection, restoration, better management)
3. What is the relationship of this attribute to the focus area? Could the relationship be represented by other attributes that are being considered?

The AHSS began with a list of 90 potential attributes and narrowed it to 18. The resulting suite of attributes address all the key physical processes that form and maintain nearshore and upland habitats, the individual marine and freshwater species that are most important to the ecosystem and human wellbeing, and constitute a complete picture of the South Sound ecosystem. Attributes and ecosystem focus area are outlined in Table 3.2 below.

Table 3.2 Attributes and Ecosystem Focus Areas

Ecosystem Focus Area	Attribute
Prairies and Oak Woodlands	Native Prairie and Oak Woodlands
Forests and Freshwater Habitats	Forest Cover
	Freshwater Riparian Vegetation
	Fish Passable Streams
	Freshwater Flows in Rivers and Small Streams
Marine Nearshore Habitat	Intact Feeder Bluffs (sediment supply)
	Marine Riparian Vegetation
	Intact Large Estuaries
	Eelgrass Beds
	Herring Abundance and Distribution
	Surf Smelt and Sand Lance Abundance and Distribution
	Unmodified Shoreline
	Intact Small Estuaries
Water Quality	Freshwater Quality
	Benthic Macroinvertebrate Populations
	Marine Water Quality
Shellfish Population	Harvestable Shellfish
Salmon	Salmon Presence and Abundance (e.g., Chinook, Coho, chum, steelhead)

IV. South Sound Pressures

Pressures are human activities that give rise to stress in the ecosystem, such as development and pollution, and stressors are the proximate causes of change in the environment, such as shoreline armoring associated with development. Pressures and stressors are roughly equivalent to limiting factors as that term is used in salmon recovery planning, in that, like salmon limiting factors they disrupt natural processes and reduce the distribution, abundance, and viability of native species. Pressures and stressors focus entirely on human activities, whereas limiting factors analyses often include natural processes (such as drought or flood) as well.

In the South Sound, as in other parts of Puget Sound, many human activities create stress on the ecosystem, and influence and may disrupt many natural processes. Intact natural processes are critical for maintaining a sustainable and productive ecosystem, an ecosystem that provides goods and services vital to the South Sound economy and healthy, thriving human communities, including:

- Clean and abundant water for human use and consumption.
- Natural resource-based industries such as fishing, shellfishing and shellfish aquaculture, agriculture, and forestry.
- Cultural and traditional uses guaranteed to South Sound Tribal Nations.
- Recreation and tourism values.
- Aesthetic values and other culturally and economically important services.

Preparing a list of priority human pressures on the ecosystem is a complex task for at least two reasons. First, many activities that can threaten or disrupt natural processes ("pressures") also provide important benefits to humans (see above). The goal, therefore, is not to eliminate all pressures, but instead to understand and manage their influence to optimize both ecosystem and human benefits. Second, pressures operate on a series of nested spatial and temporal scales such that the most significant pressure in any given sub-watershed or any particular drift cell is highly dependent on the particular conditions and context in each specific place. AHSS identified pressures to highlight in this deliverable using existing assessments. Most pressures assessments, including the ones used here, focus at least in part on the prevalence of the pressure in the environment. This means places that are relatively less impacted by existing pressures, or pressures that have not yet been fully expressed, may show up as "lower" priority when, in fact, they should be the focus of special attention to prevent adverse impacts in the future. Similarly, pressures operate differently on different natural process or species endpoints, so a pressure that may appear less important overall may nonetheless be critically important to a species in a place.

In 2014 AHSS prepared a list of priority human pressures in South Puget Sound and used that list to shape identification of recovery sub-strategies and NTAs submitted for inclusion in the 2014 Puget Sound Action Agenda. To prepare an updated list of human pressures on the South Sound ecosystem for this effort, AHSS started from the 2014 work and examined two additional recent pressure assessments:

1. The Monitoring and Adaptive Management Phase 1 effort, completed in late 2014, examined and updated pressures on salmon throughout the South Sound and produced results for the South Sound watersheds and the Nisqually watershed. This process worked from existing pressure evaluations captured in the All Salmonid Species Recovery Plan for the Marine Waters of South Puget Sound and the Chinook Salmon Recovery Plan for the Nisqually Watershed and relied on local experts to evaluate and generate updated pressures lists.
2. The Puget Sound Pressures Assessment, completed in late 2014, used a combination of structured expert elicitation and geospatial analysis to rank the potential impact of human stressors. These stressors can be cross-walked with their sources to generate lists of pressures. Results are provided for South Sound watersheds and for the Nisqually watershed.

Each assessment was reviewed, and individual assessment results were tabulated, along with the 2014 AHSS priority pressures list. Two of the assessments, the 2014 AHSS work and the Puget Sound Pressures Assessment, produced results at the stressor level. Stressor results were cross-walked to the standard menu of human pressures used in PSP recovery planning for comparison to the other assessments.

The result of these efforts is a set of tables that allows comparison across the existing assessments. A binning process was used to identify pressures that were ranked highly in multiple assessments. Pressures that were identified as priorities in both locally focused assessments (the 2014 South Sound work and the monitoring and adaptive management work) were placed in bin 1; pressures identified as priorities in one or more of the locally focused assessments were placed in bin 2.

AHSS focused this initial recovery planning work on the subset of pressures that were identified as priorities in both local pressure assessments (i.e., bin 1, as described above). These are the following pressures: **Housing & Urban Areas; Roads and Railroads (including culverts); Shipping Lands and Dredged Waterways; Abstraction of Surface Water; Abstraction of Ground Water; Freshwater Shoreline Infrastructure; Marine Shoreline Infrastructure; Domestic and Municipal Wastewater to Sewer; Runoff from Residential and Commercial Lands; Agricultural and Forestry Effluents; and Air-Borne Pollutants**. To that list the AHSS Technical Team recommended, and the AHSS Executive Committee approved, addition of two stressors that were identified in only one of the local assessments but are known and significant problems in the south sound: **Dams**, **Freshwater and Marine Levees, Floodgates, Tide Gates**, and **Domestic and Commercial Waste Water to On Site Sewage**.

Pressures were then cross-walked to stressors using the PSPA stressor/pressure crosswalk provided by PSP, emphasizing stressors that had a “high” or “very high” relationship to initial priority pressures. Pressures/stressors from the resulting menu were crosswalked to the PSP sub strategies identified by AHSS as best representing current and emerging work, and then were further reduced (or focused) based on the content of AHSS’s current near-term actions included in the 2014 Action Agenda. This resulted in a quite limited list of pressures and stressors to highlight in this initial effort, as follows.

Housing & Urban Areas, Commercial & Industrial Areas, Tourism & Recreation Areas, Annual & Perennial Non-Timber Crops, Runoff from Residential and Commercial Lands: these pressures are

grouped because they generally represent pressure on the natural environment in the form of increased stormwater runoff, uptake of freshwater resources for human consumption, increased coverage by impervious surfaces, and altered peak and low water flows.

Roads & Railroads (Including Culverts): transportation infrastructure in South Sound has a significant impact on ecosystem function. Vehicle pollution and runoff into freshwater and marine water systems, and impediments to natural ecosystem function such as railroad levees and culverts, are significant stressors.

Freshwater & Marine Levees, Floodgates & Tide gates, and Freshwater & Marine Shoreline Infrastructure, Dams: this group of pressures shares several related stressors, including shoreline hardening, culverts and other fish passage barriers, altered peak and low flows from land cover change, prevention of flood flows, and shading of shallow water habitat. Addressing these pressures is considered a vital element of restoring natural ecosystem function in South Sound.

Agricultural & Forestry Effluents: given the large number of tribal, private, and government-owned forest lands, in addition to significant agricultural activities, South Sound partners are concerned with limiting persistent toxic chemicals in aquatic systems as well as conventional water pollutants.

Onsite Septic System(OSS) - Domestic and Commercial Wastewater to On-site Sewage Systems: poorly functioning on-site sewage systems can be a source of human pathogens into South Sound's ecosystem and can adversely affect multiple South Sound Vital Signs, including marine water quality, swimming beaches, shellfish beds, and freshwater quality.

These pressures are consistent with the pressures addressed by the actions in the 2016 and 2017 actions AHSS put forward for the Action Agenda, and continue to provide the initial focus for AHSS recovery planning in the South Sound. These are not, however, a complete list of pressures nor are they meant to limit the actions that South Sound partners take. The pressures identified here were drawn from a larger list based mostly on ongoing work and priorities – that is, the subset of priority pressures being addressed by priority actions were carried forward as representative of South Sound priorities at the time this Strategy was developed. However, the AHSS will not limit strategies and actions to only those that address pressures identified here.

As part of recovery planning, AHSS explored these pressures in a series of conceptual models in Miradi. Conceptual models describe how pressures and stressors act on the South Sound ecosystem. They also describe the actions, attitudes, and external factors that give rise to (or amplify) pressures, and identify strategies to address these factors and thereby lessen the adverse effects of pressures on ecosystem processes and functions. Conceptual models can be found in Appendix B.

V. Target Setting & Targets

Once selected, attributes were examined for their suitability for setting a numerical target as a desired future condition. When considering which attributes to identify for target setting, the AHSS took a largely pragmatic approach considering the availability of data and historic South Sound priorities as represented by current and proposed future work. The AHSS also considered:

- Availability of attribute data for the entire South Sound and the existence of an established, ongoing data collection program
- Relevancy of data collection program to AHSS objectives (i.e., focus on natural and habitat-forming ecosystem processes)
- Understanding of attribute and how to affect its condition through South Sound protection, prevention, restoration, and direct management actions
- Availability of finer scale data that is more appropriate or useful
- Whether an attribute could also demonstrate ecosystem benefits to humans
- How easily an attribute could be aligned with PSP Puget Sound scale vital sign targets

Attributes that were not suitable for target setting included those for which there is no established data collection program for the entire South Sound, those for which the AHSS does not believe there is adequate data or information to confidently connect actions to outcomes, and those that are covered by other attributes selected for target setting. In addition, for attributes where finer scale data are available (e.g., water quality and salmonid presence), the AHSS determined it was not useful or appropriate to set a target based on the coarse-scale data available for the entire South Sound and that instead the AHSS should rely, to the extent they exist, on finer scale locally derived targets developed by tribal governments, counties, cities, and as part of the South Sound salmon recovery work.

Of the 18 attributes the AHSS identified, it is setting new numeric targets for eight:

- Forest cover
- Freshwater riparian habitat
- Fish passage barriers
- Marine riparian habitat
- Intact large estuaries
- Intact small estuaries
- Intact feeder bluffs (sediment supply)
- Unarmored shorelines

The AHSS is adopting existing locally-derived numeric targets for three additional attributes:

- Summer low flows in rivers & small streams
- Salmon abundance and distribution

- Harvestable shellfish

For the remaining seven attributes, AHSS is not adopting specific numeric targets at this time but may in the future.

The AHSS's approach to setting targets was to identify numerical values which could measure progress in protecting and restoring the subject attributes. Generally, each target has a protection component, which focuses on completing restoration sufficient to recover the attribute in priority areas. This focus on locating restoration in the best (most intact) areas is based on experience that many of the restoration projects funded through recovery work, particularly those focused on marine nearshore and freshwater habitats, are relatively small-scale. These small-scale projects are more likely to provide sustainable ecosystem lift if they are placed in areas that are already relatively intact. To determine where to focus protection and restoration efforts AHSS relied on two locally derived watershed-level characterizations. Both the South Sound Coastal Catchment Assessment and the Juvenile Salmon Nearshore Project Selection Tool (NPST) Beneficial Model evaluations cover the entire South Sound nearshore.

The Coastal Catchment Nearshore Assessment for South Puget Sound uses locally derived data as well as information from the Puget Sound Nearshore Ecosystem Restoration Project (PSNERP) and the Northwest Indian Fisheries Commission (NWIFC) to provide a strategic restoration and conservation framework for the nearshore. Shoreline catchments and their neighboring upland catchments are evaluated for the condition of key ecological functions and habitats. Based on the evaluation, geographic priorities for protection/conservation and restoration/enhancement are identified. These areas constitute approximately 37% of the South Sound shoreline, or 148.7 miles, and are where restoration and protection projects are most likely to be successful over time.

The Coastal Catchment Nearshore Assessment was supplemented by application of the Juvenile Salmon NPST Beneficial model (commonly NPST). The NPST identifies priority salmon habitats in the South Sound (i.e., pocket estuaries, salmonid bearing freshwater tributaries, eelgrass beds, and emergent marsh), evaluates the presence of attributes that would improve the quality of the habitat for salmon, e.g., saltmarsh, proximity to fresh water inputs), and produces a spatial representation of areas of the South Sound nearshore where protection and restoration projects would most benefit juvenile salmon. Area identified by the NPST comprises approximately 42 percent of South Sound shoreline, or 169.2 miles, and includes important areas for salmon (e.g., the Nisqually Reach; lower Budd Inlet) that are not part of the Coastal Catchment Nearshore Assessment. Like the Coastal Catchment Assessment, use of this analysis results in both a numeric value for targets and a set of geographies where work will be most fruitful. Where NPST habitats do not intersect with Coastal Catchment priorities larger or more clustered projects are recommended. Used together the Coastal Catchment Assessment and the NPST identify 64 percent of South Sound shoreline as a priority for restoration, or 255.3 miles. 15 percent, or 62.7 miles, are identified as a priority in both assessments.

Where local watershed-scale assessments were not available at the South Sound scale, AHSS used available Puget Sound scale characterizations or other studies.

Targets were set by overlaying information on attributes (e.g., marine riparian vegetation) with the geographic areas identified as a priority by the Coastal Catchment Assessment and/or the NPST. The resulting targets both provide a numeric goal for restoration and direct project sponsors to the geographies that will be most fruitful for restoration work. For areas that use this method, only actions which take place in the high-priority geographies will count toward the target. In general, the priority Coastal Catchment Assessment areas are appropriate for smaller-scale protection and restoration projects as well as larger or clustered projects, and the priority NPST areas are more appropriate for larger or clustered projects that directly benefit juvenile salmon. Targets were set at an inlet/island group scale and aggregated to the South Sound scale.

The South Sound targets are scientifically rigorous and purposefully aggressive in terms of the total area addressed, and AHSS fully expects that progress toward the targets will be incremental. AHSS took this approach to emphasize the scope and breadth of restoration work that is necessary in the South Sound and to reach toward the question often asked in these sorts of planning efforts: how much is enough? While that question cannot be answered with certainty, the AHSS believes that if remaining intact attributes are protected, and all attributes in all priority areas are restored, this will achieve significant progress toward restoring ecological processes and functions. The AHSS chose to present a version of the complete picture, based on locally derived watershed-scale assessments of where work makes the most sense, rather than establish more incremental targets based on an assessment of what might be possible in any given timeframe. The determination of incremental targets is subject to funding opportunities, willing landowners and other vagaries. Subsequent work can identify how much progress toward each of the targets is realistic over the next three, five, ten years, and, as needed, adaptive management provides an opportunity to refine targets over time.

Table 5.1 lists attributes and targets and summarizes the methodology and data used for each. Individual attributes and targets are discussed in more detail in the sections of the plan addressing related ecosystem focus areas, strategies, and actions.

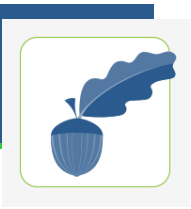
Table 5.1 Methodology and data used for each attribute and target

Ecosystem Focus Area	Attribute	Target	Data Source(s)	Date - Period
Prairies and Oak Woodlands	Native Prairie and Oak Woodlands	No new local targets at this time. Coordinated and ongoing efforts will maintain 100% of all remaining prairie and oak woodlands (as classified by WDNR Heritage Program data), place lands in protected status, and work to restore historic extant areas as identified and prioritized in current management plans.	WDNR NHP Oaks and Grasslands of the Puget Trough Ecoregion dataset (link) USGS National Inventory of Protected Areas (link)	2005
Forests and Freshwater Habitats	Forest Cover	FOREST: (1) Protect and maintain forest in all of the HUC 12 assessment units (below) that have currently have greater than 65% cover, (2) Restore forest cover to above 65% in the following HUC 12 assessment units: Burley Creek-Frontal in Carr Inlet and Cranberry Creek Frontal in Oakland Bay, (3) Restore forest cover to above 60% in the lower and middle Nisqually watershed (included units: Lower Nisqually, McAllister Creek, and Middle Nisqually). IMPERVIOUS: No new targets at this time, but reference existing effective impervious surface targets adopted at local levels (if available).	NOAA C-CAP 2011 (link)	Every 5 years from 1992-2011 (NOAA-funded program)
	Freshwater Riparian Vegetation	(1) Protect all intact fresh water riparian habitat in areas identified for protection or restoration in the Ecology watershed characterization, 25,664 acres; and (2) restore 5,197 acres of fresh water riparian habitat in areas identified for protection or restoration in the Ecology watershed characterization.	NOAA C-CAP 2011 (link)	Every 5 years from 1992-2011 (NOAA-funded program)
	Fish Passable Streams	(1) Restore the four partial barriers in Carr Inlet, Henderson Inlet, and Nisqually that have a WDFW Priority Index greater than 50, (2) Prioritize restoring both total and partial barriers that have a WDFW Priority Index between 25 and 50 (50 barriers).	WDFW Fish Passage Database (link)	Ongoing updates
	Freshwater Flows in Rivers and Small Streams	No new targets at this time; reference existing local targets as available.	USGS Gage Monitoring (link)	USGS 1975-2014
Marine Nearshore Habitat	Intact Feeder Bluffs (sediment supply)	(1) Protect all drift cells with >80% intact feeder bluffs throughout South Sound, 92.5 miles, of which 61.7 miles are in the areas identified as a priority in the Coastal Catchment Assessment and/or the NPST for Juvenile Salmon.	Puget Sound Feeder Bluff Shore Type Mapping (Ecology 2013) (link)	2013

Ecosystem Focus Area	Attribute	Target	Data Source(s)	Date - Period
	Marine Riparian Vegetation	(1) Protect all intact marine riparian habitat throughout South Sound, 260 miles, of which 170.3 miles are in the areas identified as a priority in the Coastal Catchment Assessment and/or the NPST for Juvenile Salmon; and (2) restore 36.6 miles of degraded marine riparian habitat in the areas identified as a priority in the Coastal Catchment Assessment and/or the NPST for Juvenile Salmon.	NOAA C-CAP 2011 (link) Squaxin Nearshore Assessment Tool (link)	Every 5 years from 1992-2011 (NOAA-funded program)
	Intact Large Estuaries	(1) Protect all intact large estuary shoreline throughout South Sound, 15.7 miles, of which 15.5 miles are in the areas identified as a priority in the Coastal Catchment Assessment and/or the NPST for Juvenile Salmon; and (2) restore 1.5 miles of degraded large estuary habitat in the areas identified as a priority in the Squaxin Island Tribe NPST for Juvenile Salmon.	Squaxin Nearshore Assessment Tool (which was based on WDNR ShoreZone) (link)	2016
	Eelgrass Beds	Eelgrass beds are expected to benefit from actions to improve water quality and marine nearshore habitat. A target for eelgrass beds may be set in the future.	Squaxin Nearshore Assessment Tool (WDNR ShoreZone data for eelgrass) (link) WDNR Puget Sound Eelgrass Monitoring Main Geodatabase (link)	WDNR Eelgrass dataset 2000-2014 (last updated)
	Herring Abundance and Distribution	We are not confident that we could directly attribute changes in Squaxin Pass herring abundance and distribution to local actions and are therefore not setting a target at this time. A target may be set in the future.	WDFW Puget Sound Herring Spawning Biomass Estimates (link)	1973-2010
	Surf Smelt and Sand Lance Abundance and Distribution	Surf smelt and sand lance are expected to benefit from actions to improve marine nearshore habitat. A target for surf smelt and sand lance may be set in the future.	Priority Habitat Species (WDFW 2016) - doc_sand_lance_spawning; doc_smelt_spawning; herrhold; herrspwn. Integrated Nearshore Priorities Project (link)	WDFW PHS, 2016 INP, 2014
	Unmodified Shoreline	(1) Protect all intact shoreline throughout South Sound, 278.6 miles, of which 201.7 miles are in the areas identified as a priority in the Coastal Catchment Assessment and/or the NPST for Juvenile Salmon; and (2) Restore 73.1 miles of modified shoreline in the areas identified as a priority in the Coastal Catchment Assessment and/or the NPST for Juvenile Salmon.	Squaxin Nearshore Assessment Tool (link)	2014

Ecosystem Focus Area	Attribute	Target	Data Source(s)	Date - Period
	Intact Small Estuaries	(1) Protect all intact small pocket estuary shoreline throughout South Sound, 85 miles, of which 82.4 miles are in the areas identified as a priority in the Coastal Catchment Assessment and/or the NPST for Juvenile Salmon; and (2) restore 14.3 miles of degraded small estuary habitat in the areas identified as a priority in the Coastal Catchment Assessment and/or the NPST for Juvenile Salmon.	Salmon and Steelhead Habitat Inventory and Assessment Project (SSHIAP) (link) Squaxin Nearshore Assessment Tool (which was based on WDNR ShoreZone) (link)	SSHIAP (current) WDNR ShoreZone 2000
Water Quality	Freshwater Quality	No new targets at being set at this time; however, AHSS supports local county level targets for water quality improvement and may set a South Sound target in the future.	Statewide Water Quality Monitoring Network (Ecology) (link) As summarized in PSP Vital Signs Report (link)	2000 - 2013
	Benthic Macroinvertebrate Populations	Not at this time	Puget Sound Stream Benthos - Data Repository for macroinvertebrate data collected throughout Puget Sound region (link)	2000-2011
	Marine Water Quality	Not at this time. Maintain or improve the MWCI score for the South Sound monitoring stations.	Ecology Marine Water Quality Monitoring (link)	1999-2014
Shellfish Population	Harvestable Shellfish	(1) Maintain all South Sound shellfish areas that are currently approved for harvest (33,691 acres); and (2) reopen 703 acres to harvest in Burley Lagoon, Oakland Bay, McLane Cove, Henderson Inlet, Rocky Bay, Vaughn Bay, Filucy Bay, and Nisqually Reach in accordance with SPD recovery plans.	Department of Health Recreation Harvest maps (link) Commercial Harvest maps (link)	2016 - Annually
Salmon	Salmon Presence and Abundance (e.g., Chinook, Coho, chum, steelhead)	No local target proposed, AHSS supports targets outlined in local Salmon Recovery Plans	WDFW Statewide Washington Integrated Fish Distribution (link)	2016 - Annually

VI. Protection and Restoration of Prairies and Oak Woodlands



Background

South Sound is unique in the Puget Sound Region as the historic and only remaining location for native prairies and oak woodlands. South Sound native prairies support an array of plant and animal species, including several endangered species: Taylor's Checkerspot butterfly, Mardon skipper, streaked horned lark, Western gray squirrel, and Mazama pocket gopher. According to the Center for Natural Lands Management (CNLM), 150,000 acres of prairie landscape and habitat has been reduced by 90%, with only 3% of that remaining as pristine prairie. Oak woodlands are dominated by Oregon white oak, the only oak species native to Washington, and contribute to the South Sound's rich biological diversity by providing feeding, breeding, resting and sheltering habitat for more than 200 species of birds, mammals, reptiles, and amphibians.

Key threats to remaining native prairie and oak woodland include:

- Conversion of land from prairie or oak woodland to agriculture or urban and suburban development
- Lack of natural disturbance
- Spread of invasive species and weeds
- Overgrazing
- Habitat fragmentation

Baseline and Status

The conversion of land is a threat for prairie and oak woodlands which occur at lower elevations and are often near centers of urban and suburban growth. In just Thurston County between 1992 and 2011, large-scale changes detectable from satellite imagery indicated that approximately 11,518 acres were changed into low, medium, or high-density developed land cover, and approximately 42,152 acres of land were converted from forest stands to non-forest vegetation or high, medium, or low-density development (link). Another threat to prairie and oak woodlands is the suppression of natural disturbance. Historically, periodic low-intensity fires maintained these areas as grasslands and were a vital component of prairie ecology. Long-term fire suppression has resulted in to conifer tree invasion as well as invasion of nonnative plant species. Thirdly, some prairie habitats have simply been lost to overgrazing and replacement by other, more quickly regenerating plant species. In fact, the spread of invasive vegetation is considered a primary cause of prairie habitat loss. As aggressive grass and shrub species (such as Scot's broom and tall oat grass) crowd out native species, the habitat becomes unsuitable for prairie plants and associated wildlife.

The AHSS identified two attributes to help understand prairie and oak woodland habitats in the South Sound. Both attributes focus on the presence and extent of these habitats (i.e., where do prairies and

oak woodlands occur and how much is there?) and were chosen to provide a measure of baseline conditions from which to track progress toward protection goals. The Washington Department of Natural Resources (DNR) Natural Heritage Program (NHP) has mapped prairie/grassland habitats and oak woodlands in Washington state. Figure 6.1 below shows the location of these habitats.

Two of the largest intact prairie and oak woodland habitats, Mima Mounds Natural Area Preserve and the Scatter Creek Wildlife Area, occur outside of the South Sound boundary in Thurston County. Both include large amounts of habitat protected and managed by the state.

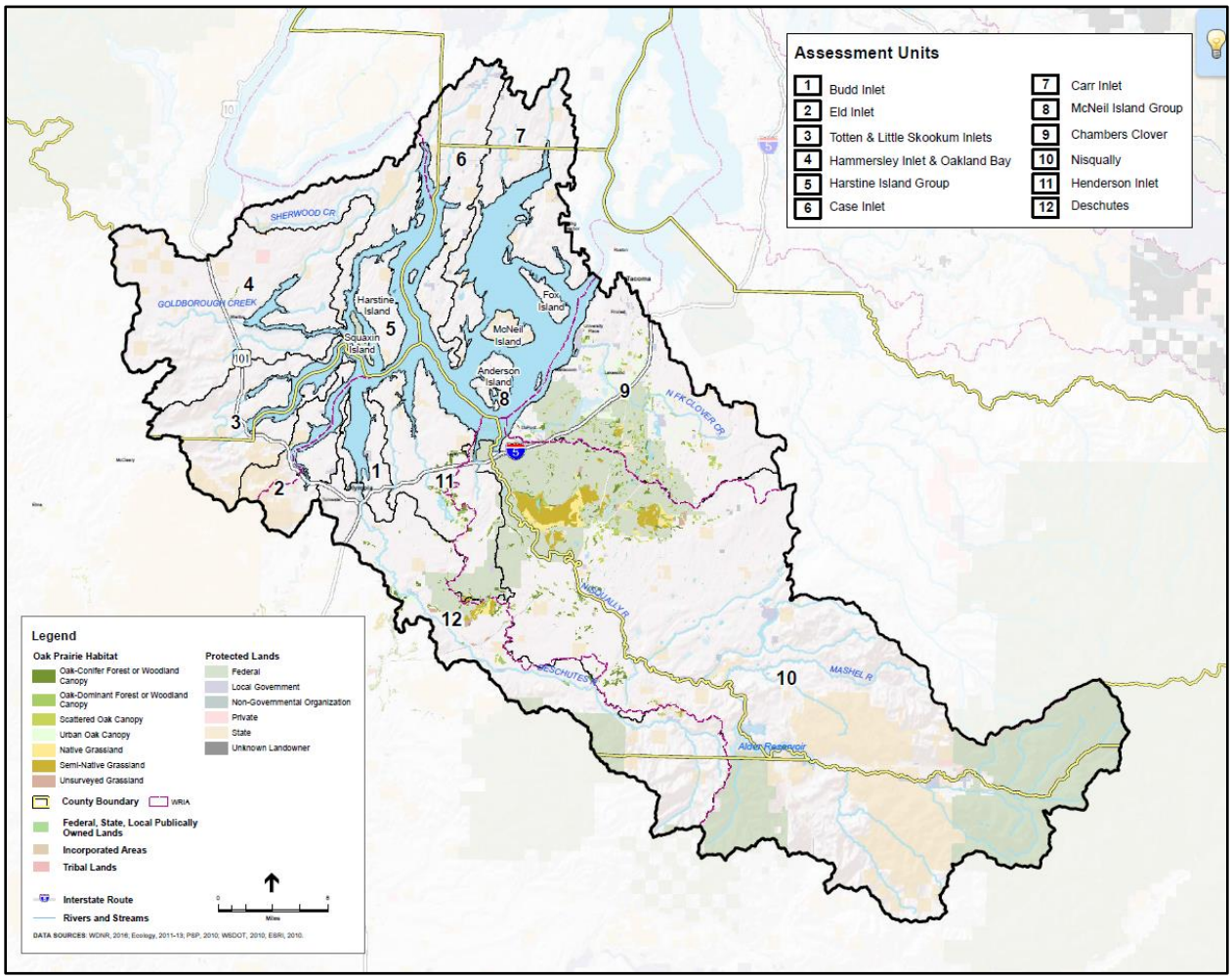


Figure 6.1. Prairie/Grasslands and Oak Woodlands in Puget Lowlands (Washington DNR, NHP)

According to the WDNR NHP, there are only about 16,000 acres of native prairie habitat remaining in the South Sound. Approximately 14,300 acres (90%) occur on lands protected and managed by federal and state agencies and non-governmental organizations. Prairie habitats are generally concentrated in a few locations in the lower and middle watersheds of the Deschutes and Nisqually rivers, with the majority present inside the Joint Base Lewis-McChord (JBLM). The Chambers-Clover watershed contains nearly 2,000 acres of prairie and 97% is in some type of protected status. The greatest amount occurs

within the Nisqually watershed (11,606 acres) with 95% in protected status. A summary of prairie/grassland habitat by AU is presented in Table 6.1 below.

Table 6.1 Prairie/Grassland Habitat in Protected Status by Assessment Unit

Assessment Unit	Native Prairie/ Grassland (Acres)	Amount in Protected Status (Acres)	% Protected
Chambers Clover	1,930	1,868	97%
Deschutes	2,136	1,328	62%
Hammersley Inlet & Oakland Bay	272	0	0%
Henderson Inlet	80	80	100%
Nisqually	11,606	11,030	95%
	16,024	14,306	89%

*No Prairie/Grassland habitat mapped within the following Assessment Units: Budd Inlet, Carr Inlet, Case Inlet, Eld Inlet, Harstine Island, McNeil Island, Totten & Little Skookum Inlets

Oak woodlands are present on nearly 12,000 acres with the majority located in the lower Deschutes and Nisqually watersheds and the Lower Chambers-Clover watershed. Only 36% of oak woodlands (4,300 acres) occur on land owned and managed resource agencies or non-profits. The greatest amount of Oak Woodland habitat occurs in the Chambers-Clover watershed and the Nisqually watershed (4,257 and 4,345 acres, respectively). A summary of oak woodland habitat by AU is presented in below.

Table 6.2 Oak Woodland Habitat in Protected Status by Assessment Unit

Assessment Unit	Oak Woodlands (Acres)	Amount in Protected Status (Acres)	% Protected
Chambers Clover	4,257	1,492	35%
Deschutes	1,411	259	18%
Eld Inlet	16	0	0%
Hammersley Inlet & Oakland Bay	55	0	0%
Henderson Inlet	1,867	468	25%
Nisqually	4,345	2,049	47%
Totten & Little Skookum Inlets	7	0	0%
	11,959	4,268	36%

Note: There is no Oak Woodland habitat mapped within the following Assessment Units: Budd Inlet, Carr Inlet, Case Inlet, Harstine Island, McNeil Island

Strategies, Existing Programs, and Actions

Strategies to address native prairie and oak woodlands focus on:

- Direct protection of intact areas (e.g., through acquisition and transfer/purchase of development rights);
- Support and implement land management plans and regulations. Specifically, county and city growth management and critical area programs that concentrate growth in urban growth areas and protect sensitive prairie and oak woodland habitats;

- Support to landowners to help them protect and restore prairie and oak woodland habitats (e.g., through investment in restoration and by incentivizing natural areas and open space, invasive species removal, and native plant establishment)
- Education and outreach about how prairie woodlands support ecosystem functions and services to raise support for prairie and oak woodland protection and restoration efforts;
- Direct Protection of intact areas (e.g., through acquisition and transfer/purchase of development rights)

In the fast-growing South Sound, significant effort also is oriented toward ensuring stewardship of rural and working lands (including working forests) for continued benefit of people and ecosystem processes and functions, protecting remaining intact critical areas, and encouraging compact, urban growth. The CNLM, JBLM, and Thurston County are all working on protection and restoration of South Sound prairies and oak woodlands. Information on these organizations' programs is provided below.

Thurston County Prairie Habitat Conservation Plan

Thurston County is developing a Prairie Habitat Conservation Plan (HCP) in response to recent species listings under the Endangered Species Act (link) of Mazama pocket gopher, Streaked Horned lark, Oregon spotted frog, and Taylor's Checkerspot butterfly. The Prairie HCP will describe Thurston County's efforts to mitigate impacts of development on prairie habitat. Thurston County anticipates that the HCP will be ready for review and comment in 2016. The Thurston County Prairie HCP includes four conservation strategies:

1. **Avoidance**. This include facilitating protection of conservation lands and use of best management practices.
2. **New Conservation Lands**. Habitat protection, enhancement and maintenance through a third-party conservation entity (e.g., a land trust) or through conservation easement.
3. **Working Lands Outreach**. Entering voluntary working lands stewardship agreements, neighboring landowner assurances, and providing outreach and education.
4. **Legacy Land Support**. Providing habitat enhancement and maintenance endowments for lands already under protection.

The draft Prairie HCP estimates that development in unincorporated Thurston County during the next 30 years will occur on approximately 18,000 acres of prairie habitat. However, since development will occur largely on low-quality prairie habitat, the HCP targets approximately 7,630 acres of functional/high quality prairie habitat for conservation. The HCP separates these acres as follows:

Table 6.3 HCP habitat conservation acres

Strategy	Acres
Avoidance (minimizing impacts)	3,000
New Conservation Lands	3,130
Working Lands	500
Legacy Land Support	1,000

Total	**7,630**

NOTE: Values presented above are draft/deliberative and subject to change in final Thurston County Prairie HCP.

Center for Natural Lands Management (CNLM)

The CNLM South Sound Prairies Program focuses on protection of prairies and oak woodlands. The program was operated by The Nature Conservancy until 2011, at which time it was transferred to CNLM.

In 2004 The Nature Conservancy, with support from US Fish and Wildlife Service (USFWS), completed the Willamette Valley–Puget Trough–Georgia Basin (WPG) Ecoregional Assessment (link). The WGP notes that prairies have been heavily altered from their historic extent[1], with a corresponding species loss, and they suggest that both preservation and active restoration must occur. Although the WGP assessment did not attempt to identify suitable places for prairie restoration, it sets a goal for maintaining and restoring greater than 100% of all remaining prairies based on the following rationale:

> "Assuming that remaining prairies are about 2 to 4% of their historic extent, then the species/area curve predicts that between 38 to 75% of all prairie species will eventually be lost. A reduction in the current extent of prairie habitat would cause even greater species loss. Therefore, the goal for prairies was set at 100% of all that remains... Maintaining 100% of all remaining prairie is not sufficient to maintain all currently existing prairie biodiversity. Because maintaining 100% of all remaining prairie is not sufficient to sustain all existing prairie biodiversity, restoration of this ecological system is needed. In other words, the goal for prairie habitat should be greater than 100% of all remaining prairies, requiring the restoration of additional habitat to sustain a greater proportion of existing species."

For oak woodlands (classified as "northern oak woodlands"), the WPG sets a numerical goal for the Puget Trough section as 25% of historic extant (circa 1850). The WPG, however, notes that the numeric goals are most useful as a tool for priority-setting rather than a quantifiable estimate; protection and restoration is required to ensure that species that rely upon the various habit/ecological systems will survive over the long term.

Joint Base Lewis-McChord

The largest and most intact prairies in the South Sound exist within the boundaries of JBLM south of the City of Tacoma. This federal military complex contains over 14,000 acres of grasslands across at least 37 distinct prairie sites. As part of the Army Compatible Use Buffer (ACUB) program, JBLM staff work with USFWS staff to adapt military training programs to minimize impacts on sensitive habitats. The JBLM ACUB program helps sustain military readiness by minimizing the consequences of listing of the federal species. The ACUB program also looks at off-base property acquisitions, restoration, and direct actions to mitigate these impacts. JBLM works with multiple partners including CNLM, the Washington Departments of Fish & Wildlife and Natural Resources, and Wolf Haven International. These partners have enrolled their prairie preserves in the ACUB program and the federal Department of Defense has

[1] The WGP sets the baseline for historic extent as prior to European settlement, around approximately 1850.

provided support (over $16 million to date) for on-the-ground conservation actions on those preserves. This funding is essential for the initial, expensive recovery efforts for the species such as:

- Land acquisition
- Prescribed fire and controlled burns
- Invasive species control
- Native plant production and habitat enhancement
- Reintroduction to increase numbers and sizes of populations
- Research, planning, and monitoring

In 2014, JBLM and the Washington Department of Fish and Wildlife (WDFW) began to collaboratively develop spatially-explicit management strategies to identify, prioritize, and plan management activities. An annual report (link) describes habitat management actions performed on the base across 4 broad categories: Management Strategy Development, Prairie-habitat Monitoring, Prairie-habitat Enhancements, and Research.

AHSS NTAs for Native Prairies and Oak Woodlands

None of the actions recently put forward by the AHSS for inclusion in the Puget Sound Action Agenda directly addressed native prairies or oak woodlands. The AHSS expects and would support future prairie and oak woodland protection and conservation projects consistent with the restoration and protection plans developed by the key land stewards, as described above.

Contribution to PSP Vital Signs

As a South Sound focus area, prairies and oak woodlands falls under the broader PSP strategy umbrella of habitat protection and restoration and more specifically under the PSP Vital Sign for land development and cover. Three of the four indicators for land development and cover Vital Sign apply to prairie and oak woodlands: Forest loss, conversion of ecologically important lands, and growth in urban growth areas.

VII. Protection and Restoration of Forests and Freshwater Habitats

Background

The South Sound is one of the fastest growing areas in the state, exceeding the State's growth rate consistently since the 1960s. Much of the population centers on towns and cities of Shelton, Olympia, Lacey, Tumwater, Steilacoom, University Place, Lakewood, Tacoma, and DuPont, the community of Allyn, and along shorelines of the finger inlets and islands. Forest and freshwater habitats have been and continue to be impacted by varying land uses such as urban, rural and mixed use developments, commercial forestry, and tribal and non-tribal commercial shellfish industries. The loss of forest cover and degradation of freshwater habitats (such as rivers and streams) negatively affects the South Sound's natural ability to deliver watershed functions that support freshwater systems, provide habitat for terrestrial species, and provide ecological and cultural services for humans.

Key threats to forests and freshwater habitats include:

- Conversion of land from more natural cover to housing and urban areas
- Conversion of land from more natural cover to commercial and industrial areas
- Roads and railroads (including culverts)
- Dams
- Freshwater levees, floodgates, tide gates, armoring and other shoreline alterations including freshwater infrastructure
- Tourism and recreation[2]
- Spread of invasive species and weeds
- Habitat fragmentation

Baseline and Status

The AHSS identified four attributes to understand forests and freshwater habitats: forest cover, freshwater riparian vegetation, freshwater flows in rivers and small streams, and fish-passable streams (a measure of removal of barriers to fish passage). The AHSS considered attributes related to freshwater wetlands, but ultimately decided not to specify additional freshwater habitat attributes at this time. The AHSS selected water quality and macroinvertebrates as attributes that characterization the condition of freshwater habitats. The status and trends of these attributes are reported later in this document.

Forest Cover

Forest and shrub cover is critical to the health of South Sound watersheds and varies widely from the upper watersheds near Mt. Rainier down to the lowlands that are characterized by small, steep ravines that drain upland areas. Tracking changes in land cover provide a way to monitor the South Sound's

[2] It is important to note that tourism and recreation also help create awareness and advocacy for protecting habitat compared to other uses.

success in maintaining or improving forest cover. AHSS partners anticipate work to reduce loss of vegetated land cover to developed land and limit the increase of impervious surfaces in specific watersheds.

Forest cover is defined as deciduous, evergreen, mixed and scrub/shrub land cover categories in the National Oceanic and Atmospheric Association's (NOAA) Coastal Change Analysis Program (C-CAP) dataset. Large and small patches of forest and shrub vegetation occur throughout the South Sound with Harstine Island supporting the greatest proportion of forest cover (93%). The Key Peninsula and upper reaches of the Nisqually watershed also have some of the highest forest cover in the South Sound (Figure 7.1).

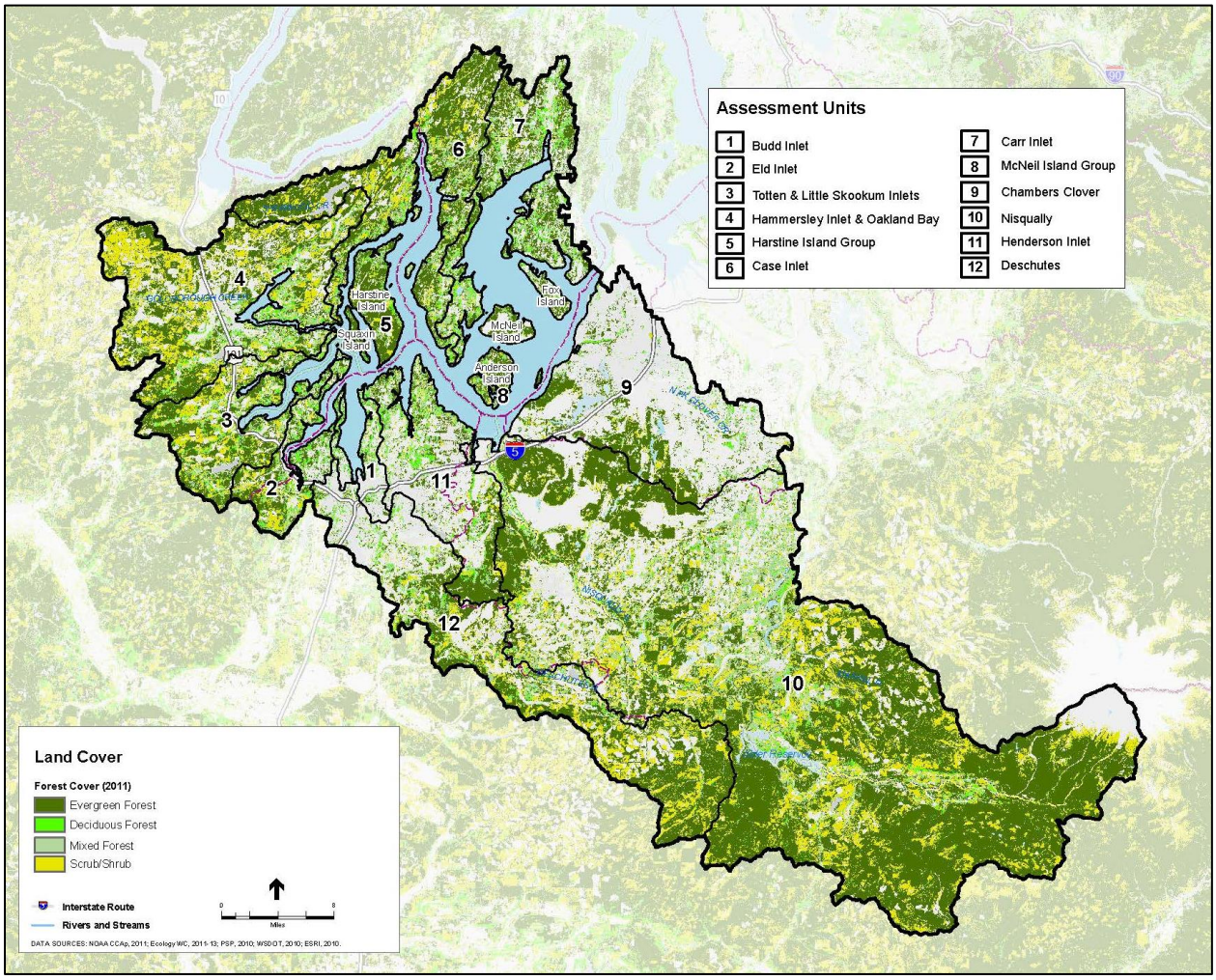


Figure 7.1. Forest Cover – Existing Conditions (NOAA C-CAP, 2011)

The following table provides a summary of forest cover within each upland AU based on the 2001 and 2011 data from the NOAA C-CAP dataset of land cover classes. The far-right column indicates the percent change in forest cover between 2001 and 2011. The Deschutes unit experienced the greatest reduction in forest cover (-5%) and the Harstine Island and Totten & Little Skookum Inlet groups experienced the least (-0.8%).

Table 7.1. Forest Cover by Upland Assessment Unit

Forest Cover		2001		2011		
Assessment Unit	Total Area (Acres)	Forest Cover (Acres)	% Forest Cover	Forest Cover (Acres)	% Forest Cover	% Change (2001-2011)
Budd Inlet	10,908	4,189	38%	4,095	38%	-0.9%
Carr Inlet	52,039	35,792	69%	34,857	67%	-1.8%
Case Inlet	69,819	57,701	83%	55,240	79%	-3.5%
Chambers Clover	95,235	28,521	30%	25,572	27%	-3.1%
Deschutes	109,431	74,264	68%	68,772	63%	-5.0%
Eld Inlet	23,876	18,099	76%	17,699	74%	-1.7%
Hammersley Inlet & Oakland Bay	100,969	73,499	73%	71,367	71%	-2.1%
Harstine Island Group	13,452	12,478	93%	12,353	92%	-0.9%
Henderson Inlet	53,432	27,666	52%	25,900	48%	-3.3%
McNeil Island Group	12,621	8,682	69%	8,785	70%	0.8%
Nisqually	474,131	353,571	75%	345,075	73%	-1.8%
Totten & Little Skookum Inlets	44,329	34,837	79%	34,491	78%	-0.8%
	1,060,241	**729,298**	**69%**	**704,205**	**66%**	**-2.4%**

As a complement to the forest cover information, the AHSS also evaluated impervious surfaces in South Sound. As a proxy for the amount of impervious surface in each assessment unit, AHSS viewed data from the NOAA C-CAP dataset which includes three land cover classes that contain varying amounts of impervious surface: high intensity developed, medium intensity developed, and low intensity developed. Areas classified as high intensity developed are characterized by high amounts of concrete, asphalt, or constructed surfaces (buildings, homes, etc.) and have less than 20 percent vegetation or other cover. Medium and low intensity developed areas have lower amounts of concrete, asphalt, and constructed surfaces (50-79 percent for medium and 21-49 percent for low) and more vegetated areas. The data indicate that impervious surface is likely highest in the Chambers-Clover watershed (64%) and the watersheds that drain to Budd and Henderson inlets (51% and 32%). Figure 7.2 shows the distribution of the three developed land cover classes in the South Sound based on 2011 data.

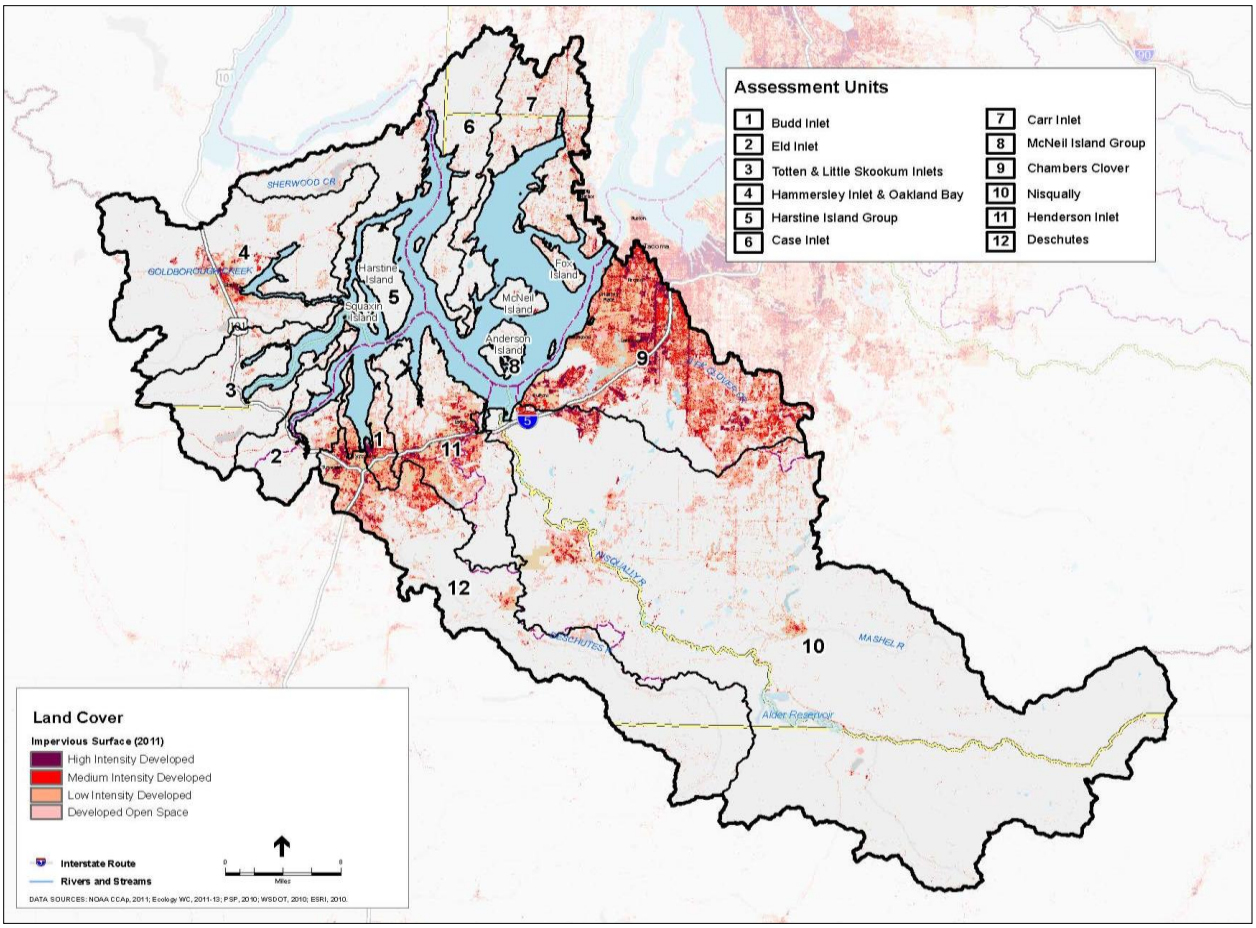


Figure 7.2. Developed Land Cover Classes – Existing Conditions (NOAA C-CAP, 2011)

Table 7.2 provides a summary of developed land cover within each upland AU based on the 2001 and 2011 data from the NOAA C-CAP program. As above, the far-right column indicates the percent change in forest cover between 2001 and 2011. The Henderson Inlet AU experienced the greatest increase in developed land cover (+4.1%) and the Budd and Case Inlet groups experienced the least (both at +0.2%).

Table 7.2. Developed Land Cover (High, Medium, and Low Intensity Developed land cover classes) by Upland Assessment Unit- Existing Conditions (NOAA C-CAP, 2011)

Developed Land Cover (High, Medium, Low Intensity)		2001		2011		
Assessment Unit	Total Area (Acres)	Developed Land Cover (Acres)	% Developed	Developed Land Cover (Acres)	% Developed	% Change (2001-2011)
Budd Inlet	10,908	5,591	51%	5,615	51%	0.2%
Carr Inlet	52,039	10,455	20%	10,910	21%	0.9%
Case Inlet	69,819	3,234	5%	3,389	5%	0.2%
Chambers Clover	95,235	56,055	59%	60,653	64%	4.8%
Deschutes	109,431	14,517	13%	15,856	14%	1.2%
Eld Inlet	23,876	2,666	11%	2,923	12%	1.1%
Hammersley Inlet & Oakland Bay	100,969	7,317	7%	7,847	8%	0.5%
Harstine Island Group	13,452	135	1%	138	1%	0.0%
Henderson Inlet	53,432	14,725	28%	16,891	32%	4.1%
McNeil Island Group	12,621	1,242	10%	1,274	10%	0.3%
Nisqually	474,131	23,173	5%	24,872	5%	0.4%
Totten & Little Skookum Inlets	44,329	2,172	5%	2,297	5%	0.3%
	1,060,241	**141,282**	**13%**	**152,665**	**14%**	**1.1%**

Target for Forest Cover

The target for forest cover is based on a 2002 study (Booth et. al.) which observed that watersheds with 65% or greater forest cover were indicative of more minimally degraded downstream conditions. The AHSS focused its evaluation on sub watersheds that were near the 65% forest cover level, and looked at aerial photographs and other information, including best professional judgment, to identify sub watersheds to emphasize for restoration. The AHSS also considered the percent change in forest cover as well as impervious surface cover from 2001 to 2011 as an indication of population growth and development rates in each of the sub watersheds (at the HUC 12 unit). This analysis results in the following targets:

> *(1) Protect and maintain forest in all the HUC 12 assessment units (below) that have currently have greater than 65% cover, (2) Restore forest cover to above 65% in the following HUC 12 assessment units: Burley Creek-Frontal in Carr Inlet and Cranberry Creek Frontal in Oakland Bay, (3) Restore forest cover to above 60% in the lower and middle Nisqually watershed (included units: Lower Nisqually, McAllister Creek, and Middle Nisqually) (Note: The lower goal is meant to be more realistic for these subwatersheds due to higher development pressure).*

Figure 7.3 shows the upland AUs and four categories of percent forest cover in the South Sound.

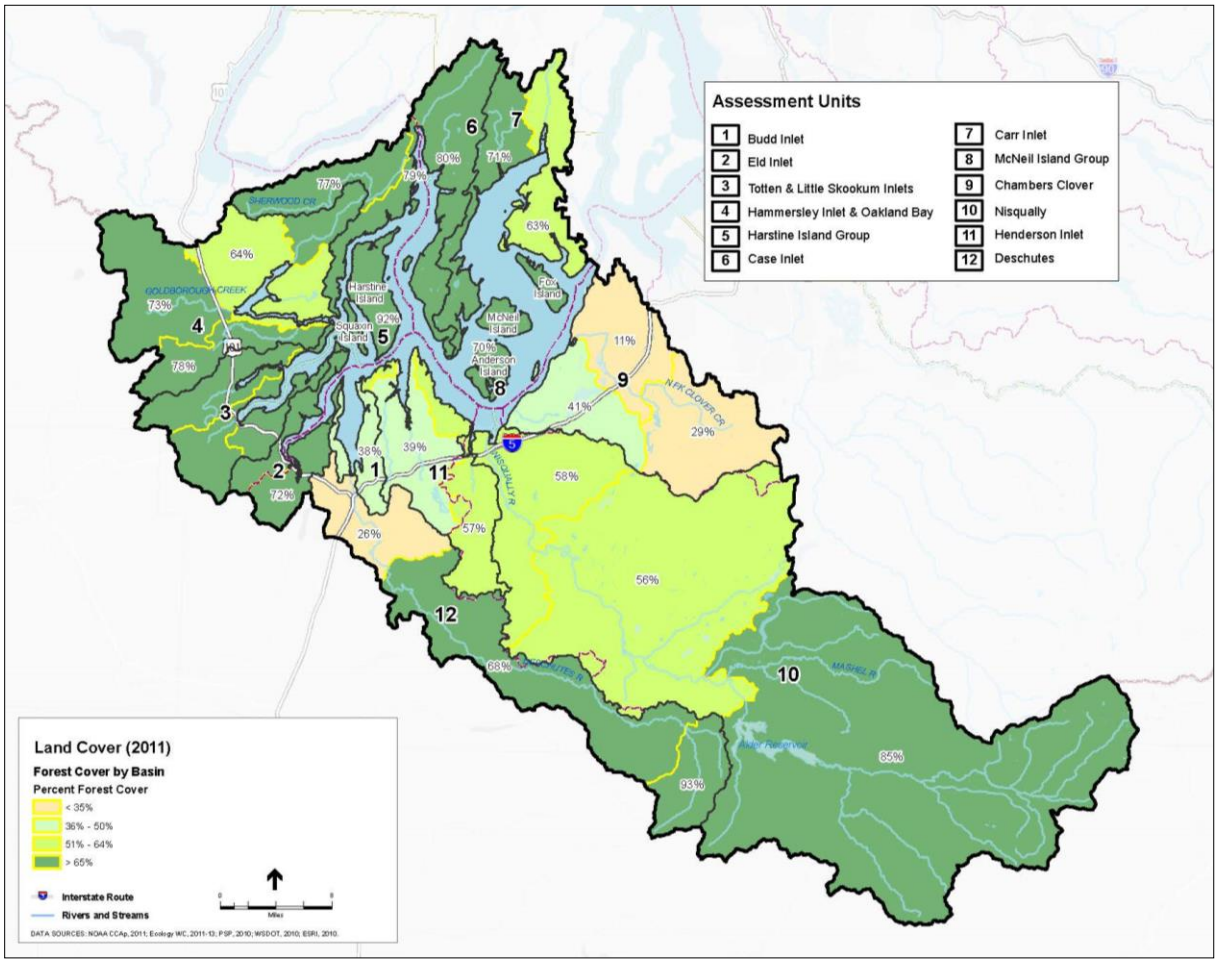


Figure 7.3. Percent Forest Cover by Sub watershed – Existing Conditions (NOAA C-CAP, 2011)

Table 7.3 provides the percent forest cover within each upland AU, at the HUC 12 scale, based on the 2011 data from the NOAA C-CAP program.

Table 7.3. Forest Cover by Upland Assessment Unit, HUC 12 Watershed Boundaries

Forest Cover		
Assessment Unit (HUC 12)	**Total Area (Acres)**	**Percent Forest Cover**
Upper Deschutes	19,751	**93**
Harstine Island	13,452	**92**
Upper Nisqually	267,822	**85**
Key Peninsula-Frontal Case Inlet	37,945	**80**
Jones Creek-Frontal Case Inlet	11,363	**79**
Schneider Creek-Frontal Totten Inlet	12,292	**79**
Kennedy Creek	12,627	**78**
Mill Creek	19,008	**78**
Sherwood Creek	20,511	**77**
Skookum Creek-Frontal Skookum Inlet	19,409	**77**
Perry Creek-Frontal Eld Inlet	10,191	**77**
Goldsborough Creek	37,987	**73**
Beatty Creek-Frontal Eld Inlet	13,685	**72**
Deer Creek	10,309	**72**
Key Peninsula-Frontal Carr Inlet	24,586	**71**
Anderson Island	12,621	**70**
Middle Deschutes	65,196	**68**
Cranberry Creek-Frontal Oakland Bay	33,665	**64**
Burley Creek-Frontal Carr Inlet	27,453	**63**
City of Beachcrest-Frontal Nisqually Reach	6,637	**63**
Lower Nisqually	51,058	**58**
McAllister Creek	19,399	**57**
Middle Nisqually	155,251	**56**
Sequalitchew Creek	26,143	**41**
Woodland Creek-Frontal Henderson Inlet	27,396	**39**
Ellis Creek-Frontal Budd Inlet	10,908	**38**
Middle Chambers Clover	39,653	**29**
Lower Deschutes	24,485	**26**
Lower Chambers Clover	29,439	**11**
	1,060,241	

Freshwater Riparian Vegetation

Riparian vegetation helps to keep freshwater cool, moderate flood storage, and provide habitat critical to salmon and other terrestrial and freshwater aquatic species. Riparian vegetation also helps to filter pollutants, stabilize stream banks, provide detritus for aquatic food webs and prevent erosion. Restoration of freshwater riparian vegetation has long been a priority for South Sound jurisdictions and groups and is expected to remain a priority.

To evaluate the condition of riparian vegetation in each of the South Sound upland AU, the AHSS first identified all streams with an annual average of 20 mean cubic feet per second (CFS) or greater. The

AHSS then identified all the potential channel migration zones as mapped for the Nisqually and Deschutes Rivers. To determine the determine the amount of intact or degraded riparian vegetation, the AHSS used the NOAA C-CAP 2011 dataset and calculated the total amount of vegetation cover within a 500-foot buffer off the centerline of the streams and the edge of the channel migration zones. Based on this analysis, riparian habitat along major streams (with flow greater than 20 cfs) is the greatest and most intact in the Nisqually watershed (Figure 7.4).

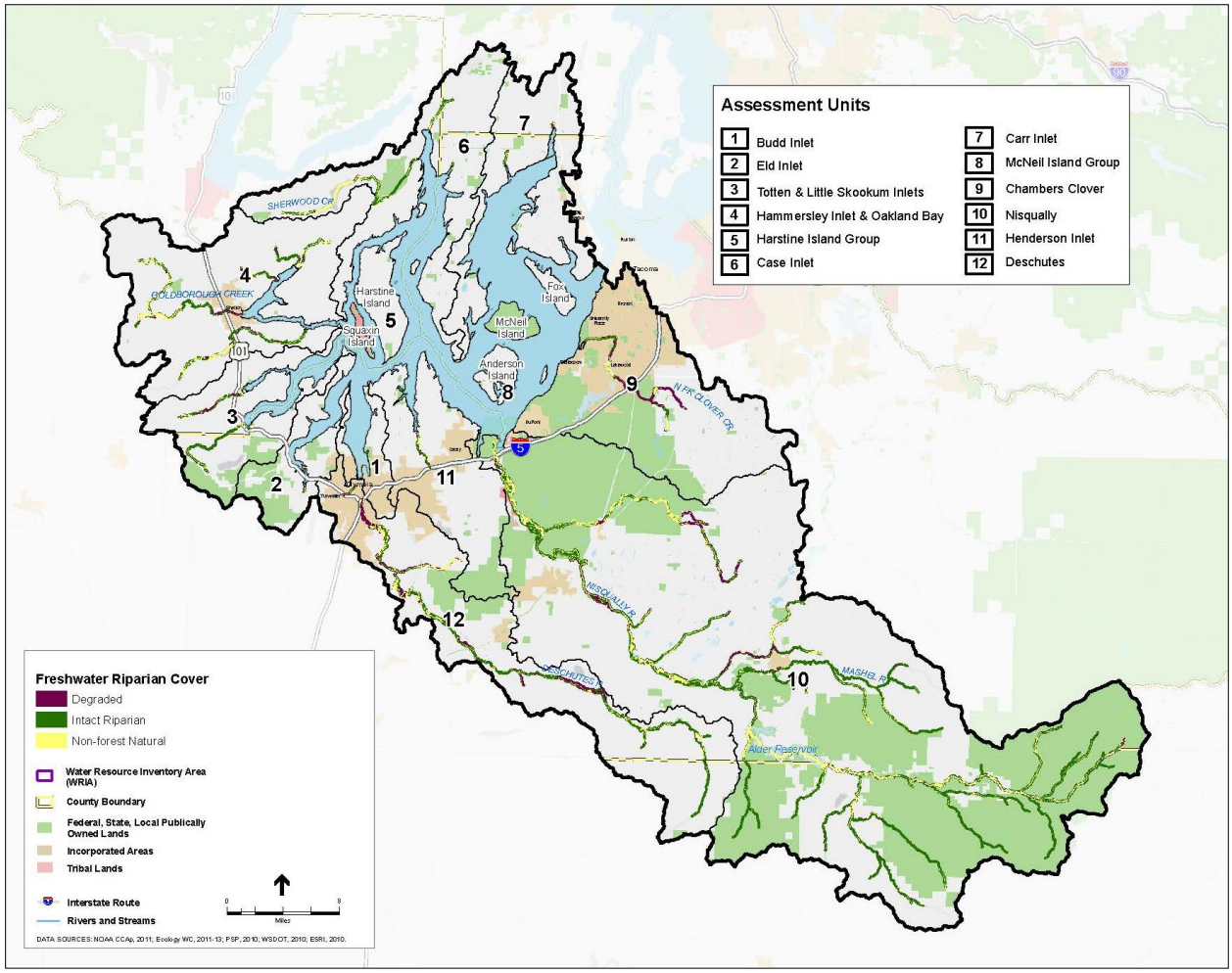


Figure 7.4. Freshwater Riparian Vegetation – Existing Conditions (NOAA C-CAP, 2011)

The following table provides a summary of where freshwater riparian vegetation is most intact or degraded by upland AU. Overall, the major streams in the South Sound have an average of 61% intact riparian cover. The major streams with most degraded riparian habitat cover include Sequalitchew Creek and waterbodies in the Chambers-Clover watershed.

Table 7.4. Freshwater Riparian Vegetation by Upland Assessment Unit

		Intact		Degraded	
Assessment Unit*	**Freshwater Riparian Corridor (Total Acres)**	**Intact Riparian (Acres)**	**% of AU with Intact Riparian Cover**	**Degraded Riparian (Acres)**	**% of AU with Degraded Riparian Cover**
Carr Inlet	264	148	56%	59	22%
Case Inlet	2,361	1,301	55%	53	2%
Chambers Clover	1,996	512	26%	1,054	53%
Deschutes	8,471	4,632	55%	1,765	21%
Eld Inlet	73	25	35%	26	36%
Hammersley Inlet & Oakland Bay	5,355	2,932	55%	654	12%
Henderson Inlet	520	282	54%	77	15%
Nisqually	32,619	21,436	66%	2,265	7%
Totten & Little Skookum Inlets	1,798	1,234	69%	251	14%
	53,455.92	**32,503**	**61%**	**6,204**	**12%**

**Assessment Units Budd Inlet, Harstine Island Group, and McNeil Island Group do not contain any streams >20 cfs*

Target for Freshwater Riparian

To identify a target for freshwater riparian habitat the AHSS examined the results of the Department of Ecology Puget Sound Watershed Characterization Water Flow model. This analysis evaluates the extent to which water delivery and movement processes are intact and examines loss of these processes at the sub watershed scale. It makes this evaluation on both an individual catchment basis and with respect to neighboring catchments to create "bins" of catchments that are priorities for protection, restoration, or low impact use. The AHSS overlaid the results of the Ecology water flow model results with freshwater riparian vegetation and defined the target as the intersection of freshwater riparian vegetation with priorities for protection and restoration. This results in the following target.

> *(1) Protect all intact fresh water riparian habitat in areas identified for protection or restoration in the Ecology water flow analysis, 25,664 acres; and (2) restore 5,197 acres of fresh water riparian habitat in areas identified for protection or restoration in the Ecology water flow analysis.*

Figure 7.5 shows the results of the Ecology Watershed Characterization water flow analysis for all the South Sound. Figure 7.6 show the freshwater riparian target.

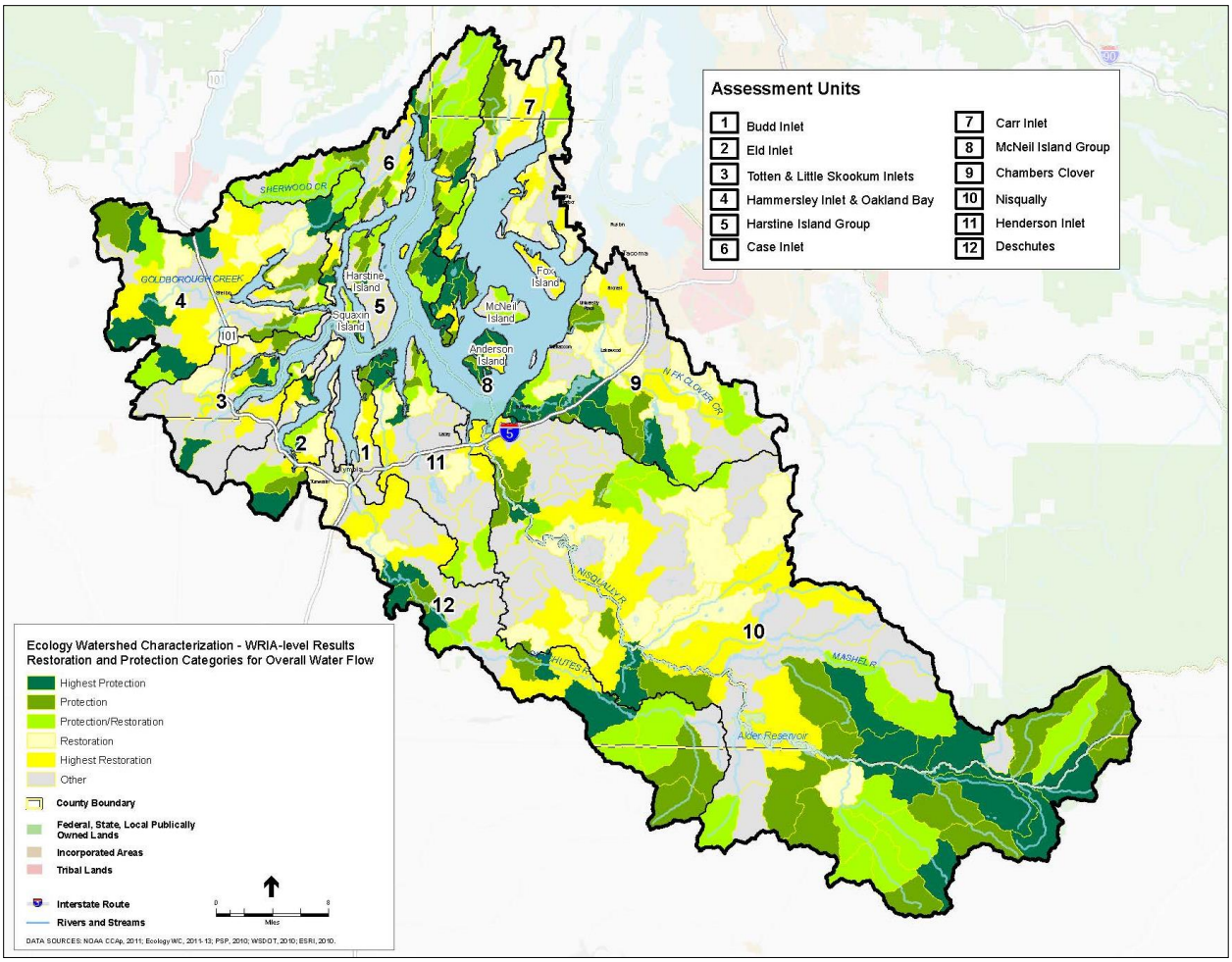


Figure 7.5. Ecology Protection and Restoration Strategies (Ecology Watershed Characterization Water Flow Model)

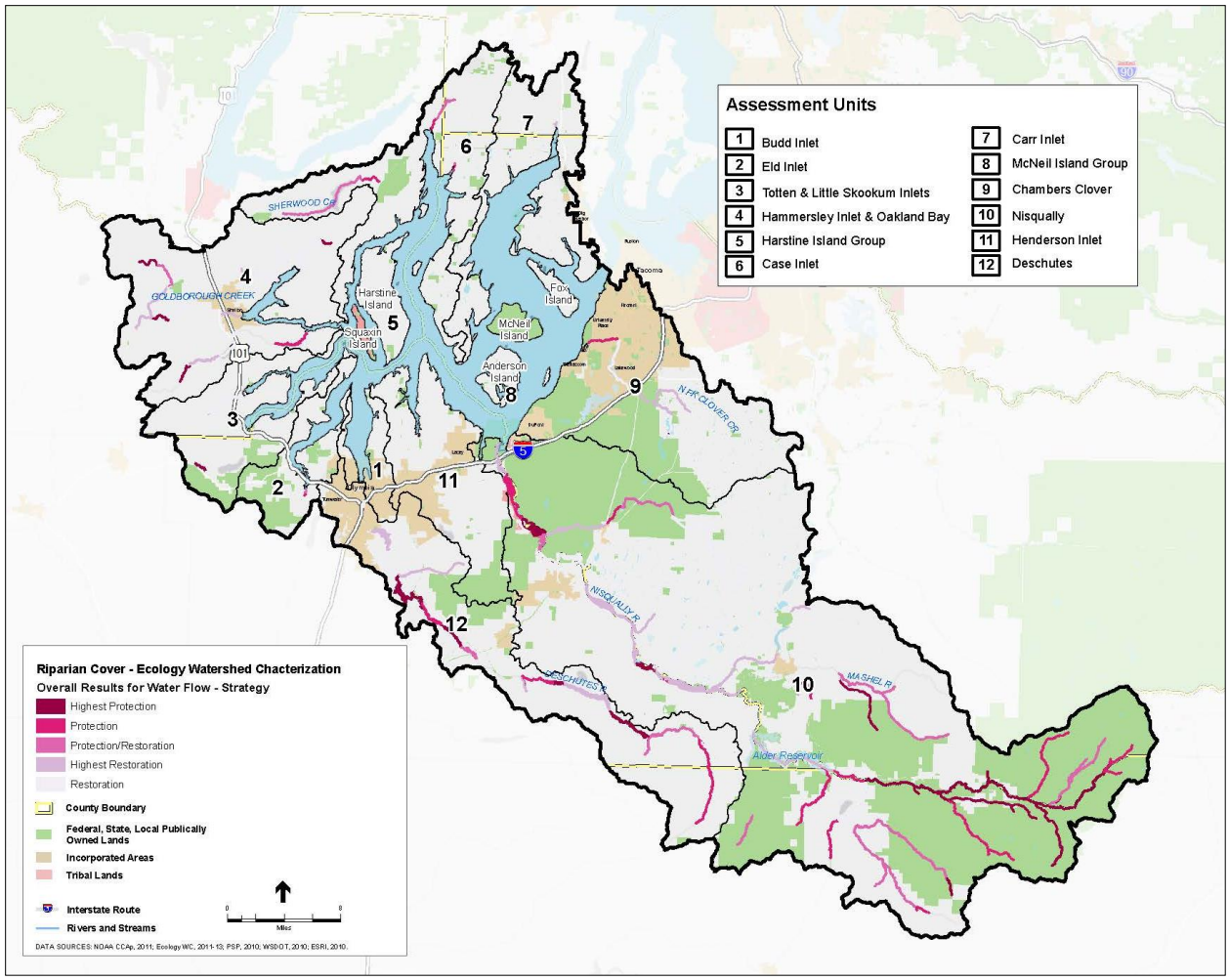


Figure 7.6. Freshwater Riparian Vegetation – Ecology Protection and Restoration Strategies (NOAA C-CAP, 2011; Ecology Watershed Characterization)

In some AHSS jurisdictions, most notably in Mason County, there are finer resolution locally-derived assessments and prioritizations of freshwater riparian habitat. Where they exist, these assessments should inform project identification and selection. Efforts are underway to expand the coverage of these assessments. The AHSS supports these efforts and, as they are completed, will use them to adaptively manage and adjust the freshwater riparian target.

Freshwater Flows in Rivers and Streams

Low flows in rivers and streams occur during summer months when there is less rain and warmer weather. Low summer flows can affect salmon recovery, wildlife, and water supply. Development that draws water away from streams can further reduce water quantity in streams through groundwater withdrawals and diversions. New buildings, roads, and parking lots and other impervious surfaces that prevent water from percolating into the ground also can reduce the amount of water that would otherwise recharge summer streams. Shrinking snowpack and warmer summer temperatures also reduce summer flows.

United States Geologic Survey (USGS) monitoring stations in the Nisqually River (at McKenna) or Deschutes River (near Rainier) provide an indication of summer low flows for large river systems in the South Sound. As reported in 2015 State of the Sound Vital Signs, summer low flows in the Nisqually River show a strongly increasing trend over the current period of record (1975-2014) and low flows in the Deschutes River are weakly decreasing, as shown in table 7.5.

Table 7.5. Long-term Trends in Summer Low Flows in 2 Major Rivers and Status Relative to the 2020 Targets (excerpt from the 2015 State of the Sound Vital Signs, pg. 64)

River Gauge Station	Description of the 2020 Target Value for Each River	Summer Low Flow Trend (% change per year, 1975-2014)	Trend Category (1975-2014)	Is 1975-2011 Reference Trend Consistent with 2020 Target Value?	Is 1975-2014 Trend Consistent with the 2020 Target Value
Nisqually River (at McKenna)	Maintain stable or increasing flows in highly regulated river	0.40%	Strongly Increasing	Yes	Yes
Deschutes River (near Rainier)	Restore low flows from a strongly decreasing trend to a weakly decreasing trend	-0.50%	Weakly Decreasing	No	Yes

Summer flows in smaller streams and tributaries also are critical for salmon recovery. The goal is to increase flows in all small streams that are flow-limited. The primary factors affecting stream flow are rainfall and snowmelt. However, there are other contributing factors including dams and hydrologic modifications, loss of vegetative cover, wells that tap groundwater, over-allocation of water rights, and new buildings and roads that prevent water from recharging the ground water. There are several actions that should be considered to support minimum flow, including reducing stormwater pollution and infiltration, groundwater well withdrawal limits, monitoring vegetation cover, and land use regulations.

The Washington Administrative Code has established in-stream regulations and closures due to low-flow conditions in the four Water Resource Inventory Areas (WRIA) in South Puget Sound (WRIA 10, WRIA 11, WRIA 12, and WRIA 13). The affected streams, creeks and waterbodies can be found in Table 7.6 on the following page.

Table 7.6. Low Flow Limitations in each WRIA in South Puget Sound

	Stream	Tributary to	Limitation
WRIA 10	Unnamed stream	Puyallup River	No diversion when flow falls to 0.10 cfs.
	Taylor Creek	Carbon River	No diversion when flow falls to 1.0 cfs.
	Van Ogle Creek	Puyallup River	No diversion when discharge into the Puyallup River drops to 1.0 cfs
	Canyon Creek	Puyallup River	No diversion when flow falls to 1.0 cfs.
WRIA 11	Harts Lake	Nisqually River	Low Flow (0.5 cfs bypass)
	Ohop Lake	Ohop Creek	Lake Level (523 ft)
	Thompson Creek	Nisqually River	Low Flow (1.0 cfs bypass)
	Unnamed stream	Centralia Canal	Low Flow (0.75 cfs bypass)
	Unnamed stream	Nisqually River	Low Flow (0.50 cfs bypass)
WRIA 13	Percival Creek	Capital Lake	Closure
	Unnamed Stream	Puget Sound (Eld Inlet)	Low Flow (1.5 cfs)
	Unnamed stream	Gull Harbor	Low Flow (1.0 cfs)
	Woodward Creek	Woodward Bay	Closure

Fish Passable Streams

The ability of salmon and steelhead to migrate upstream to their traditional spawning grounds is critical to their recovery. Dams, bridges, roadways, culverts, and other manmade barriers block fish passage in many streams of the South Sound, preventing access to salmonids and inhibiting overall salmon recovery.

The South Sound has 361 total fish passage barriers, and 521 partial barriers (Table 7.7). The Totten & Little Skookum Inlet Group has the highest concentration of total barriers (55) followed by the Hammersley Inlet & Oakland Bay Group (51). Harstine Island has the fewest total blockages (7), although this mostly due to the low number of freshwater streams on the island.

Table 7.7. Fish Passage Barriers by Assessment Unit

Assessment Unit	Total Barriers	Partial Barriers
Budd Inlet	19	30
Carr Inlet	47	84
Case Inlet	28	34
Chambers Clover	19	40
Deschutes	38	39
Eld Inlet	21	14
Hammersley Inlet & Oakland Bay	51	72
Harstine Island Group	7	5
Henderson Inlet	19	24
McNeil Island Group	13	0
Nisqually	44	141
Totten & Little Skookum Inlets	55	38
	361	**521**

Target for Fish Passable Streams

Ultimately, the AHSS believes that all fish passage barriers must be removed to fully support salmon recover. To set a target for fish passage barrier removal the AHSS used the priority index ranking system.

This system develops a numeric ranking for each barrier considering the habitat gain, mobility and health status of the fish stocks that would benefit from increased access to the habitat, and the project cost. This is an imperfect system in part because only a fraction of barriers have been evaluated and given a priority index rating (only 39% of total barriers and 42% of partial barriers), and the ratings that do exist are largely dated. Table 7.8 below shows the number of total barriers in each upland AU and the priority index ratings for those barriers that have been evaluated and given a rating. The second table (7.9) summarizes the same information for partial barriers.

Table 7.8. Total Fish Passage Barriers by Assessment Unit and WDFW Priority Index Ratings

		WDFW Priority Index			
Assessment Unit	**Total Barriers**	**0-25**	**25-50**	**50-75**	**75-100**
Budd Inlet	19	6	3	0	0
Carr Inlet	47	30	2	0	0
Case Inlet	28	5	0	0	0
Chambers Clover	19	12	2	0	0
Deschutes	38	10	1	0	0
Eld Inlet	21	5	0	0	0
Hammersley Inlet & Oakland Bay	51	17	0	0	0
Harstine Island Group	7	0	0	0	0
Henderson Inlet	19	3	0	0	0
McNeil Island Group	13	5	0	0	0
Nisqually	44	12	1	0	0
Totten & Little Skookum Inlets	55	27	0	0	0
	361	**132**	**9**	**0**	**0**

Table 7.9 Partial Fish Passage Barriers by Assessment Unit and WDFW Priority Index Ratings

		WDFW Priority Index			
Assessment Unit	**Partial Barriers**	**0-25**	**25-50**	**50-75**	**75-100**
Budd Inlet	30	6	6	0	0
Carr Inlet	84	49	15	1	0
Case Inlet	34	5	0	0	0
Chambers Clover	40	16	1	0	0
Deschutes	39	4	1	0	0
Eld Inlet	14	2	1	0	0
Hammersley Inlet & Oakland Bay	72	17	1	0	0
Harstine Island Group	5	0	0	0	0
Henderson Inlet	24	3	0	1	0
McNeil Island Group	0	0	0	0	0
Nisqually	141	53	14	2	0
Totten & Little Skookum Inlets	38	19	2	0	0
	521	**174**	**41**	**4**	**0**

The target calls for removal of barriers with the highest Priority Index Rating, and for updating of ratings to ensure all barriers are assessed.

> *(1) Restore the four partial barriers in Carr Inlet, Henderson Inlet, and Nisqually that have a WDFW Priority Index greater than 50, (2) Prioritize restoring both total and partial barriers that have a WDFW Priority Index between 25 and 50 (50 barriers).*

Figure 7.7 shows the fish passage barriers with Priority Index Ratings. The figure combines total and partial barriers.

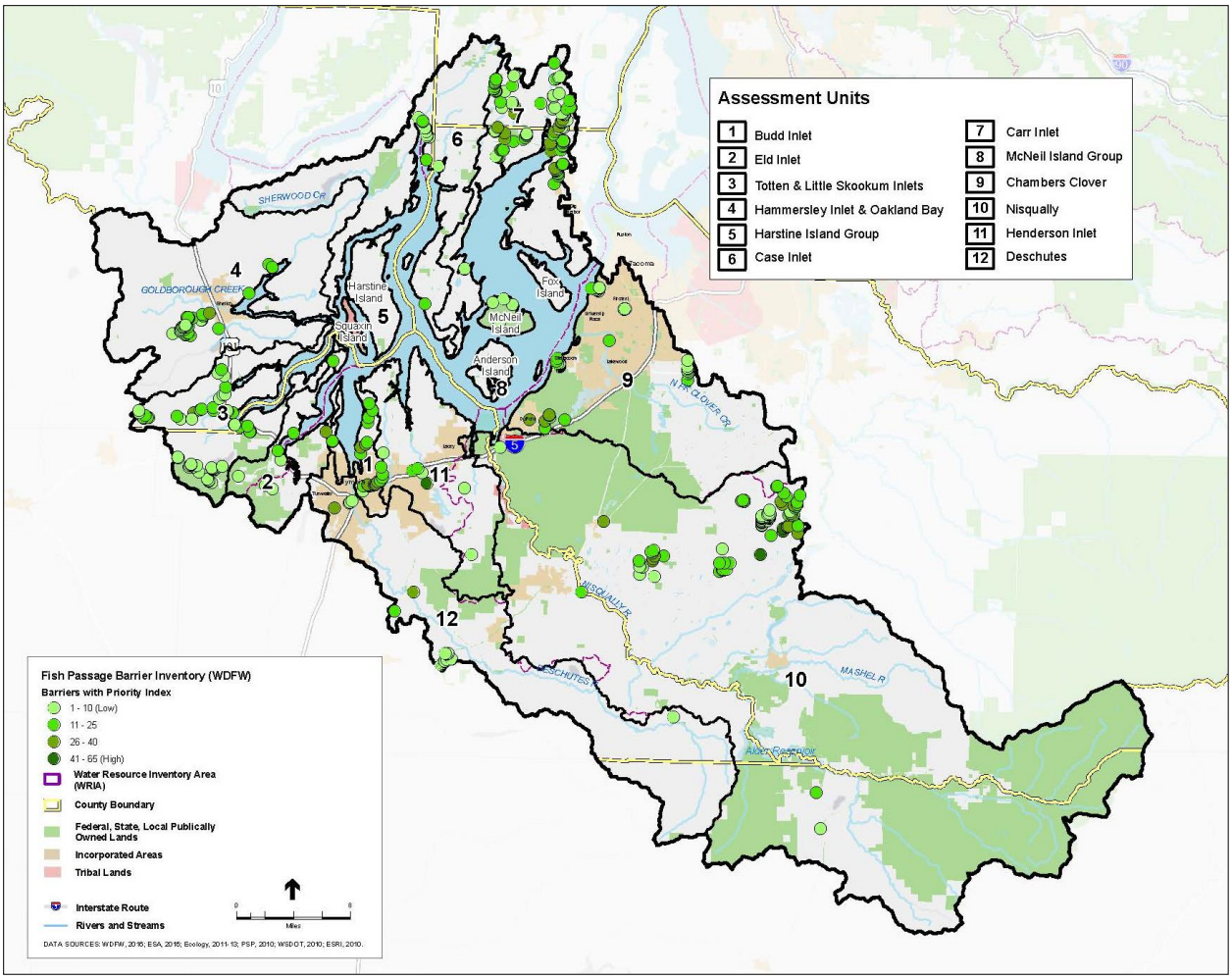


Figure 7.7. Fish Passage Barriers (Total and Partial) and their WDFW Priority Index (Washington Department of Fish and Wildlife)

Like freshwater riparian habitat, fish passage barriers are an area where tribal governments, county governments, and local groups may have finer scale, more recent, data. The AHSS was unable to obtain or compile these data for this effort; however, the AHSS supports removal of fish passage barriers in South Sound on an aggressive timeline and consistent with science-based local priorities. Where these prioritizations exist, they should drive fish barrier removal efforts.

The State also prioritizes its investment in fish passage barrier removal. State investment in fish passage barrier removal is directed by the Fish Barrier Removal Board. The purpose of the board is to "aid the restoration of healthy and harvestable levels of salmon and steelhead statewide through the coordinated and strategic removal of barriers to fish passage." (RCW 77.95.160) Their initial set of proposed priorities, which covers 2017-2019 state investments, includes removal of 9 barriers in the Goldsborough Creek watershed in Mason County – including removal of barriers on Coffee, Dayton, Uncle John's, Deer, and Likes creeks.

Strategies, Existing Programs, and Actions

Strategies to address forests and freshwater habitats focus on:

- Direct protection of intact areas (e.g., through acquisition and transfer/purchase of development rights);
- Support and implement land management plans and regulations, particularly county and city growth management and critical area programs that concentrate growth in urban growth areas and protect freshwater habitats such as lakes, wetlands, and streams;
- Support for sustainable forestry efforts and sustainable agricultural practices, and for efforts to ensure these practices maintain or improve forest and freshwater habitat quality;
- Education and outreach about how forest and freshwater processes support ecosystem functions and services (such as abundant salmon) that are important to people to raise support for forest and freshwater protection and restoration efforts.

Growth Management Plans

In 1990, the Washington State Legislature passed RCW 36.70A, the Growth Management Act (GMA), to guide local jurisdictions in their decisions regarding land use. The GMA was enacted in response to rapid population growth and concerns about suburban sprawl and the impacts on quality of life and environmental degradation. The GMA requires that cities and counties create a plan that addresses the following goals:

- Sprawl reduction
- Affordable housing
- Open space and recreation
- Environmental protection
- Natural resource industries
- Permit processing
- Early and continuous public participation
- Concentrated urban growth
- Economic development
- Regional transportation
- Property rights
- Historic lands and building
- Public facilities and services
- Shoreline management

Another critical piece of the GMA is the requirement that local governments include best available science and coordinate with jurisdictions that share common borders or regional issues so that decisions are consistent throughout landscapes, even if they span political boundaries. The following table (Table 7.10) provides a link to each jurisdictions' Comprehensive Plan and the date of the last major update.

Table 7.10. Comprehensive Plans in South Puget Sound Jurisdictions

Jurisdiction	Link to Comprehensive Plans	Last Major Update
City of Tumwater	Link	Fall 2016
City of Olympia	Link	2014
City of Lakewood	Link	December 2014
City of Shelton	Link (currently under revision)	December 2007
Thurston County	Link (currently under revision)	2005

Pierce County	Link	June 2015
Mason County	Link (undergoing updates)	2005
Kitsap County	Link	June 2016

Critical Areas Designation

The GMA recognizes that the first step required in implementing the GMA is the designation and protection of critical areas. This does two things: 1. Excludes critical areas from urban growth designations and impacts, and 2. Prevents irreversible environmental harm while comprehensive plans and implementing development regulations are prepared. RCW 36.70A.170(1) requires that all critical areas in all counties and cities must be designated where appropriate. The GMA permits no exemptions, exclusions, or limitations on applicability that would result in some critical areas not being designated.

Thurston County Noxious Weeds & Lakes Management

Thurston County Noxious Weed control monitors for 41 species of noxious weeds which are designated by the State of Washington. The goal of this program is to protect citizens, natural resources, and the agricultural resources of Thurston County from the degrading impact of invasive weeds. This is an ongoing program that is funded and managed by Thurston County. It includes noxious weed disposal sites for community members to use for free, as well as special projects that are larger in scale.

Thurston County Urban Forest Program

Thurston county is currently undergoing a process to create an Urban Forest Management Plan. The plan for this process is to incorporate the most effective elements of the cities' tree ordinances to create framework for policies and actions that enhance and protect the urban forests in the county. This process begun in 2016, and they are in the process of creating a timeline, so the completion date is currently to be determined. The county is responsible for funding this program.

This program includes the facilitation of the Urban Forestry Restoration Project. This is an opportunity for local governments, park districts, tribes and non-profit organizations to apply for four weeks of Puget Sound Corps crew time to assists with urban forestry tasks that enhance the health and function of urban trees and forests. This is funded by DNR and the timeframe for each individual project is approximately one month.

Family Forest Fish Passage Program

This is an ongoing program run jointly by the Washington State DNR and the Washington State Recreation and Conservation Office (RCO). The goal of the program is to assists landowners in replacing culverts and other stream crossing structures to keep trout, salmon, and other fish from reaching upstream habitat. While this is a voluntary program, landowners that choose not to enroll by December 2016, must fix the blockages at their own expense. This program began in 2003.

Manure Exchange Program

The Mason Conservation District began this free program to address the problem of excess manure polluting streams, lakes, and manure waterways. To do this, the program connects local livestock owners with excess manure, to gardeners in search of free, local fertilizer.

Conservation Reserve Enhancement Program (CREP)

CREP is a voluntary program that pays landowners an annual rental rate, a signing bonus and all the costs of establishing buffers along creeks, ditches, and wetlands. The annual rental rate is per acre of land the participant enrolls in the program. Landowners have the choice to sign a 10 or 15-year contract, and have the choice to extend their contract for an additional 10 or 15 years. Once a landowner has agreed to the contract. The Conservation District establishes wooded buffers along waterways on the private land. This program seeks protection for water quality in creeks, ditches, and wetlands.

Protected Areas Management Program

The Nisqually Land Trust is a Non-Government Organization (NGO) and a nonprofit corporation. Their goal is to acquire and manage critical lands to permanently benefit the water, wildlife and people of the Nisqually River Watershed. This program, administered by the Nisqually Land trust, promotes beneficial habitat for fish and wildlife species. This includes acquisition of land, hosting events for planting native trees and shrubs and the removal of invasive species, and specific "special projects" to steward lands that have not been acquired.

Stream Teams Program

The Stream Team program is cooperatively sponsored and funded by the storm and surface water utilities of the cities of Lacey, Olympia, and Tumwater, and Thurston County. The program specializes in providing free quality environmental education programs and activities and hands-on projects in the South Sound. Examples of Stream Team workshops include Amphibian Monitoring, Shorebird Monitoring, Tree Planting: Revegetation/Restoration, Salmon Stewards, Watershed tours and many others.

Examples of Current Projects

Lake Lawrence Restoration Project

The South Puget Sound Salmon Enhancement Group (SPSSEG) is working to improve fish passage in a small stream by removing a partial barrier culver and replacing it with a full spanning bridge across the stream. The Lake Lawrence stream confluence is located on the Deschutes River in Thurston County. This project will increase instream habitat by installing complex log jams and wood into the stream channel. Existing boulders form the culvert embankment will be placed along the stream channel to increase habitat diversity. Approximately three acres will be planted with native trees and shrubs. The project complements significant upstream word being done by the cities of Lacey, Olympia, and Yelm. This project will benefit Chinook, Coho, Chum and steelhead and cutthroat trout.

This project received grant funds from the Puget Sound Acquisition and Restoration grant as well as the Salmon Federal Projects Grant, both facilitated by RCO. The project also received a sponsor match. The planned completion for this restoration is December 2018.

Ohop Creek Restoration Monitoring

The South Puget Sound Enhancement Group completed Ohop Creek Restoration in the Summer of 2014. This project, in collaboration with the Nisqually Land Trust and Nisqually Indian Tribe widened a

channelized stream and added large woody debris (LWD), stream substrate and buffers along the bank. The continued monitoring of this project by the South Puget Sound Enhancement Group has showed increasing salmon stocks since completion in 2014. The continued monitoring of this project is crucial to show if the restoration was successful, and if not, how it can be adaptively managed to achieve the desired results.

Deschutes Restoration and Design Project

The SPSSEG received funds from the Puget Sound Acquisition and Restoration grant to develop a preliminary design to enhance salmon habitat by adding LWD, channel complexity and bank roughness to a degraded, 1500-foot section of the Deschutes River in Thurston County. This project will also develop a plan to plant and maintain a riparian buffer of native conifers and hardwoods. The goal of this project is to reduce fine sediments entering the river, create pools for refuge from heat, and add LWD. This project is meant to benefit Chinook, Coho, Chum, steelhead and cutthroat trout. This project began in January 2016 and is set to be completed in June 2017.

Anderson Creek Enhancement Project

This proposal will enhance salmonid rearing habitat in Anderson Creek, a major tributary and refuge in the Sherwood Creek basin. This project, facilitated by the SPSSEG began in January 2016 and has a completion date of December 2018. This project will improve stream conditions by adding LWD and mixed size gravel to the stream bed. Riparian treatments will include native, woody vegetation and treatment of noxious weeds. The funding for this project is provided by the Salmon State projects grant and the Puget Sound Acquisition and Restoration grant.

AHSS NTAs

For the 2016 Action Agenda for Puget Sound, AHSS partners proposed several near-term actions related to forests and fresh water.

1. **Nisqually Community Forest Acquisition** would permanently protect sensitive properties under threat of forestry practices that could result in excessive erosion.
2. Pierce County **Huge Creek Culvert Replacement** would fund replacement of an undersized obstructive culvert on Huge Creek, a tributary to Minter Creek.
3. Mason Conservation District **Restoration of Naturally Functional Riparian Buffers in South Sound** would expand on efforts to restore and protect naturally functioning riparian and floodplain areas by providing for planting, site maintenance, and knotweed inventory and control.
4. Thurston County Development of a **Thurston County Riparian Restoration Program**.

Contribution to PSP Vital Signs

The South Sound work on forests and freshwater contributes to progress for multiple PSP Vital Signs including: land cover, floodplains, shellfish beds, Chinook salmon, and orca.

VIII. Protection and Restoration of Marine Nearshore Habitat

Background

Marine nearshore habitat has long been a focus of South Sound ecosystem protection efforts and will remain so. The nearshore is the transitional zone among terrestrial, freshwater, and marine ecosystems. Many of the important and unique characteristics of Puget Sound depend upon the nearshore, including its physical complexity, high productivity, complex food webs, diverse habitats, and diversity of organisms (link).[3] Marine nearshore habitats are some of the primary places where young salmon and steelhead find refuge, food, and passage to the sea. These important rearing, feeding, and migration areas are the result of natural processes that move sediments; provide nutrients, organic matter, and LWD from plants; and produce insects and similar marine animals (link).[4]

The finger inlets and various islands in South Sound provide extensive sand and gravel beaches used for spawning by forage fish (i.e. surf smelt and sand lance). Because adult and juvenile Chinook rely on forage fish for a significant portion of their diet, protecting or restoring beaches is critical to salmon populations that originate in South Sound rivers as well as other rivers in the greater Puget Sound ecosystem.

Key pressures affecting marine nearshore habitat in Puget Sound include:

- Conversion of land from natural cover to housing and urban areas
- Conversion of land from natural cover to commercial and industrial areas
- Roads & railroads (including culverts)
- Dams
- Marine levees, floodgates, tide gates, armoring and other shoreline alterations
- Marine shoreline infrastructure
- Tourism & recreation areas

Baseline and Status

For the South Sound Strategy, marine nearshore habitat is described in eight interrelated ecosystem attributes: intact feeder bluffs, marine riparian vegetation, intact large and small estuaries, eelgrass beds, herring abundance and distribution, surf smelt and sand lance abundance and distribution, and unmodified (unarmored) shoreline. Each of these attributes contribute to essential processes and functions beneficial to forming and sustaining marine nearshore ecosystems. Feeder bluffs deliver sediment for sustaining beaches and, along with riparian vegetation, provide organic matter and invertebrate prey to the marine nearshore. Surf smelt and sand lance spawn in sand and small gravel substrates in upper intertidal zones easily disrupted by nearshore energy, interrupted sediment supply,

[3] PSNERP Technical Document 2012-01: Strategies for Nearshore Protection and Restoration in Puget Sound.
[4] NOAA Fisheries: Nearshore Habitat Fact Sheet, Spring 2012.

and shoreline armoring placed below the ordinary high water line. Large and small estuaries provide shallow habitats where eelgrass beds grow and provide critical spawning habitat for herring, another important prey item for juvenile salmon.

Marine Riparian Vegetation

Marine riparian vegetation provides shade, woody debris, and detritus to nearshore habitats such as beaches and estuarine wetlands. Riparian vegetation also helps to filter pollutants, stabilize shorelines, and prevent erosion.

The AHSS evaluated marine riparian cover using the NOAA C-CAP data set, which is a nationally standardized, raster-based inventory of all intertidal areas, wetlands, and adjacent uplands for the coastal U.S. that is derived from the analysis of multiple dates of remotely sensed Landsat imagery. The NOAA C-CAP data is updated every five years through documented, repeatable procedures using standardized data and methods to ensure consistency through time and across geographies. Areas with deciduous, evergreen, and/or mixed forest were considered to have "intact" marine riparian cover. Of the 400 miles of shoreline in South Sound, approximately 65% (260 miles) currently have intact marine riparian cover (Figure 8.1). Marine riparian habitat is most intact along Totten and Little Skookum Inlets, both sides of Pickering Passage, and around Harstine Island. The shorelines with the least marine riparian habitat include the northern end of Case Inlet, Budd Inlet, and the eastern shoreline near the cities of Steilacoom, University Place, and Tacoma.

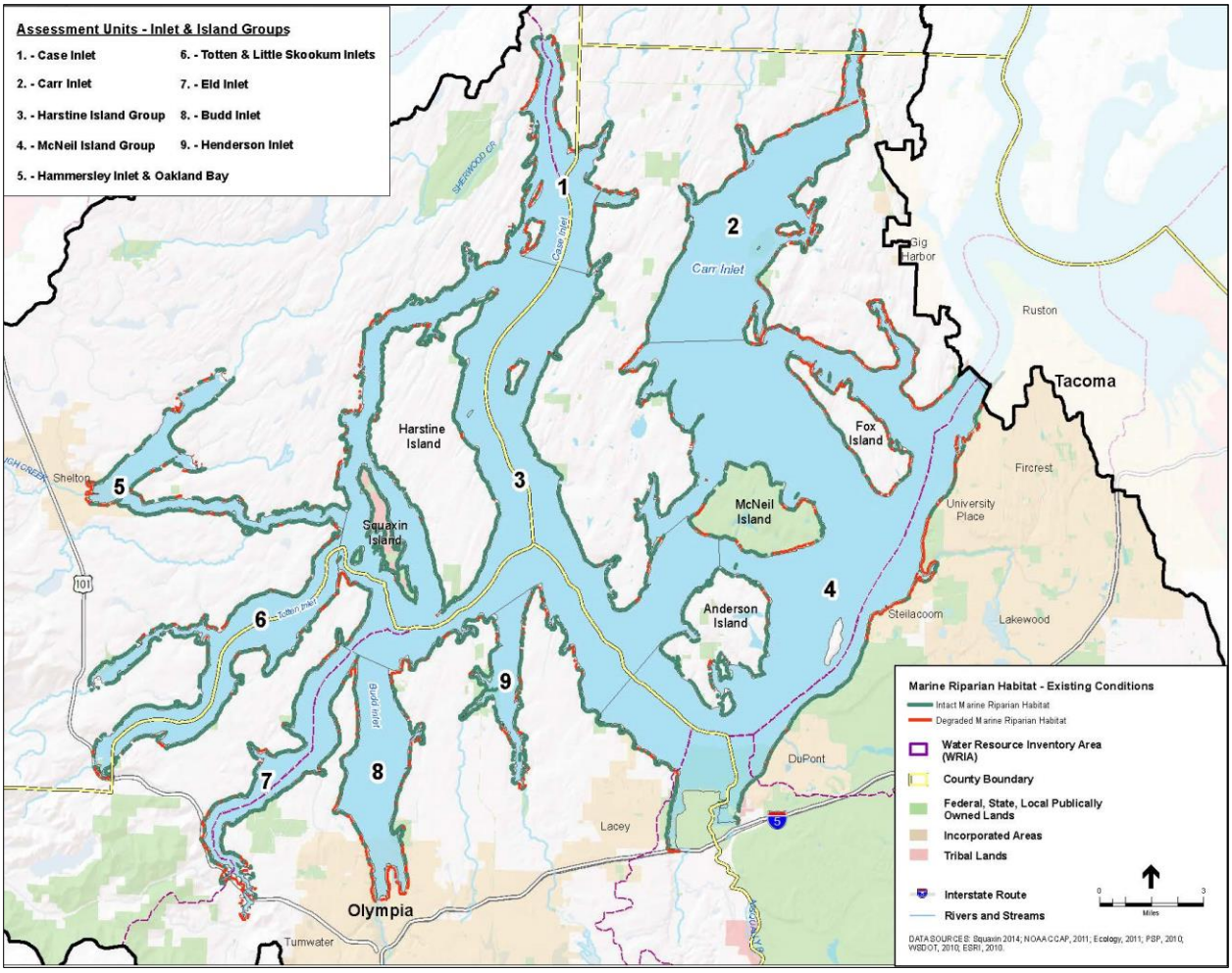


Figure 8.1. Marine Riparian Habitat – Existing Conditions (NOAA C-CAP, 2011)

The following table provides a summary of marine riparian habitat within each Inlet/Island Group.

Table 8.1. Marine Riparian Habitat by Inlet/Island Group

		Intact		Degraded	
Inlet/Island Group	Shoreline Length (Miles)	Shoreline with Intact Riparian (Miles)	% of Shoreline with Intact Riparian Cover	Shoreline with Degraded Riparian (Miles)	% of Shoreline with Degraded Riparian Cover
Budd Inlet	19	10	52%	8	40%
Carr Inlet	37	23	62%	9	25%
Case Inlet	24	13	54%	6	26%
Eld Inlet	28	18	63%	6	21%
Hammersley Inlet / Oakland Bay	33	19	59%	5	15%
Harstine Island Group	104	82	79%	9	9%
Henderson Inlet	17	11	67%	2	14%
McNeil Island Group	101	57	56%	28	27%
Totten Inlet / Little Skookum	37	28	74%	4	11%
	400	**260**	**65%**	**77**	**19%**

Target for Marine Riparian Vegetation

As with other marine nearshore attributes, the AHSS set ambitious targets oriented toward protecting all the remaining intact habitat in South Sound and restoring all habitat in nearshores identified as a priority in either of two local landscape-scale assessments: The South Sound Coastal Catchment Assessment and the Priority NPST for Juvenile Salmon. This results in the following target:

> (*1) Protect all intact marine riparian habitat throughout South Sound, 260 miles, of which 170.3 miles are in priority areas identified in the South Sound Coastal Catchment Assessment and/or the NPST for Juvenile Salmon; and (2) restore 36.6 miles of degraded marine riparian habitat in the areas identified as a priority in the South Sound Coastal Catchment Assessment and/or the NPST for Juvenile Salmon.*

Figure 8.2 shows marine riparian vegetation in the areas identified as a priority in the South Sound Coastal Catchment Assessment. Figure 8.3 shows it in areas identified as a priority for juvenile salmon.

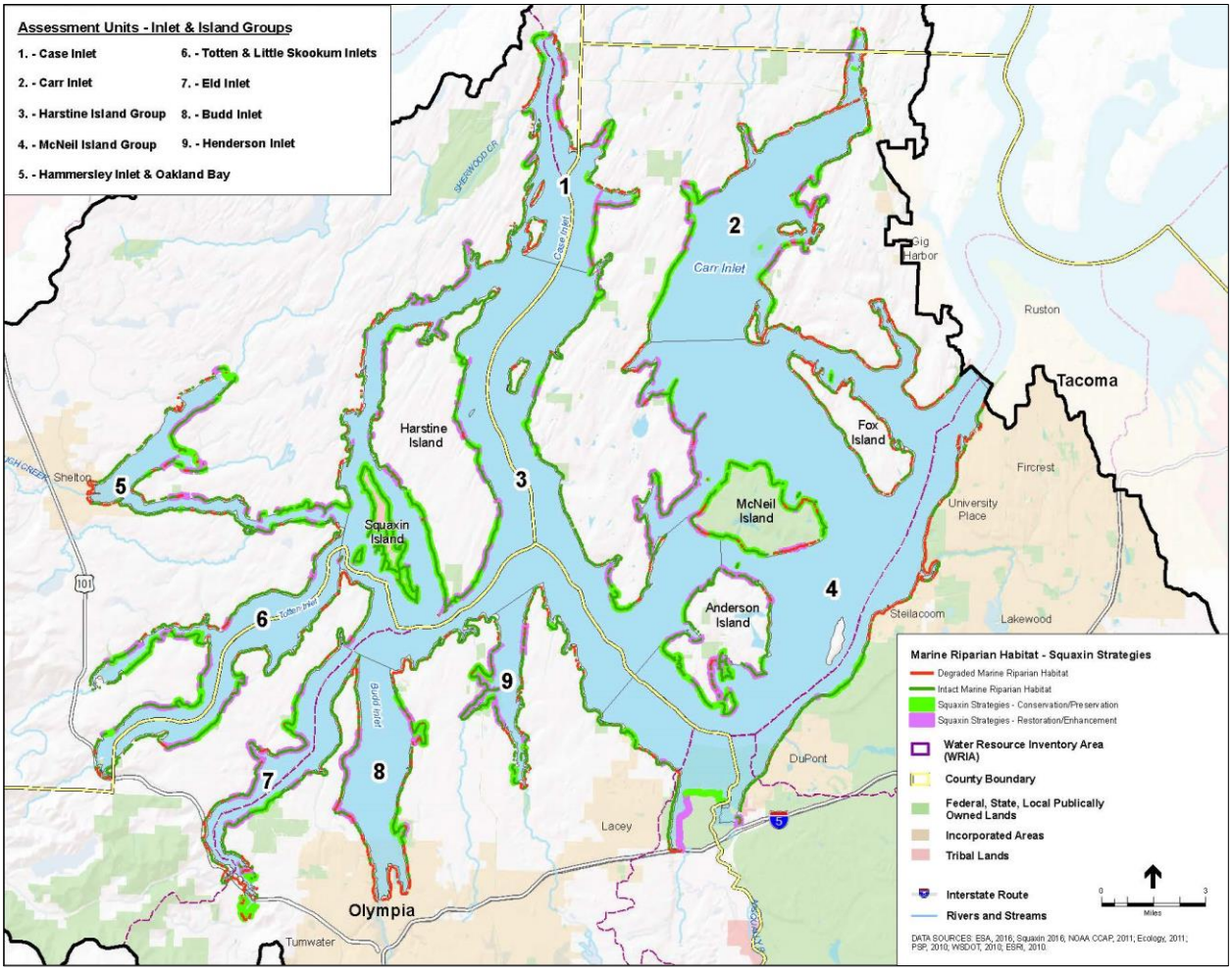


Figure 8.2. Marine Riparian Habitat – Squaxin Strategies (Coastal Catchment Assessment)

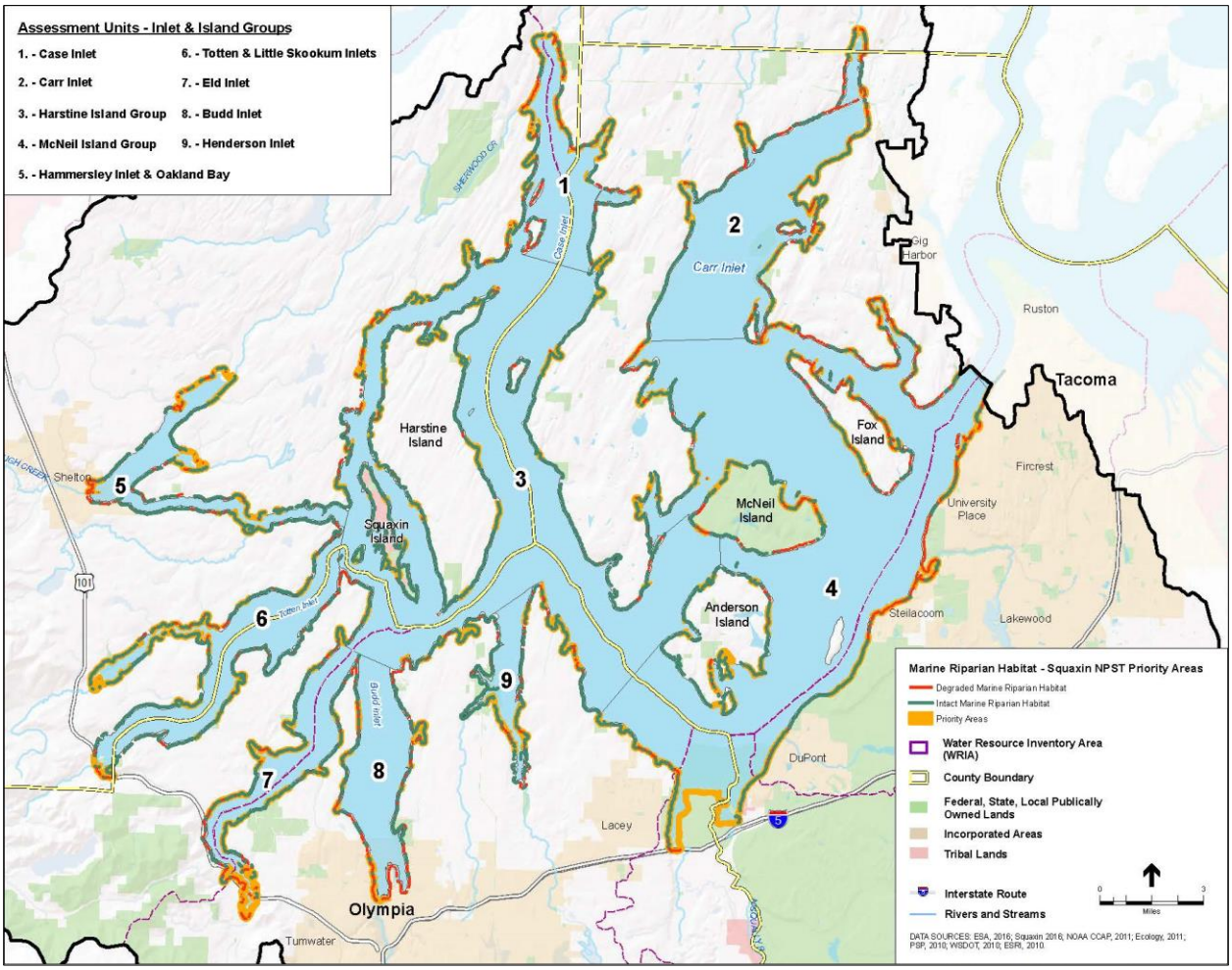


Figure 8.3. Marine Riparian Habitat – Squaxin NPST Priority Areas (Squaxin Island Tribe Nearshore Project Selection Tool for Juvenile Salmon)

Estuaries

Estuaries are one of the most productive habitats on the planet. In Puget Sound, estuaries of all sizes from small "pocket estuaries" to large river deltas are vital habitat for Chinook and other salmon. Pocket estuaries such as those common in South Sound provide critical functions, including rearing (feeding and growth), refuge from predators and extreme events, and opportunity for physiological transition for juvenile salmon, primarily early fry migrants of very small size. The importance of estuary habitat for natal and non-natal Chinook has been widely documented, and estuary restoration is considered a top priority for salmon recovery.

The AHSS defined large estuaries as including both the large South Sound river systems (Nisqually and Deschutes) and the Tier 1 streams in each WRIA. Using this definition, large estuaries comprise approximately 18 miles of the South Sound shoreline with the Nisqually delta as the largest (Figure 8.4).

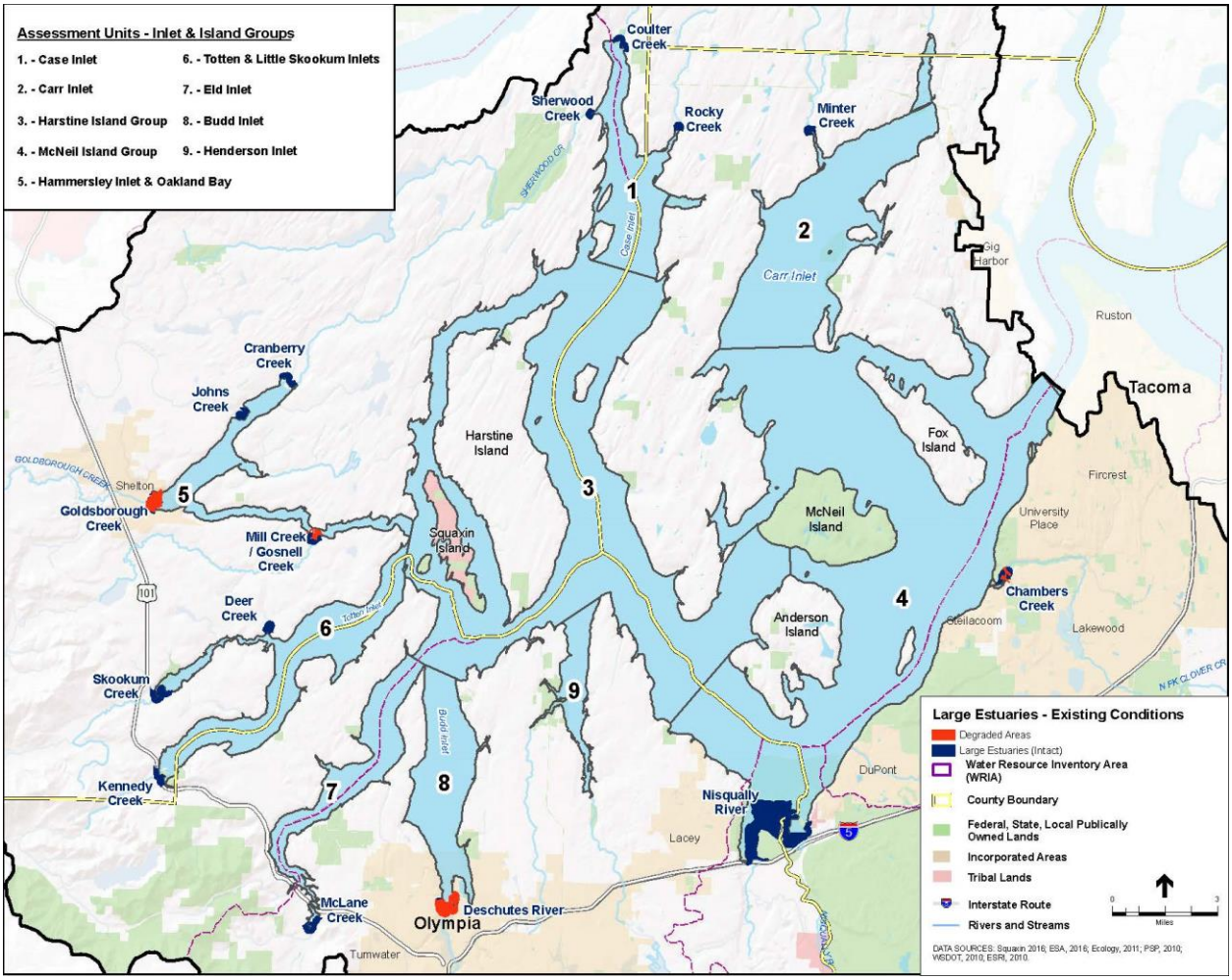


Figure 8.4. Large Estuaries – Existing Conditions (Squaxin Island Tribe Nearshore Assessment Tool)

Portions of estuary shorelines are armored with riprap, bulkheads, or other hard structures and are thus characterized as “degraded” in the Squaxin Nearshore Assessment - Shoreline Modifications Layer. The AHSS defined a large estuary as "intact" if the shoreline contains is less than 12% modifications. As shown in the following table, four of the inlet/island groups only have 1 large intact estuary, while the other three inlet/island groups have 3 intact estuaries based on the amount of modified shoreline.

Table 8.2 Shoreline Modification per Large Estuary

Inlet/Island Group	Large Estuary Name	Estuary Shoreline Length (Miles)	Estuary Shoreline Modification (Miles)	% Modified
Budd Inlet	Deschutes River / Capitol Lake	1.2	1.1	92.2%
Carr Inlet	Minter Creek	0.5	0	0.0%
Case Inlet	Coulter Creek	0.8	0	0.0%
	Rocky Creek	0.3	0	0.0%
	Sherwood Creek	0.2	0	0.0%
Eld Inlet	McLane Creek	0.9	0	0.0%
Hammersley Inlet & Oakland Bay	Cranberry Creek	0.7	0	0.0%
	Johns Creek	1.1	1.1	100.0%
	Mill Creek / Gosnell Creek	0.7	0	0.0%
	Goldsborough Creek	0.8	0.1	12.0%
McNeil Island Group	Chambers Creek	0.8	0.1	13.0%
	Nisqually River	5.3	0	0.0%
Totten & Little Skookum Inlets	Deer Creek	0.5	0	0.0%
	Kennedy Creek	0.7	0	0.0%
	Skookum Creek	1.2	0	0.0%
		15.7	**2.4**	**15.0%**

Pocket estuaries form where small streams meet the Puget Sound, creating a unique and important environment where freshwater mixes with saltwater and sediments collect. Small pocket estuaries comprise approximately 20 miles of the South Sound shoreline although some have been heavily modified by development, including nearshore fill and shoreline armoring (Figure 8.5).

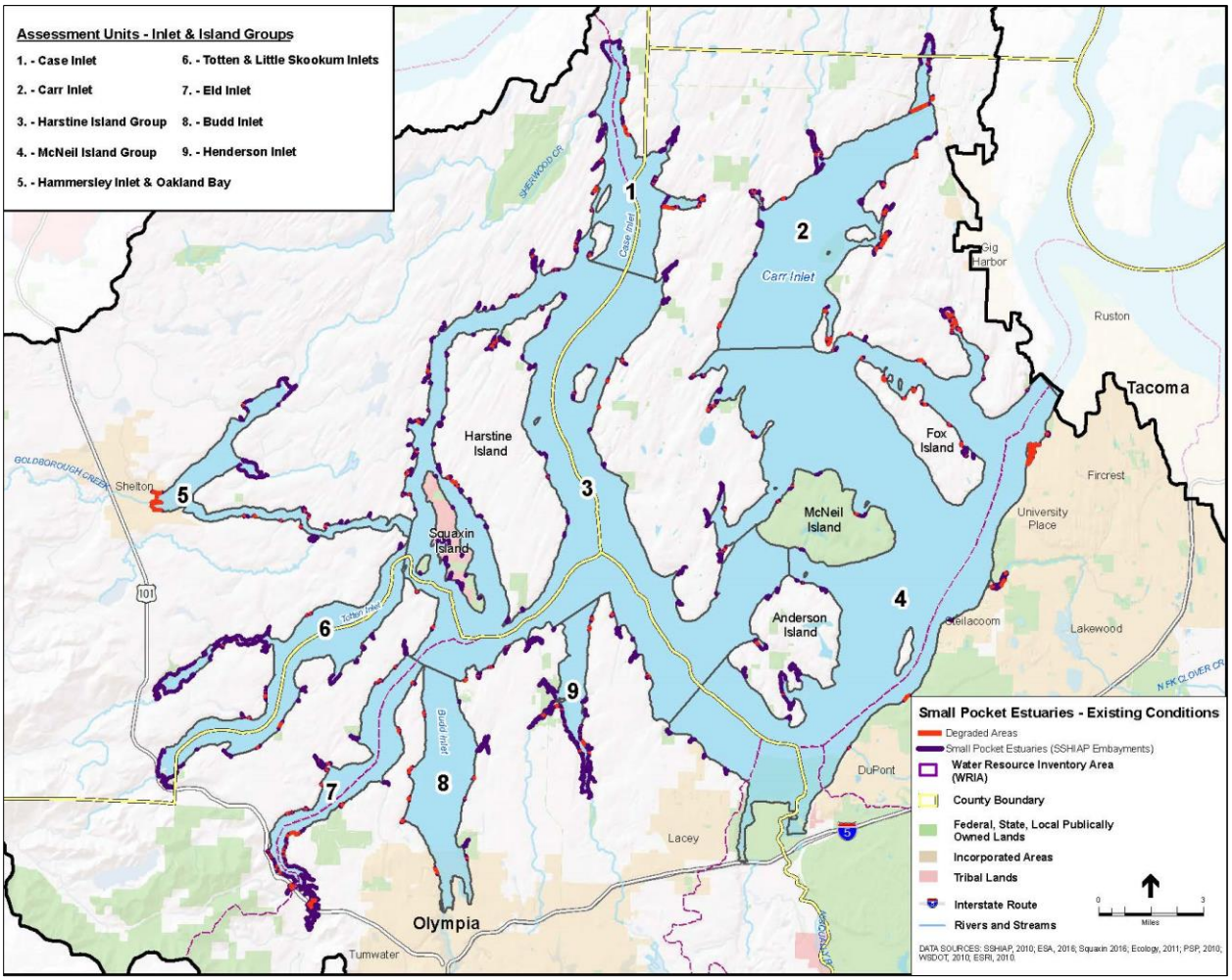


Figure 8.5. Small Pocket Estuaries – Existing Conditions (Squaxin Island Tribe Nearshore Assessment Tool)

To determine the amount of small estuary shoreline as intact or degraded (i.e. modified), the AHSS used the same methods as for large estuaries (i.e., Squaxin Nearshore Assessment - Shoreline Modifications Layer). As shown in the following table, Totten & Little Skookum Inlets, Eld Inlet, and Henderson Inlet have the greatest amount of intact small estuaries while Budd Inlet has the least.

Table 8.3 Shoreline Modification of Small Estuaries by Inlet/Island Group

Inlet/Island Group	Estuary Shoreline Length (Miles)	Estuary Shoreline Modification (Miles)	% Modified
Budd Inlet	2.7	0.8	30%
Carr Inlet	10.4	2.8	26%
Case Inlet	6.5	1.1	17%
Eld Inlet	12.7	1.9	15%
Hammersley Inlet & Oakland Bay	6.2	1.7	28%
Harstine Island Group	22.0	1.7	8%
Henderson Inlet	10.4	0.6	6%
McNeil Island Group	17.3	5.0	29%
Totten & Little Skookum Inlets	12.9	0.5	4%
	101.1	**16.1**	**16%**

Targets for Estuaries

The AHSS seeks to restore all large estuaries in South Sound. To accomplish this, ambitious targets have been set that aim toward protecting remaining intact habitat and restoring nearshore areas. Two local landscape-scale assessments have been completed to identify habitats most in need or restoration: The South Sound Coastal Catchment Assessment and the Priority NPST for Juvenile Salmon. This results in the following targets.

For large estuaries:

> *(1) Protect all intact large estuary shoreline throughout South Sound, 15.7 miles, of which 15.5 miles are in the areas identified as a priority in the South Sound Coastal Catchment Assessment and/or the NPST for Juvenile Salmon; and (2) restore 1.5 miles of degraded large estuary habitat in the areas identified as a priority in the NPST for Juvenile Salmon.*

Figure 8.6 shows large estuaries in the areas identified as a priority in the South Sound Coastal Catchment Assessment. Figure 8.7 shows large estuaries in areas identified as a priority for juvenile salmon.

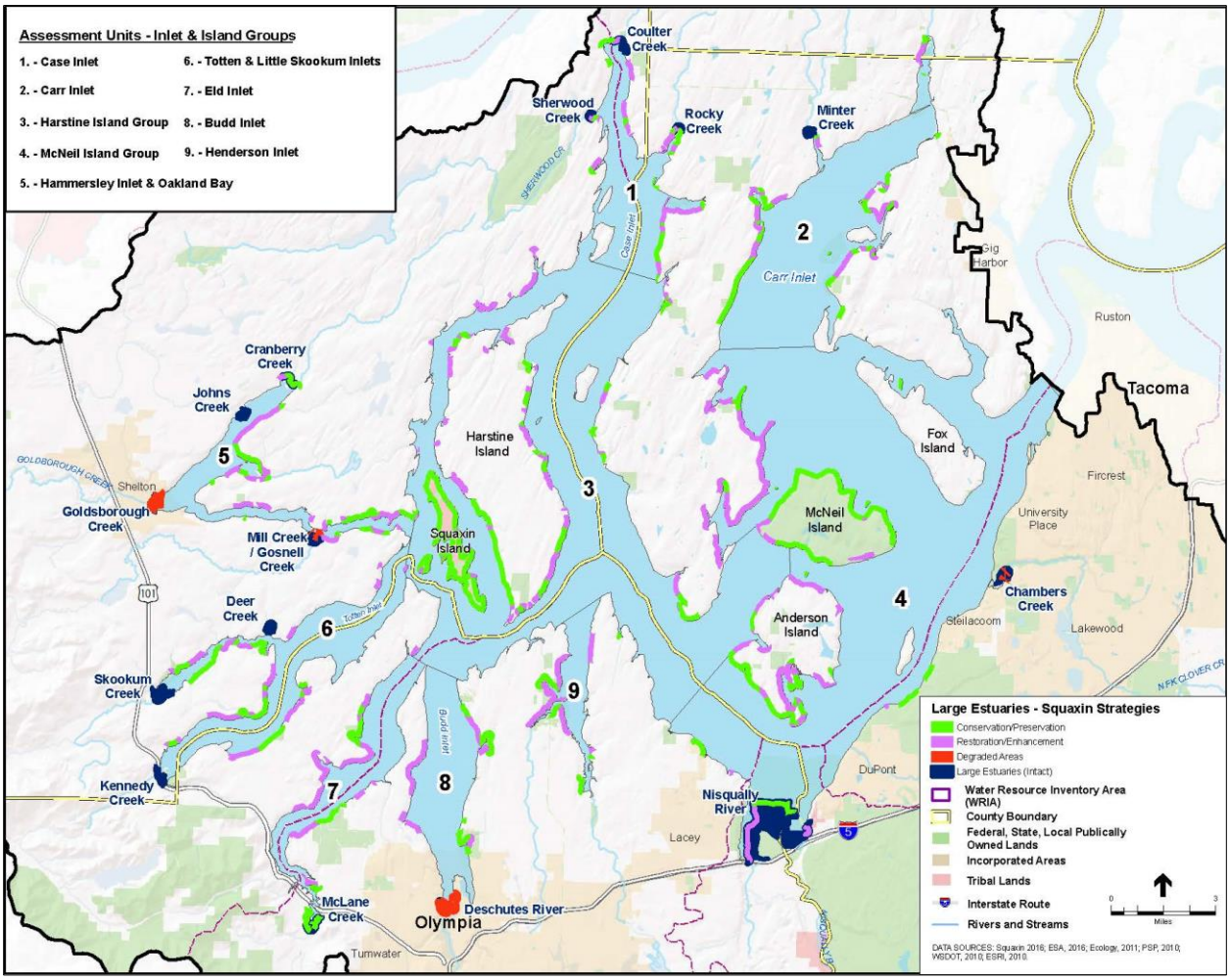


Figure 8.6. Large Estuaries – Squaxin Strategies (Coastal Catchment Assessment)

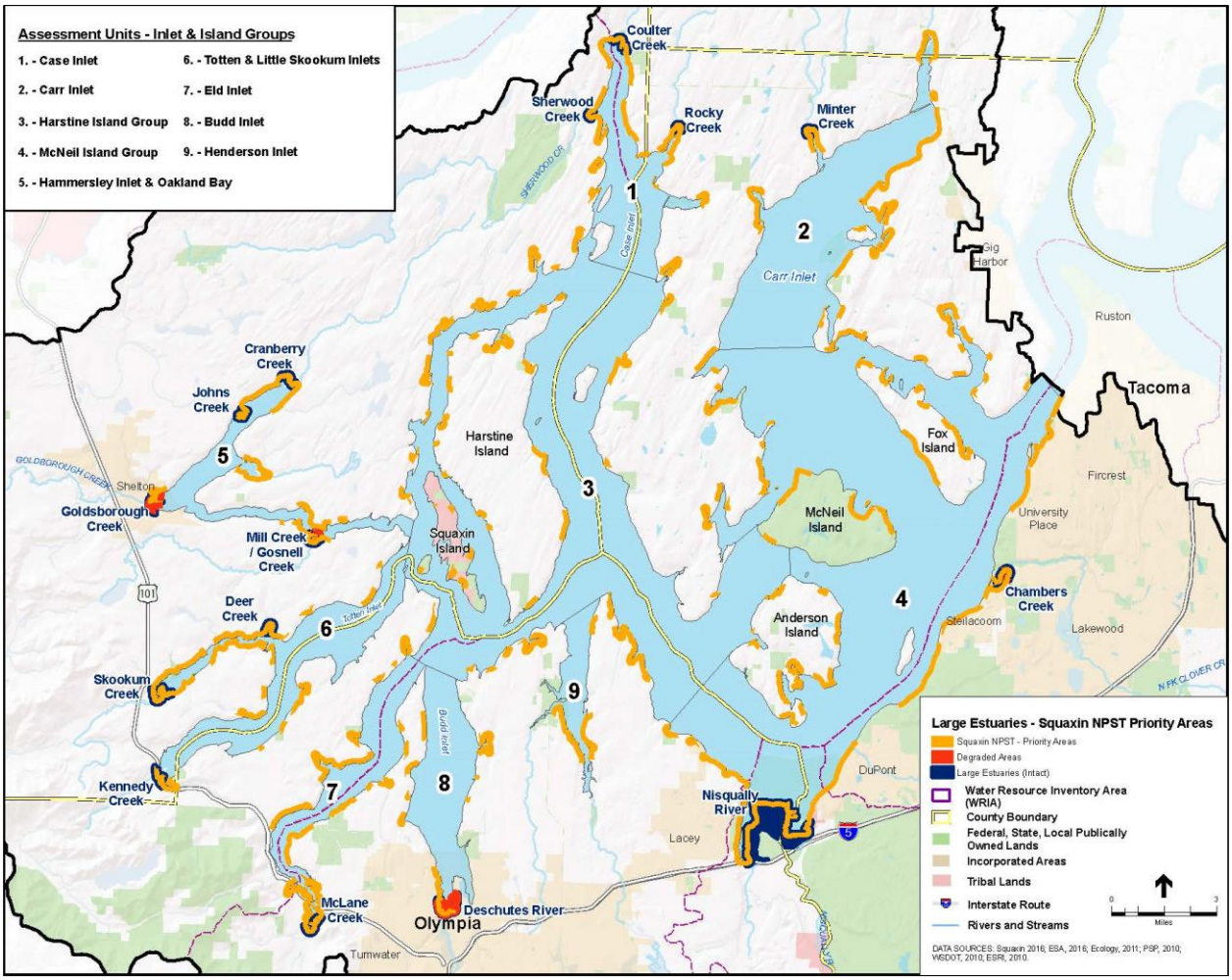


Figure 8.7. Large Estuaries – Squaxin NPST Priority Areas (Squaxin Island Tribe NPST for Juvenile Salmon)

For small estuaries:

> *(1) Protect all intact small estuary shoreline throughout South Sound, 85 miles, of which 82.4 miles are in the areas identified as a priority in the South Sound Coastal Catchment Assessment and/or the NPST for Juvenile Salmon; and (2) Restore 14.3 miles of modified shoreline in the areas identified as a priority in the South Sound Coastal Catchment Assessment and/or the NPST for Juvenile Salmon.*

Figure 8.8 shows estuaries in the areas identified as a priority in the South Sound Coastal Catchment Assessment. Figure 8.9 shows estuaries in areas identified as a priority for juvenile salmon.

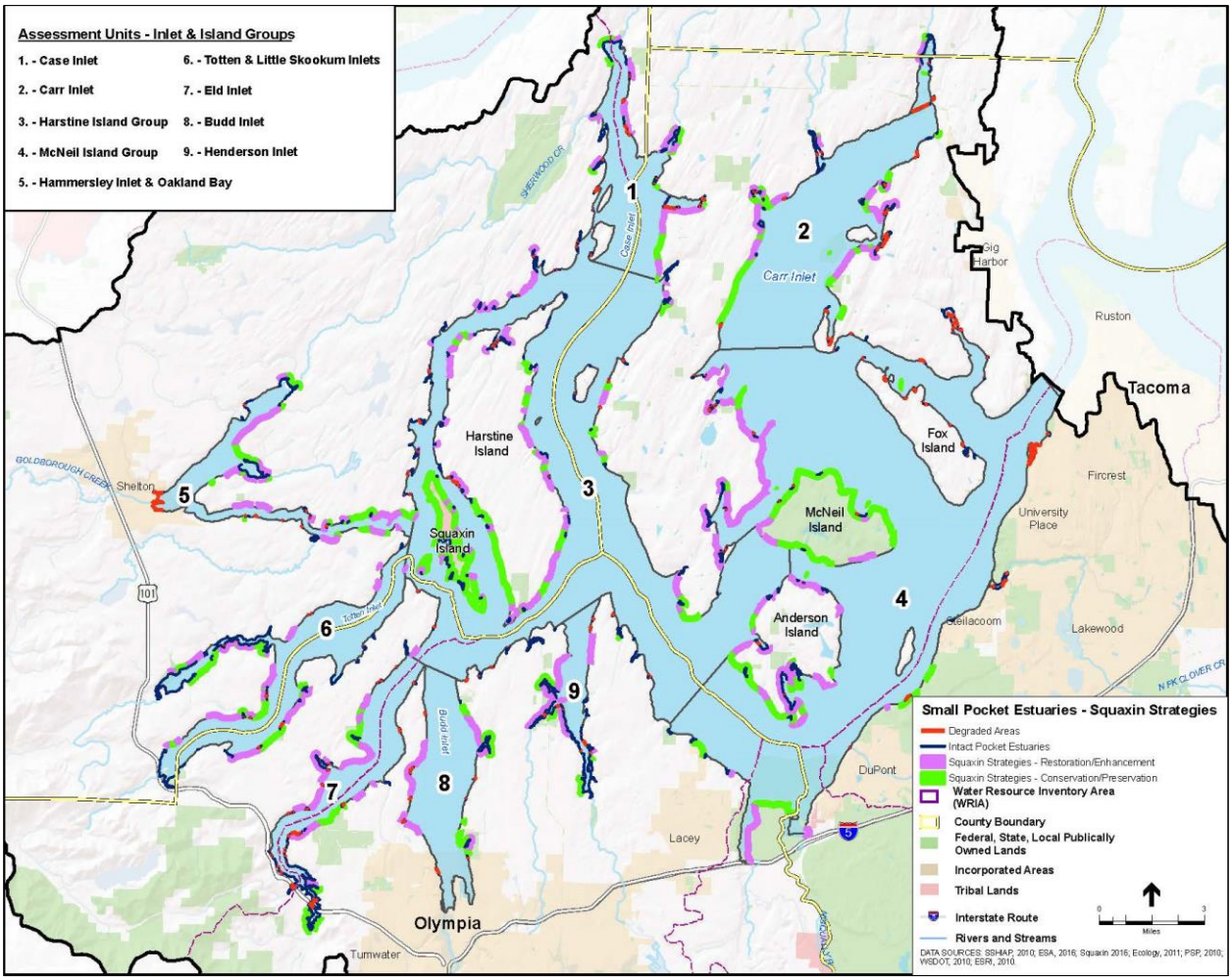


Figure 8.8. Small Pocket Estuaries – Squaxin Strategies (Coastal Catchment Assessment)

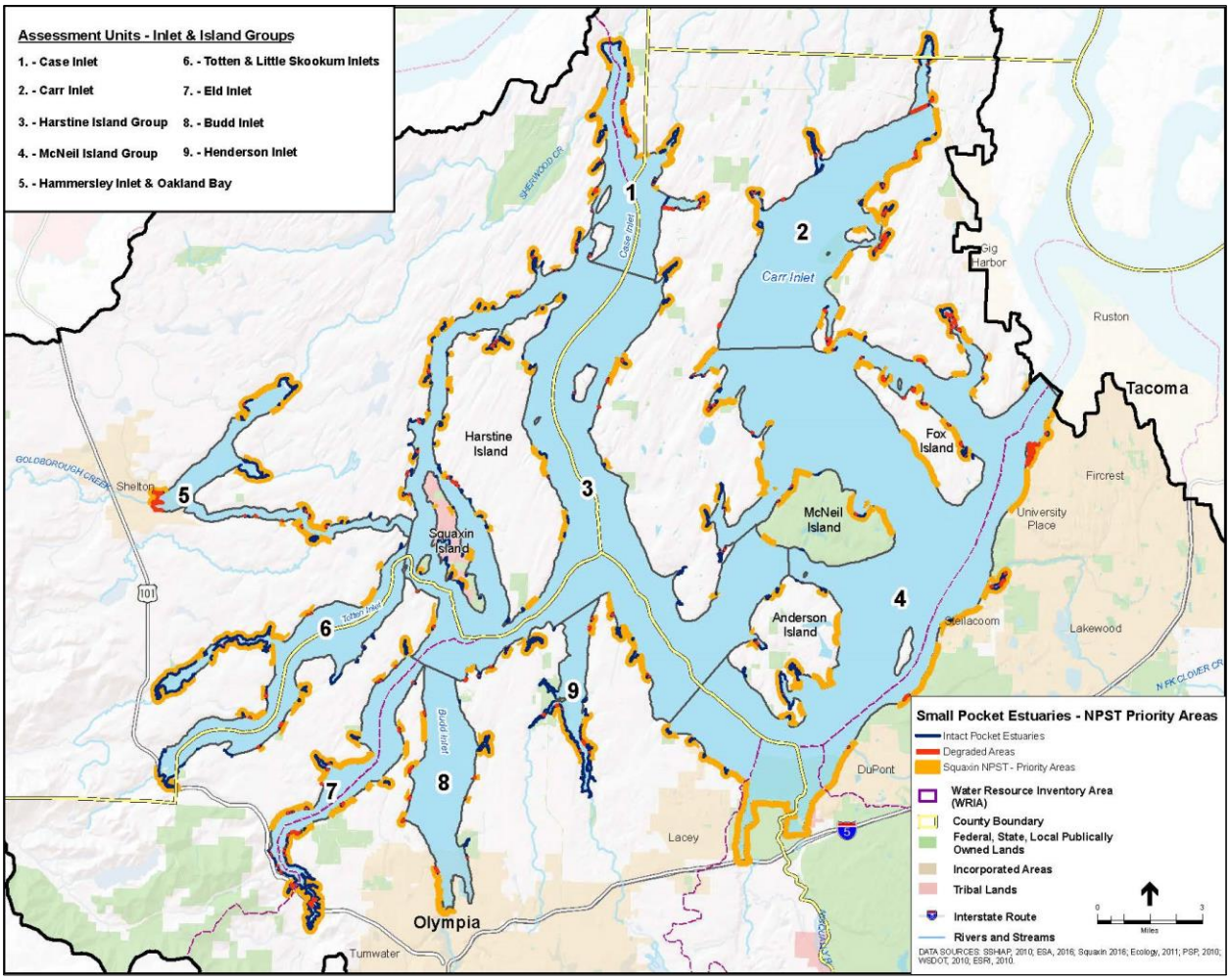


Figure 8.9. Small Pocket Estuaries – Squaxin NPST Priority Areas (Squaxin Island Tribe Nearshore Project Selection Tool for Juvenile Salmon)

Like other marine nearshore targets, these are ambitious; however, the AHSS is optimistic that with funding they can be achieved in a reasonable timeframe. South Sound has historically and will continue to place a very high priority on estuary protection and restoration, and has made significant progress in this area. In 2014 South Sound identified four specific estuary restoration projects for inclusion in the Puget Sound Action Agenda. These were: (1) the Chambers Bay estuarine and riparian enhancement project in WRIA 10/12, which would increase salt marsh and restore marine riparian habitat within and around Chambers Bay, improving shallow-water refuge and increasing foraging opportunity and rearing capacity for early life stages of Chinook, chum, and pink salmon; (2) Sequalitchew Creek estuary restoration; (3) John's Creek/Bayshore estuary restoration; and (4) the Deschutes estuary restoration through removal of the 5th Avenue dam in Olympia, which will restore 346 acres of estuarine and intertidal habitat within sight of the State Capital, in the Southern reaches of Puget Sound. The Squaxin Island Tribe led the project at John's Creek, which was completed in summer 2016; the project restored 74 acres of ecologically and culturally significant estuary, nearshore, riparian, and prairie oak habitat in the Oakland Bay watershed.

In addition to the estuary restoration actions listed in the 2014 Action Agenda, in recent years, estuary restoration also has been accomplished or substantially moved forward at Mission Creek on Budd Inlet, and Skookum Creek on Totten Inlet. Additional estuary restoration projects are in the active planning/development phase, including the mouth of Kennedy/Goldsborough Creek on Oakland Bay, and Whiteman Cove in Case Inlet. The Nisqually estuary has been the focus of the largest estuary restoration effort in the Pacific Northwest, with over 900 acres restored since 2002.

Eelgrass Beds

Eelgrass occurs in shallow sediments and is widely recognized for its provision of important ecological functions in sustaining diverse nearshore food webs and creating structurally complex habitat for a suite of species including herring, crab, shrimp, shellfish, waterfowl, and salmonids. Annual monitoring by Washington DNR has documented that eelgrass is more abundant in north Puget Sound. This is due to a variety of factors including appropriate substrate availability, water clarity, wave energy, light attenuation, water temperature, tidal amplitude, and desiccation stress. Where historically or currently present, eelgrass is critically important for maintaining nearshore ecosystem function.

A little over 60 miles of shoreline, or 15% of the total shoreline (450 miles) supports patchy or continuous eelgrass beds, as shown in figure 8.10 and Table 8.4. Beds only occur in the north and eastern portion of the South Sound and not in the finger inlets or islands of the southern end. The Nisqually Delta front and directly adjacent areas contain some of the largest eelgrass beds in South Sound. The intertidal areas around Anderson, McNeil, and Fox Islands contain patchy eelgrass beds as annually surveyed by WDNR. In addition, the shoreline adjacent to Steilacoom and University Place supports patchy eelgrass beds as does portions of Carr and Case Inlets. Very little (~6 miles) continuous eelgrass bed has been documented in the South Sound.

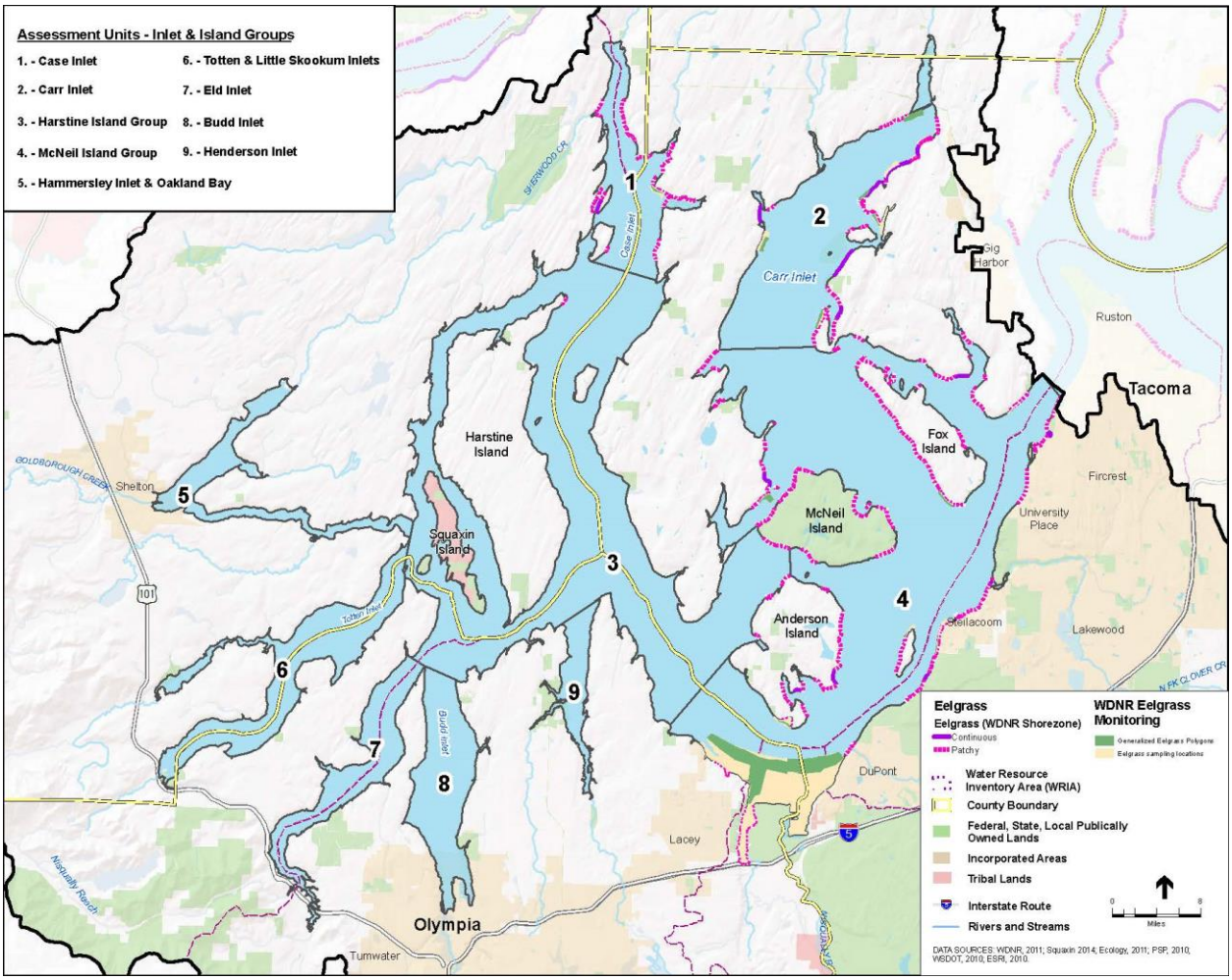


Figure 8.10. Eelgrass Beds – Existing Conditions (Washington DNR)

Table 8.4 Eelgrass Bed Extent by Inlet/Island Group

Inlet/Island Group	Total Shoreline Length (feet)	Continuous bed (feet)	Patchy bed (feet)
Budd Inlet	116,097	0.0	0.0
Carr Inlet	221,346	3.7	8.0
Case Inlet	150,784	0.4	7.7
Eld Inlet	166,160	0.0	2.3
Hammersley Inlet & Oakland Bay	182,867	2.0	39.0
Harstine Island Group	616,103	0.0	0.0
Henderson Inlet	106,389	0.0	0.0
McNeil Island Group	601,481	0.0	0.0
Totten & Little Skookum Inlets	212,894	0.0	0.0
	2,374,123	**6.1**	**57.0**

At this time, the AHSS is not proposing a local target for eelgrass beds. Protection of existing eelgrass beds should largely be accomplished by progress on other marine nearshore and freshwater quality attributes that protect and restore natural sediment dynamics and reduce overwater structures. The PSP has a recovery target for eelgrass beds, and the AHSS will monitor progress against that target for any insight it can offer into trends in South Sound.

Herring Abundance and Distribution

Herring have an important and unique intermediary role in the food web as an essential source of food for larger fish (including salmon), seabirds, and marine mammals. They are divided into three unique genetic groupings in the Puget Sound: Cherry Point, Squaxin Pass, and all other stocks. The Squaxin Pass stock has documented spawning and holding grounds in South Puget Sound occurring mostly in Carr Inlet and north of McNeil Island, the north side of Fox Island, and south of the Key Peninsula (shown as pink polygons on Figure 8.11).

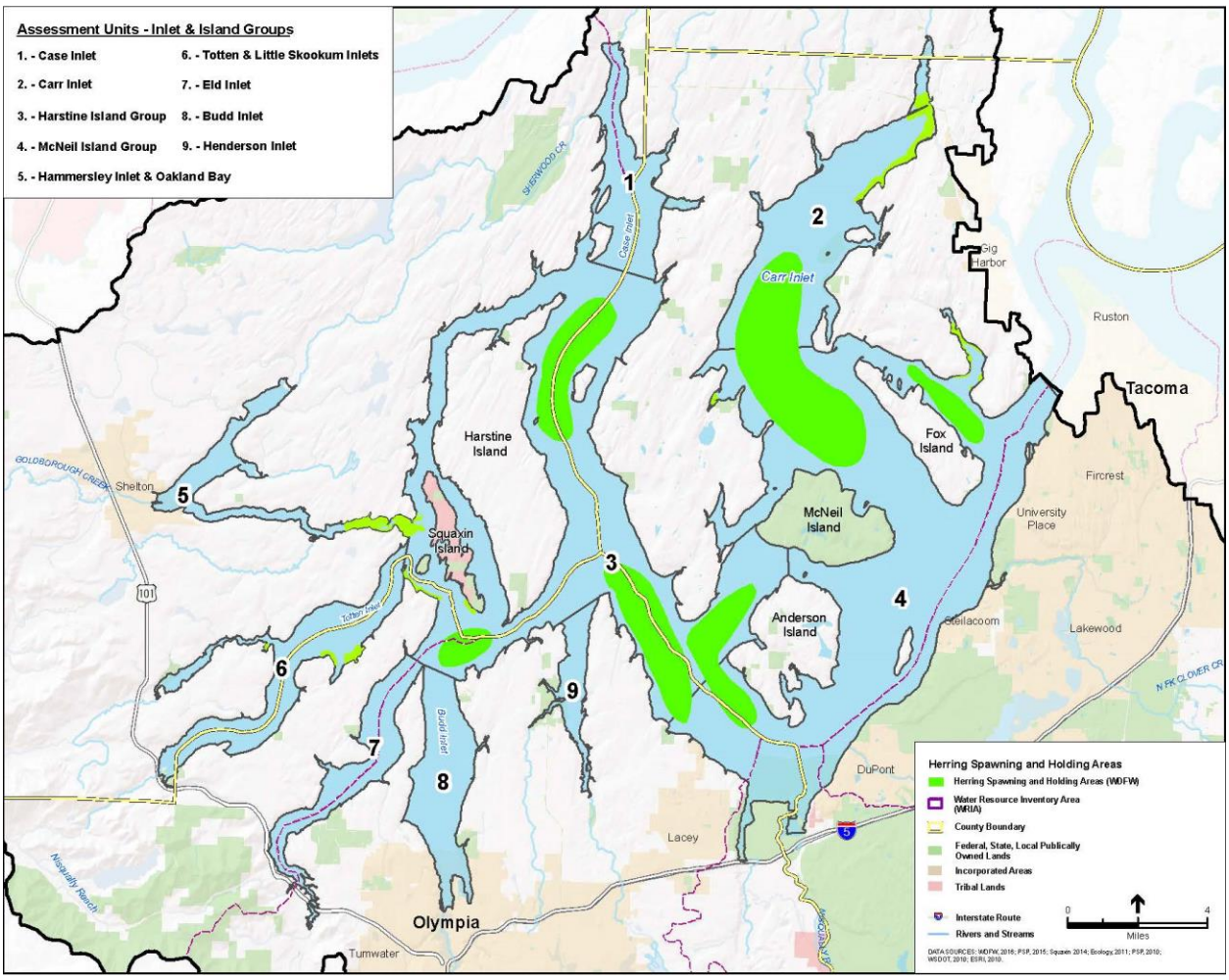


Figure 8.11. Herring Spawning and Holding Areas – Existing Conditions (WDFW)

WDFW has tracked the spawning biomass of the Squaxin Pass herring population annually since 1973 (Figure 8.12). In 2015, the biomass was 324 tons. The average amount over the period of record is 710 tons, with the highest year recorded as 2002 (3,150 tons) and the lowest year in 1997 (20 tons).

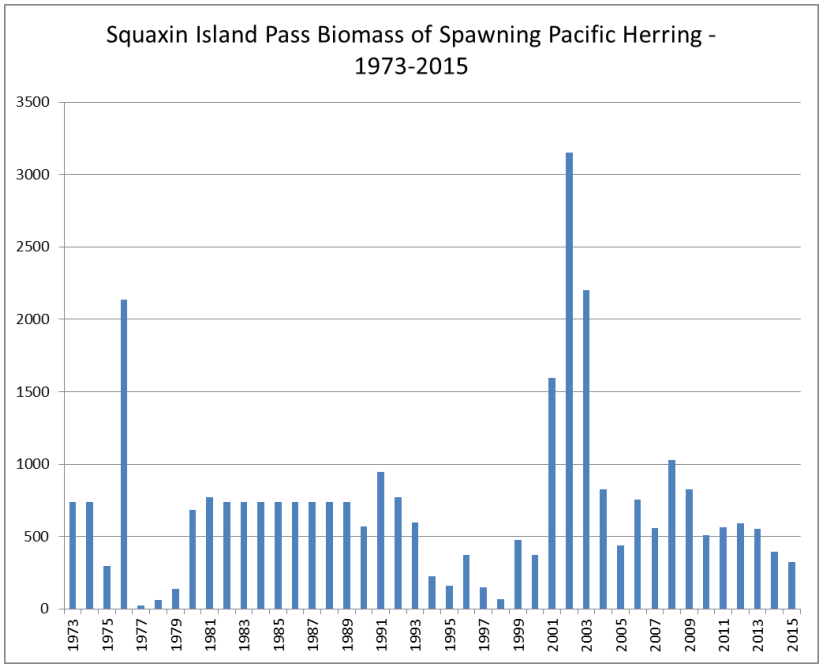


Figure 8.12 Spawning biomass of the Squaxin Pass Herring Population since 1973

As shown in the table below, Hammersley Inlet & Oakland Bay Inlet/Island Group has the most herring spawning area (11%) while Carr Inlet and the Harstine Island and McNeil Inlet/Island Groups have the greatest number of herring holding areas. Several Inlet/Island Groups do not contain herring spawning or holding areas including Budd Inlet, Case Inlet, and Henderson Inlet.

Table 8.5 Herring Spawning by Inlet/Island Group

Inlet/Island Group	Herring Spawning Areas (Acres)	Herring Spawning Areas (%)	Herring Holding Areas (Acres)	Herring Holding Areas (%)	Acres
Budd Inlet	0.0	0%	0.0	0%	5,102.7
Carr Inlet	545.2	5%	2,557.4	22%	11,589.4
Case Inlet	0.0	0%	0.0	0%	5,077.2
Eld Inlet	0.0	0%	0.0	0%	3,982.3
Hammersley Inlet & Oakland Bay	348.5	11%	0.0	0%	3,217.6
Harstine Island Group	182.0	1%	7,989.8	25%	31,754.6
Henderson Inlet	0.0	0%	0.0	0%	1,859.1
McNeil Island Group	146.6	0%	6,561.9	17%	39,724.0
Totten & Little Skookum Inlets	158.0	3%	0.0	0%	6,272.4

At this time, the AHSS is not proposing a local target for herring.

Intact Feeder Bluffs (Sediment Supply) & Shoreline Armoring

Littoral drift cells are units of the shorelines made up of feeder bluffs, which supply the sand and gravel; a transport zone in which the material moves in one direction along the beach; and areas of deposition, such as sand spits. Drift cell length is highly variable. In the South Sound the longest drift cell is nearly 10 miles in length and located within the McNeil Island Group and the smallest is only 10 feet long and located within Totten & Little Skookum Inlets.

Intact drift cells are those that do not have barriers to sediment supply and transport, such as armoring or nearshore fill. Protection of intact drift cells and restoration of sediment supply processes by removing armoring and nearshore fill is important for beach maintenance, which in turn is important for forage fish spawning, including surf smelt and sand lance, which lay their eggs on the upper intertidal beach.

There are 494 individual drift cells in the South Sound. Of these, 297 contain either historic or current feeder bluffs (or both) that once provided or still provide sediment supply to shoreline beaches and nearshore habitats. The amount of shoreline, number of drift cells, and functioning feeder bluff for each Inlet/Island Group is provided in the following table. It should be noted that the percent intact feeder bluff provided for each inlet/island group is a conservative estimate based on the data sources available.

Table 8.6 Intact Feeder Bluffs by Inlet/Island Group

Inlet/Island Group	Shoreline Length (miles)	Number of Drift Cells	Number w/Historic or Current Feeder Bluff	Intact Feeder Bluff (functioning sediment supply)
Budd Inlet	21.3	16	11	35%
Carr Inlet	41.9	38	20	29%
Case Inlet	28.5	37	23	21%
Eld Inlet	31.6	27	14	28%
Hammersley Inlet & Oakland Bay	34.6	30	19	40%
Harstine Island Group	114.9	159	91	73%
Henderson Inlet	20.0	18	6	38%
McNeil Island Group	109.5	127	91	45%
Totten & Little Skookum Inlets	40.4	42	22	66%
	442.6	**494**	**297**	

Intact feeder bluffs occur where shoreline development has been less intense, such as Harstine, McNeil, and Anderson Islands, and there is less shoreline armoring. Areas of higher density population and development have markedly reduced sediment supply from feeder bluffs, such as Carr and Case Inlets. Figure 8.13 shows feeder bluffs in five categories of intactness.

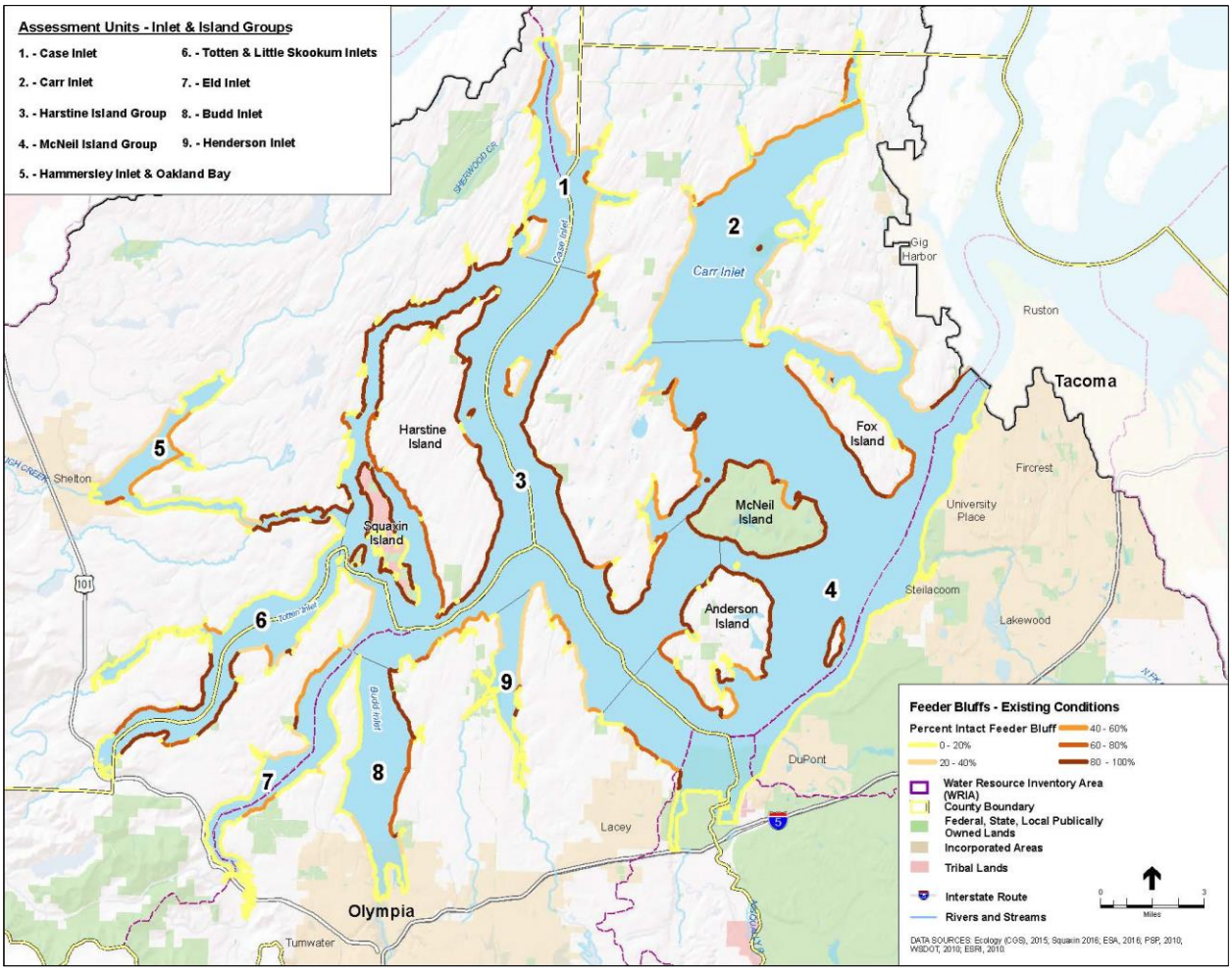


Figure 8.13. Feeder Bluffs – Existing Conditions (Washington Department of Ecology)

The status of drift cells is directly related to the amount of shoreline armoring present in South Sound. Shoreline armoring directly alters geologic processes that build and maintain beaches and spits by blocking sediment supply. Bulkheads also impact erosion patterns on nearby beaches, alter beach substrate and hydrology, and reduce the availability of large wood. These physical changes to beaches can diminish the availability and condition of habitat and can also directly impact plants and animals. Feeder bluffs that are blocked by shoreline armoring result in impaired sediment supply and transport processes and an impaired drift cell. Of the 400 miles of shoreline in the South Sound, approximately 120 contain some type of armoring such as bulkheads or riprap (approximately 30% of the total shoreline). As shown in the table and figure below, Budd, Carr, and Case Inlets have the most shoreline armoring at 53%, 48%, and 43% respectively, relating directly to them also having the most markedly reduced sediment supply from feeder bluffs, as discussed above.

Table 8.7 Comparison of shoreline modification percentages throughout South Puget Sound

Inlet/Island Group	Total Shoreline Miles	Shoreline Without Modifications (Miles)	Shoreline With Modifications (Miles)	% Modified
Budd Inlet	18.9	8.8	10.1	53%
Carr Inlet	36.6	19.0	17.6	48%
Case Inlet	24.5	14.1	10.4	43%
Eld Inlet	27.9	19.6	8.4	30%
Hammersley Inlet & Oakland Bay	32.6	24.8	7.8	24%
Harstine Island Group	103.8	84.4	19.3	19%
Henderson Inlet	17.0	14.2	2.8	16%
McNeil Island Group	101.0	61.3	39.8	39%
Totten & Little Skookum Inlets	37.3	32.5	4.8	13%
Grand Total	**400**	**278.6**	**120.9**	**30%**

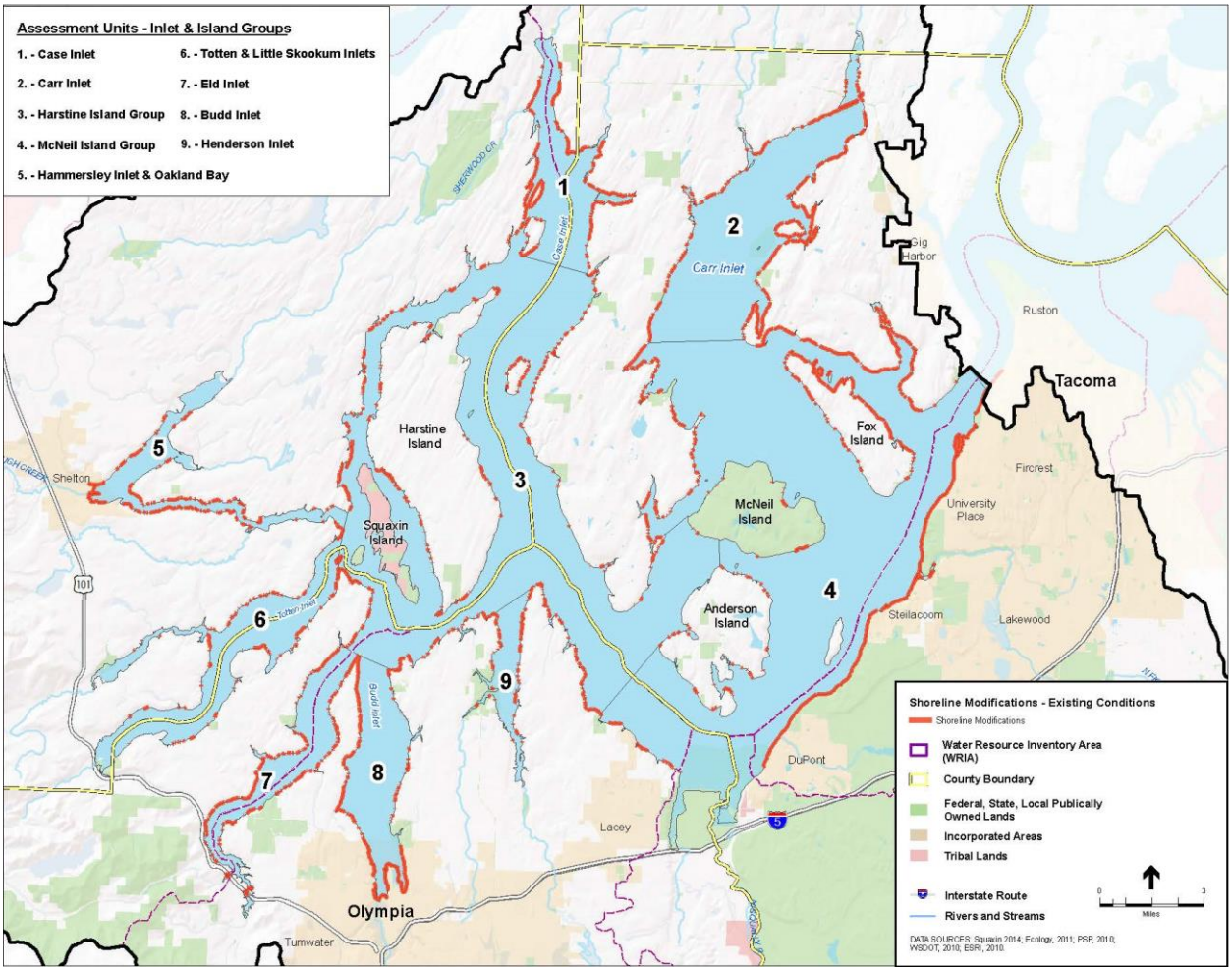


Figure 8.14. Shoreline Armoring (Modifications) – Existing Conditions (Squaxin Island Tribe Nearshore Assessment Tool)

Targets for Feeder Bluffs and Shoreline Armoring

The AHSS seeks to improve nearshore sediment supply processes in South Sound by protecting remaining intact (unarmored) shoreline and feeder bluffs and restoring significant sediment supplies and transport processes, especially in priority nearshore areas. As with other marine nearshore

attributes, these are ambitious targets, particularly the shoreline armoring target which seeks to remove almost half the hard armoring in South Sound and replace it with natural processes and/or softer armoring.

For feeder bluffs/ sediment supply the target is:

> *(1) Protect all drift cells with >80% intact feeder bluffs throughout South Sound, 92.5 miles, of which 61.7 miles are in the areas identified as a priority in the South Sound Coastal Catchment Assessment and/or the NPST for Juvenile Salmon.*

Figure 8.15 shows drift cells with >80% intact feeder bluffs in the areas identified as a priority in the South Sound Coastal Catchment Assessment. Figure 8.16 shows drift cells with >80% intact feeder bluffs in areas identified as a priority for juvenile salmon.

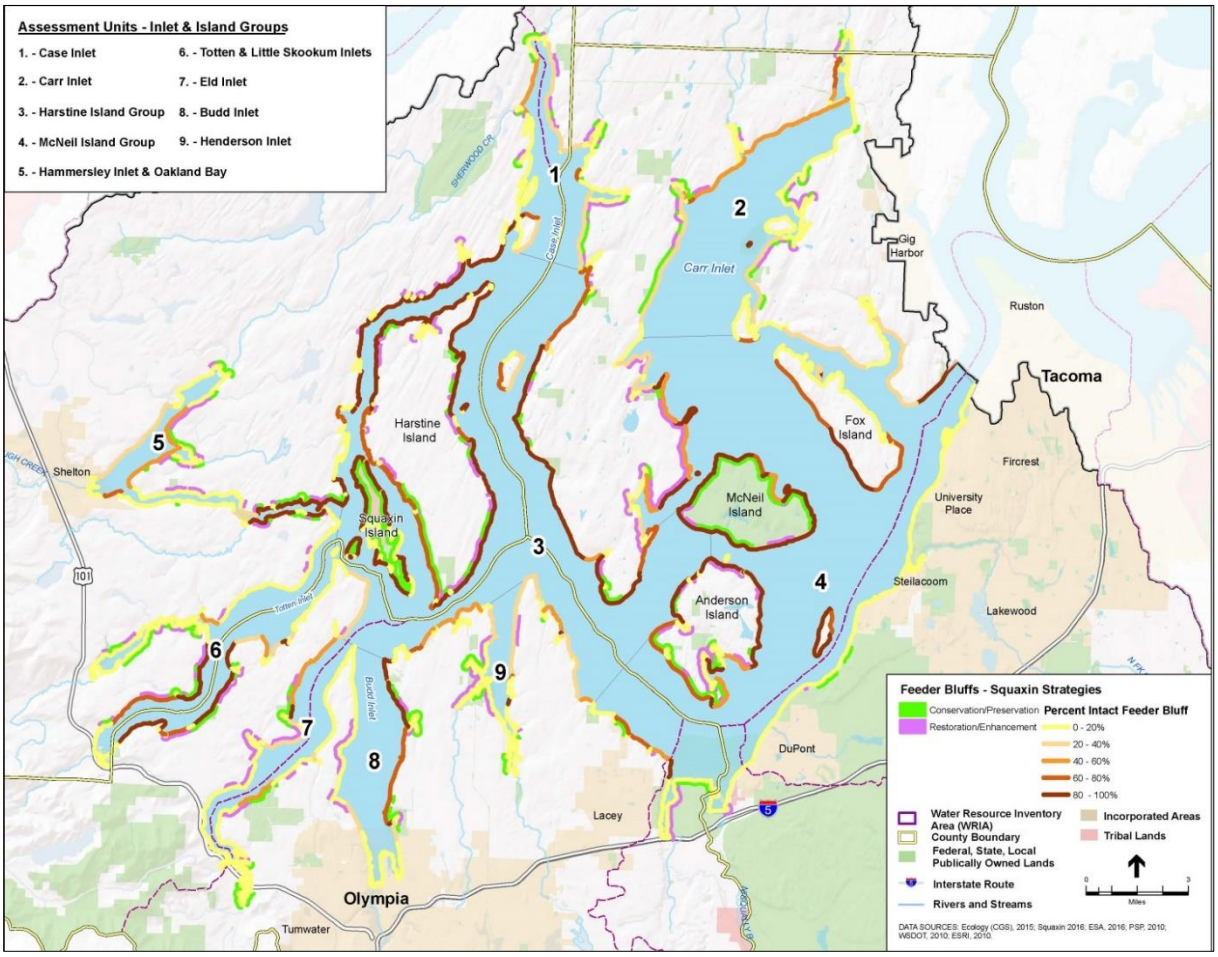


Figure 8.15. Feeder Bluffs – Squaxin Strategies (Coastal Catchment Assessment)

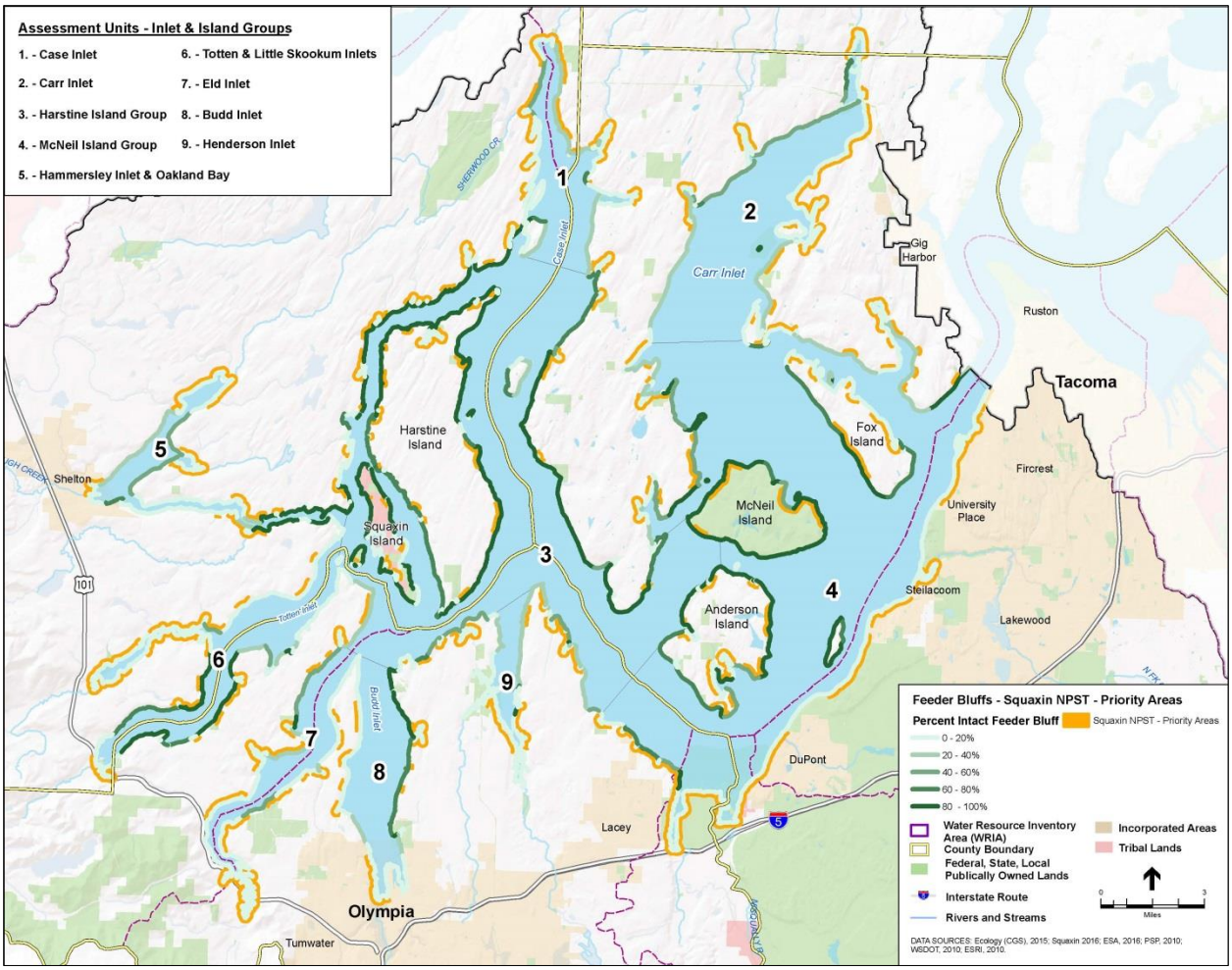


Figure 8.16. Feeder Bluffs – Squaxin NPST Priority Areas (Squaxin Island Tribe NPST for Juvenile Salmon)

For shoreline armoring:

> *(1) Protect all intact shoreline throughout South Sound, 278.6 miles, of which 201.7 miles are in the areas identified as a priority in the South Sound Coastal Catchment Assessment and/or the NPST for Juvenile Salmon; and (2) Restore 73.1 miles of modified shoreline in the areas identified as a priority in the South Sound Coastal Catchment Assessment and/or the NPST for Juvenile Salmon.*

Figure 8.17 shows shoreline armoring in the areas identified as a priority in the South Sound Coastal Catchment Assessment. Figure 8.18 shows shoreline armoring in areas identified as a priority for juvenile salmon. Existing unarmored shoreline occurring within areas identified (for protection and/or juvenile salmon) is shown in Figure 8.19.

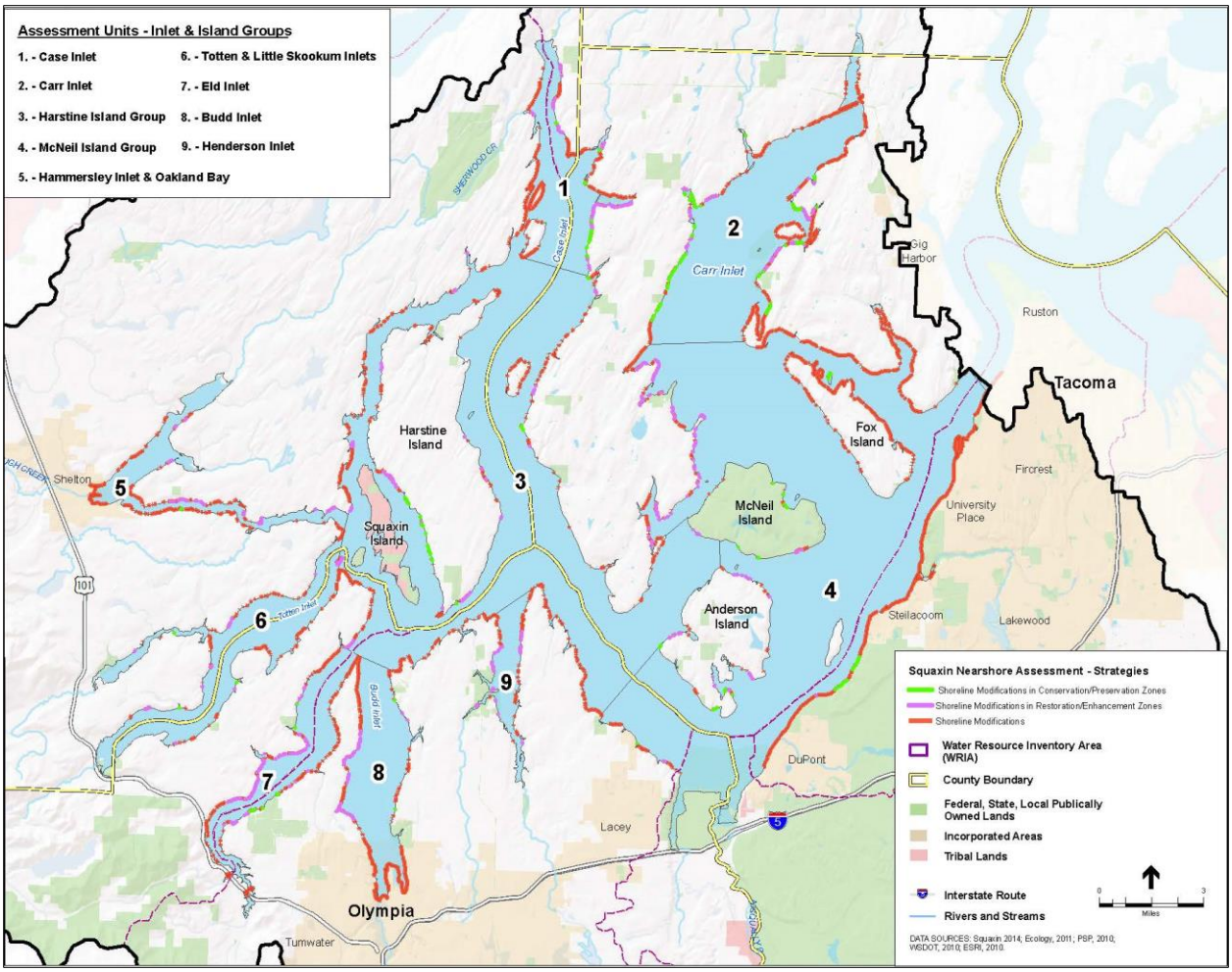


Figure 8.17. Shoreline Armoring (Modifications) – Squaxin Strategies (Coastal Catchment Assessment)

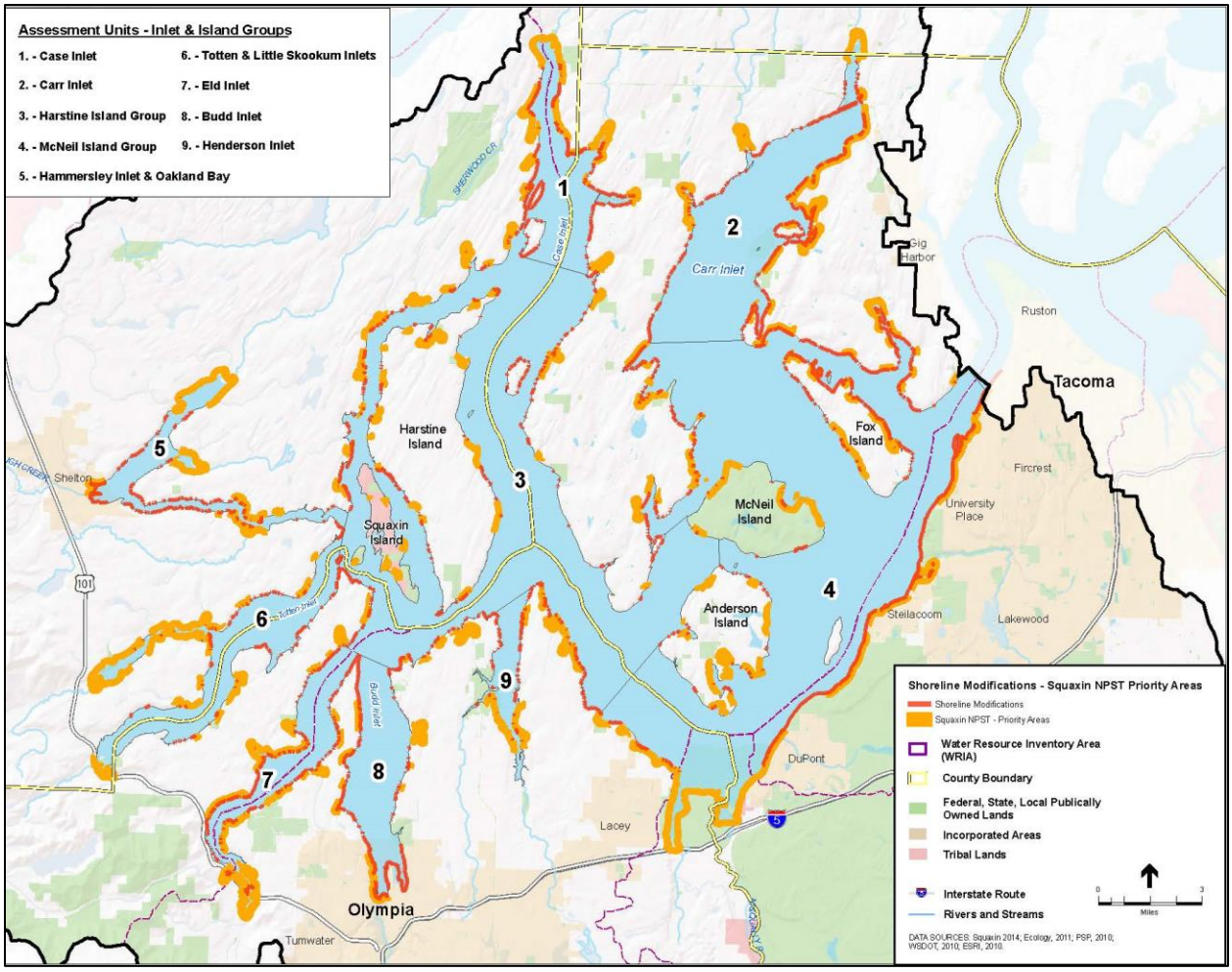


Figure 8.18. Shoreline Armoring (Modifications) – Squaxin NPST Priority Areas (Squaxin Island Tribe NPST for Juvenile Salmon)

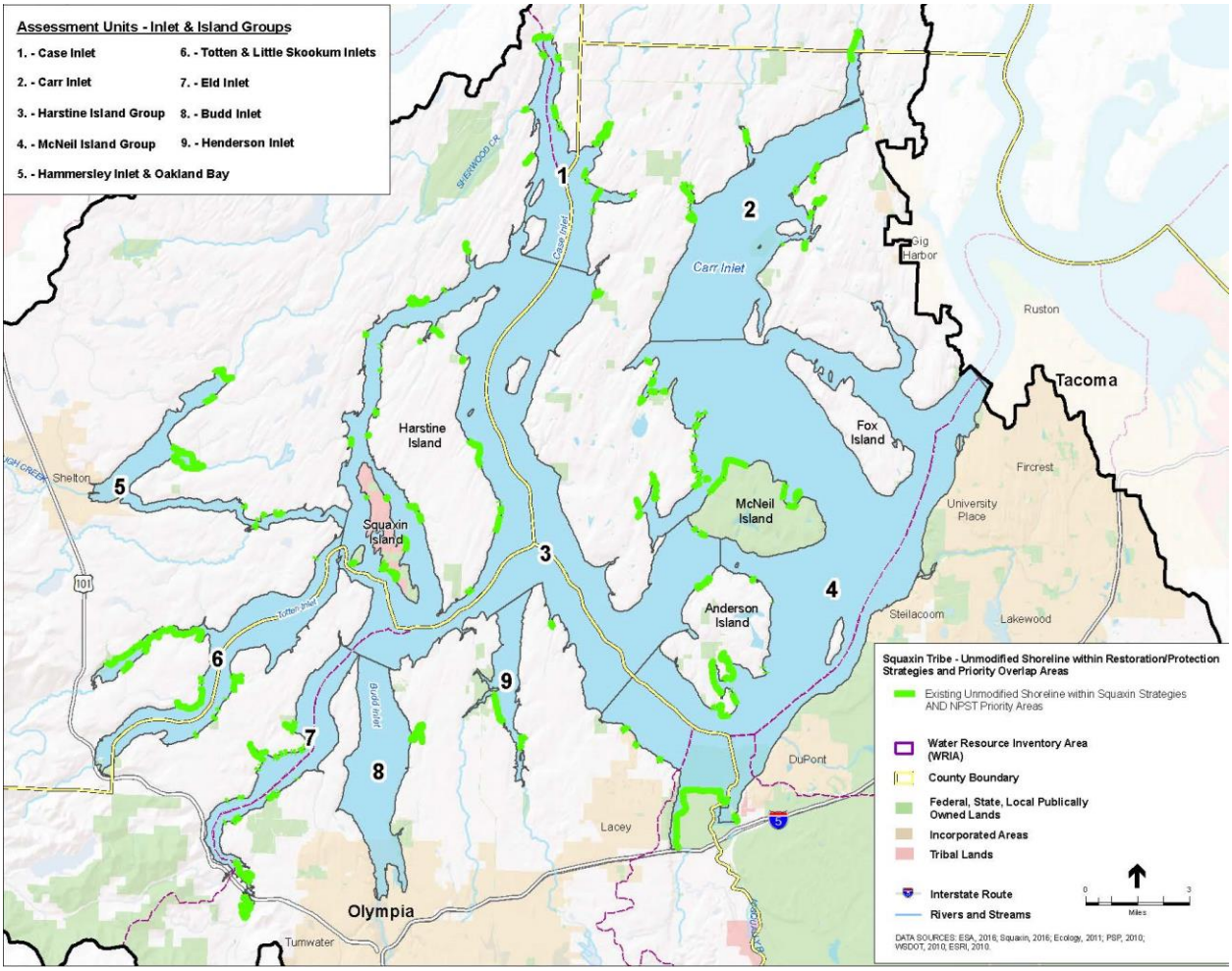


Figure 8.19. Existing Unmodified Shorelines within Squaxin Strategies and NPST Priority Areas

While these targets are ambitious, the AHSS does not believe they are impossible. Recent projects, such as the Edgewater Beach Bulkhead Remover point to an ever-increasing public understanding of the importance of sediment supply processes, and acceptance of softer armoring techniques.

Surf Smelt and Sand Lance

Shoreline development in the South Sound has significantly decreased the amount and quality of available habitat for forage fish that spawn on beaches. Forage fish such as sand lance and surf smelt rely on upper intertidal areas of nearshore beaches to spawn. Similar to herring, these fish play a unique and important intermediary role in the marine food web and are a critical food source for larger fish, including salmon, and marine mammals. Surf smelt and sand lance spawning has been documented across the South Sound (shown in Table 8.6), with the greatest amount on the beaches of Harstine Island (24.6% for surf smelt and 6.2% for sand lance). Overall, surf smelt spawning areas are more abundant than sand lance with over 100 documented miles versus 15 miles, respectively.

Table 8.8. Sand Lance and Surf Smelt abundance

	Documented Sand Lance			Documented Smelt			Total Shoreline Length	
Inlet/Island Group	Length (Ft)	Sand Lance Length (Mi)	%	Length (Ft)	Smelt Length (Mi)	%	Length (Mi)	Length (Ft)
Budd Inlet	3,070.7	0.6	3%	97,226.3	18.4	87%	21.2	112,119.8
Carr Inlet	528.6	0.1	0%	7,314.1	1.4	3%	41.7	220,302.0
Case Inlet	1,916.2	0.4	1%	35,256.8	6.7	24%	28.3	149,567.9
Eld Inlet	2,223.9	0.4	1%	102,176.5	19.4	62%	31.5	166,075.7
Hammersley Inlet & Oakland Bay	371.0	0.1	0%	978.7	0.2	1%	34.5	181,907.4
Harstine Island Group	32,518.0	6.2	5%	129,645.1	24.6	21%	114.7	605,735.4
Henderson Inlet	0.0	0.0	0%	37,413.5	7.1	36%	19.9	105,324.0
McNeil Island Group	24,787.7	4.7	4%	26,844.7	5.1	5%	109.1	576,304.5
Totten & Little Skookum Inlets	16,088.5	3.0	8%	96,690.4	18.3	45%	40.3	212,851.6
	81,504.5	**15.4**	**3%**	**533,546.1**	**101.1**	**23%**	**441.3**	**2,330,188.2**

Figure 8.20 shows the location of documented sand lance and surf smelt spawning beaches.

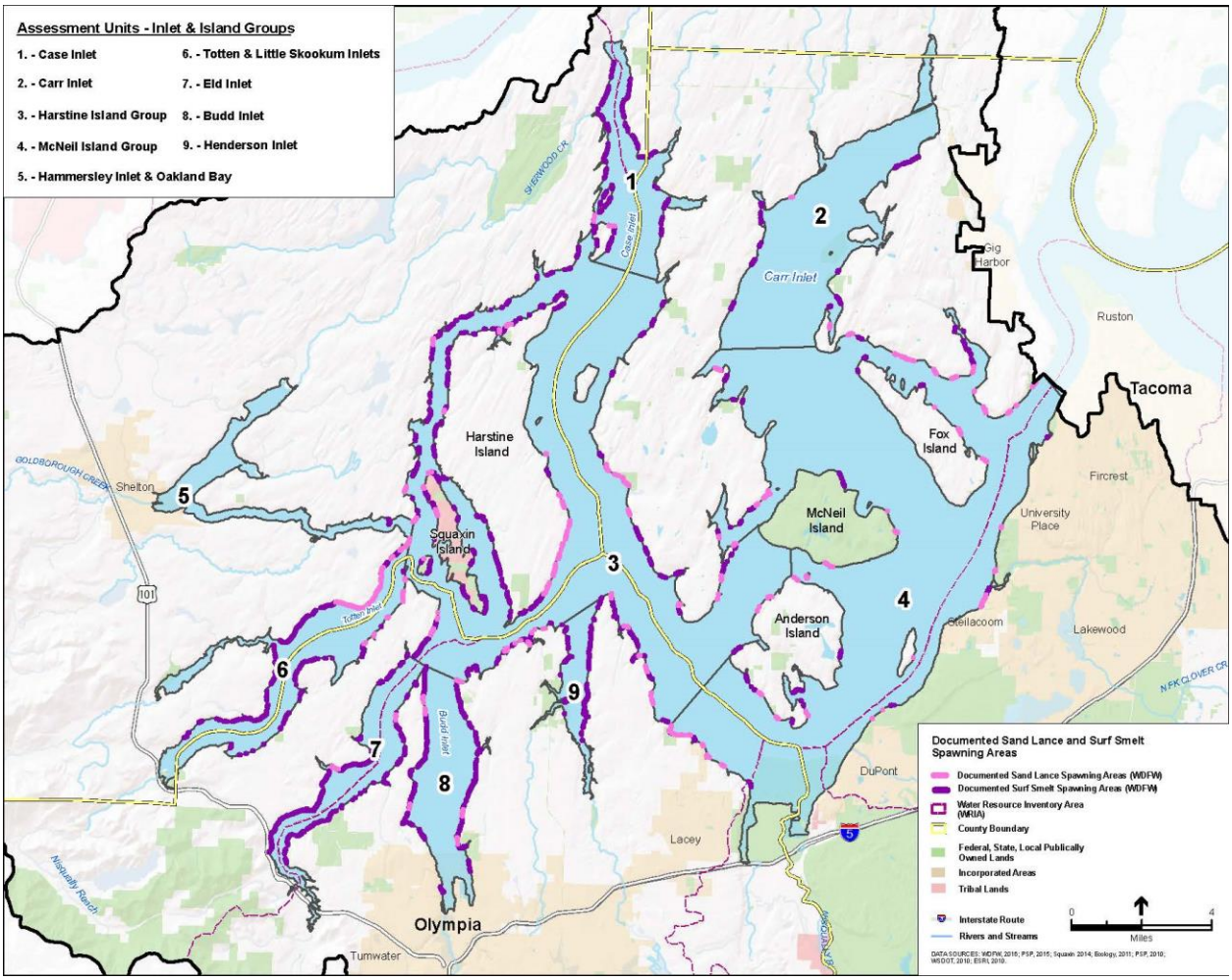


Figure 8.20. Documented Sand Lance and Surf Smelt Spawning Areas – Existing Conditions (Washington Department of Fish and Wildlife)

At this time, the AHSS is not proposing a local target for surf smelt and sand lance. The AHSS believes that protection and restoration of beach habitat forming and sustaining process (i.e., sediment supply and transport) through reduction of shoreline armoring will improve surf smelt and sand lance abundance and distribution over time.

Strategies, Existing Programs, and Actions

Strategies to address marine and nearshore habitat focus on:

- Direct protection of intact areas (e.g., through acquisition and transfer/purchase of development rights)
- Support and implement land management plans and regulations, particularly local shoreline master programs that concentrate growth in urban growth areas and limit further shoreline alterations;
- Support to landowners to help them protect and restore remaining marine riparian and other intact nearshore habitat. This can be done by protecting and restoring sediment supplies and transfer particularly through removing or softening shoreline armoring, other alterations, and overwater structures (e.g., through investment in restoration and by incentivizing natural areas and open space);
- Education and outreach about how nearshore processes support ecosystem functions and services (such as abundant salmon) that are important to people to raise support for nearshore protection and restoration efforts;
- Direct protection of land adjacent to streams and lakes (e.g., through acquisition and transfer/purchase of development rights).

Shoreline Master Programs (SMP)

The key efforts to protect marine nearshore habitat flow from local jurisdictions' Shoreline Master Programs (SMPs). These programs, which operate at the city and county level, are combined planning and regulatory documents intended to "prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines." SMPs must contain: goals for shoreline use, economic development, economic development, public access, circulation, recreation, conservation and historical/cultural values. Goals provide the basis for, and are intended to help implement, SMP policies and regulations. They also classify shorelines into specific environment designations based on their physical, biological and development characteristics, generally "natural", "conservancy", "rural" and "urban" and specify policies and regulations are developed for each designation, reflecting the specific purpose and intent of each environment and responding to its specific conditions as well as general policies and regulations that govern shoreline use and modifications.

All of the South Sound SMPs (both county and related city-level programs) are currently undergoing revision. Updated programs will establish specific protection and restoration priorities in each Inlet Island group. Many of the updates are including "no net loss of ecological function" as a priority in the revised SMPs.

City of Lacey SMP

The City of Lacey is currently undergoing an update of their Shoreline Master Plan, which was last updated in 2011. The goals of this update include: protecting ecological function, and fostering reasonable use and maintaining the public's right of navigation, access and corollary uses of the shoreline.

City of Olympia SMP

The City of Olympia completed their update of the Shoreline Master Plan in 2015. The updated version of the plan emphasizes development of the shoreline while maintaining a net gain of ecological function.

Thurston County SMP

Thurston County is currently working on an update to their Shoreline Master Plan. The last update to this program was completed in 1990, thirteen years before state Shoreline Master Plan guidelines were released in 2003. This update of the plan will be consistent with the latest state requirements. It states goals of: developing a document that contains policy, goals, and specific land use regulations for shorelines.

Shore Friendly Programs

The state-level Shore Friendly program offers guidance and resources to local jurisdictions to help waterfront homeowners protect their property in ways that also protect or improve ecosystem processes, and encourages alternatives to hard armoring. This state-wide program provides funding to local jurisdictions to manage the programs. In the South Sound, Mason County has the most active shore friendly program and routinely offers free workshops and site evaluations for waterfront homeowners, as well as "mini grants" to support restoration planning. They are actively working to expand this program to other South Sound counties.

An example of the Shore Friendly program is the Mason Conservation District Shore Friendly Mason program. The goal of this program is to connect Mason County waterfront landowners to technical support and resources that allow them to make informed, cost-effective and environmentally-friendly decision about shoreline management.

Pollution Identification Correction (PIC) Program

Pollution Identification Correction (PIC) Programs affect marine nearshore habitat, freshwater quality, marine water quality, and shellfish, these programs are described within each of the respective chapters in the Strategy.

The Environmental Protection Agency (EPA) provides more than $7.2 million in National Estuary Program (NEP) funds to support the PIC Program. These programs help to reduce marine and nearshore pollution. Brief descriptions of the AHSS counties' PIC programs are provided below. More detailed descriptions are provided in Chapter IX – Water Quality.

Mason County PIC Program

Mason County operates this PIC program (link). They use EPA funding to encourage septic system maintenance, undergo septic tracking, produce education materials and collect water quality data to identify and address sources of pollution.

Tacoma Pierce County PIC Program

The Tacoma-Pierce County Health Department manages this PIC program. The states goal is to develop a strategic plan and an outreach plan with educational and marketing tools to guide their PIC work. This is an ongoing program with funding from the NEP grant.

Thurston County PIC Program

Thurston County Public Health and Social Services Department utilizes the NEP grant to identify failures in septic system in Eld and Henderson Inlets. They work with landowners in those areas to correct problems with OSS. To assist with this, they are working on the implementation of a GIS-based prioritization tool.

Puget Sound Marine and Nearshore Grant Program

While this program is facilitated at the state level by the Washington State Department of Fish and Wildlife, the funds from the program go toward local restoration efforts. The funds are provided through an EPA grant. The purpose of this grant program is to fund actions that advance Puget Sound recovery by protecting and restoring marine and nearshore habitats and ecosystem functions. Examples of projects funded through this program in the past include: Shoreline armoring removal, Oil spill preparedness and response, Invasive species detection and prevention, Eelgrass restoration, and Shoreline and estuary restoration and acquisition projects.

Manure Exchange Program

The Mason Conservation District manages this program that matches up local livestock owners with excess manure, to gardeners in search of local, free fertilizer. This ongoing program is funded by the conservation district. It serves as a mechanism for reducing the amount of manure reaching local streams, lakes and marine waterways.

Green Shores for Homes Program

This program is a voluntary, incentive-based program that helps waterfront homeowners restore natural shorelines and enjoy the many recreational, scenic, environmental, and shoreline-protection benefits they bring. A shoreline project is assessed by the program against a series of credits for which a homeowner or builder can achieve points. There are 27 credits for which points may be achieved. Depending on the number of points a homeowner receives based on a third-party review, they can be in one of two recognition levels: Chinook, or Orca.

Lost Net Response and Retrieval Program

The Northwest Straits Foundation created the Reporting, Response, and Retrieval Program to prevent the re-accumulation and harmful impacts of lost fishing nets by responding to and retrieving newly lost nets before they become derelict.

Examples of Current Projects

Nisqually Wildlife Refuge Comprehensive Conservation Plan

The Nisqually Wildlife Refuge have completed a draft plan and Environmental Impact Statement for their proposed Comprehensive Conservation Plan. These documents were released for review in October 2016. The goal of this plan is to restore over 700 acres of estuarine habitat, including 30+ acres of riparian surge plan. This project is a priority for Puget Sound Chinook.

West Oakland Bay Restoration and Conservation

The SPSSEG is working on the restoration, planning and conservation of Goldsborough Creek estuary in Oakland Bay. This project is funded by the Puget Sound Acquisition and Restoration grant. It involves rebuilding a salt marsh habitat, engineering logjams, enhancing estuary and tidelands, and removing a dike and bulkhead. This project was started in May 2015 and is expected to be completed in June 2019.

WRIA 11/12 Nearshore Assessment

This program, managed and coordinated by the SPSSEG seeks to fill in data gaps between previously assessed areas adjacent to the project reach. The assessment was designed to be consistent with other nearshore assessments in Puget Sound by following the PSP's guidance for nearshore assessments.

AHSS NTAs for Marine Nearshore

For the 2016 Action Agenda for Puget Sound, AHSS partners proposed several near-term actions related to marine nearshore projects.

1. Capitol Land Trust **Henderson Inlet Habitat Protection & Restoration** would acquire 105 acres of estuary, nearshore, and riparian habitat and restore the marine shoreline of the Harmony Farms property. (Cost: $1,237,000)
2. Mason Conservation District expand **Shore Friendly Programs** would expand these programs to other jurisdictions in South Sound. (Cost: $576,005)
3. Squaxin Island Tribe **Deschutes River Estuary Restoration** would complete one of the final two studies needed before restoration can begin by creating an equitable funding strategy.
4. SPSSEG **Titlow Estuary Restoration** would remove shoreline armor and fill, restore fish passage and tidal hydrology, reclaim estuarine and emergent wetlands, and remediate effects of stormwater form Titlow Park. (Cost: $866,000)
5. Forterra **Chambers Creek Dam Acquisition and Design** would acquire the dam and dam site and complete a site restoration plan for multiple dam removal scenarios. (Cost: $389,000)

Contribution to PSP Vital Signs

The South Sound work on marine nearshore habitat contributes to progress for multiple PSP Vital Signs including: shoreline armoring, eelgrass beds, forage fish, shellfish beds, Chinook salmon and orca.

IX. Improved Water Quality

Background

The AHSS is interested in improving water quality in freshwater and marine systems over time. Clean freshwater is vital to people and to fish and wildlife populations. When rivers and streams pick up pollutants, toxic contaminants, or excessive sediments and nutrients, the health of watersheds, salmon habitat, and recreational opportunities are adversely affected. Similarly, the opportunity to swim, fish, or dig clams in the South Sound relies on good marine water quality. Marine waters are affected by many different factors including weather and climate, inflow from rivers and streams, stormwater runoff, and discharges from wastewater treatment plants and industries. Excess pollution can force beach closures, shellfish harvesting restrictions, and harmful algae blooms (HAB) that produce toxins that can be dangerous to people, pets and livestock. HAB's will eventually deplete oxygen levels leading to fish kills.

Key threats to water quality include:

- Changing land cover from natural covers such as forests to more developed status
- Increasing the amount of impervious surfaces, which leads to changes in stormwater flow and increases pollution in stormwater
- Pollution from improperly maintained septic systems
- Pollution from point sources such as wastewater treatment plants, stormwater outfall, and industry sources
- Pollution from nonpoint sources such as forestry, agriculture, and livestock management
- Increasing temperatures and precipitation changes related to climate change
- Pet waste
- Boating
- Transportation spills (trucks, trains and ships)
- Invasive species
- Residential use of pesticides and fertilizers
- Emerging contaminants (medicines and home care products not removed by wastewater treatment plants or septic systems)

The AHSS identified three attributes to help understand water quality conditions and trends: freshwater quality, benthic macroinvertebrate populations, and marine water quality. In combination, these attributes provide a measure of the physical, chemical, and biological condition of both fresh and saltwater bodies in the South Sound. Based on these attributes, freshwater quality in the South Sound is generally good. Marine water quality is currently fair in the South Sound waters and finger inlets; however, monitoring data over the last 15 years document a negative change in marine water quality over time. There are some areas of concern around wastewater treatment plants and ports, as documented in 303(d) listings.

Several waterbodies, both fresh and marine, in South Sound are currently impaired and not supporting beneficial uses due to water quality problems, having exceeded state water quality standards (WAC 173-201A) for one or more parameters. These waterbodies are listed on Ecology's 303(d) list (link).

Freshwater Quality Baseline and Status

To understand freshwater quality in South Sound, the AHSS will rely primarily on water quality monitoring conducted by county and tribal governments in lakes and smaller streams. All three South Sound counties have extensive freshwater quality monitoring programs. Programs may involve water quality index monitoring, benthic macroinvertebrate monitoring, toxic algae monitoring, illicit discharge detection and elimination (IDDE) monitoring, and pollution Identification and correction activities. The objectives of county water quality monitoring programs generally are to:

- Collect baseline information about water quality and quantity of streams and lakes
- Identify problem areas
- Public notification
- Track trends in streamflow and water quality over time

Water quality index monitoring compares data on temperature, pH, fecal coliform bacteria, dissolved oxygen, total suspended sediment, turbidity, total phosphorus and total nitrogen to State water quality curves and standards (described below). Benthic macroinvertebrate monitoring examines the type, number and diversity of bugs that live on the stream bottom. Insect samples are collected and sent to laboratories where the bugs are identified, grouped, and counted. The bug population data is analyzed using a scoring system called the Benthic Index of Biological Integrity (B-IBI). This produces a number ranging from 10 (very poor) to 50 (excellent), which describes the biological condition of stream sites and their surrounding habitat based on the diversity and relative abundance of the benthic (bottom dwelling) macroinvertebrates living there. B-IBI sampling can provide a measure of stream health at a given point in time as well detect changes in stream condition over time.

Toxic algae monitoring tracks algae extent, density, and toxin concentrations to identify when harmful algal blooms (HABs) pose a health concern. IDDE monitoring is conducted to address stormwater pollution in response to the National Pollution Discharge Elimination System (NPDES) Stormwater Permit. Pollution Identification and Correction (PIC) activities generally sample for fecal coliform bacteria and may include water temperature, pH, and conductivity. PIC sampling is generally done in watersheds with commercial and/or recreational shellfish resources. It is important to note that PIC Programs affect marine nearshore habitat, freshwater quality, marine water quality, and shellfish. Therefore, these programs are described within each of the respective chapters in the Strategy.

State-wide Monitoring

The Statewide Water Quality Monitoring Network is operated by the Washington Department of Ecology (Ecology). The state uses a Freshwater Quality Index for rivers and streams for ongoing monitoring that combines eight measures of water quality. Four of the component measures, dissolved oxygen, pH, temperature, and fecal coliform bacteria, are tied to the state's Water Quality Standards for

protecting aquatic life and contact recreation. The other four measures, nitrogen, phosphorus, suspended sediment, and turbidity, do not have numeric standards, although they are related to general ecosystem function. The data is compiled to create an index score between 1 and 100, with higher numbers indicating better water quality. Scores are calculated for each water year from October 1st to September 30th and results aggregated over time to produce a single yearly score for each sample station.

The statewide monitoring network has only two stations on waterbodies in the South Sound: (1) Nisqually River at Nisqually, and (2) Deschutes River at East St. Bridge. In 2013, the Nisqually River station scored 83 points on the index and the Deschutes scored 78 points. Water quality scores for both stations have steadily improved between 2000 and 2013. Both stations have averaged 75 points over the period indicating relatively good water quality, shown below in Figure 9.1.

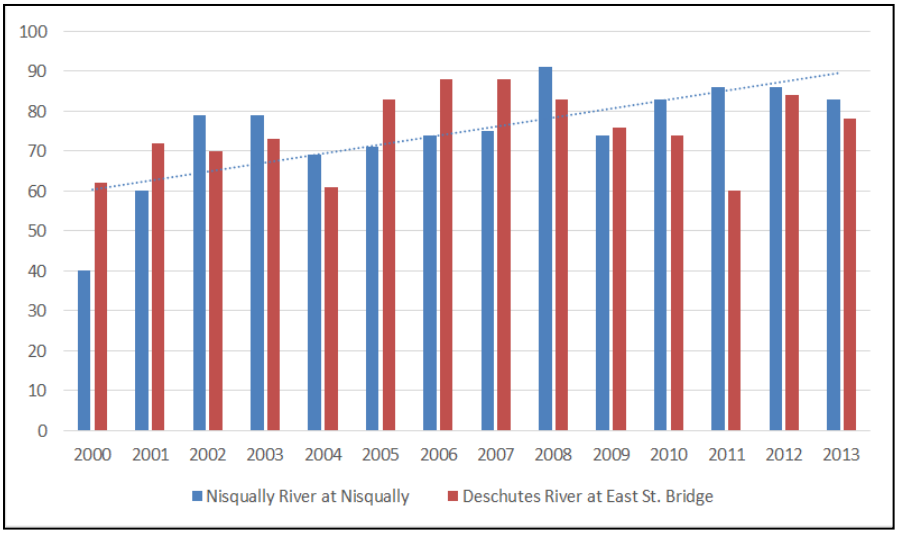


Figure 9.1. Freshwater Quality Index Scores at Nisqually and Deschutes River Stations 2000-2013 (Statewide Water Quality Monitoring Network, Department of Ecology)

Benthic macroinvertebrate sampling has been conducted at multiple locations in the South Sound by Ecology, Pierce, Thurston and Kitsap counties since the late 1990s (locations can be seen below in Figure 9.2). However, many locations are not regularly sampled and some have only one or two sampling events. The Puget Sound Stream Benthos is a data repository for macroinvertebrate data collected throughout Puget Sound region (link). Data and B-IBI scores determined by local and state agencies are uploaded and available through the website.

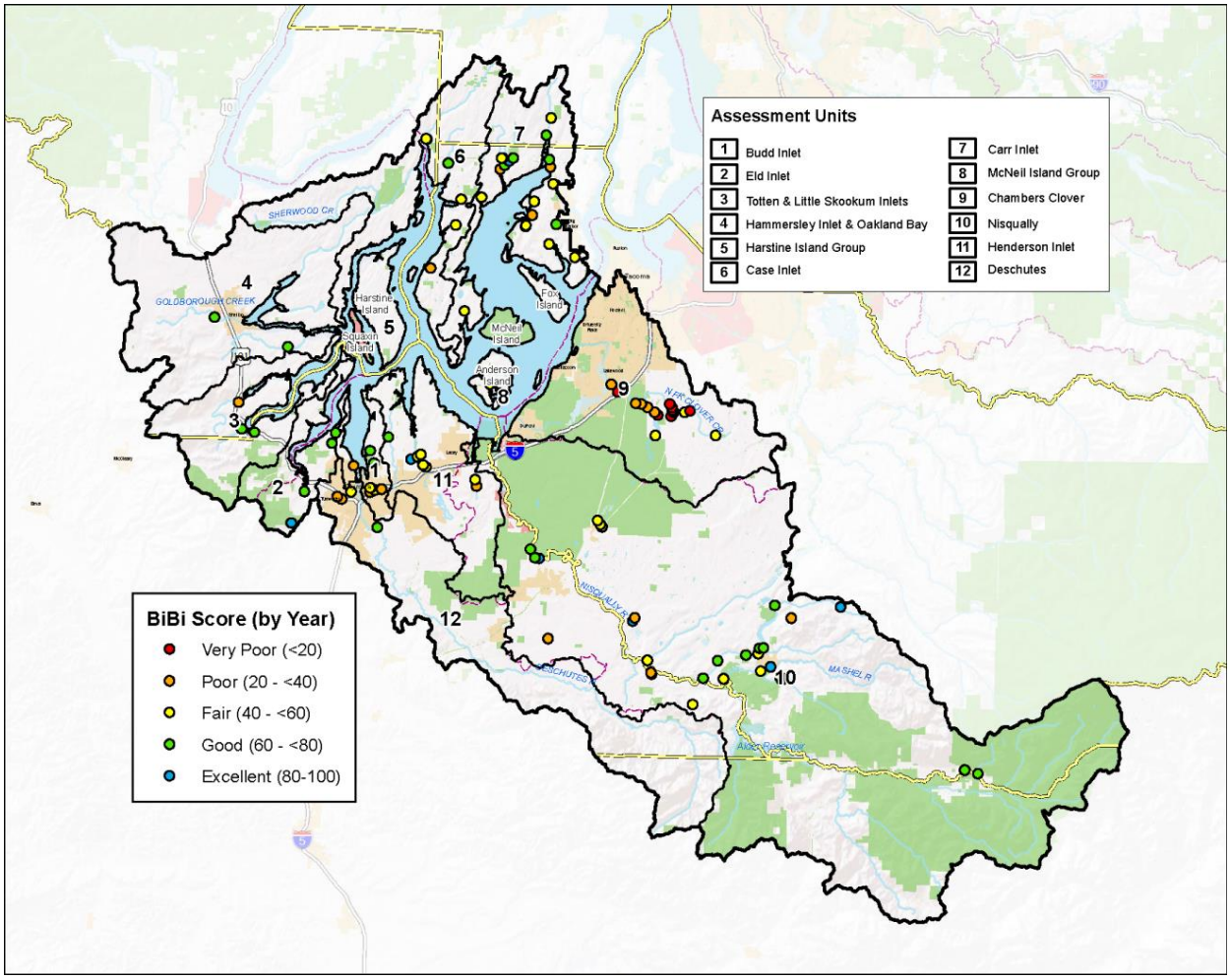


Figure 9.2. B-IBI Sampling Station Locations and Overall Scores (Puget Sound Stream Benthos)

Based on a review of all available data, stream conditions reported by B-IBI scores range widely throughout the South Sound (Figure 9.3). B-IBI scores since the late 1990s show improvement of stream conditions for locations in the Upper Nisqually watershed, Goldsborough Creek, Key Peninsula, and Burley Creek areas. Kennedy Creek, Lower Deschutes, and McAllister Creek also show increasing trends in B-IBI scores. However, several areas show decreasing trends in B-IBI scores including Woodland Creek, lower and middle Nisqually watershed, lower Chambers-Clover.

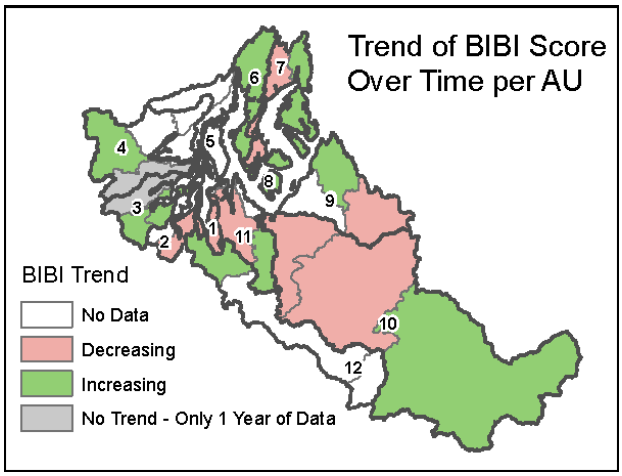


Figure 9.3. B-IBI Trends from 1994-2015 (Puget Sound Stream Benthos)

The above depiction of trends is based on available data. As noted previously, many locations are not regularly sampled and some have only or two sampling events.

Local Monitoring

Pierce County

In Pierce County, water quality index sampling is done in more than 50 streams and B-IBI sampling is done in more than 30. Pierce County combines water quality index scores with B-IBI scores to create a single letter grade for the 39 major watersheds in the County. The goal is for all streams and lakes to score "better than average." In 2015 42% of streams and lakes met that goal. Of the 13 streams showing statistically significant trends two (Crescent and Purdy creeks) are improving in both the water quality index and BIBI, and five (Canyon Falls, Squally, Swan, Ray Nash, and Artondale creeks) are improving in WQI but decreasing in BIBI, and four (Clear, Horn, Lacamas, and Huge) are declining in SWI but improving in BIBI. Two streams (Ohop and Clover creeks) are declining in both WQI and BIBI.

Toxic algae sampling has occurred at 28 lakes throughout Pierce County with a core list of 12 lakes. It is a year-round sampling activity with Waughop Lake having had a continuous advisory since 2008 and Wapato, Spanaway, Tanawax as well as Ohop Lakes having frequent blooms. All of the 12 core lakes have had blooms but not all produce high levels of toxin. Waughop, Wapato and Spanaway Lakes have either concluded or are in the process of Lake Management Plan Studies.

More information on water quality monitoring in Pierce County, including annual water quality report cards, is available on the Pierce County Surface Water Management website (link).

Thurston County

Thurston County water quality monitoring is conducted by Thurston County Environmental Health Division. The most recent publicly available report on Thurston County water quality monitoring is from water years 2009/10 and 2010/11 (link). During those years, Thurston County collected water quality information for 38 streams. Specifically, the streams were sampled for total phosphorous, nitrate, nitrite

nitrogen, turbidity, fecal coliform, temperature, pH, specific conductivity, and dissolved oxygen. Thurston County uses the following guidelines to categorize water quality in streams:

- "Excellent" - No water quality standard violations, and very low fecal coliform and nutrient concentrations.
- "Good" - Usually meets water quality standards; OR violates only one part of the two-part fecal coliform standard; OR the violation is most likely the result of natural conditions rather than pollution.
- "Fair" - Frequently fails one or more water quality standards and other parameters such as nutrients indicate water quality is being impacted by pollution.
- "Poor" - Routinely fails water quality standards by a large margin; other parameters such as nutrients are at elevated concentrations

Thurston County also collects data on macroinvertebrates. In 2011, the county collected 27 samples and developed a B-IBI score of low, moderate or high biological integrity.

The table below summarizes the most recent status report from Thurston County:

Table 9.1. B-IBI score

Stream Name	Watershed	Condition	B-IBI Score
Black Lake Ditch	Budd Inlet	Fair	26 – Moderate
Capitol Lake	Budd Inlet	Poor	36 – Moderate
Chambers Creek	Budd Inlet	Good	n/a
Deschutes River	Budd Inlet	Good	38 – Moderate
Ellis Creek	Budd Inlet	Good	44 – High
Indian Creek	Budd Inlet	Poor	36 – Moderate
Mission Creek	Budd Inlet	Fair	46 – High
Moxlie Creek	Budd Inlet	Poor	30 – Moderate
Percival Creek	Budd Inlet	Fair	36 – Moderate
Reichel Creek	Budd Inlet	Fair	n/a
Schneider Creek	Budd Inlet	Good	22 – Low
Spurgeon Creek	Budd Inlet	Good	n/a
Green Cove Creek	Eld	Good	46 – High
McLane Creek	Eld	Fair	38 – Moderate
Perry Creek	Eld	Good	44 – High
Tanglewilde Stormwater Outfall	Henderson	Poor	n/a
Woodard Creek	Henderson	Fair	42 – High
Woodland Creek	Henderson	Fair	34 – Moderate
Eaton Creek	Nisqually Reach	Fair	34 – Moderate
McAllister Creek	Nisqually Reach	Fair	30 – Moderate
Thompson Creek	Nisqually Reach	Good	44 – High
Yelm Creek	Nisqually Reach	Good	44 – High

Kennedy Creek	Totten/Little Skookum	Good	46 – High
Schneider Creek	Totten/Little Skookum	Good	44 – High

Mason County and Tribal Governments

Mason County and the Squaxin Island Tribe work together closely on marine water quality monitoring. This monitoring is linked with the Mason County PIC program (see next section on marine water quality for details). Mason County administers a Water Quality Program that includes monitoring, lab analysis, long-term trend analysis, investigations, and emergency/complaint response to ensure that wasters of Mason County meet the ground and surface water quality criteria set by the Washington State Department of Ecology and Health. The program also seeks out grants for projects intended to prevent waters from failing water quality requirements, or to restore waters to those standards. This is generally associated with specific habitat restoration projects in the county (e.g., a local project sponsor will sample water quality upstream and downstream of a project site pre- and post-project). More information on the Mason County Water Quality Program is available on the Mason County Public Health website (link).

Strategies, Existing Programs, and Actions

Strategies to maintain and improve freshwater quality are based on the major threats to water quality and include:

- Direct protection of land adjacent to streams and lakes (e.g., through acquisition and transfer/purchase of development rights)
- Support and implement land management plans and regulations, particularly county and city growth management and critical area programs that concentrate growth in urban growth areas, protect sensitive habitats, and limit the amount of new impervious surfaces created, and local shoreline master programs that concentrate growth in urban growth areas and limit further shoreline alterations
- Support and implement stormwater management plans and regulations at a watershed scale
- Support and incentives to landowners to keep land in natural, or nearer to natural land covers, such as forest and agriculture
- Education, outreach, and support to landowners, particularly agricultural and livestock land owners, to help them limit pollutant loads to surface water through best management practices (e.g., through technical and financial assistance from conservation districts)
- Support and implement programs to identify and correct specific sources of pollution (commonly pollution identification and correction programs, or PIC)
- Support and implement programs that ensure septic systems do not create pollution and support and incentives for septic system owners to maintain their systems in good working order, and conversion of septic systems to sewer
- Reducing sources of pollution by choosing less toxic products and materials and encouragement of these choices by county and local governments, businesses, and residents

- Collect and treat urban stormwater to reduce pollutant loading, such as through stormwater retrofit actions and stormwater quality focused street sweeping
- Education and outreach about pollution reduction and how water quality supports ecosystem functions and services (such as shellfish harvest) that are important to people to raise support for water quality protection and restoration efforts

In addition to the programs described below, a variety of local South Sound jurisdictions operate programs that affect freshwater quality. These programs are described in detail in other sections of the South Sound Strategy, primarily Section VII: Forests and Freshwater Habitats. Programs include: Growth management plans, critical areas designations, noxious weeds management, urban forests, fish passage, conservation reserves, protected areas management, and Stream Teams.

Freshwater Quality Programs

South Sound jurisdictions operate various programs that benefit freshwater quality, including stormwater management programs. Thurston County, Mason County, and Pierce County each operate stormwater programs, while at the city level the cities of Shelton, Olympia, Tumwater, and Lacey have stormwater utilities responsible for managing the county stormwater plans. An important element of most stormwater management plans is the Illicit Discharge Detection and Elimination (IDDE) rule. The IDDE is one of six requirements for the operator of a Phase II regulated small municipal separate storm sewer system, according to the NPDES permit. An illicit discharge is "…any discharge to an MS4 that is not composed entirely of stormwater…"[5] Other elements of each counties' stormwater programs are described below.

Pierce County Stormwater: Pierce County stormwater management is covered by a NPDES municipal Phase I permit. The Permit requires the county to produce a Stormwater Management Plan (the 2016 plan is here). Pierce County's stormwater plan includes multiple elements: Stormwater system mapping and documentation, interdepartmental coordination and intragovernmental mechanisms, public involvement and participation, prevention and control of stormwater runoff impacts from new development, redevelopment and construction activities, watershed-scale stormwater planning, structural stormwater controls, source control program for existing development, ongoing work to address illicit connections and illicit discharges into the stormwater system, operations and maintenance, and education and outreach.

Mason County: Mason County stormwater management is covered by EPA Phase II stormwater regulations and an associated WA Department of Ecology Phase II NPDES Municipal Stormwater Permit. There are four separate stormwater management plans in Mason County: Belfair Urban Growth Areas, Allyn Urban Growth Area, the Hoodsport Rural Activity Center, and a Countywide Comprehensive Stormwater Management Plan (the plans are available on the Mason County website here). Many of the stormwater outreach and education programs in Mason County are operated by WSU Mason County extension and the Mason Conservation District.

[5] EPA Office of Water NPDES (link)

Thurston County: Thurston County's Water Resources Program operates the Thurston County Storm and Surface Water Utility. The Utility provides several services, including development, maintaining county-owned stormwater infrastructure, monitoring, and education/stream restoration.

City of Shelton: Two full time staff members operate the City of Shelton's Storm and Surface Water Utility. The Utility's infrastructure – pipes, retaining ponds, and storm drains – conveys water to Oakland Bay and Henderson Inlet. The City's Street department is responsible for street sweeping.

City of Olympia: Olympia maintains over 160 miles of underground pipe, 7,500 storm drains, and 79 stormwater ponds that carry stormwater runoff from roads and rooftops to local streams and Budd Inlet. Olympia also offers a variety of incentives for citizens around water quality, including:

- Limited reimbursement to private landowners for installing rain gardens.
- Free pet waste pickup stations
- Free pet waste bag holders
- Free lawn aerator rental
- Free eco-friendly car wash kits

In 2016 the Olympia City Council passed a set of LID code revisions intended to make LID stormwater techniques the commonly used approach to site development. For outreach and education, the Cities of Olympia, Lacey, and Tumwater jointly fund the Stream Team. Stream Team is a program that offers seasonal activities for interested citizens to raise awareness and involvement around South Sound environmental issues. Olympia operates a street sweeping program wherein downtown streets are swept two times per week, arterials and bike lanes once every two weeks and residential zones up to two times per year.

City of Lacey and City of Tumwater: Both Lacey and Tumwater operate stormwater utilities. Similar to City of Olympia, the Lacey and Tumwater Utilities maintain stormwater infrastructures and provide technical assistance to property owners upon request. Tumwater and Lacey also provide street sweeping services.

Nisqually Tribe: The Nisqually Tribe's Public Works department operates the Tribe's stormwater utility on the Nisqually Reservation. The Nisqually Tribe has also partnered with the neighboring City of Eatonville to fund an update to the City's stormwater plan as part of an effort to enhance and protect Ohop Creek and the Mashel River, two priority salmon streams.

Washington Stormwater Center: The Washington Stormwater Center is a joint venture between Washington State University (WSU) and the University of Washington (UW) Center for Urban Waters. The Center provides a broad range of resources to support municipalities, stormwater permittees, and businesses that deal with stormwater.

LOTT Clean Water Alliance: The LOTT Clean Water Alliance includes the Budd Inlet Treatment Plant, a facility that serves over 100,000 homes and businesses in Lacy, Olympia, and Tumwater. LOTT

encourages water conservation through rebates for water-intensive appliances such as washing machines and free water conservation kits. LOTT also operates an outreach and education program, including the WET Science Center with hands-on exhibits.

Port of Olympia: The Port of Olympia has operated a stormwater treatment facility since 2015. The Port of Olympia is covered by two stormwater permits, both issued by Ecology: An industrial stormwater general permit and a municipal general stormwater permit.

The Washington State Department of Ecology collects and manages information on total maximum daily loads (TMDLS). TMDLs describe the type, amount and sources of water pollution in a water body. They analyze how much the pollution needs to be reduced or eliminated to meet water quality standards, and provide targets to control pollution. ECY lists information for water quality improvement projects, including TMDLs for each county and WRIA in Washington State. The chart below shows the projects in South Puget Sound.

Table 9.2. Overview of Water Quality Improvement Projects by WRIA in South Puget Sound

WRIA	Waterbody Name	Pollutants	Status
WRIA 11	Nisqually Watershed	Fecal Coliform Dissolved Oxygen	EPA approved implementation plan
WRIA 12	Clover Creek	Dissolved Oxygen Fecal Coliform Temperature	Water Quality Assessment project under development
	Wapato Lake	Total Phosphorus	Approved by EPA
WRIA 13	Deschutes River and Tributaries	Dissolved Oxygen Fecal Coliform pH Sediment Temperature	Submitted for EPA approval
	Budd Inlet and Capitol Lake	Dissolved Oxygen Phosphorus	Under development
	Henderson Inlet Watershed	Dissolved Oxygen Fecal Coliform pH Temperature	Implementation plan approved
WRIA 14	Oakland Bay & Hammersley Inlet	Fecal Coliform Dissolved Oxygen	EPA Approved
	Mill, Cranberry, and John Creeks	Temperature	Under development
	Totten/Eld Inlets Tributaries	Fecal Coliform Temperature	Implementation plan approved
WRIA 15	Liberty Bay Tributaries	Fecal Coliform	Implementation plan approved
	Sinclair-Dyes Inlets	Fecal Coliform	Implementation plan approved
	Union River	Fecal Coliform	Implementation plan approved

AHSS NTAs for Freshwater Quality

In the short term the AHSS has identified four priority actions focused on freshwater quality. They are:

1. **Water Quality Focused Street Sweeping in the City of Olympia**, an effort to expand an existing limited street sweeping program to city-wide with deliberate focus on water quality to reduce pollutants released to surface waters. GIS-based analysis will direct development and implementation of sweeper operating procedures & routes. (Cost estimate $356,805)
2. **K-12 stormwater field investigation programs in Mason County**, a project of the Mason Conservation District coordinate local partners to provide reliable field sites for place-based stormwater curricula with Mason County schools. (Cost estimate $187,569)
3. **WSU Stormwater Stewards**, a capacity-building program in which capable, committed, and well-trained citizen volunteers provide peer-to-peer technical assistance to other residents seeking opportunities to manage and treat polluted runoff on their home or small-commercial sites. (Cost estimate $299,628)
4. **Clover Creek Water Quality Improvements**, Clover Creek near Brookdale road received the lowest marks for water quality in the Pierce County Surface Water Report Card. This project would retrofit two Clover Creek storm water outfalls with filter devices to improve water quality. (Cost estimate $600,000).

Marine Water Quality Baseline and Status

To understand marine water quality in South Sound, the AHSS will rely primarily on state sampling that is conducted on an annual basis. In addition, local pollution identification (PIC) programs will be used to monitor and implement actions to reduce nonpoint source pollution primarily on shellfish beds (see Shellfish chapter).

State-wide Monitoring – Department of Ecology

Monitoring of marine water quality is ongoing in stations throughout the South Sound by Ecology (link).

Ecology's program is the major source of data for the 303(d) assessment and provides long term status and trends data on water quality conditions. Like the freshwater monitoring program, Ecology uses an index called the Marine Water Condition Index (MWCI) to communicate conditions for marine water bodies. The index aggregates physical, chemical, and biological data collected from moorings, ships, planes, and satellite imagery. MWCI scores range from -50 to +50 points, with higher numbers indicating better water quality. There are seven individual monitoring stations in the South Sound.

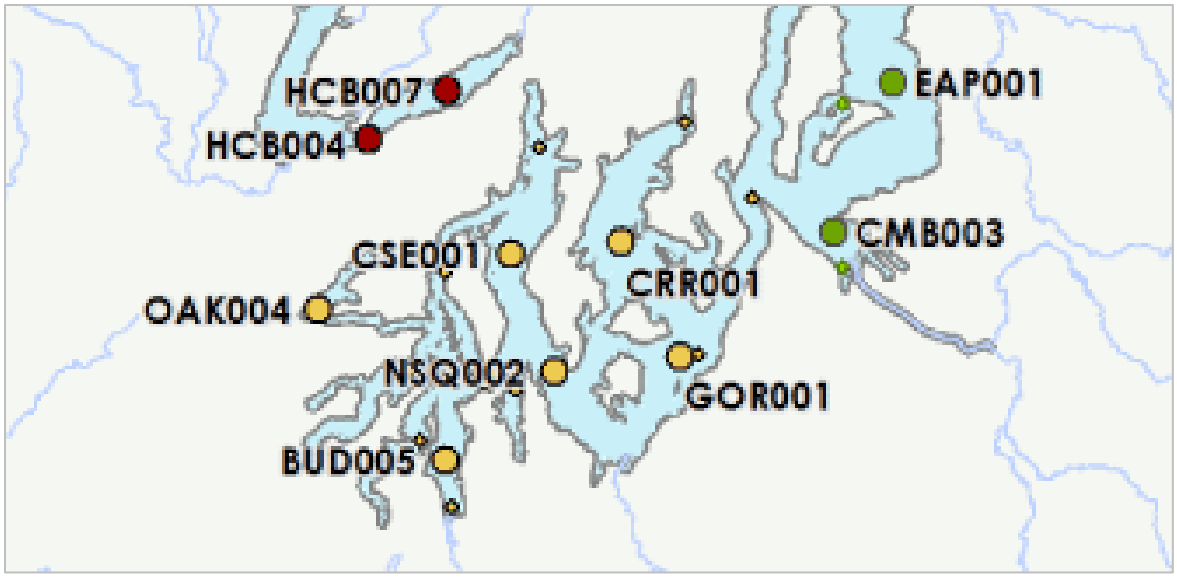


Figure 9.4. Long-term Marine Water Quality Monitoring Program Station Locations – South Puget Sound (Department of Ecology)

In 2014, a composite score of all the South Sound stations received a MWCI score of -2. For individual stations, both Oakland Bay and Budd Inlet received a -12 score. Over time, MWCI scores for the South Sound between 1999 and 2014 indicate the area has experienced a negative change and suggest that marine water quality has gone from good to fair in the past 15 years. Both the Budd Inlet and Oakland Bay stations show negative trends over the period. However the six stations in the Sound show an "improving tendency" as defined by the MWCI. The chart below shows the index scores over the last 15 years.

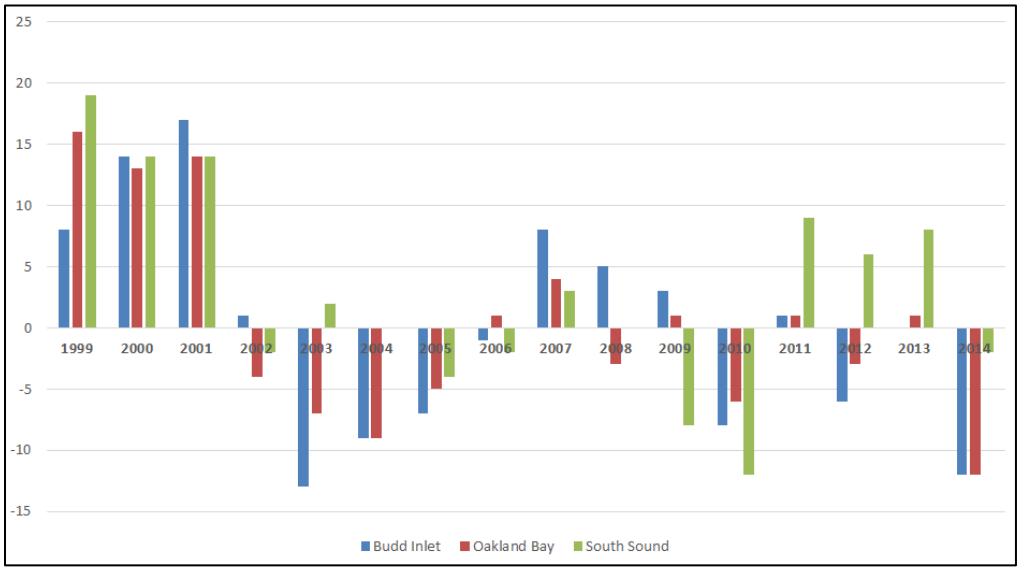


Figure 9.5. Marine Water Condition Index Scores 1999-2014 (Marine Water Quality Monitoring Program, Department of Ecology)

Ecology is responsible for maintaining the 303(d) list of impaired waterbodies for the State of Washington; this includes all rivers, lakes, and marine water with available data (link). Ecology updates the list every two years and submits an assessment to US EPA for approval. Waters that are on the 303(d) list require a cleanup plan (such as a TMDL). The list also helps state agencies focus their resources on those waters most in need of cleanup action.

Ecology is also conducting a water quality study on low dissolved oxygen levels in South Puget Sound to evaluate how human activities, along with natural factors, affect low dissolved oxygen levels in South Puget Sound (link). AHSS has heard presentations from Ecology staff and various AHSS organizations are interested and tracking Ecology's progress on the study.

State-wide Monitoring – Department of Health (DOH)

The Washington State DOH also monitors marine water quality throughout the South Sound for public health safety (link). DOH's Shellfish Program regularly monitors marine waters and shellfish for biotoxins, pathogens, and other contaminants to make sure they are safe to eat. The Beach Environmental Assessment, Communication, and Health (BEACH) Program, managed jointly by DOH and the Washington State Department of Ecology, samples water quality at recreational beaches from Memorial Day to Labor Day and reports closures and advisories. As of December 2016, there are no beaches monitored by the BEACH program that are closed for swimming. Eleven beaches have a swimming advisory issued, that warns children, elderly, and those in ill health not to swim because of increased levels of bacteria in the water. Nine beaches are being monitored and are currently open. The chart below outlines the beaches currently being monitored, and their status.

Table 9.3. Beaches in Washington monitored through the DOH and ECY BEACH program

Beach	County	Status	Description
Little Squalicum Park	Whatcom	Swimming Advisory	Elevated bacteria levels have been observed at this beach
Larabee State Park, Wildcat Cove North	Whatcom	Swimming Advisory	Elevated bacteria levels in previous years due to wildlife bacteria inputs from stream.
Larabee State Park, Wildcat Cove Main	Whatcom	Swimming Advisory	Elevated bacteria levels in previous years due to wildlife bacteria inputs from stream.
Larabee State Park, Wildcat Cove, South	Whatcom	Swimming Advisory	Elevated bacteria levels in previous years due to wildlife bacteria inputs from stream.
Windjammer Park	Island	Swimming Advisory	Consistent moderately high bacteria levels.
Chimacum Creek	Jefferson	Swimming Advisory	Irondale Creek which drains to the beach has high bacteria counts. Source Unknown.
Dave Mackie Memorial County Park	Island	Swimming Advisory	The lagoon is CLOSED for swimming, the shoreline beach sites remain open.
Priest Point Park	Thurston	Swimming Advisory	Public safety risk associated with re-suspension of bacteria from sediments and a nearby treatment plant outfall.
West Bay Park	Thurston	Swimming Advisory	Risk associated with a nearby treatment plant outfall, stormwater outfalls, and a marina.
West Bay Marina	Thurston	Swimming Advisory	Risk associated with nearby sewage treatment outfall, stormwater outfall, and marina.
Walker County Park	Mason	Swimming Advisory	Proximity to the wastewater treatment plant outfall
Sooes Beach	Clallam	Open and Monitored	N/A

Hobuck Beach, South	Clallam	Open and Monitored	N/A
Hobuck Beach, South Central	Clallam	Open and Monitored	N/A
Hobuck Beach, Central	Clallam	Open and Monitored	N/A
Hobuck Beach, North Central	Clallam	Open and Monitored	N/A
Hobuck Beach, North	Clallam	Open and Monitored	N/A
Dakwas Park Beach	Clallam	Open and Monitored	N/A
Front Street Beach, East	Clallam	Open and Monitored	N/A
Third Beach, Neah Bay	Clallam	Open and Monitored	N/A

Local Monitoring

Marine water quality monitoring in South Sound is largely the purview of ECY and DOH, although some limited local marine water quality monitoring occurs in Pierce County and through Mason County and the Squaxin Island Tribe as part of the Mason County PIC program. It important to note that PIC work improves both freshwater quality and marine water quality, as well as shellfish habitat and marine nearshore habitat. Because of this, PIC programs are described at various levels of detail in each of the respective chapters.

Pierce County

Pollution Identification and Correction (PIC) work focus on 12 shellfish areas in Pierce County. All the shellfish areas sampled include Filucy Bay, Burley Lagoon, Minter Bay, Von Geldern Cove, Henderson Bay, Rocky Bay, Dutchers Cove, Vaughn Bay, Amsterdam Bay and Oro Bay and are sampled on a rotating basis throughout the year. Several areas such as Vaughn Bay and Rocky Bay have undergone classification downgrades from the Washington State DOH due to declining water quality. Both Rocky Bay (1995) and Vaughn Bay (2016) have formed Shellfish Protection Districts (SPDs) with associated Closure Response Plans (CRPs) which encompass activities to identify, correct and prevent pollution generating sources and activities. A summary of Pierce County surface water and shellfish advisories from 2006 – 2015 is provided in Figure 9.6 below.

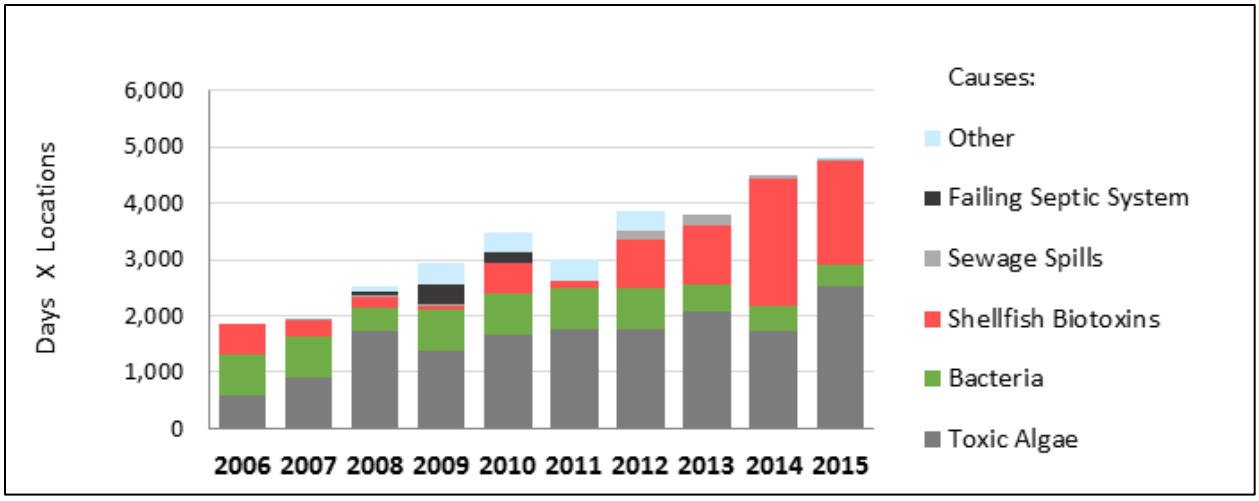


Figure 9.6: Pierce County Surface Water and Shellfish Advisories (Courtesy of Tacoma Pierce County Health Department)

The Tacoma-Pierce County Health Department currently monitors nine marine water swimming beaches during the summer season, beginning Memorial Day and ending on Labor Day. Six of these beaches are designated Core Beaches because of the level of use and risk potential, the other three are selected based on TPCHD priorities and available funding.

These marine beaches are tested for the fecal indicator bacteria enterococcus to determine possible health risk to the public from water contact recreation. During the swimming season, water samples are collected at high-use, high-risk, marine beaches primarily used for swimming, wading, surfing, and SCUBA diving. The public is notified when results exceed the BEACH Program Guidance thresholds, which are based on EPA's 1986 Ambient Water Quality Criteria.

As of 2015, the Marine Beaches of Pierce County have generally had good water quality and on occasion when an exceedance does occur, an advisory is posted. All marine beach samples are evaluated in accordance with our Marine Beach Protocol which has been approved by Washington State Department of Ecology Marine Beach Program.

Mason County and Tribal Governments

Mason County and the Squaxin Island Tribe produce an annual summary report of their monitoring activities (link). The County and the Tribe operate several ambient monitoring sites at river/creek mouths and on shorelines, and conduct some active monitoring as needed and as resources allow. In 2015, none of the Squaxin Island Tribe's monitoring sites met the marine water quality standard; however, all but one site met the state freshwater standard for geometric mean (Table 9.2 below).

Table 9.4. Geometric Means of Fecal Coliform Concentration at Squaxin Island Tribe Sampling Sites (# of Colonies Per 100 Ml)

	Geometric Mean				90th Percentile			
Site	**2004-2012**	**2013**	**2014**	**2015**	**2004-2012**	**2013**	**2014**	**2015**
CAM1	22	15	31	28	142	54	107	116

Site	Geometric Mean				90th Percentile			
	2004-2012	2013	2014	2015	2004-2012	2013	2014	2015
COU1		11	17	18		55	52	89
CRA0	38	12	10	26	157	85	52	129
DEE0	22	21	20	26	113	102	93	95
GOL0	27	29	26	25	120	100	88	101
HUR1	46	12	20	63	279	72	155	222
JOH0	14	9	15	23	59	31	44	70
LIT1	32	10	22	52	185	94	125	317
MAL1	28	17	21	26	172	131	128	101
MIL0	17	12	32	32	70	25	152	72
ROC1		21	18	36		214	58	71
SHE1	71	63	53	88	449	340	140	235
SHR1		16	18	29		59	39	64
SKO0	45	26	41	72	275	56	156	165
SKO3	45	28	36	53	231	108	89	104
TR24	69	25	28	116	1012	261	372	854
UNC00	55	21	42	82	324	72	181	450
UNC02		17	36	76		65	125	299

2015 ambient marine water quality collected by Mason County is shown in Table 9.3 below. Numbers in red indicate results that exceeded the freshwater standard (approximately ¼ of the Mason County ambient sites are under marine influence at high tide but the samples are taken flowing off land during a lower tidal stage, therefore the freshwater standard is applied).

Table 9.5. Ambient Marine Water Quality Data, Mason County, 2015

Precip. (Inches)	0	0.01-0.25	0	0	0	0	0	0	0	1.0-2.0	Geometric Mean (excluding rain events)
Site	2/18	4/15	4/16	6/2	7/14	8/11	9/21	10/21	10/28	12/8	
19	15	84		52	120	40	59	51	80	43	54.311
DER1		9		49	23	56	120		320	200	52.858
LYN1	3	17		49	49	71	24		4	52	18.815
NB-022			1	57	580	100	9.5	2	60	87	23.336
NB-023			20	106	520				75	95	95.356
PBW1	9	3		14	31	26	15	13	4	47	11.143
PP-001	4	7		110	160	36	30	16	44	44	27.971
PP-003	4	17		200	100	50.5	16	8	28	95	26.54
RAU1	100	15								130	38.73
TL-001	1	1		14			36	21	35	29	8.4746

Strategies, Existing Programs, and Actions

Strategies to maintain and improve marine water quality are based on the major threats to water quality and include:

- Support and implementation of land management plans and regulations, particularly county and city growth management and critical area programs. These concentrate growth in urban growth areas, protect sensitive habitats, and limit the amount of new impervious surfaces created. Local shoreline master programs concentrate growth in urban areas and limit further shoreline alteration;
- Support and implementation of stormwater management plans and regulations at a watershed scale;
- Support and incentives for landowners to keep land in natural, or nearer to natural, land covers, such as forest and agriculture;
- Education, outreach, and support to landowners, particularly agricultural and livestock landowners, to help them limit pollutant loads to surface water through best management practices (e.g., technical and financial assistance from conservation districts);
- Support and implementation of program to identify and correct specific sources of pollution (commonly pollution identification and correction programs, or PIC);
- Support and implement programs that ensure: septic systems do not create pollution, incentivize septic system owners to maintain their systems, and conversion of septic systems to sewer;
- Reducing sources of pollution by choosing less toxic products and materials and encouraging these choices by county and local governments, businesses, and residents;
- Collect and treat urban stormwater to reduce pollutant loading, through actions such as stormwater retrofitting and street sweeping focused on stormwater quality;
- Education and outreach about pollution reduction and how water quality supports ecosystem functions and services (like shellfish harvest) that are important to people to raise support for water quality protection and restoration efforts

Marine Water Quality Programs

Marine water quality is enhanced through voluntary and incentive-based stormwater management programs, as described in the freshwater quality section above.

In addition to the programs described below, a variety of local South Sound jurisdictions operate programs that affect freshwater quality. These programs are described in detail in other sections of the South Sound Strategy, primarily Section VIII: Marine Nearshore Habitat. Programs include: SMPs, shore friendly programs, PIC programs, manure exchange, and Green Shore for Homes.

The other primary category of marine water quality programs is Pollution Identification and Correction (PIC) programs. Since these programs are most closely associated with shellfish populations and harvest, they are described in detail in the next chapter (Chapter 10: Expansion of Healthy, Productive Shellfish

Populations and Harvest). It is important to note that (PIC) work improves both freshwater quality and marine water quality as well.

AHSS NTAs for Marine Water Quality

In the short term the AHSS has identified two priority actions focused on marine water quality. They are:

1. **The South Sound shellfish** recovery NTA for the 2016 Action Agenda update identified the following estimated potential acres for upgrade for each impacted growing area:

Table 9.6. Estimated potential acres for upgrade in each impacted growing area

Shellfish Growing Area	Potential Acres
Burley Lagoon	172
Oakland Bay	250
McLane Cove	31
Henderson Inlet	46
Rocky Bay	8
Vaughn Bay	54
Filucy Bay	67
Nisqually Reach	75
Total	**703**

*The cost for upgrading (or being on target to upgrade) 100 acres of Conditional or Restricted shellfish growing area from the potential acres above is estimated at $5.7 million.

2. **Thurston County urban septic to sewer conversion**, an effort to protect shellfish growing areas that may be impacted by leaking urban septic systems, which includes public outreach, code development, policies, and city-specific implementation plans to adopt the conversion program in Lacey, Tumwater, and Olympia. (Cost estimate $180,000 for phase 1).

Contribution to PSP Vital Signs

As a South Sound focus area, water quality is connected to multiple PSP water quality Vital Signs: Marine water quality, freshwater quality, marine sediment quality, toxics in fish, shellfish beds, onsite sewage, and drinking water. Water quality is also connected with PSP Vital Signs for species and food web, including Pacific Herring, Orcas, and Chinook salmon.

X. Expansion of Healthy, Productive Shellfish Populations and Harvest

Background

Harvesting of shellfish in the South Sound has a long history, beginning with the Squaxin Island Tribe and Nisqually Tribe which continue to rely on shellfish as a source of food and cultural tradition. In the present day, there also are significant recreational harvests and larger-scale commercial production in the South Sound. In additional to economic and cultural benefits from harvest, shellfish -- whether harvestable or not -- provide significant water quality benefits.

Baseline & Status

Overall, the AHSS aims to expand healthy, productive shellfish populations and shellfish harvest. There are approximately 40,000 acres of commercial and recreational shellfish beds in South Sound, and nearly 80% of these beds are open for harvest, shown in Figure 10.1 (both approved and conditional). However, pollution from stormwater runoff and failing on-site sewage systems impair marine water quality and can lead to frequent harvest restrictions and closures of shellfish beds. These closures are determined by the DOH based on regular marine water samples collected throughout the year. During the sampling, all potential pollution sources that may impact water quality are evaluated. If sampling indicates poor water quality the beach can be closed to shellfish harvest, as the shellfish are not safe to eat. A closed classification for recreational harvesting indicates that water quality does not meet standards for safe consumption of the shellfish. The commercial equivalent of “closed” is “prohibited”. This indicates the presence of contaminants that pose a health risk to shellfish consumers. Both classifications are long-term. Occasionally an event occurs that degrades water quality and creates conditions that make shellfish unsafe for human consumption. When things like floods, sewage spills or other pollution events occur, an emergency closure is imposed on the affected area. This is a temporary closure that remains until water quality returns to previous levels and shellfish have had time to naturally rid themselves of contaminants. Portions of the beaches near the head of Henderson Bay, Nisqually and the eastern shoreline near the cities of Steilacoom, University Place, and Tacoma are closed due to non-point source pollution, such as that from stormwater runoff, failing septic systems, and protective closures around sewage treatment plant outfalls. Shellfish growing areas are monitored for water quality by the Washington State DOH and classified based on monitoring results. If water quality has improved in a shellfish growing area then it has the potential to be upgraded in classification, allowing for greater accessibility.

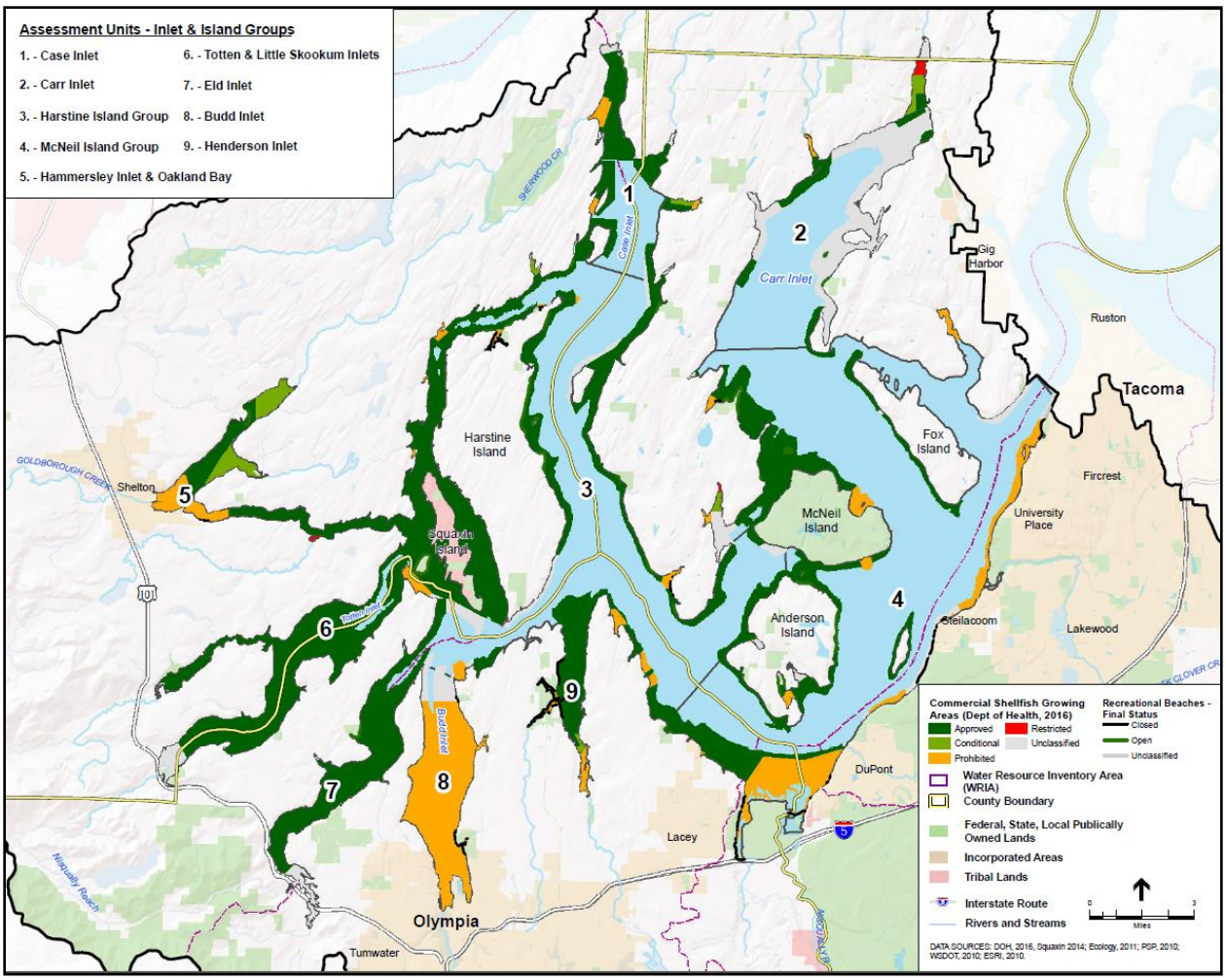


Figure 10.1. Commercial Shellfish Growing Areas and Recreational Beaches (Washington Department of Health, Shellfish Program)

In addition, regulations specify that as a risk reduction measure, beaches near wastewater treatment plant outfalls or marinas must be closed to harvest. Beaches where harvest is prohibited or restricted due to wastewater treatment plant outfalls include Budd Inlet, Oakland Bay, a bay on the southwestern side of Key Peninsula, and two large stretches along the Pierce County mainland shoreline. Beaches that are closed because of proximity to marinas include Reach Island in Case Inlet, several areas along Pickering Passage, and portions of Oro Bay of Anderson Island, Filucy Bay at the south of the Key Peninsula, and Wollochet Bay.

The AHHS uses Washington DOH assessment of shellfish growing area reclassifications to compile shellfish status and trends data. It is important to acknowledge that commercial and recreational shellfish harvest classification is not a complete illustration of healthy shellfish populations; some areas that are permanently closed to shellfish harvest (for example, shellfish beds near waste treatment outfalls) will have viable shellfish populations with intrinsic ecosystem value despite their "closed" classification.

Table 10.1. Commercial Growing Areas and Acres Available for Harvest in each Inlet/Island Group

Inlet/Island Group	Area Available for Harvest (Approved + Conditional) (Acres)	Area NOT Available for Harvest (Prohibited, Restricted, Unclassified) (Acres)
Budd Inlet	0	4,911
Carr Inlet	1,008	105
Case Inlet	2,296	220
Eld Inlet	3,512	0
Hammersley Inlet / Oakland Bay	2,424	671
Harstine Island Group	10,976	636
Henderson Inlet	1,585	194
McNeil Island Group	6,349	2,861
Totten Inlet / Little Skookum	5,541	0
	33,691	**9,598**

Source: Washington DOH; Commercial Growing Area Classification data

Key pressures on shellfish in the South Sound include:

- Housing & Urban Areas (which increase stormwater runoff and are sources of non-point pollution such as from pet waste)
- Commercial & Industrial Areas, including agricultural and forest lands (which increase stormwater runoff and are sources of non-point pollution)
- Runoff from Residential and Commercial Lands
- OSS - Domestic and Commercial Wastewater to On-site Sewage Systems

The AHSS did not create a new numeric goal for shellfish as part of this planning exercise. Rather, the AHSS has adopted existing targets from SPD CRPs. Our target for shellfish is to maintain all currently open areas in open status and to implement CRPs associated with SPDs at Burley Lagoon, Nisqually Reach, Henderson Inlet, and Filucy, Rocky, Vaughn and Oakland Bays. If fully implemented these CRPs will result in reopening 703 acres of shellfish to harvest.

Strategies, Existing Programs, and Actions

AHSS does not have separate, specific strategies for shellfish. The strategies for forests and freshwater, marine nearshore, and water quality all support shellfish protection and recovery by protecting and restoring shellfish habitat. More specific strategies (e.g., related to reintroduction of native shellfish) may be developed in the future.

Shellfish Protection Districts

RCW Chapter 90.72 requires the county legislative authority to create a SPD within 180 days after the Washington State DOH closes or downgrades a shellfish growing area due to a degradation of water quality. There are six established SPDs in the South Sound: Rocky Bay (1995), Filucy Bay (2002), Burley Lagoon (1999), Oakland Bay (2006), and Henderson Inlet/Nisqually Reach (2001). In response to downgrades, SPDs develop CRPs to outline specific actions to improve water quality to achieve upgrade

of shellfish growing areas. The shellfish protection near-term action (NTA) developed for the 2016 update to the Action Agenda for Puget Sound compiles the actions described in the CRPs that originally accompanied the establishment of the SPDs. Pierce County Shellfish Partners also completed a 2020 Strategic Plan in 2013 (link). The Strategic Plan is focused around Preventing, Identifying, and Correcting sources of bacterial pollution and includes actions and cost estimates for achieving 2017 and 2020 targets.

SPDs and CRPs are also being adopted for Vaughn Bay and McLane Cove because of recent classification downgrades. Finally, Totten-Little Skookum and North Bay have been established as "sensitive areas". All these reflect the downgrade of almost 800 acres of shellfish growing area. Each CRP outlines specific tasks and actions. In general, the major tasks in all the CRPs are derived from, or consistent with (for those established earlier) the Pierce County Shellfish Partners 2020 Strategic Plan:

1. Enhanced On-site Sewage System O&M Programs
2. Education and Outreach of District residents on bacterial pollution sources, and pollution prevention actions such as on-site maintenance and farm management
3. Effective Communication between agencies
4. Inspection/Monitoring/Sampling to identify potential problems
5. Pollution Correction Facilitation and Enforcement
6. Owner/Operator Incentives to encourage improvements
7. State and Local Regulatory Support
8. Research to identify improved practices
9. Program Evaluation to ensure long term program effectiveness

The Pierce County Shellfish Partners Program used the above approach to achieve upgrade of more than 400 acres of shellfish growing beds between 2005 and 2014.

County OSS Programs

Each of the South Sound counties operates programs to address issues related to on-site sewage systems (OSS), one of the primary pressures on marine water quality and shellfish growing. These programs generally include pollution identification and correction (PIC) elements, outreach and education for OSS owners, and resources for OSS O&M. In May 2016 Thurston County updated its on-site sewage management plan (link). The updated plan describes overarching goals for OSS management (summary list below) and various funding strategies to meet these goals. Tacoma-Pierce County Public Health's OSS management plan (link), adopted in September 2007, includes similar overarching goal statements. A summary of these goal statements is below.

Table 10.2: Goal Statements for Two South Sound OSS Management Plans

Thurston County	Tacoma-Pierce County Public Health
• Protect public health & water resources by making sure that sewage is treated and disposed of adequately • Inventory septic systems, identify and ensure repair of failing septic systems • Focus on the ongoing maintenance and • Operation of septic systems • Plan elements should meet the requirements of state law: WAC246-272A, RCW 70.118A and meet the needs of Thurston County citizens, make sense, and be reasonable	• Begin a comprehensive inventory to locate and index existing unknown OSS by tax parcel number • Improve how O&M inspection records are received, maintained and disseminated to interested parties • Expand outreach and education efforts so more OSS owners are aware of the type, location and maintenance requirements of their system and better understand the benefits of ongoing O&M • Increase compliance enforcement for operation, monitoring and maintenance requirements, and the identification and repair of failing OSS • Review areas currently recognized as environmentally sensitive to determine whether existing protection measures are adequate, and determine whether new sensitive areas should be designated • Coordinate with and augment existing programs that provide long-term protection for groundwater, surface water and marine resources, add staffing and new program activities to increase public health protection. • Develop long-term funding and create local capacity to implement and sustain the needed O&M program improvements

On-the-ground outreach and education for PIC programs is implemented by the counties (primarily their public health departments) and organizations such as WSU Mason County extension and Mason Conservation District.

AHSS Near-Term Actions for Shellfish

AHSS identified two specific NTAs related to shellfish as part of the 2016 Action Agenda update: South Sound shellfish recovery and Thurston County urban septic to sewer conversion. Both NTAs are described below. Other South Sound NTAs that are not focused on shellfish will also benefit shellfish, primarily through improved marine water quality.

1. **The South Sound shellfish** recovery NTA for the 2016 Action Agenda update identified the following estimated potential acres for upgrade for each impacted growing area:

Table 10.3. Estimated potential acres for upgrade by impacted growing area

Shellfish Growing Area	Potential Acres
Burley Lagoon	172
Oakland Bay	250
McLane Cove	31
Henderson Inlet	46
Rocky Bay	8

Shellfish Growing Area	Potential Acres
Vaughn Bay	54
Filucy Bay	67
Nisqually Reach	75
Total	**703**

The cost for upgrading (or being on target to upgrade) 100 acres of Conditional or Restricted shellfish growing area from the potential acres above is estimated at $5.7 million.

2. The Thurston County urban septic to sewer conversion project is an effort to protect shellfish growing areas through public outreach, code and policy development, and city-specific implementation plans to adopt the conversion program. The cost estimate for phase 1 of this NTA is approximately $180,000.

XI. Increase in Abundance, Distribution & Productivity of Native Salmon Species and Harvest

Background

South Puget Sound is home to ten species of native salmon, and is a documented feeding ground for stocks from other Puget Sound waters, which dip into the South Sound to feed. Salmon are a favorite food of orcas, are highly prized by anglers and commercial fisherman, and are an important cultural and economic resource for tribes.

Baseline and Status

There are over 500 miles of salmonid-bearing streams in the South Sound with documented presence of Chinook, Coho, Sockeye, Chum, and Pink salmon as well as steelhead and bull trout (Figure 11.1). The McNeil Island and Budd Inlet areas have the least amount (1.1 miles and 5.3 miles) and Nisqually watershed has the most extensive presence (189 miles) (Table 11.1).

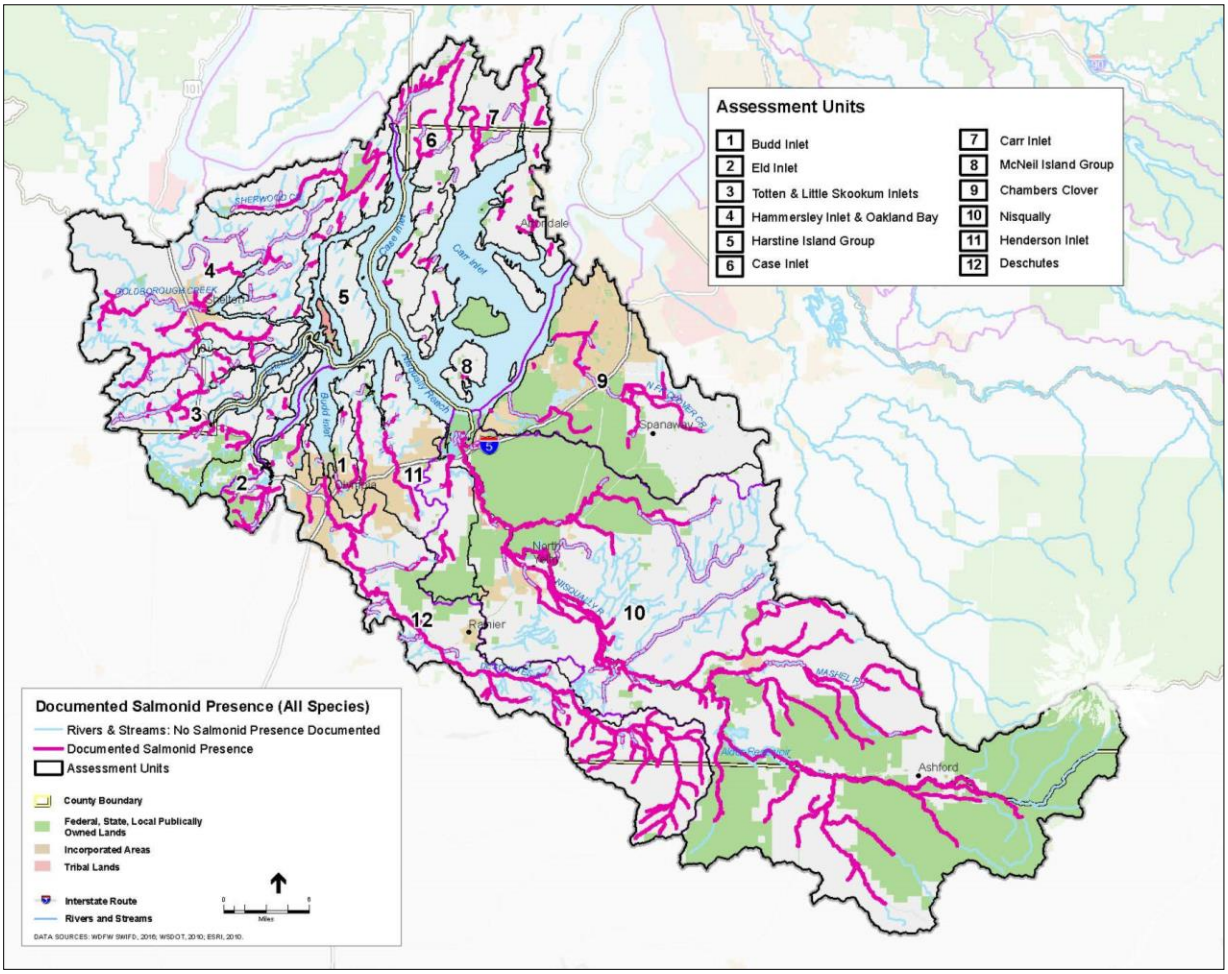


Figure 11.1. Documented Salmonid Presence – Key Species (WDFW Statewide Integrated Fish Distribution)

The following tables summarize documented presence, spawning, and rearing within each upland AUs for five key salmonid species: bull trout, Chinook salmon, Chum salmon Coho salmon, and steelhead trout. The Nisqually watershed is the only AU with documented bull trout presence. Spawning Coho salmon have been documented in most areas while Chinook and steelhead trout are limited to only a few watersheds. There is no documented spawning or rearing bull trout in any of the watersheds.

Table 11.1. Documented Presence of Key Salmonid Species by Assessment Unit

Documented Presence						
Inlet/Island Group	**Bull Trout**	**Chinook Salmon**	**Chum Salmon**	**Coho Salmon**	**Steelhead Trout**	**Total (miles)**
Budd Inlet		1.8	2.0	3.5		**7.3**
Carr Inlet		2.0	5.4	10.1	12.7	**30.2**
Case Inlet		6.9	31.1	37.4	18.9	**94.3**
Chambers Clover		0.3	22.1	20.7	11.1	**54.3**
Deschutes		9.0	2.8	7.2	2.9	**21.8**
Eld Inlet		4.9	3.6	15.3	4.2	**28.0**
Hammersley Inlet & Oakland Bay		10.6	21.4	44.7	39.0	**115.7**
Henderson Inlet		3.4	5.4	13.1	17.8	**39.6**
McNeil Island Group			1.1	1.1		**2.1**
Nisqually	38.1	36.5	3.5	58.4	56.2	**192.7**
Totten & Little Skookum Inlets		0.7	20.6	25.5	14.0	**60.8**
	38.1	**76.0**	**118.9**	**237.0**	**176.7**	**646.8**

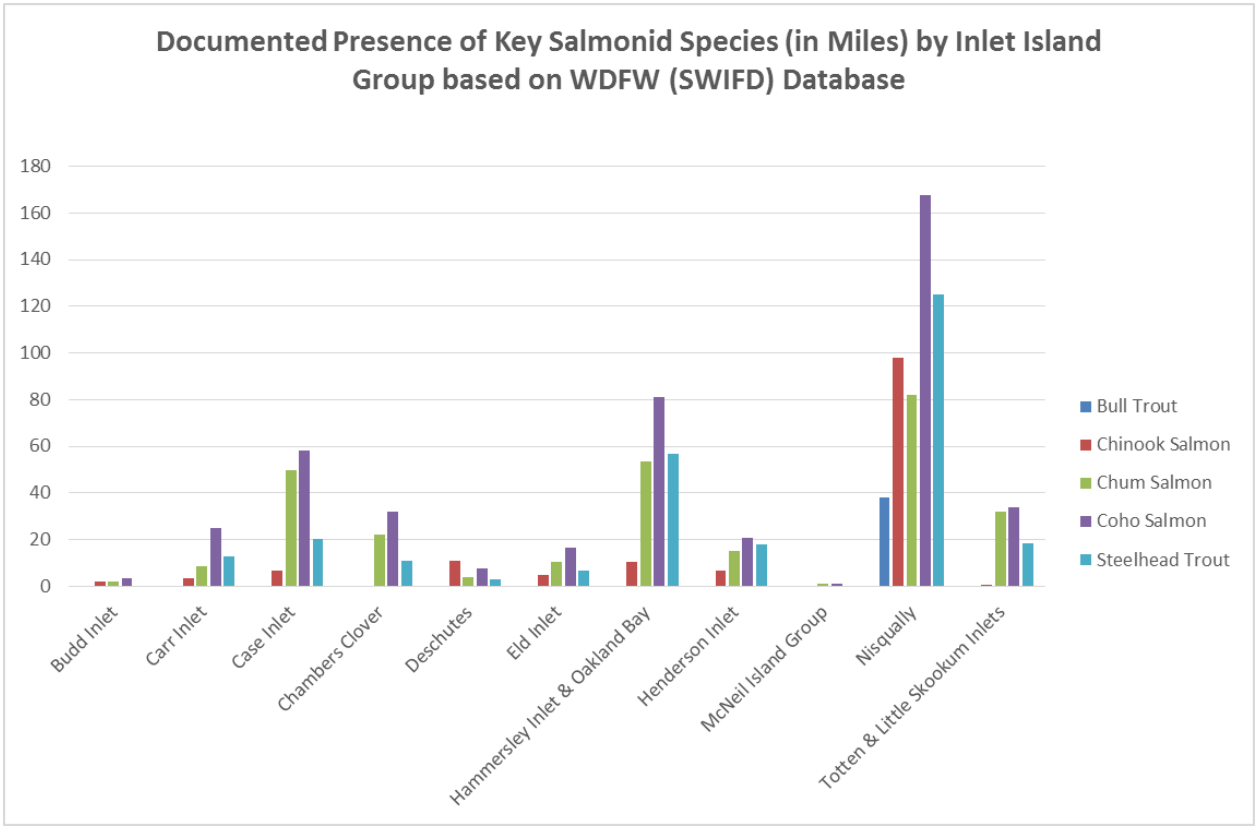


Figure 11.2. Documented Salmonid Presence of Key Species (in miles) by Inlet Island Group

Table 11.2. Documented Spawning of Key Salmonid Species by Assessment Unit

Documented Spawning						
Inlet/Island Group	**Bull Trout**	**Chinook Salmon**	**Chum Salmon**	**Coho Salmon**	**Steelhead Trout**	**Total (miles)**
Budd Inlet		0.4				**0.4**
Carr Inlet		1.3	14.8	14.8		**19.5**
Case Inlet			20.6	20.6	1.3	**40.6**
Chambers Clover			11.3	11.3		**11.3**
Deschutes			0.6	0.6		**1.7**
Eld Inlet			1.2	1.2	2.6	**10.7**
Hammersley Inlet & Oakland Bay			36.3	36.3	18.0	**86.5**
Henderson Inlet		3.6	7.8	7.8		**21.4**
McNeil Island Group						
Nisqually		60.0	105.5	105.5	45.7	**289.7**
Totten & Little Skookum Inlets			8.2	8.2	4.4	**24.1**
	0.0	**65.3**	**206.3**	**206.3**	**72.0**	**505.9**

Table 11.3. Documented Rearing of Key Salmonid Species by Assessment Unit

Documented Rearing						
Inlet/Island Group	**Bull Trout**	**Chinook Salmon**	**Chum Salmon**	**Coho Salmon**	**Steelhead Trout**	**Total (miles)**
Budd Inlet						
Carr Inlet		0.2				**0.2**
Case Inlet						
Chambers Clover						
Deschutes		1.8				**1.8**
Eld Inlet						
Hammersley Inlet & Oakland Bay						
Henderson Inlet						
McNeil Island Group						
Nisqually		1.6		3.8	23.1	**28.4**
Totten & Little Skookum Inlets						
		3.6		**3.8**	**23.1**	**30.5**

Strategies, Existing Programs, and Actions

AHSS does not have separate, specific strategies for Salmon. The strategies for forests and freshwater, marine nearshore, and water quality all support salmon protection and recovery by protecting and restoring salmon habitat. In addition, AHSS actively supports local salmon recovery groups and the strategies and actions described in local salmon recovery plans.

Salmon recovery work in the South Sound is a longstanding and well-known process. Current strategies and priorities for salmon recovery are defined by the South Sound Lead Entity groups in their recovery plans and strategy documents and updated yearly in rolling four year workplans. These workplans define and prioritize specific actions that will further salmon recovery, in a bottom-up structure.

The South Sound Strategy is intended to reinforce and complement existing salmon recovery plans, not replace the current process. These plans and related documents establish specific targets for salmon recovery, which the AHSS endorses and supports. While not always explicit, salmon recovery is inherently intertwined with the other sections of the South Sound Strategy. Restoration work noted in other chapters likely improves stream conditions and habitat for salmon, even if that isn't the stated goal of the project. Similarly, projects slated specifically for salmon recovery often have positive impacts

on more than just salmon. For example, the Stream Team program sponsored by the cities of Lacey, Olympia, and Tumwater, and Thurston County runs workshops and events to promote freshwater stream health, but many of their events also steward the health of salmon. Correspondingly, the SPSSEG facilitates restoration of fish bearing streams to enhance fish habitat. In doing this, the program is often revegetating and restoring bank and stream conditions more than what solely benefits salmon.

Salmon recovery is a high priority in Washington State, with a defined process for project proposals and funding allocation. The AHSS expects that the salmon recovery work and priorities will continue to be a key driver for South Sound protection and recovery and that many of the projects that come forward for AHSS consideration and endorsement will have their origin in the salmon recovery work.

The Puget Sound Salmon Recovery Plan is the statewide document guiding salmon recovery. It includes a regional chapter and fourteen watershed specific chapters as well as a nearshore chapter. The plan includes strategies and actions associated with marine and freshwater habitat protection and restoration, hatchery management, and harvest management. The full Puget Sound Salmon Recovery Plan as well as the watershed chapters specific to the South Puget Sound action area are included below.

Key salmon recovery documents in the South Sound include:

- Puget Sound Salmon Recovery Plan
- WRIA 12 Chambers/Clover Creek Watershed Recovery Plan
- WRIA 14 Kennedy-Goldsborough Watershed Management Plan
- WRIA 15 East Kitsap Peninsula Salmon Habitat Restoration Strategy
- Nisqually River Chinook Stock Management Plan
- Nisqually Steelhead Recovery Plan

XII. How to Use the South Sound Strategy

AHSS will use the South Sound Strategy to facilitate broad conversations about the work needed to protect and restore the South Puget Sound and to inform selection of projects to endorse and advocate for. Currently the AHSS (like other LIOs) controls very little project funding; however, the AHSS is hopeful that this will change over time and, as it does, the AHSS anticipates using the Strategy to inform funding decisions.

AHSS encourages and welcomes the opportunity to endorse and advocate for projects that are consistent with the Strategy. The AHSS is particularly interested in projects that accomplish habitat protection and restoration, protection and restoration or shellfish beds, and stormwater reduction and control. All actions proposed for AHSS endorsement should demonstrate a sound scientific and technical basis. Nearshore projects that are located outside the catchments identified as a priority for protection and restoration in the South Sound Coastal Catchment Assessment should document that they are (1) in priority nearshore salmon habitat or (2) describe how the project considers the condition of its catchment and the surrounding catchments and why it is anticipated to be successful over time. In general, the AHSS believes that, for smaller projects, the focus should be in catchments identified as a priority for protection and restoration and/or priority nearshore salmon habitat.

In general, AHSS uses a 2-step technical review process to make decisions about which projects to endorse. This process is available at any time; project proponents can initiate review by completing a project information sheet through the AHSS website and requesting endorsement.

Step 1: Benefit review – The action will be evaluated considering the geographic scale (size of area affected by the action) and intensity (degree or strength of the effect of the action), with projects that restore (or halt a threat to) part of the ecosystem over a larger area (geographic scale) to a greater extent (intensity) ranking higher. The following scoring criteria will be used:

- Scale:
  - 1 = action addresses the entire South Puget Sound region
  - 2 = action addresses a watershed/inlet/island
  - 3 = action addresses a sub watershed/sub inlet/shoreline reach
  - 4 = action is small, e.g., less than 10 acres, pocket estuary

- Intensity:
  - 1 = effect of action is widespread throughout the geographic scale and is likely to restore or halt threats/ stressors
  - 2 = effect of action is widespread at the geographic scale and will significantly restore ecosystem function or retard threats/stressors
  - 3 = effect of action is localized through the geographic scale and will moderately restore ecosystem function or retard threats/stressors

- 4 = effect of action is very localized in a portion of the geographic scale and will slightly restore or retard threats/stressors

Category ratings will be entered into the following matrix to provide a benefit score.

		Intensity Rating			
		1	**2**	**3**	**4**
Scale Rating	**1**	1	1	2	4
	2	1	2	3	4
	3	2	3	3	4
	4	4	4	4	4

Step 2: Readiness Review – Readiness will evaluate project feasibility and community support using the following considerations.

- Feasibility (+/- 1)
  - Does technology exist / to what extent is it understood or proven?
  - Does the NTA proponent have the technical and financial capacity to manage / accomplish the action?

- Community support (+/- 1)
  - Are landowner / other necessary partnerships in place?
  - Is there stakeholder interest and/or support?

Projects which score 15 points or higher will be endorsed by the AHSS. Projects which score fewer than 15 points can be considered for endorsement on a case-by-case basis, based on project merit. The AHSS Executive Committee makes decisions about endorsement of projects that score less than 15 points, considering recommendations from the Technical Team, and on a case-by-case basis.

In addition, approximately every two years, the AHSS is required to develop a list of priority near-term actions for Puget Sound recovery and submit the list to the PSP for review and approval. When this occurs the AHSS will issue a call for near-term actions describing priorities for project submittals. It is likely that the AHSS call for actions will be informed by funding guidelines published by EPA and/or by the state agencies responsible for the habitat, shellfish, and stormwater Puget Sound strategic initiatives. Because the process and requirements to submit near-term actions for PSP consideration typically are extensive, the AHSS generally supplements its normal technical review process (described above) with a pre-screening/consultation process to, as much as possible, make sure the AHSS believes that actions will be able to successfully navigate AHSS and (as much as it can be predicted) PSP review before project proponents invest time and resources in preparing full proposals. The AHSS Executive

Committee makes final decisions about which near-term actions to submit to PSP as priorities for South Sound.

XIII. Outreach and Education

Overview

Outreach and education refers to programs and activities that engage citizens and elevate their awareness of the challenges facing Puget Sound, the actions being taken to address these issues, and the actions that individuals can take to contribute to Puget Sound recovery. Outreach and education programs can be targeted at many different audiences such K-12 students, landowners, rural populations, and the public. Programs can include door-to-door interactions, convening or attending community meetings, producing and distributing informational materials, providing hands-on training for volunteers, and community based social marketing projects aimed at changing the public's behavior. Through the South Sound Strategy and by fostering other communications and networking channels, AHSS also aims to connect outreach and education organizations with technical organizations so that these groups are aware of each other's activities throughout the South Sound and can work together to further recovery efforts. This will create a greater awareness among practitioners and greater connectedness among organizations working toward a common goal.

Importance of Outreach and Education

Education and outreach are critical to Puget Sound recovery and protection. Without an active and educated citizenry, recovery and protection action can quickly be negated through unintended or intended collective detrimental behavior of individuals on the Puget Sound ecosystem. Given the projected population increase in the Puget Sound region over the short, intermediate, and long term, education and outreach are key to ensuring that gains in environmental health and human well-being in the Puget Sound are durable and sustainable.

While building awareness of the challenges facing Puget Sound and the solutions that AHSS member organizations are implementing is key to this sustainability, the AHSS also recognizes the importance of moving beyond simple awareness building. Simply informing the public of these challenges and the work AHSS is doing does not lead to citizens changing their detrimental behavior. The AHSS must find ways to make citizens active partners in recovery efforts through greater community engagement in the planning phases of projects, increased volunteer opportunities, and community based social marketing.

Project Selection

AHSS' experience with the NTA selection process for the 2016 Puget Sound Action Agenda revealed a significant gap regarding the ability to evaluate projects with a primary focus on outreach and education. The AHSS NTA selection process is primarily designed to evaluate technical projects (e.g., habitat restoration, street sweeping) and contains no criteria by which outreach and education projects can be evaluated. In addition, the existing project evaluation process does not provide for projects with outreach and education elements as part of a broader project design. One of the underlying causes of this gap is the time-limited scope of NTAs (as implied by their very name, these actions are "near" term); most outreach and education programs/projects are, by nature, attempting to influence or change behaviors over long time frames – often generational time frames – and therefore project outcomes will

often not materialize within a pre-established two or four-year period. Another reason for the lack of ability to evaluate education and outreach projects is that AHSS has mostly focused on technical projects through its Technical Team and only recently established an Outreach and Education Team to help provide input to AHSS on ongoing outreach and education activities and other outreach and education perspectives.

AHSS will work to improve the project selection process by incorporating criteria for evaluating stand-alone outreach and education project proposals as well as project proposals with outreach and education components. As organizations use the South Sound Strategy to select projects or compile data that supports their project selection, the AHSS encourages project sponsors to incorporate outreach and education into their project design.

Project Design

Whenever a restoration or protection action is undertaken, project sponsors or affiliated organizations should seize the opportunity to publicize the project's benefits as well as its impact on human health and well-being. AHSS encourages organizations to incorporate outreach and education into project design since outreach and education are most effective at the project level. For organizations with limited outreach and education capacity, this may require partnering with outreach and education-focused organizations. A list and brief description of South Sound outreach and education organizations is included in the "resources" section below. Designing a stand-alone outreach and education program or a project that includes an outreach and education component is a multi-step process. The table below, adapted from "Nonformal Environmental Education Programs: Guidelines for Excellence" (link)[6], provides a basic outline of the steps in the project design process.

1. Needs Assessment (What needs will the program meet?)
• Identify environmental issue(s) to be addressed. • Inventory existing programs. • Seek input from community and potential audience(s).
2. Organizational Needs and Capacities (How will the program support the parent organization's goals?)
• Consider goals and priorities of parent organization. • Identify parent organization's need for the program. • Determine resources and capacities of parent organization.

[6] North American Association for Environmental Education. Available online at:

3. Program Scope and Structure (How is the program structured and what does it hope to accomplish?)
• Develop program goals and objectives. • Assess overall fit with field of environmental education. • Determine format, techniques, and training needs. • Explore potential for partnerships.
4. Program Delivery Resources (Are instructional staff members fully prepared to deliver the program? Are supplies and facilities available?)
• Assess logistical and resource needs • Assess staff competencies and training needs • Arrange needed facilities, supplies, and equipment
5. Program Quality and Appropriateness (Are instructional materials educationally sound?)
• Obtain or develop educationally sound materials. • Field test new instructional materials. • Market program. • Develop sustainability strategies.
6. Evaluation (Has an evaluation strategy been developed and implemented?)
• Develop evaluation strategies, techniques, and criteria. • Implement practical program evaluation and use results.

Community Based Social Marketing

In many environmental programs, traditional outreach and education outputs (e.g., workshops, videos, posters, fact sheets) are, by themselves, acknowledged as relatively ineffective at changing behavior. These outputs are being phased out as grantmaking and permitting agencies begin to include social marketing requirements in their programs with a greater emphasis on outcomes, (e.g. measurable changes in behavior vs number of people reached).

An example of this ineffectiveness can be found in a study conducted by Scott Geller around an intensive energy conservation workshop. Following the workshop, "attendees indicated greater awareness of energy issues, more appreciation for what could be done in their own homes to reduce energy use, and a willingness to implement the changes that were advocated in the workshop." However, in follow up interviews, only 1 out of the 40 attendees had followed through with the recommendation to lower the hot water thermostat, only 2 out of 40 installed insulating blankets

around their hater water heaters, and only 8 out of the 40 installed the water-efficient shower heads that each was given, for *free.*[7]

As an alternative, community based social marketing (CBSM) has been shown to be very effective at bringing about behavior change by using social levers and specifically targeting the barriers people face in adopting new behaviors.

> *Community-based social marketing is composed of four steps: uncovering barriers to behaviors and then, based upon this information, selecting which behavior to promote; designing a program to overcome the barriers to the selected behavior; piloting the program; and then evaluating it once it is broadly implemented (McKenzie-Mohr & Smith, 1996 (*link*)*

A recent example of a stand-alone community based social marketing program is the joint King/Pierce County "Don't Drip and Drive" campaign, which won the National Association of Clean Water Agencies' (NACWA) National Environmental Achievement Award for Excellence in Public Information and Education (link).[8] The campaign adopted a social marketing approach to design a program that makes it easier for vehicle owners to fix car leaks. This included minimizing barriers that impede their ability to repair their vehicle and using motivating messages that emphasized the benefits of making repairs that resonated with vehicle owners (link).[9] To reach drivers, the campaign used a combination of regional advertising and a variety of face-to-face strategies: online advertising, the campaign website, leak check events, participating auto shops and other outreach activities. Overall, at least 1,669 leaks were estimated to be repaired because of the campaign.

South Sound Outreach and Education Resources

Several groups work on outreach and education throughout South Sound, either as a core mission or as an element of their restoration/protection activities. Like AHSS, Thurston ECO Network and Mason ECO Network are umbrella organizations that include most (if not all) outreach and education organizations in and around the South Puget Sound. The ECO Networks are a key resource for connecting with the outreach and education community. A brief description of the ECO Networks and some of their member organizations is provided below. Please note that this list is not exhaustive; the ECO Networks maintain more complete lists of outreach and education organizations on their

Targeted Outreach

A key aspect of outreach and education is targeting the appropriate audience. Outreach and education organizations (such as those listed in this section) can deliver specific messages to different audiences and project sponsors should consider which audience or audiences are most important to project success.

[7] "Evaluating energy conservation programs: is verbal report enough?" *Journal of Consumer Research,* 8, 331 – 335. Cited by Doug McKenzie-Mohr in "Fostering Sustainable Behavior".
[8] Don't Drip and Drive Campaign: Vehicle Leak Education and Behavior Change Project Social Marketing Planning Process. Prepared for Stormwater Outreach for Regional Municipalities (STORM) July 2013.
[9] Don't Drip and Drive: A Social Marketing Program to Address Vehicle Leaks. Steering Committee Report.

respective websites. Local governments also have outreach and education programs within various departments.

Thurston ECO Network (link):

Thurston ECO Network is a community of education, communication, and outreach professionals committed to working collaboratively to protect and enhance the health and vitality of the Thurston County region. Thurston ECO Network is a resource for professionals, the public, and policymakers for environmental and sustainability issues in Thurston County.

Mason ECO Network (link):

Mason ECO Network's mission is to provide education, outreach, and involvement with partner organizations to motivate and inspire our community's understanding and stewardship to sustain and improve our environment.

Thurston Conservation District (link):

TCD's mission is to conserve and sustain the beneficial use and protection of local natural resources in partnership with Thurston County rural, agricultural, and urban communities using volunteerism, cooperation, leadership, education, and technical & financial assistance in a non-regulatory.

Mason Conservation District (link):

Mason Conservation District helps landowners responsibly and efficiently manage their land and associated natural resources. As a non-regulatory agency, Mason Conservation District provides service solely at the request of the property owner. District staff assess the landowner's desired result and provide technical assistance and in some cases, financial assistance to achieve that goal.

Pierce Conservation District (link):

The Pierce Conservation District works with the community to improve water quality, promote sustainable agriculture, create thriving habitat, and build a just and healthy food system for all, through education, community engagement, and financial and technical assistance.

LOTT Clean Water Alliance (link):

LOTT provides wastewater management services for the urban area of north Thurston County, Washington. LOTT is a non-profit corporation, formed by four government partners – Lacey, Olympia, Tumwater, and Thurston County. LOTT also provides a range of school and community education programs and operates the WET (Water, Education, and Technology) Science Center.

Deschutes Estuary Restoration Team (link):

DERT works to restore the urban estuary in downtown Olympia by reconnecting the Deschutes River to the Salish Sea. DERT has done significant outreach to share its message with the community, as well as with key state agency leaders and legislators.

Nisqually River Education Project (link):

The Nisqually River Project (NREP) is a watershed education program which implements key elements of the Nisqually Watershed Stewardship Plan, providing students service learning projects that link Washington State learning goals and standards with local environmental issues. Each year, the NREP actively involves hundreds of student participants in an on-going water quality monitoring program. These students then engage in problem-solving and action education projects.

South Sound Estuary Association (link):

SSEA fosters learning opportunities that inspire people of all ages to connect with, protect, and enjoy the unique estuary environment of the South Puget Sound. SSEA's programs and activities include public meetings, media, science, marine art activities and education in classroom, field, and on the water interactive settings.

Other Outreach and Education Organizations Operating in South Sound:

Capitol Land Trust
Citizen Action Training School (CATS)
City of Lacey - Multiple Departments
City of Shelton
City of Tumwater - Water Resources - Stream Team
Evergreen State College - Multiple Departments
GRuB Institute
Hood Canal Coordinating Council
Intercity Transit
Mason County - Multiple Departments
Mason PUD
Mount Rainier Institute
New Nature Movement, South Sound GREEN
Nisqually Indian Tribe
Nisqually Land Trust
Nisqually Reach Nature Center
Nisqually River Foundation
Northwest ECO Building Guild
Olympia Coalition for Ecosystems Preservation
Pacific Shellfish Institute
Piercy County - Multiple Departments
Puget Sound Partnership
Puget Sound Restoration Fund
Skokomish Indian Tribe
Sound Experience
South of the Sound Community Farm Land Trust
South Puget Sound Salmon Enhancement Group
South Sound Salmon Enhancement Association
Squaxin Island Tribe
Stewardship Partners - 12,000 Rain Gardens Program
Stillwaters Environmental Center
Sustainable South Sound (and Motion in Balance Studio)
Taylor Shellfish
The Russell Family Foundation
Thurston Climate Action Team
Thurston Conservation District
Thurston County - Multiple Departments
ThurstonTalk Editor
Tumwater School District
US Fish and Wildlife Service - Grays Harbor National Wildlife Refuge
US Fish and Wildlife Service - Nisqually Wildlife Refuge
Veteran's Affairs - Veteran's Conservation Corps
WA State Department of Ecology - Multiple Offices
WA State Department of Fish & Wildlife
WA State Department of Health
WA State Parks Foundation
Washington Sea Grant
Wolf Haven International
WSU Mason County Extension

XIV. Adaptive Management

Definition

Adaptive management is a process of paying attention to results and experiences of implementation over time, considering new and emerging information, and making changes to adjust and evolve strategies and actions to continuously improve performance and results.

Adaptive Management Strategy

The South Sound Strategy is the first comprehensive attempt to develop a rigorous, science-based approach to ecosystem management in and around South Sound. As such there is no previous adaptive management process within the South Sound LIO; the following information is a description of the AHSS's approach to adaptively managing the South Sound Strategy in the future. The AHSS adaptive management approach follows the *Conservation Measures Partnership (CMP)* Cycle (Figure 1).

Conceptualization (step 1), and action and plan monitoring (step 2), are underway with the South Sound Strategy. Action implementation and monitoring (step 3) is taking place through ongoing projects as implemented and monitored by South Sound partners (captured to a limited extent in the suite of South Sound NTAs) and will also occur as South Sound partners implement projects based on the South Sound Strategy framework. As data and results become available from these projects (step 4), South Sound partners will share lessons learned through the South Sound LIO convening forum (step 5). The AHSS Technical Team will compile this information and use it as additional input to refine the South Sound Strategy.

Figure 14.1: Adaptive Management Cycle from CMP

AHSS will pursue adaptive management of the South Sound strategy by regularly reviewing efforts and results including consideration of:

- What strategies have been executed and to what extent, for example, for the strategy of septic to sewer conversion in urban areas, review of how many have been accomplished and where.
- Where performance and results are not moving as quickly as desired work with program implementers and project sponsors to identify barriers to implementation and/or program refinements.

- Review of South Sound goals and targets to track progress and to adjust over time as needed.
- Adjustment of conceptual models and strategies to new scientific and technical information when needed.

AHSS will accomplish adaptive management primarily through ongoing discussions with the South Sound Technical Team and the AHSS Council. The AHSS Executive Committee will continue to make decisions about changes to South Sound goals or targets in response to advice from the Technical Team and Council. The AHSS anticipates at least one plan review per year; the review may be implemented as a session at the longstanding and well attended South Sound Science Symposium.

The AHSS notes that adaptive management and evolutionary decision making involve a combination of responding to scientific and technical information and interactions with policy makers, project sponsors, and the broader community so the overall South Sound Strategy can continue to reflect what is needed and what can be done.

Decision Process

The South Sound LIO decision process for adaptively managing the South Sound Strategy will follow a similar structure to current LIO decision making and is described in Figure 2 below. The AHSS Technical Team will compile emerging data and project results on an ongoing basis and will bring compiled data to the annual review session as described above). The Technical Team will develop a list of recommendations for adaptation of the South Sound Strategy; the AHSS Council will review the recommendations and provided feedback. After Council feedback, the Technical Team will submit its recommendations to the Executive Committee, which will make final decision. The Technical Team will then review the South Sound Strategy by the direction indicated by the Executive Committee. The revised strategy will be circulated with AHSS Council members to ensure broad distribution to parties working in and around South Sound.

Figure 14.2: AHSS Decision Making Structure

Appendices

Appendix A: Descriptions of Inlet/Island Groups

Budd Inlet

Budd Inlet is six miles long and is the southernmost arm of Puget Sound, with the city of Olympia located at the southern end. Budd Inlet is an urbanized inlet with an intact dam (5th Avenue dam) at the South end of the Deschutes estuary. It has chronically high and persistent fecal coliform bacteria counts, high sensitivity to eutrophication and the highest concentrations of Nitrites in the Puget Sound in the inner inlet (Newton, 2002). It is also Clean Water Act (CWA) 1998 303(d) listed for dissolved oxygen, pH, contaminated sediment and extensive chemical contamination, including Ammonium-N as well as Polychlorinated Biphenyls (PCBs) (detected in the Dutch et. al. 2003 sediment study). Utilizing five indicators of water quality concern (strong stratification, low DO, limiting nutrients, high fecal coliform bacteria concentrations, and high ammonium concentrations), Butt Inlet was within the highest concern category for the state's marine stations during 1998 – 2000 (Newton et. al. 2002). Budd Inlet contains documented surf smelt spawning areas as well as other critical faunal areas in the nearshore, feeder bluffs and areas of prohibited shellfish harvest.

Carr Inlet

Carr Inlet is located between Key Peninsula and Gig Harbor Peninsula. Its southern end is connected to the southern basin of Puget Sound. Northward, it separates McNeil Island and Fox Island as well as the peninsulas of Key and Gig Harbor. Henderson Bay is at the northern end of Carr Inlet. Carr Inlet has been identified as a CWA 1998 Section 303 (d) listed inlet for both dissolved oxygen and fecal coliform. Proposed listings for pH and for toxic sediment contamination, including PCBs (Dutch et. al. 2003) were also made in 2002/2004. Dissolved oxygen is low and Nitrites were high (Newton et. al. 2002). Carr Inlet has areas of extensive eelgrass beds, forage fish spawning and active feeder bluff.

Case Inlet

Case Inlet is located between Key Peninsula and Harstine Island. Its northern end, called North Bay, reaches nearly to Hood Canal, creating the defining isthmus of Kitsap Peninsula. Case Inlet is the boundary between Pierce County and Mason County. The southern end of Case Inlet is connected to Nisqually Reach, part of the southern basin of Puget Sound. Herron Island lies in Case Inlet. Case Inlet was CWA 1998 Section 303(d) listed for pH, and fecal coliform. 2002/2004 additional proposed listings made were for dissolved oxygen, phthalates and for three toxic sediment contaminants. It is recorded as having low dissolved oxygen (based on Ecology marine monitoring) and high ammonium and nitrites (Newton et al. 2002). Case inlet has been documented as having forage fish spawning areas, feeder bluffs and eelgrass beds as well as several high priority conservation areas.

Eld Inlet

Eld Inlet lies between Budd Inlet to the east and Totten Inlet to the northwest. Eld Inlet is about 6 miles long. The southern end of the inlet is called Mud Bay. Eld Inlet has extremely high level of residential shoreline landowners and armoring. In addition, Highway 101 runs along a stretch of the shoreline. The

Evergreen State College is located along this inlet. It has very high shellfish commercial and residential usage, including geoduck tubes. It has low dissolved oxygen and high ammonium concentrates (Newton et. al. 2002). PCBs were detected in the sediment (Dutch, 2003). In addition to shellfish harvest, Eld Inlet contains spawning areas for surf smelt, and large populations of sand dollars. Western grebes also use habitat in Eld inlet.

Hammersley Inlet and Oakland Bay

Hammersley Inlet connects Oakland Bay to greater Puget Sound. It is approximately 8 nautical miles long. As tides change in the South Puget Sound, Hammersley Inlet is the only artery through which all water must flow between the Oakland Bay and the greater Puget Sound. As tides change, they force the water through narrow, winding, shallow, Hammersley, producing erratic currents up to 5 knots (9 km/h). Hammersley Inlet is also known for its abundant shellfish production of clams and oysters. Hammersley Inlet & Oakland bay are moderately urbanized and include the city of Shelton as well as multiple commercial uses. Hwy 3 runs along the shoreline. Hammersley Inlet has been identified as CWA 1998 Section 303(d) listed for fecal coliform. Fecal coliform tested extremely high twice (1998, 2000) but is currently (2013) at acceptable levels. The inlet also had high ammonium levels. Additional 303 (d) waters of concern listings 2002/2004 have been proposed for dissolved oxygen and pH. PCBs were detected in the sediment (Dutch et. al., 2003). Hammersley Inlet & Oakland Bay contain a wide variety of valuable habitat which includes forage fish spawning habitat, high quality habitat for juvenile salmon, extensive shellfish harvest areas. In addition, there are multiple priority conservation sites and several priority estuary feeder bluffs.

Harstine Island Group

Harstine Island Group is located in Mason County and includes Harstine Island, the Squaxin Island Indian Reservation, and Hope Island State Park. Harstine Island is located west of Case Inlet and 10 miles north of Olympia. It has a land area of 19 square miles and a population of around 1,000. Pickering Passage, to the northwest, separates the island from mainland, while Case Inlet, to the east, separates it from Key Peninsula. Squaxin Island, approximately 2.2 square miles and unpopulated, lies to the southwest, separated by Peale Passage. To the south, Harstine Island is separated from the mainland by Dana Passage. Harstine Island is home to Jarrell Cove State Park and Harstine Island State Park. This inlet has portions of high residential density, multiple marinas, including Boston Harbor and Zittel's marinas as well as three state parks – Big Slough, Tolmie and Hope Island. In addition, Highway 101 runs along a length of the shoreline. Habitat in this inlet includes: multiple forage fish spawning sites, active feeder bluffs, high quality habitat (both used currently and with potential for conservation), shellfish harvest areas and historic estuary area.

Henderson Inlet

Henderson Inlet is a small, southern inlet situated between Budd Inlet to the west and Nisqually Reach to the east. Since 1987 a large section of the western shore of Henderson Inlet has been managed by the Woodard Bay Natural Resources Conservation Area, including the former property of the Weyerhaeuser Timber Company and, to its north, part of the historic Esterly Farm and its associated woodland. The conservation area, now covering 600 acres, has expanded in stages by purchasing surrounding

properties as they became available, and has developed into an important sanctuary for birds, bats, seals and otters. Henderson inlet was CWA 1998 Section 303(d) listed for dissolved oxygen and fecal coliform. It was proposed for the 2002/2004 waters of concern list for pH and four toxic sediment contaminants. The inlet provides multiple forage fish (smelt) spawning sites as well as areas for shellfish harvest and feeder bluffs. There is a historic log yard in the inlet. In addition, Woodard Bay offers seal pupping habitat.

Totten & Little Skookum Inlets

Totten Inlet extends 9 miles southwest from the western end of Squaxin Passage, and much of the county line between Mason and Thurston counties runs down the center of it. Totten Inlet splits into two smaller inlets, Oyster Bay and Little Skookum Inlet. Oyster Bay, located south of Burns Point, is an extensive mudflat. Oysters are grown in this area, and there are log booms. Totten Inlet is one of Washington's most productive areas for growing oysters, which grow extremely fast in the algae-rich water. Taylor Shellfish, the United States' largest producer of farmed shellfish, began in Totten Inlet and is still headquartered today near its waters. This inlet measured high in Ammonium and has high sensitivity to added nutrients (based on Newton et al. 2002). The inlets contain multiple forage fish spawning habitat as well as active feeder bluffs and significant shellfish aquaculture. There are extensive WDNR land holdings on the shoreline.

McNeil Island Group

The McNeil Island Group consists of most of the shoreline and the uplands of McNeil Island, Fox Island, Anderson Island, and Ketron Island. McNeil Island, the largest, is located just west of Steilacoom and is approximately 7 square miles. The government (federal and state) has owned McNeil Island for most of its history and was home to a United States Federal Penitentiary from 1875 until turned over to Washington State Department of Corrections in 1981. In 2011 the DOC closed the penitentiary but the detention center for violent sexual offenders continues to operate. Anderson Island, with approximately 1,000 residents, is the southernmost island in Puget Sound and is south of McNeil. Fox Island is to the north of McNeil Island, across Carr Inlet, and has approximately 3,600 residents. Ketron Island is located just off the shore from Steilacoom. It is the smallest island by size (220 acres) and population (17 residents). McNeil Island Group contains multiple sites for forage fish spawning, including sand lance and surf smelt. There are critical bird areas and historical estuary, including the Nisqually estuary. Shellfish harvest, eelgrass populations, kelp beds and feeder bluffs are also found in this area.

Appendix B: AHSS NTAs

Habitat Strategic Initiative				
NTA Name	**Owner**	**Cost Estimate**	**Description**	**Year**
Henderson Inlet Habitat Protection & Restoration	Capital Land Trust	$1,237,000	This project will acquire in fee title 105-acres of biologically-sensitive estuary, nearshore and riparian habitat along the shoreline of Henderson Inlet in Thurston County, Washington, and restore the marine shoreline of the Harmony Farms property.	2016
Expand Conservation District Shore Friendly Programs Across Puget Sound	Mason Conservation District	$5,576,005	The Shore Friendly effort proactively connects shoreline owners with science-based, non-regulatory, professional technical assistance to reverse the trends of shoreline armoring and degradation, and encourages change toward stewardship and conservation.	2016
Restore Naturally Functioning Riparian Buffers in South Sound	Mason Conservation District	$253,494	Expand on efforts to restore and protect naturally functioning riparian and floodplain areas that support aquatic habitat by conducting planting, site maintenance, and knotweed inventory and control.	2016
Deschutes River Estuary Restoration	Squaxin Island Tribe	$100,000	The proposed project would restore tidal processes to 275 acres of large river delta at the mouth of the Deschutes River. This phase will complete one of the final two studies needed before restoration can begin by creating an equitable funding strategy.	2016
Titlow Estuary Restoration	South Puget Sound Salmon Enhancement Group	$866,000	The Titlow NTA is a multi-faceted planning and implementation effort to remove shoreline armor and fill, restore fish passage and tidal hydrology, reclaim estuarine and emergent wetlands, and remediate effects of stormwater in Titlow Park.	2016
Develop a Riparian Restoration Program in Thurston County	Thurston County	$305,000	Thurston County proposes to develop a riparian restoration program to improve water quality and mitigate impacts from stormwater and nonpoint pollution, restore habitat, increase resiliency to floods and droughts, and support recreational use of streams.	2016
Huge Creek Culvert Replacement	Pierce County Public Works and Surface Water Management	$662,735	This proposal will fund the replacement of an undersized obstructive culvert on Huge Creek, a tributary to Minter Creek located on 160th St (SW Countyline Road).	2016
Chambers Creek Dam Acquisition and Design	Forterra	$389,000	A feasibility study for dam removal was funded by SRFB in Dec. 2015. This proposal is to acquire the dam & complete a site restoration plan (final design) based off the data derived from the master plan under multiple dam removal scenarios.	2016
Nisqually Community Forest Acquisition	Nisqually community Forest	$8.750,000	Permanently protect habitat for threatened Nisqually steelhead and Chinook and to protect the recovery trajectory of Machel sub-basin through acquisition of sensitive properties under threat of forestry practices that could result in excessive erosion.	2016

Salmon Recovery 3-Year Work Plan Implementation	WRIA 10/12	N/A	Each lead entity will implement at least on top tier project each year form their South Sound Salmon Recovery 3-Year Work Plan. They will determine year one project and set up performance measures at the start of each fiscal year.	2014
Salmon Recovery 3-Year Work Plan Implementation	WRIA 13	N/A	Each lead entity will implement at least on top tier project each year form their South Sound Salmon Recovery 3-Year Work Plan. They will determine year one project and set up performance measures at the start of each fiscal year.	2014
Salmon Recovery 3-Year Work Plan Implementation	WRIA 14	N/A	Each lead entity will implement at least on top tier project each year form their South Sound Salmon Recovery 3-Year Work Plan. They will determine year one project and set up performance measures at the start of each fiscal year.	2014
Salmon Recovery 3-Year Work Plan Implementation	WRIA 11	N/A	Each lead entity will implement at least on top tier project each year form their South Sound Salmon Recovery 3-Year Work Plan. They will determine year one project and set up performance measures at the start of each fiscal year.	2014
Salmon Recovery 3-Year Work Plan Implementation	WRIA 15	N/A	Each lead entity will implement at least on top tier project each year form their South Sound Salmon Recovery 3-Year Work Plan. They will determine year one project and set up performance measures at the start of each fiscal year.	2014
Habitat and Shellfish Recovery Through Education and Outreach	WSU Extension	N/A	Implement the Shore Stewards Program throughout the South Puget Sound Action Area. The voluntary program engages shoreline homeowners to implement BMPs and behavior practices to reduce pollutant inputs and to improve habitat. Develop a local welcome pack to engage, connect, and educate new shoreline homeowners about local issues and resources available to them.	2014
McNeil Island Long-Term Conservation and Low-Impact Public Access	Pierce County	N/A	Track State efforts to determine the long-term management strategy of McNeil Island. Support protection and restoration of habitat and natural resources of the island for low-impact public access.	2014
Shellfish Strategic Initiative				
NTA Name	**Owner**	**Cost Estimate**	**Description**	**Year**
South Sound Shellfish Recovery	Pierce County Surface Water Management	$5,694,900	Implement CRPs associated with SPDs at Burley Lagoon, Nisqually Reach, Henderson Inlet, and Filucy, Rocky, Vaughn and Oakland Bays.	2016
Thurston County Urban Septic to Sewer Conversion	Thurston County Public Health and Social Services Department	$180,000	Protect shellfish growing areas through an urban septic to sewer conversion program. Conduct public outreach, develop codes, policies, and city-specific implementation plans to adopt the conversion program.	2016

Bringing Together Farms and Fish for Water Quality and Habitat Protection	Thurston Conservation District	$300,000	Restore riparian function while preserving farmland by adjacent to salmon-bearing streams.	2016
Mason County Enhanced Septic Repair Grant and Loan Program	AHSS	N/A	Achieve a self-sustaining septic repair and loan program through a partnership with Craft3, expressly targeting shellfish reopening and/or preserved open status in Oakland Bay, North Bay, Hammersley, Totten, and Little Skookum Inlet watersheds.	2014
Thurston County Enhanced Septic Repair Grant and Loan Program	AHSS	N/A	Achieve a self-sustaining septic repair grant and loan program, expressly targeting shellfish reopening and/or preserved open status in Henderson and Eld Inlet watersheds.	2014
Pierce County Enhanced Septic Repair Grant and Loan Program	AHSS	N/A	Achieve a self-sustaining septic repair grant and loan program, expressly targeting shellfish reopening and/or preserved open status in Nisqually, Case, Pickering, Carr and Island Inlet watersheds.	2014
NPDES municipal stormwater permit implementation funding strategy development	AHSS	N/A	Municipal stormwater jurisdictions will develop a funding strategy to achieve a balance of local, state, and federal funding for their stormwater programs, as needed.	2014
Small Community Stormwater Reduction Program	AHSS	N/A	Develop and enhance program with education, advocacy, and restoration elements addressing non-NPDES mandated stormwater program in small communities.	2014
Stormwater Strategic Initiative				
NTA Name	**Owner**	**Cost Estimate**	**Description**	**Year**
Water Quality Focused Street Sweeping Program	City of Olympia	$365,805	Expand an existing limited street sweeping program to city-wide with deliberate focus on water quality to reduce pollutants released to surface waters. GIS-based analysis will direct development and implementation of sweeper operating procedures & routes.	2016
K-12 Field Investigation Program	Mason Conservation District	$187,569	K-12 Stormwater Field Investigation Program coordinates local partners to provide reliable field sites for place-based curricula with Mason County schools.	2016
Stormwater Stewards	WSU	$299,628	A capacity-building program in which capable, committed, and well trained citizen volunteers provide peer-to-peer technical assistance to other residents seeking opportunities to manage and treat polluted runoff on their home or small-commercial sites.	2016
Clover Creek Water Quality Improvements	Pierce County Public Works and Surface	$600,000	Clover Creek near Brookdale road received the lowest marks for water quality in the Pierce County Surface Water Report Card. This proposal will retrofit two Clover Creek storm water outfalls with filter devices.	2016

	Water Management			
South Puget Sound Nutrient Reduction Strategy	AHSS	N/A	Implement nutrient reduction strategies as recommended in the Ecology dissolved oxygen study or as indicated from modeling results based on that report.	2014
Prevention of Pollution and/or Recovery of Shellfish Beds through Education, Outreach, and Advocacy	WSU Extension	N/A	Customize outreach efforts aimed at each watershed-inlet for citizen involvement and improved effectiveness to achieve behavioral change through ECO Net.	2014
Deschutes River Estuary Restoration	Squaxin Island Tribe	N/A	Remove the 5th Ave. dam and restore 346 acres of estuarine and intertidal habitat. Project recommended by the Capitol Lake Adaptive Management Plan steering committee and is a WRIA 13 Lead Entity and Puget Sound Nearshore Estuarine Restoration Program priority project.	2014
Sequalitchew Creek Restoration	South Puget Sound Salmon Enhancement Group	N/A	Restore Sequalitchew Creek, a Puget Sound Nearshore Estuarine Restoration Program project.	2014
Chambers Bay Estuarine and Riparian Enhancement Project	WRIA 10/12 Lead Entity	N/A	Enhance estuarine habitat structure, increase salt marsh, and restore marine riparian habitat within and around Chambers Bay, a Puget Sound Nearshore Estuarine Program project. These actions will improve shallow water refuge, increase foraging opportunity, and improve rearing capacity of the shoreline for salmon, particularly early life stages of Chinook, chum and pink salmon.	2014
Johns Creek (Bayshore) Estuary Restoration	Squaxin Island Tribe	N/A	Restore John's Creek (Bayshore) Estuary, a Puget Sound Nearshore Estuarine Restoration Program project.	2014