STRATEGIES AND ACTIONS

C: POLLUTION

« Cover Photo: Contaminated Beach, Bainbridge Island, courtesy of Brian Walsh

Reducing and controlling the sources of pollution to Puget Sound is of paramount importance to the long-term health of the Puget Sound ecosystem and its residents. Human and animal wastes, fertilizers, pesticides, and the toxic chemicals that run off pavement during storms and are discharged from industrial facilities can enter the water and harm aquatic life, and also pose several health and safety problems to humans. A successful approach to pollution in Puget Sound must ensure that toxics in marine waters and sediments, and in mammals, fish, birds, shellfish, and plants, do not harm the persistence of these species; urban stormwater runoff, as well as agricultural and forest runoff, is effectively controlled and managed in an integrated way; loadings of toxics, nutrients, and pathogens do not exceed levels consistent with healthy ecosystem function; shellfish populations are healthy and abundant; the threat and severity of oil-spills is minimized; and our legacy of pollution impacts in Puget Sound is addressed and cleaned up.

The strategies in this section will contribute most significantly to achieving recovery targets for the following vital signs.

- Freshwater water quality
- Toxics in fish
- Marine sediment quality
- Shellfish bed
- Marine water quality
- Eelgrass
- Swimming beaches
- Orcas
- Land development and cover
- Pacific herring
- Onsite sewage systems

THIS SECTION DESCRIBES NINE STRATEGIES—and associated sub-strategies, ongoing programs, and actions—that are essential to the addressing pollution in Puget Sound. The strategies and actions are organized under the following headings.

Contaminants

C1. Prevent, Reduce, and Control the Sources of Toxic Contaminants Entering Puget Sound

Built Environment Runoff

C2. Use a Comprehensive Approach to Manage Urban Stormwater Runoff at the Site and Landscape Scales

Agricultural Runoff

C3. Prevent, Reduce, and Control Agricultural Runoff

Forest Land Runoff

C4. Prevent, Reduce, and Control Surface Runoff from Forest Lands

Wastewater

C5. Prevent, Reduce, and/or Eliminate Pollution from Decentralized Wastewater Treatment Systems

C6. Prevent, Reduce, and/or Eliminate Pollution from Centralized Wastewater Systems

Shellfish

C7. Ensure Abundant, Healthy Shellfish for Ecosystem Health and for Commercial, Subsistence, and Recreational Harvest Consistent with Ecosystem Protection

Oil Spills

C8. Effectively Prevent, Plan for, and Respond to Oil Spills

Cumulative Impacts

C9. Address and Clean Up Cumulative Water Pollution Impacts in Puget Sound

RECOVERY IN FOCUS

Pollution strategies and actions contribute to achieving recovery targets for the vital signs presented in color in this *Puget Sound Vital Signs* graphic. The *Puget Sound Vital Signs* is an online tool that tracks and communicates ecosystem conditions and progress toward achieving recovery targets.

Contaminants

The Challenge

For decades, humans have released toxic chemicals, nutrients, and pathogens into Puget Sound and its watersheds through a variety of activities. Concerns about the possible harmful effects of these contaminants led to the creation of Washington's Pollution Control Commission in 1945, almost 30 years before the federal Clean Water Act, as well as the Puget Sound Water Quality Authority in 1985. While these and other federal and state efforts have been important at addressing threats to water quality, many sources continue to release contaminants to the water, air, and lands of the Puget Sound basin.

Contaminants of concern for Puget Sound include excess nutrients, pathogens, sediments, and toxic chemicals. Human-caused releases of excess nutrients, pathogens, and sediments can harm aquatic life and the human uses of fresh and marine waters. A number of toxic chemicals used by humans (e.g., pesticides, industrial chemicals) are released to the Puget Sound environment where they harm or threaten harm to biota and humans. Among toxic chemicals, persistent, bioaccumulative, and toxic (PBT) chemicals raise special challenges because they remain in the environment for a long time and accumulate in people and in the food chain. They also can travel long distances and generally move easily between air, land and water. Prevention is especially important for PBT chemicals, since they can remain in the environment and continue to harm wildlife. One example is PCBs, which were banned more than 30 years ago, but remain in the environment and continue to harm wildlife and people. An effective way to reduce and control problems from all types of pollution is to prevent the initial release of contaminants to the environment.

In 2007, Washington became the first state in the country to ban specific polybrominated diphenyl ethers (PBDEs) because of human health and environmental concerns. More recently, Washington State enacted laws banning the use of bisphenol A (BPA) in children's bottles and other containers, banning the use of lead wheel weights to balance tires, and restricting the amount of copper in vehicle brake pads. Since 2012, manufacturers of children's products in Washington have been required to report to Ecology if their products contain chemicals on a list of chemicals of high concern to children, under the Children's Safe Products Act.

PUGET SOUND TOXICS ASSESSMENT

In 2011, Ecology, in coordination with the Partnership and other organizations, completed a multi-year study of toxic chemicals in Puget Sound. The 17 chemicals evaluated in this study were selected based on the threat or known harm to biota, the broad range of conveyance pathways, and the availability of monitoring data. These chemicals of concern include metals, PBT chemicals such as PCBs, and contaminants of emerging concern, including endocrine disrupting compounds. Of the 17 chemicals, only five have been restricted nation-wide under the federal Toxic Substances Control Act. Additional contaminants of emerging concern, such as those from pharmaceutical waste, personal care products, and plastic pollution, may also be important toxic threats to Puget Sound, although much less is known about the exposures and effects of those contaminants in Puget Sound.

The Puget Sound Toxics Assessment found the following.

- Levels of copper, mercury, PCBs, PBDEs, dioxins and furans, DDT and related compounds, and PAHs occur at levels in the Puget Sound basin associated with documented or potential adverse effects to a variety of aquatic organisms.
- Sources of toxics are varied and include vehicles, pesticides, industrial air emissions, combustion emissions, and leaching or off-gassing of toxics from products in the environment. Industrial, commercial, and institutional point sources do not account for the largest releases of toxic chemicals; a variety of diffuse sources account for the majority of toxic chemical releases.
- Runoff and leaching from roofing materials appears to be a large source of release of metals.
- Vehicle-related releases—from wear of vehicle components, combustion of fuel, and leaks of motor oil and fuel—contribute large amounts of a variety of contaminants (e.g., copper, zinc, PAHs, dioxins and furans).
- Toxic chemicals move into Puget Sound aquatic habitats through numerous pathways, including surface runoff, air deposition, discharges from industrial sources and wastewater treatment plants, groundwater discharges, combined sewer overflows, spills, contaminated sediments, exchange with oceanic waters, and biological transport.
- Surface runoff or stormwater is the primary way that many of the contaminants evaluated in this study enter Puget Sound. Runoff from commercial/industrial lands typically has the highest concentrations. Due to the large of forests in the Puget Sound basin, considerable loads of contaminants are delivered to aquatic environments in runoff from forest-covered lands.
- Atmospheric deposition of contaminants to surface waters is an important loading pathway for PBDEs and some PAHs.

The assessment concludes the following.

- Priorities for source control actions should focus on copper, PAHs, bis(ethylhexyl)phthalate, and petroleum.
- High priority should be given to implementing control strategies to prevent the initial release of contaminants.
- Source control strategies should focus on reducing or treating stormwater inputs, especially identifying and controlling contaminant releases from existing and new developments.
- Source control strategies should be developed around reducing contaminant inputs from vehicles.
- Field investigations should be conducted to improve information about runoff and leaching from roofing materials.

For more information see the following Ecology reports.

- *Assessment of Selected Toxic Chemicals in the Puget Sound Basin, 2007–2011* (Publication No. 11-03-055).
- *Primary Sources of Selected Toxic Chemicals and Quantities Released in the Puget Sound Basin* (Publication No. 11-03-024).

The strategies in this section are focused on source-reduction efforts to keep chemicals and other contaminants from being used or generated in the Puget Sound region or released to the Puget Sound environment. This includes reducing and restricting the use of toxic chemicals, controlling initial releases of contaminants to the Puget Sound environment, and improving how businesses and other entities use and manage chemicals and other contaminants. It also includes efforts to control specific pathways of delivery, such as wastewater and stormwater pollution, and to clean up areas where pollution has occurred. For instance, while strategy C1 includes approaches for reduced releases of contaminants to wastewater treatment plants, much of what we think of as wastewater controls is presented in strategies C5 and C6. Similarly, controlling sources contaminants to reduce the levels of pollution entrained in stormwater and surface runoff is addressed in strategy C1, while other aspects of management of urban stormwater and runoff from agricultural and forest lands are presented in strategies C2, C3, and C4.

CLIMATE CHANGE

Climate change impacts on precipitation timing including seasonal stream flow, more severe winter flooding, and more frequent and extreme storm events, will likely increase runoff from stormwater. Preventing, reducing, and controlling contaminants before they reach land and water is important part of preparing for this increase in runoff.

Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy (Washington State Department of Ecology 2012a) contains high-priority response strategies to reduce the vulnerability of coastal communities, habitat, and species, as well as, those to address stormwater (addressed by strategy C2).

Recovery Targets

The strategies and actions in this section will contribute most significantly to achieving the recovery targets listed below with their associated vital signs and indicators. They also will help achieve targets for freshwater quality.

Vital Sign	Indicator	Recovery Target(s)
Toxics in Fish	Levels of four types of toxic contaminants in fish: polychlorinated biphenyls, flame retardants, hydrocarbons, and endocrine-disrupting compounds	By 2020, contaminant levels in fish will be below health effects thresholds (i.e., levels considered harmful to fish health or harmful to the health of people who consume them).
Marine Sediment Quality	Sediment Chemistry Index	By 2020, all Puget Sound regions and bays achieve chemistry measures reflecting minimum exposure with Sediment Chemistry Index scores >93.3.
	Sediment Quality Standards	Have no sediment chemistry measurements exceeding the Sediment Quality Standards set for Washington State.
	Sediment Quality Triad Index	All Puget Sound regions and bays, as characterized by ambient monitoring, achieve the following: Sediment Triad Index scores reflect unimpacted conditions (i.e., SQTI values >81).
Shellfish Beds	Acres of harvestable shellfish beds	A net increase of 10,800 harvestable shellfish acres, including 7,000 acres where harvest had been prohibited between 2007 and 2020.
Swimming Beaches	Conditions of swimming beaches.	Have all monitored beaches in Puget Sound meet EPA standards for what is called enterococcus, a type of fecal bacteria.

Local Priorities

LIOs identified near-term actions that address contaminants. These local actions are presented in the *Strategies and Actions* section along with Soundwide actions under the sub-strategy shaded below. The local action numbering contains the area abbreviation shown in parentheses after each LIO name. See Section 4, *Local Recovery Actions*, for detailed information about local planning.

Local Integrating Organization	Sub-Strategy C1.1	C1.2	C1.3	C1.4	C1.5	C1.6
Hood Canal Coordinating Council (HC)						
Island (ISL)				■		
San Juan (SJI)						
Snohomish-Stillaguamish (SNST)						
South Central Caucus Group (SC)		■				
Alliance for a Healthy South Sound (SS)				■		
Strait ERN (STRT)						
West Central (WC)					■	
Whatcom (WH)						

Strategies and Actions

C1. Prevent, Reduce, and Control the Sources of Contaminants Entering Puget Sound

C1.1 Implement and strengthen authorities and programs to prevent toxic chemicals from entering the Puget Sound environment

Based on a priority of EPA Administrator Lisa Jackson, EPA announced plans to reauthorize the Toxic Substances Control Act to reform and strengthen the effectiveness of the nation's chemical management legislation. Ecology, environmental agencies from other states, and various non-governmental organizations are involved in the Toxic Substances Control Act–reform efforts. EPA is also implementing a phthalates action plan, which included issuing rulemakings under the Toxic Substances Control Act in 2012 to regulate eight phthalates. Ultimately, keeping toxic substances out of our waters will require more effective federal legislation. Until this act and other federal statutes are updated, states need to continue to address chemicals of concern.

Ecology has a Reducing Toxic Threats initiative that aims to prevent the use of toxic chemicals, assist businesses to reduce or manage the amount of toxic chemicals that enter the environment, and clean up toxics that have polluted the air, land, or water. Key focus areas include reducing the use of toxics in products and preventing toxics from entering stormwater. In its efforts to reduce and help phase out PBT chemicals, Ecology develops chemical action plans (CAPs), which identify, characterize, and evaluate all uses and releases of a specific toxic chemical, and then recommend actions to protect human health and the environment. Past CAPs have addressed lead, mercury, and PBDEs. Ecology began focusing specifically on PAHs in 2010 as part of the Puget Sound Toxic Loading Study and completed the *PAH Chemical Action Plan* in December 2012 (Washington State Department of Ecology 2012b). Results from the Puget Sound loading analysis identify wood smoke, creosote-treated lumber, and vehicle emissions as the largest sources of PAHs in Puget Sound.

These federal and state toxics control programs are complemented by an array of toxics reduction initiatives of local hazardous waste programs and environmental organizations such as the Washington

Toxics Coalition, Washington Environmental Council, and Futurewise. These efforts are further discussed in the technical assistance and education sub-strategy below (C1.4). To be fully effective, federal, state, and local entities in the U.S. will also need to collaborate with Environment Canada to address transboundary sources of toxic contaminants in Puget Sound. This sub-strategy helps reduce the release of toxic chemicals to the Puget Sound environment by continuing and enhancing programs that prevent the release of chemicals. Based on the priorities of Ecology's Reducing Toxic Threats Initiative and the findings of the Puget Sound Toxics Assessment, the near-term actions that support this sub-strategy focus on preventing pollution that enters Puget Sound from a few key sources: vehicles, pesticides, and toxic pollutants in air emissions (also discussed in sub-strategy C1.3). Actions to address pesticide use are covered here and under the agricultural runoff strategy (C3). Ecology and its partners are specifically focusing in the near-term on addressing chemicals of concern in Puget Sound as evaluated in the Puget Sound toxics assessment. However, it will also be important to better understand and characterize any potential threats to Puget Sound from contaminants of emerging concern, such as pharmaceuticals, personal care products, and micro-plastics, and then develop appropriate toxic-reduction strategies to address the most important problems.

OCEAN ACIDIFICATION

As identified in *Ocean Acidification: From Knowledge to Action, Washington State's Strategic Response* (Washington State Blue Ribbon Panel on Ocean Acidification 2012), local emissions of carbon dioxide, nitrous oxides, and sulfur oxides may also be enhancing acidification in local waters, especially in urbanized areas around Puget Sound. For example, nitrogen oxides and sulfur oxides may contribute to local acidification downwind from their primary sources. Contributors of these gases include motor vehicles, ships, and electric utilities.

One of the Blue Ribbon Panel's recommendations includes taking action to reduce global, national, and local emissions of carbon dioxide by implementing additional actions recommended by the Climate Action Team, where such actions would reduce acidification of Washington's marine waters. The Action Agenda strategies for preventing, reducing, and controlling the sources of contaminants entering Puget Sound help to implement the Blue Ribbon Panel's recommendations by implementing policy actions recommended for reducing local emission of carbon dioxide, nitrogen oxides and sulfur oxides.

Ongoing Programs

Over the next few years, Ecology's Reducing Toxics Threats Initiative plans to support congressional reform of Toxic Substances Control Act[1], implement the Better Brakes Law (Chapter 173-901 WAC) adopted October 19, 2012, implement the CAP for PAHs, establish a mercury lamp product stewardship program, and complete a CAP for PFOS (perfluorooctane sulfonate, a PBT chemical). Key performance metrics in evaluating the success of toxics efforts include the number and volume of chemicals of high concern to children replaced with safer alternatives and reduced environmental levels of toxics in fish, the primary exposure route to humans through consumption. Statewide, Ecology also has an overall target of reducing the amount of hazardous materials used by 2% per year. Ecology has been awarded a Toxics and Nutrient Grant from EPA's National Estuary Program, which provides funding for toxics reduction efforts in Puget Sound. This grant can be used to help implement near-term actions identified in the Action Agenda to reduce toxic threats.

[1] www.ecy.wa.gov/programs/hwtr/betterbrakes.html

Key Ongoing Program Activities

- Ecology continues to implement the state law relating to limiting copper used in vehicle brake friction material (Chapter 173-901 WAC) and will track the pounds/year of copper reduced. Brake pads and shoes manufactured after January 1, 2015, must not contain asbestos, lead, cadmium, mercury, or chrome (VI). Brakes manufactured after this date must also be marked to indicate the amount of copper they contain.
- Ecology convened an Advisory Committee to develop a CAP for PCBs, which is planned for completion in 2014. After the completion of the PCB CAP, Ecology will review the PBT list and prioritize the next PBTs for CAPs with a multi-year schedule. Ecology will also determine if it is necessary to revise the PBT Rule to update the list of PBTs. Rulemaking would be required if revisions are needed.

Near-Term Actions

The near-term actions[2] identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

In addition, actions related to removal of creosote pilings and derelict vessels are described in strategy B3.

C.1.1.1 **Polycyclic aromatic hydrocarbons and perfluorooctane sulfonate chemical action plans.** Ecology, working with its partners, will complete a polycyclic aromatic hydrocarbons chemical action plan and a chemical action plan for perfluorooctane sulfonate or all perfluorinated compounds, and begin to implement the recommendations from the Plans. (Wood smoke actions in the polycyclic aromatic hydrocarbons chemical action plan will build from the control strategies outlined in the Tacoma State Implementation Plan for fine particulates. The polycyclic aromatic hydrocarbons chemical action plan may also include recommendations to reduce polycyclic aromatic hydrocarbons from incomplete combustion and/or other sources. The perfluorooctane sulfonate/ perfluorinated compounds chemical action plan will include an evaluation of safer alternatives and recommendations for reducing use of perfluorooctane sulfonate and/or perfluorinated compounds.)

C.1.1.2 **Mercury lamp product stewardship.** Ecology will establish a mercury lamp product stewardship program.

C.1.1.3 **Fish consumption rates.** The Ecology will finalize a technical report on fish consumption rates. Ecology will initiate rulemaking to develop Human Health Criteria for Washington and advance a related rule that will provide options for permit holders to comply with water quality standards. In one other related action, Ecology will complete changes to the Sediment Management Standards rule to include methods and policies for establishing sediment cleanup standards based on human health protection.

[2] Gaps in numbering reflect near-term actions that have been completed or otherwise retired.

C.1.1.6 **Emerging contaminants.** Ecology and PSP will assemble information on chemicals of emerging concern, beyond the 17 chemicals of concern in the Puget Sound Toxics Loading Studies, including PBTs, endocrine disruptors, other chemicals, and nanotechnology and nanomaterials, and will recommend actions to (1) better understand the threats to Puget Sound and (2) address the highest priority problems.

C1.2 Promote the development and use of safer alternatives to toxic chemicals

Governmental and non-governmental green chemistry and green design initiatives such as EPA's Design for Environment Program help evaluate and promote products and process alternatives that are cost effective and safer for the environment. Green chemistry refers to the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances. Green design or Design for Environment refers to an approach for designing products or processes that minimizes negative environmental impacts throughout the life cycle of the product; often this includes replacing toxic material inputs with less toxic or non-toxic alternatives. This sub-strategy complements the sub-strategies focused on reducing the use of toxic chemicals through regulations, enforcement, technical assistance, and education by ensuring that safer alternatives to problem chemicals, formulations, and/or products are available for businesses and consumers to use.

Ongoing Programs

Activities to support the development and use of safer alternatives to toxic chemicals include developing new alternatives through green chemistry approaches, conducting assessments of alternatives, and providing guidance and training to assist organizations with their efforts to find safer alternatives. Ecology's Reducing Toxic Threats Initiative has identified several priority activities related to spurring the development of safer alternatives to toxics for 2011–2013 and beyond, including the following.

- **Strategy development.** Create a green chemistry roundtable "roadmap" for the state and implement recommendations, including establishing a green chemistry center.
- **Guidance development.** Work with certain member states of the Interstate Chemicals Clearinghouse (IC2) to develop a chemical alternative assessment guidance document. Ecology also plans to develop a case study portfolio.
- **Alternatives assessment.** Perform an assessment of five chemicals to identify safer alternatives (if grant funding is received).
- **Education and training.** Train businesses on GreenScreen™ Version 1.2 (a tool to help businesses to evaluate the toxicity of various chemicals), train staff on a Quick Chemical Assessment Tool (a tool based upon the GreenScreen™ to evaluate alternatives to toxic chemicals), and conduct a green chemistry workshop for high school teachers.

Overall, by reducing toxic chemicals in products and promoting safer alternatives, Ecology aims to achieve the following statewide, quantitative performance target.

- Reduce the annual pounds of hazardous materials used by 2% per year.

As part of its Phthalates Action Plan, EPA is conducting a Design for Environment and Green Chemistry alternatives assessment to assist with phthalate rulemakings under the Toxic Substances Control Act and

the identification of safer alternatives. EPA's alternative assessment will present data on the hazards associated with the eight phthalates found in Ecology's list of chemicals of high concern to children.

Key Ongoing Program Activities

- The EPA Design for Environment Program has convened Alternatives to Certain Phthalates Partnership to assess alternatives to commercial uses of phthalates as part of its Phthalates Action Plan. Ecology will interpret the data provided in EPA's phthalate alternative assessment, as well as other sources, and recommend alternative(s) to phthalates in specific applications. Ecology will also incorporate the information on safer alternatives into its guidance materials and technical assistance efforts and recommend and take actions to reduce phthalates entering Puget Sound. Future efforts will incorporate the recommendations of the Sediment Phthalate Workgroup, which provided recommendations on sediment recontaminated by phthalates in stormwater.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.1.2.1 **Chemical alternatives assessments.** Ecology will work with the Interstate Chemicals Clearinghouse (IC2) to develop a guidance document on chemical alternatives assessment and, depending on funding availability, will complete assessments of five chemicals to identify safer alternatives.

C.1.2.2 **Toxics in roofing materials.** Ecology will establish a task force that will oversee a study evaluating toxic materials (including toxic metals and, possibly, phthalates) in roofing materials and recommend strategies for promoting less-toxic alternatives or ways to use materials that minimize releases of toxic materials to receiving waters. To support the task force's work, Ecology will solicit information from manufacturers on the presence of toxic chemicals in roofing materials. Using any data from manufacturers or previously published studies, Ecology will create and implement a sampling strategy to assess the release of contaminants from different roofing materials. The task force will use this information to develop its recommendations.

C.1.2 SC11 **Keep toxics and excess nutrients out of the waste stream.**

- Identify and implement strategies to keep toxics and excess nutrients out of the waste stream through product stewardship and source control.
- Support state and local programs for safe reduction, recycling, or disposal of hazardous wastes from households, small businesses, and agriculture.
- Support programs and projects that implement, teach, or otherwise encourage BMPs that remove toxic pollutants from the environment (source control; alternative products; hazardous waste technical assistance).
- Inventory toxics reduction efforts and programs and additional chemicals of concern that need to be reduced.

- Through the NW Product Stewardship Council, coordinate efforts for product-focused strategies to reduce the use of toxic chemicals.
- Coordinate with and support new product stewardship initiatives.
- Support and promote the implementation of the Washington Toxics Reduction Strategy Workgroup Recommendations of January 16, 2013.
- Support efforts to increase funding.
- Implement and strengthen authorities and programs to prevent toxic chemicals from entering the Puget Sound environment.

C1.3 Adopt and implement plans and control strategies to reduce pollutant releases into Puget Sound from air emissions

One of the ways that toxic chemicals enter Puget Sound is through air emissions. Sources include vehicle emissions, air emissions from business and industry, and combustion emissions from wood stoves and fire places, among others. There are numerous woodstoves contributing to emissions; for example, in Pierce County, there are more than 25,000 uncertified stoves in the air quality non-attainment area alone. Statewide, Ecology has completed close to 9,000 retrofits on school buses and publicly owned fleets to reduce diesel emissions, resulting in large gains for public health; however, private fleets and vehicles are still large contributors to regional air quality issues. Private heavy duty trucks, locomotives, ships, and construction equipment all contribute large quantities of soot, PAHs, oils, and other toxics to the environment, and much of that ends up washing downstream into Puget Sound. This sub-strategy focuses on adopting air quality plans and requirements to reduce toxic air emissions, such as through state implementation plans to meet stricter National Ambient Air Quality Standards (NAAQS), and implementing the plans to achieve the reductions needed to meet the air quality goals. Over the longer term, there is also a need to improve air quality laws, regulations, and guidance to protect public health and the environment from air toxics.

Ongoing Programs

Air quality requirements will be tightening over the next several years, as EPA adopts new air quality standards for fine particulates and ozone, and as the boundaries of non-attainment areas in Puget Sound and elsewhere are subsequently redrawn. EPA adopted revised air quality standards for nitrogen dioxide (NO_2) and sulfur dioxide (SO_2) in 2010 and fine particulates (PM 2.5) in 2012. The ozone standard will likely be revised next. After adopting standards, EPA designates non-attainment areas, which are geographic areas that do not meet the standards, and then states need to prepare revised state implementation plans that outline emissions reductions and control strategies needed to meet the standards.

With the changes in air quality standards over the next several years, the number of nonattainment areas in Washington is expected to increase from one to four or more. The Tacoma/Pierce County State state implementation plan for fine particulates was completed in 2012, and the necessary regulations adopted in 2013. Maintenance state implementation plan revisions are underway for PM10 for Tacoma Tideflats, Kent Valley and Seattle-Duwamish areas and a PM10 maintenance state implementation plan revision was approved for Thurston County in 2013. Additional monitoring for NO_2 and SO_2 began in

2012, driven by the revised standards. Ecology is also continuing its efforts to reduce diesel emissions. Ecology is operating a grant program[3] to help local organizations (e.g., public utilities, tribes, private companies, etc.) to implement various clean diesel technologies

An important aspect of air quality management in the region is inter-jurisdictional coordination, as sources of air pollutant emissions come from both within and outside the Puget Sound basin. For example, the NW AIRQUEST Consortium (Northwest International Air Quality Environmental Science and Technology Consortium), which encompasses Washington, Oregon, Idaho, Montana, Alaska, British Columbia, and Alberta, seeks to develop, maintain, and enhance a sound scientific basis for air quality management decision-making in the Pacific Western Region of North America. The state implementation plans that Ecology develops for specific non-attainment areas within Puget Sound consider the effects of transboundary air pollution and information from regional data centers such as NW AIRQUEST.

Key Ongoing Program Activities

- Ecology will continue implementation of anti-idling education programs and write a statewide anti-idling regulation, to reduce petroleum emissions to the air. The regulations would be designed to reduce diesel soot, PAHs, and greenhouse gases from petroleum-powered engines and equipment.

Near-Term Actions

None; work in the near-term will focus on implementation of ongoing programs.

C1.4 Provide education and technical assistance to prevent and reduce releases of pollution

This sub-strategy involves developing toxic chemical control and nutrient reduction strategies to encourage homeowners, businesses, and others to adopt behaviors that reduce their contribution to pollution. Numerous government and non-governmental organizations around Puget Sound have education and technical assistance programs; these include local stormwater, wastewater, and solid waste utilities; educational organizations such as Washington Sea Grant, Washington State University extension, and other colleges, universities, and schools; and non-profit and community-based organizations. Examples of programs that are particularly relevant to toxics reduction include the following.

- **Local source control program** is a partnership among Ecology and 25 local government jurisdictions that focus business technical assistance to prevent stormwater pollution and improve hazardous waste management practices. Local source control specialists help small businesses stop pollution that could harm Puget Sound.
- **EnviroStars** is a program that originated in 1995 in which local governments in six Puget Sound counties provide assistance and incentives for small businesses to reduce hazardous materials and waste, in order to protect public health, municipal systems, and the environment.
- **Washington Environmental Council and Futurewise** work through education and action to protect and restore the land and waters of the Puget Sound basin. These organizations are carrying on the

[3] See Washington State Clean Diesel Grant Program at: www.ecy.wa.gov/programs/air/cars/DieselGrantPage.htm

work of the former People for Puget Sound, which developed a series of fact sheets and communication resources on toxics threatening Puget Sound.

- **Puget Sound Partnership Stewardship Program** is the Partnership's education and outreach effort to help people understand the threats to the Puget Sound ecosystem and what actions they can take to reduce toxic contaminants, nutrients, and other pollution into Puget Sound.
- **STORM** (Stormwater Outreach for Regional Municipalities) is a coalition of more than 60 municipal stormwater permitees in the Puget Sound region. These counties and cities work collaboratively to deliver relevant, vetted, coordinated stormwater messages and social marketing to the region's 4.5 million residents. STORM is a principal partner in the Puget Sound Starts Here campaign.
- **Puget Sound Starts Here** is a partnership of local governments, the Partnership, Ecology, and local organizations that are part of the Partnership's Education, Communication and Outreach Network (ECO Net). This program leverages the combined investments of all these organizations, and provides consistent public awareness and education messages across the twelve county Puget Sound region. Using state of the art communications techniques, it provides a regional communications umbrella to support and enhance the effectiveness of local stormwater program delivery.
- **Take Back Your Meds** is a group of organizations that support a statewide program for safe return and disposal of unused medicines to reduce access to addictive drugs, prevent poisonings, and reduce environmental contamination; it has a series of locations such as pharmacies where medicines can be dropped off.
- **Washington Toxics Coalition** advocates for policy changes to reduce toxic pollution, promotes safer alternatives to toxics, and educates people to create a healthy environment. Informational resources include strategies for reducing toxics at people's homes and gardens, in food, and in products children use.

These and other programs have had success in reducing the use and releases of toxic chemicals to our environment; however, funding constraints have limited the extent of implementation and, therefore, the results that have been achieved. Several existing EPA grants for Puget Sound-specific funding can be used for education and technical assistance; these include grants for work on toxics and nutrients, watersheds, and public engagement and stewardship, with Ecology and the Partnership serving as lead organizations.

Ongoing Programs

Ecology's Reducing Toxic Threats Initiative has several performance objectives and priority activities that relate to education and technical assistance for the 2013–2015 biennium. Education-related objectives include developing a "Washington Green Chemistry road map" to institute safer approaches to product design, initiating a task force to identify safer roofing alternatives and expanding the Partnership's STORM social marketing effort for Soundwide education and outreach (Washington State Department of Ecology 2012c). Statewide performance objectives and activities related to technical assistance include the following.

- Document 150,000 pounds in lead, mercury, and cadmium reductions from businesses reporting via the Toxics Release Inventory (TRI).

- Reduce annual pounds of hazardous waste generated overall by 4% annually, with a long-term goal of 80% statewide reduction from 1990 levels by 2020.
- Through the Local Source Control Partnership, fund local government agencies to conduct 600 small business technical assistance visits per quarter to explain hazardous waste requirements to small businesses and prevent sources of polluted runoff to Puget Sound and the Spokane River. (Ecology currently has funding from EPA to support local source control inspections in the Puget Sound region.) Ecology prepares a biennial progress report on the Local Source Control Program describing program activities and results.
- Ecology staff will conduct 520 compliance-related technical assistance visits during 2013–15 to help businesses determine how to manage their hazardous wastes and reduce toxics use.
- Develop policy guidance on safe hazardous waste management and toxics use reduction for hospitals, used paint recycling, and auto shred residue.
- Create web-based dangerous waste workshop module for business technical assistance.
- Receive and review 100% (approximately 450) of pollution prevention plans received annually from businesses and facilities.
- Visit or assist 100% of pollution prevention planner facilities using or producing waste containing lead, mercury, or cadmium (about 25 toxic metal visits per quarter).
- Conduct two to four detailed technical assistance projects annually and 20 energy assessments.

In addition to these toxics and hazardous-waste focused programs, state, tribal, and local agencies and non-governmental organizations across Puget Sound also have education and assistance programs that focus specifically on preventing and reducing water pollution problems, including the following two ongoing program activities. Additional programs are discussed in other strategies in Section 3C.

Key Ongoing Program Activities

- EPA and Ecology will continue to support and expand the Local Source Control Partnership in Puget Sound in which local jurisdictions provide education and technical assistance to small businesses to prevent pollution and reduce sources of polluted runoff.
- Ecology will continue to support site visits and other technical assistance for pollution prevention planner facilities in the state that use or produce waste containing lead, mercury, or cadmium to help them to reduce their hazardous wastes.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.1.4 ISL9 **Stormwater technical assistance and incentive programs implementation**. Island County will implement a stormwater retrofit program to target private properties. The program will include designing and conducting workshops for landowners and providing incentives for compliance (incentives may include cost sharing for rain gardens, no-cost engineering).

C.1.4 SS7 **Prevention of pollution and/or recovery of shellfish beds through education, outreach, and advocacy.** Customize outreach efforts aimed at each watershed-inlet for citizen involvement and improved effectiveness to achieve behavioral change through ECO Net.

C.1.4 SS17 **Habitat and shellfish recovery through education and outreach.** 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 packet to engage, connect, and educate new shoreline homeowners about local issues and resources available to them.

C1.5 Control wastewater and other sources of pollution such as oil and toxics from boats and vessels

Establishment of a No Discharge Zone along with sufficient and convenient pump out capacity and an effective outreach and education program will reduce pollution from vessels. The availability of sewage pump-out stations, the importance of the water body for human health and recreation, and the desire for more stringent protection of a particular aquatic ecosystem are important considerations in the designation of No Discharge Zones for vessel sewage. Discharge of untreated or partially treated human wastes from vessels sends toxic chemicals as well as pathogens, such as fecal coliform and viruses, into the water and increases human health risks. Excessive amounts of nutrients from vessel sewage exacerbate the known nutrient and low dissolved oxygen problems in Puget Sound.

In addition to wastewater management, boats and vessels have the potential, because they are operated in the marine environment, to be a source of other pollutants to Puget Sound. These include oils, greases, paints, soaps and trash. Programs like the Clean Marina program, a collaboration between Puget Soundkeeper Alliance, Northwest Marine Trade Association, EnviroStars Cooperative, Washington Sea Grant, Ecology, DNR, and the State Parks and Recreation Commission work with marinas to help boat owners reduce and eliminate all sources of pollution to Puget Sound.

Ongoing Programs

Using National Estuary Program grant funds, Ecology and DOH coordinate with State Parks' Clean Vessel Program to inventory and improve existing pump-out facilities, gauge stakeholder support, and determine the geographic scope of a No Discharge Zone. This work culminated in a draft petition to EPA for the designation of a No Discharge Zone in February 2014, with a final petition by the end of 2016. Expected performance measures include those listed below.

- Improved pump-out capacity.
- Successful designation of No Discharge Zones in Puget Sound.
- Reduction in vessel sewage discharged into Puget Sound.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.1.5.1 **No Discharge Zone evaluation and petition.** Ecology, in collaboration with State Parks and EPA, will administer grants to fund the development of a petition to EPA to establish a No Discharge Zone to prohibit recreational and commercial vessels from discharging sewage in all or parts of Puget Sound.

C.1.5.2 **Pump-out station improvements.** Ecology and DOH, with National Estuary Program grant funding, will coordinate with Washington State Parks' Clean Vessel Program to assist in construction, repair and monitoring of pump-out stations to meet requirements of the NDZ petition.

C.1.5 WC10 **West Sound pump out stations.** Kitsap Public Health District will identify pump out stations and develop needs assessment to address marine vessel sewage.

C1.6 Increase compliance with and enforcement of environmental laws, regulations, and permits

Local, state, and federal programs periodically inspect regulated facilities in Puget Sound to ensure compliance with applicable laws and regulations. These include air emissions control requirements under the Clean Air Act and the relevant state implementation plan (as discussed in sub-strategy C1.3 above), industrial wastewater pretreatment requirements under the Clean Water Act (discussed in sub-strategy C6.1), and hazardous materials and waste management requirements, such as the federal Resource Conservation and Recovery Act and the state Dangerous Waste and Pollution Prevention Plan regulations. This sub-strategy helps ensure compliance with environmental laws governing hazardous materials and waste through targeted enforcement of those laws. Many of the agencies that conduct compliance inspections, as well as some not-for-profit organizations, also have technical assistance programs that provide education, training, and assistance to businesses seeking to prevent pollution and emissions and improve facility operations (technical assistance efforts are discussed in sub-strategy C1.4).

Ongoing Programs

Ecology has Puget Sound-specific funding from EPA for work in this area, under the Toxics and Nutrients grant award. Additional funding could allow Ecology staff to conduct more compliance inspections and follow-up activities to prevent and reduce toxic releases. In its *Federal Fiscal Year 2013 Work Plan and Multi-Year Implementation Strategy* (2013), Ecology has proposed the following actions for its hazardous waste compliance program.

- Assist small businesses prevent polluted runoff from entering Puget Sound by performing source control visits and providing source control technical assistance.
- Provide safer solvent alternatives and spray efficiency technical assistance to at least 30 auto body and repair shops to encourage them to switch to non-solvent cleaning systems. Provide shops with a free 3-month trial of safer brake cleaning products or paint gun washing systems, a before and after air monitoring study and technical support;
- Provide secondary containment information and spill kit equipment to businesses that develop a voluntary spill prevention plan

- Conduct dangerous waste compliance and pollution prevention workshops to improved regulatory compliance.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.1.6.1 **Hazardous waste, wastewater, and air quality compliance and enforcement.** Increase Ecology's hazardous waste, and wastewater compliance inspection and enforcement programs in the Puget Sound.

C.1.6.2 **Compliance for use of toxics in products.** Ecology will conduct compliance activities for state laws banning the use of toxic materials (e.g., PBDEs) in products, including taking appropriate enforcement actions against noncompliant products.

C.1.6.3 **Water quality enforcement.** Ecology, working with DOH, will increase the capacity for enforcement, and enforce all regulations pertaining to pathogens and contaminants that pollute waters of the state to ensure achievement of approved shellfish growing water certification.

Emerging Issues and Future Opportunities

Specific longer-term activities to control sources of toxics that were identified during the Action Agenda update process include the following.

- If justified by findings from Puget Sound basin studies of pesticides, WSDA will work with Ecology and other partners to tailor pesticide management in the Puget Sound basin. A WSDA decision to adapt the management of pesticides in the Puget Sound basin will consider information about pesticide use (e.g., uses of copper containing pesticides, homeowner use of pesticides), refined estimates of pesticide contributions to toxic chemical loading, and surface water monitoring of pesticides.
- Ecology will continue to work with EPA and other partners to evaluate, recommend, and institute additional requirements to address threats posed by air toxics.
- Options should be evaluated for expanding the phase-out of copper bottom paint to include ships over 65 feet in length and/or commercial vessels of various sizes. A work group could be formed to develop recommendations related to an expanded phase-out.

Other ways that this strategy to reduce the sources of toxic chemicals entering Puget Sound could be advanced include the following items.

- Conducting scientific investigations of topics such as chemical causes of endocrine disruption (apparent as reproductive impairment) in Puget Sound fish, studies of the amount, fate, and transport of petroleum releases from drips and leaks, and gathering source data for PBT chemicals that were not included in the Puget Sound Toxics Loading Study.
- Exploring the possibility of additional authorities and/or voluntary agreements to have the private sector accept responsibility for product stewardship (e.g., targeting products that contain chemicals

of concern). (Ecology already plans to develop a product stewardship program for lamps containing mercury.)

- Initiating a broad-based effort to investigate additional ways to reduce the release of toxic contaminants from vehicles and roadways (i.e., are there alternative means of ensuring the mobility of people and goods that would decrease the loads of toxic chemicals released to the environment?).
- Developing a chemical action plan or similar assessment and plan for reducing the use and releases of halogenated flame retardants. (This would be completed after a CAP on PFCs, depending on funding availability.)
- Addressing the use and application of sewage sludge.

Built Environment Runoff

The Challenge

Urban stormwater runoff poses a high risk to the health of Puget Sound by causing two major problems.

First, the runoff transports a mixture of pollutants such as petroleum products, heavy metals, bacteria, nutrients, and sediments from construction sites, roads, highways, parking lots, lawns, and other developed lands with the following consequences.

- Urban stormwater is the leading contributor to water quality pollution in urban creeks, streams and rivers in the state.
- Urban stormwater is a significant contributor of toxics to marine sediment, including contaminated sites undergoing cleanup.
- Three species of salmon (Chinook, Summer Chum, and Steelhead) and bull trout are listed as threatened species under the federal Endangered Species Act. Loss of habitat due to stormwater and development is one of the causes.
- Shellfish harvest at many beaches is restricted or prohibited due to pollution. Stormwater runoff is often one of the causes.
- Stormwater causes the death of high percentages of healthy coho salmon in Seattle creeks within hours of the fish entering the creeks before the fish are able to spawn.
- English sole are more likely to develop cancerous lesions on their livers in more urban areas. Stormwater pollutants likely play a role.
- Although more research is needed, there are some indications that urban stormwater runoff may contribute to the decline of eelgrass populations.

Second, during the wet winter months, high stormwater flows, especially long-lasting high flows, can do the following.

- Cause flooding.
- Damage property.
- Harm and render unusable fish and wildlife habitat by eroding stream banks, scouring stream beds and widening stream channels, depositing excessive sediment, and altering natural streams and wetlands.

In addition, more impervious surface area means fewer opportunities for water to soak into the ground. As a result, groundwater drinking water supplies may not replenished and streams and wetlands may not be recharged. This can lead to water shortages for people and inadequate stream flows and wetland water levels for fish and other wildlife.

SALMON RECOVERY PLAN PRIORITY: MANAGING AND REDUCING STORMWATER

Improvement in water quality is identified in the Salmon Recovery Plan with a call to resolve uncertainty about whether the regional water quality actions address the needs of salmon. Volume I identifies general concerns related to stormwater runoff. Watershed chapters for WRIA 8 and WRIA 9 have strategies/actions related to stormwater and water quality. One item that is of particular interest in WRIA 8 and 9 but also in other watersheds is the issue of pre-spawn mortality of different species of salmon.

How are these priorities integrated? The Action Agenda contains more detailed strategies and actions to address stormwater runoff in the built environment than the Salmon Recovery Plan. While the Action Agenda addresses the general concerns in the Recovery Plan, the resolution about the effectiveness of actions still needs to be addressed.

A significant amount of the work completed for the 2012/2013 Action Agenda was informed by the draft *Stormwater Vision and Financing Strategy for Puget Sound* (Bissonnette 2011)*, Task 1: Urban Stormwater Runoff Preliminary Needs Assessment Technical Memorandum* (Bissonnette and Parametrix 2010), and work by a subcommittee of the Ecosystem Coordination Board (ECB) focused on stormwater funding. An interagency team of stormwater professionals used these foundation documents to suggest the draft sub-strategies and near-term actions contained in this section. The purpose of the Stormwater Vision is to suggest comprehensive actions and financing strategies that will reduce polluted surface runoff from urban and rural landscapes to Puget Sound.

The Stormwater Needs Assessment highlights the needs for regional local governments to fully implement the municipal NPDES stormwater permit programs and estimated costs to carry out stormwater retrofits (described below in sub-strategy C2.3 on existing development). Puget Sound municipal permit holders invested between $160 and 170 million in 2009 to implement the municipal permits. This figure represents a significant portion of the total they spent on stormwater management. While state and federal assistance via grants and loans are substantial—in FY 2011 Ecology disbursed $23.5 million for permit assistance and an additional $23.4 million for Low Impact Development and retrofit projects—the state and federal portion of total costs pales in comparison to what local governments spent.

The ECB Stormwater Funding Subcommittee's report (Puget Sound Partnership 2011b) details recommendations that include the need for greater overall investment in stormwater management in the region and the need for more financial assistance to local governments, who currently shoulder the majority of costs. Current investments in addressing problems caused by existing development through structural retrofits are not nearly sufficient—the cost to retrofit existing development for treatment alone is estimated to cost, at a minimum, $3 to 16 billion (Bissonnette and Parametrix 2010). Local stormwater utilities in many cases will need to be increased, and local governments need support to successfully raise local stormwater rates. Concurrently, the level of investment by the state and federal government must be increased significantly to help share the burden of costs so that we can adequately address the scope of stormwater problems and meet related recovery targets.

In addition to strategy C2 and related sub-strategies and actions, the strategies to reduce land development pressures (A1, A2, A3, A4, A5, and B1 and B2) plus the toxics control strategy (C1) are essential to addressing stormwater.

CLIMATE CHANGE

Declining snow pack and loss of natural water storage, changes in precipitation timing including seasonal stream flow and more severe winter flooding, and more frequent and extreme storm events will likely strain our stormwater systems and increase the amount of polluted runoff flowing to Puget Sound. Potential impacts include the following.

- Winter flooding could strain the capacity of urban drainage infrastructure and result in more frequent combined sewer overflows.
- The intrusion of seawater due to increased melting of polar ice caps coupled with higher storm surges could damage equipment and strain the capacity of wastewater and stormwater systems.
- Backflow of water through stormwater pipes could cause localized flooding in low-lying areas. Drainage of low-lying areas will become more difficult and stormwater management may require installation of tide gates, control works, or pump systems.

To reduce the risk of damage to buildings, transportation systems, and other infrastructure is a high-priority overarching response strategy identified in *Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy* (Washington State Department of Ecology 2012a), which directly relates to stormwater. This means identifying vulnerable areas and taking proactive steps to reduce risks to infrastructure and avoiding risks when siting new infrastructure, supporting local efforts to prepare for coastal flooding and storm surges and considering climate change impacts when new developments and infrastructure are sited.

Specific strategies related to stormwater include those listed below.

- **Managing water resources in a changing climate by implementing integrated water resources management approaches in highly vulnerable basins**. This includes developing guidance for whether and how to incorporate project climate information and adaptation actions into planning, policies and investment decisions. This will ensure that investments made now are not increasing future vulnerability and causing unintended consequences.
- **Building the capacity** of state, tribal and local governments, watershed/regional groups, water managers, and communities to identify and assess risks and vulnerabilities to climate change impacts on water. This includes making sure utilities have tools and modeling to integrate climate impact information into stormwater planning and design.
- **Enhance the preparedness of transportation, energy, and emergency service provides to respond to more frequent and intense weather-related emergencies**. This includes early warning and adjustment of routine maintenance and inspection to prepare for more frequent and intense storms and floods.

The stormwater strategies and actions in the Action Agenda will need to be adapted over time to address climate change effects. This includes infrastructure siting and design, as well as prioritization criteria.

Recovery Targets

The strategies and actions in this section will contribute most significantly to achieving the freshwater quality recovery target for the Benthic Index of Biotic Integrity indicator listed below.

Vital Sign	Indicator	Recovery Target(s)
Freshwater Quality	Benthic Index of Biotic Integrity	Protect small streams that are currently ranked *excellent* by the Benthic Index of Biotic Integrity for biological condition, and improve and restore streams ranked *fair* so their average scores become *good*.

Runoff from the built environment directly affects the structure, habitat, and fish and wildlife in small, wading-depth lowland streams of Puget Sound. Insects found in these small streams serve as strong indicators for the relative biological health of Puget Sound freshwater stream systems. If communities of native insects in these streams are plentiful and diverse, other biological components, including salmonids, should be healthy as well.

The Puget Sound Stream Benthos, a website developed by officials from the City of Seattle, King County, Pierce County, Snohomish County, and others provides a database that allows sharing of benthic macroinvertebrate data among organizations and provides tools for calculating metrics and indices. The database fulfills the goal of storing macroinvertebrate data in a manner that allows for reliable comparisons across sites and programs over time.

These strategies and actions will also contribute to achieving targets for land development and cover, freshwater quality, shellfish beds, toxics in fish, and marine sediment quality. Finally, although more research is needed, there are some indications that urban stormwater runoff may contribute to the decline of eelgrass populations.

Local Priorities

LIOs identified near-term actions that address built environment runoff. These local actions are presented in the *Strategies and Actions* section along with Soundwide actions under the sub-strategy shaded below. The local action numbering contains the area abbreviation shown in parentheses after each LIO name. See Section 4, *Local Recovery Actions*, for detailed information about local planning.

	Sub-Strategy				
Local Integrating Organization	**C2.1**	**C2.2**	**C2.3**	**C2.4**	**C2.5**
Hood Canal Coordinating Council (HC)			■		
Island (ISL)	■		■		
San Juan (SJI)		■			■
Snohomish-Stillaguamish (SNST)	■	■	■		
South Central Caucus Group (SC)		■	■		■
Alliance for a Healthy South Sound (SS)	■				■
Strait ERN (STRT)		■	■	■	■
West Central (WC)			■		■
Whatcom (WH)	■		■		

Strategies and Actions

C2. Use a Comprehensive Approach to Manage Urban Stormwater Runoff at the Site and Landscape Scales

C2.1 Manage urban runoff at the basin and watershed scale

Urban runoff cannot be fully managed at the site and parcel levels alone—it is also necessary to manage runoff at the broader basin and watershed scales. Numerous regional and national studies show that as native vegetation and soils are replaced by rooftops, roads, and other hard surfaces, numerous environmental indicators decline. Local land use decisions (i.e., location, type, and intensity of development) directly affect urban runoff quantity and quality within watersheds. This sub-strategy addresses the need to protect native vegetation, soils, and high quality habitat; site new development appropriately; and better connect land use and stormwater management.

In addition to the sub-strategies listed in this section, the region must have a robust, effective program to regularly monitor and assess the effects of stormwater runoff on receiving waters and the effectiveness of BMPs, programs and permit requirements in mitigating these effects. The ongoing monitoring and assessment work of the Stormwater Monitoring Work Group, Washington Stormwater Center and partners are described in strategy D4.

- **Protect native vegetation and high quality streams.** Protecting native vegetation, soils and high quality habitat, particularly in remaining stream drainages with "excellent" B-IBI scores through actions outlined in Sections 3A and 3B, requires mapping locations of these streams, and carrying out strategies to protect the streams. This involves using tools such as the Puget Sound Watershed Characterization Project (Watershed Characterization), growth management and shoreline planning, critical areas and other land development regulations, proposed Low Impact Development requirements in municipal NPDES permits, stormwater management manuals, land conservation programs, landowner incentive programs, and other measures. More information on strategies and actions related to watershed characterization is described in sub-strategy A1.1.
- **Site new development appropriately.** New development needs to be sited appropriately, using the watershed characterization study, Growth Management Act, Shoreline Management Act, State Environmental Protection Act, and other tools. The Watershed Characterization, other watershed plans, and, where needed, finer scale analyses can be used to identify areas most appropriate to protect, develop and restore through structural retrofits, legacy pollutant removal, and other means. Where development is targeted, smart growth concepts can ensure that compact, mixed-use, mass-transit supported development increases. More information on these issues is provided under strategies A2, A3, and A4.
- **Better connect land use and stormwater management.** Land use planning and stormwater management need to be integrated. Development of watershed plans based on Watershed Characterization data that integrate land use planning and stormwater management could be

accomplished by either (1) reactivating and funding Clean Water Act Section 208 planning to include major land uses (urban, agricultural/rural, and forestry) and water resource elements such as stormwater, combined sewers, wastewater, water supply, reuse and non-point sources; or (2) supporting and funding the development of stormwater plans, watershed plans, or WRIA plans that address the full spectrum of water resource elements and land use on a regional basis. The impacts of land use decisions on stormwater runoff and receiving waters should be evaluated. Regulations should be aligned with watershed plans, including municipal, industrial and construction NPDES permits, non-point source control programs, critical areas ordinances, Shoreline Management Act, State Environmental Protection Act, Endangered Species Act, and the Growth Management Act if warranted.

OCEAN ACIDIFICATION

As mentioned in *Ocean Acidification: From Knowledge to Action, Washington State's Strategic Response* (Washington State Blue Ribbon Panel on Ocean Acidification 2012), much progress has been made in reducing pollutants that affect water quality, including nutrients and organic carbon. Yet many challenges still remain, especially with regards to the management of nutrients. Various existing local, state, and federal programs and planning efforts focus on reducing pollution and improving water quality. These efforts advance the goals of economic vitality, environmental protection, resource conservation, and future sustainable development. Additional benefits could be realized by strengthening and reinforcing these efforts.

The Blue Ribbon Panel recommends monitoring the effects of existing regulatory and voluntary programs that reduce pollution and improve water quality to determine the effectiveness of these programs. The Action Agenda strategies in this section directly implement the Blue Ribbon Panel's recommendations.

Ongoing Programs

The Puget Sound Watershed Characterization, a collaborative effort among Ecology, the Partnership, and WDFW, is designed to provide local governments with better information to improve land use planning and resource protection at the watershed scale. The Watershed Characterization is a regional-scale perspective that divides Puget Sound geographically into three areas: those most important to protect, those most beneficial to restore, and those most suitable for development. It is designed to describe a multi-scale framework for land-use planning. The results from the assessments should help guide the protection and restoration of watersheds and the habitats they support. The Watershed Characterization effort includes an outreach component to explain the role and proper application of these assessments.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.2.1.1 **Watershed based stormwater management.** The Ecosystem Coordination Board requested an evaluation of the feasibility, cost, and effectiveness of transitioning the existing municipal stormwater jurisdiction by jurisdiction permit approach using "general permits," to watershed-based municipal stormwater management. PSP agreed to l work with interested parties, particularly Ecology and local governments, to ensure their perspectives and concerns are addressed and accounted for when developing the

scope of work for their evaluation. Based on limited funding, a decision was made: to first survey other programs to examine experiences in implementing a watershed-based permit and to learn from those experiences. Any subsequent tasks will be evaluated by the ECB for further action as appropriate.

C.2.1.2 **Protect best remaining streams.** King County, in cooperation with agencies populating the Puget Sound Stream Benthos database, will identify and map remaining streams with Benthic Index of Biotic Integrity scores of at least 42-46 and develop an overall strategy and tailored actions to protect these areas.

C.2.1.3 **Stormwater system mapping.** King County, in cooperation with Ecology, local governments, WSDOT, and DNR, will help improve understanding and management of the region's stormwater infrastructure by developing data collection protocols, methodology and definitions for stormwater system mapping.

C.2.1 ISL7 **The City of Oak Harbor will implement Freund Marsh restoration and stormwater improvement project.** The project will restore natural treatment functions to reduce nutrient loading and improve flow rates by increasing infiltration in Oak Harbor, the only urban watershed in the County. The project will complete the Freud Marsh improvements including a trails network and interpretive center to educate public about stormwater, water quality, and wetland issues.

C.2.1 SNST2 **Identify existing data and prioritize needs.**

- Water quality: Compile water quality data from the previous 10 years for streams in the Snohomish and Stillaguamish River watersheds, and evaluate available data to establish priority areas for water quality improvements.
- Culverts: Collect and assess existing data on public and private stream culverts in the Snohomish and Stillaguamish basins to identify high priority culverts for replacement based on multiple factors, such as fish passage.
- Map systems: Inventory and map stormwater facilities and conveyance systems in the Snohomish and Stillaguamish basins, and begin to prioritize the need for public and private stormwater retrofits.

C.2.1 SS6 **South Puget Sound nutrient reduction strategy.** Implement nutrient reduction strategies as recommended in the Ecology dissolved oxygen study or as indicated from modeling results based on that report.

C.2.1 WH11 **Implement the Birch Bay watershed and aquatic resources management (BBWARM) district stormwater program.** The BBWARM program includes both capital and programmatic elements to improve water quality, reduce flooding, and protect aquatic habitat. BBWARM works with a variety of partners including the Birch Bay Shellfish Protection District, Birch Bay Water Sewer District, Whatcom Conservation District, Nooksack Salmon Enhancement Association, MRC, and other Whatcom County programs. BBWARM program areas include:

- Capital Improvement Projects

- Maintenance and Operations
- Water Quality Monitoring
- Education and Outreach

C2.2 Prevent problems from new development at the site and subdivision scale

New development at the site and sub-division scale can be a significant source of stormwater-related problems. Effective management of sediment on construction sites using best management practices (BMPs) and other tools from the Stormwater Management Manual for Western Washington (or a local, equivalent manual), inspections, and enforcement (when needed) can prevent sediment and other contaminants from reaching surface waters, where they can cause harm. Appropriate design, siting, installation, and maintenance of permanent BMPs is critical to ensure they perform as designed. This sub-strategy includes NPDES permits for municipalities, state highways, industries, construction sites, and boatyards; continued transition to low impact development; and ensuring new development outside NPDES permitted areas uses standards and practices equivalent to those used within permitted areas.

- **Stormwater NPDES permits**. Federal NPDES permits are in place for municipalities, state highways, industries, construction sites, and boatyards. All NPDES stormwater permits for western Washington must be issued, implemented, overseen, complied with, and improved over time according to federally established timelines. Municipal stormwater permits need to contain requirements for Low Impact Development, monitoring, and structural retrofits. The need to bring in additional local governments under municipal permits to cover more land area of the basin should be evaluated. Funding is needed for municipal permittees to carry out permit requirements. Permits for federal and tribal lands/facilities also need to be consistent with state-issued NPDES stormwater standards and permits. The state-approved stormwater manuals should be updated as needed, including planning for climate change.
- **Low Impact Development**. The regional transition to low impact development should continue, Technical guidance and educational materials should continue to be developed and revised to help transition the region to the use of Low Impact Development and other green infrastructure approaches. State-approved runoff manuals should continue to refine how these techniques are modeled, sited, designed and maintained. Guidance to local governments on integrating Low Impact Development into codes and standards should also continue. This work includes providing information on projects, costs, performance, longevity, maintenance needs, and how best to integrate Low Impact Development facilities into existing drainage systems. Refining and providing incentives for Low Impact Development and other green infrastructure approaches is part of this sub-strategy. Local governments need funding review of development proposals, inspections, enforcement, and maintenance of facilities.
- **Consistent, basin-wide management of new development**. To protect and restore resources and beneficial uses everywhere in the basin, including shellfish harvest areas and salmon habitat, ensure that new development outside NPDES-permitted areas includes stormwater management standards and thresholds that are technically equivalent to the Stormwater Management Manual for Western Washington. Ensure that local governments located outside NPDES-permitted areas carry out

stormwater management programs that are consistent with the NPDES municipal stormwater permit for western Washington.

Ongoing Programs

NPDES permits. Ecology administers NPDES stormwater permits for municipalities, industries, construction sites, boatyards, and WSDOT.

Municipalities with populations over 100,000 are covered by NPDES Phase I permits. In Puget Sound, this includes King, Pierce and Snohomish counties and the cities of Seattle and Tacoma. Municipalities with populations under 100,000 located in urbanized areas, as defined by EPA rules, are covered under Phase II permits. In 2012, there were 76 local governments in Puget Sound covered by the western Washington Phase II permit. An NPDES municipal stormwater permit also exists that covers WSDOT's transportation facilities within the Phase I and II permit areas. Ecology maintains the Stormwater Management Manual for western Washington, the region's stormwater technical manual, which contains minimum requirements, technical standards and BMPs for new and redevelopment projects. Ecology also issues and oversees NPDES permits for construction sites, industries, and boatyards.

In 2009, the Legislature directed Ecology to work with stakeholders to establish a stormwater technical resources center. The Washington Stormwater Center, jointly managed by WSU Extension, the City of Puyallup, and The Center for Urban Waters (University of Washington, Tacoma)provides technical assistance to municipal and industrial stormwater NPDES permit holders, education and training, research and monitoring of Low Impact Development practices, and review and approval of new stormwater BMPs.

Low Impact Development. Providing the right tools is key to transitioning the region to the use of Low Impact Development techniques. WSU Extension and the Partnership, with help from regional professionals, are revising the region's Low Impact Development manual, *LID Technical Guidance Manual for Puget Sound*. WSU Extension and UW offer Low Impact Development professional training and certificate programs. Seattle and other local governments have developed guidance, educational materials, and checklists for ongoing maintenance of systems. The Partnership is developing *Integrating LID into Local Codes: A Guidebook for Local Governments* to help local staff integrate Low Impact Development into their codes and standards. Ecology plans to provide new standards and training on maintenance of systems. Many local governments, developers and builders, and consulting engineers provide leadership by designing and building innovative Low Impact Development projects.

Key Ongoing Program Activities

- Ecology issued updated 2013–2018 Phase II municipal NPDES stormwater permits for western Washington and an updated *Stormwater Management Manual for Western Washington* in 2012. The permits became effective August 1, 2013. The municipal stormwater permits require Low Impact Development for new developments and redevelopment unless site conditions are prohibitive.
- WSU Extension and the Partnership (2012) issued the updated *Low Impact Development Technical Guidance Manual for Puget Sound*.

- The Partnership issued *Integrating LID into Local Codes: A Guidebook for Local Governments* in (Puget Sound Partnership 2012b).

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.2.2.1 **NPDES municipal permits.** Ecology will issue municipal permits for western Washington and provide financial assistance to permittees for implementation, particularly for code changes, stormwater system mapping, operations and maintenance, inspections and enforcement. This will require additional resources to Ecology for permit oversight, technical assistance, and enforcement. Ecology will provide incentives to NPDES permittees who, by interlocal agreement, lead or carry out regional or watershed scale NPDES implementation.

C.2.2.2 **Stormwater treatment standards.** Ecology will evaluate under which circumstances (i.e., for which pollutants, from which land uses) discharges to Puget Sound should be required to provide treatment beyond sediment removal (i.e., TSS removal) to help meet 2020 recovery targets.

C.2.2.3 **Stormwater management outside permitted areas.** Ecology, in coordination with DOH, will identify two high priority shellfish growing areas degraded by urban stormwater discharges and work with local governments and other key parties to reduce these impacts to the areas.

C.2.2.4 **New development under earlier stormwater programs.** Ecology will initiate a process to assess projected implications and impacts of current state law concerning the level of stormwater control from new development approved under earlier stormwater programs.

C.2.2 SC9 **Share information on low impact development/green stormwater infrastructure and facilitate the transition from conventional stormwater management.**

- Use LIO as a forum for sharing approaches to implementing Low Impact Development policies.
- Encourage local government participation in Washington State University Low Impact Development technical workshops.
- Support ECO Net endorsed education and outreach efforts for this near-term action.
- Support development of regulations that implement Action Agenda priorities.

C.2.2 SJI5 **Control and mitigate stormwater runoff (Near Term Run Off Action I).**

C.2.2 SNST15 **Low impact development.** Provide funding for the construction of up to five Low Impact Development projects in the Snohomish and Stillaguamish basins, including the City of Everett's Green Stormwater Infrastructure Implementation Program.

C.2.2 STRT17 **Implement the highest priority projects listed within the City of Sequim Restoration Plan, a part of the city's updated Shoreline Master Program.** The current focus for this action is on Restoration Priority 7.1 from the city's Restoration Plan, namely "Improve Water Quality and Reduce Pollutant Delivery". This focus area is also a part of the local near-term action titled Develop a Storm and Surface Water Management Plan for the City of Sequim.

C.2.2 STRT27 **Adopt the City of Port Townsend's Stormwater Management Plan.** Review and adopt local Low Impact Development codes and standards related to stormwater management and land development practices, to include an evaluation of stormwater conditions and needs within the 18 sub-basins of Port Townsend.

C.2.2 STRT28 **Develop and adopt a Storm and Surface Water Management Plan for the City of Sequim.** Develop a Storm and Surface Water Management Plan, including adoption of Low Impact Development incentives and stormwater ordinances to support surface water pollution reduction. Initially, conduct a stormwater management needs assessment and develop a Storm and Surface Water Management Master Plan, including the possibility of a utility.

C.2.2 STRT30 **Implement the City of Port Angeles NPDES Phase II permit and Stormwater Management Program.** Implement NPDES Phase II Stormwater Management Program, including Low Impact Development incentives and ordinances to support surface water pollutant reduction.

C.2.2 STRT32 **Update, adopt, and implement the Clallam County Stormwater Management Plan.** Update and implement the Clallam County Stormwater Management Plan, including adoption of Low Impact Development incentives and ordinances to support stormwater management.

C2.3 Fix problems caused by existing development

Most development within the Puget Sound basin was built prior to the use of local and state stormwater manuals that require management of stormwater discharges. This development, unless already retrofitted, may be presumed to be discharging untreated or undertreated stormwater, and inadequate management of high flows. Stormwater discharges from existing development can be mitigated through a variety of means: Structural retrofits, regular and enhanced maintenance to remove legacy pollutant loads, and/or redevelopment policies. The *Urban Stormwater Runoff Preliminary Needs Assessment Technical Memorandum* (Bissonnette and Parametrix 2010), in a survey of 20 permit holders, found that system cleaning was highly effective: 234,000 tons of total solids were removed in 2009. This is believed to be due to "past underfunded maintenance" of stormwater systems. The report further estimates that, conservatively, an estimated $3–15.6 billion is needed to upgrade existing stormwater systems within municipal permit areas for treatment. The report states that "prioritization is necessary" (given the huge investment required) and that "acceleration of the maintenance, inspection, and pollutant source investigation elements of the… permit program, in combination with addressing the highest priority retrofits, is recommended." This sub-strategy includes: fixing problems from existing

development through structural retrofits; ongoing regular maintenance and enhanced maintenance; and redevelopment policies and activities.

- **Structural retrofit.** Over time, existing development needs to be upgraded, as needed, with flow control and treatment techniques that contribute towards meeting the recovery targets. Structural retrofits should focus on areas that would benefit most, and assess whether structural upgrades or other means (e.g., source control, maintenance) will achieve objectives. This work should include, assessing the level of effort needed (i.e., number of projects and acres retrofitted) to meet goals. Adequate, new funding will be needed to ensure significant progress is made.
- **Maintenance.** Stormwater pollution prevention plans must be carried out and all stormwater systems need to be regularly inspected and maintained to function to engineering design standards. Removing legacy loads from portions of the systems needs to be assessed and carried out, building on City of Tacoma's study on removal of legacy loads. Technical and financial assistance should be provided to local governments.
- **Redevelopment.** Ensure that redevelopment policies in state-approved stormwater manuals and permits are fully implemented and bring about improvements to runoff from existing development. Revise policies as needed as one tool to upgrade stormwater controls on existing development.

Ongoing Programs

Retrofit. Local governments in Puget Sound run capital improvement programs and, as funding becomes available, undertake projects to improve their stormwater systems. While flood prevention and property protection are most often targeted, many programs and projects also address water quality, fish habitat, and discharges to shellfish harvest areas. Municipal phase I permit holders are required to run structural stormwater programs that include construction of new and improvements to existing facilities.

The municipal NPDES permits require that existing stormwater systems be upgraded when certain thresholds are reached during a redevelopment project. This is an opportune time, or "window of opportunity" to improve existing stormwater infrastructure; however, the current rate of redevelopment within the basin is fairly low.

Maintenance. Local governments, industries, and boatyards regularly maintain their permanent BMPs according to permit requirements and to ensure they continue to perform as designed. This regular, systematic, ongoing maintenance is critical to the functioning of systems, since unmaintained stormwater infrastructure can actually export pollutants.

Several local governments, such as the City of Tacoma, have undertaken enhanced maintenance activities to remove legacy (or long-residing) pollutants from their systems. This system "flushing" can be highly effective at removing large amounts of pollutants in a cost-effective manner.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.2.3.1 **Stormwater retrofit projects.** Ecology will lead a process to identify high priority retrofit projects that will contribute to the recovery of Puget Sound and complete conceptual

design to a stage sufficient to seek project implementation funding. The work will build on retrofit prioritization work by WSDOT, King County and others, and will be replicable in other urban and suburban areas around the Sound.

C.2.3.2 **Map, prioritize, and restore degraded streams.** King County, in cooperation with agencies populating the Puget Sound Stream Benthos database, will identify and map stream drainages with "fair" Benthic Index of Biotic Integrity scores, and develops a prioritized list, strategies and actions to improve scores of 30 of these streams.

C.2.3.3 **Legacy pollutant removal.** Ecology, in cooperation with local governments, will provide guidance and financial assistance to local governments to help them remove legacy pollutant loads from their stormwater systems.

C.2.3 HC4 **HCCC stormwater retrofit plan.** Stormwater retrofit and Low Impact Development practices improve water quality, help protect shellfish beds, decrease flooding risks, and increase aquifer recharge. HCCC is developing a Hood Canal Regional Stormwater Retrofit Plan to coordinate stormwater and Low Impact Development retrofit efforts on a regional scale. The plan will include conceptual designs for 10 to 12 retrofit projects in the Hood Canal Action Area, which will be implemented by the county governments or other partners as funding is available.

C.2.3 ISL12 **Identify, map, and prioritize blocked and failing culverts and replace one to two priority culverts using fish-friendly passage designs.** Fish-blocking culverts negatively affect flood risk, scouring, erosion, landslides, and water quality. Island County will map all existing culverts noting which are blocked and failing, and will create a prioritization schedule for replacing these culverts.

C.2.3 SC6 **Identify, guide, and fund stormwater retrofits.**

- Complete WRIA 9 retrofit study and promote it as a model.
- Advocate locally and sound-wide through the LIO for increased funding for priority stormwater retrofit projects.
- Develop a list of high-priority stormwater retrofit projects to support local investments and state funding request in 2014 and 2015, using upcoming guidance from Ecology and findings from the WRIA 9 study on stormwater retrofit priorities.
- Participate in the Commerce's technical assistance and study of examples of urban-specific implementation or stormwater retrofit projects.
- Support ECO Net endorsed education and outreach efforts for this near-term action.

C.2.3 SC7 **Promote operation and maintenance and improvements to existing stormwater systems.** Promote, support and guide technical assistance for local government adoption of improved operation and maintenance techniques for existing stormwater infrastructure, such as:

- System flushing
- Vactoring

- High-efficiency street cleaning

C.2.3 SNST10 **Inspections and maintenance.** Provide regular inspections of public and private stormwater facilities in the Snohomish and Stillaguamish basins and identify prescriptive maintenance needs and retrofit opportunities.

C.2.3 STRT35 **Complete the collection of habitat information for use by WSDOT to inform the prioritization of stormwater road retrofit projects within the Strait Action Area.**

C.2.3 WC21 **Ridgetop Boulevard Green Street.** Kitsap Surface and Stormwater Management will install 10-14 median bioretention (rain gardens) facilities on Ridgetop Boulevard near Silverdale, treating 18 acres of road runoff and reducing fecal coliform and other contaminants flowing into Dyes Inlet.

C.2.3 WC22 **Poulsbo Low Impact Development retrofit study for Upper South Fork Dogfish Creek basin and downtown Poulsbo.** City of Poulsbo will seek funding and complete stormwater retrofit plans for the Upper South Fork Dogfish Creek Basin and Downtown Poulsbo basins.

C.2.3 WC23 **Gig Harbor stormwater retrofit study.** City of Gig Harbor and Pierce County will complete a stormwater retrofit study for the City of Gig Harbor. The primary deliverable will be a comprehensive, prioritized list of beneficial stormwater projects within the City. Once completed, Gig Harbor and Pierce County can include identified projects on their Capital Facilities Plans and/or apply for relevant stormwater retrofit grants to fund construction.

C.2.3 WC27 **Marine Drive/Kitsap Way/Oyster Bay Avenue storm system filtration retrofit.** With a goal of improving water quality impacting shellfish harvest in Oyster and Ostrich bays, the City of Bremerton will install a passive stormwater filtration system prior to the outfall into Oyster Bay and Low Impact Development components along approximately 1.5 miles and 65 acres on Marine Drive, approximately 31 acres along the north portion of Kitsap Way, and approximately 1.5 miles and 40 acres on Oyster Bay Avenue.

C.2.3 WC28 **Ostrich Bay Creek retrofit plan design.** With a goal of improving water quality impacting shellfish harvest in Oyster and Ostrich bays, the City of Bremerton will complete a stormwater retrofit design study for Ostrich Bay Creek. The retrofit design plan will evaluate and determine the best locations and types of Low Impact Development components to use for this drainage basin. The basin is more than 230 acres of pervious and impervious surface used for light commercial facilities, residences and State Highway. The plan will address water quality and quantity issues that impact Ostrich Bay Creek by using various Low Impact Development components and treatment systems. The City will pursue funding through the LIO process, grants, and local partnerships to construct the designed components as funding is made available.

C.2.3 WH12 **Lake Whatcom watershed stormwater projects.** Implement stormwater retrofit projects identified in the Lake Whatcom Comprehensive Stormwater Plan.

- Coronado-Fremont Stormwater Improvements: Construction of Phase 1 in 2013 included a bio-infiltration swale and stormwater vaults. The project will treat runoff from approx. 10 acres.
- Academy Road Stormwater Improvements: Partner with the City of Bellingham on a joint stormwater retrofit project to improve stormwater quality in the Lake Whatcom Watershed. This project will treat runoff from approximately 80 acres.
- Cedar Hills/Euclid Stormwater Improvements: Install rain gardens, filter vaults, and treatment swales. This project will treat runoff from approximately 60 acres.

C.2.3 WH13 **Birch Bay area stormwater projects.** Implement stormwater retrofit projects identified in the Birch Bay Comprehensive Stormwater Plan:

- Birch Bay Stormwater Priority Retrofit Projects Pre-Design: Ecology Watershed protection and Restoration grant-funded project to complete preliminary design and analysis for priority capital projects.
- Beachway Drive & Fern/Park Stormwater Improvements: Stormwater retrofit project to improve stormwater quality entering Birch Bay and reduce flooding impacts.
- Harborview Road Culvert Replacement: Replace undersized driveway culverts and catch basins to alleviate flooding along Harborview Road.
- Cottonwood Drive Drainage Improvements: Stormwater retrofit project to improve conveyance from uplands areas, reduce nearshore flooding, and provide additional drainage connections along Birch Bay Drive. Water quality treatment options will be incorporated.

C.2.3 WH14 **Ferndale stormwater projects.** Implement stormwater projects that address runoff to the Nooksack River, and that are identified in the City of Ferndale Stormwater Management Plan.

- Gateway Stormwater Facility projects: Upgrade the stormwater conveyance reaches identified in the 2013 Ferndale Gateway Stormwater Study and planned for implementation (project reaches W-R-2 and W-R-3).
- Decant Design and Construction: Design and construct a covered facility for the City of Ferndale stormwater decant process, which currently is located in the floodplain.
- City of Ferndale Stormwater Studies: Complete stromwater drainage studies for two areas within the City of Ferndale: Main Street and Labounty and Thornton Street Stormwater Pond.

C2.4 Control sources of pollutants

Stormwater runoff from urban and rural areas is a significant source of toxics, nutrients, and pathogens delivered to Puget Sound. (Even small concentrations of polluted runoff can be harmful to fish and other aquatic life.)

Proper control and treatment of this stormwater, as discussed in earlier strategies and actions, is critical to Puget Sound recovery. It also is important to reduce the amount of contamination that becomes caught up in the stormwater stream. Many pollutants, such as dissolved metals, are very expensive and difficult to remove from the stormwater stream through treatment BMPs. Other pollutants, like pathogens, are commonly found in stormwater, and, like other pollutants, cause problems in receiving waters. It is far more cost-effective to minimize the introduction of pollutants to stormwater that to rely only on stormwater flow control and treatment. This sub-strategy includes on local pollution and control programs; inspections, technical assistance, and enforcement; and development and implementation of total maximum daily loads (TMDLs).

- **Local pollution and control programs.** Local programs should be developed and implemented to identify, track and control/eliminate sources of stormwater-related pollutants. Local governments need guidance and ongoing financial assistance to carry out this work. In addition, pollution identification and correction programs are discussed more fully in C.9.4.
- **Inspections, technical assistance, and enforcement.** Needed work includes carrying out periodic inspections of businesses and industries with high likelihood of discharging pollutants of concern, working with property owners and operators to use BMPs to reduce discharges, and using technical assistance, incentives and enforcement to achieve compliance. Information from local pollution identification efforts, watershed plans, and regional monitoring activities should be used to identify pollutant hotspots/areas to restore. Local governments need guidance ongoing financial assistance to carry out this work. In addition, strategies and actions related to source control of toxics are discussed in strategy C.1.
- **TMDLs.** Water quality implementation plans to eliminate impairments to water quality from stormwater discharges need to be developed and implemented. TMDLs need to contain monitoring, and follow up work should be conducted to ensure plans are achieving goals. Local governments need guidance and ongoing financial assistance to carry out this work. In addition, strategies and actions related to TMDLs are described more fully in sub-strategy C9.1.

Ongoing Programs

Local governments carry out source control actions through their illicit discharge detection and elimination programs (a requirement in all NPDES municipal permits). These programs can be effective tools to identify and address sources of illegal discharges to stormwater systems. In addition, NPDES phase I permit holders are required to run source control programs, which can lead to reductions in pollutants running off properties through site visits, assistance, and enforcement (when needed).

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.2.4.1 **Compliance assurance program.** Ecology and local governments will increase inspection, technical assistance, and enforcement programs for high-priority businesses and at construction sites.

C.2.4.2 **Vehicle leak detection program.** King County, in cooperation with Seattle, WSDOT, the STORM advisory committee, and PSP will lead a regional discussion to develop options and recommendations for a new program to inspect and eliminate privately owned vehicle drips and leaks. This work builds on the related work of existing grants to STORM and Seattle on vehicle leaks and drips.

C.2.4 STRT34 **Continue Clallam County Streamkeepers ambient monitoring program to understand stormwater baseline conditions and expand monitoring according to the Washington State Stormwater Work Group recommendations.** Consider partnerships with the cities of Port Angeles and Sequim to accomplish this action.

C2.5 Provide focused stormwater-related education, training, and assistance

Cities and counties rely on a variety of education, training and technical and financial assistance resources to deliver effective local stormwater management programs. By providing these resources, in addition developing supplementary guidance and model ordinances, stormwater can be more effectively managed throughout the region.

Focused information, education, and training on stormwater-specific issues should be provided for multiple audiences.

- **Citizens (especially homeowners).** Importance of problem, sources of contaminants and effects, their role in helping to solve problems.
- **Legislators and elected officials.** Issues, funding needs, results of significant studies and reports, product bans and phase-outs.
- **Local government staff.** Training on permit activities, including inspections and maintenance, source control, spill response, and Low Impact Development implementation.
- **Businesses.** Source control training, BMPs, proper material disposal, and other technical assistance.

A variety of techniques, such as sharing of science and research, social marketing, prioritization of issues and contaminants, media with vetted messages, proven BMPs and program strategies, classes, and training workshops should be used.

Support for and participation in Puget Sound Starts Here, STORM, and other regional programs designed to facilitate coordination and implementation of municipal stormwater public education and stewardship programs should be encouraged. Transportation-related topics need to be included in this effort.

Ongoing Programs

The Partnership, Ecology, local governments, Washington Sea Grant, WSU Extension, and non-profit organizations carry out a broad stormwater-focused behavior change campaign. These programs emphasize problems, sources, solutions and roles, funding needs, and stormwater management on residential properties.

Puget Sound Starts Here is a partnership of local governments, the Partnership, Ecology, and local organizations that are part of the Partnership's ECO Net. This program leverages the combined

investments of all these organizations and provides consistent public awareness and education messages across the twelve-county Puget Sound region. Using state-of-the-art communications techniques, it provides a regional communications umbrella to support and enhance the effectiveness of local stormwater program delivery.

The Washington Stormwater Center serves as a central resource for integrated NPDES education, permit technical assistance, stormwater management and new technology research, development, and evaluation.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.2.5.1 **Low Impact Development training and certification.** Ecology will provide focused training for local government staff on Low Impact Development project review, and inspections and approvals, as well as to local government staff and private sector on maintenance. Develop new professional certification for stormwater maintenance specialists. Provide business staff and contractors with training on source control, spill recognition, spill response, and erosion control.

C.2.5.2 **Education for the next generation of stormwater professionals.** The Tulalip Tribes will develop a near-term plan to provide sustainable water resource management academic curriculum in all Puget Sound counties for future stormwater professionals that is inclusive of tribal treaty rights, history, civics, and emphasizes continuing improvements in stormwater management in the context of the larger issues of sustainable water resource management and climate change.

C.2.5 SC8 **Increase education of and stewardship by homeowners and businesses to reduce stormwater pollution.**

- Increase education of and stewardship by homeowners, businesses, and institutions to reduce pollutant loadings to stormwater (e.g., fertilizers, pesticides, oils, cleaners).
- Support ECO Net endorsed education and outreach efforts for this action.

C.2.5 SJI7 **Provide technical and financial assistance, outreach, incentives, education and natural resource planning on a voluntary basis to interested residents to improve stormwater management and reduce polluted runoff and nutrient loading into the marine environment (Near-Term Run Off Action III).**

C.2.5 SS5 **Small community stormwater reduction program.** Develop and enhance program with education, advocacy, and restoration elements addressing non-NPDES mandated stormwater programs in small communities.

C.2.5 STRT31 **Provide stormwater education, training, and technical assistance in Jefferson County and Port Townsend using a watershed-based approach through implementation of Phase 2 of SquareONE.** Consider expansion of the SquareONE concept to the other

three local jurisdictions within the Strait Action Area. Following lessons learned from the SquareONE pilot project in Jefferson County, consider implementing Phase 2 to include the City of Port Townsend. Also, consider possible expansion of the concept to the other three local jurisdictions within the Strait Action Area. Phase 2 would (a) Implement the stormwater management public education plans in Jefferson County and Port Townsend by increasing citizen awareness and capacity to self-select preferred actions and methods; (b) Provide training on BMPs and Low Impact Development to the development community to increase capacity for successful site assessment and facility design, installation, and maintenance; and (c) Provide training to county and city staff to increase capacity for successful plan review and site inspections. (Note: This action has a double benefit in that it is also linked toB1.3 STRT18.)

C.2.5 STRT33 **Provide stormwater management education, training, and technical assistance in Clallam County using a watershed-based approach.** Consider partnerships with the cities of Port Angeles and Sequim to accomplish this action. Work to (a) increase citizen awareness and understanding of the importance, need, and techniques for stormwater management and familiarity with the new stormwater management plans requirements; (b) provide technical assistance to homeowners in Clallam County to assist in implementation of Low Impact Development BMPs contained with the Small Project Drainage Manual; and (c) provide training in Low Impact Development and BMPs to Clallam County staff to improve development plan review, site inspections, and assistance at the Permit Center. Consider partnerships with the cities of Port Angeles and Sequim. Also consider the Watershed Stewardship Resource Center concept used in Jefferson County and City of Port Townsend to accomplish this action.

C.2.5 WC4 **West Sound Low Impact Development Training.** Kitsap County Surface and Stormwater Management Program – with direct assistance from and close coordination with other stormwater utilities and agencies in the County – will provide training for 80% of Low Impact Development professionals in Kitsap County, including plan review staff, designers, installers, inspection, and maintenance staff.

C.2.5 WC24 **Low Impact Development peer leaders network.** With funding provided through Kitsap County Surface and Stormwater Management, WSU Cooperative Extension will develop and implement a Low Impact Development professionals network program.

Emerging Issues and Future Opportunities

- More explicitly incorporate climate change information and state climate adaptation strategies into Puget Sound stormwater strategies. This includes downscaled climate projections for stream flows, sea level rise and salt water intrusion, as well as consideration of extreme weather events for planning, designing and siting stormwater infrastructure. Examples include prioritization criteria for retrofits and adaptation of basin-scale hydrologic models.
- Additional local governments should be evaluated for coverage to bring more land area under the NPDES permits over time.
- Providing Low Impact Development training at colleges.

Target View: Benthic Index of Biotic Integrity (Freshwater Quality)

Runoff from developed lands and clearing of trees along waterways can harm the health of small streams that support salmon, other aquatic life, and wildlife. Water insects (benthic macroinvertebrates) are an indicator of biological health of stream systems, and a common method for quantifying this indicator is the Benthic Index of Biotic Integrity, which produces a numerical value to indicate a stream's ecological condition.

Further information on the Benthic Index of Biotic Integrity scoring system is available at the Puget Sound stream benthos website[4], an ongoing project to store and analyze data from macroinvertebrate sampling programs. Soundwide results have not been reported, but King County data show that about 37% of sites are rated "good" or "excellent" with the remaining 63% rated "fair" or "poor."

Recovery Target

Protect small streams that are currently ranked excellent by the Benthic Index of Biotic Integrity for biological condition, and improve and restore streams ranked fair so their average scores become good.

Relevant Strategies (and Sub-Strategies)

- A4.2. Provide infrastructure and incentives to accommodate new and re-development within urban growth areas
- C2. Use a comprehensive approach to manage urban stormwater runoff at the site and landscape scales (C2.1, C2.2, C2.3, C2.5)
- C1. Prevent, reduce, and control the sources of contaminants entering Puget Sound (C1.2, C1.4, C1.6)
- A6.1. Implement high priority projects identified in each salmon recovery watershed's 3-year work plan
- C3. Prevent, reduce, and control agricultural runoff (C3.1, C3.2)
- C4. Prevent, reduce, and control surface runoff from forest lands (C4.1, C4.2)

Figure C-11 (Appendix C, *Results Chains*) depicts how the strategies (and related sub-strategies) contribute to reducing pressures on water insects (benthic macroinvertabrates) and achieving the Benthic Index of Biotic Integrity recovery target. Appendix C also contains a results chain for each individual strategy in the Action Agenda, showing how that strategy (and its related sub-strategies) reduces pressures and contributes to achieving numerous recovery targets.

[4] www.pugetsoundstreambenthos.org

Agricultural Runoff

The Challenge

Improperly managed surface water runoff from farms can convey a variety of pollutants to groundwater and Puget Sound. These pollutants include sediment, pathogens, pesticides and other chemicals, and excess nutrients. Nutrients can pose particular risks because they can support and enhance production and accumulation of algal blooms. As the algae die and decompose, they deplete the water of available oxygen, contributing to the death of aquatic organisms, such as fish and shellfish. In Puget Sound, inlets with few freshwater inputs and deep basins that have limited exchange with surrounding waters such as South Puget Sound and Hood Canal are particularly vulnerable. Excess nutrients can also contaminate drinking water from both surface and groundwater sources.

Agricultural and rural areas constitute about 30 to 35% of the Puget Sound, these lands include commercial agriculture, small farms, and rural development and they can produce significant sediment, nutrient, pathogenic, and chemical loads to stormwater through non-point sources. Strategies in this area seek to provide both incentives and tools to farmers to help them apply BMPs to improve the quality of surface water runoff, while ensuring that working farmland can be maintained and agriculture in the Puget Sound remains economically viable. Particularly challenging are the large number of small acreage farms. These farms typically contain small numbers of animals, including cows, horses, sheep, or goats. Wastes from these animals, if not properly managed can be a significant source of polluted runoff. Small agricultural operations such as those found in many areas of Puget Sound may not meet eligibility requirements for federal incentive programs.

Maintenance of agricultural land also is critical. Strategies and actions oriented towards protection and stewardship of ecologically sensitive rural and resource lands and maintaining the vibrancy of agriculture are discussed in sub-strategy A3.3.

CLIMATE CHANGE

Declining snow pack and loss of natural water storage, changes in precipitation timing may likely exacerbate runoff concerns from agricultural lands. A high-priority overarching response strategy identified in *Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy* (Washington State Department of Ecology 2012a) directly relates to runoff.

- **Safeguard fish and wildlife and protect critical ecosystem services that support human and natural systems**. This includes reducing existing stresses on fish, wildlife, plants, and ecosystems. Reducing polluted runoff improves water quality and aquatic habitat, thereby increasing the resilience of aquatic species to additional stresses from climate change.

Implementing the agricultural runoff strategy in the Action Agenda helps prepare for climate change.

SALMON RECOVERY PLAN PRIORITY: AGRICULTURAL RUNOFF

As described in Action Agenda strategy C2, improvement in water quality is identified in the salmon recovery plan with a call to resolve uncertainty about whether the regional water quality actions address the needs of salmon. Volume I identifies general concerns related to stormwater runoff. Several watershed chapters specifically mention rural runoff from areas such as agricultural lands as needing to be addressed.

How are these priorities integrated? The Action Agenda contains more detailed strategies and actions to address rural runoff than the Salmon Recovery Plan. More work is needed to address rural run-off priorities as identified in the specific watershed chapters. In addition, the resolution about the effectiveness of actions still needs to be addressed.

Recovery Targets

The strategies and actions in this section will contribute to achieving the recovery targets listed below with their associated vital signs and indicators.

Vital Sign	Indicator	Recovery Target(s)
Freshwater Quality	Water Quality Index	At least half of all monitored stations should score 80 or more on the Water Quality Index.
	Number of *impaired* waters	Reduce the number of *impaired* waters.
	Benthic Index of Biotic Integrity	Protect small streams that are currently ranked *excellent* by the Benthic Index of Biotic Integrity for biological condition, and improve and restore streams ranked *fair* so their average scores become *good*.
Marine Sediment Quality	Sediment Chemistry Index	By 2020, all Puget Sound regions and bays achieve chemistry measures reflecting minimum exposure with Sediment Chemistry Index scores >93.3.
	Sediment Quality Standards	Have no sediment chemistry measurements exceeding the Sediment Quality Standards set for Washington State.
	Sediment Quality Triad Index	All Puget Sound regions and bays, as characterized by ambient monitoring, achieve the following: Sediment Triad Index scores reflect unimpacted conditions (i.e., SQTI values >81).
Marine Water Quality	Dissolved oxygen levels	Prevent dissolved oxygen levels from declining more than 0.2 milligrams per liter in any part of Puget Sound as a result of human input.
Shellfish Beds	Acres of harvestable shellfish beds	A net increase of 10,800 harvestable shellfish acres, including 7,000 acres where harvest had been prohibited between 2007 and 2020.
Swimming Beaches	Conditions of swimming beaches.	Have all monitored beaches in Puget Sound meet EPA standards for what is called enterococcus, a type of fecal bacteria.
Eelgrass	Eelgrass area	A 20% increase in the area of eelgrass in Puget Sound relative to the 2000–2008 baseline reference by 2020.

Local Priorities

LIOs identified near-term actions that address agricultural runoff. These local actions are presented in the *Strategies and Actions* section along with Soundwide actions under the sub-strategy shaded below. The local action numbering contains the area abbreviation shown in parentheses after each LIO name. See Section 4, *Local Recovery Actions*, for detailed information about local planning.

Local Integrating Organization	Sub-Strategy C3.1	Sub-Strategy C3.2
Hood Canal Coordinating Council (HC)		
Island (ISL)		
San Juan (SJI)		
Snohomish-Stillaguamish (SNST)		
South Central Caucus Group (SC)		
Alliance for a Healthy South Sound (SS)		
Strait ERN (STRT)		
West Central (WC)		
Whatcom (WH)		

Strategies and Actions

C3. Prevent, Reduce, and Control Agricultural Runoff

C3.1 Target voluntary and incentive-based programs that help working farms contribute to Puget Sound recovery

Numerous programs, guidelines and technical assistance opportunities exist to help farmers identify potential pollution impacts from farming activities and implement BMPs to reduce, control or eliminate pollution.

For example, conservation districts and local USDA NRCS offices currently work with farmers to develop voluntary farm management plans (farm plan). A farm plan identifies the resources on the property and the possible impacts to those resources from agricultural activities, identifies the practices the landowner can undertake to correct these impacts, and identifies the state or federal funding programs the landowner may apply for in order to help implement the practices. If the landowner chooses to implement the practices consistent with the plan, the landowner will address the resource impacts. The practices a landowner might undertake include streamside fencing, manure composting, pasture renovation, and weed management techniques. The planning evaluates site specific characteristics such as the size of the farm, types of soil, slope of the land, proximity to streams or water bodies, types of livestock, or crops, resources such as machinery or buildings, and available finances. Once the farmer decides what changes he or she wants to make on their property, they work with the local Farm Planner to set a tentative implementation schedule.

Another program to address impacts to water quality due to agricultural activities is the Conservation Reserve Enhancement Program. This program is administered by USDA's Farm Service Agency and is a voluntary program that helps farmers protect environmentally sensitive land, decrease erosion, restore wildlife habitat and safeguard ground and surface water resources. Under this program, eligible farmers can receive financial compensation when they enter into ten to fifteen year contracts to keep valuable resource land out of production and technical and financial assistance (up to 50%) to install restoration measures such as riparian plantings along streams.

These incentive-based programs, publicized by local programs, conservation districts, and NRCS, are currently implemented in an "opportunistic" manner—that is, the landowner seeks out their local conservation district or WSU Extension staff for information and assistance. Consequently, service delivery is not targeted to specific locations to address specific resource concerns, such as degraded riparian areas and water quality. These programs can be better targeted to address priority resources concerns and better coordinated with regulatory efforts to make them more effective.

Ongoing Programs

The primary objective of these actions is to enhance the targeting of ongoing landowner incentive programs to address specific resource concerns on commercial and non-commercial farms. In order to better target voluntary, incentive, and technical assistance programs and promote their use in Puget Sound, the Washington State Conservation Commission (WSCC) has worked with all the Puget Sound conservation districts to develop a Puget Sound Conservation District Action Agenda. This document links the work of the 12 conservation districts in the Puget Sound basin to the specific threats identified by the Partnership. Funding is then provided by the WSCC to the conservation districts to implement on-the-ground activities that address the identified threats. In this way, specific conservation district work and landowner activities can be directly linked to specific Puget Sound threats.

The WSCC also is working with counties and other state agencies to implement the Voluntary Stewardship Program (VSP). This new program is intended to address the contentious issue of the protection of critical areas on agricultural lands while maintaining viable agricultural production. The VSP provides counties with an alternative to protecting critical areas from agricultural activities through the Growth Management Act process. If they decide to opt-in, counties must identify, in accordance with specified criteria, watersheds that will participate in the VSP and nominate, watersheds for consideration by the WSCC as state priority watersheds.

Once a county has opted-in to the VSP and funding is made available, the county must also identify a watershed group to develop a work plan that will identify how critical areas in the watershed will be protected in the context of agricultural activities. The work plan is submitted to the WSCC for approval in consultation with affected state agencies. The work plan must include measureable goals and benchmarks for the protection of critical areas. The watershed group must show progress on these goals and benchmarks every 5 years, or implement adaptive management if progress is not being made.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.3.1.1 **Water quality BMPs.** Ecology, WSDA, and WSCC, after conferring with federal, tribal, and local partners will work on a solution to improved implementation of BMPs that protect water quality.

C.3.1.2 **Effectiveness of incentive programs.** WSCC—in consultation with WSDA, DOH, and Ecology; conservation districts; federal agencies; and tribes—will report to the Governor and the Legislature on the effectiveness of incentive programs to achieve resource objectives. The report will include a section from Ecology on compliance with water quality standards.

C.3.1.3 **Voluntary stewardship program.** WSCC, Ecology, and WSDA should support implementation, funding, and assistance to those counties participating in the Voluntary Stewardship program, as well as new capacity for enforcement of state and federal water quality regulations.

C.3.1 ISL8 **Implement a small farm water quality improvement project in Ebey's Prairie.** The project will include water quality treatment technology (e.g., grassy swales, filter strips, phytoremediation) and landowner farm practices (e.g., manure management, filter strips) to reduce non-point stormwater pollution.

In addition, actions associated with Ecology, DOH, WSDA, and WSCC in identifying priority areas for implementation of voluntary, incentive, and technical assistance programs for rural unincorporated landowners, small acreage farms, and other working farms are described in sub-strategy A3.1.

C3.2 Ensure compliance with regulatory programs designed to reduce, control, or eliminate pollution from working farms

The Washington Water Pollution Control Act, RCW 90.48, administered by Ecology, prohibits the discharge of pollutants from all lands in the state, including agricultural lands. WSDA inspects dairy operations and ensures their compliance under the Dairy Nutrient Management Act, RCW 90.64.

Ongoing Programs

Ecology has the responsibility to control and prevent the pollution of streams, lakes, rivers, ponds, inland waters, salt waters, watercourses, and other surface and underground waters of the State of Washington. Ecology also is authorized to provide grants to address pollution problems.

Ecology identifies priority areas for work to address agricultural runoff through a variety of processes, including ambient monitoring and the state Water Quality Assessment, which lists the impaired waters in the state. To address these impaired waters, Ecology may develop a total maximum daily load/water cleanup plan or may work to directly implement the practices necessary to solve the water quality problems. In many cases, incentive and technical assistance programs are available to help land owners identify and implement BMPs; some of these programs provide financial assistance. Ultimately, Ecology uses a combination of tools—education, technical and financial assistance, and compliance actions to ensure water quality standards are met. In conducting this work, Ecology often works with and may provide funding for other entities such as conservation districts or WSU Extension.

Water quality BMPs, referenced by RCW 90.48, is a legal term that refers only to those combinations of pollution controls used to prevent and control water pollution that achieve compliance with water quality law. Regulations in Washington State specifically define water quality BMPs as those approved by Ecology (WAC 173-201A-020), and those that are applied to attain compliance with the water quality regulations (WAC 173-201A-510).

Dairies must control the use of nutrients and limit bacteria discharge on their dairy operations in order to eliminate runoff from their fields getting into surface water or to minimize leaching into groundwater. Nutrients and bacteria may come from dairy manure, commercial fertilizer or other non-agricultural sources. Nutrient controls are intended to prevent nutrients from reaching surface water and thus helps to prevent reductions of dissolved oxygen or changes in pH. Bacteria controls are intended to prevent bacteria from reaching surface water, which protects human health from harmful organisms, and supports safe shellfish production. Preventing nutrients and bacteria from reaching groundwater protects human health from contaminated drinking water and protects surface water from potential contamination through hydraulic connectivity between groundwater and surface water

To protect Puget Sound from dairy discharges of nutrients and bacteria, WSDA inspects all dairies and identifies those that have infrastructure conditions or management practices that may result or have the potential to discharge nutrients and bacteria to waters of the state, both surface and ground. If risks are identified, WSDA works with the dairy operation to identify structural improvements or changes in management practices that will reduce and eliminate the risk of discharge. WSDA inspections may include referrals to technical assistance agencies or may result in enforcement when needed.

WSDA inspections evaluate dairies to ensure that operators properly collect, transfer, treat and store manure and contaminated water. Proper collection, handling and storage of dairy generated manure and wastewater and protect water of the state and Puget Sound from nutrient and bacterial contamination. WSDA evaluates nutrient management on dairies by reviewing the dairy's soil tests, their nutrient application timing, methods, locations, amounts, and the crops grown on their fields. WSDA monitors the nutrient levels and operators response in management from year to year and takes compliance actions as needed. This recordkeeping requirement helps the dairy operator to focus on applying just enough nutrients for their fields in each growing season. Fall soil tests show how much nitrogen and phosphorus are left on fields after crop removal and thereby help inform the operator on management adjustments for future improvements.

Finally, there is a specific permit focused on addressing pollution from animal feeding operations. The concentrated animal feeding operation NPDES permit is administered by Ecology. This permit is required for all animal feeding operations that discharge to waters of the state. Animal feeding operations are defined as operations that confine and feed animals for a total of 45 days or more in any 12-month period where vegetation or post harvest residues are not sustained in the normal growing season over any portion of the facility where animals are confined. Ecology's work implementing the concentrated animal feeding operation permit is focused on ensuring that manure is stored, handled and applied properly and at agronomic rates to prevent discharges to surface and groundwater. This includes discharges from application fields, waste storage facilities and animal confinement areas.

Near-Term Actions

The near-term actions[5] identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.3.2.1 **Priority Areas for voluntary incentive and regulatory programs.** WSCC, WSDA, Ecology, and DOH will identify priority areas to better target and coordinate implementation of voluntary incentive and regulatory programs for rural landowners, small-acreage landowners, and working farms.

C.3.2.4 **Concentrated Animal Feeding Operation General Permit.** Ecology will issue an updated Concentrated Animal Feeding Operation General Permit by December 2016.

C.3.2 SNST3 **Agricultural runoff.** Engage with the WSCC Agriculture Stormwater Committee to develop implementation and monitoring priorities related to agricultural runoff in the Snohomish and Stillaguamish basins. Both the King Conservation District and the Snohomish Conservation District will work with agricultural producers and livestock owners to implement BMPs that will address water quality and habitat resource concerns.

Emerging Issues and Future Opportunities

Reducing nutrient pollution is important, particularly in areas like parts of Puget Sound where harmful algal blooms and depressed oxygen levels affect both aquatic life and human use and health. Currently, only dairies or facilities covered under the concentrated animal feeding operation permit have requirements and oversight to control nutrient applications. Monitoring nutrient applications from all sources, including manure, fertilizer, tilled-in cover crops, and other organic soil amendments is needed in Washington State to ensure beneficial application of nutrients are conducted.

Existing technical assistance to agricultural operators should be augmented with focused nutrient management education to third-party applicators of manure and fertilizers as well as major crop growers. The objective should be to increase awareness across the industry sectors of the importance of accounting for all nutrient sources, of making necessary applications at the right time, in the right place, in the right form and in the right amount. In addition, education on field conditions and appropriate measures to take to prevent runoff into adjacent or nearby surface water should also be communicated to landowners and applicators. The dairy industry has found savings in their fertilizer costs by better accounting of all sources; there may be similar economic advantages for other agricultural growers.

Manure handling and storage of manure solids can include periodic transport from manure generators to crop fields for stockpiling in preparation for spreading at a later time. Manure is an important source of crop nutrients and improves soil health. Continued export of manure to crop growers is an important element of sustainable agricultural practices and economy. However, improper transport and stockpiling can result in runoff of nutrients and bacteria as well as cause nuisance issues related to odor. Only dairies currently have regular oversight on this practice. Existing technical assistance to agricultural operators should be augmented with focused education to third-party haulers and applicators of manure as well as major crop growers on handling and storage. Agencies may need to review current standards for potential improvements to the standard as well as the implementation of the standards.

[5] Gaps in numbering reflect near-term actions that have been completed or otherwise retired.

Target View: Dissolved Oxygen (Marine Water Quality)

One important measure of water quality and a component of the Marine Water Condition Index is the amount of dissolved oxygen in the water. Fish, crabs, and many other species living in Puget Sound need oxygen to survive. As dissolved oxygen decreases, animals become stressed. When levels of dissolved oxygen get too low, fish and other animals may die, often in widespread "fish kills." An over-abundance of nitrogen can be a major cause of low dissolved oxygen since it fosters growth in marine plants and algae. When these plants and algae die, their decay robs the water of oxygen. Nitrogen occurs naturally in water, but we also add more through discharge from wastewater treatment plants, septic systems, and run-off from developed and agricultural lands. One way we can improve marine water quality is to reduce the amount of nitrogen we contribute from these sources. Linking the amount of nitrogen pollution from humans to the growth of algae and the amount of dissolved oxygen is critical to protecting water quality.

Because dissolved oxygen concentrations are a result of many natural and human influences, we cannot simply measure dissolved oxygen and understand how much humans contribute directly. A combination of monitoring data, studies on the sources of nitrogen, and sophisticated mathematical models are required to determine whether human inputs are contributing to a decline in dissolved oxygen.

Ecology and Pacific Northwest National Laboratory recently released the report *Dissolved Oxygen Assessment for Puget Sound and the Straits: Impacts of Current and Future Human Nitrogen Sources and Climate Change through 2070*. Modeling efforts indicate most of the Salish Sea reflects a relatively low impact from human nitrogen sources. Portions of South and Central Puget Sound experience the greatest impacts, which would worsen with future population growth. In addition, timing of freshwater flow due to climate change could worsen impacts in some regions but lessen others. As we gain a better understanding of how humans contribute to low levels of dissolved oxygen, it will be possible to develop targeted management actions to address them. In the future we will update these results using better models and more recent estimates of nitrogen loads coming into Puget Sound. Together, model assessments and the Marine Water Condition Index will be used to track current conditions and long term changes in dissolved oxygen and overall water quality of Puget Sound.

The Marine Water Condition Index combines measurements relevant to water quality in Puget Sound. Changes in water quality are reported with numbers greater than zero indicating improving water quality in green and numbers smaller than zero indicating decreasing water quality in red. Although the index is well suited to track changes in water quality in Puget Sound it cannot be used to identify the specific sources of human contribution that are causing poor water quality.

Ecology's Marine Water Condition Index

Annual, 1999-2010

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Admiralty Reach	20	13	8	4	0	-5	-3	-6	3	1	-7	-4
Georgia Basin	-2	14	13	-2	-2	10	-2	-7	2	9	-10	7
South Hood Canal	16	7	9	2	-4	-8	-1	-12	6	10	-1	-13
Central Basin	15	14	12	8	0	-6	-9	-3	4	1	-7	-11
Bellingham Bay	10	13	23	-3	1	6	-13	-10	7	2	-12	-14
Sinclair Inlet	8	16	13	0	-1	-5	-6	-10	3	1	1	-14
Oakland Bay	16	13	14	-1	-6	-10	-5	1	3	-3	-2	-7
South Sound	19	14	14	-6	4	0	-5	-2	3	0	-8	-12
Elliot Bay	28	19	5	-4	-9	3	-16	-9	3	3	-6	-6
Commencement Bay	17	8	13	-3	-6	-1	-4	-1	6	-4	-8	-8
Whidbey Basin	11	8	8	-6	-2	-10	-1	-1	8	7	-9	-13
Budd Inlet	8	14	17	1	-12	-9	-7	-1	8	4	0	-9

Source: Marine Monitoring Unit, Washington State Department of Ecology

Recovery Target

Prevent dissolved oxygen levels from declining more than 0.2 milligrams per liter in any part of Puget Sound as a result of human input.

Relevant Strategies (and Sub-Strategies)

- C1. Prevent, reduce, and control the sources of contaminants entering Puget Sound (C1.1, C1.2, C1.3)
- C2. Use a comprehensive approach to manage urban stormwater runoff at the site and landscape scales (C2.1, C2.2, C2.3, C2.4, C2.5)
- C3. Prevent, reduce, and control agricultural runoff (C3.1, C3.2)
- C6. Prevent, reduce and/or eliminate pollution from centralized wastewater systems (C6.1, C6.2, C6.3, C6.4, C6.5)
- C9. Address and clean up cumulative water pollution impacts in Puget Sound (C9.1, C9.3)

Figure C-12 (Appendix C, *Results Chains*) depicts how the strategies contribute to reducing pressures on dissolved oxygen and achieving the marine water quality recovery target for dissolved oxygen. Appendix C also contains a results chain for each individual strategy in the Action Agenda, showing how that strategy reduces pressures and contributes to achieving numerous recovery targets.

Forest Land Runoff

The Challenge

Approximately 60 to 65% of the Puget Sound basin is forested land. A significant amount of this area is being actively managed for timber production (non-national park/wilderness areas). Surface runoff from forestry, particularly forest roads, stream crossings, delivery of water from road ditches and the capturing of seeps and springs as part of road cuts, has the potential to deliver excess sediment to streams. Forest harvesting also has the potential to affect the hydrology of a watershed, by affecting evapotranspiration rates; and as a result of skid trails, yarding corridors and harvesting near unstable slopes.

In Washington State, forest practices are regulated under the Forest Practices Act, established by the Legislature, and by the rules adopted by the Washington Forest Practices Board (the Board). The most recent significant change in rules was adopted in July 2001. The 2001 rules were informed by the Forests and Fish Report, which was the product of a multi-stakeholder effort to recommend improvements to forest practices that would protect water quality and the aquatic and riparian habitat associated with fish and riparian dependent amphibians on forestlands.

The forest practices program meets the requirements of the Endangered Species Act through establishing rules that are designed to meet the *Forest Practices Habitat Conservation Plan*. In addition, the forest practices program, as guided by a well-funded and robust adaptive management program, was intended to bring these forested waters into compliance with state and federal water quality requirements. Through meeting the *Forest Practices Habitat Conservation Plan* and the Clean Water Act requirements, the State of Washington seeks to provide long-term conservation of covered species by restoring and maintaining riparian habitat on non-federal forestland, meeting water quality standards and supporting an economically viable timber industry.

CLIMATE CHANGE

Declining snow pack and loss of natural water storage, changes in precipitation timing may likely exacerbate runoff from forests. A high-priority overarching response strategy identified in *Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy* (Washington State Department of Ecology 2012a) directly relates to runoff.

- **Safeguard fish and wildlife and protect critical ecosystem services that support human and natural systems**. This includes reduce existing stresses on fish, wildlife, plants, and ecosystems. Reducing polluted runoff improves water quality and aquatic habitat, thereby increasing the resilience of aquatic species to additional stresses from climate change.

Implementing the forest runoff strategy in the Action Agenda helps prepare for climate change.

SALMON RECOVERY PLAN PRIORITY: FOREST LAND RUNOFF

As described in Action Agenda strategy C2, improvement in water quality is identified in the salmon recovery plan with a call to resolve uncertainty about whether the regional water quality actions address the needs of salmon. Volume I identifies general concerns related to stormwater runoff. Several watershed chapters specifically mention rural runoff from areas such as forest roads as needing to be addressed.

How are these priorities are integrated? The Action Agenda contains more detailed strategies and actions to address rural runoff than the Salmon Recovery Plan. More work is needed to address rural run-off priorities as identified in the specific watershed chapters. In addition, the resolution about the effectiveness of actions still needs to be addressed.

Recovery Targets

The strategies and actions in this section will contribute to achieving the recovery targets listed below with their associated vital signs and indicators.

Vital Sign	Indicator	Recovery Target(s)
Freshwater Quality	Water Quality Index	At least half of all monitored stations should score 80 or more on the Water Quality Index.
	Number of *impaired* waters	Reduce the number of *impaired* waters.
	Benthic Index of Biotic Integrity	Protect small streams that are currently ranked *excellent* by the Benthic Index of Biotic Integrity for biological condition, and improve and restore streams ranked *fair* so their average scores become *good*.
Toxics in Fish	Levels of four types of toxic contaminants in fish: polychlorinated biphenyls, flame retardants, hydrocarbons, and endocrine-disrupting compounds	By 2020, contaminant levels in fish will be below health effects thresholds (i.e., levels considered harmful to fish health or harmful to the health of people who consume them).
	Levels of contaminant-related disease in fish	By 2020, contaminant-related disease or impairments in fish are reduced to background levels.
Marine Sediment Quality	Sediment Chemistry Index	By 2020, all Puget Sound regions and bays achieve chemistry measures reflecting minimum exposure with Sediment Chemistry Index scores >93.3.
	Sediment Quality Standards	Have no sediment chemistry measurements exceeding the Sediment Quality Standards set for Washington State.
	Sediment Quality Triad Index	All Puget Sound regions and bays, as characterized by ambient monitoring, achieve the following: Sediment Triad Index scores reflect unimpacted conditions (i.e., SQTI values >81).
Shellfish Beds	Acres of harvestable shellfish beds	A net increase of 10,800 harvestable shellfish acres, including 7,000 acres where harvest had been prohibited between 2007 and 2020.

Local Priorities

Whatcom LIO identified a near-term action that addresses forest land runoff. This local action is presented in the *Strategies and Actions* section along with Soundwide actions under the sub-strategy

shaded below. The local action numbering contains the area abbreviation shown in parentheses after each LIO name. See Section 4, *Local Recovery Actions*, for detailed information about local planning.

Local Integrating Organization	Sub-Strategy C4.1	Sub-Strategy C4.2
Hood Canal Coordinating Council (HC)		
Island (ISL)		
San Juan (SJI)		
Snohomish-Stillaguamish (SNST)		
South Central Caucus Group (SC)		
Alliance for a Healthy South Sound (SS)		
Strait ERN (STRT)		
West Central (WC)		
Whatcom (WH)		

Strategies and Actions

C4. Prevent, Reduce, and Control Surface Runoff from Forest Lands

C4.1 Achieve water quality standards on state and privately owned working forests through implementation of the Forest and Fish Report

In 1999, the Forest and Fish Report included Clean Water Act assurances granted by Ecology with the expectation that by 2009, research and monitoring would demonstrate that water quality standards would be achieved or a trend towards that achievement identified. In 2009, Ecology found there was insufficient data and information to substantiate the assurance that water quality standards were being achieved in working forests. At the same time, Ecology also found that the Forest and Fish program, even with its challenges, creates a well-established foundation for achieving full compliance with the water quality standards. Ecology extended Clean Water Act assurances, conditioned on achievement of 21 program milestones, with some scheduled to be completed by as late as 2019. These include the following.

- Support rules and funding to implement the Forest and Fish Report.
- Support an adaptive management program to update rules and guidance as necessary, with particular focus on water quality-related rules.
- Consistent compliance and enforcement of Forest Practices Rules.
- Bring roads up to design and maintenance standards.

Recent Progress

As of August 2011, 10 of the 21 program milestones have been completed. DNR, Ecology, and the Forests and Fish cooperators continue to make progress on completing key milestones towards maintaining Clean Water Act assurances.

One of the main constraints to accomplishing the milestones on schedule is personnel capacity and funding limitations at DNR and other agencies and partners in the implementation of the Forest and Fish Report. The Forest Practices Program has experienced decreased funding in the last two biennial budgets, with an overall decrease of $4 million in FY 2009–2011 and an additional $2 million in FY 2011–2013 from state general funds. This represents a decrease of approximately 28% in state general fund appropriations, and has impacted DNR's ability to support the Adaptive Management Program, compliance monitoring, and enforcement of the Forest Practices Rules. Compounding the decreased state funding, federal funding from the Pacific Coastal Salmon Recovery grants has also diminished.

Federal funding through the Pacific Coastal Salmon Recovery Fund supported a substantial portion of the Forest Practices Adaptive Management Program between 2000 and 2011. Averaging almost $5 million a biennium, and spanning a period of ten years, this funding is no longer being provided by the federal government. These funds supported the development of tools to aid implementation of the Forests and Fish Report, and in the last 6 years, went almost entirely to support adaptive management program research and monitoring. This loss of funding has created a serious challenge for the Forest Practices Program to meet adaptive management program obligations. While those funding losses have been offset somewhat by the creation of the Forests and Fish Support Account by the Legislature to support tribal and non-governmental participation in the implementation of the Forests and Fish Report, this does not completely bridge program costs associated with the Adaptive Management Program.

Ongoing Programs

DNR is working to complete the remaining 11 milestones on a schedule to maintain Clean Water Act assurances from Ecology. Among those remaining, a few have been a particular challenge for DNR and its cooperators to complete due to funding and staffing resource limitations. These include obtaining an independent review of the Adaptive Management Program, training and certification of staff and cooperators, assessing the condition of small forest landowner roads, and completing the Cooperative Monitoring, Evaluation, and Research work that drives the science-based adaptive management process. In the coming years, DNR and the Forest and Fish Cooperators will continue to work towards these milestones. The operational and procedural milestones had completion due dates by 2013, while a schedule of Cooperative Monitoring, Evaluation, and Research studies stretches out through 2019.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.4.1.1 **Forest Practices Adaptive Management Program review.** DNR will work to secure long-term and dependable funding for the Forest Practices Adaptive Management Program to conduct science and research to assist the Forest Practices Board to achieve the resource goals and objectives of the Forests and Fish Report.

C.4.1.2 **Forest Practices Adaptive Management Program.** DNR will work to secure long-term and dependable funding for the Forest Practices Adaptive Management Program, training, compliance monitoring, and enforcement.

C.4.1.3 **Continue to implement road maintenance and abandonment programs on forested trust lands.** DNR will continue to complete scheduled and planned road work on forested trust lands in the Puget Sound basin to protect water quality and provide for fish passage.

C4.2 Maintain forest roads and implement road abandonment plans for working forest lands subject to the Forest Practices Rules on schedule, and ensure federal forest managers meet or exceed state standards for road maintenance and abandonment on federal lands

Forest Practices Rules include road maintenance and abandonment provisions to prevent sediment and hydrology-related impacts to public resources such as water quality and fish habitat. The rules require large forest landowners to develop and implement road maintenance and abandonment plans (RMAP) for roads within their ownership. Large forest landowners are required to have all roads within their ownership covered under a DNR-approved RMAP (WAC 222-24-051) by July 1, 2006, and to bring all roads into compliance with forest practices standards by October 1, 2016 (or with approved extension by 2021). This includes all roads that were constructed or last used for forest practices since 1974. An inventory and assessment of orphaned roads (i.e., forest roads and railroad grades not used for forest practices since 1974) also must be included in the RMAP.

In an effort to minimize the economic hardship on small forest landowners (also known as family forest landowners), the 2003 Legislature passed a RMAP bill (House Bill [HB] 1095) that modified the definition of "small forest landowner" and specified how the road requirements applied to small forest landowners. Small forest landowners have the option to submit a "checklist" RMAP with each forest practices application or notification, rather than to provide a plan for their entire ownership. The RMAP checklist is a brief assessment of certain characteristics of roads proposed to be used under a forest practice application, and does not provide a complete inventory of the condition of all of the landowner's forest roads. This means that specific roads on small forest landowner properties need not be brought up to current standards until they are being actively used for a forest practices activity.

To assist small forest landowners in achieving road maintenance requirements specific to fish passage, the Legislature created the Family Forest Fish Passage Program[6] in 2003. This is a cost-share program that provides 75 to 100% of the cost of correcting fish barriers. The program is managed by three Washington State agencies (DNR, WDFW, and RCO).

The federal *Northwest Forest Plan* has been in place since the mid-1990s and has dramatically lowered rates of timber harvest on federal lands within the range of the northern spotted owl. This has resulted in less timber revenue to support maintenance of federal forest roads. In 2000, the USFS Region 6 and Ecology signed a memorandum of agreement in which the USFS agreed to develop RMAPs for all federal forest roads within 5 years (2005) and fully implement those plans within 15 years (by 2015). Yet,

[6] www.dnr.wa.gov/BusinessPermits/Topics/SmallForestLandownerOffice/Pages/fp_sflo_fffpp.aspx

continued reductions in federal funding has created an estimated $300 million (2005 dollars) shortfall in the funds needed to upgrade roads to current standards, repair fish passage barriers, and decommission roads no longer needed or supportable.

In November 2010, as part of implementation guidance on national regulations for Travel Management Planning[7] the Deputy Chief for the U.S. Forest System set a target for each National Forest to complete plans that would "right size" the federal forest road system by 2015. Each unit of the National Forest System is to identify the minimum road system needed for travel and the protection, management and use of National Forest System lands, and identify roads that are no longer needed to meet forest management objectives, and therefore scheduled for decommissioning. The National Forest System expects to identify an appropriately sized and environmentally sustainable road system that is responsive to ecological, economic, and social concerns, which will include water quality effects from forest runoff. National Forest System staff is expected to engage the public in the process, involving a broad spectrum of interested and effected citizens, other state and federal agencies, and tribal governments.

Recent Progress

State and private forest landowners have made a significant capital commitment to protecting public resources and listed species through the RMAP requirement, as detailed in the *Forest Practices Habitat Conservation Plan Annual Report* (Washington State Department of Natural Resources 2013). As of June 2013, approximately 20,026 miles have been improved to current standards. There are currently 254 approved RMAPs and submitted checklists statewide. Between 2001 and 2012, over 4,846 fish passage barriers were removed or replaced, which is about 66% of known fish barriers identified in RMAPs. As a result, over 2,659 miles of fish habitat were opened in streams on forestlands. In addition, over 10,268 RMAP checklists have been submitted by small forest landowners associated with the approval of forest practice applications.

As of June 2012, over 289 projects were completed and up to 682 miles of stream habitat previously inaccessible to fish were opened up through the Family Forest Fish Passage Program. Over that same time period, the state of Washington has invested approximately $20.85 million in the program (Washington State Department of Natural Resources 2013).

According to the *FY 2010 Legacy Roads and Trails Accomplishment Report* (U.S. Forest Service 2010), $7.3 million was spent on Washington State's federal forest roads and trails. With this funding, 42 miles of roads were decommissioned, and 788 miles of road storm proofing and maintenance were conducted. In addition, five fish passage barriers were restored, opening a total of 12.2 miles of fish habitat. This is the greatest commitment of legacy roads and trails funding for the Pacific Northwest region in more than a decade. Unfortunately, this level of effort is insufficient to address the backlog of National Forest System roads system repairs.

Given that more than 80% of the current National Forest System roads system was built before 1980, and there are over 90,000 miles of forest roads just in the Pacific Northwest region, it seems unlikely this restoration effort will meet its commitment with the State of Washington to implement all necessary

[7] www.fs.fed.us/recreation/programs/ohv/final.pdf

road maintenance and abandonment by 2015. It was estimated in the 2000 memorandum of agreement that Congress (at that time) allocated less than 20% of the funding necessary for the USFS to adequately maintain their roads. More recent estimates in 2005 suggest a $300 million backlog of work on forest roads in Washington alone. With 2010 marking the greatest commitment of funding in a decade, it appears that Congress will have to substantially increase funding in order to ensure road systems on federal lands do not contribute to poor water quality for salmon and people in the Puget Sound basin or threaten downstream habitat improvements that have been made.

The effort to appropriately size the National Forest System road network has begun, with nine of 17 National Forests in the Pacific Northwest region having begun the process of conducting a "Travel Analysis" to identify an appropriate road system.

Ongoing Programs

Large landowners must bring all roads into compliance with forest practices standards by October 31, 2016 (or with approved extension by 2021).

DNR will continue to ensure that small forest landowner roads used for forest practices activities are brought up to forest practices standards as part of the checklist RMAP process. In addition, Forest Practices will continue to track RMAPs and checklist RMAPs submitted by small landowners, reporting progress in its annual published HCP report. DNR reported to the Legislature in December 2013 on the progress of checklist RMAP implementation.

The Family Forest Fish Passage Program has more than 500 landowner-proposed repair projects that are not funded. Several hundred more barriers likely exist on these smaller forest ownerships, in addition to those already waiting for funding. However, this is not a complete inventory. Every year 50 to 100 new landowners enroll in the program. The major factor limiting progress is funding. More than 30 local community conservation organizations around the state provide project oversight and accountability, and work with the small forestland owners to ensure projects are identified and installed according to plan. Minimal state agencies staff provide the program structure, accounting, coordination and consistency. In terms of stream habitat opened up per dollar spent, Family Forest Fish Passage Program has proven to be one of the soundest investments in salmon recovery being made in Washington State.

When USFS received $20 million of 2010 funding for the Legacy Roads and Trails Program in the Pacific Northwest region, they planned 3 years of projects, assuming maintenance of that budget. In FY 2011, however, that budget was reduced to $8.5 million. In FY 2013 funding for Legacy Roads and Trails Program was folded together with four other watershed protection and restoration programs into the Integrated Resource Restoration budget as a pilot[8]. The pilot program consistently showed improved efficiencies and USFS is seeking $820 million in FY 2015 funding nationwide (U.S. Forest Service 2014).

All National Forest System units in the region are preparing plans for completion of the travel analysis by 2015. They will each identify a road network that can be reasonably maintained under current budget constraints, given management objectives, and responsive to ecological, economic and social concerns. In addition, each unit has been asked to identify the capital budget needed to bring that appropriately

[8] Integrated Resource Restoration budget includes: Wildlife and Fisheries Management, Vegetation and Watershed Management, Forest Products, Non-wildland urban interface (WUI) Hazardous Fuels, and Legacy Roads and Trails

sized road network up to a level that can be maintained under the current budget. This will include road maintenance and abandonment needs, and fish passage issues needing correction. This capital budget needs assessment will provide an updated estimate of the true backlog of road maintenance needs on federal forestlands.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.4.2.1 **Risk assessment of small forest landowner roads.** DNR, in consultation with Ecology, will design and complete a resource risk assessment of small forest landowner roads for the delivery of sediment to waters of the state. Work with stakeholders to propose an approach to solving identified problems, and focus restoration efforts on small forest landowner lands in the Puget Sound Basin.

C.4.2.2 **Accelerate Family Forest Fish Passage Program implementation.** DNR, will continue to implement and seek to expand financial support for the Family Forest and Fish Passage Program which improves water crossing projects within the Puget Sound Basin.

C.4.2.3 **Fish passage barriers.** WDFW will assess and prioritize fish passage barriers by watershed within the Puget Sound.

C.4.2.4 **Enhance road maintenance and abandonment plan database.** DNR will continue to update the Large Landowner Road Maintenance and Abandonment Plan database to ensure tracking of progress in bringing roads up to current standards.

C.4.2.5 **Road maintenance and abandonment plan coordination with federal partners.** DNR will work to secure participation in annual road maintenance and abandonment plan coordination meetings with landowners, WDFW, Ecology, affected tribes, NMFS, USFWS, affected counties, watershed councils and other interested parties within each watershed (per WAC 222-24-051(11)). Participants will discuss opportunities to provide a coordinated approach within each watershed resource inventory area by (1) prioritizing road maintenance and abandonment planning and (2) exchanging information on road maintenance and stream restoration projects.

C.4.2 WH2 **WRIA 1 Forest Road Inventory and Assessment for implementation.** Compile information on federal, state, and private forest roads identified as risks to aquatic resources. In addition, identify additional non-system roads and prioritize road segments based on potential for mass wasting and sediment delivery to streams. Develop treatments for road decommissioning, storage, and seek funding for implementation.

Wastewater

The Challenge

Pollution of the rivers, creeks, bays and open waters of Puget Sound comes from a variety of sources and travels along many pathways. This section focuses on the potential for pollution from wastewater collection, treatment, and disposal—the system that is designed to collect and treat used water and human waste from homes and businesses and, in some cases, wastewater from industrial processes and urban stormwater. Essentially, everything that goes down a sink or is flushed down a toilet ends up in the wastewater system. This includes not just human waste but also a wide range of household cleaning products and chemicals and personal care products.

Wastewater management involves a spectrum of approaches and technologies that can be used to effectively treat sewage in different situations. In every case, the selected approach and technology must be tailored to local site conditions and take into account such factors as development densities; capital, maintenance and operation costs; and protection of public health and water resources. Generally, wastewater is treated either through a wastewater treatment plant or through an onsite sewage system. Both types of systems are regulated and permitted by state and/or local agencies.

Wastewater treatment plants are centralized facilities that use sewer collection systems to serve densely developed areas; they typically discharge treated effluent to surface water. Onsite sewage systems, commonly known as septic systems, are decentralized or distributed systems that serve small communities, areas of limited development, and individual properties. They are called onsite systems because they treat wastewater on or near the site where the wastewater is generated.

Both types of systems are part of the region's permanent wastewater infrastructure. There are roughly 100 wastewater treatment plants that discharge to surface waters in the Puget Sound region. There are about 300 large onsite sewage systems and more than a half million small onsite sewage systems in the Puget Sound basin. Wastewater treatment systems play a critical role protecting public health and water quality, but they need proper management, operation, and maintenance to ensure effective treatment and to protect the infrastructure investments.

Ten centralized Puget Sound facilities include combined sewer overflows (CSOs) as part of their sewage and stormwater system. CSOs often are located in older parts of cities. Sewage and stormwater flow through a single piping system to a sewage treatment plant. During heavy rainfall events the system can be overwhelmed and is then designed to "overflow" untreated wastewater and stormwater at specific outfalls. In some locations, these CSO outfalls have been associated with sediment contamination and other impacts. Untreated wastewater also is discharged to Puget Sound from some boats and vessels.

Strategies for reducing pressures on Puget Sound from wastewater include efforts to prevent and control pollution from onsite sewage systems, wastewater treatment plants, and boats and vessels. They also include consideration of overarching approaches to promote watershed-based and integrated approaches to better manage the region's wastewater treatment needs.

CLIMATE CHANGE

Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy (Washington State Department of Ecology 2012a) identifies reducing existing stresses on the ecosystem as an important part of climate adaptation strategies. Action Agenda strategies to reduce pressure from wastewater from onsite sewage systems and treatment plants, help implement the state's climate response strategies to achieve the following.

- Safeguard fish and wildlife and protect critical ecosystem services that support human and natural systems.
- Reduce the vulnerability of coastal communities, habitat, and species.

In addition, wastewater facilities can be vulnerable to climate change impacts. Extreme weather events could cause more frequent combined sewer overflow events and intrusion of seawater could damage equipment and strain. Higher water tables and increased flood events may increase corrosion of underground utilities. Siting of retrofits and new facilities will need careful consideration.

Recovery Targets

The strategies and actions in this section will contribute to achieving the recovery targets listed below with their associated vital signs and indicators.

Vital Sign	Indicator	Recovery Target(s)
Onsite Sewage Systems	Onsite sewage inventory, inspection, and repair.	Inventory all onsite sewage systems in Marine Recovery Areas and other specially designated areas; be current with inspections at 95%; and fix all failures.
		Phase in an expansion of Marine Recovery Areas and other specially designated areas to cover 90% of Puget Sound's unsewered marine shorelines.
Shellfish Beds	Acres of harvestable shellfish beds	A net increase of 10,800 harvestable shellfish acres, including 7,000 acres where harvest had been prohibited between 2007 and 2020.
Swimming Beaches	Conditions of swimming beaches.	Have all monitored beaches in Puget Sound meet EPA standards for what is called enterococcus, a type of fecal bacteria.
Eelgrass	Eelgrass area	A 20% increase in the area of eelgrass in Puget Sound relative to the 2000–2008 baseline reference by 2020.
Toxics in Fish	Levels of four types of toxic contaminants in fish: polychlorinated biphenyls, flame retardants, hydrocarbons, and endocrine-disrupting compounds	By 2020, contaminant levels in fish will be below health effects thresholds (i.e., levels considered harmful to fish health or harmful to the health of people who consume them).
	Levels of contaminant-related disease in fish	By 2020, contaminant-related disease or impairments in fish are reduced to background levels.
Marine Water Quality	Dissolved oxygen levels	Prevent dissolved oxygen levels from declining more than 0.2 milligram per liter in any part of Puget Sound as a result of human input.
Marine Sediment Quality	Sediment Chemistry Index	By 2020, all Puget Sound regions and bays achieve chemistry measures reflecting minimum exposure with Sediment Chemistry Index scores >93.3.

Vital Sign	Indicator	Recovery Target(s)
	Sediment Quality Standards	Have no sediment chemistry measurements exceeding the Sediment Quality Standards set for Washington State.
	Sediment Quality Triad Index	All Puget Sound regions and bays, as characterized by ambient monitoring, achieve the following: Sediment Triad Index scores reflect unimpacted conditions (i.e., SQTI values >81).

Local Priorities

LIOs identified near-term actions that address wastewater. These local actions are presented in the *Strategies and Actions* section along with Soundwide actions under the sub-strategy shaded below. The local action numbering contains the area abbreviation shown in parentheses after each LIO name. See Section 4, *Local Recovery Actions*, for detailed information about local planning.

	Sub-Strategy							
Local Integrating Organization	C5.1	C5.2	C5.3	C6.1	C6.2	C6.3	C6.4	C6.5
Hood Canal Coordinating Council (HC)								
Island (ISL)								
San Juan (SJI)	■							
Snohomish-Stillaguamish (SNST)			■					
South Central Caucus Group (SC)								
Alliance for a Healthy South Sound (SS)			■					
Strait ERN (STRT)					■			
West Central (WC)								
Whatcom (WH)								

Strategies and Actions

C5. Prevent, Reduce, and/or Eliminate Pollution from Decentralized Wastewater Treatment Systems

Onsite sewage systems are an essential and valuable part of Puget Sound's wastewater infrastructure. They provide a high level of treatment and great flexibility developing and using properties where construction of, or connection to, centralized sewer systems is not feasible or practical. They can be designed and configured to treat sewage in most settings. Small systems (peak design flows below 3,500 gallons per day) typically serve single family residences or combined flows from fewer than a dozen homes. The vast majority of these systems are very small. The typical design for a 3-4 bedroom home is 360–480 gallons per day, and because of water efficiency measures such as low flow showers and faucets, most of these systems operate at closer to 250 gallons per day. Large systems (peak design flows up to 100,000 gallons per day) can be engineered to treat flows from up to 370 residential connections.

Small onsite sewage systems traditionally consist of collection pipes, a septic tank, and a drainfield. In this design, the septic tank holds and separates wastewater into solid and liquid components to allow initial decomposition and treatment in an anaerobic (septic) environment. From the tank, the liquid effluent flows into the drainfield, which is generally a series of perforated pipes or molded chambers installed in suitable soil. The drainfield provides further treatment by allowing the effluent to be exposed to an oxygen-rich environment where bacteria and other microbes continue to treat contaminants. The drainfield removes and inactivates pathogens as the effluent filters through the soil layers before entering the groundwater.

There are other treatment technologies in use that are collectively referred to as "alternative systems." These systems often use devices to enhance aerobic treatment and may use filters to screen solids and pumps to pressurize and distribute the septic tank effluent more evenly over the drainfield to promote better soil treatment. Large onsite sewage systems are often engineered to include additional or other types of treatment.

When onsite sewage systems don't function properly they can pollute groundwater or, if there is a direct connection, nearby surface water. The pathogens and chemicals in sewage can make people sick, contaminate shellfish and other water resources, and disrupt ecosystem functions. Older onsite sewage systems and systems in sensitive areas often present higher risks. In addition, even properly operating systems can leach excess nutrients into Puget Sound; an issue that needs further study and action to address. Work is underway to better understand and document the sources, loadings, and impacts of nitrogen on Puget Sound and the appropriate steps to effectively address this emerging challenge.

There are many strategies for improving the region's decentralized wastewater infrastructure. The key is life-cycle management and care of onsite sewage systems, making sure they are properly sited, designed, installed, operated and maintained. Overarching strategies include (1) implementing and funding effective state and local onsite sewage programs; (2) providing low-interest loans to help homeowners repair and replace failed and malfunctioning systems; (3) documenting problem areas and pollution impacts and developing appropriate wastewater treatment solutions; and (4) improving practices, partnerships, and professional services to effectively and efficiently manage and maintain onsite sewage systems.

C5.1 Effectively manage and control pollution from onsite sewage systems

DOH administers the state rule for onsite sewage systems with peak design flows below 3,500 gallons per day (Chapter 246-272A WAC). This is the vast majority of all systems in Puget Sound. Local health jurisdictions adopt and implement this rule to regulate and permit onsite sewage systems at the local level. Among other requirements, the rule sets standards for siting, designing, installing, operating and maintaining onsite sewage systems. Once systems are in use, onsite sewage system owners are responsible for operating, monitoring, and maintaining their systems to make sure they function properly.

Under the state rule, the 12 Puget Sound local health jurisdictions are required to develop and carry out comprehensive plans to help ensure that systems are properly managed, with emphasis on operation and maintenance activities and geographic areas where onsite sewage systems pose an increased public health risk. The local operations and maintenance programs are designed and implemented differently

in each county and are applied strategically to different types of systems, sensitive areas, and other situations (e.g., time-of-sale inspections) on the basis of public health risk and other criteria.

As part of the planning process, local health jurisdictions also are required to designate and protect marine recovery areas (Chapter 70.118A RCW). Marine recovery areas (MRAs) must be designated when the local health officer determines that existing onsite sewage systems are a significant factor contributing to concerns associated with the degradation of shellfish growing areas, marine waters listed by Ecology for low-dissolved oxygen levels or fecal coliform, or marine waters where nitrogen has been identified as a contaminant of concern. The focus in marine recovery areas is to: (1) find existing failing systems and ensure that system owners make necessary repairs, and; (2) find unknown systems and ensure that they are inspected and functioning properly, and repaired if necessary.

Ongoing Programs

The state and local onsite sewage system programs are designed to regulate the safe and appropriate use of onsite sewage systems to effectively treat sewage and to protect public health and water quality. Ongoing implementation of these programs includes many activities and responsibilities. Some are unique to DOH, some are unique to the local health jurisdictions, and some are shared. The work includes the following DOH performance measures: (1) Reviewing and approving local rule changes and reviewing waivers to ensure ongoing consistency with the state rule; (2) reviewing and registering proprietary products, additives, and sewage tanks for use in the state; (3) regularly updating state standards and guidance documents for alternative technologies; (4) contracting with and distributing state funds to help implement the local onsite sewage system management plans and coordinating semi-annual performance reporting; and (5) adapting onsite sewage system management plan implementation and reporting to align with and make progress toward onsite sewage system performance measures adopted for Government Management Accountability and Performance (GMAP) and the Action Agenda.

All 12 Puget Sound counties have developed local management plans and submitted them to the DOH for approval, and nine counties have designated one or more marine recovery areas. Based on the number of onsite sewage systems noted in an earlier section of more than 500,000 and an annual failure rate of 1%, the annual need should approach 5,000. Many system repairs or replacements are financed privately or by lending institutions. Additionally, Ecology oversees funding to LHJs, which is directed to owners to support repairs; LHJs issue permits for repairs/replacements to many owners who self-finance repair work. These amount to hundreds of annual improvements and personal investments.

The GMAP program identifies two measures for onsite sewage systems. First the state tracks the number of onsite sewage system repairs or replacements funded by Ecology in Puget Sound counties. The target is 39 every 6 months. Ecology passes funding to local health jurisdictions that identify the systems for repair or replacement and oversee the work. Since 2007, performance has been at or above the target, and as of December 2010, 388 systems had been repaired or replaced by local health jurisdictions through financial assistance from Ecology. Second, the state tracks the status of onsite sewage systems inventoried, inspected, and fixed in marine recovery areas and other designated sensitive areas. The target, consistent with the Puget Sound recovery goal, is to inventory all onsite sewage systems, fix all failures, and be current with inspections at 95% in marine recovery areas and

other designated areas by 2020. The target also calls on local health jurisdictions to expand these areas and programs to cover 90% of Puget Sound's un-sewered marine shorelines by 2020.

Near-Term Actions

The near-term actions[9] identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.5.1.2 **Onsite sewage system operation and maintenance program best practices.** DOH will work with Local Health Jurisdictions (LHJs) to identify successes and best practices, develop common performance standards, and recommend approaches to improve core functions of local operation and maintenance programs.

C.5.1.3 **Onsite sewage system nitrogen treatment technologies.** DOH will evaluate public domain onsite sewage system treatment technologies for nitrogen reduction and develop standards and guidance for their use if testing results indicate the technologies are effective and reliable. The evaluation will be completed and work on standards and guidance, if needed, will begin after that.

C.5.1.4 **Wastewater facilities treatment.** Outside urban growth areas. Commerce, in partnership with Ecology and DOH, will identify shoreline areas outside urban growth boundaries where residential densities are great enough that it may be appropriate to extend centralized wastewater collection systems and that are in close enough proximity to centralized treatment that extension of infrastructure may be feasible. The goal of this effort is completion of the design of at a least one pilot project and construction of a least one pilot project.

C.5.1 SJI6 **Fully implement the Onsite Sewage System Operation and Maintenance Program Plan (Near-Term Run Off Action II).**

C5.2 Effectively manage and control pollution from large onsite sewage systems

DOH directly regulates and permits large onsite sewage systems with flows between 3,500 and 100,000 gallons per day (gpd) (Chapter 246-272B WAC). DOH adopted a revised large onsite sewage systems rule in 2011. Among other changes, the expanded large onsite sewage system program consolidates all large onsite sewage system permitting authority at DOH, requires annual operating permits for all large onsite sewage systems, and requires protection of public health and the environment. The rule is structured to regulate and permit large onsite sewage systems in different situations ranging from newly constructed systems to existing systems that have never been documented or permitted. The revised rule includes many new requirements and approaches for siting, designing, constructing, operating, maintaining, repairing, permitting and managing large onsite sewage systems.

Ongoing Programs

The overarching performance objective of the large onsite sewage system program is to regulate the systems and owners to achieve effective long-term treatment and to protect public health and water

[9] Gaps in numbering reflect near-term actions that have been completed or otherwise retired.

quality. The program includes a strong focus on Puget Sound. The work includes the following DOH performance measures: (1) locate, assess, and permit all large onsite sewage systems with emphasis on marine recovery areas and other designated areas; (2) annually review and renew operating permits; (3) issue permits for large onsite sewage systems previously permitted by Ecology as the permits expire; (4) issue permits for large onsite sewage systems previously permitted by local health jurisdictions as the permits transfer to DOH; (5) work with large onsite sewage system owners as needed to address deficiencies in order to achieve adequate treatment and compliance with the rule and permit conditions; (5) develop technical guidelines and standards for large onsite sewage system design and operations and maintenance, system evaluations, document submittals, and other program activities; and (6) reset and report on the large onsite sewage system performance measure for GMAP based on the new large onsite sewage system rule and database and make progress toward the targets.

The state GMAP performance measure for large onsite sewage systems addresses compliance with requirements of the revised large onsite sewage system rule adopted by DOH in 2011. By the end of 2011, DOH had identified 277 large onsite sewage systems in the Puget Sound region, 263 of which were under permit.

Near-Term Actions

None; work in the near-term will focus on implementation of ongoing programs.

C5.3 Improve and expand funding for onsite sewage systems and local large onsite sewage system programs

Funding for proper operation and maintenance of onsite sewage systems and for replacement of failing systems is an ongoing challenge. The work is expensive; the cost of replacing a system can be as high as $40,000.

Funding assistance currently is comprised of a variety of grant and loan programs, including a $4.2 million state program administered by Ecology to help homeowners and small businesses in the 12 Puget Sound counties repair, replace, or improve their existing systems. (See discussion of performance objectives for ongoing onsite sewage systems programs, above.) Since 2007, this program has funded replacement of 388 failing systems around Puget Sound. In addition, Craft3 (formerly Enterprise Cascadia) offers low interest loans to homeowners and businesses in Jefferson, Kitsap, Mason, and Clallam Counties to repair or replace onsite sewage systems. This program, funded in part through Ecology, uses public and private resources to help owners fix or replace malfunctioning systems. From 2007 through December 2010, 245 systems were improved using this mechanism.

Other Puget Sound counties have established their own low-interest loan programs, as well. While these programs have helped, eligibility for them can be constrained by the age and location of the system, the income level of the homeowner, and other criteria. Additional and more reliable sources of funding are needed to support local operation and maintenance programs and programs to repair or replace failing onsite sewage systems.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.5.3.1 **Regional onsite sewage system homeowner loan program.** DOH and Ecology and the PSP will help evaluate options and support proposals to fund a unified, self-sustaining, low-interest loan program in the Puget Sound region to help onsite sewage system owners repair and replace their systems.

C.5.3.2 **Regional onsite sewage system program funding source.** DOH will evaluate approaches and mechanisms (e.g., a regional flush tax or sewer surcharge) to generate and distribute funds to Puget Sound counties to implement their onsite sewage system management plans and programs.

C.5.3 SNST5 **Onsite septic systems maintenance and retrofit.** Seek stable funding and expand Snohomish Health District program to provide technical assistance to property owners with septic systems. Investigate role of failing onsite septic systems in elevating stream bacteria and nutrient loads in Kimball and Coal Creek subbasins. Explore upgrading or decommissioning septic systems and connecting to municipal sewer systems.

C.5.3 SNST8 **Pollution identification and correction project.** Snohomish County, together with project partners, will conduct a pollution identification and correction project to identify specific sources of fecal coliform bacteria contamination in the Lower Stillaguamish sub-basin and expand to the Snohomish Basin.

C.5.3 SS1 **Mason County enhanced septic repair grant and loan program.** Achieve a self-sustaining septic repair 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.

C.5.3 SS2 **Thurston County enhanced septic repair grant and loan program.** 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.

C.5.3 SS3 **Pierce County enhanced septic repair grant and loan program.** Achieve a self-sustaining septic repair grant and loan programs, expressly targeting shellfish reopening and/or preserved open status in Nisqually, Case, Pickering, Carr and Island Inlet watersheds.

Emerging Issues and Future Opportunities

In addition to the specific ongoing program activities and near-term actions described above, a number of ideas for future work might be considered to better address the Puget Sound region's wastewater treatment needs and further reduce pressures on the Puget Sound ecosystem. These ideas should be an ongoing part of the regional discussion about how to best address wastewater treatment needs in the Puget Sound basin, and may inform future funding decisions, programmatic priorities and guidance, and/or may become near-term actions in future Action Agenda cycles.

Many of these ideas have to do with exploring potential future funding to ensure local health jurisdictions can effectively oversee and administer programs for reliable operation, maintenance, repair and replacement for onsite systems. They include the following.

- Evaluate funding options to help local governments with projects involving onsite sewage systems conversions to more centralized treatment and to decommission abandoned systems. Residences in older neighborhoods in some cities remain on onsite sewage systems even though surrounding, newer neighborhoods are served by centralized wastewater treatment. It can be difficult to convert these neighborhoods to centralized treatment—often individual homeowners do not have adequate resources or incentives to work together to fund conversion, utilities have little incentive to convert older neighborhoods, and local governments do not have the resources to subsidize these efforts.
- Evaluate and discuss models and ways to engage private wastewater companies and public utilities in onsite sewage system management as pilot projects or in new working relationships.
- Explore approaches to expand funding options for large onsite sewage systems.

Other ideas raise a range of issues related to targeting technical and financial assistance, considering cumulative impacts, and improving treatment technologies.

- Identify priority areas around Puget Sound needing focused technical and financial assistance to solve chronic sewage problems. Explore options to provide targeted technical and financial assistance to solve these problems.
- Revise the definition of onsite sewage systems failure to account for cumulative impacts of multiple onsite sewage systems. We need to address situations where the cumulative effect of pollution from onsite sewage systems in a community has a significant effect on water quality, even though the individual systems do not meet the traditional definition of failure (i.e., sewage that surfaces or backs up into a structure). This may be the case, for example, where it is clear that a certain neighborhood is creating water quality impacts but no individual onsite sewage system in that area is failing.
- Objectively evaluate impacts of onsite sewage system for pollutants of concern other than fecal coliform, like nitrogen and toxic chemicals, and update regulations and management plan guidance to address these findings.
- Work with the onsite sewage system industry and others to develop new, affordable, and reliable technologies that reduce nutrient and fecal coliform concentrations in onsite sewage system effluent.
- Work to develop cost effective ways to effectively separate urine from wastewater.
- Develop standards of practice for onsite sewage system operations and maintenance service providers in the Puget Sound region.
- Include assessment of cumulative impacts in planning and permitting for centralized and decentralized wastewater systems in comprehensive plans. Centralized wastewater management options largely flow from the location at which the wastewater is generated—inside or outside an urban growth area; served by centralized treatment or not. Options to reduce wastewater generation through re-use of gray water, and to re-use treated water through reclaimed water projects are implemented largely on an ad hoc basis. There may be opportunities to take a more

holistic approach to wastewater planning and thereby to better and more efficiently provide needed treatment and use all water resources fully. This issue also is discussed in sub-strategy C5.1 on effectively managing and controlling pollution from onsite sewage systems. In the 2012/2013 Action Agenda, a series of near-term actions were proposed on this issue, and comments on the near-term actions were mixed, and focused on the interaction between Growth Management Act requirements and wastewater treatment planning. These ideas will be explored further as a part of near-term action C5.1.3.

- Integrate climate change considerations into siting and design of new facilities and retrofits.

C6. Prevent, Reduce, and/or Eliminate Pollution from Centralized Wastewater Systems

Centralized wastewater treatment facilities are regulated through NPDES permits administered by EPA and Ecology under the federal Clean Water Act and state regulations. Untreated wastewater from municipal, industrial, and government facilities contains a broad spectrum of pollutants, including nutrients and pathogens. Wastewater treatment removes or transforms many, but not all, contaminants. Depending on the amounts and types of treatment, treated wastewater can contain a variety of contaminants, including personal care products, caffeine, endocrine-mimicking chemicals, pharmaceuticals, and industrial chemicals.

Approximately 100 municipal and industrial wastewater treatment plants discharge to the marine waters of Puget Sound and the Straits of Georgia and Juan de Fuca and to rivers and other water bodies in the Puget Sound watershed. The combined daily discharge of treated wastewater to Puget Sound is over 430 million gallons per day. In addition, during wet weather events, CSOs in some older urban areas of ten Puget Sound cities sometimes discharge mixed stormwater and untreated domestic and industrial wastewater when conveyance or treatment plant capacities are exceeded.

The effectiveness of pollutant removal at treatment plans varies with the treatment technology and to some degree the age of the treatment facility. Treatment effectiveness also depends on the amount and types of contaminants in the wastewater treatment facilities receive from residents and businesses. Municipal facilities have traditionally focused on removing pathogens, biochemical oxygen demand, toxic chemicals, and suspended solids with a primary objective of protecting human health. Industrial facilities typically have systems customized to the exact composition of their wastewater and/or discharge to municipal systems after pre-treatment on site. In Puget Sound most municipal wastewater treatment plants use secondary treatment technology, and few have needed to install advanced treatment technology to meet current discharge limits. All new facilities constructed in recent years have been built with advanced treatment.

Reducing the amount of impervious surface also may reduce the frequency and extent of CSOs and inflow and infiltration. Implementing the stormwater actions described in strategy C2 will help reduce the pressure on Puget Sound from wastewater.

OCEAN ACIDIFICATION

As stated in *Ocean Acidification: From Knowledge to Action, Washington State's Strategic Response* (Washington State Blue Ribbon Panel on Ocean Acidification 2012), acidification of coastal waters, especially in highly populated and developed areas, is often exacerbated by locally derived human and natural inputs that generate additional carbon dioxide in marine waters. Nutrients and organic carbon provide locally important contributions. Programs that reduce nutrients and organic carbon are not only beneficial for removing pollutants that reduce pH or lower dissolved oxygen levels, but also protect people and shellfish from bacterial contamination. Substantial progress has been made in Washington to reduce the pollutants that affect water quality and human health, including nutrients and organic carbon. One existing program is underway at the LOTT sewage treatment plant, where nitrogen has been removed from its effluent for several years. This has resulted in a significant benefit to Budd Inlet, which receives the plant's discharge.

The Blue Ribbon Panel recommendations include a strategy to strengthen and augment existing pollutant reduction actions to reduce nutrients and organic carbon. Strategic actions also recommend expanding nutrient and carbon reduction efforts by initiating similar programs at other treatment plants where discharge is contributing to ocean acidification. The strategies and actions in this section directly implement the Blue Ribbon Panel's recommendations.

C6.1 Reduce the concentrations of contaminant sources of pollution conveyed to wastewater treatment plants through education and appropriate regulations, including improving pre-treatment requirements

Preventing sources of pollution conveyed to wastewater treatment plants will be a key part of reducing the overall threat to Puget Sound. Work in this area will rely heavily on strategies and actions related to reducing sources of toxics addressed in strategy C1 and include developing safer alternatives for chemicals in use, advancing programs to help prevent chemicals from entering the Puget Sound environment, education and technical assistance, and other strategies.

Pre-treatment programs, which are focused on working with businesses and industrial facilities that discharge wastewater to municipal treatment plants, also play an important role. These programs work to prevent the introduction of pollutants that could interfere with treatment plant processes, impact receiving water or biosolids quality, and/or threaten workers' safety. Effective implementation of the pre-treatment program plays a vital part in ensuring contaminants are not conveyed to wastewater treatment plants in amounts in excess of the plants' treatment capacity or acceptance requirements.

Emerging chemicals are a particular issue for pre-treatment standards, and are discussed in the emerging issues list, below. In addition, some commenters on the draft Action Agenda expressed concern that pre-treatment requirements, overall, are not protective enough for Puget Sound and should be reevaluated and updated, this is an issue that warrants further discussion.

Near-Term Actions

None; work will focus on implementation of ongoing programs.

C6.2 Reduce pollution loading to Puget Sound by preventing and reducing combined sewer overflows

Combined sewer systems are wastewater collection systems designed to carry sanitary sewage (consisting of domestic, commercial, and industrial wastewater) and stormwater in a single piping

system to a treatment facility. In periods of rainfall or snowmelt, total wastewater flows can exceed the capacity of the sewer collection systems and/or treatment facilities. When this occurs, the combined sewer system is designed to overflow directly to nearby streams, lakes, and harbors, discharging untreated sewage and stormwater. These overflows are called CSOs and can cause contribute to water and sediment quality problems.

Contaminants in CSOs can include pathogens, oxygen consuming pollutants, solids, nutrients, toxic chemicals, and floatable matter—all of which can harm the health of people, fish and wildlife. CSOs can contribute to shellfish harvesting restrictions, contaminated sediment, impairment of the aquatic habitat, and aesthetic degradation due to unsightly floating materials associated with raw sewage. Ten Puget Sound cities have combined sewage and storm collection systems.

CSO control is a vital part of the statewide effort to reduce and control stormwater discharges. CSO reduction programs are in place in 11 jurisdictions in Washington. In 1988, Ecology estimated that the average volume of untreated CSOs discharged to the state waters was 3.3 billion gallons per year. Since then, Washington has made progress in addressing this pressure, with a reduction of CSOs to less than 1 billion gallons in 2009.

A number of communities have been successful in controlling and reducing their CSOs completely and the remaining communities continue to make progress in CSO control. Strategies for controlling CSOs include separation, storage, or treatment of flows. More recently, “green” stormwater infrastructure (GSI) has been used alone or in concert with other control strategies as a cost effective approach for some CSO reduction projects. Many different tools, including a variety of stormwater control strategies, could be used to reduce pressures on the Puget Sound ecosystem from CSOs.

One of EPA’s National Priorities for enforcement and compliance assurance for FY 2008–2010 addresses CSOs and sanitary sewer overflows. The priority focuses on enforcement of the Clean Water Act and the codified CSO Control Policy, which requires that CSO discharges to be reduced to a level that does not contribute to violations of the water quality standards.

Ecology requires that CSO discharges be controlled to an average of one discharge per year per outfall, consistent with the EPA’s CSO Control Policy. As of February 2011, the following Puget Sound CSO facilities were determined to meet this standard: Anacortes, Bellingham, Bremerton, and LOTT (in Olympia). Other facilities are under permits or compliance orders to meet the standard: Everett (estimated compliance date 2017), King County (estimated compliance date 2030), Mount Vernon (estimated compliance date 2015), Port Angeles (estimated compliance date 2015), Seattle (estimated compliance date 2025), and Snohomish County (no estimated compliance date).

Ecology’s work on CSOs is focused on ensuring that facilities current in compliance, and on providing technical assistance to facilities developing compliance plans and activities to ensure they meet their compliance dates.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.6.2 STRT29 Implement City of Port Angeles combined sewer overflow reduction projects. Implement suite of combined sewer overflow Phase 1 and Phase 2 projects to reduce combined sewer overflow events into the Port Angeles Harbor to one per outfall per year on average.

C6.3 Implement priority upgrades of municipal and industrial wastewater facilities

EPA has delegated authority to Ecology to administer the Clean Water Act provisions for NPDES permits. This includes both individual permits to discharge and general permits that cover multiple dischargers in particular categories of sources (e.g., municipal stormwater permits). All wastewater treatment plants that discharge to Puget Sound have individual NPDES permits, which are highly tailored to meet water quality standards for the pollutants in the discharge.

Ecology also is responsible for establishing TMDLs or water cleanup plans for impaired water bodies that are identified as not meeting state water quality standards. In marine waters such as Puget Sound, TMDLs require that contributions from the combined total of human point and nonpoint sources cannot cause dissolved oxygen levels to fall below particular concentrations; where concentrations naturally fall below these levels, the combined total of all human sources cannot cause more than a 0.2 mg/L depletion at any time. Marine waters with measured concentrations below the thresholds must be assessed to determine whether human activities are contributing to the low levels or whether the low levels result from natural conditions. Through implementation of the TMDL program, Ecology can identify when and where wastewater treatment discharge limits for individual treatment plans must be lowered to achieve water quality goals; these studies also will identify areas where nonpoint sources, including contamination from onsite sewage systems and polluted runoff, may need to be reduced.

Municipal and industrial wastewater treatment plants provide a critical element of Puget Sound protection by giving us a way to manage wastewater; however, outfall discharges into Puget Sound prevent harvest from shellfish growing areas on state-owned lands, depriving the state of badly needed revenue, half of which is used to restore and protect the state's aquatic lands through the Aquatic Lands Enhancement Grant program. Closures on private tidelands also reduce income for private shellfish businesses and deprive residents of the opportunity to harvest shellfish at recreational sites. Closures associated with outfalls are required regardless of permit discharge limits and regardless of permittees compliance with permits. These closures are automatic, based simply on the presence of the outfall and the associated potential for pollution. Many large outfalls are not practical to remove or relocate, but others may be under used, no longer needed, or able to be combined with other nearby outfalls.

Ongoing Programs

To support TMDL or similar processes in Puget Sound, Ecology is carrying out a number of studies to determine how nitrogen from a variety of sources affects dissolved oxygen levels in South Puget Sound and other areas with low levels of dissolved oxygen. These studies are a critical first step in determining what will be needed to improve water quality. The results of the studies may show that human-related sources of nitrogen need to be reduced to keep South Puget Sound and other regions healthy. If reductions are needed, the study will also help determine where reductions might need to occur and what actions might be needed, such as upgrading wastewater treatment plans to advanced treatment. These studies also will identify areas where nonpoint sources, include contamination from onsite

systems and polluted runoff, need to be reduced. The TMDL program and related near-term actions are described under strategy C9.

Near-Term Actions

None; work in the near-term will focus on implementation of ongoing programs; see C9 for additional discussion of TMDLs and water cleanup plans.

C6.4 Ensure all centralized wastewater treatment plants meet discharge permit limits through compliance monitoring, technical assistance, and enforcement where needed

NPDES permit holders, including all wastewater treatment plants that discharge to Puget Sound, must report compliance in Daily Monitoring Records (DMRs) submitted to Ecology. Ecology reviews these DMRs and also inspects facilities for compliance.

Ecology's goal is that all wastewater treatment plants maintain compliance with permits written to meet standards for all permit limits. Consistent with this goal, Ecology recognizes wastewater treatment plants for perfect performance—that is, meeting every permit condition, every day, for an entire year. In 1995, only 14 plants in Washington State were in full compliance with permit requirements; in 2010, over 100 plants were in full compliance including 40 within the Puget Sound watershed.

When violations are found, Ecology's goal is to ensure plants return to compliance quickly. EPA guidance defines a major violation as any parameter violated by a permittee for the months in a row. In that case, Ecology's permit manager initiates contact with the permittee and takes a range of action to ensure a return to compliance. Ecology may issue enforcement orders if a permittee is unable to correct the violation. Ecology's goal is to inspect major plants once a year and minor plants every 2 years.

One issue that gained some attention during development of the 2012/2013 Action Agenda was inflow and infiltration (I&I). Excess water that flows into sewer pipes from groundwater and stormwater is called infiltration and inflow, or I&I. Groundwater (infiltration) can seep into sewer pipes through holes, cracks, joint failures, and faulty connections. Stormwater (inflow) can rapidly flow into sewers via roof drain downspouts, foundation drains, storm drain cross-connections, and through holes in manhole covers. Most I&I is caused by aging infrastructure that needs maintenance or replacement. There is some evidence that a substantial portion of excess water entering conveyance lines derives from side sewers that connect individual homes and businesses to the collection system. This excess water takes up capacity during peak flows that could otherwise be used for wastewater treatment alone and generates the need to build added capacity in pipelines, treatment plants, and other wastewater facilities.

Wastewater treatment providers manage I&I as part of the overall maintenance of the conveyance system; however where I&I derives largely from side sewers or individual homes or businesses opportunities for centralized utilities to find and repair the sources of I&I can be limited, and present funding challenges. NPDES permits do not necessarily specify a target for the percentage of water delivered to treatment plants that comes from I&I rather than through wastewater. Permittees are required to report I&I in their annual reports to Ecology. I&I levels are reviewed, along with any permit violations or sanitary sewer overflows considered spills, and must be reported to Ecology. Ecology may

issue a compliance order to plants that have multiple problems, and I&I controls, if appropriate, could be one of several actions required. Currently, one plant in South Puget Sound is under a compliance order. Recent permits added a new requirement that permittees pressure test force mains for exfiltration. Plants that have high levels of I&I in the winter may be more likely to produce exfiltration in the summer months, and some permits stipulate that any gravity sewers close to water bodies must pressure tested once per permit cycle.

Ongoing Programs

Key Ongoing Program Activities

- Ecology, in accordance with NPDES permits issued under the Clean Water Act, will continue to work with permittees to reduce sanitary sewer overflows in all areas of Puget Sound, with an emphasis on Marine Recovery Areas.
- Ecology will work with permittees reduce inflow and infiltration in centralized wastewater collection systems in all areas of Puget Sound with an emphasis on watersheds with declining baseflows or watersheds closed to additional withdrawals or otherwise water stressed.
- Ecology will work with permittees to reduce exfiltration in all areas of Puget Sound with an emphasis on watersheds and marine waters where bacteria concentrations violate water quality standards.
- Ecology will complete evaluations of I&I project effectiveness in Puget Sound basin and review evaluations from elsewhere to determine the potential effectiveness of I&I reduction programs.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.6.4.1 **Water quality standards update.** Ecology has initiated rulemaking to amend the Water Quality Standards to update and develop predictable regulatory compliance tools that address short and long-term source control programs. The proposed changes will provide predictable regulatory tools to help entities comply with existing and new source control requirements or discharge limits. The changes will allow compliance with requirements while they effectively work toward meeting permit limits and control sources of pollutants.

C6.5 Promote appropriate reclaimed water projects to reduce pollutant loading to Puget Sound

Reclaimed water is derived from domestic wastewater and small amounts of industrial process water or stormwater. The process of reclaiming water, sometimes called water recycling or water reuse, involves a highly engineered, multi-step treatment process that speeds up nature's restoration of water quality. The process provides a high-level of disinfection and reliability to ensure that only water meeting stringent requirements leaves the treatment facility.

Reclaimed water can be used for a wide variety of beneficial uses such as irrigation, industrial process and cooling water, toilet flushing, dust control, construction activities, and many other non-potable uses. Reclaimed water also can be used as resource to create, restore, and enhance wetlands, recharge

groundwater supplies, and increase the flows in rivers and streams. Reclaimed water is classified based on intended use. Class A reclaimed water must meet strict standards. Reclaimed water must not cause a violation of state water quality standards.

Ongoing Programs

Expansion of reclaimed water programs will be a vital part of Puget Sound recovery. In 2006, the Legislature directed Ecology to adopt a rule for reclaimed water use by 2010. The rulemaking has been delayed due to other legislation (2011 Washington State Legislature ESHB 1478), but Ecology can now move forward and will file an intent for rulemaking in June 2014 to continue the rulemaking process. When final, the rule will provide a consistent, predictable, and efficient regulatory process. It also will encourage the generation and beneficial use of reclaimed water while preserving and protecting public health, the environment, and existing water rights.

Key Ongoing Program Activities

- Ecology will resume the Reclaimed Water Rule no earlier than 2013 or as directed by the Governor. The intent of this rule is to encourage the appropriate use of reclaimed water.
- Ecology will develop materials that describe the full range of beneficial uses for reclaimed water, best and appropriate uses, and public health issues (in consultation with DOH) to expand market demand for reclaimed water. The draft guidance document developed for the rule is on hold along with the Reclaimed Water Rule.
- As part of the future Reclaimed Water Rule, the Partnership, and Ecology will develop a comprehensive outreach and education approach to promote the appropriate use of reclaimed water, including incentives for reclaimed water use where appropriate, and reduce barriers to reclaimed water projects.

Near-Term Actions

No near-term actions identified. Work in the near-term will focus on implementation of ongoing programs.

Emerging Issues and Future Opportunities

In addition to the specific ongoing program and near-term actions described above, a number of ideas for future work might be undertaken to address the Puget Sound region's ongoing need for centralized wastewater treatment and to further reduce pressures on the Puget Sound ecosystem. These ideas should be an ongoing part of the regional discussion about how to best address wastewater treatment needs in the Puget Sound basin, and may inform future funding decisions, programmatic priorities and guidance, and/or may become near-term actions in future Action Agenda cycles. They include the following.

- Consideration of whether increasing nutrient removal requirements should be applied through the water quality based programs such as TMDL implementation, or whether Ecology should pursue a revision in secondary treatment technology standards for new treatment plants and upgrades at treatment plants that discharge to Puget Sound before all TMDLs are complete. Some stakeholders advocate requiring advanced secondary treatment (largely for nitrogen removal) and/or tertiary

treatment (largely for additional chemical treatment or other forms of polishing) for all wastewater treatment plants that discharge to Puget Sound; others are concerned about making such a large investment (and thereby precluding other needed investments) without specific documentation that such treatment is needed to protect water quality.

- Better understanding and addressing other contaminants of concern. Due to new detection and sampling methods and new products and consumption patterns we are increasingly aware of chemicals that can threaten human and environmental health in effluents from wastewater treatment plants at very low concentrations. These include pharmaceuticals, personal care products, caffeine, natural hormones, and other chemicals. We should better understand where this is occurring and the impacts of these chemical in the environment and continue to refine source control and wastewater treatment, pre-treatment, and reclaimed water programs to address chemicals of concern.
- Replacement of aging infrastructure.
- Integrate climate change considerations into siting and design of new facilities and retrofits.

Target View: Onsite Sewage Systems

For many people, especially those in rural areas of Puget Sound, onsite sewage systems are the best option for sewage treatment. When properly designed and installed, these systems provide a high level of treatment. Proper care is the key to long-term performance of all sewage treatment systems. Older onsite systems and systems located in sensitive areas often present higher risks. With newer systems, advances in technology mean there is more need for regular maintenance to keep things working smoothly. Poorly maintained systems can break down, requiring costly repairs and polluting our prized waterways and water resources. Regular inspections help protect onsite sewage systems and Puget Sound.

Recovery Target

- Inventory all onsite sewage systems in Marine Recovery Areas and other specially designated areas; be current with inspections at 95%; and fix all failures.
- Phase in an expansion of Marine Recovery Areas and other specially designated areas to cover 90% of Puget Sound's unsewered marine shorelines.

Relevant Strategies (and Sub-Strategies)

- C5. Prevent, reduce, and/or eliminate pollution from decentralized wastewater treatment systems (C5.1, C5.2, C5.3)
- C7. Ensure abundant, healthy shellfish for ecosystem health and for commercial, subsistence, and recreational harvest consistent with ecosystem protection (C7.1, C7.2, C7.3, C7.4)
- C9. Address and clean up cumulative water pollution impacts in Puget Sound (C9.3, C9.4).

Figure C-13 (Appendix C, *Results Chains*) depicts how the strategies (and related sub-strategies) contribute to reducing pressures related to onsite sewage systems and achieving the onsite sewage systems recovery target. Appendix C also contains a results chain for each individual strategy in the Action Agenda, showing how that strategy (and its related sub-strategies) reduces pressures and contributes to achieving numerous recovery targets.

Shellfish

The Challenge

Shellfish play a significant role in the biological, cultural and historical context of Puget Sound. Healthy shellfish beds are essential to Puget Sound's ecosystem diversity and complexity. Pacific Northwest tribes have lived and harvested shellfish in Puget Sound for about 12,000 years, and archeologists have uncovered shell middens dating back as far as 5,000 years. Shellfish provide sustenance and figure prominently in tribal spiritual beliefs. In the 1850s tribal governments signed treaties with the U.S. government relinquishing land but reserving rights to fish and harvest shellfish in usual and accustomed areas except for staked or cultivated shellfish beds.

Commercial shellfish harvesting began during the California Gold Rush era and continues today providing a significant source of jobs and economic activity in Puget Sound. Overall, Washington State leads the country in production of farmed clams, oysters and mussels with an annual value of over $107 million. Across the state, shellfish growers directly and indirectly employ over 3,200 people and provide an estimated total economic contribution of $270 million. In both Mason and Pacific counties, the commercial shellfish industry is the second largest private-sector employer, supporting more than 1,200 jobs and an estimated total annual payroll that exceeds $27 million. In Puget Sound specifically, there are about 270 recreational shellfish beaches open to harvesting. WDFW conservatively estimates that $125 shellfish harvesting trips are made each year to Puget Sound beaches, providing a net economic value of $5.4 million to the region.

In addition to the cultural, recreational, and economic contributions shellfish make in Puget Sound, they also can play a role in improving the water quality of Puget Sound. Shellfish filtering can improve water clarity so sunlight penetrates the depths, which can improve eelgrass and macroalgae (attached seaweed) growth. Shellfish assimilate some of what they take in and pass on the rest as digested and undigested material that settles to the bottom sediments. These filtering and recycling processes can contribute to regulating the health of nearshore ecosystems and take on more importance as human activities and related pollution increase in shoreline areas. They also provide structure to the nearshore and refuge and forage opportunities and can help remove nitrogen from the water.

A significant number of shellfish beds are closed in Puget Sound due to pollution. The pollution is from a variety of sources, but mostly from fecal bacteria from humans, livestock, and pets that gets into the water and threatens the areas where oysters, clams and other bivalve shellfish grow. Work to improve water quality to enable the re-opening of shellfish beds closed because of pollution, such as enhanced inspection and reporting requirements for onsite sewage systems (see figure next page), has been ongoing for many years and has achieved considerable success, especially since 1995. Nonetheless, expanding and promoting financial incentives and programs that protect, reopen, and enhance shellfish harvest areas and that restore and enhance the native Olympia Oyster and Pinto Abalone will contribute further to local and state economies.

The significant economic contribution of the shellfish industry was a major motivating factor behind the Washington State Shellfish Initiative announced on December 9, 2011. The initiative is a convergence of the NOAA's National Shellfish Initiative and the state's interest in promoting a critical clean water industry. The NOAA policy establishes a framework to allow sustainable domestic aquaculture to contribute to the U.S. seafood supply, support coastal communities and important commercial and recreational fisheries, and help to restore species and habitat. NOAA sees aquaculture as a critical component to meeting increasing global demand for seafood and maintaining healthy ecosystems.

The Washington Shellfish Initiative is the first of its kind in the nation. While the initiative supports Governor Gregoire's goal of a "dig-able" Puget Sound by 2020, it also encompasses the extraordinary value of shellfish resources on the coast. As envisioned, the initiative will protect and enhance a resource that is important for jobs, industry, citizens, and tribes.

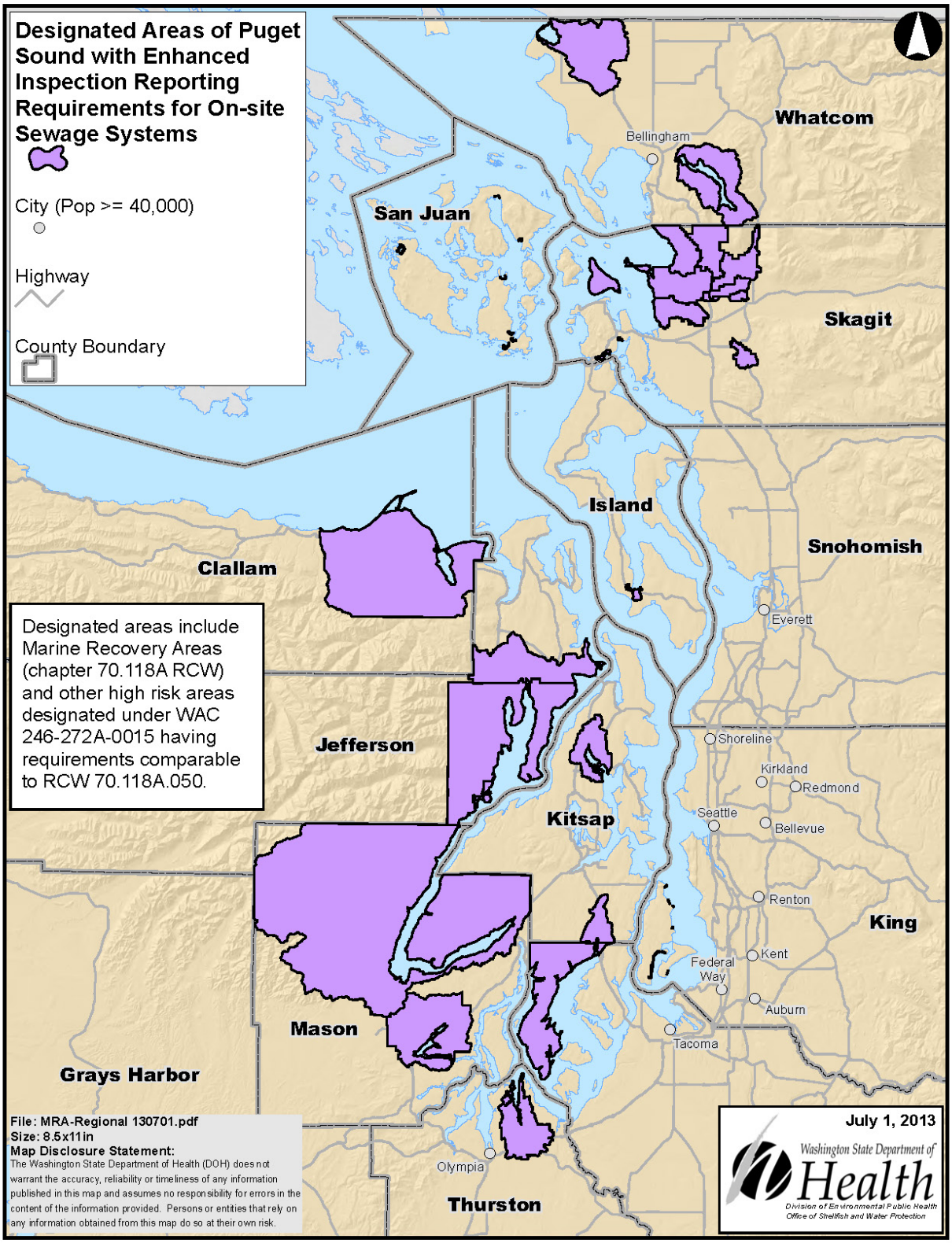
Strategies in this area focus on implementing the Washington Shellfish Initiative. The collective actions support working aquatic lands and improve water quality to protect and restore shellfish beds for human consumption. Strategies related to wastewater, stormwater, and toxics also contribute to the health and recovery of shellfish beds.

CLIMATE CHANGE

Increased acidity in marine waters from carbon dioxide emissions and upland runoff is threatening the aquaculture and shellfish industry. Ocean acidification is related to, but distinct from climate change, although they share a common cause, increasing carbon dioxide in the atmosphere. Ocean acidification is also a concern for harvest of wild shellfish and fish species that use marine plankton as a food source.

Adaptation strategies outlined in *Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy* (Washington State Department of Ecology 2012a) include enhancing our understanding and monitoring of ocean acidification in Puget Sound and coastal waters, as well as our ability to adapt to and mitigate effects of seawater acidity on shellfish, other marine organisms, and marine ecosystems.

The Action Agenda includes support of a key action in the state response strategy: Supporting the work of newly created Blue Ribbon Panel on Ocean Acidification.


Designated Areas of Puget Sound with Enhanced Inspection Reporting Requirements for On-site Sewage Systems
City (Pop >= 40,000)
Highway
County Boundary
Designated areas include Marine Recovery Areas (chapter 70.118A RCW) and other high risk areas designated under WAC 246-272A-0015 having requirements comparable to RCW 70.118A.050.
Whatcom
Bellingham
San Juan
Skagit
Island
Snohomish
Clallam
Everett
Jefferson
Shoreline
Kirkland
Redmond
Kitsap
Seattle
Bellevue
Renton
King
Kent
Federal Way
Auburn
Mason
Tacoma
Grays Harbor
Olympia
Thurston
File: MRA-Regional 130701.pdf
Size: 8.5x11in
Map Disclosure Statement:
The Washington State Department of Health (DOH) does not warrant the accuracy, reliability or timeliness of any information published in this map and assumes no responsibility for errors in the content of the information provided. Persons or entities that rely on any information obtained from this map do so at their own risk.
July 1, 2013
Washington State Department of Health
Division of Environmental Public Health
Office of Shellfish and Water Protection

Recovery Targets

The strategies and actions in this section will contribute to achieving the recovery target listed below for shellfish beds.

Vital sign	Indicator	Recovery target(s)
Shellfish Beds	Acres of harvestable shellfish beds	A net increase of 10,800 harvestable shellfish acres, including 7,000 acres where harvest had been prohibited between 2007 and 2020.

Local Priorities

LIOs identified near-term actions that address shellfish. These local actions are presented in the *Strategies and Actions* section along with Soundwide actions under the sub-strategy shaded below. The local action numbering contains the area abbreviation shown in parentheses after each LIO name. See Section 4, *Local Recovery Actions*, for detailed information about local planning.

	Sub-Strategy				
Local Integrating Organization	C7.1	C7.2	C7.3	C74	C7.5
Hood Canal Coordinating Council (HC)					
Island (ISL)					
San Juan (SJI)					
Snohomish-Stillaguamish (SNST)					
South Central Caucus Group (SC)					
Alliance for a Healthy South Sound (SS)					
Strait ERN (STRT)					
West Central (WC)					
Whatcom (WH)					

Strategies and Actions

C7. Ensure Abundant, Healthy Shellfish for Ecosystem Health and for Commercial, Subsistence, and Recreational Harvest Consistent with Ecosystem Protection

OCEAN ACIDIFICATION

As stated in *Ocean Acidification: From Knowledge to Action, Washington State's Strategic Response* (Washington State Blue Ribbon Panel on Ocean Acidification 2012), ocean acidification produces conditions that make it difficult for shellfish and other calcifiers to form, build, and maintain calcium shells. If the acidification of Washington's marine waters follows its projected pace, it will become more difficult for some calcifiers to make or maintain their shells. Growth rates can be expected to decrease and mortality rates increase. Larval and juvenile shellfish are especially vulnerable. In order to adapt to and remediate the impacts of ocean acidification and limit future losses to shellfish, a comprehensive approach is needed. This approach includes monitoring and maintaining the water quality of hatcheries and commercial shellfish beds.

The Blue Ribbon Panel recommends strategies for preserving and enhancing the resilience of native shellfish. These recommendations include innovative approaches and technologies to maintain and enhance cultivated shellfish production through water quality monitoring in hatchery facilities, post-hatchery facilities, and shellfish farms, developing commercial-scale water treatment methods or hatchery designs to protect larvae from corrosive seawater, and supporting programs to reduce sources of pollutants in commercial shellfish beds. The Action Agenda strategies in this section directly support these Blue Ribbon Panel recommendations.

C7.1 Improve water quality to prevent downgrade and achieve upgrades of important current tribal, commercial and recreational shellfish harvesting areas

Protection and improvement of water quality and control of pollution will be critical to meeting the recovery target for shellfish beds.

DOH monitors shellfish harvesting areas and classifies them as safe or unsafe for harvest. As of the end of 2011, DOH managed the classification of 326,000 commercial shellfish harvesting acres throughout the state, approximately 190,000 in Puget Sound. There were 252,000 acres in 'Approved' classification, 12,000 acres 'Conditionally Approved,' 300 acres with 'Restricted' classifications, and 61,000 acres with 'Prohibited' classifications (see table below).

Department of Health Shellfish Harvesting Area Classifications, as of the End of 2011 (acres)					
	Approved	Conditionally Approved	Restricted	Prohibited	Total
Washington State	252,000	12,000	300	61,000	326,000
Puget Sound					190,000
Note: figures may not add up to total due to rounding.					

In 2011, DOH upgraded the classification of 697 acres in five commercial shellfish areas. Over the same time, 4,960 acres were downgraded in two areas. Poor water quality in the Samish Bay (Samish River) and Pacific coast growing areas resulted in significant classification downgrades.

Over the past 30 years, DOH has downgraded the classification of about 56,000 acres and upgraded the classification of about 46,000 acres (see table below). Most of the downgrades took place between 1981 and 1995, when 45,000 acres were downgraded and 7,000 acres were upgraded. Since 1995, Health has downgraded 11,000 acres while upgrading 40,000 acres. In Puget Sound, approximately 36,000 acres—or about 19% of commercial and recreational shellfish beds—are closed due to pollution sources.

Department of Health Shellfish Harvesting Area Classifications, 1981—2011 (acres)			
	1981—1995	1995—2011	Total: 1981—2011
Area Upgrades	7,000	40,000	46,000
Area Downgrades	45,000	11,000	56,000
Note: figures may not add up to total due to rounding.			

DOH also lists shellfish beds that are threatened with downgrade each year. In 2011, seven areas in Puget Sound were "threatened" with a downgrade in classification: Burley Lagoon, Dyes Inlet, Filucy Bay, Padilla Bay, Pickering Passage, Port Townsend Bay, and South Skagit Bay.

Even with significant downgrades in 2011, in recent years, through efforts of state and local government, tribes, private landowners, and shellfish growers, we have had a net increase of about 1,400 acres of shellfish areas reopen for harvest due to pollution control. Strategies and actions in this area are focused on capitalizing on the lessons learned from these experiences and increasing this trend.

Ongoing Programs

DOH is responsible for assuring that marine water is monitored and all potential pollution sources are evaluated to ensure a safe shellfish harvest. To evaluate shellfish growing areas and protect public health, each year Health commonly collects over 10,000 marine water samples, evaluates about 125 miles of shoreline, and inspects numerous wastewater treatment plants and marinas.

Based on water quality and pollution source evaluations, Health identifies specific locations where shellfish harvest is "threatened" or "of concern" due to pollution. These areas meet the marine water quality standards; however, if pollution problems are not addressed, a downgrade is probable. Often these areas require special attention to prevent a downgrade.

DOH, Ecology, WSDA, Partnership, WSCC and conservation districts, Washington Sea Grant and WSU Extension, tribes, local health departments, shellfish growers and many other stakeholders work together to maintain and improve water quality to protect and restore shellfish areas. Local and tribal governments play significant roles in protecting and restoring water quality in shellfish harvesting areas. Pollution identification and correction programs are locally driven processes focusing on specific geographic areas to find and fix nonpoint water pollution problems. These programs consist of a complete survey of all individual properties to identify nonpoint pollution sources, comprehensive education and outreach activities, technical assistance to homeowners, and financial incentives to encourage pollution control. These programs are widely considered one of the best approaches to protecting and reopening shellfish beds. Pollution identification and correction programs have been successful in reopening beds in Henderson Inlet in Thurston County, Oakland Bay in Mason County, and in several growing areas in Kitsap County where the Pollution Identification and Correction program is most developed. These programs are resource-intensive to accomplish all necessary aspects of the comprehensive program, but experience shows that this is necessary and effective in the long run. A major pollution identification and correction program effort is underway in Skagit County in Samish Bay to recover 4,000 acres of downgraded beds.

Current funding for pollution identification and correction programs comes from local and tribal sources and from state and federal grants. In 2011 and 2012, over $3 million in EPA funds was dispersed to

counties to develop sustainable pollution identification and correction programs; stable long-term funding and support from local and tribal governments and citizens are also necessary for these programs to continue to protect and reopen important commercial and recreational shellfish harvest areas.

When shellfish growing areas are downgraded from nonpoint source pollution, counties are required to form Shellfish Protection Districts. In order to protect important shellfish resources, counties may also voluntarily form Shellfish Protection Districts. The purpose of Shellfish Protection Districts is to bring stakeholders together under a prescribed process to identify sources of pollution, develop a plan, and then implement that plan with accountability steps identified. The district may provide a funding mechanism for local and state resources to contribute to the implementation, but the district may also have a strong education and public involvement elements to change public behavior in such areas as onsite sewage system correction, improved agricultural practices, or stormwater control. In most cases, generation of funds is required to implement a Shellfish Protection District, and often districts incorporate pollution identification and correction programs as part of the restoration process.

Near-Term Actions

The near-term actions[10] identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.7.1.1 **Shellfish best practices library.** DOH will work with the PSP, Ecology, WSCC, and conservation districts and local governments to create a best practices library or menu highlighting successful locally driven efforts to assist in the development of shellfish protection districts, shellfish protection programs, and shellfish growing area restoration activities, such as the Henderson Inlet, Oakland Bay, and Samish Bay efforts.

C.7.1.3 **Local clean water programs.** Ecology, working with WSDA, DOH, EPA, and the tribes will form a Pollution Control Action Team to respond quickly when areas are identified where water quality problems threaten shellfish areas. They will initiate community outreach and education, pollution identification, inspection, technical assistance to local agencies and landowners and finally, enforcement. The team will focus its work in priority areas and support pollution identification and correction programs where they are established. The first effort will be in Drayton Harbor and Portage Bay.

C.7.1 WC26 **South Dyes Inlet wastewater infrastructure.** With an ultimate goal of making Oyster Bay viable for commercial shellfish harvest, the City of Bremerton will assess, improve, and expand sewer infrastructure in South Dyes Inlet.

In addition, strategies and actions related to controlling pollution from runoff and wastewater described in strategies C3, C4, C5, and C6, and to establishment of pollution identification and correction programs in strategy C9 are directly related to improving water quality and recovery of shellfish beds.

[10] Gaps in numbering reflect near-term actions that have been completed or otherwise retired.

C7.2 Restore and enhance native shellfish populations

Native shellfish restoration efforts will focus on two species: native Olympia oysters and pinto abalone.

The Olympia oyster, the Pacific Northwest coast's only native oyster, ranges from southeastern Alaska to Baja, California. For thousands of years, Olympia oysters provided sustenance for tribes and habitat for a host of marine organisms. Until the late 1800s, Olympia oysters were the most abundant bivalves in Puget Sound, where they occupied thousands of acres of productive, diverse habitat. Over-harvesting, sediment loads, and pollution drove the oyster to near extinction. Today, it occupies a fraction of its former range and is a Candidate Threatened Species in Washington State and a priority species for restoration.

Pinto abalone were once widely distributed throughout the waters of British Columbia and Washington state. In recent decades, populations have undergone sharp declines. Known for their large, muscular foot and their pearlescent oval shell, pinto abalone are slow-growing, long-lived marine snails and are typically found in nearshore rocky habitats in semi-exposed or exposed coastal regions. More than 60 abalone species are found worldwide but the pinto, or northern, abalone is the only species found in Washington State, where they range from Admiralty Inlet to the San Juan Islands and the Strait of Juan de Fuca and are typically found at depths to about 20 m.

WDFW regularly monitors the abundance of pinto abalone at 10 index stations throughout the San Juan Archipelago. Data from surveys made in 2006 showed an overall mean abalone density of 0.04 m^2, which is well below the minimum densities for successful reproduction.

Ongoing Programs

WDFW, NOAA, tribes, and many other small and large local groups are involved in native shellfish restoration. Programs focused on Olympia Oyster restoration are oriented around the *Native Oyster Rebuilding Plan*, which will result in restoration of 19 historical large natural oyster beds and associated local ecosystems throughout Puget Sound by 2022. Abalone programs are focused on the work needed to ensure there is adequate abalone production capacity to support restoration. DNR is involved in native shellfish restoration efforts through the aquatic leasing program and the wildstock geoduck fishery management program.

Key Ongoing Program Activities

- WDFW, in collaboration with partners such as Puget Sound Restoration Fund, shellfish growers, the Northwest Straits Commission and The Nature Conservancy, and in collaboration with individual tideland owners, tribes, Marine Resources Committees of the Northwest Straits Commission, Health and other state and local partners, will revise, update, and continue to implement the *Native Oyster Rebuilding Plan* including accelerating restoration of the Olympia oyster.
- WDFW, Puget Sound Restoration Fund, Washington Sea Grant, and university researchers, and SeaDoc Society in conjunction with others will use a 3-year NOAA grant to improve wild stock abalone hatchery methods and increase production of genetically diverse and disease free juveniles for out-planting. They also will seek additional funding to staff and expand abalone hatchery capacities and to develop remote nurseries and abalone food resources, thereby improving the opportunity to build local stocks to naturally reproducing levels.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.7.2 WC13 **West Sound shellfish gardening.** Kitsap Public Health will continue to work with the Puget Sound Restoration Fund on the expansion of community shellfish gardens in Kitsap County. This dovetails with the Health District's plans to implement a permanent marine shoreline survey program throughout Kitsap County in 2014.

C7.3 Ensure environmentally responsible shellfish aquaculture based on sound science

Intensive shellfish aquaculture can put pressure on Puget Sound and there are concerns that these activities may increase pollution, change the physical beach structure and substrate to the detriment of native species abundance and diversity, disrupt the food web, and affect other resource-based jobs such as fishing or crabbing. In particular, the effects of geoduck aquaculture on the benthic environment and fauna, food webs, water quality, and aesthetics are a concern. In 2007, the Legislature passed HB 2220 to address these issues.

HB 2220 established a Shellfish Aquaculture Regulatory Committee to advise Ecology on revisions to Chapter 173-26, Part III WAC (Shoreline Master Program Guidelines) regarding geoduck aquaculture. Effective March 2011, Ecology published provisions that require future local Shoreline Master Programs include an inventory of water quality data; known sediment contamination; existing shellfish cultivation areas and shellfish protection districts; and other data that inform the siting of aquaculture. These provisions also require local shoreline conditional use permits for new commercial geoduck aquaculture, provide guidance for permit content and administration, and ensure public and tribal notification of proposed geoduck aquaculture projects.

HB 2220 also directed Washington Sea Grant to review existing scientific information and commission scientific research, with Shellfish Aquaculture Regulatory Committee input, to examine key uncertainties related to geoduck aquaculture that have implications for the health of the Puget Sound ecosystem and the wild geoduck population. Ongoing studies include investigations of: the ecological and geochemical consequences of disturbances associated with geoduck aquaculture; cultured-wide interactions; and resilience of soft-sediment communities after geoduck harvest in Samish Bay.

In March 2010, the Legislature passed and the governor enacted a law on marine spatial planning in Puget Sound and along the Washington Coast requiring an interagency assessment and report on information related to marine spatial planning and recommendations. This report was completed in January 2011 and contains 21 recommendations related to implementing marine spatial planning in Washington, including Puget Sound. Implementation of marine spatial planning will give shellfish growers and upland owners greater certainty about where aquaculture will be permitted and further reduce the likelihood of conflicts related to aquaculture. Continuing work is needed to clarify the potential impacts of shellfish aquaculture and to help communities build consensus and collaboration on the role of shellfish aquaculture in Puget Sound.

Ongoing Programs

Key Ongoing Program Activities

- Washington Sea Grant and university researchers completed the Geoduck Aquaculture Research Program December 2013. The report includes recommendations for continuing research and for monitoring environmental effects for geoduck aquaculture (Washington Sea Grant 2013).
- DNR is initiating a small pilot program to allow geoduck aquaculture on state-owned aquatic lands in Hood Canal and southern Puget Sound. DNR plans to require monitoring at geoduck cultivation sites on state-owned aquatic land to provide further opportunity to study the effects of geoduck aquaculture on the aquatic environment (Washington State Department of Natural Resources 2014).
- Pacific Coast Shellfish Growers Association, Pacific Shellfish Institute, World Wildlife Fund and the Food Alliance will promote and implement sustainable aquaculture standards and work with grower members to incorporate environmental codes of practice in members' sustainable aquaculture activities.
- Ecology will review any new aquaculture proposals for consistency with the Coastal Zone Management Act.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.7.3.1 **Aquaculture Shoreline Master Program Handbook.** Ecology will publish an aquaculture Shoreline Master Program Handbook section with special emphasis on geoduck aquaculture and finfish net pen operations, update its aquaculture web resources to make them more comprehensive, and provide direct assistance and training to local governments on the aquaculture handbook.

C.7.3.2 **Areas suitable for future shellfish aquaculture.** Ecology will coordinate with interested local governments, DNR, and stakeholders to support pre-planning and implementation of marine spatial planning and local shoreline master program updates by gathering, compiling an ground-truthing baseline information on current aquaculture and filling data gaps and completing research to identify areas that are suitable and unsuitable for future shellfish aquaculture. Ecology will support marine spatial planning related to aquaculture by coordinating with interested local governments, DNR, and stakeholders on gathering, compiling, and ground-truthing baseline information on current aquaculture and filing data gaps.

C.7.3.3 **Shellfish Model Permitting Program.** Ecology will work with the Governor's Office of Regulatory Assistance to lead and facilitate a state team to develop and implement a Model Permitting Program that ensures early and continued coordination among state and federal agencies, tribes and local governments for permitting and licensing of shellfish aquaculture.

C.7.3.4 **Nitrogen control pilots using shellfish.** Ecology will work with DNR, the shellfish industry and researchers to create pilot projects testing the use of mussel culture or other suspended or beach culture to help address nitrogen pollution in sensitive areas, such as Quartermaster Harbor.

C7.4 Enhance the public's connection to shellfish and increase recreational harvest opportunities

When the public goes to Puget Sound beaches, they want to dig shellfish that are safe to eat and swim in safe waters. Annually, tourists and residents purchase 160,000 licenses to harvest shellfish from Washington waters, providing more than $1 million in state revenues. WDFW estimates that the 125,000 shellfish harvesting trips made each year to Puget Sound beaches provide a net economic value of $5.4 million to the region. It will be important to increase this connection to shellfish and to help people understand the connections between water quality and clean, healthy shellfish beds.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.7.4.1 **Shellfish interpretive programs and events.** Washington State Parks, in collaboration with other public, tribal and private interests, will conduct shellfish interpretive programs and events to help forge personal connections between clean, productive Puget Sound waters, the shellfish we eat, and the iconic role shellfish occupy in Washington's cultural and culinary identify.

C7.5 Answer key shellfish safety research questions and fill information gaps

Some obstacles to expanding shellfish harvest opportunities are lack of knowledge to better estimate risk and delineate where and when shellfish are safe to eat. Actions under this sub-strategy will assist implementing agencies to better evaluate food safety issues related to shellfish and to make better decisions on shellfish area classification and status. Research to better define collateral environmental benefits of shellfish aquaculture (like nutrient removal) is also included in this sub-strategy.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.7.5.1 **Point source dilution analyses modeling.** Ecology and DOH will work cooperatively under an existing EPA grant to evaluate use of Ecology environmental models for point source dilution analyses in DOH's commercial shellfish area classification program.

C.7.5 SNST6 **Water quality monitoring for ocean acidification.** Collect water quality data for temperature, salinity, dissolved oxygen, pH, CO_2 (pCO_2) to identify local trends.

Emerging Issues and Future Opportunities

- Implementation of the Blue Ribbon Panel on Ocean Acidification recommendations.

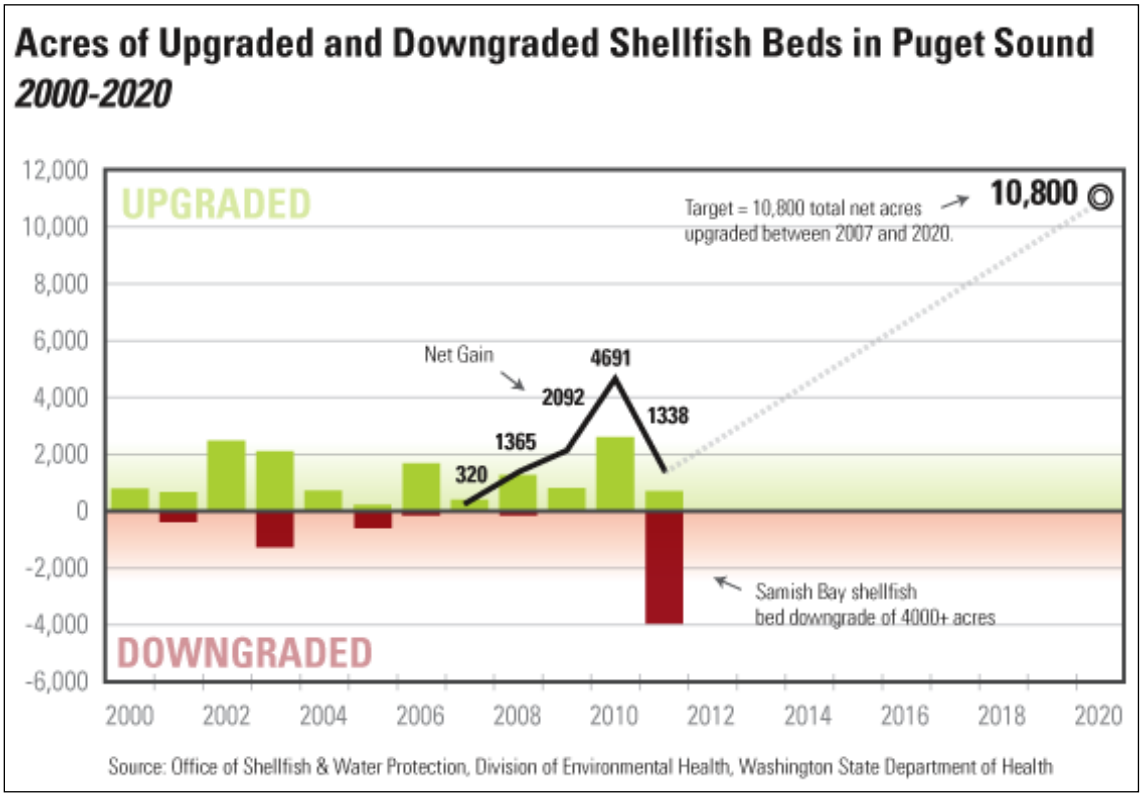
Target View: Shellfish Beds

Around Puget Sound, there are an estimated 190,000 acres of classified commercial and recreational shellfish beds. According to the DOH, about 36,000 acres—approximately 19%—are closed due to pollution. The pollution is from a variety of sources, but mostly from fecal bacteria from humans, livestock and pets that gets into the water and threatens the areas where oysters, clams and other bivalve shellfish grow.

Recovery Target

- A net increase of 10,800 harvestable shellfish acres, including 7,000 acres where harvest had been prohibited between 2007 and 2020.

The graph below illustrates recent data on the status of shellfish beds in Puget Sound, and relationship to the recovery target. Green and red bars represent the annual upgraded and downgraded acres, respectively, while black line represents the net increase in harvestable acres of commercial and recreational shellfish beds in Puget Sound toward the recovery goal of 10,800 total net acres. Net increase is the upgraded acres in existing shellfish growing areas (or the restoration of unclassified acreage) to allow harvest, minus any downgrades in classification that prevent harvest. Downgrades of the shellfish beds are generally caused by fecal bacteria or other pollutants in the water that makes the shellfish unsafe to eat.



Relevant Strategies (and Sub-Strategies)

- A4.2. Provide infrastructure and incentives to accommodate new and re-development within urban growth areas
- B1. Focus development away from ecologically important and sensitive nearshore areas and estuaries (B1.1, B1.2, B1.3)
- B4.1 Use, coordinate, expand and promote financial incentives and programs for best practices at ports and in the marine industry that are protective of ecosystem health
- B5. Prevent and respond to the introduction of terrestrial and aquatic invasive species (B5.3, B5.4)
- C1. Prevent, reduce, and control the sources of contaminants entering Puget Sound (C1.1, C1.5, C1.6)
- C2.4. Prevent problems from new development (C2.4)
- C3. Prevent, reduce, and control agricultural runoff (C3.1, C3.2)
- C5. Prevent, reduce and/or eliminate pollution from decentralized wastewater treatment systems (C5.1, C5.2, C5.3)
- C6. Prevent, reduce and/or eliminate pollution from centralized wastewater treatment systems (C6.1, C6.2, C6.3, C6.4)
- C7. Ensure abundant, healthy shellfish for ecosystem health and for commercial, subsistence, and recreational harvest consistent with ecosystem protection (C7.1, C7.2, C7.3, C7.4, C7.5)
- C8. Effectively prevent, plan for and respond to oil spills (C8.1, C8.2, C8.3)
- C9. Address and clean up cumulative water pollution impacts in Puget Sound (C9.1, C9.3, C9.4)

Figure C-14 (Appendix C, *Results Chains*) depicts how the strategies (and related sub-strategies) contribute to reducing pressures on shellfish beds and achieving the shellfish beds recovery target. Appendix C also contains a results chain for each individual strategy in the Action Agenda, showing how that strategy (and its related sub-strategies) reduces pressures and contributes to achieving numerous recovery targets.

Oil Spills

The Challenge

Over 20 billion gallons of oil and hazardous chemicals are transported through Washington State each year by ship, barge, pipeline, rail, and road. Organizational failure, equipment failure, and human error can all lead to unintended and potentially disastrous consequences. Oil and chemical spills can threaten Puget Sound's productive and valuable ecosystems.

These incidents can kill fish, birds, and marine animals and contaminate beaches and shellfish. All spills whether on land or water can threaten public health, safety, the environment, and ultimately damage the state's economy and quality of life.

CLIMATE CHANGE

The risk of vessel incidents and oil spills could increase with climate change. Increased storm frequency and severity could increase the risk of vessel incidents and oil spills, as well as reduce the ability to respond quickly. Oil dispersion, movement on shore, and fate and effects could change as a result of changing ocean temperature and chemistry, as well as onshore conditions and habitats. Strengthened prevention and response readiness are part of adaptation needs.

Recovery Targets

The strategies and actions in this section will contribute to achieving virtually all the Puget Sound recovery targets, and are particularly important for achieving the target for orcas. The NOAA listing document for the species identified major oil spills as the single greatest acute threat to the survival of this species. The indicator and recovery target for orcas are listed below.

Vital Sign	Indicator	Recovery Target(s)
Orcas	Number of southern resident killer whales	By 2020, achieve an end-of-year census of 95 individual southern resident killer whales, which would represent a 1% annual average growth rate from 2010 to 2020.

Local Priorities

LIOs identified near-term actions that address oil spills. These local actions are presented in the *Strategies and Actions* section along with Soundwide actions under the sub-strategy shaded below. The local action numbering contains the area abbreviation shown in parentheses after each LIO name. See Section 4, *Local Recovery Actions*, for detailed information about local planning.

Local Integrating Organization	Sub-Strategy C8.1	C8.2	C8.3
Hood Canal Coordinating Council (HC)			
Island (ISL)			
San Juan (SJI)			
Snohomish-Stillaguamish (SNST)			
South Central Caucus Group (SC)			
Alliance for a Healthy South Sound (SS)			
Strait ERN (STRT)			
West Central (WC)			
Whatcom (WH)			

Strategies and Actions

C8. Effectively Prevent, Plan for, and Respond to Oil Spills

The 2009 Legislature directed the Partnership to provide independent advice and assessment of Washington State's oil spill programs and make recommendations for any necessary improvements. To that end, the Legislature recommended the appointment of a special advisory body with statewide representation. As a result, the Partnership's Leadership Council (Leadership Council) authorized the formation of the Cross Partnership Oil Spill Work Group (Work Group) in summer 2010.

That broadly based stakeholder work group met for 3 days during September and October 2010. At the conclusion of the third day, the group adopted four recommendations by consensus of the attending members. The Leadership Council passed Resolution 2010–04 on November 19, 2010, supporting the four work group recommendations.

Ongoing Programs

Engrossed Second Substitute HB 1186 was signed into law by Governor Gregoire in April 2011. Each of the four original work group recommendations was represented in the legislation and/or final state budget. In a letter to the, Director of Ecology, Governor Gregoire requested that the state oil spill programs continue to work closely with the Partnership and the work group during rulemaking for HB 1186. In January 2013, Chapter 173-183 WAC was amendment to implement HB1186.

In addition, the 2011 Legislature called for the Partnership and the Cross Partnership Work Group to continue their efforts to independently assess the state's oil spill programs during the 2011–2013 biennium. To that end, the work group met in May 2011 to establish the following consensus priorities for future work.

- Use of risk assessments to develop measures to reduce the risk of major oil spills.
- Enhance transboundary coordination and marine safety in our shared waters with Canada.
- Support the involvement of the state and local governments at tabletop oil spill drills.

These priorities provide the foundation from which the Partnership, Ecology, and WDFW developed the sub-strategies and near-term actions identified below.

In October 2012, the Puget Sound Partnership Oil Spill Work Group and Puget Sound Harbor Safety Committee (HSC) formed a joint Vessel Traffic Risk Assessment (VTRA) Steering Committee, co-chaired by Partnership and HSC, comprising about a dozen representatives; drawn from several maritime industry sectors, the Makah Nation, Washington Association of Counties, environmental NGO's, Ecology and the US Coast Guard.

In November 2012, the Partnership awarded a grant to George Washington University to update the VTRA for north Puget Sound. The VTRA Steering Committee met almost monthly between Dec. 2012 and February 2014 to update the assessment. [11]

Key Ongoing Program Activities

- Strengthen marine safety standards in our shared waters with Canada by consulting with industry, federal agencies, tribes and others.
- Report on deployments of the industry-funded emergency response tug at Neah Bay.
- Engage the Partnership's Oil Spill Work Group in the short-term work priorities described above.
- Continue the EPA and Ecology's Spill Prevention Control and Countermeasures Programs under the Clean Water Act.

C8.1 Prevent and reduce the risk of oil spills

While the relative rarity of major spills and catastrophic has not led to obvious complacency by industry or a lack of vigilance by government, two decades of success has led to limited funding for State Programs to systematically analyze regional and industry-specific patterns in oil spill risk by regulated industries, which would allow for subsequent targeting of prevention efforts. This funding shortage is a particularly concern considering the dramatic increase in ship and crude oil traffic that is projected to occur over the next 10 years. Ongoing changes in marine transportation patterns, including the substantial increase in crude oil exportation from Vancouver, BC, and the proposed Gateway Pacific Terminal at Cherry Point in northern Puget Sound, increase the risk of major spills to Washington's marine waters.

Ecology's *Spills Program 2009–2015 Strategic Plan* for its oil spill program identifies "improving marine safety by emphasizing a risk-based approach" as one of its five strategic initiatives. The first recommendation in the joint report by Ecology and the Partnership on lessons learned from the 2011 National Commission on the Deepwater Horizon spill is to "complete a rigorous risk analysis on higher risk industry sectors to ensure that there is an appropriate level of investment reducing the risk of oil spills." The following near-term actions are necessary for Ecology and the broader spills community to fulfill legislation direction, accomplish Ecology's strategic plan and implement the Cross Partnership Oil Spill Work Group's recommendations.

[11] The final report was released on 3/31/14. It is 128Mb and can be downloaded at: http://www.seas.gwu.edu/~dorpjr/tab4/publications_VTRA_Update_Reports.html

Near-Term Actions

The near-term actions[12] identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.8.1.2 **Promote and coordinate the proactive use of maritime risk assessments.** The Puget Sound Partnership will share findings from its 2010 Vessel Traffic Risk Assessment and related studies in policy forums: like the Puget Sound Harbor Safety Committee, the National Energy Board of Canada (supporting Ecology, the Makah Tribe and other interveners) and various other regional and local groups in order to further develop and inform vetted recommendations that promote continuous improvements in safe shipping.

C.8.1 SJI4 **Expand and maintain Derelict Vessel Compliance Program (Near-Term Major Oil Spills Action IV).**

C8.2 Strengthen and integrate spill response readiness of the state, tribes, and local government

In 2010, the Cross Partnership Oil Spill Work Group recommended the state's participation in tabletop and worst case oil spill drills be restored to make the oil spill response system more robust. The Work Group recognized that the response system is enhanced when spill responders sharpen their technical skills and build trust in one another by practicing in drills together. Given the rarity of major spills requiring a Unified Command, and the recent reduction in the participation of state and local governments in drills due to budget cuts, some relationships and expertise has deteriorated over time. The following near-term actions seek to strengthen those relationships and the effectiveness of actual response actions.

Ongoing Programs

Key Ongoing Program Activities

- Support an appropriate level of tabletop drill participation by Ecology and local government.
- Support the involvement of local government in Northwest Area Committee meetings and updates of the Area Contingency Plan.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.8.2 SJI1 **Coordinate actions and prepare to respond to major oil spills (Near-Term Major Oil Spills Action I).**

C.8.2 SJI2 **Integrate and define parameters for responses to increased vessel traffic and potential vessel spills (Near-Term Major Oil Spills Action II).**

[12] Gaps in numbering reflect near-term actions that have been completed or otherwise retired.

C.8.2 STRT12 **Expand oil spill drills along the Strait of Juan de Fuca and coast.** Regularly conduct worst-case oil spill exercises, including equipment deployment, in this region. The combined spill response assets housed in Neah Bay and Port Angeles afford substantial opportunities to drill. In addition, consider coordinating efforts with the Northwest Maritime Center in Port Townsend to host and expand drills and table-top exercises along the Strait of Juan de Fuca, outer Coast, and Puget Sound waterways utilizing their Pilothouse/Oil Spill Training Center. Drills and exercises should incorporate vessels of opportunity, publicly funded response equipment caches, and maritime industry participants as well. All of these assets are owned by various different organizations, that if drilled together, would afford opportunities to improve efficiencies through coordination.

C.8.2 STRT13 **Improve trans-boundary coordination on oil spill preparedness and response.** Support enhancement of the U.S. and Canadian Coast Guards' annual joint spill response exercises, known as U.S./Canadian Joint Response Team (CANUSPAC), on both sides of the border with additional equipment and personnel. Also, support implementation of the U.S. Coast Guard Reauthorization Act that called for both countries to reevaluate the comparability of spill response, tug escort, and rescue towing assets on either side of the border as cited within the Combined Vessel Traffic Service Treaty. Additionally, the current estimates of Canadian vessel traffic projections need to be incorporated into updates of vessel traffic risk assessments.

C.8.2 STRT14 **Support the establishment of a Neah Bay Vessel of Opportunity Program.** Once established in Neah Bay, support expansion of the program to other locations along the Strait of Juan de Fuca, including the Ports of Port Angeles and Port Townsend.

C8.3 Respond to spills and seek restoration using the best available science and technology

The Cross Partnership Work Group's overarching recommendation was to improve the state's response capacity by requiring the regulated community to have timely access to the best achievable technology and training necessary to safely, promptly and properly respond to a worst-case oil spill. The following near-term actions support implementation of legislative direction under HB 1186, Ecology's rulemaking efforts, and strengthen coordination with Canada during transboundary spills.

The 2011 National Commission's Report on the Deepwater Horizon Spill generally recommended that restoration decisions be based on transparent, independent science and also provide compensation for poorly understood marine impacts. In addition, it recommended that long-term monitoring of affected resources take place for years following catastrophic spills.

Ongoing Programs

Key Ongoing Program Activities

- Implement Ecology's recommendations from the Pacific States/BC Oil Spill Task Force transboundary report.

Near-Term Actions

The near-term actions[13] identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.8.3.4 **Identify species and locations at risk in spills.** WDFW will establish planning efforts for coordinated, scientific collection of ephemeral data by local and regional entities for key species and locations at risk in oil spills to enhance response and Resources Damage Assessment and Restoration program.

Emerging Issues and Future Opportunities

Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy (Washington State Department of Ecology 2012a) calls for revising oil spill geographic response plans to account for changes in shorelines, river conditions, and environmental conditions caused by climate change. These revisions should include geographic specific response strategies based on risk assessments and considerations of changes in infrastructure and logistical support.

[13] Gaps in numbering reflect near-term actions that have been completed or otherwise retired.

Cumulative Impacts

The Challenge

Water pollution in the marine waters and freshwater of Puget Sound comes from the introduction of toxic chemicals, pathogens, nutrients, and suspended sediments. These contaminants can harm aquatic life and pose health and safe problems in seafood, public water supplies, and beaches. There are many contaminated sites within and near Puget Sound that have resulted from past and ongoing releases of pollutants into the environment.

Water quality data indicate that the region's marine and fresh waters continue to have pollution challenges, but cleanup efforts have made some improvements.

- Ecology's Long Term Ambient Monitoring Program tracks water quality in 14 major rivers in Puget Sound using a Water Quality Index, which evaluates common pollutants such as temperature, bacteria, and dissolved oxygen, but not toxic pollutants. The Index shows that conventional water quality pollution has made small general improvements since 1995, but a majority of freshwater monitoring locations do not have good water quality (see chart).

Annual Water Quality Index (WQI) Scores at Freshwater Monitoring Locations, 2000–2010

Rivers Meeting Goals	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Duckabush	93	95	94	90	74	94	89	85	88	96	86	89
Elwha	86	88	83	76	73	74	86	67	66	81	81	78
Skokomish	95	95	94	85	70	67	92	89	89	94	86	87
Snohomish	92	91	89	81	74	75	89	75	81	85	76	83
Borderline Rivers	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Cedar	87	76	60	78	72	84	81	79	79	81	77	78
Upper Skagit	87	86	59	85	64	81	84	75	75	81	56	76
Lower Skagit	89	91	71	76	61	73	77	77	75	76	74	76
Deschutes	62	72	70	73	61	83	88	88	83	76	74	75
Nisqually	40	60	79	79	69	71	74	75	91	74	83	72
Rivers Not Meeting Goals	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
Green	82	73	66	67	75	49	72	68	60	69	63	68
Nooksack	65	68	58	57	52	54	61	51	60	69	56	59
Puyallup	60	58	57	55	51	58	59	58	61	49	62	57
Samish	86	75	32	49	34	71	67	74	59	80	63	63
Stillaguamish	81	60	44	72	55	67	71	69	75	75	71	67

Note: The Water Quality Index (WQI) is an aggregation of monthly measurements of typical water pollutants reported on a scale of 1 to 100. A higher number indicates better quality. An index score of 80 or above indicates that water quality is generally meeting our goals; between 70 and 80 is considered "fair" or "borderline;" 40-70 is failing to meet water quality goals and less than 40 is "poor."

Source: River and Stream Ambient Monitoring Program, Washington State Department of Ecology

- Ecology's 2008 water quality assessment identifies 501 different rivers and streams in the Puget Sound basin that require cleanup plans (TMDLs). Some waterbodies have multiple segments listed and many segments are listed for more than one pollutant. Ecology's 2008 list included a total of 1,272 Puget Sound river and stream impairments (individual segment and parameter combinations).

Bacteria (398 listings), dissolved oxygen (392), and temperature (341) are the most frequently occurring impairments of Puget Sound rivers and streams. Impairments occur in rivers and streams each of the 19 water resource inventory areas (WRIAs) in the Puget Sound basin. More than 60% of the total number of listings for Puget Sound rivers and streams are in five watersheds: Nooksack (238 listings), Kitsap (160), Cedar/Sammamish (154), Duwamish-Green (131), and Lower Skagit-Samish (113).

- Ecology's 2008 water quality assessment identifies an additional 129 impairments to Puget Sound lakes. Approximately one-half of these listings relate to toxic chemical contamination. These 67 toxics-related impairments of lakes combined with 24 toxics-related listings for Puget Sound rivers and streams indicate that toxic chemicals are the fourth most common type of impairment in Puget Sound freshwaters.
- Almost half of routinely monitored beaches in Puget Sound (50–70 beaches) consistently met water quality standards every year from 2004 to 2010, and another third met standards every year except for 1 or 2 years. Pollution sources have been addressed at several beaches since 2004, and two permanent beach closures were lifted in Island County in 2008. Despite these efforts, problems remain. In 2010, 26% of monitored beaches in Puget Sound failed to meet water quality standards and thus were unsafe for swimming.
- Ecology has been working to clean up 1,580 toxic-contaminated sites located within a half-mile of Puget Sound, including 150 contaminated sediment sites. As of December 2011, 664 of these sites had been cleaned up or reported as cleaned up by Ecology, potentially responsible parties, and other entities.

In urban bays and harbors in Puget Sound, marine sediment quality data indicate mixed trends over time. Ecology's Urban Waters Initiative represents a major effort to reduce toxics entering urban bays and prevent re-contamination of sediments at cleanup sites including Elliott Bay and the Lower Duwamish in Seattle and Commencement Bay in Tacoma. Marine Sediment Chemistry Index (SCI) scores have improved in Elliott Bay and Commencement Bay, but declined in Bellingham Bay and Bainbridge basin from 1997–1999 to 2007–2010. The recent SCI scores for the Bainbridge basin and Bellingham Bay just meet the target score of 93.3, but the scores for Elliott Bay and Commencement Bay are still below the target score (Washington State Department of Ecology 2011b). The SCI score for Bellingham Bay does not reflect sediment cleanup efforts that commenced after this sampling was conducted. This strategy is focused on efforts to correct water quality and sediment quality problems related to toxic chemicals, nutrients, and pathogens by diagnostic studies and targeted cleanup activities. Implementing corrective actions to clean up impaired marine and fresh waters is essential for reducing the harm from pollution in the Puget Sound ecosystem. Sub-strategies in this section include completing TMDL studies that serve as water column cleanup plans for water bodies, completing cleanup action plans to restore and clean up contaminated upland and sediment sites within and near Puget Sound, addressing water quality issues at swimming beaches and recreational areas, implementing local pollution identification and correction programs, and developing a long-term effectiveness monitoring program for water quality improvement efforts.

Many of the sub-strategies presented here are important components of programs to address water quality problems that might be caused by pollution from urban runoff, wastewater discharge, and agricultural and forest runoff. Other strategies in priority C deal with efforts to reduce the release of

chemicals to the environment and to control pathways by which pollutants are delivered to Puget Sound waters.

CLIMATE CHANGE

Reducing existing stresses on the ecosystem is an important part of climate change adaptation strategies. Strategies in the Action Agenda to reduce pressure from cumulative water pollution help implement the state climate response strategies to achieve the following.

- Safeguard fish and wildlife and protect critical ecosystem services that support human and natural systems.
- Reduce the vulnerability of coastal communities, habitat, and species.

Future sea level rise will need to be considered in the prioritization, design, and post-project maintenance of cleanup sites near the shoreline.

Recovery Targets

The strategies and actions in this section will contribute most significantly to achieving the recovery targets listed below with their associated vital signs and indicators. They will also help achieve targets for shellfish beds, toxics in fish, freshwater quality (Benthic Index of Biotic Integrity), eelgrass, Pacific herring, and orcas.

Vital Sign	Indicator	Recovery Target(s)
Marine Water Quality	Dissolved oxygen levels	Prevent dissolved oxygen levels from declining more than 0.2 milligrams per liter in any part of Puget Sound as a result of human input.
Marine Sediment Quality	Sediment Chemistry Index	By 2020, all Puget Sound regions and bays achieve chemistry measures reflecting minimum exposure with Sediment Chemistry Index scores >93.3.
	Sediment Quality Standards	Have no sediment chemistry measurements exceeding the Sediment Quality Standards set for Washington State.
	Sediment Quality Triad Index	All Puget Sound regions and bays, as characterized by ambient monitoring, achieve the following: Sediment Triad Index scores reflect unimpacted conditions (i.e., SQTI values >81).
Freshwater Quality	Number of *impaired* waters	Reduce the number of *impaired* waters.
Swimming Beaches	Conditions of swimming beaches.	Have all monitored beaches in Puget Sound meet EPA standards for what is called enterococcus, a type of fecal bacteria.

Local Priorities

LIOs identified near-term actions that address cumulative impacts. These local actions are presented in the *Strategies and Actions* section along with Soundwide actions under the sub-strategy shaded below. The local action numbering contains the area abbreviation shown in parentheses after each LIO name. See Section 4, *Local Recovery Actions*, for detailed information about local planning.

Local Integrating Organization	Sub-Strategy C9.1	C9.2	C9.3	C9.4
Hood Canal Coordinating Council (HC)				
Island (ISL)				
San Juan (SJI)				
Snohomish-Stillaguamish (SNST)				
South Central Caucus Group (SC)				
Alliance for a Healthy South Sound (SS)				
Strait ERN (STRT)				
West Central (WC)				
Whatcom (WH)				

Strategies and Actions

C9. Address and Clean up Cumulative Water Pollution Impacts in Puget Sound

OCEAN ACIDIFICATION

Ocean acidification is characterized by a decrease in the pH of ocean water. Other factors, such as nutrients and organic carbon exacerbate local ocean acidification. Efforts to reduce acidification should include programs that address pollution, such as nutrients and organic carbon, and also address other potential indicators of the water's health. *Ocean Acidification: From Knowledge to Action, Washington State's Strategic Response* (Washington State Blue Ribbon Panel on Ocean Acidification 2012), states that although pH is the only water quality criteria that is readily associated with ocean acidification, low dissolved oxygen is also associated with acidification, and recent scientific research suggests that other chemical parameters and biological indicators in the ocean may be relevant to local ocean acidification.

Programs that reduce nutrient and organic carbon protect people and shellfish from bacterial contamination, remove pollutants that lower dissolved oxygen levels, and remove pollutants that reduce pH. The Blue Ribbon Panel recommends expanding such programs to locations were local inputs are contributing to acidification. The Panel also recommends reviewing existing water quality standards to determine whether they are sufficient in controlling the impacts of local sources. The Action Agenda strategies in this section directly support these recommendations.

C9.1 Complete Total Maximum Daily Load (TMDL) studies and other necessary water cleanup plans for Puget Sound to set pollution discharge limits and determine response strategies to address water quality impairments

In Washington State, Ecology administers the water quality improvement program known as the TMDL process under Section 303(d) of the Clean Water Act. TMDLs establish limits on pollutants that can be discharged to water bodies. For impaired waters, TMDLs serve as water cleanup plans, articulating the sources of pollution, how much pollution needs to be reduced to meet water quality standards, pollution-reduction targets, and strategies to control the pollution. The TMDL process is the primary

regulatory program that EPA and Ecology use to protect and restore water bodies from the cumulative impacts of multiple sources of pollution, including point and non-point sources.

Common water quality parameters evaluated in TMDLs include dissolved oxygen and the nutrients responsible for reducing available oxygen, suspended solids, temperature, metals, pesticides, and other toxic chemicals and pollutants, all of which can harm aquatic organisms and their habitat. One of the important cumulative effects of pollution from multiple sources is reductions in the availability of oxygen in the water, known as dissolved oxygen. When an excess amount of nitrogen, phosphorus, and/or other nutrients enters a water body, it can result in a condition of depleted oxygen levels known as hypoxia that causes stress to the environment depending on the severity and duration of the event. In Puget Sound, there are chronic hypoxia zones including areas of Hood Canal, Budd Inlet, and Sequim Bay.

This sub-strategy helps ensure that Puget Sound marine and fresh waters support aquatic life and provide for other beneficial uses by ensuring that Ecology implements its responsibilities to develop and implement TMDLs so that pollution sources are identified and corrective actions are taken to address problems. These efforts to implement water cleanup plans to improve water quality in specific water bodies through the TMDL process complement the source-specific strategies discussed elsewhere in the Action Agenda. In particular, strategies to control the sources and pathways that excess nutrients and toxic chemicals enter Puget Sound include toxics source reduction (C1), stormwater runoff (C2), agricultural runoff (C3), and wastewater (C5 and C6) strategies. These strategies outline particular requirements, BMPs, assistance, enforcement, and education efforts to reduce sources of toxic pollutants, pathogens, nutrients, and other contributors to water quality issues in Puget Sound and its watersheds.

Ongoing Programs

Ecology and EPA's water quality programs are key ongoing programs that advance this sub-strategy to address water quality impairments in Puget Sound. These include the programs to develop and implement TMDL studies for dissolved oxygen, temperature, suspended solids, and other water quality contaminants; state and federal water quality financial assistance programs; and state and local non-point source control programs. Puget Sound-specific funding to advance this sub-strategy may be available from the Pathogens Lead Organization grant award from EPA to DOH and Ecology and the Toxics and Nutrients Lead Organization grant award from EPA to Ecology.

Overall, there is a backlog of TMDLs needing to be completed, and Ecology is also in the process of prioritizing future TMDL studies and implementation plans. Ecology's ongoing TMDL development and implementation activities in Puget Sound include the following.

TMDL Development (Continuing work to complete a TMDL)

- Bacteria TMDLs for Sinclair-Dyes Inlets and Liberty Bay.
- Dissolved Oxygen TMDL for Clark's Creek.
- Temperature TMDLs for Cranberry, Johns, Mill, and Soos Creeks.
- pH TMDL for White River.
- Multi-parameter TMDL for Deschutes River/Budd Inlet.

TMDL Implementation (Ongoing staff support for implementation plan activities for a completed TMDL)

- Bacteria TMDLs for Henderson Inlet watershed, Puyallup River, Skokomish River, Nisqually/McAllister Creek, Oakland Bay, South Prairie Creek, Lower Skagit River watershed, Samish basin, Union River, North Creek, Swamp Creek, Piper's Creek, Issaquah Creek basin, Little Bear Creek, and Fauntleroy Creek.
- Temperature TMDLs for Upper White River, Skagit River, Snoqualmie River, Green River, and Newaukum Creek.
- Phosphorus TMDLs for Campbell and Erie Lakes, Lake Sammamish, Lake Ballinger, Cottage Lake, Lake Sawyer, and Fenwick Lake.
- Water bodies with multiple TMDLs are listed below.
    - Bacteria and temperature TMDLs for tributaries to Totten, Eld, and Skookum Inlets.
    - Multi-parameter and temperature TMDLs for Stillaguamish River.
    - Multi-parameter and bacteria TMDLs for Snoqualmie River.
    - Biological oxygen demand and ammonia TMDLs for Snohomish River estuary and bacteria TMDL for Snohomish River tributaries.
- Bacteria, dissolved oxygen, and temperature TMDLs for the Bear-Evans watershed.

Other Studies

- South Puget Sound Dissolved Oxygen Study (the results from the study will determine if a TMDL, or other action, is needed).
- Quartermaster Harbor Dissolved Oxygen Study (Ecology is evaluating available data and modeling to determine whether a TMDL is needed to address the dissolved oxygen impairment).

Key Ongoing Program Activities

- Ecology will continue ongoing work to complete TMDL assessments for high-priority water bodies in Puget Sound watersheds. Ecology also will continue to support implementation plan activities for completed TMDLs for Puget Sound and adjacent watersheds.
- *South Puget Sound Dissolved Oxygen Study: Water Quality Model Calibration and Scenarios* found that although low oxygen concentrations naturally occur through much of South and Central Puget Sound, human contributions from marine point sources and within watershed inflows decrease oxygen by 0.2 to 0.4 mg/L in some area (Washington State Department of Ecology 2014b). Additional modeling will be necessary to guide management actions and Ecology will coordinate subsequent modeling with the Salish Sea Dissolved Oxygen Modeling efforts.
- Ecology will accelerate other ongoing efforts, including prioritizing watersheds needing TMDLs, to identify areas where enhanced wastewater treatment may be needed. In Puget Sound. Ecology is using a phased approach to developing the *Deschutes River, Capitol Lake, and Budd Inlet Water Quality Improvement Report/Implementation Plan* that involves development of freshwater sections

of the TMDL in 2014. Ecology will address the marine section of the TMDL (Capitol Lake and Budd Inlet) after additional modeling is finished. [14]

- The Hood Canal Aquatic Rehabilitation Program is working to address the human contributions to low dissolved oxygen problems in Hood Canal, using the scientific findings from the Hood Canal Dissolved Oxygen Program and others, to develop and advance corrective actions.

Near-Term Actions

No near-term actions identified. Work in the near-term will focus on implementation of ongoing programs.

C9.2 Clean up contaminated sites within and near Puget Sound

This sub-strategy helps reduce the risk to humans and the Puget Sound ecosystem from toxic chemicals by cleaning up contaminated sites, focusing on contaminated sediment in the nearshore and contaminated upland sites near marine and freshwater. Sediment sites are contaminated with chemicals that have built up over time. These pollutants can enter the food chain and contaminate fish, shellfish, seals, orcas, and humans that eat the fish and shellfish. Sediment sites also contain contaminants that harm or kill the benthic community affecting the aquatic ecosystem and food sources of other animals. Contaminated sites along Puget Sound shorelines and in upland areas of watersheds also contribute to pollution in Puget Sound, since stormwater runoff from those sites can contain toxic chemicals and contaminants can leach into groundwater. Several regulatory programs govern the cleanup of contaminated sites, including the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, known as Superfund) for cleanup of hazardous waste sites and the Resource Conservation and Recovery Act governing the management and disposal of wastes, as well as the state cleanup program administered under the Model Toxics Control Act and the state Sediment Management Standards. Ecology is the primary regulatory agency that oversees sediment and upland cleanup efforts. Washington DNR, as the land manager, works cooperatively with Ecology on cleanup of state-owned aquatic lands.

Cleanup activities are made more effective and efficient by efforts to (1) integrate with source control (e.g., in agency water quality programs) to facilitate and protect investments in cleanup, and (2) link cleanup activities and habitat restoration efforts. This linkage can be accomplished through Shoreline Management Act restoration plans, Natural Resource Damage Assessment actions, and WRIA restoration actions. However, there are significant barriers to optimally integrating source control, cleanup, and restoration activities—for example, source control efforts on private property (e.g., private pipes that connect to sewer systems) tend to be limited, funding is very limited for Shoreline Management Act and WRIA activities (among other agency programs), and NRDA trustees can be resistant to accept habitat related to cleanup sites as creditable habitat for NRDA purposes.

Preparing for a Changing Climate: Washington State's Integrated Climate Change Response Strategy (Washington State Department of Ecology 2012a) includes the recommendation to incorporate future sea level rise in the prioritization, design, and post-project maintenance of shoreline toxic cleanup sites.

[14] http://www.ecy.wa.gov/programs/wq/tmdl/deschutes/technical.html

Since 1988, a total of 664 contaminated sites (both upland and sediment sites) have been cleaned up within a half mile of Puget Sound, including over 100 since the Puget Sound Initiative began in 2006. A specific emphasis has been placed on contaminated sediment sites in Puget Sound. Forty-four percent of the known contaminated sediment sites in Puget Sound have been cleaned up or reported cleaned up and 41% of contaminated sediment sites are in the process of being cleaned up One hundred percent of publicly funded toxic site cleanups are currently on schedule, exceeding the 90% target. The number of cleanups that are completed each year has been declining over time, however. One contributor to this decline may be the reduced availability of private-sector funding to voluntarily cleanup sites; another factor may be that sites have become more complex.

One of the ways that contaminated sediment can be managed for cleanup and maintenance dredging is through the appropriate disposal of dredged material. Dredging supports site cleanup activities or other purposes, such as navigation and maritime commerce. The Washington Dredged Materials Management Program, an interagency program of the Corps (Seattle District), EPA Region 10, Ecology, and DNR, works to facilitate navigation and marine commerce while also protecting the aquatic environment. DNR manages and monitors 12 aquatic land disposal sites for dredged materials on state-owned aquatic land, including eight in Puget Sound and the Strait of Juan de Fuca. Statewide, annual volumes of dredged material disposal range from 120,000 cubic yards to over 1.5 million cubic yards. The program implements sediment sampling, chemical and biological testing, and test interpretation to evaluate the suitability of dredged material before approving it for in-water disposal.

Ongoing Programs

Major ongoing programs related to this sub-strategy include Ecology's Toxics Cleanup Program and EPA's cleanup programs including Superfund and the Resource Conservation and Recovery Act. These programs include targeted work within the Puget Sound basin as well as base program cleanup activities that occur elsewhere around the state and nation. Funding for contaminated site cleanup comes from the federal Superfund program, the State and Local Toxics Control Accounts established by state law, and responsible parties. Efforts are underway to update the fish consumption rate used for state cleanups Model Toxics Control Act; this will result in changes to sediment cleanup and other standards.

One of initiatives highlighted in EPA's 2011–2015 Strategic Plan is an Urban Waters effort in which the cleanup and reuse of contaminated land in urban watersheds is coordinated with regional water quality improvement efforts including TMDLs, CSO long term control plans, and green infrastructure to reduce stormwater pollution, thereby connecting source-control efforts with cleanup and restoration efforts. Ecology's Urban Waters Initiative, which originated with $2.7 million in funding from the Legislature in 2007, focuses specifically on addressing the contamination of three major urban waters—the Lower Duwamish and Commencement Bay in Puget Sound, as well as the Spokane River. Federal, state, tribal, and local cleanup activities are also occurring throughout the Puget Sound region, including major cleanup locations in Bellingham, Bremerton, and Elliott Bay and the Lower Duwamish Waterway in the Seattle area. In Bellingham Bay, for example, a partnership of 15 federal, state, tribal, and local stakeholders are working to expedite sediment cleanup, source control, and habitat restoration for cleanup sites around the bay through the Bellingham Bay Demonstration Pilot organized by Ecology in 1996. Ecology has also identified a series of "priority bays" for accelerated cleanup and restoration efforts for the Puget Sound Initiative, these include the following.

- Anacortes Area (Fidalgo/Padilla Bays)
- Budd Inlet
- Dumas Bay
- Everett Area (Port Gardner Bay)
- Oakland Bay
- Port Angeles Bay
- Port Gamble Bay

In recent years, funding set aside for the State and Local Toxics Control Accounts to support remediation and related activities has also been used to support other causes related to the general fund. For the 2011–2013 fiscal biennium, for example, the Legislature specified that the Local Toxics Control Account could be used for shoreline update grants and actions for reducing public exposure to toxic air pollution; this means that there has been less money remaining to support site cleanup activities.

Key Ongoing Program Activities

- Performance measures for EPA include number of remedial action projects completed at Superfund National Priority List sites, number of Superfund remedial site assessments completed, number of brownfields properties cleaned up using brownfields funding (and other brownfields measures), and Resource Conservation and Recovery Act cleanup measures such as control migration of contaminated groundwater and complete construction of final remedies.
- Ecology continually evaluates reported contaminated sites and their priority for cleanup and restoration around Puget Sound. This includes an initial investigation and an assessment to determine the contaminated site's hazard ranking. As appropriate, Ecology will initiate cleanup planning, implementation, and monitoring activities for those contaminated areas as funding and resources are available.
- Ecology recently adopted revised rules in the Sediment Management Standards (WAC 173-204, Part V) to address contaminated sediments encountered during development. These rules include conferring with a sediment specialist if contamination is encountered, to determine if the area is, or should be designated for cleanup; and for contaminants that do not have numeric criteria, Ecology works with stakeholders to establish levels according to the rules, including a process for defaulting to background value. Ecology is developing guidance for these rules, which will provide more detail for establishing background concentrations and establishing site-specific standards. Ecology is also engaged in establishing background concentrations for bioaccumlative contaminants, such as dioxin, throughout the Puget Sound.
- Ecology will continue to work with other organizations clean up and restore contaminated sites located within one-half mile of Puget Sound. This includes the following "priority bays" for the Puget Sound Initiative: Anacortes Area (Fidalgo/Padilla Bays), Budd Inlet, Dumas Bay, Everett Area (Port Gardner Bay), Oakland Bay, Port Angeles Bay, and Port Gamble Bay. It also includes the following other major Puget Sound cleanup locations: Bellingham Bay, Bremerton area (Port Washington Narrows), Elliott Bay, and Lower Duwamish Waterway. Ecology will consult with DNR regarding cleanup activities on state-owned aquatic lands. Ecology will also ensure that these and other

cleanup sites within the Puget Sound area have post-construction monitoring plans in place that provide data on the effectiveness of the cleanup remedy.

- Maintain adequate funding to ensure continued, timely cleanup and remediation of toxic sites. Ensure that funding to Ecology provides an appropriate level of state match to approved Remedial Action Grant projects and that the LTCA is protected for its intended statutory purposes.

Near-Term Actions

None; work in the near-term will focus on implementation of ongoing programs.

C9.3 Restore and protect water quality at swimming beaches and recreational areas

Swimming in water contaminated with pathogens and other pollutants can cause illness in humans, as can contact with contaminated water through water-based recreational activities such as surfing, paddle boarding, kayaking, kite boarding, and scuba diving. Water at beaches can be contaminated by fecal matter, which can contain harmful bacteria, parasites, and viruses. Sources of contamination vary and include improperly disposed diapers or animal waste, stormwater runoff containing human or animal waste, malfunctioning septic systems or sewage treatment plants, CSOs, and wildlife (issues with agricultural runoff, stormwater pollution, onsite sewage systems, and centralized wastewater treatment systems are discussed in strategies C3 through C6). Marine waters can be contaminated through pollution carried by freshwater streams as well as through other pathways. While swimming beaches are most often used by bathers during warmer months of the year, other popular water-based recreational activities like surfing, scuba diving, and kite boarding occur throughout the year in Puget Sound. As noted in the Challenge section, 26% of monitored marine beaches in Puget Sound failed to meet water quality standards in 2010, and others have failed to meet the standards in some of the last few years.

Additional funding is needed to create and implement a freshwater swimming beach monitoring and notification program in the Puget Sound region. Today, only six of 39 counties throughout the state monitor bacteria at freshwater swimming beaches. These locally funded programs provide information to the public regarding health at public swimming beaches. Over the past few years, cities and counties have discontinued these programs due to lack of funding.

Ongoing Programs

Ecology's and EPA's water quality programs, including the programs to develop and implement TMDL studies, state and federal water quality financial assistance programs, and state and local non-point source control programs are key ongoing programs that advance this sub-strategy. Under the TMDL program, Ecology completes a Water Quality Assessment for EPA every 2 years that produces a list of water bodies (called a 303[d] list) that do not meet water quality standards. In 2010, this assessment focused on marine waters; the next assessment will focus on fresh water.

The DOH- and Ecology-administered Beach Environmental Assessment, Communication, and Health (BEACH) program is the primary state program for monitoring and notification of water quality contamination at marine beaches. This program to protects people who enjoy Washington's saltwater beaches. The BEACH program monitors marine beaches for fecal bacteria, notifies the public when the

results are high, and educates the public on how to avoid getting sick from playing in saltwater. There is no comparable statewide program for freshwater beaches; however, local public health agencies may have their own programs for freshwater areas. This sub-strategy helps ensure that swimming and other contact recreational activities in both marine and fresh waters in Puget Sound does not pose risks to human health. It provides for corrective actions to address pollution problems that cause swimming beaches and other contact recreation areas to not meet water quality standards for pathogens or other forms of contamination.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.9.3.1 **Freshwater swimming beach program.** By 2014, Ecology and DOH will develop a proposal to coordinate a monitoring and notification freshwater swimming beach program for the Puget Sound region.

C.9.3.2 **Correct pollution problems at marine beaches.** Ecology and DOH will develop a plan to conduct pollution source surveys and correct pollution problems at marine beaches used for swimming, surfing, diving and other recreational uses. Ecology and DOH will coordinate with local, state and tribal programs that address point source and nonpoint source pollution to assure that activities are not duplicative.

In addition, near-term actions to address wastewater pollution, a key source of contamination of swimming beaches, are discussed in strategies C5 and C6. Sub-strategies C9.1 (covering TMDLs) and C9.4 (covering local and tribal pollution identification and control programs) also are very important for addressing water quality and public health issues at swimming beaches and recreational areas.

C9.4 Develop and implement local and tribal pollution identification and correction programs

Local agencies and tribes across Puget Sound implement pollution identification and correction programs to determine the causes and sources of nonpoint water pollution in specific geographical areas, and to take corrective actions to address the pollution sources, such as outreach and education, technical assistance, incentives for BMPs, and enforcement. For example, the Kitsap County Health District's pollution identification and correction program, which is funded by the County's Surface and Stormwater Management program and grants from Ecology, developed a 2010 priority area work list to identify priority pollution identification and correction project locations to address bacterial water pollution, thereby protecting public health, protecting shellfish resources, and restoring surface water quality. This sub-strategy helps ensure that Puget Sound marine and freshwaters support aquatic life and provide for other beneficial uses by ensuring that pollution sources are identified and corrective actions are taken to address problems. These activities are closely associated with state requirements for local health jurisdictions to carry out comprehensive plans to ensure that onsite sewage systems are properly managed to protect public health and sensitive waters; sub-strategies and actions related to onsite sewage systems are further discussed in strategy C5.

Ongoing Programs

With funding from EPA available from November 2011 through September 2014, DOH and Ecology are offering grants to county governments, local health jurisdictions, and tribal governments adjacent to Puget Sound to establish or enhance pollution identification and correction programs to identify and address pathogen and nutrient pollution from a variety of nonpoint sources, including onsite sewage systems, farm animals, pets, sewage from boats, and stormwater runoff. Although this grant opportunity is focused on pathogens, pollution identification and correction programs can also be an important way that local communities can monitor and protect against other pollutants, including toxic chemicals. The goal with federal funding of these programs is support for the establishment and/or enhancement of programs that can eventually be sustainable programs that integrate across various local water quality programs, interests, and concerns. Local and tribal water quality improvement programs funded from utility fees, Ecology and EPA's water quality programs, and other water quality financial assistance may have similar objectives of identifying and addressing water pollution issues.

Key Ongoing Program Activities

- Local jurisdictions and tribes will establish or enhance pollution identification and correction programs to identify and address pathogen, nutrient, and toxic pollution problems in specific geographical areas that may arise from a variety of sources, including onsite sewage systems, stormwater runoff, agricultural sources, and other nonpoint sources. Grant funding available through 2014 can help these agencies to design programs that integrate across multiple local water quality interests.
- Ecology will continue to provide guidance and financial assistance to local governments to establish and carry out pollution identification and correction programs.

Near-Term Actions

The near-term actions identified for this sub-strategy are described below. Appendix D, *Near-Term Actions*, provides a consolidated table of all near-term actions, performance measures, and owners.

C.9.4.1 **Pollution Identification and Correction Programs.** DOH and Ecology will administer EPA grants to help counties and tribes set up sustainable programs to identify and correct nonpoint pollution sources to improve and protect water quality in shellfish growing areas and at marine swimming beaches. These sustainable programs will have ongoing monitoring to identify pollution sources and assess effectiveness of efforts, a local sustainable funding source, and a compliance assurance component.

C.9.4 HC3 **Hood Canal Pollution Identification and Correction Program.** By April 2014, HCCC will complete Phase I of a regional Hood Canal Pollution Identification and Correction Program to determine the needs for a comprehensive regional program and advance funding proposal(s) for implementation. If funding is secured, Phase II of the program will be advanced. Phase II may include (depending on funds), program work in priority areas, monitoring, and education and outreach. The program will provide information about the sources of pollution, including failing septic systems.

C.9.4 HC8 **Seepage pits and cesspools.** Reduce the use of seepage pits and eliminate cesspools as discovered in all Hood Canal shoreline (marine and freshwater) properties.

C.9.4 STRT2 **Implementation of water quality cleanup plans for Sequim-Dungeness Bay and East Jefferson County Clean Water Districts.** Implement Sequim-Dungeness Bay and East Jefferson County Clean Water District Cleanup Plans and projects according to implementation strategies, onsite sewage system management plans, monitoring, and other activities required in Marine Recovery Areas under RCW 70.118A.

C.9.4 WH9 **Implement a pollution identification and control project in northern Chuckanut Bay (Mud Bay) to restore the recreational shellfish area.** Through a partnership of community groups and local agencies, identify bacteria sources and implement water quality improvement projects to reduce bacteria levels in Mud Bay and restore the recreational shellfish area. This program includes:

- Monitoring.
- Community outreach.
- Technical and financial assistance for onsite sewage system operation and maintenance.
- Stormwater retrofits.

C.9.4 WH10 **Implement Whatcom County Pollution Identification and Control Program.** Through a partnership of local, state, and tribal agencies identify priority areas and implement projects to decrease bacteria levels in local marine waters, rivers, and streams. This program includes:

- Monitoring and focus area identification.
- Community outreach and engagement.
- Technical and financial assistance for agricultural operations.
- Technical and financial assistance for onsite sewage system operation and maintenance.
- Stormwater retrofits.
- Regulatory backstop.
- Nutrient Management, TMDL Implementation.

Emerging Issues and Future Opportunities

Specific longer-term activities to address Puget Sound water quality impairments that were identified during the Action Agenda update process include the following.

- **Microplastics.** There is increasing evidence of plastic pollution in Puget Sound marine and nearshore areas. Plastics have the potential to strangle marine wildlife. Mammals, birds, and fish also ingest small microplastics and the toxics they contain. The Strait ERN for the Strait Action Area has identified a priority action led by the Port Townsend Marine Science Center for microplastics (as part of a "toxic source reduction programs" priority strategy). Ecology will work with the Port Townsend Marine Science Center and other partners to continue to assemble information on plastics pollution and microplastics, including any data specific to Puget Sound, and will recommend actions to (1) better understand the threats to Puget Sound, and then (2) address the highest priority problems.
- **Incentives and binding mechanisms for reducing pollution from non-point sources.** Ecology, EPA, and local organizations will confer on possible incentives and/or binding mechanisms for ensuring that non-point pollutant reductions strategies called for in TMDLs are actually implemented for high priority TMDLs.
- **Dredged materials management.** The Dredged Materials Management Program (DNR, Ecology, EPA Region 10, and the Corps Seattle District) will continue to update standards, sampling and analysis protocols, and risk assessment procedures based on best available science through the Sediment Management Annual Review Meetings. Stakeholders have identified the need for additional analysis of dioxins in disposed material.
- **Interagency coordination.** Ecology, DNR, WDFW, and other agencies will seek to remove barriers and conflicts between programs with similar goals—including the Model Toxics Control Account and NRDA cleanup programs and the Shoreline Management Act and WRIA restoration efforts—to facilitate improved integration of habitat restoration and cleanup activities in and near Puget Sound. This will include examining whether NRDA credits can be more easily obtained for work completed under other restoration programs.
- **Local funding.** State and local agencies should collaborate to develop sufficient, stable funding for local governments to implement pollution identification and correction programs, implement actions called for in TMDLs, and undertake other efforts to improve water quality.
- **Cleanup program evaluation and improvements.** Stakeholders have suggested (1) an analysis of how interim cleanups have been used in the past, including whether they have slowed or sped up the pace of entire cleanup, and/or have influenced the cleanup decision and (2) evaluating how to better implement public participation and include all stakeholders in the early stages of clean ups.
- **Viruses in wastewater discharges.** DOH will evaluate the application of male specific coliphage (MSC) for use in the management of shellfish harvest areas affected by raw or partially untreated sewage discharges from wastewater treatment plants or community sewage collection systems. This supplements work by the U.S. Food and Drug Administration to develop a reliable viral risk indicator and to evaluate if virus uptake and persistence are different in Puget Sound than other areas of the country. This research could help better evaluate when to open shellfish harvest sites after a transient pollution event and to better delineate Prohibited areas where there is chronic pollution.

In addition, this research could help better understand the efficiency of various wastewater treatment systems to inactivate/remove enteric viruses prior to discharge.

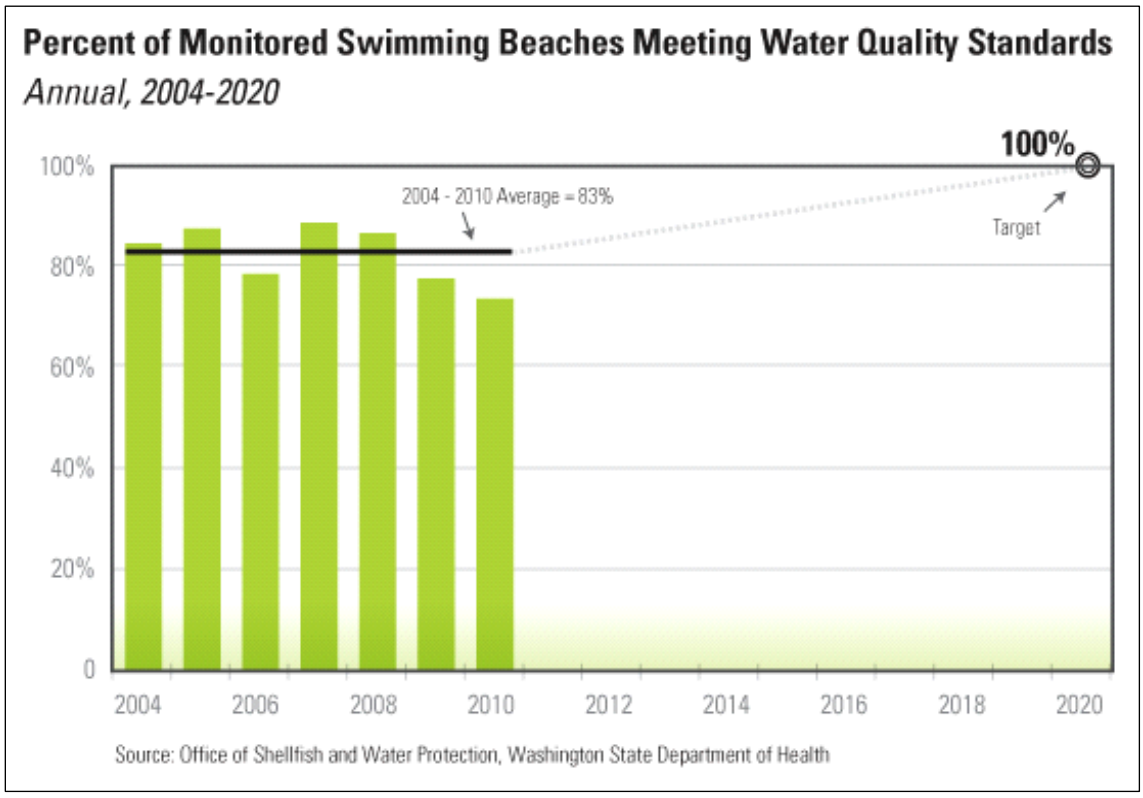
- **Predict pathogens to protect public health.** DOH is using their 2013–2014 Hershman Fellow to assist the University of Washington and NOAA's Northwest Fisheries Science Center to identify environmental criteria to develop and implement a predictive model for Vibrio parahaemolyticus, a naturally occurring bacteria that can make people sick from eating raw oysters (Washington Sea Grant 2013). The model would help us take action where problems occur and ultimately prevent illnesses.
- Future sea level rise should be considered in the prioritization, design, and post-project maintenance of cleanup sites near the shoreline.

Target View: Swimming Beaches

Fecal bacteria are found in human and animal waste. These contaminants can enter the water through a variety of means, including leaky or inadequate septic systems, wastewater treatment overflows, boat and vessel discharges, and stormwater contaminated by pet and animal waste. Controlling these sources of pollution is the key to improving water quality at swimming beaches.

Luckily, many of Puget Sound's swimming beaches already meet high standards for clean water—almost half of routinely monitored beaches consistently met the standards between 2004 and 2010; another third met the standard except for 1 or 2 years. At the same time, there is room for improvement. In any given year from 2004—2010, 7 to 15 beaches failed to meet standards, resulting in the issuance of health advisories to the public.

Percent of Puget Sound marine swimming beaches meeting water quality standards for healthy human use, allowing for one exception per swimming season. In general, samples are collected weekly. The basic measure is for enterococcus, but fecal coliform bacteria and E. coli are also sampled if warranted.



Recovery Target

Have all monitored beaches in Puget Sound meet EPA standards for what is called enterococcus, a type of fecal bacteria.

Relevant Strategies (and Sub-Strategies)

- B1.2. Support local governments to adopt and implement plans, regulations, and policies that protect the marine nearshore and estuaries, and incorporate climate change forecasts
- B4.2. Increase access to and knowledge of publicly owned Puget Sound shorelines and the marine ecosystem
- C1. Prevent, reduce, and control the sources of contaminants entering Puget Sound (C1.5, C1.6)
- C2.4. Prevent problems from new development
- C3. Prevent, reduce, and control agricultural runoff (C3.1, C3.2)
- C5. Prevent, reduce and/or eliminate pollution from decentralized wastewater treatment systems (C5.1, C5.2, C5.3)
- C6. Prevent, reduce and/or eliminate pollution from centralized wastewater treatment systems (C6.1, C6.2, C6.4, C6.3)
- C7.1. Improve water quality to prevent downgrade and achieve upgrades of important current tribal, commercial and recreational shellfish harvesting areas
- C8. Effectively prevent, plan for and respond to oil spills (C8.1, C8.2, C8.3)
- C9. Address and clean up cumulative water pollution impacts in Puget Sound (C9.1, C9.3, C9.4)

Figure C-15 (Appendix C, *Results Chains*) depicts how the strategies (and related sub-strategies) contribute to reducing pressures on swimming beaches and achieving the swimming beaches recovery target. Appendix C also contains a results chain for each individual strategy in the Action Agenda, showing how that strategy (and its related sub-strategies) reduces pressures and contributes to achieving numerous recovery targets.

Target View: Freshwater Quality

Clean water is vital to people and key to healthy fish and wildlife populations. But when our rivers and streams pick up pollutants, toxic contaminants, or excessive sediments and nutrients, it not only affects the health of our watersheds, but impacts our marine waters, swimming beaches, and shellfish beds as well. Our fresh waters should be safe for drinking and swimming, able to support farms, fish, and wildlife, and not harm our beaches, shellfish beds, or marine waters.

Walk along a small stream or creek in the region, and on the rocks and sediments of the streambed you may find a lively community of aquatic insect larvae, snails, and other small invertebrates. These small creatures thrive in clean, cool waters and form a critical part of the aquatic food chain. But this unique biological community is sensitive to many things, including pollution and runoff from agricultural and developed lands, reduced water levels and high temperatures in the summer, and the clearing of trees and vegetation along streambanks. Scientists often measure the condition of the aquatic community as an indicator of overall water quality and stream health.

The Water Quality Index is an aggregation of monthly measurements of typical water pollutants reported on a scale of 1 to 100. A higher number indicates better quality. An index score of 80 or above indicates that water quality is generally meeting our goals for sediments, nutrients, temperature, dissolved oxygen, fecal coliform bacteria, and other conventional pollutants (the index does not address toxic contaminants for a number of technical reasons). A score between 70 and 80 is considered “fair” or “borderline”; 40 to 70 is failing to meet water quality goals and less than 40 is “poor”. In general, fresh water quality index scores for the major rivers in Puget Sound have slowly improved since the index was first established in 1995 and now average in the mid-70s range. Scores in small urban streams are lower.

The Water Quality Index graph below shows that stations meeting water quality goals are all in the relatively undeveloped Olympic Peninsula (except for the Snohomish River). Stations not meeting water quality goals tend to be in watersheds with more people and more agricultural development.

Recovery Target

- At least half of all monitored streams should score 80 or above on the fresh water quality index.
- Reduce the number of “impaired” waters.
- Protect (i.e., allow no degradation of) any small streams that are currently ranked “excellent” for biological condition, and improve water quality in streams ranked “fair” so their average scores become “good.”

Water Quality Index

Annual, 2000-2010

Meeting Goals	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Avg
Duckabush	93	95	94	90	74	94	89	85	88	96	86	89
Elwha	86	88	83	76	73	74	86	67	66	81	81	78
Skokomish	95	95	94	85	70	67	92	89	89	94	86	87
Snohomish	92	91	89	81	74	75	89	75	81	85	79	83
Borderline	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Avg
Cedar	87	76	60	78	72	84	81	79	79	81	77	78
Upper Skagit	87	86	59	85	64	81	84	75	75	81	56	76
Lower Skagit	89	91	71	76	61	73	77	77	75	76	74	76
Deschutes	62	72	70	73	61	83	88	88	83	76	74	75
Nisqually	40	60	79	79	69	71	74	75	91	74	83	72
Not Meeting Goals	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Avg
Green	82	73	66	67	75	49	72	68	60	69	63	68
Nooksack	65	68	58	57	52	54	61	51	60	69	56	59
Puyallup	60	58	57	55	51	58	59	58	61	49	62	57
Samish	86	75	32	49	34	71	67	74	59	80	63	63
Stillaguamish	81	60	44	72	55	67	71	69	75	75	71	67

Source: River and Stream Ambient Monitoring Program, Washington State Department of Ecology

Relevant Strategies (and Sub-Strategies)

- C1. Prevent, reduce, and control the sources of contaminants entering Puget Sound (C1.1, C1.2)
- C2. Use a comprehensive approach to manage urban stormwater runoff at the site and landscape scales (C2.1, C2.2, C2.3, C2.4, C2.5)
- C3. Prevent, reduce, and control agricultural runoff (C3.1, C3.2)
- C4. Prevent, reduce, and control surface runoff from forest lands (C4.1, C4.2)
- C6. Prevent, reduce and/or eliminate pollution from centralized wastewater treatment systems (C6.1, C6.2, C6.3, C6.4, C6.5)
- C9. Address and clean up cumulative water pollution impacts in Puget Sound (C9.1, C9.3).

Figure C-16 (Appendix C, *Results Chains*) depicts how the strategies (and related sub-strategies) contribute to reducing pressures on freshwater quality and achieving the freshwater quality recovery target. Appendix C also contains a results chain for each individual strategy in the Action Agenda, showing how that strategy (and its related sub-strategies) reduces pressures and contributes to achieving numerous recovery targets.

Target View: Marine Sediment Quality

In a healthy, well-functioning estuary, marine sediments support an important and healthy biological community. But in Puget Sound and many estuaries around the world, sediments have become contaminated with toxic chemicals from industrial discharges, contaminated run-off from urban roads, discharges from wastewater treatment plants, agricultural and forest chemicals carried down rivers and streams, oil spills, and even chemicals carried long distances through the atmosphere that eventually fall with rain. As the forests around Puget Sound have been logged, streams and rivers channelized, and towns and cities built up, the amount, rate, and quality of sediment deposited into Puget Sound have changed dramatically.

All eight regions of Puget Sound monitored from 1997 to 2009 demonstrated minimum exposure to toxic chemicals in sediment. Four of eight regions demonstrated unimpacted benthic invertebrate communities. The other four demonstrated likely impacted communities.

Two of four Puget Sound urban bays monitored from 1998–2010 demonstrated minimum exposure to toxic chemicals in sediment. The other two urban bays that have been monitored showed improving chemistry index scores but low levels of exposure. Benthic community results are available for only three urban bays: One appears unimpacted, one has likely impacted communities and the third is on the border of unimpacted-likely impacted. According to both chemistry and benthos measures, the targets are not met in all urban bays.

Recovery Target

- By 2020, all Puget Sound regions and bays achieve chemistry measures reflecting minimum exposure with Sediment Chemistry Index scores >93.3.
- Have no sediment chemistry measurements exceeding the Sediment Quality Standards set for Washington State.
- All Puget Sound regions and bays, as characterized by ambient monitoring, achieve the following: Sediment Triad Index scores reflect unimpacted conditions (i.e., SQTI values >81).

Relevant Strategies (and Sub-Strategies)

- C1. Prevent reduce, and control the sources of contaminants entering Puget Sound (C1.1, C1.2, C1.3)
- C2. Use a comprehensive approach to manage urban stormwater runoff at the site and landscape scales (C2.1, C2.2, C2.3, C2.4, C2.5)
- C3. Prevent, reduce, and control agricultural runoff (C3.1, C3.2)
- C6. Prevent, reduce and/or eliminate pollution from centralized wastewater systems (C6.1, C6.2, C6.3, C6.4, C6.5)
- C8. Effectively prevent, plan for and respond to oil spills (C8.1, C8.2, C8.3)
- C9. Address and clean up cumulative water pollution impacts in Puget Sound (C9.1, C9.2, C9.3)

Figure C-17 (Appendix C, *Results Chains*) depicts how the strategies (and related sub-strategies) contribute to reducing pressures on marine sediment quality and achieving the marine sediment quality recovery target. Appendix C also contains a results chain for each individual strategy in the Action Agenda, showing how that strategy (and its related sub-strategies) reduces pressures and contributes to achieving numerous recovery targets.

Target View: Toxics in Fish

Toxic pollutants in Puget Sound bays, rivers and streams can show up in native fish, causing them to become diseased and posing a health threat to humans if consumed. One of the most worrisome pollutants in the Puget Sound ecosystem is a group of chemicals called PCBs. Concern over these chemicals in Puget Sound is high because they are toxic, they last for a long time in the ecosystem, and their levels increase in predators as the chemicals move up the food chain. Measuring these pollutants in fish tissues tells us whether present-day levels are harmful to the fish or the predators that consume them, and whether they are safe for us to eat.

PCBs were originally used in many industrial applications, but many of these uses were banned in the US in the 1970s. Although PCB levels have decreased in some fish since then, they remain high in certain areas and species. In Puget Sound, PCBs are high in bottom fish that live near urban or industrial areas with contaminated sediments. Surprisingly, PCBs are also high in many species from Puget Sound's pelagic, or open-water food web, including herring, salmon, seals, and orcas. Exposure to PCBs may be harming these species, and concern for human health from this contamination has led the DOH to issue consumption advisories for some Puget Sound salmon and bottom fish. Scientists have been tracking PCBs and other chemicals in Puget Sound fish since 1989, and have established threshold limits for these chemicals in fish tissues. These thresholds provide a guideline for the level of toxic chemicals that fish can tolerate, before they become diseased or show other harmful effects, or that presents elevated levels of risk to humans consuming these fish.

Current data on contaminants in Puget Sound fish are displayed in the graph below. Average concentration of PCBs as a summation of congeners, compared to a tissue threshold of 2400 ng PCBs/g lipid. English sole data from 2007, 2009, n=137; herring data from 2007–2010, n=70; Coho data from 2006, 2008, n=86; adult Chinook data from 2003, 2004, n=48; juvenile Chinook data from 2010, n=5; pink, chum, and sockeye salmon data from 2003, 2004, n=5 each.

Recovery Target

- By 2020, contaminant levels in fish will be below health effects thresholds (i.e., levels considered harmful to fish health or harmful to the health of people who consume them).
- By 2020, contaminant-related disease or impairments in fish are reduced to background levels.

Relevant Strategies (and Sub-Strategies)

- C1. Prevent, reduce, and control the sources of contaminants entering Puget Sound (C1.1, C1.2, C1.3)
- C2. Use a comprehensive approach to manage urban stormwater runoff at the site and landscape scales (C2.1, C2.2, C2.3, C2.4, C2.5)
- C3. Prevent, reduce, and control agricultural runoff (C3.1, C3.2)
- C6. Prevent, reduce and/or eliminate pollution from centralized wastewater systems (C6.1, C6.2, C6.3, C6.4, C6.5)
- C8. Effectively prevent, plan for and respond to oil spills (C8.1, C8.2, C8.3)
- C9. Address and clean up cumulative water pollution impacts in Puget Sound (C9.2, C9.1, C9.3)

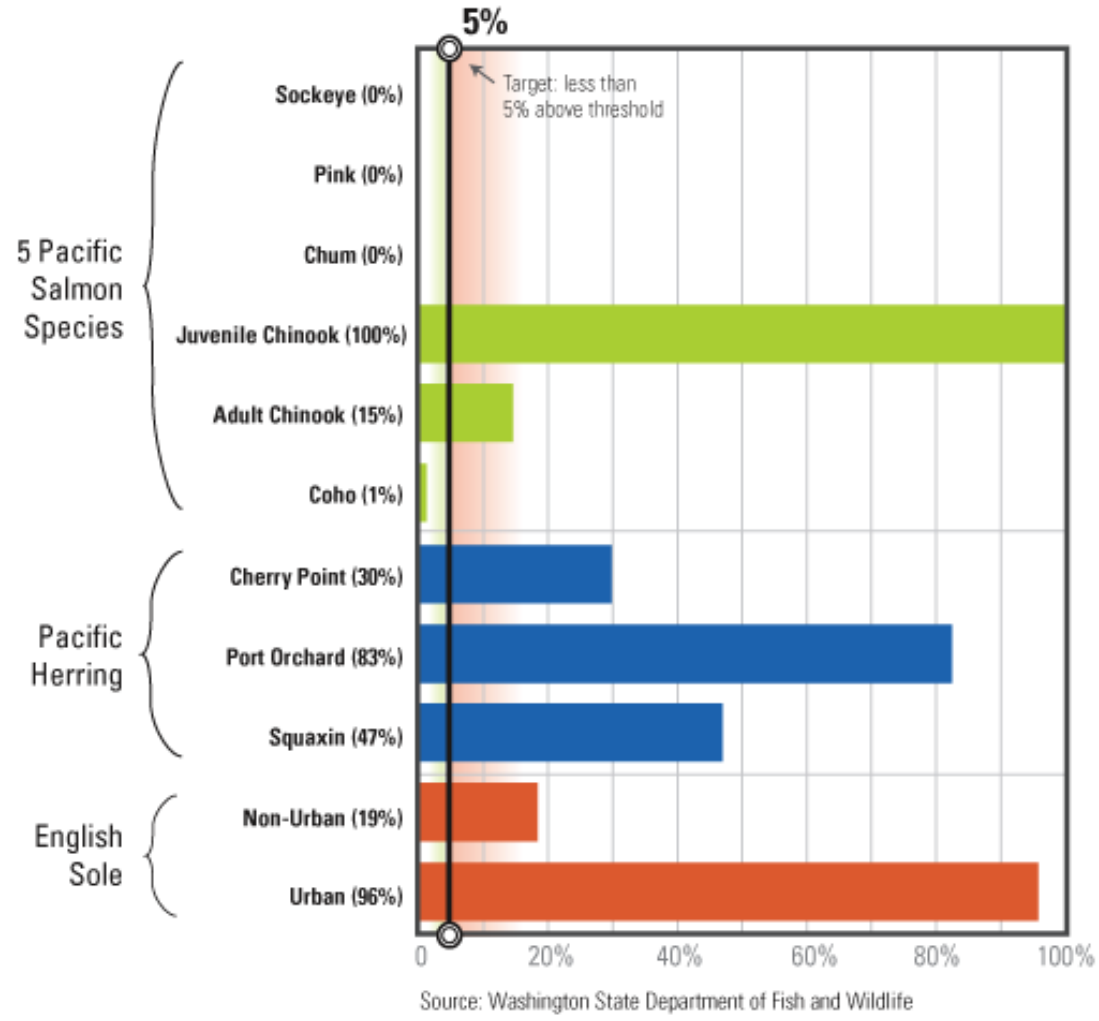


Figure C-18 (Appendix C, *Results Chains*) depicts how the strategies (and related sub-strategies) contribute to reducing pressures related to toxics in fish and achieving the toxics in fish recovery target. Appendix C also contains a results chain for each individual strategy in the Action Agenda, showing how that strategy (and its related sub-strategies) reduces pressures and contributes to achieving numerous recovery targets.