

Puget Sound Vital Signs – Biophysical (Water Quality and Quantity, Habitats, Species)

DRAFT Feb 25, 2015

Vital Sign	Description	Scope	Indicators	2020 Targets
WATER QUALITY				
Marine Sediment Quality	<p><i>A functioning, resilient Puget Sound ecosystem is defined to include marine sediment quality that supports functioning, healthy communities of sediment-dwelling invertebrates.</i> The sediment (gravel, sand, silt, and clay) on the "floor" of Puget Sound forms a unique habitat that is home to clams, marine worms, burrowing shrimp, bottom-dwelling fish, and thousands of other unique species. In turn, these animals form a critical part of the marine food web, help filter the overlying water, and process and help breakdown the sediments themselves. In Puget Sound, the sediments have become contaminated. This Vital Sign tells us about the condition of these sediments and their ability to support the aquatic life that rely on them and can help us understand whether efforts to reduce pollutants to marine waters are effective.</p>	<p>Includes all aspects of marine sediment quality, including chemistry, toxicity and the aquatic invertebrates that live in sediment (benthos). Includes all areas in Puget Sound marine waters (nearshore and offshore areas; urban bays)</p> <p>Does not include: Information about suspended sediment, including sediment transport and drift cells, which would be an attribute of marine water quality</p>	<p>(1) Sediment chemistry index;</p> <p>(2) Sediment Quality Triad Index;</p> <p>(3) Percent of chemical measurements exceeding SQS.</p>	<p>(1) By 2020, all Puget Sound regions and bays achieve chemistry measures reflecting "minimum exposure" with Sediment Chemistry Index (SCI) scores >93.3;</p> <p>(2) All Puget Sound regions and bays, as characterized by ambient monitoring, achieve the following: Sediment Quality Triad Index (SQTI) scores reflect "unimpacted" conditions (i.e., SQTI values >81). The threshold criteria for "unimpacted" sediments has been revised from 83 (when the Leadership council adopted the target in 2011) to 81, based on quality control checks indicating the original calculation was incorrect.;</p> <p>(3) Have no sediment chemistry measurements exceeding the Sediment Quality Standards (SQS) set for Washington state.</p>
Marine Water Quality	<p><i>A functioning, resilient Puget Sound ecosystem is defined to include marine waters that support species, communities, and food webs.</i> Marine water quality refers to many aspects of water such as temperature, salinity, oxygen, nutrient balance, algae biomass, nitrates, phosphate, and pH. In much of Puget Sound, marine water quality is affected by many different factors including weather, climate and natural circulation patterns, inflow from rivers and streams, discharges from wastewater treatment plants and industries, off-shore ocean conditions, storm-water runoff, ground water, and pollution. This Vital Sign tells us about the combined impacts of global change and local human-caused stresses on Puget Sound marine waters.</p>	<p>Includes: All parameters of marine water quality covered in the Marine Water Condition Index. Includes all areas in Puget Sound marine waters</p> <p>Does not include: Toxics, contaminants , pathogens, or marine water conditions in the Pacific Ocean and the Canadian portion of the Salish Sea</p>	<p>(1) Dissolved oxygen in marine waters,</p> <p>(2) Marine Water Condition Index.</p>	<p>(1) Keep dissolved oxygen levels from declining more than 0.2 milligrams per liter in any part of Puget Sound as a result of human input.</p> <p>(2) No target adopted</p>

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Toxics in Fish	<p><i>A functioning, healthy Puget Sound ecosystem is defined to include fish populations not harmed by toxic contaminants and fish safe for consumption by predators and humans.</i> Toxic pollutants in bays, rivers, and streams can show up in the fish that live there, causing them to become diseased and posing a health threat to humans when they eat the fish. The indicators for this Vital Sign track a few important chemicals that are toxic and are signs and symptoms of fish health impaired by exposure to toxic chemicals. The toxic chemicals tracked in Puget Sound fish include those that last for a long time in the ecosystem and whose levels increase in predators as the chemicals move through food webs. 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 humans to eat.</p>	<p>Includes: All toxic chemicals and associated effects on all marine, anadromous, and freshwater fish (not only those specified in indicators and targets.) Includes all areas in Puget Sound marine waters.</p> <p>Does not include: Toxic chemicals in fish sold in markets but not harvested from Puget Sound marine and fresh waters; Mussels, marine mammals, marine birds</p>	<p>(1) Contaminant levels below thresholds (PCBs, PAHs, PBDEs)</p> <p>(2) Contaminant-related disease in fish.</p>	<p>(1) 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)</p> <p>(2) By 2020, contaminant-related disease or impairments in fish are reduced to background levels.</p>
Freshwater Quality	<p><i>A functioning, resilient Puget Sound ecosystem is defined to include (a) freshwater quality that protects aquatic life and other uses of the state's waters and (b) lowland streams that support the salmonids and invertebrates native to this region.</i> This Vital Sign tells us about the condition of the fresh water that is vital to people, fish and wildlife populations and whether or not we are keeping pollutants, toxic contaminants, and excessive sediments and nutrients out of our rivers and streams.</p>	<p>Includes: All parameters of freshwater quality and benthic health in lakes, rivers and streams as defined by the water quality index, B-IBI and the 303d list</p> <p>Does not include: Ground water quality or the quality of water in systems that supply drinking water</p>	<p>(1) Water quality index</p> <p>(2) Benthic index of biotic integrity (B-IBI)</p> <p>(3) Number of impaired waters</p>	<p>(1) At least half of all monitored streams should score 80 or above on the Water Quality Index</p> <p>(2) Protect small streams that are currently ranked "excellent" by B-IBI for biological condition; and improve and restore streams ranked "fair" so their average scores become "good"</p> <p>(3) Reduce the number of "impaired" waters</p>

WATER QUANTITY				
Summer Stream Flows	<p><i>A functioning, resilient Puget Sound ecosystem is defined to include summer stream flows that support salmon habitat needs, other ecosystem needs, and provide water for people. Some seasonal variation is normal, but exceptionally low flows exacerbated by development that draws water away from streams in the summer can cause problems for salmon and people. This Vital Sign helps us track the effects of climate change and variability on flows and whether or not management actions intended to reduce withdrawals and increase recharge in developed areas are working to restore summer flows.</i></p>	<p>Includes: Stream flows in the Puget Sound major rivers identified in the 2020 target</p> <p>Does not include: Other dimensions of ecological flows (e.g., sediment- and LWD-transporting high flows)</p>	<p>Percent of rivers with stable, increasing, or decreasing flows.</p>	<p>Increase, maintain, monitor, and/or restore summer flows in 12 key rivers, including those regulated by dams (Nisqually, Cedar, Skokomish, Skagit, and Green Rivers), and those that are not (Puyallup, Dungeness, Nooksack, Snohomish, Deschutes, North Fork Stillaguamish, and Issaquah Rivers).</p>
PROTECT AND RESTORE HABITAT				
Land Development and Cover	<p><i>A functioning, resilient Puget Sound ecosystem is defined to include (a) sufficient forestlands, agricultural lands, open space, natural lands (i.e., forest, prairie), and developed lands and related infrastructure to support habitat needs, support natural processes, and generate ecosystem services; and (b) landscapes that provide important habitat and hydrology functions and a land base to support the built environment for a growing human population. During the past 50 years, Puget Sound lost at least two-thirds of its remaining old growth forest, more than 90% of its native prairies, and 80% of its marshes. The need for homes, businesses, roads, and agriculture must be balanced with protection of the important functions provided by forested and riparian areas. This Vital Sign tells us about the gains (through restoration), maintenance (through protection) and losses of habitat (through development) and also how well we are directing our region's ongoing growth to protect our best remaining natural areas and working forests.</i></p>	<p>Land Cover includes: All vegetated lands (urban and rural), agricultural lands, prairies, open space, and natural lands, and all vegetated riparian areas along all Puget Sound streams</p> <p>Land Development includes: All development activity and its effect on ecologically important areas. Includes shorelines, uplands and watersheds.</p> <p>Does not include: Dredging and filling, development of in- or over-water structures</p>	<p>(1) Land cover change: forest to developed;</p> <p>(2) Land cover change: riparian restoration;</p> <p>(3) Land development pressure: conversion of ecologically important lands;</p> <p>(4) Land development pressure: proportion of basin-wide population growth distribution within urban growth areas (UGAs).</p>	<p>(1) The average annual loss of forested land cover to developed land cover in non-federal lands does not exceed 1,000 acres per year, as measured with Landsat-based change detection; (2) Restore 268 miles of riparian vegetation or have an equivalent extent of restoration projects underway; (3) Basin-wide loss of vegetation cover on ecologically important lands under high pressure from development does not exceed 0.15% of the total 2011 baseline land area over a five-year period; (4) The proportion of basin-wide growth occurring within UGAs is at least 86.5% (equivalent to all counties exceeding their population growth goals by 3%), with all counties showing an increase over their 2000 - 2010 percentage.</p>

<p>Shoreline Armoring</p>	<p><i>A functioning, resilient Puget Sound ecosystem is defined to include dynamic shorelines maintained by coastal processes such as shoreline erosion and ecological exchange between terrestrial and aquatic systems. Shorelines are among the most valuable and fragile of our natural resources. More than 25% of the shoreline has been armored to protect public and private property, ports and marinas, roads and railways, and other uses. Shoreline armoring, the practice of constructing bulkheads (also known as seawalls) and rock revetments, disrupts the natural process of erosion, which supplies much of the sand and gravel that forms and maintains our beaches and creates habitat for many other species. This Vital Sign tells us how we are doing to protect intact shorelines, to reduce the total amount of shoreline armoring – particularly in those areas along feeder bluffs – and replace armoring with soft-shore techniques, and how much new armoring (whether hard or soft) in our effort to restore the natural processes and function of shorelines.</i></p>	<p>Includes: All shoreline armoring on marine and freshwaters in Puget Sound, including the location and type of armoring.</p> <p>Does not include: Dredging and filling, overwater structures</p>	<p>Amount of shoreline armoring</p> <p>Armoring of feeder bluffs</p> <p>Use of soft-shore techniques to protect shoreline infrastructure</p>	<p>From 2011 to 2020, the total amount of armoring removed should be greater than the total amount of new armoring in Puget Sound (total miles removed is greater than the total miles added).</p> <p>Feeder bluffs receive strategic attention for removal of armoring and avoidance of new armoring</p> <p>Soft shore techniques use for all new and replacement armoring, unless it is demonstrably infeasible.</p>
<p>Estuaries</p>	<p><i>A functioning, resilient Puget Sound ecosystem is defined to include tidally-influenced wetland habitats at the estuaries of Puget Sound's major rivers that provide ecosystem functions, goods, and services. The estuary Vital Sign tracks protection, loss, and restoration of large and small estuaries. 75% of river delta tidal wetlands that have been lost or degraded in Puget Sound. River delta estuaries, a unique environment where freshwater mixes with salt water and sediments collect, provide important feeding and resting habitat for young salmon, migratory birds, and many other species that cannot find these unique benefits in any other place in our landscape. These areas are also highly valuable for people: they have been heavily developed and they provide some of the most fertile agricultural lands in the region.</i></p>	<p>Includes: All estuaries of Puget Sound, including major rivers estuaries and pocket estuaries, not only those major river deltas covered by the 2020 target.</p>	<p>(1) Number of salmon habitat recovery goals met;</p> <p>(2) Estuary acres restored.</p>	<p>(1) All Chinook natal river deltas meet 10-year salmon recovery goals (or 10% of restoration need as proxy for river deltas lacking quantitative acreage goals in salmon recovery plans);</p> <p>(2) 7,390 quality acres are restored basin-wide, which is 20% of total estimated restoration need.</p>

Floodplains	<p><i>A functioning, resilient Puget Sound ecosystem is defined to include freshwater floodplains that support natural processes and deliver ecological services to keep people and property safe during flood flows, support fisheries production, and provide water filtration and ground water recharge. This Vital Sign tracks protection, loss and progress toward recovering the function of our many floodplains that have been lost through a combination of shoreline armoring, levees and residential, commercial, industrial and agricultural development. Floodplains provide critical functions and services like absorbing overflow from heavy rains, providing refuge, food, and fresh water for a variety of species as well as good agricultural land and flat land that supports a variety of human uses.</i></p>	<p>Includes: Floodplain areas in all Puget Sound freshwater systems. In systems with FEMA delineations, the extent of floodplain is as defined by the FEMA 500-year floodplain delineation. (Note that alternative definitions of floodplain extent are currently being considered and might expand or reduce the extent of floodplains included in the future.)</p> <p>Does not include: Floodplain area outside the FEMA 500-year floodplain boundaries (e.g., valley bottom areas beyond the delineated floodplain area)</p>	<p>(1) Floodplain function (specific indicator not yet adopted);</p> <p>(2) Floodplain area restored.</p>	<p>2020 Recovery Target: Restore, or have projects underway to restore, 15% of degraded Puget Sound floodplain area, and have no net loss of floodplain function in any watershed.</p>
Eelgrass	<p><i>Fringing beds and meadows of eelgrass (<i>Zostera marina</i>) provide important habitat functions and services. This Vital Sign tells us about progress toward recovering healthy eelgrass and other submerged aquatic vegetation (SAV) beds. Eelgrass, a marine plant in the shallow waters of Puget Sound, serves as food source, nursery, and haven for many species. It also filters sediments and nutrients, improving water clarity, and protects shorelines from erosion. Eelgrass is also valuable as an indicator because it is sensitive to environmental stressors such as pollution, sediment inputs and physical damage and it allows tracking of both gains and losses.</i></p>	<p>Includes: All submerged aquatic vegetation (SAV) beds in Puget Sound and kelp.</p>	<p>Eelgrass area</p>	<p>2020 Recovery Target: A 20% increase in the area of eelgrass in Puget Sound relative to the 2000 - 2008 baseline reference by the year 2020.</p>

SPECIES AND FOOD WEB				
Chinook Salmon	<p><i>A functioning, resilient Puget Sound ecosystem is defined to include a spatially and genetically diverse collection of viable Chinook salmon populations.</i> This Vital Sign tells us about the health of Puget Sound Chinook populations and whether our efforts to improve Chinook habitat and coordinate management of harvest and hatcheries are having the desired effect of improving Chinook populations. Although it focuses on Chinook populations specifically, it is intended to serve as an indicator of the health of all salmon and steelhead species in Puget Sound. Chinook salmon are a cultural icon of the Pacific Northwest and are listed as “Threatened” under the federal Endangered Species Act; currently they are about one-third as abundant as they were in the early 1900s. Returning Chinook are highly prized by anglers and commercial fisherman and are a favorite food of orca whales. Throughout their lifecycle, they depend on a wide variety of freshwater, estuary, nearshore and marine habitats.</p>	<p>Includes: Chinook and other salmon species, including Summer Chum, Treaty rights species and other ESA-listed species</p> <p>Does not include: Any other species. See also other Vital Signs: Outdoor Activities, Local Foods, Economic Vitality, and Cultural Practices</p>	<p>Chinook salmon population abundance as measured by the number of natural origin adult fish returning to spawn.</p>	<p>2020 Recovery Target: Stop the overall decline and start seeing improvements in wild Chinook abundance in two to four populations in each biogeographic region.</p>
Birds	<p><i>Birds serve as ecological indicators of environmental health, biodiversity, condition of habitats, and climate change.</i> The bird Vital Sign will tell us about the health of populations of native resident and migratory species of birds and also about Puget Sound ecosystem health and ecosystem change. This is a community-based indicator for marine and terrestrial habitats.</p>	<p>Includes: Marine birds (resident and migratory) that are highly dependent on the Puget Sound marine environment, resident birds associated with interior conifer forests, and resident birds associated with humans.</p> <p>Does not include: Other bird species or groups</p>	<p>Population abundance, breeding success and diet.</p>	<p>2020 Recovery Target: Not adopted.</p>
Orcas	<p><i>A functioning, resilient Puget Sound ecosystem is defined to include a viable population of southern resident killer whales, also called orcas.</i> This Vital Sign addresses the health of our local killer whale population. Killer whales occupy an important niche at the top of the food web and support a multi-million dollar whale-watching industry. The unique</p>	<p>Includes: Southern Resident Killer Whales population</p> <p>Does not include: Transient Killer Whale populations; Northern</p>	<p>Number of Southern Resident Killer Whales</p>	<p>2020 Recovery Target: 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.</p>

	<p>population of orcas living in and around the Salish Sea, the Southern Resident Killer Whales, once numbered around 200 whales but recently has declined to fewer than 90 individuals.</p>	<p>Resident Killer Whale population</p>		
<p>Pacific Herring</p>	<p><i>A functioning, resilient Puget Sound ecosystem is defined to include herring to satisfy predators' consumption requirements, meet bait and other fishery needs, and assure sufficient herring for successful spawning and recruitment.</i> This Vital Sign tell us about the health of forage fish in Puget Sound, with a specific focus on Pacific herring, one of the most abundant forage fish species in Puget Sound. Together with a few other small schooling fish species, herring play a unique role in the food web: they are an essential source of food for larger fish, seabirds, and marine mammals. They require clean water and natural shorelines, so their continued survival depends on maintaining links between nearshore and open-water habitats.</p>	<p>Includes: Forage fish species including Pacific herring, surf smelt and sand lance</p> <p>Does not include:</p>	<p>Biomass of spawning Pacific Herring</p>	<p>2020 Recovery Target: Increase the overall amount of spawning herring throughout Puget Sound to about 19,000 tons. For each stock, the targets are: Cherry Point: 5000 tons; Squaxin Pass: 880 tons; all other stocks: 13,500 tons.</p>