

Chapter 2. WRIA 9 and Salmon Conservation

This chapter summarizes some of the major characteristics of WRIA 9, including physical features, salmon use, and major factors of decline. It highlights the work of the WRIA 9 Technical Committee in formulating an initial WRIA 9 Salmon Conservation and Recovery Strategy (Strategy), and discusses characteristics of healthy salmon populations. The chapter concludes by summarizing some of the key activities occurring in the WRIA.

Physical Characteristics

WRIA 9 is made up of the Green/Duwamish watershed and the Central Puget Sound watershed (the short independent streams that drain to Puget Sound from Elliott Bay south to the Puyallup watershed, and the associated shorelines of Puget Sound). For salmon habitat conservation planning purposes, the streams on Vashon/Maury Island and its Puget Sound shorelines also are included in WRIA 9. WRIA 9 is bordered on the north by the Lake Washington/Cedar/Sammamish watershed (WRIA 8) and to the south by the Puyallup/White River watershed (WRIA 10) (see Figure 1 in Chapter 1).

The Green/Duwamish River watershed is the largest portion of WRIA 9. Historically, the Green River joined the White River in Auburn. Farther downstream, in Tukwila, the Cedar/Black rivers joined the Green/White to form the Duwamish River, which meandered a further 15 miles to empty into Elliott Bay. The three major rivers drained a watershed of about 1,600 square miles.

The last 150 years have seen major changes in the Green/Duwamish watershed. The Green River fish hatchery on Soos Creek was built in 1901-02 and is still in operation. (The hatchery is operated by the Washington Department of Fish and Wildlife.) The Tacoma diversion dam was built in 1913 on the Upper Green River, near the town of Palmer at river mile (RM) 61, to supply water to the City of Tacoma. The diversion dam completely blocked fish passage to the upper watershed, significantly reducing the amount of habitat available to fish. In 1911 and 1916, the White and Cedar/Black Rivers, respectively, were diverted from the Green/Duwamish, reducing the remaining drainage area to about 560 square miles. Figure 2 shows the Duwamish drainage prior to 1900 and after the 1916 diversion. Habitats of importance to salmon include not only the water and sediment attributes of the Green/Duwamish River and the Puget Sound estuary and nearshore, but also other associated waters such as streams (Soos Creek and Newaukum Creek being the largest); small tributaries and riparian wetlands; and seeps and groundwater linkages to those water bodies. In addition to these physical features, the *WRIA 9 Reconnaissance Assessment* includes water quality, flows, riparian zones, and upland terrestrial conditions as components of salmon habitat.⁴

The Duwamish estuary historically contained over 4,000 acres of tidal marshes and intertidal mudflats. The estuary was filled between 1900 and 1940, creating Harbor Island and the East

⁴ Page 2-1 of the *Habitat Limiting Factors and Reconnaissance Assessment Report, Volume 1*.

and West Waterways, largely to support industrial and shipping activities. The Green/Duwamish River was also dredged and channelized, reducing the lower 9 miles of meandering channel to 5 miles of deeper, uniform channel more suitable for navigation. Revetments and levees were built along most of the lower Green River to protect the flat, alluvial valley from flooding. In 1962, the Howard Hanson Dam was built on the Upper Green River (near RM 63.5) for flood control and water storage purposes. No fish passage facilities were incorporated into the dam.

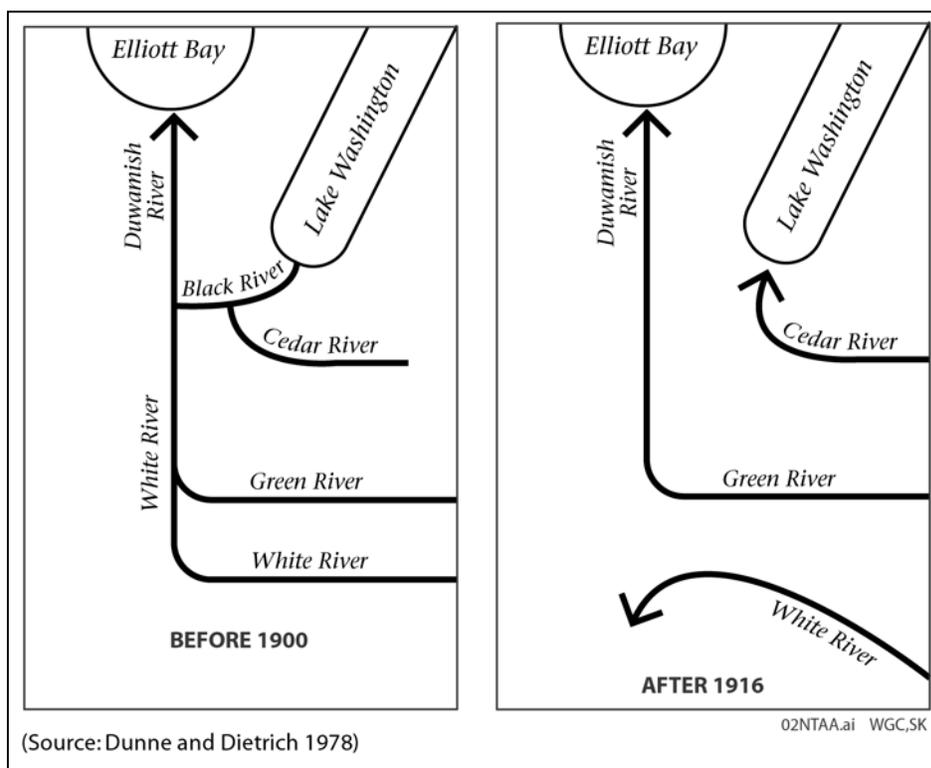


Figure 2. Duwamish Drainage Prior to 1900 and After 1916.

Before 1945, agriculture was the predominant land use in the Green/Duwamish valley. Gradually, commercial and industrial land uses replaced agriculture on the valley floor, although some important agricultural production areas still exist, in part through a King County-sponsored program to purchase development rights.

The nearshore area of WRIA 9, including Vashon/Maury Island and the mainland, has experienced less dramatic alteration. Although the shoreline of Vashon/Maury Island is relatively undisturbed, bulkheading has occurred. Much of the mainland shoreline also has been modified. It is estimated that 64 percent of the nearshore has some sort of armoring to accommodate residential and commercial development. Despite many alterations in the watershed and estuary, the Green/Duwamish system continues to support important fishery resources.

The human population in WRIA 9 has increased significantly over time. Today over a half a million people live in the watershed, most of whom reside in the WRIAs 15 cities. Growth management planning, as prescribed by Washington State law, has designated an urban growth area boundary in King County, and additional growth is anticipated on the urban side of the boundary (Figure 1). Accommodating future growth within urban areas can relieve pressure on more resource-rich areas outside the growth boundary.

Fish Use and Factors of Decline

The Green/Duwamish River is home to all eight species of anadromous salmon native to the west coast of North America. The Green/Duwamish River supported an average yearly run (fish returning to the river and those caught in the fisheries) of about 41,000 adult chinook salmon during the period from 1968 to 1996. The Green River has not experienced the same decline in naturally spawning adult chinook salmon that has occurred in other Puget Sound rivers but these numbers may be masked by a high rate of hatchery chinook salmon that stray into the spawning grounds. Habitat in the Green/Duwamish has, however, severely and steadily declined.

Chinook, coho, chum, sockeye, and pink salmon, coastal cutthroat trout, steelhead, and bull trout/Dolly Varden char occur in the watershed. The health of these species is mixed. Some stocks, such as steelhead trout, appear to be showing recent declines, although they were listed as healthy in 1992⁵. The populations of coho and chum salmon have mixed status because both healthy stocks and depressed stocks exist in the watershed. The status of pink salmon, sockeye salmon, cutthroat trout, and bull trout is not known. Kokanee have been planted in the late 1960s in Deep Lake (Middle Green River subwatershed) and are surviving locally (Lakey, Kirk. 2001. Personal communication [electronic message to WRIA 9 Steering Committee staff, King County], Washington Department of Fish and Wildlife, Bellevue, WA).

Major engineered changes in the river and estuary (diversion of flows, creation of dams, and channel confinement by levee and revetment) have created conditions detrimental to fish and fish habitat. Channel complexity has been reduced, tidal marshes and flats have been eliminated, and connections with the old river side-channels were severed. In addition, loss of connection between the river and its floodplain and other riparian areas interferes with the natural functions of recharge of cold groundwater from flood infiltration and with the supply of gravel and large woody debris from riparian areas. Loss of fresh-to-saltwater transition habitat in the estuary reduced the available juvenile and adult transition and holding areas and reduced the invertebrate food supply. Thirteen specific factors of decline have been identified throughout the five subwatersheds of WRIA 9 (see Table 1). Two of these factors of decline are considered WRIA-wide in effect: land use alterations and water quality changes⁶. Others are split between freshwater and saltwater factors of decline and apply on a subwatershed scale.

⁵ 1992 Washington State Salmon and Steelhead Stock Inventory. Washington State Department of Fish and Wildlife, Olympia, WA.

⁶ See *Habitat Limiting Factors and Reconnaissance Assessment Report* (2000) for more information.

Table 1. WRIA 9 factors of decline.

	Factor of Decline	Description	Examples of Items Related to Factor of Decline
WRIA-wide	Land Use Alteration	Human activities, primarily on the terrestrial portions but also in the aquatic areas of the watershed. These activities affect other factors of decline such as hydrology, riparian condition, water quality, and sediment transport.	Residential, commercial, and industrial development such as homes and factories have added impervious surfaces, altering stormwater runoff patterns. Farms, forestry activities, and infrastructure such as dikes, levees, and roads have interrupted normal basin hydrology.
	Water Quality	Presence of metals, nutrients, and other substances in the water at levels that exceed standards or impair beneficial uses of the water	Stormwater runoff, malfunctioning septic systems, point source discharges, agricultural practices (cropping and animal keeping), oil spills, clearing and grading practices, combined sewer overflows
Freshwater	Hydrology	Water storage and flow via surface water (e.g., lakes, streams, and wetlands) or ground water	Stormwater runoff, water withdrawals, dams, increases in impervious surfaces
	Sediment Transport	Movement of sand, gravel, and other sediment downstream	Clearing and grading practices, forestry activities, construction practices, dams, landslides
	Hydromodification	Changes to the channel or banks of the river; includes changes in the amount of in-channel large woody debris	Bank hardening, levees, loss of large woody debris, dams, channel straightening, dredging
	Riparian Condition	Presence or absence of native vegetation along the shorelines	Bank hardening, increase in impervious surfaces, vegetation removal, agricultural and forestry practices
	Fish Passage	Ability of fish to access a stream or river reach	Culverts, dams, drops in water levels, dikes, levees, flapgates
	Non-Native Species	Introduction of plant and animal species whose natural distribution did not include Puget Sound	Fishery management stocking, intentional introduction of gamefish by anglers, and liberation of baitfish by anglers; introducing non-native vegetation like reed canarygrass
Estuary and Nearshore	Loss of Habitat in Migratory Corridor	Degradation or elimination of shallow-water habitats, such as mud flats, eelgrass, and kelp beds	Shoreline armoring, dredging, filling, and overwater structures
	Sediment Quality	Presence of metals, organics, and other substances in sediments at levels that exceed standards or affect food chains	Stormwater runoff, malfunctioning septic systems, point source discharges, agricultural practices, oil spills, industrial and commercial practices
	Alteration of Habitat-Forming Processes	Interruption or other modification of processes that form nearshore habitat, such as sediment transport and freshwater input	Shoreline armoring; development on top of and below banks, bluffs, and beaches; changes in flow due to diversion of rivers or streams
	Riparian Condition	Presence or absence of native vegetation along the shorelines	Shoreline armoring, overwater structures, development, vegetation removal
	Non-Native Species	Introduction of plant and animal species whose natural distribution did not include Puget Sound	Ballast water discharge, packing materials from foreign seafood, intentional or unintentional establishment by the aquaculture industry

Land use activities have resulted in many direct and indirect impacts to salmon habitat. Loss of riparian vegetation has increased temperature and reduced leaf and insect inputs to the river, affecting the base of the salmon food chain. Increases in runoff volume have disrupted the timing and magnitude of flows, increased erosion, and carried pollutants into streams, first from agricultural, then urban sources. Pipes, culverts, ditches, and dams have resulted in blockages to fish passage and changes to the movement of gravel and large woody debris.

Water quality has been affected throughout the watershed. Wastewater and industrial discharges accentuated the effects of land use changes by reducing dissolved oxygen, altering temperatures, and releasing a variety of chronic contaminants, particularly in the lower Green River and Duwamish estuary. Erosion from agriculture, forestry, urban construction, and other activities increased the load of sediment entering the river, plugging spawning gravel and suffocating salmon eggs. Failing septic systems are also a problem in some rural and nearshore areas. Pesticides and fertilizers from farms, gardens, and yards have also altered water quality. Some common pesticides are believed to interfere with detection of olfactory cues by salmon, in addition to having direct toxicity and indirect food chain effects.

The WRIA 9 Salmon Conservation and Recovery Strategy

The Technical Committee has developed an interim conservation and recovery Strategy for WRIA 9⁷. The Strategy is based on the current state of knowledge of watershed conditions, including the thirteen habitat factors of decline (Table 1) and ecological principles. The Strategy helps identify priority early actions for salmon conservation and recovery in the WRIA. The Strategy will be revisited periodically and revised as appropriate as new information is collected and critical examination of issues yields additional insights into WRIA 9 and Puget Sound salmon conservation needs. Users of this Near-Term Action Agenda are encouraged to check with WRIA 9 staff or the WRIA 9 salmon habitat conservation website to be sure they have the latest version of the Strategy.

The WRIA 9 Strategy identifies three high-priority watershed goals for salmon conservation and recovery:

- **Protect currently functioning habitat** primarily in the Middle Green River subwatershed and the nearshore areas of Vashon/Maury Island.
- **Ensure adequate juvenile salmon survival** in the Lower Green River, Elliott Bay/Duwamish, and Nearshore subwatersheds. Meeting this goal involves several types of actions, including protecting currently

⁷ More information on the WRIA 9 Strategy can be found in the document *Technical Strategy for Multi-Species Salmonid Conservation and Recovery in the Green/Duwamish and Central Puget Sound Watersheds, June 2001*. The document is available on-line at [http://dnr.metrokc.gov/wrias/9/technical reports/technicalreports.htm](http://dnr.metrokc.gov/wrias/9/technical%20reports/technicalreports.htm) (in Part III, Conclusions, Technical Strategy Working Paper).

functioning habitat, restoring degraded habitat, and maintaining or restoring adequate water quality and flows.

- **Restore access for salmon** (efficient and safe passage for adults and juveniles) to and from the Upper Green River subwatershed.

Because the lower subwatersheds (Lower Green River, Elliott Bay/Duwamish, Nearshore) are highly developed, the Strategy recognizes the importance of preserving options for future actions as well as carrying out near-term projects and actions.

Four categories of actions have been identified to help carry out these goals: actions that protect; restore and/or enhance; connect; and study and/or fill data gaps. These four action categories, and how they relate to specific areas of the watershed, are described below.

1. **Protect**— This Strategy element seeks to protect currently functioning habitat and habitat-forming processes. This habitat is primarily in the Middle Green River and the nearshore areas of Vashon/Maury Island. Some examples of protection actions include:
 - Protecting physical habitat and natural ecosystem processes, such as long-shore sediment transport
 - Managing flows to protect and maximize salmon habitat in the mainstem Green River
 - Protecting water quality, such as ensuring that sources of cold, clean water inputs are not disturbed
 - Protecting habitat connectivity, linking freshwater, estuarine and saltwater habitats
 - Managing landscapes to minimize adverse effects to aquatic habitats.

The level of protection needed varies by subwatershed. For instance, the Upper Green River subwatershed currently has a significant degree of protection afforded by Tacoma Public Utilities' Habitat Conservation Plan and the Washington State Forest and Fish Agreement. In contrast, the Lower Green River and the Elliott Bay/Duwamish subwatersheds have experienced significant habitat alteration. In these subwatersheds, protecting remaining habitat, identifying restoration opportunities, or protecting flows or water quality could be important goals.

2. **Restore or Enhance**— This Strategy element seeks to improve habitats that currently adversely affect juvenile salmon survival and to restore or enhance habitat that could increase survival of all salmon life stages. Restoration may be a more important salmon conservation element in the highly altered Lower Green

River, Elliott Bay/Duwamish and the Nearshore subwatersheds than in the Upper and Middle Green River subwatersheds.

3. **Connect**—Multiple actions are part of the *connect* element of the Strategy. One aspect is the restoration of access for salmon to and from the Upper Green River above the Tacoma diversion dam and the Howard Hanson Dam. Restoring access from the Upper Green River mainstem to its tributaries is another aspect of this category. It is important to reconnect side channels in the Middle Green River and reduce culvert blockages where such culverts restrict access to intact spawning and rearing habitat. The Lower Green River, Elliott Bay/Duwamish, and Nearshore subwatersheds have few remnant areas in which connection could significantly increase chinook salmon habitat. Therefore, some connection activities in the Upper and Middle Green River subwatersheds are likely to be relatively more important than in the lower subwatersheds. However, other types of connection projects, such as revetment setbacks to reconnect the river and floodplain, may have high importance in the lower subwatersheds.
4. **Study**— This Strategy element includes research that will lead to better understanding of the factors that limit healthy salmon populations in WRIA 9 and that will contribute to a better definition of the relationship between habitat and salmon population dynamics. This work is especially critical in the Lower Green River, Elliott Bay/Duwamish, and Nearshore subwatersheds. These subwatersheds have been most heavily altered and potential actions are constrained by past development and significant social and economic considerations. Research will help to better direct resource expenditures in these subwatersheds. Research in the Middle and Upper Green River subwatersheds will focus on specific issues, including protection of habitats and habitat-forming processes that are intact, and optimal techniques for improving connection, as noted above.

For the Near-Term Action Agenda, the WRIA 9 Strategy is to focus first on actions that improve the conservation and recovery of listed species (chinook salmon and bull trout). Figure 3 depicts the WRIA 9 Strategy.

Highlights of Current WRIA 9 Salmon Conservation Actions

Much work focused on protecting salmon has already been initiated in WRIA 9. Those actions that are WRIA-wide are summarized here to create a backdrop for the actions that are recommended in the next chapter.

The 16 local jurisdictions in WRIA 9 have initiated policies, programs, and practices that manage or regulate development within their jurisdictions as well as improve their own operations to better conserve salmon resources. Actions undertaken by jurisdictions, including programs, policies, practices, or studies, are summarized in Appendix A.

There are also many community and environmental groups promoting salmon-related projects in WRIA 9, including Trout Unlimited, People for Puget Sound, Mid-Puget Sound Fisheries Enhancement Group, the Green/Duwamish Watershed Alliance, I'M A PAL (International Marine Association Protecting Aquatic Life), the Environmental Coalition of South Seattle, and the Soos Creek Action Area Response. These groups are a direct link between people and salmon in the watershed. In addition to on-the-ground efforts to protect and restore habitat, the groups help make salmon conservation relevant to the broader public.

In addition to local jurisdictions, other governments are also active in the WRIA. The Muckleshoot Indian Tribe, along with the Washington State Department of Fish and Wildlife, are co-managers of fishery resources in the WRIA. The Muckleshoots operate a hatchery on Crisp Creek, sponsor habitat restoration projects, and advocate for improved management and reduction in impacts to fishery habitat and resources. As noted above, the Washington Department of Fish and Wildlife operates the hatchery on Soos Creek. The Washington Department of Fish and Wildlife also enforces fishing regulations within the WRIA.

The U.S. Army Corps of Engineers, in conjunction with local jurisdictions, is involved in two major programs in WRIA 9: the Green/Duwamish Ecosystem Restoration Project and the Additional Water Storage Project. The Green/Duwamish Ecosystem Restoration Project is a cooperative effort with all the local jurisdictions in WRIA 9 to restore habitat functions in the watershed. As part of this program, the U.S. Army Corps of Engineers and local governments will construct a wide variety of habitat restoration projects and conduct studies to help guide their efforts. The Additional Water Storage Project is designed to improve flows in the river and enable Tacoma Public Utilities to increase the amount of water it withdraws from the Green River for its water supply. Tacoma Public Utilities and the U.S. Army Corps of Engineers are sharing the costs of this program, which also will construct habitat projects and conduct studies and monitoring throughout the watershed. Tacoma Public Utilities also has developed a Habitat Conservation Plan with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service that covers its water supply and land management activities (including logging) in the watershed. The Habitat Conservation Plan will result in significant habitat projects and monitoring.

A number of initiatives govern forestry and agricultural practices in WRIA 9. The Washington State Department of Natural Resources and Plum Creek Timber have developed Habitat Conservation Plans with the National Marine Fisheries Service that allow them to continue logging using practices that provide improved management of riparian areas, wildlife habitat, and roads. The Forest and Fish Agreement, as codified in Washington Administrative Code 222, developed the current forest practices rules that cover areas not covered by a specific habitat protection plan. The Agriculture, Fish, and Wildlife negotiations are a state effort at developing new guidelines for riparian buffers in agricultural areas.

Two major programs are underway to improve habitat quality in the Duwamish estuary: the Elliott Bay/Duwamish Restoration Program and the Lower Duwamish Superfund Program. The Puget Sound Nearshore Ecosystem Restoration Project, a U.S. Army Corps of Engineers project with co-sponsorship from state and local governments, which began in 2001, will identify nearshore habitat acquisition and restoration projects throughout Puget Sound, including

WRIA 9. In addition, the Port of Seattle is involved in a number of salmon habitat-focused projects and studies in the Elliott Bay/Duwamish subwatershed.

A large number of projects have been undertaken or are planned in the WRIA by the WRIA jurisdictions, other governments, non-governmental stakeholders, and the efforts described above. Chapter 4 offers more information about the specific projects planned or underway that benefit chinook salmon and bull trout, as well as other species of salmon.

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Figure 3. Salmon Conservation Strategy in the Green/Duwamish and Central Puget Sound Watershed.

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