15 Washougal River Subbasin

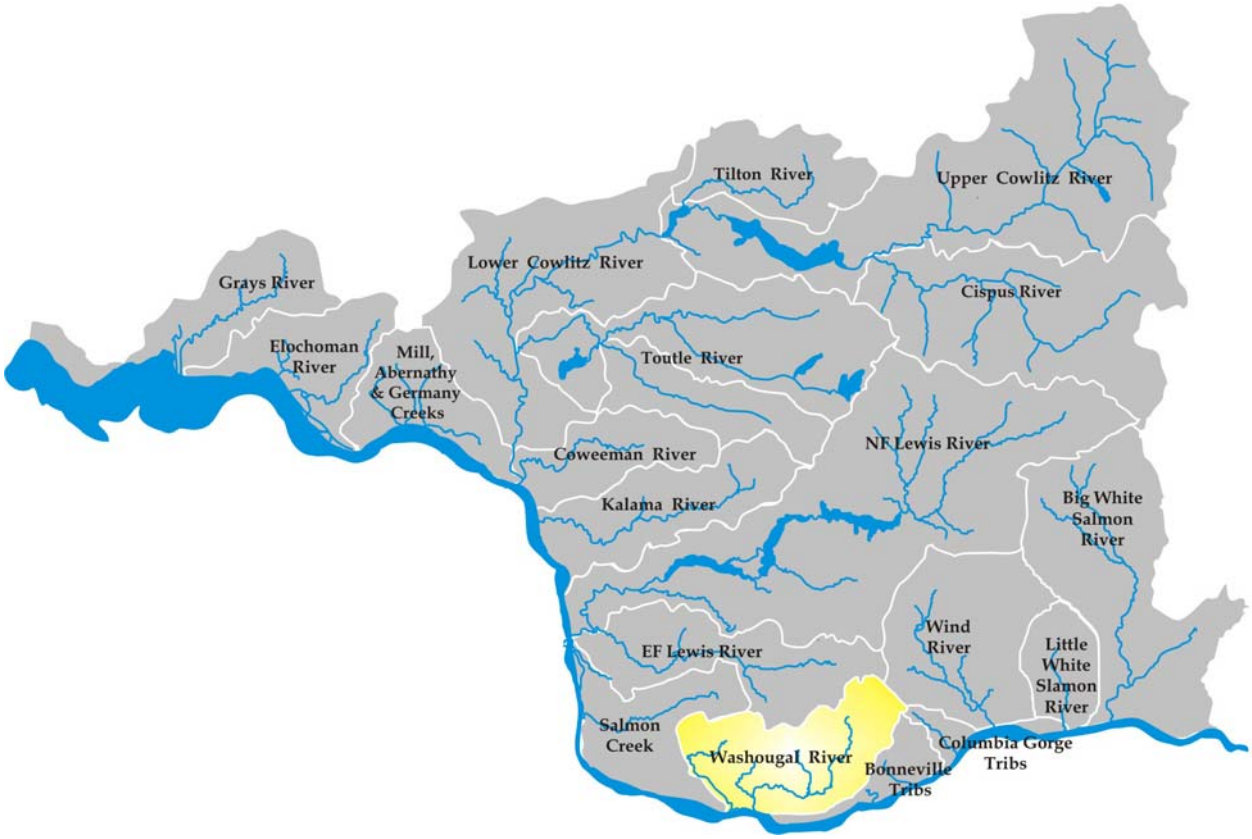


Figure 15-1. Location of the Washougal Subbasin within the Lower Columbia River Basin.

15.1 Basin Overview

The Washougal River Subbasin comprises approximately 240 square miles, two-thirds of which is located in Skamania County and one-third in Clark County. The river enters the Columbia at RM 121, near the town of Camas, Washington. Principal tributaries include the West Fork, Little Washougal River, and Lacamas Creek. The subbasin is part of WRIA 28.

The Washougal Subbasin will play a key role in the recovery of salmon and steelhead. The subbasin has historically supported populations of fall Chinook, summer and winter steelhead, chum, and coho. Today, Chinook, steelhead and chum are listed as threatened under the ESA. Coho salmon are a candidate for listing. The health or viability of these populations is currently low to moderate, except for coho, which is very low. Recovery goals call for restoring Chinook, steelhead, and chum population to a high or better viability level. This level will provide for a 95% or better probability of populations survival over 100 years. Coho will be restored to a moderate level of viability or a 75 to 95% probability of persistence over 100 years. Other fish species of interest are Pacific lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Washougal salmon and steelhead are affected by a variety of in-basin and out-of basin factors including stream, Columbia River mainstem, estuary, and ocean habitat conditions; harvest; hatcheries; and ecological relationships with other species. Analysis has demonstrated that recovery cannot be achieved by addressing only one limiting factor. Recovery will require action to reduce or eliminate all manageable factors or threats. The deterioration of habitat

conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonids within the Columbia Basin. Direct harvest of listed salmon and steelhead is prohibited but sport and commercial fisheries focusing on hatchery fish and other healthy wild populations, primarily in the mainstem Columbia and ocean, incidentally affect ESA-listed Washougal fish. Skamania and Washougal hatcheries operate within the basin with the potential to both adversely affect wild salmon and steelhead populations and to assist in recovery efforts. Key ecological interactions of concern include effects of nonnative species; nutrient inputs from salmon carcasses; and predation by species affected by development including Caspian terns, northern pikeminnow, seals, and sea lions. Discussions of out-of-basin factors, strategies, and measures common to all subbasins may be found in Volume I, Chapters 4 and 7. This subbasin chapter focuses on habitat and other factors of concern specific to the Washougal Subbasin.

Nearly all of the lands in upper portions of the Washougal Subbasin (upper mainstem and upper reaches of the West Fork, Little Washougal, and Dougan Creek) are forested. Stream habitat in these areas is particularly important for summer steelhead spawning. However, watershed processes in the upper areas of subbasin also affect salmon and steelhead habitat in the lower areas of the basin through influence on flows, water temperature, and sediment transport. Principal landowners in the upper subbasin are the U.S. Forest Service, the Washington Department of Natural Resources, and industrial forest companies. Landscape conditions in some of these areas are largely intact. Federal and state forest management plans and state forest practice regulations are expected to protect and restore watershed processes and habitat conditions in this area in the intermediate and long-term (10–100 years). Additional active restoration efforts will help to achieve improved habitat conditions in the near-term.

The middle portion of the subbasin (middle mainstem and the lower reaches of the West Fork and Little Washougal) is a mixed-use area comprised largely of rural residential development, small scale or noncommercial agriculture, and non-industrial forestlands. These areas are important for summer and winter steelhead spawning and rearing, chum spawning, and Chinook spawning and rearing. Watershed functions and habitat conditions have been altered by clearing of riparian zones, filling of wetland areas, isolation of side channel habitat, bank hardening, increased sediment inputs, and stormwater runoff. Degraded watershed processes in the middle subbasin impact habitat conditions in the lower subbasin.

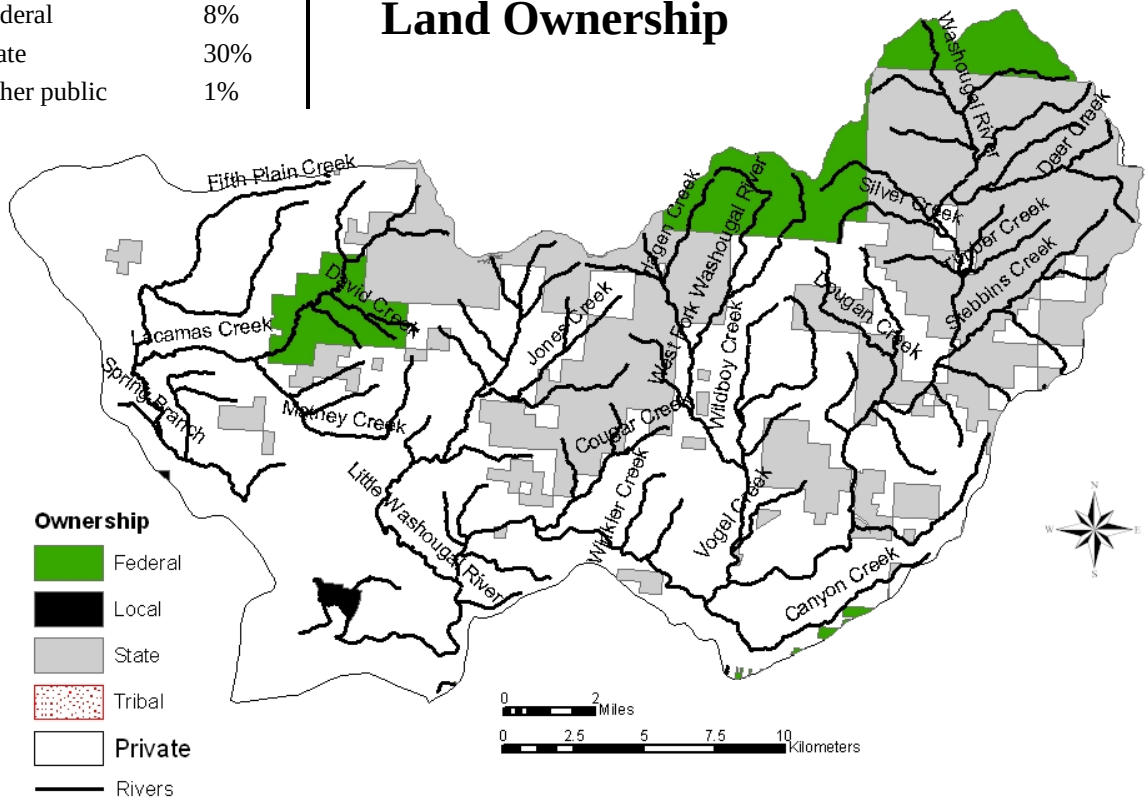
The lower area of the subbasin is characterized by industrial, urban, and suburban land uses. Watershed functions and habitat conditions have been significantly compromised by these high intensity uses. Although some riparian areas in the lower reaches near the mouth have been protected through public ownership, destruction of riparian habitat, bank hardening, increased stormwater runoff, and channelization are major limiting factors. Lacamas Creek, the lowest tributary, has been dammed to provide water for industrial use. The reservoir and the creek's heavily altered upper watershed have resulted in increased temperatures and decreased water quality. The lower subbasin is particularly important for chum spawning. It is also important for steelhead and Chinook rearing.

Between 2000 and 2020, human population in the Washougal Subbasin is expected to increase from 36,600 to 92,800 (LCFRB 2001). These substantial population increases reflect the eastward expansion of the Vancouver metropolitan area. Most development is expected to occur in the Lacamas, Little Washougal, and lower mainstem basins. This growth will place increased pressure on the middle mainstem of the Washougal and the Little Washougal watershed. Conversions of forest and agricultural lands to residential use within stream valley bottom areas have the potential to seriously degrade watershed processes and habitat conditions.

Current Clark and Skamania County land use regulations will provide moderate habitat protection. Clark County is pursuing an ESA Section 4(d) limit by developing additional protective measures. Both counties will need to adopt measures to protect watershed processes and habitat from degradation resulting from land use conversions. Land use regulations for the cities of Camas and Washougal provide only limited protection and will require strengthening. While improved land use regulation can make a significant contribution to habitat protection, it will not and, in all likelihood, cannot effectively prevent any further deterioration of habitat conditions. Seemingly minor unregulated activities such as application of fertilizers and pesticides and removal of riparian vegetation can cause incremental deterioration of habitat conditions. These impacts must be addressed through public information and outreach efforts that promote appropriate practices and landowner incentive programs. A closure of the basin to further surface water withdrawals has also been proposed based on low and high flow targets identified in Watershed planning efforts. However, existing withdrawals in two tributaries of the Little Washougal significantly reduce available flow during low flow periods. Active efforts to restore riparian habitat, side channels, and instream conditions will be required to compensate for development in the lower and middle portion of the subbasin that will likely preclude the full restoration of watershed processes.

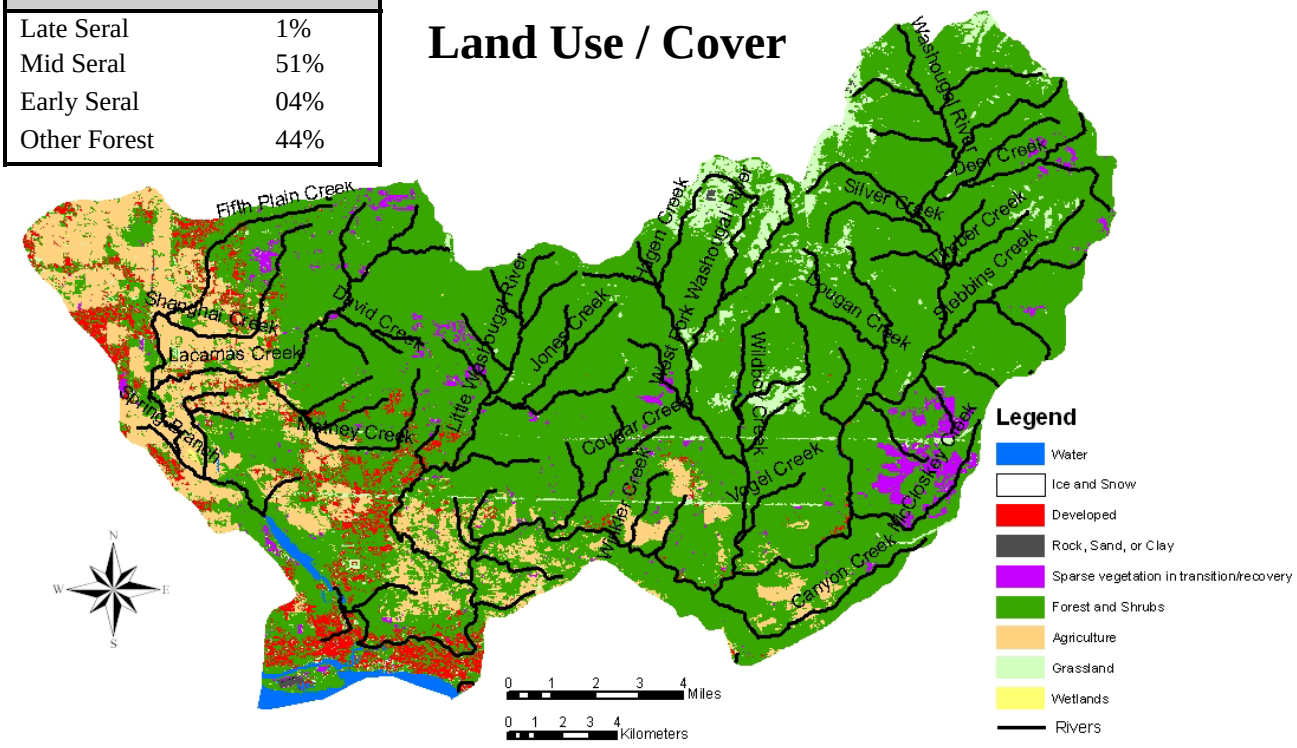
Land Ownership	
Private	61%
Federal	8%
State	30%
Other public	1%

Land Ownership



Vegetation Composition	
Late Seral	1%
Mid Seral	51%
Early Seral	04%
Other Forest	44%

Land Use / Cover



15.2 Species of Interest

Focal salmonid species in the Washougal Basin include fall Chinook, winter steelhead, summer steelhead, chum, and coho. The health or viability of these populations is currently low to medium, except for coho, which is very low. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Other species of interest in the Washougal Subbasin include coastal cutthroat trout and Pacific lamprey. Regional objectives for these species are described in Volume I, Chapter 6. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and Washougal subbasin although specific spawning and rearing habitat requirements of lamprey are not well known.

Table 15-1. Current viability status of Washougal populations and the biological objective status that is necessary to meet the recovery criteria for the Cascade strata and the lower Columbia ESU.

	ESA	Hatchery	Current		Objective	
Species	Status	Component	Viability	Numbers	Viability	Numbers
Fall Chinook	Threatened	Yes	Low+	2,000-4,500	High	4,000-5,800
Winter Steelhead	Threatened	Yes	Low+	100-800	Medium	600-1,000
Summer Steelhead	Threatened	Yes	Low+	100-200	High+	500-900
Chum	Threatened	No	Low	<1,000	High+	1,100-9,400
Coho	Candidate	Yes	Very Low	unknown	Medium	unknown

Fall Chinook– The historical Washougal adult population is estimated from 3,000-9,000 fish. The current natural spawning number is 2,000-4,500, but the majority of the returns are hatchery fall Chinook released as juveniles from the Washougal Hatchery. Natural spawning occurs primarily in four miles of the mainstem Washougal from Salmon Falls Bridge (RM 15) to the Fish and Wildlife access area. A ladder was constructed at Salmon Falls in the late 1950s providing spawning access up to Dougan Falls (RM 21). Spawning upstream of Salmon Falls can be significant in years with early fall rain. Juvenile rearing occurs near and downstream of the spawning areas. Juveniles migrate from the Washougal in the spring and early summer of their first year.

Winter Steelhead– The historical Washougal adult population is estimated from 2,000-9,500 fish. Current natural spawning returns range from 100-800 fish. In-breeding with Skamania Hatchery produced steelhead is thought to be low because of differences in spawn timing. Spawning occurs primarily in the mainstem Washougal upstream to Dougan Falls, the Little Washougal, North Fork Washougal and tributaries. Spawning time is early March to early June. Juvenile rearing occurs both downstream and upstream of the spawning areas. Juveniles rear for a full year or more before migrating from the Washougal

Summer Steelhead– The historical Washougal adult population is estimated from 2,000-8,000 fish. Current natural spawning returns range from 100-200 fish. In-breeding with Skamania Hatchery produced steelhead is thought to be low because of differences in spawn timing. Spawning occurs throughout the Washougal Basin, extending to the mainstem Washougal and tributaries upstream of Dougan Falls, the Little Washougal, and the North Fork Washougal. Spawn timing is generally from early march to early June. Juvenile rearing occurs

both downstream and upstream of the spawning areas. Juveniles rear for a full year or more before migrating from the Washougal.

Chum– The historical Washougal adult population is estimated from 25,000-40,000. Current natural spawning is less than 100 fish in the Washougal and less than 1,000 fish in the Washougal area, including the mainstem Columbia and tributaries near I-205 Bridge. Spawning occurs in the lower reaches of the mainstem Washougal, Little Washougal, and Lacamas Creek. A potentially related population spawns in the mainstem Columbia and tributaries near the I-205 Bridge. Spawning occurs from late November through December. Natural spawning chum in the Washougal are all naturally produced as no hatchery chum are released in the area. Juveniles rear in the lower reaches for a short period in the early spring and quickly migrate to the Columbia.

Coho– The historical Washougal adult population is estimated from 5,000-35,000, with the majority of returns late stock which spawn from late November to March. Some early stock coho were also historically present with spawning occurring primarily in early to mid November. Current returns are unknown but assumed to be very low. A number of hatchery produced fish spawn naturally. Natural spawning can occur in most areas of the basin upstream to Dougan Falls, but the principal spawning area is the Little Washougal River. Juvenile rearing occurs upstream and downstream of spawning areas. Juveniles rear for a full year in the Washougal Basin before migrating as yearlings in the spring.

Coastal cutthroat– Coastal cutthroat abundance in the Washougal has not been quantified but the population is considered depressed. Cutthroat trout have been observed throughout the basin upstream to Dougan Falls and in Lacamas Lake. Anadromous, fluvial, and resident forms of cutthroat trout are found in the basin. Anadromous cutthroat enter the Washougal from July-December and spawn from December through June. Most juveniles rear 2-4 years before migrating from their natal stream. A hatchery cutthroat program was discontinued in 1999.

Pacific lamprey.– Information on lamprey abundance is limited and does not exist for the Washougal basin population. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have declined in the Washougal Basin also. Adult lamprey return from the ocean to spawn in the spring and summer. Spawning likely occurs in the small to mid-size streams of the Washougal Basin. Juveniles rear in freshwater up to seven years before migrating to the ocean.

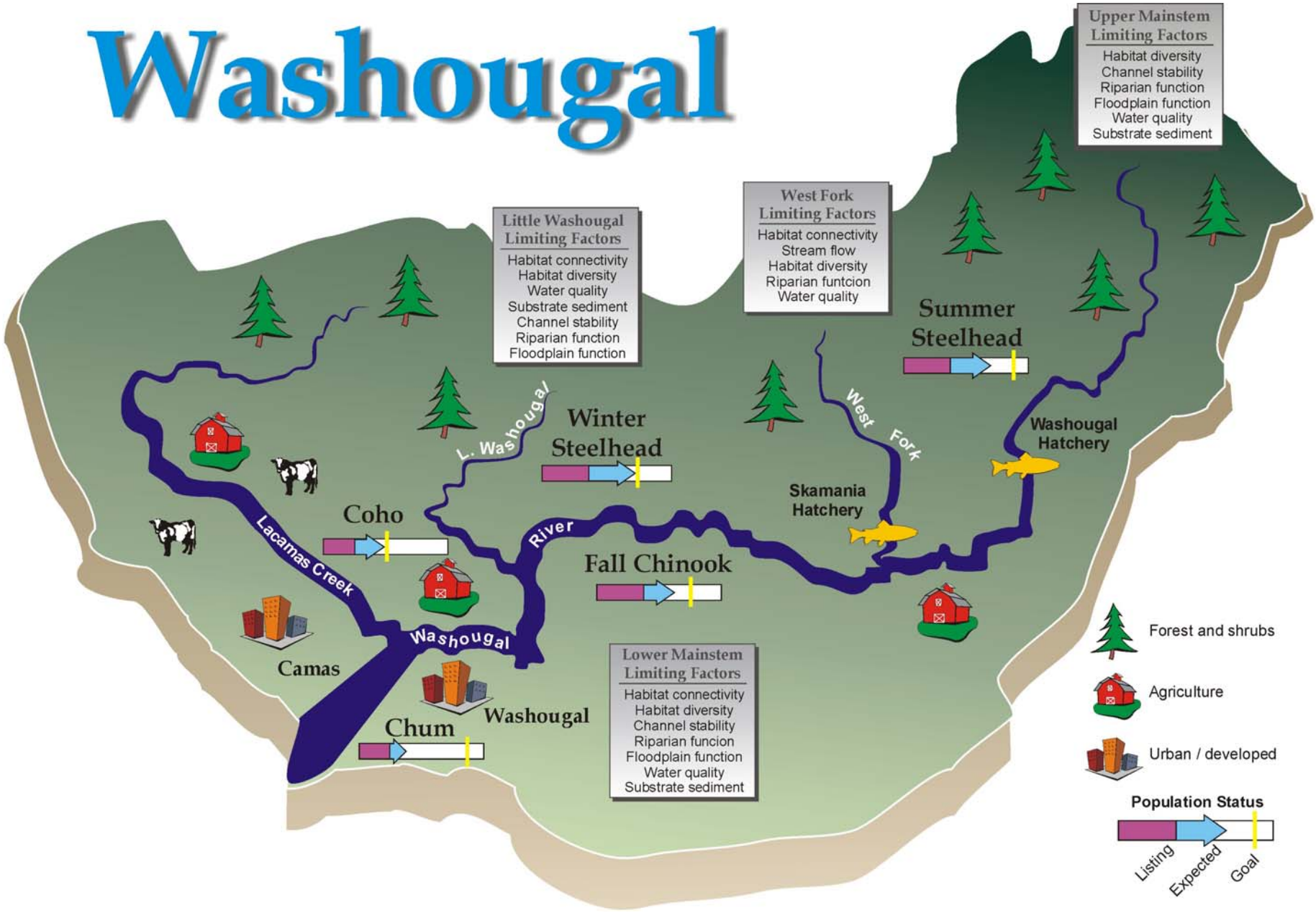


Figure 15-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs, and biological objectives depicted for the Washougal Subbasin.

15.3 Potentially Manageable Impacts

Stream habitat, estuary/mainstem habitat, harvest, hatchery and predation effects have all contributed to reduced salmonid productivity, numbers, and population viability in the Washougal subbasin. The pie charts below represent the relative order of magnitude of quantifiable effects for each of these factors for each focal species. The preferred recovery scenario targets an equivalent reduction in each impact factor in proportion to the magnitude of the effect. Population-specific targets are discussed in further detail in Volume I, Chapter 6.

- Loss of tributary habitat quality and quantity is an important impact for all species, particularly for chum and steelhead. Loss of estuary habitat quality and quantity is also important, particularly for chum.
- Harvest has a large relative impact on fall Chinook and moderate impacts on coho. Harvest effects on winter and summer steelhead and chum are minimal.
- Hatchery impacts include domestication of natural populations (most applicable to Chinook and coho) and ecological interactions which can impact all species to variable degrees.
- Predation impacts of northern pikeminnow, Caspian terns, and marine mammals in the mainstem and estuary are moderate for winter and summer steelhead, but appear to be less important for coho, chum, and fall Chinook.
- Hydrosystem access and passage impacts are relatively minor for all species.

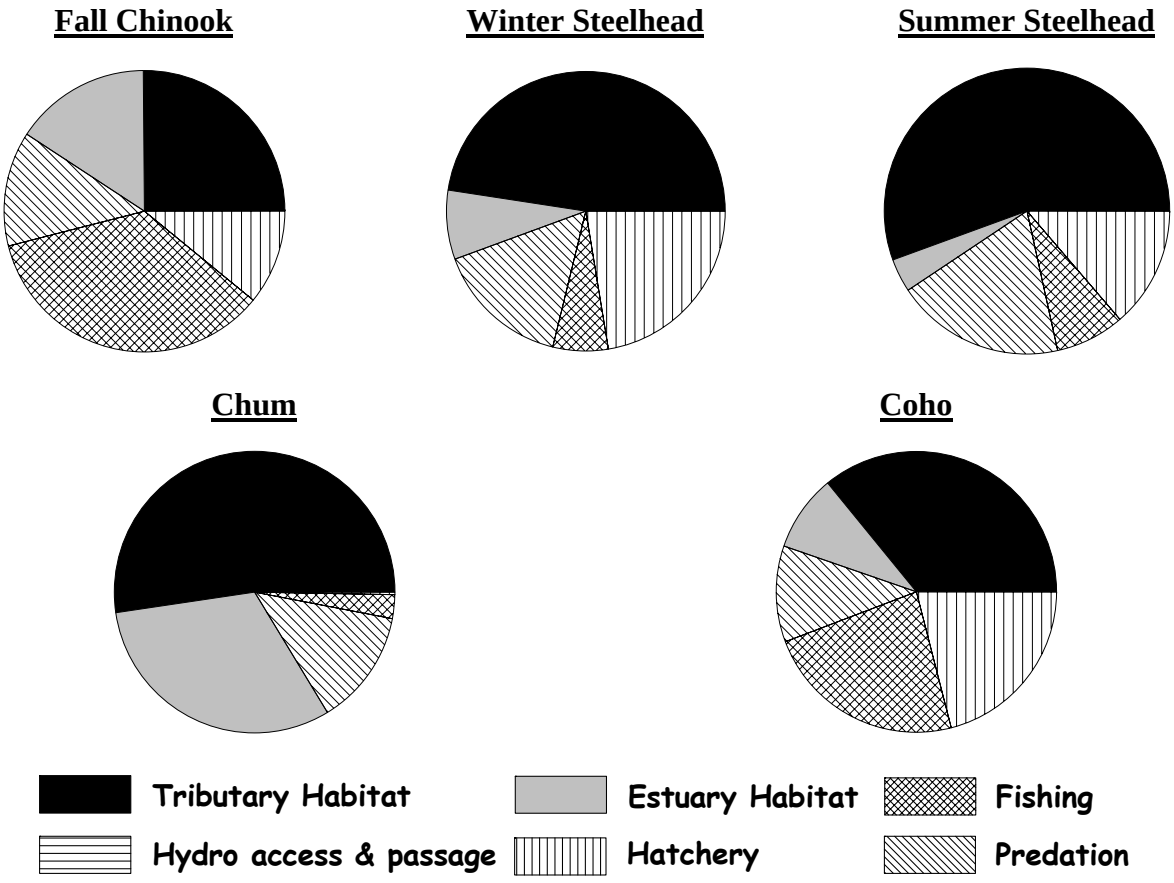


Figure 15-3. Relative contribution of potentially manageable impacts for Washougal populations.

15.4 Limiting Factors, Threats, and Measures

15.4.1 Hydropower Operation and Configuration

There are no hydro-electric dams in the Washougal River Basin. However, Washougal species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. These factors are described in further detail in Volume I, Chapter 4. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I, Chapter 7.

15.4.2 Harvest

Most harvest of wild Washougal salmon and steelhead is incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. Harvest mortality is very low for chum and steelhead, but is more significant for fall Chinook. Washougal fall Chinook are harvested in ocean and Columbia River commercial and sport fisheries as well as in-basin sport fisheries. Harvest is controlled by an ESA harvest limit associated with Coweeman natural fall Chinook. No harvest of chum occurs in ocean fisheries, there are no directed Columbia River or Washougal Basin chum fisheries and retention of chum is prohibited in Columbia River and Washougal sport fisheries. Chum are impacted incidental to fisheries directed at coho and winter steelhead. Harvest of Washougal coho occurs in the ocean commercial and recreational fisheries off the Washington and Oregon coasts and Columbia River as well as recreational fisheries in the Washougal Basin. Wild coho impacts are limited by fishery management to retain marked hatchery fish and release unmarked wild fish. Incidental mortality of steelhead occurs in freshwater commercial fisheries directed at Chinook and coho and freshwater sport fisheries directed at hatchery steelhead and salmon. All recreational fisheries are managed to selectively harvest fin-marked hatchery steelhead and commercial fisheries cannot retain hatchery or wild steelhead.

Measures to address harvest impacts are generally focused at a regional level to cover fishery impacts accrued to lower Columbia salmon as they migrate along the Pacific Coast and through the mainstem Columbia River. The regional measures cover species from multiple watersheds which share the same migration routes and timing, resulting in similar fishery exposure. Regional strategies and measures for harvest are detailed in Volume I, Chapter 7. A number of regional strategies for harvest involve implementation of measures within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest measures with significant application to Washougal Subbasin populations are summarized in the following table:

Table 15-2. Regional harvest measures from Volume I, Chapter 7 with significant application to Washougal Subbasin populations.

Measure	Description	Comments
F.M17	Monitor chum handle rate in winter steelhead and late coho tributary sport fisheries.	State agencies would include chum incidental handle assessments as part of their annual tributary sport fishery sampling plan.
F.M13	Develop a mass marking plan for hatchery tule Chinook for tributary harvest management and for naturally-spawning escapement monitoring.	Provides the opportunity to implement selective tributary sport fishing regulations in the Washougal watershed. Recent legislation passed by Congress mandates marking of all Chinook, coho, and steelhead produced in federally funded hatcheries that are intended for harvest. Details for implementation are currently under development by WDFW, ODFW, treaty Indian tribes, and federal agencies.
F.M18	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	Includes monitoring of naturally-spawning steelhead encounter rates in fisheries and refinement of long-term catch and release handling mortality estimates. Would include assessment of the current monitoring programs and determine their adequacy in formulating naturally-spawning steelhead incidental mortality estimates.
F.M19	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	Regulatory agencies should continue to refine gear, handle and release methods, and seasonal options to minimize mortality of naturally-spawning steelhead in commercial and sport fisheries.
F.M24	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	Mass marking of lower Columbia River coho and steelhead has enabled successful ocean and freshwater selective fisheries to be implemented since 1998. Marking programs should be continued and fisheries monitored to provide improved estimates of naturally-spawning salmon and steelhead release mortality.

15.4.3 Hatcheries

As noted in the regional strategies, hatcheries can adversely affect wild salmon and steelhead populations in several ways. These include domestication or the reduction in the fitness of wild fish due to interbreeding with hatchery fish, direct competition between wild and hatchery fish for habitat and nutrients, and the introduction of disease. Hatcheries can also assist in recovery efforts by providing fish needed to reestablish extirpated populations or to augment wild populations that have reached critically low levels.

There are two hatcheries operating in the Washougal Basin. Skamania Hatchery (since 1956) produces winter and summer steelhead for harvest opportunity. The Skamania Hatchery produced steelhead are released into several lower Columbia basins as well as the Washougal. Skamania Hatchery steelhead are a composite stock and are genetically different from the naturally-produced steelhead in the Washougal. The main threats from hatchery steelhead are potential domestication of the naturally produced steelhead as a result of adult interactions or ecological interactions between natural juvenile salmon and hatchery released juvenile steelhead.

The Washougal Hatchery (since 1958) produces fall Chinook for harvest opportunity and coho for harvest and for transfer to the Klickitat River as per an agreement with the Columbia River treaty Indian tribes. The Washougal Hatchery is also utilized for a chum enhancement program to assist in the rebuilding of the lower Gorge chum populations. The main hatchery

threats are domestication of natural fall Chinook and coho and potential ecological interactions between hatchery and natural juvenile salmon.

Table 15-3. Washougal Basin hatchery production.

Hatchery	Release Location	Fall Chinook	Coho	Chum	Winter Steelhead	Summer Steelhead
Washougal	Washougal	4,000,000	500,000			
	Other basins		2,500,000	100,000		
Skamania	Washougal				60,000	60,000
	Other basins				130,000	224,000

Regional hatchery strategies and measures are focused on evaluating and reducing biological risks and reducing the risks to natural populations. Artificial production programs within the Washougal facilities will be evaluated in detail through the WDFW Benefit-Risk Assessment Procedure (BRAP) relative to risks to natural populations. The resulting program specific actions will be developed, evaluated, and documented through the Hatchery and Genetic Management Plan for public review and consideration by NOAA Fisheries (details in programs Technical Foundation, Volume IV). Regional hatchery measures identified in Volume I, Chapter 7 with potential applications at facilities within the Washougal subbasin are summarized in Table 15-4.

Table 15-4. Regional hatchery measures from Volume I, Chapter 7 with potential implementation actions in the Washougal Subbasin.

Measure	Description	Comments
H.M2 H.M13 H.M38	Integrated hatchery and wild program for fall Chinook. Evaluate potential for integration of a late stock coho program.	Assures fitness of the natural produced fish which will improve population productivity. Integrated programs would be developed specific to the Washougal populations in the BRAP procedure. Coho program integration opportunity may be limited by legal obligations to rear coho for release in the Klickitat River.
H.M14	Use only local broodstock in the fall Chinook hatchery program.	This measure will preclude transfer of outside basin stock into the Washougal hatchery program. This will enable a hatchery and wild integrated program to be developed with fall Chinook that are ecologically adapted to the Washougal Basin.
H.M15 H.M32 H.M40	Juvenile release strategies to minimize interactions with naturally-spawning fish.	Release strategies are aimed at reducing or avoiding interactions with wild steelhead, fall Chinook, coho by release timing and release location strategies.
H.M7 H.M17 H.M34 H.M41	Mark hatchery steelhead, coho, fall Chinook with an adipose fin-clip for identification and selective harvest.	Marking hatchery fish allows for identification of hatchery fish in the natural spawning grounds and at collection facilities which enables accurate accounting of wild fish. Marking also enables selective fisheries to retain hatchery fish and release wild fish.
H.M24 H.M36	Hatchery program utilized for supplementation and enhancement of wild chum and coho populations.	The Washougal Hatchery is currently used for supplementation and risk management of lower Gorge chum populations. This program could be potentially expanded to include more areas and populations. Supplementation programs for Washougal natural coho could be developed with appropriate brood stock in the Washougal Hatchery.
H.M8	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.
H.M2 H.M6	Evaluate Washougal and Skamania hatcheries facility operations.	Evaluate Washougal and Skamania hatcheries facility operations.

15.4.4 Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Washougal salmon and steelhead are affected throughout their lifecycle by ecological interactions with non-native species, food web components, and predators. Interactions are similar for Washougal populations to those of most other subbasin salmonid populations. These interactions are described in further detail in Volume I, Chapter 4. Ecological Interactions are addressed by regional strategies and measures identified in Volume I, Chapter 7.

15.4.5 Habitat – Estuary and Lower Columbia Mainstem

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. A variety of human activities in the mainstem and estuary have decreased both the quantity and quality of habitat used by juvenile salmonids. These include floodplain development; loss of side channel habitat, wetlands and marshes; and alteration of flows due to upstream hydro operations and irrigation withdrawals. Effects are similar for Washougal populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook than spring Chinook, steelhead, and coho. These interactions are described in further detail in Volume I, Chapter 4. Estuary and mainstem effects on Washougal salmon and steelhead populations are addressed by regional strategies and measures identified in Volume I, Chapter 7 and the Columbia Mainstem and Estuary Subbasin sections of this chapter.

15.4.6 Habitat – Subbasin Streams and Watersheds

Decades of human activity have significantly altered watershed processes and reduced both the quality and quantity of habitat needed to sustain viable populations of salmon and steelhead. Moreover, with the exception of fall Chinook, stream habitat conditions within the Washougal Subbasin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factor and threats discussed in this chapter.

Subwatersheds, reaches, and habitat attributes have been prioritized for protection and/or restoration based on the plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Priority areas for habitat protection and restoration are shown in Figure 15-4. A summary of the primary habitat limiting factors and threats are presented in Table 15-6. Habitat strategies and measures and related information are presented in Table 15-7. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 15-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 15-5. Details on species-specific spatial priorities and limiting factors at the subbasin level may be found in Volume II of the Technical Foundation. A description of the methodology used to generate composite (multi-species) reach and subwatershed priorities can be found in the introduction to this volume of the recovery plan.

The areas with the greatest current or potential contribution to focal salmonid population health and productivity are listed below. Tier 1 and 2 reaches within these priority areas are included in the list. The habitat limiting factors, threats, and measures included in this chapter focus primarily on the priority areas and the Tier 1 and 2 reaches within them. Tier, 3, 4, and non-tiered reaches are considered secondary priority, but in many cases, these lower priority

areas will also require restoration and preservation actions in order to achieve recovery objectives. Watershed process measures generally focus on the entire basin as opposed to being limited only to high priority areas because conditions in high priority areas are often influenced by cumulative watershed effects. High priority areas and reaches in the Washougal Basin include the following:

- Lower mainstem Washougal - Washougal reach 1-tidal to Washougal reach 3
- Middle mainstem Washougal – Washougal 4 - 9
- Upper mainstem Washougal - Washougal 11 - 17
- West Fork Washougal – WF Washougal 1-3; Wildboy Creek 1; Texas Creek
- Little Washougal - Little Washougal 1A-1B, 2-3

The following paragraphs provide a brief overview of each of these priority areas, including species most affected, land-use threats, and the general type of measures that will be necessary for recovery. Additional detail can be found in the tables and figures that follow.

While reach level habitat conditions often result from local factors, they are also affected or shaped by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input and large woody debris recruitment are often affected by or result from upstream conditions and degraded watershed processes. Access to key reaches may also be affected by barriers that occur downstream of a reach. Accordingly, restoration of a priority reach may require action outside the targeted reach. The IWA analysis was used to identify potential upstream watershed areas that could influence reach level habitat attributes. EDT was used to allow a relative comparison of reaches and habitat attributes within a reach.

Urban and suburban development in the lower Washougal mainstem has significantly altered and degraded watershed processes and habitat conditions. These areas are critically important for chum and fall Chinook spawning and fry colonization. The restoration and protection of the Washougal reach flowing through the town of Washougal provides high potential for fall Chinook. The tidally influenced reaches are the most important for chum. Riparian and floodplain functions are degraded in these areas due to streamside development and channelization features associated with residential/urban development, agriculture, and roadways. Needed habitat measures in the lower mainstem will involve protection of remaining functional habitat, riparian restoration, re-establishing connections between the stream channel and floodplain areas, storm water controls, and measures that address the potential impacts from expanding urban and suburban development around Washougal and Camas.

The middle mainstem is important for fall Chinook and coho spawning, incubation, and fry colonization. It is also used by steelhead for rearing. As the human population continues to grow in Clark County, this mixed-use area of rural residents and small farms and woodlands is likely to experience conversion to more intensive residential use. Riparian areas have been degraded through streamside development and roads. Sediments, lack of habitat diversity, and temperature are the most significant limiting factors in this area. County land use protections will be necessary to protect habitat in these areas should lands be converted from forest to residential.

Upper mainstem reaches are important summer and winter rearing areas for summer steelhead. The habitat conditions and watershed processes associated with these reaches are

influenced primarily by actions on public and private timberland. While these lands have relatively intact landscape conditions, sediment supply processes are thought to be moderately impaired due to the prevalence of forest roads on unstable slopes. The potential for effective passive restoration is high through upgrading or obliterating roads and improving drainage systems. Policies to enable such actions are underway on private, state, and federal forest lands. Restoration of riparian function is also important. Preservation of existing functional conditions is the primary emphasis on these lands. Forest management policy currently being implemented by the USFS and WA DNR, as well as forest practice regulations for private lands, are expected to provide continuing protections of watershed processes.

The West Fork Washougal is important for summer steelhead spawning and rearing. Winter steelhead also make limited use of these reaches. Most of the basin is in private or state forestland with a small amount of crop and pasture land in the lower portion of the basin. Portions of the headwaters (i.e., Hagen Creek basin) have intact forest conditions, while most other areas have been extensively harvested and heavily roaded. Effective habitat measures in the West Fork will involve watershed process restoration and preservation associated with forest practices, much of which is addressed in current forest practices policy and regulations. An additional habitat concern in the West Fork Basin is a dam on Wildboy Creek, which blocks several miles of potentially productive habitat.

The Little Washougal Basin provides important habitat for winter steelhead adult holding, spawning, and rearing. Most other species (especially coho) also use these reaches. The basin is mixed use and is comprised mostly of private and state forest land with agricultural uses and rural residential development within the lower river valley. The City of Camas water withdrawals from Jones and Boulder creeks create an increased risk of critically low summer flows. Effective habitat measures in the Little Washougal will involve riparian restoration, re-establishing connections between the stream channel and floodplains, growth management, water withdrawal management, and watershed process restoration and preservation on forest lands.

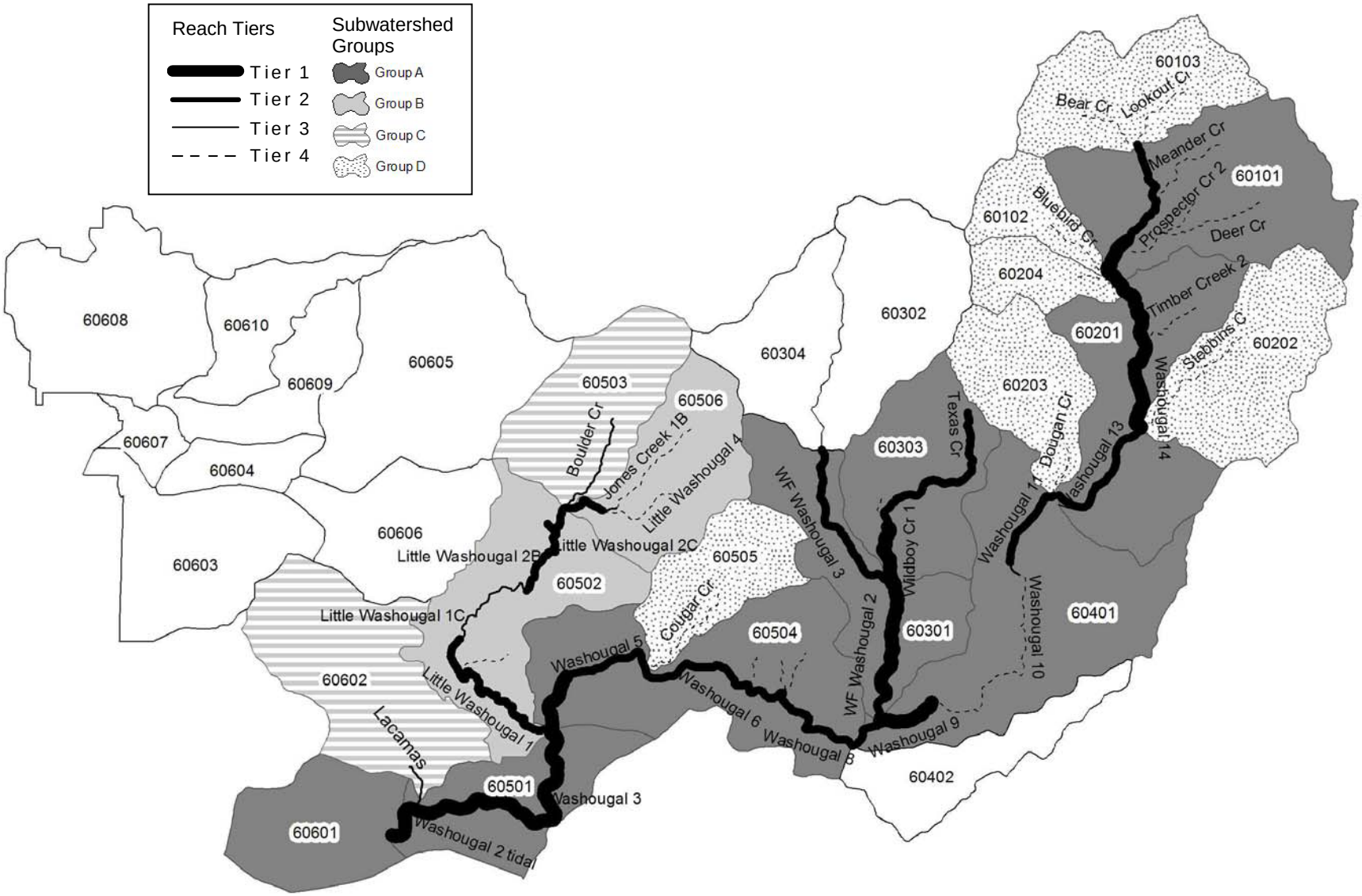


Figure 15-4. Reach tiers and subwatershed groups in the Washougal River Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at the reach scale are useful for identifying stream corridor recovery measures. Priorities at the subwatershed scale are useful for identifying watershed process recovery measures. Watershed process recovery measures for stream reaches will need to occur within the surrounding (local) subwatershed as well as in upstream contributing subwatersheds.

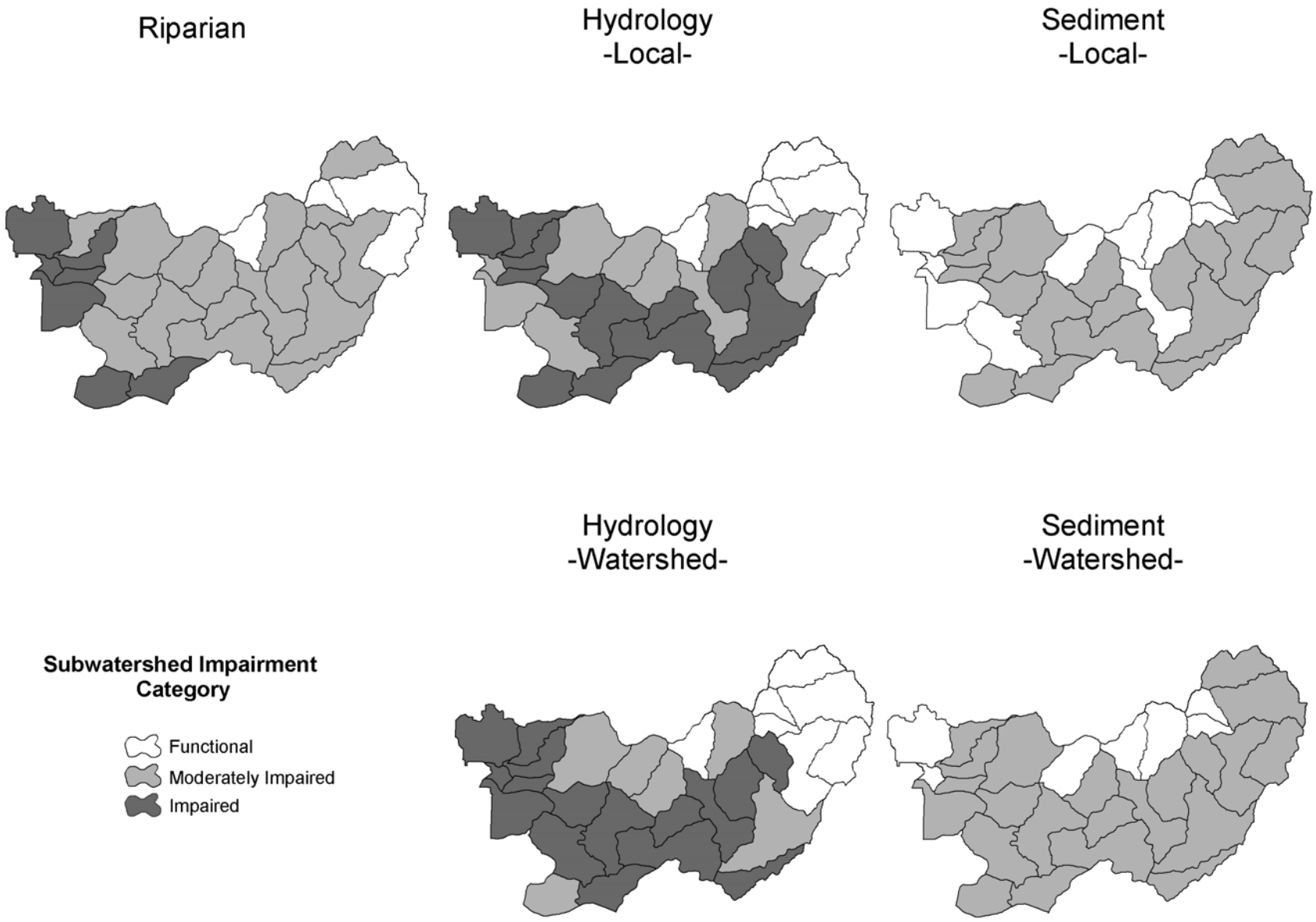


Figure 15-5. IWA subwatershed impairment ratings by category for the Washougal Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 15-5. Summary Table of reach- and subwatershed-scale limiting factors in priority areas. The table is organized by subwatershed groups, beginning with the highest priority group. Species-specific reach priorities, critical life stages, high impact habitat factors, and recovery emphasis (P=preservation, R=restoration, PR=restoration and preservation) are included. Watershed process impairments: F=functional, M=moderately impaired, I=impaired. Species abbreviations: ChS=spring Chinook, ChF=fall Chinook, StS=summer steelhead, StW=winter steelhead.

Sub-watershed Group	Subwatersheds	Reaches within subwatershed	Species present	High priority reaches by species	Critical life stages	High impact habitat factors	Restoration or preservation emphasis	Watershed processes (local)			Watershed processes (watershed)	
								Hydrology	Sediment	Riparian	Hydrology	Sediment
A	60101	Deer Cr Meander Cr Prospector Cr 1 Prospector Cr 2 Prospector Creek 1B Prospector Creek Culv1 Washougal 16 Washougal 17 Washougal 18 Washougal 19	StS	Washougal 16 Washougal 17	summer rearing winter rearing	habitat diversiy flow	P	F	M	F	F	M
			Coho									
	60201	Dougan Falls Timber Cr Timber Creek 2 Timber Creek Culv1 Washougal 12 Washougal 13 Washougal 14 Washougal 15	StS	Washougal 14 Washougal 15	summer rearing winter rearing	habitat diversiy flow	P	M	M	M	F	M
			Coho									
	60301	WF Washougal 1 WF Washougal 1B WF Washougal 2 WF Washougal 3 WF Washougal Falls1 WF Washougal Weir	StS	WF Washougal 1B WF Washougal 2	egg incubation summer rearing winter rearing	habitat diversiy temperature flow sediment pathogens	PR	M	F	M	I	M
			StW	WF Washougal 1	egg incubation fry colonization summer rearing	temperature sediment	R					
	60303	Texas Cr Wildboy Cr 1 Wildboy Cr 2	StS	Wildboy Cr 1	egg incubation summer rearing winter rearing	none	P	I	M	M	I	M
	60501	Washougal 1 tidal Washougal 2 tidal Washougal 3	StS					I	M	I	I	M
			Chum	Washougal 1 tidal Washougal 2 tidal	spawning egg incubation fry colonization adult holding	none	R					
			ChF	Washougal 3	spawning egg incubation fry colonization	sediment	PR					
			StW									
			Coho	Washougal 3	egg incubation summer rearing winter rearing	habitat diversity temperature sediment	R					
	60601	Washougal 1 tidal	StS					I	M	I	M	M
			Chum	Washougal 1 tidal	spawning egg incubation fry colonization adult holding	none	R					
			ChF									
			StW									
			Coho									
	60401	Salmon Falls Washougal 10 Washougal 10A Washougal 11 Washougal 9 Washougal Falls1	StS					I	M	M	M	M
			ChF	Washougal 9	spawning egg incubation fry colonization	sediment	P					
			StW									
			Coho	Washougal 9	egg incubation summer rearing winter rearing	habitat diversity temperature sediment	R					
	60504	RB trib 1A RB trib 1B RB trib 1C RB trib 2 RB trib1 Barrier 1 Washougal 4 Washougal 5 Washougal 6 Washougal 7 Washougal 8 Winkler Cr	StS					I	M	M	I	M
			ChF	Washougal 4	spawning egg incubation fry colonization	none	PR					
			StW	Washougal 5	egg incubation fry colonization summer rearing winter rearing	none	R					
			Coho	Washougal 4 Washougal 8	egg incubation fry colonization summer rearing winter rearing	channel stability habitat diversity sediment	R					

Sub-watershed Group	Subwatersheds	Reaches within subwatershed	Species present	High priority reaches by species	Critical life stages	High impact habitat factors	Restoration or preservation emphasis	Watershed processes (local)			Watershed processes (watershed)	
								Hydrology	Sediment	Riparian	Hydrology	Sediment
B	60502	LB tribA (28.0211)	StS					I	M	M	I	M
		Little Washougal 1 Little Washougal 1B Little Washougal 1C Little Washougal 2 Little Washougal 2 Culv1 Little Washougal 2B	StW	Little Washougal 1 Little Washougal 1B Little Washougal 2 Little Washougal 2B Little Washougal 2C Little Washougal 2D	egg incubation fry colonization summer rearing winter rearing adult holding	temperature sediment key habitat quantity	PR					
		Little Washougal 2C Little Washougal 2D Little Washougal 2E Little Washougal Culv1 Little Washougal Culv2	Coho	Little Washougal 2C Little Washougal 2E	egg incubation fry colonization summer rearing winter rearing	channel stability habitat diversity temperature sediment key habitat quantity	R					
	60506	Jones Cr Jones Creek 1B Jones Creek Culv1 Little Washougal 3	StW	Little Washougal 3	egg incubation fry colonization summer rearing winter rearing	none	PR	M	M	M	M	M
		Little Washougal 4	Coho									
C	60503	Boulder Cr Boulder Creek 1B Boulder Creek 1C Boulder Creek Culv1 Boulder Creek Falls1	StW Coho					M	F	M	M	F
	60602	Lacamas	StW					M	F	M	I	M
			Coho									
D	60102	Bluebird Cr	StS					F	F	F	F	F
			Coho									
	60103	Bear Cr Degraded Lookout Cr Washougal 20	StS					F	M	M	F	M
	60202	Stebbins C	StS					F	M	F	F	M
	60203	Dougan Cr Dougan Creek 1B Dougan Creek Culv1	StS					I	M	M	I	M
	60204	Silver Cr	StS					F	F	M	F	F
	60505	Cougar Cr	StW					I	M	M	I	M

Table 15-6. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower mainstem (LM), middle mainstem (MM), upper mainstem (UM), West Fork (WF), and Little Washougal (LW) portions of the Washougal Subbasin. Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors	LM	MM	UM	WF	LW
Habitat connectivity					
Blockages to off-channel habitats	✓				
Blockages to stream habitats due to structures				✓	
Habitat diversity					
Lack of stable instream woody debris	✓	✓	✓	✓	✓
Altered habitat unit composition	✓	✓	✓	✓	✓
Loss of off-channel or side-channel habitats	✓	✓			✓
Channel stability					
Bed and bank erosion	✓		✓		✓
Riparian function					
Reduced stream canopy cover	✓	✓	✓	✓	✓
Reduced bank/soil stability	✓	✓	✓	✓	✓
Exotic and/or noxious species	✓	✓			✓
Reduced wood recruitment	✓	✓	✓	✓	✓
Floodplain function					
Altered nutrient exchange processes	✓				✓
Reduced flood flow dampening	✓				✓
Restricted channel migration	✓				✓
Disrupted hyporheic processes	✓				✓
Stream flow					
Altered magnitude, duration, or rate of change	✓	✓		✓	✓
Water quality					
Altered stream temperature regime	✓	✓	✓	✓	✓
Excessive turbidity	✓				
Bacteria					✓
Substrate and sediment					
Lack of adequate spawning substrate	✓	✓	✓		
Excessive fine sediment	✓	✓		✓	✓

Threats	LM	MM	UM	WF	LW
Agriculture/grazing					
Clearing of vegetation	✓	✓			✓
Riparian grazing	✓	✓			✓
Floodplain filling	✓	✓			✓
Urban and rural development					
Clearing of vegetation	✓	✓			✓
Floodplain filling	✓	✓			✓
Increased impervious surfaces	✓	✓			✓
Increased drainage network	✓	✓			✓
Roads – riparian/floodplain impacts	✓	✓			✓
Leaking septic systems					✓
Forest practices					
Timber harvests: sediment supply impacts	✓	✓	✓	✓	✓
Timber harvests: impacts to runoff	✓	✓		✓	✓
Riparian harvests			✓	✓	✓
Forest roads: impacts to sediment supply	✓	✓	✓	✓	✓
Forest roads: impacts to runoff	✓	✓		✓	✓
Forest roads: riparian/floodplain impacts				✓	✓
Catastrophic wildfire (historical)			✓	✓	✓
Splash-dam logging (historical)		✓	✓		
Channel manipulations					
Bank hardening	✓	✓			✓
Channel straightening	✓	✓			✓
Artificial confinement	✓	✓			✓
Passage obstruction (dams)				✓	
Water withdrawals					
Livestock, irrigation, or municipal uses	✓	✓			✓

Table 15-7. Habitat measures in priority areas, with reference to limiting factors addressed, threats addressed, target species, and estimated time until benefits would be realized (time). Tier 1 and 2 reaches, or other areas of known priority, are listed under the location column for some measures (i.e., stream corridor measures). Reaches not included in the table (Tier 3, 4, and non-tiered reaches) are considered secondary priority.

Priority Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
1. Protect and restore floodplain function and channel migration processes ***A. Set back, breach, or remove artificial channel confinement structures***					
Lower mainstem Washougal 1 tidal, 2 tidal, 3 ***Little Washougal*** Little Washougal 1 ***Middle mainstem*** Washougal 4-9	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes	• Floodplain filling • Channel straightening • Artificial confinement	• chum • Coho • Winter steelhead	2-15 years	High potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channel to restore naturally once confinement structures are removed. There are challenges with implementation due to existing infrastructure already in place, private property, potential flood risk to property, large expense, and no regulatory mechanisms in place for this type of restoration.
2. Protect and restore off-channel and side-channel habitats ***A. Restore historical off-channel and side-channel habitats where they have been eliminated*** ***B. Provide access to blocked off-channel habitats*** ***C. Create new off-channel or side-channel habitats (i.e. spawning channels)***					
Lower mainstem Washougal 1 tidal, 2 tidal, 3 ***Little Washougal*** Little Washougal 1 ***Middle mainstem*** Washougal 4-9	• Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats • Altered habitat unit composition	• Artificial confinement • Channel straightening • Floodplain filling	• Chum • Coho	2-15 years	Good potential benefit especially for chum, which have lost a significant portion of historically available off-channel habitat for spawning. Potential benefit is limited by moderate probability of success with creation of new habitats. There are challenges with implementation due to existing infrastructure already in place, private property, and large expense. No regulatory mechanisms in place for this type of restoration.
3. Protect and restore riparian function ***A. Reforest riparian zones*** ***B. Allow for the passive restoration of riparian vegetation*** ***C. Livestock exclusion fencing*** ***D. Invasive species eradication*** ***E. Hardwood-to-conifer conversion***					
Lower mainstem Washougal 1 tidal, 2 tidal, 3 ***Little Washougal*** Little Washougal 1, 2C	• Reduced stream canopy cover • Altered stream temperature regime	• Timber harvest – riparian harvests • Riparian grazing • Clearing of	• chum • Coho • Winter steelhead	20-100 years	High potential benefit due to the many limiting factors that are addressed. Riparian impairment is related to most land-uses and is a concern throughout the basin. Riparian protections on forest lands are provided for under current

Priority Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
WF Washougal WF Washougal, Wildboy 1 ***Upper mainstem*** Washougal 14-17 ***Middle mainstem*** Washougal 4-9	• Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species	vegetation due to urban and agricultural uses	• Summer steelhead		harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. The specified stream reaches are the highest priority for riparian measures, however, riparian restoration and preservation should occur throughout the basin since riparian conditions affect downstream reaches. Use IWA riparian ratings to help identify restoration and preservation opportunities.
4. Protect and restore fish access to channel habitats ***A. Wildboy Creek Dam*** ***B. Culvert barriers throughout basin***					
Wildboy Creek Wildboy Creek Dam ***Culvert barriers throughout basin***	• Blockages to channel habitat	• Passage obstruction	• Summer steelhead	2-5 years	Moderate potential benefit because of marginal habitat available above blockage. There are challenges with implementation due to no regulatory mechanism to require passage and large expense.
5. Protect and restore natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources*** ***C. Address agricultural sources***					
Entire basin	• Excessive fine sediment • Excessive turbidity • Embedded substrates	• Timber harvest – impacts to sediment supply • Forest roads – impacts to sediment supply • Agricultural practices – impacts to sediment supply	• All species	5-50 years	High potential benefit due to sediment effects on egg incubation and early rearing. Improvements are expected on timber lands due to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. There are challenges with implementation on agricultural lands due to few sediment-focused regulatory requirements for agricultural lands. Use IWA impairment ratings to identify restoration and preservation opportunities.
6. Protect and restore runoff processes ***A. Address forest road impacts*** ***B. Address timber harvest impacts*** ***C. Limit additional watershed imperviousness*** ***D. Manage stormwater runoff***					
Entire basin	• Stream flow – altered magnitude, duration, or rate of change of flows	• Timber harvest – impacts to runoff • Forest roads –	• All species	5-50 years	High potential benefit due to flow effects on habitat formation, redd scour, and early rearing. Improvements are expected on timber lands due

Priority Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
		impacts to runoff • Increased impervious surfaces • Increased drainage network (road ditches, storm drains) • Clearing of vegetation			to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. There are challenges associated with addressing runoff issues on developed lands due to continued increase in watershed imperviousness related to development and lack of adequate mitigation. Use IWA impairment ratings to identify restoration and preservation opportunities.
7. Protect and restore instream flows ***A. Water rights closures*** ***B. Purchase or lease existing water rights*** ***C. Relinquishment of existing unused water rights*** ***D. Enforce water withdrawal regulations*** ***E. Implement water conservation, use efficiency, and water re-use measures to decrease consumption***					
Entire basin – with emphasis on Jones and Boulder creeks (Little Washougal Basin)	• Stream flow – altered magnitude, duration, or rate of change of flows	• Diversions/ withdrawals (for livestock, irrigation, or municipal uses)	• All species	Immediate	Instream flow management strategies for the Washougal River basin have been identified as part of Watershed Planning for WRIA 28 (LCFRB 2004). Particular concerns exist with City of Camas municipal withdrawals on Jones and Boulder creeks, tributaries to the Little Washougal River. The presence of illegal water withdrawals may be contributing to low flow problems in some areas. Increased monitoring and enforcement is needed to prevent illegal withdrawals.
8. Protect and restore instream habitat complexity ***A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting*** ***B. Structurally modify stream channels to create suitable habitat types***					
Lower mainstem Washougal 3 ***Little Washougal*** Little Washougal 1, 2C ***WF Washougal*** WF Washougal, Wildboy Cr 1 ***Upper maisntem*** Washougal 14-17 ***Middle mainstem***	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• coho • winter steelhead • summer steelhead	2-10 years	Moderate potential benefit due to the high chance of failure. Failure is probable if habitat-forming processes are not also addressed. These projects are relatively expensive for the benefits accrued. Moderate likelihood given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects.

Priority Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Washougal 4-9					
9. Protect and restore water quality ***A. Restore the natural stream temperature regime*** ***B. Reduce fecal coliform bacteria levels*** ***C. Reduce turbidity sources***					
Entire basin	• Altered stream temperature regime • Bacteria • Excessive turbidity	• Riparian harvests • Riparian grazing • Leaking septic systems	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are listed on the 2004 303(d) list.
10. Protect habitat conditions and watershed functions through land-use planning that guides population growth and development ***A. Plan growth and development to avoid sensitive areas (e.g., wetlands, riparian zones, floodplains, unstable geology)*** ***B. Encourage the use of low-impact development methods and materials*** ***C. Apply mitigation measures to off-set potential impacts***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Especially important in the heavy growth areas surrounding the Washougal and Camas urban areas. The focus should be on management of land-use conversion and continued development in sensitive areas (e.g., wetlands, stream corridors, unstable slopes). Many critical areas regulations do not have a mechanism for restoring existing degraded areas, only for preventing additional degradation. Legal and/or voluntary mechanisms need to be put in place to restore currently degraded habitats.
11. Protect habitat conditions and watershed functions through land acquisition or easements where existing policy does not provide adequate protection ***A. Purchase properties outright through fee acquisition and manage for resource protection*** ***B. Purchase easements to protect critical areas and to limit potentially harmful uses*** ***C. Lease properties or rights to protect resources for a limited period***					
Privately owned portions of the basin	***Preservation Measure*** – addresses many potential limiting factors and threats		• All species	5-50 years	Land acquisition and conservation easements in riparian areas, floodplains, and wetlands have a high potential benefit where other protection measures such as incentives and regulation do not provide adequate protection These programs are under-funded and have low landowner participation.

15.5 Program Gap Analysis

The Washougal Basin's (~240 square miles) headwaters begin in the Gifford Pinchot NF and flow through substantial public and private forestlands; the forests transition to agricultural, residential, and rural lands; gradually these lands give way to suburban and urbanizing uses.

- Approximately 8% or about 19 square miles of the 240 square mile Washougal Basin falls within the Gifford Pinchot National Forest.
- Approximately 72 square miles are public forestlands managed by the Department of Natural Resources.
- Small- and industrial forest lands comprise approximately 12 square miles in the Washougal Basin.
- Current population of the Washougal Basin is approximately 36,600; it is expected to increase to approximately 92,800 by the year 2020.

Protection Programs

Federal Programs

- ***U.S. Forest Service Gifford Pinchot National Forest***

  - Forest Plan: The Gifford Pinchot NF Forest Plan provides high levels of protection for riparian areas and forest stands within the Washougal Basin. Protection efforts are subject to NOAA Fisheries and U.S. Fish and Wildlife Service ESA Section 7.
    - ✓ Riparian buffers in all areas of the Gifford Pinchot NF include at least 300' setbacks.
    - ✓ Matrix designated lands (~5 sq mi) observe the forest-wide 'no clear cut' policy;
    - ✓ Approximately (14 sq mi) of Administratively Withdrawn Areas are located in the Washougal Basin headwaters.
    - ✓ Gifford Pinchot NF restoration activities within the basin are a low priority forest-wide and restoration needs are low to modest. [M.3A; M.3B; M.5A; M.5B; M.6A; M.6B; M.9A; M.9B]

- ***U.S. Army Corps of Engineers***

  - Regulatory Programs: U.S. Army Corps of Engineers administers the Section 10 (Rivers and Harbor Act) and Section 404 (Clean Water Act) permit processes. Section 10 requires approval of any activity in, above, or below a navigable river, which affects course, location, condition, or capacity of navigable waters. Section 404 requires prior approval of dredging, filling, grading, clearing, and bank hardening. In waters used by listed fish species, the permits are subject to ESA Section 7 consultation with NOAA Fisheries to ensure that any approved action is adequately protective of the ESA listed fish. [M.1A; M.2A; M.2B; M.2C; M.4A; M.4B; M.8A; M.8B]

State Programs

- ***Department of Natural Resources***

  - State Forest Land HCP: State forestlands are managed under the provisions of a Habitat Conservation Plan (HCP). The Habitat Conservation Plan has protects riparian areas through the use of buffers, mitigates impacts on watershed processes through harvest restrictions and new road construction standards that are more stringent than Forest Practices Rules. [M.3A; M.3B; M.5A, M.9A; M.9C]
  - State Forest Practices: Riparian areas and watershed functions on small- and industrial forest lands are protected under the State of Washington Forest Practices Rules, including the Forest and Fish Module. These rules provide for riparian buffers, harvest restrictions, sensitive area protections, and protective standards for new road construction. [M.3A, M.3B, M.5A; M.9A; M.9C]

- ***Washington Department of Fish and Wildlife***

  - Hydraulics Project Approval (HPA): The Department administers the state Hydraulic Code. The purpose of this program is to protect stream conditions and habitat. The regulations apply to such activities as streambank protection, instream construction, culvert installation, channel changes or realignments, debris removal, and water diversion facilities. Those proposing such actions must obtain a Hydraulic Project Approval (HPA) permit. [M.1A; M.2A; M.2B; M.2C; M.4A; M.4B; M.8A; M.8B]

  - Habitat Program: The Department provides advice to local governments and landowners interested in measures to protect habitat values on their property. [M.1A; M.2A; M.2B; M.2C; M.4A; M.4B; M.8A; M.8B; M.10A; M.10B; M.10C]

- ***Washington Department of Ecology***

  - Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administratively closed selected areas within the North Fork Lewis watershed to further surface and groundwater withdraws (where groundwater is in continuity with surface water). Existing administrative closures by the Department of Ecology protect surface waters from further withdrawals. Formal rule-making would strengthen the closures. The extent of unauthorized surface water withdrawals is unknown, but may have the potential to adversely impact low summer stream flows. [M.7A; M.7B; M.7C; M.7D]

  - Water Resources Program/Watershed Planning: In cooperation with the Lower Columbia Fish Recovery Board, other state and federal agencies, tribes, local governments, and citizens, the Department funds and participates in a state authorized watershed planning process for Water Resource Inventory Area (WRIA) 27 pursuant to RCW 90.82. The goal of the plan is to ensure adequate water for people and fish. The planning process is dealing with water quantity and quality, stream flows and fish habitat. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. M.7A; M.7B; M.7C; M.7D; M.7E; M.9A; M.9B; M.9C; M.10A]

- ***Salmon Recovery Funding Board (SFRB)/ Lower Columbia Fish Recovery Board (LCFRB)***
  - Washington Salmon Recovery Act (RCW 77.85): The SRFB and the LCFRB jointly administer a habitat restoration grant program that allocates federal Pacific Salmon Recovery Funds and State dollars for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. [M.1A; M.2A; M.2B; M.2C; M.3A; M.4B; M.8A; M.8B; M.9A; M.9B; M.9C; M.11A; M.11B]

- ***Conservation Commission/ Clark Conservation District*** provides technical assistance and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to protect riparian areas and stream habitat. The Conservation District has been involved in the lower Washougal basin. These programs could help address measure M.1A; M.2A; M.2B; M.2C; M.3A; M.4B; M.8A; M.8B; M.9A; M.9C]

Local Government Programs

- ***Clark County***
  - ESA Program: The County has established an Endangered Species Program to address ESA requirements and develop a comprehensive county strategy for salmon recovery. An ESA committee with representatives from federal and state agencies, tribes, citizens, the business community and environmental groups has been established to advise the county as it works to bring its ordinances and programs into compliance with ESA requirements.

  - Comprehensive Planning and Land Use Regulation:
    - ✓ The County is actively engaged in a comprehensive review and revision of its programs to better protect watershed processes and habitat and to secure ESA Section 4d assurances from NOAA Fisheries.
    - ✓ The County comprehensive sets policies calling for the protection of habitat for ESA listed salmon and other aquatic and terrestrial species.
    - ✓ Zoning that directs growth throughout the County [M.12] and maintains low-density development in rural areas. The County has a designated Urban Growth Area pursuant to the Washington Growth Management Act (GMA). The UGA helps protect rural lands by directing high intensity uses to developed areas.
    - ✓ A Habitat Conservation Ordinance provides stream buffers and measures for the protection of important habitat, including ESA listed salmonids. Addresses measures: [M.10A; M.10B; M.10C]

  - Road Maintenance:
    Clark County Road Program utilizes Best Management Practices to guide their operations and is actively seeking programmatic ESA Section 4d assurances from NOAA Fisheries that these measures provide adequate protection for fish. [M.4B]

  - Stormwater Management:

The County stormwater program, based on Best Available Science, is implementing an NPDES permit, including measures to protect water quality and reduce impacts on stream flows. [M.6C, M.9C]

- **Skamania County**
  - Comprehensive Planning and Land Use Regulation: [M.10A; M.10B; M.10C]

Skamania County is required by state law to have a critical areas ordinance. It is not otherwise required to plan in accordance with the Washington Growth Management Act (GMA). The County's land use controls provide only fair protection of watershed processes and habitat. Wetland and stream setbacks range from 25 to 200 feet depending on the class designation. The County shoreline management ordinance provisions for the Washougal protect the shorelines from substantial development or extensive timber harvest within a 200-foot buffer.

- Road and Parks Programs: The County Road and Parks and Recreation programs have implemented management practices to deal with environmental issues. [M.4B]

- ***City of Washougal*** has a comprehensive plan with a critical areas ordinance and zoning. The Cities land use measures provide limited protection of habitat and watershed conditions. Effective protection measures within the City are important to support Chum and Fall Chinook recovery. [M.10A; M.10B; M.10C]

- ***City of Camas*** has a comprehensive plan with a critical areas ordinance and zoning. The Cities land use measures provide limited protection of habitat and watershed conditions. Effective protection measures within the City are important to support Chum and Fall Chinook recovery. [M.10A; M.10B; M.10C]

- ***City of Vancouver*** has comprehensive land use programs with high levels of protection for critical areas and zoning to direct growth into appropriate areas within their jurisdictions. These regulations pertain to only a small area of the LaCamas Creek watershed. M.10A; M.10B; M.10C]

Community Programs

- ***Columbia Land Trust*** is a nonprofit organization whose mission is to preserve and restore unique landscapes, natural areas, and sensitive habitats. The Trust has participated in several land acquisition efforts in the Washougal including Schoolhouse Creek and Slough Creek. [M.11A; M.11B]

Restoration Programs

A limited number of agencies and organizations have programs that initiate restoration and/or management activities in the urban and suburban lands in the lower Washougal Basin.

Federal Programs

- ***U.S. Forest Service Gifford Pinchot National Forest:*** Restoration activities within the upper Washougal Basin are a low priority on the Gifford Pinchot NF, but needs are modest. [M.3A, M.3B, M.4A, M.5A; M.9A; M.9C]

State Programs

- ***Department of Natural Resources***

  - State Forest Land Habitat Conservation Plan (HCP): The Department manages state forest lands pursuant to a Habitat Conservation Plan (HCP). The HCP road maintenance and restoration objectives require barrier upgrades and road abandonment and/or other improvements. [M.3A, M.3B, M.4A, M.5A; M.9A; M.9C]

  - State Forest Practices Act:
    - ✓ Industrial forests within the lower NF Lewis Basin are governed by Forest and Fish regulations and have rigid schedules for maintaining and improving roads and removing barriers. Industrial landowners have 15 years to bring roads and barriers into compliance with regulations [M.3A, M.3B, M.4A, M.5A; M.9A; M.9C]
    - ✓ Small private forest owners are governed by Forest and Fish regulations; however their road and barrier maintenance and improvement programs are tied to state funding. In the State 2003-05 Biennial Budget, 2 million dollars was allocated statewide to support small private forest owners [M.3A, M.3B, M.4A, M.5A; M.9A; M.9C]

- ***Department of Fish and Wildlife***

  - Habitat Program: The Department provides advice and assistance to local governments and landowners interested in measures to restore habitat. [M.1A; M.2A; M.2B; M.2C; M.4A; M.4B; M.8A; M.8B]

- ***Department of Transportation***

  - Road Maintenance Program

WSDOT has an ESA Section 4(d) Road Maintenance Program. The Maintenance Program uses trained crews to primarily manage roadside vegetation, litter control, and maintenance of safety rest areas associated with SR 14. [M.4A]

  - Barrier Replacement Program

In partnership with the County WSDOT has provided over $50,000 in funding for county culvert assessment, design and engineering. [M.6C; M.9A; M.9C]

- ***Salmon Recovery Funding Board (SFRB)/ Lower Columbia Fish Recovery Board (LCFRB)***

Washington Salmon Recovery Act (RCW 77.85): The SRFB and the LCFRB jointly administer a habitat restoration grant program that allocates federal Pacific Salmon Recovery Funds and State dollars for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date the SRFB has award over $600,000 for projects. [M.1A; M.2A; M.2B; M.2C; M.3A; M.4B; M.8A; M.8B; M.9A; M.9B; M.9C; M.11A; M.11B]

- ***Conservation Commission/ Clark Conservation District*** provides technical assistance and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to restore riparian areas and stream habitat. The Conservation District has been involved in the lower Washougal basin. These programs could help address measure M.1A; M.2A; M.2B; M.2C; M.3A; M.4B; M.8A; M.8B; M.9A; M.9C

Local Government Programs

- ***Clark County***

  - Clark County ESA Program: The Clark County ESA program encourages and recognizes citizen efforts to conserve and restore habitat for salmon through education and outreach activities.
  - Clark County Culvert Program: The County inventories and replaces priority barriers associated with its roads. The program has replaced barriers in the Washougal basin, such as the culvert at Coyote Creek where it intersects the Washougal Highway. [M.4A]
  - Noxious Weed Control Board: The Board has three primary programs that address weed control in the lower Cowlitz Basin; [M.3D]
    - ✓ Public education to prevent the spread of noxious weeds;
    - ✓ Survey County lands to assess emerging issues; and
    - ✓ Enforcement of noxious weed control

    A primary focus of the Board has been the control of Japanese Knotweed in Washougal riparian areas.

- ***Skamania County***

  - Public Works Program:
    The County inventoried culverts on county roads and is replacing and/or upgrading barrier culverts. The replaced a culvert on Schoolhouse Creek to facilitate the restoration of salmon and steelhead habitat. [M.4A]

  - Noxious Weed Control Board: The Board has three primary programs that address weed control in the lower Cowlitz Basin; [M.3D]
    - ✓ Public education to prevent the spread of noxious weeds;
    - ✓ Survey County lands to assess emerging issues; and
    - ✓ Enforcement of noxious weed control.

    A primary focus of the Board has been the control of Japanese Knotweed in Washougal riparian areas.

Community Programs

- ***Columbia Land Trust*** is a nonprofit organization whose mission is to preserve and restore unique landscapes, natural areas, and sensitive habitats. The Trust has participated in several land acquisition efforts in the Washougal including Schoolhouse Creek and Slough Creek. [M.11A; M.11B]

- ***Lower Columbia Fish Enhancement Group*** is one of many nonprofit enhancement groups authorized by state law. The group focuses on various riparian, instream restoration, and nutrient enhancement projects. Projects in the Washougal Basin include: [M.1A; M.2A; M.2B; M.3A; M.4B; M.8A; M.8B]
  - Larson Creek Fish Passage project;
  - Schoolhouse Creek; and
  - Little Washougal Restoration efforts.

- ***Clark Skamania Fly Fishers*** is another nonprofit restoration group working with the Lower Columbia Fish Enhancement Group on the Schoolhouse Creek and other projects. [M.1A; M.2A; M.2B; M.3A; M.4B; M.8A; M.8B]

- ***Lower Columbia River Estuary Partnership*** provides guidance and funding to implement habitat restoration activities in the estuary. The organization is considering whether to fund chum habitat work in the lower Washougal Basin. [M.1A; M.2A; M.2B; M.2C; M.3A]

Gap Analysis

Forest-related Programs: Nearly 50 percent of the Washougal basin in public and private forest use. Accordingly, forestry programs play a large role in restoring watershed functions and habitat conditions at levels supporting recovery goals. This is because these programs apply to approximately half of the basin. Certainty of forestry-related protection and restoration programs is relatively high because programs are being implemented and, for the most part, fully funded. Program areas of concern include state funding for small commercial forest landowners and the continued potential for hydrologic impacts caused by past harvest practices. Monitoring of watershed processes and habitat conditions will be required to confirm the effectiveness of these measures. The Gifford Pinchot NF's Forest Plan identifies restoration in the Washougal Basin as a low priority relative to other basins.

Agricultural-related Programs: Best Management Practices, incentives, and regulations for agricultural practices need to be developed to ensure protection of watershed processes and habitat conditions.

Protection-related Programs: Protection of watershed processes and habitat in the urban, suburban, residential, and agricultural areas of the Washougal basin are fundamental to achieving recovery goals. Population growth in Southwest Washington will exert tremendous pressures in these areas over the next 20 to 50 years. Land use programs vary significantly among Camas, Washougal, Vancouver, Clark County and Skamania County. They also offer varying levels of watershed and habitat protection from limited to significant. Overall, land use programs throughout the basin need to be revised and updated based on recent habitat surveys and modeling and best available science. Potential for greater consistency exists as comprehensive plans are updated. Protection of instream flows should receive greater attention within the next

year as WRIA 27/28 Planning Units make their recommendations to DOE for new protections. Program areas of concern include inconsistent land use protections, unregulated landowner activities, and existing water rights held by the City of Camas in Jones and Boulder Creeks.

Restoration-related Programs: The Washougal Basin has received good attention from restoration-focused programs and there is reason to believe these efforts will continue. Program areas of concern include the magnitude of efforts and corresponding funding to support those efforts at a level necessary to achieve recovery goals. Relative to other program categories, restoration is likely to have the most significant resource needs because of impacts that haven't been fully addressed, new threats that protection mechanisms may not address, and the cumulative impacts caused by population growth over time.

Proposed Actions

Table 15-8. Actions to Address Gaps

Action #	Lead Agency	Proposed Action
WASH.1	State of Washington	Provide state funding for small forest owners in the Washougal Basin to a level sufficient to achieve the road and barrier improvements of Forest and Fish on a schedule parallel to private industrial forest owners
WASH.2	Forest Managers LCFRB, and DFW	Identify early action forest-wide restoration projects that analysis indicates could provide significant benefits. In these cases, it may be appropriate to identify outside funding to initiate these early actions
WASH.3	Restoration Agencies and Organizations	Coordinate barrier removal projects to ensure they are conducted in a logical sequence that will generate maximum benefits for fish in the highest priority subwatersheds (e.g., Wildboy Dam)
WASH.4	City of Washougal, Skamania County	Protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
WASH.5	City of Washougal	Develop and implement controls to adequately protect riparian areas to maintain currently functional habitat as well as restored habitat needed habitat conditions around all rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
WASH.6	City of Washougal	Zoning and development standards to adequately protect wetlands, wetland buffers, and wetland function.
WASH.7	Vancouver, Washougal, Camas, Skamania County and Clark County	Develop and implement controls to address erosion and sediment run-off during (and after) construction to prevent sediment and pollutant discharge to streams, wetlands and other water bodies
WASH.8	Skamania and Clark Counties, Cities, and State Agencies	Utilize a combination of public outreach/education, incentives, and authority to positively influence landowner behaviors toward land stewardship in practices not covered by land use regulations
WASH.9	Clark County, Skamania county Cities, State of Washington	Apply land use code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
WASH.10	WRIA 27/28 PU, DOE, and DFW	Close the Washougal to further surface water withdrawals, including groundwater in connectivity with surface waters
WASH.11	City of Camas, DOE, WRIA 27/28 PU	Work with DOE to develop new municipal water supplies and relinquish existing water rights in Jones and Boulder Creek
WASH.12	Clark County, Cities, DOE, DFW, CLT	Increase summer low-flow conditions in the Washougal Basin through the purchase of existing water rights and land use actions (e.g., wetland

		restoration and re-connecting side-channels)
WASH.13	Clark County, Cities, DOE, DFW, CLT	Decrease the frequency and duration of peak-flow events on the Washougal by reducing impervious surfaces, controlling stormwater and re-connecting riparian wetlands
WASH.14	Clark County, Cities, CCD, CLT and LCFRB	Build support for the acquisition of conservation easements, long-term leases, and fee-simple purchase through outreach and increased project funding for non-profit organizations like the Columbia Land Trust or the Nature Conservancy
WASH.15	State of Washington, LCFRB, CC, Weed Boards	Build institutional capacity for agencies and organizations to undertake additional protection and restoration projects, including noxious weed control
WASH.16	LCFRB, DOE, DFW, NOAA, USFWS, ACOE	Increase available funding for projects that implement measures and addresses underlying threats.
WASH.17	LCFRB and Program Managers	Address threats proactively by building agreement on priorities among the various program implementers
WASH.18	CC	Increase capacity of agencies like Clark Conservation District to perform outreach, design/implement farm plans, restoration projects, education, and compliance, etc.
WASH.19	CC, WDA, GSRO	Develop agricultural practices that protect watershed processes and habitat conditions.
WASH.20	FEMA	Update floodplain maps using Best Available Science