6 Cowlitz Subbasin - Lower Cowlitz

Figure 6-1. Location of the Lwer Cowlitz River Basin within the Lower Columbia River Basin.

6.1 Basin Overview

The lower Cowlitz River Bsin comprises approximately 440 square miles in Cowlitz and Lewis counties, The Cowlitz river enters the Columbia at RM 68, approximately 3.5 miles southeast of Longview, Washington. Principal tributaries include the Coweeman and Toutle riverssubbasin is part of WRIA 26.

The lower Cowlitz basin will play a key role in the recovery of salmon and steelhead. The basin has historically supported populations of fall Chinook, winter steelhead, chum, and coho. Today, Chinook, steelhead and chum are listed as threatened under the ESA. Coho salmon are a candidate for listing. Other fish species of interest are Pacific lmprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Lower Cowlitz 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 lower Cowlitz fish. Cowlitz

Salmon and Cowlitz Trout 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 lower Cowlitz Subbasin.

The lower Cowlitz basin is nearly entirely privately owned (94%); much of it by large industrial timber land owners. Forestry is the dominant land use. Commercial forestland makes up over 80% of the basin. The river valleys are mostly in agricultural or residential uses.

The middle mainstem reaches below Mayfield Dam represent important spawning and rearing areas for several species. Below the Barrier Dam, the river flows south through a broad valley. Degraded riparian and floodplain function in these reaches is primarily a result of intensive agricultural development. The Toutle River, which enters the Cowlitz at RM 20, is a major lower tributary that drains the north and west sides of Mount St. Helens. The Toutle River was impacted severely by the 1980 eruption of Mount St. Helens and the resulting massive debris torrents and mudflows, which also impacted the Cowlitz mainstem downstream of the Toutle confluence. Following the eruption, the lower mainstem Cowlitz was dredged and dredge spoils were placed in the floodplain.

Conditions in the lower mainstem limit the productivity of all species. These reaches have experienced intensive diking, agricultural development, urbanization, Mt. St. Helens sediments, and placement of dredge spoils. Restoring these conditions would provide great benefits, especially to fall Chinook and chum; however, feasibility issues may limit the potential for improvement.

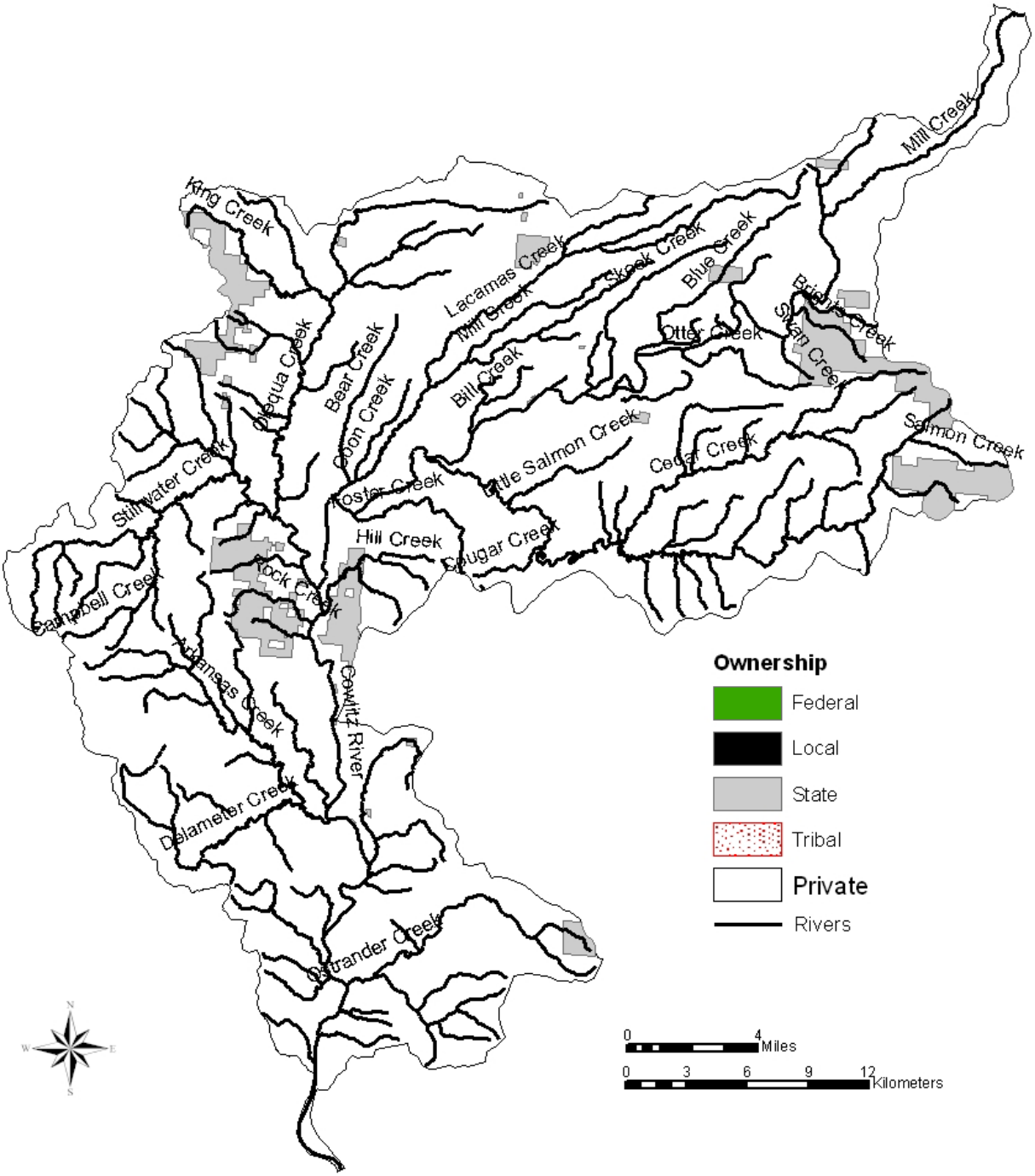
Flow regulation has decreased the risk of high temperatures, sedimentation, and flow extremes; however, stranding of steelhead redds, lack of spawning gravel replenishment, lack of habitat forming flows, and lack of large woody debris transported from upstream are potential problems.

Tributary systems to the middle mainstem provide important habitats for winter steelhead, coho, and resident species, but many of these suffer from degraded habitat conditions. Reaches in Salmon Creek, in particular, are severely limiting for steelhead. This basin has experienced intensive forest harvest in the upper basin and agriculture and grazing impacts along the lower river. Steelhead production is also severely limited in lower reaches of Ostrander, Leckler, and other smaller tributaries to the mainstem.

Population centers in the basin consist primarily of small rural towns, with the larger towns of Castle Rock and Longview/Kelso along the lower river. Projected population change from 2000 to 2020 for unincorporated areas in WRIA 26 is 22%. The following towns in the lower Cowlitz basin are listed with their estimated population change between 2000 and 2020: Longview 21%, Kelso 42%, Castle Rock 2%, Vader 64%, Toledo 64%, and Winlock 49% (LCFRB 2001). Population growth will result in conversion of forestry and agricultural land uses to residential uses, with potential impacts to habitat conditions. It is important that growth management policy adequately protect sensitive habitats and the conditions that create and support them.

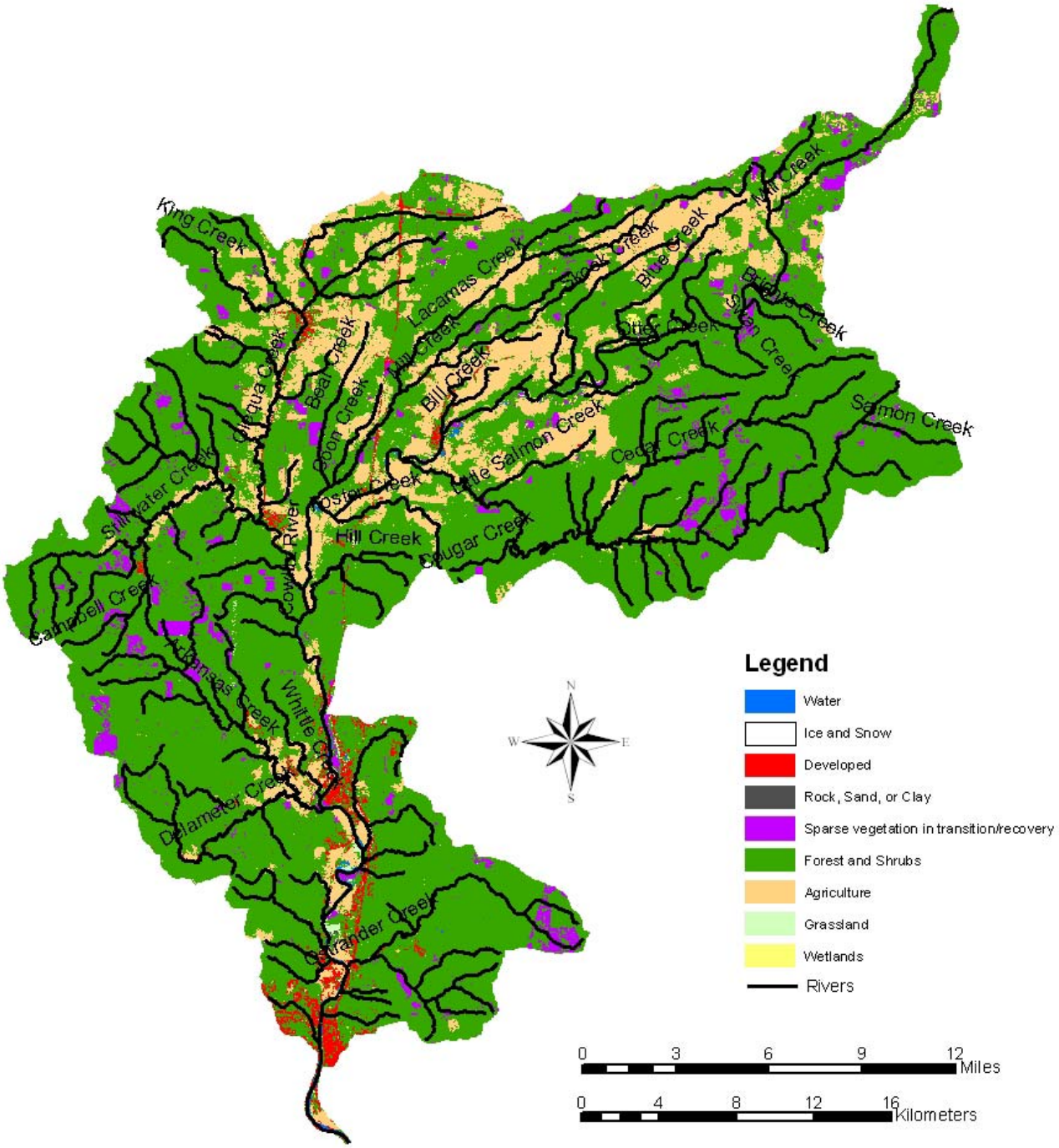
Land Ownership	
Private	94%
State	6%
Federal	0%
Other public	0%

Land Ownership



Vegetation Composition	
Late Seral	0%
Mid Seral	23%
Early Seral	8%
Other Forest	49%
Non Forest	20%

Land Use / Cover



6.2 Species of Interest

Focal salmonid species in the lower Cowlitz include fall Chinook, winter steelhead, chum and coho. The health or viability of these populations is currently low to medium for fall Chinook, low for winter steelhead and coho, and very low for chum. Focal populations need to improve to a targeted level that contributes to recovery of the species (see Volume I, Chapter 6). Recovery goals call for restoring fall Chinook, winter steelhead and chum to a medium level. This level will provide for a 75-94%probability of population survival over 100 years. Coho goals for recovery are high providing a 95% or better probability of persistence over 100 years.

Other species of interest in the lower Cowlitz 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 lower Cowlitz subbasin although specific spawning and rearing habitat requirements of lamprey are not well known.

Table 6-1.Current viability status of lower Cowlitz 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+	1,000-13,000	Medium	3,900-33,200
Winter steelhead	Threatened	Yes	Low	unknown	Medium	600-1,500
Chum	Threatened	No	Very Low	<150	Medium	1,100-135,700
Coho	Candidate	Yes	Low	unknown	High	unknown

Fall Chinook – The historical lower Cowlitz adult population is estimated from 30,000-40,000 fish. Current natural spawning returns range from 1,000-13,000 with the majority hatchery origin fish. There is also a number of North Lewis wild fall Chinook which stray into the Lower Cowlitz and spawn. Spawning is primarily concentrated in 11 miles of river from the Cowlitz Salmon Hatchery downstream to the Cowlitz Trout Hatchery. Juvenile rearing occurs near and downstream of the spawning area. Juveniles emerge in early spring and migrate to the Columbia in spring and summer of their first year.

Winter Steelhead – The historical lower Cowlitz adult population is estimated from 2,000-28,000 fish. Current natural spawning returns are unknown. Some interaction may occur between the natural population and Cowlitz origin winter steelhead produced from the hatchery. Interaction with Chambers Creek stock hatchery steelhead is likely low due to different spawn timing. Spawning in the lower Cowlitz primarily occurs in Olequa, Ostrander, Salmon, Arkansas, Delameter, and Stillwater creeks. Spawning time is 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 Cowlitz Basin

Coho – The historical lower Cowlitz adult population is estimated from 20,000-120,000 fish. with the majority of returns being late stock which spawn in November. Current returns are unknown but assumed to be low. A number of hatchery produced fish spawn naturally. Natural spawning occurs primarily in Olequa, Lacamas, Ostrander, Blue, Otter, Mill, Arkansas, Foster, Stillwater, Campbell, and Hill creeks. Juvenile rearing occurs upstream and downstream of

spawning areas. Juveniles rear for a full year in the Cowlitz Basin before migrating as yearlings in the spring.

Chum – The historical Cowlitz adult population was the largest in the lower Columbia and estimated from 300,000-500,000 fish. This estimate includes production from the mainstem Cowlitz, Toutle, and Coweeman rivers. Current returns are very low, likely less than 150 fish. Typically, less than 20 chum are collected annually in the hatchery trap at the Barrier Dam. Natural spawning primarily occurs in the lower Cowlitz, lower mainstem Toutle, Ostrander Creek, and the lower Coweeman. Peak spawning occurs in late November. Juveniles emerge in the early spring and migrate to the Columbia after a short rearing period,

Coastal Cutthroat – Coastal cutthroat abundance in the lower Cowlitz has not been quantified but the population is considered depressed. Cutthroat trout are present throughout the basin. Both anadromous (fish which have both freshwater and marine life history) and resident forms of cutthroat trout are found in the basin. A Cowlitz Trout Hatchery program produces anadromous cutthroat trout. Anadromous cutthroat enter the Cowlitz from July to October and spawn from January to April. Most juveniles rear 2-3 years before migrating from their natal stream.

Pacific lamprey – Information on lamprey abundance is limited and does not exist for the lower Cowlitz population. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have also declined in the lower Cowlitz. The 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 lower Cowlitz. Juveniles rear in freshwater up to seven years before migrating to the ocean.

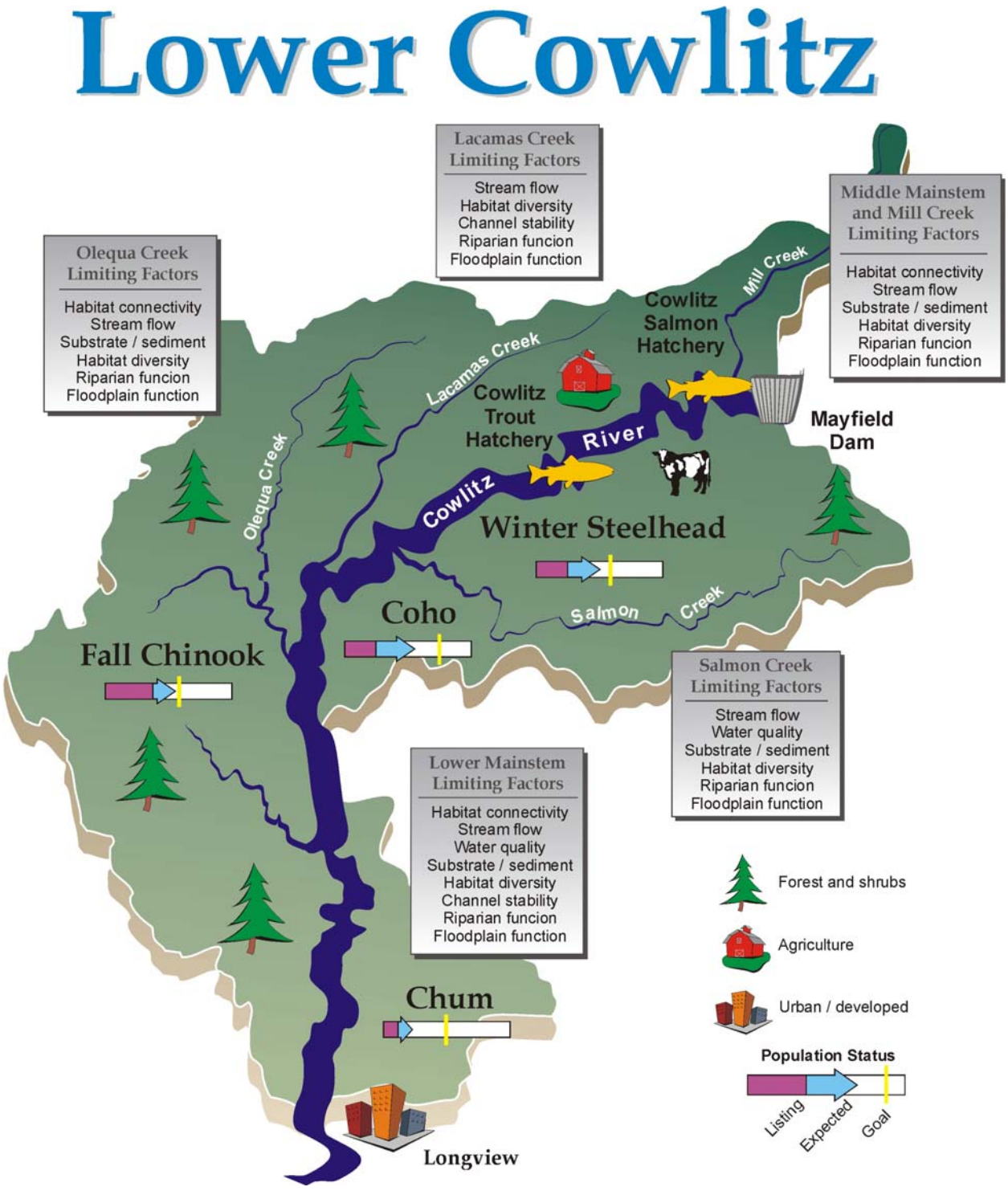


Figure 6-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs,and biological objectives depicted for the lower Cowlitz Basin.

6.3 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 lower Cowlitz 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 has significant impacts on fall Chinook, chum, winter steelhead and coho in the lower Cowlitz.
- Loss of estuary habitat is moderately important for fall Chinook and chum, but is not of great importance for spring Chinook, winter steelhead or coho.
- Harvest has moderately high impacts for fall Chinook and coho, but has minor impacts on winter steelhead and chum.
- Hatchery impacts are moderately important to all four populations.
- Predation is of moderate to minor importance for each of the lower Cowlitz populations.

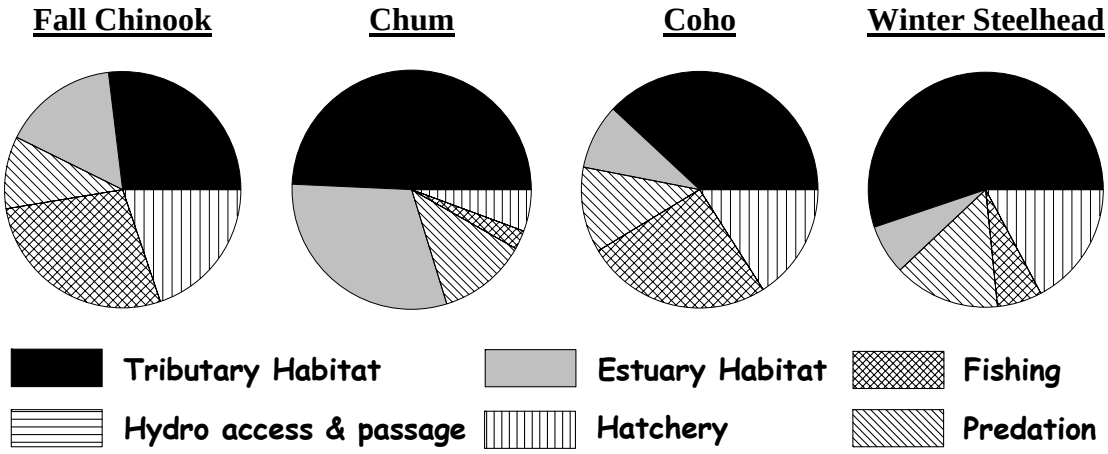


Figure 6-3. Relative contribution of potentially manageable impacts for lower Cowlitz populations.

6.4 Limiting Factors, Threats, and Measures

6.4.1 Hydropower Operation and Configuration

The three hydro-electric dams on the Cowlitz River are considered to be located in the upper Cowlitz basin. However, lower Cowlitz species, in particular fall Chinook have been reduced by loss of habitat in the reservoirs and are affected by flow regimes from Cowlitz River hydro operations which effect spawning and rearing habitat in the lower Cowlitz. The quantity and quality of fall Chinook habitat in the lower Cowlitz can be addressed by;maintaining a flow regime, including minimum flow requirements, that enhance the spawning and rearing habitats for natural salmonid populations downstream of the Cowlitz hydrosystem.

In addition, mainstem Columbia hydro operations and flow regimes affect habitat utilized by lower Cowlitz species in migration corridors and in the estuary. Key regional strategies affecting lower Cowlitz populations are included in the following table.

Table 6-2. Regional hydro measures from Volume I, Chapter 7 with significant application to lower Cowlitz Subbasin populations.

Measure	Description	Comments
D.M4	Operate the tributary hydrosystems to provide appropriate flows for salmon spawning and rearing habitat in the areas downstream of the hydrosystem.	The quantity and quality of spawning and rearing habitat for salmon, in particular fall Chinook in the Cowlitz, is affected by the water flow discharged at Mayfield Dam. The operational plans for the Cowlitz hydrosystem, in conjunction with fish management plans, should consider flow regimes, including minimum flow and ramping rates, which enhance the lower river habitat for fall Chinook.

6.4.2 Harvest

Most harvest of wild Cowlitz salmon and steelhead is incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. This mortality is very low for chum and steelhead, but is more significant for fall Chinook. Cowlitz 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 Cowlitz basin fisheries and retention of chum is prohibited in Columbia River and Cowlitz River sport fisheries. Chum are impacted incidental to fisheries directed at coho and winter steelhead. Harvest of Cowlitz 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 Cowlitz Basin. Wild coho impacts are limited by fishery management to retain fin-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 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 lower Cowlitz subbasin populations are summarized in the following table:

Table 6-3. Regional harvest measures from Volume I, Chapter 7 with significant applicationto lower Cowlitz 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	Consider developing 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 Cowlitz watershed. This program is not federally funded and therefore is not subject to the Congressional mandate to mass mark federally funded hatchery production.
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.

6.4.3 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 lower Cowlitz. The Cowlitz Salmon Hatchery (since 1967) produces fall Chinook, spring Chinook, and coho for harvest opportunity and is used for reintroduction of spring Chinook, coho, and winter steelhead to the upper Cowlitz basins. The harvest program also includes transfer of spring Chinook and coho to the Deep River net pens. The Cowlitz Salmon Hatchery also supplies spring Chinook and coho to the Friends Of The Cowlitz (FOC) organization for rearing and release into the lower Cowlitz. The salmon programs were derived from local Cowlitz stock with negligible transfers from outside the basin. The main hatchery salmon threats are domestication of lower Cowlitz natural fall Chinook and coho and potential ecological interactions between hatchery and natural juvenile salmon. The Cowlitz Trout Hatchery (since 1967) produces early-timed winter steelhead for harvest, late-timed winter steelhead for upper Cowlitz and Tilton basin reintroduction and for harvest,

summer steelhead for harvest, and sea-run cutthroat for harvest. The Cowlitz Trout Hatchery supplies sea-run cutthroat trout and summer steelhead to FOC for rearing and release into the lower Cowlitz The early winter steelhead are a composite Elochoman, Chambers Creek, and Cowlitz stock, and the summer steelhead are Skamania stock. 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.

Table 6-4. Cowlitz Basin Hatchery Production.

Hatchery	Release Location	Fall Chinook	Spring Chinook	Late Coho	Sea-run Cutthroat	Winter Steelhead	Summer Steelhead
Cowlitz Salmon	Lower Cowlitz	5,000,000	967,000	3,200,000			
	Upper Cowlitz		300,000				
Cowlitz Trout	Lower Cowlitz				150,000	652,500	500,000
	Upper Cowlitz					287,500	
	Tilton					100,000	

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 Cowlitz 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 Cowlitz subbasin are summarized in Table 6-5.

Table 6-5. Regional hatchery measures from Chapter 6 with potential implementation actions in the Cowlitz Subbasin.

Measure	Description	Comments
H.M2,5,13,	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 Cowlitz populations in the BRAP procedure.
H.M14	Use only local brood stock in the fall Chinook hatchery program.	This measure will preclude transfer of outside basin stock into the Cowlitz hatchery program. This will enable a hatchery and wild integrated program to contiue with fall Chinook ecologically adapted to the Cowlitz Basin
H.M15, 22,32, 40	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.M32,41,17	Mark hatchery steelhead, coho, and perhaps 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, 36	Hatchery program utilized for supplementation and enhancement of lower Cowlitz chum and coho populations	The Cowlitz hatchery complex is used for reintroduction in the upper basin. This program could be considered for expansion to include enhancement of chum and coho populations in the lower Cowlitz.
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.M2,6	Evaluate the Cowlitz Salmon and Trout Hatcheries facility operations.	Both facilities would be evaluated in the BRAP process for potential hazards associated with barriers to fish passage and adequacy of screens.
H.M19, 29, 37	Hatcheries utilized for reintroduction of coho, spring Chinook, and winter steelhead into the upper Cowlitz basin.	Hatchery facilities and operations to accommodate the reintroduction effort including rearing; collection, transport, marking, sorting, brood stock development, and M&E.

6.4.4 Ecological Interactions

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

6.4.5 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 lower Cowlitz 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. Estuary and mainstem effects on lower Cowlitz salmon and steelhead populations are addressed by regional strategies and measures identified in Volume I and the Columbia Mainstem and Estuary Subbasin sections of Volume II.

6.4.6 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 lower Cowlitz River basin have the greatest impact on the health and viability of salmon and steelhead relative to the other limiting factors 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 preservation and restoration are identified in Figure 6-4. A summary of the primary habitat limiting factors and threats are presented in Table 6-7. Habitat measures and related information are presented in Table 6-8. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 6-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 6-6. 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 lower Cowlitz basin include the following:

- Lower mainstem & tributaries – Lower Cowlitz 1-2; Salmon Cr 1-5; Delameter 1-2; Ostrander 1
- Middle mainstem & Mill Creek – Mid Cowlitz 5B-6; Mill Creek
- Olequa Creek & tributaries – Olequa 1-7; Stillwater 1-5
- Lacamas Creek – Lacamas 1-2, 4-7
- Salmon Creek & tributaries – upper Salmon Creek 1-3; Cedar Creek

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.

The lower mainstem Cowlitz and lower tributaries (e.g. Ostrander Creek, Lower Salmon Creek, Delameter Creek) historically provided productive habitat for chum, coho, and fall Chinook. These habitats, especially the mainstem, have been heavily impacted by mixed use development. In addition to the influence of hydro-regulation from upstream dams, the primary impacts include channel manipulations, increased watershed imperviousness, and riparian degradation. Effective recovery measures will include riparian and floodplain restoration and land-use planning that protects and restores habitat and habitat-forming processes.

Reaches with the greatest historical productivity in the middle mainstem are located between Skook Creek and Mayfield Dam. These reaches supported chum, fall Chinook, coho, and winter steelhead. Mill Creek was historically productive for coho and winter steelhead. These reaches have high preservation as well as restoration value. One of the most effective recovery measures will be to preserve the canyon reaches downstream of the dam. In other areas, emphasis should be placed on restoration and preservation of riparian areas and floodplains. This mixed use area will also benefit from land-use planning that protects and restores habitat and habitat-forming processes.

The Olequa Creek basin contains potentially productive habitat for coho and winter steelhead. Key reaches include the mainstem Olequa and Stillwater Creek. These reaches are impacted primarily by urban and rural development and agriculture. Recovery emphasis is for restoration of riparian areas, floodplains, and commercial forest lands. As with other rapidly developing portions of the lower Cowlitz basin, this areas will benefit from land-use planning that protects and restores habitat and habitat-forming processes.

Lacamas Creek contains potentially productive habitats for coho, although winter steelhead also utilize these reaches. Lacamas Creek is impacted primarily by agriculture and rural development. The most effective recovery measures are consistent with those identified above for Olequa Creek.

Salmon Creek contains productive habitat for coho and winter steelhead. Salmon Creek is impacted by agriculture along the first few reaches and by forest practices throughout the remainder of the basin. Riparian and floodplain restoration should be the emphasis along the first few reaches while restoration and preservation of watershed processes should be the emphasis on forest lands.

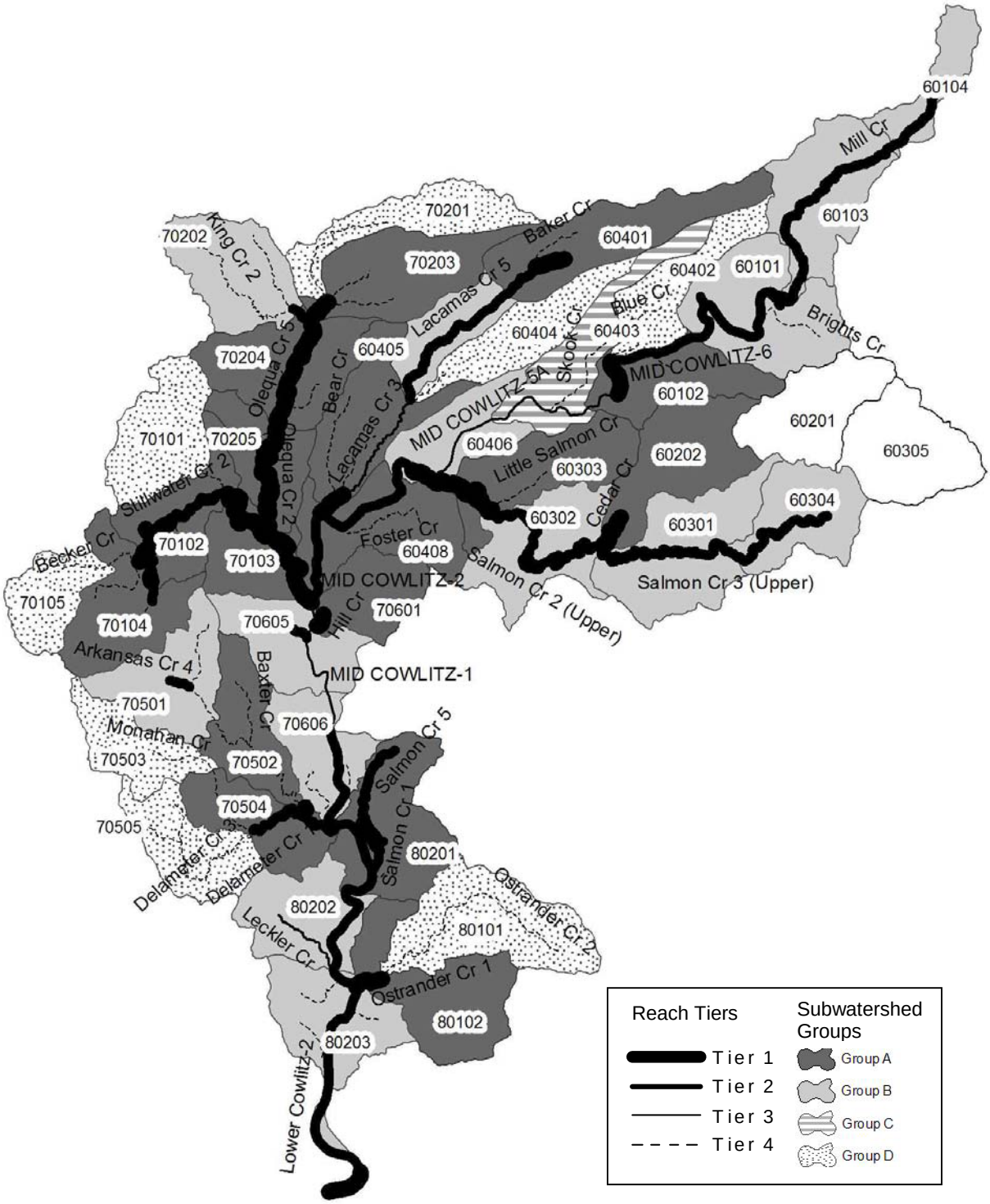


Figure 6-4. Reach tiers and subwatershed groups in the Lower Cowlitz Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at 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.

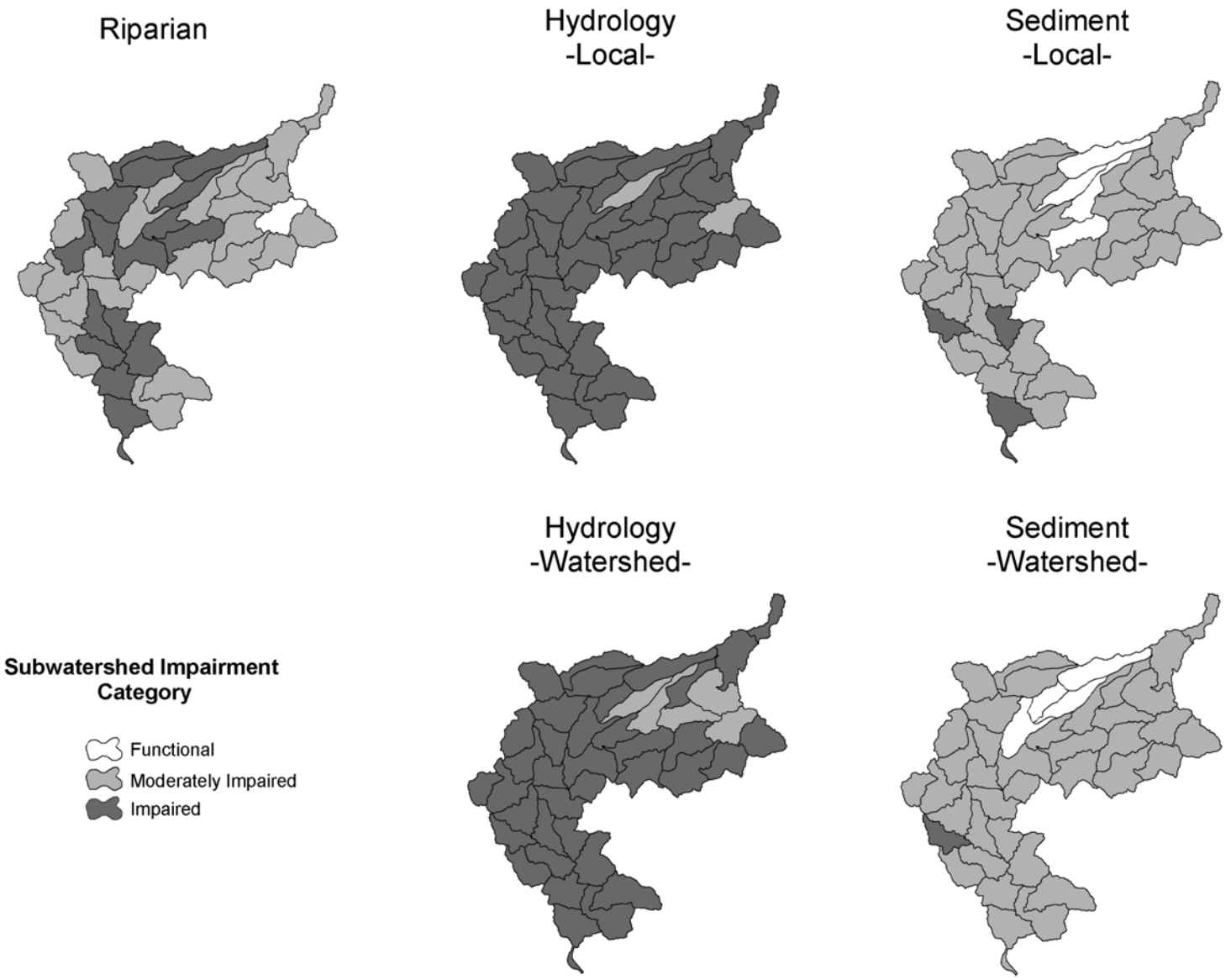


Figure 6-5. IWA subwatershed impairment ratings by category for the Lower Cowlitz Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 6-6. 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	Sub-watershed	Reaches within subwatershed	Species Present	High priority reaches by species	Critical life stages by species	High impact habitat factors	Preservation or restoration emphasis	Watershed processes (local)			Watershed processes (watershed)	
								Hydrology	Sediment	Riparian	Hydrology	Sediment
A	80407	Lower Cowlitz-1	Chum	Lower Cowlitz-1	Spawning Egg incubation Fry colonization Adult migrant Adult holding	habitat diversity key habitat quantity	R	I	M	I	I	M
			Coho	none								
			ChF	none								
			StW	none								
	80201	Salmon Cr 2 Pond 1 Pond 2 Salmon Cr 3 Salmon Cr 4 Borrow pit Salmon Cr 1 LB tribA (No number) Salmon Cr 5 LB trib3 (26.0186)	Chum	Salmon Cr 2	Spawning Egg incubation Fry colonization Adult migrant Adult holding	habitat diversity	R	I	M	H	I	M
			Coho	Salmon Cr 2 Pond 1 Pond 2 Salmon Cr 3 Salmon Cr 4 Borrow pit	Spawning Egg incubation Summer rearing Winter rearing	habitat diversity temperature sediment	R					
			StW	none								
	80102	Ostrander Cr 1	Chum	none				I	M	M	I	M
			Coho	Ostrander Cr 1	Egg incubation Juvenile migrant	sediment	R					
			StW	none								
	70601	Hill Cr	Coho	Hill Cr	Spawning Egg incubation Fry colonization Summer rearing Winter rearing	none	PR	I	M	M	I	M
			StW	none								
	70504	Arkansas Cr 1 Delameter Cr 1 Delameter Cr 2 Lake 1 Monahan Cr	Chum	none				I	M	H	I	M
			Coho	Arkansas Cr 1	Egg incubation Fry colonization Summer rearing	channel stability habitat diversity temperature sediment key habitat quantity	R					
			StW	none								
	70502	Lake 2 Arkansas Cr 2 Arkansas Cr 3 Baxter Cr	Coho	Lake 2	Egg incubation Summer rearing Winter rearing	channel stability habitat diversity key habitat quantity	R	I	M	H	I	M
			StW	none								
	70205	Olequa Cr 2 Olequa Cr 3 Snow Cr Olequa Cr 3 Olequa Cr 4 Olequa Cr 5 King Cr 1 Ferrier Cr Curtis Cr	Coho	Olequa Cr 2 Olequa Cr 3	Egg incubation Fry colonization Summer rearing Winter rearing	habitat diversity	R	I	M	H	I	M
			StW	Olequa Cr 2 Olequa Cr 3	Egg incubation Fry colonization Summer rearing Winter rearing Juvenile migrant (age 1)	habitat diversity temperature	R					
	70204		Coho	Olequa Cr 3 Olequa Cr 4 Olequa Cr 5	Egg incubation Fry colonization Summer rearing Juvenile migrant (age 0) Winter rearing Juvenile migrant (age 1)	habitat diversity key habitat quantity	R	I	M	H	I	M
			StW	Olequa Cr 3 Olequa Cr 4	Egg incubation Fry colonization Summer rearing Juvenile migrant (age 0) Winter rearing Juvenile migrant (age 1)	habitat diversity	R					
	70203	Olequa Cr 5 Olequa Cr 6 Olequa Cr 7 LB tribC (right fork) (26.0427) Olequa Cr 8 (center fork)	Coho	Olequa Cr 5 Olequa Cr 6 Olequa Cr 7	Egg incubation Fry colonization Summer rearing Juvenile migrant (age 0) Winter rearing Juvenile migrant (age 1)	channel stability habitat diversity temperature sediment key habitat quantity	R	I	M	H	I	M
			StW	Olequa Cr 5 Olequa Cr 6 Olequa Cr 7	Spawning Egg incubation Fry colonization Summer rearing Winter rearing Juvenile migrant (age 1)	habitat diversity	PR					

Sub-watershed Group	Sub-watershed	Reaches within subwatershed	Species Present	High priority reaches by species	Critical life stages by species	High impact habitat factors	Preservation or restoration emphasis	Watershed processes (local)			Watershed processes (watershed)	
								Hydrology	Sediment	Riparian	Hydrology	Sediment
A	70104	Stillwater Cr 5 Campbell Cr 2 Becker Cr Campbell Cr 3 Masonry Dam Stillwater Cr 6	Coho	Stillwater Cr 5	Egg incubation Fry colonization Summer rearing Winter rearing	none	H	I	M	M	I	M
			StW	Stillwater Cr 5	Egg incubation Fry colonization Summer rearing	temperature sediment	PR					
	70103	Olequa Cr 1 Stillwater Cr 1	Chum	Olequa Cr 1	Spawning Egg incubation Fry colonization Adult holding	none	PR	I	M	M	I	M
			Coho	Olequa Cr 1 Stillwater Cr 1	Egg incubation Summer rearing Winter rearing	habitat diversity	R					
			StW	none								
	70102	Stillwater Cr 5 Stillwater Cr 1 Stillwater Cr 3 Stillwater Cr 4 Campbell Pond Owens Cr Stillwater Cr 2 Campbell Cr 1 Campbell Cr 2 Brim Cr RB tribB (26.0440)	Coho	Stillwater Cr 5 Stillwater Cr 1 Stillwater Cr 3 Stillwater Cr 4 Campbell Pond Owens Cr	Egg incubation Fry colonization Summer rearing Winter rearing Juvenile migrant (age 1)	channel stability habitat diversity temperature sediment key habitat quantity	PR	I	M	H	I	M
			StW	Stillwater Cr 5	Egg incubation Fry colonization Summer rearing	temperature sediment	PR					
	60408	Lacamas Cr 1 MID COWLITZ-4 MID COWLITZ-2 MID COWLITZ-3 Foster Cr	Chum	Lacamas Cr 1	Egg incubation Fry colonization Adult holding	habitat diversity	PR	I	M	H	I	M
			Coho	Lacamas Cr 1	Egg incubation Fry colonization Summer rearing	none	R					
			ChF	MID COWLITZ-4 MID COWLITZ-3	Egg incubation Fry colonization Adult holding	sediment	P					
			StW	none								
	60406	Lacamas Cr 1 Lacamas Cr 2 Lacamas Cr 3 Bear Cr Coon Cr	Chum	Lacamas Cr 1	Spawning Egg incubation Fry colonization Adult holding	habitat diversity	PR	I	M	M	I	F
			Coho	Lacamas Cr 1 Lacamas Cr 2	Egg incubation Fry colonization Summer rearing Winter rearing	channel stability habitat diversity sediment	R					
			StW	none								
	60401	Lacamas Cr 7 Lacamas Cr 6 Baker Cr	Coho	Lacamas Cr 7	Egg incubation Fry colonization Summer rearing Winter rearing	none	PR	I	F	H	I	F
			StW	none								
	60303	Salmon Cr 1 (Upper) Little Salmon Cr	Chum	Salmon Cr 1 (Upper)	Spawning Egg incubation Fry colonization Adult holding	none	PR	I	F	H	I	M
			Coho	Salmon Cr 1 (Upper)	Egg incubation Fry colonization Summer rearing Winter rearing	habitat diversity	R					
			StW	none								
	60202	Cedar Cr	Coho	Cedar Cr	Spawning Egg incubation Fry colonization Summer rearing Juvenile migrant (age 0) Winter rearing	none	R	I	M	M	I	M
			StW	none								
	60102	MID COWLITZ-6 MID COWLITZ-5B MID COWLITZ-5A Otter Cr	Chum	MID COWLITZ-6	Spawning Egg incubation Fry colonization Adult holding	none	P	I	M	M	M	M
			Coho	MID COWLITZ-5B	Egg incubation Summer rearing Winter rearing	habitat diversity key habitat quantity	R					
			ChF	none								
			StW	MID COWLITZ-6	Egg incubation Fry colonization Summer rearing Winter rearing Juvenile migrant (age 1)	habitat diversity pathogens	R					

Sub-watershed Group	Sub-watershed	Reaches within subwatershed	Species Present	High priority reaches by species	Critical life stages by species	High impact habitat factors	Preservation or restoration emphasis	Watershed processes (local)			Watershed processes (watershed)	
								Hydrology	Sediment	Riparian	Hydrology	Sediment
B	60101	MID COWLITZ-7 MID COWLITZ-6 Jones Cr Brights Cr	Chum	MID COWLITZ-6 MID COWLITZ-7	Spawning Egg incubation Fry colonization Adult holding	habitat diversity	PR	I	M	M	M	M
			Coho	none								
			ChF	none								
			StW	MID COWLITZ-6 MID COWLITZ-7	Egg incubation Fry colonization Summer rearing Winter rearing Juvenile migrant (age 1)	habitat diversity pathogens	R					
	70605	Rock Cr MID COWLITZ-1	All	none				I	M	M	I	M
	70606	Whittle Lake Lower Cowlitz-2 Whittle Cr 1 Whittle Cr2 LB trib4 (No number)	Chum	none				I	I	H	I	M
			Coho	Whittle Lake	Egg incubation Summer rearing Winter rearing	none	PR					
			ChF	none								
			StW	none								
	70501	Arkansas Cr 4 Arkansas Cr 3 LB tribB (26.0215)	Coho	none				I	M	M	I	M
			StW	none								
	70202	King Cr 1 King Cr 2 LB tribD (26.0462)	Coho	none				I	M	M	I	M
			StW	none								
	60407	MID COWLITZ-4 MID COWLITZ-5A	Chum	none				I	M	H	I	M
			Coho	none								
			ChF	MID COWLITZ-4	Egg incubation Fry colonization Adult holding	none	P					
			StW	none								
	60405	Lacamas Cr 4 Lacamas Cr 5	Coho	none				I	M	M	I	F
			StW	none								
	60304	Salmon Cr 3 (Upper)	Coho	none				I	M	M	I	M
			StW	none								
	60302	Salmon Cr 2 (Upper)	Chum	none				I	M	M	I	M
			Coho	none								
			StW	Salmon Cr 2 (Upper)	Spawning Egg incubation Fry colonization Summer rearing Winter rearing Juvenile migrant (age 1)	habitat diversity	R					
	60301	Salmon Cr 3 (Upper)	Coho	none				I	M	M	I	M
			StW	none								
	60104	Mill Cr	Coho	none				I	M	M	I	M
			StW	none								
	60103	Mill Cr	Coho	none				I	M	M	I	M
			StW	none								
	80203	LB trib1 (26.0127) LB trib2 (26.0129) Rb trib1 (26.0123) RB trib2 (26.0163)	Coho	none				I	I	H	I	M
			StW	none								
	80202	Leckler Cr	Coho	none				I	M	H	I	M
			StW	none								
C	70506	MID COWLITZ-1	All	none				I	M	M	I	M
	60403	MID COWLITZ-5A Skook Cr	All	none				I	F	M	M	M
D	80101	Ostrander Cr 2 Ostrander Cr 3 RB trib Ostrander (No number)	Coho	none				I	M	M	I	M
			StW	none								
	70505	Delameter Cr 3 Delameter Cr 4 Tucker Cr	Coho	none				I	M	M	I	M
			StW	none								
	70503	Monahan Cr	Coho	none				I	I	M	I	I
			StW	none								
	70201	RB trib A (left fork) (26.0427)	Coho	none				I	M	H	I	M
			StW	none								
	70105	Stillwater Cr 6	Coho	none				I	M	M	I	M
			StW	none								
	70101	Brim Cr	Coho	none				I	M	M	I	M
			StW	none								
	60404	Mill Cr (Lacamas Trib)	Coho	none				M	F	H	M	F
	60402	Blue Cr	Coho	none				I	M	M	I	M
			StW	none								

Table 6-7. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower mainstem and tributaries (LM), middle mainstem and Mill Creek (MM), Olequa Creek and tributaries (OC), Lacamas Creek (LC), and Salmon Creek (upper) and tributaries (SC). 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	OC	LC	SC
Habitat connectivity					
Blockages to off-channel habitats	✓	✓	✓		
Blockages to channel habitats	✓	✓			✓
Habitat diversity					
Lack of stable instream woody debris	✓	✓	✓	✓	✓
Altered habitat unit composition	✓	✓	✓	✓	✓
Loss of off-channel /side-channel habitat	✓	✓	✓		
Channel stability					
Bed and bank erosion	✓			✓	
Channel down-cutting (incision)	✓				
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, rate of chg	✓	✓	✓	✓	✓
Alterations to temporal pattern of flow	✓	✓			
Water quality					
Altered stream temperature regime	✓		✓		✓
Bacteria	✓				
Chemical contaminants			✓		
Substrate and sediment					
Lack of adequate spawning substrate	✓				
Excessive fine sediment	✓	✓	✓		✓
Embedded substrates	✓	✓	✓		✓
Disrupted sediment transport (hydro)	✓	✓			

Threats	LM	MM	OC	LC	SC
Hydropower operations					
Flow manipulations	✓	✓			
Alterations to stream temperature regime	✓	✓			
Changes to sediment transport dynamics	✓	✓			
Agriculture grazing					
Clearing of vegetation	✓	✓		✓	✓
Riparian grazing	✓	✓		✓	✓
Floodplain filling	✓	✓		✓	✓
Application of chemicals			✓		
Urban/rural/suburban development					
Clearing of vegetation	✓	✓	✓		
Floodplain filling	✓	✓	✓		
Increased impervious surfaces	✓	✓	✓		
Increased drainage network	✓	✓	✓		
Roads – riparian/floodplain impacts	✓	✓	✓		
Leaking septic systems	✓				
Forest practices					
Timber harvest –sediment supply impacts			✓		✓
Timber harvests – impacts to runoff			✓	✓	✓
Riparian harvests (historical)					✓
Forest roads – sediment supply impacts			✓		✓
Forest roads – impacts to runoff			✓	✓	✓
Channel manipulations					
Bank hardening	✓	✓	✓	✓	✓
Channel straightening	✓	✓	✓	✓	✓
Artificial confinement	✓	✓	✓	✓	✓
Clearing and snagging	✓	✓			
Dredge and fill activities	✓				

Table 6-8. 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.

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 + tribs Lower Cowlitz 1-2, Salmon Cr 1-5, Delameter 1-2, Ostrander Cr 1 ***Middle mainstem + Mill*** Mid Cowlitz 5B-6, Mill ***Olequa Creek + tribs*** Olequa 1-7,Stillwater 1-5 ***Lacamas Creek*** Lacamas 1-2, 4-7 ***Salmon Cr (Upper) +tribs*** Salmon Cr 1-3, Cedar Cr	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes	• Floodplain filling • Channel straightening • Artificial confinement	• Coho • Chum • Winter steelhead	2-15 years	Great potential benefit due to improvements in many limiting factors. This passive restoration approach can allow channels to restore naturally once confinement structures are removed. There are challenges with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.
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 + tribs Lower Cowlitz 1-2, Salmon Cr 1-5, Delameter 1-2, Ostrander Cr 1 ***Middle mainstem + Mill*** Mid Cowlitz 5B-6, Mill ***Olequa Creek + tribs*** Olequa 1-7,Stillwater 1-5 ***Lacamas Creek*** Lacamas 1-2, 4-7 ***Salmon Cr (Upper) +tribs*** Salmon Cr 1-3, Cedar Cr	• Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats • Altered habitat unit composition	• Floodplain filling • Channel straightening • Artificial confinement	• Coho • Chum • Winter steelhead	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 on private lands due to existing infrastructure already in place, potential flood risk to property, and large expense. Opportunities exist in areas of public ownership in these reaches.
3. Protect and restore riparian function					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
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 + tribs Lower Cowlitz 1-2, Salmon Cr 1-5, Delameter 1-2, Ostrander Cr 1 ***Middle mainstem + Mill*** Mid Cowlitz 5B-6, Mill ***Olequa Creek + tribs*** Olequa 1-7,Stillwater 1-5 ***Lacamas Creek*** Lacamas 1-2, 4-7 ***Salmon Cr (Upper) +tribs*** Salmon Cr 1-3, Cedar Cr	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or noxious species	• Timber harvest – riparian harvests • Riparian grazing • Clearing of vegetation due to urban/rural/suburban development and agriculture	• All species	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 harvest policy. Riparian restoration projects are relatively inexpensive and are often supported by landowners. Whereas the specified stream reaches are the highest priority for riparian measures, 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 natural sediment supply processes ***A. Address forest road related sources*** ***B. Address timber harvest related sources*** ***C. Address agricultural sources*** ***D. Address developed land sources***					
Entire basin	• Excessive fine sediment • 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.
5. Protect and restore runoff processes					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
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 – impacts to runoff • Increased impervious surfaces • Increased drainage network (road ditches, storm drains) • Clearing of vegetation	• 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 to requirements under the new FPRs, the USFS Northwest Forest Plan, and forest land HCPs. There are challenges with addressing runoff conditions 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.
6. 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	• Stream flow – altered magnitude, duration, or rate of change of flows	• Water withdrawals	• All species	1-5 years	Instream flow management strategies for the Lower Cowlitz basin have been identified as part of Watershed Planning for WRIA 26 (LCFRB 2004). Strategies include water rights closures, setting of minimum flows, and drought management policies.
7. Manage regulated stream flows to provide for critical components of the natural flow regime ***A. Provide adequate flows for specific life stage requirements (i.e,. migration, summer rearing)*** ***B. Address geomorphic effects of hydro-regulation (channel-forming flows, sediment transport)***					
All mainstem Cowlitz reaches	• Alterations to the temporal pattern of stream flow • Altered stream temperature regime	• Hydropower operations – flow manipulation • Hydropower	• All species	1-5 years	Large potential benefit due to flow regulation and dam effects on habitat formation, stream temperatures, and fish movements. Adequate flow protections are being negotiated as part

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
	• Disrupted sediment transport processes (hydro)	operations – changes to sediment transport • Hydropower operations – changes to stream temperature			of Hydro re-licensing efforts conducted by Tacoma Power in consultation with the Federal Energy Regulatory Commission (FERC) and various stakeholders.
8. Protect and restore water quality ***A. Restore the natural stream temperature regime*** ***B. Reduce fecal coliform bacteria levels*** ***C. Reduce delivery of chemical contaminants to streams***					
Entire basin	• Altered stream temperature regime • Bacteria • Chemical contaminants	• Riparian harvests • Riparian grazing • Leaking septic systems • Application of pesticides, herbicides, and fertilizers	• All species	1-50 years	Primary emphasis for restoration should be placed on stream segments that are listed on the 2004 303(d) list.
9. 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 + tribs Lower Cowlitz 1-2, Salmon Cr 1-5, Delameter 1-2, Ostrander Cr 1 ***Middle mainstem + Mill*** Mid Cowlitz 5B-6, Mill ***Olequa Creek + tribs*** Olequa 1-7,Stillwater 1-5 ***Lacamas Creek*** Lacamas 1-2, 4-7 ***Salmon Cr (Upper) +tribs*** Salmon Cr 1-3, Cedar Cr	• Lack of stable instream woody debris • Altered habitat unit composition	• None (symptom-focused restoration strategy)	• Coho • Winter 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 to high likelihood of implementation given the lack of hardship imposed on landowners and the current level of acceptance of these type of projects.

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
10. Protect and restore fish access to channel habitats ***A. Culverts, dams, and other barriers on Cowlitz tributaries***					
Mill Creek ***Blue Creek*** ***Skook Creek*** ***Foster Creek*** ***Salmon Creek (lower)*** ***Leckler Creek*** ***Other small tribs***	• Blockages to channel habitats	• Dams, culverts, in-stream structures	• Coho • Winter steelhead	Immediate	As many as 50 miles of potentially accessible habitat are blocked by culverts or other barriers (approximately 25 barriers total). The blocked habitat is believed to be marginal in most cases. Passage restoration projects should focus on cases where it can be demonstrated that there is good potential benefit and reasonable project costs.
11. 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	The basin is growing rapidly. The focus should be on management of land-use conversion and managing 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.
12. 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. These programs are under-funded and have low landowner participation.

6.5 Program Gap Analysis

The Cowlitz Basin (~440 sq mi) is located in Cowlitz and Lewis County:
- No federal land ownership in the lower Cowlitz Basin.
- Large private industrial forest lands (~228 sq miles) are the largest land use.
- Small private commercial forest lands (~124 sq mi) are found throughout the lower Cowlitz Basin.
- Department of Natural Resources forest lands (~26 sq mi) are relatively small land use.
- The upper two-thirds of the lower Cowlitz basin is located in Lewis County.
- The lower third of the lower Cowlitz basin is in Cowlitz County.
- Cities in the lower Cowlitz Basin include Toledo, Winlock, Vader, Kelso, and Longview.
- Significant population growth is expected by the year 2020.

Protection Programs

Protection of watershed process and habitat in the lower Cowlitz Basin is provided primarily through local land use controls, the state forest practices rules, Department of Natural Resources HCP. Protection programs include those programs that protect habitat conditions or watershed functions through management policies and programs, regulatory measures, and acquisition of sensitive habitats or protective easements.

Federal Programs

- ***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.9A; M.9B]

- ***Federal Energy Regulatory Commission (FERC)***
  - Licensing of Hydroelectric Projects: Tacoma and Lewis County PUD operate hydroelectric facilities on the upper Cowlitz pursuant to FERC licenses. The licenses prescribe protection measures to be implemented by the utilities over the term of the licenses. A licensing settlement agreement between Tacoma Power and federal and state agencies, Lewis County, the Yakama Indian Nation and various non-governmental organizations (NGOs) prescribes additional measures for the Tacoma Power Cowlitz Hydro Project (Barrier, Mayfield and Mossyrock Dams and associated reservoirs). The license and settlement provide modest funding for the acquisition of sensitive habitats in the lower Cowlitz basin. They provide for flow regimes protective of spawning and rearing salmonids in the lower Cowlitz. [M.7A; M.7B; M.12A]

State Programs

- ***Washington Department of Natural Resources***

  - State Forest Land HCP:
    State forest lands 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.4A; M.4B; M.5A; M.5B]
  - 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. These activities address measures [M.3A; M.3B; M.4A; M.4B; M.5A; M.5B]

- ***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.9A; M.9B]

  - 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.4D; M.5C; M.5D; M.7A; M.7B; M.8A; M.8B; M.8C; M.9A; M.9B; M.10A; M.11A; M.11B; M.11C; M.12A; M.12B]

- ***Washington Department of Ecology***

  - Water Resources Program/Water Rights: Department of Ecology, in consultation with the Department of Fish and Wildlife, has administrative closed selected areas within the lower Cowlitz basin 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 could exacerbate summer low flows on smaller tributaries. [M.6A; M.6B; M.6C; M.6D; M.6E]

  - 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) 26 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.6A; M.6B; M.6C; M.6D; M.7A; M.7B; M.8A; M.8B; M.8C; M.11A]

- ***Department of Transportation***

  - Barrier Removal Program:
    WSDOT is working to improve blockages associated with I-5. [M.5B; M.8C; M.10A]

  - 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. [M.5B; M.8C; M.10A]

- ***Conservation Commission/ Lewis Conservation District/ Cowlitz Conservation District*** The Conservation Districts provide technical assistance and incentives (e.g. Conservation Reserve and Enhancement Program) to encourage agricultural landowners to protect riparian areas and stream habitat. The Cowlitz Conservation District has been actively involved in the lower Cowlitz basin within Cowlitz County. [M.3A; M.3C; M.4C; M.8A; M.8B; M.8C]

Local Government Protection Programs

- ***Lewis County*** [M.11A; M.11B; M.11C]
  - Comprehensive Planning and Land Use Zoning: Lewis County comprehensive planning and zoning are subject to the requirements of the Washington Growth Management Act (GMA). Zoning is mixed throughout the upper Cowlitz, but significant agricultural zoning (R-20) exists within the valley floor. Some lands are zoned for rural residential uses.
  - Critical Areas Ordinance: The County critical areas ordinance includes protections for fish and wildlife habitat. Stream buffers vary from 25 to 100 feet depending on DNR water typing and whether urban or rural uses are involved. Wetland buffers vary from 50 to 100 feet depending on type and the intensity of use involved. Existing agricultural practices are exempt.
  - Road Maintenance: The County has not adopted road maintenance standards that are protective of fish habitat. [M.5C; M.5D; M.8C; M.10A]

- ***Cowlitz County***
  - Land Use: [M.11A; M.11B; M.11C]
    - ✓ The comprehensive plan that applies to the non-federal lands, but contains no significant policies for the protection of watershed processes and stream habitat.
    - ✓ Zoning along State Highway 503 provides for one dwelling per 2 acres and one dwelling per 5 acres along non-county roads.
    - ✓ Cowlitz County has not adopted protective stream buffers.
    - ✓ Wetland buffers vary from 25' to 200' and are based upon soil type and wildlife utilization.
    - ✓ The County has not developed comprehensive ordinances for the protection of watershed processes or stream habitat conditions.
  - Road Maintenance

    The County has not developed or implemented a road maintenance program to protect habitat. [M.5C; M.5D; M.8C; M.10A]

Community Protection Programs

- ***Davis Creek Community Group:*** provides watershed stewardship and restoration activities in Davis Creek. To date they have provide $4,500 in private donations for riparian restoration. [M.3A; M.3D]

Restoration Programs

Restoration programs in the lower Cowlitz Basin are implemented by a variety of agencies, organizations, and private interests. Major programs implementing protection measures are identified below:

Federal Restoration Programs

- ***Federal Energy Regulatory Commission (FERC)***
  - Licensing of Hydroelectric Projects: Tacoma and Lewis County PUD operate hydroelectric facilities on the upper Cowlitz pursuant to FERC licenses. The licenses prescribe protection measures to be implemented by the utilities over the term of the licenses. A licensing settlement agreement between Tacoma Power and federal and state agencies, Lewis County, the Yakama Indian Nation and various non-governmental organizations (NGOs) prescribes additional measures for the Tacoma Power Cowlitz Hydro Project (Barrier, Mayfield and Mossyrock Dams and associated reservoirs). Required restoration activities include augmentation of spawning gravel large woody debris and restoration of sensitive habitat in the lower Cowlitz Basin. [M.7A; M.7B; M.8A; M.8C; M.9A; M.9B; M.12A]

State Restoration Programs

- ***Washington 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.4B; M.5A; M.5B; M.8A; M.8C]

  - 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.4B; M.5A; M.5B; M.8A; M.8C]
    - ✓ 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.4B; M.5A; M.5B; M.8A; M.8C]

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

  - Habitat Program: The Department provides advice to local governments and landowners interested in measures to restoring watershed processes and stream habitat. [M.1A; M.2A; M.2B; M.2C; M.4D; M.5C; M.5D; M.7A; M.7B; M.8A; M.8B; M.8C; M.9A; M.9B; M.10A; M.11A; M.11B; M.11C; M.12A; M.12B]

- ***Washington Department of Ecology***

  - Water Quality Program:
    The Cowlitz is listed as temperature impaired on the WA State 303(d) list. It is also listed for arsenic however Ecology is in the process of de-listing this impairment. [M.5D; M.8A; M.8B; M.8C]

  - Water Resources Program/Watershed Planning:
    The planning process for WRIA 26 is dealing with water quantity and quality, stream flows and fish habitat. Potential restoration efforts address improving summer low flows through conservation and acquisition of water rights. Once approved by counties within the WRIA, the plan will be binding on state agencies and local governments. [M.6A; M.6B; M.6C; M.6D; M.7A; M.7B; M.8A; M.8B; M.8C; M.11A]

- ***Washington Department of Transportation***

  - Barrier Removal Program:
    WSDOT is working to improve blockages associated with I-5. [M.5D; M.8C; M.10A]

  - 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. [M.5C; M.8C]

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

  - Washington Salmon Recovery Act (RCW 77.85): As noted under preservation programs above, the SRFB and the LCFRB jointly administer a grant program that allocates federal Pacific Salmon Recovery Funds and State funds for habitat protection and restoration projects by state and local agencies, nonprofit organizations, and landowners. To date the SFRB has provided close to $900,000 for county barrier replacements and restoration efforts in this basin. [M.1A; M.2A; M.2B; M.3A; M.8A; M.9A; M.9B; M.10A]

- ***Conservation Commission/ Lewis Conservation District/Cowlitz Conservation District:*** The Conservation District provides technical assistance (e.g., farm plans) and incentives (e.g., Conservation Reserve and Enhancement Program) to encourage agricultural landowners to restore riparian areas and stream habitat. Both Conservation Districts have undertaken restoration projects in the lower Cowlitz Basin. M.3A; M.3C; M.4C; M.8A; M.8B; M.8C; M.9A; M.9B; M.10A]

Local Government Restoration Programs

- ***Cowlitz County***
  - Public Works Program:

The County inventoried culverts on county roads and is replacing and/or upgrading barrier culverts. Baxter Creek Fish Passage is an example of a culvert replacement project in the lower Cowlitz Basin. [M.10A]

- Cowlitz 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

➢ ***Lewis County***

- Public Works Program: The County inventoried culverts on county roads and is replacing and/or upgrading barrier culverts. Skook Creek is an example of a culvert replacement project in the lower Cowlitz Basin; [M.10A]
- Lewis County Noxious Weed Control Board: The Board has three primary programs that address weed control in the upper Cowlitz Basin; [M.3D]
  - ✓ Public education to prevent the spread of noxious weeds;
  - ✓ Survey of the County to assess emerging issues; and
  - ✓ Enforcement of noxious weed control

Gap Analysis

***Forest-related Programs*:** Given that 80 percent of lower Cowlitz Basin is forest land, the state forest practices rules and the Department of Natural Resources HCP play a substantial role in protecting and restoring watershed functions and habitat conditions at levels supporting recovery goals. 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.

Protection-related Programs: Non-federal lands in the lower Cowlitz Basin have limited protections through the land use regulatory mechanisms Cowlitz and Lewis Counties. Cowlitz County programs lack effective provisions that commonly are used to direct growth away from sensitive habitat, preserve watershed processes, protect streams and wetlands, and manage stormwater. Lewis County land use regulations afford a slightly higher level of protection, but do not have measures tailored to protect watershed process and habitat conditions critical to recovery of salmon and steelhead. In addition, as in all lower Columbia subbasins, there are very limited protection mechanisms to ensure that agricultural practices protect riparian areas and hydrologic functions.

Restoration-related Programs: Over a long period of time, improvements to the lower Cowlitz Basin will occur as a result of improved forest management practices that are already in place. Active restoration in the lower mainstem should focus on floodplain function and channel migration, as well as restoring off-channel and side-channel habitats. Programs to address these issues are currently not in place. Improved restoration mechanisms habitat and watershed conditions adversely affected by agricultural practices throughout the lower Cowlitz Basin are needed. Relative to the hydroelectric facilities, upstream and downstream passage for coho, steelhead, and spring chinook is needed to allow to access high-quality habitats upstream of the

reservoirs. Recovery of Spring Chinook, in particular, hinges upon success of the Tacoma Public Utilities and Lewis PUD passage program. Actions to address downstream impacts of the hydro-electric facilities are also important to salmon and steelhead recovery efforts. These include: monitoring and augmentation of gravel, where and when necessary; Augmentation of LWD; and assurance of flow regimes needed for downstream spawning and rearing.

Table 6-9. Program Actions to Address Gaps

Action #	Lead Agency	Proposed Action
L-COW.1	Cowlitz County, Lewis County, Vader, Toledo, Winlock, Longview, Kelso	Develop and implement controls to adequately protect riparian areas to maintain currently functional and restored habitat around rivers, estuaries, streams, lakes, deepwater habitats, and intermittent streams. Require mitigation, where necessary, to offset unavoidable damage to habitat conditions in riparian management areas
L-COW.2	Cowlitz County	Develop and implement stormwater discharge controls to protect water quality and quantity and reduce localized stream flow impacts detrimental to fish —including peak and base flows
L-COW.3	Cowlitz County, Vader, Toledo, Winlock, Longview, Kelso	Development and implement controls to protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
L-COW.4	Cowlitz County, Lewis County, Vader, Toledo, Winlock, Longview, Kelso	Development and implement controls and development standards to adequately protect wetlands, wetland buffers, and wetland function.
L-COW.5	Cowlitz County, Lewis County, Vader, Toledo, Winlock, Longview, Kelso	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
L-COW.6	Cowlitz County, Lewis County, Vader, Toledo, Winlock	Apply land use and resource protection code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
L-COW.7	FEMA	Update floodplain maps using Best Available Science
L-COW.8	State of Washington	Provide state funding for small forest owners in the lower Cowlitz 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
L-COW.9	Forest Managers LCFRB, and DFW	Identify and sequence 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
L-COW.10	LCFRB, WDNR. WSDOT, Counties, cities, private property owners.	Develop and implement a coordinated and strategic barrier removal program based on watershed fish priorities and ensuring an effective and efficient sequencing of barrier removal work.
L-COW.11	Cowlitz County, Lewis County	Utilize a combination of public outreach/education and, incentives, and to promote (1) stewardship practices for protecting habitat and water quality and (2) landowner support of and participation in habitat restoration efforts.
L-COW.12	State of	Close the lower Cowlitz Basin to further surface water withdrawals,

	Washington (DOE, DFW)	including groundwater in connectivity with surface waters; curtail unauthorized withdrawals
L-COW.13	LCFRB, WDFW, Cowlitz County, Lewis County, Cowlitz CD, LCFEG	Build capacity (e.g. technical and administrative skills, personnel and fiscal resources) needed to allow agencies and organizations to undertake protection and restoration projects, including noxious weed control in a reasonable period time.
L-COW.14	SRFB, BPA, NOAA, USFWS, DOE, ACOE	Increase available funding for projects that implement measures and address underlying threats
L-COW.15	State of Washington (Dept of Agriculture, and Department of Ecology)	Develop and implement agricultural practices and regulations to protect riparian conditions and water quality
L-COW.16	Cowlitz/Lewis Conservation District	Expand landowner incentive (e.g. CREP) and education plans to promote further habitat protection and restoration.
L-COW.17	LCFRB, Cowlitz CD, Cowlitz County, Lewis County	Address threats proactively by building agreement on priorities among the various program implementers
L-COW.18	Tacoma Public Utilities, Lewis PUD	Increase fish and wildlife habitat mitigation measures (upstream and downstream) commensurate with recovery goals for populations affected by hydrosystem impacts