16 Lower Columbia Mainstem Subbasin – Bonneville Tributaries

Figure 16-1. Location of the Bonneville Tributaries Basin within the Lower Columbia River Basin.

16.1 Basin Overview

Streams in the Bonneville Tributaries Basin originate on the steep valley walls of the Columbia River Gorge and flow south through Columbia River floodplain terraces before entering the Columbia River. Most of the streams are high gradient and spawning habitat is only available in the lowest reaches. Hamilton Creek has the largest channel length at over 8 miles.

The Bonneville Tributaries 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 lamprey and coastal cutthroat trout – these species are also expected to benefit from salmon protection and restoration measures.

Bonneville tributaries 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 Bonneville tributary fish. Key ecological interactions of concern include effects of non-native 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 Bonneville Tributary Subbasin.

The Bonneville Tributary watersheds are mostly forested, with a higher degree of residential and agricultural development in the western portion, especially near the town of Washougal. The eastern portion of the basin lies within the Columbia River Gorge National Scenic Area, where land use and development is limited; however, rural residential and industrial uses are located along the Columbia on the lower reaches of some streams.

All species, but particularly chum, are impacted by riparian and floodplain impacts to the lower reaches of these tributaries just prior to their confluence with the Columbia River. Of particular concern are dikes and transportation corridor crossings that prevent the streams' access to floodplains and disrupt natural sediment transport processes. Lower Hamilton Creek, which is affected by development in North Bonneville and by the Highway 14 and railroad crossing, has some of the most productive existing habitat as well as good potential benefit from restoration.

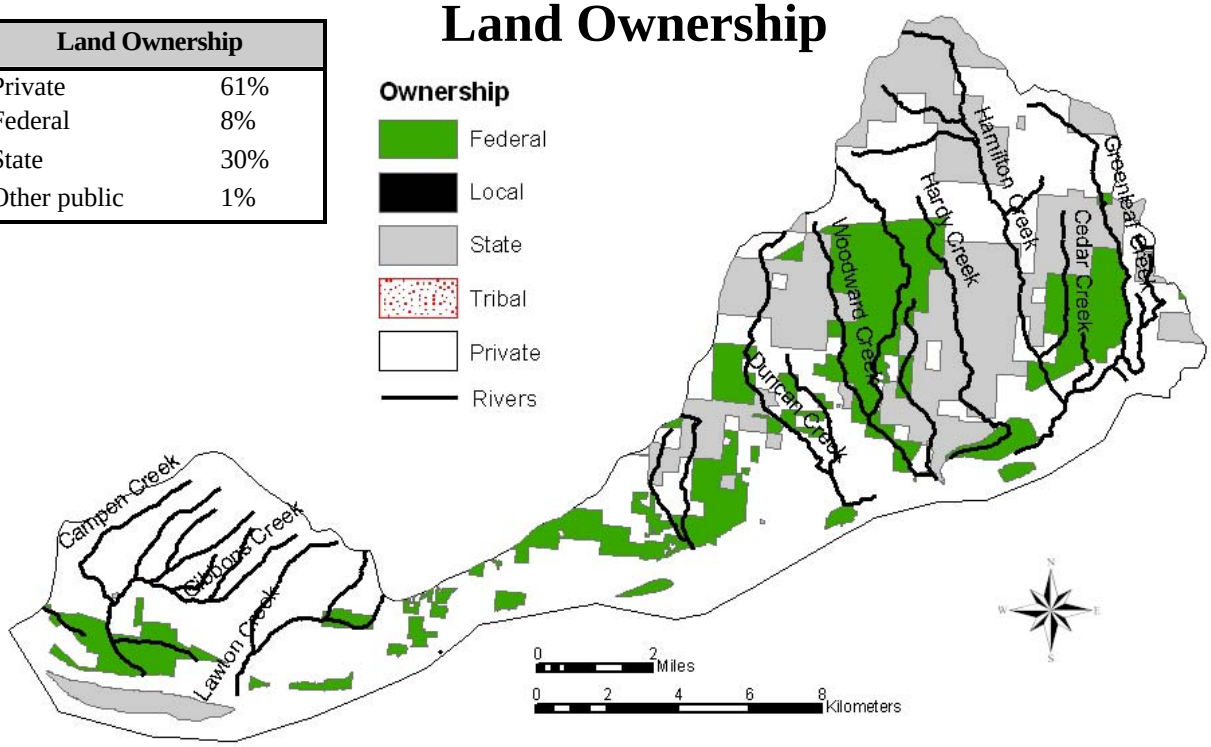
Upper Hamilton Creek is a key area for winter steelhead production. The relatively healthy conditions in this basin should at the least be maintained and ideally improved. This basin currently has a high percentage of forest in mid-seral (64%) and early-seral (10%) stages, indicating the potential for improved conditions if these forests can be protected from future intense timber harvest and road building.

Lower Gibbons Creek also has restoration potential where an artificial channel now courses through the Steigerwald National Wildlife Refuge. Reconnecting off-channel habitats in this reach would open up new habitats that could increase salmonid productivity.

There is a considerable amount of urban development in the western portion of this basin including the expanding suburban development around the town of Washougal. The only population center in the eastern portion of the basin is the town of North Bonneville, situated on the Columbia River just west of Bonneville Dam. The year 2000 population is estimated at approximately 7,000 persons, and is expected to increase to 10,500 by 2020. Most of this growth will occur in the western portion of the basin. Growth in the eastern portion of the basin is naturally limited by topography and legally limited by the Columbia Gorge National Scenic Area.

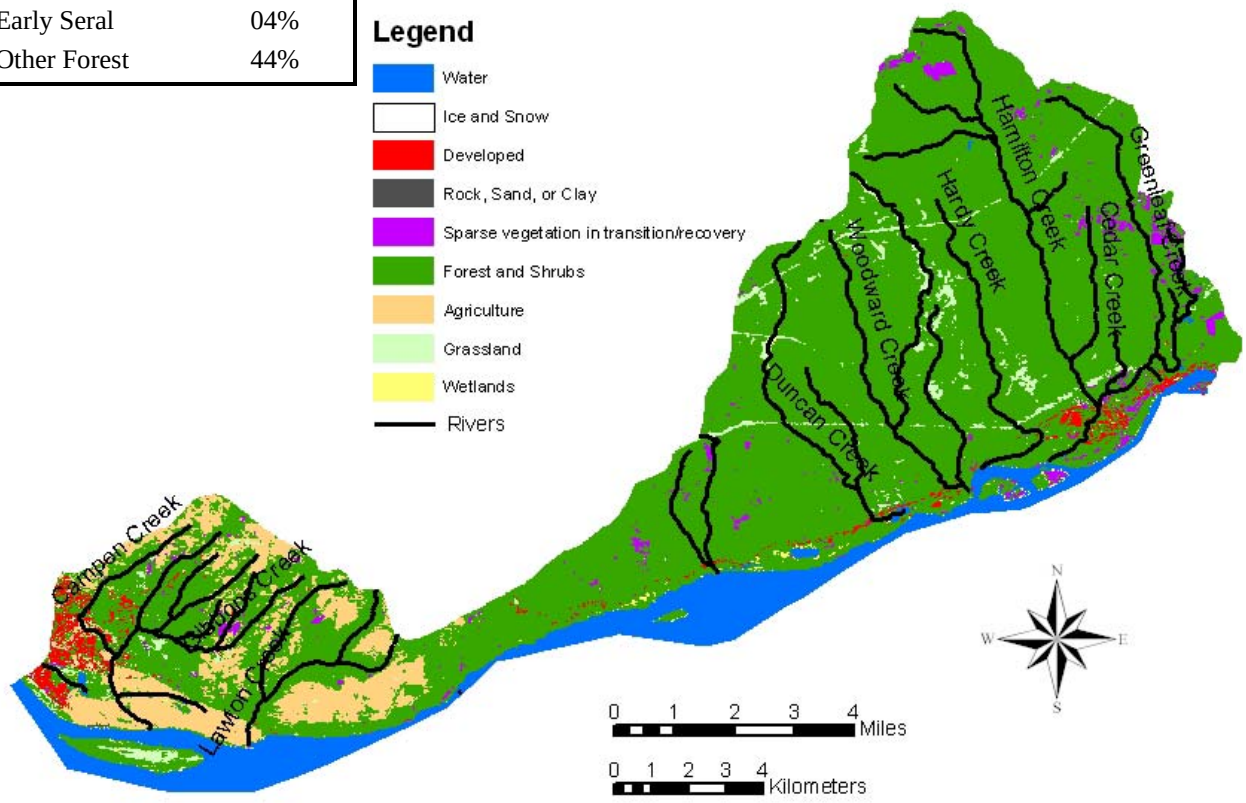
Land Ownership

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



Land Use / Cover

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



16.2 Species of Interest

Focal salmonid species in the Bonneville tributaries include fall Chinook, winter steelhead, chum, and coho. The health or viability of these populations is currently low, except for chum, which is above medium. 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 to a medium viability level, providing for a 75-95% chance of persistence over 100 years. Winter steelhead and coho recovery goals call for a high level of viability, providing a 95% probability of persistence over 100 years, and chum recovery goals are to exceed a high level of viability, calling for greater than 95% probability of persistence over 100 years.

Other species of interest in the Bonneville tributaries 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 expected to benefit from habitat improvements in the estuary, Columbia River, and mainstem, and in the Bonneville tributaries, although specific spawning and rearing habitat requirements for lamprey are not well known.

Table 16-1. Current viability status of Bonneville tributary populations and the biological objective status that is necessary to meet the recovery criteria for the Gorge strata and the lower Columbia ESU.

	ESA	Hatchery	Current		Objective	
Species	Status	Component	Viability	Numbers	Viability	Numbers
Fall Chinook	Threatened	No	Low	100	Med	1,400-2,800
Winter Steelhead	Threatened	No	Low+	200-300	High	200-300
Chum	Threatened	No	Med+	1,000-6,000	High+	2,600-3,100
Coho	Candidate	No	Low	<100	High	unknown

Fall Chinook– The historical Bonneville tributary adult population is estimated from 300-3,000 fish. The current natural spawning number in the tributaries is about 100 fish. However, there are significant numbers of upriver bright stock fall Chinook (not part of the lower Columbia ESU) that spawn in the mainstem Columbia near the Bonneville tributaries. Natural spawning occurs primarily in the lower reaches of Hamilton and Hardy creeks. Access in the early fall is dependent on mainstem Columbia and tributary flow conditions. Spawning time in the tributaries peaks in October. Juvenile rearing occurs near and downstream of the spawning areas. Juveniles migrate from the Bonneville tributaries in the spring and early summer of their first year.

Winter Steelhead– The historical Bonneville adult population is estimated from 600-4,000 fish. Current natural spawning returns are 200-300 fish. Spawning occurs primarily in the lower 2 miles of Hamilton Creek. 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 Bonneville tributaries.

Chum– The historical Bonneville tributary adult population is estimated from 9,000-40,000. Current natural spawning returns range from 1,000-6,000, including tributary and mainstem Columbia spawning. Spawning occurs in the lower 1.0 miles of Hardy and Hamilton creeks, Hamilton Slough, Duncan Creek, and in the mainstem Columbia near Ives and Pierce

islands. Spawning occurs from late November through December. Natural spawning chum in the Bonneville tributaries 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 Bonneville tributary adult population is estimated from 300-13,000, with both early and late stock coho produced. Current natural spawning returns are presumed to be 100 fish or less. There is no hatchery production in the Bonneville tributaries. Natural spawning can occur in Hamilton, Greenleaf, Hardy, Woodard, Duncan, Gibbons and Lawton creeks. Early coho spawning occurs from mid October to mid-November and late coho from mid-Novenber to March. Juvenile rearing occurs upstream and downstream of spawning areas. Juveniles rear for a full year in the Bonneville tributaries before migrating as yearlings in the spring.

Coastal cutthroat– Coastal cutthroat abundance in the Bonneville tributaries has not been quantified but the population is considered depressed. Anadromous and resident forms of cutthroat trout are present in the Bonneville tributaries. Anadromous cutthroat enter the Bonneville tributaries from July-December and spawn from December through June. Most juveniles rear 2-4 years before migrating from their natal stream.

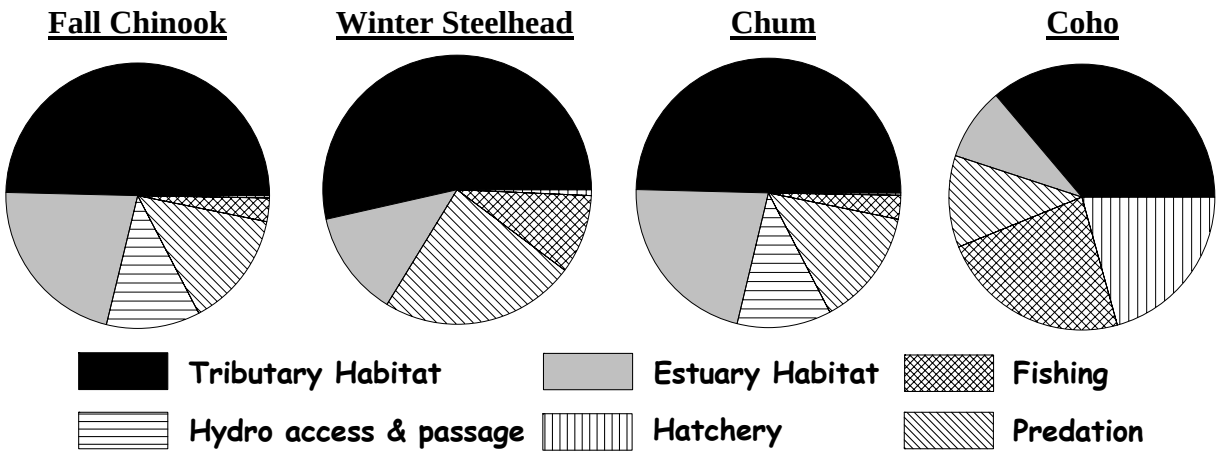
Pacific lamprey.– Information on lamprey abundance is limited and does not exist for the Bonneville tributary populations. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have declined in the Bonneville tributaries also. Adult lamprey return from the ocean to spawn in the spring and summer. Juveniles rear in freshwater up to 6 years before migrating to the ocean.

Figure 16-2. Summary of habitat limiting factors, population status, expected population improvement trend with existing programs, and biological objectives depicted for the Bonneville Tributaries Basin.

16.3 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 Bonneville Tributaries 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. Loss of estuary habitat quality and quantity is most important to chum of the four species.
- Harvest has moderate impacts on coho and winter steelhead, but is relatively low for chum and fall Chinook.
- Hatchery impacts are substantial for coho but are minimal for winter steelhead, chum, and fall Chinook.
- Predation impacts are moderate for winter steelhead, but are less important for the other three species.
- Hydrosystem access and passage impacts appear to be relatively important for chum and fall Chinook.



16-3. Relative contribution of potentially manageable impacts for Bonneville tributary populations.

16.4 Limiting Factors, Threats, and Measures

16.4.1 Hydropower Operation and Configuration

There are no hydro-electric dams in the Bonneville tributaries. However, Bonneville tributary species are affected by mainstem Columbia hydro operations and flow regimes which affect habitat in migration corridors and in the estuary. Mainstem hydro factors and threats are addressed by regional strategies and measures identified in Volume I.

16.4.2 Harvest

Most harvest of Bonneville tributary wild salmon and steelhead occurs 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. Bonneville tributary 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 commercial chum fisheries and retention of chum is prohibited in Columbia River and tributary sport fisheries. Some chum can be impacted incidental to fisheries directed at coho and winter steelhead. Harvest of Bonneville tributary coho occurs in the ocean commercial and recreational fisheries off the Washington and Oregon coasts and Columbia River. There are no salmon fisheries in the Bonneville tributaries. 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 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 the Bonneville tributary subbasin populations are summarized in the following table:

Table 16-2. Regional harvest measures from Volume I, Chapter 7 with significant application to the Bonneville tributary populations.

Measure	Description	Comments
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.

16.4.3 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 no hatcheries operating in the Bonneville tributaries. A chum enhancement program for Bonneville tributary and mainstem Columbia natural chum populations is implemented using the Washougal Hatchery facility. The program objectives include supplementation of chum in Duncan Creek as part of a rebuilding program and a risk reduction program for the mainstem Columbia, Hamilton and Hardy creek chum populations. There have been small numbers of hatchery winter steelhead planted into Hamilton Creek in the past, but there are no current releases. The main threats from hatchery released 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 steelhead.

Table 16-3. Bonneville tributary hatchery production.

Hatchery	Release Location	Chum
Washougal	Bonneville tributaries and Columbia	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 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 Bonneville Tributaries Subbasin are summarized in Table 7.

Table 16-4. Regional hatchery measures from Volume I, Chapter 7 with potential implementation actions in the Bonneville Subbasin.

Measure	Description	Comments
H.M 24, 26	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.

16.4.4 Ecological Interactions

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

16.4.5 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 Bonneville tributary 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 estuary and mainstem effects on Bonneville tributary 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.

16.4.6 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 Bonneville Tributaries 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 16-4. A summary of the primary habitat limiting factors and threats are presented in Table 16-6. Habitat measures and related information are presented in Table 16-7. Results of IWA watershed process modeling are depicted for subwatersheds in Figure 16-5. Reach- and subwatershed-scale limiting factors generated from the technical assessment are included in Table 16-5. 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 Bonneville Tributaries Basin include the following:

- Lower Hamilton Creek – Hamilton 1A, 2; Hamilton Springs
- Upper Hamilton and Greenleaf Creeks – Hamilton 4; Greenleaf 1-3
- Hardy and Duncan Creeks – Duncan 1-2; Duncan Springs; Lake Outlet; Hardy 2-3
- Gibbons & Lawton Creeks – no reach priorities specified

The following paragraphs provide a brief overview of each of these 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.

Lower Hamilton Creek contains potentially good spawning habitat but conditions have been impacted by development around the town of North Bonneville and by the Hwy 14 crossing. The artificially created Hamilton Springs spawning channel provides important chum spawning habitat. Effective recovery measures here will include riparian and floodplain restoration, in particular addressing channel confinement adjacent to N. Bonneville and associated with the Hwy 14 crossing. Addressing upstream sediment inputs will also help these reaches to recover.

Upper Hamilton and upper Greenleaf creeks contain good quality habitat for winter steelhead and coho. Above reach Hamilton 4, the gradient increases dramatically with several large falls that cannot be ascended. Reach Hamilton 4 currently supports a significant portion of the production for these populations. Preservation is the primary recovery emphasis for these areas, although restoration of sediment supply conditions will also provide important benefits.

Most of the good spawning habitat in Duncan Creek is located just above Duncan Lake. This area is most important for chum and coho although it is also used by fall Chinook and winter steelhead. Access to spawning areas in Duncan Creek has recently been improved by the construction of a dam that lowers lake levels during salmonid migration periods. Hardy reach 2 and 3 contain the greatest potential in Hardy Creek. Recovery measures in these areas will primarily involve floodplain and riparian restoration.

Gibbons and Lawton creeks were not evaluated using the EDT model and therefore specific reach and limiting factor priorities have not been developed for these streams. Although these streams do not support significant abundance of anadromous salmonids, they nevertheless contain some potentially productive habitat that is in need of restoration and preservation. These streams are threatened primarily by expanding development from the town of Washougal. Effective recovery measures will entail floodplain reconnection, riparian reforestation, and land-use planning that is adequate to protect habitat-forming processes in sensitive areas (i.e., wetlands, riparian areas, floodplains).

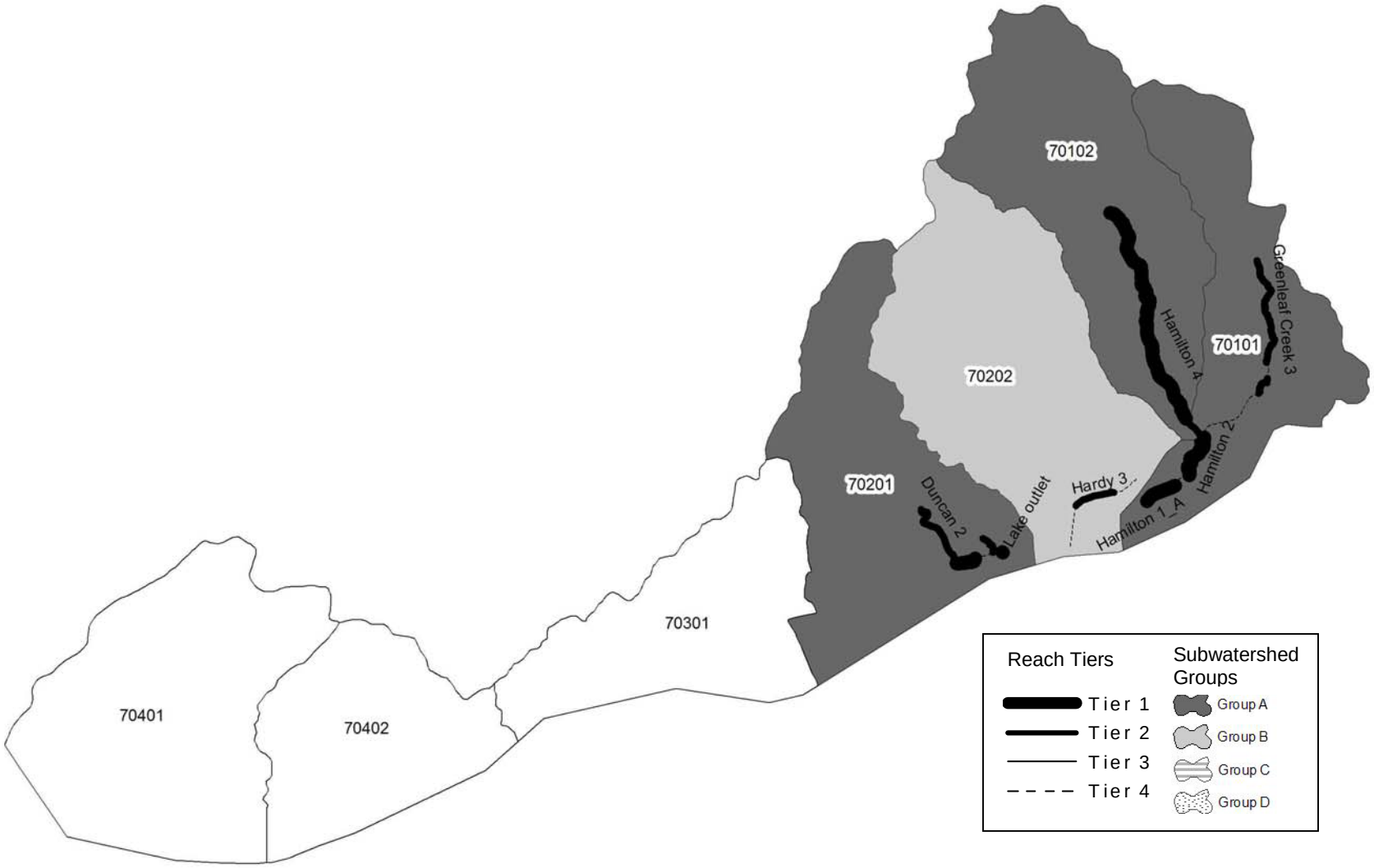


Figure 16-4. Reach tiers and subwatershed groups in the Bonneville Tributaries Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities 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.

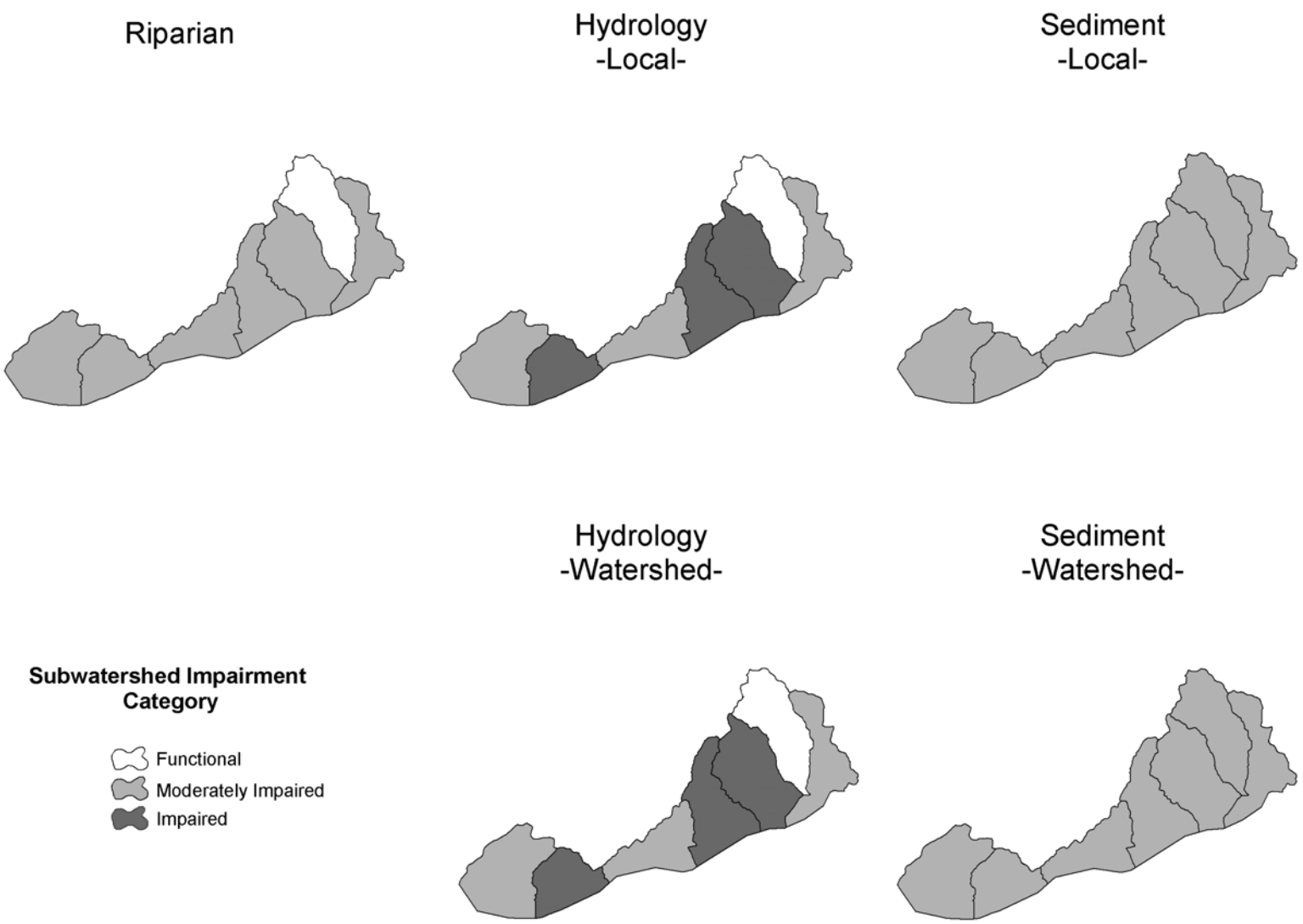


Figure 16-5. IWA subwatershed impairment ratings by category for the Bonneville Tributaries Basin. Watershed process impairment ratings are based on landscape conditions that influence the hydrologic regime, the sediment regime, and riparian function. See Volume II and Volume V of the Recovery Plan Technical Foundation for additional information.

Table 16-5. 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	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	70101	Hamilton 2 Hamilton 1_A Greenleaf Creek 1	ChF	Hamilton 1_A	Spawning Egg incubation Adult holding	temperature sediment key habitat quantity	PR	M	M	M	M	M
		Greenleaf Creek 3 Hamilton 3 Hamilton 1_B Greenleaf Creek 2	Chum	Hamilton 2 Hamilton 1_A	Spawning Egg incubation Fry colonization Adult holding	habitat diversity harassment key habitat quantity	P					
		Greenleaf outlet	StW	none								
		Greenleaf Slough	Coho	Hamilton 2	Egg incubation Fry colonization Summer rearing	habitat diversity temperature flow sediment key habitat quantity	R					
	70201	Lake outlet	ChF	none				I	M	M	I	M
		Duncan 1 Duncan 2	Chum	Lake outlet	Fry colonization Adult migrant	none	P					
		Duncan Springs	StW	none								
		Duncan Lake Duncan Dam	Coho	Duncan 1	Egg incubation Summer rearing Winter rearing	sediment	R					
	70102	Hamilton 4	StW	Hamilton 4	Spawning Egg incubation Fry colonization Adult holding	sediment key habitat quantity	P	F	M	F	F	M
			Coho	none								
B	70202	Hardy 2	Chum	none				I	M	M	I	M
		Hardy 3	StW	none								
		Hardy 1 Slough Hardy 4 Hardy 5	Coho	none								

Table 16-6. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower Hamilton Creek (LH), upper Hamilton & Greenleaf Creek (UH), Duncan & Hardy Creeks (DU), and Gibbons & Lawton Creek (GI). Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors	LH	UH	DU	GI
Habitat connectivity				
Blockages to off-channel habitats	✓		✓	✓
Habitat diversity				
Lack of stable instream woody debris	✓	✓	✓	✓
Altered habitat unit composition	✓	✓	✓	✓
Loss of off-channel and/or side-channels	✓	✓	✓	✓
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, or rate of chng	✓		✓	✓
Water quality				
Altered stream temperature regime	✓	✓	✓	✓
Bacteria				✓
Substrate and sediment				
Excessive fine sediment	✓	✓	✓	✓
Embedded substrates	✓	✓	✓	✓

Threats	LH	UH	DU	GI
Agriculture/grazing				
Clearing of vegetation				✓
Riparian grazing				✓
Floodplain filling				✓
Urban & 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	✓		✓	
Channel manipulations				
Bank hardening	✓			✓
Channel straightening	✓	✓	✓	✓
Artificial confinement	✓	✓	✓	✓
Dredge and fill activities	✓	✓		

Table 16-7. 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.

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 Hamilton Hamilton 1A-2 ***Upper Hamilton*** Hamilton 4 (lower portion) ***Hardy & Duncan*** Hardy 2-3; Duncan 1 ***Gibbons & Lawton*** Lower Gibbons; lower Lawton	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes • Channel incision	• Floodplain filling • Channel straightening • Artificial confinement	• All species	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 Hamilton Hamilton 1A-2 ***Upper Hamilton*** Hamilton 4 (lower portion) ***Hardy & Duncan*** Hardy 2-3; Duncan 1 ***Gibbons & Lawton*** Lower Gibbons; lower Lawton	• Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats • Altered habitat unit composition	• Floodplain filling • Channel straightening • Artificial confinement	• 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 private lands, existing infrastructure already in place, potential flood risk to property, and large expense.
3. Protect and restore riparian function ***A. Reforest riparian zones*** ***B. Allow for the passive restoration of riparian vegetation***					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
C. Livestock exclusion fencing ***D. Invasive species eradication*** ***E. Hardwood-to-conifer conversion***					
Lower Hamilton Hamilton 1A-2 ***Upper Hamilton*** Hamilton 4 ***Hardy & Duncan*** Hardy 2-3; Duncan 1-2 ***Gibbons & Lawton*** Gibbons, Lawton, and Campen creeks	• 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	• Riparian grazing • Clearing of vegetation due to 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 ***A. Address forest road impacts*** ***B. Address timber harvest impacts***					

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
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 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.
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 Bonneville Tributaries basin have been identified as part of Watershed Planning for WRIA 28 (LCFRB 2004).
7. Protect and restore water quality ***A. Restore the natural stream temperature regime*** ***B. Reduce fecal coliform bacteria levels***					
Entire basin	• Altered stream temperature regime • Bacteria	• 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.
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 Hamilton	• Lack of stable instream	• None (symptom-	• Coho	2-10 years	Moderate potential benefit due to the high

Location	Limiting Factors Addressed	Threats Addressed	Target Species	Time	Discussion
Hamilton 1A-2 ***Upper Hamilton*** Hamilton 4 ***Hardy & Duncan*** Hardy 2-3; Duncan 1-2 ***Gibbons & Lawton*** Gibbons, Lawton, and Campen creeks	woody debris • Altered habitat unit composition	focused restoration strategy)	• Qinter steelhead		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.
9. 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 western portion of the basin is developing rapidly. The eastern portion is protected in large part by the Columbia Gorge National Scenic Area. 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.
10. 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.

16.5 Program Gap Analysis

The Bonneville Tributaries Basin (~100 sq mi) is located in Clark and Skamania Counties and the Columbia River Gorge National Scenic Area. The Bonneville Tributaries Basin streams originate on the steep valley walls of the Columbia River Gorge and flow south through Columbia River floodplain terraces before entering the Columbia River. The major streams, from west to east, are Gibbons, Lawton, Duncan, Woodward, Hardy, and Hamilton Creeks. Hamilton Creek has the largest channel length at over 8 miles.

- Columbia River Gorge National Scenic Area lands are estimated at 15 square miles.
- Department of Natural Resources timber lands are estimated at 12 square miles.
- Beacon Rock State Park encompasses an estimated 8 square miles.
- Industrial forest lands are estimated at 8 square miles.
- Small commercial forest land acreage is estimated to be 2 square miles.
- Overall the Bonneville tributaries subbasin is lightly populated. The highest population concentration is found in the Gibbons and Lawton watersheds, the closest to the Camas/Washougal area.

Protection Programs

Protection programs in this analysis include programs that protect habitat conditions or watershed functions through management policies and programs, regulatory measures, incentives, and acquisition of sensitive habitat or protective easements. Major programs implementing protection measures are identified below.

Federal Programs

- ***U.S. Forest Service-Columbia Gorge Commission – Columbia River Gorge National Scenic Area***

  - The purpose of the National Scenic Area Act is to protect and provide for the enhancement of the scenic, cultural, recreational and natural resources of the Gorge; and to protect and support the economy of the Columbia River Gorge area by encouraging growth to occur in existing urban areas and by allowing future economic development. All proposed development and land use changes are reviewed to determine if they are consistent with the Act and the implementing land-use ordinances. The Act authorized the Forest Service to acquire and exchange lands in the Special Management Area to achieve the purposes of the Act if the owners wish to sell or exchange their lands; [M.9A; M.9B; M.9C; M.10A]

- ***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 fish. [M.1A; M.2A; M.2B; M.4D; M.8A; M.8B]

➢ ***U.S. Fish and Wildlife Service***

- The USFWS manages three refuges in the Bonneville Tributaries Subbasin. These are the Steigerwald, Franz Lake, and Pierce. These refuges encompass wetlands and floodplain areas near the Columbia River. Two Bonneville tributaries flow through these refuge areas: Gibbons Creek and Hardy Creek. Gibbons Creek is largely contained within an artificial channel and water control structures in the Stiegerwald Refuge. USFWS is working with the Corps of Engineers to develop restoration options. Riparian habitat and channel conditions for Hardy are well protected within the Pierce Refuge. [M.1A; M.2A; M.2B; M.2C; M.3A; M.7A]

State Programs

➢ ***Department of Natural Resources***

- State Forest Land Habitat Conservation Plan (HCP):
  State forest lands are managed under the provisions of a HCP. The HCP 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; M.7A]
- State Forest Practice Rules:
  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 to manage sedimentation, runoff, and slope failure. [M.3A; M.3B; M.4A; M.4B; M.5A; M.5B; M.7A]

➢ ***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.3A; M.7A; 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.3A; M.4C; M.5C; M.5D; M.6A; M.6B; M.6C; M.6D; M.7A; M.7B; M.8A; M.8B; M.9A; M.9B; M.9C; M.9D]

➢ ***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 Coweeman Basin to 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. [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) 28 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.6E; M.7A; M.7B; M.9A]

➢ ***Washington Parks and Recreation Commission – Beacon Rock State Park:*** Beacon Rock State Park encompasses nearly all the Hardy Creek watershed above the USFWS Pierce Refuge. Watershed conditions and habitat conditions receive a high level of protection within the park. [M.3A; M.3B; M.3D; M.5C; M.7A; M.7B]

Local Government Protection 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.

- Land Use: [M.9A; M.9B; M.9C]
  - 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 includes special provisions implementing the stringent environmental and land use standards of the Columbia Gorge National Scenic Area. A Habitat Conservation Ordinance provides stream buffers and measures for the protection of important habitat, including ESA listed salmonids.

- 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.

➢ ***Skamania County***

- Land Use: [M.9A; M.9B; M.9C]

Skamania County has adopted special land use and environmental regulations implementing the Columbia River Gorge National Scenic Area Act. These measures provide a high level of protection to watershed processes and stream habitat in the Bonneville Tributaries Subbasin.

Community Plans

No active programs.

Restoration Programs

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

Federal Programs

- ***U.S. Forest Service Columbia River Gorge National Scenic Area***
  The USFS conducts stream and habitat restoration projects within the National Scenic Area. [M.9A; M.9B; M.9C; M.10A]

- ***U.S. Fish and Wildlife Service***
  The USFWS has conducted chum spawning improvements on Hardy Creek and is working with the Corps of Engineers to make channel improvements to Gibbons Creek. [M.2C]

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.4B; M.5A; M.5B; M.7A]

  - 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.7A]
    - ✓ 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.7A].

- ***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.3A; M.4C; M.5C; M.5D; M.6A; M.6B; M.6C; M.6D; M.7A; M.7B; M.8A; M.8B; M.9A; M.9B; M.9C; M.9D]

- ***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.

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

  - Washington Salmon Recovery Act (RCW 77.85): 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 SRFB has awarded over $375,000 in grants for restoration activities including the replacement of the Duncan Creek Dam and off channel chum rearing habitat restoration. [M.1A; M.2A; M.2B; M.3A; M.7A; M.7B; M.8A; M.8B; M.10A; M.10B]

Local Government Programs

- ***Clark and Skamania County Noxious Weed Control Boards*** has three primary programs that address weed control in the Bonneville Tributaries 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

Both Boards are focusing on the control of highly invasive Japanese Knotweed in riparian areas.

Community Restoration Programs

- ***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. The group is pursuing restoration projects in the Bonneville Tributaries Subbasin. [M.1A; M.2A; M.2B; M.3A; M.4B; M.8A; M.8B]

- ***Skamania Landing Homeowners Association*** has volunteered time and resources to enhancing the Duncan Creek area including the replacement of the Duncan Creek Dam and the development of several off channel chum rearing sites. [M.2C]

Gap Analysis

Forest-related Programs: In the Bonneville Tributaries Basin, forestry programs play an important 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 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: Watershed process and habitat conditions in the Bonneville Tributaries Basin are well protected through Clark and Skamania Counties' land use controls and the Columbia River Gorge National Scenic Area Act.

Restoration-related Programs: Forest related improvements to the Bonneville Tributaries Basin will accrue over time as a result of improved forest management practices that are already in place. Although several significant projects have occurred (Duncan Creek Access) in the Bonneville Tributaries Basin, there are few agencies and organizations actively working to restore impaired habitat. For example, the Clark and Underwood Conservation Districts are not active in this Basin. Efforts to generate interest and build the capacity of organizations in the Bonneville Tributaries Basin are critical. Significant transportation-related issues in the lower mainstems of the Bonneville Tributaries (e.g., Hamilton Creek) are outstanding restoration needs.

Table 16-8. Program Actions to Address Gaps

Action #	Lead Agency	Proposed Action
BONTRIB.1	Skamania County, N. Bonneville	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
BONTRIB.2	Skamania County; N. Bonneville	Development and implement controls to protect historic stream meander patterns and channel migration zones and avoid hardening stream banks and shorelines
BONTRIB.3	Skamania County, N. Bonneville	Development and implement controls and development standards to adequately protect wetlands, wetland buffers, and wetland function.
BONTRIB.4	Clark County, Skamania County, N. Bonneville	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
BONTRIB.5	Clark County, Skamania County, N. Bonneville	Apply land use and resource protection code enforcement across jurisdictions in a consistent manner, using appropriate funding levels and application
BONTRIB.6	LCFRB, WDNR. WSDOT, Counties, 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.
BONTRIB.7	Clark County, Skamania County, N. Bonneville	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.
BONTRIB.8	State of Washington (DOE, DFW)	Close the Bonneville Tributaries Basin to further surface water withdrawals, including groundwater in connectivity with surface waters; curtail unauthorized withdrawals
BONTRIB.9	LCFRB, WDFW, Clark County, Skamania County, Clark CD, Underwood 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.
BONTRIB.10	SRFB, BPA, NOAA, USFWS, DOE, ACOE	Increase available funding for projects that implement measures and address underlying threats
BONTRIB.11	Clark CD	Expand landowner incentive (e.g. CREP) and education plans to promote further habitat protection and restoration.
BONTRIB.12	LCFRB, Clark CD, Clark County, Skamania County	Address threats proactively by building agreement on priorities among the various program implementers
BONTRIB.13	FEMA	Update floodplain maps using Best Available Science