Appendix A
Regional Summaries

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INTRODUCTION

The geographic area of the proposed action and alternatives stretches across the entire State of Washington and includes all non-Federal and non-Tribal forestlands of the State (see Figure 3-1 in Chapter 3). These are the covered lands or the lands subject to State Forest Practices Rules.

The State has been divided into 12 analysis regions (see Figure 3-1 in Chapter 3), which are used in Chapters 3 and 4 of this EIS to help describe the affected environment and environmental effects of the proposed action and alternatives. The regions were defined based on three factors: the distribution of threatened and endangered salmonids, Water Resource Inventory Area (WRIA) boundaries, and physiographic regions. The 12 analysis regions consist of 7 western Washington regions and 5 in eastern Washington as follows:

Western Washington Analysis Regions

- North Puget Sound
- South Puget Sound
- West Puget Sound
- Islands
- Olympic Coast
- Southwest
- Lower Columbia

Eastern Washington Analysis Regions

- Middle Columbia
- Upper Columbia – Downstream of Grand Coulee Dam
- Upper Columbia – Upstream of Grand Coulee Dam
- Snake River
- Columbia Basin

Detailed summary descriptions were written for each of the 12 regions, providing baseline information for each area. The summaries include detailed descriptions of land ownership and use, as well as physical and biological factors that were developed for each of the analysis regions containing a substantial area of covered lands.

Each Regional Summary includes seven sections: physical description, landownership and use, forestland ownership and management, habitat limiting factors, habitat trends, fish resources, and amphibians. Each of these sections is described below along with the sources of information used in each one. The Regional Summaries were developed by a number of individuals representing the Washington Department of Natural Resources, Washington Department of Fish and Wildlife, and Tetra Tech FW, Inc.

1.0 Physical Description

The physical description section describes the location, geology, and hydrology of the region. Geology information was obtained from *The Geology of Washington* (Lasmanis 1991) and Washington DNR watershed analyses. Hydrology information was obtained from the Washington State Conservation Commission Habitat limiting Factors and Reconnaissance Reports and *The Geology of Washington* (Lasmanis 1991).

2.0 Landownership and Use

The land ownership and use section contains tables showing land ownership parameters (Federal, State, etc.) by WRIA and land cover and use (forestland, shrubland, etc.) for each region. The source for the data in the tables includes: the United States Geological Survey /U.S. Environmental Protection Act (EPA) National Land Cover Data GIS layer, Washington DNR Major Public Lands GIS layer, and Forest Service Northwest Forest Plan GIS layer.

3.0 Forestland Ownership and Management

The forestland ownership and management section provides percentages of forestland ownership types including a percent of forestlands owned by small 20-acre exempt forest landowners. The section contains two tables, one including ownership and management of forestlands, and another including stream miles in each region by ownership category. The information for this section came from DNR major Public Lands, Forest Service Northwest Forest Plan, United States Geological Survey/EPA National Land Cover Data, and Washington DNR stream hydrography GIS layers

4.0 Habitat Limiting Factors

Section 4.0 (Habitat Limiting Factors) was primarily written by Washington Department of Fish and Wildlife biologists and discusses habitat limiting factors for salmon and trout, as well as for amphibians where relevant. The primary limiting factors are described for the region as a whole, and by major watershed or WRIA where data are available. Habitat limiting factors are specifically described for: (1) sedimentation and mass wasting, (2) riparian, floodplain and wetland conditions, (3) channel and hydrology conditions, (4) estuarine and nearshore habitat, (5) large woody debris, (6) fish passage, and (7) water quality issues. Information provided on limiting factors pertains not only to forest practices, but also includes other regional landscape conditions and uses (i.e., hydropower, agriculture, irrigation, development, and grazing). Major sources of information include, but are not limited to, Limiting Factors Analysis (Washington State Conservation Commission), Washington Department of Ecology's 303(d) lists, Watershed Analysis, Federal recovery plans, and subbasin planning documents.

5.0 Habitat Trends

Section 5.0 (Habitat Trends) was written by Washington Department of Fish and Wildlife biologists and presents trends in habitat changes based primarily on land use practices, with an emphasis on forest practices. As with Section 4.0, primary sources of information include, but are not limited to, Limiting Factors Analysis (Washington State Conservation Commission), Washington Department of Ecology's 303(d) lists, Watershed Analysis, Federal recovery plans, and subbasin planning documents.

6.0 Fish Resources

Section 6.0 (Fish Resources) was written by Washington Department of Fish and Wildlife biologists and describes the status and distribution of fish species. Fish distribution is provided for all fish species by WRIA. Federal and State status is provided for salmonid species, as well as other fish species. Sources of information include Washington Department of Fish and Wildlife fish distribution databases and SaSI, Wydoski and Whitney's Inland Fishes of Washington (2003), Limiting Factors Reports (Washington State Conservation Commission), and Federal Recovery Plans.

7.0 Amphibians

Section 7.0 (Amphibians) was written by Washington Department of Fish and Wildlife biologists and describes presence and status of any of the seven species of amphibians covered by the proposed HCP. This section also describes habitat limiting factors affecting these amphibian species. Sources of information include various scientific publications, as well as research and surveys conducted by professional biologists.

NORTH PUGET SOUND REGIONAL SUMMARY

NORTH PUGET SOUND REGIONAL SUMMARY

1.0 PHYSICAL DESCRIPTION

The North Puget Sound region includes five WRIAs (01, 03, 04, 05, and 07). Major stream systems include the Nooksack, Skagit, Sauk, Stillaguamish and Snohomish River Basins, as well as other smaller tributaries. Portions of Whatcom, Skagit, Snohomish and King Counties are contained within the North Puget Sound region. A map showing the WRIAs of the North Puget Sound region is provided in Figure 1.

The North Puget Sound region extends from the Puget Lowland physiographic province in the west to the Northern Cascades physiographic province in the east (Lasmanis 1991). Elevations range from sea level to over 10,000 feet atop Mount Baker.

General Geology

The North Puget Sound region is characterized by high mountains in the Cascade Range, wide alluvial river valleys draining east to Puget Sound, and high steep foothills between these river valleys. Geologically recent continental and alpine glaciations have left deep deposits of mineral sediment ranging from silt to rounded gravel, cobbles and boulders. The surface material in many of these foothills is composed of this poorly consolidated sediment, and the river valley substrate represents the alluvial sorting of this material. Geologically, contemporary eruptions from two volcanoes in the Cascade Range have deposited large volumes of mostly fine sediment in the Nooksack, Sauk and lower Skagit Rivers.

Information concerning erosion processes in the North Puget planning region has been extracted from the following watershed analyses: Skookum (Resource Investments Inc. 1993); Deer Creek (Collins et al. 1994); Hansen (WDNR 1995a); Jordan-Boulder (WDNR 1995b); Hazel (WDNR 1996a); Lake Whatcom (WDNR 1997a).

Mass wasting is the dominant erosion process in the North Puget region. Results of watershed analyses indicate debris avalanches, debris flows, and debris torrents are the most common landslide types. Debris avalanches comprised 72 percent of all landslides inventoried as part of the Jordan-Boulder watershed analysis (WRIA 05). In the Hansen watershed administrative unit (WAU) (WRIA 03), almost 95 percent of mapped landslides were classified as either debris avalanches or debris torrents.

Most debris avalanches initiate in convergent topography such as bedrock hollows and inner gorges. Debris avalanches are controlled primarily by hillslope gradient, soil or colluvium thickness, rooting strength, and soil saturation and are less influenced by rock lithology (Collins et al. 1994). In the Jordan-Boulder WAU, 62 percent and 27 percent of identified debris avalanches were associated with bedrock hollows and inner gorges, respectively. Because shallow landslides occur when soil moisture and streamflows are high and most originate from steep, near-channel slopes, a large majority deliver sediment to stream channels. In the Skookum WAU, 76 percent of landslides delivered sediment to streams while delivery was associated with 87 percent of debris avalanches in the Hansen WAU.

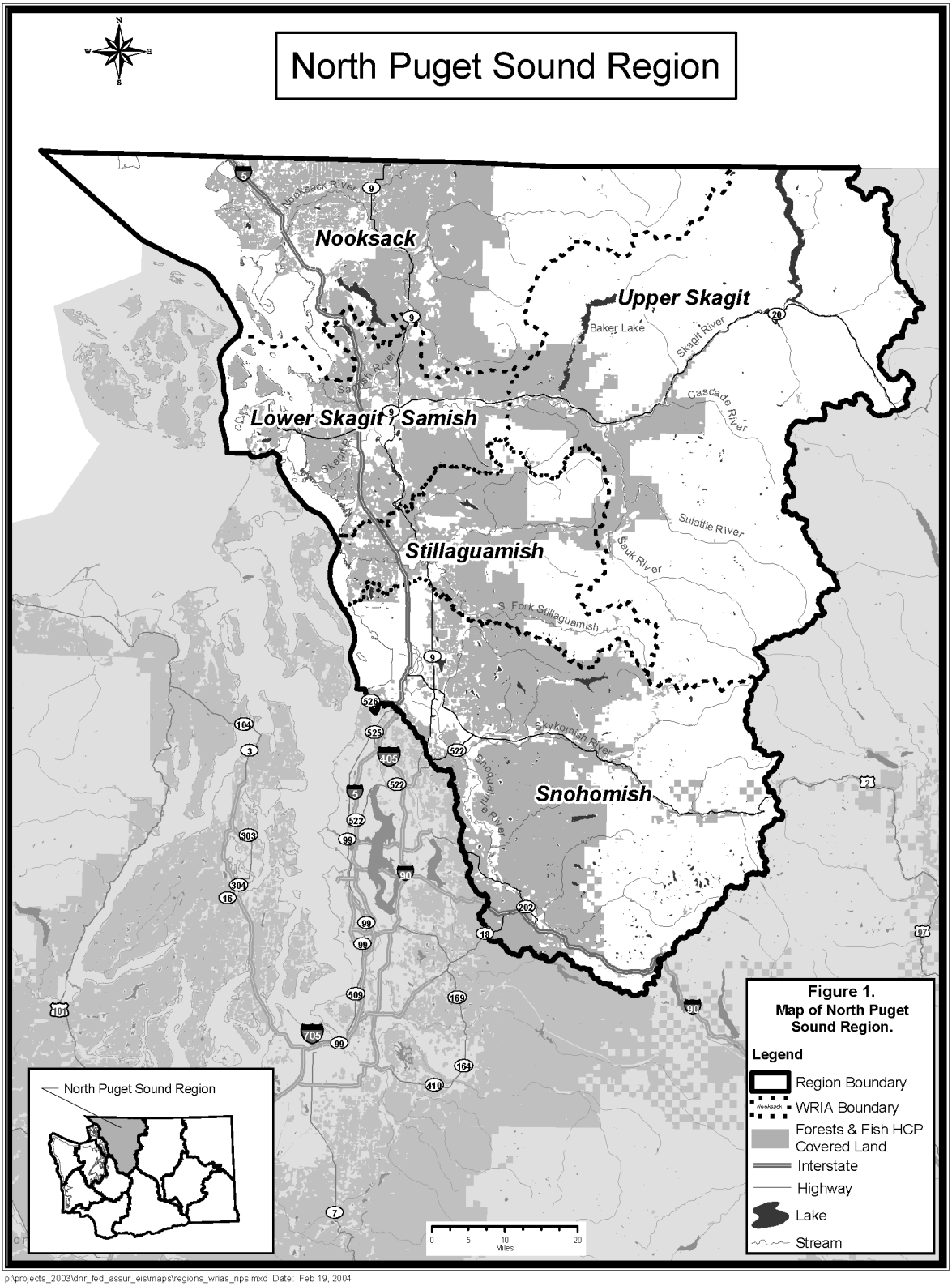

Figure 1.
Map of North Puget Sound Region.

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Due to the significant relief and prevalence of high-gradient, confined stream channels, debris torrents are a common occurrence in the region. The results of the Jordan-Boulder watershed analysis illustrate this point, where 41 percent of mapped debris avalanches formed debris torrents.

Thick glacial sediments blanket valley floors in almost all parts of the region. Rapid channel incision into these glacial fills during the early to mid-Holocene created a series of erosional terraces along all major drainages and many minor tributaries (Collins et al. 1994). Relief created by these terraces coupled with perched groundwater tables creates a favorable environment for deep-seated slumps and earthflows. Most deep-seated landslides in the region are associated with these glacial terraces. In the Deer Creek WAU, over 90 percent of mapped deep-seated slumps and earthflows were associated with glacial deposits. Watershed analyses conducted in the North Puget region generally indicate that deep-seated landslides comprise 10 percent or less of all mapped landslides.

Hillslope erosion assessments conducted in the Jordan-Boulder, Hansen, Lake Whatcom, and Hazel WAUs concluded that surface erosion was not a significant contributor to sediment delivery. In most cases, delivery was closely related to the level of soil disturbance and proximity to streams. The low frequency of hillslope delivery was attributed to limited soil disturbance in near-stream areas and rapid rates of natural revegetation following disturbance.

General Hydrology

The region has a marine climate characterized by mild, wet winters and cool, dry summers. Average annual precipitation ranges from 25 inches in the San Juan Islands, just west of the region, to over 100 inches along the western slopes of the Northern Cascades. Most of the precipitation falls as rain at lower elevations while snow is the dominant form of precipitation above 4,000 feet. The region receives more than 75 percent of its annual precipitation from October through March

The North Puget Sound region includes several major river basins (Figure 1). The Nooksack, Skagit, Stillaguamish, and Snohomish rivers have their headwaters in the North Cascades and flow west through the Puget Lowland province to Puget Sound. Peak flows generally occur during the fall and winter months and commonly result from rain or rain-on-snow precipitation events. Spring snowmelt produces smaller magnitude peak flows while low flows occur during late summer and early fall.). The Skagit River flows are regulated by major hydropower storage dams in the Upper Skagit Valley. Smaller dams are scattered elsewhere, but have relatively little effect on mainstem hydrology. Based on the DNR stream hydrography GIS coverage, there are approximately 28,653 stream-miles (both fish-bearing and non-fish streams) in the North Puget Sound region, with an average stream density of 4.17 stream miles/mile^2 (Table 1).

Table 1. Stream Miles in the North Puget Sound Region by WRIA[1/]

	WRIA 01 Nooksack	WRIA 03 Lower Skagit/Samish	WRIA 04 Upper Skagit	WRIA 05 Stillaguamish	WRIA 07 Snohomish	Total North Puget Sound
Stream Length (miles)	4,848	2,469	8,069	3,591	9,676	28,653
Stream Density (miles/mi^2)	3.82	4.27	3.30	5.09	5.17	4.17

[1/] Primary Data Source: DNR stream hydrography GIS layer. Stream miles include all mapped Type 1-9 streams.

2.0 LAND OWNERSHIP AND USE

Major Land Ownership and Management

Approximately 53 percent of all lands in the North Puget Sound region are in Federal ownership and the majority of these (representing 30 percent of all lands) are being managed for long-term preservation, primarily in national parks, national recreation areas, and wildernesses (Table 2). Another large portion of these Federal lands is being managed by the Forest Service outside of wilderness (22 percent of all lands); a substantial portion of these non-wilderness National Forest System lands is being managed under a very limited management status (e.g., Late Successional Reserves [LSA], Managed LSAs, Adaptive Management Areas [AMAs], or Riparian Reserves) according to the Northwest Forest Plan. The remainder of the Federal lands (<1 percent of all lands) are being managed by other agencies. Tribal lands represent about 1 percent of the region. State lands (primarily under management for timber production) represent 12 percent of all lands in the region, private lands represent 34 percent, and city/county lands represent 1 percent.

Generally the upper basins are in Federal ownership, the middle basins are in State and private ownership, and the lower basins are in private ownership. For example, only 2 percent of the WRIA 03, which consists of the Lower Skagit and the Samish watersheds, is in Federal ownership, but 87 percent of WRIA 04, which consists of the Upper Skagit watershed, is in Federal ownership.

Land Cover and Use

Forestland makes up approximately 78 percent of the North Puget Sound region (Table 3). Agricultural lands in the lower elevations make up about 7 percent of the region and ice, snow, and bare rock in the higher elevations make up about 6 percent. Approximately 5 percent of the region is mapped as shrubland or grassland, and the remaining 4 percent consists of water and wetlands and residential/commercial lands. The percent forestland within each WRIA ranges from a low of about 67 percent in WRIA 03 to a high of 89 percent in WRIA 05.

Table 2. Land Ownership Parameters for North Puget Sound Region by WRIA[1/]

Land Ownership	WRIA 01 Nooksack	WRIA 03 Lower Skagit/ Samish	WRIA 04 Upper Skagit	WRIA 05 Stillaguamish	WRIA 07 Snohomish	Total North Puget Sound
Federal – Long-term Congressionally Protected Lands [2/]	162,594	3	926,590	41,662	192,736	1,323,585
Federal – Other National Forest System Lands [3/]	108,380	7,865	441,572	130,317	292,387	980,522
Federal – Other Federal Lands [4/]	46	27	355	4,154	2,594	7,177
State – Protected Lands [5/]	4,876	6,385	1,819	1,284	6,343	20,707
State – Managed Lands [6/]	115,206	59,985	48,040	78,009	192,329	493,568
Tribal Lands/Indian Reservations	13,142	7,266	-	101	20,276	40,785
Municipal Watershed	-	-	-	-	17,383	17,383
Other County/City Lands	5,893	2,862	1	2,478	3,144	14,378
Private	402,179	285,637	148,743	193,413	469,885	1,499,857
TOTAL	**812,316**	**370,030**	**1,567,120**	**451,419**	**1,197,077**	**4,397,962**

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan GIS layers.
[2/] Includes national parks, national monuments, national recreation areas, national wildlife refuges, and wildernesses.
[3/] Includes all non-wilderness National Forest System lands; the majority of the acres consists of lands protected under the Northwest Forest Plan (e.g., LSR, Managed LSR, AMA, Riparian Reserves)
[4/] Includes all Department of Defense, Department of Energy, Bureau of Land Management, and Bureau of Reclamation lands.
[5/] Includes all State Parks and Wildlife Areas.
[6/] Includes all DNR, Department of Corrections, and University lands.

Table 3. General Land Cover Classifications in the North Puget Sound Region by WRIA[1/]

Land Cover	WRIA 01 Nooksack	WRIA 03 Lower Skagit/Samish	WRIA 04 Upper Skagit	WRIA 05 Stillaguamish	WRIA 07 Snohomish	Total North Puget Sound
Forestland	573,473	247,078	1,201,875	401,421	1,003,542	3,427,389
Shrubland	12,266	4,548	66,060	3,515	19,785	106,174
Grassland	14,360	4,534	77,987	5,190	31,024	133,094
Water & Wetlands	9,368	6,280	27,777	3,600	23,290	70,315
Ice, Snow, & Bare Rock	52,333	3,593	187,741	6,122	23,386	273,175
Residential & Commercial	20,618	15,510	1,029	5,436	41,413	84,006
Agricultural	129,900	88,487	4,652	26,134	54,638	303,810
TOTAL	**812,316**	**370,030**	**1,567,120**	**451,419**	**1,197,077**	**4,397,962**

[1/] Primary Data Source: USGS/EPA National Land Cover Data GIS layer.

3.0 FORESTLAND OWNERSHIP AND MANAGEMENT

Approximately 54 percent of the forestlands in the North Puget Sound region are in Federal ownership, 1 percent are in Tribal ownership, 14 percent are in State ownership, and 31 percent are in private or other ownership (Table 4). A Federal or State status of preservation or limited management covers approximately 48 percent of the forestlands in the region. Approximately 8 percent of the forestlands are available for Federal or Tribal timber management. State timber management may occur on approximately 14 percent of the forestlands, and 31 percent of the forestlands are in private, county, or city ownership, where timber management may occur. Overall, lands covered by the forest practices rules represent approximately 45 percent of the forestlands in the region (see Figure 1, which displays these lands). Existing HCPs cover the vast majority (89 percent) of the State-managed lands, but less than 1 percent of the combined private, county, and city ownerships. WRIA 03 has the largest percentage of forest practices rules-covered lands (94 percent of all forestlands, 23 percent of which are covered by existing HCPs) and WRIA 04 has the lowest (14 percent of all forestlands, 26 percent of which are covered by existing HCPs).

Most of the private forestlands are located in the foothills west of the Cascade Range. Some private forestlands exist in the river valleys; however, much of this land has been converted to other uses. The lower foothills, especially in the southern and western parts of this region, are being converted to residential and other land uses.

Small, 20-acre exempt forest landowners make up about 0.7 percent of the forestlands and about 1.5 percent of the forestlands subject to forest practices rules in the North Puget Sound region, based on the analysis by Rogers (2003). Although this analysis may represent an underestimate, it is believed to have identified the majority of all small, 20-acre exempt parcels (personal communication, Luke Rogers, Rural Technology Initiative, University of Washington, May 2004). The small landowner parcels are mainly found in the lower elevation lands, especially along the major rivers. The highest percentage (about 2.5% of the forestland) is in the Lower Skagit/Samish (WRIA 03) and the lowest percentage (0.1%) is in the Upper Skagit (WRIA 04).

Approximately 11,283 stream miles occur on lands subject to forest practices rules in the North Puget Sound region (Table 5). This represents 39 percent of all streams in the region. Approximately 6,965 miles or 62 percent of the 11,283 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre exempt forest landowner parcels in this region is estimated to be about 0.9 percent and the percentage of all fish-bearing streams on small, 20-acre exempt forest landowner parcels is about 1.5 percent (Rogers 2003).

Table 4. Ownership and Management of Forestlands (acres and percent) in the North Puget Sound Region by WRIA[1/]

Forestlands Category	WRIA 01 Nooksack	WRIA 03 Lower Skagit/Samish	WRIA 04 Upper Skagit	WRIA 05 Stillaguamish	WRIA 07 Snohomish	Total North Puget Sound
Federal and State Protected Forestlands Not Managed for Timber Production[2/]	198,447	9,981	932,380	157,652	346,059	1,644,519
Federal Lands and Tribal Forestlands Available for Timber Management[3/]	16,267	5,892	100,887	9,070	102,912	235,028
Forestlands Available for Timber Management Under the State Forest Practices Rules						
DNR and Other State Forestlands	109,683	55,843	46,369	76,419	184,618	472,932
Private, County, and City Forestlands	249,076	175,361	122,239	158,281	369,953	1,074,910
Subtotal	358,759	231,204	168,608	234,700	554,571	1,547,842
TOTAL FORESTLANDS	573,473	247,078	1,201,875	401,421	1,003,542	3,427,389
% IN FEDERAL OR STATE PROTECTION	35%	4%	78%	39%	34%	48%
% AVAILABLE FOR FEDERAL OR TRIBAL TIMBER MANAGEMENT	3%	2%	8%	2%	10%	7%
% AVAILABLE FOR STATE TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	19%	23%	4%	19%	18%	14%
% AVAILABLE FOR PRIVATE OR COUNTY/CITY TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	43%	71%	10%	39%	37%	31%

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan, and USGS/EPA National Land Cover Data GIS layers.
[2/] Federal and State Protected Lands includes: Wilderness, LSR, Late Successional Old Growth LSOG, AMA, National Wildlife Refuges, National Parks, Washington State Parks, and WDFW lands.
[3/] Federal and Tribal Lands Available for Timber Management include: USFS Matrix lands, USFS other lands, BLM lands, Dept of Defense lands, and Indian Reservation lands.

Table 5. Stream Miles in the North Puget Sound Region by Ownership, Forested Stream Miles, and Forest Practices Rules (FPR)-Regulated Stream Miles[1/]

Category	WRIA 01 Nooksack	WRIA 03 Lower Skagit/Samish	WRIA 04 Upper Skagit	WRIA 05 Stillaguamish	WRIA 07 Snohomish	Total North Puget Sound
Total Stream Miles						
Federal	1,232	60	6,315	1,422	4,045	13,072
Tribal	106	29	-	0	94	230
State	963	515	389	668	1,728	4,263
County/City	51	18	-	32	226	327
Private	2,495	1,848	1,366	1,470	3,583	10,761
Total Miles	**4,848**	**2,469**	**8,069**	**3,591**	**9,676**	**28,653**
Forested Stream Miles						
Forested Miles	3,457	1,536	5,753	3,053	7,734	21,534
% of Total Miles	71%	62%	71%	85%	80%	75%
FPR-Regulated Stream Miles						
FPR-Reg. Miles	2,576	1,444	1,312	1,744	4,206	11,283
% of Total Miles	53%	58%	16%	49%	43%	39%

[1/] Data sources: DNR stream hydrography GIS layer, DNR Major Public Lands layer, and USGS/EPA National Land Cover Data. Stream miles include all Type 1-9 streams.

4.0 HABITAT LIMITING FACTORS

Primary Regional Factors

High mountains, geologically recent continental and alpine glaciation, and high precipitation have created wide river valleys and steep forested hillslopes. River valleys were impacted by historic timber harvest and subsequent agricultural and urban development. Many of the lower foothills have more recently been converted to residential and other land uses. The higher foothills and the Cascade Mountains are still forested, and much of these areas are managed for timber. Because of increasing restrictions on riparian timber harvest over the past three decades, managed timberlands provide considerably better salmonid habitat than most urban and agricultural lands. However, these riparian areas still require time to recover fully from historic harvest. Mass wasting is probably the most significant impact associated with past forest practices.

Sedimentation/Mass Wasting

Steep slopes and, in many foothill areas, relatively unconsolidated glacial deposits and phyllite bedrock formations, make this region vulnerable to landslides (WDNR 1993a, WDNR 1997a, WDNR 1997b). All watershed analyses in this region, except for the Woods Creek Watershed Analysis (WRIA 07) (WDNR 1993c), inventoried at least 100 landslides using historic aerial photos, and some inventoried more than 300. These figures may not be representative of the region as a whole, because the data sources (watershed analyses) targeted watersheds with a history of problems. However, other sources also point to a significant shallow rapid landslide (SRLS) problem. In the Nooksack Basin, over 2,200 landslides have been identified, with 37 percent associated with clearcuts and 32 percent associated with roads (WSCC 2002b). In the Stillaguamish Basin, 1,100 landslides have been inventoried since the 1940s (WSCC 1999). Lands prone to SRLS are often managed for timber, because they are unsuited to most other uses. Landslides can occur naturally, but inappropriate forest practices greatly accelerate their frequency.

The North Puget Sound region is also characterized by several active glacial deep-seated landslides (DSLS) (WDNR 1993b, WDNR 1994, WDNR 1998), and a larger number of smaller dormant DSLSs. These are deep rotational bodies of unconsolidated and semi-consolidated glacial deposits. The Deer Creek landslide in the Stillaguamish River impacted fish habitat for 50 years (Edie 1990), and the Hazel landslide in the upper North Fork Stillaguamish is currently active and impacting habitat (WDNR 1998). A stream or river typically undercuts the bases of these landslides, which destabilizes the landslide and causes it to gradually slip downhill. This, in turn, triggers bank collapses and SRLSs into the channel. Rerouting of channel flow into the toe of a DSLS may occur naturally, or as a result of human alterations (e.g., Hazel landslide, see WDNR 1998a). Besides the activated landslides, many dormant DSLSs exist that could be activated by disturbing the toe, or by improperly routing of water from road surfaces.

Forest practices may trigger or exacerbate DSLSs by increasing ground water infiltration, and thus, increasing pore pressure along the slip zone. However, geologists are still debating this effect, which is the subject of current research by the Cooperative Monitoring, Evaluation and Research group using Forests and Fish research funds.

Fine sediment enters the channel from unpaved roads. Unpaved roads are widespread on industrial forestlands, and to a lesser extent, in rural residential areas and recreational forestlands. Industrial forestlands throughout Washington State have extensive networks of unpaved roads. Proper management of unpaved forest roads to reduce surface erosion, while similar in all regions of the state, is somewhat easier in the North Puget Sound region because of the availability of competent (hard) rock for road surface material. Glaciation tends to erode and pulverize softer rock; and hard rocks are available for surfacing in most watersheds of this region.

Riparian/Floodplain and Wetland Conditions

Historic or old growth timber harvest removed most of the riparian trees from the stream channels. In the North Puget Sound region, this harvest started in the 1870s and was substantially completed by the 1960s. Subsequent agricultural and urban conversion permanently altered riparian vegetation in the river valleys, leaving either no trees, or a thin band of trees. The riparian zone along many agricultural areas are now dominated by alder, invasive canary grass and blackberries, and provide substantially reduced shade and large woody debris (LWD) recruitment. It is difficult or impossible for native conifers to re-establish in buffers with these vegetative characteristics. The limiting factors reports (WSCC 1999, 2002a, 2002b, 2003) made frequent note of the deficiencies in riparian buffers on agricultural and urban lands. A photometric study by Lunetta et al. (1997) suggests that functional riparian buffers in urban and agricultural areas are substantially lacking (See Habitat Trends below).

For those riparian areas that remained in timber production, riparian stands harvested prior to 1972 were often allowed to regenerate naturally, although riparian harvest since 1972 has benefited from mandatory conifer regeneration requirements. Since the soils in many riparian areas are moist, hardwoods dominate many of them, at least initially (See Habitat Trends below).

Diking, agriculture, revetments, railroads and roads in lower stream reaches have caused significant loss of secondary channels in major valley floodplains in this region. Confined main channels create high-energy peak flow events that remove smaller substrates and LWD. The loss of side-channels, oxbow lakes, and backwater habitats result in a significant loss to juvenile salmonid rearing and refuge habitat. The lower South Fork Nooksack River has dikes along 60 percent of its length (WSCC 2002b). Sixty-two percent of the lower Skagit River and 'much' of the Samish River is modified by diking and riprap (WSCC 2003). Diking and other floodplain impacts are not typically associated with commercial or small landowner forestry; however, some loss of floodplain functions has occurred in smaller mountain channels as a result of placing logging roads along stream channels.

Freshwater wetlands have been extensively lost. These wetlands provide rearing habitat, especially for coho. Wetlands play an important role in modifying extremes in flow. Loss of wetlands is described as extensive in the lower Nooksack Basin, but this loss has not been quantified (WSCC 2002b). In the Stillaguamish Basin, wetland acreage declined from approximately 29,100 acres, historically, to 6,299 acres (WSCC 1999). In the Snohomish Basin, 74 percent of the floodplain wetlands have been lost (WSCC 2002a). The large scale loss of wetlands that has occurred in the major valley floodplains of the North Puget Sound region is not typically associated with commercial or small landowner forestry; however, loss or alteration of smaller forested wetlands sometimes occurs by the placement of roads. Small forested wetlands are filled with road sediment under some circumstances.

Channel/Hydrology Conditions

Two dams on the upper Skagit River and two dams on the Baker River are major hydropower storage facilities that modify the seasonal and daily discharge in the Skagit River, and have a substantial impact on the Skagit System (WSCC 2003). A municipal water facility and a small hydropower project reduce total discharge on the Tolt River, a tributary to the Snoqualmie River. In addition, at least four run-of-the-river hydropower projects exist in the region; one on the Nooksack River and three on the Snoqualmie River).

Except for run-of–the-river projects, these river facilities have been trapping substrate for decades, and the downstream reaches are gravel deficient. Most of the dam sites also intercept LWD and do not pass it downstream. These two actions can cause the downstream channel to incise and/or become simplified, thus impacting fish habitat. Water withdrawal can reduce

available fish habitat and alter sediment transport. Hydropower projects can also fluctuate flow, which strands and often kills fish and reduces aquatic invertebrate productivity (Hunter 1992). The Skagit and Baker Rivers' hydropower projects continue to fluctuate flow daily (hydropeaking); although, this has been somewhat modified in recent decades.

Peak stream flows have systematically increased over time due to paving (roads and parking areas), reduced percolation through surface soils on residential and agricultural lands, simplified and extended drainage networks, loss of wetlands, and rain-on-snow events in higher elevation clearcuts. Groundwater withdrawal and increased peak flow may decrease surface flow during the dry season (WSCC 2003). Loss of forest canopies can substantially increase peak flow events due to 'rain-on-snow' runoffs. Warm heavy rain can rapidly melt snow. Snow accumulations, especially at high elevations, are substantially greater on unforested surfaces than on forested surfaces. This is primarily a concern with clearcut timber harvest at high elevations (above 1,200 ft.), and is specifically a concern in this region with the high mountains and heavy snow accumulations.

Estuarine and Nearshore Habitat

Estuaries are considered essential for the survival of juvenile salmonids that are in transition between freshwater and saltwater habitats. This habitat typically consists of salt marshes and mudflats. A number of recent studies have concluded that the loss of estuarine habitat in the Skagit River is the single most important limiting factor for salmonid production (WSCC 2003). The Stillaguamish River lost 85 percent of its tidal marshland between 1860 and 1968, mostly before 1886 (WSCC 1999). The Skagit Basin has lost 72 percent of its inter-tidal habitat (WSCC 2003), and the Snohomish Basin has lost 32 percent of its habitat (WSCC 2002a). Intertidal habitat has been lost in the Nooksack basin; however, this loss is not quantifiable (WSCC 2002b).

The nearshore marine habitat is the saltwater shoreline. The substrate is typically mud, sand or gravel along the eastern side of Puget Sound. Vegetation may include eelgrass, kelp, and other marine macrophytes. This habitat has been extensively altered near the Skagit River (WSCC 2003). Nearshore habitat in the North Puget Sound region has not been extensively discussed in Limiting Factors reports.

Estuarine and nearshore habitat losses are not typically associated with commercial or small landowner forestry (WSCC 1999, WSCC 2002a, WSCC 2003).

Large Woody Debris (LWD)

The recruitment of LWD has been impacted by past riparian forest harvest, and the failure to re-establish these riparian forests, following harvest on lands converted to other uses.

The retention of in-channel LWD has been impacted by removal of LWD for navigational purposes, dikes and levee interference, debris torrents, and historic removal of wood as a misguided fisheries management tool. The confinement of valley floor river channels by diking assures rapid downstream transportation of LWD during peak flows.

The increased frequency of landslides and debris torrents, as a result of timber harvest, has probably increased LWD recruitment in steep hillslope channels. However, landslide-recruited LWD is less likely to contribute to fish habitat. Such recruitment is often transported by debris torrents and deposited in large logjams in relatively short sections at the foot of the hill (McGarry 1994), or the wood gets flushed out into the main valley channels and delivered far downstream.

Most of the watershed analyses conducted in the region have noted a difference in LWD recruitment potential between managed forestlands and non-forestland uses (i.e., residential, urban and agricultural; WDNR 1993a, WDNR 1994, WDNR 1997a, WDNR 1998a; also see

Lunetta et al. 1997, Fig 6). In all cases, the potential future LWD recruitment was substantially better in managed forestlands. This is a result of either narrower riparian tree buffers or the lack of a buffer on residential, urban and agricultural lands.

Because of the long period of time it takes for riparian forests to regenerate and recruit LWD to the channel, most managed forestland stream channels (with gradients less than 6 percent) have reduced levels of LWD because of historic riparian timber harvest. These riparian forests have generally regenerated as alder, a tree that typically lives only 80 years, and rots quickly when recruited to the stream channel (Harmon et al. 1986). Thus, alder LWD is less functional than other hardwoods and conifer species; although recent research suggests that alder leaf-litter may be an important source of nitrogen for the aquatic food chain (e.g., Wipfli and Gregovich 2002). Marshall and Associates (2000) conducted a detailed photometric study of riparian buffers and found that 50 percent of the private forestland buffers in the North Puget Sound region were hardwood-dominated. The remaining buffers were composed of both mixed hardwood and conifer, or conifer-dominated. Mixed riparian buffers are considered to be on a successional pathway to conifer domination.

In steeper stream channels of this region, LWD retention is the primary issue, rather than LWD recruitment. Debris torrents have removed most of the LWD in the channels where they have recently occurred. Debris-torrent-scoured channels have greatly diminished habitat value, and typically take years or decades to recover. LWD has a particularly important role in controlling channel incision in channels crossing unconsolidated glacial deposits. These channels may not have sufficient armoring (i.e., boulders large enough to resist mobilization at peak flows) to prevent incision without large LWD (see WDNR 1998b).

Fish Passage

Statewide, thousands of miles of fish channels have been rendered partially or completely inaccessible to fish, as a result of road culverts and other water crossing structures. This removes potential fish habitat from fish production. In the past decade, fish passage through forestry, agricultural and urban road culverts has been an area of renewed interest and directed funding. However, there is no meaningful statewide database documenting regional passage deficiencies or recovery trends.

The upper Skagit River, above the Gorge Dam, was naturally inaccessible to anadromous fish, with the possible exception of steelhead. As is the case with a number of dam sites, the proof or disproof of anadromous access is now buried under water and sediment. The Baker River dams have upstream and downstream fish passage structures. In recent years, these structures have functioned well enough to contribute to the recovery of Baker River Sockeye salmon (personal communication, Gary Sprague, WDFW, 2003).

Water Quality Issues

Physical: Loss of riparian trees will increase water temperature where the open channel is less than 100 feet wide (Sullivan et al 1990). Extensive loss of vegetative cover may contribute to increased groundwater temperatures, which may impact thermal refuges in the larger channels (personal communication, Patricia Olsen, The Pacific Watershed Institute, Seattle, WA, 2003). Channelization, water withdrawals, loss of wetlands, and altered land cover have resulted in inadequate stream flows in some drainages.

Most of the watershed analyses conducted in the region made note of the disparity between shade in managed forestlands, and non-forest land uses (i.e., residential, urban and agricultural), with conditions being substantially better in managed forestlands (WDNR 1998a, WDNR 1994, WDNR 1993, WDNR 1997). Similarly, limiting factors analysis reports note poor water quality

(high temperature, fine sediment) in the floodplain channels where agriculture and urban/residential development have prevailed (Haring 2002, Smith 2002, Smith 2003, WSCC 1999). Riparian condition in managed forestlands was mixed, with some areas still impacted by historic harvest of riparian areas. WSCC (1999) states, "Riparian zones associated with agriculture and rural residential land use are the most severely degraded." Past riparian timber harvest has removed shade and impacted water temperature; however, recovery is rapid in small stream channels, because smaller trees can provide adequate shade. Temperature impacts from riparian harvest along wider channels (i.e., greater than30 ft.) are less significant, because, even under natural conditions, the channel is only partially shaded by riparian trees and water temperatures are naturally higher. However, tall trees do affect water temperature on larger channels, thus temperature recovery from riparian timber harvest takes longer.

In the North Puget Sound region, 52 percent of the riparian buffers on private timberlands regenerated from historic timber harvest as hardwood-dominated stands (i.e., >70 percent hardwoods; Marshall and Assoc. 2000), with most of this being alder. Because alder has a short life span (80 years) and limited height potential (50 to 90 feet depending on soil and climate), they are less effective in shading wider channels. Severe debris torrents can remove enough riparian trees to impact shade and water temperature. This was noted in at least two watershed analyses (WDNR 1997, WDNR 1997b; see also Beschta and Taylor 1988, Coho and Burges 1994).

In WRIA 01, Whatcom Creek has high temperatures and portions of the Nooksack River are impaired due to high temperatures, low instream flow and excessive fine sediment. A few tributaries of the Lower Skagit River in WRIA 03 are impaired due to high temperatures. In WRIA 05, portions of the Stillaguamish River are impaired due to high temperatures (as are a few of its tributaries) and low dissolved oxygen. The Snohomish, Snoqualmie and Pilchuck rivers in WRIA 07 are also impaired due to high temperatures.

Chemical: Elevated levels of nutrients have been documented in the lower main-stem Skagit River, presumably from urban and highway runoff, wastewater treatment, failing septic systems, agriculture or livestock impacts (Smith 2003). Loss of riparian habitat, sedimentation, hydrologic alterations (wetland losses), inputs from agriculture, and failing septic systems have resulted in water quality problems such as warm water temperatures, increased nitrogen and phosphorus, and higher levels of turbidity.

Chemical use in forestlands is substantially limited to herbicide applications to suppress alder, maple, and brush competition during early phases of conifer forest regeneration. No local factors exist to suggest that impacts from herbicides would be different from other regions in Washington State.

The State list of impaired waters, in compliance with Section 303(d) of the Clean Water Act, lists waters that do not meet water quality standards or fully protect beneficial uses (see http://www.ecy.wa.gov/programs/wq/303d/index.html). Impairments to parameters in this region, such as temperature, turbidity, and dissolved oxygen, may be related to past forest practices or other land uses.

5.0 HABITAT TRENDS

Potentially unstable landforms are now routinely identified and mapped. However long-term trends of landslide activity is difficult to systematically measure. Part of the problem is that practices that cause instability, and the storm events that trigger landslides as a result of instability are often separated by years or decades. At this point, no reliable data exist on the long-term trend of landslide events.

Direct measure of in-channel fine sediment is costly and impractical because very large sample sizes are necessary to achieve statistical significance. Because of this, the watershed analysis methodology (WFPB 1997) and the more recent Road Maintenance and Abandonment Plans (RMAP) focus on measuring fine sediment before it enters the channel. This method measures surface erosion for the tread surface, cut slope, and fill slope, based on road use, soil type, vegetative cover, gradient, water routing and other factors. No recent independent assessments of forest road maintenance have been made in Washington State or the North Puget Sound region.

Forestry tends to be one of the primary landuses, which is more vulnerable to landslides, surface erosion and fine sediment issues. Limiting factors pertaining to riparian functions can also be associated with forest practices. Within the North Puget Sound region, forestlands make up approximately 78 percent (See Table 3). Approximately 53 percent of the forestland is actively managed for timber. Forest Practices HCP-covered lands make up 45 percent of all forested lands within the region (See Table 4).

Habitat trends in LWD and shade can be determined, given the following three assumptions: 1) riparian stand conditions can adequately represent recovery of current and future LWD and shade; 2) riparian stand conditions can be determined by contemporary aerial photographs; and 3) most riparian buffers on non-Federal lands were historically harvested; thus, the current riparian condition represents the state of recovery from that harvest. On a large scale, meaningful trends can be determined based on two photometric studies.

A dataset used by Lunetta et al. (1997) was made available from Brian Cosentino (personal communication, Brian Cosentino, WDFW, 2000) which allowed isolation of data from the North Puget Sound WRIAs (Table 6). 'Response reaches' were generally defined by Lunetta et. al. as the lower gradient (< 4 percent) habitat where most of the anadromous fish production occurs. Table 6 shows that 12 percent[1] of the response reach riparian buffers (RRRB) were classified as late seral stage. Thirty-five percent of the RRRBs were unforested, primarily as a result of urban and agricultural development. Another third of the data (35 percent) was classified as 'other forestlands,' which was defined to be "hardwood dominated, brush, or recent clearcuts."

In a separate photometric survey, Marshall and Associates (2000) looked at riparian buffers on private forestlands only, and determined that 52 percent[2] of the riparian buffers in the North Puget Sound region were hardwood-dominated (>70 percent hardwoods). These two photometric assessments suggest that a substantial portion of the 'other forestland' riparian zone in Table 6 is hardwood-dominated.

The above data are consistent with the watershed analysis reports. All but two watershed analyses made note that a significant portion of the riparian zones that had poor shade coverage and poor LWD recruitment potential, had been converted to agricultural and residential uses. The exceptions are: 1) the Tolt River (WRIA 07), which is located in a municipal watershed, thus protected from development, and 2) the Griffin-Tokul watershed, which was mostly owned by one timber landowner. The lowest reaches of the Griffin-Tokul were open wetlands, thus, naturally deficient in shade and LWD recruitment potential.

[1] 'Late Seral' Stands should not be confused with 'Old Growth Stands.' 'Late Seral' as defined by Lunetta et al (1997) means the conifer crown cover is >70% and more than 10% of the crown cover in trees are greater than 21 inches diameter breast height (dbh). Thus, 'Late Seral' can include some mature second growth conifer stands.

[2] This study used regional definitions that overlap the regional definitions used herein. Marshall and Assoc. found relatively little variation in hardwood stand percentages on private lands throughout western Washington.

Table 6. Percent of response reach riparian buffers by WRIA for the North Puget Sound Region. [(personal communication, Brian Cosentino, WDFW, 2000) See Lunetta et al. (1997) for further description of data.]

Canopy Class	Late Seral Stage	Mid Seral Stage	Early Seral Stage	Other Forest-lands	Water	Non-forest lands
Canopy Class Definition	>70% conifer canopy; >10% of the canopy must be conifer>21"dbh	>70% conifer canopy; <10% of the canopy must be conifer>21"dbh	Conifer Crown cover > 10% and <70%	Hardwood dominated, shrub or recent clearcut,	Lakes, large rivers and other large water bodies	Urban, agriculture, rangeland, barren, glaciers
WRIA or Basin Name						
Nooksack	5.9%	2.6%	2.7%	34.4%	1.2%	53.1%
Lower Skagit-Samish	0.2%	1.4%	2.5%	26.3%	5.6%	64.0%
Upper Skagit	33.7%	18.1%	1.3%	29.4%	5.7%	11.7%
Stillaguamish	12.2%	13.6%	3.6%	45.8%	0.5%	24.2%
Snohomish	9.8%	18.9%	7.5%	36.0%	1.3%	26.5%
Total Response Reach Riparian Acres	16,808	17,323	6,118	49,586	3,465	49,494
Region Total	11.8%	12.1%	4.3%	34.7%	2.4%	34.7%

In summary, although managed forestland buffers are still recovering from historic harvest, increased restrictions on riparian timber harvest over the past 30 years places them on a much faster track to LWD and shade recovery than it would be for most urban and agricultural land uses.

6.0 FISH RESOURCES

Salmonid Stocks

Table 7 lists the salmonids that occur in the North Puget Sound region. The asterisk next to the species name indicates the fish is introduced, and not native to Washington State. This list should not be regarded as an exhaustive list of the species present.

Table 7. Salmonid species present by WRIA within the North Puget Sound Region (WDFW 2003).

Species	State Status[1/]	Federal Status[2/]	Nooksack (WRIA 01)	Lower Skagit and Samish (WRIA 03)	Upper Skagit (WRIA04)	Stillaguamish (WRIA 05)	Snohomish (WRIA 07)
Arctic Char*			X				
Resident Cutthroat Trout		FC	X	X	X	X	X
Sea run Cutthroat Trout		FC	X	X	X		X
Pink Salmon				X	X	X	
Chum Salmon			X	X	X	X	X
Coho Salmon		FCo	X	X	X	X	X
Rainbow Trout			X	X	X	X	X
Summer Steelhead			X	X	X	X	X
Winter Steelhead			X	X	X	X	X
Sockeye Salmon			X	X	X	X	X
Kokanee Salmon			X	X		X	X
Fall Chinook Salmon		FT	X	X	X	X	X
Spring Chinook Salmon		FT	X	X	X		
Summer Chinook Salmon		FT		X	X	X	X
Dolly Varden/ Bull Trout	SC	FT	X	X	X	X	X
Eastern Brook Trout*			X		X		X
Brown Trout*					X	X	
Lake Trout*			X				
Mountain Whitefish				X	X	X	

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Other Fish Species

Table 8 is a list of non-salmonid freshwater species that exist in the North Puget Sound region (WDFW 2003, Wydoski and Whitney 2003). The asterisk next to the species name indicates that the fish is not native to Washington State. This list should not be regarded as an exhaustive list of the species present.

Table 8. Non-salmonid freshwater fish species by WRIA within the North Puget Sound Region (WDFW 2003, Wydoski and Whitney 2003).

Species	State Status[1/]	Federal Status[2/]	Nooksack (WRIA 01)	Lower Skagit and Samish (WRIA 03)	Upper Skagit (WRIA 04)	Stillaguamish (WRIA 05)	Snohomish (WRIA 07)
Dace Longnose			X	X		X	X
Lamprey Pacific		FCo	X	X		X	X
Lamprey River	SC	FCo		X		X	X
Lamprey Western Brook							X
Peamouth						X	X
Redside Shiner							X
Sculpin Coastrange			X	X	X	X	X
Sculpin Prickly			X	X	X	X	X
Sculpin Shorthead							X
Sculpin Torrent						X	X
Sucker Largescale					X	X	X
Sucker Salish	SM		X	X	X	X	X
Three-Spine Stickleback						X	X
Sunfish spp*			X				X
Pumpkinseed*							X
Crappie spp*			X			X	X
Black Crappie*							X
Largemouth Bass*							X
Yellow Perch*							X
Eulachon	SC		X	X		X	X
Longfin Smelt				X			
Pacific Sand Lance						X	
Pacific Herring						X	
Surf Smelt						X	

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Status of Salmonid Stocks

The State and Tribal Stock status of 72 stocks in the North Puget Sound region is shown by river basin in Table 9. For State and Tribal Stock Status, *Healthy* refers to a stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock; *Depressed* refers to a stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely; *Critical* refers to a stock of fish experiencing production levels that are so low that permanent damage to the stock is likely or has already occurred; and *Unknown* refers to a stock of fish which has insufficient information to rate stock status.

Table 9. Puget Sound salmon and steelhead stock list presented by river basin (2002 SASI Report, 1998 Bull Trout Status Report).

River Basin/WRIA	Species	Stock Status
Nooksack/Samish (WRIAs 01,03)		
NF Nooksack	Chinook	Critical
SF Nooksack	Chinook	Critical
Samish/MS Nooksack Fall	Chinook	Unknown
NF Nooksack	Chum	Healthy
Mainstem/SF Nooksack	Chum	Unknown
Samish/Independent	Chum	Healthy
Nooksack	Coho	Unknown
Samish	Coho	Healthy
N Puget Sound Tribs	Coho	Unknown
NF/Middle Fork Nooksack	Pink	Healthy
SF Nooksack	Pink	Unknown
SF Nooksack	Steelhead - Summer	Unknown
Dakota Cr.	Steelhead - Winter	Unknown
Mainstem/NF Nooksack	Steelhead - Winter	Unknown
SF Nooksack	Steelhead - Winter	Unknown
Middle Fork Nooksack	Steelhead - Winter	Unknown
Samish	Steelhead - Winter	Healthy
Lower Nooksack	Bull Trout/Dolly Varden	Unknown
Canyon Creek	Bull Trout/Dolly Varden	Unknown
Upper MF Nooksack	Bull Trout/Dolly Varden	Unknown
Skagit (WRIAs 03,04)		
Upper Skagit Mainstem/Tribs Summer	Chinook	Depressed
Lower Skagit Mainstem/Tribs Fall	Chinook	Depressed
Lower Sauk Summer	Chinook	Depressed
Upper Sauk Spring	Chinook	Depressed
Suiattle Spring	Chinook	Healthy
Upper Cascade Spring	Chinook	Depressed
Mainstem Skagit	Chum-Fall	Healthy
Sauk	Chum-Fall	Healthy
Lower Skagit Tribs	Chum-Fall	Unknown

Table 9. Puget Sound salmon and steelhead stock list presented by river basin (2002 SASI Report, 1998 Bull Trout Status Report) (continued).

River Basin/WRIA	Species	Stock Status
Skagit	Coho	Healthy
Baker	Coho	Healthy
Skagit	Pink	Healthy
Baker	Sockeye	Healthy
Finney Cr.	Steelhead-Summer	Unknown
Sauk	Steelhead-Summer	Unknown
Cascade	Steelhead-Summer	Unknown
Mainstem Skagit/Tribs	Steelhead-Winter	Depressed
Sauk	Steelhead-Winter	Unknown
Cascade	Steelhead-Winter	Unknown
Lower Skagit	Bull Trout/Dolly Varden	Healthy
Upper Skagit	Bull Trout/Dolly Varden	Unknown
Baker Lake	Bull Trout/Dolly Varden	Unknown
Stillaguamish (WRIA 05)		
Stillaguamish Summer	Chinook	Depressed
Stillaguamish Fall	Chinook	Depressed
NF Stillaguamish	Chum-Fall	Healthy
SF Stillaguamish	Chum-Fall	Healthy
Stillaguamish	Coho	Healthy
Deer Cr.	Coho	Unknown
NF Stillaguamish	Pink	Healthy
SF Stillaguamish	Pink	Healthy
Deer Cr.	Steelhead-Summer	Depressed
SF Stillaguamish	Steelhead-Summer	Unknown
Canyon Cr.	Steelhead-Summer	Unknown
Stillaguamish	Steelhead-Winter	Depressed
Snohomish (WRIA 07)		
Skykomish	Chinook	Depressed
Snoqualmie	Chinook	Depressed
Skykomish	Chum-Fall	Healthy
Snoqualmie	Chum-Fall	Unknown
Wallace	Chum-Fall	Healthy
Snohomish	Coho	Healthy
Skykomish	Coho	Healthy
SF Skykomish	Coho	Healthy
Snoqualmie	Coho	Healthy
Snohomish Odd-Year	Pink	Healthy
Snohomish Even-Year	Pink	Healthy
Tolt	Steelhead-Summer	Healthy
NF Skykomish	Steelhead-Summer	Unknown
SF Skykomish	Steelhead-Summer	Healthy
Snohomish/Skykomish	Steelhead-Winter	Depressed
Pilchuck	Steelhead-Winter	Depressed
Snoqualimie	Steelhead-Winter	Depressed
Skykomish	Bull Trout/Dolly Varden	Healthy

7.0 AMPHIBIANS

The North Puget Sound region harbors 15 amphibian species, including two established introduced species, the bullfrog and the green frog (Dvornich et al. 1997; McAllister 1995). Of these 15, the largest assemblage (including the two introduced species) consists of 11 taxa that reproduce in stillwater habitats including lakes, oxbows, ponds, and other freshwater wetlands with sufficient stillwater habitat. Except for high elevation lakes, most stillwater wetland habitat occurs at low elevations. Since a large proportion of this wetland habitat has been lost (see Floodplain and Wetland Conditions section), significant impact to stillwater amphibians is presumed. Lowland stillwater habitats are also the habitat in which introduced warmwater species (bullfrogs, green frogs, and selected fish [catfish, mosquitofish, sunfish]), and interactive facilitation among some introduced species, particularly bullfrogs and warmwater fish, may promote their survival (Adams et al. 2003) and contribute to their potential negative effects on native amphibians (Adams 1999). Of the remaining four native amphibian species, two species (ensatina and western red-backed salamander) reproduce in terrestrial habitats, and the last two species (coastal tailed frog and coastal giant salamander) reproduce in streams.

Of the entire amphibian assemblage for the region, only the coastal tailed frog (*Ascaphus truei*) would be a Forest Practices HCP-covered species (Table 10). Except at the absolute highest elevations, the coastal tailed frog appears to be relatively widespread in small to medium-sized streams in the region (Brown 1975, 1999). Although locally well studied in this region (Brown 1975, 1989, 1990), no systematic surveys have been performed to precisely determine its occupancy over even portions of the region. Currently, insufficient data exist even to perform a status survey for coastal tailed frog because of lack of a baseline.

Regardless of the incomplete knowledge of its regional distribution, the coastal tailed frog may be at some level of risk because sedimentation has the potential to substantially reduce its instream habitat (Bury 1983, Bury and Corn 1988, Corn and Bury 1989). Timber harvest, which can result in significant sedimentation (Beschta 1978, Jakob 1999), occurs over a significant portion of the North Puget Sound region landscape (see Primary Regional Factors section). Nevertheless, the precise nature of the risk in this region is currently unknown.

Although not covered under the Forest Practices HCP, seven other amphibians (namely northwestern salamander [*Ambystoma gracile*], long-toed salamander [*Ambystoma macrodactylum*], western toad [*Bufo boreas*], Pacific treefrog [*Hyla regilla*], northern red-legged frog [*Rana aurora*], Cascades frog [*Rana cascadae*] and rough-skinned newt [*Taricha granulosa*]) may receive some protection as a result of Forests and Fish patch buffer prescriptions. Two of these species, western toad and Cascades frog, have State watch list (special concern) status (WDFW 2001). Both species have declined elsewhere in their geographic ranges (Carey 1993, Fellers and Drost 1993), but their status in the North Puget Sound region is unknown. Development and hydrological alteration may have resulted in habitat loss for western toads at low elevations.

Table 10. Amphibians of the North Puget Sound Region

Group	Name	Habitat			Regional Distribution
		Active Season		Over-wintering	
		Breeding	Non-Breeding		
Frogs	Coastal tailed frog *Ascaphus truei*	Streams	Streams	Terrestrial	Widespread

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SOUTH PUGET SOUND REGIONAL SUMMARY

SOUTH PUGET SOUND REGIONAL SUMMARY

1.0 PHYSICAL DESCRIPTION

The South Puget Sound region is defined to include six WRIAs (08, 09, 10, 11, 12, and 13). Major stream systems include Lake Washington, Cedar River, Sammamish River, Green River, Duwamish River, Soos Creek, Puyallup River, White River, Carbon River, Nisqually River, Deschutes River and South Sound independent tributaries. Portions of Snohomish, King, Pierce, Thurston, and Lewis Counties are contained within the South Puget Sound region. A map of the South Puget Sound region is provided in Figure 1.

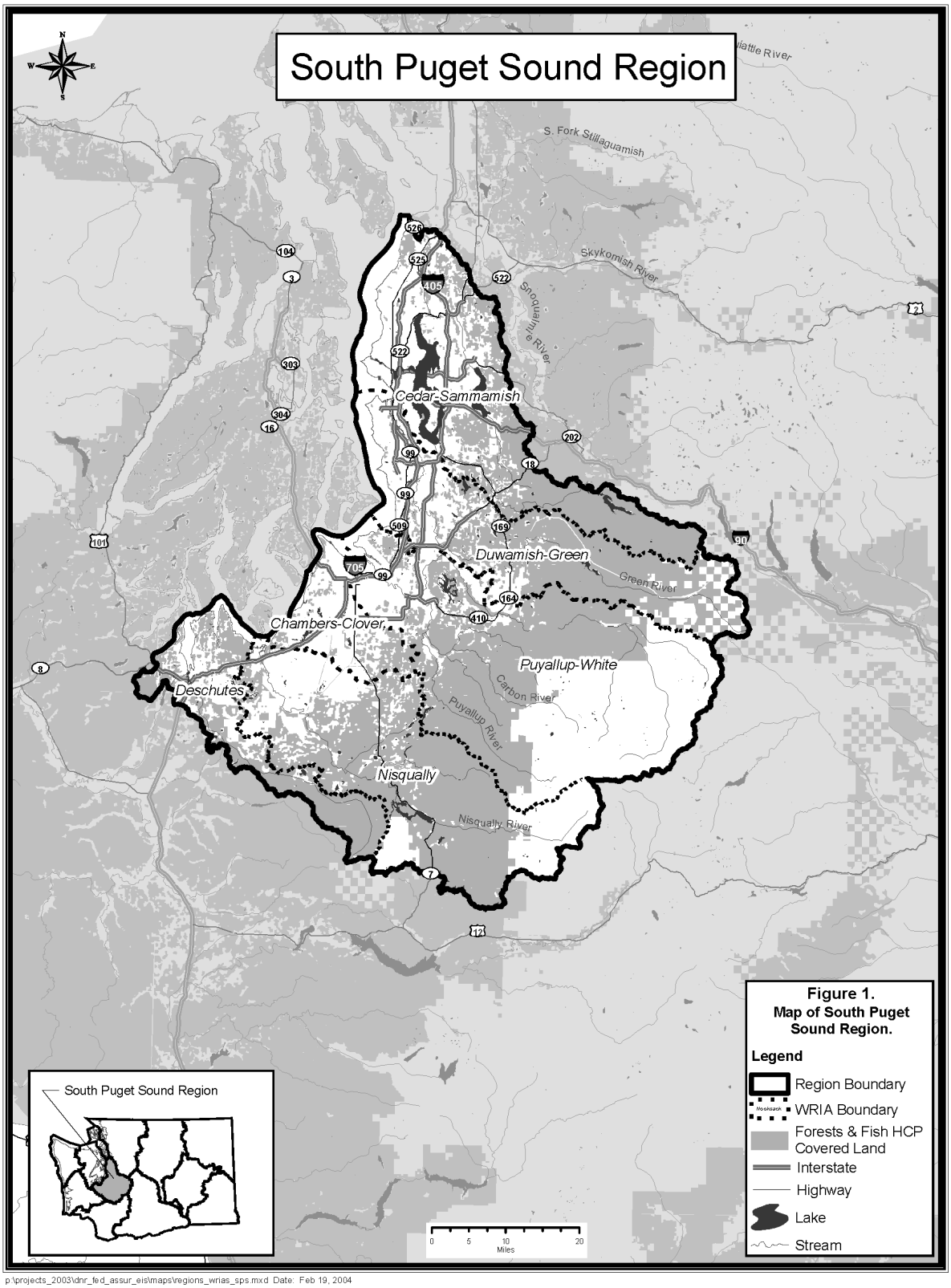
The South Puget Sound region extends from the Puget Lowland physiographic province in the west to the Southern Cascades physiographic province in the east (Lasmanis 1991). Elevations range from sea level to over 14,000 feet atop Mount Rainier.

General Geology

The western portion of the South Puget Sound region is characterized by wide valleys and foothills, and high mountains along the eastern margin. In the eastern part, geologically recent continental glaciation has left deep deposits of mineral sediment ranging from silt to rounded gravel, cobbles and boulders through the western part of this region. This region is at or near the southern end of several continental ice sheets, and thus has considerable deposition of glacial material, as well as a variety of features including outwash deposition, glacial lakes and hardpan layers that create perched aquifers. The surface material in many of these foothills is composed of this poorly consolidated sediment, and the river valley substrate represents the alluvial sorting of this material.

Along the eastern margin are the Cascade Mountains. These mountains are the product of uplifting and fracturing over millions of years. Oligocene sedimentary and volcanoclastic rocks appear to be the most prevalent. Geologically recent alpine glaciation has cut deeply into these mountains creating steep hill slopes and has greatly increased the risk of mass wasting. High precipitation contributes to active erosion in these mountains. With the exception of Mt Rainer, the Cascade peaks are less than 1,800 meters (approximately 6000 feet) in elevation in this region. Mt. Rainer is a massive and active volcano, although the last eruption was several hundred years ago. At 4,392 meters (14,410 feet), it is the highest point in Washington State. Glaciers are currently present on all faces of the mountain, providing a source of cold water and glacial flour (very fine mineral sediment that gives the water a whitish or light brownish color) to the headwaters of the Puyallup, Nisqually, White, and Carbon rivers. Eruptions have deposited deep layers of ash and pumice on the nearby Cascade Mountains and foothills. Large mudflows triggered by the rapid melting of the glaciers have transported this volcanic sediment down the flanking rivers to Puget Sound and as far north as the southern end of Lake Washington. These mudflow deposits have created very wide flat valleys in the lower Puyallup, Nisqually and Duwamish Basins.

Information concerning erosion processes in the South Puget planning region has been extracted from the following watershed analyses: Lester (WRIA 09) (Plum Creek Timber Company 1994); Upper Green (WRIA 09) and Sunday Creek (WRIA 09) (Plum Creek Timber Company 2002).


South Puget Sound Region
S. Fork Stillaguamish
Skykomish River
Snoqualmie River
Cedar-Sammamish
Duwamish-Green
Green River
Chambers-Clover
Puyallup-White
Carbon River
Puyallup River
Deschutes
Nisqually
Nisqually River
South Puget Sound Region
0 5 10 20
Miles
Figure 1.
Map of South Puget Sound Region.
Legend
Region Boundary
WRIA Boundary
Forests & Fish HCP Covered Land
Interstate
Highway
Lake
Stream
p:\projects_2003\dnr_fed_assur_eis\maps\regions_wrias_sps.mxd Date: Feb 19, 2004

Mass wasting is the dominant erosion process in the South Puget region. Results of watershed analyses indicate debris avalanches, debris flows, and debris torrents are the most common landslide types. In the Lester WAU, debris avalanches, debris flows, and debris torrents comprised 72 percent of all landslides inventoried. Most debris avalanches originate from inner gorges, the toes of large deep-seated landslides, and steep, planar hillslopes dissected by stream channels. In the Sunday Creek WAU, inner gorges and deep-seated landslide toes were the source of 33 percent of all debris avalanches.

Hillslope surface erosion is generally limited to exposed soils such as landslide scars and eroding streambanks and was not found to be a significant sediment source. Surface erosion from roads, however, was identified as the major source of fine sediment in several sub-basins of both the Lester and Sunday Creek WAUs.

General Hydrology

The region has a marine climate characterized by mild, wet winters and warm, dry summers. Average annual precipitation ranges from 35 inches for some areas along Puget Sound to over 100 inches on the western slopes of the Southern Cascades. Most of the precipitation falls as rain at lower elevations while snow is the dominant form of precipitation above 4,000 feet. The region receives more than 75 percent of its annual precipitation from October through March.

Several major rivers flow west from the Southern Cascades into Puget Sound including the Cedar, Green, Puyallup, Nisqually, and Deschutes. The hydrologic regime of these rivers is characterized by rain or rain-on-snow generated peak flows that occur during the fall and winter and low flows that occur during late summer and early fall. Spring snowmelt may also produce significant peak flows in glacially influenced systems such as the Puyallup, White, and Carbon rivers. Based on the DNR stream hydrography GIS coverage, there are approximately 13,832 stream-miles (both fish-bearing and non-fish streams) in the South Puget Sound region, with an average stream density of 4.06 stream miles/mile^2 (Table 1).

Table 1. Stream Miles in the South Puget Sound Region by WRIA[1/]

	WRIA 08 Cedar-Sammamish	WRIA 09 Duwamish-Green	WRIA 10 Puyallup-White	WRIA 11 Nisqually	WRIA 12 Chambers-Clover	WRIA 13 Deschutes	Total South Puget Sound
Stream Length (miles)	1,920	2,244	4,347	3,884	213	1,223	13,832
Stream Density (miles/mi^2)	3.05	4.15	4.19	5.08	1.30	4.60	4.06

[1/] Primary Data Source: DNR stream hydrography GIS layer. Stream miles include all mapped Type 1-9 streams.

2.0 LAND OWNERSHIP AND USE

Major Land Ownership and Management

Approximately 22 percent of all lands in the South Puget Sound region are in Federal ownership and a portion of these lands (about 9 percent of all lands) are being managed for long-term preservation, primarily in national parks, wildernesses, and national recreation areas (Table 2). Another large portion of these Federal lands is being managed by the Forest Service outside of wilderness (9 percent of all lands); a substantial portion of these non-wilderness National Forest System lands is being managed under a very limited management status (e.g., LSRs, Managed LSAs, AMAs, or Riparian Reserves) according to the Northwest Forest Plan. The remainder of the Federal lands (4 percent of all lands) are being managed by other agencies. Tribal lands represent about 1 percent of the region. State lands represent 8 percent of all lands in the region, private lands represent 64 percent, and city/county lands represent slightly less than 1 percent.

The vast majority of the Federal lands managed for long-term preservation and other National Forest System lands are in the upper parts of the Puyallup-White and Nisqually (WRIAs 10 and 11, respectively). Private lands make up the largest percentage of the Deschutes (WRIA 13) at 90 percent and the lowest percentage of the Puyallup-White and Nisqually (WRIAs 10 and 11, at 53 and 54 percent, respectively.)

Land Cover and Land Use

Forestland makes up approximately 70 percent of the South Puget Sound region (Table 3). Residential and commercial lands represent the next largest cover type, making up approximately 17 percent of the region. Agricultural lands make up about 5 percent, water and wetlands make up about 3 percent, and other types comprise the remaining 5 percent. The percent forestland within each WRIA ranges from a low of about 35 percent in the Chambers-Clover (WRIA 12) to a high of 86 percent in the Nisqually (WRIA 11).

Table 2. Land Ownership Parameters for the South Puget Sound Region by WRIA[1/]

Land Ownership	WRIA 08 Cedar-Sammamish	WRIA 09 Duwamish-Green	WRIA 10 Puyallup-White	WRIA 11 Nisqually	WRIA 12 Chambers-Clover	WRIA 13 Deschutes	Total South Puget Sound
Federal – Long-term Congressionally Protected Lands [2/]	-	-	161,454	38,592	-	-	200,046
Federal – Other National Forest System Lands [3/]	113	32,455	110,048	47,518	-	599	190,733
Federal – Other Federal Lands [4/]	640	-	-	58,811	24,491	5,232	89,174
State – Protected Lands [5/]	2,886	2,370	1,346	1,207	50	143	8,003
State – Managed Lands [6/]	18,713	33,928	20,984	74,901	2,598	10,439	161,563
Tribal Lands/Indian Reservations	-	319	21,427	1,605	-	-	23,351
Municipal Watershed	84,123	21,288	-	-	-	-	105,411
Other County/City Lands	12,979	1,070	162	1,141	1,094	319	16,764
Private	283,956	254,308	349,047	265,611	76,839	153,423	1,383,184
TOTAL	**403,409**	**345,739**	**664,467**	**489,386**	**105,073**	**170,153**	**2,178,228**

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan GIS layers.
[2/] Includes national parks, national monuments, national recreation areas, national wildlife refuges, and wildernesses.
[3/] Includes all non-wilderness National Forest System lands; the majority of the acres consists of lands protected under the Northwest Forest Plan (e.g., LSR, Managed LSR, AMA, Riparian Reserves)
[4/] Includes all Department of Defense, Department of Energy, Bureau of Land Management, and Bureau of Reclamation lands.
[5/] Includes all State Parks and Wildlife Areas.
[6/] Includes all DNR, Department of Corrections, and University lands.

Table 3. Land Cover and Use for the South Puget Sound Region by WRIA [1/]

Land Cover/Land Use	WRIA 08 Cedar-Sammamish	WRIA 09 Duwamish-Green	WRIA 10 Puyallup-White	WRIA 11 Nisqually	WRIA 12 Chambers-Clover	WRIA 13 Deschutes	Total South Puget Sound
Forestland	200,635	231,675	519,632	421,088	36,760	122,655	1,532,444
Shrubland	7,657	5,289	7,675	4,879	3,960	2,840	32,300
Grassland	2,611	3,528	7,565	10,599	3,222	2,517	30,042
Water & Wetlands	31,291	4,585	8,754	7,273	3,961	3,038	58,902
Ice, Snow, & Bare Rock	1,965	819	33,398	10,450	776	74	47,483
Residential & Commercial	150,944	74,826	55,477	8,586	48,218	24,546	362,597
Agricultural	8,305	25,019	31,967	26,510	8,176	14,483	114,460
TOTAL	**403,409**	**345,739**	**664,467**	**489,386**	**105,073**	**170,153**	**2,178,228**

[1/] Primary Data Source: USGS/EPA National Land Cover Data GIS layer.

3.0 FORESTLAND OWNERSHIP AND MANAGEMENT

Approximately 26 percent of the forestlands in the South Puget Sound region are in Federal ownership, 10 percent are in State ownership, less than 1 percent are in Tribal ownership, and 63 percent are in private or other ownership (Table 4). A Federal or State preservation or limited management status covers approximately 19 percent of the forestlands in the region. Approximately 8 percent of the forestlands are available for Federal or Tribal timber management. State timber management may occur on approximately 10 percent of the forestlands, and 63 percent of the forestlands are in private, county, or city ownership, where timber management may occur. Overall, lands covered by the forest practices rules represent approximately 73 percent of the forestlands in the region (see Figure 1, which displays these lands). Existing HCPs cover the majority (69 percent) of the State-managed lands, and 16 percent of the combined private, county, and city ownerships. WRIA 08 (Cedar-Sammamish) has the largest percentage of forest practices rules-covered lands (98 percent of all forestlands, 46 percent of which are covered by existing HCPs) and WRIA 10 (Puyallup-White) has the lowest (55 percent of all forestlands, only 1 percent of which are covered by existing HCPs).

Most of the private forestlands are located in the lowlands, outside of and on the edge of developed areas. Because of this and because of the rapid population growth that is occurring in this region, many of these lands have been or will be converted to other uses.

Small, 20-acre exempt forest landowners make up about 0.6 percent of the forestlands and about 0.8 percent of the forestlands subject to forest practices rules in the South Puget Sound region, based on the analysis by Rogers (2003). Although this analysis may represent an underestimate, it is believed to have identified the majority of all small, 20-acre exempt parcels (personal communication, Luke Rogers, Rural Technology Initiative, University of Washington, May 2004). The small landowner parcels are mainly found in the lower elevation lands, especially along the major rivers. The largest concentrations, ranging from 1.0 to 1.6 percent of the forestland, respectively, are in the Nisqually (WRIA 11) and the Chambers-Clover WRIAs (WRIA12); all remaining WRIAs have percentages ranging from 0.6 to 0.8 percent of forestland.

Approximately 8,535 stream miles occur on lands subject to forest practices rules in the North Puget Sound region (Table 5). This represents 62 percent of all streams in the region. Approximately 4,870 miles or 57 percent of the 8,535 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre exempt forest landowner parcels in this region is estimated to be less than 1 percent and the percentage of all fish-bearing streams on small, 20-acre exempt forest landowner parcels is about 1.2 percent (Rogers 2003).

Table 4. Ownership and Management of Forestlands (acres and percent) in the South Puget Sound Region by WRIA[1/]

Forestlands Category	WRIA 08 Cedar-Sammamish	WRIA 09 Duwamish-Green	WRIA 10 Puyallup-White	WRIA 11 Nisqually	WRIA 12 Chambers-Clover	WRIA 13 Deschutes	Total South Puget Sound
Federal and State Protected Forestlands Not Managed for Timber Production[2/]	2,773	14,795	209,295	63,609	-	720	291,193
Federal Lands and Tribal Forestlands Available for Timber Management[3/]	316	19,457	25,557	58,539	14,885	4,150	122,903
Forestlands Available for Timber Management Under the State Forest Practices Rules							
DNR and Other State Forestlands	14,255	31,413	18,205	73,943	927	9,605	148,349
Private, County, and City Forestlands	183,291	166,010	266,575	224,997	20,948	108,180	970,000
Subtotal	197,546	197,423	284,780	298,940	21,875	117,785	1,118,349
TOTAL FORESTLANDS	200,635	231,675	519,632	421,088	36,760	122,655	1,532,444
% IN FEDERAL OR STATE PROTECTION	1%	6%	40%	15%	0%	1%	19%
% AVAILABLE FOR FEDERAL OR TRIBAL TIMBER MANAGEMENT	0%	8%	5%	14%	40%	3%	8%
% AVAILABLE FOR STATE TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	7%	14%	4%	18%	3%	8%	10%
% AVAILABLE FOR PRIVATE OR COUNTY/CITY TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	91%	72%	51%	53%	57%	88%	63%

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan, and USGS/EPA National Land Cover Data GIS layers.
[2/] Federal and State Protected Lands includes: Wilderness, LSR, LSOG, AMA, National Wildlife Refuges, National Parks, Washington State Parks, and WDFW lands.
[3/] Federal and Tribal Lands Available for Timber Management include: USFS Matrix lands, USFS other lands, BLM lands, Dept of Defense lands, and Indian Reservation lands.

Table 5. Stream Miles in the South Puget Sound Region by Ownership, Forested Stream Miles, and Forest Practices Rules (FPR)-Regulated Stream Miles[1/]

Category	WRIA 08 Cedar-Sammamish	WRIA 09 Duwamish-Green	WRIA 10 Puyallup-White	WRIA 11 Nisqually	WRIA 12 Chambers-Clover	WRIA 13 Deschutes	Total South Puget Sound
Total Stream Miles							
Federal	1	288	1,597	1,042	59	17	3,004
Tribal	-	0	110	11	-	-	121
State	134	308	163	809	3	68	1,486
County/City	807	245	2	3	6	2	1,064
Private	977	1,404	2,475	2,018	146	1,137	8,157
Total Miles	**1,920**	**2,244**	**4,347**	**3,884**	**213**	**1,223**	**13,832**
Forested Stream Miles							
Forested Miles	1,337	1,790	3,400	3,375	91	1,046	11,039
% of Total Miles	70%	80%	78%	87%	42%	86%	80%
FPR-Regulated Stream Miles							
FPR-Reg. Miles	1,319	1,486	2,139	2,506	56	1,029	8,535
% of Total Miles	69%	66%	49%	65%	26%	84%	62%

[1/] Data sources: DNR stream hydrography GIS layer, DNR Major Public Lands layer, and USGS/EPA National Land Cover Data. Stream miles include all Type 1-5 streams and a portion of Type 9 streams. Because many Eastern Washington Type 9 waters are not defined channels, only 25% of Type 9 streams are counted as streams in the Ponderosa Pine and drier vegetation zones, 50% are counted in the Mixed Conifer vegetation zones, and 75% are counted in the wettest vegetation zones. These proportions are based on field observations by DNR foresters, but are very approximate.

4.0 HABITAT LIMITING FACTORS

Primary Regional Factors

This region is one of the most developed and populated regions of the State, and managed forestlands are fragmented and sparse in the floodplains and lower foothills. Urban development has significantly impacted nearshore areas, estuaries, freshwater wetlands and floodplains. Some of the remaining managed forestlands in the Cascade Range and higher foothills are vulnerable to landslides.

Sedimentation/Mass Wasting

Steep slopes created by geologically recent alpine glaciation, moderately weathered rock and heavy precipitation make the Cascade Range within the region moderately vulnerable to landslides and debris torrents. All watershed analyses records in the Cascade Range of this region (WDNR 1996a, 1996b, 1998b, 2002) exceeded 90 inventoried landslides per Watershed Administrative Unit (WAU). Forest practices and historic fires have contributed or triggered most of these landslides. Lands prone to Shallow Rapid Landslides (SRLS) are often managed for forestry, because they are unsuitable for most other uses. It should also be noted that the watershed analysis process targeted watersheds with a history of problems, especially mass-wasting. Thus, this selection of WAUs may be biased with regard to regional landslide frequency. Outside the Cascade Range, landslides are less frequent, but may occur along high terraces and outside bends of rivers.

Weathered Oligocene volcanoclastic rocks contribute to the sensitivity in upper Green River Basin and Nisqually Basin (WDNR 1998a, WDNR 1998b, WDNR 2002). In the upper White River Basin (WRIA 10), 625 landslides were inventoried in two WAUs (Clearwater and Middle White; WDNR 1996a). The geology here is a mix of intrusive and volcanic rock. In the Mashel Watershed Analysis in WRIA 11 (Nisqually Basin, WDNR 1996b), 362 landslides were inventoried, these being mostly debris torrents and SRLSs. The Mashel WAU is composed of weathered sedimentary rocks and more recent intrusive, volcanic, glacial and alluvial material. Forest practices and historic fires have contributed or triggered most of these landslides (WDNR 1996a, WDNR 1996b, WDNR 1998a, WDNR 1998b, WDNR 2002).

Numerous earth flows and deep-seated landslides of various sizes are reported in the upper Green River Basin (WDNR 1998a, WDNR 2002) and upper Nisqually Basin (WDNR 1998b). In both cases, the geology was described as weathered Oligocene volcanoclastic rocks. Earth flows are deep-seated landslides (DSLS) composed of fine sediment and are partially rotational and partially elastic. Like other DSLSs, the toe of the slide is undercut by a stream, causing the formation to slip slowly down. This can cause the banks to collapse, and trigger SRLSs. In addition to the upper Green River earth flows, several river-adjacent DSLSs exist in the middle Green River. These are a major source of sand for the mid- and lower Green River. A series of earthflows were identified along the lower Mashel River as well.

Fine sediment also enters the channel from unpaved roads. Unpaved roads are widespread on industrial forestlands, and, to a lesser extent, in rural residential areas and recreational forestlands. Commercial forestlands throughout Washington State have extensive networks of unpaved roads, and the South Puget Sound region is no exception.

Riparian/Floodplain and Wetland Conditions

Past old growth timber harvest removed most of the riparian trees from the stream channels. In this region, this practice started in the 1860s and was substantially completed by the 1950s. Subsequent agricultural and urban conversion permanently altered riparian vegetation in the river

valleys, leaving either no trees, or a thin band of trees. The riparian zone along many agricultural areas are now dominated by alder, invasive canary grass and blackberry, and provide substantially reduced shade and LWD recruitment. It is difficult for native conifer to re-establish in buffers with these vegetative characteristics. Widespread urbanization has permanently impacted riparian buffers throughout the lowlands in this region. The limiting factors reports for this region (WSCC 1999a, 1999b, 1999c, 2000, 2001) made frequent note of the deficiencies in riparian buffers on agricultural and urban lands. A photometric study by Lunetta et al. (1997) suggests that functional riparian buffers in urban and agricultural areas are substantially lacking (See habitat trends below).

Most riparian stands, harvested prior to 1972 but remaining in timber production, regenerated naturally. Since the soils in many riparian areas are moist, hardwoods dominate many of them (See habitat trends discussion below). Since 1972 on state and private lands, riparian buffers have benefited from mandatory conifer regeneration requirements, although it is not clear that the establishment of conifer was consistently successful.

Diking, widespread floodplain development and channel revetments have caused significant loss of secondary channels and wetlands in the lower Green, lower Cedar and lower Puyallup floodplains (WSCC 1999b, 2000, 2001). Confined channels create high-energy peak flow events, resulting in coarser substrates and a reduction in LWD. The loss of side-channels, oxbow lakes and wetlands represents a significant loss of juvenile salmonid rearing and refuge habitat (WSCC 2000). When the water level of Lake Washington was dropped 9 feet in the 1910s, thousands of acres of wetlands along the shoreline of Lake Washington, Lake Sammamish and the Sammamish River corridor were drained and converted to agricultural and urban uses (WSCC 2001).

Although wetland and floodplain habitat losses are extensive in this region, little of this land is currently managed for forestry. Small stream-adjacent wetlands in forested drainages can be impacted by inappropriate placement of roads and filled by road sediment. The scale of this loss is small compared to the loss from urban and agricultural lands in this region.

Channel/Hydrology Conditions

The Cascade headwaters of the Cedar and Green Rivers are both managed as municipal water supplies and are dammed to provide storage to meet summer water demands for urban areas. The Mud Mountain Dam on the White River diverts flow to Trap Lake, a recreational and residential development. Discharge from Trapp Lake is used to generate power. The Electron Dam is a run-of-the-river project that reduces flow in the upper Puyallup River for approximately 8 miles. The upper Nisqually River has two large dams, the Alder and LaGrande. The Alder Dam is the largest in this region. In addition, the Yelm Hydropower Project on the lower Nisqually River reduces flow in a 10-mile stretch of the river.

Except for the two run-of-the-river projects, these dams have been trapping substrate for decades, and the downstream reaches are gravel deficient. Most of the dam sites also intercept LWD and do not pass it downstream. These two actions tend to promote downstream channel incision and/or simplification, limiting fish habitat. Water withdrawals reduce available fish habitat and alter sediment transport. Hydropower projects often result in fluctuating flow, which often strands and kills fish and reduces aquatic invertebrate productivity (Hunter 1992). At some storage dam sites, benefits to the fish habitat may be realized by increased summer flows.

Peak stream flows have systematically increased over time due to land use activities including paving (roads and parking areas), reduced percolation through surface soils on residential and agricultural lands, simplified and extended drainage networks, loss of wetlands, and rain-on-snow events. Increased peak flow may decrease surface flow during the dry season due to reduced ground water recruitment (WSCC 1999a, 2000, 2001). Loss of forest canopies can substantially

increase peak flow events because of what is referred to as 'rain-on-snow' runoffs, which occur when heavy warm rain falls on a snowpack. Snow accumulations, especially at high elevations, are substantially greater on unforested surfaces than on forested surfaces. Rain-on-snow events are primarily a concern with clearcut timber harvests at high elevations (above 366 m). Within this region, it is a concern in the Cascade range along the eastern margin.

Estuarine and Nearshore Habitat

Estuary habitat is considered essential for the survival of juvenile salmon that are in transition between freshwater and saltwater habitats, particularly chum and chinook salmon. Because drainage from Lake Washington has been rerouted from the Duwamish River to the shipping canal, this basin has no estuary, and this may impact early marine survival of stocks from this basin (WSCC 2001). The Duwamish and Puyallup basin estuaries are the major shipping ports for Washington State and are also extensively industrialized (WSCC 1999b, 2000). Both estuaries have been severely impacted. One hundred percent of estuarine wetlands have been filled in the lower Duwamish Basin, and the main channel has been dredged for shipping and diked for flood control. The Nisqually Basin estuary is essentially preserved in Federal and State wildlife refuges, and is the least modified estuary in Puget Sound (WSCC 1999b). The estuary for the Deschutes Basin is modified by the creation of a freshwater lake (Capitol Lake) and moderate urban and residential development (WSCC 1999a).

The nearshore marine habitat has been extensively altered and armored by industry activities and intensive residential development near the mouths of the Cedar-Sammamish Basin, Duwamish Basin, and the Puyallup Basin. A railroad runs along most of the shoreline adjacent to these three basins, which eliminates natural cover along the shore and natural recruitment of beach sand. When erosion occurs, the railroad bed is aggressively armored with large riprap (WSCC 2001). Piers and buildings are common in some areas, and dredging has occurred to allow shipping and boating access adjacent to the shoreline. (WSCC 1999a, 2000, 2001) The nearshore environment close to the Nisqually River mouth is lightly impacted by some residential development (WSCC 1999c). The mouth of the Deschutes River is moderately impacted by residential development, marinas and an international trade port (WSCC 1999a).

Estuarine and nearshore habitat losses are not typically associated with commercial or small landowner forestry.

Large Woody Debris

The recruitment of LWD has been impacted by past harvest of riparian forests and the failure to re-establish these riparian forests on lands converted to other uses. The retention of in-channel LWD has been impacted by removal of LWD for navigational purposes, dikes and levy interference, debris torrents and historic removal of wood as a misguided fisheries management tool. The confinement of valley floor river channels by diking assures rapid downstream transportation of LWD during peak flows.

Landslides typically increase LWD recruitment into steep hillslope channels. However, landslide-recruited LWD is less likely to contribute to fish habitat. Such recruitment is often transported by debris torrents and deposited in piles in relatively short sections where channel gradient and confinement decline enough to allow deposition (McGarry 1994). In other instances, LWD gets flushed out into the main valley channels and delivered far downstream. In mountainous landscapes, the supply of functional in-channel LWD is controlled primarily by the retention of LWD, rather than the recruitment of LWD. Debris torrents have removed most of the LWD in the channels where they have recently occurred. Debris-torrent-scoured channels have greatly diminished habitat value, and will take years or decades to recover.

Because of the long duration of time it takes for riparian forests to regenerate and provide recruitment of LWD to the channel, most low-gradient (< 6 percent) stream channels have reduced levels of LWD. Larger streams need larger trees to achieve effective LWD function; thus, at least some trees 50 to 100 cm dbh range are needed (Bilby and Ward 1989, Grette 1985). The riparian forests along many low-gradient streams regenerated as alder, a tree that typically lives only 80 years and rots quickly when recruited to the stream channel (Harmon et al 1986). Thus, alder LWD is less functional than other hardwoods and coniferous species, although recent research suggests that alder leaf-litter may be an important source of nitrogen for the aquatic food chain (e.g., Wipfli and Gregovich 2002). Marshall and Assoc. (2000) conducted a detailed photometric study of riparian buffers and found that 51 percent of the private forestland buffers in the South Puget Sound region were hardwood-dominated (> 70 percent hardwood by composition; Marshall and Assoc. 2000), with most of this being alder. Alder has a short life span (80 years) and limited height potential and diameter potential (50 to 90 feet depending on soil and climate). The rest of forestland buffers were either mixed-hardwood-conifer, or conifer-dominated. Mixed buffers typically become conifer-dominated if left undisturbed.

Water Quality Issues

Groundwater withdrawal and increased peak flow may decrease surface flow during the dry season. Loss of riparian trees will increase water temperature where the open channel is less than 100 feet wide (Sullivan et al 1990). Extensive loss of vegetative cover can increase groundwater temperatures, which may impact surface water temperatures (personal communication, Patricia Olsen, The Pacific Watershed Institute, Seattle, WA, 2003). Channelization, water withdrawals, loss of wetlands, and altered land cover have resulted in inadequate stream flows in some drainages. Past riparian timber harvest has removed shade and increased water temperatures; however recovery is quicker in small stream channels, because smaller trees provide a greater proportion of required shade sooner on small channels. Poor water quality (high temperature, fine sediment) were relatively frequent in association with floodplain channels where agriculture and urban/residential development predominate (WSCC 1999b, 2000). Riparian conditions in managed forestlands was mixed. Temperature impacts from riparian harvest along wider channels (i.e., >10 meters [approximately 33 feet]) are less significant because, even under natural conditions, the channel is only partially shaded by riparian trees and water temperatures are naturally higher. However, taller trees do make a difference on larger channels, thus temperature recovery from riparian timber harvest takes longer. As noted above, this problem is compounded by the fact that 51 percent of the riparian buffers in the South Puget Sound region regenerated from timber harvest as hardwood-dominated stands (i.e., > 70 percent hardwoods). Severe debris torrents can remove enough riparian trees to impact shade and water temperature (Beschta and Taylor 1988, Coho and Burges 1994).

Waters impaired by temperature in this region include portions of the Sammamish River in WRIA 08, the Green River in WRIA 09, the Clearwater River, Lower White River, Boise Creek and Wilkeson Creek in WRIA 10, and the Deschutes River in WRIA 13 (WDOE 1998, 2003). Temperature TMDLs have been done for the Upper White River basin (Ketcheson et al. 2003) and South Prairie Creek/Wilkeson Creek (Barreca and Roberts 2003).

Dissolved oxygen impairments include portions of the Sammamish River and certain tributaries of the Green River. A dissolved oxygen TMDL has been done for the Puyallup River (Pelletier, G. 1993). The Upper Deschutes River is impaired due to excessive fine sediment.

Chemical use in forestlands is substantially limited to herbicide applications to suppress alder, maple, and brush competition during early phases of conifer forest regeneration. No regional factors exist to suggest that impacts from herbicides would be different in this region than other regions in Washington State.

The State list of impaired waters, in compliance with Section 303(d) of the Clean Water Act, lists waters that do not meet water quality standards or fully protect beneficial uses (see http://www.ecy.wa.gov/programs/wq/303d/index.html). Impairments to parameters in this region, such as temperature, turbidity, and dissolved oxygen, may be related to past forest practices or other land uses.

5.0 HABITAT TRENDS

Forest practice regulations over the past twenty years have been extensively modified to reduce landslide and road surface input of fine sediment to stream channels. However, no reliable data exist on the long-term trend of landslide events at a basin or regional scale, nor road surface input (personal communication, Nancy Sturhan, WDNR, 2003). Habitat trends in LWD and shade can be determined, given the following three assumptions: 1) Riparian stand conditions can adequately represent recovery of current and future LWD and shade; 2) Riparian stand conditions can be determined by contemporary aerial photographs; and 3) Most riparian buffers on non-federal lands were historically harvested, thus, the current riparian condition represents the state of recovery from that harvest. Coarse, but meaningful, regional trends can be determined from two photometric studies. It is important to note that forestlands make up approximately 48 percent of the South Puget Sound region. Of that forestland, only 1 percent is under Federal or State protection. Forty-six percent of the total forestlands are under private management (See Tables 3 and 4).

A dataset used by Lunetta et al. (1997) was made available from Cosentino (personal communication, Brian Cosentino, WDFW 2003), which allowed isolation of data for the South Puget Sound WRIAs (Table 6). 'Response reaches' were generally defined by Lunetta et al. as the lower gradient (< 4 percent) habitat where most of the anadromous fish production occurs. Table 6 shows that almost 4 percent of the response reach riparian buffers (RRRB) are classified as late seral stage[3]. Thirty percent of the RRRBs were unforested, primarily as a result of urban and agricultural development. Twenty-seven percent of the RRRBs are mid- or late-seral conifer-dominated stands. In other words, these are riparian stands that are either currently fully functional or on a pathway to functional recovery. Thirty-eight percent of RRRBs are classified as 'other forestlands,' defined to be "hardwood dominated, brush, or recent clearcuts." In a separate photometric survey, Marshall and Associates (2000) looked at riparian buffers on private forestlands only, and determined that 51 percent[4] of the riparian buffers in the South Puget Sound region were hardwood dominated (>70 percent hardwoods). These two photometric assessments suggest that a substantial portion of the 'other forestland' riparian zone in Table 6 is hardwood-dominated.

In summary, many managed forestlands are still recovering from historic harvest. The regeneration of many of these conifer stands as hardwoods, primarily alder, may delay recovery. However increasing restrictions on riparian timber harvest over the past 30 years places forestlands on a much faster track to LWD and shade recovery than most urban and agricultural land uses.

[3] 'Late Seral' Stands should not be confused with 'Old Growth Stands.' 'Late Seral' as defined by Lunetta et al (1997) means the conifer crown cover is >70% and more than 10% of the crown cover in trees are greater than 21 inches diameter breast height (dbh). Thus, 'Late Seral' can include some mature second growth conifer stands.

[4] This study used regional definitions that overlap the regional definitions used herein. The actual figures used in this study were 51% for the 'South Puget Sound' Region, and 57% for the 'North Coast' Region. These two regions are roughly the same as the combined Olympic Coast, West Puget Sound and South Puget Sound regions as defined in this report. Marshall and Assoc. found relatively little variation in hardwood stand percentages on private lands throughout western Washington.

Table 6. Percent of response reach riparian buffers by WRIA for the South Puget Sound Region. [See Lunetta et al. (1997) for description of data.]

Canopy Class	Late Seral Stage	Mid Seral Stage	Early Seral Stage	Other Forest-lands	Water	Non-forest lands
Canopy Class Definition	**>70% conifer canopy; >10% of the canopy must be conifer>21"dbh**	**>70% conifer canopy; <10% of the canopy must be conifer>21"dbh**	**Conifer crown cover > 10% and <70%**	**Hardwood dominated, shrub or recent clearcut,**	**Lakes, large rivers and other large water bodies**	**Urban, agriculture, rangeland, barren, glaciers**
WRIA or Basin Name						
Cedar-Sammish	2.2%	20.3%	5.6%	23.7%	0.9%	47.3%
Duwamish-Green	3.4%	17.0%	5.0%	31.4%	0.5%	42.8%
Puyallup-White	7.3%	28.2%	3.8%	36.9%	0.4%	23.4%
Nisqually	2.6%	22.4%	5.3%	47.5%	0.4%	21.8%
Deschutes	0.0%	24.9%	9.0%	45.6%	0.2%	20.3%
Total response reach riparian acres	2938	18613	4213	30616	414	24571
Regional percentage	3.6%	22.9%	5.2%	37.6%	0.5%	30.2%

6.0 FISH RESOURCES

Salmonid Stocks

Table 7 lists the salmonids that occur in the South Puget Sound region. The asterisk next to the species name indicates that the species is introduced, and not native to Washington State.

The Pygmy Whitefish, a non-game salmonid species listed as State Sensitive, is present in this region. The Pygmy Whitefish occurs in the Chester Morse Reservoir on the Cedar River, and associated tributaries.

Table 7. Salmonid species present by WRIA within the South Puget Sound Region (WDFW 2003).

Species	State Status[1/]	Federal Status[2/]	Cedar-Sammamish Basin (WRIA 08)	Duwamish-Green Basin (WRIA 09)	Puyallup Basin (WRIA 10)	Nisqually Basin (WRIA 11)	Deschute Basin (WRIA 13)
Resident Cutthroat Trout		FC	X	X	X	X	X
Searun Cutthroat Trout		FC	X	X	X	X	X
Pink Salmon					X	X	
Chum Salmon			X	X	X	X	X
Coho Salmon		FCo	X	X	X	X	X
Rainbow Trout			X	X	X	X	X
Summer Steelhead			X	X	X	X	
Winter Steelhead			X	X	X	X	X
Sockeye Salmon			X	X	X		
Kokanee Salmon						X	
Fall Chinook Salmon		FT	X	X	X		X
Spring Chinook Salmon		FT			X		
Dolly Varden/ Bull Trout	SC	FT	X	X	X		
Brook Trout*						X	
Mountain Whitefish					X	X	
Pygmy Whitefish	SS		X				

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Other Fish Species

Table 8 is a list of non-salmonid freshwater species that exist in the South Puget Sound region. The asterisk next to the species name indicates that the fish is not native to Washington State. This list should not be regarded as exhaustive of the species present. The Olympic Mudminnow is a non-salmonid freshwater species present in the region, which is listed as State Sensitive. The Olympic Mudminnow prefers slow water and wetlands, and was historically found in the lowlands of the Thurston and Pierce counties. This species is endemic to Western Washington and may be vulnerable to degradation of wetlands and introductions of non-native warmwater fish (Rodrick and Milner 1991).

Status of Salmonid Stocks

All anadromous salmonid species are present in the South Puget Sound region. Chinook and Bull Trout are listed as threatened in the region. Coho salmon is a Federal species of concern. The State and Tribal Stock status for 46 salmonid stocks in the South Puget Sound region is shown in Table 9.

Table 8. Non-salmonid freshwater species by WRIA within the South Puget Sound Region (WDFW 2003, Wydoski and Whitney 2003).

Species	State Status[1/]	Federal Status[2/]	Cedar-Sammamish Basin (WRIA 08)	Duwamish-Green Basin (WRIA 09)	Puyallup Basin (WRIA 10)	Nisqually Basin (WRIA 11)	Deschutes Basin (WRIA 13)
Longnose Dace			X	X	X	X	X
Speckled Dace			X	X	X	X	X
Largescale Sucker			X	X	X		
Salish Sucker	SM			X			
Prickly Sculpin			X	X	X	X	X
Riffle Sculpin			X	X		X	X
Reticulate Sculpin				X	X	X	X
Shorthead Sculpin			X	X	X	X	
Torrent Sculpin				X			
Three-Spine Stickleback			X			X	X
Brown Bullhead*			X			X	
Channel Catfish*						X	
Pacific Lamprey		FCo		X		X	X
River Lamprey	SC			X	X		
Brook Lamprey			X	X		X	X
Northern Pikeminnow			X			X	
Sunfish spp*.						X	
Pumpkinseed*						X	
Crappie spp*			X			X	X
Largemouth Bass*			X				X
Yellow Perch*			X				
Longfin Smelt			X				
Peamouth			X				
Redside Shiner				X			
Olympic Mudminnow	SS		X				X
Tench*			X				

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Table 9. Puget Sound Salmon and Steelhead Stock List presented by River Basin (2002 SASI Report, 1998 Bull Trout Status Report).

River Basin	Species	Stock Status
Lake Washington		**2002**
Issaquah	Chinook	Healthy
N. Lake Washington Tributaries	Chinook	Healthy
Cedar River	Chinook	Depressed
Lake Washington / Sammamish Tributaries	Coho	Depressed
Cedar River	Coho	Depressed
Sammamish Tributaries	Sockeye	Healthy
Lake Washington Beach Spawning	Sockeye	Depressed
Cedar River	Sockeye	Depressed
Lake Washington	Winter Steelhead	Critical
Chester – Morse Lake	Bull Trout/Dolly Varden	Unknown
Green – Duwamish River		
Duwamish/Green River	Chinook	Healthy
Duwamish/Green River	Fall Chum	Unknown
Crisp Creek	Fall Chum	Unknown
Green River-Soos Ck	Coho	Healthy
Duwamish/Green River	Summer Steelhead	Depressed
Duwamish/Green River	Winter Steelhead	Healthy
Green - Duwamish	Bull Trout/Dolly Varden	Unknown
Puyallup River		
White River	Spring Chinook	Critical
White River	Fall Chinook	Unknown
Puyallup River	Chinook	Unknown
Hylebos Creek	Fall Chum	Unknown
Puyallup/Carbon	Fall Chum	Healthy
Fennel Creek	Fall Chum	Healthy
Puyallup River	Coho	Healthy
White River	Coho	Healthy
Puyallup River	Pink	Depressed
Mainstem Puyallup	Winter Steelhead	Depressed
White River	Winter Steelhead	Depressed
Carbon	Winter Steelhead	Depressed
Puyallup River	Bull Trout/Dolly Varden	Unknown
White River	Bull Trout/Dolly Varden	Unknown
Carbon River	Bull Trout/Dolly Varden	Unknown
Nisqually River		
Nisqually River	Chinook	Depressed
Nisqually River	Winter Chum	Healthy
Nisqually River	Coho	Healthy
Nisqually River	Pink	Unknown
Nisqually River	Winter Steelhead	Depressed
Nisqually River	Bull Trout/Dolly Varden	Unknown
South Sound Independent Tributaries		
Independent Tributaries*	Chinook	Not Rated
Henderson Inlet	Fall Chum	Unknown
Eld Inlet *	Fall Chum	Healthy
Chambers Creek	Winter Chum	Healthy
Chambers Creek	Coho	Depressed
Deep South Sound Tribs*	Coho	Healthy
Deschutes River	Coho	Critical
Deschutes River	Winter Steelhead	Not Rated
Eld Inlet*	Winter Steelhead	Unknown

*The spawning distribution of these stocks occurs in both the South Puget Sound and West Puget Sound regions, as defined for purposes of this document.

For State and Tribal Stock Status, *Healthy* refers to a stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock; *Depressed* refers to a stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely; *Critical* refers to a stock of fish experiencing production levels that are so low that permanent damage to the stock is likely or has already occurred; and *Unknown* refers to a stock of fish which has insufficient information to rate stock status.

7.0 AMPHIBIANS

The South Puget Sound region harbors 17 amphibian species, including the introduced bullfrog (Dvornich et al. 1997; McAllister 1995). Of these 17 species, the largest assemblage (including the bullfrog) consists of 9 taxa that reproduce in stillwater habitat including lakes, oxbow, ponds, temporary pools, and other freshwater wetlands. (Table 10) Stillwater habitats are split between high elevation lakes and ponds, and lower elevation habitats associated with the riparian margins of larger streams and rivers. Since a large proportion of the latter habitat has been altered or lost (see Floodplain and Wetland Conditions and Large Woody Debris Conditions), significant impact to stillwater amphibians is presumed, but documentation has been attempted for only one stillwater-breeding amphibian species, the Oregon spotted frog (see McAllister et al. 1993), the habitat requirements of which fall largely outside of this HCP. Lowland stillwater habitats are also the habitats in which introduced warmwater species, including bullfrogs and fish species (catfish, mosquitofish, sunfish; see Table 8), may adversely impact native amphibians (Adams 1999). Of the remaining eight native amphibian species, four (ensatina, Larch Mountain salamander, Van Dyke's salamander, and western red-backed salamander) reproduce in terrestrial habitats and four (Cope's giant salamander, coastal giant salamander, coastal tailed frog and Cascades torrent salamander) reproduce in streams, springs, or seeps.

Three regional species (coastal tailed frog, Cascades torrent salamander, and Van Dyke's salamander) are Forest Practices HCP-covered taxa (Table 10). Both Cascades torrent salamander and Van Dyke's salamander have marginal distributions in the region. Known distributions of all three species may be conservative because no systematic survey has been performed to understand distribution or determine status. All three species may be at risk because sedimentation has the potential to substantially reduce its in- or near-stream habitat (Bury 1983, Bury and Corn 1988, Corn and Bury 1989). Furthermore, timber harvest, which can result in significant sedimentation (Beschta 1978, Jakob 1999) in Type N waters, occurs over most of the South Puget Sound region where these species occur (see Habitat Trends).

Table 10. Forest and Fish Amphibians of the South Puget Sound Region

Group	Name	Habitat			Regional Distribution
		Active Season			
		Breeding	Non-Breeding	Over-wintering	
Frogs	Coastal tailed frog *Ascaphus truei*	streams	streams	terrestrial	streams with enough gradient from low to high elevations
Salamanders	Van Dyke's salamander *Plethodon vandykei*	terrestrial	terrestrial	terrestrial	Known from a few sites in WRIAs 10 and 11
	Cascades torrent salamander *Rhyacotriton cascadae*	streams	streams	terrestrial	Predicted, but not known from the south margin of WRIA 11

Although not covered under this Forest Practices HCP, seven other amphibians (namely northwestern salamander [*Ambystoma gracile*], long-toed salamander [*Ambystoma macrodactylum*], western toad [*Bufo boreas*], Pacific treefrog [*Hyla regilla*], northern red-legged frog [*Rana aurora*], Cascades frog [*Rana cascadae*], and rough-skinned newt [*Taricha granulosa*]) may receive some protection as a result of Forests and Fish patch buffer prescriptions. Two of these species, western toad and Cascades frog have State watchlist (special concern) status (WDFW 2001). Both have declined elsewhere in their geographic ranges (Carey 1993, Fellers and Drost 1993), but the western toad is known to have disappeared from a number of locations in the Puget Sound area (K. McAllister, M. Hayes, pers. comm. 2003). Development and hydrological alteration may have resulted in habitat loss for western toads at low elevations.

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WEST PUGET SOUND
REGIONAL SUMMARY

WEST PUGET SOUND REGIONAL SUMMARY

1.0 PHYSICAL DESCRIPTION

The West Puget Sound region includes five WRIAs (14, 15, 16, 17, and 18). Major stream systems include the Skokomish, Duckabush, Dosewalips, Big Quilcene, Elwha, and Dungeness Rivers, as well as other South Sound and Hood Canal tributaries. Portions of Thurston, Mason, Kitsap, Jefferson, and Clallam Counties are included within the West Puget Sound region. A map of West Puget Sound region is provided in Figure 1.

The West Puget Sound region extends from the Puget Lowland physiographic province in the east to the Olympic Mountains physiographic province in the west (Lasmanis 1991). Elevations range from sea level to almost 8,000 feet.

General Geology

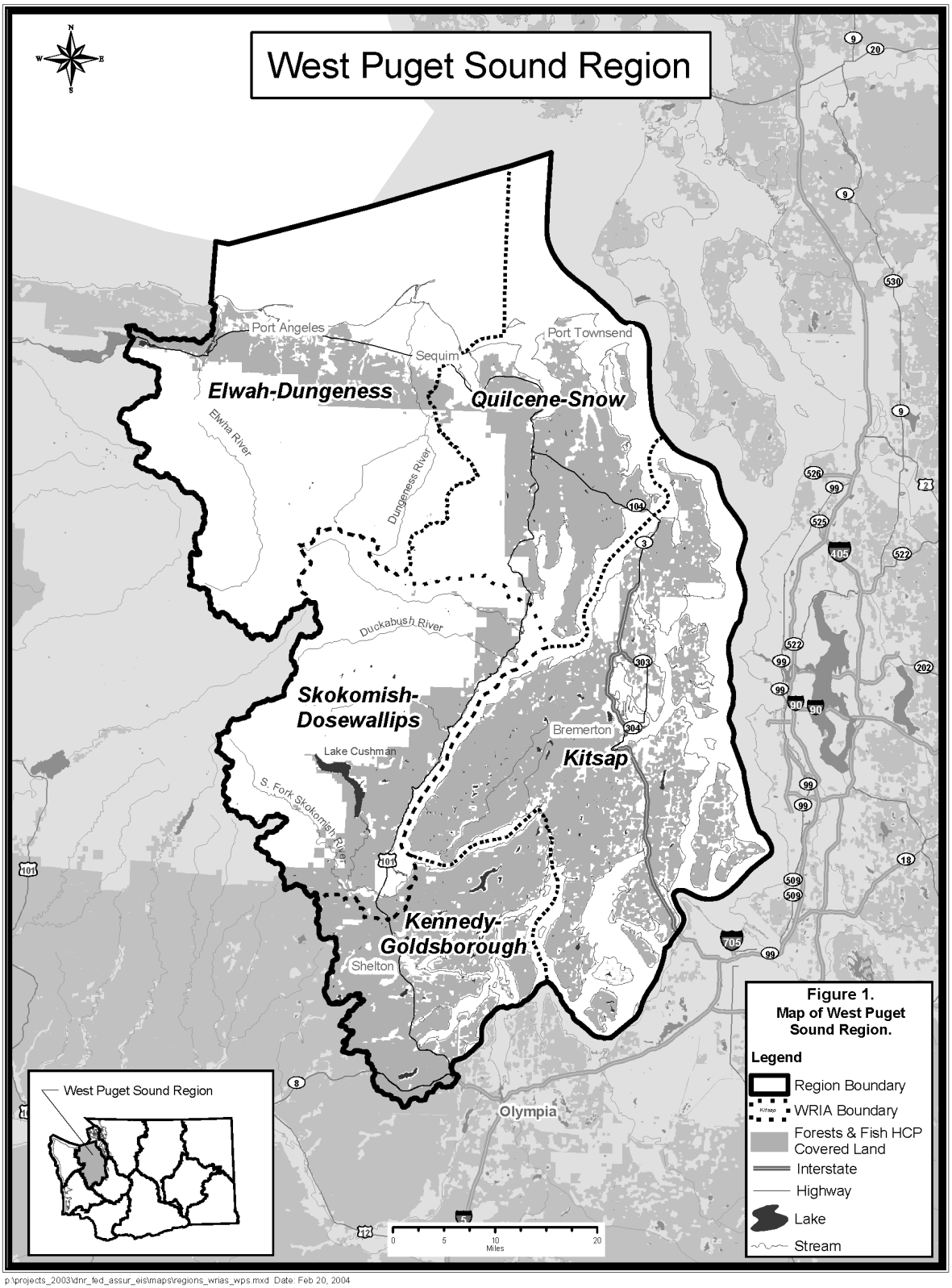
The geology of the West Puget Sound region includes Tertiary volcanic and sedimentary rocks that form the eastern Olympic Mountains and Pleistocene glacial sediments that cover the Puget Lowland. The Crescent Formation, including basalts and limestone, dominates the bedrock geology in the region. Alpine and continental glaciation shaped the region by sculpting the Olympic Mountains and depositing thick layers of sands and gravels in valley bottoms and on coastal plains along Puget Sound.

The West Puget Sound region can be divided into two geological areas, the Puget Lowlands and Olympic Mountains. Recent continental glaciation has left deep deposits of moraine sediments in the Puget Lowlands. Glaciers, which have over-ridden deposits left by previous glaciers, have created hardpan layers and perched aquifers (e.g., WDNR 1998, WSCC 1999), which in turn, have created small basins with lakes, ponds and wetlands. The Olympic Mountains is an area of geologically rapid uplift, forming mountains up to 2400 meters (approximately 7900 feet) in elevation. Recent glaciation and ongoing heavy precipitation has resulted in a topographically complex landscape with long and steep hillslopes, and high gradient channels.

Information concerning erosion processes in the West Puget planning region has been extracted from the following watershed analyses: Kennedy Creek in WRIA 14 (WDNR 1995c); West Kitsap in WRIA 15 (WDNR 1995d); and Big Quilcene in WRIA 17 (WDNR 1997b).

Mass wasting is the dominant erosion process in the West Puget planning region. Results of watershed analyses indicate debris avalanches, debris flows, and debris torrents are the most common landslide types. In high elevation areas of the Olympic Mountains, snow avalanches can sometimes deliver significant volumes of sediment to headwater streams (WDNR 1997b). Most debris avalanches originate in convergent topography such as bedrock hollows, channel heads, headwalls, and inner gorges along streams. Deep-seated landslides are relatively common in this region and are most often associated with deposits of glacial sediments.

Due to high soil infiltration capacities, surface erosion is rare except in areas that have been heavily disturbed or compacted. Where soils in close proximity to streams are disturbed or compacted, sediment delivery is more likely to occur.


West Puget Sound Region
Port Angeles
Sequim
Port Townsend
Elwah-Dungeness
Quilcene-Snow
Elwha River
Dungeness River
Duckabush River
Skokomish-
Dosewallips
Lake Cushman
S. Fork Skokomish River
Bremerton
Kitsap
Kennedy-
Goldsborough
Shelton
Olympia
West Puget Sound Region
0 5 10 20
Miles
Figure 1.
Map of West Puget
Sound Region.
Legend
Region Boundary
WRIA Boundary
Forests & Fish HCP
Covered Land
Interstate
Highway
Lake
Stream
p:\projects_2003\dnr_fed_assur_eis\maps\regions_wrias_wps.mxd Date: Feb 20, 2004

General Hydrology

The region has a marine climate characterized by mild, wet winters and cool, dry summers. Average annual precipitation ranges from 15 inches near Sequim to almost 200 inches at higher elevations. The large disparity in precipitation totals is attributable to the Olympic Mountains. The range intercepts moisture-laden Pacific storms, resulting in extremely high precipitation totals in the western part of the region while creating a rain-shadow effect in areas to the east. Most of the precipitation falls as rain at lower elevations while snow is the dominant form of precipitation above 4,000 feet. The region receives more than 75 percent of its annual precipitation from October through March.

The region contains several rivers, all of which originate in the Olympic Mountains. The Elwha and Dungeness rivers drain north into the Strait of Juan de Fuca while the Dosewallips, Duckabush, Hamma Hamma, and Skokomish rivers drain east to Puget Sound. The hydrologic regime of these systems is similar to other western Washington rivers; peak flows generally occur during fall and winter and as a result of rain or rain-on-snow precipitation events while low flows occur during late summer or early fall. Smaller magnitude peak flows sometimes result from spring snowmelt. Based on the DNR stream hydrography GIS coverage, there are approximately stream-miles (both fish-bearing and non-fish streams) in the North Puget Sound region, with an average stream density of stream miles/mile^2 (Table 1).

Table 1. Stream Miles in the West Puget Sound Region by WRIA[1/]

	WRIA 14 Kennedy-Goldsborough	WRIA 15 Kitsap	WRIA 16 Skokomish-Dosewallips	WRIA 17 Quilcene-Snow	WRIA 18 Elwah-Dungeness	Total West Puget Sound
Stream Length (miles)	1,134	2,411	2,163	1,459	1,947	9,114
Stream Density (miles/mi^2)	3.42	3.61	3.57	3.64	2.76	3.36

[1/] Primary Data Source: DNR stream hydrography GIS layer. Stream miles include all mapped Type 1-9 streams.

2.0 LAND OWNERSHIP AND USE

Major Land Ownership

Approximately 40 percent of all lands in the North Puget Sound region are in Federal ownership and the majority of these (representing 26 percent of all lands) are being managed for long-term preservation, primarily in national parks, national recreation areas, and wildernesses (Table 2). Another large portion of these Federal lands is being managed by the Forest Service outside of wilderness (13 percent of all lands); a substantial portion of these non-wilderness National Forest System lands is being managed under a very limited management status (e.g., LSRs, Managed LSAs, AMAs, or Riparian Reserves) according to the Northwest Forest Plan. The remainder of the Federal lands (1 percent of all lands) are being managed by other agencies. Tribal lands represent about 1 percent of the region. State lands (primarily under management for timber production) represent 11 percent of all lands in the region, private lands represent 48 percent, and city/county lands represent less than 0.1 percent.

Land ownership varies considerably among the WRIAs of the region. The majority of WRIAs 16 (Skokomish-Dosewallips) and 18 (Elwah-Dungeness) (71 and 74 percent, respectively) and 29 percent of WRIA 17 (Quilcene-Snow) are in Federal ownership in Olympic National Park and Forest. In contrast, little to no Federal ownership occurs in WRIAs 14 (Kennedy-Goldsborough) and 15 (Kitsap); the vast majority of these WRIAs (89 and 80 percent, respectively) is in private ownership.

Land Cover and Land Use

Forestland makes up approximately 88 percent of the West Puget Sound region (Table 3). Ice, snow, and bare rock represent about 2 percent, residential and commercial areas make up 4 percent, and agricultural lands make up about 3 percent of the region. Individual WRIAs consist of between 84 and 92 percent forestland. Residential and commercial lands make up the highest percentage (12 percent) of WRIA 15 (Kitsap) and the lowest percentage (0.2 percent) of WRIA 16 (Skokomish-Dosewallips). Agricultural lands also make up the lowest percentage (0.5 percent) of WRIA 16 and make up the highest percentage of WRIA 18 (Elwah-Dungeness).

Table 2. Land Ownership Parameters for West Puget Sound Region by WRIA[1/]

Land Ownership	WRIA 14 Kennedy-Goldsborough	WRIA 15 Kitsap	WRIA 16 Skokomish-Dosewallips	WRIA 17 Quilcene-Snow	WRIA 18 Elwah-Dungeness	Total West Puget Sound
Federal – Long-term Congressionally Protected Lands [2/]	-	-	147,617	15,425	291,425	454,466
Federal – Other National Forest System Lands [3/]	-	-	128,229	54,625	39,971	222,825
Federal – Other Federal Lands [4/]	-	8,984	-	3,274	279	12,537
State – Protected Lands [5/]	656	5,410	1,500	5,339	248	13,154
State – Managed Lands [6/]	22,310	53,488	34,275	35,455	30,637	176,166
Tribal Lands/Indian Reservations	1,086	8,653	5,009	-	601	15,349
Municipal Watershed	-	7,623	-	-	840	8,463
Other County/City Lands	47	168	-	-	516	731
Private	188,065	342,698	71,438	142,667	86,728	831,597
TOTAL	**212,165**	**427,025**	**388,068**	**256,785**	**451,244**	**1,735,288**

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan GIS layers.
[2/] Includes national parks, national monuments, national recreation areas, national wildlife refuges, and wildernesses.
[3/] Includes all non-wilderness National Forest System lands; the majority of the acres consists of lands protected under the Northwest Forest Plan (e.g., LSR, Managed LSR, AMA, Riparian Reserves)
[4/] Includes all Department of Defense, Department of Energy, Bureau of Land Management, and Bureau of Reclamation lands.
[5/] Includes all State Parks and Wildlife Areas.
[6/] Includes all DNR, Department of Corrections, and University lands.

Table 3. General Land Cover Classifications in the West Puget Sound Region by WRIA[1/]

Land Cover	WRIA 14 Kennedy-Goldsborough	WRIA 15 Kitsap	WRIA 16 Skokomish-Dosewallips	WRIA 17 Quilcene-Snow	WRIA 18 Elwah-Dungeness	Total West Puget Sound
Forestland	191,128	356,782	355,031	237,492	381,766	1,522,197
Shrubland	3,623	4,187	5,017	2,380	4,445	19,653
Grassland	883	1,264	10,473	2,441	7,455	22,516
Water & Wetlands	5,645	5,147	6,152	1,091	2,634	20,668
Ice, Snow, & Bare Rock	77	328	8,933	1,160	22,132	32,629
Residential & Commercial	7,731	50,504	647	4,830	7,526	71,238
Agricultural	3,079	8,813	1,817	7,391	25,287	46,387
TOTAL	**212,165**	**427,025**	**388,068**	**256,785**	**451,244**	**1,735,288**

[1/] Primary Data Source: USGS/EPA National Land Cover Data GIS layer.

3.0 FORESTLAND OWNERSHIP AND MANAGEMENT

Approximately 41 percent of the forestlands in the West Puget Sound region are in Federal ownership, 1 percent are in Tribal ownership, 12 percent are in State ownership, and 46 percent are in private or other ownership (Table 4). A Federal or State preservation or limited management status covers approximately 41 percent of the forestlands in the region. Only about 1 percent of the forestlands are available for Federal or Tribal timber management. State timber management may occur on approximately 11 percent of the forestlands and 46 percent of the forestlands are in private, county, city, or tribal ownership, where timber management may occur. Overall, lands covered by the forest practices rules represent approximately 57 percent of the forestlands in the region (see Figure 1, which displays these lands). Existing HCPs cover the majority (86 percent) of the State-managed lands, and about 13 percent of the combined private, county, and city ownerships. WRIA 14 has the largest percentage of forest practices rules-covered lands (99 percent of all forestlands, 45 percent of which are covered by existing HCPs) and WRIA 18 has the lowest (22 percent of all forestlands, 33 percent of which are covered by existing HCPs). Most of the private forestlands in the region are found on and adjacent to the Kitsap Peninsula, especially in WRIAs 14 and 15.

Small, 20-acre exempt forest landowners make up about 2.2 percent of the forestlands and about 3.8 percent of the forestlands subject to forest practices rules in the West Puget Sound region, based on the analysis by Rogers (2003). However, this analysis may represent an overestimate because of a potential anomaly in the Kitsap WRIA (15), where an unusually high number of parcels were tallied (personal communication, Luke Rogers, Rural Technology Initiative, University of Washington, May 2004). The small landowner parcels are mainly found in the lower elevation lands, especially on the Kitsap Peninsula and along the major rivers. The highest percentage (about 4.5% of the forestland) is in the Kitsap WRIA (15) and the lowest percentage (0.1%) is in the Skokomish-Dosewallips WRIA (16).

Approximately 4,879 stream miles occur on lands subject to forest practices rules in the West Puget Sound region (Table 5). This represents 54 percent of all streams in the region. Approximately 3,134 miles or 64 percent of the 4,879 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre exempt forest landowner parcels in this region is estimated to be about 5 percent and the percentage of all fish-bearing streams on small, 20-acre exempt forest landowner parcels is about 5.5 percent (Rogers 2003). However, the percentage in this region may be unrealistically high (see above).

Table 4. Ownership and Management of Forestlands (acres and percent) in the West Puget Sound Region by WRIA[1/]

Forestlands Category	WRIA 14 Kennedy-Goldsborough	WRIA 15 Kitsap	WRIA 16 Skokomish-Dosewallips	WRIA 17 Quilcene-Snow	WRIA 18 Elwah-Dungeness	Total West Puget Sound
Federal and State Protected Forestlands Not Managed for Timber Production[2/]	624	4,850	254,444	72,069	299,209	631,196
Federal Lands and Tribal Forestlands Available for Timber Management[3/]	1,074	13,606	4,001	2,980	445	22,105
Forestlands Available for Timber Management Under the State Forest Practices Rules						
DNR and Other State Forestlands	21,203	50,280	33,462	35,019	28,727	168,691
Private, County, and City Forestlands	168,226	288,046	63,124	127,423	53,385	700,204
Subtotal	189,429	338,326	96,586	162,442	82,112	868,896
TOTAL FORESTLANDS	191,128	356,782	355,031	237,492	381,766	1,522,197
% IN FEDERAL OR STATE PROTECTION	0%	1%	72%	30%	78%	41%
% AVAILABLE FOR FEDERAL OR TRIBAL TIMBER MANAGEMENT	1%	4%	1%	1%	0%	1%
% AVAILABLE FOR STATE TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	11%	14%	9%	15%	8%	11%
% AVAILABLE FOR PRIVATE OR COUNTY/CITY TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	88%	81%	18%	54%	14%	46%

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan, and USGS/EPA National Land Cover Data GIS layers.
[2/] Federal and State Protected Lands includes: Wilderness, LSR, LSOG, AMA, National Wildlife Refuges, National Parks, Washington State Parks, and WDFW lands.
[3/] Federal and Tribal Lands Available for Timber Management include: USFS Matrix lands, USFS other lands, BLM lands, Dept of Defense lands, and Indian Reservation lands.

Table 5. Stream Miles in the West Puget Sound Region by Ownership, Forested Stream Miles, and Forest Practices Rules (FPR)-Regulated Stream Miles[1/]

Category	WRIA 14 Kennedy-Goldsborough	WRIA 15 Kitsap	WRIA 16 Skokomish-Dosewallips	WRIA 17 Quilcene-Snow	WRIA 18 Elwah-Dungeness	Total West Puget Sound
Total Stream Miles						
Federal	-	35	1,260	353	1,273	2,921
Tribal	7	40	46	-	7	100
State	121	343	264	224	164	1,115
County/City	0	58	-	-	12	70
Private	1,007	1,936	593	882	490	4,908
Total Miles	**1,134**	**2,411**	**2,163**	**1,459**	**1,947**	**9,114**
Forested Stream Miles						
Forested Miles	932	1,932	1,926	1,286	1,593	7,669
% of Total Miles	82%	80%	89%	88%	82%	84%
FPR-Regulated Stream Miles						
FPR-Reg. Miles	922	1,849	725	931	452	4,879
% of Total Miles	81%	77%	34%	64%	23%	54%

[1/] Data sources: DNR stream hydrography GIS layer, DNR Major Public Lands layer, and USGS/EPA National Land Cover Data. Stream miles include all Type 1-9 streams.

4.0 HABITAT LIMITING FACTORS

Primary Regional Factors

The Puget Lowlands are composed of many small drainages, which have historically supported large runs of chum and coho salmon. Managed forestlands throughout this area are becoming increasingly fragmented by urban development, although some large commercial timber plantations remain on the western side of the Kitsap Peninsula and in eastern Jefferson County (Quilcene – Port Ludlow area of the Olympic Peninsula). Agricultural uses are common in the floodplains of the area.

In the Olympic Mountains, stream channel gradients are high, and natural barriers limit anadromous salmonid utilization in many basins. Recreational, residential and limited urban development has resulted in some impact, especially along the marine shorelines. Most of the larger rivers drain from the Olympia National Park and USFS Wilderness; thus, many of the upper watersheds are substantially protected. However, timber harvest and the associated forest road construction occurred in some of the high Olympics in the South Fork Skokomish and Dungeness Basins. These forest practices were followed by severe landslide episodes (Bounty et al 2002, WDNR 1997). Private and State commercial timber plantations are present around the fringes of this Federal land, and occupy most of the foothills. Hydropower dams block anadromous fish access to the upper Elwha River (however these dams are slated for removal in 2008), and summer irrigation and groundwater withdrawals create problems in the lower Dungeness River.

Sedimentation/Mass Wasting

In the Puget Lowlands, shallow rapid landslides (SRLSs) are not a widespread problem; however, locally sensitive areas occur. Activity that loosens soils, increases hillslope gradients, removes trees and concentrates runoff can trigger landslides on steep gradients (WDNR 1998, WSCC 1999). These landslides can deliver both fine and course sediments to stream channels and aggrade channel beds (WDNR 1998).

In the Olympic Mountains, slow weathering rock formations and high mountains have created long and steep hillslopes. The natural incidence of mass wasting is high (WDNR 1994, WSCC 2003b), especially where forest fires have occurred. Extensive road construction and timber harvests on steep slopes are triggering hundreds of SRLSs. Mid-slope roads are particularly troublesome. Although conflicting assessments exist concerning the downstream impact of these slides, the most recent assessment concluded that impacts were severe (WSCC 1999). Hundreds of SRLSs, as a result of historic timber harvest and road construction on steep slopes, have been documented in the South Fork Skokomish River and Big Quilcene Rivers (WDNR 1994, WDNR 1997). In the Dungeness Basin, a sizeable portion of land is outside the National Park and wilderness area preserves, and some deep glacial deposits exist in the middle of the watershed (WSCC 1999).

Large deep-seated landslides (DSLSs) are not common to the West Puget Sound region. The Puget Sound Lowlands lack the steep long slopes, and the Olympic Mountains have relatively hard unweathered bedrock as a result of rapid geological uplift. However, the Olympic Mountains do contain a number of active large DSLSs in large alluvial and glacial deposits. For example, the Dungeness River has been severely impacted by three DSLSs (PSCRBT 1991). A number of DSLSs are located at or near the west Hood Canal shoreline, where deep glacial and alluvial deposits are being undercut by shoreline or river channel erosion. Highway placement, timber harvest, and residential development may have contributed to this problem. Several of these landslides were activated during a period of high precipitation in 1996, resulting in closure of State Route 101 for seven months (WSCC 2003b).

In addition to the coarse sediment mentioned above, fine sediment from unpaved roads enter stream channels. Unpaved roads are wide spread on industrial forestlands, and to a lesser extent, in rural residential areas and recreational forestlands. Commercial forestlands throughout Washington State have extensive networks of unpaved roads, and the West Puget Sound region is no exception. Fortunately, competent "hard" rock for road surfaces is readily available.

On the Kitsap Peninsula, within the Puget Lowlands, many rural unpaved roads in low gradient areas are not graded above the surrounding surface, but are sunken below the surface of the land. This makes the discharge of surface water impossible. During high rainfall, water flows down the road until there is a dip in the road gradient. Water and sediment are discharged at these points, often directly into a channel. Most of these roads are residential, and not subject to forest practices rules (WDNR 1998).

Riparian, Floodplain and Wetland Conditions

Most drainages within the Puget Lowlands are small and relatively low in gradient, thus they lack the water volume or energy to form wide floodplains. Many of the smaller floodplains, which do exist, have already been developed. Perched aquifers have contributed to freshwater wetlands in the headwaters of various drainages (e.g., West Kitsap watershed). These wetlands are being filled or impacted by adjacent residential developments (WDNR 1998).

Heavy rainfall and relatively steep channel gradients in the Olympic Mountains result in flashy systems and relatively few small wetlands. Alpine lakes and bogs occur within the interior of the Olympic Mountains. With the exception of the Skokomish River System, floodplains are restricted to the lowest reaches of these rivers adjacent to marine waters. These floodplain areas were the most suitable (i.e., flat) for settlement, and towns and farms were frequently established there. Once established, the river channels were diked and levied for protection from flooding. The Skokomish River has a more extensive floodplain extending 14 miles inland. Most of this floodplain has been converted to agricultural uses, and much of the wetlands that once existed have now been drained or filled (WSCC 1999, WDNR 1997). Although, the valley has a history of flooding, a large influx of sediment from the upper south fork has occurred in the past 20 years, causing rapid aggradation of the riverbed and more frequent floods. A combination of historic forest practices and natural events have contributed to this bedload influx (WDNR 1997).

Channel/Hydrology Conditions

Hydropower storage dams are operating on the Elwha River and the North Fork Skokomish River, and both dams contribute to downstream gravel depletion (WSCC 1999, WSCC 2003b). The Elwha River dams block anadromous fish access to 70 miles of channel. On the North Fork Skokomish River, historical anadromous fish access to the dam sites is uncertain; however, the hydropower plant diverts flow directly to Hood Canal, and thus bypasses a substantial portion of the flow from 17 miles of habitat. Other small hydropower projects and municipal water diversions may have localized impacts to the aquatic environment (WSCC 1999, WSCC 2003b).

Within the West Puget Sound region, peak stream flows have systematically increased over time due to land use activities including paving (roads and parking areas), reduced percolation through surface soils on residential and agricultural lands, simplified and extended drainage networks, loss of wetlands, and rain on snow events in higher elevation clearcuts (WDNR 1997, WDNR 1998). The impact of residential development on peak flow is well documented in the West Kitsap Watershed Analysis in WRIA 15 (WDNR 1998). Loss of forest canopies can substantially increase peak flow events due to 'rain-on-snow' runoffs. Snow accumulations, especially at high elevations, are substantially greater on unforested than on forested surfaces. This is primarily a concern with clearcut timber harvest at elevations above 900 meters (approximately 3000 feet) in the Olympic Mountains (WFPB 1997).

The northeast coast of the Olympic Peninsula is the driest place in western Washington because it is located in the rain shadow of the Olympic Mountains. This has made the Port Angeles – Sequim area popular for residential, recreational and retirement development; however, this creates a high demand for water during the summer. Irrigation and municipal water withdrawals and residential ground water withdrawals have impacted surface flow in the lower Dungeness River, and, to a lesser extent, in the lower Elwha and small tributaries in the Port Angeles-Sequim area. However, irrigation actually improves summer flow in some smaller tributaries as a result of continuous groundwater recharge (WSCC 1999).

The Puget Lowlands are relatively low in elevation, thus snow accumulation is rare. Furthermore, soil percolation is naturally high in most of the West Puget Sound region. Groundwater withdrawal and increased peak flow may decrease surface flow during the dry season in urban areas. However in some areas of the Puget Lowlands, impervious surfaces such as paved roads, buildings, and lawns contribute to reduced soil percolation. The filing and degradation of freshwater wetlands has also increased peak flows in some areas (WSCC 1999, WDNR 1998).

Estuarine and Nearshore Habitat

The Puget Lowlands exhibit a complex network of roughly 1000 miles of marine and estuarine shorelines. Most of these estuaries are still present, but some level of modification or alteration has occurred in most of them. Failing septic systems is a common problem in many areas, leading to closure of shellfish beds. The more urbanized areas exhibit a wider range of problems from sedimentation, road surface runoff, industrial pollutants, and heavy metal contamination of the marine sediments (WSCC 2003).

Some of the rivers draining from the Olympic Mountains have well-developed estuaries (i.e., the Skokomish River), while others (i.e. Dosewallops, Elwha Rivers) have relatively abrupt transitions from freshwater to salt water. The Skokomish River Estuary has been impacted by a dike preventing tidal and floodwater circulation; however, the dike has recently been breached in places to allow more natural function (WSCC 2003b). Industrial pollution and the substantial reduction of late summer flow in the Dungeness River have contributed to the decline of eelgrass in the Dungeness estuary (WSCC 1999).

Degradation of the near-shore environment has occurred in the southeastern areas of Hood Canal in recent years resulting in late summer marine oxygen depletion and significant fish kills. This problem was severe in 2003. Circulation of marine waters is naturally limited, and partially driven by freshwater runoff, which is often low in the late summer. However, human development has increased nutrient loads from failing septic systems along the shoreline, and from use of nitrate and phosphate fertilizers on lawns and farms. Shoreline residential development is widespread and dense in many places. The combination of highways and dense residential development has impacted both physical and chemical characteristics of the near-shore environment (WSCC 2003a).

Large Woody Debris

The recruitment of LWD has been impacted by past riparian forest harvest and, on lands converted to other uses, the failure to re-establish these riparian forests following harvest. The retention of in-channel LWD has been impacted by its removal for navigational purposes, dikes and levee interference, debris torrents, and the historic practice of LWD removal as a misguided fisheries management tool. The recent removal of in-channel large cedar logs occurred in Big Beef Creek (WDNR 1998). Removal of newly recruited LWD from the Skokomish River for commercial timber has occurred in recent years (WDNR 1997).

Most of the stream channels in the Puget Lowlands are small to medium in size and do not require very large wood to achieve most LWD function. Historic harvest of the riparian timber, regeneration of those stands as hardwoods, and agriculture and urban development, have impacted the existence and function of riparian buffers (WDNR 1995, WDNR 1998). Some channels in this region are exceptionally sensitive to the loss or removal of LWD, because they cross deep deposits of unconsolidated glacial material. Channels flowing across such deposits often lack bedrock, boulder and large cobbles necessary to armor the channel bed; and therefore, the loss of LWD can lead to rapid channel incision and accelerated bank failures (e.g. Big Beef Creek, WDNR 1998). Other channels such as those in the South Fork Skokomish basin are in moderately good condition in terms of current and future in-channel LWD. Those areas with a high LWD recruitment hazard in the South Fork Skokomish basin have very good prospects for future improvement for LWD (WDNR 1997). In the Kennedy Creek watershed, 68 percent of the riparian areas of fish bearing streams were found to have the ability to supply an adequate amount of LWD in the near term and that percentage will likely increase over time, given the riparian protections that are now in place (WDFW 1995).

In the Olympic Mountains, landslides are the primary means of LWD recruitment, although riparian adjacent recruitment is still important. Steep gradients and precipitation results in high-energy peak flows. Thus, very large conifer LWD, with attached rootwads, is required to achieve LWD function in these larger channels. Confinement of valley floor river channels by diking and levees accelerates downstream transportation of LWD during peak flows (e.g., Bountry et al. 2002).

Water Quality Issues

In the upper watersheds of the Olympic Mountains, data on water temperature is sparse, but water temperature problems are not expected (WSCC 1999, 2003b). Along the coastline of WRIA 18 (Port Angeles-Sequim area); however, a few water temperature problems have been documented (e.g. Dry Creek, WDOE 1998). Within the Puget Lowlands, elevated water temperature problems are more common, but variable from drainage to drainage. Agricultural land use and the associated lack of riparian buffers are the key reason for elevated temperatures, although lakes, wetlands and residential development can be contributors in some areas (WSCC 2000, 2002a, 2002b, 2003a). In WRIA 17, high temperatures have been documented in Chimacum Creek, the Little Quilcene River and tributaries, Tarboo Creek and Thorndike Creek. In WRIA 15, Big Beef Creek and Gamble Creek have had high temperatures (WDOE 1998).

A few low dissolved oxygen problems have been noted, primarily associated with low stream velocities through agricultural lands. Many stream channels have not been monitored for water quality (WSCC 1999, 2000, 2002a, 2002b, 2003a).

Forest roads and harvest activities, as well as dikes and levees downstream, have increased aggradation of sediments and peak flows in the Skokomish River (WRIA 16), Dungeness River (WRIA 18), and to some extent the Big Quilcene River (WRIA 17) (Barreca 1998). These three rivers are also impaired due to low instream flow from water withdrawals or diversions. Fish and wildlife forested habitat owned by Simpson Timber in the Skokomish watershed is now protected by a Habitat Conservation Plan (Simpson Timber Company 2000).

5.0 HABITAT TRENDS

Potentially unstable landforms are routinely identified and mapped. However long-term trends of landslide activity are difficult to systematically measure, because activities that cause landslides (roads, steep slope timber harvest) and the actual occurrence of landslides are often separated by years or decades. At this point, no reliable data exist on the long-term trend of landslide events.

Direct measure of in-channel fine sediment is costly and impractical because very large sample sizes are necessary to achieve statistical significance. Therefore, the watershed analysis methodology (WFPB 1997) and the more recent Road Maintenance and Abandonment Plans (RMAP) focus on measuring fine sediment before it enters the channel. This method measures surface erosion for the tread surface, cutslope, ditchline and fillslope, based on road use, soil type, vegetative cover, gradient, water routing and other factors. No recent independent assessments of forest road maintenance have been made in Washington State or the West Puget Sound region.

Habitat trends in LWD and Shade can be determined, given the following three assumptions: 1) riparian stand conditions can adequately represent recovery of current and future LWD and shade; 2) riparian stand conditions can be determined from contemporary aerial photographs; and 3) most riparian buffers on non-Federal lands were historically harvested, thus, the current riparian condition represents a state of recovery. It is important to note that forestlands make up approximately 88 percent of the West Puget Sound region, most under private and State management. Approximately 41 percent of the forestland is under Federal or State protection (See Tables 3 and 4).

On a large scale, meaningful trends can be determined, based on two photometric studies. A dataset used by Lunetta et al. (1997) was made available from Cosentino (personal communication, Brian Cosentino, WDFW, 2003), which isolated data from the West Puget Sound region by WRIAs (Table 6). 'Response reaches' were generally defined by Lunetta et. al. as the lower gradient (< 4 percent) habitat where most of the anadromous fish production occurs. Table 6 shows that 11 percent of the response reach riparian buffers (RRRBs) were classified as late seral stage. Almost 18 percent of the RRRBs were non-forested, primarily as a result of urban and agricultural development. The West Puget Sound region has a smaller percentage of non-forested lands than North and South Puget Sound regions because of the large areas of National Park and National Forest lands on the Olympic Peninsula, and the generally reduced pace of urban and agricultural conversion. Thirty-two percent of the Olympic Mountains were in late seral condition[5], as compared to almost 2 percent within the Puget Lowlands. This reflects the extent of historical timber harvest within the Puget Lowlands and the reduced timber harvest on Federal lands. Thirty-eight percent of the Puget Lowlands were described as other forestlands, defined as either hardwood, brush, or clearcuts. This may reflect the regeneration of riparian areas as hardwoods following historic harvest. In a separate photometric survey, Marshall and Associates (2000) looked at riparian buffers on private forestlands only, and determined that roughly 54 percent[6] of the riparian buffers on private forestlands were hardwood dominated (e.g., > 70 percent hardwoods). These two photometric assessments suggest that a substantial portion of the 'other forestland' riparian zone in Table 6 is hardwood-dominated.

In summary, this data set suggests that riparian areas on Federal lands in the Olympic Mountains have seen only limited harvest, and are now substantially protected (personal communication, Mark Hunter, WDFW, 2003). Gradual increased restrictions on riparian timber harvest over the past 30 years places private forestlands on a pathway to recovery, although that pathway is longer for hardwood stands in the Puget Lowlands. Urban and agricultural impacts on riparian buffers,

[5] 'Late Seral' Stands should not be confused with 'Old Growth Stands.' 'Late Seral' as defined by Lunetta et al (1997) means the conifer crown cover is >70% and more than 10% of the crown cover in trees are greater than 21 inches diameter breast height (dbh). Thus, 'Late Seral' can include some mature second growth conifer stands.

[6] This study used regional definitions that overlap the regional definitions used herein. The actual figures used in this study were 51% for the 'South Puget Sound' Region, and 57% for the 'North Coast' Region. These two regions are roughly the same as the combined Olympic Coast, West Puget Sound and South Puget Sound regions as defined in this report. Marshall and Assoc. found relatively little variation in hardwood stand percentages on private lands throughout western Washington.

Table 6. Percent of response reach riparian buffers by WRIA for the West Puget Sound Region. [See Lunetta et al. (1997) for description of data.]

Canopy Class	Late Seral Stage	Mid Seral Stage	Early Seral Stage	Other Forest-lands	Water	Non-forest lands
Canopy Class Definition	>70% conifer canopy; >10% of the canopy must be conifer>21"dbh	>70% conifer canopy; <10% of the canopy must be conifer>21"dbh	Conifer Crown cover > 10% and <70%	Hardwood dominated, shrub or recent clearcut,	Lakes, large rivers and other large water bodies	Urban, agriculture, rangeland, barren, glaciers
WRIA or Basin Name						
Kennedy-Goldsborough	2.7%	26.6%	10.5%	47.3%	1.2%	11.6%
Kitsap	0.0%	39.6%	10.6%	31.9%	0.9%	17.0%
Skokomish-Dosewallops	37.8%	21.6%	4.4%	28.2%	0.4%	7.6%
Quilcene-Snow	5.8%	25.0%	5.9%	43.5%	0.5%	19.2%
Elwah-Dungeness	27.9%	11.4%	1.3%	28.7%	0.2%	30.5%
Total response reach riparian acres	7157	17994	4811	22605	453	11306
Regional percentage	11.1%	28.0%	7.5%	35.1%	0.7%	17.6%
Puget Lowlands (14,15 &17)	1.8%	33.4%	9.6%	38.1%	0.9%	16.1%
Olympic Mountains (16,18)	32.1%	15.7%	2.6%	28.5%	0.3%	20.9%

while significant, are less extensive for the West Puget Sound region than the other Puget Sound regions.

6.0 FISH RESOURCES

Salmonid Stocks

All anadromous salmonid species are present in the West Puget Sound region. Chinook salmon and bull trout are Federally listed as threatened in the region. Coho salmon is a Federal species of concern.

Table 7 lists the salmonid species that occur within the West Puget Sound region. The asterisk next to the species name indicates that the species is introduced, and not native to Washington State.

Table 7. Salmonid species present by WRIA within West Puget Sound Region (WDFW 2003).

Species	State Status[1/]	Federal Status[2/]	Kennedy - Goldsborough Basin (WRIA 14)	Kitsap Peninsula (WRIA 15)	Skokomish-Dosewallops (WRIA16)	Quilcene-Snow Creek (WRIA 17)	Elwha-Dungeness (WRIA 18)
Resident Cutthroat Trout		FCo	X	X	X	X	X
Searun Cutthroat Trout		FCo	X	X	X	X	X
Pink Salmon					X	X	X
Chum Salmon			X	X	X	X	X
Coho Salmon		FCo	X	X	X	X	X
Rainbow Trout			X	X	X	X	X
Summer Steelhead				X	X	X	
Winter Steelhead			X	X	X	X	X
Sockeye Salmon					X		
Kokanee Salmon					X		X
Fall Chinook Salmon		FT		X	X	X	X
Spring Chinook Salmon		FT					X
Dolly Varden/Bull Trout	SC	FT			X	X	X
Brook Trout*					X	X	X
Mountain Whitefish					X		X

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Other Freshwater Fish Species

Table 8 is a list of non-salmonid freshwater species that exist in the West Puget Sound region. The asterisk next to the species name indicates that the fish is not native to Washington State. This list should not be regarded as an exhaustive list of the species present. Additionally, the Olympic Mudminnow, a State sensitive species, is endemic to Western Washington and prefers slow water and wetlands. It was historically found in the lowlands of Thurston and Mason counties at the southern end of the Western Puget Sound region (Rodrick and Milner 1991).

Table 8. Other non-salmonid freshwater species by WRIA within the West Puget Sound Region (WDFW 2003).

Species	State Status[1/]	Federal Status[2/]	Kennedy - Goldsborough (WRIA 14)	Kitsap Peninsula (WRIA 15)	Skokomish-Dosewallops (WRIA 16)	Quilcene-Snow Creek (WRIA 17)	Elwha-Dungeness (WRIA 18)
Speckled Dace			X	X			
Salish Sucker	SM				X		
Sculpin spp.						X	X
Prickly Sculpin			X	X	X	X	X
Riffle Sculpin			X	X	X		
Reticulate Sculpin			X		X		
Shorthead Sculpin				X	X		
Torrent Sculpin				X	X		
Three-Spine Stickleback			X			X	
Pacific Lamprey		FCo		X	X	X	X
River Lamprey	SC	FCo			X		
Western Brook Lamprey			X	X	X	X	X
Olympic Mudminnow	SS		X				
Peamouth			X				
Brown Bullhead*				X			
Channel Catfish*			X	X	X	X	
Sunfish spp*.						X	X
Crappie spp*			X	X	X	X	X
Largemouth Bass*				X		X	
Smallmouth Bass*						X	
Yellow Perch*				X			

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Status of Salmonid Stocks

The State and Tribal Stock status for 79 stocks in the West Puget Sound region by drainage is shown in Table 9.

Table 9. Puget Sound Salmon and Steelhead Stock List presented by River Basin (2002 SASI Report, 1998 Bull Trout Status Report).

River Basin	Species	Stock Status
Deep South Sound Tributaries		**2002**
Hammersley Inlet	Summer Chum	Healthy
Case Inlet	Summer Chum	Healthy
Blackjack Creek	Summer Chum	Healthy
Henderson Inlet	Fall Chum	Unknown
Eld Inlet	Fall Chum	Healthy
Totten Inlet	Fall Chum	Healthy
Skookum Inlet	Fall Chum	Healthy
Upper Skookum Creek	Fall Chum	Healthy
Johns/Mill Creeks	Fall Chum	Healthy
Goldsbourgh/Shelton Creeks S	Fall Chum	Depressed
Case Inlet	Fall Chum	Healthy
Carr Inlet	Fall Chum	Healthy
Deep South Sound Tributaries	Coho	Healthy
Eld Inlet	Winter Steelhead	Unknown
Totten Inlet	Winter Steelhead	Unknown
Hammersley Inlet	Winter Steelhead	Unknown
Case/Carr Inlets	Winter Steelhead	Unknown
Hood Canal Drainages		
Skokomish River	Chinook	Depressed
Mid-Hood Canal	Chinook	Critical
Big Beef Creek	Summer Chum	Extinct
Anderson Creek	Summer Chum	Extinct
Dewatto Creek	Summer Chum	Extinct
Tahuya River	Summer Chum	Extinct
Union River	Summer Chum	Healthy
Skokomish River	Summer Chum	Extinct
Finch Creek	Summer Chum	Extinct
Lilliwap Creek	Summer Chum	Critical
Hamma Hamma River	Summer Chum	Depressed
Duckabush River	Summer Chum	Depressed
Dosewallips River	Summer Chum	Depressed
Big/Little Quilcene	Summer Chum	Depressed
Northeast Hood Canal	Fall Chum	Healthy
Dewatto Creek	Fall Chum	Healthy
Southeast Hood Canal	Fall Chum	Healthy
Lower Skokomish River	Fall Chum	Unknown
Upper Skokomish River	Late Fall Chum	Healthy
West Hood Canal	Fall Chum	Healthy
Hamma Hamma River	Late Fall Chum	Healthy
Duckabush River	Late Fall Chum	Healthy
Dosewallips River	Late Fall Chum	Healthy
Quilcene	Late Fall Chum	Healthy
Northeast Hood Canal	Coho	Healthy
Dewatto Creek	Coho	Healthy
Southeast Hood Canal	Coho	Healthy
Skokomish River	Coho	Healthy
Southwest Hood Canal	Coho	Healthy
Hamma Hamma River	Coho	Unknown

Table 9. Puget Sound Salmon and Steelhead Stock List presented by River Basin (2002 SASI Report, 1998 Bull Trout Status Report) (continued).

River Basin	Species	Stock Status
Duckabush River	Coho	Healthy
Dosewallips River	Coho	Unknown
Quilcene/Dabob Bay	Coho	Depressed
Hamma Hamma River	Pink	Healthy
Duckabush River	Pink	Depressed
Dosewallips River	Pink	Depressed
Skokomish River	Summer Steelhead	Unknown
Duckabush River	Summer Steelhead	Unknown
Dosewallips River	Summer Steelhead	Unknown
Dewatto Creek	Winter Steelhead	Depressed
Tahuya River	Winter Steelhead	Depressed
Union River	Winter Steelhead	Unknown
Skokomish River	Winter Steelhead	Depressed
Hamma Hamma River	Winter Steelhead	Depressed
Duckabush River	Winter Steelhead	Depressed
Dosewallips River	Winter Steelhead	Depressed
Quilcene/Dabob Bay	Winter Steelhead	Unknown
South Fork Skokomish River	Bull Trout/Dolly Varden	Unknown
Lake Cushman	Bull Trout/Dolly Varden	Healthy
Upper NF Skokomsih River	Bull Trout/Dolly Varden	Unknown
Juan De Fuca Strait – Admirality Inlet		
Dungeness River	Chinook	Critical
Elwha River	Chinook	Depressed
Chimacum Creek	Summer Chum	Extinct
Snow & Salmon creeks	Summer Chum	Depressed
Jimmycomelately Creek	Summer Chum	Critical
Dungeness River	Summer Chum	Unknown
Dungeness& Strait	Fall Chum	Unknown
Elwha River	Fall Chum	Unknown
Chimacum Creek	Coho	Healthy
Discovery Bay	Coho	Critical
Sequim Bay	Coho	Depressed
Dungeness Rver	Coho	Unknown
Morse Creek	Coho	Depressed
Elwha River	Coho	Unknown
Upper Dungeness River	Pink	Depressed
Lower Dungeness River	Pink	Critical
Elwha River	Pink	Critical
Dungeness River	Summer Steelhead	Unknown
Elwha River	Summer Steelhead	Unknown
Discovery Bay	Winter Steelhead	Healthy
Sequim Bay	Winter Steelhead	Unknown
Dungeness River	Winter Steelhead	Depressed
Morse Creek	Winter Steelhead	Depressed
Elwha River	Winter Steelhead	Depressed
Dungeness –Gray Wolf	Bull Trout/Dolly Varden	Unknown
Upper Dungeness	Bull Trout/Dolly Varden	Healthy
Lower Elwha River	Bull Trout/Dolly Varden	Unknown
Upper Elwha River	Bull Trout/Dolly Varden	Unknown

For Washington State and Tribal Stock Status, *Healthy* refers to a stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock; *Depressed* refers to a stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely; *Critical* refers to a stock of fish experiencing production levels that are so low that permanent damage to the stock is likely or has already occurred; and *Unknown* refers to a stock of fish which has insufficient information to rate stock status.

7.0 AMPHIBIANS

The West Puget Sound region harbors 14 amphibian species, including the introduced bullfrog (Dvornich et al. 1997; McAllister 1995). Of these 14 species, the largest assemblage (including the bullfrog) consists of 8 taxa that reproduce in stillwater habitats including lakes, oxbows, ponds, temporary pools, and other stillwater wetlands. Stillwater habitats are largely dichotomously split between high-elevation lakes and ponds, and lower elevations habitats associated with the riparian margins of larger stream or riverine systems. Since a large proportion of the lowland habitat has been altered or lost (see Floodplain Conditions and Wetland Conditions Section), significant impact to stillwater amphibians is presumed. Lowland habitats are also inhabited by introduced warmwater species (bullfrogs, catfish, and sunfish, see Table 8), and interactive facilitation may promote their survival (Adams et al. 2003) and contribute to negative effects on native amphibians (Adams 1999). Of the remaining six native amphibian species, three (ensatina, Van Dyke's salamander, and western red-backed salamander) reproduce in terrestrial habitats and the remaining three (Cope's giant salamander, coastal tailed frog and Olympic torrent salamander) reproduce largely in headwater streams, springs, or seeps (Table 10).

Three headwater species (coastal tailed frog, Cascades torrent salamander, and Van Dyke's salamander) are Forest Practices HCP-covered taxa (Table 10). All three species occur within the Olympic Mountains, but are absent from the Puget Lowlands. Known distributions may be conservative as no systematic surveys, either to understand distribution or to determine status (i.e., surveys of historic sites), have been performed in the region.

Regardless of the incomplete knowledge of the regional distribution of these species, all three may be at some level of risk because sedimentation has the potential to substantially reduce their instream habitat (Bury 1983, Bury and Corn 1988, Corn and Bury 1989). Timber harvest, which can result in significant sedimentation (Beschta 1978, Jakob 1999), occurs over a large part of the West Puget Sound region where they occur (see Habitat Trends section). Nevertheless, the precise nature of the risk in this region is currently unknown.

Table 10. Forest and Fish Amphibians of the West Puget Sound Region.

		Habitat			
		Active Season			
Group	Name	Breeding	Non-Breeding	Over-wintering	Regional Distribution
Frogs	Coastal tailed frog *Ascaphus truei*	Streams	Streams	Terrestrial	widespread but absent from WRIA 15
Salamanders	Van Dyke's salamander *Plethodon vandykei*	Terrestrial	Terrestrial	Terrestrial	Largely restricted to upper elevations of WRIA 16
	Olympic torrent salamander *Rhyacotriton olympicus*	Streams	Streams	Terrestrial	Known only from WRIAs 16-18

Although not covered under this Forest Practices HCP, seven other amphibians (namely northwestern salamander [*Ambystoma gracile*], long-toed salamander [*Ambystoma macrodactylum*], western toad [*Bufo boreas*], Pacific treefrog [*Hyla regilla*], northern red-legged frog [*Rana aurora*], Cascades frog [*Rana cascadae*] and rough-skinned newt [*Taricha granulosa*]) may receive some protection as a result of Forests and Fish patch buffer prescriptions. Two of these species, western toad and Cascades frog, have State watchlist (special concern) status (WDFW 2001). Both species have declined elsewhere in their geographic ranges (Carey 1993, Fellers and Drost 1993), but their status in the West Puget Sound region is unknown. Development and hydrological alteration may have resulted in habitat loss for western toads at low elevations.

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[WSCC 2003b] Washington State Conservation Commission. 2003. Salmon and Steelhead Limiting Factors Water Resource inventory Area 16. Dosewallops-Skokomish Basin. (Correa, G.)

ISLANDS
REGIONAL SUMMARY

ISLANDS
REGIONAL SUMMARY

1.0 PHYSICAL DESCRIPTION

The Islands region includes two WRIAs (San Juan WRIA 2, and Island WRIA -6). These two WRIAs lack extensive freshwater habitat, but have considerable nearshore habitat. The Island region includes San Juan and Island Counties. A map of the Islands region is presented in Figure 1.

The region has a marine climate characterized by mild, wet winters and cool, dry summers. Average annual precipitation ranges from 25 inches in the San Juan Islands.

General Geology

Due to gentle slopes and low relief in the Islands region, erosion is low relative to other planning regions. Mass wasting is generally limited to two landforms. The first includes inner gorges associated with incised stream channels where debris avalanches and short run-out debris flows sometimes occur. The second area includes coastal bluffs where shallow-rapid (i.e., debris avalanches and debris flows) and deep-seated landslide processes deliver sediment to marine waters. Surface erosion is rare except in cases where soils have been heavily disturbed or compacted.

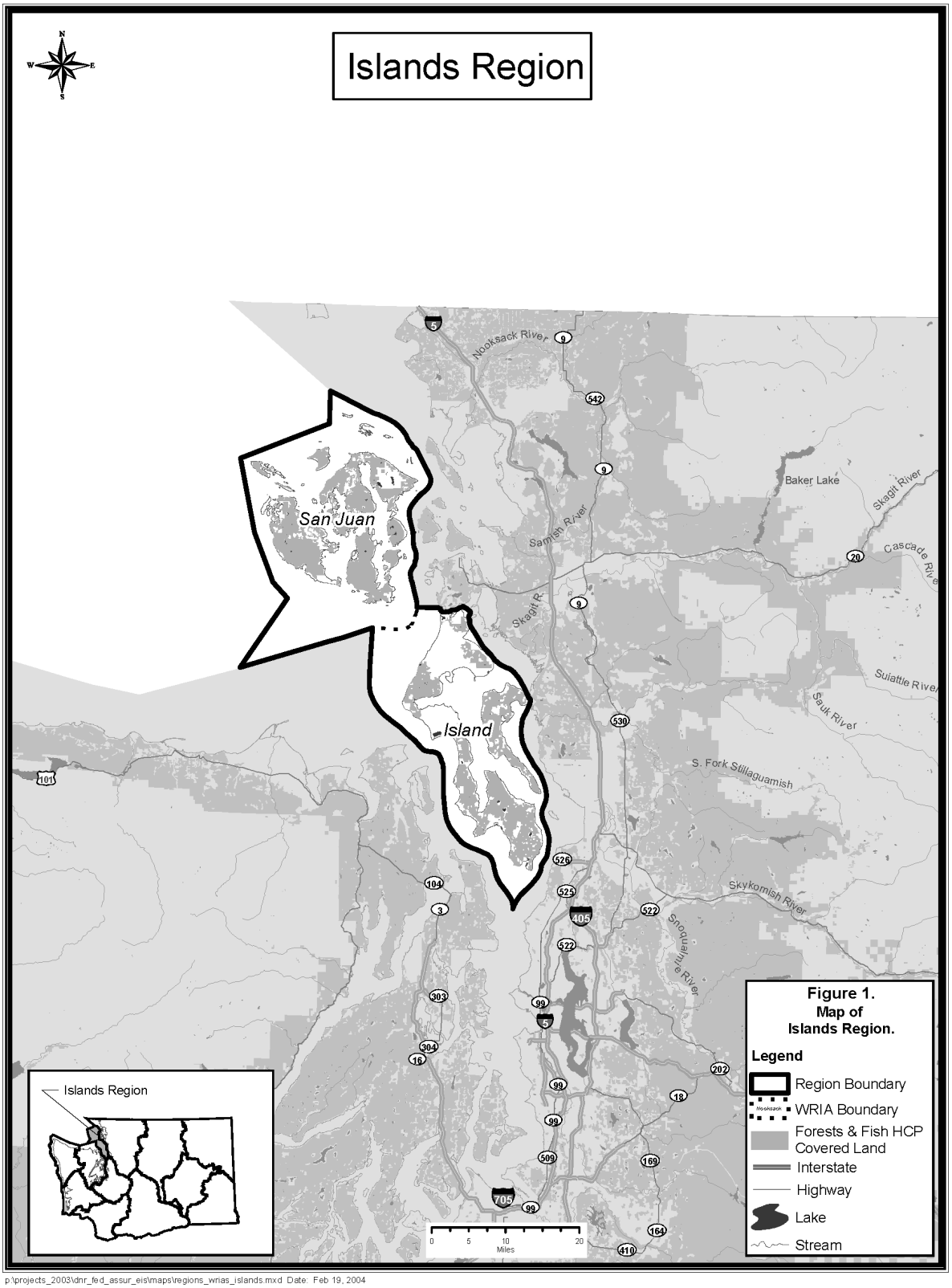
Stream Overview

The Islands region has no major rivers and has a relatively low stream density. Based on the DNR stream hydrography GIS coverage, there are approximately 1,009 stream-miles (both fish-bearing and non-fish streams) in the Olympic Coast region, with an average stream density of 2.62 stream miles/mile^2 (Table 1).

Table 1. Stream Miles in the Islands Region by WRIA[1/]

	WRIA 02 San Juan	WRIA 06 Island	Total Islands Region
Stream Length (miles)	523	486	1,009
Stream Density (miles/mi^2)	2.97	2.32	2.62

[1/] Primary Data Source: DNR stream hydrography GIS layer. Stream miles include all mapped Type 1-9 streams.


Islands Region
San Juan
Island
Nooksack River
Samish River
Skagit R.
Baker Lake
Skagit River
Cascade River
Sauk River
Suiattle River
S. Fork Stillaguamish
Skykomish River
Snoqualmie River
Islands Region
0 5 10 20
Miles
Figure 1.
Map of
Islands Region.
Legend
Region Boundary
WRIA Boundary
Forests & Fish HCP Covered Land
Interstate
Highway
Lake
Stream
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2.0 LAND OWNERSHIP AND USE

Major Land Ownership and Management

Only about 4 percent of all lands in the Islands region are in Federal ownership and only about 1 percent of all lands are being managed for long-term preservation by the national wildlife refuges and parks (Table 2). Most of the Federal lands (3 percent of all lands) are under management at the Whidbey Island Naval Air Station. None of the lands are under Tribal management. State lands represent about 10 percent of all lands in the region, and city/county lands represent less than 0.5 percent. The vast majority of lands in the Islands region are in private ownership (85 percent). The San Juan and the Island WRIAs (WRIAs 2 and 6) have almost the same percentage in private ownership (85 to 86 percent).

Land Cover and Use

Forestland makes up approximately 73 percent of the Islands region (Table 3). It is more prevalent in the San Juan WRIA (78 percent) than in the Island WRIA (69 percent). Agricultural uses make up approximately 17 percent of the region, and are about equally prevalent in the two WRIAs. Residential and commercial uses make up the next largest percentage (6 percent), with more development in the Island WRIA and less in the San Juan WRIA.

3.0 FORESTLAND OWNERSHIP AND MANAGEMENT

Approximately 3 percent of the forestlands in the Islands region are in Federal ownership, none is in Tribal ownership, 12 percent are in State ownership, and 86 percent are in private or other ownership (Table 4). A Federal or State status of preservation or limited management covers approximately 6 percent of the forestlands in the region. Approximately 2 percent of the forestlands are available for Federal or Tribal timber management. State timber management may occur on approximately 6 percent of the forestlands, and 86 percent of the forestlands are in private, county, or city ownership, where timber management may occur. Overall, lands covered by the forest practices rules represent approximately 92 percent of the forestlands in the region (see Figure 1, which displays these lands). Existing HCPs cover about 32 percent of the State-managed lands, but none of the private, county, and city ownerships. The percentage of forestlands that are subject to the forest practices rules ranges from 90 percent in the San Juan WRIA to 93 percent in the Islands WRIA.

Small, 20-acre exempt forest landowners make up about 1 percent of the forestlands and about 1.1 percent of the forestlands subject to forest practices rules in the Islands region, based on an analysis done only in the San Juan WRIA by Rogers (2003). Although this analysis may represent an underestimate, it is believed to have identified the majority of all small, 20-acre exempt parcels (personal communication, Luke Rogers, Rural Technology Initiative, University of Washington, May 2004).

Approximately 497 stream miles occur on lands subject to forest practices rules in the Islands region (Table 5). This represents 49 percent of all streams in the region. Approximately 340 miles or 68 percent of the 497 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre exempt forest landowner parcels in this region is estimated to be less than 1 percent (Rogers 2003).

Table 2. Land Ownership Parameters for Islands Region by WRIA [1/]

Land Ownership	WRIA 2 San Juan	WRIA 6 Island	Total Islands Region
Federal – Long-term Congressionally Protected Lands [2/]	1,990	-	1,990
Federal – Other National Forest System Lands [3/]	-	-	-
Federal – Other Federal Lands [4/]	611	7,814	8,425
State – Protected Lands [5/]	7,049	4,367	11,417
State – Managed Lands [6/]	5,767	7,127	12,895
Tribal Lands/Indian Reservations	-	-	-
Municipal Watershed	583	-	583
Other County/City Lands	148	591	738
Private	96,406	114,369	210,775
TOTAL	**112,554**	**134,268**	**246,822**

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan GIS layers.
[2/] Includes national parks, national monuments, national recreation areas, national wildlife refuges, and wildernesses.
[3/] Includes all non-wilderness National Forest System lands; the majority of the acres consists of lands protected under the Northwest Forest Plan (e.g., LSR, Managed LSR, AMA, Riparian Reserves)
[4/] Includes all Department of Defense, Department of Energy, Bureau of Land Management, and Bureau of Reclamation lands.
[5/] Includes all State Parks and Wildlife Areas.
[6/] Includes all DNR, Department of Corrections, and University lands.

Table 3. General Land Cover Classifications in the Olympic Coast Region by WRIA[1/]

Land Cover	WRIA 02 San Juan	WRIA 06 Island	Total Islands Region
Forestland	87,569	92,711	180,280
Shrubland	2,010	2,236	4,246
Grassland	1,162	957	2,120
Water & Wetlands	1,726	899	2,625
Ice, Snow, & Bare Rock	420	1,389	1,809
Residential & Commercial	2,146	12,259	14,405
Agricultural	17,521	23,817	41,338
TOTAL	**112,554**	**134,268**	**246,822**

[1/] Primary Data Source: USGS/EPA National Land Cover Data GIS layer.

Table 4. Ownership and Management of Forestlands (acres and percent) in the Islands Region by WRIA[1/]

Forestlands Category	WRIA 02 San Juan	WRIA 06 Island	Total Islands Region
Federal and State Protected Forestlands Not Managed for Timber Production[2/]	8,005	3,701	11,706
Federal Lands and Tribal Forestlands Available for Timber Management[3/]	508	3,100	3,607
Forestlands Available for Timber Management Under the State Forest Practices Rules			
DNR and Other State Forestlands	5,123	5,439	10,562
Private, County, and City Forestlands	73,933	80,472	154,405
Subtotal	79,056	85,911	164,967
TOTAL FORESTLANDS	87,569	92,711	180,280
% IN FEDERAL OR STATE PROTECTION	9%	4%	6%
% AVAILABLE FOR FEDERAL OR TRIBAL TIMBER MANAGEMENT	1%	3%	2%
% AVAILABLE FOR STATE TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	6%	6%	6%
% AVAILABLE FOR PRIVATE OR COUNTY/CITY TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	84%	87%	86%

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan, and USGS/EPA National Land Cover Data GIS layers.
[2/] Federal and State Protected Lands includes: Wilderness, LSR, LSOG, AMA, National Wildlife Refuges, National Parks, Washington State Parks, and WDFW lands.
[3/] Federal and Tribal Lands Available for Timber Management include: USFS Matrix lands, USFS other lands, BLM lands, Dept of Defense lands, and Indian Reservation lands.

Table 5. Stream Miles in the Olympic Coast Region by Ownership, Forested Stream Miles, and Forest Practices Rules (FPR)-Regulated Stream Miles1/

Category	WRIA 02 San Juan	WRIA 06 Island	Total Islands Region
Total Stream Miles			
Federal	9	38	47
Tribal	-	-	-
State	56	42	98
County/City	6	3	9
Private	452	403	855
Total Miles	**523**	**486**	**1,009**
Forested Stream Miles			
Forested Miles	291	258	549
% of Total Miles	56%	53%	54%
FPR-Regulated Stream Miles			
FPR-Reg. Miles	264	233	497
% of Total Miles	51%	48%	49%

[1/] Data sources: DNR stream hydrography GIS layer, DNR Major Public Lands layer, and USGS/EPA National Land Cover Data. Stream miles include all Type 1-9 streams.

4.0 HABITAT LIMITING FACTORS

The natural characteristics of the Islands region (WRIAs 02 and 06) are directly affected by human population and land use. Island County is the second smallest but second fastest growing county in Washington State. Lands zoned for forest management (44.5 km^2) and agriculture (18.6 km^2) comprise 12 percent of Island County land. About 55 percent of those lands have been developed. Currently, no known quantitative information exists concerning the riparian zones for streams or estuaries within WRIA 6 (Island). From a regional standpoint, the islands' major contribution to salmon productivity is its nearshore habitat. Nearshore habitats are important for migrating adult salmon. The Islands region nearshore environment includes numerous estuaries and salt marches and provides important habitat for spawning herring and other species that are food for salmonids. Much of the shoreline in Island and San Juan counties (WRIAs 2, 6) have been developed for single family homes and other development associated with recreational and leisure activities. Shoreline residential development is a greater concern in Island County, than for San Juan County. Such development often results in removal of trees along with shade and bank stability, and bulkhead bank armoring resulting in reduction of beach sand recruitment. Septic tanks often leak and affect water quality (WSCC 2000). Only 20 percent of the San Juan Island (WRIA 2) and Eastern Juan De Fuca Strait shoreline is considered modified, which is significantly better than the mainland shorelines (Berry 1997, as cited in WSCC 2002). Although these islands have no self sustaining runs of anadromous salmonids (WSCC 2002), nearshore habitats in these islands are important for various salmon runs from the Frasier (Canada), Nooksack, Skagit, Stilliguamish, and Snohomish Rivers.

Most of WRIA 6 streams are intermittent or ephemeral, and generally do not provide a sufficient flow of water to support salmonids. A few streams on Whidbey Island (Maxwelton and Glendale Creeks) are presumed to flow year-around and to support small populations of resident salmonids. These perennial streams are fed by year-around springs and forested wetlands. Ten more sub-basins have been identified as having the potential to provide salmonid habitat. Coho and chum are known to occur in freshwater streams on Whidbey Island.

Fish access is a major limiting factor in WRIA 6, though not yet identified as significant for anadromous fish. Culverts, tide gates, and dikes are the main structures impeding or preventing fish passage. A few small dams are also present. Low stream flow or temperature conditions can also function as barriers to fish passage, especially during the summer (WSCC 2000).

Water Quality Issues

Although high temperatures have been documented in a few streams in WRIA 2, there is no continuous monitoring or multi-year record of temperature problems. None of the streams in WRIAs 2 or 6 are considered to be impaired for temperature, turbidity or fine sediments (WDOE 2004). Several creeks are considered to be impaired by non-pollutants: for fish habitat in WRIAs 2 and 6, and for instream flow in WRIA 6.

5.0 FISH RESOURCES

The following fish species (Table 6) occur in the Islands region. This list should not be regarded as an exhaustive list of the species present (WDFW 2003, Wydoski and Whitney 2003). No systematic stream survey and genetic analysis for all salmonid species within the region has yet been conducted. Neither has any systematic survey of salmonid use of nearshore and estuarine habitats. However, state and tribal studies have documented use of nearshore habitat by chum, pink, chinook, coho, sockeye, steelhead and char (WSCC 2000, 2002).

Table 6. Fish species present by WRIA within the Islands Region (WDFW 2003, Wydoski and Whitney 2003)

Species	State Status[1/]	Federal Status[2/]	San Juan (WRIA 02)	Island (WRIA 06)
Resident Cutthroat Trout		FCo		X
Sea run Cutthroat Trout		FCo	X	
Coho Salmon			X	X
Rainbow Trout				X
Sculpin Pacific Staghorn				X
Pacific Sand Lance			X	X
Pacific Herring			X	X
Surf Smelt			X	X

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Status of Salmonid Stocks

The State and Tribal Stock status for salmon found in the Islands region is shown in Table 7. No self sustaining runs exist in WRIA 2 (San Juans, WSCC 2002), and evidence of recent returns in Island County (WRIA 6) are anecdotal (WSCC 2000).

In Table 7, the State and Tribal Stock Status of *Unknown* refers to a stock of fish, which has insufficient information to rate stock status.

6.0 AMPHIBIANS

Within the Islands region, no Forest Practices HCP-covered amphibian species are known to occur. Although not proposed for coverage under this Forest Practices HCP, six other amphibians (namely northwestern salamander [Ambystoma gracile], long-toed salamander [Ambytoma macrodactylum], western toad, Pacific treefrog [Hyla regilla], northern red-legged frog [Rana aurora], and rough-skinned newt [Taricha granulosa]) are known to occur within the Islands region. These species may receive some protection as a result of Forests and Fish patch buffer prescriptions. The western toad has State watch list (special concern) status (WDFW 2001). It has declined elsewhere in its geographic range (Carey 1993), but its status in the Islands region is unknown.

Table 7. Salmon and Steelhead Stock List presented by River Basin for the Islands Region (2002 SASI Report).

River Basin	Species	Stock Status
Islands (WRIAs 02 and 06)		
Orcas Island	Coho	Unknown
Whidbey Island	Coho	Unknown

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OLYMPIC COAST
REGIONAL SUMMARY

OLYMPIC COAST REGIONAL SUMMARY

1.0 PHYSICAL DESCRIPTION

The Olympic Coast region includes three WRIAs (19, 20, and 21). Major stream systems include the Hoko, Pysht, Sekiu, Soleduc, Hoh, Quillayute, Queets, Copalis, Quinault and Clearwater River Basins, as well as other smaller tributaries. Portions of Clallam, Jefferson, Gray's Harbor, and Mason Counties are contained within the Olympic Coast region. A map showing the WRIAs of the Olympic Coast region is provided in Figure 1.

The Olympic Coast region includes the western portion of the Olympic Mountains physiographic province (Lasmanis 1991) and extends west to the Pacific Ocean and north to the Strait of Juan de Fuca. Elevations range from sea level to almost 8,000 feet.

General Geology

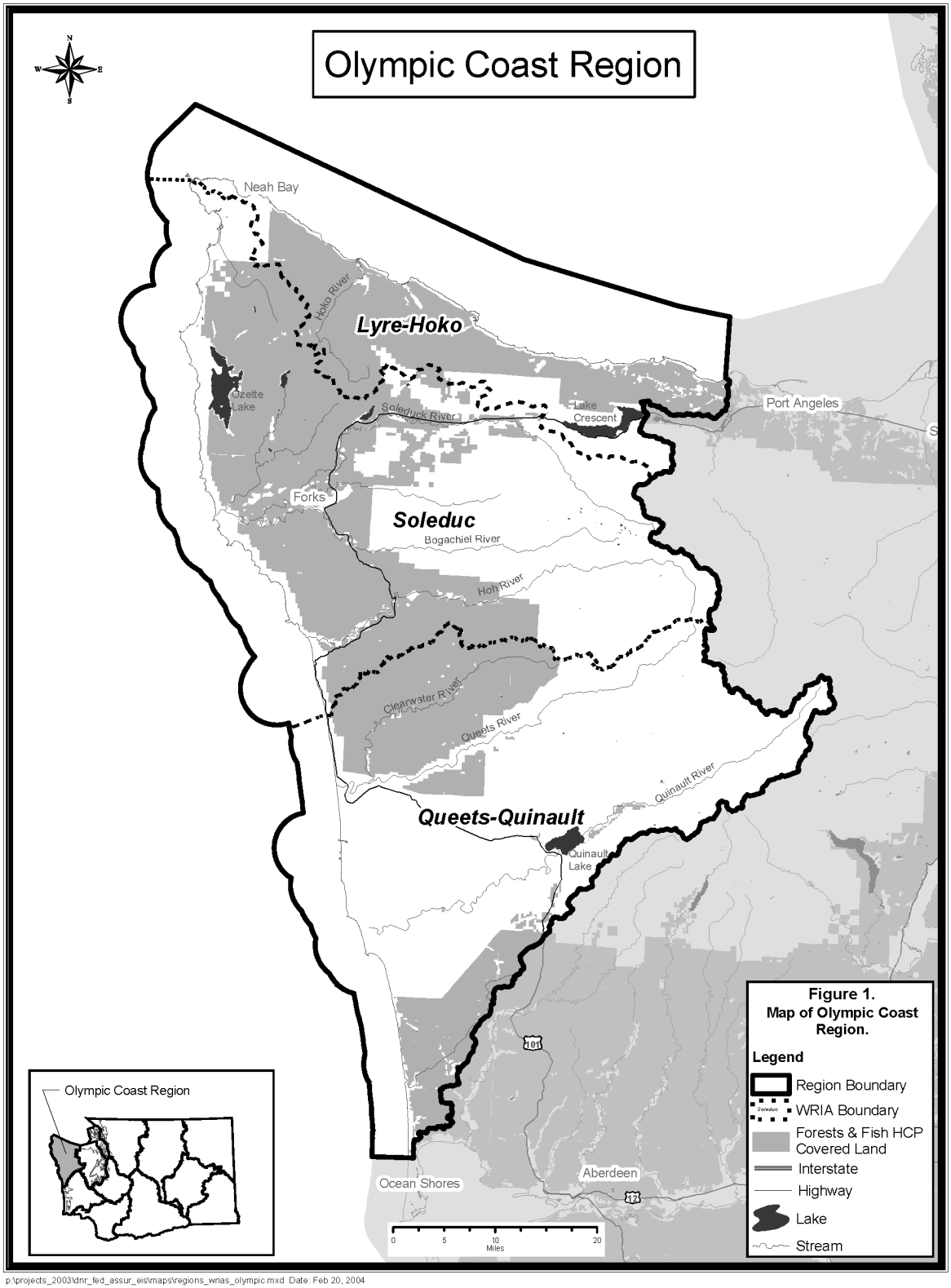
The Olympic Mountains, in the eastern half of this region, have experienced geologically rapid uplift, forming mountains up to 2,400 meters (approximately 7900 feet) in elevation. Rapid uplift, recent alpine glaciation and the highest precipitation in the continuous 48 states have resulted in mountainous landscape with long and very steep hillslopes. Natural rates of erosion are very high. Since the retreat of alpine glaciers, natural mass wasting has been the primary mechanism of erosion.

In the western portion of the region, uplift has been slower. The landscape is composed of hills of variable height separated by very wide glacial outwash and alluvial valleys. Hills are the dominant feature along the Strait of Juan De Fuca, while the coastal areas to the south are a mix of hills and valleys. These valleys are very wide, a geologic legacy of extensive erosion and glacial and alluvial deposition primarily from the Olympic Mountains. The hills are composed of moderately to highly weathered marine sandstones and other marine sedimentary rocks. Numerous active faults have fractured and weakened this bedrock in many areas. Crescent basalt supports some of the higher foothills.

Information concerning erosion processes in the Olympic planning region has been extracted from the following watershed analyses: Sol Duc in WRIA 20 (WDNR 1995e); and Hoko in WRIA 19 (Hanson Natural Resources Company 1995).

Mass wasting is the dominant erosion process in the Olympic planning region. Results of watershed analyses indicate debris avalanches, debris flows, and debris torrents are the most common landslide types. Most debris avalanches initiate in convergent topography such as bedrock hollows, headwalls, channel heads and inner gorges. Over 90 percent of debris avalanches in the Hoko watershed administrative unit (WAU) originated in these four landforms; 70 percent of these landslides delivered sediment to streams.

Deep-seated landslides are somewhat common and are typically associated with glacial sediments or structurally weak bedrock. Surface erosion is not a common erosion process and is limited to areas of disturbed or compacted soils.


Olympic Coast Region
Neah Bay
Hoko River
Lyre-Hoko
Ozette Lake
Sol duc River
Lake Crescent
Port Angeles
Forks
Soleduc
Bogachiel River
Hoh River
Clearwater River
Queets River
Quinault River
Queets-Quinault
Quinault Lake
101
Ocean Shores
Aberdeen
12
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Miles
Olympic Coast Region
Figure 1.
Map of Olympic Coast Region.
Legend
Region Boundary
WRIA Boundary
Forests & Fish HCP Covered Land
Interstate
Highway
Lake
Stream
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General Hydrology

The region has a marine climate characterized by mild, wet winters and cool, dry summers. Persistent coastal fog is common during the summer. Average annual precipitation ranges from 65 inches along the Strait of Juan de Fuca to almost 200 inches at higher elevations in the Olympic Mountains. Most of the precipitation falls as rain at lower elevations while snow is the dominant form of precipitation above 4,000 feet. The region receives more than 75 percent of its annual precipitation from October through March.

The region contains multiple rivers, all of which originate in the Olympic Mountains. The Hoko and Pysht rivers flow north into the Strait of Juan de Fuca while the Sol Duc, Hoh, Queets, and Quinault flow west into the Pacific Ocean. Fall and winter rain events produce peak flows in the Hoko and Pyhst rivers. In higher elevation basins such as the Sol Duc, Hoh, Queets, and Quinault rivers, peak flows result both from rain and rain-on-snow precipitation events. Smaller magnitude peak flows in higher elevation basins sometimes result from spring snowmelt. Low flows generally occur during late summer or early fall. Based on the DNR stream hydrography GIS coverage, there are approximately 14,959 stream-miles (both fish-bearing and non-fish streams) in the Olympic Coast region, with an average stream density of 5.45 stream miles/mile^2 (Table 1).

Table 1. Stream Miles in the Olympic Coast Region by WRIA[1/]

	WRIA 19 Lyre-Hoko	WRIA 20 Soleduc	WRIA 21 Queets-Quinault	Total Olympic Region
Stream Length (miles)	1,986	7,131	5,842	14,959
Stream Density (miles/mi^2)	5.17	5.96	5.02	5.45

[1/] Primary Data Source: DNR stream hydrography GIS layer. Stream miles include all mapped Type 1-9 streams.

2.0 LAND OWNERSHIP AND USE

Major Land Ownership and Management

Approximately 41 percent of all lands in the Olympic Coast region are in Federal ownership and the majority of these (representing 30 percent of all lands) are being managed for long-term preservation, primarily in national parks, national recreation areas, and wildernesses (Table 2). Another large portion of these Federal lands is being managed by the Forest Service outside of wilderness (11 percent of all lands); a substantial portion of these non-wilderness National Forest System lands is being managed under a very limited management status (e.g., LSRs, Managed LSAs, AMAs, or Riparian Reserves) according to the Northwest Forest Plan. Other Federal agencies manage only a very small percentage of the remainder (<0.1 percent of all lands). Tribal lands represent about 13 percent of the region; they consist mostly of the Quinault Indian Reservation in WRIA 21 and the Makah Indian Reservation in WRIA 19, along with several smaller reservations. State lands (primarily under management for timber production) represent 18 percent of all lands in the region, private lands represent 27 percent, and city/county lands represent less than 0.5 percent.

Generally the upper portions of the basins are in Federal ownership in Olympic National Park and Forest, and the lower basins are in private ownership. The Lyre-Hoko WRIA (19) is 53 percent

in private ownership, 4 percent in Tribal ownership, and 19 percent in Federal ownership. In contrast, the Queets-Quinault WRIA (21), 13 percent in private ownership, 27 percent in Tribal ownership, and 43 percent in Federal ownership.

Land Cover and Use

Forestland makes up approximately 95 percent of the Olympic Coast region (Table 3). Water and wetlands and ice, snow and bare rock each comprise 2 percent. The percent forestland is almost constant among the WRIAs of this region, ranging from 95 to 96 percent.

3.0 FORESTLAND OWNERSHIP AND MANAGEMENT

Approximately 41 percent of the forestlands in the Olympic Coast region are in Federal ownership, 14 percent are in Tribal ownership, 18 percent are in State ownership, and 27 percent are in private or other ownership (Table 4). A Federal or State status of preservation or limited management covers approximately 41 percent of the forestlands in the region. Approximately 14 percent of the forestlands are available for Federal or Tribal timber management. State timber management may occur on approximately 18 percent of the forestlands, and 27 percent of the forestlands are in private, county, or city ownership, where timber management may occur. Overall, lands covered by the forest practices rules represent approximately 45 percent of the forestlands in the region (see Figure 1, which displays these lands). Existing HCPs cover the vast majority (98 percent) of the State-managed lands, but none of the private, county, and city ownerships. The percentage of State lands under an HCP ranges from 95 percent in WRIA 19 to 100 percent in WRIA 21. WRIA 19 has 76 percent of its lands subject to the forest practices rules. This percentage drops to 30 percent under WRIA 21.

Small, 20-acre exempt forest landowners make up about 0.3 percent of the forestlands and about 0.7 percent of the forestlands subject to forest practices rules in the Olympic Coast region, based on the analysis by Rogers (2003). Although this analysis may represent an underestimate, it is believed to have identified the majority of all small, 20-acre exempt parcels (personal communication, Luke Rogers, Rural Technology Initiative, University of Washington, May 2004). The small landowner parcels are mainly found in the lower elevation lands, especially along the major rivers. The highest percentage (about 0.8% of the forestland) is in the Lyre-Hoko WRIA (19) and the lowest percentage (0.2%) is in the Queets-Quinault WRIA (21).

Approximately 7,480 stream miles occur on lands subject to forest practices rules in the Olympic Coast region (Table 5). This represents 50 percent of all streams in the region. Approximately 4,773 miles or 64 percent of the 7,480 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre exempt forest landowner parcels in this region is estimated to be about 0.4 percent and the percentage of all fish-bearing streams on small, 20-acre exempt forest landowner parcels is about 0.8 percent (Rogers 2003).

Table 2. Land Ownership Parameters for Olympic Coast Region by WRIA [1/]

Land Ownership	WRIA 19 Lyre-Hoko	WRIA 20 Soleduc	WRIA 21 Queets-Quinault	Total Olympic Region
Federal – Long-term Congressionally Protected Lands [2/]	25,351	256,708	247,735	529,794
Federal – Other National Forest System Lands [3/]	21,839	100,684	73,853	196,375
Federal – Other Federal Lands [4/]	109	96	94	299
State – Protected Lands [5/]	703	652	319	1,673
State – Managed Lands [6/]	57,318	138,759	113,070	309,147
Tribal Lands/Indian Reservations	9,801	21,524	203,666	234,990
Municipal Watershed	-	-	-	-
Other County/City Lands	218	-	7,535	7,752
Private	130,562	247,390	98,886	476,837
TOTAL	**245,899**	**765,813**	**745,156**	**1,756,869**

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan GIS layers.
[2/] Includes national parks, national monuments, national recreation areas, national wildlife refuges, and wildernesses.
[3/] Includes all non-wilderness National Forest System lands; the majority of the acres consists of lands protected under the Northwest Forest Plan (e.g., LSR, Managed LSR, AMA, Riparian Reserves).
[4/] Includes all Department of Defense, Department of Energy, Bureau of Land Management, and Bureau of Reclamation lands.
[5/] Includes all State Parks and Wildlife Areas.
[6/] Includes all DNR, Department of Corrections, and University lands.

Table 3. General Land Cover Classifications in the Olympic Coast Region by WRIA[1/]

Land Cover	WRIA 19 Lyre-Hoko	WRIA 20 Soleduc	WRIA 21 Queets-Quinault	Total Olympic Region
Forestland	235,481	724,990	710,601	1,671,071
Shrubland	920	3,906	6,643	11,469
Grassland	479	2,629	3,883	6,991
Water & Wetlands	6,510	15,219	11,961	33,691
Ice, Snow, & Bare Rock	420	15,419	11,242	27,081
Residential & Commercial	262	954	807	2,023
Agricultural	1,826	2,697	19	4,542
TOTAL	**245,899**	**765,813**	**745,156**	**1,756,869**

[1/] Primary Data Source: USGS/EPA National Land Cover Data GIS layer.

Table 4. Ownership and Management of Forestlands (acres and percent) in the Olympic Coast Region by WRIA[1/]

Forestlands Category	WRIA 19 Lyre-Hoko	WRIA 20 Soleduc	WRIA 21 Queets-Quinault	Total Olympic Region
Federal and State Protected Forestlands Not Managed for Timber Production[2/]	46,729	335,534	302,023	684,287
Federal Lands and Tribal Forestlands Available for Timber Management[3/]	10,028	21,085	197,715	228,828
Forestlands Available for Timber Management Under the State Forest Practices Rules				
DNR and Other State Forestlands	57,011	137,632	112,528	307,170
Private, County, and City Forestlands	121,713	230,739	98,335	450,786
Subtotal	178,724	368,371	210,863	757,957
TOTAL FORESTLANDS	235,481	724,990	710,601	1,671,071
% IN FEDERAL OR STATE PROTECTION	20%	46%	43%	41%
% AVAILABLE FOR FEDERAL OR TRIBAL TIMBER MANAGEMENT	4%	3%	28%	14%
% AVAILABLE FOR STATE TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	24%	19%	16%	18%
% AVAILABLE FOR PRIVATE OR COUNTY/CITY TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	52%	32%	14%	27%

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan, and USGS/EPA National Land Cover Data GIS layers.
[2/] Federal and State Protected Lands includes: Wilderness, LSR, LSOG, AMA, National Wildlife Refuges, National Parks, Washington State Parks, and WDFW lands.
[3/] Federal and Tribal Lands Available for Timber Management include: USFS Matrix lands, USFS other lands, BLM lands, Dept of Defense lands, and Indian Reservation lands.

Table 5. Stream Miles in the Olympic Coast Region by Ownership, Forested Stream Miles, and Forest Practices Rules (FPR)-Regulated Stream Miles1/

Category	WRIA 19 Lyre-Hoko	WRIA 20 Soleduc	WRIA 21 Queets-Quinault	Total Olympic Coast Region
Total Stream Miles				
Federal	293	2,769	2,092	5,154
Tribal	83	205	1,509	1,797
State	459	1,438	1,261	3,158
County/City	2	-	57	60
Private	1,150	2,718	924	4,792
Total Miles	**1,986**	**7,131**	**5,842**	**14,959**
Forested Stream Miles				
Forested Miles	1,875	6,479	5,276	13,629
% of Total Miles	94%	91%	90%	91%
FPR-Regulated Stream Miles				
FPR-Reg. Miles	1,508	3,866	2,105	7,480
% of Total Miles	76%	54%	36%	50%

1/ Data sources: DNR stream hydrography GIS layer, DNR Major Public Lands layer, and USGS/EPA National Land Cover Data. Stream miles include all Type 1-9 streams.

4.0 HABITAT LIMITING FACTORS

Primary Regional Factors

The Olympic Mountains are largely within the Olympic National Park. Extensive temperate rainforests interspersed mostly at higher elevations with alpine meadows, rock, glaciers and snowfields characterize the area. Timber harvest or road construction is limited in extent. As the Olympic Mountains are substantially preserved within the National Park, they are not extensively discussed herein.

The western portion of the region is mostly rainforest, and much of it has been subject to timber harvest at least once. Extensive clearcut timber harvest along the Strait of Juan de Fuca started in the 1900's. The harvest of old growth stands continued into the 1980s in parts of the Hoh, Queets and Quinault basins, where visible impacts still linger. In general, the timber harvest started later here than in other regions of western Washington. Heavy rainfall and remoteness from existing urban areas has discouraged agricultural and residential development; however, small towns and communities are scattered throughout the region. Most of the lands outside the Olympic National Park and USFS Wilderness Areas are managed for timber. Historic timber harvest, road construction and forest fires have had substantial impacts on salmon habitat (WSCC 1999, 2000, 2001). Contemporary forest practices are more sensitive to salmon habitat and wildlife habitat in general; however, the climate and geology of the region make these efforts challenging.

Sedimentation/Mass Wasting

In the Olympic Mountains, the natural incidence of shallow rapid landslides (SRLSs) is high, and the limited forestry that has occurred has triggered many more (WDNR 1999), creating severe downstream impacts.

The valleys of the western portion of the region lack the hillslope gradients for mass wasting, except along river channels where banks and high terraces are prone to collapse. While some stream bank collapse is natural, harvest of the riparian timber has removed the root strength needed to support banks, and contributed to sediment and the loss of very large LWD (whole tree) recruitment. The decline of large in-channel LWD has caused channel incision in some places, which increases bank heights and the frequency of bank collapses (WSCC 1999, 2000).

The quantity of natural and forestry-related SRLSs is very high in many of the higher foothills because of high hillslope gradients, high precipitation and weathered sandstones. The SRLSs represent the most severe environmental impact in these areas. However, the lower foothills such as the Dickey River drainage (WSCC 2000) and the Raft River (WDNR 2002a) are less sensitive to SRLSs. Watershed analyses in this region have documented hundreds of SRLSs and debris torrents associated with forest roads and timber harvest. While watershed analyses have targeted the watersheds with the worse history of mass wasting, the pattern is consistent, and most of these higher foothills appear to be vulnerable to SRLSs (WDNR 1995, 1996, 1997, 1998, 2002b; WSCC 1999, 2000). A forest fire in 1951, likely initiated by humans, caused significant damage and numerous landslides in the North Fork Calawah Basin.

The Salmon River Watershed Analysis in WRIA 21 (WDNR 2002b) noted several active and numerous potential deep-seated landslides (DSLSs). Two types appear to exist. One type forms on the outside of river meanders in the alluvial and glacial deposits in the valley, and the other forms in deep weathered rock on the higher hills. Only a few other DSLSs were documented in the region.

Besides mass wasting problems, forest roads in the sandstone foothills produce substantial amounts of fine sediment. Cutslopes, ditches and fill slopes readily produce fine sediments, especially following construction or rehabilitation when they lack vegetative cover. Fine

sediments from roads and mass wasting are identified as the most significant habitat limiting factor in all the western Strait of Juan de Fuca drainages (WSCC 1999), and this likely applies to all foothills with weathered sandstones and siltstones.

Riparian/Floodplain and Wetland Conditions

Limiting Factors Analyses (WSCC 1999, 2000, 2001) have noted that roadbed construction has confined the active channel in many floodplains. Channel confinement prevents natural channel meander and LWD recruitment and blocks access to off-channel habitat, which has been clearly identified as important habitat for coho and other species in this region (Cederholm et al. 1988). Limiting Factors Analyses (WSCC 2000, 2001) described many floodplains in this region as being in poor condition. Road construction has occurred as a result of timber harvest, residential development and public transportation.

No large wetlands were noted in the regional literature. The floodplains, and low gradient foothills (e.g., the Dickey River in the Sol Duc drainage) have many small wetlands; some of which are forested and some are open water. Beaver play a role in creating many of these wetlands. Wetlands are important as hydrologic controls and, where accessible to fish, are important refugia during peak flows. Road construction alters surface drainage and blocks fish access to some wetlands. Wetland draining for agricultural and residential development has occurred, but the extent of the problem is poorly documented.

Channel/Hydrology Conditions

This region has no major hydropower dams or municipal water withdrawals. Urban development is relatively sparse, and partially concentrated along the coastline where effects on freshwater channels are limited. Agriculture is also limited in extent. Rain-on-snow peak flows occur primarily on clearcuts above 1200 ft in elevation. Some of the high foothills that are managed for timber have extensive stands above this elevation (WDNR 1995, 1996, 1998). The extensive network of forest roads may contribute to increased peak flows by road ditches acting as an extension of the channel network, accelerating runoff and increasing the peak flows. Cross-drains and other BMPs may mitigate this effect, and local soil characteristics may vary the response. The existence and severity of a road network effect is still subject to research and debate. A detailed analysis of long term hydrological data from two gauges on the Quinault River found no evidence that human disturbance has affected peak flows (WDNR 1999). However, impacts may occur at small drainage scales.

Estuarine and Nearshore Habitat

Estuaries throughout this region are naturally smaller comparable to drainages in Puget Sound and Southwest Washington, and may explain the lack of significant chum runs in this region. High marine hillslope gradients, currents, heavy wave action, and geologically recent continental glaciation in the Strait of Juan de Fuca have not been conducive to the formation of large deltas and associated estuaries. However, small estuaries occur at the mouths of most rivers and streams. A number of the Strait of Juan de Fuca estuaries have recently been disturbed by substantial mass wasting deposits, caused both by forest practices and by natural processes. Road construction has constrained tidal and floodwater circulation in some of these small estuaries, such as Salt Creek and Soes River (WSCC 1999, 2000), reducing rearing habitat for juvenile salmon that are in transition to the ocean.

In WRIA 19 and WRIA 20, the nearshore habitat is substantially composed of rocky substrates with occasional sand or gravel beaches. The rocky nearshore areas support extensive kelp beds. While many kelp beds provide cover for adult and possibly juvenile salmon, evidence linking salmonid survival rates with kelp beds is currently lacking. In WRIA 21 (Queets, Quinault, Moclips, Copalis drainages) sandy beaches prevail, although rock outcrops are still common.

The shorelines in this region are extensively protected by parks and tribal lands. Although the beaches in southern WRIA 21 have experienced some residential and recreational development, the nearshore habitat is in good condition compared to other regions.

Large Woody Debris

The recruitment of LWD has been impacted by past riparian forest harvest and, on lands converted to other uses, the failure to re-establish these riparian forests following harvest. The retention of in-channel LWD has been impacted by its removal for navigational and misguided habitat enhancement efforts, dikes and levee interference and debris torrents.

In the Olympic Mountains and the higher foothills, landslides are the primary means of LWD recruitment, although riparian adjacent recruitment is still important. High gradients and precipitation results in very high peak flows, which readily transports smaller wood. In the large floodplain channels, very large conifer LWD with attached rootwads is required to achieve LWD functions (Abbe and Montgomery 1996). Dikes and levees are not extensive in this region; however, floodplain roadbeds are more prevalent and can reduce LWD recruitment by constraining channel meander and recruitment by bank erosion (WSCC 1999, 2001). Old growth harvest occurred in the 1970s and 1980s in parts of the Hoh, Queets and Quinault drainages, leaving no riparian buffers, or inadequate riparian buffers (WDNR 1999; WSCC 1999, 2001). These impacts are relatively recent, thus these basins have a long path to LWD recovery. Alder regeneration following riparian timber harvest is a significant impact to future LWD recruitment throughout this region (WSCC 1999, 2000, 2001). Reed canary grass was identified as a factor preventing the regeneration of riparian forests (WSCC 1999).

Fish Passage Barriers

Limiting Factors Analyses (WSCC 2000) provide a thorough list of culverts that are partial or complete barriers to fish passage in WRIA 20. These fish passage barriers represent various land ownership and land uses.

The Olympic Coast region has no major hydropower developments.

Water Quality Issues

High water temperatures have been documented in many locations, typically at lower elevations (WSCC 1999, 2000, 2001). Some of these exceedances are natural, either the result of an upstream lake, a wide channel, or in one case, a geological formation. In other situations, riparian harvest and canopy reduction, as a result of mass wasting, contributed to high water temperatures. Alder riparian stands were frequently mentioned as a contributing factor. Alder lacks the tree height and the foliage density of conifers, and does not provide the same shade. One case of a fish kill resulting from high water temperature and low dissolved oxygen has been documented.

Turbidity from mass wasting and road surface erosion was also identified as a water quality issue in several Strait of Juan de Fuca (WRIA 19) streams. Specifically, Deep Creek is impaired due to fine sediment from a mass wasting event. Waters impaired due to high temperatures in WRIA 19 include Deep Creek, the Clallam River and the Sekiu River (WSCC 1999).

A number of coastal streams in WRIA 20, including the Big River and the Soleduck River, were found to have low pH. This appears to be largely natural, although the accumulation of cedar wastes from cedar bolt cuttings may be locally significant (WSCC 2000). WRIA 20 also has several waters that are considered impaired for temperature. These include the Bogachiel River, Dickey River, and Soleduck River.

Limiting Factors Analyses (WSCC 1999, 2000, 2001) make no mention of industrial pollution, and only one other case of development-related pollution. A municipal wastewater treatment

facility in the southern part of WRIA 21 was believed to be contributing to a dissolved oxygen condition in Joe Creek, a small independent drainage.

No TMDL studies have been conducted in this region. The state list of impaired waters, in compliance with Section 303(d) of the Clean Water Act, lists waters that do not meet water quality standards or fully protect beneficial uses (see http://www.ecy.wa.gov/programs/wq/303d/index.html). Impairments to parameters in this region, such as temperature, turbidity, and dissolved oxygen, may be related to past forest practices or other land uses.

5.0 HABITAT TRENDS

Potentially unstable landforms are routinely identified and mapped. However long-term trends of landslide activity are difficult to systematically measure, because events are often separated by years or decades. At this point, no reliable data exists in this region on the long-term trend of landslide events.

Direct measure of in-channel fine sediment is costly and impractical because very large sample sizes are necessary to achieve statistical significance. Therefore, the watershed analysis methodology (WFPB 1997) and the more recent Road Maintenance and Abandonment Plans (RMAP) focus on measuring fine sediment before it enters the channel. This method measures surface erosion for the tread surface, cutslope, ditchline and fillslope, based on road use, soil type, vegetative cover, gradient, water routing and other factors. No recent independent assessments of forest road maintenance have been made in Washington State or the Olympic Coast region.

Habitat trends in LWD and Shade can be determined, given the following three assumptions: 1) riparian stand conditions can adequately represent recovery of current and future LWD and shade; 2) riparian stand conditions can be determined from contemporary aerial photographs; and 3) most riparian buffers on non-Federal lands were historically harvested; thus, the current riparian condition represents a state of recovery. It is important to note that forestlands make up approximately 95 percent of the Olympic Coast region. Forty-one percent of that forestland is under Federal or State protection, and 27 percent is under private management (See Tables 3 and 4).

On a large scale, meaningful trends can be determined, based on two photometric studies.

A dataset used by Lunetta et al. (1997) was made available from Cosentino (personal communication, Brian Cosentino, WDFW, 2003), which allowed isolation of data from the Olympic Coast WRIAs (Table 6). 'Response reaches' were generally defined by Lunetta et. al. as the lower gradient (< 4 percent) habitat where most of the anadromous fish production occurs. Table 6 shows that 16 percent[7] of the response reach riparian buffers (RRRBs) were classified as late seral stage. Nearly 4 percent of the RRRBs were unforested, primarily as a result of urban and agricultural development. This is the lowest of any of the Western Washington regions. Likewise, 64 percent of the RRRBs are either mixed or conifer dominated, the highest of any Western Washington region.

One notable statistic is that 48 percent of the RRRBs is in either early- or mid-seral stages, the highest of any Western Washington region. Two potential reasons probably account for this. First, timber harvest in much of this region occurred later than in other parts of the state. Second,

[7] 'Late Seral' Stands should not be confused with 'Old Growth Stands.' 'Late Seral' as defined by Lunetta et al (1997) means the conifer crown cover is >70% and more than 10% of the crown cover in trees are greater than 21 inches diameter breast height (dbh). Thus, 'Late Seral' can include some mature second growth conifer stands.

riparian buffers in this region remained in forestry use, whereas forestlands in other regions were often converted to agricultural and urban land uses following harvest.

The percent of riparian buffers defined as 'other forestlands,' 31 percent, is similar to other regions. Marshall and Associates (2000) estimated that approximately 55 percent[8] of the private and tribal fish-bearing riparian buffers were alder-dominated. Since Lunetta et al. (1997) included Federal forestlands in their survey, and much of this Federal land is old-growth in the Olympic National Park, this would suggest that most of this 'other forestland' is hardwood-dominated. Although Lunetta et al. (1997) and Marshall and Associates (2002) had different metrics and objectives, they appear to compliment each other on the issue of hardwoods.

In summary, the Olympic Coast region has benefited from a lower rate of agricultural and urban development along streams and rivers. Because old-growth timber harvest in this region occurred later than in other regions, many of the conifer-dominated and mixed riparian stands are at an earlier stage of post-harvest recovery. Similar to other regions, a significant part of the harvested riparian stands regenerated as hardwoods, placing these stands on a much longer pathway to LWD recovery.

Table 6. Percent of response reach riparian buffers by WRIA for the Olympic Coast Region. [See Lunetta et al. (1997) for description of data.]

Canopy Class	Late Seral Stage	Mid Seral Stage	Early Seral Stage	Other Forest-lands	Water	Non-forest lands
Canopy Class Definition	>70% conifer canopy; >10% of the canopy must be conifer>21"dbh	>70% conifer canopy; <10% of the canopy must be conifer>21"dbh	Conifer Crown cover > 10% and <70%	Hardwood dominated, shrub or recent clearcut,	Lakes, large rivers and other large water bodies	Urban, Agriculture, Rangeland, barren, glaciers
WRIA or Basin Name						
Lyre- Hoko (WRIA 19)	3.5%	40.7%	1.9%	48.1%	0.0%	5.8%
Sol Duc-Hoh (WRIA 20)	17.6%	26.7%	9.9%	40.1%	1.3%	4.4%
Queets-Quinault (WRIA21)	17.0%	26.8%	33.5%	19.3%	0.6%	2.8%
Total response reach riparian acres	14869	26226	18972	28925	791	3540
Region total percentage	15.9%	28.1%	20.3%	31.0%	0.8%	3.8%

[8] This study used regional definitions that overlap the regional definitions used herein. The actual figures used in this study were 51% for the 'South Puget Sound' Region, and 57% for the 'North Coast' Region. These two regions are roughly the same as the combined Olympic Coast, West Puget Sound and South Puget Sound regions as defined in this report. Marshall and Assoc. found relatively little variation in hardwood stand percentages on private lands throughout western Washington.

5.0 FISH RESOURCES

Salmonid Stocks

All anadromous salmonid species are present in the Olympic Coast region. Bull trout are Federally listed as threatened in the region. Table 7 lists salmonids that occur in the Olympic Coast region. The asterisk next to the species name indicates the species is introduced and not native to Washington State.

The Pygmy Whitefish is a non-game salmonid species, which is listed as State sensitive. The Pygmy Whitefish rears in Lake Crescent in the Lyre River drainage.

Table 7. Salmonid species present by WRIA within the Olympic Coast Region (WDFW 2003).

Species	State Status[1/]	Federal Status[2/]	Lyre-Hoko (WRIA 20)	Soleduc (WRIA 20)	Queets Quinault (WRIA 21)
Resident Cutthroat Trout		FCo		X	X
Searun Cutthroat Trout		FCo	X	X	X
Pink Salmon			X		X
Chum Salmon			X	X	X
Coho Salmon			X	X	X
Rainbow Trout			X	X	X
Summer Steelhead			X	X	X
Winter Steelhead			X	X	X
Ozette Lake Sockeye Salmon		FT	X	X	X
Kokanee Salmon			X	X	X
Fall Chinook Salmon			X	X	X
Spring Chinook Salmon				X	X
Dolly Varden/Bull Trout	SC	FT		X	X
Mountain Whitefish				X	X
Pygmy Whitefish	SS		X		
Lake Whitefish					X
Brook Trout*			X	X	
Lake Trout*			X		X

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Other Fish Species

Table 8 is a list of non-salmonid freshwater species that exist in the Olympic Coast region. The asterisk next to the species name indicates that the fish is not native to Washington State. This list should not be regarded as an exhaustive list of the species present. There is one sensitive non-

Table 8. Non-salmonid freshwater fish species by WRIA in the Olympic Coast Region (WDFW 2003, Wydoski and Whitney 2003).

Species	State Status[1/]	Federal Status[2/]	Lyre-Hoko (WRIA 19)	Soleduc (WRIA 20)	Queets Quinault (WRIA 21)
Longnose Dace					X
Speckled Dace			X	X	X
Pacific Lamprey		FCo	X	X	X
Western Brook Lamprey			X	X	X
Olympic Mudminnow	SS			X	X
Northern Pikeminnow				X	
Peamouth				X	X
Largescale Sucker					X
Prickly Sculpin					X
Riffle Sculpin			X	X	X
Reticulated Sculpin			X	X	X
Shorthead Sculpin			X	X	X
Torrent Sculpin			X	X	X
Three-Spine Stickleback					X
Redside Shiner			X	X	X
Channel Catfish*					X
Sunfish spp*.			X	X	X
Pumpkinseed*				X	
Crappie spp*			X		X

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

salmonid freshwater species in this region, the Olympic Mudminnow. The Olympic Mudminnow (endemic to Western Washington) prefers slow water and wetlands, and is found in lowlands of Grays Harbor and western Jefferson counties (Rodrick and Milner 1991). The Pacific Lamprey is listed as a Federal species of concern.

Status of Salmonid Stocks

The State and Tribal Stock status of 96 stocks in the Olympic Coast region is shown in Table 9.

Table 9. Olympic Coast Salmon and Steelhead Stock List presented by River Basin (2002 SASI Report, 1998 Bull Trout Status Report).

River Basin	Species	Stock Status
Western Juan De Fuca – WRIA 19		
Hoko River	Fall Chinook	Depressed
Lyre River	Fall Chum	Unknown
Deep Cr, East and West Twin	Fall Chum	Depressed
Pysht River	Fall Chum	Healthy
Hoko-Clallam-Sekiu	Fall Chum	Unknown
Salt Creek	Coho	Healthy
Lyre River	Coho	Unknown
Pysht-Twin-Deep	Coho	Healthy
Clallam River	Coho	Healthy
Hoko River	Coho	Healthy
Sekiu-Sail Rivers	Coho	Healthy
Salt Creek/Independents	Winter Steelhead	Healthy
Lyre River	Winter Steelhead	Unknown
Pysht River	Winter Steelhead	Healthy
Clallam River	Winter Steelhead	Unknown
Hoko River	Winter Steelhead	Healthy
Sekui River	Winter Steelhead	Unknown
Sail River	Winter Steelhead	Unknown
Soleduc River – WRIA 20		
Sooes River	Fall Chinook	Unknown
Quillayute-Soleduc River	Spring Chinook	Healthy
Quillayute-Soleduc River	Summer Chinook	Unknown
Quillayute-Soleduc River	Fall Chinook	Healthy
Quillayute-Bogachiel River	Summer Chinook	Healthy
Quillayute-Bogachiel River	Fall Chinook	Healthy
Quillayute-Dickey River	Fall Chinook	Unknown
Quillayute-Calawah River	Summer Chinook	Healthy
Quillayute-Calawah River	Fall Chinook	Healthy
Hoh River	Spring-Summer Chinook	Healthy
Hoh River	Fall Chinook	Healthy
Sooes River	Fall Chum	Unknown
Ozette River	Fall Chum	Unknown
Quillayute River	Fall Chum	Unknown
Hoh River	Fall Chum	Unknown
Sooes-Waatch	Coho	Unknown
Ozette River	Coho	Unknown
Quillayute-Sol Duc River	Summer Coho	Healthy
Quillayute-Sol Duc River	Fall Coho	Healthy
Quillayute-Dickey River	Fall Coho	Healthy
Quillayute-Bogachiel River	Fall Coho	Healthy
Quillayute-Calawah River	Fall Coho	Healthy
Hoh-Goodman&Mosquito Cr	Coho	Unknown
Hoh River	Coho	Healthy
Lake Ozette	Sockeye	Unknown
Lake Pleasant	Sockeye	Healthy
Sooes-Waatch	Winter Steelhead	Unknown

Table 9. Olympic Coast Salmon and Steelhead Stock List presented by River Basin (2002 SASI Report, 1998 Bull Trout Status Report) (continued).

River Basin	Species	Stock Status
Ozette River	Winter Steelhead	Unknown
Quillayute-Bogachiel River	Summer Steelhead	Unknown
Quillayute-Bogachiel River	Winter Steelhead	Healthy
Quillayute-Dickey River	Winter Steelhead	Healthy
Quillayute-Sol Duc River	Summer Steelhead	Unknown
Quillayute-Sol Duc River	Winter Steelhead	Healthy
Quillayute-Calawah River	Summer Steelhead	Unknown
Quillayute-Calawah River	Winter Steelhead	Healthy
Hoh –Goodman Creek	Winter Steelhead	Healthy
Hoh River	Summer Steelhead	Unknown
Hoh River	Winter Steelhead	Healthy
Quillayute River	Bull Trout/Dolly Varden	Unknown
Hoh River	Bull Trout/Dolly Varden	Unknown
Queets Quinault Basin WRIA 21		
Queets River	Spring-Summer Chinook	Depressed
Queets River	Fall Chinook	Healthy
Queets-Clearwater River	Spring-Summer Chinook	Critical
Queets-Clearwater River	Fall Chinook	Healthy
Quinault River	Spring-Summer Chinook	Depressed
Quinault River	Fall Chinook	Healthy
Quinault- Cook Creek	Fall Chinook	Unknown
Queets River	Fall Chum	Unknown
Quinault River	Fall Chum	Unknown
Kalaloch Creek	Coho	Unknown
Queets River	Coho	Healthy
Queets-Clearwater River	Coho	Healthy
Queets Salmon River	Coho	Healthy
Raft River	Coho	Unknown
Quinault River	Coho	Unknown
Quinault- Cook Creek	Coho	Unknown
Moclips River	Coho	Unknown
Copalis River	Coho	Unknown
Lake Quinault	Sockeye	Healthy
Kalaloch Creek	Winter Steelhead	Unknown
Queets River	Summer Steelhead	Unknown
Queets River	Winter Steelhead	Healthy
Queets River	Summer Steelhead	Unknown
Queets River	Winter Steelhead	Healthy
Raft River	Winter Steelhead	Unknown
Quinault River	Summer Steelhead	Unknown
Quinault River	Winter Steelhead	Healthy
Quinault-Quinault Lake	Winter Steelhead	Depressed
Moclips River	Winter Steelhead	Unknown
Copalis River	Winter Steelhead	Unknown
Queets River	Bull Trout/Dolly Varden	Healthy
Quinault River	Bull Trout/Dolly Varden	Unknown
Moclips River	Bull Trout/Dolly Varden	Unknown
Copalis River	Bull Trout/Dolly Varden	Unknown

For State and Tribal Stock Status, *Healthy* refers to a stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock; *Depressed* refers to a stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely; *Critical* refers to a stock of fish experiencing production levels that are so low that permanent damage to the stock is likely or has already occurred; and *Unknown* refers to a stock of fish which has insufficient information to rate stock status.

7.0 AMPHIBIANS

The Olympic Coast region harbors 14 amphibian species, including the introduced bullfrog (Dvornich et al. 1997; McAllister 1995). Of these 14 species, the largest assemblage (including the bullfrog) consists of 8 taxa that reproduce in stillwater habitats including lakes, oxbows, ponds, temporary pools and other stillwater wetlands. Stillwater habitats are split between high-elevation lakes and ponds, and lower elevations habitats associated with the riparian margins of larger streams or rivers. Unlike other regions, riverine riparian habitat has not been nearly as extensively altered in the Olympic Coast region; thus stillwater amphibians are not likely impacted to the extent of more urbanized regions. Lowland stillwater habitats in the region are also much less impacted by introduced warmwater species (bullfrogs, catfish and sunfish, see Table 8), which may have negative effects on native amphibians (Adams 1999). For example, bullfrogs have only one known location of introduction.

Of the remaining six native amphibian species, three species (ensatina, Van Dyke's salamander, and western red-backed salamander) reproduce in terrestrial habitats and the remaining three species (Cope's giant salamander, coastal tailed frog and Olympic torrent salamander) reproduce in headwater streams, springs, or seeps (Table 10).

Three species (coastal tailed frog, Cascades torrent salamander, and Van Dyke's salamander) are Forest Practices HCP-covered taxa (Table 10). Of the three species, Van Dyke's salamander appears to have spotty distribution. However, all three species have been the subject of systematic surveys to determine their distribution in Olympic National Park (Adams and Bury 2002) and on US Forest Service lands (L. Jones, M. Raphael, pers. comm. 2002), and except for Van Dyke's salamander, seem broadly distributed. Unpublished US Forest Service studies indicate that all three species occur at lower densities in the Olympic Coast region timber harvested landscape, and that Van Dyke's salamander may be at risk (personal communication, Larry Jones and Martin. Raphael, U.S. Forest Service, 2002). All three species may be at some level of risk because sedimentation can substantially reduce instream habitat (Bury 1983, Bury and Corn 1988, Corn and Bury 1989); and timber harvest, which can result in significant sedimentation (Beschta 1978, Jakob 1999), occurs over most of the Olympic Coast region where these two species occur. However, the local and regional nature of this risk within the Olympic Coast region is largely unknown for all three species.

Although not covered under this Forest Practices HCP, seven other amphibians (namely northwestern salamander [Ambystoma gracile], long-toed salamander [Ambystoma macrodactylum], western toad [Bufo boreas], Pacific treefrog [Hyla regilla], northern red-legged frog [Rana aurora], Cascades frog [Rana cascadae] and rough-skinned newt [Taricha granulosa]) may receive some protection as a result of Forests and Fish patch buffer prescriptions. Two of these species, western toad and Cascades frog, are State watchlist (special concern) species (WDFW 2001). Both species have declined elsewhere in their geographic ranges (Carey 1993, Fellers and Drost 1993), but their status in the Olympic Coast is unknown. Limited urban and agricultural development in the region increases the likelihood that these species are safe. Some evidence exists for disappearance of Cascades frog at lower elevations on the Olympic Peninsula, but the basis of this pattern is unclear (personal communication, Kelly McAllister, WDFW. comm. 1985).

Table 10. Forest and Fish Amphibians of the Olympic Coast Region.

Group	Name	Habitat			Regional Distribution
		Active Season			
		Breeding	Non-Breeding	Over-wintering	
Frogs	Coastal tailed frog *Ascaphus truei*	streams	streams	terrestrial	widespread in streams in sufficient gradient
Salamanders	Van Dyke's salamander *Plethodon vehiculum*	terrestrial	terrestrial	terrestrial	Known occurrence spotty, mostly mid to high elevations
	Olympic torrent salamander *Rhyacotriton olympicus*	streams	streams	terrestrial	widespread

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SOUTHWEST WASHINGTON REGIONAL SUMMARY

SOUTHWEST WASHINGTON REGIONAL SUMMARY

1.0 PHYSICAL DESCRIPTION

The Southwest Washington region includes three WRIAs (22, 23, and 24). Major stream systems include the Naselle, Elochoman, Hoquiam, Satsop, Chehalis, North and Willapa River Basins, as well as other smaller tributaries. Portions of Gray's Harbor, Thurston, Pacific, Lewis, and Cowlitz Counties are contained within the Southwest Washington region. A map of the Southwest region is provided in Figure 1.

The region includes portions of four physiographic provinces: the Olympic Mountains, the Willapa Hills, the Puget Lowland, and the Southern Cascades (Lasmanis 1991). Elevations range from sea level to approximately 3,500 feet.

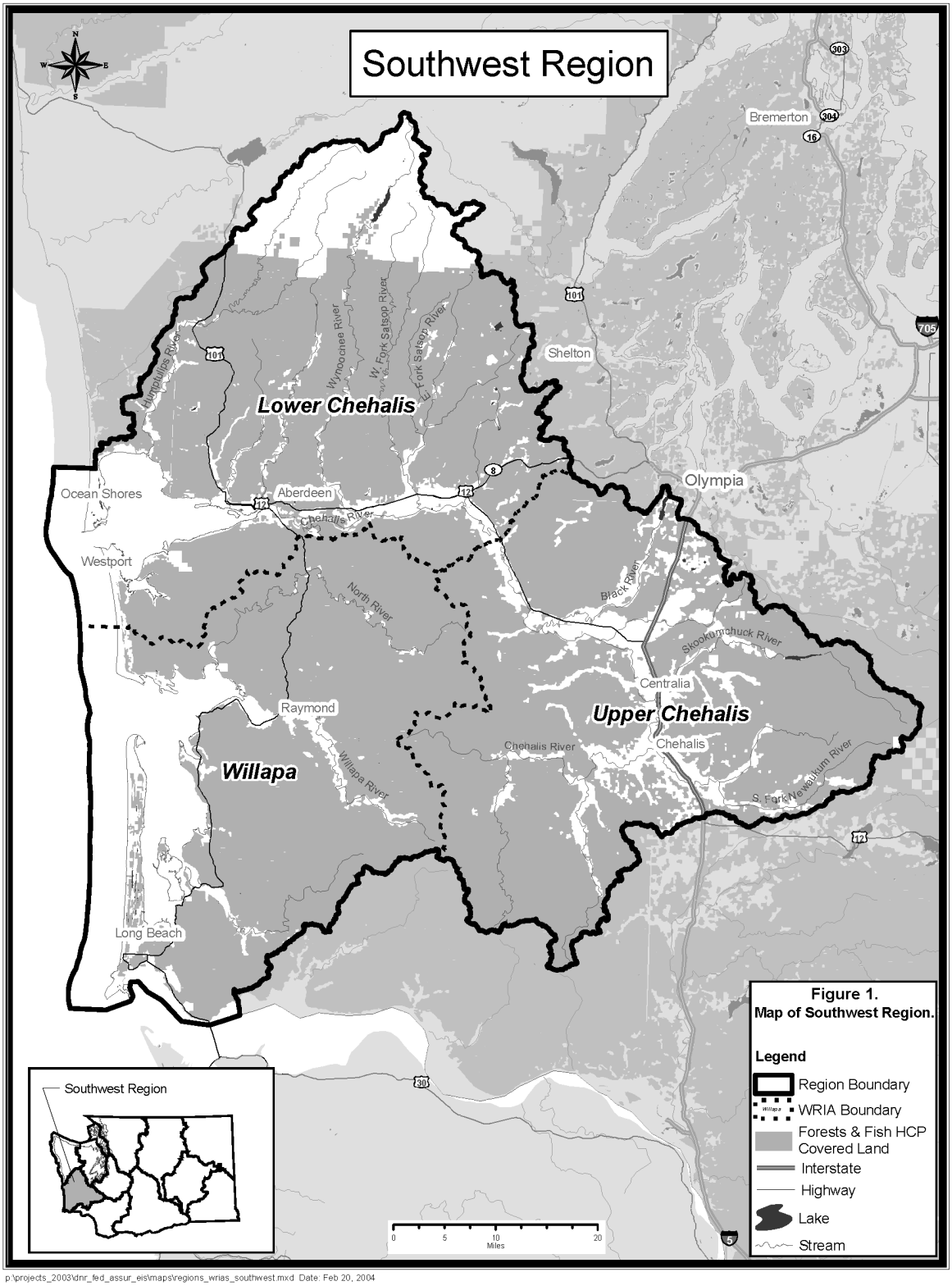
General Geology

The primary surface features of this region are the 'coastal hills' (including the Willapa Hills, Black Hills and south Olympic foothills) and the Chehalis Valley. The coastal hills are currently one of the key timber producing areas of the State. Most of the coastal hills in the region are low in elevation (100 to 1000 m). Geologically, this region has been formed by gradual uplift, with the oldest rocks being about 57 million years old. These rocks have not been exposed to either continental or alpine glaciations. A key consequence of this is that the softer and highly weathered rocks that have not been removed by glaciers are still very much present and widespread (mostly marine sedimentary and volcanic rock). In many areas, the rock decomposes directly into sand and silt, and therefore, spawning habitat can be in short supply. Easily erodable geology and heavy rainfall results in relatively short steep hillslopes and low gradient stream channels.

The Chehalis Valley is a wide valley that drains portions of the Olympic Mountains, Cascade foothills, Black Hills and Willapa Hills. The northern and western extents of the Chehalis River valley are influenced by continental glaciation. At the maximum extent of the continental glaciation, huge moraine deposits and meltwater outwash areas formed along the southern margins of the Puget Sound. At times, this meltwater drained through the Chehalis Valley. While the moraine material is rich in fines, it also provides gravel and boulders of hard rock, resulting in better spawning substrate than in other areas of the coastal hills.

The Southwest Washington region also contains small sections of the Olympic Mountains (upper reaches of the Wynoochee, Humptulips and Satsop Basins), two watersheds in the Cascade foothills (Skookumchuck and Newuakum basins), and smaller coastal river floodplains scattered around Grays Harbor and Willapa Hills. The issues concerning the Olympic Mountains are identical to those discussed on the Olympic Coast and West Puget Sound regions, and are not reiterated in this section. The Cascade foothills within this region exhibit most of the same characteristics and problems as the coastal foothills, and are not discussed separately in this section.

Information concerning erosion processes in the Southwest planning region has been extracted from the following watershed analyses: Chehalis Headwaters (Weyerhaeuser Company 1994a); Willapa Headwaters (Weyerhaeuser Company 1994b); Vesta-Little North (Weyerhaeuser Company 1995).


Southwest Region
Bremerton
Shelton
Olympia
Lower Chehalis
Upper Chehalis
Willapa
Ocean Shores
Aberdeen
Westport
Raymond
Centralia
Chehalis
Long Beach
Humptulips River
Wynoochee River
W. Fork Satsop River
E. Fork Satsop River
Chehalis River
North River
Black River
Skookumchuck River
Willapa River
S. Fork Newaukum River
Southwest Region
0 5 10 20
Miles
Figure 1.
Map of Southwest Region.
Legend
Region Boundary
WRIA Boundary
Forests & Fish HCP Covered Land
Interstate
Highway
Lake
Stream
p:\projects_2003\dnr_fed_assur_eis\maps\regions_wrias_southwest.mxd Date: Feb 20, 2004

Erosion in the Southwest planning region is dominated by mass wasting. Debris avalanches, debris flows, and debris torrents are by far the most common mass wasting processes. In the Chehalis Headwaters WAU, 93 percent of inventoried landslides were classified as either debris avalanches or debris flows while in both the Vesta-Little North and Willapa Headwaters WAUs, these processes comprised 92 percent of all landslides. Due to the uninterrupted nature of most slopes and high stream densities, a large majority of landslides deliver sediment to streams (81 percent in the Willapa Headwaters WAU). Due to the low topographic relief in the Willapa Hills portion of the planning region, debris torrents typically travel short distances relative to the Southern Cascades where slope and channel conditions support longer run-out lengths. Most debris avalanches originate in bedrock hollows, convergent headwalls, channel heads, and inner gorges.

Surface erosion from hillslopes is uncommon and typically does not contribute significant amounts of sediment to streams.

General Hydrology

The region has a marine climate characterized by mild, wet winters and warm, dry summers. Persistent coastal fog is common during the summer. Average annual precipitation ranges from 40 inches in the Puget Lowland to nearly 100 inches in the Willapa Hills. Nearly all of the precipitation falls as rain with snow occurring infrequently. The region receives more than 75 percent of its annual precipitation from October through March.

The Chehalis River drains much of the Southwest region and flows into Grays Harbor at the town of Aberdeen. The region also contains several smaller river basins including the Humptulips, North, Willapa, and Naselle. The Humptulips River is tributary to Grays Harbor while the others flow into Willapa Bay. Because these rivers drain relatively low elevation watersheds, peak flows result almost exclusively from high-magnitude rainfall events that occur during fall and winter. Low flows occur in late summer or early fall. Based on the DNR stream hydrography GIS coverage, there are approximately 28,607 stream-miles (both fish-bearing and non-fish streams) in the Southwest Washington region, with an average stream density of 7.91 stream miles/mile^2 (Table 1). This is the highest stream density among the 12 regions of the State, and reflects the high rainfall of the region, but also the fact that stream surveys are probably more complete in this region of the State.

Table 1. Stream Miles in the Southwest Washington Region by WRIA[1/]

	WRIA 22 Lower Chehalis	WRIA 23 Upper Chehalis	WRIA 24 Willapa	Total Southwest Washington Region
Stream Length (miles)	8,607	9,903	10,097	28,607
Stream Density (miles/mi^2)	6.54	7.63	10.09	7.91

[1/] Primary Data Source: DNR stream hydrography GIS layer. Stream miles include all mapped Type 1-9 streams.

2.0 LAND OWNERSHIP AND USE

Major Land Ownership and Management

Approximately 6 percent of all lands in the Southwest Washington region are in Federal ownership and 1 percent of all lands are being managed in a Federal long-term preservation status, primarily in national parks, national wildlife refuges, and wildernesses (Table 2). Most of the remaining 5 percent of Federal lands is being managed by the Forest Service outside of wilderness; a substantial portion of these non-wilderness National Forest System lands is being managed under a very limited management status (e.g., LSRs, Managed LSAs, AMAs, or Riparian Reserves) according to the Northwest Forest Plan. Other Federal agencies manage only a very small percentage of the remainder (0.1 percent of all lands). Tribal lands represent less than 1 percent of the region. State lands (primarily under management for timber production) represent 14 percent of all lands in the region, private lands represent 78 percent, and city/county lands represent about 1 percent.

Private lands dominate the entire region, except for the northern portion of the Lower Chehalis WRIA and a coastal strip along the western boundaries of the Lower Chehalis and Willapa WRIAs. Private ownership is most prevalent in the Willapa WRIA (85 percent) and least prevalent in the Lower Chehalis WRIA (74 percent).

Land Cover and Use

Forestland makes up approximately 89 percent of the Southwest Washington region, ranging from 84 percent in the Upper Chehalis WRIA to 91 percent in the Willapa WRIA (Table 3). Agricultural lands comprise 6 percent of the region, and they are particularly prevalent in the river valleys of the Upper Chehalis WRIA, where they make up 13 percent of the WRIA.

Table 2. Land Ownership Parameters for the Southwest Washington Region by WRIA[1/]

Land Ownership	WRIA 22 Lower Chehalis	WRIA 23 Upper Chehalis	WRIA 24 Willapa	Total Southwest Washington Region
Federal – Long-term Congressionally Protected Lands [2/]	4,943	-	7,189	12,132
Federal – Other National Forest System Lands [3/]	122,874	608	-	123,482
Federal – Other Federal Lands [4/]	-	-	1,391	1,391
State – Protected Lands [5/]	5,601	2,206	4,775	12,582
State – Managed Lands [6/]	46,236	175,268	82,557	304,062
Tribal Lands/Indian Reservations	-	4,307	316	4,623
Municipal Watershed	10,972	-	-	10,972
Other County/City Lands	27,478	35	1,577	29,090
Private	623,850	648,381	542,690	1,814,921
TOTAL	**841,954**	**830,805**	**640,495**	**2,313,254**

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan GIS layers.
[2/] Includes national parks, national monuments, national recreation areas, national wildlife refuges, and wildernesses.
[3/] Includes all non-wilderness National Forest System lands; the majority of the acres consists of lands protected under the Northwest Forest Plan (e.g., LSR, Managed LSR, AMA, Riparian Reserves)
[4/] Includes all Department of Defense, Department of Energy, Bureau of Land Management, and Bureau of Reclamation lands.
[5/] Includes all State Parks and Wildlife Areas.
[6/] Includes all DNR, Department of Corrections, and University lands.

Table 3. General Land Cover Classifications in the Southwest Washington Region by WRIA[1/]

Land Cover	WRIA 22 Lower Chehalis	WRIA 23 Upper Chehalis	WRIA 24 Willapa	Total Southwest Washington Region
Forestland	768,835	699,216	589,796	2,057,847
Shrubland	7,645	4,692	4,047	16,384
Grassland	2,824	3,796	2,088	8,708
Water & Wetlands	16,412	5,968	(4,986)	17,393
Ice, Snow, & Bare Rock	6,320	352	31,033	37,705
Residential & Commercial	13,486	11,968	5,496	30,949
Agricultural	26,432	104,813	13,023	144,267
TOTAL	**841,954**	**830,805**	**640,495**	**2,313,254**

[1/] Primary Data Source: USGS/EPA National Land Cover Data GIS layer.

3.0 FORESTLAND OWNERSHIP AND MANAGEMENT

Approximately 6 percent of the forestlands in the Southwest Washington region are in Federal ownership, 0.1 percent are in Tribal ownership, 15 percent are in State ownership, and 79 percent are in private or other ownership (Table 4). A Federal or State status of preservation or limited management covers approximately 7 percent of the forestlands in the region. Less than 1 percent of the forestlands are available for Federal or Tribal timber management. State timber management may occur on approximately 14 percent of the forestlands, and 79 percent of the forestlands are in private, county, or city ownership, where timber management may occur. Overall, lands covered by the forest practices rules represent approximately 93 percent of the forestlands in the region (see Figure 1, which displays these lands); this is the highest percentage among the regions of the State with substantial forestland acreage. Existing HCPs cover the vast majority (87 percent) of the State-managed lands, and a small portion (9 percent) of the private, county, and city ownerships.

The overall percentage of forestlands subject to the State forest practices rules ranges from 83 percent in the Lower Chehalis WRIA to 99 percent in the Upper Chehalis WRIA. The overall percentage covered by an HCP ranges from 14 percent in the Willapa WRIA to 27 percent in the Lower Chehalis WRIA.

Small, 20-acre exempt forest landowners make up about 0.8 percent of the forestlands and about 0.8 percent of the forestlands subject to forest practices rules in the Southwest Washington region, based on the analysis by Rogers (2003). Although this analysis may represent an underestimate, it is believed to have identified the majority of all small, 20-acre exempt parcels (personal communication, Luke Rogers, Rural Technology Initiative, University of Washington, May 2004). The small landowner parcels are mainly found in the lower elevation lands, especially along the major rivers. The highest percentage (about 1% of the forestland) is in the Upper Chehalis WRIA and the lowest percentage (0.4%) is in the Willapa WRIA.

Approximately 24,654 stream miles occur on lands subject to forest practices rules in the Southwest Washington region (Table 5). This represents 86 percent of all streams in the region. Approximately 13,820 miles or 56 percent of the 24,654 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre exempt forest landowner parcels in this region is estimated to be about 0.7 percent and the percentage of all fish-bearing streams on small, 20-acre exempt forest landowner parcels is about 1 percent (Rogers 2003).

Table 4. Ownership and Management of Forestlands (acres and percent) in the Southwest Washington Region by WRIA[1/]

Forestlands Category	WRIA 22 Lower Chehalis	WRIA 23 Upper Chehalis	WRIA 24 Willapa	Total Southwest Washington Region
Federal and State Protected Forestlands Not Managed for Timber Production[2/]	130,089	2,042	8,560	140,690
Federal Lands and Tribal Forestlands Available for Timber Management[3/]	274	2,594	1,065	3,933
Forestlands Available for Timber Management Under the State Forest Practices Rules				
DNR and Other State Forestlands	42,092	170,749	81,844	294,684
Private, County, and City Forestlands	596,381	523,831	498,328	1,618,539
Subtotal	638,472	694,580	580,171	1,913,223
TOTAL FORESTLANDS	768,835	699,216	589,796	2,057,847
% IN FEDERAL OR STATE PROTECTION	17%	0%	1%	7%
% AVAILABLE FOR FEDERAL OR TRIBAL TIMBER MANAGEMENT	0%	0%	0%	0%
% AVAILABLE FOR STATE TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	5%	24%	14%	14%
% AVAILABLE FOR PRIVATE OR COUNTY/CITY TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	78%	75%	84%	79%

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan, and USGS/EPA National Land Cover Data GIS layers.
[2/] Federal and State Protected Lands includes: Wilderness, LSR, LSOG, AMA, National Wildlife Refuges, National Parks, Washington State Parks, and WDFW lands.
[3/] Federal and Tribal Lands Available for Timber Management include: USFS Matrix lands, USFS other lands, BLM lands, Dept of Defense lands, and Indian Reservation lands.

Table 5. Stream Miles in the Southwest Washington Region by Ownership, Forested Stream Miles, and Forest Practices Rules (FPR)-Regulated Stream Miles[1/]

Category	WRIA 22 Lower Chehalis	WRIA 23 Upper Chehalis	WRIA 24 Willapa	Total Southwest Washington Region
Total Stream Miles				
Federal	920	7	85	1,011
Tribal	-	42	4	45
State	573	1,850	1,367	3,790
County/City	453	1	32	486
Private	6,661	8,004	8,609	23,275
Total Miles	**8,607**	**9,903**	**10,097**	**28,607**
Forested Stream Miles				
Forested Miles	7,509	8,781	9,436	25,725
% of Total Miles	87%	89%	93%	90%
FPR-Regulated Stream Miles				
FPR-Reg. Miles	6,566	8,743	9,345	24,654
% of Total Miles	76%	88%	93%	86%

[1/] Data sources: DNR stream hydrography GIS layer, DNR Major Public Lands layer, and USGS/EPA National Land Cover Data. Stream miles include all Type 1-9 streams.

4.0 HABITAT LIMITING FACTORS

Primary Regional Factors

Fine sediment is the key limiting factor in much of the coastal hill drainages (WDNR 1996a). Landslides and unpaved roads are both significant contributors (WDNR 1994, 1996b, 1997b, 1997c, 1997d). The coastal foothills are one of the most landslide sensitive areas of the State. LWD is especially important in these channels because of the deficiency of armoring substrates. Beaver thrive in the low gradient channels that are typical of the foothills, and beaver dams can play a significant positive role in moderating the extremes of water flow and fine sediment routing, but beaver ponds can exacerbate water temperature problems.

Urbanization, and agricultural development have impacted the Chehalis Valley and, to a lesser degree, the smaller coastal valleys. Fine sediment from bank erosion is a significant problem (WSCC 2001). Water temperatures routinely exceed State water quality standards in the Chehalis River mainstem and wider tributaries (WDOE 2001). While these water temperatures are partially a result of a naturally wide channel and a low elevation, deficient riparian buffers on agricultural and urban lands affect many smaller tributaries. This loss of cold temperature refugia may have a severe impact on salmonid production in the region.

Sedimentation/Mass Wasting

The coastal hills are the most landslide-sensitive areas of the State because of the highly weathered marine sedimentary and volcanic bedrock. The degree of sensitivity depends on the underlying bedrock formation and the elevation of the hills. However, most of the underlying bedrock decays directly to sand, silt and/or clay, providing weak hillslope support, and providing little or no large substrate to armor the stream channels (WDNR 1996a). Heavy precipitation has also been conducive to erosion and landslides. The geological consequences of highly weathered marine sedimentary and volcanic bedrock and heavy precipitation are relatively short steep hillslopes and low gradient stream channels. Most of the watershed analyses inventoried hundreds of shallow rapid landslides (SRLSs), including 1,100 landslides in one (WDNR 1997c) and 675 landslides in another (WDNR 1994, also see WSCC 2001 for Newaukum watershed information, WDNR 1996b, 1997b, 1997c, 1997d). Only the Palix Watershed landslide inventory recorded less than 100 SRLSs (WDNR 1997a). Forest roads, and to a lesser extent, clearcut harvesting on steep slopes, helped trigger most of these landslides. Lands prone to SRLSs are often managed for forestry, because they are unsuitable for most other uses. It should also be noted that the watershed analysis process targeted watersheds with a history of problems, especially mass wasting. Thus, this selection of Watershed Administrative Units (WAUs) may be biased with regard to regional landslide frequency.

Deep-seated landslides (DSLSs) and slumps occur in certain geological formations, and are scattered throughout the coastal foothills (WDNR 1994, 1995, 1996b, 1997a, 1997d).

Landslides are not a factor in the Chehalis Valley; however, streambank erosion is a problem in some areas and a significant source of fine sediment. Loss of riparian forests to agricultural and urban land uses is a primary cause of stream bank erosion. Increased peak flows from loss of soil permeability may also be a factor (WSCC 2001).

The underlying geology and heavy rainfall in the coastal foothills results in sensitivity to road surface erosion. Unpaved forest and rural residential roads require significant maintenance to minimize sediment delivery to channels. In some areas, hard rock for road surfacing is difficult to find (e.g. Vesta-Little North, WDNR 1997), and the next best available material must be used for road surfaces. This has led to extensive gravel mining of river alluvium in the Humptulips and Hoquiam River basins, and has contributed to other fish habitat impacts (WSCC 2001).

Lower gradients in the Chehalis Valley minimize surface erosion from unpaved roads; however, there may be pockets of locally significant surface erosion.

Riparian, Floodplain and Wetland Conditions

Historical old-growth timber harvest removed riparian trees. In the Southwest Washington region, this harvest practice started in the early 1860s and was substantially completed by the 1960s. Subsequent agricultural and urban conversion permanently altered riparian vegetation in the river valleys, leaving either no trees, or a thin band of trees. The riparian zone along many agricultural areas are now dominated by alder, invasive canary grass and blackberry, and provide substantially reduced shade and LWD recruitment. It is difficult or impossible for native conifer to re-establish in buffers with these vegetative characteristics. The limiting factors reports (WSCC 1999, 2001) made frequent note of the deficiencies in riparian buffers on agricultural and urban lands. A photometric study by Lunetta et al. (1997) suggests that functional riparian buffers in agricultural and urban areas are substantially lacking (See habitat trends below).

For those riparian areas that remained in timber production, riparian stands harvested prior to 1972 were often allowed to regenerate naturally, although riparian harvest since 1972 has benefited from mandatory conifer regeneration requirements. Since the soils in many riparian areas are moist, hardwoods currently dominate most of the riparian buffers that are forested (See habitat trends discussion below).

The Chehalis Valley floodplain has seen extensive conversion to agricultural land use. Streambank damage and erosion by livestock are scattered throughout the region (WSCC 2001). Agricultural activity has also occurred in the floodplains of smaller coastal rivers, including the Humptulips, Wynoochee, Satsop and Willapa valleys. The Chehalis Valley has also experienced industrial and urban development near the river mouth (Cosmopolis) and in the upper valley (Chehalis and Centralia). Rural residential development has occurred on the flatter and more accessible land throughout this region.

Limiting Factors Analyses (WSCC 1999, 2001) don't mention extensive pre-Euro-amercian freshwater wetlands in the main river valleys, such as the Chehalis. It is unclear whether this is an oversight, lack of historic information, or that freshwater wetlands were not very extensive in comparison to the Puget Sound River valleys. Small valleys in the coastal foothills contain many small wetlands along low gradient channels. Beaver thrive in these small low gradient channels, and most of these wetlands are a result of beaver dams (WDNR 1996b, WDNR 1997a).

Channel/Hydrology Conditions

Medium-sized dams currently exist on the Wynoochee River and Skookumchuck River. These capture the sediment and contribute to channel incision and bedrock dominated channels downstream. Gravel supplementation is currently occurring at the Wynoochee Dam. Both the Wynoochee Dam and the Skookumchuck Dam use storage to enhance summer flows (WSCC 2001).

The widespread agricultural and urban conversion in the Chehalis Valley has reduced the percolation of precipitation into the soil, and has likely contributed to scour and stream bank erosion.

Loss of forest canopies can substantially increase peak flow events because of what is referred to as 'rain-on-snow' runoffs, which occur when heavy warm rain falls on a snow pack. However, this region generally lacks extensive areas above 1,200 feet, necessary to accumulate heavy snow packs. The Stillman Creek drainage and south Olympic foothills are the only areas in the region high enough in elevation to trigger this concern (WDNR 1995, 1997c).

The extensive network of forest roads may contribute to increased peak flows. Road ditches may act as an extension of the channel network, accelerating runoff and increasing the peak flows. Cross-drains and other BMPs may mitigate this effect, and local soil characteristics may vary the response. The existence and severity of road network effect is still subject to research and debate (Whemple 1994).

Estuarine and Nearshore Habitat

The Southwest Washington region has two large estuaries, Grays Harbor and Willapa Bay. Willapa Bay is one of the leading oyster producing estuaries in the nation, and Grays Harbor is also a major producer.

Grays Harbor differs from Willapa Bay in that industrial and urban developments are much more extensive, mostly associated with forest products. It is also a major industrial port. In the 1980s, paper mill wastes were identified as a significant contributor to the low survival of Chehalis River coho. Much of this has been cleaned-up, however other industrial toxic discharges, and the storage of toxins in sediments from historic industries remain a concern and may affect the survival of juvenile salmonids. Roughly 30 percent of the Grays Harbor estuary (presumably both inter-tidal marshes and mudflats) has been lost to industrial and urban development, including containment of dredge spoils. The environmental condition of the outer harbor is indeterminable. Marine water quality standards for temperature and dissolved oxygen have been exceeded, but these violations appear to be natural (WSCC 2001).

Willapa Bay is the most undeveloped large estuary in Washington State. Several towns and fishing ports exist around the margins; however, major industries are lacking. The economy is largely based on natural resource extraction (timber, fishing, agriculture and oysters) and some tourism. Draining and diking for livestock production have reduced inter-tidal marshes by roughly 25 percent in the north end of the Bay (North, Willapa and Palix estuaries) and less than 5 percent in the south bay area (Nemah, Naselle and Bear estuaries) (WSCC 1999).

Exotic Spartina has invaded both estuaries and is subject to ongoing eradication efforts. This grass can easily invade the open mudflats and drastically change the appearance of the bay. It is unclear what effect this would have on salmon production (WSCC 1999, 2001).

The coastal nearshore area in this region is composed of mostly sandy beaches. The beaches have not experienced much modification in historic times, nor have they been identified as critical for salmonid habitat.

Large Woody Debris

The recruitment of LWD has been impacted by past riparian forest harvest and, on lands converted to other uses, the failure to re-establish these riparian forests following harvest. While near-term recruitment ranges from 60 to 80 percent in the Upper Skookumchuck, West Satsop, Palix, and Fall River watersheds (WDNR 1995, 1996a, 1997a, 1997b), the outlook for long-term LWD recruitment is good on most stream reaches in the region. In addition, 64 percent of the Chehalis Headwaters is categorized as having good near-term LWD recruitment potential (WDNR 1994).

The retention of in-channel LWD has been impacted by its removal for navigational purposes, dikes and levee interference, debris torrents, and its historic removal as a misguided fisheries management tool.

Fifty-two percent of riparian stands on private lands in southwest Washington are dominated by hardwoods (Marshall and Associates 2000). Hardwoods do not grow to the size of conifer, and rot quickly. Thus, they are not as useful as conifer for LWD. However, hardwoods, especially

alder, are an important source of nitrogen, which may be more important in the small channels that don't readily flush leaf-litter (Wipfli and Gregovich 2002).

The high frequency of landslides and sediment input from other sources, and the lack of large substrate (gravel, cobble and boulders), make LWD input important for maintaining fish habitat. The scour around large LWD creates pools and spawning habitat, where gravel is present. Beavers are the other significant factor in this region. As noted above, they thrive in the smaller low gradient channels common in the coastal foothills. Beavers actively recruit LWD and build small dams, creating large ponds and trapping fine sediment. Thus, the beavers perform many of the functions of LWD recruited by other methods (WDNR 1996b, 1997a). One issue of notable regional interest is the widespread use of splash-dams to transport timber downstream to mills between 1890 and 1920. All logjams were systematically removed prior to the start of log drives. Splash dams of various sizes released pulses of high velocity water periodically to facilitate log transportation. The locations of over 130 splash dams were documented by Wendler and Deschamps (1955). River transportation of timber did severe damage to fish habitat. This included the loss of stable logjams, obstructing upstream passage, removal of riparian trees and vegetation, extensive bank damage, streambed scour and channel incision. By the 1920s, river transportation ceased in favor of rail and road transportation, and many dams were abandoned. In the 1930s, most of the remaining dams were destroyed to restore fish passage (Wendler and Deschamps 1955). Residual habitat effects from river transportation still persist.

Fish Passage

Limiting Factors Analyses (WSCC 2001) documented hundreds of known and potential culvert blockages in the Chehalis Basin. However in the past decade, fish passage through forestry, agricultural and urban road culverts has been an area of renewed interest and funding.

The Wynoochee River Dam has upstream and downstream fish passage facilities. The downstream passage facilities are still only partially effective (DeMond pers. comm. 2003); however, self-sustaining runs of coho and other species return to the upper river. The Skookumchuck Dam has upstream passage facilities, which are used to pass steelhead above the dam.

Water Quality Issues

Many river and stream segments throughout this region do not meet state water quality standards for temperature. Dissolved oxygen water quality violations are also relatively widespread.

Natural factors have contributed to the water temperature problem, including low elevations throughout the region, wide channels, low water velocity, lack of heat exchange with the streambed as a result of widespread fine sediment, and numerous beaver ponds (WSCC 1999, 2001). In addition, agricultural and urban development has reduced the riparian canopy throughout most of the river valleys. Livestock has removed shade and trampled vegetation. In the past decade, there have been extensive efforts to fence livestock out of riparian buffers. National Park and National Forest lands are limited to the far upper end of the Wynoochee, Satsop and Humptulips Basins (Southern Olympics). As a result, there are almost no old-growth riparian buffers remaining. Roughly half the second growth riparian buffers are alder-dominated, which lack the height to provide shade on larger channels. While some recovery can be accomplished to protect riparian buffers and allow trees to grow, this region is naturally sensitive to shade. (Also see Rashin and Graeber, 1992.)

In WRIA 22, the Upper Humptulips River has a TMDL for temperature (Peredney 2001).

In addition to temperature, low dissolved oxygen is a problem in the Black River and central Chehalis River (WRIA 23), where water is deep, and velocity is slow. The Upper Chehalis River

and its tributaries have TMDLs for temperature (WDOE, 2001) and for dissolved oxygen (Jennings and Pickett 2000). A significant fish kill has occurred in the Black River. Nutrients from agricultural and industrial sources have contributed to the problem (WSCC 2001).

The Willapa River, North River and some tributaries (WRIA 24) are impaired due to high temperatures. The Willapa River is also impaired due to low dissolved oxygen (WSCC 1999).

Chemical use in forestlands is substantially limited to herbicide applications to suppress alder, maple, and brush competition during early phases of conifer forest regeneration. There are no regional factors to suggest that impacts from herbicides would be different from other regions in Washington State.

The State list of impaired waters, in compliance with Section 303(d) of the Clean Water Act, lists waters that do not meet water quality standards or fully protect beneficial uses (see http://www.ecy.wa.gov/programs/wq/303d/index.html). Impairments to parameters in this region, such as temperature, turbidity, and dissolved oxygen, may be related to forest practices or other land uses.

5.0 HABITAT TRENDS

Potentially unstable landforms are now routinely identified and mapped. However, long-term trends of landslide activity are difficult to systematically measure because events causing landslides are often separated by years or decades from the actual triggering of the landslide. At this point, no reliable data exists on the long-term trend of landslide events.

Direct measure of in-channel fine sediment is costly and impractical, because very large sample sizes are necessary to achieve statistical significance. Therefore, the watershed analysis methodology (WFPB 1997) and the more recent Road Maintenance and Abandonment Plans (RMAP) focus on measuring fine sediment before it enters the channel. This method measures surface erosion for the tread surface, cutslope, ditchline and fillslope, based on road use, soil type, vegetative cover, gradient, water routing and other factors. No recent independent assessments of forest road maintenance have been made in Washington State or the Southwest Washington region (Sturhan pers.comm. 2003).

Habitat trends in LWD and shade can be determined, given the following three assumptions: 1) riparian stand conditions can adequately represent recovery of current and future LWD and shade; 2) riparian stand conditions can be determined from contemporary aerial photographs; and 3) most riparian buffers on non-Federal lands were historically harvested; thus, the current riparian condition represents a state of recovery. It is important to note that forestlands make up approximately 89 percent of the Southwest Washington region. Ninety-three percent of the total forestland is under private and State management; approximately 7 percent is under Federal or State Protection.

On a large scale, meaningful trends can be determined, based on two photometric studies.

A dataset used by Lunetta et al. (1997) was made available from Cosentino (personal communication, Brian Cosentino, WDFW, 2003), which allowed isolation of data from the Southwest Washington WRIAs (Table 6). 'Response reaches' were generally defined by Lunetta et al. as the lower gradient (< 4 percent) habitat where most of the anadromous fish production occurs. Table 6 shows that 4 percent of the response reach riparian buffers (RRRBs) were considered late seral[9] in composition. This low percentage reflects the fact that most of the

[9] 'Late Seral' Stands should not be confused with 'Old Growth Stands.' 'Late Seral' as defined by Lunetta et al (1997) means the conifer crown cover is >70% and more than 10% of the crown cover in trees are greater than 21 inches diameter breast height (dbh). Thus, 'Late Seral' can include some mature second growth conifer stands.

Table 6. Percent of response reach riparian buffers by WRIA for the Southwest Washington Region. [See Lunetta et al. (1997) for description of data.]

Canopy Class	Late Seral Stage	Mid Seral Stage	Early Seral Stage	Other Forest-lands	Water	Non-forest lands
Canopy Class Definition	>70% conifer canopy; >10% of the canopy must be conifer>21"dbh	>70% conifer canopy; <10% of the canopy must be conifer>21"dbh	Conifer Crown cover > 10% and <70%	Hardwood dominated, shrub or recent clearcut	Lakes, large rivers and other large water bodies	Urban, Agriculture, Rangeland, barren, glaciers
WRIA or Basin Name						
Lower Chehalis (WRIA 22)	9.2%	25.7%	1.6%	53.6%	0.3%	9.7%
Upper Chehalis (WRIA 23)	0.3%	16.3%	5.1%	46.7%	0.1%	31.5%
Willapa Bay (WRIA 24)	2.9%	30.0%	4.4%	47.3%	0.6%	14.8%
Total response reach riparian acres	8,582	46,893	7,016	96,794	626	35,854
SWW percentage	4.4%	24.0%	3.6%	49.4%	0.3%	18.3%

forestlands are State and private forests. The only Federal land occurs in the lower Chehalis WRIA, which extends into the southern Olympics. Nearly half of the RRRBs are 'other forestlands,' which are hardwood dominated or clearcuts (prior to 1994). This is the highest of any western Washington region, and nearly identical to the 52 percent[10] hardwood dominated buffer percentage estimated by Marshall and Associates (2000). These figures should be similar because there is very little Federal forest ownership in the region, and Marshall and Associates (2000) did not assess riparian composition on Federal lands.

6.0 FISH RESOURCES

Salmonid Stocks

Table 7 lists the salmonids that occur in the Southwest Washington region. The asterisk next to the species name indicates the species is introduced and not native to Washington State.

[10] This study used regional definitions that overlap the regional definitions used herein. Marshall and Assoc. found relatively little variation in hardwood stand percentages on private lands throughout western Washington.

Table 7. Salmonid species present by WRIA within the Southwest Washington Region (WDFW 2003).

Species	State Status[1/]	Federal Status[2/]	Lower Chehalis (WRIA 22)	Upper Chehalis (WRIA 23)	Willapa (WRIA 24)
Resident Cutthroat Trout		FCo	X	X	X
Searun Cutthroat Trout		FCo	X	X	X
Chum Salmon			X	X	X
Coho Salmon			X	X	X
Rainbow Trout			X	X	X
Summer Steelhead			X		X
Winter Steelhead			X	X	X
Sockeye Salmon			X		
Kokanee Salmon			X		X
Fall Chinook Salmon			X	X	X
Summer Chinook Salmon			X		
Spring Chinook Salmon			X	X	
Dolly Varden/Bull Trout	SC	FT	X		
Mountain Whitefish			X		

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Other Fish Species

Table 8 is a list of non-salmonid freshwater species that exist in the Southwest Washington region. The asterisk next to the species name indicates that the fish is not native to Washington State. This list should not be regarded as an exhaustive list of the species present. One State sensitive species, the Olympic Mudminnow, is endemic to western Washington and prefers slow water and wetlands. The Olympic Mudminnow is found in Grays Harbor and the Chehalis River drainages (Rodrick and Milner 1991).

Table 8. Non-salmonid freshwater fish species by WRIA within the Southwest Washington Region (WDFW 2003, Wydoski and Whitney 2003).

Species	State Status[1]	Federal Status[2]	Lower Chehalis (WRIA 22)	Upper Chehalis (WRIA 23)	Willapa (WRIA 24)
Longnose Dace			X	X	X
Speckled Dace				X	X
Pacific Lamprey		FCo	X	X	X
Western Brook Lamprey			X	X	X
Olympic Mudminnow	SS		X	X	
Riffle Sculpin			X	X	X
Reticulated Sculpin			X	X	X
Torrent Sculpin			X	X	X
Redside Shiner				X	X
Three-Spine Stickleback			X	X	X
Bridgelip Sucker			X	X	X
Largescale Sucker			X	X	X
Northern Pikeminnow			X	X	
Channel Catfish*					X
Brown Bullhead*				X	
Sunfish spp*.			X	X	
Pumpkinseed*			X		
Crappie spp*			X		X
Yellow Perch*				X	X
Largemouth Bass*			X	X	

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Status of Salmonid Stocks

The State and Tribal stock status of 50 stocks in the Southwest Washington region is shown in Table 9.

Table 9. Southwest Washington Salmon and Steelhead Stock List presented by River Basin (2002 SASI Report, 1998 Bull Trout Status Report).

River Basin	Species	Stock Status
Grays Harbor Basin WRIA 22 and 23		
Chehalis	Spring Chinook	Healthy
Satsop	Summer Chinook	Depressed
Humptulips	Fall Chinook	Depressed
Hoquiam	Fall Chinook	Depressed
Wishkah	Fall Chinook	Healthy
Wynoochee	Fall Chinook	Depressed
Satsop	Fall Chinook	Healthy
Chehalis	Fall Chinook	Healthy
South Bay	Fall Chinook	Unknown
Humptulips	Fall Chum	Healthy
Chehalis	Fall Chum	Healthy
Humptulips	Coho	Healthy
Hoqiuam	Coho	Healthy
Wishkah	Coho	Depressed
Wynoochee	Coho	Healthy
Satsop	Coho	Healthy
Chehalis	Coho	Healthy
Johns/Elk River, South Bay Tributaries	Coho	Healthy
Humptulips	Summer Steelhead	Depressed
Chehalis	Summer Steelhead	Depressed
Humptulips	Winter Steelhead	Healthy
Hoquiam	Winter Steelhead	Healthy
Wishkah	Winter Steelhead	Healthy
Wynoochee	Winter Steelhead	Healthy
Satsop	Winter Steelhead	Depressed
Chehalis	Winter Steelhead	Healthy
Skookumchuck/Newaukum	Winter Steelhead	Healthy
South Bay	Winter Steelhead	Unknown
Grays Harbor/Chehalis	Bull Trout/Dolly Varden	Unknown
Willapa Bay– WRIA 24		
Willapa Bay	Fall Chinook	Healthy
North River/Smith Creek	Fall Chinook	Depressed
Naselle River	Fall Chinook	Depressed
North River	Fall Chum	Healthy
Willapa River	Fall Chum	Unknown
Palix River	Fall Chum	Healthy
Nemah River	Fall Chum	Unknown
Naselle River	Fall Chum	Healthy

Table 9. Southwest Washington Salmon and Steelhead Stock List presented by River Basin (2002 SASI Report, 1998 Bull Trout Status Report) (continued).

River Basin	Species	Stock Status
Bear River	Fall Chum	Unknown
North River/Smith Creek	Coho	Healthy
Willapa River	Coho	Healthy
Palix/Nemah	Coho	Healthy
Nemah River	Coho	Healthy
Naselle River	Coho	Healthy
Bear River	Coho	Healthy
North River /Smith Creek	Winter Steelhead	Healthy
Willapa River	Winter Steelhead	Healthy
Palix River	Winter Steelhead	Healthy
Nemah River	Winter Steelhead	Healthy
Naselle River	Winter Steelhead	Healthy
Bear River	Winter Steelhead	Healthy

For State and Tribal Stock Status, *Healthy* refers to a stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock; *Depressed* refers to a stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely; *Critical* refers to a stock of fish experiencing production levels that are so low that permanent damage to the stock is likely or has already occurred; and *Unknown* refers to a stock of fish which has insufficient information to rate stock status.

All anadromous salmonid species are present in the Southwest Washington region, except for Pink Salmon. Bull trout/Dolly Varden are Federally listed as threatened in the region.

7.0 AMPHIBIANS

The Southwest Washington region harbors 19 amphibian species, including the established introduced bullfrog (Dvornich et al. 1997; McAllister 1995), making it among the most amphibian-rich regions in the State. Of these 19 species, the largest assemblage (including the bullfrog) consists of 9 taxa that reproduce in stillwater habitats, including lakes, oxbows, ponds, temporary pools, and other freshwater wetlands with sufficient stillwater habitat. Stillwater habitats are predominantly associated with the riparian margins of larger stream or riverine systems within the region, and relatively few ponds or lakes (at least those not built by human agencies) exist at the higher (but still moderate) elevations within the region. Since a large proportion of this habitat has been altered or lost (see Riparian, Floodplain and Wetland Conditions sections), significant impact to stillwater amphibians is presumed. Lowland stillwater habitats are also the habitats in which introduced warmwater species (i.e., bullfrogs and selected fish [i.e., catfish, mosquitofish, sunfish], see Table 8); and interactive facilitation among these introduced species, particularly bullfrogs and warmwater fish, may promote survival of introduced species (Adams et al. 2003) over native amphibians (Adams 1999). Of the remaining 10 native amphibian species, four species (Dunn's salamander, ensatina, Van Dyke's salamander, and western red-backed salamander) reproduce in terrestrial habitats and the remaining six species (Cope's giant salamander, coastal giant salamander, coastal tailed frog, Cascades torrent salamander, Columbia torrent salamander, and Olympic torrent salamander) reproduce in streams, springs, or seeps.

Of the entire amphibian assemblage for the region, six species (Dunn's salamander, Cascades torrent salamander, coastal tailed frog, Columbia torrent salamander, Olympic torrent salamander, and Van Dyke's salamander) are Forest Practices HCP-covered species (Table 10), making it the

region richest for Forests and Fish-covered amphibian species in the State. Several of these species have limited distributions in the region. Cascades and Olympic torrent salamanders are known only from relatively small areas in the eastern and northern portions of the region. Coastal tail frog and Van Dyke's salamander both appear to have distributions at largely higher elevations in the region that are varyingly spotty (Table 10). Known distributions may be conservative as no systematic surveys, either to understand distribution or determine status (i.e., surveys of historic sites), have been performed in the region for most of these species. Recent systematic work on Coastal tailed frog in the Willapa Hills has revealed a pattern of landscape occupancy that is relatively low (personal communication, Marc Hayes, WDFW, 2003). Too few data exist even to perform a status survey for any of these species because of lack of a baseline. All of these species may be at some level of risk because sedimentation has the potential to substantially reduce its instream habitat (Bury 1983, Bury and Corn 1988, Corn and Bury 1989). Timber harvest, which can result in significant sedimentation (Beschta 1978, Jakob 1999), occurs over most of the Southwest Washington region where these species occur (see Habitat Trends section).

Although not covered under this Forest Practices HCP, six other amphibians (namely northwestern salamander [*Ambystoma gracile*], long-toed salamander [*Ambystoma macrodactylum*], western toad [*Bufo boreas*], Pacific treefrog [*Hyla regilla*], northern red-legged frog [*Rana aurora*], and rough-skinned newt [*Taricha granulosa*]) may receive some protection as a result of Forests and Fish patch buffer prescriptions. One of these species, the western toad, has State watchlist (special concern) status (WDFW 2001), and has declined elsewhere within its geographic range (Carey 1993); however, its status in the Southwest Washington region is unknown. Hydrological alteration may have resulted in habitat loss for western toads at low elevations in the riparian areas of larger riverine systems.

Table 10. Forest and Fish Amphibians of the Southwest Washington Region.

Group	Name	Habitat			Regional Distribution
		Active Season		Over-wintering	
		Breeding	Non-Breeding		
Frogs	Coastal tailed frog *Ascaphus truei*	streams	streams	terrestrial	In streams with enough gradient in the Willapa Hills, southern Olympics, and Capitol Forest uplands
Salamanders	Dunn's salamander *Plethodon dunni*	terrestrial	terrestrial	terrestrial	Widespread but restricted to south of the Chehalis River
	Van Dyke's salamander *Plethodon vandykei*	terrestrial	terrestrial	terrestrial	Localized in uplands of Willapa Hills and southern Olympics
	Cascades torrent salamander *Rhyacotriton cascadae*	stream	stream	terrestrial	Known only from extreme east portion of WRIA 23
	Columbia torrent salamander *Rhyacotriton kezeri*	stream	stream	terrestrial	Widespread but restricted to south of the Chehalis River
	Olympic torrent salamander *Rhyacotriton olympicus*	stream	stream	terrestrial	Widespread but restricted to north of the Chehalis River

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LOWER COLUMBIA RIVER REGIONAL SUMMARY

LOWER COLUMBIA RIVER REGIONAL SUMMARY

1.0 PHYSICAL DESCRIPTION

The Lower Columbia River region includes four WRIAs (25, 26, 27, and 28). Major stream systems include the Kalama, Grays, Elochoman, Cowlitz, Coweeman, Lewis, Salmon Creek, and Washougal River Basins, as well as other smaller tributaries. Portions of Wahkiakum, Skamania, Cowlitz, and Clark Counties are contained within the Lower Columbia River region. A map of the Lower Columbia River region is provided in Figure 1.

The Lower Columbia region lies within the Southern Cascades and Willapa Hills physiographic provinces and encompasses all of the Portland Basin physiographic province (Lasmanis 1991). Elevations range from sea level to over 14,000 feet atop Mount Rainier.

General Geology

The Lower Columbia River region is composed of the coastal hills, the Cascade Mountains, volcanoes, glacial/volcanic valleys and non-glacial valleys. The lower Columbia River was unaffected by continental glaciation; however, alpine glaciation was significant in shaping several valleys.

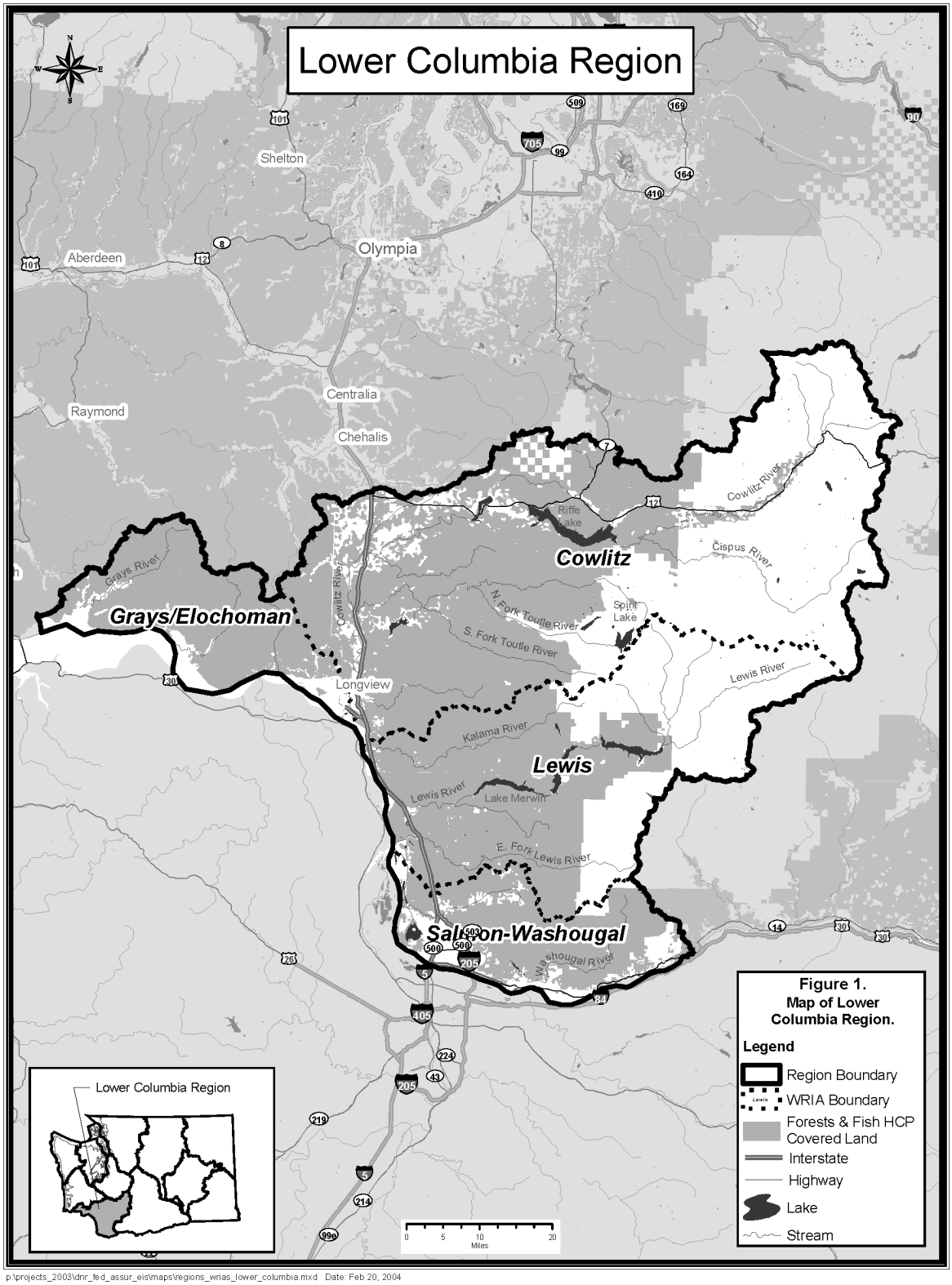
The coastal hills in WRIA 25 and part of WRIA 26 are essentially the same coastal hills described in the Southwest Washington region (see the Southwest Washington Regional Summary for details).

West of the lower Cowlitz River are the Cascade foothills (<500 m) and mountains (>500 m). The Cascade Mountains and foothills are composed of mostly Oligocene and Miocene volcanic rocks, which are not as extensively fractured or weathered as the coastal hills (Walsh et al. 1987). However, the higher elevations and steeper slopes make these hills moderately vulnerable to landslides. Most of the non-volcanic mountains lack the elevation to have had significant alpine glaciers during the recent (Pleistocene) ice age.

Mt. Rainer, Mt. St. Helens and Mt. Adams are geologically active volcanoes. Mt. St. Helens erupted massively in 1980, drastically altering the landscape near the mountain. Similar eruptions have occurred many times for all three volcanoes. All three volcanoes have alpine glaciers and these alpine glaciers extended far downstream during the most recent ice age. The larger river valleys such as the North Fork (NF) Toutle and Upper Cowlitz River are typically wide from alpine glaciations, and the valley bottoms are relatively flat as a result of alluvial deposits, mudflow and eruptive landslide depositions. Other river valleys, such as the South Fork (SF) Toutle, Kalama and Washougal are primarily products of alluvial erosion ('V' shaped), and have not experienced much glaciation.

Information concerning erosion processes in the Lower Columbia planning region has been extracted from the following watershed analyses: Connelly Creek (Murray-Pacific Corporation 1993); Kiona (Murray-Pacific Corporation 1995); North Elochoman (WDNR 1996b); Upper Coweeman (Weyerhaeuser Company 1997); Silver (West Fork Timber Company 1999).

Erosion in the Lower Columbia region, like most western Washington planning regions, is dominated by mass wasting. The most common forms of mass wasting are debris avalanches, debris flows, and debris torrents. Steep slopes and shallow soils overlying bedrock combine to produce high rates of these shallow-rapid landslide processes. In the Upper Coweeman WAU, 74


Lower Columbia Region
Shelton
Olympia
Aberdeen
Centralia
Raymond
Chehalis
Cowlitz River
Riffe Lake
Cowlitz
Cispus River
Grays River
Grays/Elochoman
N. Fork Toutle River
Spirit Lake
S. Fork Toutle River
Lewis River
Longview
Kalama River
Lewis
Lake Merwin
E. Fork Lewis River
Salmon-Washougal
Washougal River
Lower Columbia Region
0 5 10 20
Miles
Figure 1.
Map of Lower Columbia Region.
Legend
Region Boundary
WRIA Boundary
Forests & Fish HCP Covered Land
Interstate
Highway
Lake
Stream
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percent of all mapped landslides were classified as debris avalanches and debris flows. Most debris avalanches initiate in convergent topography such as bedrock hollows, headwalls, and inner gorges. These three landforms were the sites of 88 percent of all debris avalanches and debris flows in the Kiona watershed administrative unit.

Large, persistent deep-seated landslides are also common in the Lower Columbia planning region. Although they may cover extensive areas, most of these features have been described as "ancient" and "inactive" or "dormant," and have not been identified as a significant sediment source on forestlands (Murray Pacific Corporation 1993; Murray Pacific Corporation 1995; WDNR 1996b; Weyerhaeuser Company 1997). However, the oversteepened headscarps and toeslopes of these features are often sites of shallow-rapid landslides such as debris avalanches and debris flows.

Watershed analyses conducted throughout the region indicate surface erosion is not a significant sediment source except in cases where soils adjacent to streams are heavily disturbed or compacted. Roads, including road surfaces, cutslopes, fillslopes, and stream crossings, were identified as significant sources of fine sediment in portions of almost every watershed administrative unit.

General Hydrology

The region has a marine climate characterized by mild, wet winters and warm, dry summers. Average annual precipitation ranges from 40 inches near the city of Vancouver to over 100 inches on the western slopes of the Southern Cascades. Most of the precipitation falls as rain at lower elevations while snow is the dominant form of precipitation above 4,000 feet. The region receives more than 75 percent of its annual precipitation from October through March.

The Cowlitz River drains much of the Lower Columbia region and flows into the Columbia River at the town of Longview. Other rivers in the region include the Grays, Elochoman, Kalama, Lewis, Salmon and Washougal, all of which are tributary to the Columbia. Peak flows are driven by large magnitude rainfall events in lower elevation basins such as the Grays and Elochoman rivers. Rain and rain-on-snow precipitation events produce peak flows in the remaining basins. Because of its origins on Mount Rainier, the Cowlitz River sometimes experiences significant snowmelt peak flows during the spring. Low flows occur during the late summer and early fall. Based on the DNR stream hydrography GIS coverage, there are approximately 29,645 stream-miles (both fish-bearing and non-fish streams) in the Lower Columbia River region, with an average stream density of 6.18 stream miles/mile^2 (Table 1).

Table 1. Stream Miles in the Lower Columbia Region by WRIA[1/]

	WRIA 25 Grays/Elochoman	WRIA 26 Cowlitz	WRIA 27 Lewis	WRIA 28 Salmon/Washougal	Total Lower Columbia Region
Stream Length (miles)	4,769	14,913	8,000	1,963	29,645
Stream Density (miles/mi^2)	9.45	5.98	6.11	3.96	6.18

[1/] Primary Data Source: DNR stream hydrography GIS layer. Stream miles include all mapped Type 1-9 streams.

2.0 LAND OWNERSHIP AND USE

Major Land Ownership and Management

Approximately 35 percent of all lands in the Lower Columbia region are in Federal ownership and 11 percent of all lands are being managed in a Federal long-term preservation status, primarily in national parks, national wildlife refuges, and wildernesses (Table 2). Essentially all of the remaining 24 percent of Federal lands is being managed by the Forest Service outside of wilderness; a substantial portion of these non-wilderness National Forest System lands is being managed under a very limited management status (e.g., LSRs, Managed LSAs, AMAs, or Riparian Reserves) according to the Northwest Forest Plan. Other Federal agencies manage only a very small percentage of the remainder (0.1 percent of all lands). Only 95 acres of Tribal lands occur in the region (< 0.1 percent). State lands (primarily under management for timber production) represent 11 percent of all lands in the region, private lands represent 54 percent, and city/county lands represent about 0.1 percent.

Private lands are common throughout the region, but are especially prominent in the Grays-Elochoman (80 percent) and the Salmon-Washougal (70 percent) WRIAs. Federal lands are most prevalent in the other two WRIAs – Cowlitz and Lewis – making up 43 percent of each.

Land Cover and Use

Forestland makes up approximately 85 percent of the Lower Columbia River region, ranging from 59 percent in the Salmon-Washougal WRIA to 90 percent in the Lewis WRIA (Table 3). Agricultural lands comprise 6 percent of the region, and they are particularly prevalent in the river valleys of the Salmon-Washougal WRIA. Residential-commercial lands make up 2 percent of the region overall, but are also particularly prevalent in the Salmon-Washougal WRIA, making up 14 percent.

Table 2. Land Ownership Parameters for Lower Columbia Region by WRIA [1/]

Land Ownership	WRIA 25 Grays/Elochoman	WRIA 26 Cowlitz	WRIA 27 Lewis	WRIA 28 Salmon/Washougal	Total Lower Columbia Region
Federal – Long-term Congressionally Protected Lands [2/]	2,355	263,115	57,771	4,115	327,355
Federal – Other National Forest System Lands [3/]	-	423,104	305,651	17,279	746,034
Federal – Other Federal Lands [4/]	-	439	197	3,568	4,205
State – Protected Lands [5/]	514	4,807	797	7,914	14,033
State – Managed Lands [6/]	60,856	98,998	106,151	59,009	325,013
Tribal Lands/Indian Reservations	-	95	-	-	95
Municipal Watershed	-	-	-	-	-
Other County/City Lands	-	118	702	1,692	2,512
Private	259,384	804,272	366,144	223,352	1,653,152
TOTAL	**323,109**	**1,594,948**	**837,413**	**316,929**	**3,072,398**

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan GIS layers.
[2/] Includes national parks, national monuments, national recreation areas, national wildlife refuges, and wildernesses.
[3/] Includes all non-wilderness National Forest System lands; the majority of the acres consists of lands protected under the Northwest Forest Plan (e.g., LSR, Managed LSR, AMA, Riparian Reserves)
[4/] Includes all Department of Defense, Department of Energy, Bureau of Land Management, and Bureau of Reclamation lands.
[5/] Includes all State Parks and Wildlife Areas.
[6/] Includes all DNR, Department of Corrections, and University lands.

Table 3. General Land Cover Classifications in the Lower Columbia Region by WRIA[1/]

Land Cover	WRIA 25 Grays/Elochoman	WRIA 26 Cowlitz	WRIA 27 Lewis	WRIA 28 Salmon/Washougal	Total Lower Columbia Region
Forestland	272,000	1,403,735	752,429	187,553	2,615,716
Shrubland	2,179	29,687	6,839	7,261	45,965
Grassland	784	10,415	5,485	7,349	24,033
Water & Wetlands	24,722	29,821	19,308	16,380	90,231
Ice, Snow, & Bare Rock	3	45,680	12,258	849	58,791
Residential & Commercial	6,449	9,012	6,134	44,294	65,890
Agricultural	16,972	66,598	34,958	53,243	171,772
TOTAL	**323,109**	**1,594,948**	**837,413**	**316,929**	**3,072,398**

[1/] Primary Data Source: USGS/EPA National Land Cover Data GIS layer.

3.0 FORESTLAND OWNERSHIP AND MANAGEMENT

Approximately 37 percent of the forestlands in the Lower Columbia region are in Federal ownership, almost none (<0.1 percent) are in Tribal ownership, 12 percent are in State ownership, and 50 percent are in private or other ownership (Table 4). A Federal or State status of preservation or limited management covers approximately 27 percent of the forestlands in the region. Approximately 10 percent of the forestlands are available for Federal or Tribal timber management. State timber management may occur on approximately 12 percent of the forestlands, and 50 percent of the forestlands are in private, county, or city ownership, where timber management may occur. Overall, lands covered by the forest practices rules represent approximately 62 percent of the forestlands in the region (see Figure 1, which displays these lands). Existing HCPs cover the vast majority (85 percent) of the State-managed lands, and a small portion (3 percent) of the private, county, and city ownerships.

The overall percentage of forestlands subject to the State forest practices rules ranges from 55 percent in the Lewis WRIA to almost 100 percent in the Grays-Elochoman WRIA. The overall percentage covered by an HCP ranges from 15 percent in the Cowlitz WRIA to 31 percent in the Salmon-Washougal WRIA.

Small, 20-acre exempt forest landowners make up about 1.4 percent of the forestlands and about 2.3 percent of the forestlands subject to forest practices rules in the Lower Columbia region, based on the analysis by Rogers (2003). Although this analysis may represent an underestimate, it is believed to have identified the majority of all small, 20-acre exempt parcels (personal communication, Luke Rogers, Rural Technology Initiative, University of Washington, May 2004). The small landowner parcels are mainly found in the lower elevation lands, especially along the major rivers. The highest percentage (about 2.7% of the forestland) is in the Salmon-Washougal WRIA and the lowest percentage (0.7%) is in the Cowlitz WRIA.

Approximately 18,647 stream miles occur on lands subject to forest practices rules in the Southwest Washington region (Table 5). This represents 63 percent of all streams in the region. Approximately 9,794 miles or 53 percent of the 18,647 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre exempt forest landowner parcels in this region is estimated to be about 1.2 percent and the percentage of all fish-bearing streams on small, 20-acre exempt forest landowner parcels is about 1.9 percent (Rogers 2003).

Table 4. Ownership and Management of Forestlands (acres and percent) in the Lower Columbia Region by WRIA[1/]

Forestlands Category	WRIA 25 Grays/Elochoman	WRIA 26 Cowlitz	WRIA 27 Lewis	WRIA 28 Salmon/Washougal	Total Lower Columbia Region
Federal and State Protected Forestlands Not Managed for Timber Production[2/]	681	496,487	212,585	9,500	719,253
Federal Lands and Tribal Forestlands Available for Timber Management[3/]	-	116,157	131,391	14,934	262,482
Forestlands Available for Timber Management Under the State Forest Practices Rules					
DNR and Other State Forestlands	59,790	96,220	102,822	54,691	313,523
Private, County, and City Forestlands	211,530	694,871	305,631	108,427	1,320,459
Subtotal	271,319	791,091	408,453	163,119	1,633,982
TOTAL FORESTLANDS	272,000	1,403,735	752,429	187,553	2,615,716
% IN FEDERAL OR STATE PROTECTION	0%	35%	28%	5%	27%
% AVAILABLE FOR FEDERAL OR TRIBAL TIMBER MANAGEMENT	0%	8%	17%	8%	10%
% AVAILABLE FOR STATE TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	22%	7%	14%	29%	12%
% AVAILABLE FOR PRIVATE OR COUNTY/CITY TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	78%	50%	41%	58%	50%

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan, and USGS/EPA National Land Cover Data GIS layers.
[2/] Federal and State Protected Lands includes: Wilderness, LSR, LSOG, AMA, National Wildlife Refuges, National Parks, Washington State Parks, and WDFW lands.
[3/] Federal and Tribal Lands Available for Timber Management include: USFS Matrix lands, USFS other lands, BLM lands, Dept of Defense lands, and Indian Reservation lands.

Table 5. Stream Miles in the Lower Columbia Region by Ownership, Forested Stream Miles, and Forest Practices Rules (FPR)-Regulated Stream Miles[1/]

Category	WRIA 25 Grays/Elochoman	WRIA 26 Cowlitz	WRIA 27 Lewis	WRIA 28 Salmon/Washougal	Total Lower Columbia Region
Total Stream Miles					
Federal	42	4,783	2,805	215	7,846
Tribal	-	0	-	-	0
State	925	1,233	1,117	543	3,819
County/City	-	2	10	20	32
Private	3,802	8,894	4,068	1,184	17,948
Total Miles	**4,769**	**14,913**	**8,000**	**1,963**	**29,645**
Forested Stream Miles					
Forested Miles	4,136	12,871	7,009	1,391	25,407
% of Total Miles	87%	86%	88%	71%	86%
FPR-Regulated Stream Miles					
FPR-Reg. Miles	4,123	8,814	4,507	1,203	18,647
% of Total Miles	86%	59%	56%	61%	63%

[1/] Data sources: DNR stream hydrography GIS layer, DNR Major Public Lands layer, and USGS/EPA National Land Cover Data. Stream miles include all Type 1-9 streams.

4.0 HABITAT LIMITING FACTORS

Primary Regional Factors

Hydropower development is the single largest impact to salmonid habitat in the Lower Columbia region. Construction of dams on the Cowlitz and Lewis rivers has removed hundreds of miles of channels from anadromous fish access (WSCC 2000a, 2000b).

The May 18, 1980 eruption of Mt. St. Helens triggered the collapse of the entire north face of the mountain (3,000 meters (approximately 9800 feet) in elevation), sending a massive landslide 12 miles down the North Fork Toutle River, and burying the entire river valley deep with unconsolidated mineral sediments, rich in fines. Melt water from the glaciers on the flanks of the mountain sent mudflows down both the North and South Forks of the Toutle River, and through the lower Cowlitz River to the Columbia River. These mudflows destroyed or severely impacted riparian zones over its entire path. The staggering volume of loose sediment in the North Fork Toutle Valley created a long-term threat to thousands of residences, businesses and industries in the lower Cowlitz Valley communities of Castle Rock, Kelso and Longview. Efforts to protect property included construction of a large dam, officially named the 'Sediment Retention Structure' (SRS) immediately downstream of the landslide. In addition, extensive dredging, riprapping and diking occurred throughout the lower Toutle, Cowlitz and Coweeman rivers. The long-term consequences of these actions are not fully understood at this time (Mt. St. Helens Volcanic National Monument Website http://www.fs.fed.us/gpnf/mshnvm/).

Fine sediment is the key limiting factor in the coastal hills and many of the Cascade foothills and mountains. Landslides and unpaved roads are both significant contributors of fine sediment. Water temperature problems are widespread in the lower reaches, but less of an issue in the Cascade Mountains. Most streams and rivers are currently deficient in LWD. Urbanization and agricultural development have impacted most of the larger valleys, especially the Cowlitz Valley and eastern Clark County (WSCC 2000b).

Sedimentation/Mass Wasting

The coastal hills in WRIA 25 and the western edge of WRIA 26 are very sensitive to Shallow Rapid Landslides (SRLS) and debris torrents; with all the same problems of highly weathered and fractured rocks discussed in the Southwest Washington Regional Summary. The hills in Grays River and Elochoman River basins have naturally high sediment backgrounds, but forest practices have exacerbated the problem (WSCC 2002, WDNR 1996).

The Cascade foothills and mountains are moderately vulnerable to landslides. Steep slopes tend to be greater in length, and thus, the events can be more severe than in the coastal hills. Forest roads, and to a lesser extent, clearcut harvesting on steep slopes helped trigger most of these landslides. Lands prone to SRLS are often managed for forestry, because they are unsuitable for most other uses. Watershed analyses conducted in the Cascade Mountains suggest a moderate to severe vulnerability to SRLSs and debris torrents (WDNR 1993, 1994a, 1994b, 1996[11]).

Fine sediment from the mudflows and ash fall from the May 18, 1980 eruption of Mt. St. Helens continue to flush into the rivers near the mountain, and recovery in the North Fork and South Fork Toutle Basins is still far from complete. Partial or substantial recovery has occurred elsewhere. Sediment has filled the Sediment Retention Structure on the North Fork Toutle River,

[11] In the LCR Region, all but two of the available watershed analyses have been conducted on West Fork Timber Co. (formerly Murray-Pacific) lands in the upper Cowlitz Basin. This company is currently operating under its own HCP, which requires a watershed analysis in all watersheds within their ownership.

and it is unclear what additional actions will be taken to abate this problem (personal communication, Craig Olds, WDFW, 2003).

A number of the watershed analyses in the Lower Columbia region note a high frequency of deep-seated landslides (DSLSs) (WDNR 1994a, 1996). It is unclear whether this is a regional feature, or simply a result of a thorough search for these formations in the watershed analyses conducted within this region. Many DSLSs have been dormant for centuries, but could potentially be activated by forest practices by removing weight from the toe of the landslide, redirecting flow into the toes such that accelerated erosion occurs, or modifying the channel inputs such that channel incision occurs. However currently, landslides are not a significant factor in the Cowlitz Valley.

The underlying geology and heavy rainfall in the coastal foothills contribute to sensitivity to road surface erosion. Unpaved forest and rural residential roads require significant maintenance to minimize sediment delivery to channels. In some areas, hard rock for road surfacing is difficult to find; and roads must be surfaced with the next best available material (WDNR 1996; See also Southwest Washington Regional Summary).

Riparian, Floodplain and Wetland Conditions

Historic timber harvest removed most riparian buffers. In the Lower Columbia River region, timber harvesting started in the early 1860s and was mostly completed by the 1970s. Subsequent agricultural and urban conversion permanently altered riparian vegetation in the river valleys, leaving either no trees, or a thin band of trees. The riparian zones along many agricultural areas are now dominated by alder, invasive canary grass and blackberries, resulting in reduced shade and LWD recruitment. It is difficult for native conifer to re-establish in buffers with these characteristics. A photometric study by Lunetta et al. (1997) suggests that functional riparian buffers in agricultural and urban areas are substantially lacking or inadequate (See Habitat Trends below).

Wetlands were likely historically extensive in the lower gradient river valleys near the Columbia River. Farmers in the late 1800s started draining and diking most of this land. Remaining wetlands are limited and should be a priority for restoration and preservation (WSCC 2000b, 2001).

The 1980 eruption of Mt. St. Helens released mudflows that destroyed the riparian forests along the entire lengths of the North Fork, South Fork, and Mainstem Toutle River, and the Muddy River and Pine Creek tributaries of the Lewis River. In addition, extensive damage occurred in the blast zone north of the mountain, including most of the Green River Basin and small tributaries to the Cowlitz, Cispus, Lewis and North Fork Toutle basins. While some recovery has occurred, the full recovery of the North and South Fork Toutle River riparian stands is well into the future. The remaining wetlands and side channels in the North Fork, South Fork, and mainstem Toutle River and lower Cowlitz River have filled with mudflow deposits or dredge spoils. Extensive diking in the lower Cowlitz and the lower Coweeman has resulted in permanent confinement of the channel (WSCC 2000b).

Diking, channelization, wetland draining and related activities have occurred in other floodplains throughout this region. Floodplain impacts have varied in intensity from efforts to protect farmlands on the Cowlitz River above Cowlitz Falls (WSCC 2000b), to systematic floodplain development and flood control activities in the urban areas of Clark County (Salmon Creek and lower Washougal River, WSCC 2001). Habitat Limiting Factors Analyses (WSCC 2001) noted that urban development was still occurring in the floodplains of the Washougal River. Smaller floodplains in smaller drainages are often confined as a result of road or railroad construction (WSCC 2000b).

Channel/Hydrology Conditions

This region has seen significant modification to sediment and water routing as a result of dam construction. Three dams were constructed on the Cowlitz River, which significantly modified gravel supply, resulting in a decline in the quality of spawning substrate. A number of studies suggest that much of the natural spawning occurring below the dams is from hatchery strays, and not a result of self-sustaining natural production (DeVore 1987 in WSCC 2000b). Three hydropower dams were built on the Lewis River, again modifying the hydrology and gravel supply. The mainstem of the Lewis River below the lowest dam is largely bedrock and boulders. Flow fluctuations from hydropower peaking may cause stranding and fish kills (WSCC 2000a).

Loss of forest canopies can substantially increase peak flows due to rain-on-snow events. The Cascade Range within this region has extensive areas above 1200 feet (WFPB 1997); and clearcuts above this elevation can accumulate significant snow packs that would not occur in forested areas.

The Mt. St. Helens eruption triggered a powerful blast and ash-laden windstorm, that destroyed approximately 230 square miles of forests to the north of the mountain (Mt. St. Helens Volcanic National Monument Website). While much of this area should now be re-establishing hydrological maturity, rain-on-snow events have impacted the channels in this zone over the past twenty years (personal communication, Mark Hunter, WDFW. 2003).

The extensive network of forest roads may contribute to increased peak flows. Road ditches may act as an extension of the channel network, accelerating runoff and increasing peak flows (Whemple 1994). Cross-drains and other best management practices (BMPs) may mitigate this effect, and local soil characteristics may vary the response. The existence and severity of road network effect is still subject to research and debate (Whemple 1994).

Estuarine and Columbia Mainstem Habitat

The impacts to the lower Columbia River are an accumulation of upstream activities in Washington, Oregon, Idaho and British Columbia. The most significant modification of fish habitat in the Columbia River results from the extensive network of upstream hydropower dams. These dams have caused drastic changes in seasonal flow, sediment discharge, water temperature, fish communities and water chemistry. Along the Columbia River shorelines of this region, diking and filling as a result of urban and agricultural development, has reduced the sloughs and wetlands that likely provided rearing and over-wintering habitat for juvenile salmon. Road and railroad beds along the Columbia River have filled or cut off access to wetlands and side channels (Schaller et al.2002).

Large Woody Debris

The recruitment of LWD has been impacted by past riparian forest harvest and, on lands converted to other uses, the failure to re-establish these riparian forests following harvest. Long-term recruitment potential of LWD is good throughout the forested areas in the region.

The retention of in-channel LWD has been impacted by removal of LWD for navigation, dikes and levee interference, debris torrents, splash damming and historic removal of wood as a misguided fisheries management tool. The generally high occurrences of debris torrents make retention of LWD a significant issue.

The Washington State Conservation Commission has determined that LWD deficiency is widespread in this region. The reasons include riparian timber harvest, splash dams (see Southwest Washington discussion), agricultural and urban conversion of riparian habitat, and stream cleanouts. The mudflows that resulted from the Mt. St. Helens eruption, and the ensuing

flood control responses completely removed the riparian zone in the North Fork Toutle, South Fork Toutle, Mainstem Toutle and the lower Cowlitz River; and recovery has been slow (WSCC 2000a, 2000b, 2001, 2002).

Fifty five percent of riparian stands on private lands in the Lower Columbia River region are dominated by hardwoods (Marshall and Associates 2000). Hardwoods do not grow to the size of conifer, and rot quickly; thus, they are not as useful as conifers for LWD. However, hardwoods, especially alder, are an important source of nitrogen, which may be more important in the small channels that don't readily flush leaf-litter (Wipfli and Gregovich 2002).

Fish Passage

The construction of the Cowlitz and Lewis River dams constitute the two largest losses of anadromous fish access in western Washington State. In both systems, the loss of natural fish production was compensated with the construction of hatcheries, a common practice during 1940s and 1950s when these dams were constructed. Over 300 miles of accessible fish habitat were lost above Mayfield Dam on the Cowlitz, and roughly 150 miles above Merwin Dam on Lewis River. In both cases, 80 to 90 percent of the production potential had been lost (WSCC 2000a, 2000b).

The third dam on the Cowlitz River (Cowlitz Falls) was constructed in the early 1990s. Downstream fish passage screens were constructed as part of the structure. Currently, juvenile fish coming down the river are trapped and trucked around the dams; whereas previously, many of these fish would residualize in Riffe Lake, the large reservoir behind the second dam. This trap has been mostly successful in establishing self-sustaining runs of spring chinook, coho and steelhead in the upper Cowlitz basin. However, the downstream migrant trap cannot capture fish during flood flows; thus many juvenile outmigrants still end up in Riffe Lake (personal communication, Craig Olds and Lauri Vigue, 2003). Even if this trap becomes completely successful, only part of the historic potential of this watershed will be restored. A substantial section of the middle Cowlitz Basin remains inundated or inaccessible. The dams on the Lewis River remain a total blockage to anadromous fish use (WSCC 2001).

Following the eruption of Mt. St. Helens, the SRS dam was constructed on the North Fork Toutle River. A fish trap was constructed to pass fish over the dam. Despite elaborate measures to flush silt out of the trap, operation of the trap was only partially successful. Since the habitat above the dam is still recovering from the eruption and associated disturbances, fish production above this structure is quite limited at this time. However, most of the land above the SRS is preserved in parks and wildlife refuges, thus the long-term prospects for habitat recovery are good (personal communication, Craig Olds, WDFW, 2003).

Statewide, thousands of miles of fish channels have been rendered partially or completely inaccessible to fish, as a result of road culverts and other water crossing structures. This fish passage problem occurs in all regions of the State, and removes potential fish habitat from fish production. In the past decade, fish passage through forestry, agricultural and urban road culverts has been an area of renewed interest and directed funding. Habitat Limiting Factors Analyses (WSCC 2000a, 2000b, 2001, 2002) documents hundreds of known and potential culvert blockages in the region.

Water Quality Issues

Freshwater temperatures routinely exceed state water standards at low elevations near the Columbia River and the lower Cowlitz River. Many river and stream segments are on the state 303(d) for water temperature. A moderate number of water temperature readings higher than state water quality standards have been documented even on moderate sized channels in private

lands. A variety of factors may explain these, including debris torrent damage, recent harvest, naturally wide channels, and lack of conifer regeneration. The Cowlitz River below the Mayfield Dam benefits from cool water drawn from below the thermocline in Mayfield Lake, thus water temperatures are in compliance for a considerable distance downstream.

In WRIA 25, portions of the Columbia River, Germany Creek, Abernathy Creek, Elochoman Creek, Wilson Creek and Grays River at times have not met water quality standards for temperature (WDOE 1998). The Elochoman River, Abernathy Creek, Germany Creek and especially the Grays River have been impacted by sedimentation from forest practices (Simms 1997).

Many creeks in WRIA 26, including the Cispus and Coweeman Rivers and some of their tributaries have had temperature exceedances. In WRIA 27, temperature exceedances have been documented in the Kalama River, East Fork Lewis River, Lewis River, and a few tributaries in the Gifford Pinchot National Forest near Mount St. Helens (WDOE 2004). Several streams in this WRIA have instream flow or fish habitat impairments (WSCC 2000).

In addition to the Columbia River in WRIA 28, high temperatures have been recorded in the Salmon Creek and Burnt Bridge Creek watersheds (WDOE 2004). Many creeks have documented fish habitat or instream flow impairments (WSCC 2001).

Chemical use in forestlands is substantially limited to herbicide applications to suppress alder, maple, and brush competition during early phases of conifer forest regeneration. There are no regional factors to suggest that impacts from herbicides would be different from other regions in Washington State. The use of forest fertilizers and septic tank discharges were identified as the causes for eutrophication in Silver Lake, a large lake in the lower Cowlitz Valley (WDNR 1999).

5.0 HABITAT TRENDS

Potentially unstable landforms are now routinely identified and mapped. However long-term trends of landslide activity are difficult to systematically measure, because events causing landslides are often separated by years or decades from the actual triggering of the landslide. At this point, no reliable data exist on the long-term trend of landslide events in the Lower Columbia region.

Direct measure of in-channel fine sediment is costly and impractical because very large sample sizes are necessary to achieve statistical significance. Therefore, the watershed analysis methodology (WFPB 1997) and the more recent Road Maintenance and Abandonment Plans (RMAP) focus on measuring fine sediment before it enters the channel. This method measures surface erosion for the tread surface, cutslope, ditchline and fillslope, based on road use, soil type, vegetative cover, gradient, water routing and other factors. No recent independent assessments of forest road maintenance have been made in Washington State or the Lower Columbia region (personal communication, Nancy Sturhan, WDNR, October 2003).

Habitat trends in LWD and shade can be determined, given the following three assumptions: 1) riparian stand conditions can adequately represent recovery of current and future LWD and shade; 2) riparian stand conditions can be determined from contemporary aerial photographs; and 3) most riparian buffers on non-Federal lands were historically harvested; thus, the current riparian condition represents a state of recovery. It is important to note that forestlands make up approximately 85 percent of the Lower Columbia River region. Private and State management covers 62 percent of the total forestland management. Approximately 27 percent of forestlands are under Federal or State protection (See Tables 3 and 4).

On a large scale, meaningful trends can be determined, based on two photometric studies. A dataset used by Lunetta et al. (1997) was made available from Cosentino (personal

communication Brian Cosentino, WDFW, 2003), which allowed isolation of data from the Lower Columbia River WRIAs (Table 6). 'Response reaches' were generally defined by Lunetta et. al. as the lower gradient (< 4 percent) habitat where most of the anadromous fish production occurs. Table 6 shows that almost 8 percent[12] of the response reach riparian buffers (RRRBs) were considered late seral in composition. Nearly half of the RRRBs are 'other forestlands,' i.e., either hardwood-dominated, brush-dominated, or recent clearcuts. This is nearly identical to the hardwood dominated buffer percentage (55 percent[13]) estimated by Marshall and Associates (2000).

6.0 FISH RESOURCES

Salmonid Stocks

All anadromous salmonid species are present in the Lower Columbia River region, except Pink Salmon. Table 7 lists the salmonids that occur within the Lower Columbia River region. The asterisk next to the species name indicates the species is introduced, and not native to Washington State.

Table 6. Percent of response reach riparian buffers by WRIA for the Lower Columbia River Region. [See Lunetta et al. (1997) for description of data.]

Canopy Class	Late Seral Stage	Mid Seral Stage	Early Seral Stage	Other Forest-lands	Water	Non-forest lands
Canopy Class Definition	>70% conifer canopy; >10% of the canopy must be conifer>21"dbh	>70% conifer canopy; <10% of the canopy must be conifer>21"dbh	Conifer Crown cover > 10% and <70%	Hardwood dominated, shrub or recent clearcut	Lakes, large rivers and other large water bodies	Urban, Agriculture, Rangeland, barren, glaciers
WRIA or Basin Name						
Grays Elochoman (WRIA 25)	0.5%	19.5%	6.4%	47.7%	3.3%	22.7%
Cowlitz (WRIA 26)	9.0%	10.5%	4.3%	54.2%	1.1%	20.9%
Lewis River (WRIA 27)	13.1%	13.2%	2.7%	47.7%	1.1%	22.2%
Washougal - Salmon (WRIA 28)	0.1%	16.6%	1.7%	26.1%	11.5%	43.9%
Total response reach riparian acres	10080	17421	5317	64516	3284	31416
Regional percentage	7.6%	13.2%	4.0%	48.9%	2.5%	23.8%

[12] 'Late Seral' Stands should not be confused with 'Old Growth Stands.' 'Late Seral' as defined by Lunetta et al. (1997) means the conifer crown cover is >70% and more than 10% of the crown cover in trees are greater than 21 inches diameter breast height (dbh). Thus, 'Late Seral' can include some mature second growth conifer stands.

[13] This study used regional definitions that overlap the regional definitions used herein. Marshall and Assoc. found relatively little variation in hardwood stand percentages on private lands throughout western Washington.

Table 7. Salmonid species present by WRIA within the Lower Columbia River Region (SASI 2002).

Species	State Status[1/]	Federal Status[2/]	Grays-Elochomin (WRIA 25)	Cowlitz (WRIA 26)	Lewis River (WRIA 27)	White Salmon (WRIA 28)
Resident Cutthroat Trout		FCo	X	X	X	X
Searun Cutthroat Trout		FCo	X	X	X	X
Chum Salmon		FT	X	X	X	X
Coho Salmon		FC	X	X	X	X
Rainbow Trout			X	X	X	
Summer Steelhead			X	X	X	X
Winter Steelhead		FT	X	X	X	X
Sockeye Salmon			X	X	X	X
Kokanee					X	
Fall Chinook Salmon		FT	X	X	X	X
Spring Chinook Salmon			X	X	X	X
Summer Chinook			X	X	X	X
Dolly Varden/Bull Trout	SC	FT			X	
Mountain Whitefish				X	X	X
Lake Trout*				X		
Eastern Brook Trout*				X	X	X
Brown Trout*						X

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX - Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Fderal species of concern.

Other Fish Species

Table 8 is a list of non-salmonid freshwater species that exist in the Lower Columbia River Region. The asterisk next to the species name indicates that the fish is not native to Washington State. This list should not be regarded as an exhaustive list of the species present.

Table 8. Non-salmonid Freshwater Fish Species by WRIA within the Lower Columbia River Region (WDFW 2001, Wydoski and Whitney 2003).

Species	State Status[1]	Federal Status[2]	Grays-Elochoman (WRIA 25)	Cowlitz (WRIA 26)	Lewis River (WRIA 27)	White Salmon (WRIA 28)
Speckled Dace				X		
Longnose Dace				X	X	X
Leopard Dace	SC			X	X	X
Pacific Lamprey		FCo	X	X	X	X
River Lamprey	SC	FCo		X		X
Western Brook Lamprey				X	X	
Peamouth			X		X	X
Northern Pikeminnow			X	X		X
Sandroller	SM		X	X	X	X
Coastrange Sculpin			X	X	X	X
Prickly Sculpin					X	X
Riffle Sculpin			X	X		
Reticulate Sculpin			X	X	X	X
Shorthead Sculpin			X	X	X	X
Torrent Sculpin				X		
Redside Shiner						X
Three-Spine Stickleback			X	X	X	X
Bridgelip Sucker				X		X
Largescale Sucker			X	X	X	X
Mountain Sucker	SC			X		
Largemouth Bass*			X	X	X	X
Brown Bullhead*			X	X		X
Carp*			X	X		X
Crappie spp*			X	X	X	X
White Crappie*			X			
Black Crappie*			X			
Pumpkinseed*			X			X
Sunfish spp*.			X	X	X	X
Yellow Perch*			X	X		X
Starry Flounder			X	X	X	X
Eulachon	SC		X	X	X	X
Green Sturgeon		FCo	X	X	X	X
White Sturgeon			X	X	X	X
Longfin Smelt			X	X	X	X

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Status of Salmonid Stocks

The State and Tribal Stock status of 50 stocks in the Lower Columbia River region is shown in Table 9.

Table 9. Lower Columbia River Salmon and Steelhead Stock List presented by River Basin (2002 SASI Report, 1998 Bull Trout Status Report).

River Basin	Species	Stock Status
Grays and Elochoman WRIA 25		
Grays River	Fall Chinook	Depressed
Skamokawa Creek	Fall Chinook	Depressed
Elochoman River	Fall Chinook	Healthy
Mill Creek	Fall Chinook	Depressed
Abernathy Creek	Fall Chinook	Healthy
Germany Creek	Fall Chinook	Depressed
Grays River	Coho	Unknown
Skamokawa Creek	Coho	Unknown
Elochoman River	Coho	Unknown
Mill Creek	Coho	Unknown
Abernathy Creek	Coho	Unknown
Germany Creek	Coho	Unknown
Grays River	Fall Chum	Depressed
Grays River	Winter Steelhead	Depressed
Skamokawa Creek	Winter Steelhead	Depressed
Elochoman River	Winter Steelhead	Depressed
Mill Creek	Winter Steelhead	Unknown
Abernathy Creek	Winter Steelhead	Depressed
Germany Creek	Winter Steelhead	Depressed
Cowlitz River Basin WRIA 26		
Cowlitz River	Spring Chinook	Depressed
Cowlitz River	Fall Chinook	Depressed
Coweeman River	Fall Chinook	Depressed
Green River	Fall Chinook	Healthy
SF Toutle River	Fall Chinook	Depressed
Cowlitz River	Coho	Depressed
Coweeman River	Coho	Unknown
Toutle River	Coho	Unknown
Green River	Coho	Unknown
SF Toutle River	Coho	Unknown
Cowlitz River	Winter Steelhead	Unknown
Coweeman River	Winter Steelhead	Depressed
Mainstem&NF Toutle River	Winter Steelhead	Depressed
Green River	Winter Steelhead	Depressed
SF Toutle River	Winter Steelhead	Depressed
Lewis River Basin WRIA 27		
Kalama River	Spring Chinook	Depressed
Lewis River	Spring Chinook	Depressed
Kalama River	Fall Chinook	Healthy
Lewis River	Fall Chinook	Healthy
EF Lewis River	Fall Chinook	Depressed

Table 9. Lower Columbia River Salmon and Steelhead Stock List presented by River Basin (2002 SASI Report, 1998 Bull Trout Status Report) (continued).

River Basin	Species	Stock Status
Kalama River	Coho	Unknown
Lewis River	Coho	Unknown
EF Lewis River	Coho	Unknown
Kalama River	Summer Steelhead	Depressed
NF Lewis River	Summer Steelhead	Unknown
EF Lewis River	Summer Steelhead	Unknown
Kalama River	Winter Steelhead	Healthy
Mainstem and NF Lewis River	Winter Steelhead	Depressed
EF Lewis River	Winter Steelhead	Unknown
Lewis River	Bull Trout/Dolly Vardon	Depressed
Washougal - Salmon Basin WRIA 28		
Washougal River	Fall Chinook	Healthy
Bonneville Bright	Fall Chinook	Unknown
Salmon Creek	Coho	Unknown
Washougal River	Coho	Unknown
Bonneville Tributaries	Coho	Depressed
Bonneville	Fall Chum	Depressed
Washougal River	Summer Steelhead	Unknown
Salmon Creek	Winter Steelhead	Unknown
Washougal River	Winter Steelhead	Depressed
Hamilton Creek	Winter Steelhead	Unknown

Table 9 includes only stocks that spawn in the rivers of this region, and not migratory species from other regions of the Columbia River Basin. For State and Tribal Stock Status, *Healthy* refers to a stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock; *Depressed* refers to a stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely; *Critical* refers to a stock of fish experiencing production levels that are so low that permanent damage to the stock is likely or has already occurred; and *Unknown* refers to a stock of fish which has insufficient information to rate stock status.

7.0 AMPHIBIANS

The Lower Columbia region harbors 19 amphibian species, including the established introduced bullfrog (Dvornich et al. 1997; McAllister 1995), ranking it among the most amphibian-rich areas of Washington State. Of these 19 species, the largest assemblage (including the bullfrog) consists of 9 taxa that reproduce in stillwater habitat including lakes, oxbows, ponds, temporary pools, and other freshwater wetlands with sufficient stillwater habitat. Stillwater habitats are largely dichotomously split between high-elevation lakes and ponds, and lower elevation habitats associated with the riparian margins of larger stream or riverine systems. Since a large proportion of this habitat has been altered or lost (see Riparian, Floodplain and Wetland Conditions sections), especially along the mainstem Columbia (Schaller, et al. 2002), significant impact to stillwater amphibians is presumed. Lowland stillwater habitats are also the habitats in which introduced warmwater species (bullfrogs, and selected fish [catfish, mosquitofish, sunfish], see Table 8), and interactive facilitation among some introduced species, particularly bullfrogs and warmwater fish, may promote their survival (Adams et al. 2003) and contribute to the potential negative affects on native amphibians (Adams 1999). Of the remaining 10 native amphibian

species, five species (Dunn's salamander, ensatina, Larch Mountain salamander, western red-backed salamander, and western red-backed salamander) reproduce in terrestrial habitats and the remaining five (Cope's giant salamander, coastal giant salamander, coastal tailed frog, Cascadaes torrent salamander, and Columbia torrent salamander) reproduce in streams, springs, or seeps.

Of the entire amphibian assemblage for the region, five species (Dunn's salamander, Cascades torrent salamander, Columbia torrent salamander, coastal tailed frog, and Van Dyke's salamander) are Forest Practices HCP-covered species (Table 10). Some of the five species have relatively localized distributions within the region with Dunn's and Columbia torrent salamanders being restricted mostly to WRIA 25, Cascades torrent salamander being restricted to the Cascades slope, and Van Dyke's having a highly spotty distribution on some of the Cascades slope as well as in the southern Willapa Hills. Known distributions are probably conservative as no systematic surveys, either to understand distribution or determine status (i.e., surveys of historic sites), have been performed in the region. Currently, too few data exist even to perform a status survey for any of these species because of lack of a baseline. All species may be at some level of risk because sedimentation has the potential to substantially reduce its in- and near-stream habitat for these stream-associated taxa (Bury 1983, Bury and Corn 1988, Corn and Bury 1989); and timber harvest, which can result in significant sedimentation (Beschta 1978, Jakob 1999), occurs over most of the Lower Columbia region where these species occur (see Habitat Trends section).

Although not covered under this Forest Practices HCP, six other amphibians (namely northwestern salamander [*Ambystoma gracile*], long-toed salamander [*Ambystoma macrodactylum*], western toad [*Bufo boreas*], Pacific treefrog [*Hyla regilla*], northern red-legged frog [*Rana aurora*], and rough-skinned newt [*Taricha granulosa*]) may receive some protection as a result of Forests and Fish patch buffer prescriptions. One of these species, the western toad, has State watchlist (special concern) status (WDFW 2001), and has declined elsewhere in its geographic range (Carey 1993); however, their status in the Lower Columbia region is unknown. Hydrological alteration may have resulted in habitat loss for western toads at low elevations, as over a dozen sites were historically recorded on the Columbia mainstem; no sites date from the post-dam building era (i.e., 1970 onwards) and only one site on the mainstem Columbia is known to currently have western toads (personal communication, M. Hayes, WDFW, 2003).

Table 10. Forest and Fish Amphibians of the Lower Columbia River Region.

Group	Name	Habitat			Regional Distribution
		Active Season		Over-wintering	
		Breeding	Non-Breeding		
Frogs	Coastal tailed frog *Ascaphus truei*	Streams	Streams	Terrestrial	Widespread at mid to high elevations
Salamanders	Dunn's salamander *Plethodon dunni*	Terrestrial	Terrestrial	Terrestrial	Known only from WRIA 25 and western edge of WRIA 26
	Van Dyke's salamander *Plethodon vandykei*	Terrestrial	Terrestrial	Terrestrial	Known only from WRIAs 25-27
	Cascades torrent salamander *Rhyacotriton cascadae*	Stream	Stream	Terrestrial	At mid-elevations in WRIAs 26-28
	Columbia torrent salamander *Rhyacotriton kezeri*	Stream	Stream	Terrestrial	In WRIAs 25 and extreme west edge of WRIA 26

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MIDDLE COLUMBIA RIVER REGIONAL SUMMARY

MIDDLE COLUMBIA REGIONAL SUMMARY

1.0 PHYSICAL DESCRIPTION

The Middle Columbia region is defined to include six WRIAs (29, 30, 31, 37, 38, and 39). Major stream systems include the White Salmon, Klickitat, and Yakima River Basins, as well as other smaller Columbia River tributaries. Portions of Skamania, Klickitat, Yakima, and Benton Counties are contained within the Middle Columbia region. A map of the Middle Columbia Region is provided in Figure 1.

The region lies within the Columbia Basin physiographic province (Lasmanis 1991) that covers nearly the entire southeast quarter of Washington. Elevations range from approximately 200 feet along the Columbia River to over 12,000 feet atop Mount Adams.

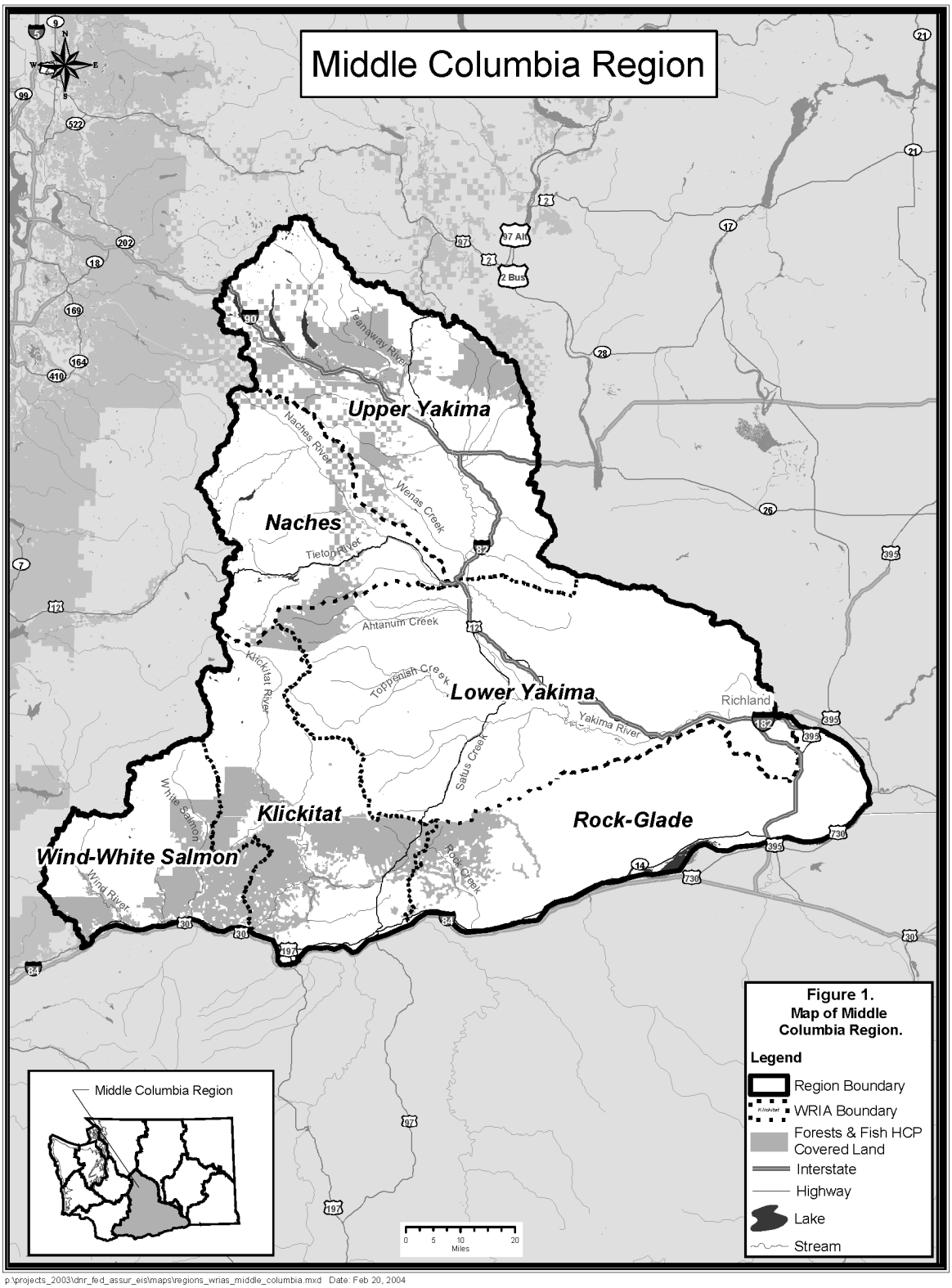
General Geology

The Middle Columbia region encompasses two geologic provinces: the Southern Washington Cascades and Columbia Basin Provinces (Franklin and Dyrness 1973).

The Middle Columbia region includes the southern and eastern portions of the Southern Washington Cascades geologic province. Steep, deeply dissected valleys separated by generally accordant ridge crests characterize the area (Franklin and Dyrness 1973). General ridge elevation is around 1,200 m in most of the area with increasing elevations to the north and along the Cascades crest. Mount Adams (3,801 m) dominates the regional landscape in the eastern portion of this province. Andesite and basalt flows with their associated breccias and tuffs of Eocene to Recent age dominate at least 90 percent of the province. The most widespread soils are derived from a combination of parent materials consisting of pumice, basalt and andesite. In some instances, the surface layers consist of unmixed eolian volcanic ash and pumice overlying residual soils. Soils are generally poorly developed with only weakly differentiated horizons; textures range from gravelly sandy to silt loams. Although soil development is generally poor, rock land and stony skeletal soils are less widespread than in the more glaciation-influenced Northern Washington Cascades geologic province.

The Middle Columbia region includes the western and southwestern portions of the Columbia Basin geologic province (Franklin and Dyrness 1973). Topography, which varies from gently undulating to moderately hilly, is generally less steep than in the Southern Washington Cascades geologic province except in isolated basalt buttes and canyons. Many of these are associated with the Columbia River margin. Tertiary rocks are found at scattered locations, but the lava-derived Columbia River Basalt formations of Miocene-Pleistocene age dominate much of this region. Columbia River Basalts, 600-1,500 meters (approximately 2000-5000 feet) thick, consist of numerous individual flows 8-30 meters approximately 30-100 feet) thick. The bottom portions of individual flows are dark-gray basalt, but become scoriaceous near their upper margins. In much of the Yakima Basin and the Columbia River margin, deformation of the Columbia River Basalt flows has produced ridges and hills. Plio-Pleistocene deposits of silt-textured soils cover Columbia River Basalt over extensive areas, but in the Middle Columbia region, these are best developed along the tributaries of the lower Yakima River.

Depending on precipitation, these soils develop varying amounts of carbonate-enriched horizons; the latter are manifest as cemented hardpans in the B-horizons in the areas with the least precipitation.


Middle Columbia Region
Upper Yakima
Naches
Lower Yakima
Klickitat
Rock-Glade
Wind-White Salmon
Teanaway River
Naches River
Wenas Creek
Tieton River
Ahtanum Creek
Toppenish Creek
Klickitat River
Yakima River
Satus Creek
White Salmon
Wind River
Rock Creek
Richland
Middle Columbia Region
0 5 10 20
Miles
Figure 1.
Map of Middle
Columbia Region.
Legend
Region Boundary
WRIA Boundary
Forests & Fish HCP
Covered Land
Interstate
Highway
Lake
Stream
p:\projects_2003\dnr_fed_assur_eis\maps\regions_wrias_middle_columbia.mxd Date: Feb 20, 2004

Information concerning erosion processes in the Middle Columbia planning region has been extracted from the following watershed analyses: North Fork Teanaway (Boise-Cascade 1996); Big Creek (Plum Creek Timber Company 1997); Upper Little Klickitat (Boise-Cascade 1999).

Erosion in the Middle Columbia region is low relative to regions west of the Cascade Crest. This is primarily due to more moderate topography and lower rainfall, although more competent rock types found in some areas also contribute to more stable conditions.

Mass wasting patterns in the Middle Columbia region are similar to other eastern Washington planning regions. Landslide rates are relatively low, ranging from 0.011 landslides/mi2/year in the Butler Creek, Brooks, and West Prong watershed administrative units (WAU) to 0.023 landslides/mi2/year in the North Fork Teanaway WAU.

Debris avalanches comprise the dominant mass wasting process. Most debris avalanches originate in convergent swales or hollows and inner gorges along streams. In the Big Creek WAU, 43 percent of debris avalanches originated in convergent swales while 38 percent were associated with inner gorges. The toeslopes of large deep-seated landslide deposits were also sources of debris avalanches (Plum Creek Timber Company 1997). In cases where debris avalanches enter high-gradient, confined channels, debris torrents may develop but they appear to be rare.

Surface erosion is not a significant sediment source except in cases where soils adjacent to streams are heavily disturbed or compacted.

General Hydrology

The climate of the region differs greatly from areas west of the Cascade crest. Most areas receive less precipitation and temperature ranges are more extreme. The region has a marine-continental climate characterized by cold winters and hot summers. Most precipitation falls as snow during the winter, although spring and summer rains are common. Average annual precipitation for forested areas of the region range from 15 inches along the southern Cascade foothills to over 80 inches at higher elevations.

The Yakima River drains nearly two-thirds of the Middle Columbia region. Other rivers in the region include the Wind, White Salmon, and Klickitat. Rivers of the region have a snowmelt-driven hydrologic regime where most peak flows occur from April through June in response to spring snowmelt. However, large magnitude peak flows result from rain-on-snow precipitation events that occur during the fall and winter months. Low flows generally occur during late summer and early fall, although extreme cold can substantially reduce flows during the winter. Based on the DNR stream hydrography GIS coverage, there are approximately 18,631 stream-miles (both fish-bearing and non-fish streams) in the Middle Columbia region, with an average stream density of 1.84 stream miles/mile^2 (Table 1).

2.0 LAND OWNERSHIP AND USE

Major Land Ownership and Management

Approximately 26 percent of all lands in the Middle Columbia region are in Federal ownership and portion of these lands (about 5 percent of all lands) are being managed for long-term preservation, primarily in national parks, wildernesses, and national recreation areas (Table 2). Another large portion of these Federal lands is being managed by the Forest Service outside of wilderness (14 percent of all lands); a substantial portion of these non-wilderness National Forest System lands is being managed under a very limited management status (e.g., LSRs, Managed LSAs, AMAs, or Riparian Reserves) according to the Northwest Forest Plan. The remainder of the Federal lands (6 percent of all lands) are being managed by other agencies. Tribal lands

represent a substantial portion of the region (about 19 percent). State lands represent 10 percent of all lands in the region, private lands represent 34 percent, and city/county lands represent much less than 1 percent.

The WRIAs differ markedly in their ownership. The upper Klickitat and most of the Lower Yakima WRIAs are inside the Yakama Indian Reservation. Much of the remainder of the Lower Yakima WRIA is in U.S. Department of Defense (Yakima Training Center) and Department of Energy (Hanford) Reservations. Most of the Naches, Upper Yakima, and Wind-White Salmon WRIAs are in National Forest System or State land ownership. The Rock-Glade WRIA is almost entirely private lands with scattered State-owned sections.

Land Cover and Land Use

Forestland makes up approximately 41 percent of the Middle Columbia region and shrubland and grassland comprise about 38 percent (Table 3). Agricultural lands make up 17 percent and the remaining 4 percent consist of residential/commercial, water and wetlands, and ice, snow, and bare rock. The percent forestland within each WRIA varies considerably, ranging from a low of 9 percent in the Rock-Glade WRIA (#31) to a high of 93 percent in the Wind-White Salmon WRIA (#29). .

Table 1. Stream Miles in the Middle Columbia Region[1/]

	WRIA 29 Wind/ White Salmon	WRIA 30 Klickitat	WRIA 31 Rock-Glade	WRIA 37 Lower Yakima	WRIA 38 Naches	WRIA 39 Upper Yakima	Total Middle Columbia
Stream Length (miles)	2,633	2,746	1,296	3,000	2,230	6,725	18,631
Stream Density (miles/mi^2)	2.92	1.90	0.78	1.03	2.02	3.14	1.84

[1/] Primary Data Source: DNR stream hydrography GIS layer. Stream miles include all Type 1-5 streams and a portion of Type 9 streams. Because many Eastern Washington Type 9 waters are not defined channels, only 25% of Type 9 streams are counted as streams in the Ponderosa Pine and drier vegetation zones, 50% are counted in the Mixed Conifer vegetation zones, and 75% are counted in the wettest vegetation zones. These proportions are based on field observations by DNR foresters, but are very approximate.

Table 2. Land Ownership Parameters for Middle Columbia Region by WRIA[1/]

Land Ownership	WRIA 29 Wind/ White Salmon	WRIA 30 Klickitat	WRIA 31 Rock-Glade	WRIA 37 Lower Yakima	WRIA 38 Naches	WRIA 39 Upper Yakima	Total Middle Columbia
Federal – Long-term Congressionally Protected Lands [2/]	39,087	7,714	7,286	2,064	226,749	72,438	355,338
Federal – Other National Forest System Lands [3/]	289,207	56	-	647	283,933	325,710	899,553
Federal – Other Federal Lands [4/]	140	3,096	19,381	217,717	1,295	161,751	403,380
State – Protected Lands [5/]	672	17,993	-	11,695	29,792	118,673	178,826
State – Managed Lands [6/]	79,929	80,057	65,983	86,834	34,116	117,087	464,006
Tribal Lands/Indian Reservations	24	367,138	444	887,854	9	-	1,255,468
Municipal Watershed	-	-	-	-	-	37	37
Other County/City Lands	-	-	-	1,198	153	-	1,351
Private	167,939	446,861	965,707	654,417	130,973	573,263	2,939,158
TOTAL	**576,997**	**922,914**	**1,058,801**	**1,862,427**	**707,019**	**1,368,958**	**6,497,115**

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan GIS layers.
[2/] Includes national parks, national monuments, national recreation areas, national wildlife refuges, and wildernesses.
[3/] Includes all non-wilderness National Forest System lands; the majority of the acres consists of lands protected under the Northwest Forest Plan (e.g., LSR, Managed LSR, AMA, Riparian Reserves)
[4/] Includes all Department of Defense, Department of Energy, Bureau of Land Management, and Bureau of Reclamation lands.
[5/] Includes all State Parks and Wildlife Areas.
[6/] Includes all DNR, Department of Corrections, and University lands.

Table 3. Land Cover and Use for the Middle Columbia Region by WRIA [1/]

Land Cover/Land Use	WRIA 29 Wind/ White Salmon	WRIA 30 Klickitat	WRIA 31 Rock-Glade	WRIA 37 Lower Yakima	WRIA 38 Naches	WRIA 39 Upper Yakima	Total Middle Columbia
Forestland	525,098	667,531	48,269	269,800	537,466	643,263	2,691,428
Shrubland	10,086	124,524	404,363	767,994	82,636	438,418	1,828,019
Grassland	6,238	43,704	106,819	306,016	29,474	128,237	620,489
Water & Wetlands	9,826	9,047	40,950	8,665	6,325	17,859	92,672
Ice, Snow, & Bare Rock	10,462	11,984	912	1,635	16,135	11,721	52,850
Residential & Commercial	2,267	2,185	15,851	39,430	3,096	13,493	76,321
Agricultural	13,020	63,937	441,637	468,888	31,888	115,966	1,135,336
TOTAL	**576,997**	**922,914**	**1,058,801**	**1,862,427**	**707,019**	**1,368,958**	**6,497,115**

[1/] Primary Data Source: USGS/EPA National Land Cover Data GIS layer.

3.0 FORESTLAND OWNERSHIP AND MANAGEMENT

Approximately 42 percent of the forestlands in the Middle Columbia region are in Federal ownership, 21 percent are in Tribal ownership, 11 percent are in State ownership, and 26 percent are in private or other ownership (Table 4). A Federal or State preservation or limited management status covers approximately 33 percent of the forestlands in the region. Approximately 32 percent of the forestlands may be under Federal or Tribal timber management. State timber management may occur on approximately 9 percent of the forestlands and 26 percent of the forestlands are in private, county, city, or tribal ownership, where timber management may occur. Overall, lands covered by the forest practices rules represent approximately 35 percent of the forestlands in the region (see Figure 1, which displays these lands). Existing riparian HCPs cover none of the State-managed lands (although an HCP relating to some wildlife covers 90 percent of the State lands in the region), but 11 percent of the combined private, county, and city ownerships. WRIA 31 (Rock-Glade) has the largest percentage of forest practices rules-covered lands (94 percent of all forestlands, none of which are covered by existing HCPs) and WRIA 38 (Naches) has the lowest (13 percent of all forestlands, 34 percent of which are covered by existing HCPs).

Most of the private forestlands are located in Klickitat, Upper Yakima, and the Wind-White Salmon WRIAs, generally at lower to middle elevations. State forestlands managed for timber production are located primarily in 29, 30, and 39 WRIAs.

Small, 20-acre exempt forest landowners make up less than 0.1 percent of the forestlands and about 0.2 percent of the forestlands subject to forest practices rules in the Middle Columbia region, based on the analysis by Rogers (2003). Although this analysis may represent an underestimate, it is believed to have identified the majority of all small, 20-acre exempt parcels (personal communication, Luke Rogers, Rural Technology Initiative, University of Washington, May 2004). The highest percentage (about 0.2% of the forestland) is in the Wind-White Salmon WRIA (#29) and the lowest percentage, with no identified parcels, is in the Rock-Glade WRIA (#31).

Approximately 5,290 stream miles occur on lands subject to forest practices rules in the Middle Columbia region (Table 5). This represents 28 percent of all streams in the region. Approximately 4,594 miles or 87 percent of the 5,290 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre exempt forest landowner parcels in this region is estimated to be less than 0.1 percent and the percentage of all fish-bearing streams on small, 20-acre exempt forest landowner parcels is about 0.3 percent (Rogers 2003).

Table 4. Ownership and Management of Forestlands (acres and percent) in the North Puget Sound Region by WRIA[1/]

Forestlands Category	WRIA 29 Wind/ White Salmon	WRIA 30 Klickitat	WRIA 31 Rock-Glade	WRIA 37 Lower Yakima	WRIA 38 Naches	WRIA 39 Upper Yakima	Total Middle Columbia
Federal and State Protected Forestlands Not Managed for Timber Production[2/]	171,338	13,342	5	2,282	375,054	317,841	879,862
Federal Lands and Tribal Forestlands Available for Timber Management[3/]	136,929	350,252	2,864	223,764	96,702	56,958	867,469
Forestlands Available for Timber Management Under the State Forest Practices Rules							
DNR and Other State Forestlands	78,250	62,884	3,769	21,730	19,010	46,008	231,650
Private, County, and City Forestlands	138,582	241,053	41,631	22,024	46,701	222,457	712,447
Subtotal	216,832	303,937	45,400	43,754	65,711	268,464	944,097
TOTAL FORESTLANDS	525,098	667,531	48,269	269,800	537,466	643,263	2,691,428
% IN FEDERAL OR STATE PROTECTION	33%	2%	0%	1%	70%	49%	33%
% AVAILABLE FOR FEDERAL OR TRIBAL TIMBER MANAGEMENT	26%	52%	6%	83%	18%	9%	32%
% AVAILABLE FOR STATE TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	15%	9%	8%	8%	4%	7%	9%
% AVAILABLE FOR PRIVATE OR COUNTY/CITY TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	26%	36%	86%	8%	9%	35%	26%

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan, and USGS/EPA National Land Cover Data GIS layers.
[2/] Federal and State Protected Lands includes: Wilderness, LSR, LSOG, AMA, National Wildlife Refuges, National Parks, Washington State Parks, and WDFW lands.
[3/] Federal and Tribal Lands Available for Timber Management include: USFS Matrix lands, USFS other lands, BLM lands, Dept of Defense lands, and Indian Reservation lands.

Table 5. Stream Miles in the Middle Columbia Region by Ownership, Forested Stream Miles, and Forest Practices Rules (FPR)-Regulated Stream Miles[1/]

Category	WRIA 29 Wind/ White Salmon	WRIA 30 Klickitat	WRIA 31 Rock-Glade	WRIA 37 Lower Yakima	WRIA 38 Naches	WRIA 39 Upper Yakima	Total Middle Columbia
Total Stream Miles							
Federal	1,133	51	55	221	1,382	3,050	5,892
Tribal	0	934	0	1,547	-	-	2,481
State	511	361	87	234	257	977	2,427
County/City	-	-	-	3	1	0	4
Private	990	1,400	1,155	995	589	2,697	7,826
Total Miles	**2,633**	**2,746**	**1,296**	**3,000**	**2,230**	**6,725**	**18,631**
Forested Stream Miles							
Forested Miles	2,315	2,105	259	885	1,766	4,593	11,923
% of Total Miles	88%	77%	20%	30%	79%	68%	64%
FPR-Regulated Stream Miles							
FPR-Reg. Miles	1,264	1,172	241	263	464	1,886	5,290
% of Total Miles	48%	43%	19%	9%	21%	28%	28%

[1/] Data sources: DNR stream hydrography GIS layer, DNR Major Public Lands layer, and USGS/EPA National Land Cover Data. Stream miles include all Type 1-5 streams and a portion of Type 9 streams. Because many Eastern Washington Type 9 waters are not defined channels, only 25% of Type 9 streams are counted as streams in the Ponderosa Pine and drier vegetation zones, 50% are counted in the Mixed Conifer vegetation zones, and 75% are counted in the wettest vegetation zones. These proportions are based on field observations by DNR foresters, but are very approximate.

4.0 HABITAT LIMITING FACTORS

Primary Regional Factors

Primary limiting factors for fish, wildlife and associated habitats in the Mainstem Columbia River are generally a result of (1) hydropower system development and operation, (2) other human activities such as farming, grazing, urban and suburban development, transportation, and industrial or nuclear development, or (3) introduction and proliferation of exotic species. These factors are often interrelated and hard to separate (Draft Mainstem Columbia River Subbasin Summary 2001).

Within the Yakima Basin, many land and water use actions have impacted salmonid habitat conditions and productivity. However, decline in salmon and steelhead in the Yakima Basin is likely associated with irrigation development and diversions, irrigation storage reservoirs and dams, splash damming, mining, removal of beaver dams, and grazing that occurred in the late 1800s/early 1900s. Irrigation was the largest of these impacts. Other habitat impacts began in the later 1900s associated with transportation (rail and roads), urbanization, agriculture, and logging (WSCC 2001). Historically, bull trout occurred throughout the Yakima River basin, but now are fractured into isolated subpopulations (SaSI 1998). The USFWS (2002) considers isolation by dams, agricultural practices and irrigation withdrawal as a threat to each subpopulation. Additional threats include forest practices, grazing, roads, mining, harvest, non-native species, and residential development.

Hydroelectric development on the White Salmon River, construction of Bonneville Dam with its associated pool, logging, poorly designed and installed culverts, especially along State Highway 14 have been detrimental to aquatic resources within WRIA 29. The Wind River is the major fish-producing stream system remaining within the WRIA, and its productivity has steadily declined over the years. Major factors within the Wind River system have included stream cleanouts, past timber harvest, a dam without functional fish passage, lack of large woody debris, mass bedload movement, loss of floodplain capacity, and increased siltation (WSCC 2003).

Within the Klickitat drainage (WRIA 30), sedimentation, turbidity, and low flows from irrigation and water supply diversions are viewed as significant factors limiting habitat productivity (WSCC 1999). Also, on the plateau reaches where agricultural and urban land uses occur, the riparian forests have mostly been harvested, or are in a condition where only minimal ecological functions can be provided (WSCC 1999).

Sedimentation/Mass Wasting

Gravel substrates are impaired in many areas of the Yakima watershed by significant presence of fine sediments, and in other areas by loss of suitable spawning and rearing substrate due to altered hydrology (e.g. Tieton River) and channel simplification (WSCC 2001). Dry Creek, a tributary to the Wind River, has excessive bedload transport from past harvesting of the riparian zone and the direct removal of LWD in past stream clean out projects. Other streams have also been impacted by increased sediment load due to timber harvest and the loss of riparian cover (e.g., Youngman, Trout, Crater, Compass, and Layout Creeks within the Wind Basin). A number of landslides have occurred within the Wind River Basin and other streams (e.g., Rock Creek) associated with timber harvest and a gas pipeline (WSCC 2003). Turbidity due to road runoff, logging, and land development has impacted various streams within this region (e.g., Nelson Creek, Carson Creek, Little White Salmon River and Jewett Creek, WSCC 2003; Little Klickitat and Swale Creek within the Klickitat drainage, WSCC 1999). Within the Klickitat drainage, naturally generated glacial silt from Mount Adams also contributes significantly to sedimentation and turbidity in the watershed (WSCC 1999).

Road densities (highly correlated to sediment levels in gravels) in the upper, middle, and lower White Salmon were calculated to be 3.7 miles/mile^2, 3.1 miles/mile^2, and 4.0 miles/mile^2, respectively. Quigley et al. (1997) found that bull trout are less likely to use streams for spawning and rearing in areas with high road densities, and were typically absent at mean road densities above 1.7 miles/mile^2 (USFWS 2002).

Riparian/Floodplain and Wetland Conditions

Impaired riparian function has resulted in increased water temperature, loss of bank stability, loss of instream cover, and loss of LWD recruitment to streams. Riparian function has been severely impaired through much of the Yakima basin by (1) removal of riparian vegetation, (2) structures such as dikes, roads, and railroads, (3) channel incision, drains, and channelization that lowers the water table in riparian areas, (4) altered hydrology that either dewaters riparian zones or increases and/or changes timing of peak flows, and (5) cattle grazing (WSCC 2001).

Within the Columbia River, the mainstem habitat has been reduced, for the most part, to a single channel, floodplains have been reduced in size, and off-channel habitat features have been lost or disconnected from the main channel (Mainstem/Systemwide Habitat Summary 2002).

Salmonid access to productive side-channel habitats has been lost and the productivity of floodplain areas has been reduced in much of the Middle Columbia region (e.g., Wapato, Naches, Yakima, and Wind Rivers). Floodplain function has been impacted by (1) dikes, levees, roads and railroads that have constricted floodplain extent, (2) extensive mining within the floodplain, (3) channel incision that has disconnected the channel from the floodplain, and (4) channelization and construction of drains that eliminate or interrupt hyporheic or superficial side-channel flow (WSCC 2000, 2001, 2003).

Channel/Hydrology Conditions

Within the Columbia mainstem, the natural hydrograph has been altered by storage dams, with decreasing spring and summer flows and increasing fall and winter flows. This alteration has affected channel conditions such as floodplains, off-channel habitat, LWD, and water velocities (Mainstem/Systemwide Habitat Summary 2002).

Within the Yakima Basin, the loss of channel complexity (e.g., LWD), cover, bank stability, and presence of pools has adversely affected spawning and rearing habitat (WSCC 2001). In the lower White Salmon River, Condit Dam has resulted in the lack of coarse substrate for spawning, a lack of pools and channel complexity (due to lack of LWD), and low flows (WSCC 2003).

Large Woody Debris

Along with other major channel modifications caused by hydropower (i.e., floodplain and off-channel habitat, fluctuating flows and water velocities), as well as adjacent land uses on the Columbia River mainstem, the amount of LWD (large snags and log structures) have been reduced in the river (Mainstem/Systemwide Habitat Summary, 2002).

The loss/removal of LWD has resulted in additional associated habitat impacts, particularly in tributaries, such as Rattlesnake Creek (White Salmon River). The lack of LWD has resulted in loss of substrate roughness and increased flow energy, which has resulted in washout of limited streambed gravels, increased bank erosion, and channel incision. This in turn, has reduced floodplain connectivity, and may reduce summer baseflows (WSCC 2003). However, in the Naches Pass and Quartz Mountain watersheds, the dense mature conifer stands in the riparian areas provide sufficient large woody debris recruitment causing a low hazard rating for LWD recruitment (WDNR 1994, 1995).

Fish Passage

Within the Columbia River mainstem, hydropower operations have resulted in either complete or partial fish passage barriers both up and downstream. Power operations have also affected fish movement through reservoirs by stranding fish in shallow areas and cutting off important spawning areas in tributary streams during drawdowns (Mainstem/Systemwide Habitat Summary 2002).

Adult and juvenile salmonids have been precluded from historic spawning and rearing habitats. Barriers in the Yakima and Wind basins have resulted from irrigation diversions (e.g., Toppenish and Ahtanum Creeks within the Yakima), dams at major storage reservoirs (e.g., Tieton, Bumping, Cle Elum, Keechelus, and Kachess dams within the Yakima; Hemlock Dam within the Wind; Condit Dam within the White Salmon), and by forest road culverts (e.g., Youngman and Oldman Creeks in the Wind Drainage, WSCC 2003). Productive side-channel habitats have been blocked to fish by structures that constrict floodplains. Bull trout access to smaller tributary streams has been blocked by low flows during drought periods and by extreme reservoir drawdown (WSCC 2001). Natural barriers (deep canyons, falls and cascades) and man-made barriers (e.g., fishway/tunnel complex at Castile Falls and numerous road culverts) prevent access of anadromous fish within the Klickitat drainage (WSCC 1999).

Fish access problems occur in Rock and Glade Creeks (WRIA 31) due to low or non-existent flows during the late summer, fall, and early winter; barrier road culverts (e.g. Pine Creek); and high stream temperatures in the lower reaches during summer and early fall (WSCC 2000).

Water Quality Issues

In WRIA 29, the mainstem of the White Salmon River has excellent flows and water temperatures year around, due to the fact that the majority of the flow is from glacial melt runoff and/or springs and seeps from the porous basalts that are present throughout much of the watershed. However, two major tributaries (Rattlesnake and Trout Lake Creeks) are impaired by water temperatures that exceed State water quality standards for extended periods of time in the summer (WSCC 2003). The Wind River and several tributaries, especially Trout Creek, are impaired due to high temperatures (Pelletier 2002) but a TMDL has been completed. High temperatures have also been recorded in the Little White Salmon River and Major Creek, which is impaired due to low instream flow as well.

The Little Klickitat River and Swale Creek in WRIA 30 have been placed on the 303d list and are considered impaired for insufficient flows due to diversions from water supply and irrigation, and for high stream temperatures due to low flows and lack of stream shading (WSCC 1999, Brock and Stohr 2002). The Little Klickitat River has a TMDL for temperature.

Portions of the entire Columbia River mainstem are included on the 303(d) list and, at times, do not meet water quality standards for total dissolved gases. Most of the river is listed for temperature (EPA Columbia and Snake River mainstem TMDL homepage).

Increased water temperatures in the Yakima mainstem (WRIA 37) and many tributaries affect habitat suitability for spawning and rearing, and also increase suitability for predator species that are known to predate on juvenile salmonids. Water temperatures are often naturally elevated in this region, but may be further exacerbated by human induced impacts, including loss of riparian function, altered hydrology, and increased erosion/fine sediment delivery (e.g. Trout, Crater, Compass, and Layout Creeks within the Wind Basin; Rock Creek (WSCC 2003); the Yakima Basin). The Yakima River is also impaired due to low dissolved oxygen.

High presence levels of toxic substances (e.g., pesticides) have been detected in sediment and fish tissue samples, particularly in mainstem and tributary areas with agricultural return flows (WSCC

2001). Some resident fish in the Hanford Reach of the Columbia mainstem and the Yakima River have high concentrations of toxic organic chemicals (EPA 2002). The Lower Yakima River has a TMDL for turbidity and DDT (Joy 1997).

In WRIA 38, high temperatures have been recorded in the Naches River and its tributaries, including Cowiche Creek, Tieton River, Rattlesnake Creek, Bumping River and the Little Naches River. The Naches River, Cowiche Creek and Tieton River are also impaired due to low instream flow.

The Teanaway River has high temperatures and a temperature TMDL (Stohr and Leskie 2000). It is also impaired due to low instream flow. Other WRIA 39 waters with high temperatures and low instream flows include the Cle Elum River, Manastash Creek, Swauk Creek, Big Creek, and Taneum Creek. Wenas Creek also has low instream flows.

The State list of impaired waters, in compliance with Section 303(d) of the Clean Water Act, lists waters that do not meet water quality standards or fully protect beneficial uses (see http://www.ecy.wa.gov/programs/wq/303d/index.html). Impairments to parameters in this region, such as temperature, turbidity, and dissolved oxygen, may be related to forest practices or other land uses.

5.0 HABITAT TRENDS

The major watersheds of the Middle Columbia region include the Wind River, White Salmon and Yakima River. Other smaller creeks and river systems (within WRIA 31) flow directly into the Columbia River mainstem. The land base of these smaller systems is predominately agricultural (50%) and rangeland (37%). Less than 10% of the land base of these smaller creeks and river systems consists of forestland. Much of this forested land also has active grazing allotments. Low or non-existent flows occur in most of these streams during the late summer, fall, and early winter which limits or precludes utilization by fall spawning adults and limits mobility of juveniles of all species (WSCC 2000).

The Wind River watershed consists of predominately even-aged (50-150 years) coniferous forests. Most of the watershed has been harvested in the past 150 years and is currently occupied by second-growth Douglas-fir stands. Some remnant stands in excess of 300 years in age remain, predominantly along the Trout Creek and Dry Creek drainages (USFS 1996). The seral stage make-up of the watershed has shifted over the last 150 years (USFS 1996): 58 to 22 percent in late-successional forest, 9 to 47 percent in mid-successional forest, 28 to 24 percent in early-successional forest, and 5 to 7 percent in non-forest. Between 1900 and 1930, fires naturally occurred; however after 1930, aggressive fire suppression was implemented. Fires altered the pattern of LWD input, erosion, snow accumulation and snowmelt, peak flows, and summer low flows. In this century, logging has replaced fire as the dominant land-disturbing event. Some of the effects of logging can be similar to fires. However, logging usually decreases available LWD recruitment to streams; whereas, fires would often increase available LWD, which could dampen the negative effects of some of the other factors mentioned above (USFS 1996, WSCC 2003).

In the White Salmon Basin, widespread timber harvest began after the first access roads were established in 1882. Near the turn of the century, splash dams became a common means of transporting logs down the White Salmon River. Since 1882, at least 90 percent of the forests within the White Salmon basin have been harvested at least once. Between 1890 and 1900, many open tracts were planted with orchards. The Condit Dam was built in 1913, which blocked anadromous fish access to most of the basin. Negotiations are currently underway to remove this dam and restore access. Today, forestland management is the predominant land use. Secondary land uses include agriculture, recreation, residential, and commercial development (WSCC 2003).

The decline of salmonid stocks within the Yakima watershed occurred in two major phases. The first phase, from 1850 through 1900, resulted in a decline of about 90 percent of historical salmon stocks (Davidson 1953, Tuck 1995, Lichatowich 1996; as cited in YSS 2001 DRAFT, WSCC 2001). The major causes of decline during this period were associated with water diversions, including fish passage barriers, loss of instream flow, and lack of juvenile fish screening (Tuck 1993, WSCC 2001). Other significant agricultural, logging, and mining impacts also occurred prior to 1900. The second phase of major impacts occurred in the 1900s. Construction of dams within the Yakima River Basin (i.e., Keechelus, Kachess, Cle Elum, Bumping, Tieton Rivers) to provide water storage for irrigation precluded anadromous salmonid passage to 112 miles of highly productive reaches upstream. In addition, upstream adult fish passage was precluded at Roza Dam from its completion in 1940 until the installation of the fish ladder in 1989. Fish passage barriers also resulted from construction of splash dams used for ponding and transport of logs throughout the upper Yakima River and tributaries. Channel encroachment and floodplain confinement and alteration, associated with road construction and conversion to urban/suburban developments, have also adversely impacted the quantity and quality of salmonid habitat. Another major problem involved the complete dewatering of extensive river reaches downstream of the Cle Elum, Tieton, Wapatox, Keechelus, Sunnyside, and Prosser Dams. Dewatering of these reaches precluded upstream migration of adult salmonids, reduced spawning habitat, dewatered redds, and impaired/eliminated juvenile salmonid rearing in these reaches (WSCC 2001).

It should be noted that for the Middle Columbia region overall, forestlands make up approximately 41 percent. Of the total forestlands for the region, 67 percent are available for timber management, and 35 percent are regulated under the State forest practices rules (see Tables 3 and 4).

6.0 FISH RESOURCES

Salmonid Stocks

Within the Middle Columbia region, three Federally listed fish species occur: Chinook salmon, steelhead and bull trout. In the westernmost portion of the region, Chinook salmon are listed as threatened. Steelhead are listed as threatened throughout the region except for the White Salmon River. Bull trout are listed as threatened and are present in many parts of the region, but dams, water quality degradation, and other factors have fragmented their distribution.

Within the Middle Columbia region, the pygmy whitefish, a State-listed sensitive species, is currently only known to occur within the Kachess, Keechelus, and Cle Ellum Lakes and associated tributaries (Hallock and Mongillo 1998). Interior redband trout and westslope cutthroat are Federal Species of Concern.

The following salmonids occur in the Middle Columbia region (Table 6). The asterisk next to the species name indicates the species is introduced, and not native to the region. This list should not be regarded as an exhaustive list of the species present. In some cases, migratory salmonids may be listed as present within a WRIA merely because of its presence in the Columbia River mainstem.

Table 6. Salmonid species presence by WRIA within the Middle Columbia Region (WDFW 2003).

Species	State Status[1/]	Federal Status[2/]	Wind-White Salmon (WRIA 29)	Klickitat (WRIA 30)	Rock-Glade (WRIA 31)	Lower Yakima (WRIA 37)	Naches (WRIA 38)	Upper Yakima (WRIA 39)
Brown Trout*				X	X	X		X
Bull Trout	SC	FT	X	X	X	X	X	X
Chinook Fall		FT	X	X	X	X		
Chinook Spring		FT	X	X	X	X	X	X
Chinook Summer			X	X	X	X		
Coho Salmon			X	X	X	X	X	
Cutthroat Resident			X					
Cutthroat Searun		FCo	X	X				
Cutthroat Westslope		FCo				X	X	X
Eastern Brook Trout*			X	X		X	X	X
Kokanee Trout			X				X	X
Lake Trout*			X	X				
Rainbow/Redband Trout		FCo	X	X	X	X	X	X
Sockeye Salmon			X	X	X	X		
Steelhead Summer		FT	X	X	X	X	X	X
Steelhead Winter		FT	X	X	X	X		
Whitefish Lake*					X	X		
Whitefish Mountain			X	X		X	X	X
Whitefish Pygmy	SC							X

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Other Fish Species

Table 7 is a list of non-salmonid species that exist in the Middle Columbia region (WDFW 2003, Wydoski and Whitney 2003). The asterisk next to the species name indicates that the fish is not native to Washington State. This list should not be regarded as an exhaustive list of the species present. The Pacific and River Lamprey, both Federal species of concern, are present within the larger streams of the lower Yakima and Columbia Rivers (WDFW 2003, Wydoski and Whitney 2003).

Table 7. Non-salmonid Fish Species by WRIA within the Middle Columbia Region (WDFW 2003, Wydoski and Whitney 2003).

Species	State Status[1/]	Federal Status[2/]	Wind-White Salmon (WRIA 29)	Klickitat (WRIA 30)	Rock-Glade (WRIA 31)	Lower Yakima (WRIA 37)	Naches (WRIA 38)	Upper Yakima (WRIA 39)
Bass, Largemouth*					X	X		X
Bass, Smallmouth*					X	X		X
Bullhead Black*					X	X		
Bullhead Brown*				X	X	X		
Bullhead General*						X		
Bullhead Yellow*					X	X		
Burbot					X	X		
Carp Common*					X	X		X
Carp Grass *			X	X				
Catfish Channel*					X	X		
Chiselmouth					X	X	X	X
Crappie Black*					X	X		
Crappie General*			X	X	X	X	X	X
Crappie White*					X	X		X
Dace Leopard	SC					X		
Dace Longnose			X			X	X	X
Dace Speckled				X	X	X	X	X
Dace Umatilla	SC					X		
Lamprey General							X	
Lamprey Pacific		Fco	X	X	X	X		
Lamprey River	SC	Fco	X					
Lamprey Western Brook			X					
Longfin Smelt			X					
Peamouth			X				X	X
Perch Yellow*					X	X	X	X
Pikeminnow Northern						X	X	X
Redside Shiner			X	X		X	X	X
Sandroller	SM		X	X	X	X		
Sculpin Mottled					X	X		
Sculpin Paiute						X	X	X
Sculpin Prickly			X	X	X		X	
Sculpin Reticulate			X					
Sculpin Shorthead							X	X
Sculpin Torrent				X				
Starry Flounder							X	
Sturgeon White			X	X	X	X	X	X
Sucker Bridgelip				X	X	X	X	X
Sucker Largescale			X	X	X	X	X	X
Sucker Longnose					X	X		

Table 7. Non-salmonid Fish Species by WRIA within the Middle Columbia Region (WDFW 2003, Wydoski and Whitney 2003) (continued).

Species	State Status[1/]	Federal Status[2/]	Wind-White Salmon (WRIA 29)	Klickitat (WRIA 30)	Rock-Glade (WRIA 31)	Lower Yakima (WRIA 37)	Naches (WRIA 38)	Upper Yakima (WRIA 39)
Sucker Mountain	SC					X		X
Sunfish Pumpkinseed*			X	X	X	X		
Sunfish General*			X	X	X	X		
Threespine Stickleback					X			
Tui Chub			X	X		X		
Walleye*					X	X		

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, Fco – Federal species of concern.

Status of Salmonid Stocks

The State and Tribal Stock status of stocks in the Middle Columbia region is shown by river basin in Table 8. For State and Tribal Stock Status, *Healthy* refers to a stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock; *Depressed* refers to a stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely; *Critical* refers to a stock of fish experiencing production levels that are so low that permanent damage to the stock is likely or has already occurred; and *Unknown* refers to a stock of fish which has insufficient information to rate stock status.

The Wind River supports winter steelhead, fall chinook, and possibly limited numbers of coho (USFS 1996) and Bull Trout/Dolly Varden (personal communication, John Weinheimer, WDFW 1999 in WSCC 2003) in its lower reaches below Shipherd Falls and in the Little Wind River. Historically, summer steelhead, winter steelhead, coho, fall chinook, chum, and searun cutthroat were present in the basin. Spring chinook were introduced into the river in 1952 (WDW et al. 1990).

The White Salmon River is recognized as historic core habitat and necessary for recovery of bull trout in the Lower Columbia Recovery Unit (USFWS 2002). Currently, no local populations of bull trout are known to exist in the White Salmon, though two sightings of bull trout have been reported upstream of Condit Dam in Northwestern Lake, as well as a few sightings downstream of Condit Dam (SaSI 1998). Most other streams in WRIA 29 are not accessible to anadromous fish due to natural geological barriers (i.e., gorge wall) (WSCC 2003).

Within the Klickitat drainage, all anadromous stocks, except possibly winter steelhead, are supplemented by the Klickitat Hatchery (WSCC 1999). The only known local population of bull trout exists in the West Fork Klickitat River. The Klickitat basin is considered to be a core area and necessary for recovery of bull trout (USFWS 2002).

Table 8. State Stock Status for the Middle Columbia region's Salmon, Steelhead, and Bull Trout. [Information for salmon and steelhead was taken from the Draft SaSI (2002), and the information for bull trout was taken from SaSI (1998).]

River Basin/WRIA	Species	Stock Status
Wind-White Salmon (WRIA 29)		
Wind River	Chinook Spring	Healthy
Wind River	Chinook Tule Fall	Critical
White Salmon River	Chinook Tule Fall	Depressed
Wind River	Chinook Bright Fall	Healthy
White Salmon River	Chinook Bright Fall	Healthy
Wind River	Steelhead Summer	Depressed
White Salmon River	Steelhead Summer	Unknown
Wind River	Steelhead Winter	Unknown
White Salmon River	Steelhead Winter	Unknown
White Salmon River	Bull Trout/Dolly Varden	Unknown
Klickitat (WRIA 30)		
Klickitat River	Chinook Spring	Depressed
Klickitat River	Chinook Tule Fall	Healthy
Klickitat River	Chinook Bright Fall	Healthy
Klickitat River	Coho	Unknown
Klickitat River	Steelhead Summer	Unknown
Klickitat River	Steelhead Winter	Unknown
Klickitat River	Bull Trout/Dolly Varden	Unknown
Rock-Glade (WRIA 31)		
Rock Creek	Steelhead Summer	Unknown
Lower Yakima (WRIA 37)		
Yakima	Chinook Bright Fall	Healthy
Marion Drain	Chinook Fall	Healthy
Yakima	Steelhead Summer	Depressed
Yakima	Bull Trout/Dolly Varden	Critical
Ahtanum Creek	Bull Trout/Dolly Varden	Critical
Naches (WRIA 38)		
American River	Chinook Spring	Depressed
Naches River	Chinook Spring	Depressed
Naches River	Bull Trout/Dolly Varden	Critical
Rimrock Lake	Bull Trout/Dolly Varden	Healthy
Bumping Lake	Bull Trout/Dolly Varden	Depressed
Upper Yakima (WRIA 39)		
Upper Yakima River	Chinook Spring	Depressed
North Fork Teanaway	Bull Trout/Dolly Varden	Critical
CleElum/Waptus Lakes	Bull Trout/Dolly Varden	Unknown
Kachess Lake	Bull Trout/Dolly Varden	Critical
Keechelus Lake	Bull Trout/Dolly Varden	Critical

7.0 AMPHIBIANS

The Middle Columbia region harbors 21 amphibian species, including the established introduced bullfrog (Dvornich et al. 1997, McAllister 1995), ranking it among the most amphibian rich areas in the state. Of these 21, the largest assemblage (including the bullfrog) consists of 14 taxa that reproduce in stillwater habitat including lakes, oxbow, ponds, temporary pools, and other freshwater wetlands with sufficient stillwater habitat. Stillwater habitats are largely

dichotomously split in elevation between high-elevation lakes and ponds, and lower elevation habitats associated with the riparian margins of larger stream or riverine systems. As a large proportion of this habitat has been altered or lost (see Floodplain Conditions and Riparian Conditions sections), including habitat along the mainstem Columbia, significant impact to stillwater amphibians is presumed.

Lowland stillwater habitats are also the habitats in which warmwater species have been introduced (bullfrogs and selected fish [catfish, mosquitofish, sunfish], see Table 7); and interactive facilitation among some introduced species, particularly bullfrogs and warmwater fishes, may promote their survival (Adams et al. 2003) and contribute to their potential negative effects on native amphibians (Adams 1999). Of the remaining seven native amphibian species, three (ensatina, Larch Mountain salamander, and western red-backed salamander) reproduce in terrestrial habitats, and the remaining four (Cope's giant salamander, coastal giant salamander, coastal tailed frog and Cascades torrent salamander) reproduce in streams, springs, or seeps (Table 9).

Of the entire amphibian assemblage for the region, coastal tailed frog (*Ascaphus truei*) and Cascades torrent salamander (*Rhyacotriton cascadae*) are the only two Forest Practices HCP-covered species (Table 9). The known distribution of both species lies entirely within WRIA 29, which represents the most pluvial portion of the Middle Columbia region. Known distributions may be conservative as no systematic survey, either to understand distribution or determine status (i.e., surveys of historic sites) has been performed in the region. Currently, too few data exist even to perform a status survey for either species because of lack of a baseline. Both species may be at some level of risk because sedimentation has the potential to substantially reduce its instream habitat (Bury 1983, Bury and Corn 1988, Corn and Bury 1989). Timber harvest, which can result in significant sedimentation (Beschta 1978, Jakob 1999), occurs over most of the Middle Columbia region where these two species occur (see Habitat Trends section).

Although not covered under this Forest Practices HCP, seven other amphibians (namely northwestern salamander [Ambystoma gracile], long-toed salamander [Ambystoma macrodactylum], western toad, Pacific treefrog [Hyla regilla], northern red-legged frog [Rana aurora], Cascades frog [Rana cascadae], and rough-skinned newt [Taricha granulosa]) may receive some protection as a result of Forests and Fish patch buffer prescriptions. Two of these species, western toad and Cascades frog have State watchlist (special concern) status (WDFW 2001). Both have declined elsewhere in their geographic ranges (Carey 1993, Fellers and Drost 1993), but their status in the Mid-Columbia is unknown. Development and hydrological alteration may have resulted in habitat loss for western toads at low elevations.

Table 9. Forests and Fish Amphibians of the Middle Columbia Region.

Group	Name	Habitat			Regional Distribution
		Active Season			
		Breeding	Non-Breeding	Over-wintering	
Frogs	Coastal tailed frog *Ascaphus truei*	streams	streams	terrestrial	WRIA 29; west margin of WRIAs 30, 38, 39
Salamanders	Cascades torrent salamander *Rhyacotriton cascadae*	stillwater	terrestrial	terrestrial	Known only from WRIA 29

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UPPER COLUMBIA – DOWNSTREAM OF GRAND COULEE REGIONAL SUMMARY

UPPER COLUMBIA – DOWNSTREAM OF GRAND COULEE REGIONAL SUMMARY

1.0 PHYSICAL DESCRIPTION

The Upper Columbia - Downstream region (downstream of Grand Coulee Dam) includes the mainstem of the Columbia River and its tributaries to Grand Coulee Dam; this includes eight WRIAs (40, 44, 45, 46, 47, 48, 49, and 50). Major stream systems within the region are the Wenatachee River, Entiat River, Methow River, Okanogan River, and Lake Chelan with its tributaries. Portions of Kittitas, Chelan, Douglas, and Okanogan Counties are contained within the Upper Columbia - Downstream region. A map of the Upper Columbia - Downstream region is provided in Figure 1.

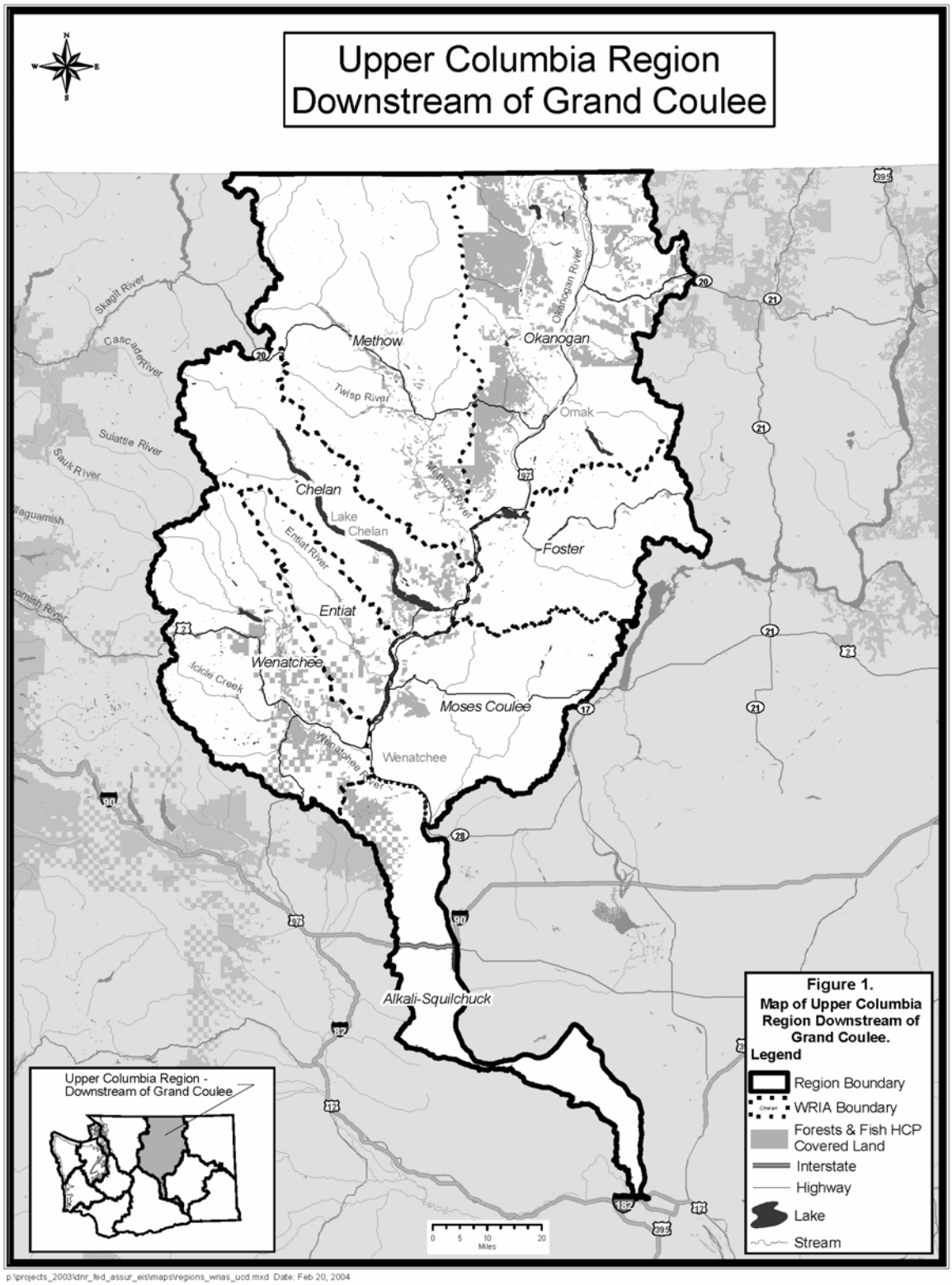
Covered lands of the Upper Columbia region downstream from Grand Coulee Dam lie within the Northern Cascades and Okanogan Highlands physiographic provinces (Lasmanis 1991). Elevations range from approximately 500 feet along the Columbia River to over 8,000 feet along the Cascade crest.

General Geology

The Upper Columbia - Downstream region includes portions of two geological provinces: (1) the Northern Cascades, roughly the western two-thirds of the Upper Columbia – Downstream region (west of the Okanogan and Columbia Rivers); and (2) the Okanogan Highlands, the remaining third of the Upper Columbia - Downstream region largely east of the Okanogan River.

Jagged mountain topography shadowing glaciation-formed steep-sided, U-shaped valleys characterizes the Northern Cascades Province, a part of the area with the highest density of alpine glaciers in the continental United States. Mesozoic crystalline and metamorphic rocks dominate parent geology. Drainages generally face east from a Cascade Mountains crest largely > 2,200 meters (approximately 7200 feet) and regionally dominated by the 3,185-meter (10,450 feet) stratovolcano, Glacier Peak, which lies just west of the crest outside the Upper Columbia - Downstream region. Well-drained glacial till, in highly variable fine- to coarse-textured deposits, exists in virtually every major valley. Rapid geologic erosion on steep slopes has restricted soil formation over large areas resulting in rocklands and shallow stony soils. Soils east of the Cascade crest reflect their drier formation conditions, frequently influenced by volcanic ash and, in areas, by loess; soil textures range from stone-free silt loams to cobble-strewn loams (Franklin and Dyrness 1973).

In contrast, a shallower topography with moderate slopes; broad, rounded summits; and wide V-shaped valleys characterize the Okanogan Highlands Province. Excepting the main river valleys, most of the province is above 1,200 meters (approximately 4000 feet); several peaks extend over 2,400 meters (approximately 8000 feet). Mesozoic era granitic rocks dominate parent materials and tertiary deposits are largely confined to areas adjacent to main river valleys. Columbia River Basalt extends across the Columbia River into the province in an area south of Okanogan. The soil patterns are closely tied to elevation. Montane areas away from major river valleys typically have shallow gravelly or silty loams of glacial origin derived from granitic parent materials. Montane soils may have considerable volcanic ash, resulting in superficial silt loam with underlying gravelly loam. At lower elevations, along the margins of rivers, soils (predominantly glacial till) reflect the drier climate and transitional forest-grassland vegetation. Lower elevation soils occupying terraces and floodplains are typically coarse textured, deeper, and well drained, and largely derived from glacial outwash sands and gravels (Franklin and Dyrness 1973).


Upper Columbia Region
Downstream of Grand Coulee
Skagit River
Cascade River
Sauk River
Sulattle River
Methow
Okanogan
Okanogan River
Twisp River
Omak
Methow River
Chelan
Lake Chelan
Entiat River
Foster
Entiat
Wenatchee
Icicle Creek
Moses Coulee
Wenatchee River
Wenatchee
Alkali-Squilchuck
Upper Columbia Region -
Downstream of Grand Coulee
0 5 10 20
Miles
Figure 1.
Map of Upper Columbia Region Downstream of Grand Coulee.
Legend
Region Boundary
WRIA Boundary
Forests & Fish HCP Covered Land
Interstate
Highway
Lake
Stream
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Information concerning erosion processes in the Upper Columbia - Downstream region has been extracted from the following watershed analyses conducted in the Upper Columbia - Downstream region and the Middle Columbia planning region: Huckleberry Creek (WDNR 1995f); North Fork Teanaway (Boise-Cascade 1996); LeClerc (WDNR 1997c).

Erosion in the Upper Columbia - Downstream region is low relative to regions west of the Cascade Crest. This is primarily due to more moderate topography and lower rainfall, although more competent rock types found in some areas also contribute to more stable conditions.

Watershed analyses conducted in adjacent regions have documented very low rates of mass wasting. Landslide densities ranging from 0.01 to 0.04 landslides/ mi^2/year have been reported and are assumed to be representative of conditions in the region (WDNR 1995f; Boise-Cascade 1996; WDNR 1997c). Debris avalanches and large, ancient deep-seated landslides are the most common landslide types; debris flows and debris torrents also occur but are infrequent.

Hillslope surface erosion can contribute substantial volumes of sediment where soils immediately adjacent to streams are heavily disturbed.

General Hydrology

The climate of the region differs greatly from areas west of the Cascades. Most areas receive less precipitation and temperature ranges are more extreme. The region has a marine-continental climate characterized by cold winters and hot summers. Most precipitation falls as snow during the winter, although spring and summer rains are common. Average annual precipitation for forested areas of the region range from 15 inches along the northern Cascade foothills to over 80 inches at higher elevations.

Accumulations of heavy snowfall along the North Cascades mountain axis serves as the water storage for summer flows. Channels draining lower foothills lack this storage, and are more prone to seasonal drying. Summers are typically very dry, especially at lower elevations. In dry years with reduced snowpacks, instream flows become severely reduced, resulting in dewatered reaches and substantially higher summertime water temperatures (WSCC 2000).

In the Methow River headwaters, annual precipitation ranges from over 80 inches along the Cascade Crest to approximately 10 inches near the town of Pateros. Approximately two-thirds of the precipitation occurs between October and March, mostly in the form of snow. Summers are generally hot and dry with infrequent precipitation coming from brief and intense thunderstorms. In fall, precipitation increases and generally peaks in the winter between December and February in the form of snowfall (WSCC 2000).

In the Methow watershed, seasonal hydrology is dominated by snowmelt, with peak flows occurring during spring and early summer. Rainfall driven peak flows may occur in November and December. From September to March, stream flow is sustained by groundwater, autumn precipitation, and limited snowmelt (WSCC 2000).

Major forested watersheds in the Upper Columbia - Downstream region include the Wenatchee, Entiat, Methow, and Okanogan rivers. These rivers, including Lake Chelan, are all tributary to the Columbia River. The rivers have a snowmelt-driven hydrologic regime where most peak flows occur from April through June in response to spring snowmelt. However, large magnitude peak flows result from rain-on-snow precipitation events that occur during the fall and winter months. Low flows generally occur during late summer and early fall, although extreme cold can substantially reduce flows during the winter. Based on the DNR stream hydrography GIS coverage, there are approximately 23,240 stream-miles (both fish-bearing and non-fish streams) in the Upper Columbia - Downstream region, with an average stream density of 2.32 stream miles/$mile^2$ (Table 1).

2.0 LAND OWNERSHIP AND USE

Major Land Ownership and Management

Approximately 51 percent of all lands in the Upper Columbia – Downstream region are in Federal ownership and a portion of these lands (about 19 percent of all lands) are being managed for long-term preservation, primarily in national parks, wildernesses, and national wildlife refuges (Table 2). Another large portion of these Federal lands is being managed by the Forest Service outside of wilderness (25 percent of all lands); a substantial portion of these non-wilderness National Forest System lands is being managed under a very limited management status (e.g., LSRs, Managed LSAs, AMAs, or Riparian Reserves) according to the Northwest Forest Plan. The remainder of the Federal lands (7 percent of all lands) are being managed by other agencies. Tribal lands represent 7 percent of the region. State lands represent 12 percent of all lands in the region, private lands represent 31 percent, and city/county lands represent much less than 1 percent.

The WRIAs differ markedly in their ownership. The Wenatchee, Entiat, Chelan, and Methow WRIAs are dominated by Federal lands (80 to 86 percent) in the Wenatchee and Okanogan National Forests. In contrast, the Foster and Moses Coulee WRIAs contain only 2 and 6 percent Federal lands, respectively.

Land Cover and Land Use

Forestland makes up approximately 43 percent of the Upper Columbia - Downstream region and shrubland and grassland together also comprise about 43 percent (Table 3). Agricultural lands make up 9 percent and the remaining 4 percent consist of water/wetlands and ice, snow, and bare rock. The percent forestland within each WRIA varies considerably, ranging from a low of 1 percent in the Moses Coulee WRIA to a high of 74 percent in the Wenatchee WRIA.

Table 1. Stream Miles in the Upper Columbia - Downstream Region by WRIA[1/]

	WRIA 40 Alkali-Squilchuck	WRIA 44 Moses Coulee	WRIA 45 Wenatchee	WRIA 46 Entiat	WRIA 47 Chelan
Stream Length (miles)	988	607	7,466	2,122	2,259
Stream Density (miles/mi^2)	1.17	0.53	5.44	4.44	2.16

Table 1. Stream Miles in the Upper Columbia - Downstream Region by WRIA[1/] (continued).

	WRIA 48 Methow	WRIA 49 Okanogan	WRIA 50 Foster	Total Upper Columbia Downstream Of Grand Coulee
Stream Length (miles)	3,921	5,252	625	23,240
Stream Density (miles/mi^2)	1.85	2.50	0.69	2.32

[1/] Primary Data Source: DNR stream hydrography GIS layer. Stream miles include all Type 1-5 streams and a portion of Type 9 streams. Because many Eastern Washington Type 9 waters are not defined channels, only 25% of Type 9 streams are counted as streams in the Ponderosa Pine and drier vegetation zones, 50% are counted in the Mixed Conifer vegetation zones, and 75% are counted in the wettest vegetation zones. These proportions are based on field observations by DNR foresters, but are very approximate.

Table 2. Land Ownership Parameters for Upper Columbia - Downstream Region by WRIA[1/]

Land Ownership	WRIA 40 Alkali-Squilchuck	WRIA 44 Moses Coulee	WRIA 45 Wenatchee	WRIA 46 Entiat	WRIA 47 Chelan	WRIA 48 Methow	WRIA 49 Okanogan	WRIA 50 Foster	Total Upper Columbia – Downstream Region
Federal – Long-term Congressionally Protected Lands [2/]	-	-	319,975	25,646	337,270	498,056	22,592	258	1,203,796
Federal – Other National Forest System Lands [3/]	2,881	-	375,246	225,800	197,697	663,565	160,620	-	1,625,809
Federal – Other Federal Lands [4/]	281,242	47,041	4,627	5,289	10,696	5,082	53,350	10,027	417,355
State – Protected Lands [5/]	91,645	7,072	4,886	7,429	8,451	26,140	31,344	6,095	183,062
State – Managed Lands [6/]	65,270	83,713	13,747	11,614	5,237	41,910	259,988	92,162	573,642
Tribal Lands/Indian Reservations	-	-	-	-	-	-	279,381	152,158	431,539
Municipal Watershed	-	-	-	-	-	-	-	-	-
Other County/City Lands	-	80	272	-	-	-	-	885	1,237
Private	98,141	592,220	159,671	29,980	108,785	124,417	535,202	315,722	1,964,137
TOTAL	**539,179**	**730,127**	**878,423**	**305,757**	**668,136**	**1,359,170**	**1,342,477**	**577,307**	**6,400,577**

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan GIS layers.
[2/] Includes national parks, national monuments, national recreation areas, national wildlife refuges, and wildernesses.
[3/] Includes all non-wilderness National Forest System lands; the majority of the acres consists of lands protected under the Northwest Forest Plan (e.g., LSR, Managed LSR, AMA, Riparian Reserves)
[4/] Includes all Department of Defense, Department of Energy, Bureau of Land Management, and Bureau of Reclamation lands.
[5/] Includes all State Parks and Wildlife Areas.
[6/] Includes all DNR, Department of Corrections, and University lands.

Table 3. General Land Cover Classifications for the Upper Columbia - Downstream Region by WRIA[1/]

Land Cover	WRIA 40 Alkali-Squilchuck	WRIA 44 Moses Coulee	WRIA 45 Wenatchee	WRIA 46 Entiat	WRIA 47 Chelan	WRIA 48 Methow	WRIA 49 Okanogan	WRIA 50 Foster	Total Upper Columbia - Downstream Region
Forestland	44,968	5,430	650,580	204,366	338,636	952,792	555,762	21,430	2,773,963
Shrubland	398,793	307,221	55,881	25,725	73,970	109,861	386,678	275,296	1,633,425
Grassland	58,104	94,581	96,187	62,922	142,406	241,804	287,563	130,045	1,113,611
Water & Wetlands	19,760	7,490	9,495	2,752	36,707	6,220	26,601	16,259	125,284
Ice, Snow, & Bare Rock	330	42	43,171	7,522	63,893	36,411	1,781	541	153,691
Residential & Commercial	10,793	3,821	5,701	152	1,039	982	6,518	1,122	30,129
Agricultural	6,432	311,542	17,408	2,318	11,485	11,099	77,575	132,615	570,474
TOTAL	**539,179**	**730,127**	**878,423**	**305,757**	**668,136**	**1,359,170**	**1,342,477**	**577,307**	**6,400,577**

[1/] Primary Data Source: USGS/EPA National Land Cover Data GIS layer.

3.0 FORESTLAND OWNERSHIP AND MANAGEMENT

Approximately 78 percent of the forestlands in the Upper Columbia - Downstream region are in Federal ownership, 4 percent are in Tribal ownership, 9 percent are in State ownership, and 9 percent are in private or other ownership (Table 4). A Federal or State preservation or limited management status covers approximately 46 percent of the forestlands in the region. Approximately 37 percent of the forestlands are available for Federal or Tribal timber management. State timber management may occur on approximately 8 percent of the forestlands and 9 percent of the forestlands are in private, county, city, or tribal ownership, where timber management may occur. Overall, lands covered by the forest practices rules represent approximately 17 percent of the forestlands in the region (see Figure 1, which displays these lands). Existing riparian HCPs cover none of the State-managed lands (although an HCP relating to some wildlife covers 12 percent of the State lands in the region) and only about 0.1 percent of the combined private, county, and city ownerships.

More than half of the forestlands under the State forest practices rules in the region, occur in the Okanogan WRIA. This WRIA contains the largest acreage of both State and privately managed lands (167,535 acres of State lands and 107,596 acres of private.city/county lands). Another WRIA with a high acreage (86,090 acres) of privately managed forestlands is the Wenatchee WRIA. All other WRIAs have less than 35,000 acres of combined State and privately managed forestlands.

Small, 20-acre exempt forest landowners make up about 0.3 percent of the forestlands and about 1.5 percent of the forestlands subject to forest practices rules in the Upper Columbia - Downstream region, based on the analysis by Rogers (2003). Although this analysis may represent an underestimate, it is believed to have identified the majority of all small, 20-acre exempt parcels (personal communication, Luke Rogers, Rural Technology Initiative, University of Washington, May 2004). The highest percentage (about 1 percent of the forestland) is in the Moses Coulee WRIA and the lowest percentage (less than 0.1 percent) is in the Methow WRIA.

Approximately 3,130 stream miles occur on lands subject to forest practices rules in the Upper Columbia – Downstream region (Table 5). This represents 13 percent of all streams in the region. Approximately 2,629 miles or 84 percent of the 3,130 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre exempt forest landowner parcels in this region is estimated to about 0.6 percent and the percentage of all fish-bearing streams on small, 20-acre exempt forest landowner parcels is about 0.8 percent (Rogers 2003).

Table 4. Ownership and Management of Forestlands (acres and percent) in Upper Columbia –Downstream Region by WRIA[1/]

Forestlands Category	WRIA 40 Alkali-Squilchuck	WRIA 44 Moses Coulee	WRIA 45 Wenatchee	WRIA 46 Entiat	WRIA 47 Chelan
Federal and State Protected Forestlands Not Managed for Timber Production[2/]	15,158	2	449,449	97,392	272,618
Federal Lands and Tribal Forestlands Available for Timber Management[3/]	1,224	307	105,808	88,023	51,542
Forestlands Available for Timber Management Under the State Forest Practices Rules					
DNR and Other State Forestlands	16,256	298	9,232	6,739	1,566
Private, County, and City Forestlands	12,329	4,823	86,090	12,213	12,911
Subtotal	28,586	5,121	95,322	18,952	14,477
TOTAL FORESTLANDS	44,968	5,430	650,580	204,366	338,636
% IN FEDERAL OR STATE PROTECTION	34%	0%	69%	48%	81%
% AVAILABLE FOR FEDERAL OR TRIBAL TIMBER MANAGEMENT	3%	6%	16%	43%	15%
% AVAILABLE FOR STATE TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	36%	5%	1%	3%	0%
% AVAILABLE FOR PRIVATE OR COUNTY/CITY TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	27%	89%	13%	6%	4%

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan, and USGS/EPA National Land Cover Data GIS layers.
[2/] Federal and State Protected Lands includes: Wilderness, LSR, LSOG, AMA, National Wildlife Refuges, National Parks, Washington State Parks, and WDFW lands.
[3/] Federal and Tribal Lands Available for Timber Management include: USFS Matrix lands, USFS other lands, BLM lands, Dept of Defense lands, and Indian Reservation lands.

Table 4. Ownership and Management of Forestlands (acres and percent) in Upper Columbia –Downstream Region by WRIA[1/] (continued).

Forestlands Category	WRIA 48 Methow	WRIA 49 Okanogan	WRIA 50 Foster	Total Upper Columbia -Downstream Region
Federal and State Protected Forestlands Not Managed for Timber Production[2/]	407,370	25,175	54	1,267,217
Federal Lands and Tribal Forestlands Available for Timber Management[3/]	511,097	255,456	21,149	1,034,605
Forestlands Available for Timber Management Under the State Forest Practices Rules				
DNR and Other State Forestlands	12,644	167,535	35	214,305
Private, County, and City Forestlands	21,681	107,596	192	257,835
Subtotal	34,325	275,130	227	472,140
TOTAL FORESTLANDS	952,792	555,762	21,430	2,773,963
% IN FEDERAL OR STATE PROTECTION	43%	5%	0%	46%
% AVAILABLE FOR FEDERAL OR TRIBAL TIMBER MANAGEMENT	54%	46%	99%	37%
% AVAILABLE FOR STATE TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	1%	30%	0%	8%
% AVAILABLE FOR PRIVATE OR COUNTY/CITY TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	2%	19%	1%	9%

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan, and USGS/EPA National Land Cover Data GIS layers.
[2/] Federal and State Protected Lands includes: Wilderness, LSR, LSOG, AMA, National Wildlife Refuges, National Parks, Washington State Parks, and WDFW lands.
[3/] Federal and Tribal Lands Available for Timber Management include: USFS Matrix lands, USFS other lands, BLM lands, Dept of Defense lands, and Indian Reservation lands.

Table 5. Stream Miles in the Upper Columbia – Downstream Region by Ownership, Forested Stream Miles, and Forest Practices Rules (FPR)-Regulated Stream Miles[1/]

Category	WRIA 40 Alkali-Squilchuck	WRIA 44 Moses Coulee	WRIA 45 Wenatchee	WRIA 46 Entiat	WRIA 47 Chelan	WRIA 48 Methow	WRIA 49 Okanogan	WRIA 50 Foster	Total Upper Columbia - Downstream Region
Total Stream Miles									
Federal	205	46	5,463	1,649	1,659	2,861	841	16	12,739
Tribal	-	-	-	-	-	-	922	302	1,224
State	481	69	162	156	50	300	1,146	44	2,409
County/City	-	1	1	-	-	-	-	1	3
Private	302	492	1,840	317	550	760	2,343	261	6,865
Total Miles	**988**	**607**	**7,466**	**2,122**	**2,259**	**3,921**	**5,252**	**625**	**23,240**
Forested Stream Miles									
Forested Miles	304	10	5,474	1,420	1,068	2,624	2,255	68	13,223
% of Total Miles	31%	2%	73%	67%	47%	67%	43%	11%	57%
FPR-Regulated Stream Miles									
FPR-Reg. Miles	205	9	1,216	241	107	190	1,161	1	3,130
% of Total Miles	21%	1%	16%	11%	5%	5%	22%	0%	13%

[1/] Data sources: DNR stream hydrography GIS layer, DNR Major Public Lands layer, and USGS/EPA National Land Cover Data. Stream miles include all Type 1-5 streams and a portion of Type 9 streams. Because many Eastern Washington Type 9 waters are not defined channels, only 25% of Type 9 streams are counted as streams in the Ponderosa Pine and drier vegetation zones, 50% are counted in the Mixed Conifer vegetation zones, and 75% are counted in the wettest vegetation zones. These proportions are based on field observations by DNR foresters, but are very approximate.

4.0 HABITAT LIMITING FACTORS

Primary Regional Factors

The predominant limiting factor for the Columbia mainstem has generally been the result of the development and operation of hydropower and storage dams. Other human activities associated with farming, irrigation, grazing, urban and suburban development and transportation have also contributed to habitat degradation. Exotic species have competed and often displaced native species (Draft Mainstem Columbia River Subbasin Summary 2001, Mainstem/Systemwide Habitat Summary 2002).

Within the Upper Columbia - Downstream region, habitat limiting factors naturally occur within the environment, such as extreme winter conditions, summertime high water temperatures, reduced stream flows, and natural disturbances such as fire, flood, and landslides. However, various land management practices have exacerbated the influence of these limiting factors by further altering natural processes. These human-induced alterations have occurred primarily in lower gradient, lower elevation reaches of watersheds and include road building and placement, conversion of riparian habitat to agriculture and residential development, water diversions, reduced LWD recruitment, and flood control efforts (WSCC 2000, 2001). In Cub, Boulder, Eightmile and Falls creeks (all in the Chewuch River subwatershed), and in the Goat, Beaver, Libby and Gold creek drainages, impacts also extend into the upper reaches of the drainages. These impacts are mostly the result of past timber harvest operations, road building and placement, and grazing (WSCC 2000). Overall, habitat quality is rated higher within the upper reaches of the watersheds (e.g., Methow, Wenatchee, and Entiat) (WSCC 2000, 2001).

A lack of juvenile overwintering habitat appears to be the most limiting condition to sustaining salmon populations in the Entiat watershed. This pattern is a function of the alteration of the natural hydrologic and geomorphic processes in the watershed resulting from losses in floodplain connectivity and riparian zone conditions (USDA NRCS Stream Team 1998, USFS 1996, Rocky Reach Dam Hydroelectric Facility et al. 1998, WSCC 1999).

Within the Okanogan basin, barriers to fish migration, elevated temperatures, and sedimentation are among the primary limiting factors to anadromous fish reproductive success. Unnaturally warmer waters, low velocities and heavy sedimentation in the mainstem favor exotic species, which can compete with native stocks (Okanogan/ Similkameen Subbasin Plan 2002).

Sedimentation/Mass Wasting

Chronic and catastrophic sediment delivery to streams (correlated with highly erodible soils, exacerbated by high road densities, road placements, and grazing) and reduced levels of LWD (from stream cleanouts and loss of riparian recruitment material) are driving habitat degradation in the lower half of the Chewuch River, Libby Creek, Gold Creek and Boulder Creek drainages (WSCC 2000). Grazing has been identified as a limiting factor for bull trout in riparian areas adjacent to the Twisp River, lower Wolf Creek, Upper Methow River, Chewuch River, Buttermilk Creek, Gold Creek and Goat Creek (USFWS 2002).

Sediment delivery from high road densities on Forest Service lands is one of the most important impacts driving habitat degradation in Chumstick Creek, which is considered one of the most problematic drainages in the entire Wenatchee basin relative to land use impacts and management issues. The second most important habitat limiting factor in the basin comes from road location and density in the Little Wenatchee River drainage, with emphasis on the lower reaches of the mainstem and Rainy Creek (WSCC 2001). High road densities have also been identified in the Entiat River and Methow River basins as contributing towards habitat degradation (USFS 2002).

Sedimentation of the Okanogan mainstem and tributary systems is primarily attributed to roads, logging, agricultural practices, and hydrological manipulations. Roads are likely the greatest contributing source of sediment to streams in the Okanogan watershed. Road densities in most Okanogan sub-watersheds exceed 4 miles/mile^2 (Okanogan/ Similkameen Subbasin Planning 2002). According to Cederholm et al. (1981), sediment delivery to streams is considered to be greater than natural erosion rates when road densities exceed 4 miles/mile^2. Within the Omak subwatershed, bank erosion from heavy livestock grazing and high road densities have been identified as significant sources of sediment (Okanogan/Similkameen Subbasin Plan 2002).

Riparian/Floodplain and Wetland Conditions

Within the Columbia River, most of the mainstem habitat has been reduced to a single channel; floodplains have been reduced in size, and off-channel habitat features have been lost or disconnected from the main channel (Mainstem/Systemwide Habitat Summary 2002).

Floodplain connectivity, side channel habitat, and riparian function is especially limiting within the Entiat and Methow watersheds (e.g. Entiat mainstem, Mad River, Stormy Creek, Stillwaters Reach, and Roaring Creek; Methow River watershed; WSCC 1999).

The alluvial fans of every major tributary to the Methow River, from the Lost River to the town of Winthrop, have been diked and channelized to some extent (Lost River, Early Winters Creek, Goat Creek, Wolf Creek, Chewuch tributaries, Twisp River). Accelerated bank destabilization is occurring where riparian lands have been converted to residential and agricultural use (WSCC 2000).

To provide for year-around spawning, rearing and migratory habitat needs of all life history stages of spring and summer chinook salmon, steelhead trout, sockeye salmon and bull trout, floodplain habitat along the Wenatchee River corridor must provide accessible, high quality off-channel habitat. Maintaining and restoring these habitat conditions within the mainstem Wenatchee River has the greatest potential to improve salmonid fish production in the watershed. In order to maintain connectivity within the Nason Creek, Icicle Creek, Mission Creek, and Peshastin Creek watersheds, floodplain function and riparian habitat in the lower reaches of those streams need to be restored. Loss of floodplain and off channel habitat is also the greatest threat to salmonid production in the White/Little Wenatchee Watershed, which has among the best aquatic habitat and strongest native fish populations within the Columbia basin (USFS 1998; WSCC 2001).

Within the Okanogan River, floodplain connectivity is limited due to the presence of Highway 97. The river is also slightly entrenched and the control of the water level does not allow the channel to overflow its banks into the floodplain (Okanogan/Similkameen Subbasin Plan 2002).

Channel/Hydrology Conditions

Within the Columbia mainstem, the natural hydrograph has been altered by storage dams, decreasing spring and summer flows and increasing fall and winter flows. This alteration has affected most associated channel conditions such as floodplains, off-channel habitat, LWD, and water velocities (Mainstem/Systemwide Habitat Summary 2002).

As part of the Limiting Factors Analyses (WSCC 1999), the transport zone of the upper Entiat system has been rated to have good to excellent habitat quality with habitat diversity provided by side channels, boulders and LWD. Within the Transitional Zone (mid-Entiat), the aquatic habitat has been modified from historic conditions, with 30-60 percent loss of pools in the mainstem and a contrasting recovery of pool habitat in the Mad River. Some channel reaches have been locally impacted by timber harvest in tributaries and at road crossings. However, the habitat is rated fair to excellent in the transitional zone and is primarily used by bull trout and other resident fishes.

The lower depositional zone of the Entiat is the principal spawning/rearing habitat for anadromous fish. This zone has poor to fair habitat quality with low levels of LWD, a 90 percent reduction of pools, and high levels of fine sediment, largely the result of past flood control efforts (WSCC 1999).

Within the mainstem Okanogan, high levels of fine sediments, silt, and mud has resulted in low quality in-channel habitat (Okanogan/Similkameen Subbasin Plan 2002).

Large Woody Debris

The amount of LWD (large snags and log structures) has been reduced in the Columbia River mainstem (Mainstem/Systemwide Habitat Summary 2002).

Large woody debris levels are inadequate throughout the upper and middle Methow River watersheds, although LWD has been improving and reaching "adequate" levels from the headwaters to Goat Creek. Removal of large riparian trees along the lower 25 miles of the Chewuch River, the lower reaches of Lake Creek, and the lower 15 miles of the Twisp River have reduced LWD levels (WSCC 2000). Large woody debris is virtually nonexistent in the Okanogan mainstem (Okanogan/Similkameen Subbasin Plan 2002).

Past timber harvest within riparian areas on the mainstem Little Wenatchee and Rainy Creek has reduced potential for LWD recruitment, altered runoff and water storage patterns, and increased fine sediment input into receiving waters (WSCC 2001).

Fish Passage

Within the Columbia River mainstem, hydropower operations have resulted in either complete or partial fish passage barriers both up and downstream. Power operations have also affected fish movement through reservoirs by stranding fish in shallow areas and cutting off important spawning areas in tributary streams during drawdowns (Mainstem/Systemwide Habitat Summary 2002).

Unscreened, inadequately screened, and improperly designed surface water diversions (pumps and ditches) and dams pose a direct threat to salmonids in the Entiat watershed (WSCC 1999).

Numerous man-made fish passage barriers and unscreened water diversions have been identified in the Beaver Creek drainage (Methow watershed WSCC 2000).

On Icicle Creek (Wenatchee watershed), reestablishing fish passage at man-made barriers as well as barriers resulting from low flows and high stream temperatures would provide access to a highly functional watershed (WSCC 2001).

The Okanogan River and most tributaries have man-made barriers, including dams, culverts, and dewatered stream channels. Twenty-one dams exist within the U.S. portion of the Okanogan watershed. The Similkameen River is impassable to all anadromous salmonids at Enloe Dam, with 95 percent of the available potential fish habitat upstream. Diversions in Loup Loup, Salmon Creek and Antoine Creek prevent full use of the habitat potentially available in those systems (Okanogan/Similkameen Subbasin Plan 2002).

Water Quality Issues

Portions of the Columbia River mainstem do not meet water quality standards for total dissolved gases or temperature (EPA Columbia and Snake River mainstem TMDL homepage).

The lower reach of the Entiat River (WRIA 46) is considered impaired due to high temperature and low instream flow. The Mad River also has high stream temperatures, but reports have shown that these temperature exceedances have mostly resulted from natural geology and hydrology of the system (USFS 1999, WSCC 1999).

Portions of the mainstem Methow River (WRIA 48), from Robinson Creek downstream to the Weeman bridge, naturally dewater during drought years. Low flows also occur in the lower 8 miles of the Chewuch River, the lower 4 miles of the Twisp River, the lower Wolf Creek, and the lower portions of Libby and Gold creeks (WSCC 2000). The Methow and Twisp Rivers also have elevated water temperatures. High water temperatures in lower and middle Goat Creek could be attributed to the aspect of the drainage, the lack of seeps and springs in the confined channel, and the removal of vegetative cover in Goat Creek and its tributaries (USFS 2000).

Within some areas of the Wenatchee basin (WRIA 45), low instream flows and dewatering naturally occur due to climatic and geologic conditions. However, water diversions and withdrawals also contribute to low flows and high stream temperatures in the lower Wenatchee River, lower Icicle Creek, Peshastin Creek and Mission Creek. Stream temperature is also a limiting factor in the lower Chiwawa River (WSCC 2001). Low dissolved oxygen has been recorded in some WRIA 45 waters including the Wenatchee River and Icicle Creek (WDOE 1998, 2003).

In WRIA 49, portions of the Okanogan River are impaired due to high temperatures and low dissolved oxygen. The Similkameen River at times fails to meet water quality standards for temperature and arsenic, and Salmon Creek is impaired due to low instream flow. Stream flow in the Okanogan River, as well as most of the tributaries, has been altered for flood control, irrigation, and recreation activities. As a result, the natural hydrograph has been severely altered and is likely a key limiting factor in this system (Okanogan/Similkameen Subbasin Plan 2002).

5.0 HABITAT TRENDS

Past and present land uses have altered the landscape. Sheep grazing, especially in the late 1800's and early 1900's has contributed to altering the natural plant community (especially in the Entiat and Wenatchee basins). In addition, logging and agriculture (primarily orchards) are ongoing uses that have changed the makeup of the vegetation (WSCC 1999, 2001). From the 1930's to present, the development of the Columbia River for hydroelectric power production, hatchery mitigation programs, fishing harvest pressures, degradation of tributary habitats, and the loss of Columbia River estuary rearing areas for juvenile anadromous salmonids have contributed to suppressing naturally producing anadromous salmonid runs in the Methow basin [and other watersheds in the Upper Columbia - Downstream region] (USFS 1995). With the construction of the Grand Coulee Dam in 1939, anadromous salmonids were barred from 1,140 miles of potential spawning and rearing habitat in the upper Columbia River drainage (Fish and Havana 1948, WSCC 2000).

Forestlands currently make up approximately 43 percent of the Upper Columbia - Downstream region. Of the total forestlands, 46 percent are under Federal and State protection and 17 percent of the total forestlands are under private or State management under State forest practices rules (See Tables 3 and 4). Fire suppression has caused important changes in some areas. In middle-to-lower-elevation arid areas, the historic fire interval was often short (usually 10-50 years). Fire suppression has led to an increase in tree density in some areas as well as increased abundance of more shade tolerant trees such as grand fir. In higher elevation and/or more maritime areas where historic fire intervals were longer (usually 50-200+ years), the short time since effective fire suppression began may not have allowed for significant change in stand densities or composition, when compared to historic conditions (WSCC 1999, 2001).

Some irrigation diversions and delivery systems developed at the turn of the century still operate mostly without modifications designed to conserve water or screens designed to avoid and minimize fish impacts. The decline of beaver, the loss of nutrient input from salmon carcasses, the introduction of Eastern brook trout, flood control, and residential and commercial development also continue to negatively impact habitat conditions (WSCC 2000).

6.0 FISH RESOURCES

Salmonid Stocks

Within the Upper Columbia - Downstream region, three Federally listed fish species occur: chinook salmon (endangered), steelhead trout (endangered), and bull trout (threatened) (WDNR 2001). The pygmy whitefish, a State listed sensitive species, is also documented to currently occur in Lake Chelan (Hallock and Mongillo 1998). The Upper Columbia Bull Trout Recovery Unit Team identified 16 local populations of bull trout, which are currently distributed within 3 Core Areas (i.e., Wenatchee, Entiat, and Methow; USFWS 2002).

The following salmonids occur in the Upper Columbia - Downstream region (Table 6). The asterisk next to the species name indicates that the species is introduced, and not native to Washington State. This list should not be regarded as an exhaustive list of the species present. In some cases, migratory salmonids may be listed as present within a WRIA merely because of its presence in the Columbia River mainstem.

Table 6. Salmonid species presence by WRIA within the Upper Columbia (downstream of Grand Coulee) Region (WDFW 2003).

Species	State Status[1/]	Federal Status[2/]	Alkali-Squilchuck (WRIA 40)	Moses Coulee (WRIA 44)	Wenatchee (WRIA 45)	Entiat (WRIA 46)	Chelan (WRIA 47)	Methow (WRIA 48)	Okanogan (WRIA 49)	Foster (WRIA 50)
Brown Trout*			X					X	X	X
Bull Trout	SC	FT	X	X	X	X		X	X	X
Chinook Fall			X	X	X	X	X	X	X	X
Chinook Spring		FE	X	X	X	X	X	X		X
Chinook Summer			X	X	X	X	X	X	X	X
Coho Salmon			X	X	X	X	X	X		X
Cutthroat Westslope		FCo		X	X	X	X	X	X	
Eastern Brook Trout*				X	X	X	X	X	X	X
Kokanee Salmon			X	X	X	X	X	X	X	X
Lake Trout*									X	
Rainbow/Redband Trout		FCo	X	X	X	X	X	X	X	X
Sockeye Salmon			X	X	X	X	X	X	X	X
Steelhead Summer		FE	X	X	X	X	X	X	X	X
Whitefish Lake*			X	X	X	X	X	X	X	X
Whitefish Mountain			X	X	X	X	X	X	X	X
Whitefish Pygmy	SC						X			

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Other Fish Species

Table 7 is a list of other non-salmonid species that exist in the Upper Columbia - Downstream region (WDFW 2003). The asterisk next to the species name indicates that the fish is not native to Washington State. This list should not be regarded as an exhaustive list of the species present. The Pacific Lamprey, a Federal species of concern, is present within the larger streams of the major basins and the Columbia Rivers (WDFW 2003, Wydoski and Whitney 2003).

Table 7. Non-salmonid Fish Species by WRIA within the Upper Columbia (downstream of Grand Coulee) Region (WDFW 2003, Wydoski and Whitney 2003).

Species	State Status[1/]	Federal Status[2/]	Alkali-Squilchuck (WRIA 40)	Moses Coulee (WRIA 44)	Wenatachee (WRIA 45)	Entiat (WRIA 46)	Chelan (WRIA 47)	Methow (WRIA 48)	Okanogan (WRIA 49)	Foster (WRIA 50)
Bass, Largemouth*			X	X	X	X	X	X	X	X
Bass, Smallmouth*			X	X	X	X	X	X	X	X
Bullhead Black*			X							
Bullhead Brown*				X	X	X	X	X	X	X
Bullhead Yellow*			X	X						
Burbot			X	X	X	X	X	X	X	X
Carp Common*			X	X	X	X	X	X	X	X
Carp Grass *					X			X		
Catfish Channel*			X							
Chiselmouth			X			X			X	
Crappie Black*			X	X	X		X			
Crappie General*			X	X	X	X	X	X	X	X
Crappie White*			X			X	X			
Dace Leopard	SC								X	
Dace Longnose								X		
Dace Speckled			X	X	X	X	X	X	X	X
Dace Umatilla	SC				X				X	
Goldfish*			X	X	X	X	X			X
Lamprey General			X	X	X	X	X	X	X	X
Lamprey Pacific		FCo	X		X		X	X		
Peamouth						X	X	X	X	X
Perch Yellow*			X	X	X	X	X	X	X	X
Northern Pikeminnow			X	X	X	X	X	X	X	X
Redside Shiner			X	X	X	X	X	X	X	X

Table 7. Non-salmonid Fish Species by WRIA within the Upper Columbia (downstream of Grand Coulee) Region (WDFW 2003, Wydoski and Whitney 2003) (continued).

Species	State Status[1/]	Federal Status[2/]	Alkali-Squilchuck (WRIA 40)	Moses Coulee (WRIA 44)	Wenatachee (WRIA 45)	Entiat (WRIA 46)	Chelan (WRIA 47)	Methow (WRIA 48)	Okanogan (WRIA 49)	Foster (WRIA 50)
Sandroller	SM		X	X	X					
Sculpin General				X	X	X		X	X	X
Sculpin Mottled			X						X	
Sculpin Prickly			X		X				X	
Sculpin Shorthead					X	X		X	X	
Sculpin Slimy							X			
Sculpin Torrent									X	
Starry Flounder							X	X	X	X
Sucker Bridgelip			X		X	X				
Sucker Largescale			X	X	X	X		X	X	
Sucker Longnose			X							
Sucker Mountain	SC				X					
Sunfish Pumpkinseed*			X	X			X	X	X	X
Sunfish General*			X	X	X	X	X	X	X	X
Tench*							X	X	X	X
Threespine Stickleback			X							
Tui Chub			X							
Walleye*			X	X	X	X	X		X	X

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Salmonid Stock Status

The State and Tribal Stock status of the stocks in the Upper Columbia – Downstream region is shown by river basin in Table 8.

Table 8. Washington State and Tribal Stock Status for the Upper Columbia - Downstream region's Salmon, Steelhead, and Bull Trout. [Information for salmon and steelhead was taken from the Draft SaSI (2002), and the information for bull trout was taken from SaSI (1998).]

River Basin	Species	Stock Status
Alkali-Squilchuck (WRIA 40)		
Hanford Reach	Chinook Fall	Healthy
Wenatchee (WRIA 45)		
Chiwawa	Chinook Spring	Depressed
Nason Creek	Chinook Spring	Depressed
Little Wenatchee	Chinook Spring	Critical
White River (Wenatchee)	Chinook Spring	Critical
Wenatchee	Chinook Summer	Healthy
Wenatchee	Sockeye	Depressed
Wenatchee	Steelhead Summer	Depressed
Ingalls Creek	Bull Trout/Dolly Varden	Unknown
Icicle Creek	Bull Trout/Dolly Varden	Unknown
Chiwaukum Creek	Bull Trout/Dolly Varden	Unknown
Chiwawa	Bull Trout/Dolly Varden	Unknown
Chikamin Creek	Bull Trout/Dolly Varden	Healthy
Rock Creek	Bull Trout/Dolly Varden	Healthy
Phelps Creek	Bull Trout/Dolly Varden	Healthy
Nason Creek	Bull Trout/Dolly Varden	Unknown
Little Wenatchee	Bull Trout/Dolly Varden	Unknown
White River (Lk Wenatchee)	Bull Trout/Dolly Varden	Unknown
Panther Creek	Bull Trout/Dolly Varden	Healthy
Entiat (WRIA 46)		
Entiat	Chinook Spring	Critical
Entiat	Steelhead Summer	Unknown
Entiat	Bull Trout/Dolly Varden	Unknown
Mad River	Bull Trout/Dolly Varden	Healthy
Chelan (WRIA 47)		
Lake Chelan	Chinook Fall	Unknown
Methow (WRIA 48)		
Methow	Chinook Spring	Critical
Twisp	Chinook Spring	Critical
Chewuch (Chewack)	Chinook Spring	Critical
Lost River	Chinook Spring	Critical
Methow	Chinook Summer	Healthy
Methow/Okanogan	Steelhead Summer	Depressed
Gold Creek	Bull Trout/Dolly Varden	Unknown
Beaver Creek	Bull Trout/Dolly Varden	Unknown
Twisp	Bull Trout/Dolly Varden	Unknown
East Fork Buttermilk Creek	Bull Trout/Dolly Varden	Unknown
East Fork Buttermilk Creek	Bull Trout/Dolly Varden	Unknown
Reynolds Creek	Bull Trout/Dolly Varden	Unknown
Lake Creek	Bull Trout/Dolly Varden	Unknown
Wolf Creek	Bull Trout/Dolly Varden	Unknown
Goat Creek	Bull Trout/Dolly Varden	Unknown

Table 8. Washington State and Tribal Stock Status for the Upper Columbia - Downstream region's Salmon, Steelhead, and Bull Trout (continued).

River Basin	Species	Stock Status
Early Winters Creek	Bull Trout/Dolly Varden	Unknown
Cedar Creek	Bull Trout/Dolly Varden	Unknown
Lost River	Bull Trout/Dolly Varden	Healthy
Monument Creek	Bull Trout/Dolly Varden	Unknown
Cougar Lake	Bull Trout/Dolly Varden	Unknown
First Hidden Lake	Bull Trout/Dolly Varden	Unknown
Middle Hidden Lake	Bull Trout/Dolly Varden	Unknown
WF Methow	Bull Trout/Dolly Varden	Unknown
Okanogan (WRIA 49)		
Okanogan	Chinook Summer	Healthy
Okanogan	Sockeye	Depressed

For State and Tribal Stock Status, *Healthy* refers to a stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock; *Depressed* refers to a stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely; *Critical* refers to a stock of fish experiencing production levels that are so low that permanent damage to the stock is likely or has already occurred; and *Unknown* refers to a stock of fish which has insufficient information to rate stock status.

7.0 AMPHIBIANS

The Upper Columbia - Downstream region harbors 13 amphibian species, including the established introduced bullfrog (Dvornich et al. 1997, McAllister 1995). Of these 13 species, the largest assemblage (including the bullfrog) consists of 11 taxa that reproduce in stillwater habitat including lakes, oxbows, ponds, temporary pools, and other freshwater wetlands with sufficient stillwater habitat. Stillwater habitats are largely dichotomously split in elevation between high elevation lakes and ponds, and lower elevation habitats associated with the riparian margins of larger stream or riverine systems. Since a large proportion of riparian habitat has been altered or lost (see Floodplain Conditions and Riparian Conditions sections), significant impact to stillwater amphibians has been presumed. Lowland stillwater habitats are also the habitats for introduced warmwater species (e.g. bullfrogs and selected fish [catfish, mosquitofish, sunfish], see Table 7), and interactive facilitation among some introduced species, particularly bullfrogs and warmwater fishes, may promote their survival (Adams et al. 2003) and contribute to potentially negative effects on native amphibians (Adams 1999). The remaining two native amphibian species (coastal giant salamander and coastal tailed frog) reproduce in streams, springs, or seeps (Table 9).

Of the entire amphibian assemblage for the region, coastal tailed frog (*Ascaphus truei*) is the only Forest Practices HCP-covered species (Table 9). The known distribution of coastal tailed frog is restricted to the upper east slope of the Cascades Mountain axis in WRIAs 45-48, which represents the most pluvial portion of the Upper Columbia - Downstream region. The known distribution may be conservative, as no systematic survey has been undertaken to either understand its regional distribution or determine species status (i.e., surveys of historic sites). Currently, too few data exist even to perform a status survey because of lack of a baseline.

Regardless of the incomplete knowledge of its regional distribution, coastal tailed frog may be at some level of risk because sedimentation has the potential to substantially reduce its instream habitat (Bury 1983, Bury and Corn 1988, Corn and Bury 1989). Timber harvest, which can result in significant sedimentation (Beschta 1978, Jakob 1999), occurs over a large part of the Upper-

Table 9. Forest and Fish Amphibians of the Upper Columbia Region Downstream of Grand Coulee.

Group	Name	Forest & Fish Species	Habitat			Regional Distribution
			Active Season		Over-wintering	
			Breeding	Non-Breeding		
Frogs	Coastal tailed frog *Ascaphus truei*	Yes	Streams	Streams	Terrestrial	Western third of region; WRIAs 45, 46, 47, and 48

Columbia - Downstream region where coastal tailed frogs occur (see Habitat Trends section). Nevertheless, the precise nature of this risk in this region is currently unknown.

Although not covered under this Forest Practices HCP, five other amphibians (namely long-toed salamander [*Ambystoma macrodactylum*], western toad [*Bufo boreas*], Pacific treefrog [*Hyla regilla*], Cascades frog [*Rana cascadae*] and rough-skinned newt [*Taricha granulosa*]) may receive some protection as a result of Forests and Fish patch buffer prescriptions. Two of these species, western toad and Cascades frog, have state watchlist (special concern) status (WDFW 2001). Both have declined elsewhere in their geographic ranges (Carey 1993, Fellers and Drost 1993), but their status in the Upper Columbia is unknown.

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UPPER COLUMBIA – UPSTREAM OF GRAND COULEE REGIONAL SUMMARY

UPPER COLUMBIA – UPSTREAM OF GRAND COULEE REGIONAL SUMMARY

1.0 PHYSICAL DESCRIPTION

The Upper Columbia - Upstream region (upstream of Grand Coulee Dam) includes 12 WRIAs (51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, and 62). Major stream systems include all of the Columbia River mainstem upstream of Grand Coulee Dam, the Nespelem River, San Poil River, Spokane River, Lake Roosevelt and tributaries, Colville River, Kettle River, and Pend Oreille River. Portions of Okanogan, Ferry, Stevens, Pend Oreille, Lincoln, and Spokane Counties are contained within the Upper Columbia – Upstream region. A map showing the WRIAs of the Upper Columbia-Upstream region is provided in Figure 1.

The Upper Columbia – Upstream region lies entirely within the Okanogan Highlands physiographic province (Lasmanis 1991). Elevations range from 1,000 feet along the Columbia River to over 7,000 feet.

General Geology

Within the Thompson Creek WAU, the parent materials consist of highly weathered metamorphic and granitics, overlain by Pleistocene glacial and glacial flood deposits, and more recent volcanic ash. Soils that are derived from metamorphic and granitics or have significant ash components are highly erodible (WDNR 1997a).

The Huckleberry Creek WAU includes three general soil types: (1) mountain soils developed in volcanic ash over shaly rock on steep, mostly unglaciated slopes; (2) foothill soils developed in volcanic ash and glacial till; and (3) low terrace and floodplain soils developed by alluvial processes (WDNR 1995).

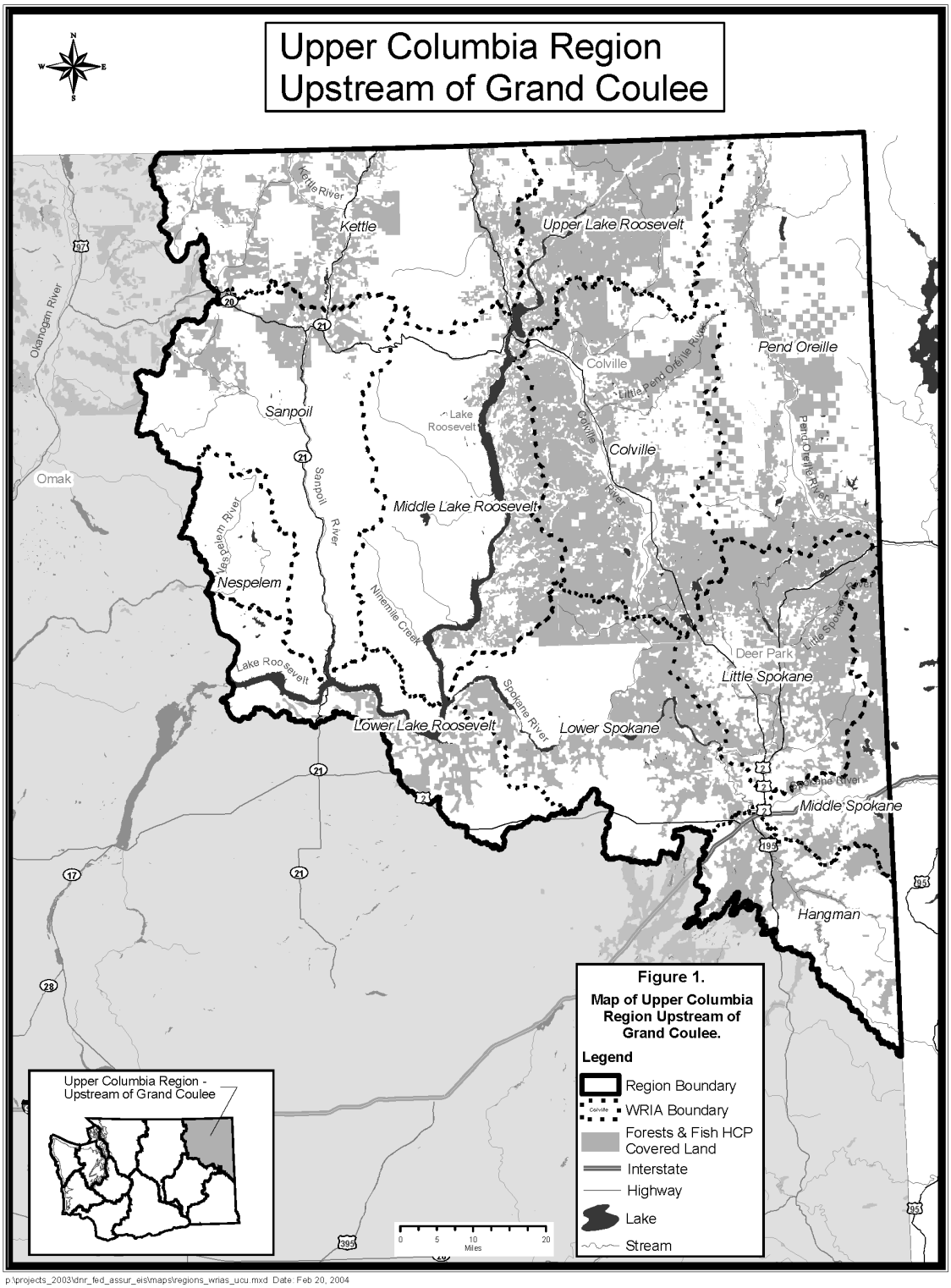
Within the LeClerc WAU, Precambrian meta-volcanic and meta-sedimentary rocks occupy a relatively minor area found in the Dry Canyon and Pend Oreille sub-basins. The remainder of the WAU is underlain by various Cretaceous granitic formations. Approximately 15,000 years ago, all but the highest elevations were affected by continental glaciation. Extensive deposits of glacio-fluvial materials continue to overlay the much older base rocks in many areas. Typically, soils are dominated by silt and, to a lesser degree, sandy textures (WDNR 1997c).

Granitic rocks underlie much of the West Branch Little Spokane WAU. In general, these rocks have not been glaciated and therefore are deeply weathered. Meta-sedimentary rocks underlie most of the remaining West Branch WAU, with a small portion underlain by glacial outwash deposits (WDNR 1997b).

Information concerning erosion processes in the Upper Columbia – Upstream planning region has been extracted from the following watershed analyses: Huckleberry Creek (WDNR 1995f); LeClerc (WDNR 1997c).

Erosion in the Upper Columbia Upstream region is low relative to regions west of the Cascade Crest. This is primarily due to more moderate topography and lower rainfall, although more competent rock types also contribute to more stable conditions in some areas.

Watershed analyses conducted in the region have documented very low rates of mass wasting. Landslide densities of 0.016 landslides/mi^2/year and 0.011 landslides/mi^2/year were reported in the Huckleberry and LeClerc watershed analyses, respectively. Debris avalanches and large, ancient deep-seated landslides were the most common landslide types. Debris flows and debris


Upper Columbia Region
Upstream of Grand Coulee
Kettle River
Kettle
Upper Lake Roosevelt
Okanogan River
Pend Oreille
Colville
Little Pend Oreille River
Sanpoil
Lake Roosevelt
Colville River
Colville
Pend Oreille River
Omak
Middle Lake Roosevelt
Sanpoil River
Nespelem River
Nespelem
Ninemile Creek
Deer Park
Little Spokane
Lake Roosevelt
Spokane River
Lower Lake Roosevelt
Lower Spokane
Middle Spokane
Hangman
Upper Columbia Region - Upstream of Grand Coulee
0 5 10 20
Miles
Figure 1.
Map of Upper Columbia Region Upstream of Grand Coulee.
Legend
Region Boundary
WRIA Boundary
Forests & Fish HCP Covered Land
Interstate
Highway
Lake
Stream
p:\projects_2003\dnr_fed_assur_eis\maps\regions_wrias_ucu.mxd Date: Feb 20, 2004

torrents were reported but not common. Debris avalanches were most commonly associated with inner gorges in both the Huckleberry and LeClerc WAUs but were also found on the toes of ancient deep-seated landslides (Huckleberry WAU) and flanks of glacial terraces (LeClerc WAU).

Hillslope surface erosion can contribute substantial volumes of sediment where soils immediately adjacent to streams are heavily disturbed. In the Huckleberry WAU, most instances of sediment delivery occurred on steep (i.e., >60 percent), stream-adjacent slopes disturbed by ground-based yarding. Hillsope surface erosion was not found to be significant in the LeClerc WAU.

General Hydrology

The climate of the region differs markedly from areas west of the Cascades. The region receives less precipitation and temperature ranges are more extreme. The climate is marine-continental characterized by cold winters and hot summers. Most precipitation falls as snow during the winter, although spring and summer rains are common. Average annual precipitation for forested areas of the region range from 15 inches at lower elevations to over 30 inches at higher elevations.

Major rivers in the region include the Sanpoil, Kettle, Pend Oreille, Colville, and Spokane. All rivers of the region are tributary to the Columbia River. The rivers have a snowmelt-driven hydrologic regime; most peak flows occur from April through June in response to spring snowmelt. However, large magnitude peak flows result from rain-on-snow precipitation events that occur during the fall and winter months. Low flows generally occur during late summer and early fall, although extreme cold can substantially reduce flows during the winter. Based on the DNR stream hydrography GIS coverage, there are approximately 25,498 stream-miles (both fish-bearing and non-fish streams) in the Upper Columbia - Upstream region, with an average stream density of 2.84 stream miles/mile^2 (Table 1).

Table 1. Stream Miles in the Upper Columbia - Upstream Region[1/]

	WRIA 51 Nespelem	WRIA 52 Sanpoil	WRIA 53 Lower Lake Roosevelt	WRIA 54 Lower Spokane	WRIA 55 Little Spokane	WRIA 56 Hangman
Stream Length (miles)	536	3,146	1,109	2,060	1,859	614
Stream Density (miles/mi^2)	2.37	3.20	2.18	2.33	2.75	1.35

Table 1. Stream Miles in the Upper Columbia – Upstream Region[1/] (continued).

	WRIA 57 Middle Spokane	WRIA 58 Middle Lake Roosevelt	WRIA 59 Colville	WRIA 60 Kettle	WRIA 61 Upper Lake Roosevelt	WRIA 62 Pend Oreille	Total Upper Columbia Upstream Of Grand Coulee
Stream Length (miles)	782	3,126	2,795	3,566	1,652	4,252	25,498
Stream Density (miles/mi^2)	2.73	2.83	2.74	3.48	2.87	3.45	2.84

[1/] Primary Data Source: DNR stream hydrography GIS layer. Stream miles include all Type 1-5 streams and a portion of Type 9 streams. Because many Eastern Washington Type 9 waters are not defined channels, only 25% of Type 9 streams are counted as streams in the Ponderosa Pine and drier vegetation zones, 50% are counted in the Mixed Conifer vegetation zones, and 75% are counted in the wettest vegetation zones. These proportions are based on field observations by DNR foresters, but are very approximate.

2.0 LAND OWNERSHIP AND USE

Major Land Ownership and Management

Approximately 27 percent of all lands in the Upper Columbia – Upstream region are in Federal ownership and a small portion of these lands (about 1 percent of all lands) are being managed for long-term preservation, primarily in wildernesses and national wildlife refuges (Table 2). Another large portion of these Federal lands is being managed by the Forest Service outside of wilderness (23 percent of all lands). The remainder of the Federal lands (2 percent of all lands) are being managed by other agencies. Tribal lands represent 19 percent of the region. State lands represent 7 percent of all lands in the region, private lands represent 47 percent, and city/county lands represent much less than 1 percent.

The WRIAs differ markedly in their ownership. Federal ownership ranges from a few hundred acres or less in the Little Spokane and Middle Spokane WRIAs to 66 percent of the Pend Oreille WRIA. The Colville Indian Reservation covers all of the Nespelem WRIA and private lands make up over 90 percent of the Little Spokane and Hangman WRIAs.

Land Cover and Land Use

Forestland makes up approximately 71 percent of the Upper Columbia - Upstream region and shrubland and grassland together comprise about 13 percent (Table 3). Agricultural lands make up 12 percent and the remaining 3 percent consist of water/wetlands and residential/commercial lands. The percent forestland within each WRIA varies considerably, ranging from a low of 14 percent in the Hangaman WRIA to a high of 93 percent in the Pend Oreille WRIA.

Table 2. Land Ownership Parameters for Upper Columbia - Upstream Region by WRIA[1/]

Land Ownership	WRIA 51 Nespelem	WRIA 52 Sanpoil	WRIA 53 Lower Lake Roosevelt	WRIA 54 Lower Spokane	WRIA 55 Little Spokane	WRIA 56 Hangman
Federal – Long-term Congressionally Protected Lands [2/]	-	-	1,123	-	-	1,524
Federal – Other National Forest System Lands [3/]	-	183,994	-	-	299	-
Federal – Other Federal Lands [4/]	-	4,636	30,996	14,754	-	397
State – Protected Lands [5/]	-	119	455	6,881	7,673	-
State – Managed Lands [6/]	-	14,936	10,354	42,612	25,519	9,841
Tribal Lands/Indian Reservations	144,376	330,116	102,205	137,860	-	-
Municipal Watershed	-	-	-	-	-	-
Other County/City Lands	-	-	-	1,336	2,303	1,578
Private	0	94,671	181,151	362,791	397,578	277,659
TOTAL	**144,376**	**628,471**	**326,285**	**566,233**	**433,371**	**291,000**

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan GIS layers.
[2/] Includes national parks, national monuments, national recreation areas, national wildlife refuges, and wildernesses.
[3/] Includes all non-wilderness National Forest System lands; the majority of the acres consists of lands protected under the Northwest Forest Plan (e.g., LSR, Managed LSR, AMA, Riparian Reserves)
[4/] Includes all Department of Defense, Department of Energy, Bureau of Land Management, and Bureau of Reclamation lands.
[5/] Includes all State Parks and Wildlife Areas.
[6/] Includes all DNR, Department of Corrections, and University lands.

Table 2. Land Ownership Parameters for Upper Columbia - Upstream Region by WRIA[1/] (continued).

Land Ownership	WRIA 57 Middle Spokane	WRIA 58 Middle Lake Roosevelt	WRIA 59 Colville	WRIA 60 Kettle	WRIA 61 Upper Lake Roosevelt	WRIA 62 Pend Oreille	TOTAL UPPER COLUMBIA UPSTREAM OF GRAND COULEE
Federal – Long-term Congressionally Protected Lands [2/]	-	-	38,462	-	-	41,597	82,706
Federal – Other National Forest System Lands [3/]	-	109,228	108,296	365,555	92,857	475,423	1,335,653
Federal – Other Federal Lands [4/]	-	47,724	7,470	13,118	21,279	1,609	141,983
State – Protected Lands [5/]	6,238	6,863	170	4,462	1	788	33,649
State – Managed Lands [6/]	10,032	23,734	91,639	44,911	38,592	32,894	345,066
Tribal Lands/Indian Reservations	-	365,456	-	-	-	4,886	1,084,900
Municipal Watershed	-	-	-	-	-	-	-
Other County/City Lands	5,076	-	-	-	-	-	10,293
Private	162,089	154,431	406,113	228,380	216,096	232,592	2,713,551
TOTAL	**183,435**	**707,437**	**652,151**	**656,426**	**368,826**	**789,790**	**5,747,801**

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan GIS layers.
[2/] Includes national parks, national monuments, national recreation areas, national wildlife refuges, and wildernesses.
[3/] Includes all non-wilderness National Forest System lands; the majority of the acres consists of lands protected under the Northwest Forest Plan (e.g., LSR, Managed LSR, AMA, Riparian Reserves)
[4/] Includes all Department of Defense, Department of Energy, Bureau of Land Management, and Bureau of Reclamation lands.
[5/] Includes all State Parks and Wildlife Areas.
[6/] Includes all DNR, Department of Corrections, and University lands.

Table 3. Land Cover and Use for the Upper Columbia – Upstream Region by WRIA [1/]

Land Cover/Land Use	WRIA 51 Nespelem	WRIA 52 Sanpoil	WRIA 53 Lower Lake Roosevelt	WRIA 54 Lower Spokane	WRIA 55 Little Spokane	WRIA 56 Hangman
Forestland	88,987	529,764	62,636	305,172	274,589	39,933
Shrubland	27,374	21,606	106,746	57,721	17,859	33,617
Grassland	23,331	67,491	59,560	27,483	13,855	19,421
Water & Wetlands	809	3,261	25,759	13,674	3,950	1,163
Ice, Snow, & Bare Rock	7	62	229	1,470	52	161
Residential & Commercial	76	633	1,312	13,416	15,886	9,655
Agricultural	3,792	5,653	70,042	147,298	107,179	187,049
TOTAL	**144,376**	**628,471**	**326,285**	**566,233**	**433,371**	**291,000**

[1/] Primary Data Source: USGS/EPA National Land Cover Data GIS layer.

Table 3. Land Cover and Use for the Upper Columbia - Upstream Region by WRIA[1/] (continued).

Land Cover/Land Use	WRIA 57 Middle Spokane	WRIA 58 Middle Lake Roosevelt	WRIA 59 Colville	WRIA 60 Kettle	WRIA 61 Upper Lake Roosevelt	WRIA 62 Pend Oreille	Total Upper Columbia Upstream Of Grand Coulee
Forestland	81,163	563,333	551,769	526,579	328,577	731,539	4,084,042
Shrubland	20,535	20,911	5,295	37,169	4,985	7,121	360,940
Grassland	14,330	51,938	17,424	70,488	12,822	8,365	386,508
Water & Wetlands	2,951	38,862	6,521	3,754	12,706	17,868	131,279
Ice, Snow, & Bare Rock	20	102	372	85	136	659	3,354
Residential & Commercial	32,260	613	4,784	414	992	1,312	81,353
Agricultural	32,177	31,678	65,986	17,937	8,607	22,927	700,325
TOTAL	**183,435**	**707,437**	**652,151**	**656,426**	**368,826**	**789,790**	**5,747,801**

[1/] Primary Data Source: USGS/EPA National Land Cover Data GIS layer.

3.0 FORESTLAND OWNERSHIP AND MANAGEMENT

Approximately 35 percent of the forestlands in the Upper Columbia - Upstream region are in Federal ownership, 21 percent are in Tribal ownership, 8 percent are in State ownership, and 37 percent are in private or other ownership (Table 4). A Federal or State preservation or limited management status covers approximately 3 percent of the forestlands in the region. Approximately 53 percent of the forestlands may be under Federal or Tribal timber management. State timber management may occur on approximately 7 percent of the forestlands and 37 percent of the forestlands are in private, county, city, or tribal ownership, where timber management may occur. Overall, lands covered by the forest practices rules represent approximately 44 percent of the forestlands in the region (see Figure 1, which displays these lands). Existing riparian HCPs cover none of the State-managed or private lands of the region. The largest percentage of forest practices rules-covered lands (93 to 97 percent of all forestlands) occurs in the Little Spokane, Hangman, and the Middle Spokane WRIAs. The Nespelem WRIA contains no lands subject to the State forest practices rules.

Small, 20-acre exempt forest landowners make up less than 0.5 percent of the forestlands and close to 0.5 percent of the forestlands subject to forest practices rules in the Upper Columbia - Upstream region, based on the analysis by Rogers (2003). Although this region was inconsistently analyzed, it is believed to have identified the majority of all small, 20-acre exempt parcels (personal communication, Luke Rogers, Rural Technology Initiative, University of Washington, May 2004).

Approximately 8,390 stream miles occur on lands subject to forest practices rules in the Upper Columbia – Upstream region (Table 5). This represents 33 percent of all streams in the region. Approximately 7,182 miles or 86 percent of the 8,390 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre exempt forest landowner parcels in this region is estimated to be about 0.7 percent and the percentage of all fish-bearing streams on small, 20-acre exempt forest landowner parcels is about 0.8 percent (Rogers 2003).

Table 4. Ownership and Management of Forestlands (acres and percent) in the Upper Columbia - Upstream Region by WRIA[1/]

Forestlands Category	WRIA 51 Nespelem	WRIA 52 Sanpoil	WRIA 53 Lower Lake Roosevelt	WRIA 54 Lower Spokane	WRIA 55 Little Spokane	WRIA 56 Hangman
Federal and State Protected Forestlands Not Managed for Timber Production[2/]	-	0	185	5,870	7,296	1,060
Federal Lands and Tribal Forestlands Available for Timber Management[3/]	88,987	458,038	33,320	118,107	292	75
Forestlands Available for Timber Management Under the State Forest Practices Rules						
DNR and Other State Forestlands	-	11,511	2,346	31,568	19,003	2,167
Private, County, and City Forestlands	-	60,214	26,785	149,628	247,998	36,631
Subtotal	-	71,726	29,131	181,195	267,001	38,798
TOTAL FORESTLANDS	88,987	529,764	62,636	305,172	274,589	39,933
% IN FEDERAL OR STATE PROTECTION	0%	0%	0%	2%	3%	3%
% AVAILABLE FOR FEDERAL OR TRIBAL TIMBER MANAGEMENT	100%	86%	53%	39%	0%	0%
% AVAILABLE FOR STATE TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	0%	2%	4%	10%	7%	5%
% AVAILABLE FOR PRIVATE OR COUNTY/CITY TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	0%	11%	43%	49%	90%	92%

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan, and USGS/EPA National Land Cover Data GIS layers.
[2/] Federal and State Protected Lands includes: Wilderness, LSR, LSOG, AMA, National Wildlife Refuges, National Parks, Washington State Parks, and WDFW lands.
[3/] Federal and Tribal Lands Available for Timber Management include: USFS Matrix lands, USFS other lands, BLM lands, Dept of Defense lands, and Indian Reservation lands.

Table 4. Ownership and Management of Forestlands (acres and percent) in the Upper Columbia–Upstream Region by WRIA[1/] (continued).

Forestlands Category	WRIA 57 Middle Spokane	WRIA 58 Middle Lake Roosevelt	WRIA 59 Colville	WRIA 60 Kettle	WRIA 61 Upper Lake Roosevelt	WRIA 62 Pend Oreille	Total Upper Columbia Upstream Of Grand Coulee
Federal and State Protected Forestlands Not Managed for Timber Production[2/]	5,863	4,858	38,409	754	1	38,291	102,588
Federal Lands and Tribal Forestlands Available for Timber Management[3/]	-	431,342	114,843	357,964	102,445	471,714	2,177,128
Forestlands Available for Timber Management Under the State Forest Practices Rules							
DNR and Other State Forestlands	6,774	21,036	86,677	35,811	37,248	30,666	284,808
Private, County, and City Forestlands	68,526	106,097	311,840	132,050	188,882	190,867	1,519,518
Subtotal	75,300	127,132	398,517	167,860	226,130	221,534	1,804,325
TOTAL FORESTLANDS	81,163	563,333	551,769	526,579	328,577	731,539	4,084,042
% IN FEDERAL OR STATE PROTECTION	7%	1%	7%	0%	0%	5%	3%
% AVAILABLE FOR FEDERAL OR TRIBAL TIMBER MANAGEMENT	0%	77%	21%	68%	31%	64%	53%
% AVAILABLE FOR STATE TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	8%	4%	16%	7%	11%	4%	7%
% AVAILABLE FOR PRIVATE OR COUNTY/CITY TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	84%	19%	57%	25%	57%	26%	37%

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan, and USGS/EPA National Land Cover Data GIS layers.
[2/] Federal and State Protected Lands includes: Wilderness, LSR, LSOG, AMA, National Wildlife Refuges, National Parks, Washington State Parks, and WDFW lands.
[3/] Federal and Tribal Lands Available for Timber Management include: USFS Matrix lands, USFS other lands, BLM lands, Dept of Defense lands, and Indian Reservation lands.

Table 5. Stream Miles in the Upper Columbia – Upstream Region by Ownership, Forested Stream Miles, and Forest Practices Rules (FPR)-Regulated Stream Miles[1/]

Category	WRIA 51 Nespelem	WRIA 52 Sanpoil	WRIA 53 Lower Lake Roosevelt	WRIA 54 Lower Spokane	WRIA 55 Little Spokane	WRIA 56 Hangman
Total Stream Miles						
Federal	-	916	312	154	2	4
Tribal	535.67	1,678.07	385.08	576.24	-	-
State	-	65	27	183	140	29
County/City	-	-	-	4	20	10
Private	-	486	385	1,142	1,697	571
Total Miles	**536**	**3,146**	**1,109**	**2,060**	**1,859**	**614**
Forested Stream Miles						
Forested Miles	350	2,737	325	1,283	1,331	105
% of Total Miles	65%	87%	29%	62%	72%	17%
FPR-Regulated Stream Miles						
FPR-Reg. Miles	0	397	139	730	1,289	104
% of Total Miles	0%	13%	13%	35%	69%	17%

[1/] Data sources: DNR stream hydrography GIS layer, DNR Major Public Lands layer, and USGS/EPA National Land Cover Data. Stream miles include all Type 1-5 streams and a portion of Type 9 streams. Because many Eastern Washington Type 9 waters are not defined channels, only 25% of Type 9 streams are counted as streams in the Ponderosa Pine and drier vegetation zones, 50% are counted in the Mixed Conifer vegetation zones, and 75% are counted in the wettest vegetation zones. These proportions are based on field observations by DNR foresters, but are very approximate.

Table 5. Stream Miles in the Upper Columbia – Upstream Region by Ownership, Forested Stream Miles, and Forest Practices Rules (FPR)-Regulated Stream Miles[1/] (continued).

Category	WRIA 57 Middle Spokane	WRIA 58 Middle Lake Roosevelt	WRIA 59 Colville	WRIA 60 Kettle	WRIA 61 Upper Lake Roosevelt	WRIA 62 Pend Oreille	Total Upper Columbia Upstream Of Grand Coulee
Total Stream Miles							
Federal	-	776	673	1,917	563	2,688	8,006
Tribal	-	1,675.61	-	-	-	29.49	4,880
State	79	109	382	241	159	177	1,591
County/City	20	-	-	-	-	-	55
Private	682	565	1,740	1,408	930	1,358	10,965
Total Miles	**782**	**3,126**	**2,795**	**3,566**	**1,652**	**4,252**	**25,498**
Forested Stream Miles							
Forested Miles	475	2,505	2,339	2,911	1,405	3,711	19,479
% of Total Miles	61%	80%	84%	82%	85%	87%	76%
FPR-Regulated Stream Miles							
FPR-Reg. Miles	449	501	1,677	1,088	940	1,077	8,390
% of Total Miles	57%	16%	60%	31%	57%	25%	33%

[1/] Data sources: DNR stream hydrography GIS layer, DNR Major Public Lands layer, and USGS/EPA National Land Cover Data. Stream miles include all Type 1-5 streams and a portion of Type 9 streams. Because many Eastern Washington Type 9 waters are not defined channels, only 25% of Type 9 streams are counted as streams in the Ponderosa Pine and drier vegetation zones, 50% are counted in the Mixed Conifer vegetation zones, and 75% are counted in the wettest vegetation zones. These proportions are based on field observations by DNR foresters, but are very approximate.

4.0 HABITAT LIMITING FACTORS

Primary Regional Factors

All Pend Oreille tributaries lie either within the Colville National Forest or on private managed timberlands. Five hydroelectric dams, all lacking fish passage facilities, are located on the Pend Oreille River (WDFW 1998). These dams have altered habitats (i.e. stream flows, sediment, temperature regimes), migratory corridors, and interspecific interactions. The legacy of past timber harvesting has resulted in high road densities, impassable culverts, channel changes, and compaction of hill slopes. Livestock grazing has degraded habitat in both upland and riparian areas of most tributaries in the watershed on public and private land. Non-native species have impacted bull trout populations through competition and hybridization (USFWS 2002).

The Huckleberry Creek (WRIA 59), Thompson Creek (WRIA 57), and LeClerc Creek (WRIA 62) watershed analyses (WDNR 1995, 1997a, 1997c) all documented two important limiting factors causing degradation of fish habitat: (1) fine sediment from hillslopes and roads, and (2) lack of potential LWD recruitment and shade from riparian areas.

All tributaries of Lake Roosevelt have been degraded by agriculture or logging activities, with the result that sediment levels are high, water temperature is too high for bull trout spawning, and habitat complexity is lost. Some tributaries are inaccessible due to waterfalls in the lower reaches (WDFW 1998).

Sedimentation/Mass Wasting

Mass wasting is not documented as being a major limiting factor within the Upper Columbia - Upstream region (WDNR 1995, 1997a, 1997c). Watershed analyses within the region, however, documented a high density of roads (approximately 5.5 miles/mile^2 within Thompson Creek WAU, and 3.3 miles/mile^2 within Huckleberry WAU; WDNR 1995, 1997a). Road densities within Sullivan, LeClerc, Mill, Indian, Tacoma, Ruby, Slate and Calispel creeks range from 1.54 to 3.86 mi/mi^2 (USFS *in litt*. 2002). Corresponding to these high densities of roads is a high surface erosion hazard from both roads and hillslopes (WDNR 1995, 1997a, 1997c). The aquatic assessment portion of the Interior Columbia Basin Ecosystem Management Project found that bull trout are less likely to use streams for spawning and rearing in highly roaded areas, and are typically absent at mean road densities above 1.7 miles/mile^2 (Quigley and Arbelbide 1997).

The most pronounced impact from cumulative effects of past forest practices in the Thompson Creek WAU is related to poor location, design, and maintenance of roads. As a result, a significant amount of sediment has entered streams and degraded fish habitat (especially pool filling). This impact is primarily related to roads and soil disturbance within 200 feet of streams and county roads on erosive soils (WDNR 1997a).

Riparian/Floodplain and Wetland Conditions

Past forest practices have decreased the function of the existing riparian areas by clearcutting and thinning of riparian vegetation, the construction of splash dams, the diversion of stream flow from the creek, the removal of riparian vegetation through the building of timber railroads and forest roads, the use of smaller side drainages as skid trails, and harvest-related wildfire. Specific areas of concern within the Pend Oreille System include portions of Sullivan, Mill, Cedar, Ruby, Tacoma, Calispel, and LeClerc creeks (USFWS 2002).

Within the Thompson Creek and Huckleberry Creek WAUs, the riparian function assessment identified significant areas of streams with high or moderate hazards for both LWD recruitment and shade (WDNR 1995, 1997a). The lowest stream reaches of Huckleberry Creek, Thompson Creek and the outlet canal of Newman Lake were historically channelized for agriculture and

diking, therefore, they were rated as naturally low in LWD and shade (WDNR 1995, 1997a). However, Big Sheep watershed has a much smaller area associated with low shade (WDNR 1997c).

Livestock grazing has also degraded riparian areas by removing vegetation, destabilizing stream banks, compacting soils, and increasing soil erosion (USFWS 2002; LeClerc valley bottoms, WDNR 1997c).

Channel/Hydrology Conditions

Mainstem Columbia River dams have changed the habitat from that of a cold fast-moving river, to a warm reservoir (NPPC 2001). Typical spawning, rearing, and overwintering habitat in a free flowing river with pools, glides, riffles, and side channel habitats have been eliminated (USFWS 2002).

Livestock grazing has degraded channel conditions in the Pend Oreille system by destabilizing stream banks, widening stream channels, promoting incised channels, lowering water tables, reducing pool frequency, increasing soil erosion, and altering water quality. Specific areas of concern include LeClerc Creek, Ruby Creek and Calispel Creek (USFWS 2002).

Large Woody Debris

The Huckleberry Creek (WRIA 59), Thompson Creek (WRIA 57), and LeClerc Creek (WRIA 62) watershed analyses (WDNR 1995, 1997a, 1997c) all documented a lack of potential LWD recruitment with correspondingly reduced instream habitat complexity.

Fish Passage

The construction and operation of Albeni Falls, Box Canyon, and Boundary Dams on the Pend Oreille River have fragmented habitat and negatively impacted migratory bull trout. Other dams and diversions without fish passage facilities in tributaries to the Pend Oreille River have further fragmented habitat and reduced connectivity (USFWS 2002). The historical salmon fishery, already in decline, was brought to an abrupt end by the construction of Little Falls Dam on the Little Spokane River in 1910 (WDNR 1997b).

Watershed analyses within the Upper Columbia - Upstream region have all documented fish passage barriers caused by forest and county road culverts (WDNR 1995, 1997a, 1997b, 1997c). However in the past decade, fish passage through forest (Forest and Fish RMAP program), agriculture and urban road culverts has been an area of renewed interest and funding.

Water Quality Issues

Total dissolved gas is a potential problem below each mainstem hydropower facility on the Pend Oreille River (WRIA 62), with levels reaching 139 percent saturation (NPPC 2001, USFWS 2002).

Nearly all Type 1, 2, and 3 waters within the LeClerc basin (WRIA 62) have temperature data above the state water quality standards. However, monitoring has demonstrated that the state standard is not achievable in the basin, even under natural circumstances and/or 100% canopy cover (WDNR 1997c). The majority of creeks in the West Branch Little Spokane WAU (WRIA 55) with conifer-dominated riparian zones do not currently meet target shade levels, and none of the alder-dominated stands meet shade targets (WDNR 1997b).

Other creeks in this region at times have temperatures above water quality standards, including Hangman Creek (WRIA 56), Sherman Creek (WRIA 58), Stensgar Creek (WRIA 59), Roosevelt Lake and Deep Creek (WRIA 61), and Lost Creek (WRIA 62). Sanpoil River (WRIA 52) and the Colville River (WRIA 59) at times have low dissolved oxygen, but the Colville River has a

TMDL for dissolved oxygen (Murray and Pelletier 2003). Several creeks in the region including Hangman Creek, the Colville River, Deep Creek and one of its tributaries have had pH excursions (WDOE 1998).

5.0 HABITAT TRENDS

Timber harvesting began in earnest in the LeClerc Creek basin between 1915 and 1930. These harvests were facilitated by construction of log-transport flumes, aerial tramways, and railroad lines. Forest fires burned two-thirds of the WAU during the same time period. Very little timber harvesting occurred between World War II and the early 1970s. Since the 1970s, additional timber harvest has occurred, primarily on large industrial private and small private land. At present, the majority of land in the WAU is occupied by mature forest. Past timber harvest and catastrophic fires have reduced the average riparian tree size and often resulted in brushy vegetation along stream banks and floodplains. Cattle grazing impacts to riparian vegetation are noticeable in isolated locations. Road systems needed to accommodate timber management are nearly complete; only limited mileage of additional road are likely (WDNR 1997c).

Over 75 percent of the 38,000-forested acres in the Huckleberry WAU were harvested prior to 1985. Timber harvest in the Huckleberry watershed usually involves ground based harvest systems. In the past five years, timber harvests have been predominately partial cuts. Estimates of peak stream discharge changes show increases from 16 to 59 percent. Throughout most of the channel network, moderate entrenchment, moderate to loose channel confinement and low valley gradients function to spill flood flows onto adjacent floodplains, reducing the potential for channel bed and bank erosion. The hydrologic and erosion regimes in the WAU have changed over time due to agricultural and mining practices, maintenance and development of a transportation network, and residential and commercial developments (WDNR 1995).

Settlers arrived in the West Branch of the Little Spokane during the late 1800s and began logging the surrounding mountains. The West Branch was extensively logged in the 1900s. Logs were skidded by horse to nearby lakes and streams, where they were stockpiled and floated downstream. During the splash-damming era, residents noted a decline in the numbers of salmon returning to the West Branch. An extensive fire occurred in the late 19th century. Prior to fire suppression policies in the 20th century, forest fires in the WAU probably recurred every several decades. The salmon fishery, already in decline, was brought to an abrupt end by the construction of Little Falls Dam on the Little Spokane River in 1910 (WDNR 1997b).

It should be noted that forestlands currently make up approximately 71 percent of the Upper Columbia – Upstream region. Of the total forestlands, 3 percent are under Federal and State protection and 44 percent of the total forestlands are under private and State management under State forest practices rules (See Tables 3 and 4).

6.0 FISH RESOURCES

Salmonid Species

Grand Coulee Dam is a complete barrier to anadromous fish. Consequently, the only Federally listed fish species present in the Upper Columbia - Upstream region is bull trout, which are listed as threatened (WDNR 2001). The pygmy whitefish, a State listed sensitive species, is currently known to be present in three lakes in the region (i.e. Bead and Sullivan Lakes in Pend Oreille county, and Osoyoos Lake in Okanogan county; Hallock and Mongillo 1998).

The following salmonids occur in the Upper Columbia – Upstream region (Table 6). The asterisk next to the species name indicates that the species is introduced and not native to Washington State. This list should not be regarded as an exhaustive list of the species present.

Table 6. Salmonid species presence by WRIA within the Upper Columbia Region (Upstream of Grand Coulee) (WDFW 2003).

Species	State Status[1/]	Federal Status[2/]	Nespelem (WRIA 51)	Sanpoil (WRIA 52)	Lower Lake Roosevelt (WRIA 53)	Lower Spokane (WRIA 54)	Little Spokane (WRIA 55)	Hangman (WRIA 56)	Middle Spokane (WRIA 57)	Middle Lake Roosevelt (WRIA 58)	Colville (WRIA 59)	Kettle (WRIA 60)	Upper Lake Roosevelt (WRIA 61)	Pend Oreille (WRIA 62)
Brown Trout*				X		X	X	X	X	X	X	X	X	X
Bull Trout	SC	FT			X	X				X		X	X	X
Cutthroat Westslope		FCo									X	X	X	X
Eastern Brook Trout*				X		X	X	X	X	X	X	X	X	X
Kokanee Salmon			X		X	X	X			X		X	X	X
Rainbow/Redband Trout		FCo	X	X	X	X	X	X	X	X	X	X	X	X
Whitefish Lake*			X		X							X	X	X
Whitefish Pygmy	SS													X
Whitefish Mountain			X		X	X	X					X	X	X

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Other Fish Species

Table 7 is a list of non-salmonid species that exist in the Upper Columbia – Upstream region (WDFW 2003, Wydoski and Whitney 2003). The asterisk next to the species name indicates that the fish is not native to Washington State. This list should not be regarded as an exhaustive list of the species present.

Status of Salmonid Stocks

Limited information exists for bull trout within Washington in the Upper Columbia River system. Because no trend data existed as of 1998, all Upper Columbia River bull trout stocks currently have a State stock status of "Unknown."

Table 7. Non-salmonid Fish Species by WRIA within the Upper Columbia – Upstream Region (WDFW 2003, Wydoski and Whitney 2003)

Species	State Status[1/]	Federal Status[2/]	Nespelem (WRIA 51)	Sanpoil (WRIA 52)	Lower Lake Roosevelt (WRIA 53)	Lower Spokane (WRIA 54)	Little Spokane (WRIA 55)	Hangman (WRIA 56)	Middle Spokane (WRIA 57)	Middle Lake Roosevelt (WRIA 58)	Colville (WRIA 59)	Kettle (WRIA 60)	Upper Lake Roosevelt (WRIA 61)	Pend Oreille (WRIA 62)
Bass, Largemouth*			X		X	X	X		X		X	X	X	X
Bass, Smallmouth*			X		X	X						X		X
Bullhead Brown*			X		X		X		X					X
Burbot			X		X									
Carp Common*			X		X	X	X		X			X		
Catfish Channel*													X	
Chub Lake	**SC**											X	X	
Crappie Black*							X		X					
Crappie General*			X	X	X	X	X	X	X		X	X	X	X
Crappie White*														X
Dace Longnose												X		
Dace Speckled			X		X	X	X	X			X			X
Dace Umatilla	**SC**										X			
Lamprey General			X		X									
MuskieTiger*									X[3]					
Peamouth			X		X						X	X	X	
Perch Yellow*			X		X	X	X	X	X		X	X	X	X
Pike Northern*						X	X							
Pikeminnow Northern			X		X	X	X	X	X	X	X	X	X	X
Redside Shiner			X	X	X	X	X				X	X		X
Sandroller	**SM**							X						
Sculpin General			X	X	X	X	X	X	X			X	X	X
Sculpin Mottled				X		X	X							
Sculpin Shorthead												X		
Sculpin Slimy							X			X		X		X
Sculpin Torrent							X				X			
Starry Flounder			X		X									
Sucker Bridgelip					X							X	X	
Sucker Largescale					X	X	X	X	X		X		X	X
Sunfish Pumpkinseed*			X		X						X			X
Sunfish General*			X		X				X[3/]			X	X	
Tench*			X		X	X								
Walleye*					X	X						X	X	X

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

[3/]Species information taken from Thompson Creek Watershed Analysis for Newman Lake (WDNR 1997a).

Table 8. Washington State Stock Status for the Upper Columbia - Upstream Region's Bull Trout (SaSI 1998).

River Basin	Species	Stock Status
Lake Roosevelt (WRIAs 53, 58, 61)		
Franklin D. Roosevelt Lk	Bull Trout	Unknown
Pend Oreille (WRIA 62)		
Pend Oreille	Bull Trout	Unknown
South Salmo	Bull Trout	Unknown
Granite Creek	Bull Trout	Unknown

For Washington State Stock Status, *Healthy* refers to a stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock; *Depressed* refers to a stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely; *Critical* refers to a stock of fish experiencing production levels that are so low that permanent damage to the stock is likely or has already occurred; and *Unknown* refers to a stock of fish which has insufficient information to rate stock status.

Only individual observations have been documented for bull trout in the Lake Roosevelt and Spokane River systems. Individual observations have been documented in the mouths of Onion, Hawk, Hunters, and Sherman Creeks (Lake Roosevelt); Boulder Creek and Deadman Creek (Kettle River); Big Sheep Creek (Upper Columbia River); and the Spokane River. No spawning activity has been observed. Within the Pend Oreille, bull trout have been identified within Slate, Sullivan, Mill, LeClerc, Cedar and Winchester Creeks; however, no spawning has been documented (WDFW 1998, USFWS 2002).

The Northeast Washington Bull Trout Recovery Unit Team identified one core area (Pend Oreille) within the recovery unit. Only one extant local population (LeClerc Creek complex) currently exists within the Pend Oreille core area; however, eight more local populations have been identified as needed for recovery. The Lake Roosevelt, Kettle River, and Spokane River systems have been designated as "research needs" areas, which means that additional information is needed to evaluate how these areas would contribute towards bull trout recovery. The result of research efforts may include the designation of an additional core area and local population(s) (USFWS 2002).

Redband trout and westslope cutthroat trout are both Federal species of concern. Although redband trout appear to be widely distributed within the Columbia Basin, their status is clouded by the uncertainty over taxonomic classification within the species, and by more than a century of stocking non-native rainbow trout and steelhead. Westslope cutthroat trout are also still widely distributed throughout the Basin. However, because of the genetic introgression of remaining populations, fragmentation, and the loss of migratory life-history forms, healthy populations may be limited to a much smaller proportion of their historical range (Behnke 1992, USDA 1997).

7.0 AMPHIBIANS

The Upper Columbia – Upstream region harbors 10 amphibian species, including the established introduced bullfrog (Dvornich et al. 1997; McAllister 1995). All 10 species (including the bullfrog) reproduce in stillwater habitats including lakes, oxbows, ponds, temporary ponds and other freshwater wetlands with sufficient stillwater habitat. Stillwater habitats are largely dichotomously split between lakes and ponds not associated with riparian systems, and those associated with the riparian margins of larger stream or riverine systems. Since a large proportion of the latter have been altered or lost (see Floodplain Conditions/Riparian Conditions sections), significant impact to stillwater amphibians is presumed. Riparian stillwater habitats are also

inhabited by introduced warmwater species (bullfrogs and selected fish [i.e. catfish, mosquitofish, sunfish], see Table 7); and interactive facilitation may promote the survival of the non-native species (Adams et al. 2003) and contribute to the potentially negative effects on native amphibians (Adams 1999).

No known amphibian species from the Upper Columbia – Upstream region is a Forest and Fish HCP-covered species. However, the Rocky Mountain tailed frog occurs in British Columbia and Idaho, immediately adjacent to this region. Since this region has the least biological data in the state, a definitive statement about absence of Rocky Mountain tailed frog cannot be made. If present, Rocky Mountain tailed frog, like coastal tailed frog, may be at some level of risk because sedimentation has the potential to substantially reduce its instream habitat (Bury 1983, Bury and Corn 1988, Corn and Bury 1989). Timber harvest, which can result in significant sedimentation (Beschta 1978, Jakob 1999), occurs over a large part of the forested area of the Upper Columbia – Upstream region (see Habitat Trends section). Data are currently lacking to address such an assessment.

Although not covered under this Forest Practices HCP, five other amphibians (namely long-toed salamander [*Ambystoma macrodactylum*], western toad [*Bufo boreas*], Pacific treefrog [*Hyla regilla*], Cascades frog [*Rana cascadae*] and rough-skinned newt [*Taricha granulosa*]) may receive some protection as a result of Forests and Fish patch buffer prescriptions. One of these species, western toad (*Bufo boreas*), has State watchlist (special concern) status (WDFW 2001), and has declined elsewhere in its geographic range (Carey 1993), but their status on the Upper Columbia is unknown. Hydrological alteration may have resulted in habitat loss for western toads at low elevations.

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SNAKE RIVER
REGIONAL SUMMARY

SNAKE RIVER REGIONAL SUMMARY

1.0 PHYSICAL DESCRIPTION

The Snake River region includes four WRIAs (32, 33, 34, and 35). Major stream systems include the Walla Walla, Lower Snake, Tucannon, Grande Ronde, Palouse, and Middle Snake River basins. Portions of Walla Walla, Columbia, Garfield, Whitman, and Asotin Counties are contained within the Snake River Region. A map showing the WRIAs of the Snake River region is provided in Figure 1.

The region encompasses the Blue Mountains physiographic province and part of the Columbia Basin province (Lasmanis 1991). Elevations range from 400 feet near the mouth of the Snake River to over 6,000 feet in the Blue Mountains, although most forested areas lie above 2,000 feet. The climate differs markedly from areas west of the Cascades.

General Geology

The Blue Mountains in the headwaters of the Tucannon River watershed are composed of uplifted Columbia River flood basalt. These basalt flows are layered, with individual flows averaging 31 meters (100 feet) in thickness. Total thickness of the formation exceeds 900 meters (approximately 3000 feet) (McKee 1972 as cited in USFWS 2002). The Tucannon River watershed is generally composed of V-shaped drainages having steep sides and narrow canyons. The steep terrain is the result of extensive folding and faulting associated with formation of the Blue Mountains. Geology of the basin consists of consolidated rock formed from Columbia River basalt that was overlain by volcanic ash from the eruption of Mount Mazama.

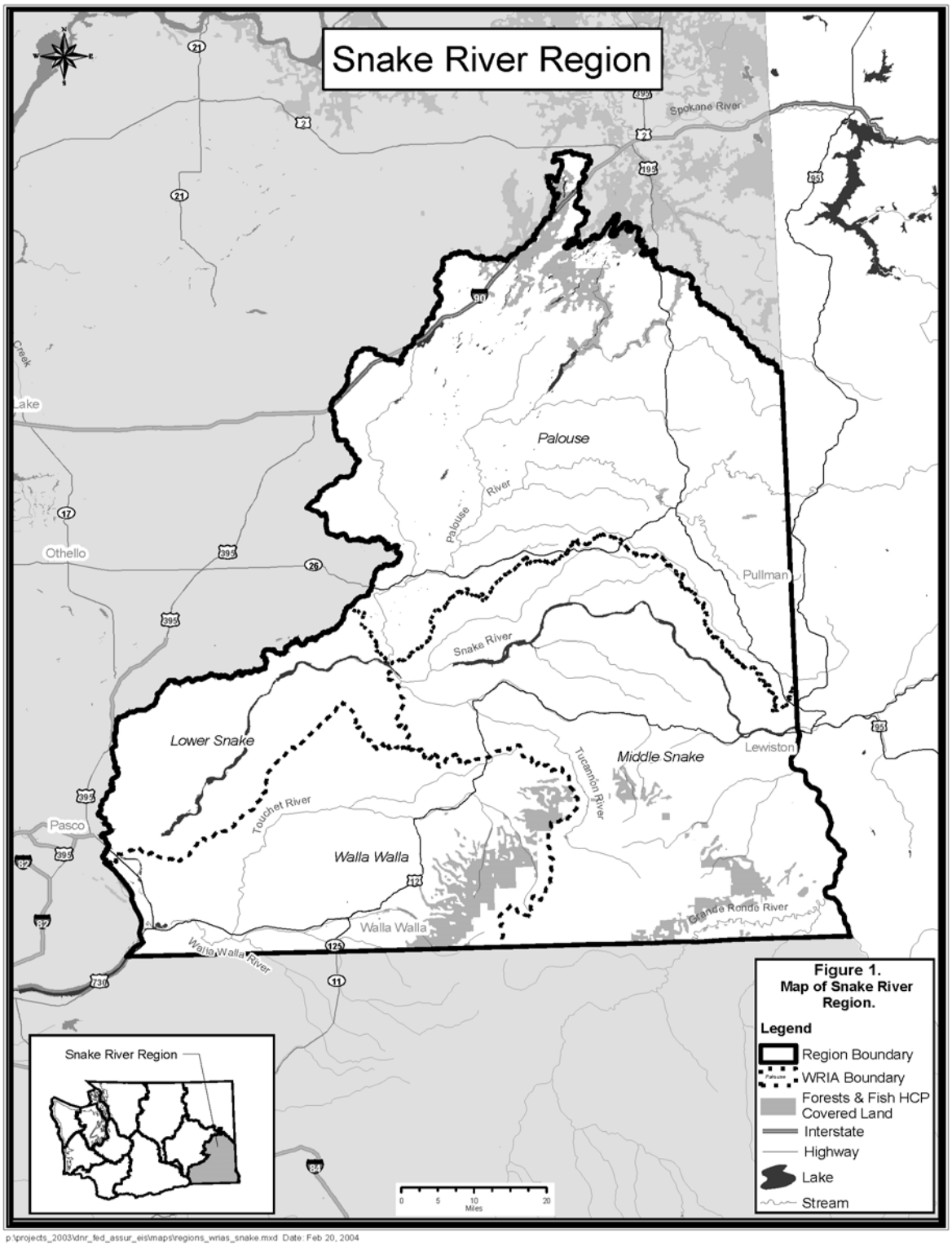
Soils formed by the volcanic ash are moderately deep, medium-textured and have high infiltration rates and water-holding capacity. These soils are highly sensitive to compaction and are easily eroded. Residual soils formed from the basalt flows are generally shallow and relatively fine-textured with little water-holding capacity (Ehmer 1978 as cited in USFWS 2002).

The source of information concerning erosion in the Snake River region is the South Fork Touchet watershed analysis (WDNR 1998).

Mass wasting is limited to steep hillslopes where debris avalanches are triggered by large magnitude rain or rain-on-snow events. Due to the relatively low stream density, many of these failures spread and dissipate as they move downslope rather than entering stream channels. When they become channelized, debris flows often result. Large, deep-seated landslides are uncommon in the region. Surface erosion and sediment delivery can be significant where soils in close proximity to stream channels have been heavily disturbed or compacted.

General Hydrology

The region receives less precipitation and temperature ranges are more extreme. The climate is marine-continental characterized by cold winters and hot summers. Much of the precipitation falls as snow during the winter, although spring and summer rains are common. Average annual precipitation for forested areas of the region range from 15 inches at lower elevations to over 40 inches at higher elevations.


Snake River Region
Spokane River
Palouse
Palouse River
Pullman
Othello
Snake River
Lower Snake
Middle Snake
Lewiston
Tucannon River
Touchet River
Pasco
Walla Walla
Grande Ronde River
Walla Walla River
Snake River Region
0 5 10 20
Miles
Figure 1.
Map of Snake River Region.
Legend
Region Boundary
WRIA Boundary
Forests & Fish HCP Covered Land
Interstate
Highway
Lake
Stream
p:\projects_2003\dnr_fed_assur_eis\maps\regions_wrias_snake.mxd Date: Feb 20, 2004

Major rivers of the region include the Walla Walla, Tucannon, Grande Ronde, and Palouse, all of which are tributary to the Snake River. The rivers have a snowmelt-driven hydrologic regime; most peak flows occur from March through May in response to spring snowmelt. However, large magnitude peak flows result from rain-on-snow precipitation events that occur during the fall and winter months. Low flows generally occur during late summer and early fall, although extreme cold can substantially reduce flows during the winter. Based on the DNR stream hydrography GIS coverage, there are approximately 8,343 stream-miles (both fish-bearing and non-fish streams) in the Snake River region, with an average stream density of 1.17 stream miles/mile^2 (Table 1).

Table 1. Stream Miles in the Snake River Region by WRIA[1/]

	WRIA 32 Walla Walla	WRIA 33 Lower Snake	WRIA 34 Palouse	WRIA 35 Middle Snake	Total Snake River Region
Stream Length (miles)	2,153	372	2,194	3,623	8,343
Stream Density (miles/mi^2)	1.52	0.52	0.80	1.61	1.17

[1/] Primary Data Source: DNR stream hydrography GIS layer. Stream miles include all Type 1-5 streams and a portion of Type 9 streams. Because many Eastern Washington Type 9 waters are not defined channels, only 25% of Type 9 streams are counted as streams in the Ponderosa Pine and drier vegetation zones, 50% are counted in the Mixed Conifer vegetation zones, and 75% are counted in the wettest vegetation zones. These proportions are based on field observations by DNR foresters, but are very approximate.

2.0 LAND OWNERSHIP AND USE

Major Land Ownership and Management

Approximately 10 percent of all lands in the Snake River region are in Federal ownership and 3 percent of all lands are being managed in a Federal long-term preservation status, primarily in national parks, national wildlife refuges, and wildernesses (Table 2). About 4 percent of all lands is being managed by the Forest Service outside of wilderness. Other Federal agencies manage about 3 percent of all lands. No Tribal lands exist in the region, but State lands (primarily under management for timber production) comprise 6 percent and city/county lands represent less than 0.1 percent. Private lands represent 84 percent of the region; they range from 71 percent of the Middle Snake WRIA to 92 percent of the Palouse WRIA. Federal lands follow the reverse pattern ranging from 2 percent in the Palouse WRIA to 22 percent in the Middle Snake.

Land Cover and Use

Forestland makes up approximately 8 percent of the Snake River region, ranging from 0 percent in the Lower Snake WRIA to 16 percent in the Middle Snake WRIA (Table 3). Agricultural lands comprise 52 percent of the region and are particularly prevalent in the Walla Walla and Palouse WRIAs. Shrublands and grasslands also comprise a substantial portion of the region representing 29 percent and 8 percent, respectively.

Table 2. Land Ownership Parameters for Snake River Region by WRIA[1/]

Land Ownership	WRIA 32 Walla Walla	WRIA 33 Lower Snake	WRIA 34 Palouse	WRIA 35 Middle Snake	Total Snake River Region
Federal – Long-term Congressionally Protected Lands [2/]	588	7,241	13,259	111,416	132,503
Federal – Other National Forest System Lands [3/]	44,402	-	-	155,214	199,616
Federal – Other Federal Lands [4/]	8,190	41,389	30,563	51,434	131,576
State – Protected Lands [5/]	414	-	2,412	41,766	44,592
State – Managed Lands [6/]	36,829	28,100	101,870	64,431	231,230
Tribal Lands/Indian Reservations	-	-	-	-	-
Municipal Watershed	350	-	-	-	350
Other County/City Lands	-	-	414	31	445
Private	817,008	385,848	1,616,956	1,015,745	3,835,557
TOTAL	**907,781**	**462,578**	**1,765,474**	**1,440,036**	**4,575,868**

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan GIS layers.
[2/] Includes national parks, national monuments, national recreation areas, national wildlife refuges, and wildernesses.
[3/] Includes all non-wilderness National Forest System lands; the majority of the acres consists of lands protected under the Northwest Forest Plan (e.g., LSR, Managed LSR, AMA, Riparian Reserves)
[4/] Includes all Department of Defense, Department of Energy, Bureau of Land Management, and Bureau of Reclamation lands.
[5/] Includes all State Parks and Wildlife Areas.
[6/] Includes all DNR, Department of Corrections, and University lands.

Table 3. General Land Cover Classifications in the Snake River Region by WRIA[1/]

Land Cover	WRIA 32 Walla Walla	WRIA 33 Lower Snake	WRIA 34 Palouse	WRIA 35 Middle Snake	Total Snake River Region
Forestland	104,203	42	41,012	231,057	376,314
Shrubland	167,692	242,546	524,960	408,389	1,343,586
Grassland	44,998	8,088	36,994	279,709	369,788
Water & Wetlands	11,685	14,759	15,788	21,211	63,443
Ice, Snow, & Bare Rock	46	62	93	712	913
Residential & Commercial	11,583	1,324	11,608	6,407	30,921
Agricultural	567,574	195,757	1,135,020	492,551	2,390,903
TOTAL	**907,781**	**462,578**	**1,765,474**	**1,440,036**	**4,575,868**

[1/] Primary Data Source: USGS/EPA National Land Cover Data GIS layer.

3.0 FORESTLAND OWNERSHIP AND MANAGEMENT

Approximately 63 percent of the forestlands in the Snake River region are in Federal ownership, 0 percent are in Tribal ownership, 5 percent are in State ownership, and 32 percent are in private or other ownership (Table 4). A Federal or State status of preservation or limited management covers approximately 25 percent of the forestlands in the region. About 40 percent of the forestlands are available for Federal or Tribal timber management. State timber management may occur on approximately 3 percent of the forestlands, and 32 percent of the forestlands are in private, county, or city ownership, where timber management may occur. Overall, lands covered by the forest practices rules represent approximately 35 percent of the forestlands in the region (see Figure 1, which displays these lands). The overall percentage of forestlands subject to the State forest practices rules ranges from 13 percent in the Middle Snake WRIA to 81 percent in the Palouse WRIA. No existing HCPs cover the State, private, or other managed forestlands of the region.

Small, 20-acre exempt forest landowners make up less than 0.5 percent of the total forestlands and of the forestlands subject to forest practices rules in the Snake River, based on the analysis by Rogers (2003). Although this analysis may represent an underestimate, the accuracy of this estimate is not high for this region because of the low sampling percentage.

Approximately 824 stream miles occur on lands subject to forest practices rules in the Snake River region (Table 5). This represents 10 percent of all streams in the region. Approximately 708 miles or 86 percent of the 824 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas). The percentage of all streams on small, 20-acre exempt forest landowner parcels in this region is estimated to be less than 0.5 percent (Rogers 2003).

Table 4. Ownership and Management of Forestlands (acres and percent) in the Snake River Region by WRIA[1/]

Forestlands Category	WRIA 32 Walla Walla	WRIA 33 Lower Snake	WRIA 34 Palouse	WRIA 35 Middle Snake	Total Snake River Region
Federal and State Protected Forestlands Not Managed for Timber Production[2/]	220	-	7,579	87,926	95,725
Federal Lands and Tribal Forestlands Available for Timber Management[3/]	37,136	9	499	111,423	149,067
Forestlands Available for Timber Management Under the State Forest Practices Rules					
DNR and Other State Forestlands	5,887	13	3,557	3,335	12,791
Private, County, and City Forestlands	60,960	21	29,376	28,373	118,730
Subtotal	66,846	33	32,934	31,708	131,522
TOTAL FORESTLANDS	104,203	42	41,012	231,057	376,314
% IN FEDERAL OR STATE PROTECTION	0%	0%	18%	38%	25%
% AVAILABLE FOR FEDERAL OR TRIBAL TIMBER MANAGEMENT	36%	21%	1%	48%	40%
% AVAILABLE FOR STATE TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	6%	30%	9%	1%	3%
% AVAILABLE FOR PRIVATE OR COUNTY/CITY TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	59%	49%	72%	12%	32%

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan, and USGS/EPA National Land Cover Data GIS layers.
[2/] Federal and State Protected Lands includes: Wilderness, LSR, LSOG, AMA, National Wildlife Refuges, National Parks, Washington State Parks, and WDFW lands.
[3/] Federal and Tribal Lands Available for Timber Management include: USFS Matrix lands, USFS other lands, BLM lands, Dept of Defense lands, and Indian Reservation lands.

Table 5. Stream Miles in the Snake River Region by Ownership, Forested Stream Miles, and Forest Practices Rules (FPR)-Regulated Stream Miles[1/]

Category	WRIA 32 Walla Walla	WRIA 33 Lower Snake	WRIA 34 Palouse	WRIA 35 Middle Snake	Total Snake River Region
Total Stream Miles					
Federal	350	75	55	1,543	2,024
Tribal	-	-	-	-	-
State	101	18	88	386	593
County/City	4	-	2	0	6
Private	1,698	280	2,049	1,694	5,720
Total Miles	**2,153**	**372**	**2,194**	**3,623**	**8,343**
Forested Stream Miles					
Forested Miles	847	0	60	1,453	2,360
% of Total Miles	39%	0%	3%	40%	28%
FPR-Regulated Stream Miles					
FPR-Reg. Miles	557	0	48	218	824
% of Total Miles	26%	0%	2%	6%	10%

[1/] Data sources: DNR stream hydrography GIS layer, DNR Major Public Lands layer, and USGS/EPA National Land Cover Data. Stream miles include all Type 1-5 streams and a portion of Type 9 streams. Because many Eastern Washington Type 9 waters are not defined channels, only 25% of Type 9 streams are counted as streams in the Ponderosa Pine and drier vegetation zones, 50% are counted in the Mixed Conifer vegetation zones, and 75% are counted in the wettest vegetation zones. These proportions are based on field observations by DNR foresters, but are very approximate.

4.0 HABITAT LIMITING FACTORS

Primary Regional Factors

Storage dams and their associated impoundments have eliminated spawning and rearing habitat and have altered the natural hydrograph of the Snake River, decreasing spring and summer flows and increasing fall and winter flows (Mainstem/Systemwide Habitat Summary 2002). Snake River dam construction has also converted riverine habitat to more reservoir-like habitat, impacting species composition and increasing predator abundance (USFWS 2002).

The Bull Trout Recovery Plan (for the Snake River Recovery Unit) identifies till crop production and irrigation withdrawals, livestock grazing, logging, hydropower production, introduction and management of nonnative species, urbanization and transportation networks as factors adversely affecting bull trout (USFWS 2002).

Within the Walla Walla basin, land use impacts associated with surface water withdrawals, dryland agriculture, and residential development have had profound impacts on salmonid habitat. Habitat conditions on public lands managed by the USFS (mostly within the headwaters) standout in stark contrast to the degraded conditions found on private lands downstream. Headwaters throughout the Blue Mountains provide the last remaining area of refuge for spawning and rearing summer steelhead and bull trout (WSCC 2001). These headwaters are also the only area where Rocky Mountain tailed frogs occur in Washington State (Dvornich et al. 1997).

Sedimentation/Mass Wasting

Many stream reaches in the Walla Walla basin adjacent to or downstream from private lands carry extremely high fine sediment loads derived from erosion of agricultural fields. This has led to embedded and/or buried streambed substrate, significantly reducing the area available for salmonid spawning habitat (WSCC 2001).

The U.S. Forest Service (1998) reported that more than 50 percent of the sediment delivered into Asotin Creek from timber harvest activities came from existing roads. Some of the forested drainages in the Asotin Creek watershed have road densities as high as 4.1 to 5.0 miles/mile^2. Salvage harvest after the 1974 floods have resulted in active erosion, sediment delivery and increased stream temperatures in the North and South Fork Asotin Creeks (personal communication, Glen Mendel, WDFW, 2002, in USFWS 2002).

Riparian/Floodplain and Wetland Conditions

Hydropower production along the Snake River has reduced the mainstem habitat (for the most part) to a single channel, floodplains have been reduced in size, and off-channel habitat features have been lost or disconnected from the main channel (Mainstem/Systemwide Habitat Summary 2002).

Diking, channelization, removing vegetation from riparian zones, and conversion of floodplains into agricultural land and road networks have all contributed towards destruction of fluvial function and off-channel habitat (e.g. Walla Walla Basin, WSCC 2001; Tucannon River, Asotin Creek, USFWS 2002).

In streams such as Lick Creek (Asotin basin), riparian zones are in poor condition along some reaches. Clear-cuts were used to harvest timber immediately adjacent to the stream edge, and trees have not reestablished (USFWS 2002). Streams in the upper watershed are generally reported to contain higher quality riparian zones compared to lower reaches where more streamside activities occur (WSCC 2002).

Channel/Hydrology Conditions

Many Walla Walla stream reaches adjacent to or downstream from private lands lack instream habitat complexity associated with abundant amounts of LWD, pools, and off-channel habitat. Though channel conditions (such as LWD and pool quantities) are not ideal on public lands in the headwaters, they are far more favorable to salmonids than those found downstream on private lands (WSCC 2001).

Pool habitat/salmonid resting habitat in lower Asotin Creek is limited in part because sources of large woody debris (trees) have been eliminated by timber harvest on private property and because livestock have grazed riparian areas (ACMWP 1995).

Large Woody Debris

Along with other major channel modifications caused by hydropower (i.e., floodplain and off-channel habitat, fluctuating flows and water velocities), as well as adjacent land uses on the Snake River mainstem, the amount of LWD (large snags and log structures) has been reduced (Mainstem/Systemwide Habitat Summary 2002).

Large woody debris is lacking in nearly all reaches of the Upper Touchet subbasin. The lack of wood is caused by widespread riparian zone degradation and removal of large wood from channels in flood control efforts. An associated impact of the low LWD loading is the lack of pool habitat (WSCC 2001).

Fish Passage

Hundreds of inadequately screened surface water diversions are present in salmonid bearing streams in the Walla Walla basin. Other structures which hinder salmonid migration in the Walla Walla basin include gravel push-up dams, concrete dams, and failed culverts (WSCC 2001).

Dams within the Tucannon River and Asotin Creek watersheds have had significant historical impacts on fluvial bull trout populations (as well as to salmon species) in both streams. Two of these dams are still present and may be affecting bull trout migrations. Many road culverts with variable impacts on fish passage have been identified within the Snake River Bull Trout Recovery Unit. In addition, destruction of riparian zones, leading to high water temperatures, is the most significant factor acting to reduce fish movement and habitat use in the middle to lower reaches of the Tucannon River and Asotin Creek (USFWS 2002).

Water Quality Issues

The Snake River (WRIAs 33 and 35), from its confluence with the Salmon River to its confluence with the Columbia River, has been included on the 303(d) list of impaired waters for temperature and total dissolved gases (EPA Columbia and Snake River TMDL homepage). The Snake River has a TMDL for total dissolved gas (Pickett and Herold, 2003).

Within the region (e.g. lower Tucannon River, USFWS 2002), many stream reaches exhibit low or non-existent summer stream flows and water temperatures far above the tolerance level of salmonids. These conditions are a combination of naturally arid summer climatic conditions, surface water withdrawals, removal of riparian vegetation, and disruption of surface water/ground water exchanges (hydraulic continuity) through bank armoring, channel straightening, and diking of floodplains (WSCC 2001). The Tucannon River (WRIA 35) is impaired due to high temperatures and the Walla Walla River and Mill Creek (WRIA 32) are impaired due to low instream flow. In WRIA 34, the Palouse River is impaired due to high temperatures and low dissolved oxygen.

Between 1970 and 1989, approximately 2,995 hectares of forest were clearcut along tributaries to Asotin Creek in WRIA 35, including Charley Creek, South Fork Asotin Creek, and two 2-hectare harvests on both sides of Cougar Creek. The U.S. Forest Service indicated that these early cuts contributed to rises in water temperatures along adjacent streams because all riparian and upslope timber was harvested. Adequate riparian canopy has not regenerated along Cougar Creek where these two cuts occurred (ACMWP 1995).

The State list of impaired waters, in compliance with Section 303(d) of the Clean Water Act, lists waters that do not meet water quality standards or fully protect beneficial uses (see http://www.ecy.wa.gov/programs/wq/303d/index.html). Impairments to parameters in this region, such as temperature, turbidity, and dissolved oxygen, may be related to forest practices or other land uses.

5.0 HABITAT TRENDS

Euro-American settlement and natural resource utilization of the Walla Walla River basin evolved through four phases: trapping, livestock production, logging, and agriculture. Commercial trapping began in the early 1800s, resulting in greatly reduced beaver populations (i.e. Walla Walla basin). With declining fur supplies in the 1830's, the operations turned to raising livestock (Meinig 1968). Intense grazing altered the landscape, replacing native perennial grasses with invasive annual grasses. Agriculture production within the lowlands was fully utilized by the 1860s. Farmers were then forced to turn to dryland farming in the uplands (Saul et al. 2000).

With the large influx of settlers in the 1880s, timber harvest began in earnest. Trees were rarely found on the lowlands except near streams. These lowland riparian zones were dominated by deciduous species such as willow, cottonwood, birch, and alder (Dice 1916, Meinig 1968, Saul et al. 2000). Early harvests within the Walla Walla basin focused on the most profitable trees such as large Douglas fir and Ponderosa pine. Harvest then shifted to western larch, grand fir, white fir, and lodgepole pine once Douglas fir and Ponderosa pine supplies were exhausted. Logs were commonly yarded across streams, destroying spawning grounds. Stream channels were also modified to reduce road construction costs (Van Cleve and Ting 1960). Clearcutting was the logging method of choice. Fires were suppressed; a practice that has changed in recent years. Fire suppression and past logging activities have resulted in dense stands of immature conifers with large amounts of litter on the forest floor (U.S. Forest Service (USDA) and Bureau of Land Management (USDI) 1997). Clearcuts and forest fires have the potential to leave large areas of the uplands devoid of mature vegetation, increasing the likelihood of erosion and landslides (mass wasting) that can result in serious impacts on fish populations (WSCC 2001).

Although timber harvest comprises the third largest economic base in the Tucannon River watershed, most of the timber-related impacts that occur today in the Snake River Washington Bull Trout Recovery Unit are the result of historical timber harvest and road building activities (legacy effects) (USFWS 2002). Agriculture, which comprises 58% of the Walla Walla watershed, is the primary component of the economy today (as well as the Asotin and Tucannon River watersheds, USFWS 2002) and has degraded salmonid habitat in many areas of the watershed. Forestland and range land cover 25% and 17% respectively (U.S. Army Corps of Engineers 1997).

It should be noted that for the Snake River Region as a whole, forestlands make up approximately 8 percent. Of the total forestlands in the region, 25 percent are under Federal and State protection. Thirty-five percent of the forestlands are under private or State management and are regulated by the State forest practices rules. (See Tables 3 and 4.)

6.0 FISH RESOURCES

Within the Snake River Region, four Federally listed salmonid fish species occur. Chinook salmon, steelhead trout, and bull trout are listed as threatened. Sockeye salmon are listed as endangered. For sockeye, however, the Snake River is only used as a migration corridor; spawning and rearing occurs in Idaho (WDNR 2001). The Snake River Washington Bull Trout Recovery Unit Team has identified the Tucannon River and Asotin Creek basins as separate core areas with the Snake River Washington Recovery Unit (USFWS 2002). Both the Pacific and river lampreys and the margined sculpin are Federally listed as species of concern.

Salmonid Stocks

The following salmonids occur in the Snake River Region (Table 6). The asterisk next to the species name indicates that the species is introduced and not native to Washington State. This list should not be regarded as an exhaustive list of the species present.

Table 6. Salmonid species presence by WRIA within the Snake River Region (WDFW 2003).

Species	State Status[1/]	Federal Status[2/]	Walla Walla (WRIA 32)	Lower Snake (WRIA 33)	Palouse (WRIA 34)	Middle Snake (WRIA 35)
Brown Trout*			X	X	X	
Bull Trout	SC	FT	X	X		X
Chinook Fall		FT	X	X	X	X
Chinook Spring		FT	X	X		X
Chinook Summer		FT	X	X	X	X
Coho Salmon			X	X		
Cutthroat Lahontan					X	
Cutthroat Westslope		FCo			X	
Eastern Brook Trout*						X
Kokanee Salmon			X		X	
Lake Trout*			X		X	
Rainbow/Redband Trout			X	X	X	X
Sockeye Salmon		FE	X	X		X
Steelhead Summer		FT	X	X		X
Steelhead Winter		FT	X	X		
Whitefish Lake*				X	X	
Whitefish Mountain			X			X

*Introduced species, not native to Washington State.

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Other Fish Species

Table 7 is a list of non-salmonid species that exist in the Snake River Region (WDFW 2003, Wydoski and Whitney 2003). The asterisk next to the species name indicates that the fish is not native to Washington State. This list should not be regarded as an exhaustive list of the species present. The Pacific and river lamprey are both Federal species of concern. The margined sculpin is also listed as State Sensitive and a Federal species of concern. Within Washington State, the margined sculpin is only found within the headwaters of the Walla Walla, Touchet, and Tucannon Rivers (WDFW 2003, Wydoski and Whitney 2003).

Table 7. Non-salmonid Fish Species by WRIA within the Snake River Region (WDFW 2003).

Species	State Status[1/]	Federal Status[2/]	Walla Walla (WRIA 32)	Lower Snake (WRIA 33)	Palouse (WRIA 34)	Middle Snake (WRIA 35)
Bass, Largemouth*			X	X	X	X
Bass, Smallmouth*			X	X	X	X
Bullhead Black*				X	X	
Bullhead Brown*			X	X	X	
Bullhead Yellow*				X	X	
Burbot				X		
Carp Common*			X	X	X	X
Carp Grass *			X			
Catfish Channel*			X	X	X	X
Chiselmouth				X	X	
Crappie Black*				X	X	X
Crappie General*			X	X	X	X
Crappie White*			X	X		X
Dace Longnose			X			X
Dace Speckled			X		X	X
Lamprey Pacific		FCo	X	X	X	X
Lamprey River	SC	FCo	X			
Lamprey Western Brook			X			X
Peamouth			X		X	
Perch Yellow*				X		X
Pikeminnow			X	X	X	X
Redside Shiner			X	X	X	X
Sandroller	SM					X
Sculpin General					X	
Sculpin Margined	SS	FCo	X			X
Sculpin Mottled				X		
Sculpin Paiute			X			X
Sculpin Torrent			X			X
Starry Flounder			X		X	
Sturgeon White			X	X	X	X
Sucker Bridgelip			X	X	X	X
Sucker Largescale			X	X	X	X
Sucker Mountain	SC					X
Sunfish Blue Gill					X	

Table 7. Non-salmonid Fish Species by WRIA within the Snake River Region (WDFW 2003) (continued).

Species	State Status[1/]	Federal Status[2/]	Walla Walla (WRIA 32)	Lower Snake (WRIA 33)	Palouse (WRIA 34)	Middle Snake (WRIA 35)
Sunfish Pumpkinseed*			X	X	X	X
Sunfish General*			X	X	X	X
Tench					X	
Threespine Stickleback				X		
Walleye*				X	X	

*Introduced species, not native to Washington State.
[1]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.
[2]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

Status of Salmonid Stocks

The State and Tribal stock status of fish stocks in the Snake River region is shown in Table 8.

For Washington State and Tribal Stock Status, Healthy refers to a stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock; Depressed refers to a stock of fish whose production is below expected levels based on available habitat and natural variations in survival rates, but above the level where permanent

Table 8. Washington State Stock Status for the Snake River Region's Salmon, Steelhead, and Bull Trout. [Information for salmon and steelhead was taken from the Draft SaSI (2002), and the information for bull trout was taken from SaSI (1998).]

River Basin	Species	Stock Status
Walla Walla (WRIA 32)		
Walla Walla River	Steelhead Summer	Unknown
Touchet River	Steelhead Summer	Depressed
Touchet River	Bull Trout/Dolly Varden	Unknown
Mill Creek	Bull Trout/Dolly Varden	Healthy
Lower Snake (WRIA 33)		
Snake River	Chinook Fall	Depressed
Middle Snake (WRIA 35)		
Tucannon	Chinook Spring	Depressed
Snake R/Asotin Creek	Chinook Spring	Extinct
Tucannon	Steelhead Summer	Depressed
Asotin Creek	Steelhead Summer	Depressed
Grande Ronde	Steelhead Summer	Unknown
Upper Tucannon	Bull Trout/Dolly Varden	Healthy
Asotin Creek	Bull Trout/Dolly Varden	Unknown
Grande Ronde-Wenaha	Bull Trout/Dolly Varden	Unknown

damage to the stock is likely; *Critical* refers to a stock of fish experiencing production levels that are so low that permanent damage to the stock is likely or has already occurred; and *Unknown* refers to a stock of fish which has insufficient information to rate stock status.

7.0 AMPHIBIANS

The Snake River Region harbors 10 amphibian species, including the established introduced bullfrog (Dvornich et al. 1997; McAllister 1995). Of these 10 species, the largest assemblage (including the bullfrog) consists of 9 taxa that reproduce in stillwater habitat including lakes, oxbows, ponds, temporary pools, and other freshwater wetlands with sufficient stillwater habitat. Most stillwater habitats occur at the lower elevations in the region and are associated with the riparian margins of larger stream or riverine systems. Since a large proportion of this habitat has been altered or lost (see Floodplain/Riparian Conditions section), significant impact to stillwater amphibians is presumed, but systematic surveys across potential historic habitat in much of the Snake Region has not been conducted. The lowest elevation stillwater habitats in the Snake River Region are also the habitats for introduced warmwater species (e.g. bullfrogs and selected fish [catfish, mosquitofish, sunfish], see Table 7). The interactive facilitation among these introduced species, particularly bullfrogs and warmwater fish, may promote the survival of the non-native species (Adams et al. 2003) and contribute to potentially negative effects on native amphibians (Adams 1999). The remaining amphibian, Rocky Mountain tailed frog, reproduces in streams (Table 9).

Of the entire amphibian assemblage for the region, the Rocky Mountain tailed frog (*Ascaphus montanus*) is the only Forest and Fish HCP-covered species (Table 9). The known distribution of Rocky Mountain tailed frog lies entirely within portions of WRIAs 32 and 35, the only areas that provide suitable habitat in this region. Known distribution is undoubtedly conservative as no systematic surveys, either to understand distribution or determine status (i.e., surveys of historic sites), have been performed in the region. Currently, too few data (only 9 known sites) exist even to perform a status survey for this species because of lack of a baseline. Rocky Mountain tailed frog may be at some level of risk because, similar to coastal tailed frog, sedimentation has the potential to substantially reduce its instream habitat (Bury 1983, Bury and Corn 1988, Corn and Bury 1989); and timber harvest, which can result in significant sedimentation (Beschta 1978, Jakob 1999), occurs over most of the Snake River Region where this species is present (see Habitat Trends section).

Although not covered under this Forest Practices HCP, four other amphibians (namely long-toed salamander [*Ambystoma macrodactylum*], western toad [*Bufo boreas*], Pacific treefrog [*Hyla regilla*], and Columbia spotted frog [*Rana luteiventris*]) may receive some protection as a result of Forests and Fish patch buffer prescriptions. One of these species, western toad has State watchlist (special concern) status (WDFW 2001) and has declined elsewhere in its geographic range (Carey 1993), but its status in the Snake River Region is unknown. Development and hydrological alteration may have resulted in habitat loss for western toads at low elevations.

Table 9. Forest and Fish Amphibians of the Snake River Region.

Group	Name	Habitat			Regional Distribution
		Active Season		Over-wintering	
		Breeding	Non-Breeding		
Frogs	Rocky Mountain tailed frog *Ascaphus montanus*	Streams	Streams	Terrestrial	Known only from WRIAs 32 and 35

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COLUMBIA BASIN
REGIONAL SUMMARY

COLUMBIA BASIN REGIONAL SUMMARY

1.0 PHYSICAL DESCRIPTION

The Columbia Basin region is represented by four WRIAs (36, 41, 42, and 43). Only the Upper Crab-Wilson WRIA (#43) has more than a few hundred acres of forestland; therefore, it is the only WRIA that is emphasized in the following discussion. The forestland that does exist, only occurs within a small portion of the eastern corner of the WRIA, close to the boundary of Lincoln and Spokane counties. A map showing the WRIA boundaries of the Columbia Basin region is provided in Figure 1.

The Crab Creek headwaters make up the most significant stream miles; however, sections downstream from the headwater springs go dry in the summer months of most years. The Crab Creek watershed is comprised mostly of agriculture (winter wheat) and irrigated pastureland. Sparse ponderosa pine occurs in small areas (WDFW 2004).

Stream Overview

Crab Creek and its tributaries make up the largest drainage system in the region. Based on the DNR stream hydrography GIS coverage, there are approximately 3,688 stream-miles (both fish-bearing and non-fish streams) in the Columbia Basin region, with an average stream density of 0.54 stream miles/mile^2 (Table 1).

2.0 LAND OWNERSHIP AND USE

Major Land Ownership and Management

Approximately 9 percent of all lands in the Columbia Basin region are in Federal ownership and 1 percent of all lands are being managed in a Federal long-term preservation status, primarily in national wildlife refuges (Table 2). The primary Federal land managers are the Bureau of Reclamation, Department of Energy (Hanford), and the Bureau of Land Management (in decreasing order of importance in the region). No Tribal lands exist in the region, but State lands comprise 7 percent and city/county lands represent less than 0.1 percent. Private lands represent 84 percent of the region; they range from 81 percent of the Esquatzel Coulee WRIA to 90 percent of the Upper Crab-Wilson WRIA.

Land Cover and Use

Forestland makes up approximately 0.3 percent of the Columbia Basin region, ranging from less than 0.05 percent in three of the four WRIAs to 1 percent in the Upper Crab-Wilson WRIA (Table 3). The region is dominated by agricultural lands (53 percent) and shrub-steppe habitats, mapped as shrubland (39 percent). Grasslands make up another 4 percent of the region, and water and wetlands, which are especially prominent in the Grand Coulee and Lower Crab WRIAs, make up 3 percent of the region.

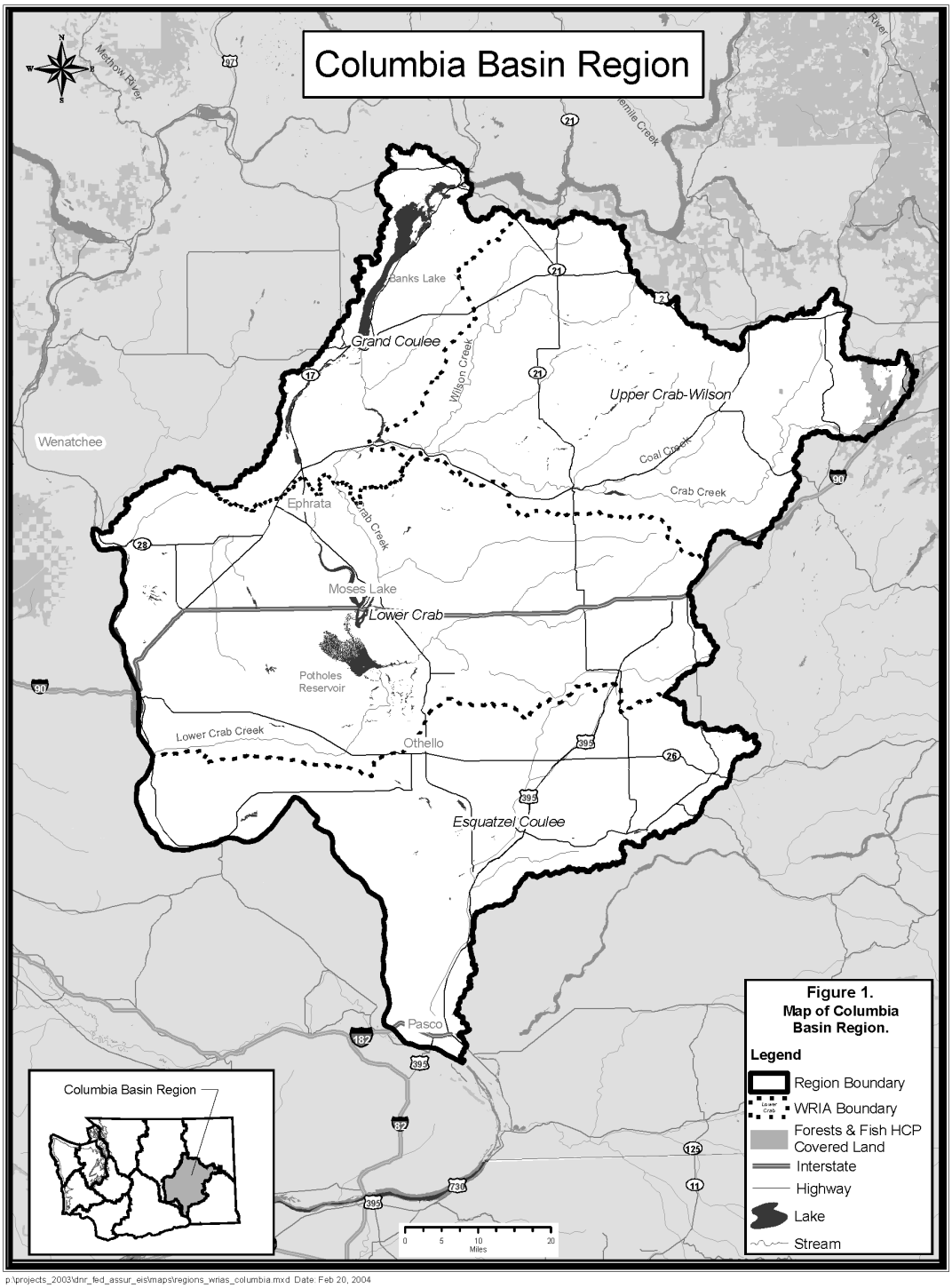
Columbia Basin Region
Methow River
Banks Lake
Grand Coulee
Wilson Creek
Upper Crab-Wilson
Coal Creek
Crab Creek
Wenatchee
Ephrata
Moses Lake
Lower Crab
Potholes Reservoir
Lower Crab Creek
Othello
Esquatzel Coulee
Pasco
Columbia Basin Region
0 5 10 20
Miles
Figure 1.
Map of Columbia Basin Region.
Legend
Region Boundary
WRIA Boundary
Forests & Fish HCP Covered Land
Interstate
Highway
Lake
Stream
p:\projects_2003\dnr_fed_assur_eis\maps\regions_wrias_columbia.mxd Date: Feb 20, 2004

Table 1. Stream Miles in the Columbia Basin Region by WRIA[1/]

	WRIA 36 Esquatzel Coulee	WRIA 41 Lower Crab	WRIA 42 Grand Coulee	WRIA 43 Upper Crab-Wilson	Total Columbia Basin Region
Stream Length (miles)	934	1,481	361	912	3,688
Stream Density (miles/mi^2)	0.56	0.58	0.48	0.49	0.54

[1/] Primary Data Source: DNR stream hydrography GIS layer. Stream miles include all Type 1-5 streams and a portion of Type 9 streams. Because many Eastern Washington Type 9 waters are not defined channels, only 25% of Type 9 streams are counted as streams in the Ponderosa Pine and drier vegetation zones, 50% are counted in the Mixed Conifer vegetation zones, and 75% are counted in the wettest vegetation zones. These proportions are based on field observations by DNR foresters, but are very approximate.

Table 2. Land Ownership Parameters for Columbia Basin Region by WRIA[1/]

Land Ownership	WRIA 36 Esquatzel Coulee	WRIA 41 Lower Crab	WRIA 42 Grand Coulee	WRIA 43 Upper Crab-Wilson	Total Columbia Basin Region
Federal – Long-term Congressionally Protected Lands [2/]	-	27,543	6,816	-	34,358
Federal – Other National Forest System Lands [3/]	-	-	-	-	-
Federal – Other Federal Lands [4/]	143,412	132,368	27,180	50,983	353,942
State – Protected Lands [5/]	3,203	36,298	7,217	19,273	65,990
State – Managed Lands [6/]	51,769	102,774	45,724	54,065	254,332
Tribal Lands/Indian Reservations	-	-	-	-	-
Municipal Watershed	-	-	-	-	-
Other County/City Lands	-	190	25	-	214
Private	860,363	1,322,202	397,522	1,061,275	3,641,362
TOTAL	**1,058,746**	**1,621,373**	**484,483**	**1,185,596**	**4,350,198**

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan GIS layers.
[2/] Includes national parks, national monuments, national recreation areas, national wildlife refuges, and wildernesses.
[3/] Includes all non-wilderness National Forest System lands; the majority of the acres consists of lands protected under the Northwest Forest Plan (e.g., LSR, Managed LSR, AMA, Riparian Reserves)
[4/] Includes all Department of Defense, Department of Energy, Bureau of Land Management, and Bureau of Reclamation lands.
[5/] Includes all State Parks and Wildlife Areas.
[6/] Includes all DNR, Department of Corrections, and University lands.

Table 3. General Land Cover Classifications in the Columbia Basin Region by WRIA[1/]

Land Cover	WRIA 36 Esquatzel Coulee	WRIA 41 Lower Crab	WRIA 42 Grand Coulee	WRIA 43 Upper Crab-Wilson	Total Columbia Basin Region
Forestland	130	449	43	12,221	12,843
Shrubland	363,534	589,004	253,861	490,048	1,696,447
Grassland	31,629	103,652	15,040	25,546	175,867
Water & Wetlands	17,264	53,304	34,116	6,895	111,579
Ice, Snow, & Bare Rock	49	708	42	75	874
Residential & Commercial	15,619	23,493	3,853	3,610	46,574
Agricultural	630,520	850,764	177,529	647,202	2,306,015
TOTAL	**1,058,746**	**1,621,373**	**484,483**	**1,185,596**	**4,350,198**

[1/] Primary Data Source: USGS/EPA National Land Cover Data GIS layer.

3.0 FORESTLAND OWNERSHIP AND MANAGEMENT

Approximately 1 percent of the 12,843 acres of forestlands in the Columbia Basin region are in Federal ownership, none are in Tribal ownership, 12 percent are in State ownership, and 87 percent are in private or other ownership (Table 4). None of the forestlands are protected by a Federal or State status of preservation or limited management. Only about 1 percent of the forestlands are potentially available for Federal timber management. State timber management may occur on approximately 12 percent of the forestlands, and 87 percent of the forestlands are in private, county, or city ownership, where timber management may occur. Overall, lands covered by the forest practices rules represent approximately 99 percent of the forestlands in the region (see Figure 1, which displays these lands). However, these lands are very limited in extent. No existing HCPs cover the State, private, or other managed forestlands of the region.

No small, 20-acre exempt forest landowners were identified in the Columbia Basin, based on the analysis by Rogers (2003). However, only a limited amount of the area was analyzed.

Approximately 20 stream miles occur on lands subject to forest practices rules in the Columbia Basin region (Table 5). This represents 1 percent of all streams in the region. Approximately 16 miles or 78 percent of the 20 stream miles on lands subject to forest practices rules are estimated to be fish-bearing stream miles (based on existing water typing and gradient analysis on sample areas).

Table 4. Ownership and Management of Forestlands (acres and percent) in the Columbia Basin Region by WRIA[1/]

Forestlands Category	WRIA 36 Esquatzel Coulee	WRIA 41 Lower Crab	WRIA 42 Grand Coulee	WRIA 43 Upper Crab-Wilson	Total Columbia Basin Region
Federal and State Protected Forestlands Not Managed for Timber Production[2/]	3	23	8	2	36
Federal Lands and Tribal Forestlands Available for Timber Management[3/]	22	86	5	7	120
Forestlands Available for Timber Management Under the State Forest Practices Rules					
DNR and Other State Forestlands	28	83	5	1,365	1,481
Private, County, and City Forestlands	77	257	25	10,846	11,205
Subtotal	105	340	30	12,212	12,687
TOTAL FORESTLANDS	130	449	43	12,221	12,843
% IN FEDERAL OR STATE PROTECTION	2%	5%	19%	0%	0%
% AVAILABLE FOR FEDERAL OR TRIBAL TIMBER MANAGEMENT	17%	19%	11%	0%	1%
% AVAILABLE FOR STATE TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	22%	18%	12%	11%	12%
% AVAILABLE FOR PRIVATE OR COUNTY/CITY TIMBER MANAGEMENT UNDER FOREST PRACTICES RULES	59%	57%	58%	89%	87%

[1/] Primary Data Sources: DNR Major Public Lands, Forest Service Northwest Forest Plan, and USGS/EPA National Land Cover Data GIS layers.
[2/] Federal and State Protected Lands includes: Wilderness, LSR, LSOG, AMA, National Wildlife Refuges, National Parks, Washington State Parks, and WDFW lands.
[3/] Federal and Tribal Lands Available for Timber Management include: USFS Matrix lands, USFS other lands, BLM lands, Dept of Defense lands, and Indian Reservation lands.

Table 5. Stream Miles in the Columbia Basin Region by Ownership, Forested Stream Miles, and Forest Practices Rules (FPR)-Regulated Stream Miles[1/]

Category	WRIA 36 Esquatzel Coulee	WRIA 41 Lower Crab	WRIA 42 Grand Coulee	WRIA 43 Upper Crab-Wilson	Total Columbia Basin Region
Total Stream Miles					
Federal	140	253	54	30	476
Tribal	-	-	-	-	-
State	46	147	35	48	275
County/City	-	0	0	-	0
Private	749	1,081	271	835	2,936
Total Miles	**934**	**1,481**	**361**	**912**	**3,688**
Forested Stream Miles					
Forested Miles	1	2	1	18	21
% of Total Miles	0%	0%	0%	2%	1%
FPR-Regulated Stream Miles					
FPR-Reg. Miles	0	2	0	18	20
% of Total Miles	0%	0%	0%	2%	1%

[1/] Data sources: DNR stream hydrography GIS layer, DNR Major Public Lands layer, and USGS/EPA National Land Cover Data. Stream miles include all Type 1-5 streams and a portion of Type 9 streams. Because many Eastern Washington Type 9 waters are not defined channels, only 25% of Type 9 streams are counted as streams in the Ponderosa Pine and drier vegetation zones, 50% are counted in the Mixed Conifer vegetation zones, and 75% are counted in the wettest vegetation zones. These proportions are based on field observations by DNR foresters, but are very approximate.

4.0 HABITAT LIMITING FACTORS

Little data is currently available for habitat limiting factors. Subbasin plans are underway, but not yet complete. The Department of Ecology website for Upper Crab/Wilson Watershed Planning indicated that the major issues included instream flow in Crab Creek and its tributaries, private property rights protection, Odessa sub-area and groundwater supply limitations, water for agriculture, water for growing communities, and trout habitat. Although many reaches of Crab Creek and its tributaries go dry during low flow periods, several reaches sustain flow year-round. These perennial, groundwater-fed reaches sustain surprisingly vigorous trout fisheries (WDOE 2003). WDFW staff also described limiting factors to include insufficient stream flows and high stream temperatures, due to lack of shade (primarily from agriculture wheat fields, pastureland, and low or lack of stream flow) (WDFW 2004).

Water Quality Issues

Although the Crab Creek watershed has impairments for temperature, turbidity and dissolved oxygen, none of these impairments are in the forested reach of the upper watershed.

5.0 FISH RESOURCES

The fish species listed in Table 6 occur within WRIA 43 of the Columbia Basin region. The asterisk next to the species name indicates that the fish is introduced, and not native to Washington State. This list should not be regarded as an exhaustive list of the species present (WDFW 2003).

Status of Salmonid Stocks

No known Federal or State listed fish species occur within WRIA 43 of the Columbia Basin region. The only native fish listed in the table above are rainbow trout, speckled dace, sculpin, and bridgelip and largescale suckers. There are no anadromous salmonids within these watersheds.

Table 6. Fish species present within WRIA 43 of the Columbia Basin Region (WDFW 2003).

Species	State Status[1]	Federal Status[2]	Upper Crab-Wilson (WRIA 43)
Resident Rainbow Trout			X
Brown Trout*			X
Bass Largemouth*			X
Bullhead Brown*			X
Bullhead Yellow*			X
Carp*			X
Crappie Black*			X
Dace Speckled			X
Perch Yellow*			X
Sculpin (sp)			X
Sucker Bridgelip			X
Sucker Largescale			X
Sunfish Pumpkinseed*			X

[1/]The Washington State Status classifications include: State Endangered (SE), State Threatened (ST), State Sensitive (SS), State Candidate (SC), and State Monitor (SM). Consult Rodrick and Milner (1991) for more details on these definitions.

[2/]The Federal Status Classifications include: EX – Extirpated, FE – Endangered, FT – Threatened, FC – ESA Candidate, FCo – Federal species of concern.

6.0 AMPHIBIANS

The Upper Crab-Wilson (WRIA 43) area of Columbia Basin region harbors 7 amphibian species, including one established introduced species, the bullfrog (Dvornich et al. 1997; McAllister 1995). The entire assemblage (including the bullfrog) reproduce in stillwater habitats including lakes, oxbows, ponds, and other freshwater wetlands with sufficient stillwater habitat. Stillwater habitats are also often introduced with warmwater fish (i.e., catfish, mosquitofish, sunfish); and interactive facilitation among some introduced species, particularly bullfrogs and warmwater fish, may promote the survival of the non-native species (Adams et al. 2003) over that of the native amphibians (Adams 1999).

No amphibian in this assemblage for the region is a Forest Practices HCP-covered species. Although not covered under this Forest Practices HCP, four other amphibians (namely long-toed salamander [*Ambystoma macrodactylum*], western toad [*Bufo boreas*], Pacific treefrog [*Hyla regilla*], Columbia spotted frog [*Rana luteiventris*]) occurring in this region may receive some protection as a result of Forests and Fish patch buffer prescriptions. One species, western toad (*Bufo boreas*) has State watch list (special concern) status (WDFW 2001), and has declined elsewhere in its geographic range (Carey 1993), but their status in WRIA 43 is unknown.

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